



# BIO-ZOOLOGY

12

*Based on the New Syllabus 2019 - 2020*

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## PREFACE

### Greetings,

**SURYA Biology -Zoology** has been written strictly in accordance with new syllabus and new textbook released by the government of Tamil Nadu. **Surya Biology Zoology for standard 12** is written with the sole objective of guiding the students to score the maximum marks for the type of questions they are expected to answer in the board examination. This guide has been framed based on the 'New 100 mark pattern' and the public exam question paper is for 70 marks. Ample number of question were added in each category, which help the students to gain mastery over the subjects and can able to answer different types of questions asked in Public examination.

It provides a precise and clear understanding of text and exercise from the examination perspective. Each chapter consists of points to remember, Answer to textual question, multiple choice question, important additional questions in 2 marks, 3 mark and 5 mark questions category, Creative questions, **NEET** based multiple choice questions. It helps to face all India competitive examination like **NEET, JIPMER ENTRANCE, B.Sc., AGRICULTURAL UNIVERSITY ENTRANCE** and other central and state entrance examination.

**Questions and answers are provided under the following headings**

### **PART A - Choose the correct answer (MCQ)**

- Textual questions
- Additional questions
- Match the following
- Assertion and reasoning
- NEET Based questions



### **PART B - Two mark question and answers**

- Textual questions
- Additional questions
- Diagram based questions

### **PART C - Three mark question and answers**

- Textual questions
- Additional questions

### **PART D – Five mark question and answers**

- Textual questions
- Additional questions

It is hoped that this guide the present form will specify all types of learners and help them improve their learning potential, apart from mentally preparing them to face any type of questions in the examinations.

Friendly suggestion for the enrichment of this book are welcome. I present this book before the Enlightened Teaching Faculty and learning Fraternity for their precious suggestions and sustained patronage.

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## POINTS TO REMEMBER

- ❖ Reproduction is the **fundamental feature**.
- ❖ **Types of reproduction:** asexual and sexual reproduction.
- ❖ In Asexual reproduction only **single parent involve and** Offspring are **genetically identical**.
- ❖ **In Sexual reproduction Two parents involve** in the reproductive process involving **fusion of two gametes (ova and sperm)**
- ❖ **Types of asexual reproduction: fission, sporulation, budding, gemmule formation, fragmentation and regeneration.**
- ❖ **Types of fission:** binary fission, multiple fission, sporulation and strobilation.
- ❖ Simple binary fission is seen in **irregular shaped organisms**, Eg. *Amoeba*
- ❖ In **Transverse binary fission**, plane of the division runs along the **transverse axis** of the organism.
- ❖ In **Longitudinal binary fission** this nucleus and the cytoplasm divides in the **longitudinal axis**
- ❖ **Oblique binary fission** is seen in **dinoflagellates**. e.g. *Ceratium*
- ❖ In multiple fission the **parent body divides into many** similar daughter cells.
- ❖ During **unfavorable conditions** *Amoeba* **withdraws its pseudopodia and secretes a three-layered, protective, chitinous cyst** wall around it and becomes inactive this is known as **Encystment**
- ❖ **Strobilation is a special type of transverse fission** occur in some **metazoan** e.g. *Aurelia*.
- ❖ **Plasmotomy** is the **division of multinucleated parent into many multinucleate daughter** individuals
- ❖ **Sporulation** is occur in **Amoeba during unfavourable** conditions without **encystment**.
- ❖ In budding, the **parent body produces one or more buds**
- ❖ **Types of budding - Exogenous budding** - e.g. *Hydra*, **Endogenous budding** - In *Noctiluca*,
- ❖ **Gemmules** - is a special types of asexual reproduction occurs in freshwater sponges and in some marine sponges.
- ❖ In fragmentation, the **parent body breaks into fragments** (pieces) and each of the fragment later develop into a new individual. Eg. many genera of sea anemones.
- ❖ **Regeneration is regrowth** in the injured region.
- ❖ Regeneration is of two types, **morphallaxis and epimorphosis**.
- ❖ Epimorphosis is the **replacement of lost body parts**.
- ❖ Types of Epimorphosis - **reparative and restorative regeneration**.
- ❖ **Syngamy is the fusion of two haploid gametes** takes place to produce a diploid zygote.
- ❖ **Types of syngamy – Autogamy, Exogamy, Hologamy, Paedogamy, Merogamy, Isogamy, Anisogamy**
- ❖ **Conjugation** -It is the **temporary union of the two individuals** of the same species.
- ❖ **Phases of life cycle - Juvenile Phase, Reproductive Phase, Senescent Phase.**
- ❖ **Types of animal** (Based on breeding) - **Seasonal Breeders, Continuous Breeders.**
- ❖ **Development of an egg into a complete individual without fertilization** is known as parthenogenesis.
- ❖ Types of Parthenogenesis : **Natural Parthenogenesis and Artificial Parthenogenesis.**
- ❖ **Types of animals** (Based on the site of development of embryo) - **Oviparous, Viviparous, Ovoviviparous**

## PART-A

## TEXTUAL QUESTIONS (1 MARK)

1. In which type of parthenogenesis are only males produced?

- a) Arrhenotoky                      b) Thelytoky  
c) Amphitoky                        d) Both a and b

Ans: a

2. Animals directly giving birth to young ones

- a) Oviparous                        b) Ovoviviparous  
c) Viviparous                        d) Both a and b

Ans: c

3. The mode of reproduction in bacteria is by

- a) Formation of gametes  
b) Endospore formation  
c) Conjugation  
d) Zoospore formation

Ans: c

4. In which mode of reproduction variations are seen

- a) Asexual                            b) Parthenogenesis  
c) Sexual                              d) Both a and b

Ans: c

5. Assertion and reasoning questions:

In each of the following questions there are two statements. One is assertion (A) and other is reasoning (R). Mark the correct answer as

- A. If both A and R are true and R is correct explanation for A  
B. If both A and R are true but R is not the correct explanation for A  
C. If A is true but R is false  
D. If both A and R are false.

I. Assertion: In bee society, all the members are diploid except drones.

Reason: Drones are produced by parthenogenesis.

- a) A                      b) B                      c) C                      d) D Ans: a

II. Assertion: Offsprings produced by asexual reproduction are genetically identical to the parent.

Reason: Asexual reproduction involves only mitosis and no meiosis.

- a) A                      b) B                      c) C                      d) D Ans: a

III. Assertion: Viviparous animals give better protection to their offsprings.

Reason: They lay their eggs in the safe places of the environment.

- a) A                      b) B                      c) C                      d) D Ans: d

## PART-B,C AND D

## TEXTUAL QUESTIONS (2,3 AND 5 MARKS)

6. Name an organism where cell division is itself a mode of reproduction.

**Amoeba, Vorticella** - reproduce by cell division

7. Name the phenomenon where the female gamete directly develops into a new organism with an avian example.

**Phenomenon - Parthenogenesis.**

❖ In some organisms **female gamete (ovum) is directly develop into a complete individual** by physical or chemical induction. e.g., Turkey, Chicken, pigeon

8. What is parthenogenesis? Give two examples from animals

❖ The process of development of an **egg into a complete individual without fertilization** is known as parthenogenesis.

❖ Eg. Annelid and sea urchin eggs.

9. Which type of reproduction is effective -Asexual or sexual and why?

❖ Sexual reproduction is an effective method of reproduction than asexual method because **Sexual reproduction contributes to the evolution** of the species by adding variation in a population.

❖ Variation occurs **because of the fusion of male and female gametes** (sexual reproduction) carrying different sets of chromosomes.

**10. The unicellular organisms which reproduce by binary fission are considered immortal. Justify.**

- ❖ Most unicellular **organisms reproduce by cell division.**
- ❖ The **whole parent body acts as reproductive unit** and disappears after new daughter cells are formed.
- ❖ **Whole parent body converted into daughter cell** thus, there is no death for unicellular organisms hence they are called immortal.

**11. Why is the offspring formed by asexual reproduction referred as a clone?**

- ❖ In Asexual reproduction **single individual can able to producing offspring.**
- ❖ These offspring are **genetically and morphologically similar** to one another and also similar to their parent.
- ❖ **Clone** is the term given to organisms that are similar in all aspects.
- ❖ Thus the offspring produced by **asexual reproduction** are called clones.

**12. Why are the offsprings of oviparous animals at a greater risk as compared to offsprings of viviparous organisms?**

- ❖ Oviparous animals laid the fertilized eggs in the **open environment without any protection.**
- ❖ So the development of the zygote takes place outside the body of mother, whereas in viviparous animals, development of the zygote takes place inside the body mother.
- ❖ Thus offsprings of **oviparous survival rate is very less** as compared to offspring of viviparous animals.

**13. Give reasons for the following:**

- a. Some organisms like honey bees are called **parthenogenetic animals**

**Reason :**

Male Honey bee (Drones) is develop from unfertilized egg so they are called as **parthenogenetic animals.**

- b. A male honey bee has **16 chromosomes** where as its female has **32 chromosomes.**

**Reason :**

1. A male honey bee – **Develop from unfertilized eggs**
2. Female honey bee - **Develop from fertilized eggs**

**14. Differentiate between the following:**

- a. Binary fission in amoeba and multiple fission in *Plasmodium*

S. no.	Binary fission in amoeba	Multiple fission in plasmodium
1.	Produce <b>two daughter cell</b>	Produce <b>many daughter cell</b> by multiple division
2.	Binary fission occur in <b>irregular shaped organisms</b>	Multiple fission occur in <b>regular shaped organisms</b>
3.	<b>Nucleus and cytoplasm divide once</b>	<b>Nucleus and cytoplasm divide multiple time</b> to produce many offspring.

**b. Budding in yeast and budding in Hydra**

S. No.	Budding in yeast	budding in <i>Hydra</i>
1.	Bud in Yeast is <b>unicellular</b>	Bud in Hydra is a <b>multicellular</b>
2.	Bud originates from a <b>small protuberance on the parent body</b>	Bud arises due to the <b>repeated mitotic division</b>
3.	Yeast gets its daughter nuclei and it <b>may or may not separate from the parent body</b>	In Hydra the daughter buds are multi-cellular and there is <b>no development of daughter buds.</b>

**c. Regeneration in lizard and Planaria**

S. No.	Regeneration in lizard	Regeneration in Planaria
1.	Type of generation : <b>Epimorphosis</b>	Type of generation : <b>Morphallaxis</b>
2.	In this type <b>replacement of lost body parts</b> occur.	In this type <b>Whole body grows</b> from a small fragment



15. How is juvenile phase different from reproductive phase?

S. No.	Juvenile phase	Reproductive phase
1.	It is a Time period between <b>birth to just before reproductive phase</b>	It is an actual <b>Reproductive phase</b>
2.	This phase also known as <b>primary growth phase or vegetative phase</b>	This phase is known as <b>secondary growth phase or sexual maturity</b>

16. What is the difference between syngamy and fertilization?

S. No.	Syngamy	Fertilization
1.	It is the process of <b>fusion of dissimilar gametes</b> (male and female gametes)	It is the process of <b>fusion of dissimilar gametes</b> (male and female gametes)
2.	Syngamy term is used to denote fusion of gamete occur mostly in <b>invertebrate or lower grade organisms</b>	Fertilization term is used to denote fusion of gamete occur in <b>higher invertebrate and all vertebrates</b>

**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

- Which is not a part of Reproduction?  
 a) Synthesis of RNA      b) Cell division  
 c) Growth                      d) Senescent      **Ans: d**
- Fission takes place in planaria is type of  
 a) Irregular binary fission  
 b) Transverse binary fission  
 c) Longitudinal binary fission  
 d) Oblique binary fission      **Ans: b**
- Repeated fission is a type of  
 a) Multiple fission  
 b) Strobilation  
 c) Sporulation  
 d) Oblique binary fission      **Ans: a**

4. \_\_\_\_\_ is a special type of transverse fission in metazoan is called

- a) Strobilation
- b) Sporulation
- c) Oblique fission
- d) Simple irregular fission      **Ans: a**

5. Plasmotomy type of fission occurs in

- a) Giant Amoeba                      b) Amoeba
- c) Aurelia                              d) Vorticella      **Ans: a**

6. Which is not match correctly?

- a) Binary fission                      - Amoeba
- b) Transverse fission                - Planaria
- c) Longitudinal fission              - Opalina
- d) Oblique fission                    - Ceratium      **Ans: c**

7. Which is not a condition of spore formation?

- a) Increase temperature
- b) Decrease temperature
- c) Scarcity of food
- d) Availability of excess food      **Ans: d**

8. Conjugation does not take place in

- a) Prokaryotes                      b) Paramecium
- c) Mesokaryotes                      d) Vorticella      **Ans: c**

9. Which among the following is known as seasonal breeder

- a) Honey bees                      b) Birds
- c) Chicken                              d) Rabbit      **Ans: b**

10. Type of binary fission occur in flagellates is

- a) Irregular binary fission
- b) Transverse binary fission
- c) Longitudinal binary fission
- d) Oblique binary fission      **Ans: c**

11. The daughter cell which comes out of Schizont of plasmodium and oocyte of plasmodium respectively are

- a) Merozoites and Sporozoites
- b) Sporozoites and Trophozoites
- c) Sporozoites and Merozoites
- d) Merozoites and Trophozoites      **Ans: a**

**12. What are all the character of encystment?**

- a) Protective layer
- b) Chitinous cyst wall
- c) Withdraws of pseudopodia
- d) All the above

**Ans: d**

**13. Plasmotomy is the division of multinucleated parent into many multinucleate daughter cell with the division of nuclei. This is common in**

- a) Noctiluca
- b) Opalina
- c) Sea anemones
- d) Archaeocytes

**Ans: b**

**14. In \_\_\_\_\_ type of Regeneration, the lost parts usually retain their original polarity, with oral ends.**

- a) Morphallaxis
- b) Reparative
- c) Restorative
- d) Epimorphosis

**Ans: d**

**15. Regeneration of starfish is an example of**

- a) Morphallaxis regeneration
- b) Reparative regeneration
- c) Restorative regeneration
- d) Epimorphosis regeneration

**Ans: c**

**16. Some organism do not produce gametes but they themselves behave as a gametes. This type of syngamy referred as**

- a) Hologamy
- b) Paedogamy
- c) Merogamy
- d) Isogamy

**Ans:a**

**17. In this type of Parthenogenetic egg may develop into individuals of any sex.**

- a) Arrhenotoky
- b) Thelytoky
- c) Amphitoky
- d) Complete parthenogenesis

**Ans: c**

**18. Which of the following statements is true of Hydra?**

- a) It produces asexual gemmules.
- b) It produces unicellular bud.
- c) It produces multicellular bud.
- d) It produces spores.

**Ans: c**

**19. Which of the following organisms exhibit binary fission?**

(1) *Bacillus*, (2) *Penicillium*, (3) Yeast, (4) *Amoeba*

- a) 1 & 4
- b) 2 & 4
- c) 1,2&4
- d) 3 & 4

**Ans: a**

**20. Asexual method of reproduction by binary fission is common to which of the following?**

(I) Some eukaryotes (ii) All eukaryotes  
(iii) Some prokaryotes (iv) All prokaryotes

- a) (I) and (ii)
- b) (ii) and (iii)
- c) (I) and (iii)
- d) (iii) and (iv)

**Ans: c**

**21. Choose the correct statements related to external fertilization**

- i) The male and female gametes are formed and released separately
- ii) Only a few gametes are released into the medium
- iii) Water is the medium in a majority of organisms exhibiting external fertilization
- iv) Offspring formed as a result of external fertilization have better chance of survival than those

formed inside an organism

- a) (iv)
- b) (iii)
- c) (ii)
- d) (I)

**Ans: b**

**22. Offspring formed by sexual reproduction exhibit more variation than offspring formed by Asexual reproduction because:**

- a) Sexual reproduction is a lengthy process
- b) Gametes of parents have qualitatively different genetic composition
- c) Genetic material comes from parents of two different species
- d) Greater amount of DNA is involved in sexual reproduction.

**Ans: b**

**23. There is no natural death in single celled organisms like *Amoeba* and bacteria because:**

- a) They cannot reproduce sexually
- b) They can reproduce by binary fission
- c) Parental body is continuously divide and grow as a offspring
- d) They are microscopic only

**Ans: c**



- 24. There are various types of reproduction. The type of reproduction adopted by an organism depends on:**
- The habitat and morphology of the organism
  - Morphology of the organism
  - Morphology and physiology of the organism
  - The organism's habitat, physiology and genetic material
- Ans: d**
- 25. Which animals have developed capacity of regeneration ?**
- Hydra, Starfish
  - Plasmodium
  - Earthworm
  - Spongilla
- Ans: a**
- 26. Sporulation occurs in.....**
- Plasmodium
  - Hydra
  - Starfish
  - Spongilla
- Ans: a**
- 27. What types of chromosomes are always present in gametes ?**
- Haploid
  - Diploid
  - Triploid
  - Tetraploid
- Ans: a**
- 28. Which physiological process is necessary for birth, growth, death, production of offspring and for continuity of the species ?**
- Digestion
  - Transportation
  - Reproduction
  - Nutrition
- Ans : c**
- 29. In which type of reproduction single parent is enough for reproduction**
- Asexual
  - Sexual
  - Vegetative
  - Fragmentation
- Ans : a**
- 30. In which type of organism asexual reproduction is seen ?**
- Unicellular
  - Bicellular
  - Multicellular
  - Both a and c
- Ans : d**
- 31. How does Amoeba reproduce ?**
- Binary fission
  - Budding
  - Sporulation
  - Both a and c
- Ans : d**
- 32. Which animals reproduce by exogenous budding ?**
- Hydra
  - Spongilla
  - Plasmodium
  - Amoeba
- Ans : a**
- 33. Which animal reproduce by multiple fission ?**
- Hydra
  - Plasmodium
  - Spongilla
  - Euglena
- Ans : b**
- 34. During which process cyst is formed ?**
- Binary fission
  - Multiple fission
  - Sporulation
  - Budding
- Ans : c**
- 35. In which organism other than amoeba, sporulation is seen ?**
- Paramoecium
  - Plasmodium
  - Hydra
  - Planaria
- Ans : b**
- 36. In which animal, formation of exogenous budding takes place from parent body ?**
- Hydra
  - Planaria
  - Amoeba
  - Paramoecium
- Ans : a**
- 37. In which animal conjugation occurs as a sexual reproduction?**
- Birds
  - Hydra
  - Paramoecium
  - Spirogyra
- Ans: c**
- 38. Development of zygote taking place outside the body is called as \_\_\_\_\_ .**
- Viviparous
  - Oviparous
  - Omnivorous
  - Ovoviviparous
- Ans: b**
- 39. In Amoeba, the plane of cytoplasmic division is in which direction ?**
- One direction
  - Two direction
  - Three direction
  - Any direction
- Ans : d**
- 40. Which type of division happens in Euglena ?**
- Transversal
  - Longitudinal
  - Peripheral
  - Radial
- Ans : b**
- 41. In which method of asexual reproduction the offspring's are genetically identical, to the parents ?**
- Amitotic division
  - Multiple fission
  - Division
  - Binary fission
- Ans : d**
- 42. In which of the following organism, internal bud formation is seen ?**
- Plasmodium
  - Amoeba,
  - Hydra
  - Spongilla
- Ans : d**

**43. Which method of asexual reproduction can be said as method of regeneration ?**

- a) Binary fission
- b) Sporulation
- c) Budding
- d) Fragmentation

**Ans : d**

**44. Which asexual reproduction process is seen in bacteria?**

- a) Budding
- b) Sporulation
- c) Fragmentation
- d) Fission

**Ans : d**

**45. Which gametes take part in sexual reproduction ?**

- a) Male gametes
- b) Female gametes
- c) Neutral gametes
- d) Both a and b

**Ans : d**

**46. Two gametes having similar appearance are called as.....**

- a) Gametes
- b) Isogametes
- c) Heterogametes
- d) Isospores

**Ans : b**

**47. Morphologically distinct gametes are called as \_\_\_\_\_ .**

- a) Isogametes
- b) Heterogametes
- c) Gametes
- d) Iso-spores

**Ans: b**

**48. The process of organ formation is known as**

- a) Embryogenesis
- b) Oogenesis
- c) Organogenesis
- d) morphogenesis

**Ans : c**

**49. Which asexual reproduction three layer of protective wall develop ?**

- a) Binary fission
- b) encystment
- c) Sporulation
- d) Fragmentation

**Ans : b**

**50. Which type of asexual reproduction takes place in spongilla ?**

- a) Exogenous budding
- b) Endogenous budding
- c) Fragmentation
- d) Division

**Ans : b**

**51. In which development of zygote takes place in female is called as.....**

- a) Oviparous
- b) Viviparous
- c) Ovoviviparous
- d) None

**Ans : b**

**Assertion and reasoning questions:**

In each of the following questions there are two statements. One is assertion (a) and other is reasoning (R). Mark the correct answer as

- A. If both A and R are true and R is correct explanation for A
- B. If both A and R are true but R is not the correct explanation for A
- C. If A is true but R is false
- D. If both A and R are false.

**52. Assertion: Hydra possess exogenous budding method.**

**Reason: Exogenous bud develops in hydra which directs asexually reproduction.**

- a) A
- b) B
- c) C
- d) D

**Ans : c**

**53. Assertion: Encystation is a structure which is hard three layered cyst.**

**Reason: Procarvates are protected in specific stage its life cycle by encystation.**

- a) A
- b) B
- c) C
- d) D

**Ans : c**

**54. Assertion: Juvenile phase possess plant growth.**

**Reason: after this phase plant is ready for pre fertilization phase.**

- a) A
- b) B
- c) C
- d) D

**Ans : d**

**55. Match the appropriate pairs.**

**Column - I**

- a) Binary fission
- b) Multiple fission
- c) Sporulation
- d) Budding
- a) a-iii, b-i, c-iv, d-ii
- c) a-iv, b-iii, c-ii, d-i

**Column - II**

- (i) Paramecium
- (ii) Hydra
- (iii) Amoeba
- (iv) Plasmodium
- b) a-i, b-ii, c-iii, d-iv
- d) a-ii, b-iii, c-iv, d-I

**Ans : a**

**56. Match the appropriate pairs.**

**Column - I**

- a) Binary fission
- b) Transverse binary fission
- c) Longitudinal
- d) Budding
- a) a-i, b-ii, c-iii, d-iv
- c) a-iv, b-ii, c-iii, d-I

**Column - II**

- (i) Paramecium
- (ii) Euglena
- (iii) Hydra
- (iv) Ameoba
- b) a-iv, b-i, c-ii, d-iii
- d) a-iii, b-iv, c-i, d-ii

**Ans : b**

## PART-B

## ADDITIONAL QUESTIONS (2 MARKS)

## 1) List out the importance of reproduction.

- ⇒ Reproduction is the **fundamental feature**.
- ⇒ Reproduction results in **persistence of species and introduces variations**, which are essential for adaptation and evolution

## 2) Define fission. Add its types

- ⇒ It is the **division of the parent body** into two or more identical daughter individuals.

**Types of fission : binary fission, multiple fission, sporulation and strobilation.**

## 3) What is encystment ?

- ⇒ During **unfavorable conditions** (increase or decrease in temperature, scarcity of food) *Amoeba* **withdraws its pseudopodia and secretes a three-layered, protective, chitinous cyst** wall around it and becomes inactive.
- ⇒ This phenomenon is called **encystment**.

## 4) What is gemmules ?

- ⇒ Gemmules are is **hard ball**, consisting of an internal mass of **food-laden archaeocytes** produce by sponges.
- ⇒ During unfavourable conditions, the sponge disintegrates but the **gemmule can withstand adverse conditions**.
- ⇒ When conditions become favourable, the **gemmules** begin to hatch.

## 5) List out the phases of life

- ⇒ **Juvenile Phase – growth phase**
- ⇒ **Reproductive Phase – actual phase of reproduction**
- ⇒ **Senescent Phase – decline phase**

## 6) List out and explain the types of natural parthenogenesis

- a) **Arrhenotoky** : In this type **only males are produced** by parthenogenesis. Eg: honey bees
- b) **Thelytoky** : In this type **females are produced by parthenogenesis**. Eg: Solenobia

c) **Amphitoky** : In this type parthenogenetic egg **may develop into individuals of any sex**. Eg: Aphids.

## 7) What is padeogenesis ?

- ⇒ It is a type of **parthenogenesis**
- ⇒ **It is also Paedogenetic parthenogenesis**
- ⇒ in this mode **larvae produce a new generation**

Eg. sporocysts, liver fluke and Gall fly.

## 8) What is senescent phase ?

- ⇒ It is the **last phase of lifecycle** of an organism
- ⇒ It begins at the end of reproductive phase when **degeneration sets in the structure and functioning** of the body.

## 9) List out the difference between endogenous budding and exogenous budding

S. No.	Endogenous budding	Exogenous budding
1.	Buds are produced inside the mother's body	Buds are arises externally on the outer surface of mother's body
2.	Eg. Noctiluca, spongilla	Eg. Hydra, yeast

## 10) List out the difference between oviparous and viviparous

S. No.	Oviparous animal	Viviparous animal
1.	<i>I.</i> these Animal lays eggs	<i>i.</i> these Animal gives birth to young ones.
2.	<i>ii.</i> there is a Less demand of resources from the female's body	<i>ii.</i> here Greater demand of resources from the female's body.
3.	<i>iii.</i> Chances of survival of progeny is low.	<i>iii.</i> Chances of survival of progeny is high.
4.	<i>iv.</i> Examples: reptiles and aves	<i>iv.</i> Examples: most of the mammals, shark, dolphin

11) List out the difference between autogamy and exogamy

S. No.	Autogamy	Exogamy
1.	Male and female gametes are produced by the <b>same cell or same organism</b> and both the gametes fuse together to form a zygote	The male and female gametes are produced by <b>different parents</b> and they fuse to form a zygote. So it is biparental.
2.	e.g. <i>Actinosphaerium</i> and <i>Paramecium</i> .	e.g. Human – dioecious or unisexual animal.

12) List out the difference between seasonal breeder and continuous breeder

S. No.	Seasonal breeder	Continuous breeder
1.	<b>This organisms reproduce at particular period</b> of the year	This organisms continue to <b>breed throughout their sexual maturity</b>
2.	<b>E.g.</b> frogs, lizards, most birds, deers etc,	E.g. honey bees, poultry, rabbit etc

13) List out the difference between external fertilization and internal fertilization

S. No.	External fertilization	Internal fertilization
1.	Fusion of gametes takes <b>place outside the body</b> of female organisms in the water medium	the fusion of gametes takes place <b>within the body of female organisms</b>
2.	E.g. sponges, fishes and amphibians	e.g. reptiles, aves and mammals.

14) List out the difference between external fertilization and internal fertilization

S. No.	Complete parthenogenesis	Incomplete parthenogenesis
1.	In this there is <b>no biparental sexual reproduction because</b> These are no male organisms and so, such individuals are <b>represented by females only.</b>	In this <b>both sexual reproduction and parthenogenesis occurs.</b>
2.	E.g. Most of insects	e.g Honeybees;.

15) List out the difference between Morphallaxis and epimorphosis

S. No.	Morphallaxis	Epimorphosis
1.	In morphallaxis the <b>whole body grows from a small fragment</b>	In Epimorphosis is the <b>replacement of lost body parts</b> Types : 1. <b>Reparative regeneration</b> → only certain <b>damaged tissue can be regenerated,</b> 2. <b>Restorative regeneration</b> → <b>several body parts can develop.</b>
2.	e.g. <i>Hydra</i> and <i>Planaria</i> .	e.g. star fish, tail of wall lizard.

16) Name the type of reproduction that can create new variants.

- ⇒ Sexual reproduction ensures creation of new variants.
- ⇒ It involves, **fusion of gametes from different parents** which results in genetic recombination that cause variations.

17) Locate site where syngamy occurs in amphibians and reptiles respectively.

- ⇒ In amphibians, **syngamy takes place outside the body** of the organism in water and in reptiles **syngamy takes place inside the body** of the female organism.
- ⇒ Thus, in **amphibians external fertilization** takes place and in **reptiles internal fertilisation** takes place.

18) Why Amoeba and yeast that can be able to reproduce asexually.

- Amoeba and yeast are able to reproduce asexually because of following reasons:
- a) They are unicellular organisms
  - b) They have simple organization

19) Cell division cannot be a type of reproduction in multicellular organisms. Give reasons.

- ⇒ Most of the multicellular organisms **have complex organization.**
- ⇒ Especially the animals show **tissue level and organ system level organization.**



- For a single cell, it is not possible to produce different tissues just by undergoing mitosis.
- Hence, cell division cannot be a type of reproduction in multicellular organisms.

### 20) Why do gametes produced in large numbers in organisms which exhibit external fertilisation?

- In case of external fertilization, **gametes are at risk** in surrounding.
- Gametes can get **blown off by wind, washed away by water or eaten by predators.**
- So, most of the gametes **die before fertilization.**
- To ensure the survival of the species, it is necessary to **produce as many gametes as possible** so that at least some of them would be able to carry out fertilization.
- Hence, organisms which exhibit **external fertilization produce a large number of gametes.**

## PART-C

### ADDITIONAL QUESTIONS

(3 MARKS)



#### 1. Write short notes on budding and its types.

##### **Budding**

- In budding, the **parent body produces one or more buds**
- Each bud is **separated and grows** into a young one.
- In sponges, the buds **constrict and detach** from the parent body and develops into a new sponge.

##### ➤ **Types of budding :**

- **Exogenous budding**
- **Endogenous budding**

##### **Exogenous budding :**

- In this **buds are formed on the outer surface of the parent body**, it is known as exogenous budding

e.g. *Hydra*.

- In *Hydra* when food is plenty, the **ectoderm cells increase and form a small elevation** on the body.

- **Ectoderm and endoderm are pushed out** to form the bud.
- The bud contains an interior **lumen and gastrovascular cavity.**
- The bud enlarges, develops a **mouth and a circle of tentacles .**
- At maturity, the **bud constricts and finally separates** from the parent body and grow independently.

##### **Endogenous budding :**

- In *Noctiluca*, hundreds of **buds are formed inside the cytoplasm**
- Many **buds remain within the body** of the parent. This is called endogenous budding.

#### 2. The cell division during gamete formation is not of the same type in different organisms. Justify.

- Heterogametic species produce two types of gametes namely **male and female.**
- Gametes are haploid though the parent body from which they arise may be either **haploid or diploid.**
- Haploid plant body in **monera, fungi, algae and bryophytes** and diploid in **pteridophytes, gymnosperms, angiosperms** and most of the animals including human beings
- **Meiosis will take place**, if the diploid body has to produce haploid gametes.
- In diploid organisms, specialised cells called **meiocytes** undergo meiosis, at the end only one set of chromosome gets incorporated into each gamete.

#### 3. Which type of reproduction called as reduction division? Why is it so?

- Reduction division is associated with sexual reproduction.
- We know that fertilization is an important step in sexual reproduction.
- Since fertilization involves fusion of two gametes, the number of chromosomes becomes diploid in zygote.
- To ensure continuity of characters in a species, it is necessary to develop some mechanism by which number of chromosomes can be haploid in the gametes.

⇒ Hence, gametogenesis involves reduction division and thus gametes have haploid number of chromosomes.

4. Write short notes on Regeneration and its types .

- **Regeneration is regrowth** in the injured region.
- It was first studied in **Hydra by Abraham Trembley** in 1740.
- Regeneration is of two types, **morphallaxis and epimorphosis**.

**Morphallaxis :**

- In morphallaxis the **whole body grows from a small fragment**

e.g. *Hydra* and *Planaria*.

- When *Hydra* is cut into several pieces, each piece can **regenerate the lost parts and develop into a whole new individual**.
- The parts usually retain their **original polarity, with oral ends**, by **developing tentacles**
- **Aboral ends**, by producing **basal discs**.

**Epimorphosis :**

- Epimorphosis is the **replacement of lost body parts**.
- Types : **reparative and restorative regeneration**.
- **Reparative regeneration** → only certain **damaged tissue can be regenerated**,
- **Restorative regeneration** → **severed body parts can develop**. e.g. star fish, tail of wall lizard.

4. Explain various phases of life cycle

Organisms have three phases of life cycle they are

1. Juvenile Phase,
2. Reproductive Phase
3. Senescent Phase.

- **Juvenile phase/ vegetative phase** : It is the period of **growth between the birth upto reproductive** maturity of the organisms.
- **Reproductive phase/ maturity phase** : It is actual reproductive period of the organisms.

- **Senescent phase** : begins at the end of reproductive phase when **degeneration sets in the structure** and functioning of the body.

5. Classify organisms based on breeding season

Based on breeding animals are classified into two categories they are

1. **Seasonal Breeders**
  2. **Continuous Breeders.**
- **Seasonal breeders** : **reproduce at particular period** of the year  
E.g. frogs, lizards, most birds, deers etc.,
  - **Continuous breeders** : continue to **breed throughout their sexual maturity**  
E.g. honey bees, poultry, rabbit etc.,

**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

1) Enumerate the differences between asexual and sexual reproduction.

Asexual Reproduction	Sexual Reproduction
i. A single parent is involved in the process	i. Two parents are involved in the process
ii. Meiosis does not happen.	ii. Meiosis happens during gametogenesis.
iii. Gametogenesis does not happen.	iii. Gametogenesis happens.
iv. Genotype of offspring is identical to that of parent.	iv. Genotype of offspring is a combination of two parents and is hence different from parents.
v. It is mostly seen in simple organisms.	v. It is prevalent in complex organisms.

2) Describe any three types of asexual reproduction exhibited by unicellular organisms.

**Types of Asexual Reproduction in Unicellular Organisms:**

**a. Binary Fission:**

- In this case, the **unicellular organism undergoes cell division** and two daughter cells are produced.
- The parent **generation ceases to exist** after binary fission.

E.g: *Amoeba*



**b. Multiple Fission:**

- In this case, the nucleus of the **mother cell divides into multiple nuclei**.
- A cyst develops around the mother cell.
- The cyst helps the mother cell to tide **over unfavourable circumstances**.
- On resumption of favourable circumstances, the cyst disintegrates and daughter nuclei develop into new individuals.

E.g: *Plasmodium, Entamoeba*

**c. Budding:**

- In this case, **a bud develops at one end of the cell**.
- The nucleus produces a **daughter nucleus** which then goes to the bud.
- The bud then gets detached from the mother cell and develops into a new individual.

E.g: yeast

**Types of budding.**

- I Exogenous budding
- II Endogenous budding

### 3) Organisms include in Kingdom Animalia and Plantae prefer sexual mode of reproduction. Add notes on it.

- ❖ Sexual reproduction **gives various survival benefits** and that why many organisms prefer this mode of reproduction.
- ❖ **Asexual reproduction is a fast process** through which a large number of offspring can be produced in shorter time span.
- ❖ However, since **offspring are clones of their parents** hence they have same shortcomings as their parents.
- ❖ They will be equally **susceptible to diseases and various other stresses** as their parents.
- ❖ But offspring; produced after **sexual reproduction have better genotype** because it is a combination of genotype of two individuals.
- ❖ Sexual reproduction helps an organism to **overcome unfavorable situation**.
- ❖ Many plants utilize asexual reproduction in possible only in favourable conditions like **plenty of food, water and sunlight**.

- ❖ But **under unfavourable conditions**, they resort to sexual reproduction.
- ❖ Asexual reproduction can only **depend on mutation for bringing evolution**
- ❖ But sexual reproduction bring variation which result in evolution.

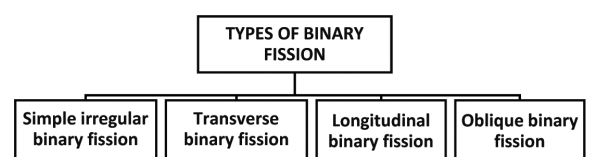
### 4) Define external fertilization. Mention its disadvantages.

- ❖ When fusion of the gametes **takes place outside the body** of the organisms, it is called **external fertilization or external syngamy**.
- ❖ The external medium like **water is required for this form of fertilization**.
- ❖ This form, is found in many aquatic animals like **fishes, amphibians, majority of algae**.
- ❖ In this, parents release eggs and sperms in the surrounding water, then fertilization and development of offspring occur externally.

**Disadvantages of external fertilization :**

- i) It occurs **only in aquatic medium**.
- ii) A chance factor is involved **requiring synchronous release of gametes** nearby and absence of turbulence of water.
- iii) There is **no protection to young ones**.
- iv) They are **susceptible to a predators**.

### 5) Write short notes on binary fission and its types.

**Binary fission:**

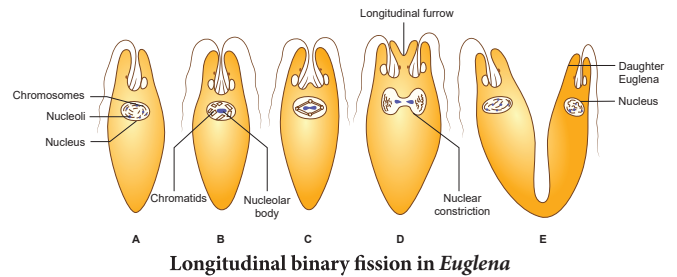
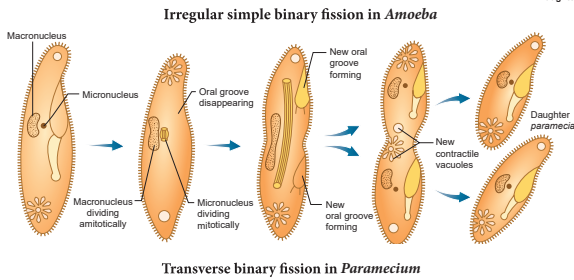
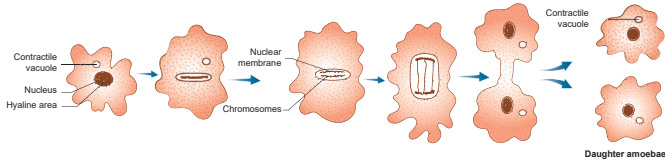
- In **this** the parent organism **divides into two halves** and each half forms a daughter individual.
- The nucleus divides first **amitotically or mitotically** (karyokinesis), followed by the division of the cytoplasm (cytokinesis).
- The offsprings are **genetically identical** to the parent.
- Depending on the plane of fission, binary fission is of the following types

I. Simple irregular binary fission

II. Transverse binary fission

III. Longitudinal binary fission

IV. Oblique binary fission



d. Oblique binary fission

- In this the **plane of division is oblique**.
- It is seen in **dinoflagellates**. e.g. *Ceratium*

6) Write short notes on types of syngamy

- **Autogamy** : Male and female gametes are produced by the **same cell or same organism** and both the gametes fuse together to form a zygote

e.g. *Actinosphaerium* and *Paramecium*.

- **Exogamy** : the male and female gametes are produced by **different parents** and they fuse to form a zygote. So it is biparental.

e.g. Human – dioecious or unisexual animal.

- **Hologamy** : In lower organisms, **organisms itself behave as gametes** and the fusion of such mature individuals is known

as hologamy e.g. *Trichonympha*.

- **Paedogamy** - **union of young individuals produced immediately after the division** of the adult parent cell by mitosis.

- **Merogamy** - **fusion of small sized and morphologically different gametes** (merogametes).

- **Isogamy** : it is the fusion of **morphological and physiological identical gametes** (isogametes)

- **Anisogamy** – it is the **fusion of dissimilar gametes** is called anisogamy e.g. *Monocystis*,

- Anisogamy occurs in higher animals but it is usually known as fertilization instead of anisogamy or syngamy.

e.g. higher invertebrates and all vertebrates.

a. Simple binary fission :

- Simple binary fission is seen in **irregular shaped organisms**, Eg. *Amoeba*
- In this **plane of division** is hard to see.
- Vacuoles **stop to function and disappear**.
- The **nucleoli disintegrate** and the **nucleus divides mitotically**.
- The **cell then constricts in the middle**, and divides to forms two daughter cells.

b. Transverse binary fission

- In this plane of the division **runs along the transverse axis** of the organism.

e.g. *Paramecium* and *Planaria*.

- In *Paramecium* → **Macronucleus divides by amitosis**

- **Micronucleus divides by mitosis.**

c. Longitudinal binary fission

- In this nucleus and the cytoplasm divides in the **longitudinal axis of the organism**.

- In flagellates, the **basal granule is divided** to forms a two flagellum. e.g. *Vorticella* and *Euglena*.



## POINTS TO REMEMBER

- ❖ Reproduction is **unavoidable for the existence** of a species.
- ❖ **Gametogenesis - Formation of gametes** by spermatogenesis and oogenesis.
- ❖ **Insemination - Transfer of sperms** by the male into the female genital tract.
- ❖ **Fertilisation - Fusion of male and female gametes** to form zygote, called fertilisation.
- ❖ **Cleavage - Rapid mitotic divisions of the zygote**
- ❖ **Implantation - Attachment of blastocyst to the uterine wall.**
- ❖ **Placentation - Formation of placenta** which is the internate connection between foetus and uterine wall of the mother
- ❖ **Gastrulation - Process by which blastocyst is changed into a gastrula** with three primary germ layers
- ❖ **Organogenesis - Formation of specific tissues, organs and organ systems** from three germ layers.
- ❖ **Parturition - Expulsion of the foetus** from the mother's womb.
- ❖ The male reproductive system include : **pair of testes, accessory ducts, glands and external genitalia.**
- ❖ **Testes** - primary male sex orgAns:
- ❖ They are **pair of ovoid bodies** present inside scrotum.
- ❖ **Seminiferous tubules** are the sites for sperm production (80%)
- ❖ Seminiferous tubuleis made of two types of cells
  1. **Sertoli cells or nurse cells,**
  2. **Spermatogenic cells**
- ❖ **Leydig cells** They act as endocrine gland and **secrete androgens** namely the **testosterone hormone**
- ❖ **Accessory ducts** - It include **rete testis, vasa efferentia, epididymis and vas deferens.**
- ❖ **Accessory glands** -It include **seminal vesicles, Bulbourethral glands and Prostate gland.**
- ❖ **Seminal vesicles** à secrete an alkaline fluid called **seminal plasma**
- ❖ **Bulbourethral glands** help in the **lubrication of the penis.**
- ❖ **Prostate gland** secretes a **slightly acidic fluid** that contains **citrate, several enzymes** and **antigens.**
- ❖ **Semen** is a **milky white fluid** which contains **sperms and the seminal plasma** (secreted by **accessory glands**).
- ❖ **Female reproductive system** consists of a **pair of ovaries, Pair of oviducts, Uterus, Cervix, Vagina, External genitalia**
- ❖ Ovaries are the **primary female sex organs** that **produce ovum.**
- ❖ **Female accessory organs** -It include **Fallopian tubes, uterus and vagina**
- ❖ **It consists of Fimbriae, Ampulla, Isthmus**
- ❖ **Uterus** is a **hollow, thick-walled, muscular, highly vascular** and **inverted pear shaped** structure.
- ❖ **Birth canal = Cervical canal + vagina**
- ❖ The wall of the uterus has **three layers of tissues - Perimetrium, Myometrium, Endometrium.**
- ❖ **The Bartholin's glands** - secrete mucus to **lubricate the vagina**
- ❖ **The Skene's glands** - secrete a **lubricating fluid**
- ❖ The external opening of the **vagina is partially closed** by a **thin ring of tissue** called the hymen.
- ❖ Mammary glands are **modified sweat glands** present in both sexes.
- ❖ Gametogenesis is the process of **formation of gametes**
- ❖ Spermatogenesis is process of **formation of male gametes**, the sperms from testes.
- ❖ Spermatogenesis takes about **64 days.**
- ❖ Rate of sperm production : **200 million/per day.**
- ❖ **Testosterone** - stimulates the process of spermatogenesis.
- ❖ Sperm is a **microscopic, flagellated and motile gamete.**
- ❖ Sperm is **enveloped by plasma membrane** and is composed of a **head, neck and a tail.**
- ❖ Single ejaculation contain **200 to 300 million sperms.**
- ❖ 60 % of sperms have normal shape
- ❖ 40 % show **vigorous motility for normal fertility.**

- ❖ Oogenesis is the **process of development of the female gamete** or ovum or egg in the ovaries.
- ❖ During foetal development, certain cells in the germinal epithelium of the foetal ovary **divide by mitosis and produce millions of egg mother cells or oogonia**.
- ❖ Human ovum is **non-cleidoic ( without shell), alecithal (no yolk)** and **microscopic** in nature.
- ❖ Its cytoplasm called **ooplasm** contains a large nucleus called the **germinal vesicle**.
- ❖ **The cycle of events starting from one menstrual period till the next one is called the menstrual cycle during which cyclic changes occurs in the endometrium every month.**
- ❖ **Menstrual cycle comprises of the following phases**
- ❖ **Menstrual phase, Follicular or proliferative phase, Ovulatory phase, Luteal or secretory phase**
- ❖ **Primary follicle in the ovary grows** to become a fully mature Graafian follicle and simultaneously, the **endometrium regenerates through proliferation**.
- ❖ **Maximum secretion of LH** during the mid cycle called **LH surge** induces the **rupture of the Graafian follicle** and the **release of the ovum** (secondary oocyte) from the ovary wall into the peritoneal cavity.
- ❖ This process is called as **ovulation**.
- ❖ During luteal phase, the remaining part of the **Graafian follicle is transformed into a transitory endocrine gland** called **corpus luteum**.
- ❖ The **corpus luteum secretes large amount of progesterone** which is essential for the maintenance of the endometrium.
- ❖ Menstrual hygiene is vital for **good health, well-being, dignity, empowerment and productivity**.
- ❖ Poor menstrual hygiene result in **stress, fear and shame** during menstruation.
- ❖ **Menopause** - In this phase there is no **ovulation and menstruation**.
- ❖ The average age of menopause is **45-50 years**.
- ❖ Fertilisation is a process of **haploid sperm fuses with a haploid ovum** to form a diploid zygote.
- ❖ **Capacitation** - is a **biochemical event** that enables the **sperm to penetrate and fertilise the egg**.
- ❖ The first cleavage produces **two identical cells** called **blastomeres**.
- ❖ **Ectopic pregnancy** - If the fertilised ovum is implanted outside the uterus it is known as **ectopic pregnancy**.
- ❖ **Twins-Two off springs** produced in the same pregnancy.
- ❖ **Monozygotic (Identical) twins** : they are produced when a **single fertilised egg**
- ❖ **Dizygotic (Fraternal) twins** : they are produced when **two separate eggs are fertilised by two separate sperms**.
- ❖ **Siamese (United) twins** : they are the **conjoined twins** who are **joined during birth**.
- ❖ **Gastrulation** – it is the process of transformation of the **blastocyst into a gastrula** with the primary germ layers by the movement of the blastomeres is called **gastrulation**.
- ❖ **Amnion** : - it is a **double layered translucent membrane** filled with the amniotic fluid.
- ❖ **Yolk sac** : it forms a **part of the gut**
- ❖ **Allantois** : it forms a **small out pocketing of embryonic tissue** at the caudal end of the yolk sac.
- ❖ **Chorion** : It is the **outermost membrane** which encloses all other membranes
- ❖ Chorionic villi + uterine tissues → placenta. (disc-shaped)
- ❖ **Placenta** is a **temporary endocrine organ** formed during pregnancy
- ❖ **Gestation period** = pregnancy period (Duration : **280 days or 40 weeks**)  
It can be divided into three trimesters (three months each)
- ❖ **1st trimester** : Organ developed are : **heart, limbs, lungs, liver and external genital organs**
- ❖ **2nd trimester** : the **face is well formed with features**, eyelids and eyelashes, eyes blink,
- ❖ **3rd trimester** : The foetus is **fully developed** and is **ready for delivery** by the end of nine months
- ❖ Colostrum, a **nutrient rich fluid produced by the human female immediately after giving birth**, is loaded with immune, growth and tissue repair factors.
- ❖ **Parturition is the completion of pregnancy and giving birth to the baby.**
- ❖ **Labour** - The **series of events** that expels the infant from the uterus is collectively called "labour".
- ❖ Relaxin is a hormone secreted by the **placenta and corpus luteum**.
- ❖ It **promotes parturition** by relaxing the pelvic joints and by dilatation of the cervix with continued powerful contractions.
- ❖ **Lactation - Lactation** is the **production of milk by mammary glands**.



**PART-A**

**TEXTUAL QUESTIONS (1 MARK)**

1. The mature sperms are stored in the
  - a. Seminiferous tubules
  - b. Vas deferens
  - c. Epididymis
  - d. Seminal vesicle

**Ans: c**
2. The male sex hormone testosterone is secreted from
  - a. Sertoli cells
  - b. Leydig cell
  - c. Epididymis
  - d. Prostate gland

**Ans: b**
3. The glandular accessory organ which produces the largest proportion of semen is
  - a. Seminal vesicle
  - b. Bulbourethral gland
  - c. Prostate gland
  - d. Mucous gland

**Ans: a**
4. The male homologue of the female clitoris is
  - a. Scrotum
  - b. Penis
  - c. Urethra
  - d. Testis

**Ans: b**
5. The site of embryo implantation is the
  - a. Uterus
  - b. Peritoneal cavity
  - c. Vagina
  - d. Fallopian tube

**Ans: a**
6. The foetal membrane that forms the basis of the umbilical cord is
  - a. Allantois
  - b. Amnion
  - c. Chorion
  - d. Yolk sac

**Ans: a**
7. The most important hormone in initiating and maintaining lactation after birth is
  - a. Oestrogen
  - b. FSH
  - c. Prolactin
  - d. Oxytocin

**Ans: c**
8. Mammalian egg is
  - a. Mesolecithal and non cleidoic
  - b. Microlecithal and non cleidoic
  - c. Iecithal and non cleidoic
  - d. Alecithal and cleidoic

**Ans: c**
9. The process which the sperm undergoes before penetrating the ovum is
  - a. Spermiation
  - b. Cortical reactio
  - c. Spermiogenesis
  - d. Capacitation

**Ans: d**

10. The milk secreted by the mammary glands soon after child birth is called
  - a. Mucous
  - b. Colostrum
  - c. Lactose
  - d. Sucrose

**Ans: b**
11. Colostrum is rich in
  - a. Ig E
  - b. Ig A
  - c. Ig D
  - d. Ig M

**Ans: b**
12. The Androgen Binding Protein (ABP) is produced by
  - a. Leydig cells
  - b. Hypothalamus
  - c. Sertoli cells
  - d. Pituitary gland

**Ans: c**
13. Which one of the following menstrual irregularities is correctly matched?
  - a. Menorrhagia - excessive menstruation
  - b. Amenorrhoea - absence of menstruation
  - c. Dysmenorrhoea - irregularity of menstruation
  - d. Oligomenorrhoea - painful menstruation

**Ans: b**



**14. Find the wrongly matched pair**

a. Bleeding phase	- fall in oestrogen and progesterone
b. Follicular phase	- rise in oestrogen
c. Luteal phase	- rise in FSH level
d. Ovulatory phase	- LH surge

**Ans: c**

**These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.**

- A. If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion
  - B. If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
  - C. If Assertion is True but the Reason is False.
  - D. If both Assertion & Reason are false.
15. **Assertion: In human male, testes are extra abdominal and lie in scrotal sacs.**

**Reason: Scrotum acts as thermoregulator and keeps temperature lower by 2°C for normal sperm production.**

- a. A      b. B      c. C      d. D      **Ans: a**

16. Assertion: Ovulation is the release of ovum from the Graffian follicle.

Reason: It occurs during the follicular phase of the menstrual cycle.

- a. A      b. B      c. C      d. D    Ans: c

7. Assertion: Head of the sperm consists of acrosome and mitochondria.

Reason: Acrosome contains spiral rows of mitochondria.

- a. A      b. B      c. C      d. D    Ans: d

**PART-B,C AND D**

**TEXTUAL QUESTIONS (2, 3 AND 5 MARKS)**

18. Mention the differences between spermiogenesis and spermatogenesis.

Spermatogenesis	Spermiogenesis
i. It is the process of formation of haploid spermatozoa from germinal cells.	It is the process of differentiation of spermatozoon from a spermatid.
ii. It involves conversion of a diploid structure into haploid structures	It changes a haploid structure into another haploid structure.
iii. There is growth and divisions during spermatogenesis.	There is re-construction during spermiogenesis. Divisions and growth are absent.
iv. No organelle is lost	Golgi bodies are lost during spermiogenesis.
v. A spermatogonium forms four spermatozoa.	Here a spermatid forms a single spermatozoon

19. At what stage of development are the gametes formed in new born male and female?

Production and maturation of gametes will take place after puberty (Secondary sexual maturity)

20. Expand the acronyms

- a. FSH - Follicle Stimulating Hormone
- b. LH - Lutenizing Hormone
- c. HCG – Human Chorionic Gonadotropin
- d. HPL - Human Placental Lactogen

21. How is polyspermy avoided in humans?

- Once fertilisation is happened cortical granules from the cytoplasm of the ovum form a barrier called the fertilisation membrane around the ovum.
- This preventing further penetration of other sperms.
- Thus polyspermy is prevented

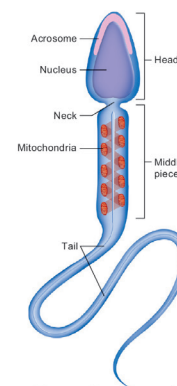
22. What is colostrum? Write its significance.

- Colostrum, a nutrient rich fluid produced by the human female immediately after giving birth, is loaded with immune, growth and tissue repair factors.
- It acts as a natural antimicrobial agent to actively stimulate the maturation of the infant's immune system.

23. Placenta is an endocrine tissue. Justify.

- During pregnancy, the placenta acts as a temporary endocrine gland and produces
  1. Human Chorionic Gonadotropin (hCG),
  2. Human Chorionic Somatomammotropin (hCS) or human Placental Lactogen (hPL),
  3. Oestrogens and progesterone

24. Draw a labeled sketch of a spermatozoan.



25. What is inhibin? State its functions.

- Sertoli cells - elongated and pyramidal

- It provide nourishment to the sperms. They also secrete **inhibin**, a hormone (role - negative feedback control of sperm production)

**26. Mention the importance of the position of the testes in humans:**

- Testes present inside **scrotal sac of skin that hangs outside** the abdominal cavity.
- **Scrotum is placed outside the abdominal cavity** to provide a temperature 2-3oC lower than the normal internal body temperature to produce viable sperm.
- Thus, the scrotum acts as a **thermoregulator** for spermatogenesis.

**27. What is the composition of semen?**

- It is a **milky white fluid** which contains **sperms and the seminal plasma** (secreted by **accessory glands**).
- The **seminal fluid** - acts as a **transport medium, provides nutrients, contains some chemicals**
- **Role of chemical** - **protect and activate the sperms** and also help in motility.

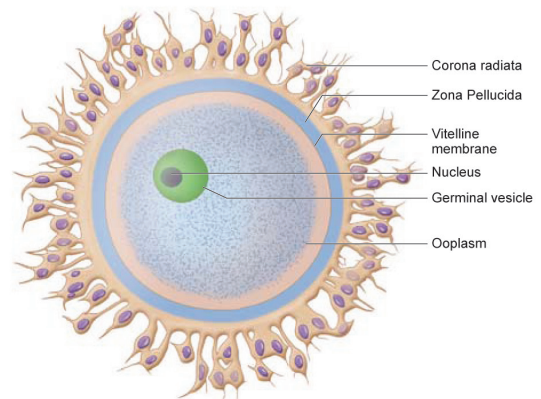
**28. Name the hormones produced from the placenta during pregnancy.**

- **Relaxin hormone** is secreted during pregnancy
- It helps in **relaxation of the pelvic ligaments** at the time of parturition.
- **hCG, hPL, Oestrogen, Progesterone and relaxin** are produced only during pregnancy.

**29. Define gametogenesis.**

- Gametogenesis is the process of **formation of gametes**
- i.e., **sperms and ovum** from testes and ovary respectively
- **Meiosis** plays the most significant role in the process of gametogenesis.

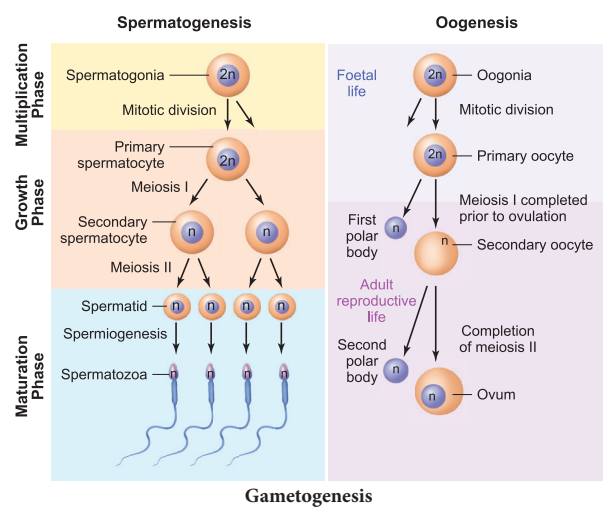
**30. Describe the structure of the human ovum with a neat labelled diagram.**



**Structure of ovum**

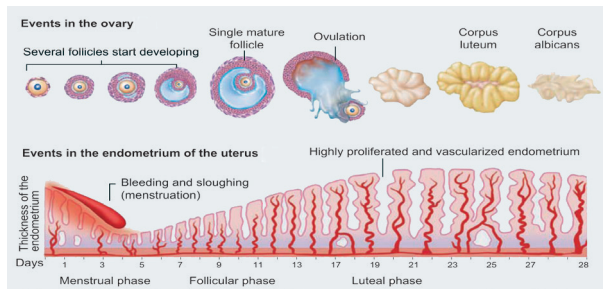
- Human ovum is **non-cleidoic (without shell), alecithal (no yolk)** and **microscopic** in nature.
- Its cytoplasm called **ooplasm** contains a large nucleus called the **germinal vesicle**.
- The ovum is surrounded 1. Inner thin transparent **vitelline membrane**,
- 2. Middle thick **zona pellucida**
- Outer thick coat of follicular cells called **corona radiata**.
- Between the vitelline membrane and zona pellucida there is a **narrow perivitelline space**.

**31. Give a schematic representation of spermatogenesis and oogenesis in humans:**



**32. Explain the various phases of the menstrual cycle. Menstrual cycle comprises of the following phases**

1. **Menstrual phase**
2. **Follicular or proliferative phase**
3. **Ovulatory phase**
4. **Luteal or secretory phase**



1. **Menstrual phase**

- ✪ It is a **initial phase**
- ✪ Duration : **3-5 days** - menstrual flow occurs
- ✪ Menstrual flow is due to the **breakdown of endometrial lining of the uterus, and its blood vessels.**
- ✪ This is due to **decline in the level of progesterone and oestrogen.**
- ✪ Menstruation occurs only if the released **ovum is not fertilized.**
- ✪ Absence of menstruation may be an **indicator of pregnancy.**
- ✪ Menstruation also be due to **stress, hormonal disorder and anaemia.**

2. **Follicular or proliferative phase**

- ✪ **Duration** : 5th day till the time of ovulation.
- ✪ **Primary follicle in the ovary grows** to become a fully mature Graafian follicle and simultaneously, the **endometrium regenerates through proliferation.**
- ✪ These changes **due to FSH and LH hormones** increase gradually.
- ✪ It stimulates **follicular development and secretion of oestrogen** by the follicle cells.

3. **Ovulatory phase**

- ✪ Both **LH and FSH attain peak level** in the middle of the cycle (about the 14th day).
- ✪ **Maximum secretion of LH** during the mid cycle called **LH surge** induces the **rupture**

**of the Graafian follicle** and the **release of the ovum** (secondary oocyte) from the ovary wall into the peritoneal cavity.

- ✪ This process is called as **ovulation.**

4. **Luteal or secretory phase**

- ✪ During luteal phase, the remaining part of the **Graafian follicle is transformed into a transitory endocrine gland** called **corpus luteum.**
- ✪ The **corpus luteum secretes large amount of progesterone** which is essential for the maintenance of the endometrium.

**33. Explain the role of oxytocin and relaxin in parturition and lactation.**

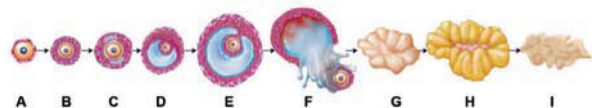
**Relaxin**

- It **promotes parturition** by relaxing the pelvic joints and by dilatation of the cervix with continued powerful contractions.

**Oxytocin**

- It causes the "**Let-Down**" reflex-the **actual ejection of milk** from the alveoli of the mammary glands.
- During lactation, oxytocin also **stimulates the recently emptied uterus to contract**, helping it to return normal size.

**34. Identify the given image and label its parts marked as a, b, c and d**



The following is the illustration of the sequence of ovarian events (a-i) in a human female.

- a) **Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.**

Ans : It represents the ovulatory stage of oogenesis – Ovulation

- b) **Name the ovarian hormone and the pituitary hormone that have caused the above-mentioned events.**

- ❖ **Ovarian hormone** - Progesterone
- ❖ **Pituitary hormone** - Follicle stimulating hormone(FSH) and luteinizing hormone (LH)

- c) **Explain the changes that occurs in the**

**uterus simultaneously in anticipation.**

- ❖ The endometrium of the **uterus gets thickened and blood supply to the endometrium increases.**
  - ❖ It is essential for **implantation of the fertilized ovum** and other events of pregnancy
- d) Write the difference between C and H.

S. No.	C	H
1.	Secondary follicle	Corpus luteum
2.	It is Surrounded by layers of granulosa cells	Layers of granulosa cells absent
3.	Presence of theca layer	No theca layer is present

### PART-A

#### ADDITIONAL QUESTIONS (1 MARK)

1. **Where testes are situated in men?**
  - a) Abdominal cavity
  - b) Dorsalside of abdominal cavity
  - c) a) and b) both
  - d) inside the Scrotal sac. **Ans: d**
2. **Which hormone is released from testes ?**
  - a) Testosterone
  - b) Estrogen
  - c) Progesterone
  - d) Relaxin **Ans: a**
3. **Which hormone is released from ovaries ?**
  - a) Testosterone
  - b) Estrogen
  - c) Progesterone
  - d) b) and c) both **Ans: d**
4. **Which of the following gland is seen in male reproductive system ?**
  - a) Seminal vesicle
  - b) Prostate gland
  - c) Bulbourethral gland
  - d) All of these **Ans: d**
5. **How much lower the temperature of scrotal sac as compare to the normal body temperature ?**
  - a) 2-3°C
  - b) 3- 4°C
  - c) 4-5°C
  - d) 5-6°C **Ans: a**

6. **The connective tissue surrounds testis is known as ?**

- a) Fibrous tissue
- b) Spongy connective tissue
- c) Tunica albuginea
- d) None of them **Ans: c**

7. **Seminiferous tubule in testis are lined by**

- a) Germinal cells
- b) only germinal cells
- c) Sertoli cell
- d) Both a and c **Ans: d**

8. **In testis which cells differentiate to produce sperms?**

- a) Germinal cells
- b) Epithelial cell
- c) Sertoli cell
- d) Both a and c **Ans: a**

9. **In testis \_\_\_\_\_ cells are present in the interstitial space between seminiferous tubules**

- a) Sertoli cells
- b) Germinal cells
- c) Leydig's cells
- d) Spermatogonic cells **Ans: c**

10. **Which cells secretes testosterone ?**

- a) Sertoli cells
- b) Germinal cells
- c) Interstitial cells
- d) a) and b) both **Ans: c**

11. **Where seminiferous tubules of each lobe empty sperms ?**

- a) Vas deference
- b) Vasa efferentia
- c) Epididymus
- d) Seminal vesicles **Ans: b**

12. **Where is situated epididymis ?**

- a) External surface of the testis
- b) adjacent side the testis
- c) Below the testis
- d) Internal surface of the testis **Ans: a**

13. **Function of epididymis is ...**

- a) A temporary storage site
- b) Maturation of the sperm
- c) Provide motile ability
- d) All of these **Ans: d**



**14. Through which of the following vas deferens runs upward from epididymis and enter the abdominal cavity ?**

- a) Ejaculatory duct
- b) Inguinal canal
- c) Urethra
- d) a) and b) both

**Ans: b**

**15. The distal end of vas deferens is expanded and in this region the opens in \_\_\_\_\_**

- a) Prostate gland
- b) Bulbourethral gland
- c) Seminal vesicle
- d) Ejaculatory duct

**Ans: c**

**16. What is the region present between part of seminal vesicle and duct of urinary bladder called ?**

- a) Ejaculatory duct
- b) Duct of urinary
- c) Urethra
- d) Seminal vesicle duct

**Ans: a**

**17. In male accessory reproductive glands which is not correct ?**

- a) Seminal vesicle
- b) Prostate gland
- c) Urinary bladder
- d) Bulbourethral gland

**Ans: c**

**18. The seminal vesicle are located at \_\_\_\_\_**

- a) Over urinary bladder
- b) Base of the urinary bladder
- c) Near urinary bladder
- d) Besides urinary bladder

**Ans: b**

**19. The estimated percent of sperms have normal shape**

- a) 50%
- b) 40%
- c) 60%
- d) 65%

**Ans: c**

**20. Which substances present in seminal vesicles is thick and yellowish secretion ?**

- a) fructose Sugar
- b) ascorbic acid
- c) Fat
- d) a) and b) both

**Ans: d**

**21. What is provided to sperms by secretion of seminal vesicles ?**

- a) Nourishment
- b) Activating
- c) Lubricant
- d) a) and c) both

**Ans: a**

**22. Where is prostate gland is located ?**

- a) Over urinary bladder
- b) Base of the urinary bladder
- c) Posterior region of the urethra
- d) Side of the urinary bladder

**Ans: c**

**23. What is provided to sperm by secretion of prostate gland ?**

- a) Nourishes
- b) Activating
- c) Lubricant
- d) a) and c) both

**Ans: b**

**24. Where is bulbourethral gland located ?**

- a) Beneath the prostate
- b) Lateral side of urethra
- c) Over urinary bladder
- d) a) and b) both

**Ans: d)**

**25. What is the function of bulbourethral gland secretion ?**

- a) Nourishes sperms
- b) role in activating sperms
- c) Serves as a lubricant during sexual intercourse
- d) Enhancing the motility of sperms

**Ans: c**

**26. Semen constitute of**

- a) Sperms
- b) Secretion of accessory glands
- c) Organic substance
- d) Both a and b

**Ans: d**

**27. Which is accessory part of female reproductive system ?**

- a) Vulva
- b) uterus
- c) Mammary gland
- d) Vagina

**Ans: c**

**28. What is size of ovaries ?**

- a) 3 c.m long, 2 c.m wide
- b) 2 c.m long, 2 c.m wide
- c) 3 c.m long, 2 c.m wide
- d) 2 c.m long, 2 c.m wide

**Ans: a**

**29. Which tissue layer covers the ovary ?**

- a) Columnar epithelium
- b) Squamous epithelium
- c) Cuboidal epithelium
- d) Ciliary epithelium

**Ans: c**

**30. The connective tissue immediately after the germinal epithelium of ovaries which is dense in nature**

- a) Stroma  
b) Tunica albuginea  
c) Ovarian epithelium  
d) None of them

**Ans: b**

**31. The ovary is covered by a thin cuboidal epithelium called the germinal epithelium which encloses the**

- a) Stroma  
b) Follicular epithelium  
c) Graffian follicles  
d) Corpus luteum

**Ans: a**

**32. Stroma of ovarian cortex contains .....**

- a) Ovarian follicles  
b) Corpus luteum  
c) Graffian follicles  
d) a) and c) both

**Ans: a**

**33. The structure which consist of mature ovum and its surrounding tissues its called**

- a) Mature ovum  
b) Ovarian follicles  
c) Graffian follicle  
d) Corpus luteum

**Ans: c**

**34. Graffian follicle after ovulation produces progesterone is called ...**

- a) Graffian follicle  
b) Corpus luteum  
c) Mass of graffion follicle  
d) both a and b

**Ans: b**

**35. Where an ovum is fertilization occurs ?**

- a) Vagina  
b) Uterus  
c) Fallopion tube  
d) Infundibullum

**Ans: c**

**36. Where is uterus situated ?**

- a) Between the urinary bladder and rectum  
b) Between the urinary bladder and urethra  
c) Between the urinary bladder and ovary  
d) Between the urinary bladder and intestine

**Ans: a**

**37. Shape of the uterus is**

- a) Inverted appleshaped  
b) Inverted pear shaped  
c) Inverted mango shaped  
d) None of this

**Ans: b**

**38. In which layer of uterus the fertilized egg is implanted ?**

- a) Endometrium  
b) Myometrium  
c) Epimetrium  
d) None of this

**Ans: a**

**39. The distal narrow end of the uterus is called.....**

- a) Vagina  
b) Cervix  
c) Hymen  
d) a) and c) both

**Ans: b**

**40. Spermatids are produce from**

- a) Secondary spermatocyte  
b) Primary spermatocyte  
c) Spermatogonium  
d) Spermatocytes

**Ans: b**

**41. In spermatogenesis which cells are produce at the end of multiplication phase ?**

- a) Primary spermatocyte  
b) Spermatogonia  
c) Secondary spermatocyte  
d) Spermatids

**Ans: b**

**42. Which enzyme is produced by acrosome ?**

- a) Testosterone  
b) Hyaluronidase  
c) FSH  
d) LH

**Ans: b**

**43. In oogenesis which cells are produced at the first division of primary oocyte in maturation phase ?**

- a) Secondary oocyte  
b) First polar body  
c) Secondary polar body  
d) a) and b) both

**Ans: d**

**44. The events of the menstrual cycle are the cyclic changes in the....**

- a) Endometrium  
b) Myometrium  
c) Epimetrium  
d) All of this

**Ans: a**

**45. The events of menstrual cycle are comprised of .... days.**

- a) 27 days  
b) 28 days  
c) 29 days  
d) 30 days

**Ans: b**

**46. In menstrual cycle which period is known as menstrual phase ?**

- a) 1 to 5 days  
b) 6 to 14 days  
c) 15 to 28 days  
d) 14 to 15 days

**Ans: a**



**47. After fertilization which changes prevents entry of other sperms in to the oocytes.**

- a) Egg membrane
- b) Fertilization membrane
- c) Vitelline membrane
- d) a) and c) both

**Ans: b**

**48. The division of zygote forms in to 16 daughter cells this stage is called....**

- a) Blasto cell
- b) Blastomeres
- c) Morula
- d) a) and b) both

**Ans: b**

**49. In human normally what is the period of pregnancy ?**

- a) 290 days
- b) 280 days
- c) 270 days
- d) 285 days

**Ans: b**

**50. Choose the incorrect statement from the following:**

- a) In birds and mammals internal fertilisation takes place
- b) Colostrum contains antibodies and nutrients
- c) Polyspermy in mammals is prevented by the chemical changes in the egg surface
- d) In the human female implantation occurs almost seven days after fertilization

**Ans: c**

**51. Spot the odd one out from the following structures with reference to the male reproductive system:**

- a) Rete testis
- b) Epididymis
- c) Vasa efferentia
- d) Isthmus

**Ans: d**

**52. Seminal plasma, the fluid part of semen, is contributed by.**

- i) Seminal vesicle
- ii) Prostate
- iii) Urethra
- iv) Bulbourethral gland
- a) (i) and (ii)
- b) (i), (ii) and (iv)
- c) (ii), (iii) and (iv)
- d) (i) and (iv)

**Ans: b**

**53. Acrosomal reaction of the sperm occurs due to:**

- a) Its contact with zona pellucida of the ova
- b) Reactions within the uterine environment of the female
- c) Reactions within the epididymal environment of the male
- d) Androgens produced in the uterus

**Ans: a**

**54. Which one of the following is not a male accessory gland?**

- a) Seminal vesicle
- b) Ampulla
- c) Prostate
- d) Bulbourethral gland

**Ans: b**

**55. Morula is a developmental stage:**

- a) Between the zygote and blastocyst
- b) Between the blastocyst and gastrula
- c) After the implantation
- d) Between implantation and parturition

**Ans: a**

**56. The membranous cover of the ovum at ovulation is:**

- a) Corona radiata
- b) Zona radiate
- c) Zona pellucida
- d) Chorion

**Ans: a**

**57. Vasa deferens is cut for**

- a) Female sterilization
- b) Male sterilization
- c) Both of the above
- d) Temporary Sterlization

**Ans: b**

**58. The function of seminal fluid is**

- a) Sexual attraction
- b) To provide stability to egg
- c) To provide a medium for the movement of sperms
- d) To provide acidic medium

**Ans: c**

**59. Seminal vesicle is present at the junction of**

- a) Prostate and urethra
- b) prostate and vas-deferens
- c) Prostate and cowper's gland
- d) vas deferns and testis

**Ans: b**

**60. What happens after vasectomy?**

- a) Absence of semen formation
- b) Sperm are dead or inactive
- c) Sperm immediately disappears in semen
- d) Sperm gradually disappears in semen

**Ans: d**

**61. A female gland corresponding to prostate of male is**

- a) Bartholin's gland
- b) Bulbourethral gland
- c) Clitoris
- d) None

**Ans: d**

- 62. Outer coat of seminiferous tubules is composed of fibrous connective tissue called**  
 a) Tunica propria      b) Lamina Propia  
 c) Plica semilunaris      d) Tunica albuginea  
**Ans: d**
- 63. In mammals, maturation of sperm take place at a temperature.**  
 a) Equal to that of body  
 b) Higher than that of body  
 c) Lower than that of body  
 d) At any temperature  
**Ans: c**
- 64. Seminal vesicles are located in**  
 a) Caput epididymis  
 b) Uterus  
 c) Above Cowper's glands  
 d) Glans penis  
**Ans: c**
- 65. Central stroma of ovary is made up of**  
 a) Fibrous connective tissue  
 b) Reticular tissue  
 c) Adipose connective tissue  
 d) None  
**Ans: a**
- 66. Ovarian follicles are present in**  
 a) Medulla  
 b) Germinal epithelium  
 c) Cortex  
 d) Mesovarium  
**Ans: c**
- 67. In gametogenesis, reduction division take place during**  
 a) Multiplication phase  
 b) Growth phase  
 c) First maturation division  
 d) Second maturation  
**Ans: c**
- 68. Graafian follicle contains**  
 a) Many oocytes  
 b) Many sperms  
 c) A single oocyte  
 d) Site for egg fertilization  
**Ans: c**
- 69. Primary follicle are converted into secondary follicle by the formation of \_\_\_\_\_**  
 a) Theca layers      b) Zona pellucida  
 c) Membrana granulosa      d) Viteline membrane  
**Ans: a**
- 70. Which statement is not correct for gastrulation?**  
 a) Formation of archenteron  
 b) Cell division stops  
 c) Oxidation reaction increase  
 d) Elongation of embryo starts  
**Ans: b**
- 71. Oxytocin mainly help in**  
 a) Milk production      b) Child birth  
 c) Urine formation      d) Gametogenesis  
**Ans: b**
- 72. Sertoli cells are regulated by the pituitary hormone known as \_\_\_\_\_**  
 a) FSH      b) GH  
 c) Prolactin      d) LH  
**Ans: a**
- 73. Which part of ovary in mammals acts as an endocrine gland after ovulation?**  
 a) Viteline membrane  
 b) Graafian follicle  
 c) Stroma  
 d) Germinal epithelium  
**Ans: b**
- 74. Which one of the following statement is incorrect about menstruation?**  
 a) At menopause in the female, there is especially abrupt increase in gonadotropic hormones.  
 b) The beginning of the cycle of menstruation is called menarche.  
 c) During normal menstruation about 40 ml blood is lost.  
 d) The menstrual fluid can easily clot.  
**Ans: d**
- 75. Which extra embryonic membrane in humans prevents desiccation of the embryo inside the uterus?**  
 a) Yolk sac      b) Amnion  
 c) Chorion      d) Allantois  
**Ans: b**
- 76. Seminal plasma in humans is rich in**  
 a) Fructose and certain enzymes but poor in calcium  
 b) Fructose, calcium and certain enzymes  
 c) Fructose and calcium but has no enzymes  
 d) Glucose and certain enzymes but has no calcium  
**Ans: b**



**77. Which one of the following is the correct matching of the events occurring during menstrual cycle?**

- a) Menstruation : Breakdown of myometrium and ovum not fertilised
- b) Ovulation: LH and FSH attain peak level and sharp fall in the secretion of progesterone.
- c) Proliferative Phase : rapid regeneration of myometrium and maturation of Graafian follicle.
- d) Development of Corpus luteum : Secretory phase and increased secretion of progesterone Luteum

**Ans: d**

**78. The correct sequence of spermatogenic stages leading to the formation of sperms in a mature human testis is:**

- a) Spermatogonia – Spermatid – Spermatocyte – Sperms
- b) Spermatocyte – Spermatogonia- Spermatid – Sperms
- c) Spermatogonia – Spermatocyte – Spermatid – Sperms
- d) Spermatid – Spermatocyte – Spermatogonia – Sperms

**Ans: c**

**79. A change in the amount of yolk and its distribution in the egg will affect:**

- a) Fertilization
- b) Formation of zygote
- c) Pattern of cleavage
- d) Number of blastomeres produced

**Ans: c**

**80. Signals for parturition originate from**

- a) Placenta only
- b) Fully developed foetus only.
- c) Both placenta as well as fully developed foetus
- d) Oxytocin released from maternal pituitary.

**Ans: c**

**81. From a to d which of the following statements are correct.**

- a) Fertilisation can occur only if the ovum and sperm are transported simultaneously to the 'ampullary isthmic junction'
- b) First movement of foetus and appearance of hair on head are usually observed during the fifth month of pregnancy.
- c) On 14th day of Menstrual cycle, the level of progesterone is maximum.

- d) The signals for parturition originate from fully developed foetus and placenta.

- a) a and c
- b) b and c
- c) c and d
- d) b and d

**Ans: d**

**82. To maintain menstrual cycle, hormone are secreted by**

- a) Pituitary and Ovary
- b) Pituitary and Uterus
- c) Only uterus
- d) Only Ovary

**Ans: a**

**83. Which of the following is correct?**

- a) Estrogen increases after ovulation
- b) Graafian follicles mature in luteal phase
- c) Maximum level of progesterone is between 11th to 13th day of menstrual cycle.
- d) Estrogen maintain pregnancy

**Ans: a**

**84. The male accessory glands include**

- a) Prostate gland
- b) Bulbourethral gland
- c) seminal vesicles
- d) All of above

**Ans: d**

**85. Which statement is wrong?**

- a) Mammary lobes containing clusters called alveoli
- b) Uterus is also called womb
- c) The last part of the oviduct is called ampulla
- d) Stroma of ovary divided into two zone

**Ans: c**

**86. Secretion of which hormone induce spermatogenesis**

- a) GnRH
- b) LTH
- c) Oxytocin
- d) Relaxin

**Ans: a**

**87. Ovulation is**

- a) Releasing of secondary oocyte from ovary
- b) Releasing of primary oocyte from ovary
- c) Releasing of polar body
- d) Releasing of graafian follicle

**Ans: a**

**88. Which hormones is essential for maintenance of endometrium?**

- a) FSH
- b) LH
- c) Progesterone
- d) Testosterone

**Ans: c**



**105.Assertion: Ovulation occurs on the 14th day of menstrual cycle in a human female.**

**Reason :** The high level of estrogen is controlled 2 or 3 days before this event due to negative feedback.

- a) A      b) B      c) C      d) D

**Ans: c**

**106.Assertion : From day 10 to 17 of the menstrual cycle is called fertile period**

**Reason:** As chances of fertilisation are very high during this period

- a) A      b) B      c) C      d) D

**Ans: a**

**107.Assertion: The level of FSH & LH attain a peak level in the middle of the menstrual cycle.**

**Reason:** The FSH & LH surge induces rupture of Graafian follicle that is called ovulation.

- a) A      b) B      c) C      d) D

**Ans: b**

**108.Assertion : The mammary glands of the female starts producing milk just after the process of parturition.**

**Reason :** High level of oxytocin induces milk production.

- a) A      b) B      c) C      d) D

**Ans: c**

**109.Assertion: In male, urethra is considered as urinogenital duct.**

**Reason :** Urethra carries both urine and semen in males.

- a) A      b) B      c) C      d) D

**Ans: a**

**PART-B**

**ADDITIONAL QUESTIONS (2 MARKS)**

**1. Write the significance of accessory gland in male**

❖ **Bulbourethral glands** are present **inferior to the prostate**

✓ It secretions also help in the **lubrication of the penis.**

**Prostate gland :**

➤ It secretes a **slightly acidic fluid** that contains **citrate, several enzymes** and prostate specific **antigens.**

**2. Write the Structure and functions of sertoli cells?**

- ❖ **Sertoli cells - elongated and pyramidal**
- ❖ **It provide nourishment** to the sperms
- ❖ They also secrete **inhibin**, a hormone (role - negative feedback control of sperm production)
- ❖ **Spermatogonic cells - divide meiotically to produce spermatozoa**

**3. What is cryptorchism?**

- ❖ **The failure of one or both testes** to fall away down into the scrotal sacs is known as cryptorchism (crypto – hidden + orchis – testicle).
- ❖ It occurs in **1 – 3 % of new born** males.
- ❖ A **surgical correction** at a young age can rectify the defect, else these individuals may become sterile.

**4. List out Function of seminal fluid**

- ❖ It is a **milky white fluid** which contains **sperms and the seminal plasma** (secreted by **accessory glands**).
- ❖ The **seminal fluid** - acts as a **transport medium, provides nutrients, contains some chemicals**
- ❖ **Role of chemical - protect and activate the sperms** and also help in motility.

**5. Why female reproductive system consider as more complex than male?**

❖ **Female reproductive system** is **more complex than** the male because apart from gamete formation, it also help in **foetus development.**

**6. List out the layers of Ovary.**

- ❖ **Ovarian stroma** - thin cuboidal epithelium called the germinal epithelium which encloses the **ovarian stroma.**
- ❖ The stroma is differentiated as the **outer cortex and inner medulla.**
- ❖ **Cortex - dense and granular** due to the presence of ovarian follicles
- ❖ **Medulla - loose connective tissue** with blood vessels, lymphatic vessels and nerve fibres.

- ❖ **Tunica albuginea** – dense connective tissue found **Below the germinal epithelium**
  - ❖ **Mesovarium** - ovarian ligament that attach ovary attached to the pelvic wall and the uterus.
- 7. Write the significance of Barthelenis glands?**
- ❖ **Location** : posterior to the **left and right of the opening of the vagina**.
  - ❖ **Role** : secrete mucus to **lubricate the vagina**
  - ❖ It is **similar to bulbourethral glands** of the male
- 8. Write the significance of skenes glands?**
- ❖ **Location** : **anterior wall of the vagina** and **around the lower end of the urethra**.
  - ❖ **Role** : secrete a **lubricating fluid**
  - ❖ It is **similar to prostate gland of the males**.
- 9. What is the role of Epidymis in reproduction ?**
- ❖ **Epidymis** is a **highly coiled tube** that temporarily **stores the spermatozoa**
  - ❖ It Help in **physiological maturation, increased motility and fertilizing capacity**.
  - ❖ The **epididymis leads to the vas deferens, ejaculatory duct, urethra**.
- 10. What is mesovarium?**
- ❖ **It is one of the layers of uterus**
  - ❖ **They are** ovarian ligament that attach ovary attached to the pelvic wall and the uterus.
- 11. What is Isthmus?**
- ❖ **Isthmus** – it is the **last part of the oviduct** connecting the ampulla and infundibulum to the uterus.
- 12. Why acrosome is important for sperm.**
- ❖ **Acrosome** is a **small cap like pointed structure** present at the tip of the nucleus
  - ❖ It contains **hyaluronidase** - a proteolytic enzyme, popularly known as **sperm lysin helps to penetrate the ovum**.
- 13. What is nebenkern ?**
- ❖ The middle piece possesses mitochondria spirally twisted around the axial filament called **mitochondrial spiral or nebenkern**.
  - ❖ **Nebenkern** - It **produces energy in the form of ATP** molecules for the movement of sperms.
- 14. List out the main functions of reproductive system**
- Main functions of reproductive system are
1. **To produce the gametes namely sperms and ova**
  2. **To transport and sustain these gametes**
  3. **To nurture the developing offspring**
  4. **To produce hormones**
- 15. Define the following term. Insemination, Implantation, Placentation**
- ❖ **Insemination** : **Transfer of sperms** by the male into the female genital tract.
  - ❖ **Implantation** : **Attachment of blastocyst to the uterine wall**.
  - ❖ **Placentation**: **Formation of placenta** which is the intimate connection between foetus and uterine wall of the mother for exchange of nutrients.
- 16. What is the role of accessory gland in reproduction.**
- ❖ **Sustain the gametes**
  - ❖ **Provide nutrient to developing offspring.**
- 17. Why scrotum called as thermoregulator ?**
- ❖ **Scrotum** – it is a **sac of skin that hangs outside** the abdominal cavity.
  - ❖ **Scrotum is placed outside the abdominal cavity** to provide a temperature 2-3oC lower than the normal internal body temperature to produce viable sperm.
  - ❖ Hence, the scrotum called as a **thermoregulator** for spermatogenesis.
- 18. Given below are the events in human reproduction. Write them in correct sequential order.**
- Insemination, gametogenesis, fertilisation, parturition, gestation, implantation**
- Gemetogenesis → Insemination → Fertilisation → Implantation → Gestation → Parturition
- 19. Write the location and functions of the following.**
- a) **Sertoli cells** - **It provide nourishment** to the sperms and it also secrete **inhibin** hormone
  - b) **Leydig's cells** - They act as endocrine gland and **secrete androgens** namely the **testosterone hormone**

**20. Why are menstrual cycles absent during pregnancy?**

High level of progesterone and estrogens during pregnancy suppress the gonadotropins which is required for the development of new follicles. Therefore, a new cycle cannot be initiated.

**21. Female reproductive organs and associated functions are given below in column A and B. Fill the blank boxes.**

Column A	Column B
Ovaries	Ovulation
Oviduct	a
b	Pregnancy
Vagina	Birth

Ans: a) Fertilization, b) Uterus

**22. From where the parturition signals arise-mother or foetus? Mention the main hormone involved in parturition.**

- ⊛ Parturition signals arise from the foetus.
- ⊛ This triggers release of oxytocin from the maternal pituitary gland.
- ⊛ Oxytocin is the main hormone involved in parturition.

**23. How does zona pellucida of ovum help in preventing polyspermy?**

Once a sperm comes in contact with zona pellucida of the ovum, it induces changes in its membrane.

These changes prevent the entry of other sperm into the ovum and thus prevent polyspermy.

**24. A human female experiences two major changes, menarche and menopause during her life.**

**Mention the significance of both the events.**

Significance of Menarche: Menarche marks the onset of puberty.

Thus, it marks the beginning of reproductive phase in female.

Significance of Menopause: Menopause marks the culmination of reproductive phase in female.

**PART-C**

**ADDITIONAL QUESTIONS (3 MARKS)**

**1. Write notes on accessory gland.**

- ✓ It include **seminal vesicles**
- ✓ **Bulbourethral glands** also called **Cowper's gland**
- ✓ **Prostate gland (one).**

➤ **Seminal vesicles** à secrete an alkaline fluid called **seminal plasma**

➤ **Seminal plasmam** - contain **fructose sugar, ascorbic acid, prostaglandins and vesiculase** (coagulating enzyme for sperm motility)

**Bulbourethral glands** à They are **inferior to the prostate**

✓ It secretions also help in the **lubrication of the penis.**

**Prostate gland :**

➤ It secretes a **slightly acidic fluid** that contains **citrate, several enzymes** and prostate specific **antigens.**

**2. List out and explain the types of twins.**

➤ Twins are **two offsprings** produced in the same pregnancy.

➤ **Monozygotic (Identical) twins** : they are produced when a **single fertilised egg splits into two** during the first cleavage. They are of the **same sex, look alike and share the same genes.**

➤ **Dizygotic (Fraternal) twins** : they are produced when **two separate eggs are fertilised by two separate sperms.** The twins may be of the **same sex or different sex and are non-identical.**

➤ **Siamese (United) twins** : they are the **conjoined twins** who are **joined during birth.**

**3. Give the names and functions of the hormones involved in the process of spermatogenesis. Write the names of the endocrine glands from where they are released.**

Hormone	Function	Origin of hormone
Gonadotropin Releasing Hormone (GnRH)	Acts on anterior pituitary gland and stimulates the release of LH and FSH	Hypothalamus
Luteinizing hormone (LH)	Acts at Leydig cells and stimulates secretion of androgen.	Pituitary
Follicle Stimulating Hormone (FSH)	Acts on Sertoli cells and stimulates factors which are involved in spermatogenesis.	Pituitary

4. During reproduction, the chromosome number (2n) reduces to half (n) in the gametes and again the original number (2n) is restored in the offspring. What are the processes through which these events take place?

- ✧ Gametogenesis involves meiosis which results in haploid number of chromosomes in daughter cells.
- ✧ Thus, chromosome number is half (n) in gametes.
- ✧ Fertilisation is the step in which the chromosome number becomes diploid (2n) because of fusion of male and female gametes.

5. What is the difference between a primary oocyte and a secondary oocyte?

Primary Oocyte	Secondary Oocyte
i) Primary oocyte is formed when the female is still in the womb.	i) Secondary oocyte is formed at the onset of puberty.
ii) It is surrounded by secondary follicle.	ii) It is surrounded by tertiary follicle as well.
iii) Chromosome number is 46.	iii) Chromosome number is 23.

6. Corpus luteum in pregnancy has a long life. However, if fertilisation does not take place, it remains active only for 10-12 days. Explain.

Corpus luteum secretes progesterone which is essential for maintaining the endometrium.

This is essential for proper development of the foetus. Hence, corpus luteum has a long life during pregnancy.

On the other hand, in the absence of fertilization; there is no work for corpus luteum and hence it remains active only for 10 – 12 days.

7. Except endocrine function, what are the other functions of placenta?

Other than endocrine function; following are the remaining functions of placenta:

- a) Facilitates supply of oxygen and nutrients to the foetus.
- b) Facilitates removal of carbon dioxide and other waste products from the foetus.

8. What are the events that take place in the ovary and uterus during follicular phase of the menstrual cycle?

Following events takes place in the ovary and uterus during follicular phase of the menstrual cycle:

- Primary follicle in the ovary grow to become fully mature Graafian follicle.
- Endometrium in the uterus regenerates through proliferation.
- Estrogen is secreted by growing follicle.

9. What are the changes in the oogonia during the transition of a primary follicle to Graafian follicle?

Following changes happen in the oogonia during the transition of a primary follicle to Graafian follicle:

- Each primary oocyte gets surrounded by a layer of granulosa cells; called primary follicle.
- Primary follicle gets surrounded by another layer of granulosa cells and a new theca. This is called secondary follicle.
- The secondary follicle soon transforms into tertiary follicle. The tertiary follicle is characterized by a fluid filled cavity called antrum. At this stage, the primary oocyte undergoes second meiotic division and forms secondary oocyte and a tiny polar body.
- The tertiary follicle then changes into mature Graafian follicle. During this stage, a new layer; called zona pellucida; develops around the secondary oocyte.

**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

1. List out the events in human reproduction

- ❖ **Gametogenesis: Formation of gametes** by spermatogenesis and oogenesis.
- ❖ **Insemination: Transfer of sperms** by the male into the female genital tract.
- ❖ **Fertilisation: Fusion of male and female gametes** to form zygote, called fertilisation.
- ❖ **Cleavage: Rapid mitotic divisions of the zygote** which convert the single celled zygote into a multicellular structure called blastocyst.

- ❖ **Implantation: Attachment of blastocyst to the uterine wall.**
- ❖ **Placentation: Formation of placenta** which is the intimate connection between foetus and uterine wall of the mother for exchange of nutrients.
- ❖ **Gastrulation: Process by which blastocyst is changed into a gastrula** with three primary germ layers
- ❖ **Organogenesis: Formation of specific tissues, organs and organ systems** from three germ layers.
- ❖ **Parturition: Expulsion of the foetus** from the mother's womb.

**2. Write short notes on male reproductive system**

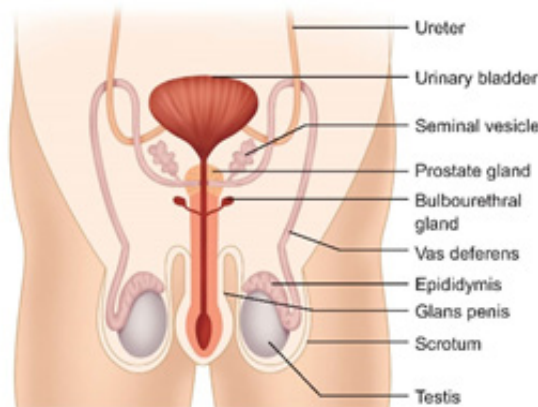


Fig. 2.2 (a) Diagrammatic view of the male reproductive system

- The male reproductive system include : **pair of testes, accessory ducts, glands and external genitalia.**
  - **Testes** - primary male sex orgAns:
- Testes :**
- They are **pair of ovoid bodies** present inside scrotum.
  - **Scrotum** – it is a **sac of skin that hangs outside** the abdominal cavity.
  - **Scrotum is placed outside the abdominal cavity** to provide a temperature 2-3°C lower than the normal internal body temperature to produce viable sperm.
  - Thus, the scrotum acts as a **thermoregulator** for spermatogenesis.
  - Testis is covered by an **outermost fibrous**

**tunica albuginea** and is divide into **200 - 250 lobules**

- Each lobules has 2-4 highly coiled **testicular tubules** or **seminiferous tubules.**
  - **Seminiferous tubules** are the sites for sperm production (80%)
  - Seminiferous tubule (stratified epithelium) is made of two types of cells
1. **Sertoli cells or nurse cells**
  2. **Spermatogenic cells or male germ cells.**
- **Sertoli cells - elongated and pyramidal**
  - **It provide nourishment** to the sperms
  - They also secrete **inhibin**, a hormone (role - negative feedback control of sperm production)
  - **Spermatogenic cells** - divide **meiotically to produce spermatozoa.**

**Interstitial cells or Leydig cells :**

- They are **placed in the soft connective tissue**
- They surrounding the **seminiferous tubules.**
- They act as endocrine gland and **secrete androgens** namely the **testosterone hormone**
- **Testosterone** - initiates the process of **spermatogenesis.** (sperm production)
- This is the **important characteristic features** of the testes of mammals.
- **Immune cells** are also present.

**Accessory ducts :**

- It include **rete testis, vasa efferentia, epididymis and vas deferens.**
- **Tubulus rectus** (converge seminiferous tubule) that transfers the sperms into the **rete testis.**
- **The rete testis** - posterior side of the testis.
- **Tubulus Rectus → Rete Testis → Vasa Efferentia → Epididymis.**

**Epididymis**

- It is a **highly coiled tube** that temporarily **stores the spermatozoa**
- Help in **physiological maturation, increased motility and fertilizing capacity.**

- The **epididymis leads to the vas deferens, ejaculatory duct, urethra.**
- **Urethra** is the **terminal portion** is used to convey both **urine and semen**
- It originates from the **urinary bladder and extends through the penis**
- External opening of urethra is called as **urethral meatus.**

#### Accessory glands :

- ✓ It include **seminal vesicles (two)**
- ✓ **Bulbourethral glands** also called **Cowper's gland**
- ✓ **Prostate gland (one).**
- **Seminal vesicles** à secrete an alkaline fluid called **seminal plasma**
- **Seminal plasman** - contain **fructose sugar, ascorbic acid, prostaglandins and vesiculase** (coagulating enzyme for sperm motility)
- **Bulbourethral gland** → They are **inferior to the prostate**
- ✓ It secretions also help in the **lubrication of the penis.**

#### Prostate gland :

- It secretes a **slightly acidic fluid** that contains **citrate, several enzymes** and prostate specific **antigens.**
- Location - The **prostate encircles the urethra** and is just below the urinary bladder

#### Penis :

- **The penis** is the male **external genitalia** act as a **copulatory organ.**
- It is made of a **special tissue** that helps in the **erection of penis to aid insemination (transfer of sperm)**
- **Glans penis** - The enlarged end of the penis it is covered by a loose fold of skin called **foreskin or prepuce.**

### 3. Write short notes on membrane of embryo

- ❖ The extra embryonic membranes are : **amnion, yolk sac, allantois and chorion**
- ❖ They protect the embryo from **dessication, mechanical shock** and help in the

**absorption of nutrients and exchange of gases.**

#### Amnion :

- ❖ It is a **double layered translucent membrane** filled with the amniotic fluid.
- ❖ It provides a **buoyant environment** to protect the developing embryo from **injury, regulates the temperature of the foetus and provides a medium** in which the foetus can move.

#### Yolk sac :

- ❖ It forms a **part of the gut**
- ❖ It is rich in **blood cells and blood vessels.**

#### Allantois :

- ❖ It forms a **small out pocketing of embryonic tissue** at the caudal end of the yolk sac.
- ❖ It is the **structural base for the umbilical cord** that links the embryo to the placenta
- ❖ It is **part of the urinary bladder.**

#### Chorion :

- ❖ It is the **outermost membrane** which encloses all other membranes
- ❖ It also helps in the **formation of the placenta.**

#### Chorionic villi :

- ❖ The trophoblast cells in the **blastocyst send out several finger like projections** called **chorionic villi**
- ❖ It **carrying foetal blood** and are surrounded by **sinuses that contain maternal blood.**

### 4. Explain Process of spermatogenesis.

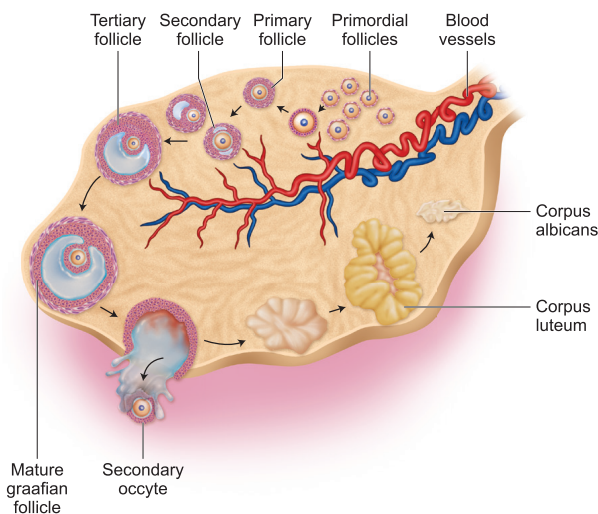
- Spermatogenesis is process of **formation of sperm (male gametes)** from testes.
- **Primordial germ cells** → migrate into the testes → **sperm mother cells or spermatogonia** (immature germ cells) in the inner surfaces of the seminiferous tubules.
- The spermatogonia → mitotic division at puberty and continue throughout life.
- Initially **spermatogonia migrate** towards the central lumen of the seminiferous tubule and become **modified and enlarged** to form



primary spermatocytes which are diploid with 23 pairs i.e., 46 chromosomes.

- **10 spermatocytes** undergo first meiotic division to form two **20 spermatocytes** which are haploid with 23 chromosomes.
- **20 spermatocytes** undergo second meiotic division to produce **four haploid spermatids**.
- The spermatids are transformed into mature **spermatozoa (sperms)** by the process called **spermiogenesis**.
- **Spermiation** – process of Sperms are released into the cavity of seminiferous tubules.
- Spermatogenesis takes about **64 days**.
- Rate of sperm production : **200 million/per day**.
- Spermatogenesis starts at the age of puberty by the influence of **Gonadotropin Releasing Hormone (GnRH)** from the hypothalamus.
- GnRH inturn act on anterior pituitary gland and stimulates the secretion **Follicle Stimulating Hormone (FSH)** and **Lutenizing Hormone (LH)**.
- **FSH** → stimulates testicular growth and enhances the production of **Androgen Binding Protein (ABP)**
- **LH** → acts on the Leydig cells and stimulates the synthesis of **testosterone**
- **Testosterone** - stimulates the process of spermatogenesis.

**5. Explain the process of oogenesis**



Sectional view of the ovary

- It is the **process of development of the female gamete** or ovum or egg in the ovaries.
- During foetal development, certain cells in the germinal epithelium of the foetal ovary **divide by mitosis and produce millions of egg mother cells or oogonia**.
- **No more oogonia** are formed after birth.
- The oogonial cells start dividing and enter into **Prophase I of meiotic division I** to form the **primary oocytes**.
- The primary oocytes then get **surrounded by a single layer of granulosa** cells to form the **primordial or primary follicles**.
- A **large number of follicles degenerate** during the period from birth to puberty, so at puberty only **60,000 to 80,000 follicles** are left in each ovary.
- **Secondary follicle** – it is new theca layer which surround the primary follicle and become **Secondary follicle**
- A **fluid filled space**, the antrum develops in the follicle and gets transformed into a **tertiary follicle**.
- The theca layer are **inner - theca interna and an outer - theca externa**.
- **Primary oocyte within the tertiary follicle** grows in size and completes its first meiotic division and forms the **secondary oocyte**.
- It is an unequal division resulting in the formation of a **large haploid secondary oocyte and a first polar body**.
- The **first polar body disintegrates**.
- During fertilisation, the **secondary oocyte undergoes second meiotic division** and produces a large cell, the **ovum** and a second polar body.
- **The second polar body also degenerates**.
- The tertiary follicle eventually becomes a mature follicle or **Graafian follicle**.
- If fertilisation does not take place, **second meiotic division is never completed** and the egg disintegrates.
- At the end of gametogenesis in females, each **primary oocyte gives rise to only one haploid ovum**.

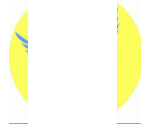


**6. Meiotic division during oogenesis is different from that in spermatogenesis. Explain how and why?**

- ❖ It is true that meiotic division during oogenesis is different from that in spermatogenesis.

**Following are the significant differences between them:**

1. In case of spermatogenesis, meiotic division begins at the time of puberty. This is the time when spermatogenesis begins in a male. On the other hand, oogenesis begins in female when the female is still in the womb. Thus, it can be said that meiotic division during oogenesis begins when the girl child is still in the womb.
2. Formation of primary oocytes stop by the 20th week of gestation of the female child. On the contrary, production of spermatocytes continues throughout the reproductive phase of a male.
3. In case of spermatogenesis, all the stages of meiosis take place quickly after one another and there is no time lag between them. In case of oogenesis, meiosis is suspended at the Prophase I stage. Meiosis resumes only once the puberty begins. Following are some possible reasons for this difference in patterns of oogenesis and spermatogenesis:
4. Male gametes need to be formed in very large number to ensure fertilization.
5. Female gametes are not exposed to external hazards and hence a less number of them would be enough. Limiting the production of female gametes helps in conservation of resources from the female body.
6. The resources can then be properly utilized during development of foetus.



## POINTS TO REMEMBER

- Reproductive health refers to a **total wellbeing in all aspects of reproduction.**
- Providing medical facilities and care to the problems like **menstrual irregularities, pregnancy related aspects, medical termination of pregnancy, STI, birth control, infertility, post natal child** and maternal management are the important aspect of the Reproductive and Child Health Care programmes.
- Creating **awareness and providing medical assistance** to build a healthy society.
- **Introducing sex education in schools** to provide information about adolescence related changes.
- India is the first few countries to initiate the **'Family planning programme'** since 1951.
- Globally, about **800 women die every day of preventable diseases** related to pregnancy and childbirth.
- India's infant mortality rate is **44 per 1,000 live.**
- India **maternal mortality rate is higher** than many developing nations.
- **So** Government of India has taken many **Health care programmes**
- **It include Child immunization, Janani Suraksha Yojana, Janani Shishu Suraksha Karyakaram, etc.,**
- **Amniocentesis** is a **prenatal technique used to detect any chromosomal abnormalities** in the foetus
- It is being **often misused to determine the sex** of the foetus.
- In India, the child sex ratio has decreased from **927 to 919 female per 1000 males.**
- **Female foeticide** is **'aborting the female in the mother's womb'**;
- **Female infanticide** is **'killing the female child after her birth'.**
- **PCPNDT Act** (Preconception and Prenatal diagnostic technique act-1994) is to ban the **identification of sex and to prevent the use of prenatal diagnostic** techniques for selective abortion.
- **POCSO Act** - implemented based on recommendations of **Justice Verma Committee**, in 2013.
- **India's population is 1.26 billion** and is expected to become the **largest country in population size.**
- **Birth control is the only solution** for population explosion.
- The **voluntary use of contraceptive procedures to prevent fertilization or prevent implantation of a fertilized egg** in the uterus is termed as birth control.
- **Types of contraception :** - **Temporary and Permanent.**
- **Temporary methods** include Natural, chemical, mechanical and hormonal barrier methods
- **Natural method** include **Rhythm method** (safe period) , **coitus interruptus, continuous abstinence** and **lactational amenorrhoea.**
- **In Barrier methods,** the **ovum and sperm are prevented from meeting** so that fertilization does not occur.
- **Types of varrier method - Chemical barrier, Mechanical barrier, Hormonal barrier**
- **Condoms for male** - it is used to cover the penis, **Cervix** - for female it is **used to cover vagina and cervix**
- **Hormonal barrier** - It **prevents the release of ovum** from ovaries by thickening the cervical fluid
- **Birth control pill** - It contains **synthetic progesterone and estrogen hormones.**

- Pills are used to **prevent ovulation**
- IUDs are **inserted into uterus** through the vagina.
- Available devices are **copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.**
- **Copper releasing IUDs** differ from each other by the amount of copper.
- **E.g. Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.**
- **Hormone releasing IUDs increase the viscosity of the cervical mucus** and thereby **prevent the entry of sperms**
- **E.g. Progestasert and LNG – 20** are often called as **intrauterine systems (IUS).**
- **Permanent birth control methods** -These methods is suitable for those **don't want children anymore.**
- **Tubectomy** → is the surgical methods in women.
- **Vasectomy** → is the surgical procedure for male
- MTP is a **voluntary termination of pregnancy** by non-surgical or non-invasive way.
- MTP is extremely **safe upto 12 weeks** (the first trimester) of pregnancy
- Government of India legalized MTP in 1971 to avoid **sex discrimination and illegal female foeticides.**
- Sexually transmitted diseases (**STD**) ,Venereal diseases (**VD**), Reproductive tract infections (**RTI**) are called as Sexually transmitted infections (**STI**).
- **Bacterial STI : Gonorrhoea, Syphilis, Chancroid, Chlamydia And Lymphogranuloma Venereum.**
- **Viral STI : Genital Herpes, Genital Warts, Hepatitis-B And AIDS.**
- **Protozoan STI - Trichomoniasis**
- **Fungal STI - Candidiasis**
- **Condoms usage reduces the risk,** but does not completely eliminate the risk of transmission of STI.
- **Prevention of STDs**
- **Avoid sex with unknown partner/ multiple partners,Use condoms**
- Cervical cancer is caused by **Human Papilloma virus (HPV).**
- It is a **sexually transmitted diseases.**
- **Inability to conceive or produce children** even after unprotected sexual course is called infertility.
- **Causes for infertility - Long-term stress** damages the menstrual cycle, Ingestion of toxins,Alcohol, tobacco and marijuana, Injuries in gonads, Aging,etc.,
- Some Women do not have functional uterus. This condition is called **Mayer-Rokitansky syndrome.**
- **ART - handling of gametes and/or embryos outside the body** to achieve a pregnancy,
- It increases the **chance of pregnancy.**
- **ART includes** - Intra-Uterine Insemination (**IUI**), *In Vitro* Fertilization, (**IVF**),Embryo Transfer (**ET**), Zygote Intra-Fallopian Transfer (**ZIFT**),Gamete Intrafallopian Transfer (**GIFT**), Intra-Cytoplasmic Sperm Injection (**ICSI**), **Preimplantation Genetic Diagnosis, Oocyte and Sperm Donation and Surrogacy.**
- **Male infertility prevention** -Micro-testicular sperm extraction (TESE)
- Amniocentesis involves taking out **amniotic fluid which surrounds the foetus** to diagnose for chromosomal abnormalities.
- **Chorionic villus sampling** is taking a sample of the **placental tissue to test for chromosomal abnormalities.**
- **Foetoscope** is used to monitor the foetal heart rate



**PART-A**

**TEXTUAL QUESTIONS (1 MARK)**

1. Which of the following is correct regarding HIV, hepatitis B, gonorrhoea and trichomoniasis?
- a) Gonorrhoea is a STD whereas others are not.
  - b) Trichomoniasis is a viral disease whereas others are bacterial.
  - c) HIV is a pathogen whereas others are diseases.
  - d) Hepatitis B is eradicated completely whereas others are not.
- Ans : c**

2. Which one of the following groups includes sexually transmitted diseases caused by bacteria only?
- a) Syphilis, gonorrhoea and candidiasis
  - b) Syphilis, chlamydiasis and gonorrhoea
  - c) Syphilis, gonorrhoea and trichomoniasis
  - d) Syphilis, trichomoniasis and pediculosis
- Ans: b**

3. Identify the correct statements from the following
- a) Chlamydiasis is a viral disease.
  - b) Gonorrhoea is caused by a spirochete bacterium, *Treponema palladium*.
  - c) The incubation period for syphilis is 2 to 14 days in males and 7 to 21 days in females.
  - d) Both syphilis and gonorrhoea are easily cured with antibiotics.
- Ans: d**

4. A contraceptive pill prevents ovulation by
- a) blocking fallopian tube
  - b) inhibiting release of FSH and LH
  - c) stimulating release of FSH and LH
  - d) causing immediate degeneration of released ovum.
- Ans: b**

5. The approach which does not give the defined action of contraceptive is
- a. H o r m o n a l Prevents entry of sperms, prevent ovulation and fertilization
  - b. Vasectomy Prevents spermatogenesis
  - c. Barrier method Prevents fertilization

- d. Intra uterine device Increases phagocytosis of sperms, suppresses sperm motility and fertilizing capacity of sperms

**Ans: b**

6. Read the given statements and select the correct option.

**Statement 1:** Diaphragms, cervical caps and vaults are made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus.

**Statement 2:** They are chemical barriers of conception and are reusable.

- a) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.
- b) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.
- c) Statement 1 is correct but statement 2 is incorrect.
- d) Both statements 1 and 2 are incorrect.

**Ans: c**

Match column I with column II and select the correct option from the codes given below.

Column I	Column II
A. Copper releasing IUD	i) LNG-20
B. Hormone releasing	ii) Lippes loop IUD
C. Non medicated IUD	iii) Saheli
D. Mini pills	iv) Multiload-375

- a) A-(iv), B-(ii), C-(i), D-(iii)
- b) A-(iv), B-(i), C-(iii), D-(ii)
- c) A-(i), B-(iv), C-(ii), D-(iii)
- d) A-(iv), B-(i), C-(ii), D-(iii)

**Ans: d**

8. Select the incorrect action of hormonal contraceptive pills from the following

- a) Inhibition of spermatogenesis.
- b) Inhibition of ovulation.
- c) Changes in cervical mucus impairing its ability to allow passage and transport of sperms.
- d) Alteration in uterine endometrium is to make it unsuitable for implantation.

**Ans: a**



**PART-B,C AND D**

**TEXTUAL QUESTIONS (2,3 AND 5 MARKS)**

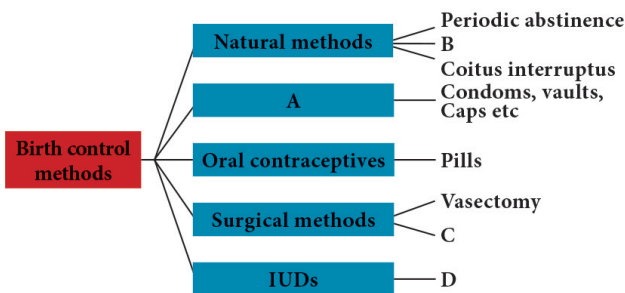
9. What is amniocentesis? Why a statutory ban is imposed on this technique?

- **Amniocentesis** is a prenatal technique used to detect any chromosomal abnormalities and metabolic disorders of the foetus.
- It is being often misused to determine the sex of the foetus.
- Once the sex of the foetus is known, there may be a chance of female foeticide.
- Hence, a legal ban on amniocentesis is compulsory.

10. Select the correct term from the bracket and complete the given branching tree

(Barriers, Lactational amenorrhoea, CuT, Tubectomy)

- A. Barriers
- B. Lactational amenorrhoea
- C. Tubectomy
- D. CuT



11. Correct the following statements

- a) Transfer of an ovum collected from donor into the fallopian tube is called ZIFT.
- b) Transferring of an embryo with more than 8 blastomeres into uterus is called GIFT.
- c) Multiload 375 is a hormone releasing IUD.

**Answer :**

- a) Transfer of an ovum collected from donor into the fallopian tube is called **GIFT**.

- b) Transferring of an embryo with more than 8 blastomeres into uterus is called **IUT**.
- c) Multiload 375 is a **Copper releasing IUD**.

12. Which method do you suggest the couple to have a baby, if the male partner fails to inseminate the female or due to very low sperm count in the ejaculate?

- Intra-Uterine Insemination (**IUI**)
- *In Vitro* Fertilization, (**IVF**)
- Embryo Transfer (**ET**)
- Zygote Intra-Fallopian Transfer (**ZIFT**)
- Gamete Intra Fallopian Transfer (**GIFT**)
- Intra-Cytoplasmic Sperm Injection (**ICSI**)
- **Pre implantation** Genetic Diagnosis,
- Oocyte and sperm donation and surrogacy.

13. Expand the following

- ZIFT - **Zygote Intra-Fallopian Transfer**
- ICSI - **Intra-Cytoplasmic Sperm Injection (ICSI)**

14. What are the strategies to be implemented in India to attain total reproductive health?

- **Child immunization,**
- **Supply of nutritional food to the pregnant women,**
- **Janani Suraksha Yojana,**
- **Janani Shishu Suraksha Karyakaram,**
- **RMNCH+Approach** (an integrated approach for reproductive, maternal, new born, child and adolescent health),
- **Pradhan Mantri Surakshit Matritva Abhiyan**

15. Differentiate foeticide and infanticide.

S. No.	Foeticide	infanticide
1.	It is an abortion, especially <b>killing of a foetus</b>	It is the <b>killing of an infant</b>
2.	Abortion is the <b>legal and humane way of killing a foetus</b>	Infanticide is the <b>unlawful and inhumane murder of a foetus</b>



- 3. How is information about reproductive health is given in schools?**  
 a) By introducing sex education as a subject  
 b) By discussion  
 c) By orators on sex education  
 d) By arranging question-answer session. **Ans: b**
- 4. What is the rank of India in population growth.?**  
 a) First  
 b) Second  
 c) Third  
 d) Fourth **Ans: b**
- 5. What is the main factor affecting the population growth?**  
 a) Increase in health care facilities  
 b) Better life style  
 c) Increase in birth rate and decrease in death rate  
 d) Industrialization. **Ans: c**
- 6. What is our main goal to control population growth?**  
 a) Decrease in death rate  
 b) Decreasing the birth rate  
 c) Organizing several programmes  
 d) Promote family planning programmes **Ans: b**
- 7. What is the reason for popularity of barrier method of family planning?**  
 a) Least or no side effects  
 b) Comparatively more reliable  
 c) Protection from sexually transmitted diseases.  
 d) Both a and b **Ans: d**
- 8. Which of the following is not a natural family planning method?**  
 a) Periodic abstinence  
 b) Interruption coitus  
 c) Hormonal method  
 d) Lactational amenorrhea **Ans: c**
- 9. Which is not related with reference to hormonal contraceptive pills ?**  
 a) Prevent ovum to release from the ovary  
 b) Thicken the cervical mucous.  
 c) Inhibits sperm penetration.  
 d) Partial activation of cervical mucous **Ans: c**
- 10. Which are the permanent methods of family planning ?**  
 a) Vasectomy, Tubectomy  
 b) Condom for female, condom for male  
 c) Copper T and pills  
 d) Vasectomy, copper T **Ans: a**
- 11. In Vasectomy which part is tied and cut ?**  
 a) Epididymis  
 b) Vas deferens  
 c) Ejeculatory duct  
 d) Urinogenital duct **Ans: b**
- 12. Which part is cut and tied in tubectomy ?**  
 a) Funnel of fallopian tube  
 b) Ovaries  
 c) Fallopian tube  
 d) Uterus **Ans: c**
- 13. When did Induced abortion act was passed by Indian Government ?**  
 a) 1970  
 b) 1971  
 c) 1972  
 d) 1980 **Ans: b**
- 14. In which of the following Induced Abortion is not necessary ?**  
 a) Chromosomal abnormality in foetus  
 b) Where the pregnancy is the result of rape  
 c) When the foetus is not of desired sex.  
 d) Unwanted pregnancy. **Ans: c**
- 15. What are sexually transmitted diseases ?**  
 a) Diseases transmitted through sexual intercourse  
 b) Diseases spread through bacteria.  
 c) Diseases spread through virus.  
 d) Diseases spread through protozoa **Ans: a**
- 16. Which microbes cause gonorrhoea ?**  
 a) Neisseria gonorrhoeae  
 b) Treponema pallidum  
 c) Herpes simplex  
 d) Trichomonas vaginitis **Ans: a**
- 17. Which microbes cause syphilis ?**  
 a) Neisseria gonorrhoeae  
 b) Treponema pallidum  
 c) Herpes simplex  
 d) Trichomonas vaginalis **Ans: b**



18. Which disease is diagnosed through ELISA Test ?

- a) Gonorrhoea
  - b) Syphilis
  - c) AIDS
  - d) Herpes
- Ans: c**

19. Which disease is diagnosed by the identification of antibodies against antigen ?

- a) Gonorrhoea
  - b) Syphilis
  - c) Hepatitis
  - d) AIDS
- Ans: d**

20. Give full form of ELISA ?

- a) Enzyme Linked Immuno sorbant Assay
  - b) Enzyme Linking Immuno soluble Assay
  - c) Enzyme Live Implantations separate Assay
  - d) Enzyme Live Immuno solute Absorbant
- Ans: a**

21. What are the principles to prevent STD diseases ?

- a) Avoid sex with unknown persons
  - b) Always use condom during coitus
  - c) with unknown persons
  - d) All above
- Ans: d**

22. What is the meaning of infertility ?

- a) Unable to produce sperms
  - b) Unable to produce ova.
  - c) Unable to produce children
  - d) Unable to coitus.
- Ans: c**

23. Full name of GIFT is....

- a) Gamete Intra fallopian transfer
  - b) Gamete Inferfile Transfer.
  - c) Gamete In vitro fertilization tube
  - d) Gamete Intra felopion tube.
- Ans: a**

24. Where does IVF method is useful ?

- a) Woman's fallopian tubes are blocked
  - b) Man produces very few sperms
  - c) Woman produces very few ova
  - d) Both a and b
- Ans: d**

25. In which Assisted Reproductive Technology the very young embryo is transferred to the woman ?

- a) IVF
  - b) ZIFT
  - c) GIFT
  - d) ART
- Ans: a**

26. In which Assisted Reproductive technology the very young embryo is transferred to the fallopian tube insted of the uterus ?

- a) IVF
  - b) ZIFT
  - c) GIFT
  - d) ART.
- Ans: b**

27. In which Assisted reproductive technology and sperms are transferred in the fallopian of woman ?

- a) IVF
  - b) ZIFT
  - c) GIFT
  - d) ART.
- Ans: c**

28. When does a previously frozen embryos needed ?

- a) Fertilization cannot occur in woman
  - b) To care infertility
  - c) Problem in coitus
  - d) Both a and b
- Ans: d**

29. Find out correct option of column I (aids) of family planning and method of family planning .

**Column-I**

- P-Copper T
- Q-Vasectomy
- R-Pills
- S-Condom

**Column-II**

- i) Permanent method
- ii) Temporary method
- iii) Intrauterine method
- iv) Hormone method.

- a) (P - iii) (Q - ii) (R - iv)(S - i)
  - b) (P - iii) (Q - i) (R - iv)(S - ii)
  - c) (P - iii) (Q - ii) (R - iv)(S - i)
  - d) (P - ii) (Q - iii)(R - iv)(S - i)
- Ans: b**

30. Find out true options from column I and II.

**Column-I**

- P-Male condom
- Q-Female condom
- R-Diaphram
- S-Copper T

**column-II**

- (i) uterus
- (ii) penis
- (iii) vagina
- (iv) cervix.

- a) (P - ii) (Q - iv) (R - i) (S - iii)
  - b) (P - ii) (Q - iii) (R - iv) (S - i)
  - c) (P - ii) (Q - i) (R - iv) (S - iii)
  - d) (P - ii) (Q - iii) (R - iv) (S - i)
- Ans: d**



**31. Match following column I and II for STDs and its carrier and select correct option****column-I**

P- Gonorrhoea

Q-Syphilis

R- Chlamydiasis

S-Trichomoniasis

**column-II**i) *Chlamydia trachomatis*ii) *Neisseria gonorrhoeae*iii) *Trichomonas vaginalis*iv) *Treponema pallidum*

a) (P - ii) (Q - i) (R - iii) (S - iv)

b) (P - iii) (Q - iv) (R - ii) (S - i)

c) (P - ii) (Q - iii) (R - i) (S - iv)

d) (P - ii) (Q - iv) (R - i) (S - iii)

**Ans: d****32. What is the function of copper-T**

a) Checks mutation

b) Stop fertilization

c) Stops zygote formation

d) Stops obliteration of blastocoel

**Ans: b****33. A contraceptive pill contains ...**

a) Progesterone and estrogen

b) Oxytocin

c) Relaxin

d) None of these

**Ans: a****34. Amniocentesis involves the analysis of**

a) Amnion

b) Body fluid of amniotes

c) Amino acids of protein

d) Amniotic fluid

**Ans: d****35. In amniocentesis the fluid is taken from**

a) Foetal blood

b) Mother's blood

c) Body fluid of mother

d) Fluid surrounding foetus

**Ans: d****36. Medical termination of the pregnancy (MTP) is considered safe up to how many weeks of pregnancy**

a) Six weeks

b) Eight weeks

c) Twelve weeks

d) Eighteen weeks

**Ans: c****37. Saheli is**

a) An oral contraceptive for females

b) A surgical sterilization method for females

c) A diaphragm for females

d) A surgical method of sterilization in male

**Ans: a****38. The method of directly injecting a sperm into ovum in assisted by reproductive technology is called:**

a) GIFT

b) ZIFT

c) ICSI

d) ET

**Ans: c****39. Intensely lactating mothers do not generally conceive due to the:**

a) Suppression of gonadotropins

b) Hyper secretion of gonadotropins

c) Suppression of gametic transport

d) Suppression of fertilization

**Ans: a****40. Emergency contraceptives are effective if used within:**

a) 72 hrs of coitus

b) 72 hrs of ovulation

c) 72 hrs of menstruation

d) 72 hrs of implantation

**Ans: a****41. Choose the right one among the statements given below:**

a) IUDs are generally inserted by the user herself

b) IUDs increase phagocytosis reaction in the uterus

c) IUDs suppress gametogenesis

d) IUDs once inserted need not be replaced

**Ans: b****42. From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs:**

a) Syphilis

b) AIDS

c) Gonorrhoea

d) Genital warts

**Ans: b****43. Condoms are one of the most popular contraceptives because of the following reasons:**

a) These are effective barriers for insemination

b) They do not interfere with coital act

c) These help in reducing the risk of STDs

d) All of the above

**Ans: d****44. Choose the correct statement regarding the ZIFT procedure:**

- a) Ova collected from a female donor are transferred to the fallopian tube to facilitate zygote formation.
- b) Zygote is collected from a female donor and transferred to the fallopian tube
- c) Zygote is collected from a female donor and transferred to the uterus
- d) Ova collected from a female donor and transferred to the uterus

**Ans: b**

**45. The correct surgical procedure as a contraceptive method is:**

- a) Ovariectomy
- b) Hysterectomy
- c) Vasectomy
- d) Castration

**Ans: c**

**46. Purpose of tubectomy is to prevent:**

- a) Egg formation
- b) Embryonic development
- c) Fertilization
- d) Coitus

**Ans: c**

**47. A contraceptive pill is:**

- a) Blocking fallopian tube
- b) Inhibiting release of FSH & LH
- c) Stimulating release of FSH & LH
- d) Causing immediately degeneration of released ovum

**Ans: b**

**48. Given below are four methods (A-D) and their modes of action (a-d) in achieving contraception. Select their correct matching from the four options that follow**

Method		Mode of Action
A. The pill	a)	Prevents sperms reaching cervix
B. Condom	b)	Prevents fertilisation
C. Vasectomy	c)	Prevents ovulation
D. Copper T	d)	Semen contains no sperms

Matching

- a) A-c), B-d), C-a), D-b)
- b) A-b), B-c), C-a), D-d)
- c) A-c), B-a), C-d), D-b)
- d) A-d), B-a), C-b), D-c)

**Ans: c**

**49. Test tube baby means a baby born when**

- a) It is developed in a test tube
- b) It is developed through tissue culture method
- c) The ovum is fertilised externally and there after implanted in the uterus
- d) It develops from a non-fertilized egg

**Ans: c**

**50. In Vitro fertilisation is a technique that involves transfer of which one of the following into the fallopian tube?**

- a) Zygote only
- b) Embryo only, upto 8 cell stage
- c) Either zygote or early embryo upto 8 cell stage
- d) Embryo of 32 cell stage

**Ans: c**

**51. The Test-tube Baby programme employs which one of the following techniques?**

- a) Gamete Intra Fallopian Transfer(GIFT)
- b) Zygote Intra Fallopian Transfer(ZIFT)
- c) Intra Cytoplasmic Sperm Injection(ICSI)
- d) Intra Uterine Insemination (IUI)

**Ans: b**

**52. Which of the following is incorrect regarding vasectomy?**

- a) Vasa deferentia is cut and tied
- b) Irreversible sterility
- c) No Sperm occurs in seminal fluid
- d) No sperm occurs in epididymis

**Ans: d**

**53. Estrogen is used to avoid pregnancy because**

- a) Prevents fertilization
- b) prevents ovulation and implantation
- c) Inhibit sperm motility
- d) forms cervical plug

**Ans: b**

**54. Which of the following is natural method of contraception?**

- a) Sterilization
- b) IUD
- c) Diaphragm
- d) Periodic abstinence

**Ans: d**

**55. In which of the following technique is in-vivo?**

- a) ZIFT
- b) GIFT
- c) ICSI
- d) IUT

**Ans; b**





**70. Assertion: - Abortion is illegal in our country.**

**Reason :** when conception is due to the rape.

a) a      b) b      c) c      d) d **Ans: b**

**71. Assertion: -STDs is a major problem in our country.**

**Reason :** Seen more in 15-24 age group.

a) a      b) b      c) c      d) d **Ans: a**

**72. Assertion: -Number of couples are facing infertility.**

**Reason :** The problem can be both in male or female partner.

a) a      b) b      c) c      d) d **Ans: a**

**73. Assertion: -The method used to achieve pregnancy by artificial or partial artificial means is known as ART.**

**Reason :** ZIFT is one of them.

a) a      b) b      c) c      d) d **Ans: a**

**74. Assertion: High doses of progesterone is present in emergency contraceptive pills.**

**Reason :** Progesterone cause cervical mucous thickening and stops entry of sperms in uterine cavity.

a) A      b) B      c) C      d) D **Ans: b**

**75. Assertion: GIFT is method used from in-vivo fertilization.**

**Reason :** Embryo is transferred directly in uterus during GIFT.

a) A      b) B      c) C      d) D **Ans: c**

**76. Assertion: Cervical diaphragm makes barrier for sperm to enter in cervix.**

**Reason :** Cervical diaphragm contain spermicide which prevent the entry of sperm into cervix.

a) A      b) B      c) C      d) D **Ans: a**

**77. Assertion: Copper releasing IUD prevent fertilization.**

**Reason :** Copper ions inhibit motility of sperms

a) A      b) B      c) C      d) D **Ans: a**

**78. Assertion: Condom provide protection against STDs**

**Reason :** Side-effect of condoms are very less.

a) A      b) B      c) C      d) D **Ans: b**

**79. Assertion: Lactation provide nature contraception for 6 months.**

**Reason :** High level of prolactin cause amenorrhoea.

a) A      b) B      c) C      d) D **Ans: a**

### PART-B

#### ADDITIONAL QUESTIONS

(2 MARKS)

1. What is amniocentesis ?

- **Amniocentesis** is a **prenatal technique used to detect any chromosomal abnormalities** in the foetus.
- It is being **often misused to determine the sex** of the foetus.
- Once the sex of the foetus is known, there may be a **chance of female foeticide**.
- Hence, a **legal ban on amniocentesis** is compulsory.

2. Define them Female foeticide and female infanticide

- **Female foeticide** is 'aborting the female in the mother's womb';
- **Female infanticide** is 'killing the female child after her birth'.

3. List out various measures adopted by government to reduce differences in the sex ratio.

- **Ensure of survival, provide better nutrition, education, protection and empowerment of girls** help to reduce differences in the sex ratio.

4. What is POSCO act?

- **POCSO Act** (Prevention of children from sexual offences),
- **Sexual harassment at workplace** (Prevention, prohibition and redressal) Act and the changes in the Criminal law based on the recommendations of **Justice Verma Committee, 2013 aims at creating a safe and secure environment for both females and males**

5. Define Birth control.

- The **voluntary use of contraceptive procedures to prevent fertilization** or

prevent implantation of a fertilized egg in the uterus is termed as birth control.

#### 6. Differentiate temporary and permanent birth control method

Temporary birth control	Permanent birth control
It is used to <b>delay or avoid</b> the pregnancy	It is used <b>avoid pregnancy permanently</b>
<b>Reversible is possible</b>	<b>Reversible is not possible</b>
Eg. IUD, Barrier method, Natural method, Hormonal contraceptive	Eg. <b>Tubectomy</b> for female, <b>Vasectomy</b> for male

#### 7. What is lactational amenorrhoea

- Menstrual cycles resume **6 to 8 weeks after parturition**.
- Normal **ovarian cycles may be delayed for six months** during breastfeeding.
- This delay in ovarian cycles is called **lactational amenorrhoea**.

#### 8. How chemical act as a barrier for the entry of sperm?

- In these methods, the **ovum and sperm are prevented from meeting by chemical method**, so that fertilization does not occur.
- **Chemical barrier**
- **Foaming tablets, melting suppositories, jellies and creams** are used to inactivate the sperms in the vagina.

#### 9. What is MTP ?when it is consider as a safe ?

- MTP is a **voluntary termination of pregnancy** by non-surgical or non-invasive way.
- MTP is extremely **safe upto 12 weeks** (the first trimester) of pregnancy
- MTP during the second trimester **is more risky** because foetus is associated with the mother tissue

#### 10. Explain Cryopreservation technique

- **Cryopreservation** is the preservation of **embryos for future use**.
- **Embryo cryopreservation can provide an additional opportunity** for pregnancy, through a **Frozen embryo transfer (FET)**, without undergoing another **ovarian stimulation and retrieval**.

#### 11. What is Foetoscope

- Foetoscope is used to **monitor the foetal heart rate** and
- Also other functions during **late pregnancy and labour**.
- The average foetal heart rate :**120 and 160 beats per minute**.
- An **abnormal foetal heart rate or pattern** indicates other problems related to heart.

#### 12. Why are copper containing intrauterine devices considered an ideal contraceptive for human females?

- **Copper releasing IUDs** differ from each other by the amount of copper.
- They release **copper and copper salts** into the uterus to **suppress sperm motility**.
- Duration : **5 - 10 years**.
- **Example : Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.**

#### 13. Why is "Saheli" considered an effective contraceptive pill for women who need space between child?

- **Eg. Saheli**, contraceptive pill
- Saheli' is an **oral contraceptive pill** containing non-steroidal preparation called centchroman.
- It has **high contraceptive value with little side effects**.
- Hence, it is considered as **effective contraceptive pill**.

#### 14. List any four characteristics of an ideal contraceptive.

- It must be **safe and user friendly**.
- It must be **easily available**.
- It must be reversible with **little or no side effects**.
- It must in **no way interfere with the sexual drive**, desire or sexual act of the user.

#### 15. Name two intrauterine contraceptive devices that affect the motility of sperms.

- **Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.**



**16. Name two hormones that are constituents of contraceptive pills. Why do they have high and effective contraceptive value? Name a commonly prescribed non-steroidal oral pill.**

- Pills are used to **prevent ovulation**
- Pills **inhibiting the secretion** of FSH and LH hormones.
- **Birth control pill** - It contains **synthetic progesterone and estrogen hormones**.
- **Eg. Saheli**, contraceptive pill
- It is prepared by Central Drug Research Institute (CDRI) in Lucknow
- **Saheli**, contains **centchroman** (a **non-steroidal**)

**17. Name any two copper releasing IUDs.**

- Two copper releasing IUDs are **CuT and Multiload 375**.

**18. What is Surrogacy?**

- It is a method of **assisted reproduction or agreement**.
- Surrogate woman **agrees to carry a pregnancy for another person**,
- Through *in vitro* fertilization (IVF), **embryos are created in a lab** and are transferred into the surrogate mother's uterus.

**19. Name any four methods to overcome infertility in human couples.**

- Intra-Uterine Insemination (**IUI**),
- *In Vitro* Fertilization, (**IVF**)
- Embryo Transfer (**ET**),
- Zygote Intra-Fallopian Transfer (**ZIFT**),
- Gamete Intra fallopian Transfer (**GIFT**),

**20. The present population growth rate in India is very high. Suggest ways to check it.**

- Increasing public awareness about the **benefits of small family**.
- Improving **child care and mother care**.
- Improving access to **various contraceptive methods** for the masses.

**21. What is the significance of progesterone-estrogen combination as a contraceptive measure?**

**Significance of contraceptive pill are**

- They are convenient as they **need to be taken orally**.
- They have **least side effects and hence are user-friendly**.

**22. Males in whom testes fail to descend to the scrotum are generally infertile. Why?**

- Sperm production **need optimum temperature** of testis should be **lower than the body temperature**.
- If testes fail to descend to scrotum then the **temperature of testis would be same as that of body temperature**.
- Hence they are **generally infertile**.

**23. Define Mayer-Rokitansky syndrome**

- All women are born with ovaries, but some do not have functional uterus. This condition is called **Mayer-Rokitansky syndrome**.

**PART-C**

### ADDITIONAL QUESTIONS

**(3 MARKS)**

**1. List out the aims of RCH.**

- Creating **awareness and providing medical assistance** to build a healthy society.
- **Introducing sex education in schools** to provide information about adolescence related changes.
- **Educating marriageable age groups** about the **birth control methods and family planning norms**.
- **Creating awareness** for care for pregnant women, post-natal care of mother and child and the importance of breast feeding.
- Encouraging and supporting governmental and non-governmental agencies **to identify new methods to improve upon the existing methods of birth control**.

**2. Explain various types of IUDS**

- **Intrauterine Devices (IUDs)**
- IUDs are **inserted into uterus** through the vagina.

- Available devices - **copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs.**
- IUDs **increase phagocytosis of sperm**
- It is also **used to delay pregnancy.**
- Its **success rate is 95 to 99%.**
- **Copper releasing IUDs** differ from each other by the amount of copper.
- They release **copper and copper salts** into the uterus to **suppress sperm motility.**
- Duration : **5 - 10 years.**
- **Example : Cu T-380 A, Nova T, Cu 7, Cu T 380 Ag, Multiload 375, etc.**
- **Hormone-releasing IUDs**
- They **increase the viscosity of the cervical mucus** and thereby **prevent the entry of sperms**
- They are made up of **plastic or stainless steel.**
- **Lippes loop** is a double S-shaped plastic device.
- **Example : Progestasert and LNG – 20** are often called as **intrauterine systems (IUS).**

### 3. Define the term 'Test tube baby' Explain its procedure.

#### Test tube baby Procedure :

- sperm and eggs are **allowed to unite outside the body** in a laboratory.
- One or more fertilized eggs may be transferred into the woman's uterus for implantation.
- Initially, **IVF was used to treat women with blocked, damaged, or absent fallopian tubes.**
- Today, IVF is used to **treat infertility.**
- **Steps : ovarian stimulation à egg retrieval à fertilization à embryo culture, à embryo transfer.**
- **Egg retrieval** - by minor surgery 34 to 37 hours **after hCG** (human chorionic gonadotropin) **injection.**
- The eggs are **prepared and exposed.**
- At the same time, **sperm preparation is done.**
- Then **sperms, the eggs are brought together.**
- **10,000-1,00,000 motile sperms are needed** for each egg.

- Then the zygote is **allowed to divide to form 8 celled blastomere** and then **transferred into the uterus.**

### 4. What is MTP ? State its significance

- MTP is a **voluntary termination of pregnancy** by non-surgical or non-invasive way.
- MTP is extremely **safe upto 12 weeks** (the first trimester) of pregnancy
- MTP during the second trimester **is more risky** because foetus is associated with the mother tissue.
- Government of India legalized MTP in 1971 to avoid **sex discrimination and illegal female foeticides.**
- If MTP performed by unqualified person then it is **unsafe and fatal.**
- **MTP of the first conception** result in serious **psychological consequences**

### 5. Write notes on foetoscope

- Foetoscope is used to **monitor the foetal heart rate** and
- Also other functions during **late pregnancy and labour.**
- The average foetal heart rate : **120 and 160 beats per minute.**
- An **abnormal foetal heart rate** indicates other problems related to heart.
- A **hand-held doppler device** is often used to count the **foetal heart rate.**
- During labour, **continuous electronic foetal monitoring** is often used.

### 6. Explain the permanent birth control methods in males and females. List its advantage and one disadvantage.

- **Permanent birth control methods** is suitable for those **don't want children anymore.**
- **Eg. Surgical sterilisation methods.**
- It **blocks the duct which transport of the gametes** and prevents conception.
- o **Tubectomy**
- It is the surgical methods in women.
- In this, both **fallopian tubes are cut and tied up** through a small incision



- This **prevents entry of the ovum into the uterus.**
- o **Vasectomy**
- It is the surgical procedure for male
- In this both **vas deferens are cut and tied** through a small incision
- It **prevent the entry of sperm** into the urethra. There by prevent fertilization
- o **Advantage :**
- There is No side effects
- o **Disadvantage**
- Result of **Reversibility of this method is very poor.**

**7. Suggest some important steps to improve the reproductive health standards in India.**

- **Proper education of girls and boys right** from the school level to make them aware about reproduction-related aspects.
- **Prevention of child marriage.**
- Prevention of **female foeticide.**
- **Strict regulation and monitoring of MTP.**
- Free distribution of **contraceptives for poor people.**
- **Effective healthcare for workers** in small villages.

**8. Write short notes on cervical cancer.**

**Cervical cancer**

- Cervical cancer is caused by **Human Papilloma virus (HPV).**
- It is a **sexually transmitted diseases.**
- **Causes :** abnormal growth of cervical cells or cervical dysplasia (senseless).
- **Symptoms :** pelvic pain, vaginal discharge and vaginal bleeding.

**The risk factors are :**

- Having **multiple sexual partners**
- **Prolonged use** of contraceptive pills
- Diagnostic test : **Papanicolaous smear (PAP smear)** combined with an HPV test.
- **X-Ray, CT scan, MRI and a PET scan.**
- **Treatment :** radiation therapy, surgery and chemotherapy.

**9. What are the conditions in which IVF and ET methods are advised?**

**IVF - In Vitro Fertilization.**

- In this technique, **sperm from the male and ovum from the female** are taken out.
- Ovum is **then fertilized in the laboratory.**
- **ET** stands for **embryo transfer**
- It is the **next procedure after IVF.**
- Embryo up to **8 blastomere stage** is transferred in the fallopian tube.
- This method are often called **test tube babies.**
- These methods are parts of **Assisted Reproductive Technologies (ART).**
- These methods are used when **medical treatment and psychotherapy may have fail**
- These methods require very **high degree of precision** and **specialized doctors.**
- These technologies require **costly equipment.**

**10. What are the conditions in which medical termination of pregnancy is advised?**

- MTP can be advised under following conditions
- When there is **risk to the pregnant lady** or to the foetus.
- if the foetus has some **genetic defects.**
- In case of **unwanted pregnancy.**

**11. All reproductive tract infections RTIs are STDs, but all STDs are not RTIs. Justify with example.**

- All Reproductive Tract Infections can be **transmitted through coitus** and hence **all RTIs are STDs.**
- But some **STDs may not affect the reproductive system** at all,
- e.g. AIDS and Hepatitis B.
- Hence, **all STDs need not be RTIs.**



## PART-D

## ADDITIONAL QUESTIONS (5 MARKS)

## 1. What is sex ratio ? Why it is decreased in India .

- **Sex ratio** is ratio of males to the females in a population.
- In India, the child sex ratio has decreased from **927 to 919 female per 1000 males**.
- So **steps are needed to change the mind set and attitudes** of people
- **Female foeticide and infanticide** is main reason for this gender gap.
- **Female foeticide** is 'aborting the female in the mother's womb';
- **Female infanticide** is 'killing the female child after her birth'.
- These have resulted in **imbalance in sex ratio**.

## 2. Write an essay on various types of birth control methods in India.

## Birth control methods :

- The **voluntary use of contraceptive procedures to prevent fertilization or prevent implantation of a fertilized egg** in the uterus is termed as birth control.

## Types of contraception : – temporary and permanent.

## i) Temporary methods : Natural, chemical, mechanical and hormonal barrier methods

## a) Natural method - prevent meeting of sperm with ovum.

- Eg. **Rhythm method** (safe period) , **coitus interruptus, continuous abstinence** and **lactational amenorrhoea**.

## a) Continuous abstinence

- It is the **simplest and most dependable way to avoid pregnancy is not to have coitus for a defined period** that prevent fertilization.

## b) Coitus interruptus

- It is the **oldest family planning method**.
- The male partner withdraws his penis **before ejaculation**, thereby preventing deposition of semen into the vagina.

## ii) Barrier methods :

- In these methods, the **ovum and sperm are prevented from meeting** so that fertilization does not occur.

## a) Chemical barrier

- **Foaming tablets, melting suppositories, jellies and creams** are used to inactivate the sperms in the vagina.

## b) Mechanical barrier

- **Condoms - for male** it is used to cover the penis.
- **Cervix - for female** it is **used to cover vagina and cervix**
- They **prevent the entry of semen** into the female reproductive tract.

## c) Hormonal barrier

- It **prevents the release of ovum** from ovaries by thickens the cervical fluid
- Cervical fluid **keeps the sperm away from ovum**.

## iii) Oral contraceptives :

- Pills are used to **prevent ovulation**
- Pills **inhibiting the secretion** of FSH and LH hormones.

## Birth control pill –

- It contains **synthetic progesterone and estrogen hormones**.

• Eg. **Saheli**, contraceptive pill

## iv) Intrauterine Devices (IUDs)

- IUDs are **inserted into uterus** through the vagina.
- Available devices - **copper releasing IUDs, hormone releasing IUDs and non-medicated IUDs**.
- IUDs **increase phagocytosis of sperm**
- It is also **used to delay pregnancy**.
- Its **success rate is 95 to 99%**.
- **Eg. Copper releasing IUDs and Hormone-releasing IUDs**

## v) Permanent birth control methods

- These methods is suitable for those who **don't want children anymore**.
- **Eg. Surgical sterilisation methods**.
- It **blocks the duct which transport of the gametes** and prevents conception.
- **Eg. Tubectomy, Vasectomy**



**3. List out the aims of RCH**

- Creating **awareness and providing medical assistance** to build a healthy society.
- **Introducing sex education in schools** to provide information about adolescence related changes.
- **Educating marriageable age groups** about the **birth control methods and family planning norms**.
- **Creating awareness** for care for pregnant women, post-natal care of mother and child and the importance of breast feeding.
- Encouraging and supporting governmental and non-governmental agencies **to identify new methods to improve upon the existing methods of birth control**.

**4. How breast-feeding the baby acts as a natural contraceptive for the mother.**

- Menstrual cycles resume **6 to 8 weeks after parturition**.
- Normal **ovarian cycles may be delayed for six months** during breastfeeding.
- This delay in ovarian cycles is called **lactational amenorrhoea**.
- It serves as a **natural, but an unreliable form of birth control**.
- **Reason** : breast-feeding stimulates the **pituitary to secrete prolactin** hormone in order to increase milk production.
- This **high prolactin concentration prevent menstrual cycle** by suppressing the release of GnRH (Gonadotropin Releasing Hormone) from hypothalamus and gonadotropin secretion from the pituitary.

**5. Explain any three Assisted Reproductive Technologies in detail****Intra-uterine insemination (IUI)**

- This is for **men with low sperm count**.
- **Procedure** : **Semen is collected** from the husband /a healthy donor → **introduced into the uterus** through the vagina **by a catheter**
- The **sperms reach fallopian tubes and fertilize the egg**, resulting in pregnancy.

**Zygote intra-fallopian transfer (ZIFT)**

- As in IVF, the **zygote (8 blastomere stage) is transferred** to the fallopian tube by laparoscopy.

- The zygote continues its **natural divisions and migrates towards the uterus** where it gets implanted.

**Intra uterine transfer (IUT)**

- Embryo with **more than 8 blastomeres is inserted into uterus** to complete its further development.

**Gamete intra-fallopian transfer (GIFT)**

- **Transfer of an ovum into the fallopian tube**.
- In this **eggs are collected from the ovaries** and placed with the sperms in one of the fallopian tubes.
- The **zygote travels toward the uterus and gets implanted** in the inner lining of the uterus.

**6. List out the reasons responsible for the cause of infertility.****Causes :**

- **Tumours** in the pituitary or reproductive organs,
- **Inherited mutations** fail to produce sex hormones
- **Malformation of the cervix or fallopian tubes**
- **Inadequate nutrition** before adulthood.
- **Long-term stress** damages the menstrual cycle.
- **Ingestion of toxins** (eg. cadmium),
- **Alcohol, tobacco and marijuana,**
- **Injuries in gonads**
- **Aging .**

**Other causes of infertility**

- **Pelvic inflammatory disease (PID)**
- **Uterine fibroids and endometriosis**
- **Low body fat or anorexia** in women.
- **Undescended testes and swollen veins** (varicocele) in scrotum.
- **Tight clothing** (Raise the temperature in the scrotum and affect sperm production)
- **Under developed ovaries or testes.**
- Female may **develop antibodies against sperm**.
- Males may develop **an autoimmune response** to their own sperm.



### 7. Discuss the mode of action and advantages/disadvantages of hormonal contraceptives.

#### Mode of Action of Hormonal Contraceptives:

- These contraceptives **prevent ovulation and implantation**.
- They also **alter the quality of cervical mucus** which **suppresses the entry of sperms** into the uterus.

#### Advantages:

These are **available as oral pills**.

They do not disturb the **normal sexual activity of the couple**.

- They have **less side effects**.

#### Disadvantages:

- Some **long term side effects**.
- These may result in **increased cholesterol level** and may cause obesity.
- They can also **alter the menstrual cycle** in some cases.

### 8. Write notes on any two bacterial STD

Disease	Causative agent	Symptom	Incubation period
<b>Bacterial STI</b>			
<b>Gonorrhoea</b>	<b>Neisseria gonorrhoeae</b>	<ul style="list-style-type: none"> <li>• Affects the <b>urethra, rectum and throat</b> and in females the <b>cervix also</b> get affected.</li> <li>• <b>Symptoms: Pain and pus discharge</b> and burning sensation during urination.</li> </ul>	<b>2 to 5 days</b>
<b>Syphilis</b>	<b>Treponema palladium</b>	<p><b>Primary stage</b></p> <ul style="list-style-type: none"> <li>• <b>painless ulcer</b> on the external genitalia.</li> </ul> <p><b>Secondary stage</b></p> <ul style="list-style-type: none"> <li>• <b>Skin lesions, rashes, swollen joints</b> and <b>fever and hair loss</b>.</li> </ul> <p><b>Tertiary stage</b></p> <ul style="list-style-type: none"> <li>• <b>chronic ulcers on nose, lower legs and palate</b>.</li> <li>• <b>Loss of movement, mental disorder, visual impairment, heart problems, gummas</b> (soft non-cancerous growths) etc</li> </ul>	<b>10 to 90 days</b>

### 9. Describe any two viral STDs diseases .

Disease	Causative agent	Symptom	Incubation period
<b>Genital warts</b>	<b>Human papilloma virus (HPV)</b>	<b>Tumour</b> on the external genitalia, cervix and perianal region.	<b>1-8 months</b>
<b>Hepatitis-B</b>	<b>Hepatitis B virus (HBV)</b>	<b>Fatigue, jaundice, fever, rash and stomach pain.</b> <b>Liver cirrhosis and liver failure</b> occur in the later stage.	<b>30-80 days</b>
<b>AIDS</b>	Human immunodeficiency virus <b>(HIV)</b>	<b>Enlarged lymph nodes, prolonged fever, prolonged diarrhoea, weight reduction, night sweating.</b>	<b>2 to 6 weeks - 10 years.</b>

## Points to Remember

- **Genetics** is a branch of biology that deals with the **study of heredity and variations**.
- **Gene is the unit of heredity and gene is the inherited factor.**
- **Variation** - is the **degree of difference** in progeny from their parents.
- **All genes have two alternative forms -Dominant and recessive alleles** E.g : tall vs dwarf (T and t).
- **Multiple alleles** : When **three or more alleles of a gene that control a particular trait** occupy the same locus on the homologous chromosome of an organism, they are called multiple alleles
- **Multiple allelism**: inheritance of multiple alleles is called **multiple allelism**.
- **Karl Landsteiner** - discovered two kinds of antigens called **antigen 'A' and antigen 'B'**
- Based on the presence or absence of these antigens blood groups are classified. They are **Type 'A', Type 'B', Type 'O' (universal donor), Type 'AB' (universal recipient)**
- **I<sup>A</sup> and I<sup>B</sup> are dominant to I<sup>O</sup>, but co-dominant to each other (I<sup>A</sup>=I<sup>B</sup>).**
- The Rh factor or Rh antigen is **found on the surface** of RBC.
- Fisher and Race hypothesis - Rh factor involves **three different pairs of alleles located on three different loci**
- This system is uses the '**Cde**' nomenclature.
- **Wiener Hypothesis** -He proposed eight alleles (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>, r, r<sup>1</sup>, r<sup>11</sup>, r<sup>y</sup>**).
- Dominant 'R allele' (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>**) will produce **Rh<sup>+</sup> positive phenotype**
- Double recessive genotypes (**rr, rr<sup>1</sup>, rr<sup>11</sup>, rr<sup>y</sup>**) will give rise to **Rh-negative phenotype**.
- Rh incompatibility has **great impact on child birth**.
- **It is resultin** Erythroblastosis foetalis
- **Sex chromosomes determine the sex** of the individual.
- Autosomes - **chromosomes other than the sex chromosomes**
- Sex chromosomes may be **similar** (homomorphic) and **dissimilar** (heteromorphic).
- **Homomorphic individuals** - produce **only one type of gametes** (homogametic)
- **Heteromorphic individuals** - produce **two types of gametes** (heterogametic).
- **Heterogametic Sex Determination** - In this **one sexes produces similar gametes** and the **other sex produces dissimilar gametes**.
- Heterogametic Males -In this **Males are heterogametic** producing dissimilar gametes **Females are homogametic** producing similar gametes.
- It is of two kinds **XX-XO type and XX-XY type**.  
XX-XO Type -This type is seen in **bugs, cockroaches and grasshoppers**.  
**XX-XY type** - This type seen in **human beings and in Drosophila**.
- **Heterogametic Females - type seen in insects, fishes, reptiles and birds**  
**Male produce a similar gametes**  
Female produce **dissimilar gametes**.
- ZO-ZZ Type - is seen in **moths, butterflies and domestic chickens**.
- **ZW-ZZ type** - This type seen in insects (**gypsy moth**), **fishes, reptiles and birds**.
- Sex determining Genes are located on **two sex chromosomes**, called **allosomes**.
- In human **22 pairs of autosomes (44A) + one pair of allosomes (XX or XY) =23 pairs of chromosomes**
- In **1949, Barr and Bertram** observed a **condensed body in the nerve cells of female cat** which was absent in the male.
- This condensed body was called **sex chromatin** later it was referred as **Barr body**.
- **Lyon's hypothesis - Mary Lyon** - Barr bodies represented **an inactive chromosome**, which in **females becomes tightly coiled**

- into a **heterochromatin**, a condensed and visible form of chromatin .
- **Haplodiploidy mechanism of sex determination** is common in **hymenopteran insects** Eg. **honeybees**,
  - In this, sex of the offspring is determined by the **number of sets of chromosomes it receives**.
  - **Fertilized eggs** develop into females (Queen or Worker)
  - **Unfertilized eggs** develop into males (drones) by parthenogenesis.
  - The inheritance of X or Y linked genes is called **sex-linked inheritance**.
  - **Genes present on region of X or Y chromosomes** are called **sex linked genes**.
  - X-linked gene inheritance are **Red-green colour blindness** or daltonism, **Haemophilia**, **Duchenne's muscular dystrophy**
  - Haemophilia is caused by a **recessive X-linked gene**.
  - Colour blindness is Due to **dominant X - linked gene** which is necessary for the **formation of cones**
  - The recessive form - **incapable of producing cone cells**.
  - They are unable to **distinguish red and green colour**.
  - Y-linked **genes for hypertrichosis** (excessive development of hairs on pinna of the ear) are transmitted **directly from father to son**
  - Karyotyping is a technique through which a complete set of **chromosomes is separated from a cell and the chromosomes are arranged in pairs**.
  - **Ideogram** - diagrammatic representation of chromosomes.
  - **Pedigree is a "family tree" which is drawn with standard genetic symbols, it show the inheritance pathway**
  - **Pedigree analysis** is the **study of traits as they have appeared in a given family line** for several past generations.
  - **Genetic Disorders Types : Mendelian disorders and chromosomal disorders**.
  - **Alteration or mutation in a single gene** causes Mendelian disorders.
  - Mendelian disorders are **Thalassemia, albinism, phenylketonuria, sickle cell anaemia, Huntington's chorea**.
  - These disorders may be dominant or recessive and autosomal or sex linked.
  - **Thalassemia** is an **autosomal recessive disorder**.
  - **Types of Thalassemia ( based on chain affected)**
  - **Alpha Thalassemia , Beta Thalassemia**
  - Phenylketonuria *is an inborn error of Phenylalanine metabolism*
  - **Causes : pair of autosomal recessive genes**.
  - It is also caused due to **mutation in the gene PAH located on chromosome 12**
  - Albinism - It is an **inborn error of metabolism**,
  - Caused by an **autosomal recessive gene**.
  - **Huntington's chorea** is an **autosomal dominant lethal gene** in man.
  - **Symptoms : involuntary jerking of the body and progressive degeneration of the nervous system**, accompanied by gradual **mental and physical deterioration**.
  - **Chromosomal Abnormalities are caused by errors in the number or structure of chromosomes**.
  - E.g - **Down's syndrome, Turner's syndrome, Klinefelter's syndrome, Patau's syndrome**
  - Several **autosomal aneuploidies** have been reported in human being
  - **Down's syndrome** (21-Trisomy),
  - **Patau's syndrome** (13-Trisomy).
  - **Down's Syndrome/Trisomy - 21**
  - Several **sex chromosomal abnormalities** have been detected.
  - Eg. **Klinefelter's syndrome and Turner's syndrome**.
  - **Klinefelter's Syndrome (XXY Males)**
  - **Causes:** presence of an **additional copy of the X chromosome** resulting in a karyotype of **47 / XXY**.
  - These Persons have **47 chromosomes** (44AA+XXY).
  - **Turner's Syndrome (XO Females)**
  - **Causes:** **loss of a X chromosome** resulting in a **karyotype of 45,X**.
  - Persons with this syndrome have **45 chromosomes** (44 autosomes and one X chromosome) (**44AA+XO**)



**PART –A**

**TEXTUAL QUESTIONS (1 MARKS)**

1. Haemophilia is more common in males because it is a

- a) Recessive character carried by Y-chromosome
- b) Dominant character carried by Y-chromosome
- c) Dominant trait carried by X-chromosome
- d) Recessive trait carried by X-chromosome

**Ans: d**

2. ABO blood group in man is controlled by

- a) Multiple alleles
- b) Lethal genes
- c) Sex linked genes
- d) Y-linked genes

**Ans: a**

3. Three children of a family have blood groups A, AB and B. What could be the genotypes of their parents?

- a)  $I^A I^B$  and  $ii$
- b)  $I^A I^o$  and  $I^B I^o$
- c)  $I^B I^B$  and  $I^A I^A$
- d)  $I^A I^A$  and  $ii$

**Ans: b**

4. Which of the following is not correct?

- a) Three or more alleles of a trait in the population are called multiple alleles.
- b) A normal gene undergoes mutations to form many alleles
- c) Multiple alleles map at different loci of a chromosome
- d) A diploid organism has only two alleles out of many in the population

**Ans: c**

5. Which of the following phenotypes in the progeny are possible from the parental combination  $A \times B$ ?

- a) A and B only
- b) A,B and AB only
- c) AB only
- d) A,B,AB and O

**Ans: d**

6. Which of the following phenotypes is not possible in the progeny of the parental genotypic combination  $IAIO \times IAIB$ ?

- a) AB
- b) O
- c) A
- d) B

**Ans: b**

7. Which of the following is true about Rh factor in the offspring of a parental combination  $Dd \times Dd$  (both Rh positive)?

- a) All will be Rh-positive
- b) Half will be Rh positive
- c) About  $\frac{3}{4}$  will be Rh negative
- d) About one fourth will be Rh negative

**Ans: d**

8. What can be the blood group of offspring when both parents have AB blood group?

- a) AB only
- b) A, B and AB
- c) A, B, AB and O
- d) A and B only

**Ans: b**

9. If the child's blood group is 'O' and fathers blood group is 'A' and mother's blood group is 'B' the

genotype of the parents will be

- a)  $I^A I^A$  and  $I^B I^o$
- b)  $I^A I^o$  and  $I^B I^o$
- c)  $I^A I^o$  and  $I^o I^o$
- d)  $I^o I^o$  and  $I^B I^B$

**Ans: b**

10. XO type of sex determination and XY type of sex determination are examples of

- a) Male heterogamety
- b) Female heterogamety
- c) Male homogamety
- d) Both b) and c)

**Ans: a**

11. In an accident there is great loss of blood and there is no time to analyse the blood group

which blood can be safely transferred?

- a) 'O' and Rh negative
- b) 'O' and Rh positive
- c) 'B' and Rh negative
- d) 'AB' and Rh positive

**Ans: a**

12. Father of a child is colourblind and mother is carrier for colourblindness, the probability of the child being colourblind is

- a) 25%
- b) 50%
- c) 100%
- d) 75%

**Ans: b**

13. A marriage between a colourblind man and a normal woman produces

- a. All carrier daughters and normal sons
- b. 50% carrier daughters, 50% normal daughters
- c. 50% colourblind sons, 50% normal sons
- d. All carrier offsprings

**Ans: a**

14. **Mangolism is a genetic disorder which is caused by the presence of an extra chromosome number**

- a) 20      b) 21      c) 4      d) 23

**Ans: b**

15. **Klinefelters' syndrome is characterized by a karyotype of**

- a) XYY      b) XO      c) XXX      d) XXY

**Ans: d**

16. **Females with Turners' syndrome have**

- a) Small uterus  
b) Rudimentary ovaries  
c) Underdeveloped breasts  
d) All of these

**Ans: d**

17. **Pataus' syndrome is also referred to as**

- a) 13 -Trisomy      b) 18-Trisomy  
c) 21-Trisomy      d) None of these

**Ans: a**

18. **Who is the founder of Modern Eugenics movement?**

- a) Mendel      b) Darwin  
c) Fransis Galton      d) Karl pearson

**Ans: c**

19. **Improvement of human race by encouraging the healthy persons to marry early and produce large number of children is called**

- a) Positive eugenics      b) Negative eugenics  
c) Positive euthenics      d) Positive euphenics

**Ans: a**

20. **The \_\_\_\_\_ deals with the control of several inherited human diseases especially inborn errors of metabolism**

- a) Euphenics      b) Eugenics  
c) Euthenics      d) All of these

**Ans: a**

21. **"Universal Donor" and "Universal Recipients" blood group are \_\_\_\_\_ and \_\_\_\_\_ respectively**

- a) AB, O      b) O, AB  
c) A, B      d) B, A

**Ans: b**

22. **ZW-ZZ system of sex determination occurs in**

- a) Fishes      b) Reptiles  
c) Birds      d) All of these

**Ans: d**

23. **Co-dominant blood group is**

- a) A      b) AB      c) B      d) O

**Ans: b**

24. **Which of the following is incorrect regarding ZW-ZZ type of sex determination?**

- a. It occurs in birds and some reptiles  
b. Females are homogametic and males are heterogametic  
c. Male produce two types of gametes  
d. It occurs in gypsy moth

**Ans: b**

## PART – B,C AND D

### TEXTUAL QUESTIONS (2.3 AND 5 MARKS)

25. **What is haplodiploidy?**

- It is a sex determination mechanism which is common in **hymenopteran insects**  
**E.g : honeybees, ants and wasps**
- In this, sex of the offspring is determined by the **number of sets of chromosomes it receives.**

26. **Distinguish between heterogametic and homogametic sex determination systems.**

S. No.	Heterogametic sex determination	Homogametic sex determination
<b>1</b>	In this type <b>two types of gametes are produced</b>	In this type <b>only one types of gamete is produced</b>
<b>2</b>	Sex chromosomes are <b>dissimilar</b>	Sex chromosomes are <b>similar</b>
<b>3</b>	These organisms are called as <b>Heteromorphic individuals</b>	These organisms are called as <b>Homomorphic individuals</b>

27. **What is Lyonisation?**

- It is an condition Where there are **two or more haploid sets of X- Linked genes** in each cell all but one of the genes are inactivated apparently at random and **have no phenotypic expression.**
- Lyonization is usual but it is **not common in all loci**
- Lyonization occurs in men with the **Klinefelter (XXY) karyotype**

**28. What is criss-cross inheritance?**

- ❖ This type of inheritance of recessive sex linked character from **father to daughter and then from the daughter to her sons** is known as **criss-cross inheritance or sex linked or X-linked inheritance.**

**29. Why are sex linked recessive characters more common in the male human beings?**

- Sex linked inherited traits are **more common in males** than females
- This is because, males are hemizygous (has **only one X gene**)

**30. What are holandric genes?**

- **Y-linked or holandric genes** – The genes present in the region of Y chromosome
- The Y linked genes have **no corresponding allele in X chromosome.**
- Y linked genes inherit along with Y chromosome and **phenotypically express only in the male.**

**31. Mention the symptoms of Phenylketonuria.**

- **Symptoms of phenylketonuria include** severe **mental retardation, light pigmentation** of skin and hair.
- Phenylpyruvic acid is **excreted in the urine.**

**32. Mention the symptoms of Downs syndrome.**

- Severe mental retardation,
- Defective development of the central nervous system,
- Increased separation between the eyes,
- Flattened nose,
- Ears are malformed,
- Mouth is constantly open and the tongue protrudes

**33. Differentiate Intersexes from Supersexes**

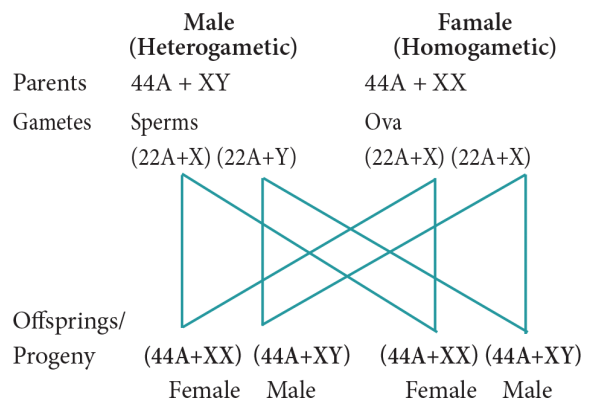
- ❖ The presence of both **male and female reproductive characteristics** in one individual is common both, but **Supersex** is a natural condition while **intersex is a disorder.**
- ❖ **Supersex individuals** are **able to reproduce** while **intersex individuals** are **usually not.**
- ❖ **Supersexes** are **found among animals and plants,** but intersex individuals are **found among humans.**

**34. Explain the genetic basis of ABO blood grouping man.**

- Blood group is determined by **-three autosomal alleles located on chromosome 9.**
- The **gene controlling** blood type are '**L**' (L-Landsteiner) or **I** (I - isoagglutination).
- I gene occurs in three allelic forms, **IA, IB and IO.**
- ✓ **IA denotes A antigen.**
- ✓ **IB denotes B antigen**
- ✓ **I<sup>0</sup> denotes no antigen.**
- **IA and IB are dominant** to I<sup>0</sup>, but **co-dominant to each other (IA=IB).**
- Dominance hierarchy is - (**IA=IB > I<sup>0</sup>**).
- A child receives one of **three alleles from each parent,** and result in **six possible genotypes** and **four possible blood groups** (phenotypes).
- The genotypes : **IAIA, IA I<sup>0</sup> - A group**
- ✓ **IBIB, IB I<sup>0</sup> - B group**
- ✓ **IA IB - AB Group**
- ✓ **I<sup>0</sup>I<sup>0</sup> - O Group**

**35. How is sex determined in human beings?**

- **Sex chromosomes determine the sex** of the individual.
- Autosomes - **chromosomes other than the sex chromosomes**
- Sex chromosomes may be **similar** (homomorphic) and **dissimilar** (heteromorphic).
- **Homomorphic individuals** - produce **only one type of gametes** (homogametic)

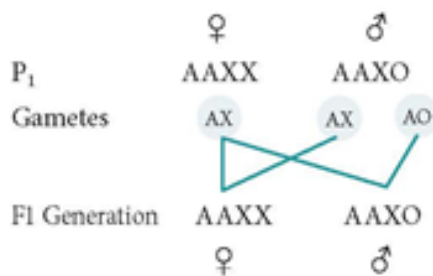


- **Heteromorphic individuals** - produce **two types of gametes** (heterogametic).
- **Females are homogametic** with XX chromosome,
- **Males are heterogametic** with X and Y chromosome.
- **Females produce only one kind of egg**, each with one X chromosome,
- **Males produce two kinds of sperms** (1. with X chromosome and 2. with Y chromosome).
- Gender - **depends on the type of fertilizing sperm.**

**36. Explain male heterogamety.**

- In this **Males are heterogametic** producing dissimilar gametes.
- **Females are homogametic** producing similar gametes.
- It is of two kinds **XX-XO type and XX-XY type.**

**XX-XO Type**

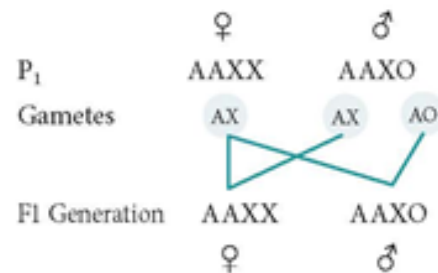


- This type is seen in **bugs, cockroaches and grasshoppers.**
- **Female - two X chromosomes** - XX (homogametic)
- **Males - only one X chromosome** - XO (heterogametic)
- **Unpaired X chromosomes determines the male sex.**
- The males produce **two types of sperms**, 1. one half **with X chromosome** 2. other half without X chromosome.
- The **sex of the offspring depends upon the sperm** that fertilizes the egg.

**XX-XY type (Lygaeus Type)**

- This type seen in **human beings and in Drosophila.**

- **Females are homogametic** with XX chromosome,
- **Males are heterogametic** with X and Y chromosome.
- **Females produce only one kind of egg**, each with one X chromosome,
- **Males produce two kinds of sperms** (1. with X chromosome and 2. with Y chromosome).
- Gender - **depends on the type of fertilizing sperm**

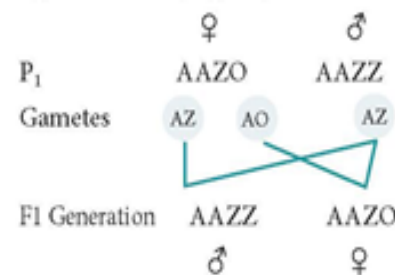


**37. Brief about female heterogamety.**

**Heterogametic Females**

- In this type seen in **insects, fishes, reptiles and birds**
- **Male produce a similar gametes**
- Female produce **dissimilar gametes.**
- **Female sex** - 'X' chromosome or one 'X' and one 'Y' chromosome.
- Thus **females are heterogametic and produce two types of eggs.**
- In this '**Z**' and '**W**' are used here instead of **X and Y respectively.**
- Heterogametic females are of two types, **ZO-ZZ type and ZW-ZZ type.**

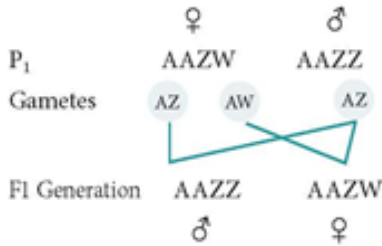
**ZO-ZZ Type**



- This type is seen in **moths, butterflies and domestic chickens.**

- Female have **single 'Z' chromosome** (heterogametic -ZO)
- Two kinds of eggs some organisms are **with 'Z' chromosome** and **without 'Z' chromosome**,
- Male have **two 'Z' chromosomes** (homogametic - ZZ)

**ZW-ZZ type**



- This type seen in insects (**gypsy moth**), **fishes, reptiles and birds.**
- Female has **one 'Z' and one 'W' chromosome (ZW)** which producing two types of eggs, **some carrying the Z chromosomes** and **some carry the W chromosome.**
- The **male sex has two 'Z' chromosomes** (homogametic -ZZ)



**38. Give an account of genetic control of Rh factor.**

**Fisher and Race hypothesis:**

- Rh factor involves **three different pairs of alleles located on three different loci**
- This system is uses the **'Cde' nomenclature.**
- Three pairs of Rh alleles are **Cc, Dd and Ee**
- Genotypes will be **one C or c, one D or d, one E or e** from each chromosome.

**E.g : CDE/cde; CdE/cDe; cde/cde; CDe/CdE etc.,**

- Atleast one **dominant genotypes 'D' allele will produce Rh+ positive** phenotype
- Double recessive genotype **'dd' will produce Rh- negative phenotype.**

**Wiener Hypothesis :**

- He proposed eight alleles (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>, r, r<sup>1</sup>, r<sup>11</sup>, r<sup>y</sup>**).
- Dominant 'R allele' (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>**) will produce **Rh<sup>+</sup> positive phenotype**

- Double recessive genotypes (**rr, rr<sup>1</sup>, rr<sup>11</sup>, rr<sup>y</sup>**) will give rise to **Rh-negative phenotype.**

**39. Explain the mode of sex determination in honeybees.**

**Haplodiploidy in Honeybees**

- **Haplodiploidy mechanism of sex determination** is common in **hymenopteran insects**

**E.g : honeybees, ants and wasps**

- In this, sex of the offspring is determined by the **number of sets of chromosomes it receives.**

- **Fertilized eggs** : develop into females (Queen or Worker)
- **Unfertilized eggs** : develop into males (drones) by parthenogenesis.
- So **males have half the number of chromosomes** (haploid), Females have **double the number**

(diploid), hence this system of sex determination is known as the name **haplodiploidy.**

- This method **assists the evolution of sociality** in which **only one diploid female becomes a queen**

and lays the eggs for the colony.

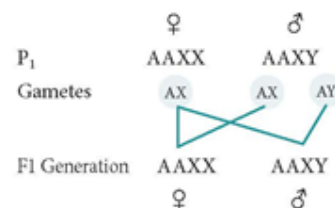
- **Kin Selection** - All diploid females which developed from fertilized eggs **help to raise the queen's**

**eggs** and so contribute to the **queen's reproductive success** and indirectly to their own, a

phenomenon known as **Kin Selection.**

- The queen constructs their social environment by **releasing a hormone that suppresses fertility of the workers.**

**40. Discuss the genic balance mechanism of sex determination with reference to Drosophila.**



**XX-XY type (Lygaeus Type)**

- This type seen in **human beings and in Drosophila**.
- **Females are homogametic** with XX chromosome,
- **Males are heterogametic** with X and Y chromosome.
- **Females produce only one kind of egg**, each with one X chromosome,
- **Males produce two kinds of sperms** (1. with X chromosome and 2. with Y chromosome.)
- Gender - **depends on the type of fertilizing sperm**.

#### 41. What are the applications of Karyotyping?

- It helps in **gender identification**.
- It is **used to detect the chromosomal aberrations** like deletion, duplication, translocation, nondisjunction of chromosomes.
- It helps to **identify chromosomal abnormalities** like aneuploidy.
- It is also used to **predict the evolutionary relationships** between species.
- It is used to **Genetic diseases** can be detected.

#### 42. Explain the inheritance of sex linked characters in human being.

- The inheritance of X or Y linked genes is called **sex-linked inheritance**.
- **Genes present on region of X or Y chromosomes** are called **sex linked genes**.
- **X linked genes** - The genes present in the I region of "X" chromosome.
- The X-linked genes have **no corresponding alleles in the Y chromosome**.
- **Y- linked or holandric genes** – The genes present in the region of Y chromosome
- The Y linked genes have **no corresponding allele in X chromosome**.
- Y linked genes inherit along with Y chromosome and **phenotypically express only in the male**.
- Sex linked inherited traits are **more common in males** than females
- This is because, males are hemizygous (has

**only one X gene)**

- **X - linked and Y - linked genes** (non homologous region) **do not undergo pairing or crossing over** during meiosis.

#### 43. What is extra chromosomal inheritance? Explain with an example.

- Transmission of characters dependent on some factor which is not connected with the chromosomes
- It is also known as **cytoplasmic inheritance**
- **Example:** Cytoplasmic inheritance of **chloroplasts and mitochondria**.

#### 44. Comment on the methods of Eugenics

##### Classical eugenics

- Advocacy for sexual abstinence
- **Sex education** in schools.
- Promoting the **use of contraception**.
- Research for **better contraceptives**.
- **Voluntary sterilization**.
- **Abortion**.

##### Negative eugenics

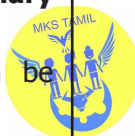
- **Incentives** for sterilization.
- **Incentives for women** on welfare to use contraceptions.
- **Compulsory sterilization** of the "mentally retarded" and criminals.

##### Positive eugenics.

- **Financial incentives** to have children.
- **Taxation of the childless**.
- Eugenic immigration

##### New eugenics

- **Artificial insemination** by donor.
- **Egg donation**.
- Pre implantation and prenatal diagnosis of genetic disorders and pregnancy terminations of defective fetuses.
- **Embryo selection**.
- **Genetic engineering**.
- **Gene therapy**
- **Cloning**



**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

1. If a genetic disease is transferred from a phenotypically normal but carrier female to only some

of the male progeny, the disease is:

- a) Autosomal dominant
- b) Autosomal recessive
- c) Sex-linked dominant
- d) Sex-linked recessive

**Ans: d**

2. Person having genotype IA, IB would show the blood group as AB. This is because of:

- a) Pleiotropy
- b) Co-dominance
- c) Segregation
- d) Incomplete dominance

**Ans: b**

3. ZZ / ZW type of sex determination is seen in:

- a) Platypus
- b) Snails
- c) Cockroach
- d) Birds

**Ans: d**

4. Mother and father of a person with blood group have 'A' and 'B' blood group respectively.

What would be the genotype of both mother and father?

- a) Mother is homozygous for 'A' blood group and father is heterozygous for 'B'
- b) Mother is heterozygous for 'A' blood group and father is homozygous for 'B'
- c) Both mother and father are heterozygous for 'A' and 'B' blood group, respectively
- d) Both mother and father are homozygous for 'A' and 'B' blood group, respectively

**Ans: d**

5. AB-Blood group shows:-

- a) Co-dominance
- b) Complete dominance
- c) Mixed inheritance
- d) Composite inheritance

**Ans: a**

6. ABO blood group is an example of

- a) Epistasis
- b) Multiple allelism
- c) Pleiotropism genes
- d) Complementary

**Ans: b**

7. A child is blood group is 'O'. His parents blood group can not be:-

- a) B & O
- b) A & O
- c) AB d)
- A & B

**Ans: c**

8. If one parent has blood group A and the other parent has blood group B. The off springs have which blood group:-

- a) AB only
- b) O only
- c) B only
- d) A,B, AB, O

**Ans: d**

9. A Child of O blood group, has B- blood father, the genotype of father would be:-

- a) I<sup>O</sup>I<sup>O</sup>
- b) I<sup>B</sup>I<sup>B</sup>
- c) I<sup>A</sup>I<sup>B</sup>
- d) I<sup>B</sup>I<sup>O</sup>

**Ans: d**

10. Sickle cell anaemia induces due to

- a) Change of Amino Acid in - Chain of Haemoglobin
- b) Change of Amino Acid - Chain of Haemoglobin
- c) Change of Amino Acid in both and chain of haemoglobin
- d) Change of Amino acid either or Chain of haemoglobin

**Ans: b**

11. If mother has blood group B, father has A group the offspring will be out:-

- a) A
- b) O
- c) AB
- d) Any of the above

**Ans: d**

12. A colour blind man marries a normal lady whose father was colour blind. If it produces two sons & two daughters, how many of them would be suffer

- a) Both sons
- b) Both daughters
- c) One son & one daughter
- d) Both sons & both daughters

**Ans: c**

13. A colourblind daughter is born when

- a) Father is colourblind, mother is normal
- b) Mother is colourblind, father is normal
- c) Mother is carrier, father is normal
- d) Mother is carrier, father is colourblind

**Ans: d**

- 14. In which of the following the inheritance takes place only by male:-**
- Nuclear
  - Cytoplasmic
  - Co-dominance
  - Holandric inheritance
- Ans: d**
- 15. Which of the following is not a sex linked characters**
- Haemophilia
  - Colour blindness
  - Hypertrichosis
  - Baldness
- Ans: d**
- 16. The condition in which only one allele of a pair is present in a diploid organism is known as**
- Homozygous
  - Heterozygous
  - Hemizygous
  - Incomplete dominance
- Ans: c**
- 17. Sex-linked disorders are generally**
- Lethal
  - Recessive
  - Dominant
  - Not inherited
- Ans: b**
- 18. If a colour blind woman marries with a normal man. The offspring will be:**
- All
  - All daughters normal and all son will be colourblind
  - All normal
  - All daughters will be colourblind and all sons will be normal
- Ans: b**
- 19. How the sex of offspring determined in humans**
- Sex chromosome of mother
  - Size of ovum
  - Size of sperm
  - Sex chromosome of father
- Ans: d**
- 20. Which chromosome set is found in male grass hopper:-**
- 2A+XY
  - 2A + XO
  - 2A + YY
  - 2A+XX
- Ans: b**
- 21. Which of the following symbols are used for representing sex chromosomes of birds:**
- ZZ –ZW
  - XX – XY
  - XO – XX
  - ZZ – WW
- Ans: a**
- 22. In which of the following sex is determined by female individual**
- Human
  - Drosophila
  - Birds
  - Grasshopper
- Ans: c**
- 23. Male heterogamy found in case of**
- XO type male in Grasshopper
  - XY type male in human
  - ZW male in birds
  - 1 and 2 both
- Ans: d**
- 24. Which is a dominant trait:**
- Colour blindness
  - Albinism
  - Haemophilia
  - Rh factor
- Ans: d**
- 25. Parents are carrier for albinism. What will be the first three children:**
- Some normal, heterozygous & albino
  - All normal
  - All heterozygous, albino
  - No normal
- Ans: a**
- 26. Which one of the following character in man is controlled by recessive gene:**
- Colourblindness
  - Woolly hair
  - Brachy-dactyly
  - Curly hairs
- Ans: a**
- 27. If a colourblind woman marries a normal visioned man, their sons will be –**
- All normal visined
  - One – half colourblind and one – half normal
  - Three – forthscourblind and one- fourth normal
  - All colourblind
- Ans: d**
- 28. ABo blood groups in humans are controlled by the gene I. It has three alleles – I<sup>A</sup>, I<sup>B</sup> and I<sup>0</sup>. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur?**
- Four
  - Two
  - Three
  - One
- Ans: a**

These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.

- a) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion
- b) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
- c) If Assertion is True but the Reason is False.
- d) If both Assertion & Reason are false.

**29. Assertion : Inheritance is the basis of heredity**

**Reason :** Inheritance is the process by which characters are passed on from parent to progeny.

- a) A      b) B      c) C      d) D

**Ans: a**

**30. Assertion : Multiple alleles can be found only when population studies are made.**

**Reason :** Occasionally, a single gene product may produce more than one effect

- a) A      b) B      c) C      d) D

**Ans: b**

**31. Assertion : XO type, XY type & ZW type are the example of male heterogamety.**

**Reason :** Male produces two types of sperms

- a) A      b) B      c) C      d) D

**Ans: d**

**32. Assertion : Sickle-cell anaemia is caused by the substitution of glutamic acid by valine at the sixth position of the beta globin chain of the haemoglobin molecule.**

**Reason :** It is due to the single base substitution at the sixth codon of the beta globin gene from GUG to GAG

- a) A      b) B      c) C      d) D

**Ans: c**

**33. Assertion : Male is haploid and female is diploid in honey bee.**

**Reason :** Sex depends on paired and unpaired chromosomes in every organism

- a) A      b) B      c) C      d) D

**Ans: c**

**34. Assertion : Most of the X – linked disorders can not be eliminated easily from nature and Our gene pool**

**Reason :** X –linked disorders are due to recessive

- a) A      b) B      c) C      d) D

**Ans: a**

**PART-B**

**ADDITIONAL QUESTIONS**

**(2 MARKS)**

**1. Define Allels.**

- According to Mendelian inheritance **all genes have two alternative forms**, these alternative form of a same gene is known as alleles
- **Dominant and recessive alleles** e.g. tall vs dwarf (T and t).

**2. Define variation.**

- **Variation** is the **degree of difference** in progeny from their parents.

**3. Define multiple alleles and multiple allelism.**

- When **three or more alleles of a gene that control a particular trait** occupy the same locus on the homologous chromosome of an organism, they are called multiple alleles
- The inheritance of multiple alleles is called **multiple allelism**.
- Multiple allelism occurs in **humans blood groups**.

**Define the term Eugenics, Euthenics, Euphenics.**

- **Eugenics** is a measure to **improve the quality of human population** by encouraging or discouraging reproduction
- **Euthenics** is a measure to **improve the environment** in order to improve health, or well being of society
- **Euphenics** is a measure to **improve the individual or phenotype** by biological method

**5. Define Gene.**

- **Gene** is the **unit of heredity** and gene is the **inherited factor**
- **Genetics** is a branch of biology that deals with the **study of heredity and variations**.

**6. List out the genes that control the blood group.**

- **I<sup>A</sup>I<sup>A</sup>, I<sup>A</sup>I<sup>O</sup> - A group**
- **I<sup>B</sup>I<sup>B</sup>, I<sup>B</sup>I<sup>O</sup> - B group**
- **I<sup>A</sup>I<sup>B</sup> - AB Group**
- **I<sup>O</sup>I<sup>O</sup> - O Group**

**7. Define secretor.**

- Individuals who possess **A antigen and B antigen in saliva** are called **secretors**.
- **Secretors** can be found in **tears, saliva, urine, semen, gastric juice** and **milk**.

**8. List out the enzyme produced by I<sup>A</sup> and I<sup>B</sup>, I<sup>O</sup>.**

- I<sup>A</sup> allele produces **N-acetyl galactose transferase** and can add N-acetyl galactosamine (NAG)
- I<sup>B</sup> allele produces **galactose transferase** that adds **galactose**.
- I<sup>O</sup>/I<sup>O</sup> allele **will not produce transferase enzyme**

**9. What is null allele? Why it is called so?**

- I<sup>O</sup>/I<sup>O</sup> allele **will not produce any transferase enzyme** therefore they are called "**null**" allele moreover it **cannot add NAG or galactose**.

**10. Define Rh factor.**

- The Rh factor or Rh antigen is **found on the surface** of RBC.
- Discovered **by Karl Landsteiner and Alexander Wiener** in 1940
- **From** - blood of **rhesus monkey, Macaca rhesus** and later in human beings.
- 'Rh factor' means "**immunogenic D antigen** of the Rh blood group system.
- Person with D antigen are **Rh D positive (Rh+)**
- Person without D antigen are **Rh D negative (Rh-)**".

**11. Explain weiner hypothesis.**

- He proposed eight alleles (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>, r, r<sup>1</sup>, r<sup>11</sup>, r<sup>y</sup>**).
- Dominant 'R allele' (**R<sup>1</sup>, R<sup>2</sup>, R<sup>0</sup>, R<sup>z</sup>**) will produce **Rh<sup>+</sup> positive phenotype**
- Double recessive genotypes (**rr, rr<sup>1</sup>, rr<sup>11</sup>, rr<sup>y</sup>**) will give rise to **Rh-negative phenotype**.

**12. Explain the term HDN.**

- Rh incompatibility in mother and foetus blood has **great impact on child birth**.
- **It Causes haemolysis** of foetal RBCs result in **haemolytic jaundice and anaemia**.
- This condition is known as **Erythroblastosis foetalis or Haemolytic disease of the new born (HDN)**.

**13. Compare the size of x and y chromosome.**

- **Y chromosome** - 60 Mb in size with 60 functional genes
- **X chromosomes** - 165 Mb in size with about 1,000 genes.

**14. What is heterogametic sex determination?**

- In this **one sexes produces similar gametes** and the **other sex produces dissimilar gametes**.
- The sex of the offspring is **determined at the time of fertilization**

**15. What is Barr Body?**

- In **1949, Barr and Bertram** observed a **condensed body in the nerve cells of female cat** which was absent in the male.
- This condensed body was called **sex chromatin** later it was referred as **Barr body**.

**16. "Genes contain the information that is required to express a particular trait." Explain.**

- After Mendel's period, scientists discover that **genes are present on chromosomes** and they were responsible for **inheritance of characters**.
- Hence, it is said that **genes contain the information** that is required to express a particular trait.

**17. In our society a woman is often blamed for not bearing male child. Do you think it is right? Justify.**

- Based on **sex determination in humans**, Y chromosome which is present in males comes from the father and not from the mother.
- **Females are homogametic** with XX chromosome,
- **Males are heterogametic** with X and Y chromosome.
- **Females produce only one kind of egg**, each with one X chromosome,
- **Males produce two kinds of sperms** (1. with X chromosome and 2. with Y chromosome).
- Gender - **depends on the type of fertilizing sperm** so **we should not blame women**



**18. Can a child have blood group O if his parents have blood group 'A' and 'B'. Explain.**

- A child from parents with blood group 'A' and 'B' can have child with O blood group.
- If genotype of one parent is  $I^A I^O$  and that of another parent is  $I^B I^O$ ; then gametes from the parents can have **any one of the genotype**, i.e.  $I^A I^O$  or  $I^B I^O$  or  $I^O I^O$
- If fertilization happens between gametes with  $I^O I^O$ , then the child's genotype will be  $I^O I^O$  and hence the **child can have blood group O**.

**19. What is Down's syndrome? Give its symptoms and cause.**

- Down's syndrome is a **chromosomal disorder**.
- **Trisomic condition of chromosome - 21** results in Down's syndrome

**Symptoms :**

- **Severe mental retardation,**
- **Defective development of the central nervous system,**
- **Increased separation between the eyes,**
- **Flattened nose,**
- **Ears are malformed,**
- **Mouth is constantly open and the tongue protrudes.**

**20. Why is the frequency of red-green colour blindness is many times higher in males than that in the females?**

- The genes that produce photo pigments are present **on X-chromosomes**.
- If some of the gene is **missing or damaged**, it can result in colour blindness.
- Since **males have only one X-chromosome**, the chances of **colour blindness is very high in males**.

**21. Identify the correct statement.**

- Female of many birds has a pair of **dissimilar ZW chromosomes**, while the males possess a pair of **similar ZZ chromosomes**.
  - Female of many birds has a pair of **similar ZZ chromosomes**, while the males possess a pair of **dissimilar ZW chromosomes**.
- Statement (a) is correct.
  - In birds, the male has two homomorphic sex chromosomes (ZZ) and is homogametic, and the female has two heteromorphic sex

chromosomes (ZW) and is heterogametic.

**22. Human population shown variations in blood groups. Explain the genetic basis for this variation seen in the population.**

- ABO blood groups are controlled by **gene I**.
- The gene I has three alleles  **$I^A$ ,  $I^B$  and  $I^O$**
- This phenomenon is known as **multiple allelism**.

**PART-C**

**ADDITIONAL QUESTIONS (3 MARKS)**

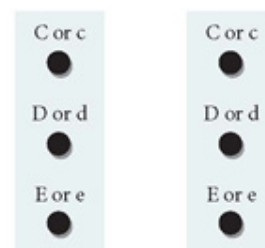
**1. Write short notes on Rh factor.**

- The Rh factor or Rh antigen is **found on the surface** of RBC.
- Discovered **by Karl Landsteiner and Alexander Wiener** in 1940
- **From** - blood of **rhesus monkey, Macaca rhesus** and later in human beings.
- 'Rh factor' means "**immunogenic D antigen** of the Rh blood group system.
- Person with D antigen are **Rh D positive (Rh+)**
- Person without D antigen are **Rh D negative (Rh-)**".
- Rhesus factor is **dominant inherited trait**.
- Normally **Anti D antibodies are absent in the plasma**
- If **Rh negative person** is exposed to **Rh positive** cells for the first time, **anti D antibodies are formed** in the blood of that individual.
- If Rh positive person receives Rh negative blood **no effect is seen**.

**2. Explain fisher and race hypothesis.**

**Fisher and Race hypothesis:**

- Rh factor involves **three different pairs of alleles located on three different loci**



- This system is uses the '**Cde**' nomenclature.



- Three pairs of Rh alleles are **Cc, Dd and Ee**
- Genotypes will be **one C or c, one D or d, one E or e** from each chromosome.  
**E.g : CDE/cde; CdE/cDe; cde/cde; CDe/CdE etc.,**
- Atleast one **dominant genotypes 'D' allele will produce Rh+ positive** phenotype
- Double recessive genotype **'dd' will produce Rh- negative phenotype.**

**3. Compare genetic basis of the human ABO blood grouping.**

Genotype	Blood group phenotype	Antigens present on RBC	Antibodies present in blood plasma
IAIA	Type A	A	Anti -B
IAIo	Type A	A	Anti -B
IBIB	Type B	B	Anti -A
IBIo	Type B	B	Anti -A
IAIB	Type AB	A and B	Neither Anti -A nor Anti-B
IoIo	Type O	Neither A nor B	Anti -A & anti - B

**4. Explain Autosomal aneuploidy in human beings.**

- Several **autosomal aneuploidies** have been reported in human being
- **Down's syndrome** (21-Trisomy),
- **Patau's syndrome** (13-Trisomy).

**(i). Down's Syndrome/Trisomy – 21**

- **Trisomic condition of chromosome - 21** results in Down's syndrome.
- **Symptoms:severe mental retardation, defective development of the central nervous system, increased separation between the eyes, flattened nose, ears are malformed, mouth is constantly open and the tongue protrudes.**

**(ii). Patau's Syndrome/Trisomy-13**

- **Trisomic condition of chromosome 13** results in Patau's syndrome.
- **Causes :** Meiotic non disjunction.
- **Symptoms:** multiple and severe **body malformations** and deep **mental deficiency.**

- **Small head with small eyes, cleft palate, malformation of the brain and internal organs**

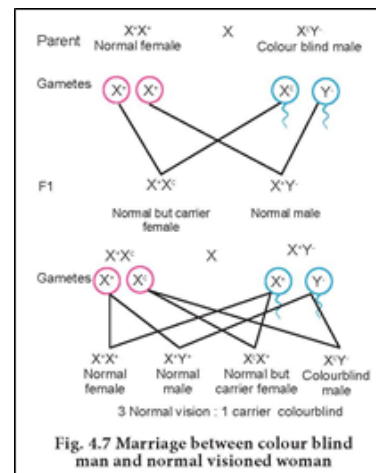


Fig. 4.7 Marriage between colour blind man and normal visioned woman

**5. If a colour blind man Marry a normal visioned woman. What would be probability of her sons and daughters to be colour blind? Explain with the help of a pedigree chart.**

**F<sub>1</sub> generation:**

- They produce **normal visioned male and female carriers.**

**F<sub>2</sub> generation :**

**They produce**

1. Normal visioned carrier daughter,
  2. Colourblind daughter
  3. Normal visioned son
  4. Colourblind son
- The marriage between a **F<sub>1</sub> normal visioned carrier woman** and a **normal visioned male** will produce
    1. One normal visioned female,
    2. One carrier female,
    3. One normal visioned male
    4. One colour blind male.
  - **Colour blindness** is inherited from the **male parent to his grandson** through carrier daughter.
  - **Colour blindness** is an example of **criss – cross pattern of inheritance.**



6. Describe the individuals having following chromosomal abnormalities. a) XXY b) XO

a) XXY - Klinefelter's Syndrome (XXY Males)

- **Causes:** presence of an **additional copy of the X chromosome** resulting in a karyotype of **47 / XXY**.
- These Persons have **47 chromosomes** (44AA+XXY).
- They are usually **sterile males, tall, obese, with long limbs, high pitched voice, under developed genitalia** and have **weak breast** (gynaecomastia) development.

b) Turner's Syndrome (XO Females)

- **Causes:** **loss of a X chromosome** resulting in a **karyotype of 45,X**.
- Persons with this syndrome have **45 chromosomes** (44 autosomes and one X chromosome) (**44AA+XO**)
- They are **sterile females**.
- **Symptoms :** **Low stature, webbed neck, under developed breast, rudimentary gonads lack of menstrual cycle during puberty.**

7. Explain the phenomena of co-dominance and multiple allelism in human population?

- In the ABO system, there are four blood groups **A, B, AB and O**.
- ABO blood groups are **controlled by gene I**.
- The gene I has three alleles **I<sup>A</sup>, I<sup>B</sup> and I<sup>o</sup>** this phenomenon is known as **multiple allelism**.
- **I<sup>A</sup> and I<sup>B</sup> are completely dominant over I<sup>o</sup>**
- When **I<sup>A</sup> and I<sup>B</sup> are present together they both express themselves and produce blood group AB**.
- This phenomenon is known as **codominance**.

8. Differentiate between dominance and co-dominance.

Dominance	Co-dominance
(i) F <sub>1</sub> is similar to the <b>dominant parent</b> .	F <sub>1</sub> is <b>different from either of the two parents</b> .
(ii) In F <sub>1</sub> hybrid, the <b>dominant trait is completely expressed</b> .	In F <sub>1</sub> hybrid, <b>both the alleles express themselves independently</b> .

9. Differentiate between male and female heterogamety.

**Male heterogamety**

- The type of **sex determination mechanism shown in female XX with male XY** is called male heterogamety because **male produces two different types of gametes**.

Example – Drosophila

**Female heterogamety**

- The type of sex determination mechanism shown in **female ZW with male ZZ** is female heterogamety because **female produces two different types of gametes**.

Example - Birds

10. Why is haemophilia generally observed in human males? Explain the conditions under which a human female can be haemophilic.

- Haemophilia is genetically due to the **presence of a recessive sex linked gene 'h'**, carried by X chromosome.
- It is generally observed in males as a **single gene for the defect is able to express itself** as the Y chromosome is devoid of any corresponding allele (XhY).



**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

1. Explain the genetic basis of ABO – blood groups in human population.

Multiple allele inheritance of ABO blood groups

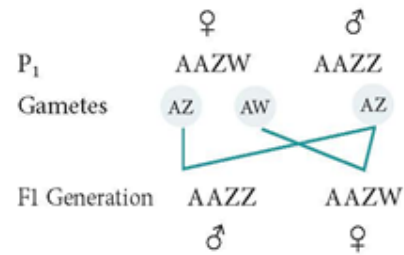
- **Chemical nature** of Blood differs individually.
- Different **incompatible blood groups** are mixed, **agglutination** (clumping) of RBC occurs.
- This is due to the **presence of different antigens** (surface antigens) on the membrane of RBC
- **Karl Landsteiner** - discovered two kinds of antigens called **antigen 'A' and antigen 'B'**
- Based on the presence or absence of these antigens blood groups are classified. They are
  1. Type 'A',
  2. Type 'B',
  3. Type 'O' (universal donor)

**2. Type 'AB' (universal recipient) rare group was discovered in 1902 by two of Landsteiner's students Von De Castelle and Sturli.**

- **Bernstein** in 1925 discovered that the **inheritance of blood groups** is determined by **multiple allelic series**.
- Blood group is determined by **-three autosomal alleles located on chromosome 9**.
- The **gene controlling** blood type are '**L'**' (L-Landsteiner) or **I** (I - isoagglutination).
- I gene occurs in three allelic forms, **IA, IB and IO**.
- ❖ **IA** denotes **A antigen**.
- ❖ **IB** denotes **B antigen**
- ❖ **IO** denotes **no antigen**.
- Individuals who possess **these antigens in saliva** are called **secretors**.
- Each allele produces a **transferase enzyme**.
- IA allele produces **N-acetyl galactose transferase** and can add N-acetyl galactosamine (NAG)
- IB allele produces **galactose transferase** that adds **galactose**.
- IO/IO allele **will not produce transferase enzyme** therefore they are called "**null**" allele moreover it **cannot add NAG or galactose**.
- IA and IB are dominant to IO, but **co-dominant to each other (IA=IB)**.
- Dominance hierarchy is - (**IA=IB > IO**).
- A child receives one of **three alleles from each parent**, and result in **six possible genotypes** and **four possible blood groups** (phenotypes).
- The genotypes :
  - IA IA, IA IO - **A group**
  - IB IB, IB IO - **B group**
  - IA IB - **AB Group**
  - IO IO - **O Group**

**3. Explain mechanism of sex-determination mechanism in birds.**

- **Mechanism of Sex-determination in birds ZW-ZZ type**



- This type of mechanism also seen in insects like **gypsy moth, fishes, reptiles and birds**.
- Female has **one 'Z' and one 'W' chromosome (ZW)** which producing two types of eggs, **some carrying the Z chromosomes** and **some carry the W chromosome**.
- The **male sex has two 'Z' chromosomes (homogametic -ZZ)**

**4. Differentiate between 'ZZ' and 'XY' type of sex-determination mechanisms.**

S. No.	ZZ-sex determination	XY-sex determination
1	This is chromosomal sex determination where <b>females are heterogametic</b> i.e, they produce two type of gametes, (ZW) while the <b>male are homogametic</b> i.e, they produce similar type of gamete (ZZ).	This is chromosomal sex determination where <b>male are heterogametic</b> , i.e, they produce <b>two types of gametes</b> (XY), while the <b>females are homogametic</b> i.e., they possess similar type of gamete (XX).
2	The <b>females produce two type of eggs</b> (A + Z) and (A + W), while the <b>males produce only one type of sperm</b> (A + Z).	The <b>females produce one type of egg</b> (X) while the <b>males produce two types of sperms</b> (X) and (Y).
3	<b>Eg : birds, fish, some reptiles, etc</b>	<b>Eg : Humans and Drosophila.</b>



5. Write the types of sex-determination mechanisms the following crosses show. Give an example of each type.

a) Female XX with male XO

b) Female ZW with male ZZ.

➤ The type of sex determination mechanism shown in **female XX with male XO** is called male **heterogamety**. In this case male are heterogametic with **half the male gametes carrying X-chromosome** while the other half being devoid of it.

➤ Example - **Grasshopper**

➤ The type of **sex determination mechanism shown in female ZW** with male ZZ is **female heterogamety** because female produces two different types of gametes.

➤ Example - **Birds**

6. What is mendelian disorder? list out Mendelian disorders. Explain in detail about Thalassemia Mendelian disorders

- **Alteration or mutation** in a single gene causes Mendelian disorders.
- These disorders are transmitted to the **offsprings by Mendelian pattern of inheritance**.
- Mendelian disorders are **Thalassemia, albinism, phenylketonuria, sickle cell anaemia, Huntington's chorea, etc.,**
- These disorders may be dominant or recessive and autosomal or sex linked.

#### Thalassemia

- It is an **autosomal recessive disorder**.
- **Causes : gene mutation resulting in excessive destruction of RBC's**
- It is also due to the **formation of abnormal haemoglobin** molecules.
- Haemoglobin is made up of **four polypeptide chains** (two **alpha** and two **beta** globin chains)
- Thalassemia patients have **defects in either the alpha or beta globin chain**
- Result in the less **production of haemoglobin** molecules leads to **anaemia**.
- **Types of Thalassemia ( based on chain affected)**
- **Alpha Thalassemia**

➤ **Beta Thalassemia**

- **Alpha Thalassemia** – due to **Mutation or deletion** of alpha gene alleles
- It is controlled by **HBA<sub>1</sub> and HBA<sub>2</sub> gene which is on chromosome 16.**
- **Beta Thalassemia** – due to production of **beta globin chain is affected.**
- It is controlled by a **single gene (HBB) on chromosome 11.**
- Thalassemia is also known as **Cooley's anaemia.**
- In this disorder the **alpha chain production is increased** and **damages the membranes** of RBC.

7. Write short notes on Haemophilia and its symptoms

- It is commonly known as **bleeder's disease**.
- This is more **common in men** than women.
- First reported by **John Cotto in 1803.**
- Haemophilia is caused by a **recessive X-linked gene.**
- This persons **lacks a normal clotting substance** (thromboplastin) in blood, hence **minor injuries cause continuous bleeding**, leading to death.
- The **females are carriers of the disease** and **transmit the disease to 50% of their sons** even if the male parent is normal.
- Characteristic feature : **criss - cross pattern of inheritance.**

8. Define pedigree analysis. State the conclusions that can be drawn from pedigree analysis.

- **Pedigree analysis** is the **study of traits as they have appeared in a given family** line for several past generations
- Pedigree analysis is useful in following ways:
  - i) It is useful in finding the possibility of **absence or presence of that trait** in a particular individual and his family members.
  - ii) It is useful in **detecting genetic defects** like haemophilia, colourblindness, phenylketonuria, thalassemia, sickle cell anaemia,
  - iii) It helps to **detect sex-linked characters** and other linkages.



9. List out the difference between chromosomal disorder and Mendelian disorder?

S. No.	Mendelian Disorder	Chromosomal Disorder
i)	This disorder is mainly due to <b>alteration or mutation in the single gene.</b>	This disorder is caused due to <b>absence or excess or abnormal arrangement</b> of one or more chromosomes.
ii)	This follows <b>Mendel's principles</b> of inheritance.	This <b>does not follow Mendel's principles</b> of inheritance.
iii)	This may be <b>recessive or dominant in nature.</b>	This is <b>always dominant in nature.</b>
iv)	<b>E.g : haemophilia, sickle-cell anaemia.</b>	<b>E.g : Turner's syndrome.</b>

10. Explain the causes, inheritance pattern and symptoms of any two Mendelian genetic disorders.

**Colourblindness and thalassemia are categorised as Mendelian disorders because of the following reasons:**

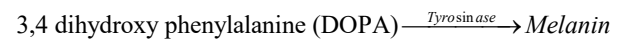
- Alteration or mutation in a single gene **causes Mendelian disorders.**
- **These disorders are** transmitted to the offsprings **by Mendelian pattern of inheritance.**
- **Mendelian disorders are** Thalassemia, albinism, phenylketonuria, sickle cell anaemia, Huntington's chorea, etc.,
- **These disorders may be** dominant or recessive and autosomal or sex linked.

**1. Albinism**

- It is an **inborn error of metabolism,**
- Caused by **an autosomal recessive gene.**
- **Melanin pigment** is responsible for skin colour.
- **Absence of melanin results albinism.**
- A person with the recessive allele lacks the **tyrosinase enzyme** which is useful in conversion of **dihydroxyphenyl alanine**

**(DOPA) into melanin pigment** inside the melanocytes.

- In an albino, **melanocytes are present in normal numbers** but they **lack melanin pigment.**



- 3, 4 dihydroxy phenylalanine (DOPA) **Melanin Huntington's chorea**
- It is an **autosomal dominant lethal gene** in man.
- **Symptoms :involuntary jerking of the body** and progressive **degeneration of the nervous system,** accompanied by gradual **mental and physical deterioration.**
- This patients die between the age of **35 and 40.**

11. Write short notes on Erythroblastosisfoetalis.

**Erythroblastosisfoetalis**

- Rh incompatibility has **great impact on child birth.**
- Condition : **Woman is Rh negative**
- **Man is Rh positive,**
- **Foetus Rh positive** (inherited the factor from its father)
- Mother becomes **sensitized by carrying Rh positive foetus.**
- Due to **damage of blood vessels,** during child birth, the mother's immune system **recognizes the**

**Rh+ antigens** and get activated.

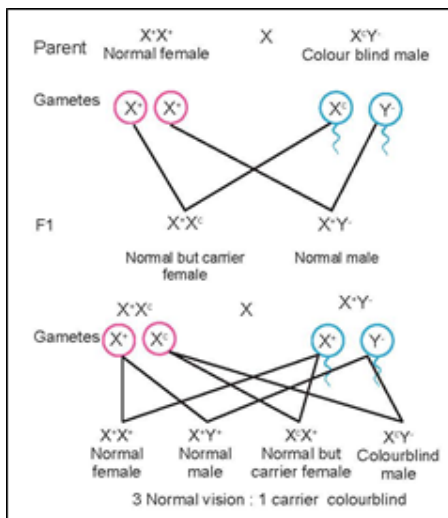
- Then mother produces **Rh antibodies.**
- **IgG antibodies cross placenta and enter the foetal circulation.**
- Before this time **the child is delivered.**
- Usually **no effects in first child birth.**
- **In next pregnancy Rh positive children** carried by the same mother, **IgG antibodies** cross placenta and enter into foetal blood circulation.
- **Causes:haemolysis** of foetal RBCs result in **haemolytic jaundice and anaemia.**
- This condition is known as **Erythroblastosisfoetalis or Haemolytic disease of the new born (HDN).**
- **Prevention of Erythroblastosisfoetalis**

- **Anti D antibodies should be administered** to the mother (28th and 34th week of gestation)
- **Anti D antibodies should be administered** to the mother soon after delivery.

**12. Explain X-linked inheritance with an example.**

**Inheritance of X - linked genes**

- X-linked gene inheritance are **Red-green colour blindness** or daltonism, **Haemophilia Duchenne’s muscular dystrophy** Haemophilia
- It is commonly known as **bleeder’s disease**.



- This is more **common in men** than women.
- First reported by **John Cotto in 1803**.
- Haemophilia is caused by a **recessive X-linked gene**.
- This persons **lacks a normal clotting substance** (thromboplastin) in blood, hence **minor injuries cause continuous bleeding**, leading to death.
- The **females are carriers of the disease** and **transmit the disease to 50% of their sons** even if the male parent is normal.
- Characteristic feature : **criss - cross pattern of inheritance**.
- **Colour blindness**
- Due to **dominant X – linked gene** which is necessary for the **formation of cones** ( Colour sensitive cells)
- The recessive form - **incapable of producing cone cells**.

- **Patients** : Homozygous recessive females (**X<sup>c</sup>X<sup>c</sup>**) Hemizygous recessive males (**X<sup>c</sup>Y**)
- They are unable to **distinguish red and green colour**.

**Marriage between colour blind man and normal visioned woman**

**F<sub>1</sub> generation:**

They produce **normal visioned male** and **female carriers**.

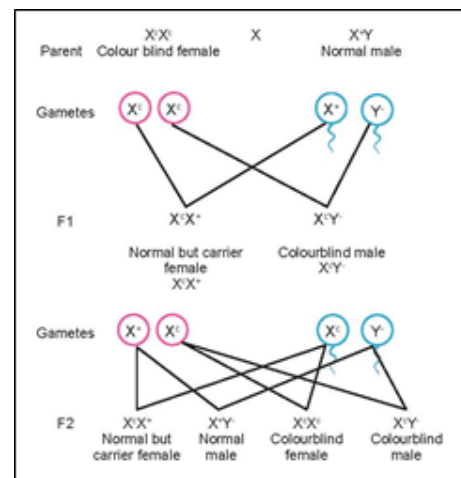
**F<sub>2</sub> generation :**

They produce

- ✓ **Normal visioned carrier daughter,**
- ✓ **Colourblind daughter**
- ✓ **Normal visioned son**
- ✓ **Colourblind son**

**The marriage between a) F<sub>1</sub> normal visioned carrier woman and a normal visioned male will produce**

- **One normal visioned female,**
- **One carrier female,**



- **One normal visioned male**
- **One colour blind male.**
- **Colour blindness** is inherited from the **male parent to his grandson** through carrier daughter.
- **Colour blindness** is an example of **criss – cross pattern of inheritance**.

**b) Marriage between normal visioned man and colour blind woman**

**F<sub>1</sub> generation :**

1. Colourblind sons
2. Normal visioned daughters.
3. F<sub>1</sub> carrier female + colourblind male
- **Result in the F<sub>2</sub> generation:**
  1. Normal visioned carried daughter
  2. Normal visioned son
  3. Colourblind son.

### 13. Explain Allosomal abnormalities in human beings.

#### Allosomal abnormalities in human beings

- **Causes :** Mitotic or meiotic non-disjunction of sex chromosomes. Several sex chromosomal abnormalities have been detected.

**E.g : Klinefelter's syndrome and Turner's syndrome.**

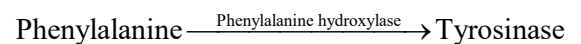
- ✓ **Klinefelter's Syndrome (XXY Males)**
  - **Causes:** presence of an **additional copy of the X chromosome** resulting in a karyotype of **47 / XXY**.
  - These Persons have **47 chromosomes** (44AA+XXY).
  - They are usually **sterile males, tall, obese, with long limbs, high pitched voice, under developed genitalia** and have **weak breast** (gynaecomastia) development.
- ✓ **Turner's Syndrome (XO Females)**
  - **Causes:** loss of a **X chromosome** resulting

in a **karyotype of 45 XO**

- Persons with this syndrome have **45 chromosomes** (44 autosomes and one X chromosome) (**44AA+XO**)
- They are **sterile females**.
- **Symptoms :** **Low stature, webbed neck, under developed breast, rudimentary gonads lack of menstrual cycle during puberty.**

### 14. Write short notes on phenylketonuria

- It is an **inborn error of Phenylalanine metabolism**
- **Causes :** pair of **autosomal recessive genes**.
- It is also caused due to **mutation in the gene PAH** (phenylalanine hydroxylase gene) **located on chromosome 12**
- PAH gene synthesis hepatic enzyme "**phenylalanine hydroxylase**"
- This enzyme convert **phenylalanine into tyrosine**.
- In Affected individual **phenylalanine gets converted to phenylpyruvic acid** and other derivatives.
- **Symptoms :** severe **mental retardation, light pigmentation** of skin and hair.
- Phenylpyruvic acid is **excreted in the urine**.



## POINTS TO REMEMBER

- Mendel's theory explain the **inheritance of character** from one generation to the next.
- DNA directs the **synthesis of proteins**.
- **Proteins determine**-shapes of cell and rate of chemical reactions.
- Genome is defined as **Totality of gene**
- A gene is a basic **physical and functional unit of heredity**.
- In 1909, Wilhelm Johannsen, **coined the term 'gene'**,
- 'Gene' is used to refer the **factor for inheritance**.
- Genes - defined as **distinct particles that follow Mendelian rules of inheritance**, occupy a definite locus in the chromosome and are responsible for the expression of specific phenotypic character.
- Several genes are **located on the same chromosome**.
- Genes are **arranged in a single linear order** like beads on a string.
- In 1940, **George Beadle and Edward Tatum** conducted experiment in *Neurospora crassa* (the red bread mould) and proposed **one gene -one enzyme hypothesis**.
- In 1944 **Oswald Avery, Colin Macleod and Maclyn McCarty** - repeated Griffith's experiments in an '*in vitro*'
- These experiments prove that **DNA is the genetic material and not proteins**
- Griffith, Avery and others, believed that **protein was the hereditary material, not DNA**.
- Eukaryotic chromosomes consist of **equal amounts of protein and DNA**.
- **Alfred Hershey and Martha Chase** (1952) conducted experiments on bacteriophages
- They proved that **DNA carries the hereditary information** from virus to bacteria.
- Nucleic acids are a long chain or polymer which is **made up of sequence of nucleotides**.
- Nucleotide consists of a **nitrogenous base, a five carbon sugar**(pentose) and a **phosphate group**.
- There are two types of nucleic acids (**based on type of pentose sugar**)
- **DNA** - contain Deoxyribose sugar.
- **RNA** - contain Ribose sugar.
- DNA and RNA **both have four bases** (two purines and two pyrimidines)
- Purines base are **Adenine (A) and Guanine (G) have double carbon-nitrogen ring structures**
- Pyrimidines base are **Thymine(T), Cytosine(C) and Uracil (U) have single ring structure**
- **Thymine is unique for DNA**, while **Uracil is unique for RNA**.
- The phosphate functional group is derived from **phosphoric acid**( $H_3PO_4$ ).
- **Nucleoside = nitrogenous base + sugar** (at the 1-carbon of the sugar)
- **Nucleotide = Nucleoside + phosphate group** (attached to the 5' carbon of the same sugar)
- **Base pair Rules** - It was proposed by Erwin Chargaff
- **Adenine pairs with Thymine**(A=T) with two hydrogen bonds and
- **Guanine pairs with Cytosine**(G ≡ C) with three hydrogen bonds.
- The ratios between Adenine with Thymine and Guanine with Cytosine are **constant and equal**.
- The term '**RNA world**' was first used by **Walter Gilbert** in 1986
- This hypothesis reveals that **RNA as the first genetic material on earth**.
- Hershey and Chase clearly explained that **DNA acts as a genetic material**.
- But in Tobacco mosaic virus (TMV), bacteriophage, **RNA acts as the genetic material**.

- **Self Replication, Stability, Information storage, Variation** through mutation:
- **Length of DNA double helix** = Total number of base pairs x distance between two consecutive base pairs
- Chromatin consists of **repeating units called nucleosomes**.
- 2 molecules of the four histone proteins **H<sub>2</sub>A, H<sub>2</sub>B, H<sub>3</sub> and H<sub>4</sub>** are organized to form a unit of eight molecules called **histone octamere**.
- DNA Replication takes place during **S phase**
- During replication, each **DNA molecule gives rise to two DNA strands**, identical to each other.
- In prokaryotes, replication process requires **DNA polymerase I, II, and III**.
- DNA polymerase III is the main enzyme for DNA replication.
- DNA polymerase I & II are involved in **DNA repair mechanism**.
- **Francis Crick** proposed the Central dogma in molecular biology.
- The process **conversion of information from DNA to RNA** is termed transcription.
- DNA has three distinct regions namely, a **promoter, the structural gene and a terminator**.
- In prokaryotes, there are three major types of RNAs: **mRNA, tRNA, and rRNA**.
- All three RNAs are needed to synthesize a protein.
- The **mRNA provides the template**,
- **tRNA brings amino acids** and reads the genetic code,
- **rRNAs - act as catalytic factor** for translation.
- **DNA is the genetic material** that carries genetic information in a cell and from generation to generation.
- There are **64 possible triplets**, and 61 of them are used to represent amino acids.
- The remaining **three triplet codons are termination signals** for polypeptide chains.
- **Marshall Nirenberg, Severo Ochoa (enzyme polynucleotide phosphorylase called Ochoa's enzyme), Hargobind Khorana, Francis Crick and many others** have contributed significantly to decipher the genetic code.
- The **genetic code is universal**.
- A non-overlapping codon means that the **same letter is not used for two different codons**.
- For instance, the nucleotide sequence **GUU GUC represents only two codons**.
- Genetic code is **comma less**, which means that the message would be read directly from one end to the other i.e., **no punctuation are needed between two codes**.
- **Non-ambiguous** code means that one codon will code for one amino acid.
- The code is always **read in a fixed direction** i.e. from 5'→3' direction called polarity.
- tRNA molecule of a cell acts as a **vehicle that picks up the amino acids** scattered through the cytoplasm and also reads specific codes of mRNA molecules. Hence it is called an **adapter molecule**.
- Translation refers to the process of polymerization of amino acids to form polypeptide chain.
- This ribosome binding site is called the **Shine - Dalgarno sequence or S-D sequence**.
- **Elongation is the second phase of translation**.
- **Termination is the third phase** of translation.
- Termination of protein synthesis occurs when one of the **three stop codons appears in the 'A' site of the ribosome**.
- Regulation of gene expression has been **extensively studied in prokaryotes**, especially in **E. coli**.
- Gene expression can be **controlled or regulated at transcriptional or post transcriptional or translational level**.
- Each **operon is a unit of gene expression and regulation** and consists of one or more structural genes and an adjacent operator gene that controls transcriptional activity of the structural gene.
- The metabolism of lactose in E.coli requires three enzymes **permease, β-galactosidase (β-gal) and transacetylase**.
- Besides these, it has three structural genes namely **lac z, y and lac a**.

- **Human genome project** was a mega project and took 13 years to complete.
- Through this all the genes (**approximately 30000**) in human DNA has been identified.
- Determine the sequence of the **three billion chemical base pairs** that make up the human DNA.
- The methodologies of the Human Genome Project involved two major approaches.
- 1. **ETSS** – Expressed **Sequence Tags** and
- 2. **Sequence Annotation**.
- The fragments are **sequenced using automated DNA sequencers** (developed by Frederick Sanger).

- The **DNA finger printing technique** was first developed by Alec Jeffreys in 1985
- Each of us have the **same chemical structure of DNA**.
- But there are **millions of differences in the DNA** sequence of base pairs.
- This makes the uniqueness among us so that each of us except identical twins
- The DNA of a person and finger prints are unique.
- Application of DNA finger printing
- Forensic analysis, Pedigree analysis, Conservation of wild life, Anthropological studies.

**PART-A**

**TEXTUAL QUESTIONS (1 MARK)**

1. **Hershey and Chase experiment with bacteriophage showed that**

- a) Protein gets into the bacterial cells
- b) DNA is the genetic material
- c) DNA contains radioactive sulphur
- d) Viruses undergo transformation

**Ans: b**

2. **DNA and RNA are similar with respect to**

- a) Thymine as a nitrogen base
- b) A single-stranded helix shape
- c) Nucleotide containing sugars, nitrogen bases and phosphates
- d) The same sequence of nucleotides for the amino acid phenyl alanine

**Ans: c**

3. **mRNA molecule is produced by**

- a) Replication
- b) Transcription
- c) Duplication
- d) Translation

**Ans: b**

4. **The total number of nitrogenous bases in human genome is estimated to be about**

- a) 3.5 million
- b) 35000
- c) 35 million
- d) 3.1 billion

**Ans: d**

5. **E. coli cell grown on <sup>15</sup>N medium are transferred to <sup>14</sup>N medium and allowed to**

**grow for two generations. DNA extracted from these cells is ultracentrifuged in a cesium chloride density gradient.**

**What density distribution of DNA would you expect in this experiment?**

- a) One high and one low density band.
- b) One intermediate density band.
- c) One high and one intermediate density band.
- d) One low and one intermediate density band.

**Ans: d**

6. **What is the basis for the difference in the synthesis of the leading and lagging strand of DNA molecules?**

- a) Origin of replication occurs only at the 5' end of the molecules.
- b) DNA ligase works only in the 3' → 5' direction.
- c) DNA polymerase can join new nucleotides only to the 3' end of the growing stand.
- d) Helicases and single-strand binding proteins that work at the 5' end.

**Ans: c**

7. **Which of the following is the correct sequence of event with reference to the central dogma?**

- a) Transcription, Translation, Replication
- b) Transcription, Replication, Translation
- c) Duplication, Translation, Transcription
- d) Replication, Transcription, Translation

**Ans: d**

8. **Which of the following statements about DNA replication is not correct?**

- a) Unwinding of DNA molecule occurs as hydrogen bonds break.

- b) Replication occurs as each base is paired with another exactly like it.  
 c) Process is known as semi conservative replication because one old strand is conserved in the new molecule.  
 d) Complementary base pairs are held together with hydrogen bonds.

Ans: b

9. Which of the following statements is not true about DNA replication in eukaryotes?

- a) Replication begins at a single origin of replication.  
 b) Replication is bidirectional from the origins.  
 c) Replication occurs at about 1 million base pairs per minute.  
 d) There are numerous different bacterial chromosomes, with replication occurring in each at the same time.

Ans: d

10. The first codon to be deciphered was \_\_\_\_\_ which codes for \_\_\_\_\_.

- a) AAA, proline                      b) GGG, alanine  
 c) UUU, Phenylalanine          d) TTT, arginine

Ans: c

11. Meselson and Stahl's experiment proved

- a) Transduction  
 b) Transformation  
 c) DNA is the genetic material  
 d) Semi-conservative nature of DNA replication

Ans: d

12. Ribosomes are composed of two subunits; the smaller subunit of a ribosome has a binding site for \_\_\_\_\_ and the larger subunit has two binding sites for two \_\_\_\_\_.

Ans: mRNA, tRNA

13. An operon is a:

- a) Protein that suppresses gene expression  
 b) Protein that accelerates gene expression  
 c) Cluster of structural genes with related function  
 d) Gene that switched other genes on or off

Ans: c

14. When lactose is present in the culture medium:

- a) Transcription of lac y, lac z, lac a genes occurs.

- b) Repressor is unable to bind to the operator.  
 c) Repressor is able to bind to the operator.  
 d) Both (a) and (b) are correct.

Ans: d

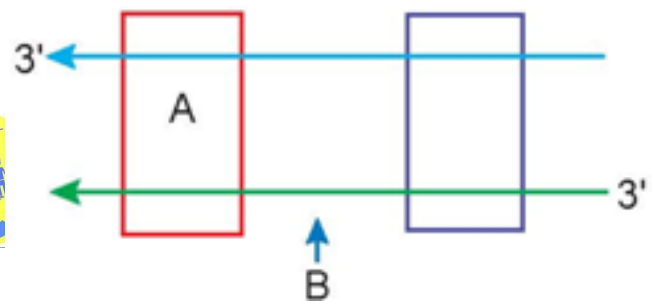
### PART-B, C AND D

#### TEXTUAL QUESTIONS (2,3 AND 5 MARKS)

15. Give reasons: Genetic code is 'universal'.

- The **genetic code is universal**.
- It means that in all living organism genetic code (triplet codon) direct the **synthesis of same kind of protein from amino acids**.
  - Eg. In mRNA (UUU) **codon codes for phenylalanine** in all cells of all organisms.

16. Name the parts marked 'A' and 'B' in the given transcription unit: A B 3' 3'



Ans :

A – Promoter

B – Coding strand

17. Mention any two ways in which single nucleotide polymorphism (SNPs) identified in human genome can bring revolutionary change in biological and medical science.

- A single-nucleotide **polymorphism is a variation in a single nucleotide that occurs at a specific position in the genome**, where each variation is present to some appreciable degree within a population
- E.g. the C nucleotide may appear in most individuals, but in a **minority of individuals, the position is occupied by an A**.
- This means that there is a **SNP at this specific position, and the two possible nucleotide variations – C or A – are said to be alleles for this position**

18. Differentiate - Leading strand and lagging strand

Leading Strand	Lagging Strand
1. This strand <b>grows continuously</b> without any gap	1. Its <b>growth is discontinuous</b> This strand formed in short segments called <b>Okazaki fragments.</b>
2. It <b>does not require DNA ligase</b> for its growth.	2. <b>DNA-ligase is required</b> for joining Okazaki fragments.
3. The direction of growth of the <b>leading strand is 5' → 3'</b>	3. The direction of growth of the <b>lagging strand is 3' → 5'</b>
4. Only a <b>single RNA primer is required.</b>	4. <b>More number of RNA primer is required</b>
5. It is a <b>rapid process.</b>	5. it's a <b>slower process.</b>

19. Differentiate - Template strand and coding strand.

Template strand	Coding strand
1. Template strand is directed in the <b>5' to 3' direction</b>	1. Coding strand is directed in the <b>3' to 5' direction</b>
2. <b>Transcribed into mRNA</b>	2. <b>Not transcribed into mRNA</b>
3. <b>Contains the complementary nucleotide sequence as the mRNA</b>	3. <b>Contains the same nucleotide sequence to mRNA, except thymine</b>
4. Contains <b>anticondons</b>	4. Contains <b>codons</b>
5. Contains the <b>same nucleotide sequence as the tRNA</b>	5. Contains the <b>complementary nucleotide sequence as the tRNA</b>
6. <b>Hydrogen bonds are formed</b> between the template strand and the synthesizing mRNA.	6. <b>No hydrogen bonds are formed</b> between the coding strand and synthesizing mRNA

Ways to identify SNP

1. **ETSS** – Expressed Sequence Tags.
2. **Sequence Annotation.**

20. State any three goals of the human genome project.

- **Identify all the genes** (approximately 30000) in human DNA.
- **Determine the sequence of the three billion chemical base pairs** that makeup the human DNA.
- To **store this information in data bases.**
- **Improve tools for data analysis.**
- **Transfer related technologies** to other sectors, such as industries.
- **Address the ethical, legal and social issues (ELSI)** that may arise from the project.

21. In E.coli, three enzymes  $\beta$ - galactosidase, permease and transacetylase are produced in the presence of lactose. Explain why the enzymes are not synthesized in the absence of lactose.

- If lactose is absent or lacking, the **transcription of lac mRNA stops.**
- The metabolism of lactose in E.coli requires three enzymes – **permease,  $\beta$ -galactosidase ( $\beta$ -gal) and transacetylase.**
- The enzyme **permease is needed for entry of lactose into the cell,**
- **$\beta$ -galactosidase brings about hydrolysis of lactose** to glucose and galactose,
- **Transacetylase transfers acetyl group from acetyl Co A to  $\beta$ -galactosidase.**
- If **lactose is available as an energy source** for the bacteria then lactose enters the cell as a result of permease enzyme.
- **Lactose acts as an inducer** and interacts with the repressor to inactivate it.
- This **allows RNA polymerase to bind to the promotor site** and transcribe the operon to produce lac mRNA which enables formation of all the required enzymes needed for lactose metabolism.

### 22. Distinguish between structural gene, regulatory gene and operator gene.

S. No.	Structural Genes	Regulator Gene	Operator Gene
1.	This gene is connected with <b>transcription or formation of mRNA for synthesis</b>	It controls the <b>functioning of operator gene.</b>	It determines the <b>functioning of structural genes.</b>
2.	It functions only when receives complementary nucleotides and <b>RNA polymerase.</b>	Regulator gene <b>produces a repressor or Apo repressor for blocking</b> operator gene	Operator gene functions <b>only when it is not blocked by repressor.</b>
3.	<b>Moderately long gene</b>	<b>Large gene.</b>	<b>Smaller gene</b>
4.	It functions through the <b>formation of mRNA for structural or enzymatic polypeptide</b>	It functions through the <b>formation of an mRNA of repressor</b>	It function through the <b>presence or absence of repressor.</b>

### 23. A low level of expression of lac operon occurs at all the windows for treatment of various genetic disorders. Justify the statement.

- A very **low level of expression of lac operon has to be present** in the cell all the time, otherwise **lactose cannot enter the cells**

### 24. Why the human genome project is called a mega project?

- Human genome project was considered to be a mega project because it **had a specific goal to sequence every base pair** present in the human genome.
- It took around **13 years for its completion** and got accomplished in year 2003.
- It was a **large scale project, which aimed at developing new technology** and generating new information in the field of genomic studies.

### 25. From their examination of the structure of DNA, What did Watson and Crick infer about the probable mechanism of DNA replication, coding capability and mutation?

- **Watson and Crick** explain the Semi – conservative mode of DNA replication
- DNA Replication takes place during **S phase**
- During replication, each **DNA molecule gives rise to two DNA strands**, identical to each other and parent

#### Hypotheses of DNA replication.

1. **Conservative replication,**
2. **Dispersive replication,**
3. **Semi –conservative replication.**

#### Semi- conservative replication.

- It was **proposed by Watson and Crick** in 1953.
- This mechanism is **based on the DNA model.**
- Initially **two polynucleotide strands of DNA molecule unwind** and start separating at one end.
- During this process, **covalent hydrogen bonds are broken.**
- The separated **single strand then acts as template** for the synthesis of a new strand.
- Later, **each daughter double helix carries one polynucleotide strand from the parent and other strand is newly synthesised.**
- Any error in replication leads to Mutation

### 26. Why tRNA is called an adapter molecule?

- The transfer RNA, (tRNA) molecule of a cell **acts as a vehicle that picks up the amino acids scattered** through the cytoplasm and also **reads specific codes of mRNA molecules.**
- Hence tRNA is called an **adapter molecule.**
- This term was **postulated by Francis Crick.**

27. What are the three structural differences between RNA and DNA?

Comparison	DNA	RNA
<b>Full Name</b>	Deoxyribonucleic Acid	Ribonucleic Acid
<b>Structure</b>	DNA consists of <b>two strands, arranged in a double helix.</b>	<b>RNA only has one strand,</b> but like DNA, is made up of nucleotides.
	These strands are <b>made up of subunits called nucleotides.</b>	<b>RNA strands are shorter than DNA strands.</b>
	Each nucleotide contains a <b>phosphate, a 5-carbon sugar molecule and a nitrogenous base.</b>	RNA sometimes forms a <b>secondary double helix structure,</b> but only intermittently.
<b>Length</b>	DNA is a much <b>longer than RNA.</b>	RNA molecules are <b>shorter than long DNA polymers.</b>
<b>Sugar</b>	The sugar in DNA is <b>deoxyribose</b>	RNA contains <b>ribose sugar molecules</b>
<b>Bases</b>	The bases in DNA are <b>Adenine ('A'), Thymine ('T'), Guanine ('G') and Cytosine ('C').</b>	RNA shares <b>Adenine ('A'), Guanine ('G') and Cytosine ('C')</b> with DNA, but contains <b>Uracil ('U')</b> rather than Thymine.
<b>Base Pairs</b>	<b>Adenine and Thymine pair (A-T) Cytosine and Guanine pair (C-G)</b>	<b>Adenine and Uracil pair (A-U) Cytosine and Guanine pair (C-G)</b>

28. Name the anticodon required to recognize the following codons:

AAU, CGA, UAU, GCA.

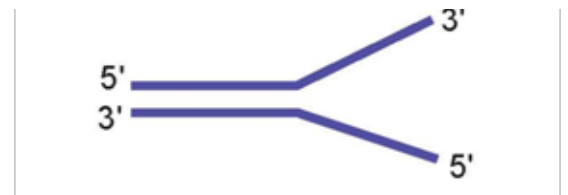
Ans :

**Codon - Anti Codon**

- AAU - UUA
- CGA - GCU
- UAU - AUA
- GCA - CGU

29. a) Identify the figure given below

b) Redraw the structure as a replicating fork and label the parts



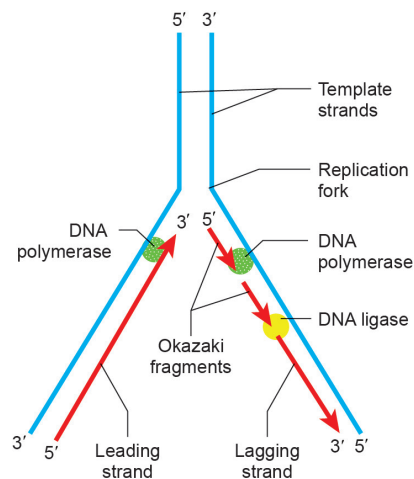
c) Write the source of energy for this replication and name the enzyme involved in this process.

d) Mention the differences in the synthesis of protein, based on the polarity of the two template strands.

Ans : a

a) Given structure represents **replicating fork.** the two parental strands of DNA unwind at the start of replication.

b)



c) Deoxy nucleotide triphosphate - provide energy for replication

d) **DNA-polymerase can polymerise nucleotides only in 5'→3' direction** on 3'→ 5' strand because it adds them at the 3' end.

- Since the **two strands of DNA run in antiparallel directions,** the two templates provide different ends for replication.
- Replication over the two templates thus **proceeds in opposite directions.**
- One strand with polarity **3'→5'** forms its **complementary strand** continuously because 3' end of the latter is always open for elongation.

- It is called **leading strand**.
- Replication is **discontinuous on the other template with polarity 5'→3'** because only a short segment of DNA strand can be built in **5'→3' direction** due to exposure of a small stretch of template at one time

**30. If the coding sequence in a transcription unit is written as follows:**

'5' TGCATGCATGCATGCATGCATGC 3' Write down the sequence of mRNA.

**Ans : mRNA -**

**'5'ACGUACGUACGUACGUACGUACG 3'**

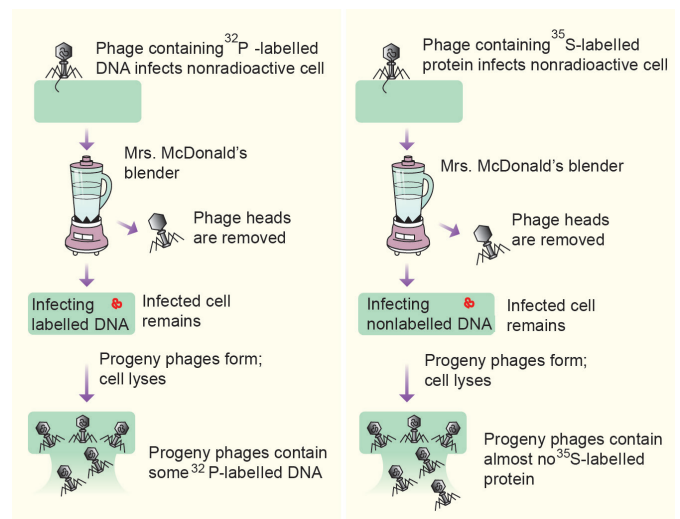
**31. How is the two stage process of protein synthesis advantageous?**

- In eukaryote, Transcription take place in **membrane bound nucleus**
- **Translation – take place in cytoplasm** (outside of nucleus)
- This two stage of protein synthesis **enable eukaryotes to regulate gene expression** in much more complicated way, and also contributing to the **richness of eukaryotic form and functions**.

**32. Why did Hershey and Chase use radioactively labelled phosphorous and sulphur only? Would they have got the same result if they use radiolabelled carbon and nitrogen?**

Hershey and Chase experiment on T2 bacteriophage

- **Alfred Hershey and Martha Chase (1952)** conducted experiments on **bacteriophages**
- **T2 - bacteriophages** is a virus that **infects the bacterium Escherichia coli**.
- **Experiment** - phages are added to bacteria → some material enters the bacterium → **bacterium lyses and release many progeny**.
- They wanted to **check which part entered the bacteria (DNA or protein)**
- All nucleic acids contain **phosphorus, and contain sulphur(also amino acid - cysteine and methionine)**.
  - Hershey and Chase designed an experiment
- Radioactive isotopes of **Sulphur (35S) and phosphorus (32P)** to keep separate pathway of the viral protein and nucleic acids during the infection process.



The Hershey-Chase (blender) experiment

- Phages were allowed to **infect bacteria containing the radioactive isotopes 35S or 32P** in the medium.
- The bacteriophage that grew in the **presence of 35S** had labelled proteins
- Bacteriophages grown in the **presence of 32P had labelled DNA**.
- They **mixed the labelled phages** with unlabeled E. coli and allowed bacteriophages to infect
- Before lysis of bacteria the **bacterial cells were gently** agitated to loosen particles.
  - **Findings :**
    - ✓ 32P was found in bacterial cells
    - ✓ 35S was found in medium
    - ✓ Phage progeny carry only 32P and not 35S.

**Results :**

- **DNA only entered the bacterial cells** and not protein coat
- Hence it proved that **DNA carries the hereditary information** from virus to bacteria.

**33. Explain the formation of a nucleosome.**

- In eukaryotes, **nucleus organization** is much **more complex**.
- Chromatin **consists of repeating units called nucleosomes**.
- **2 molecules of the four histone proteins H<sub>2</sub>A, H<sub>2</sub>B, H<sub>3</sub> and H<sub>4</sub>** are organized to form a unit of eight molecules called **histone octamere**.



- 7. Prokaryotic genetic system contains:**  
 a) DNA & histones  
 b) RNA & histones  
 c) Either DNA or histones  
 d) DNA but no histones **Ans: d**
- 8. Which of the following is not a pyrimidine N2 base?**  
 a) Thymine                      b) cytosine  
 c) Guanine                      d) Uracil **Ans: c**
- 9. Number of H – bonds between guanine and cytosine are \_\_\_\_**  
 a) One                              b) Two  
 c) Three                            d) Four **Ans: c**
- 10. What is the nature of the 2 strands of a DNA duplex ?**  
 a) Identical & Complimentary  
 b) Ant parallel & Complimentary  
 c) Dissimilar & non complimentary  
 d) Anti parallel & non complimentary **Ans: b**
- 11. Chargaff's rule is given as**  
 a) Only about Puriness    b)  $A + G = T + C$   
 c)  $A + U = G + C$             d)  $A + T / G + C = \text{Const.}$  **Ans: b**
- 12. Similarity in DNA and RNA is \_\_\_\_**  
 a) Both are polymer of nucleotides  
 b) Both have similar pyrimidine  
 c) Both have similar sugar  
 d) Both are genetic material **Ans: a**
- 13. Bond between phosphate and sugar in a nucleotide is \_\_\_\_**  
 a) H-Bond                      b) Covalent bond  
 c) Phosphodiester bond    d) Sulphide bond **Ans: b**
- 14. Nucleoside is \_\_\_\_**  
 a) Polymer of nucleic acid  
 b) Phosphoric acid + base  
 c) Phosphoric acid + sugar + base  
 d) Sugar + nitrogen base **Ans: d**
- 15. The back bone of RNA is consists of which of the following sugar?**  
 a) Deoxyribose                      b) Ribose  
 c) Sucrose                            d) Maltose **Ans: b**
- 16. DNA is acidic due to \_\_\_\_**  
 a) Sugar                              b) Phosphoric acid  
 c) Purine                              d) Pyrimidine **Ans: b**
- 17. DNA polymerase is needed for \_\_\_\_**  
 a) Replication of DNA    b) Synthesis of DNA  
 c) Elongation of DNA    d) All of above **Ans: d**
- 18. DNA Replication occurs at \_\_\_\_**  
 a) G0 & G-1                      b) G2 – stages  
 c) S – Stage                        d) Mitotic Phase **Ans: c**
- 19. Method of DNA replication in which two strands of DNA separates and synthesize new strands ?**  
 a) Dispersive                      b) Conservative  
 c) Semiconservative            d) Non conservative **Ans: c**
- 20. The direction of DNA replication is \_\_\_\_**  
 a) From 5' end towards 3' end  
 b) From 3' end towards 5' end  
 c) Amino terminus to carboxy terminus  
 d) Carboxy terminus to amino terminus **Ans: a**
- 21. Semiconservation replication of DNA was given by \_\_\_\_**  
 a) Watson and Crick  
 b) Betason and Punnett  
 c) Messelson and Stahi  
 d) Avery, McCarty and Mactleod **Ans: a**
- 22. Which of the following enzyme is used to join DNA fragments ?**  
 a) Terminase                      b) Endonuclease  
 c) Ligase                              d) DNA polymerase **Ans: c**
- 23. The strand of DNA, which does not code for anything is referred to as \_\_\_\_**  
 a) Template strand            b) Antisense strand  
 c) Coding strand                d) Non coding strand **Ans: c**

- 24. t- RNA attach to larger sub unit of ribosome with the help of which loop ?**  
 a) DHU – loop                      b) T C loop  
 c) Anticodon loop                d) Minor loop      **Ans: b**
- 25. Method by which information reaches from DNA to RNA is \_\_\_\_\_**  
 a) Transcription                    b) Translation  
 c) Transformation                d) Transduction      **Ans: a**
- 26. DNA acts as a template for synthesis of \_\_\_\_\_**  
 a) RNA                                b) DNA  
 c) Both a and b                    d) Protein      **Ans: c**
- 27. Genetic code was deciphered by chemically synthesizing the trinucleotides by \_\_\_\_\_**  
 a) Watson & Crick                b) Beadle & Tatum  
 c) Briggs & King                 d) M.W.Nirenberg      **Ans: d**
- 28. Codons constitute genetic code because**  
 a) There was 64 types of amino acid  
 b) 64 types of t-RNA  
 c) Genetic code is triplet  
 d) There are 64 enzymes      **Ans: c**
- 29. Termination of chain growth in protein synthesis is brought about by \_\_\_\_\_.**  
 a) UUG, UGC, UCA                b) UCG, GCG, ACC  
 c) UAA, UAG, UGA                d) UUG, UAG, UCG      **Ans: c**
- 30. Genetic code determines the**  
 a) Structural pattern of an organism  
 b) Sequence of amino acid in protein chain  
 c) Variation in offsprings  
 d) Constancy of morphological trait      **Ans: b**
- 31. A sequence of how many nucleotides in messenger RNA makes a codon for an amino acid?**  
 a) Three                                b) Four  
 c) One                                    d) Two      **Ans: a**
- 32. Translation is the process in which \_\_\_\_\_**  
 a) DNA is formed on DNA template  
 b) RNA is formed on DNA Template  
 c) DNA is formed on RNA template  
 d) Protein is formed from RNA      **Ans: d**
- 33. One – gene – one enzyme hypothesis was proposed by \_\_\_\_\_**  
 a) Beadle and Tatum                b) Jacob and Monod  
 c) Lederberg                         d) Watson and Crick      **Ans: a**
- 34. A gene containing multiple exons and at least one intron is termed as \_\_\_\_\_**  
 a) Split gene                         b) Operator gene  
 c) Synthetic gene                    d) Epistatic gene      **Ans: a**
- 35. What does "lac" refer to, in what we call the lac operon?**  
 a) Lactose                              b) Lactase  
 c) Lac insect                         d) The number 1,00,000      **Ans: a**
- 36. Functioning of structural genes is controlled by \_\_\_\_\_**  
 a) Operator                            b) Promoter  
 c) Ligase                                d) Regulator gene      **Ans: d**
- 37. Regulation of lac operon by repressor is referred to as \_\_\_\_\_**  
 a) Positive regulation                b) Negative regulation  
 c) Both (1) and (2)                 d) None      **Ans: b**
- 38. The change of chromosomal parts between non homologous pairs of chromosome is \_\_\_\_\_**  
 a) Crossing over                      b) Translocation  
 c) Inversion                          d) Transition      **Ans: a**
- 39. Who supported Griffith effect by molecular explanation ?**  
 a) Hershey and Chase  
 b) Watson, Crick, Nirenberg  
 c) Avery, McCarty and Macleod  
 d) Griffith and Avery      **Ans: c**
- 40. Synthesis of nucleic acids always takes place in**  
 a) 3' – 5' direction                b) 5' – 3' direction  
 c) Both ways                         d) in any direction      **Ans: b**



**41. What is called Griffith effect ?**

- a) DNA transcription
- b) RNA translation
- c) Bacterial transformation
- d) Bacterial transduction

**Ans: c****42. Genetic information is carried by the long chain molecules which are made up of \_\_\_\_\_**

- a) Amino acids
- b) Nucleotides
- c) Chromosomes
- d) Enzymes

**Ans: b****43. By which bonds the purine & pyrimidine pairs of Complementary Strands of DNA held together? ?**

- a) H - bonds
- b) O - bonds
- c) C - bonds
- d) N - bonds

**Ans: a****44. The code AUG stands for \_\_\_\_\_**

- a) Glycine
- b) Methionine
- c) N-formyl methionine
- d) Alanine

**Ans: b****45. A Sequence of three Consecutive bases in a t- RNA molecule which Specifically binds to a complementary Codon Sequence in m - RNA is known as \_\_\_\_\_**

- a) Triplet Codon
- b) Non - Sense Codon
- c) Anti Codon
- d) Termination Codon

**Ans: c****46. A Codon is made up of**

- a) Single nucleotide
- b) two nucleotides
- c) three nucleotides
- d) Four nucleotides

**Ans: c****47. DNA replication requires**

- a) DNA polymerase only
- b) DNA polymerase and ligase
- c) Ligase only
- d) RNA polymerase

**Ans: b****48. The enzyme involved in transcription is \_\_\_\_\_**

- a) RNA polymerase
- b) DNA polymerase I
- c) DNA polymerase II
- d) DNA polymerase

**Ans: a****49. Enzymes needed for formation of replication fork is \_\_\_\_\_**

- a) RNA polymerase and DNA polymerase I
- b) Helicase and gyrase

- c) Hexokinase and aldolase
- d) Ligase and endo nuclease

**Ans: b****50. Okazaki fragments are Synthesized on**

- a) Leading strands of DNA only
- b) Lagging Strands of DNA only
- c) Leading and Lagging Strands
- d) Complementary DNA Strand

**Ans: b****51. Which of the following is used in DNA multiplication?**

- a) RNA polymerase
- b) DNA endonuclease
- c) DNA exonuclease
- d) DNA Polymerase

**Ans: d****52. t - RNA attaches aminoacid at it's**

- a) 3' end
- b) 5' end
- c) Anticodon
- d) Loop

**Ans: a****53. DNA acts as a template for synthesis of \_\_\_\_\_**

- a) RNA
- b) Lipid
- c) Both 'a' and 'b'
- d) Protein

**Ans: a****54. Antiparallel strand in DNA is due to**

- a) Disulphide linkage
- b) Hydrogen bond
- c) Phosphodiester bond
- d) Ionic bond

**Ans: - c****55. Multiplication of DNA is called as \_\_\_\_\_**

- a) Translation
- b) Replication
- c) Transduction
- d) Transcription

**Ans: b****56. Which is the smallest RNA ?**

- a) r RNA
- b) m RNA
- c) t - RNA
- d) nuclear RNA

**Ans: c****57. Genetic information are transferred from nucleus to cytoplasm of cell through**

- a) DNA
- b) RNA
- c) Lysosomes
- d) Anticodon

**Ans: b****58. The information from RNA to DNA are transferred by which process?**

- a) Replication
- b) Transcription
- c) Translation
- d) Reverse transcription

**Ans: d**

59. In a transcription unit promotor is said to be located towards

- a) 3' end of structural gene
- b) 5' end of structural gene
- c) 5' end of template strand
- d) 3' end of template strand

Ans: d

60. Non - sense codons take part in

- a) formation of unspecified aminoacids
- b) Terminating gene controlled protein synthesis
- c) Releasing t-RNA from polynucleotide chain
- d) Conversion of sense DNA in to non-sense one

Ans: b

61. Select the correct sequence of following in DNA replication

- a) Single stranded binding proteins - Helicase - Topoisomerase - DNA polymerase
- b) Helicase - single stranded binding proteins -Topoisomerase - DNA polymerase
- c) Helicase - DNA polymerase - Topoisomerase - Single stranded binding proteins
- d) Helicase - Topoisomerase - DNA polymerase - Single stranded binding proteins

Ans: b

62. Which of the following enzymes can detect and correct the wrong inserted base during DNA replication?

- a) DNA polymerase-I
- b) Transacetalase
- c) Primase
- d) Ligase

Ans: a

63. Which one is a ribozyme ?

- a) Helicase
- b) Catalytic RNA
- c) ligase
- d) Both (b) & (c)

Ans: b

64. Which of the following pairs is not correctly matched ?

- a) Recombinant DNA - DNA forming by union of segments of DNA from different Sources
- b) Purines - Nitrogenous bases Cytosine , thymine and Uracil
- c) ATP - The principal energy carrying compound inthe cell
- k) r-RNA - RNA molecules found in ribosomes

Ans: b

65. Which is not the step of translation ?

- a) Initiation
- b) Replication
- c) Elongation
- d) Termination

Ans: b

66. The enzyme amino acyl t-RNA-synthetase facilitates

- a) Joining two neighbouring amino acids on ribosomes
- b) Adoption of amino acids by a t-RNA molecule
- c) Insertion of amino acyl t-RNA into the ribosome sites
- d) Transfer of amino acyl t-RNA from the ribosomal 'A' site to 'P' site

Ans: b

67. State the anticodon of initiation codon of protein synthesis

- a) UAC
- b) UUU
- c) CAU
- d) AUG

Ans: a

68. What does a gene consist of ?

- a) Promoter
- b) Initiation site & termination site
- c) coding sequence
- d) All the above

Ans: d

69. Name the enzymes needed for lactose Catabolism in E.coli ?

- a)  $\beta$  - galactosidase, permease transacetylase
- b)  $\beta$  - galactosidasee Lactase, transacetylase
- (c)  $\beta$  - galactosidase, lactase, permease
- d) Lactase, permease, transacetylase

Ans: a

70. What does operon contain ?

- a) Regulator gene + promotor gene
- b) Operator gene + structural gene
- c) Regulator gene + promotor gene structural gene
- d) Regulator gene + promotor gene + operator gene + structural gene

Ans: d

71. Select correct match with respect to lac-operon model

- a) Active repressor + inducer =Inactive repressor
- b) Active repressor + corepressor =Inactive repressor
- c) Inactive repressor + inducer =Active repressor
- d) Inactive repressor + corepressor = Active repressor

Ans: a

- 72. Which is not correct regarding the activity of helicase during DNA replication ?**
- Cuts hydrogen bonds
  - Requires ATP
  - separates DNA strands
  - Stabilizes single strands
- Ans: c**
- 73. Which of the following enzyme is not produced by E. coli during lactose catabolism ?**
- $\beta$  - galactosidase
  - Thio galactoside transacetylase
  - Lactose dehydrogenase
  - Lactose permease
- Ans: c**
- 74. DNA replication in eukaryotes is \_\_\_\_\_**
- Unidirectional with many origin
  - Bidirectional with many origin
  - Unidirectional with single origin
  - Bidirectional with single origin
- Ans: b**
- 75. Aminoacids lysine, serine and arginine are coded by how many codons ?**
- 6, 4, and 3 respectively
  - 4, 2 and 2 respectively
  - 6 codons
  - 4 codons
- Ans: c**
- 76. Which of the following amino acid is coded by 3 codons ?**
- Serine
  - Proline
  - Tryptophan
  - Isoleucine
- Ans: d**
- 77. Which of the following enzymes help in the process of formation of phosphor di-ester bond during reverse transcription ?**
- DNA - dependant RNA polymerase
  - DNA dependant DNA polymerase
  - RNA - dependant RNA polymerase
  - RNA - dependant DNA polymerase
- Ans: d**
- 78. DNA replication in lagging strand of most of the eukaryotic organisms is \_\_\_\_\_**
- conservative and continuous
  - semi conservative but discontinuous
  - conservative and semi - discontinuous
  - semi conservative but continuous
- Ans: b**
- 79. In Which of the following DNA not directly involved ?**
- Replication
  - Transcription
  - Translation
  - Transformation
- Ans: c**
- 80. Transcription begins when one of the following enzymes binds to promotor site.**
- DNA polymerase
  - RNA polymerase
  - helicase
  - Gyrase
- Ans: b**
- 81. In the genetic code dictionary how many codons are used to code for all the 20 essential amino-acids?**
- 20
  - 64
  - 61
  - 60
- Ans: b**
- 82. Which one of the following triplet codes, is correctly matched with its specificity for an aminoacid in protein synthesis or as 'start' or 'stop' codon ?**
- UCG - start
  - UUU – stop
  - UGU - Leucine
  - UAC – Tyrosine
- Ans: d**
- 83. The following ratio is generally constant for a given species**
- $A + G / C + T$
  - $T + C / G + A$
  - $G + C / A + T$
  - $A + C / T + G$
- Ans: c**
- 84. During transcription if the nucleotide sequence of the DNA strand that is being coded is ATACG then the nucleotide sequence in the m RNA would be**
- T A T G C
  - T C T G G
  - U A U G C
  - U A T G C
- Ans: c**
- 85. Which one of the following makes use of RNA template to synthesize DNA**
- DNA polymerase
  - RNA polymerase
  - Reverse transcriptase
  - DNA dependant RNA polymerase
- Ans: c**
- 86. Protein synthesis in an animal cell occurs**
- only on the ribosomes present in cytosol
  - only on ribosomes attached to the nuclear envelope and endoplasmic reticulum
  - On ribosomes present in the nucleolus as well as in cytoplasm
  - on ribosomes present in cytoplasm as well as in mitochondria
- Ans: d**



**87. Amino acid Sequence in protein synthesis is decided by the sequence of**

- a) r RNA                      b) t RNA  
c) m RNA                     d) c DNA                    **Ans: c**

**88. Polysome is formed by \_\_\_\_\_**

- a) a ribosome with several subunits  
b) ribosomes attached to each other in a linear arrangement  
c) several ribosomes attached to a single m RNA  
d) many ribosomes attached to a strand of endoplasmic reticulum

**Ans: c**

**89. Semiconservative replication of DNA was first demonstrated in**

- a) Escherichia coli  
b) streptococcus pneumoniae  
c) Salmonella typhimurium  
d) Drosophila melanogaster

**Ans: a**

**90. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a "triplet"**

- a) Hershey and chase  
b) Morgan and sturtevant  
c) Beadle and Tatum  
d) Nirenberg and Mathai

**Ans: d**

**91. The lac operon consists of \_\_\_\_\_**

- a) four regulatory genes only  
b) One regulatory gene and three structural genes  
c) Two regulatory genes and three structural genes  
d) three regulatory genes and three structural genes

**Ans: b**

**92. Ribosomal RNA is actively synthesized by \_\_\_\_\_**

- a) Lysosomes                      b) nucleolus  
c) nucleoplasm                    d) ribosomes

**Ans: b**

**93. If one strand of DNA has the nitrogenous base sequence as ATCTG, What would be the complementary RNA strand Sequence**

- a) TTAGU                      b) UAGAC  
c) AACTG                      d) ATCGU                    **Ans: b**

**94. Initiation codon of protein synthesis (in eukaryotes) is \_\_\_\_\_**

- a) GUA                              b) GCA  
c) CCA                              d) AUG                        **Ans: d**

**95. Semiconservative DNA replication using  $^{15}\text{N}$  was demonstrated by**

- a) Meselson                        b) Taylor  
c) Meselson and stahl          d) Hershey and chase

**Ans: c**

**96. Termination of polypeptide chain is brought about by**

- a) UUG , UAG and UCG      b) UAA , UAG and UGA  
c) UUG , UGC and UCA      d) UCG , GCG and ACC

**Ans: b**

**97. Correct sequence of code transfer during polypeptide formation is \_\_\_\_\_**

- a) DNA , mRNA , t RNA and amino acids  
b) DNA , t RNA , r RNA and m RNA  
c) m RNA , t RNA , DNA and amino acids  
d) r RNA , DNA , m RNA and t RNA

**Ans: a**

**98. Best method to determine paternity is \_\_\_\_\_**

- a) Protein analysis              b) chromosome counting  
c) gene counting                d) DNA finger printing

**Ans: d**

**99. Nucleotide arrangement in DNA can be seen by**

- a) X - ray crystallography      b) Electron microscope  
c) Ultra centrifuge              d) Light microscope

**Ans: a**

**100. Pneumococcus experiment proved that**

- a) Bacteria do not reproduce asexually  
b) Bacteria undergo binary fission  
c) DNA is genetic material  
d) RNA may sometimes control a production of DNA and protein

**Ans: c**

**101. A DNA nucleotide chain has A G C T T C G A sequence The nucleotide sequence of other chain would be**

- a) T C G A A G C T              b) G C T A A G C T  
c) T A G C A T A T              d) G A T C C T A G

**Ans: a**



**102.A functional unit in synthesis of protein is**

- a) Lysosome                      b) Peroxisome  
c) Polysome                      d) Dictyosome

**Ans: c****103.VNTR is employed for**

- a) Protoplasmic culture  
b) DNA finger printing  
c) Regulation of plant growth hormones  
d) Enhancing photosynthesis in desert plant

**Ans: b****104.Okazaki fragments are joined by enzyme**

- a) DNA helix                      b) DNA ligase  
c) DNA polymerase II        d) RNA polymerase II

**Ans: b****105.Heat killed pathogenic cells and live non pathogenic cells are mixed and injected into Mice the result would be**

- a) Mice develop disease and die  
b) Mice die without developing disease  
c) Mice remain healthy  
d) 50% mice develop disease and die

**Ans: a****106.Genetic mutations occur in**

- a) DNA                              b) RNA  
c) Protein                          d) RNA & protein both

**Ans: a****107.The locus of mutation is**

- a) Gene                              b) Chromosome  
c) Centromere                    d) Nucleus

**Ans: a****108.Which of the following causes mutation**

- a) Crossing-over                  b) NaCl  
c) Colchicine                      d) UV rays

**Ans: d****109.The minimum requirement for mutation is**

- a) Change of triplet codon  
b) Change in single nucleotide  
c) Change in whole DNA  
d) Change in single strand of DNA

**Ans: b****110.Which step does not involve in DNA finger printing?**

- a) Southern blotting  
b) Gel electrophoresis  
c) Restriction enzyme digestion  
d) Northern blotting

**Ans: d****111.Southern blotting is used for the identification of**

- a) DNA                              b) RNA  
c) Protein                          d) All the above

**Ans: a****112.The approximate number of genes contained in the genome of Kalpana Chawla was**

- a) 40,000                          b) 30,000  
c) 80,000                          d) 1,00,000

**Ans: b****113.Which of the following is not associated with HGP ?**

- a) Bioinformatics  
b) Cloning vectors BAC & YAC  
c) Automated DNA sequencers  
d) VNTR

**Ans: d****114.Which step is not correct in DNA finger printing ?**

- a) Isolation of DNA  
b) Digestion of DNA by DNA ligase enzyme  
c) Separation of DNA by electrophoresis  
d) Hybridisation using labelled VNTR probe

**Ans: b****115.Both deoxyribose and ribose belong to a class of sugars called as \_\_\_\_\_**

- a) trioses                          b) hexoses  
c) pentoses                        d) polysaccharides

**Ans: c****116.The net electric charge on DNA and histones is \_\_\_\_\_**

- a) both positive  
b) both negative  
c) negative and positive, respectively  
d) zero

**Ans: c**

**117. The promoter site and the terminator site for transcription are located at**

- a) 3' (downstream) end and 5' (upstream) end, respectively of the transcription unit
- b) 5' (upstream) end and 3' (downstream) end, respectively of the transcription unit
- c) the 5' (upstream) end
- d) the 3' (downstream) end

**Ans: b****118. One of the following is true with respect to AUG**

- a) It codes for methionine only
- b) It is also an initiation codon
- c) It codes for methionine in both prokaryotes and eukaryotes
- d) All of the above

**Ans: d****119. The first genetic material could be**

- a) protein
- b) carbohydrates
- c) DNA
- d) RNA

**Ans: d****120. Discontinuous synthesis of DNA occurs in one strand, because**

- a) DNA molecule being synthesised is very long
- b) DNA dependent DNA polymerase catalyses polymerisation only in one direction (5' → 3')
- c) It is a more efficient process
- d) DNA ligase has to have a role

**Ans: b****121. Control of gene expression takes place at the level of**

- a) DNA-replication
- b) Transcription
- c) Translation
- d) None of the above

**Ans: b****122. In some viruses, DNA is synthesised by using RNA as template. Such a DNA is called as \_\_\_\_\_**

- a) A-DNA
- b) B-DNA
- c) c DNA
- d) r DNA

**Ans: c****123. The amino acid attaches to the tRNA at its**

- a) 5' - end
- b) 3' - end
- c) Anti codon site
- d) DHU loop

**Ans: b**

These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.

- a) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
- b) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
- c) If Assertion is True but the Reason is False.
- d) If both Assertion & Reason are false.

**124. Assertion : Lac operon is an inducible system****Reason : Transcription occurs in the presence of lactose**

- a) A
- b) B
- c) C
- d) D

**Ans: a****125. Assertion : Operon concept was given by Hershey and chase****Reason : Separation of DNA fragments are done by centrifugation technique**

- a) A
- b) B
- c) C
- d) D

**Ans: d****126. Assertion : DNA is cut into Sections by using restriction endonucleases****Reason : Ligase is used to join DNA nucleotides**

- a) A
- b) B
- c) C
- d) D

**Ans: b****127. Assertion : Helicase is called unwindase****Reason : DNA helix uncoils and splits into single strands by breaking of hydrogen bonds between complementary bases**

- a) A
- b) B
- c) C
- d) D

**Ans: a****128. Assertion : Formation of Lagging strand is slow****Reason : Formation of lagging strand begins bit later than that of leading strand**

- a) A
- b) B
- c) C
- d) D

**Ans: a**

**129.Assertion : Mutations effect protein structure and functions**

**Reason : Only one changed codon may be missense when it changes insertion of one aminoacid**

- a) A      b) B      c) C      d) D

**Ans: a**

**130.Assertion : Catching criminals could become easier and quicker using DNA fingerprints**

**Reason : The process begins with blood or cell sample from which DNA is extracted**

- a) A      b) B      c) C      d) D

**Ans: b**

**131.Assertion :Mutation results in changes in the genotype and the phenotype of an organism**

**Reason : Mutation is a phenomenon, which results in alternation of DNA sequences:**

- a) A      b) B      c) C      d) D

**Ans: a**

**132.Assertion :Normally the genetic code is degenerate.**

**Reason : One amino acid is coded by more than one codon.**

- a) A      b) B      c) C      d) D

**Ans: a**

**133.Assertion: There occur 64 codons in dictionary of genetic code**

**Reason : Genetic code is quadraplete.**

- a) A      b) B      c) C      d) D

**Ans: c**

**134.Assertion :Replication and transcription occur in the nucleus but translation occurs in the cytoplasm.**

**Reason : Transcription and translation are unidirectional**

- a) A      b) B      c) C      d) D

**Ans: b**

**135.Assertion : Base pairing between purine and pyrimidines allows uniform distance between two strands of the helix**

**Reason : Number of hydrogen bonds between pairing bases are constant.**

- a) A      b) B      c) C      d) D

**Ans: b**

**136.Assertion :DNA is a chemically and structurally more stable.**

**Reason : DNA have no catalytic properties.**

- a) A      b) B      c) C      d) D

**Ans: a**

**137.Assertion : In DNA fingerprinting, after hybridization with VNTR probe, the autoradiogram gives many bands of different sizes**

**Reason : It differs from individual to individual in a population except fraternal twins.**

- a) A      b) B      c) C      d) D

**Ans: c**

## PART-B

### ADDITIONAL QUESTIONS

(2 MARKS)

**1. How is the information in DNA used for an organism ?**

- Based on the information on DNA **synthesis of proteins** will take place.
- **Proteins determine the shapes** of cell and rate of chemical reactions.

**2. Define genome**

- Genome is the **totality of gene**
- It is the **hereditary nature** of living organism
- It consists of a **long sequence of nucleic acids** that carry information.
- **Genome carry hereditary information** of an organism.
- Genome divided into **nucleic acid molecules.**

**3. Define gene**

- A gene is a **basic physical and functional unit of heredity.**
- Genes is defined as **distinct particles that follow Mendelian rules of inheritance, occupy a definite locus in the chromosome** and are responsible for the **expression of specific phenotypic character.**

**4. List out the Properties of Gene**

- I. **Several genes are located** on the same chromosome.
- II. The genes are **arranged in a single linear order** like beads on a string.
- III. **Locus** - Each **gene occupies a specific position called locus.**
- IV. **Alleles** - Genes may exist in **several alternate forms called alleles.**
- V. **Mutations** - genes may **undergo mutations (sudden change in positions and composition**
- VI. Genes are **capable of self-duplication** producing their own copies.

### 5. List out the contributions of scientist in research related to genetic material of an organism

- In 1848, Wilhelm Hofmeister, observed that **nuclei organize themselves into small, rod like bodies** during mitosis called **chromosomes**.
- In 1869, **Friedrich Miescher, isolated a substance from the cell nuclei** and called it as nuclein.
- **Altman renamed nucleic acid as DNA.**
- By 1920 - it became clear that **chromosomes are made up of proteins and DNA.**
- Griffith's experiment proved that **DNA is the genetic material.**

### 6. Why One gene-one enzyme hypothesis modified into one gene-one polypeptide hypothesis

- **Enzyme may be composed of more than one polypeptide chain** and a gene can code for only one polypeptide chain.
- Hence **One gene-one enzyme hypothesis modified into one gene-one polypeptide hypothesis.**

### 7. State one gene-one polypeptide hypothesis.

- One gene-one polypeptide hypothesis states that **one gene controls the production of only one polypeptide chain** of an enzyme molecule

### 8. List out the functions of DNase, RNase, Protease

- **DNase** - an enzyme which destroys DNA
- **RNase** - an enzyme which destroys RNA
- **Proteases**-an enzyme which destroys protein)

### 9. Explain the chemical nature of nucleic acid and how they are classified ?

- Nucleic acids are a **long chain or polymer** which is made up of **sequence of nucleotides**.
- Nucleotide consists of a **nitrogenous base, a five carbon sugar (pentose) and a phosphate group**.
- There are two types of nucleic acids (based on type of pentose sugar

1. **DNA** - contain **Deoxyribose sugar**.
2. **RNA** -contain **Ribose sugar**.

### 10. Classify nitrogen base.

- The bases in the genetic materials are **nitrogen containing molecules**
- DNA and RNA both **have four bases** (two purines and two pyrimidines)
- **Purines base are Adenine and Guanine (G)** have double carbon–nitrogen ring structures
- **Pyrimidines base are Thymine(T), Cytosine(C) and Uracil (U)** have single ring structure
- **Thymine is unique for DNA**, while **Uracil is unique for RNA.**

### 11. Differentiate Nucleoside and nucleotide

- **Nucleoside = nitrogenous base + sugar** (at the 1-carbon of the sugar)
- **Nucleotide = Nucleoside + phosphate group** (attached to the 5' carbon of the same sugar)

### 12. How will you calculate the size of DNA molecule

- The **distance between base pairs** of the DNA is **0.34nm** ( $0.34 \times 10^{-9} \text{m}$ )
- **Length of DNA double helix = Total number of base pairs x distance between two consecutive base pairs**  
Eg.  $6.6 \times 10^9 \times 0.34 \times 10^{-9} \text{m/bp}$ ), which is approximately **2.2 m** for mammalian nucleus
- If the length of E. coli DNA is **1.36 mm**, the number of base pairs in E. coli is  **$4 \times 10^6 \text{m}$  ( $1.36 \times 10^3$ )**

### 13. Define genophore

- DNA of prokaryotes is **almost circular and lacks chromatin organization**, hence it termed as **genophore**.

### 14. Define histone octamere

- **2 molecules of the four histone proteins**  $H_2A$ ,  $H_2B$ ,  $H_3$  and  $H_4$  are organized to form a unit of **eight molecules called histone octamere**.

### 15. What are the two types of chromatin ?

Chromatins are two types they are

1. **Loosely packed chromatin** are referred as **euchromatin - transcriptionally active**
2. **Tightly packed chromatin** are called

as **heterochromatin transcriptionally inactive**.

### 16. Explain the term exon and intron

- In eukaryotes, the monocistronic structural genes have interrupted **coding sequences known as exons** (expressed sequences) and **non-coding sequences called introns** (intervening sequences).

### 17. Define the term splicing, tailing .

- **Splicing** - The **introns are removed** by a process called splicing.
- **Tailing**-hnRNA undergoes additional processing called as **capping and tailing**.

### 18. Define genetic code.

- Genetic code is the **sequence relationship different ways** through alternate splicing patterns, a mechanism known to **play an important role in generating** both protein and functional diversity in animals.

### 19. What is Translation ?

- Translation refers to the process of **polymerization of amino acids to form poly peptide chain**.
- The decoding process is carried out **by ribosomes that bind mRNA and charged tRNA molecules**.
- The mRNA is translated **starting at the 5' end**.

### 20. Define operon .

- Extra cellular or intracellular metabolites trigger initiation or **inhibition of gene expression**.
- The **clusters of gene** with related functions are called **operons**.

### 21. Why Human Genome Project called as mega project ?

- It was a mega project and took **13 years to complete**.
- The human genome is about **25 times larger than the genome** of any organism sequenced to date and is the first vertebrate genome to be completed.
- Human genome is said to have approximately  **$3 \times 10^9$  bp**.

### 22. Define Shotgun sequencing

- The latest method of **sequencing even longer fragments** is by a method called **Shotgun sequencing using supercomputers**,

which has replaced the traditional sequencing methods.

### 23. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active?

Heterochromatin	Euchromatin
i) They are <b>darkly staining and are scattered</b> or accumulated near the nuclear envelope.	i) Euchromatin is not <b>readily stainable and is dispersed</b> .
ii) These are transcriptionally <b>less active or inactive</b>	ii) These are <b>transcriptionally active</b> .

### 24. What is the cause of discontinuous synthesis of DNA on one of the parental strands of DNA? What happens to these short stretches of synthesised DNA?

- DNA polymerase catalyses **polymerization in only one direction, i.e. 5' – 3'**.
- Due to this, **replication is continuous on one strand (3' – 5')**, while it is **discontinuous on another strand (5' – 3')**.
- The fragments which is **discontinuous is later joined by DNA ligase**.

### 25. Name a few enzymes involved in DNA replication other than DNA polymerase and ligase. Name its functions.

- **Primase**- It adds RNA primers to template strands.
- **RNase** - Removes the RNA primer.
- **Exonuclease**- Initiate cleaving of nucleotides one at a time.

### 26. Name any three viruses which have RNA as the genetic material.

1. Ebola virus
2. Tobacco Mosaic Virus
3. SARS
4. HIV Virus

### 27. Why is DNA considered a better genetic material?

- DNA is **chemically less reactive and structurally more stable** as its nucleotides are not exposed except when they are to express their effect.
- DNA is capable of **undergoing slow mutations**.
- It has **power of repairing**.
- Hence DNA is a **better material for the storage of genetic information**.



**28. State the dual role of deoxyribonucleoside triphosphates during DNA replication.**

- **Deoxyribonucleoside triphosphates** (or phosphorylated nucleotides) i.e., **deATP, deCTP, deGTP and deTTP** serve dual purpose during DNA replication.
- They act as substrates for the replication process as well as **provide energy for the polymerisation of nucleotides.**

**29. Compare the roles of the enzymes DNA polymerase and DNA ligase in the replication.**

DNA polymerase	DNA ligase
DNA polymerase catalyse the elongation of a new	The discontinuously synthesised fragments are <b>joined by the enzyme DNA ligase</b>

**30. State the difference between the structural genes in a transcription unit of prokaryotes and eukaryotes.**

S. No	Structural gene in prokaryotes	Structural gene in eukaryotes
1.	Consists of <b>functional coding sequences.</b>	Consists of both <b>exons and introns.</b>
2.	<b>Information is continuous</b> as only exons are present.	<b>Information is split</b> due to presence of introns in between exons.
3.	<b>Splicing does not take place.</b>	<b>Splicing occur</b> to make functional mRNA.

**31. State the functions of the following in a prokaryote: a) tRNA b) rRNA**

- tRNA helps in transferring amino acids** to ribosome for synthesis of polypeptide chain.
- tRNA acts as an adapter molecule.**
- rRNA plays **structural and catalytic role** during translation.

**32. Differentiate between exons and introns.**

Introns	Exons
i) Regions of a gene which <b>do not form part of mRNA.</b>	Regions of a gene which become <b>part of mRNA</b>
ii) <b>Removed</b> during the processing of mRNA	<b>Code for the different proteins.</b>

**33. What is aminoacylation?**

- Aminoacylation or charging of the tRNA is the process during which the **amino-acyl-adenylate enzyme complex reacts with tRNA specific for the amino acid** to form aminoacyl-tRNA complex.

**34. How is the translation of mRNA terminated? Explain.**

- Polypeptide chain synthesis is terminated when a **nonsense codon of mRNA reaches the A-site of ribosome** during protein synthesis.
- There are three nonsense codons-**UAA, UAG and UGA.**
- These codons **do not specify any amino acid.**
- So, translation is stopped.

**35. Differentiate between the following: Inducer and repressor in lac operon.**

- **Inducer** is a chemical, which come and contact with the repressor, and change it into **non-DNA binding state so as to free the operator gene.**
- Repressor is a **regulator protein** meant for blocking the operator gene so that the structural **genes are unable to form mRNAs.**

**36. How does DNA polymorphism arise in a population?**

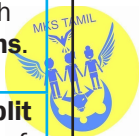
- DNA polymorphism in a population arise **due to mutations.**

**37. Write the full form of VNTR. How is VNTR different from 'Probe'?**

- VNTR stands for **Variable Number of Tandem Repeats.**
- VNTRs are **short nucleotide repeats in DNA** that are specific to each individual and vary in number from person to person.
- DNA probes, are **radioactive**, have repeated base sequence complementary to VNTRs .

**38. Explain the significance of satellite DNA in DNA fingerprinting technique**

- Satellite DNA are very specific in each individual, **vary in number from person to person and are inherited.**
- These sequences show **high degree of polymorphism.**



- Each individual **inherits the satellite DNA from, his/her parents** which are used as genetic markers in DNA fingerprinting.

### 39. Genetic code is specific and nearly universal. Justify.

- Genetic code is **specific as one codon codes for only one amino acid** and it is nearly universal as the **same codon would code for same amino acid** from bacteria to human.
- Hence it is **universal and specific**

### 40. What are the Contributions of Watson and Crick?

- A simple **model of DNA** was available because of them.
- **DNA replication** could be easily understood.
- The model **brought revolution in understanding** of biology at a molecular level.

### 41. What is Central dogma ? Who proposed it?

- Central dogma was **proposed by Crick**.
- It refers to the flow of information from **DNA to mRNA (transcription) and then decoding the information present in mRNA in the formation of polypeptide chain** or protein (translation).

### 42. How do histones acquire positive charge?

- Histones are **rich in basic amino acids lysine and arginine**, hence they are positively charged.

## PART-C

### ADDITIONAL QUESTIONS (3 MARKS)

#### 1. State Base pair Rules

- It was **proposed by Erwin Chargaff**
- 1. **Adenine pairs with Thymine** (A=T) with two hydrogen bonds and **Guanine pairs with Cytosine** (G ≡ C) with three hydrogen bonds.
- 2. The ratios between Adenine with Thymine and Guanine with Cytosine are **constant and equal**.
- 3. The **base pairing confers a unique property** to the polynucleotide chain.

4. These two strands are **complementary to each other**

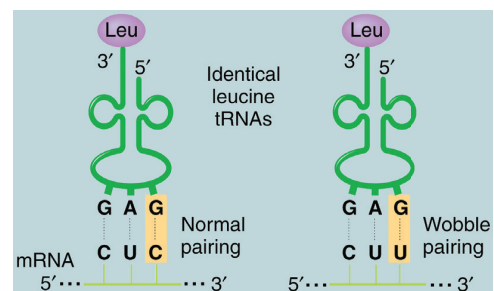
If the sequence on one strand is known we can predict sequence of other strand.

#### 2. List out the enzymes used in DNA replication

- In prokaryotes, replication process requires **DNA polymerase I, II, and III**.
- **DNA polymerase III** is the main enzyme for DNA replication.
- DNA polymerase I & II are involved in **DNA repair mechanism**.
- Eukaryotes have **five types of DNA polymerases**
- Errors replication are corrected by **nucleases enzymes**.
- **Deoxy nucleotide triphosphate** provides energy for polymerization reaction.
- **DNA helicase, Unwind the DNA strand**
- Gap in the strands are **joined by DNA ligase**
- At the point of origin of replication, the **helicases and topoisomerases (DNA gyrase) unwind and pull apart the strands**, forming a Y-Shaped structure called the replication fork.

#### 3. Explain Wobble Hypothesis

- It is a hypothesis **proposed by Crick (1966)** which states that tRNA anticodon has the **ability to wobble at its 5' end** by pairing with even non-complementary base of mRNA codon.
- According to this hypothesis, in **codon-anticodon pairing the third base** may not be complementary.
- The third base of the codon is called **wobble base and this position is called wobble position**.
- The actual base **pairing occurs at first two positions only**.



- The importance of Wobbling hypothesis is that it **reduces the number of tRNAs required for polypeptide synthesis** and it overcomes the effect of code degeneracy.
- In the above example though the **codon and the anti codon do not match perfectly, yet the required amino acid is brought perfectly.**
- This enables the economy of tRNA, **GUU, GUC, GUA and GUG code for the aminoacid-Valine.**

#### 4. Write short notes on Structure of the operon:

- Operon is a **unit of gene expression and regulation** and consists of one or more structural genes and an adjacent operator gene.
  - Operator gene that **controls transcriptional activity of the structural gene**
1. The **structural gene codes for proteins, rRNA and tRNA** required by the cell.
  2. Promoters are the **signal sequences in DNA that initiate RNA synthesis.**
  3. **RNA polymerase binds** to the promoter prior to the initiation of transcription.
  4. The operators are present between the **promoters and structural genes.**
  5. **The repressor protein binds to the operator region** of the operon.

#### 5. List out the aims of Human Genome Project

- The main goals of Human Genome Project are as follows
1. **Identify all the genes**(approximately 30000) in humanDNA.
  2. **Determine the sequence of the three billion chemical base pairs** that makeup the humanDNA.
  3. To **store this information** in databases.
  4. **Improve tools for dataanalysis.**
  5. Transfer related technologies to other **sectors, such as industries.**
  6. Address the **ethical, legal and social issues(ELSI)** that may arise from the project.

#### 6. What are the Applications and future challenges of HGP

- Once genetic sequence becomes easier to **determine, some people may attempt**

**to use this information for profit or for political power.**

- Insurance companies may **refuse to insure people at 'genetic risk'** and this would save the companies the expense of future medical bills incurred by 'less than perfect' people.
- Another fear is that **attempts are being made to "breed out" certain genes** of people from the human population in order to create a 'perfectrace'.

#### 7. List out the Application of DNA finger printing

- **Forensic analysis** - It can be used in the **identification of a person involved in criminal activities, for settling paternity or maternity disputes,** and in determining relationships for immigration purposes.
- **Pedigree analysis** – inheritance pattern of genes through generations and for **detecting inherited diseases.**
- **Conservation of wild life – protection of endangered species,** by maintaining DNA records for identification of tissues of the dead endangered organisms.
- **Anthropological studies**–It is useful in **determining the origin and migration of human populations and genetic diversities.**

#### 8. Define transformation in Griffith's experiment. Discuss how it helps in the identification of DNA as the genetic material.

- During the course of Griffith's experiment, **bacteria changed its physical form.**
- This was termed as **transformation.**
- In this experiment, the DNA of the **S strain bacteria survived after heating.**
- When a mice was injected with **mixture of killed S strain and R strain, the mice died of pneumonia.**
- This showed that **DNA had the capability of surviving adverse circumstances** and manifesting itself on return of favourable conditions.
- **Stability and survival** are key factor for a material to be classified as genetic material.
- Thus, transformation in Griffith's experiment **helped in identification of DNA as genetic material.**



## PART-D

## ADDITIONAL QUESTIONS

(5 MARKS)

## 9. Discuss the significance of heavy isotope of nitrogen in the Meselson and Stahl's experiment.

- The heavy isotope of nitrogen was used in Meselson and Stahl's experiment for various reasons.
- The heavy DNA molecule (containing  $^{15}\text{N}$ ) could be **easily distinguished from the normal DNA** by centrifugation in a Cesium chloride ( $\text{CsCl}$ ) density gradient.
- It could be **easily separated from lighter nitrogen ( $^{14}\text{N}$ )** on the basis of density.
- Use of lighter and heavier nitrogen **made the task of identifying transfer of DNAs through subsequent generation quite easier.**

## 10. Retroviruses do not follow central Dogma. Comment.

- Francis and Crick proposed the central dogma in **molecular biology**.
- According to this, genetic information flows from **DNA  $\rightarrow$  RNA  $\rightarrow$  Protein**.
- In retroviruses, genetic information flows in **reverse direction**, i.e. Protein  $\rightarrow$  RNA  $\rightarrow$  DNA.
- Hence, it is said that **retroviruses do not follow central dogma**.
- The process followed by **retroviruses is also called reverse transcription** because of the opposite sequence of the process involved.

## 11. Do you think that the alternate splicing of exons may enable a structural gene to code for several

**isoproteins from one and the same gene? If yes, how? If not, why so?**

- In humans **about 95% of multi-exonic genes** are alternatively spliced.
- Alternative **splicing helps in generating many proteins** from one and the same gene.
- In this process, a particular **exon may be excluded from or included in a specific RNA**.
- Splicing which results in a **single gene coding for multiple proteins** is called alternative splicing.

## 1. List out Properties of A molecule that can act as a genetic material:

## (a) Self Replication:

- It should **be able to replicate**.
- According to the **base pair rule and complementarity**, both nucleic acids (DNA and RNA) have the ability to duplications. Proteins will not replicate.

## (b) Stability:

- It **should be stable** structurally and chemically.
- The genetic material **should be stable** through out the life.
- **Stability of genetic material** was clearly explained by Griffith's experiments.
- Heat did not destroy some of the **properties of genetic material**.
- RNA is **catalytic and reactive**.
- Hence, **DNA is chemically more stable** than RNA.
- **Presence of thymine** in DNA provide additional stability to DNA.

## (c) Information storage:

- It should be **able to express itself**
- RNA can **directly code for protein synthesis** and can easily express the characters.
- **DNA depends on RNA** for synthesis of proteins.
- **DNA and RNA can act as a genetic material**, but DNA stores the genetic information and RNA transfers the genetic information.

## (d) Variation through mutation:

- It should **be able to mutate**.
- Both **DNA and RNA able to mutate**.
- RNA being **unstable, mutates at a faster rate**
- Thus **RNA viruses have shorter life span** can mutate and evolve faster.

## 2. Explain different types of DNA Replication

- DNA Replication takes place **during S phase**
- During replication, each **DNA molecule gives rise to two DNA strands, identical to each other** and parent Hypotheses of DNA replication.
- **Conservative replication,**
- **Dispersive replication,**
- **semi-conservative replication.**

#### a. Conservative replication,

- In this original **double helix serves as a template.**
- The original strand is preserved unbroken and an entirely **new double stranded molecule is synthesized.**

#### b. Dispersive replication,

- In this original molecule is **broken into fragments and each fragment serves as a template for the synthesis of complementary fragments.**
- Finally **two new molecules are formed** which consist of both old and new fragments.

#### c. Semi- conservative replication.

- It was proposed by **Watson and Crick** in 1953.
- This mechanism is based on the DNA model.
- Initially two polynucleotide strands of **DNA molecule unwind and start separating at one end.**
- During this process, covalent **hydrogen bonds are broken.**
- The separated **single strand then acts as template** for the synthesis of a new strand.
- Later, each daughter **double helix carries one polynucleotide strand** from the parent and other strand is newly synthesised.

### 3. Explain the process of DNA replication with a help of an Experiment.

- The mode of DNA replication was determined in **1958 by Meselson and Stahl.**
- They distinguish different types of replications method.
- They **grew two cultures of E.coli in separate media.**
- The '**heavy**' culture was grown in a medium in which the nitrogen source( $\text{NH}_4\text{Cl}$ ) with heavy isotope  $^{15}\text{N}$

- The '**light**' culture was grown in a medium in which the nitrogen source contained light isotope  $^{14}\text{N}$
- **Findings :** DNA in the heavy culture contained only  **$^{15}\text{N}$  and in the light culture only  $^{14}\text{N}$ .**
- Then heavy DNA is distinguished from light DNA ( $^{15}\text{N}$  from  $^{14}\text{N}$ ) by **Cesium Chloride ( $\text{CsCl}$ ) density gradient centrifugation technique.**
- Heavy and light DNA extracted from cells and **separate bands** (hybrid DNA).
- The heavy culture ( $^{15}\text{N}$ ) was **then transferred into a medium that had only  $\text{NH}_4\text{Cl}$ ,** and took samples at various time intervals (20 minutes duration).
- After the first replication, they extracted **DNA and subjected it to density gradient centrifugation.**
- The DNA settled into a band that was intermediate in position between the **previously determined heavy and light bands.**
- After the second replication (**40 minutes duration**), they again extracted DNA samples, and this time found the DNA settling into two bands, one at the light band position and one at intermediate position.
- These results confirm **Watson and Crick's semi conservative replication hypothesis.**

### 4. Explain the mechanism of replication.

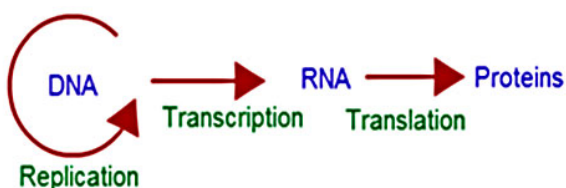
- **Replication begins at the initiation site** called the site of 'origin of replication' (ori).
- In prokaryotes, there is **only one origin of replication,**
- **Eukaryotes have several origins of replication** (replicons).
- Replication occurs at **replication fork.**
- **DNA helicase, Unwind the DNA strand**
- In one strand (**with  $3' \rightarrow 5'$  polarity**) the replication is continuous and it is known as the leading strand.
- **In other strand (with  $5' \rightarrow 3'$  polarity) replication is discontinuous,** known as the lagging strand.
- Gap in the strands are **joined by DNA ligase.**
- Discontinuous strands are called as **Okazaki fragments**



- Complementary strands are **connected by covalent bond and DNA polymerase**.
- Formation of **new strand requires a RNA primer for initiation**.
- RNA primer **removed gap from 5' end** in the newly synthesized DNA strand.
- Enzymes used : **DNA polymerase**.
- Finally, all the **gaps are sealed by DNA ligase**.
- At the point of origin of replication, the **helicases and topoisomerases (DNA gyrase) unwind and pull apart** the strands, forming a **Y-Shaped structure called the replication fork**.
- Each region has two replication forks.
- The two strands are always **antiparallel orientation**.
- DNA **polymerase enzymes catalyse the addition of a nucleotide** to the new strands in the 5'→ 3' direction, (it add nucleotides to the 3' carbon position)

#### 5. Explain Transcription process in detail.

- **Francis Crick proposed the Central dogma** in molecular biology which states that
- The process **conversion of information from DNA to RNA is termed transcription**.
- This process takes place in **presence RNA polymerase**.
- In some retroviruses, **RNA act as the genetic material(e.g, HIV)**.
- RNA synthesizes DNA by reverse transcription, then transcribed into **mRNA by transcription and then into proteins by translation**.
- For a cell to operate, its **genes must be expressed**.
- This means that the gene products, whether **proteins or RNA molecules must be made**.
- The **RNA that carries genetic information** is known as messenger RNA(mRNA).



- For transcription, **DNA's double helix drawn apart temporarily**, and RNA is synthesized by RNA polymerase.
- **RNA polymerase binds to DNA** at the start of a gene and opens the double helix.
- Finally, **RNA molecule is synthesized**.
- The nucleotide sequence in the RNA is **complementary to the DNA**.
- Both the strands of **DNA are not copied during transcription for two reasons**.
- If both the strands act as a template, **they would code for RNA with different sequences**.
- This will result in formation of **different amino acid sequences**.
- This would result in **one segment of DNA coding for two different proteins**, hence complicate the genetic information transfer mechanism.
- If two **RNA molecules were produced simultaneously, double stranded RNA would be formed**.
- This would **prevent RNA from being translated** into proteins.

#### 5. Explain various regions of DNA

- DNA has three distinct regions namely, a **promoter, the structural gene and a terminator**.

##### The promoter :

- It is **located towards the 5' end**.
- It is a **DNA sequence act as a binding site** for RNA polymerase.
- The **presence of promoter defines the template** and coding strands.

##### The terminator region :

- It is located **towards the 3' end causes the RNA polymerase to stop** transcribing.
- In eukaryotes the **promoter has AT rich regions called TATA box** (Goldberg-Hogness box)
- In prokaryotes this region is called **Pribnow box**.
- Apart from promoter, **eukaryotes also require an enhancer**.
- DNA dependent **RNA polymerase catalyses the polymerization in only one direction**,

the strand that has the polarity 3' → 5' acts as a template, and is called the template strand.

- The other strand which has the polarity 5' → 3' has a sequence same as RNA and is displaced during transcription. This strand is called **coding strand**.
- The structural gene may be **monocistronic (eukaryotes)** or **polycistronic (prokaryotes)**.
- In eukaryotes, each mRNA carries only a **single gene and encodes information for only a single protein** and is called monocistronic mRNA.
- In prokaryotes, **clusters of related genes, known as operon**, are transcribed together to give a single mRNA and hence are polycistronic.
- Bacterial RNA polymerase consists of two major components **-core enzyme + sigma subunit**.
- The core enzyme (**β1, β, and α**) is responsible for RNA synthesis
- Sigma subunit is **responsible for recognition of the promoter**.
- RNA polymerase opens up the **DNA to form the transcription bubble**.
- The **core enzyme moves ahead, manufacturing RNA** leaving the sigma subunit
- Terminator sequence that forms a **hair pin structure in the RNA**.
- The sub-class of terminators require a recognition protein, known as **rho (ρ)**, to function.

**7. List out the salient features of genetic code**

1. The genetic codon is a **triplet code (61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon(Termination))**.
2. The **genetic code is universal**.  
E.g. the mRNA (UUU)codon codes for phenylalanine in all cells of all organisms.
3. Some **exceptions are reported in prokaryotic, mitochondrial and chloroplast genomes**. However similarities are more common than differences.

4. **A non-overlapping codon** means that the **same letter is not used for two different codons**.

For instance, the nucleotide sequence GUU, GUC represents only two codons.

5. It is **comma less, which means that the message would be read directly from one end to the other** i.e., no punctuation are needed between twocodes.

6. A degenerate code means that **more than one triplet codon could code for a specific amino acid**.

For example, codons GUU, GUC, GUA and GUG code forvaline.

7. **Non-ambiguous code** means that **one codon will code for one aminoacid**.

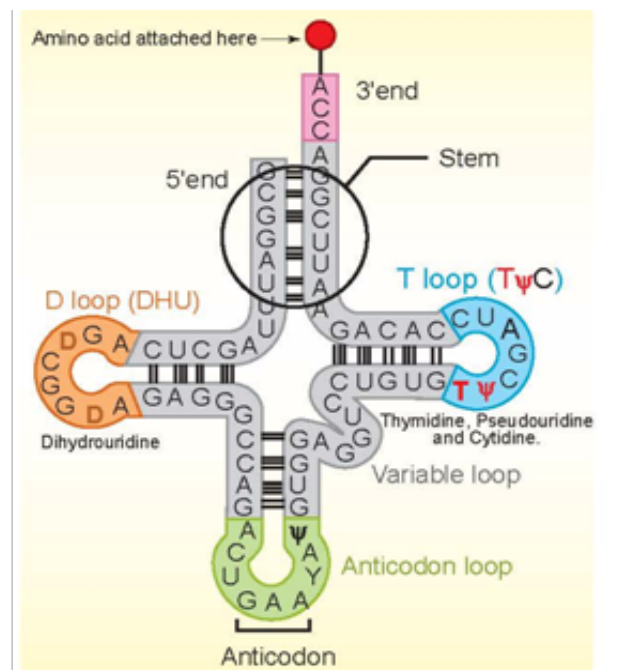
8. The code is always **read in a fixed direction** i.e. from 5'→3' direction called polarity.

9. **AUG has dual functions**. It acts as a initiator codon and also codes for the amino acidmethionine.

10.UAA, UAG (tyrosine) and UGA (tryptophan) codons are **designated as termination (stop) codons** and also are known as "non-sense" codons.

**8. Draw and explain the structure of tRNA.**

- The **two dimensional clover leaf** model of tRNA was proposed by **Robert Holley**.



- In actual structure, the **tRNA is a compact molecule** which looks like an **inverted L**.
  - tRNA has three arms namely **DHU arm, middle arm and TΨC arm**.
  - These arms have loops such as **amino acyl binding loop, anti codon loop** and ribosomal binding loop at their ends.
  - In addition it also shows a small lump called **variable loop or extra arm**.
  - The amino acid is attached to one end (amino acid acceptor end) and the other **end consists of three anti codon nucleotides**.
  - The anti codon pairs with a codon in **mRNA ensuring that the correct amino acid** is incorporated into the growing polypeptide chain.
  - Four different regions of double-stranded RNA are formed during the folding process.
  - **Modified bases are especially common in tRNA**.
  - **Wobbling between anticodon and codon allows some tRNA** molecules to read more than one codon.
  - The process of **addition of amino acid to tRNA is known as amino acylation or charging** and the resultant product is called aminoacyl-tRNA (charged tRNA).
  - Without aminoacylation tRNA is known as **uncharged tRNA**
  - This aminoacylation is catalyzed by an enzyme **aminoacyl-tRNA synthetase**.
  - 20 different aminoacyl-tRNA synthetases are known.
  - The power to **recognize codon on the mRNA lies** in the tRNA and not in the attached amino acid molecule.
  - The tRNA charged with amino acid serves as an **adapter molecule to decode the information** on mRNA.
  - There are **no tRNAs for stop codons**.
- 9. Explain in detail about Lac operon model.**
- The metabolism of lactose in E. coli requires three enzymes **permease, β-galactosidase (β-gal) and transacetylase**.
  - Permease → help **In entry of lactose into the cell**
  - **β-galactosidase → hydrolysis of lactose** into glucose and galactose,
  - **transacetylase → transfers acetyl group** from acetyl Co A to β-galactosidase.
  - The lac operon consists of one **regulator gene ('i' gene refers to inhibitor) promoter sites (p), and operator site (o)**.
  - Besides these, it has three structural genes namely **lac z, y and lac a**.
  - The **lac 'z' gene codes for β-galactosidase,**
  - **Lac 'y' gene codes for permease**
  - **Lac a' gene codes for transacetylase.**
  - In lac operon, a polycistronic structural gene is **regulated by a common promoter and regulatory gene**.
  - When the cell is using its normal energy source as glucose, the 'i' gene transcribes a repressor mRNA and after its translation, a **repressor protein is produced**.
  - It binds to the operator region of the **operon and prevents translation**, as a result, β-galactosidase is not produced.
  - When **lactose is available as an energy source** for the bacteria then lactose enters the cell as a result of permease enzyme.
  - Lactose acts as an **inducer and interacts with the repressor to inactivate it**.
  - The repressor protein binds to the **operator of the operon and prevents RNA polymerase** from transcribing the operon.
  - In the presence of inducer, such as **lactose or allolactose, the repressor is inactivated** by interaction with the inducer.
  - This allows **RNA polymerase to bind to the promoter site** and transcribe the operon to produce lac mRNA which enables **formation of all the required enzymes needed for lactose metabolism**.
  - **Jacob and Monod** proposed the classical model of Lac operon to explain gene expression
  - lac operon by the repressor is an example of **negative control of transcription initiation**.
  - Lac operon is also under the control of **positive regulation as well**.



**10. List out the Salient features of Human Genome Project:**

1. Human genome contains **3 billion nucleotide bases**, the DNA sequences that encode proteins make up only about 5% of the genome.
2. An average gene consists of **3000 bases**, the largest known human gene being **dystrophin with 2.4 million bases**.
3. The function of **50% of the genome is derived from transposable elements** such as LINE and ALU sequence.
4. Genes are **distributed over 24 chromosomes**. **Chromosome 19 has the highest gene density**. **Chromosome 13 and Y chromosome have lowest gene densities**.
5. The chromosomal organization of **human genes shows diversity**.
6. There may be **35000-40000 genes in the genome** and almost **99.9 nucleotide bases are exactly the same in all people**.
7. Functions for **over 50 percent of the discovered genes** are unknown.
8. **Less than 2 percent of the genome codes for proteins**.
9. Repeated sequences make up very large portion of the human genome. Repetitive sequences have **no direct coding functions** but they shed light on chromosome structure, dynamics and evolution (genetic diversity).
10. **Chromosome 1 has 2968 genes whereas chromosome 'Y' has 231 genes**.
11. Identification of **'SNIPS' is helpful in finding chromosomal locations** for disease associated sequences and tracing human history.

**11. Write short notes on DNA finger printing technique**

- This technique was first developed by **Alec Jeffreys in 1985**
- Each of us have the **same chemical structure of DNA**.
- But there are **millions of differences in the DNA sequence** of base pairs.
- This makes the **uniqueness among us** so that each of us except identical twins is different from each other genetically.

- The **DNA of a person and finger prints are unique**.
- There are 23 pairs of human chromosomes with **1.5 million pairs of genes**.
- It is a **well known fact that genes are segments of DNA** which differ in the sequence of their nucleotides.
- Not all segments of DNA code for proteins, some **DNA segments have a regulatory function**, while others are intervening sequences (introns) and still others are repeated DNA sequences.
- In DNA fingerprinting, short repetitive **nucleotide sequences are specific for a person**.
- These nucleotide sequences are called as **Variable number tandem repeats (VNTR)**.
- The **VNTRs of two persons generally show variations** and are useful as genetic markers.
- **DNA finger printing involves identifying differences in some specific regions in DNA** sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.
- **These sequences do not code for any proteins**, but they form a large portion of human genome.
- **These sequences show high degree of polymorphism** and form the basis of DNA fingerprinting.

**12. How are the following formed and involved in DNA packaging?**

**(i) Histone octamer (ii) Nucleosome (iii) Chromatin**

**(i) Histone octamer :**

- Histones are **positively charged proteins, rich in basic amino acid** residues lysines and arginines.
- These amino acids carry **positive charges on their side chains**.
- There are five types of histone proteins : **H<sub>1</sub>, H<sub>2</sub>A, H<sub>2</sub>B, H<sub>3</sub> and H<sub>4</sub>**.
- Four of them (H<sub>2</sub>A, H<sub>2</sub>B, H<sub>3</sub> and H<sub>4</sub>) are organised in pairs to form a **unit of eight molecules called histone octamer**.
- Negatively charged DNA wraps around this octamer to form nucleosome.

(ii) Nucleosome :

- It is the **compaction unit**.
- The positively charged ends of **histone octamer attract the negatively charged strands of DNA**.
- The DNA is thus wrapped around the **positively charged histone octamer to form a structure called nucleosome**.
- Around **200 bp of DNA is wrapped around the body** or histone octamer for 134 turns.
- DNA connecting two adjacent **nucleosomes is called linker DNA** which bears H1 histone protein. Nucleosome and linker DNA together constitute chromatosome.
- Nucleosome chain gives a bead on string appearance.

**Chromatin :**

- The **nucleosomal organization** has approximately 10 nm thickness, which **further gets condensed and coiled to produce a solenoid** (having 6 nucleosomes per turn) of 30 nm diameter.
- This solenoid structure further undergoes **coiling to produce a chromatin fibre of 30-80 nm thickness**.

### 13. Mention the contributions of the following scientists:

- (i) Maurice Wilkins and Rosalind Franklin (ii) Erwin Chargath
- (i) Maurice Wilkins and Rosalind Franklin (1953) carried out **X-ray diffraction studies to study the structure of DNA molecule**.
- Waston and Crick (1953) worked out the first correct **double helix model from the X-ray photographs of Wilkins and Franklin**.
- (ii) Erwin Chargaff (1950) proposed **Chargaff's rules** (or base pair rules) about DNA.
- **Adenine pairs with Thymine (A = T)** with two hydrogen bonds and **Guanine pairs with Cytosine (G ≡ C)** with three hydrogen bonds.
  - The ratios between Adenine with Thymine and Guanine with Cytosine are **constant and equal**.
  - The base pairing confers a **unique property to the polynucleotide chain**.

### 14. Explain the process of transcription in prokaryotes.

- Mechanism of transcription in prokaryotes: In prokaryotes, **transcription occurs in contact with cytoplasm** as their DNA lies in the cytoplasm.

#### a) Activation of ribonucleotides –

- The four types of ribonucleotides are **adenosine monophosphate (AMP), guanosine monophosphate (GMP), uridine monophosphate (UMP) and cytidine monophosphate (CMP)**.
- They occur freely in the **nucleoplasm**.
- Prior to transcription the **nucleotides are activated through phosphorylation**.
- Enzyme **phosphorylase is required along with energy**.
- The activated or phosphorylated ribonucleotides are adenosine triphosphate (ATP), guanosine triphosphate (GTP), uridine triphosphate (UTP) and cytidine triphosphate (CTP).

#### b) Binding of RNA polymerase to DNA duplex

- On a signal from the cytoplasm, **DNA segment becomes ready to transcribe**.
- The RNA polymerase enzyme binds to a specific site, called **promoter**, in the DNA double helix.
- **Prokaryotes have only one RNA polymerase** that synthesise all types of RNA.
- The **promoter also determines** which DNA strand is to be transcribed.
- Thus, a **promotor region has RNA polymerase recognition site** and RNA polymerase binding site.

#### c) Base pairing

- Ribonucleoside triphosphates present in the surrounding medium come to **lie opposite the nitrogen bases of the DNA template** (anti-sense strand).
- They form complementary pairs; **U opposite A, A opposite T, C opposite G and G opposite C**.
- A pyrophosphate is released from each **ribonucleoside triphosphate to produce ribonucleotide**.



**d) Formation of RNA chain**

- With the help of RNA polymerase the adjacent ribonucleotides held over DNA template join to form RNA chain.
- A **single RNA polymerase recognise promoter and initiation region** is prokaryotes.
- As the RNA chain formation initiates, **the sigma (σ) factor of the RNA polymerase separates.**
- **RNA polymerase** (core enzyme) moves along the DNA template causing elongation of RNA chain at the rate of some **30 nucleotides per second.**
- RNA synthesis **stops as soon as polymerase reaches the terminator region.**
- **Rho factor (ρ) has ATP-ase activity** and also possesses 4-8 adenine ribonucleotides.
- Separation of RNA chain – With the help of rho factor, the **fully formed RNA chain is now released.**
- One gene forms several molecules of RNA, which are released from the DNA template one after the other on completion.
- The released **RNA is called primary transcript.**

**(f) Duplex formation**

- As the RNA chain is released, the transcribed region of the **DNA molecule gets hydrogen bonded** to the sense strand and the two are spirally coiled to assume the original doublehelical form.
- The protective protein coat is added again to the DNA duplex.

**15. During the course of evolution why DNA was chosen over RNA as genetic material? Give reasons by first discussing the desired criteria in a molecule that can act as genetic material and in the light of biochemical differences between DNA and RNA.**

Following are the desired criteria in a molecule that can act as genetic material:

- It should have the **capability of replication.**
- It should **chemically and structurally stable.**

- It should be **able to incorporate slow changes** (mutation) which are required for evolution.
- It should be **able to express itself in the form of Mendelian characters.**

**Biochemistry of DNA and RNA:**

- Both DNA and RNA **show complementarity of base pairs** and hence are capable of replication.
- As shown by Griffith's experiment, **DNA is more stable than RNA** because it could survive even heat-killing during the experiment.
- **2'-OH group is present in RNA. This makes RNA labile and degradable;** which is not the case with DNA.
- Both **RNA and DNA can carry on mutations.** But DNA being more stable is **better suited for long term storage of mutations.**
- Hence, **DNA was preferred as the genetic material** during the course of evolution.

**16. Discuss the process of translation in detail.**

- The process of **polymerization of amino acid to form a polypeptide is called translation.**
- Thus, the biological process through which **protein is synthesized is called translation.**

- **Translation happens in following main steps:**

**Initiation:**

- Ribosome assembles around the target mRNA and we know that **ribosome is the site of protein synthesis.**
- The first **tRNA gets attached at the start codon.**
- A **codon is a triplet of amino acids.**

**Elongation:**

- The **tRNA transfers an amino acid** to the tRNA corresponding to the next codon.
- This phase involves **addition of subsequent amino acids to form a long chain.**
- This step forms the bulk of the protein synthesis.

**Translocation:**

- The **ribosome then moves to the next mRNA** codon and continues the process.
- This **creates an amino acid chain.**

**Termination:**

- When a stop codon is reached, the ribosome releases the polypeptide.

**17. Define an operon. Giving an example, explain an Inducible operon.**

- A functioning unit of genomic DNA containing a **cluster of genes under the control of a single promoter is called operon.**
- An **operon is generally transcribed** into polycistronic mRNA.
- A single **mRNA which codes for more than one protein is called polycistronic mRNA.**
- An operon is made up of **3 basic DNA components:**

**Promoter:**

- A nucleotide sequence that enables a gene to be transcribed is called promoter.
- It is recognized by **RNA polymerase, which then initiates transcription.**

**Operator:**

- A segment of DNA to which a **repressor binds is called operator.**

**Structural genes:**

- The genes that are **co-regulated by the operon** are called structural genes.

**Inducible Operon:**

- When the operon is regulated by an inducer, it is called **inducible operon.**
- An **inducer can switch on or off** the operon.
- E.g. **Lac operon**

**18. A DNA segment has a total of 2,000 nucleotides, out of which 600 are Guanine containing nucleotides.**

**How many pyrimidine bases this segment possess**

- Cytosine and thymine are pyrimidines.
- According to Chargath's Rule, purines and pyrimidine

- base pairs are in equal amount, therefore

- Total nucleotides = 2000

$$[A + G + C + T] = 2000$$

$$[A] = [T] \text{ and } [G] = [C]$$

$$\text{Guanine} = 600$$

$$\text{Therefore, } A + 600 + 600 + T = 2000$$

$$A + T + 1200 = 2000$$

$$A + T = 2000 - 1200$$

$$2T = 800(A=T)$$

$$T = 800/2 = 400$$

- Therefore, total pyrimidine,

$$C + T = [600 + 400] = 1000$$

**20. Difference between Prokaryotic Transcription Eukaryotic Transcription**

Prokaryotic Transcription	Eukaryotic Transcription
It occurs in <b>cytoplasm</b>	It occurs <b>inside the nucleus</b>
There is <b>no specific period for its occurrence</b>	Major part of <b>transcription occurs in G<sub>1</sub> and G<sub>2</sub> phases</b>
It is <b>coupled to translation</b>	Transcription and translation are <b>spacially separated</b>
Products of <b>Transcription become effective</b>	Products of <b>transcription come out of the nucleus</b> for functioning in cytoplasm
There is <b>only one RNA polymerase.</b>	There are <b>three types of RNA polymerases.</b>
mRNA is generally <b>polycistronic</b>	mRNA is generally <b>monocistronic</b>
<b>Splicing is generally not required</b>	<b>Splicing is required</b> for removing intervening sequences



## POINTS TO REMEMBER

- ❖ The term evolution is used to **describe heritable changes in one or more characteristics** of a population of species from one generation to the other.
- ❖ According **Theory of special creation**, life was created by "God".
- ❖ According to **the theory of spontaneous generation** or Abiogenesis, **living organisms originated from non-living materials**
- ❖ **Big bang theory** explains the origin of universe as a **singular huge explosion in physical terms**.
- ❖ According to the **theory of biogenesis**, life arose from pre-existing life.
- ❖ According to the **theory of chemical evolution**, primitive organisms in the primordial environment of the earth **evolved spontaneously from inorganic substances and physical forces**
- ❖ The Paleozoic era is characterized by **abundance of fossils of marine invertebrates**.
- ❖ Mesozoic era (dominance of reptiles) called the **Golden age of reptiles**.
- ❖ **Cenozoic era** (Age of mammals) is subdivided into two periods namely **Tertiary and Quaternary**.
- ❖ Urey and Miller (1953), paved way for **understanding the possible synthesis of organic compounds** that led to the appearance of living organisms.
- ❖ Paleontology is the study of **prehistoric life through fossils**.
- ❖ Fossilization is the process by which **plant and animal remains are preserved in sedimentary rocks**. They fall under three main categories.
- ❖ **Actual remains, Petrification, Natural moulds and casts**
- ❖ Structures which are similar in origin but perform different functions are called **homologous structures** that brings about **divergent evolution**.
- ❖ Organisms having different structural patterns but similar function are termed as **analogous structures**.
- ❖ Structures that are of no use to the possessor, and are not necessary for their existence are called **vestigial organs**:
- ❖ Eg. Human appendix, coccyx, wisdom teeth, ear muscles, body hair, mammae in male, nictitating membrane
- ❖ The organisms which possess the characters of two different groups (transitional stage) are called **connecting links**.
- ❖ Sudden appearance of vestigial organs in highly evolved organisms is called **atavistic organs**:  
E.g. presence of tail in a human baby
- ❖ Embryology deals with the **study of the development of individual** from the egg to the adult stage.
- ❖ **Jean Baptiste de Lamarck**, postulate the theory of evolution in his famous book 'Philosophie Zoologique' in the year 1809.
- ❖ The two principles of Lamarckian theory are:
  1. **The theory of use and disuse**
  2. **The theory of inheritance of acquired characters**
- ❖ Lamarck's "Theory of Acquired characters" was disproved by **August Weismann**
- ❖ Charles Darwin explained the theory of evolution in his book 'The Origin of Species by Natural Selection'.
- ❖ Darwin's theory was based on
  - ❖ **Over production (or) prodigality of production, Struggle for existence, Universal occurrence of variations**
  - ❖ **Hugo de Vries** put forth the Mutation theory.
  - ❖ Mutations are **sudden random changes that occur in an organism** that is not heritable.

- ❖ Mutations or discontinuous variation are transmitted to other generations.
- ❖ **Sewell Wright, Fisher, Mayer, Huxley, Dobzhansky, Simpson and Haeckel** explained Natural Selection in the light of Post-Darwinian discoveries.
- ❖ Five basic factors involved in the process of organic evolution.
- ❖ **1. Gene mutation or Chromosomal mutation, Genetic recombination, Natural selection, Reproductive isolation,**
- ❖ The evolutionary process which produces new species diverged from a single ancestral form becomes adapted to newly invaded habitats is called **adaptive radiation**.
- ❖ There are mainly three types of natural selection
- ❖ **Stabilising Selection (centripetal selection), Directional Selection, Disruptive Selection (centrifugal selection):**
- ❖ **Movement of genes through gametes or movement** of individuals in (immigration) and out (emigration) of a population is referred to as gene flow.
- ❖ Genetic drift is a **mechanism of evolution in which allele frequencies** of a population change over generation due to chance (sampling error).
- ❖ Hominid evolution occurred in **Asia and Africa**.
- ❖ **Dryopithecus and Ramapithecus** were hairy and walked like gorillas and chimpanzees.
- ❖ Australopithecus lived in East African grasslands about 5 mya and was called the **Australian ape man**.
- ❖ Homo erectus the first human like being was **around 1.7 mya** and was much closer to human in looks.
- ❖ Neanderthal human was found in **Neander Valley, Germany** with a brain size of 1400 cc
- ❖ Cro-Magnon was one of the most talked forms of modern human found from the rocks of Cro-Magnon, France and is considered as the **ancestor of modern Europe**
- ❖ Homo sapiens arose in **Africa some 25,000 years ago** and moved to other continents

## PART-A

## TEXTUAL QUESTIONS

(1 MARK)

1. **The first life on earth originated**

a) in air	b) on land
c) in water	d) on mountain

**Ans: c**
2. **Who published the book "Origin of species by Natural Selection" in 1859?**

a) Charles Darwin	b) Lamarck
c) Weismann	d) Hugo de Vries

**Ans: a**
3. **Which of the following was the contribution of Hugo de Vries?**

a) Theory of mutation	b) Theory of natural Selection
c) Theory of inheritance of acquired characters	d) Germplasm theory

**Ans: a**
4. **The wings of birds and butterflies is an example of**

a) Adaptive radiation	b) convergent evolution
c) divergent evolution	d) variation

**Ans: b**
5. **The phenomenon of "Industrial Melanism" demonstrates**

a) Natural selection	b) induced mutation
c) reproductive isolation	d) geographical isolation

**Ans: a**
6. **Darwin's finches are an excellent example of**

a) connecting links	b) seasonal migration
c) adaptive radiation	d) parasitism

**Ans: c**
7. **Who proposed the Germplasm theory?**

a) Darwin	b) August Weismann
c) Lamarck	d) Alfred Wallace

**Ans: b**

**8. The age of fossils can be determined by**

- a) electron microscope      b) weighing the fossils
- c) carbon dating              d) analysis of bones

**Ans: c**

**9. Fossils are generally found in**

- a) igneous rocks                b) meta morphic rocks
- c) volcanic rocks              d) sedimentary rocks

**Ans: d**

**10. Evolutionary history of an organism is called**

- a) ancestry                      b) ontogeny
- c) phylogeny                  d) paleontology

**Ans: c**

**11. The golden age of reptiles was**

- a) Mesozoic era                b) Cenozoic era
- c) Paleozoic era              d) Proterozoic era

**Ans: a**

**12. Which period was called "Age of fishes"?**

- a) Permian                      b) Triassic
- c) Devonian                    d) Ordovician

**Ans: c**

**13. Modern man belongs to which period?**

- a) Quaternary                 b) Cretaceous
- c) Silurian                      d) Cambrian

**Ans: a**

**14. The Neanderthal man had the brain capacity of**

- a) 650–800cc                 b) 1200cc
- c) 900cc                        d) 1400cc

**Ans: d**

**PART-B, C AND D**

**TEXTUAL QUESTIONS (2,3 AND 5 MARKS)**

**15. List out the major gases seems to be found in the primitive earth.**

- Primitive earth contain **ammonia, methane, hydrogen and water vapour.**
- Due to split up water molecules by UV rays **hydrogen and oxygen also present.**

**16. Explain the three major categories in which fossilization occur?**

**Fossilization occur in three ways they are**

1. **Actual remains**
2. **Petrifaction**

**3. Natural moulds and casts**

**i) Actual remains –**

- This is the most **common method of fossilization.**
- Hard parts such as **bones, teeth or shells are preserved as such** in the earth's atmosphere.
- If Marine animals die their parts are **covered with sediments and are protected.**
- They **get preserved as such** as they are preserved in vast ocean, the **salinity in them prevents decay.**
- The sediments **become hardened** to form definite layers or strata.
- Eg. **Woolly Mammoth fossils** were preserved in the **frozen coast of Siberia**
- Several human beings and animals ancient city of Pompeii were **preserved intact by volcanic ash**

**ii) Petrifaction**

- When animals die the **original portion of their body may be replaced** by minerals and the **original substance being lost through disintegration.**
- This method of fossilization is called **petrifaction.**
- **Minerals involved** - iron pyrites, silica, calcium carbonate and bicarbonates of calcium and magnesium.

**iii) Natural moulds and casts**

- Even after **disintegration, the body of an animal might leave indelible impression** on the soft mud which later becomes hardened into stones.
- Such impressions are called **moulds.**
- The cavities of the moulds may get **filled up by hard minerals and get fossilized,** which are called casts.



17. Differentiate between divergent evolution and convergent evolution with one example for each.

Divergent Evolution	Convergent evolution
i. Development of <b>different functional structures</b> from a common ancestral form.	i. Development of <b>similar adaptive functional structures</b> in unrelated groups of organisms.
ii. <b>Homologous organs</b> show divergent evolution.	ii. <b>Analogous organs</b> show convergent evolution.
Eg. <b>Darwin's finches, Australian Marsupials, locomotion in mammals.</b>	Eg. Australian Marsupials and placental mammals, various aquatic vertebrates and <b>wings of insect, bird and bat.</b>

18. How does Hardy-Weinberg's expression ( $p^2+2pq+q^2=1$ ) explain that genetic equilibrium is maintained in a population? List any four factors that can disturb the genetic equilibrium.

- If a population is in a state of Hardy Weinberg equilibrium, **the frequencies of alleles and genotypes or sets of alleles in that population will remain same** over generations.
- Suppose we have a large population of beetles, and appear in two **colours dark grey** (black) and **light grey**, and their colour is determined by '**A**' gene.
- '**AA**' and '**Aa**' beetles are dark grey
- '**aa**' beetles are light grey.
- In a population let's say that '**A**' allele has frequency (**p**) of 0.3 and '**a**' allele has a frequency (**q**) of 0.7.
- Then  **$p+q=1$** .
- If a population is in **Hardy Weinberg equilibrium**, the genotype frequency can be estimated by Hardy Weinberg equation.

$$(p + q)^2 = p^2 + 2pq + q^2$$

$$p^2 = \text{frequency of AA}$$

$$2pq = \text{frequency of Aa}$$

$$q^2 = \text{frequency of aa}$$

$p = 0.3, q = 0.7$  then,

$$p^2 = (0.3)^2 = 0.09 = 9\% \text{ AA}$$

$$2pq = 2(0.3)(0.7) = 0.42 = 42\% \text{ Aa}$$

$$q^2 = (0.7)^2 = 0.49 = 49\% \text{ aa}$$

- Hence the beetle population appears to be in **Hardy- Weinberg equilibrium**.
- The major factors which **disturb Hardy-Weinberg equilibrium** are

1. **Gene migration or gene flow**
2. **Mutation**
3. **Genetic drift**
4. **Recombination**
5. **Natural selection**

19. Explain how mutations, natural selection and genetic drift affect Hardy Weinberg equilibrium.

- Allele frequencies in a population may change due to four fundamental forces of evolution such as **natural selection, genetic drift, mutation and gene flow**.
- If these events are not possible the **population will not be in Hardy – Weinberg equilibrium**

20. How did Darwin explain fitness of organisms?

- Fitness is the state of **being suitably adapted** to an environment.
- Darwin proved that **fittest organisms can survive and leave more progenies** than the unfit ones through natural selection.
- Because they **will survive more** and hence are selected by nature.

21. Mention the main objections to Darwinism.

**objections against Darwinism are**

1. Darwin failed to explain the **mechanism of variation**.
2. Darwinism explains the survival of the fittest **but not the arrival of the fittest**.
3. He focused on **small changing variations that are mostly non-heritable**.
4. He did not **distinguish between somatic and germinal variations**.
5. He **could not explain the occurrence of**

**vestigial organs, over specialization** of some organs

Eg. large tusks in mammoths, oversized antlers in Irish deer, etc.,

**22. Taking the example of Peppered moth, explain the action of natural selection. What do you call the above phenomenon?**

- Phenomenon - **industrial melanism**
- **Peppered moth – Bistonbetularia** were available in two colours, **white and black**.
- Before industrialization **peppered moth both white and black** coloured were common in England.
- Pre-industrialization witnessed white coloured background of the wall of the buildings hence the **white coloured moths escaped from their predators**.
- Post industrialization, the **tree trunks became dark due to smoke and dust** let out from the industries.
- The **black moths masked on the dark bark** of the trees and the **white moths were easily identified by their predators**.
- Hence the **dark coloured moth population was selected** and their number increased when compared to the white moths.
- Nature offered **positive selection pressure to the black coloured moths**.
- The above proof shows that in a population, **organisms that can adapt will survive and produce more progenies** resulting in increase in population through natural selection.

**23. Darwin's finches and Australian marsupials are suitable examples of adaptive radiation – Justify the statement.**

- The process of **evolution of different species in a given geographical area** starting from a point and literally radiating to other areas of geography (habitats) is called **adaptive radiation**
- E.g., **Darwin's finches**.
- Common **ancestor of Darwin's finches arrived on the Galapagos** about 2 million years ago.
  - Darwin's finches have evolved into **14**

**recognized species differing in body size, beak shape and feeding behavior.**

- Changes in the size and form of the beak have **enabled different species to utilize different food resources** such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection.
- Genetic variation in the **ALX1 gene in the DNA of Darwin finches is associated with variation** in the beak shape.
- **Mild mutation in the ALX1 gene leads to phenotypic change** in the shape of the beak of the Darwin finches.

Eg., *Australian marsupials* :

- **A number of marsupials**, each different from the other **evolved from an ancestral stock**, but all within the Australian island continent.

**24. Who disproved Lamarck's Theory of acquired characters? How?**

- **August Weismann** disproved Lamarck's "Theory of Acquired characters"
- He conducted experiments on mice for **twenty generations by cutting their tails** and breeding them.
- All mice born were **with tail**.
- Weismann **proved that change in the somatoplasm will not be transferred** to the next generation but changes in the germplasm will be inherited.

**25. How does Mutation theory of De Vries differ from Lamarck and Darwin's view in the origin of new species.**

- According to de Vries, **sudden and large variations were responsible for the origin of new species** whereas Lamarck and Darwin believed in **gradual accumulation of all variations**
- According to Hugo de Vries, **mutations are sudden and heritable variations** which causes evolution, hence called it saltation (single step large mutations).
- While Darwin's theory of natural selection states that **speciation is due to accumulation of small, directional, and heritable variations**, and is a gradual process.

## 26. Explain stabilizing, directional and disruptive selection with examples.

There are mainly three types of natural selection

### 1. Stabilising Selection (centripetal selection):

- This type of selection operates in a **stable environment**.
- The organisms with average phenotypes survive whereas the **extreme individuals from both the ends are eliminated**.
- There is **no speciation but the phenotypic stability is maintained** within the population over generation.

E.g., measurements of sparrows that survived the storm clustered around the mean, and the sparrows that failed to survive the storm clustered around the extremes of the variation

### 2. Directional Selection:

- The environment which undergoes **gradual change is subjected to directional selection**
- This type of selection **removes the individuals from one end towards the other end** of phenotypic distribution.

E.g., **size differences between male and female sparrows.**

- Both male and female **look alike externally but differ in body weight**.
- Females show directional selection in relation to body weight.

### 3. Disruptive Selection (centrifugal selection) :

- When **homogenous environment changes into heterogenous environment** this type of selection is operational
- The organisms of both the extreme phenotypes are selected **whereas individuals with average phenotype are eliminated**.
- This is a rare form of selection but **leads to formation of two or more different species**.
- It is also called **adaptive radiation**.
- E.g., Darwin's finches-beak size in relation to seed size inhabiting Galapagos islands.

## 27. Rearrange the descent in human evolution

*Australopithecus* → *Homo erectus* → *Homo sapiens* → *Ramapithecus* → *Homo habilis*.

Answer : **Ramapithecus** → **Homo habilis** → **Homo erectus** → **Homo sapiens**

## 28. Differentiate between the eating habit and brain size of Australopithecus and Ramapithecus.

	Australopithecus	Ramapithecus
<b>Eating pattern</b>	It mainly ate <b>fruit, vegetables, small lizards, and tubers.</b>	It ate <b>hard nuts and seeds</b>
<b>Brain size</b>	<b>350 – 450 cc</b>	Relatively large brain

## 29. How does Neanderthal man differ from the modern man in appearance?

Neanderthal	Modern human
Neanderthals are an <b>extinct species of human</b> .	Humans refer to the <b>primate species</b> of to which modern humans belong
Named as <b>Homo Neanderthalensis</b>	Named as <b>Homo sapiens</b>
Evolved about <b>400,000 to 40,000 years ago</b> in Europe and Southwestern to central Asia	Evolved about <b>200,000</b> years ago in Africa
Skull comprised a large middle part of <b>the face, A huge nose and angled check bone</b>	Skull is <b>thin-walled, dome shape, with a flat</b> , and near vertical forehead
Brain was <b>larger in comparison to body</b>	Have special features in their skull to overcome the <b>large size of the brain</b>
Average height - <b>Males : 5 ft 5</b> <b>Females was 5 ft 1</b>	Average height - <b>Males : 5 ft 7<sup>1/2</sup></b> <b>Females was 5 ft 2</b>

## 30. Mention any three similarities found common in Neanderthal man and Homosapiens.

- Neanderthal man and *Homo sapiens* are **belongs to the genus –Homo**
- **Both are primates**
- **Both Neanderthal man and Homo sapiens have a similar size brain**

**31. According to Darwin, the organic evolution is due to**

- a) Intra specific competition
- b) Inter specific competition**
- c) Competition within closely related species
- d) Reduced feeding efficiency in one species due to the presence of interfering species.

**32. A population will not exist in Hardy- Weiberg equilibrium if**

- a) Individuals mate selectively**
- b) There are no mutations
- c) There is no migration
- d) The population is large

**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

**1. The mammal like early reptiles which gave rise to mammals, are evolved in**

- a) Silurian
- b) Mississippian
- c) Devonian
- d) Permian

**Ans: d**

**2. Dinosaurs originated:**

- a) After evolution of mammals
- b) With mammals
- c) Much before mammals
- d) Before mammals and they formed them

**Ans: b**

**3. Archaeopteryx is a connecting link because**

- a) It possessed characters of reptiles and aves
- b) It has characters of reptiles and mammals
- c) It was a reptile not a bird
- d) It had characters of non chordates and chrodates

**Ans: a**

**4. Analogous organs are**

- a) Similar in origin
- b) Similar in structure
- c) Non functional
- d) Similar in function

**Ans: d**

**5. Evolutionary history of an organism is known as**

- a) Phylogeny
- b) Ancestry
- c) Palaeontology
- d) Ontogeny

**Ans: a**

**6. Which of the following provides most evident proof of evolution?**

- a) Fossils
- b) Morphology
- c) Embryo
- d) Vestigial organs

**Ans: a**

**7. What was the basic principle of Lamarckism**

- a) Inheritance of acquired characters
- b) Survival of the fittest
- c) Natural selection
- d) Acquired characters

**Ans: c**

**8. Book 'Philosophie Zoologique' published in the year 1809 was written by**

- a) Darwin
- b) Lanmark
- c) De Vries
- d) Mendel

**Ans: b**

**9. Who published the book "Orgin of species by Natural Selection" in 1859**

- a) lanmarck
- b) Darwin
- c) Wallace
- d) Oparin

**Ans: b**

**10. Neo-Darwinism believes that new species develop through**

- a) Mutations
- b) Hybridization
- c) Mutations with natural selection
- d) None of the above

**Ans: c**

**11. Which one is linked to evolution?**

- a) Extinction
- b) Competition
- c) Variation
- d) Reproduction

**Ans: c**

**12. Ancestor of man who first time showed bipedal movement**

- a) Cro-magnon
- b) Australopithecus
- c) Java apeman
- d) Peking man

**Ans: b**

**13. Cranial capacity of Neanderthal man was**

- a) 900 cc
- b) 1075 cc
- c) 1450 cc
- d) 1400 cc

**Ans: d**

**14. Coloured rock paintings were first done by**

- a) Cro-magnon man
- b) Java ape man
- c) Peking man
- d) Neanderthal man

**Ans: a**

- 15. Primitive atmosphere was made up of the mixture of**  
 a) Oxygen, ammonia, methane, water  
 b) Hydrogen, ammonia, methane, oxygen  
 c) Hydrogen, steam, methane, ammonia  
 d) Oxygen, methane, water, nickel **Ans: c**
- 16. What is most important for origin of life**  
 a) Carbon  
 b) Oxygen  
 c) Water  
 d) Nitrogen **Ans: c**
- 17. Oxygen in atmosphere has been formed by**  
 a) Evaporation of water  
 b) Photosynthesis of blue green algae  
 c) metabolism of microorganisms  
 d) decaying organisms **Ans: b**
- 18. Oparin's theory is based on**  
 a) Artificial synthesis  
 b) Spontaneous generation  
 c) God's well  
 d) All **Ans: a**
- 19. Which biologist gave most logical biochemical theory of origin of life**  
 a) Urey  
 b) Oparin  
 c) Stanley Miller  
 d) Haeckel **Ans: b**
- 20. Who did an experiment to prove that 'The organic compounds were the basis of life'?**  
 a) Darwin  
 b) Stanely Miller and Harold C.Urey  
 c) Melvin  
 d) Fox **Ans: b**
- 21. First life on earth was**  
 a)Cyanobacteria  
 b) similar to the Monera  
 c) Autotrophs  
 d) Photoautotrophs **Ans: b**
- 22. Abiogenesis is the**  
 a) Origin of life from non-living material  
 b) Origin of life from living organism  
 c) Origin of viruses and microbes  
 d) none **Ans: a**
- 23. Most modern hypothesis regarding origin of life was given by**  
 a) Wallace  
 b) Hugo de Vries  
 c) Oparin  
 d) Charles Darwin **Ans: c**
- 24. Which is vestigial organ in man**  
 a) Pinna  
 b) Pinna muscles  
 c) Lleum  
 d) Teeth **Ans: b**
- 25. Miller and Urey performed an experiment to prove the origin of life. They took gases  $\text{NH}_3$  and  $\text{H}_2$  along with**  
 a)  $\text{N}_2$  and  $\text{H}_2\text{O}$   
 b)  $\text{H}_2\text{O}$  and  $\text{CH}_4$   
 c)  $\text{CH}_4$  and  $\text{N}_2$   
 d)  $\text{CO}_2$  and  $\text{NH}_3$  **Ans: b**
- 26. Peripatus is connecting link between**  
 a) Mollusca and Arthropoda  
 b) Flat worms and annelid  
 c) Annelida and Arthropoda  
 d) Reptilia and Mammalia **Ans: c**
- 27. Which of the following set has homologous organs**  
 a) Hands of man, monkey and kangaroo and trunk of elephant  
 b) Wings of insects, birds and bats  
 c) Hind limbs of grasshopper, horse and bat  
 d) bones such as humerus, radius, ulna, carpals, metacarpals and phalanges **Ans: d**
- 28. Who was the first to explain recapitulation theory**  
 a) Weismann  
 b) Haeckel  
 c) Darwin  
 d) Malthus **Ans: b**
- 29. Which of the following sets do not have homologous organs**  
 a) Wings of mosquito and butterfly  
 b) Wings of butterfly and bat  
 c) Mouth parts of cockroach and butter fly  
 d) None of them **Ans: b**
- 30. Golden age of Dinosaurs was during**  
 a) Cenozoic era  
 b) Palaeozoic era  
 c) Archeozoic era  
 d) Mesozoic era **Ans: d**



**31. Evolution of birds and mammals occurred in**

- a) Eocene and Oligocene periods
  - b) Silurian and Devonian periods
  - c) Carboniferous and Permian periods
  - d) Cretaceous and Triassic periods
- Ans: d**

**32. The Mesozoic era of earth is called the**

- a) Golden Age of amphibians
  - b) Golden age Age of armoured fishes
  - c) Golden Age of primitive man
  - d) Golden age of reptiles
- Ans: d**

**33. An era "age of birds and mammals"**

- a) Mesozoic
  - b) Palaeozoic
  - c) Cenozoic
  - d) Cretaceous
- Ans: c**

**34. Origin of life took place in which of the following era**

- a) Mesozoic
  - b) Palaeozoic
  - c) Precambrian
  - d) Proterozoic
- Ans: c**

**35. A connecting link between reptiles and birds is**

- a) Archaeopteryx
  - b) Platypus
  - c) Java Ape man
  - d) Whale
- Ans: a**

**36. Evolution of heart from one to two, three and four chambered proves**

- a) Biogenetic law of Haeckel
  - b) Lamarckism
  - c) Hardy Weinberg's law
  - d) Neo Darwinism
- Ans: a**

**37. Potato and sweet potato**

- a) Have edible parts which are homologous organs
  - b) Have edible which are analogous organs
  - c) Have been introduced in India from the same place
  - d) they are two species of the same genus
- Ans: b**

**38. Fossils are**

- a) Animals living in burrows
  - b) Remnants of extinct animals and plants
  - c) Floating organisms
  - d) Fast runners
- Ans: b**

**39. Convergent evolution of two species is associated with**

- a) Analogous organs
  - b) Recent common ancestor
  - c) Homologous organs
  - d) Different habitat
- Ans: a**

**40. Darwin's finches are an example of**

- a) Divergent evolution
  - b) Adaptive radiation
  - c) Allopatric speciation
  - d) All of these
- Ans: d**

**41. Name of the scientist who gave Mutation Theory**

- a) Wallace
  - b) Malthus
  - c) Dawin
  - d) De Vries
- Ans: d**

**42. The ultimate source of variation is**

- a) Mutation
  - b) Sexual reproduction
  - c) natural selection
  - d) Hormonal action
- Ans: a**

**43. Who is related with modern synthetic theory of evolution:**

- a) Dobzhansky
  - b) Haldane
  - c) Mayr
  - d) De Vries
- Ans: a**

**44. Inheritance of acquired characters comes from**

- a) Lamarckism
  - b) Darwinism
  - c) Ne- Lemarckism
  - d) Neo-Darwinism
- Ans: a**

**45. Struggle for existence and survival of the fittest theories were given by**

- a) Wallace
  - b) Darwn
  - c) Lanmarck
  - d) None of these
- Ans : b**

**46. Which fossil man had cranial capacity almost equal to modern man**

- a) Australopithecus
  - b) Java ape man
  - c) Neanderthal man
  - d) Peking man
- Ans: c**

**47. Homo habilis refers to**

- a) Wandering species
  - b) Ancient man
  - c) Modern man
  - d) Tool-maker
- Ans: d**



48. Which of the following ancestor of man was fond of painting and weapons making

- a) Neanderthal man      b) Cromagnon man  
c) Java man              d) Peking man **Ans: b**

49. Hugo Devries worked on

- a) Oenotheralamarckianab) Lathrusodoratus  
c) Pisumsativum              d) Arachis hypogeal  
**Ans: a**

50.  $(p+q)^2 = p^2 + 2pq + q^2 = 1$  represents an equation used in

- a) Population genetics  
b) Menedelian genetics  
c) Biometrics  
d) Molecular genetics **Ans: a**

51. Fossils are generally found in

- a) Sedimentary rocks      b) Igneous rocks  
c) Metamorphic rocks      d) Any type of rock  
**Ans: a**

52. The first human being like prehistoric man was

- a) Homo sapiens              b) Homo erectus  
c) Homo habilis              d) Neanderthal man  
**Ans: c**

53. What is sequence in the evolution of mammals?

- a) Fish-amphibian-bird-mammals  
b) Insect – fish –bird – mammals  
c) Fish – amphibian – reptile- mammals  
d) Fish – amphibian – reptile – bird – mammals  
**Ans: c**

54. The difference between Homo sapiens and the Homo erectus was \_\_\_\_\_.

- a. Homo sapiens originated in Africa while Homo erectus was in Asia  
b. Homo erectus were much smaller in size than homo sapiens.  
c. Homo erectus stayed in Africa while Homo sapiens did not.  
d. The size of their brain of Homo eructus was smaller to homo sapiens  
**Ans: d**

55. By studying analogous structures we look for \_\_\_\_\_.

- a. similarities in appearance and function but different in structure.  
b. similarities in appearance but differences in functions.  
c. Similarities in organ structure.  
d. Similarities in cell make up.  
**Ans: a**

56. The scientist who cut off the tails of mice of successive generations to prove Lamarck's theory was wrong was \_\_\_\_\_.

- a) Weismann                  b) Haeckel  
c) Darwin                      d) Wallace **Ans: a**

57. Human being belongs to the species of \_\_\_\_\_.

- a) Homo erectus              b) Homo habillis  
c) Homo sapiens              d) Hominidae **Ans: c**

58. Evidences of evolutionary relationships is found in \_\_\_\_\_.

- a) atmosphere                  b) fossils  
c) ocean beds                  d) rocks **Ans: b**

59. The pre-cell which is gradually transformed into living cells \_\_\_\_\_.

- a) prokaryotes                  b) coacervates  
c) eobionts                      d) chemoautotrophs  
**Ans: b**

60. The first organism to be found on a bare rock is a (an) \_\_\_\_\_.

- a) moss                          b) alga  
c) lichen                          d) fern **Ans: c**

61. The era called 'age of prokaryotic microbes' is \_\_\_\_\_.

- a. a) archaezoic                  b) precambrian  
c) phaenerozoic                  d) proterizoic **Ans: b**

62. The first photoautotroph organisms were \_\_\_\_\_.

- a. a) bryophytes                  b) algae  
c) cyanobacteria                  d) bacteria **Ans: d**



63. Who performed this famous experiment to prove origin of life ?

- a) Oparin and Haldane
- b) Spallanzani and Pasteur
- c) Urey and Miller
- d) Fox and Pasteur

Ans: c

64. Coacervates are

- a) colloidal droplets
- b) contain nucleoprotein
- c) a) and b)
- d) protobiont

Ans: c

65. According to abiogenesis life originate from \_\_\_\_\_.

- a) non-living matter
- b) pre-existing life
- c) chemicals
- d) extra-terrestrial matter

Ans: a

66. Mesozoic era is associated with mass extinction of \_\_\_\_\_.

- a) flowering plants
- b) trilobites
- c) Dodo
- d) dinosaurs

Ans: d

67. Vermiform appendix in man, nictitating membrane and wisdom teeth are \_\_\_\_\_.

- a) homologous organs
- b) analogous organs
- c) vestigial organs
- d) none of the above

Ans: c

68. Which one of the following terms would most correctly describe the relationship between the flight organs of animals like locust, bat, swallow, and flying fish ?

- a) Atavism
- b) Analogous
- c) Homologous
- d) Vestigial

Ans: b

69. Appearance of facial hair in some people is an example of

- a) Vestigial organ
- b) analogous organs
- c) atavistic organ
- d) all above

Ans: c

70. These are some examples of vestigial structures in man

- a) wisdom tooth vermiform appendix, hair
- b) wisdom tooth, vermiform appendix, coccyx
- c) wisdom tooth, head, nails
- d) none of these

Ans: b

71. The Jurassic period belongs to the ..... era

- a) a) proterozoic
- b) archezoic
- c) mesozoic
- d) cenozoic

Ans: c

72. Potato and sweet potato \_\_\_\_\_.

- a. have edible parts which are homologous organs
- b. have edible part which are analogous organs
- c. have been introduced in India from the same place
- d. None of the above

Ans: b

73. Which one is not a vestigial organ in man ?

- a) Wisdom teeth
- b) Muscles of external ear-pinna
- c) Fossa ovalis
- d) Ileum

Ans: d

74. The tracking of evolutionary history of organisms is \_\_\_\_\_.

- a) a) ontogeny
- b) phylogeny
- c) analogy
- d) homology

Ans: b

75. An old view about evolution states that the organisms were created by a super organism in the same condition as they exist now. This theory is called \_\_\_\_\_.

- a) theory of special creation
- b) theory of natural selection
- c) Lamarck's theory of evolution
- d) theory of spontaneous generation

Ans: a

76. Industrial melanism is an example of

- a) natural selection
- b) mutation
- c) adaptive convergence
- d) gene flow

Ans: a

77. Who was the first civilized man ?

- a) Cro-magnon man
- b) Neanderthal man
- c) Java ape man
- d) Peking man

Ans: a

78. Closest primate to man is \_\_\_\_\_.

- a) gorilla
- b) rhesus monkey
- c) orangutan
- d) lemur

Ans: a

## 79. Match the features from the columns

Column – I		Column – II
a)	Ape like primate	1. Homo erectus
b)	Ancestor of modern apes	2. Australopithecus
c)	Connecting link between ape and man	3. Dryopithecus
d)	First to use fire	4. Propliopethecus

- A B C D
- a) 3 4 2 1
- b) 4 3 2 1
- c) 3 4 1 2
- d) 4 2 1 3
- Ans: b**

## 80. The first human like being was

- a) neanderthal man      b) Homo erectus
- c) cro-magnon man      d) Australopithecus
- Ans: b**

## 81. Human evolution actually started in \_\_\_\_\_.

- a) asia      b) Africa
- c) Central Asia      d) a) and b)
- Ans: d**

## 82. Which of the following is correct match regarding cranial capacity and location of respective fossil.

- a) Australopithecus – east Africa (350- 450 CC)
- b) Homo erectus – 1400 cc
- c) Neanderthal – Africa (500–600 CC)
- d) Homo sapiens – 650 -800 cc
- Ans: a**

## 83. Which one of the following ancestors of man first time showed bipedal movement ?

- a) Australopithecus      b) Cro-magnon
- c) Java apeman      d) Peking man
- Ans: a**

These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.

A) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion

B) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.

C) If Assertion is True but the Reason is False.

D) If both Assertion & Reason are false.

## 84. Assertion : Fossils are always remains of hard parts of life-forms found only in rocks

Reason : Rocks are formed due to sediments

- a) A      b) B      c) C      d) D **Ans: d**

## 85. Assertion :According to Lamarck, evolution of life forms had occurred but driven by use and disuse of orgAns:

Reason : Use and disuse of organ leads to change at genetic level

- a) A      b) B      c) C      d) D **Ans: c**

## 86. Assertion : Big – Bang theory talks of a singular huge explosion unimaginable in physical terms to explain the origin of universe.

Reason : Due to big-bang origin of life took place.

- a) A      b) B      c) C      d) D **Ans: c**

## 87. Assertion : Analogous structures are a result of convergent evolution.

Reason : Different structures evolving for the same function and hence having similarity.

- a) A      b) B      c) C      d) D **Ans: a**

## 88. Assertion : Analogous organs show common ancestry.

Reason : Analogous organ show evolution

- a) A      b) B      c) C      d) D **Ans: d**

## 89. The theory of spontaneous generation stated that:

- a) life arose from living forms only.
- b) life can arise from both living and non-living.
- c) life can arise from non-living things only.
- d) life arises spontaneously, neither from living nor from the non-living. **Ans: c**

## 90. \_\_\_\_\_ is a byproduct of human exploitation of forests, oceans and fisheries or the use of pesticides, herbicides or drugs

- a) reverse evolution      b) artificial selection
- c) mutation      d) natural selection

**Ans: b**

91. Palaentological evidences for evolution refer to the:

- a) development of embryo
- b) homologous organs
- c) fossils
- d) analogous orgAns:

Ans: c

92. The bones of forelimbs of whale, bat, cheetah and man are similar in structure, because:

- a) one organism has given rise to another
- b) they share a common ancestor
- c) they perform the same function
- d) they have biochemical similarities

Ans: b

93. Analogous organs arise due to:

- a) divergent evolution
- b) artificial selection
- c) genetic drift
- d) convergent evolution

Ans: d

94. Evolution of life shows that life forms had a trend of moving from:

- a) land to water
- b) dryland to wet land
- c) fresh water to sea water
- d) water to land

Ans: d

95. Fossils are generally found in:

- a) Sedimentary rocks
- b) Igneous rocks
- c) Metamorphic rocks
- d) Any type of rock

Ans: a

96. Which type of selection is industrial melanism observed in moth, *Bistonbitularia*:

- a) Stabilising
- b) Directional
- c) Disruptive
- d) Artificial

Ans: b

97. The most accepted line of descent in human evolution is:

- a) Australopithecus → Ramapithecus → Homo sapiens → Homohabilis
- b) Homo erectus → Homo habilis → Homo sapiens
- c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens
- d) Australopithecus → Ramapithecus → Homo erectus → Homohabilis → Homo sapiens.

Ans: c

98. Which of the following is an example for link species?

- a) *Peripatus*
- b) Dodo bird
- c) Sea weed
- d) Chimpanzee

Ans: a

99. Match the scientists listed under column 'A' with ideas listed undercolumn 'B'.

Column A	Column B
(i) Darwin	M. abiogenesis
(ii) Oparin	N. use and disuse of organs
(iii) Lamarck	O. continental drift theory
(iv) Wagner	P. evolution by natural selection

- a) (i) M; (ii) P; (iii) N; (iv) O
- b) (i) P; (ii) M; (iii) N; (iv) O
- c) (i) N; (ii) P; (iii) O; (iv) M
- d) (i) P; (ii) O; (iii) N; (iv) M

Ans: b

100. Variations during mutations of meiotic recombinations are:

- a) random and directionless
- b) random and directional
- c) random and small
- d) random, small and directional

Ans: a



PART-B

ADDITIONAL QUESTIONS

(2 MARKS)

1. Define Evolution.

- Evolution is **describe heritable changes in characteristics of a population** of species from one generation to the other.
- **Types of evolution** - chemical, organic and social or cultural evolution

2. What is Abiogenesis ?

- This one of the theory of **origin of living organism on earth**
- According to this theory **living organisms originated from non-living materials** and occurred through evolution over millions of years.

3. Did aquatic life forms get fossilised? If, yes where do we come across such fossils?

- Many **aquatic life forms too got fossilized.**
- Many such fossils have **been found from oil wells.**

Many others have been **found from sedimentary rocks** because many water bodies got filled up by sedimentation

#### 4. What is coacervates ?

- **Coacervates** are large colloidal particles that **precipitate out in aqueous medium**
- They are the **first pre-cells** which gradually transformed into living cells.

#### 5. Explain Biogenesis theory.

- This one of the theory of origin of living organism on earth
- **According to the Theory of biogenesis, life arose from pre-existing life.**
- The term biogenesis also refers to the **biochemical process of production of living organisms.**

#### 6. Explain chemical evolution theory.

- According to the **theory of chemical evolution**, primitive organisms in the primordial environment of the earth **evolved spontaneously from inorganic substances** and physical forces such as **lightning, UV radiations, volcanic activities, etc.,**

#### 7. Why Mesozoic era known as Golden age of Reptiles?

- ❖ In Mesozoic era **known as Golden age of Reptiles** because reptiles are more dominated at this era

#### 8. Difference between Relative dating of Absolute dating.

- **Relative dating** - is used to determine a fossil by **comparing it to similar rocks and fossils** of known age.
- **Absolute dating** is used to determine the **precise age of a fossil by using radiometric dating** to measure the decay of isotopes

#### 9. Write the significance of Cenozoic era?

- **Cenozoic era** is also Age of mammals
- **This era** is subdivided into two periods namely **Tertiary and Quaternary.**
- Tertiary period is characterized by **abundant mammalian fauna.**
- Quaternary period characterized by **decline of mammals and beginning of human social life.**

#### 10. Define the term protobionts.

- Abiotically produced molecules can **spontaneously self assemble into droplets** that enclose a watery solution and **maintain a chemical environment** different from their surroundings.
- Scientists call these spheres as 'protobionts'.

#### 11. What are the two types of cell that are formed in Biological evolution?

##### Cell type 1 :

- One form of the earliest cell contained **clumps of nucleoproteins embedded in the cell substance.**
- Such cells were **similar to the Monera.**
- They are considered as **ancestral to the modern bacteria and blue green algae.**

##### Cell type 2 :

- The other form of earliest cells contained **nucleoprotein clumps that condensed into a central mass surrounded by a thin membrane.**

#### 12. How prokaryotes and Eukaryotes are evolved?

- The atmospheric oxygen combined with methane and ammonia to **form CO<sub>2</sub> and free nitrogen.**
- The presence of the **free O<sub>2</sub> brought about the evolution of aerobic respiration** which could yield large amounts of energy by oxidation of food stuffs.
- Thus **Prokaryotes and Eukaryotes evolved.**

#### 13. Define fossilization.

- Fossilization is the process by which **plant and animal remains are preserved in sedimentary rocks.**

#### 14. What is petrification?

- When animals die the **original portion of their body may be replaced molecule for molecule by minerals** and the original substance being lost through disintegration.
- This type of fossilization is called **petrification.**

#### 15. Define moulds, cast.

- **Moulds** - after disintegration, the body of an animal might **leave indelible impression on the soft mud which later becomes hardened into stones.**



➤ Such impressions are called **moulds**.

➤ **Cast** - The cavities of the moulds may **get filled up by hard minerals and get fossilized**, to form a casts.

### 16. What is Divergent evolution?

➤ It's a type of evolution in which structurally similar organs are produced but they perform different functions

➤ They also called **homologous structures**

E.g. Thorn of **Bougainvillea and the tendrils of Curcubita and Pisumsativum** represent homology.

### 17. What are Analogous structure?

➤ Organisms having **different structural patterns but similar function** are termed as analogous structures.

E.g. **wings of birds and insects** are different structurally but **perform the same function**.

### 18. What are vestigial organs?

➤ Organ which in **not useful or not necessary for their existence** are called vestigial orgAns:

➤ Vestigial organs may be **considered as leftovers of structures**

➤ They were **well developed and functional in the ancestors**, but disappeared in course of evolution due to their non- utilization.

E.g. **Human appendix, mammae in male**.

### 19. Define connecting link. Give an example.

➤ The organisms which **possess the characters of two different groups** (transitional stage) are called connecting links.

E.g. **Peripatus** (connecting link between Annelida and Arthropoda),

➤ **Archeopteryx** (connecting link between Reptiles and Aves).

### 20. What is Atavistic organs?

➤ Sudden appearance of **vestigial organs in highly evolved organisms** is called atavistic orgAns:

E.g. **presence of tail in a human baby** is an atavistic organ.

### 21. Define embryology,

➤ Embryology is a branch of science which deals about the **study of the development of individual from the egg** to the adult stage.

### 22. Define molecular evolution.

➤ Molecular evolution is the process of **change in the sequence composition of molecules** such as DNA, RNA and proteins across generations.

### 23. What is molecular clock?

➤ A slight **change that occurs over time** in these conserved molecules (DNA, RNA and protein) are often called **molecular clocks**.

➤ Molecules that have been used to study evolution are **cytochrome c** (respiratory pathway) and rRNA (protein synthesis).

### 24. What is the findings of August Weismann?

➤ August Weismann found out that **change in the somatoplasm will not be transferred to the next generation** but changes in the germplasm will be inherited.

### 25. Classify struggle denoted by Darwin.

➤ Darwin denoted struggle for existence in three ways –

1. **Intra specific struggle** (between the same species) for food, space and mate
2. **Inter specific struggle** (between different species) for food and space.
3. **Struggle with the environment** to cope with the **climatic variations, flood, earthquakes, drought,** etc.,

### 26. What is mutation theory?

➤ **Hugo de Vries** proposed Mutation theory.

➤ According to de Vries, **sudden and large variations were responsible for the origin of new species**

### 27. What is Adaptive Radiation?

➤ The evolutionary process which **produces new species diverged from a single ancestral form** becomes adapted to newly invaded habitats is called adaptive radiation.

E.g Darwin's finches and Australian marsupials

### 28. Define gene flow.

➤ Movement of genes through gametes or **movement of individuals in (immigration and out (emigration** of a population is referred to as gene flow.

➤ Gene flow can be a **strong agent of evolution**.



**29. How do we compute the age of a fossil?**

- Age of a fossil is computed by using **carbon dating**.
- Relative presence of  **$^{14}\text{C}$**  (radioactive carbon) is calculated to compute the age of a fossil.

**30. What is the most important pre-condition for adaptive radiation?**

- **Common ancestry** is the most important pre-condition for adaptive radiation.

**31. What is founder effect?**

- When a **new species evolves by a small number of individuals** from a larger population; the loss of genetic variation in the new species is called the **founder effect or founder principle**

**32. Are the wing of a bird and the forelimb of a horse homologous or analogous?**

- Wing of bird and the forelimb of horse are **homologous organs**
- Because both have **same fundamental structures but have different functions**
- i.e., for **flying in bird and in horse for running**.

**33. Convergent evolution leads to analogous structures. Give an example.**

- Convergent evolution is development of **similar functional structure in different organisms**.
- This will result in **analogous organs in unrelated organisms**, which have similar functions but different developmental patterns.
- E.g., **the wings of bee, bird and bat**.

**PART-C****ADDITIONAL QUESTIONS (3 MARKS)****1. Explain any two theory which explain evolution of organism.****a) Theory of special creation**

- It states that **life was created by "God"**.
- According to **Hinduis** - Lord Brahma created the Earth.
- Christianity, Islam and most religions believe that **God created the universe, the plants and the animals**.

**b) Theory of spontaneous generation**

- This theory **based on Abiogenesis**,
- It means **living organisms originated from non-living materials** and occurred through evolution over millions of years.
- **Thomas Huxley** coined the term abiogenesis.

**c) Big bang theory**

- According theory **origin of universe as a singular huge explosion** in physical terms.
- Initially earth consist of **ammonia, methane, hydrogen and water vapour**.
- UV rays from the sun **split up water molecules into hydrogen and oxygen**.
- When **temperature cooled** and the **water vapour condensed to form rain**.
- Ammonia and methane in the atmosphere combined with oxygen to form **carbon-dioxide and other gases**.

**2. Write short notes on vestigial organ.**

- Organ which in **not useful or not necessary for their existence** are called vestigial organs:
- Vestigial organs may be **considered as leftovers of structures**
- They were **well developed and functional in the ancestors**, but disappeared in course of evolution due to their non- utilization.
- Vestigial organs may be considered as **leftover structures** which were **well developed and functional in the ancestors, but disappeared** in course of evolution due to their non- utilization.
- E.g. **Human appendix** is the **remnant of caecum** which is functional in the digestive tract of herbivorous animals like rabbit.
- **Cellulose digestion takes place in the caecum** of these animals.
- Due to change in the diet containing **less cellulose**, caecum in human became functionless and is reduced to a **vermiform appendix, which is vestigial**.
- **Other vestigial organs** - coccyx, wisdom teeth, ear muscles, body hair, mammae in male, nictitating membrane of the eye, etc.,

**3. List out the features of mutation theory.**

- According to de Vries, **sudden and large variations were responsible for the origin of new species** whereas Lamarck and Darwin believed in **gradual accumulation of all variations**
- According to Hugo de Vries, **mutations are sudden and heritable variations** which causes evolution, hence called it saltation (single step large mutations).
- While Darwin's theory of natural selection states that **speciation is due to accumulation of small, directional, and heritable variations**, and is a gradual process.

**Salient features of Mutation Theory**

1. Mutations or discontinuous variation are **transmitted to other generations**.
2. In naturally breeding populations, **mutations occur from time to time**.
3. There are **no intermediate forms**, as they are fully fledged.
4. They are **strictly subjected to natural selection**.

**4. List the two main propositions of Oparin and Haldane.**

- **Oparin proposed** that the **organic compounds could have undergone** a series of reactions leading to more complex molecules.
- He proposed that the molecules formed **colloidal aggregates or 'coacervates'** in an aqueous environment. The coacervates were able to absorb and **assimilate organic compounds from the environment**.
- **"Haldane" proposed** that the **primordial sea served as a vast chemical laboratory** powered by solar energy.
- The atmosphere was oxygen free and the **combination of CO<sub>2</sub>, NH<sub>3</sub> and UV radiations gave rise to organic compounds**.
- The sea became a 'hot' dilute soup containing **large populations of organic monomers and polymers**.
- They imagined that groups of monomers and polymers acquired lipid membranes and further developed **into the first living cell**.

**5. Write short notes on Urey and Miller experiments.****Urey and Miller's experiment :**

- They paved way for understanding the **possible synthesis of organic compounds** that led to the appearance of living organisms.
- In their experiment, **a mixture of gases was allowed to circulate over electric discharge** from an tungsten electrode.
- A small flask was kept boiling and the steam emanating from it was **made to mix with the mixture of gases (ammonia, methane and hydrogen)** in the large chamber that was connected to the boiling water.
- The **steam condensed to form water** which ran down the 'U' tube.
- Experiment was conducted continuously for a week and the **liquid was analysed**.
- **Glycine, alanine, beta alanine and aspartic acid** were identified.
- Thus Miller's experiments had an understanding as to the possibility of **abiogenetic synthesis of large amount of variety of organic compounds** in nature from a mixture of sample gases in which the only source of carbon was methane.

**6. Identify the following pairs as homologous and analogous organs:**

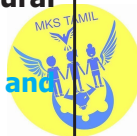
- a. Sweet potato and potato
- b. Eye of octopus and eye of mammals
- c. Thorns of Bougainvillea and tendrils of Cucurbita.
- d. Forelimbs of bat and whale.
- e. Flippers of Penguins and Dolphins.

**Answer :****Homologous organs :**

1. Thorns of Bougainvillea and tendrils of Cucurbita,
2. Forelimbs of bat and whale.

**Analogous organs:**

1. Sweet potato and potato
2. Eye of Octopus and eye of mammals.
3. Flippers of Penguins and Dolphins.



### 7. Explain Darwinian theory of evolution and add the factor responsible for it

- **Charles Darwin** explained the theory of evolution in his book '**The Origin of Species by Natural Selection**'.
- During his journey around the Earth, he made extensive observations of plants and animals.
- He noted a **huge variety and remarkable similarities** among organisms and their adaptive features to cope up to their environment.
- He proved that **fittest organisms can survive and leave more progenies** than the unfit ones through natural selection.

### 8. How does Darwin's theory of natural selection explain the appearance of new forms of life on earth?

- The theory of natural selection is based on the following factors :
  1. **Over production (or prodigality of production)**
  2. **Struggle for existence**
  3. **Universal occurrence of variations**
  4. **Origin of species by Natural Selection**

### 9. Explain the term gene flow and genetic drift?

#### a) Gene flow

- **Movement of genes through gametes** or movement of individuals in (immigration) and out (emigration)

of a population is referred to as gene flow.

- Organisms and gametes that enter the population may have new alleles or may **bring in existing alleles but in different proportions** than those already in the population.

- Gene flow can be a strong **agent of evolution**.

#### b) Genetic drift / Sewall Wright Effect

- Genetic drift is a **mechanism of evolution in which allele frequencies of a population change** over generation due to chance (sampling error).
- Genetic drift **occurs in all population sizes**, but its effects are strong in a small population.
- It may result in a **loss of some alleles**

(including beneficial ones) and **fixation of other alleles**.

- Genetic drift can have **major effects, when the population is reduced in size** by natural disaster due to **bottle neck effect** or when a small group of population splits from the main population to form a new colony due to **founder's effect**.

### 10. Name the ancestors of a man based on the features given below :

- a. Human like, meat-eater with 900 cc brain, lived around 1.7 mya
- b. More human with brain size 1400 cc, lived in neander valley, used hides and buried their dead.
- c. Human like, vegetarian, bipedal locomotion with brain capacity between 650 cc and 800 cc.
- d. Man like primate, that existed about 14 mya.

**Answer :**

- a Homo erectus,**
- b Homo sapiens neanderthalensis,**
- c Homo habilis,**
- d Ramapithecus**

### 11. Mention any three characteristics of Neanderthal man that lived in near East and Central Asia.

- Characteristics of Neanderthal man:
  - a) Their brain size of **1400 cc**
  - b) They lived between **34,000 - 1,00,000 years ago**.
  - c) They used **animal hides to protect their bodies**, knew the **use of fire and buried their dead**.
  - d) They **did not practice agriculture** and animal domestication.

### 12. State and explain any three factors affecting allele frequency in populations.

- Following are the three out of five factors which affect allele frequency in populations:
  - a) **Genetic Drift:**
    - Genetic drift is a **mechanism of evolution in which allele frequencies of a population**



**change** over generation due to chance (sampling error).

- Genetic drift **occurs in all population sizes**, but its effects are strong in a small population.
  - It may result in a **loss of some alleles** (including beneficial ones) and **fixation of other alleles**.
- b) **Genetic Recombination:**
- Production of offspring with traits which differ from parents is called **genetic recombination**.
- c) **Natural Selection:**
- It occurs when **one allele (or combination of alleles of differences makes an organism more or less fit** to survive and reproduce in a given environment.
  - E.g. one gene's **allele frequencies might be modified by both gene flow** and genetic drift, for another gene, mutation may produce a new allele, that is favoured by natural selection.

### 13. Write the significance of Paleozoic era

- The Paleozoic era is characterized by abundance of **fossils of marine invertebrates**.
- Towards the later half, other vertebrates (marine and terrestrial) **except birds and mammals appeared**.

#### Paleozoic era are

1. **Cambrian** - Age of invertebrates),
2. **Ordovician** - fresh water fishes, Ostracoderms, various types of Molluscs
3. **Silurian** - origin of fishes
4. **Devonian** - Age of fishes, many types of fishes such as lung fishes, lobe finned fishes and ray finned fishes
5. **Mississippian** - earliest amphibians, Echinoderms
6. **Pennsylvanian** - earliest reptiles
7. **Permian** - mammal like reptiles.

## PART-D

### ADDITIONAL QUESTIONS

(5 MARKS)

#### 1. Explain the process of biological evolution.

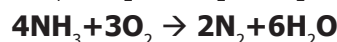
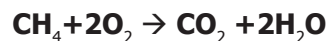
- Abiotically produced molecules can **spontaneously self assemble into droplets** that enclose a watery solution and **maintain a chemical environment**.
- Scientists call these spheres as '**protobionts**'.
- Some of the proteins inside the **liposomes acquired the properties** of enzymes resulting in fast multiplication of molecules.
- Subsequently number of **genes united to form 'proto viruses'** somewhat similar to present day viruses.

#### Cell type 1 :

- One form of the earliest cell contained **clumps of nucleoproteins embedded in the cell substance**.
- Such cells were **similar to the Monera**.
- They are considered as **ancestral to the modern bacteria and blue green algae**.

#### Cell type 2 :

- The other form of earliest cells contained **nucleoprotein clumps that condensed into a central mass surrounded by a thin membrane**.
- This membrane **separated nucleoproteins** from the cell substances.
- Such cells were referred to as **Protista**.
- These may be summarized as **parasitism, saprophytism, predator or animalism** and chemosynthesis or photosynthesis.
- When the number of photosynthetic organisms increased it result in increase in the free O<sub>2</sub>



- The atmospheric oxygen combined with methane and ammonia to **form CO<sub>2</sub> and free nitrogen**.
- The presence of the **free O<sub>2</sub> brought about the evolution of aerobic respiration** which could yield large amounts of energy by oxidation of food stuffs.

- Thus **Prokaryotes and Eukaryotes evolved.**

## 2. List out and explain the basic factor involved in the process of organic evolution.

- **Sewell Wright, Fisher, Mayer, Huxley, Dobzhansky, Simpson and Haeckel** explained Natural Selection in the light of Post-Darwinian discoveries.

### 1. Gene mutation

- It refers to the **changes in the structure of the gene.**
- It is also called **gene/ point mutation.**
- It alters the phenotype of an organism and **produces variations in their offspring.**

### 2. Chromosomal mutation

- It refers to the changes in the structure of chromosomes due to **deletion, addition, duplication, inversion or translocation.**
- This too alters the phenotype of an organism and **produces variations in their offspring.**

### 3. Genetic recombination

- It is due to **crossing over of genes during meiosis.**
- This brings about genetic variations in the individuals of the same species and **leads to heritable variations.**

### 4. Natural selection

- It does not produce any genetic variations but **once such variations occur it favours some genetic changes** while rejecting others (driving force of evolution).

### 5. Reproductive isolation

- It helps in **preventing interbreeding** between related organisms.

## 3. Explain Lamarck's theory of evolution.

- **Jean Baptiste de Lamarck**, postulate the theory of evolution in his famous book '**Philosophie Zoologique**'

- The two principles of Lamarckian theory are:

### 1) The theory of use and disuse

- Organs that are **used often will increase in size** and those that are **not used will degenerate.**

E.g. **Neck in giraffe** (use theory) **absence of limbs in snakes** (disuse theory)

## 2) The theory of inheritance of acquired characters

- Characters that are developed during the life time of an organism are called **acquired characters and these are then inherited.**

### The main objection to Lamarckism

- **August Weismann** disproved Lamarck's "Theory of Acquired characters"
- He conducted experiments on mice for **twenty generations by cutting their tails** and breeding them.
- All mice born were **with tail.**
- Weismann **proved that change in the somatoplasm will not be transferred** to the next generation but changes in the germplasm will be inherited.

### Neo-Lamarckism

- The followers of Lamarck like Cope, Osborn, Packard and Spencer tried to explain Lamarck's theory on a more scientific basis are known as **Neo-Lamarckists**
- They considered that **adaptations are universal.**
- Organisms acquire new structures **due to their adaptations to the changed environmental** conditions.

## 4. Write short notes on Darwin's theory.

- Charles Darwin explained the **theory of evolution** in his book '**The Origin of Species by Natural Selection**'.
- Darwin's theory was based on several facts, observations and influences. They are:

### 1. Over production (or prodigality of production

- All living **organisms increase their population** in larger number.
- E.g. Salmon fish produces about **28 million eggs during breeding season** and if all of them hatch, the seas would be filled with salmon in few generations.

- **Elephant, can produce six young ones** in its life time can produce

### 2. Struggle for existence

- Organisms **struggle for food, space and mate.**



- Darwin denoted struggle for existence in three ways –
- **Intra specific struggle** (between the same species) for food, space and mate
- **Inter specific struggle** (between different species) for food and space.
- **Struggle with the environment** to cope with the **climatic variations, flood, earthquakes, drought, etc.,**

### 3. Universal occurrence of variations

- **No two individuals are alike.**
- There are **variations even in identical twins.**
- Variations found in an organism **help them to overcome struggle** and such **variations are passed on to the next generation.**

### Origin of species by Natural Selection

- According to Darwin, **nature is the most powerful selective force.**
- He compared **origin of species by natural selection** to a small isolated group.
- Darwin believed that the **struggle for existence resulted in the survival of the fittest.**

### 5. List out the objections to Darwinism and add notes on Neo Darwinism

**objections against Darwinism are**

1. Darwin failed to explain the **mechanism of variation.**
2. Darwinism explains the survival of the fittest **but not the arrival of the fittest.**
3. He focused on **small changing variations that are mostly non-heritable.**
4. He did not **distinguish between somatic and germinal variations.**
5. He **could not explain the occurrence of vestigial organs, over specialization** of some organs

Eg. large tusks in mammoths, oversized antlers in Irish deer, etc.,

### Neo Darwinism

- New facts and discoveries about evolution have **led to modifications of Darwinism** and is supported by **Wallace, Heinrich, Haeckel, Weismann and Mendel.**

- Their modified concepts collectively called as **Neo Darwinism**
- This theory emphasizes the change in the frequency of genes in population arises due to **mutation, variation, isolation and Natural selection.**

### 6. Write short notes on Human evolution.

#### Origin and Evolution of Man

- Hominid evolution **occurred in Asia and Africa.**
- Hominids proved that **human beings are superior to other animals** and efficient in making tools and culture.
- Prehistoric man like **Ramapithecus and Sivapithecus** lived some 14 mya and **were derived from ape like Dryopithecus.**
- Dryopithecus and Ramapithecus were **hairy and walked** like gorillas and chimpanzees.

#### Australopithecus

- They are lived in **East African grasslands about 5 mya** and also known as Australian ape man.
- Height - **1.5 meters, bipedal locomotion, omnivorous, semi erect.**
- They are **lived in caves.**
- **Low forehead, brow ridges over the eyes, protruding face, low brain capacity - 350 – 450 cc.**
- Human like **dentition, lumbar curve in the vertebral column** were his distinguishing features.

#### Homo habilis

- They lived about **2 mya.**
- Their brain capacity : **650 – 800cc,**
- They are vegetarian.
- They had **bipedal locomotion and used tools made of chipped stones.**

#### Homo erectus

- They were the **first human like being** was around **1.7 mya**
- They were **closer to human** in looks, **skull was flatter and thicker** than the modern man
- Brain capacity - 900 cc.
- They were meat eaters.
- Homo ergaster and Homo erectus were the

**first to leave Africa.**

- Their brain size of **1400 cc**
- They lived between **34,000 - 1,00,000 years ago.**
- They used **animal hides to protect their bodies**, knew the **use of fire and buried their dead.**
- They **did not practice agriculture** and animal domestication.

**Cro-Magnon**

- They are considered as the **ancestor of modern EuropeAns:**
- They were not only **adapted to various environmental conditions**, but were also known for their **cave paintings, figures on floors and walls.**

**Homo sapiens or modern human**

- They arose in **Africa some 25,000 years ago**
- They **moved to other continents** and developed into distinct races.
- They had a brain capacity of **1300 – 1600 cc.**

- They started **cultivating crops and domesticating animals.**

**7. What are the assumption of Hardy Weinberg**

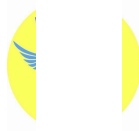
1. **No mutation**  
No new alleles are generated by mutation nor the genes get duplicated or deleted.
2. **Random mating**  
Every organism gets a chance to mate and the **mating is random** with each other with no preferences for a particular genotype.
3. **No gene flow**  
Neither individuals nor **their gametes enter (immigration or exit (emigration) the population.**
4. **Very large population size**  
The population should be **infinite in size.**
5. **No natural selection**  
All alleles are **fit to survive and reproduce.**  
If any one of these assumptions were not met, the population will not be in **Hardy-Weinberg equilibrium.**

**8. Provide a comparison table for Mesozoic era and Cenozoic era its important events**

ERA	YEARS IN MILLION	PERIOD	EPOCH	FAUNA	FLORA
Cenozoic	1	Quaternary	Recent (Holocene)	Age of Mammals	Angiosperms Monocotyledons
	6		Pleistocene	Age of Human beings	Age of Angiosperms - Dicotyledons
	15	Tertiary	Pliocene	Human evolution	
	10		Miocene	Mammals and birds	
	20		Oligocene		
	100		Eocene		
			Paleocene		
Mesozoic	125	Cretaceous		(Golden age of Reptiles) Rise of Dinosaurs	Sphenopsides, Ginkgos, Gnetales, (Dicotyledons)
	150	Jurassic			Herbaceous lycopods, Ferns, Conifers, Cycads
	180	Triassic			

9. Compare Precambrian era and Paleozoic era its important events

ERA	YEARS IN MILLION	PERIOD	EPOCH	FAUNA	FLORA
Paleozoic	205	Permian		Mammal like reptiles	Arborescent lycopods
	230	Carboniferous	Pennsylvanian	Earliest Amphibians and abundant Echinoderms	Seed ferns and Bryophytes
	255		Mississippian	Earliest reptiles	
	315	Devonian		Age of fishes	Progymnosperms
	350	Silurian		Earliest fishes and land invertebrates	Zosterophyllum
	430	Ordovician		Dominance of invertebrates	Appearance of first land plants
	510	Cambrian		Fossil invertebrates	Origin of algae
Precambrian	3000	Upper		Multicellular organisms	
		Middle		Appearance of eukaryotes	
		Lower			Planktons prokaryotes



## Points to Remember

- The WHO defines health as 'a state of **complete physical, mental and social wellbeing and not merely absence of diseases**'.
- Disease can be **defined as a disorder or malfunction of the mind or body**.
- Diseases can be broadly grouped into **infectious and non infectious types**.
- Diseases which are transmitted from one person to another are called infectious diseases or **communicable diseases**.
- **Non-infectious diseases** are not transmitted from an infected person to a healthy person.
- Viruses are the smallest **intracellular obligate parasites, which multiply within living cells**.
- Types of Viral diseases - **Pneumotropic disease, Dermotropic diseases, Viscerotropic diseases, Neurotropic diseases**
- Swine flu is caused by the **H1N1 virus strain**.
- **Amoebiasis** also called amoebic dysentery or amoebic colitis is caused by **Entamoeba histolytica**.
- **African sleeping sickness** is caused by **Trypanosoma** species.
- Trypanosoma is generally transmitted by the blood sucking **Tsetse** flies.
- **Kala - azar** or visceral leishmaniasis is caused by **Leishmania donovani**, which is transmitted by the vector **Phlebotomus (sand fly)**.
- **Malaria** is caused by different types of Plasmodium species such as **P. vivax, P. ovale, P. malariae and P. falciparum**.
- The life cycle of Plasmodium involves three phases namely **schizogony, gamogony and sporogony**.
- Incubation period of **malaria** is about 12 days.
- The early symptoms of malaria are **headache, nausea and muscular pain**.
- **Prevention** - It is possible to break the transmission cycle of malaria by **killing the insect vector**.
- **Fungi was recognized as a causative agent** of human diseases much earlier than bacteria.
- **Dermatomycosis** is a cutaneous infection caused by fungi belonging to the genera **Trichophyton, Microsporum and Epidermophyton**.
- Ringworms of the feet is known as **Athlete's foot** caused by **Tinea pedis**.
- Helminthes are mostly endoparasitic in the gut and blood of human beings and cause diseases called **helminthiasis**.
- The two most prevalent helminthic diseases are **Ascariasis and Filariasis**.
- **Ascariasis** is a disease caused by the intestinal endoparasite *Ascaris lumbricoides* commonly called the **round worms**.
- **Filariasis** is caused by **Wuchereria bancrofti**, commonly called **filarial worm**.
- *Wuchereria bancrofti* is **sexually dimorphic, viviparous and digenic**.
- The life cycle is completed in two hosts, **man and the female Culex mosquito**.
- According to WHO, hygiene refers to **"conditions and practices that help to maintain health and prevent the spread of diseases"**.
- **Immunology** is the **study of immune system**.
- The overall ability of body to **fight against the disease** causing pathogen is called **immunity**.
- Any substance capable of **eliciting immune response** is called an **ANTIGEN (ANTIbody GENERator)**.
- There are two broad classes of immunity responses namely, **innate immunity and acquired immunity**.
- Innate immunity is the natural phenomenon of resistance to infection which an individual possesses right from the birth. It is otherwise known as **non-specific immunity or natural immunity**.

- The immunity that an individual acquires after birth is known as **acquired immunity**. It is the body's **resistance to a specific pathogen**.
- The unique features of acquired immunity are antigenic **specificity, diversity, recognition of self and non-self and immunological memory**.
- The immune responses may be **primary or secondary**.
- The organs involved in the **origin, maturation and proliferation** of lymphocytes are called **lymphoid organs**.
- Based on their functions, they are classified into **primary or central lymphoid organs** and **secondary or peripheral lymphoid organs**.
- The two main types of lymphocytes are **B and T lymphocytes**.
- An **immunogen** is a substance **capable of initiating an immune response**.
- **Haptens** are substance that are non-immunogenic but can react with the products of a specific immune response.
- On the basis of origin, antigens are classified into **exogenous antigens and endogenous antigens**.
- Antibodies are **immunoglobulin (Ig) protein molecules synthesized** on exposure to antigen that can combine specifically with the antigen.
- The antibodies are classified into five major categories, based on their physiological and biochemical properties. They are **IgG** (gamma), **IgM** (mu), **IgA** (alpha), **IgD** (delta) and **IgE** (epsilon).
- The reaction between an antigen and antibody is the basis for **humoral immunity or antibody mediated immunity**.
- The reaction between antigen and antibody occurs in three stages.
  1. Antigen - antibody complex
  2. Precipitation, agglutination,
  3. Destruction of antigen or its neutralization.
- A vaccine is a **biological preparation that provides active acquired immunity**
- The vaccines are classified as **first, second and third generation vaccines**.
- **Vaccination** is the process of **administrating a vaccine** into the body or the act of introducing a vaccine into the body to produce immunity to a specific disease".
- **Immunization** is the process of the body **building up immunity** to a particular disease.
- The **exaggerated response of the immune system** to certain antigens is called **allergy**
- The substances to which produced allergy are called **allergens**.
- **Anaphylaxis** is the classical immediate hypersensitivity reaction.
- Immunodeficiency results from the **failure of one or more components of the immune system**.
- HIV is seen as a **spherical virus, 100-120 nm in diameter**, containing a dense core surrounded by a lipoprotein envelope.
- Routes of HIV transmission include **unsafe sexual contact, blood-contaminated needles, organ transplants, blood transfusion and vertical transmission from HIV infected mother to child**.
- Preliminary test - The **ELISA** test (Enzyme Linked ImmunoSorbent Assay) and confirmatory test **Western blot**.
- Autoimmunity is due to an **abnormal immune response** in which the immune system fails to properly distinguish between self and non-self and attacks its own body.
- When a **tumour continues to grow and invades healthy tissue**, it is called cancer.
- They spread to other parts of the body from the tumour and give rise to secondary tumour.
- This is known as **metastasis**.
- **Immunotherapy** also called **biological therapy** uses substances made by the body or in a laboratory to **improve or to resist the immune system function**.
- Alcohol is a **psychoactive drug**, which acts on the brain, affecting a person's mind and behaviour.
- Addiction is a **physical or psychological need** to do or take or use certain substance such as alcohol, to the point where it could be harmful to the individual.
- **Alcoholism is the inability to control drinking due to physical and emotional dependence on alcohol**.
- **Korsakoff syndrome**, a chronic memory disorder is most commonly caused by alcohol misuse.
- It is practically **possible to prevent** some one from using drugs and alcohol.

## Part - A

## TEXTUAL QUESTIONS

(1 MARKS)

- A 30 year old woman has bloody diarrhoea for the past 14 hours, which one of the following organisms is likely to cause this illness?**
  - Streptococcus pyogens
  - Clostridium difficile
  - Shigella dysenteriae
  - Salmonella enteritidis

**Ans: c**
- Exo-erythrocytic schizogony of Plasmodium takes place in -----**
  - RBC
  - Leucocytes
  - Stomach
  - Liver

**Ans: d**
- The sporozoites of Plasmodium vivax are formed from -----**
  - Gametocytes
  - Sporoblasts
  - Oocysts
  - Spores

**Ans: c**
- Amphetamines are stimulants of the CNS, whereas barbiturates are ----**
  - CNS stimulant
  - both a and b
  - hallucinogenic
  - CNS depressants

**Ans: d**
- Choose the correctly match pair.**

a) Amphetamines	- Stimulant
b) LSD	- Narcotic
c) Heroin	- Psychotropic
d) Benzodiazepine	- Pain killer

**Ans: a**
- The Athlete's foot disease in human is caused by \_\_\_\_\_**
  - Bacteria
  - Fungi
  - Virus
  - Protozoan

**Ans: b**
- Cirrhosis of liver is caused by chronic intake of \_\_\_\_\_**
  - Opium
  - Alcohol
  - Tobacco
  - Cocaine

**Ans: b**
- The sporozoite of the malarial parasite is present in \_\_\_\_\_**
  - saliva of infected female Anopheles mosquito.
  - RBC of human suffering from malaria.
  - Spleen of infected humans.
  - Gut of female Anopheles mosquito.

**Ans: a**
- Where do the following events in the life cycle of Plasmodium takes place?**
  - Fertilization - in Gut of mosquito
  - Development of gametocytes - in body of mosquito
  - Release of sporozoites - from mouth parts of mosquito to blood stream
  - Schizogony - in human body
- Paratope is an**
  - Antibody binding site on variable regions
  - Antibody binding site on heavy regions
  - Antigen binding site on variable regions
  - Antigen binding site on heavy regions

**Ans: c**
- Allergy involves**
  - IgE
  - IgG
  - IgA
  - IgM

**Ans: a**
- Spread of cancerous cells to distant sites is termed as**
  - Metastasis
  - Oncogenes
  - Proto-oncogenes
  - Malignant neoplasm

**Ans: a**
- AIDS virus has**
  - Single stranded RNA
  - Double stranded RNA
  - Single stranded DNA
  - Double stranded DNA

**Ans: b**
- B cells that produce and release large amounts of antibody are called**
  - Memory cells
  - Basophils
  - Plasma cells
  - killer cells

**Ans: c**



**PART – B,C AND D**

**TEXTUAL QUESTIONS (2,3 AND 5 MARKS)**

15. Given below are some human organs. Identify one primary and one secondary lymphoid organ.

Explain its role. Liver, thymus, stomach, thyroid, tonsils

❖ **Thymus** - is the primary lymphoid organ

**Role :** production and maturation of Lymphocytes

❖ **Tonsils** - is the secondary lymphoid organ

**Role :** it encounter antigen in the presence of lymphocytes

16. Name and explain the type of barriers which involve macrophages.

❖ Macrophages involve in **Phagocytic barrier**

❖ It is a Specialized cells for phagocytosis, and digest whole microorganisms

17. What are interferons? Mention their role.

❖ Interferons are **antiviral proteins**

❖ They are the included in **chemical mediators of innate immunity**

❖ Role : They **act against invading viral particles**

18. List out chemical alarm signals produced during inflammation.

❖ Chemical alarm signals are **serotonin, histamine and prostaglandins**

19. Explain the process of replication of retrovirus after it gains entry into the human body.

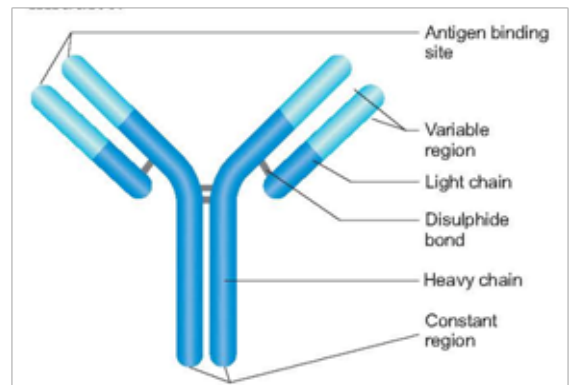
❖ After HIV virus enter into the body of the person, the **virus enters into macrophages** where **RNA genome** of the virus replicates to form **viral DNA** with the help of the enzyme **reverse transcriptase**.

❖ This viral DNA gets incorporated into the DNA of host cells and directs the **infected cells to produce viral particles**.

❖ The macrophages **continue to produce virus** and in this way acts like a HIV factory.

❖ Simultaneously, **HIV enters into helper T-lymphocytes**, replicates and produces progeny viruses.

20. Explain the structure of immunoglobulin with suitable diagram.



❖ An antibody molecule is Y shaped structure that comprises of four polypeptide chains, **two identical light chains (L)** of molecular weight 25,000 Da and **two identical heavy chains (H)** of molecular weight 50,000 Da.

❖ The polypeptide chains are **linked together by di-sulphide (S-S) bonds**.

❖ One light chain is attached to each heavy chain and two heavy chains are attached to each other to form a **Y shaped structure**.

❖ Hence, an antibody is represented by H<sub>2</sub> L<sub>2</sub>.

❖ The heavy chains have a **flexible hinge region** at their approximate middles.

❖ Each chain (L and H) has **two terminals**.

1. **C - terminal (Carboxyl)**

2. **amino or N-terminal.**

❖ Each chain (L and H) has two regions.

❖ They have **variable (V) region** at one end and a much **larger constant (c) region** at the other end.

❖ Antibodies responding to different antigens **have very different (V) regions but their c) regions are the same** in all antibodies.

21. What are the cells involved innate immune system?

Cells included in innate immunity are - **Lysozyme, Interferron, leucocytes, Monocytes, neutrophils, tissue macrophages**

22. What is vaccine? What are its types?

❖ A vaccine is a **biological preparation that provides active acquired immunity** to a particular disease and resembles a disease-

causing microorganism and is often made from weakened or attenuated or killed forms of the microbes, their toxins, or one of its surface proteins.

- ❖ The vaccines are classified as **first, second and third generation vaccines.**

1. **First generation vaccine** is further subdivided into **live attenuated vaccine, killed vaccine and toxoids.**

- ❖ **Live attenuated vaccines** use the **weakened (attenuated), aged, less virulent** form of the virus.

**E.g :** MMR vaccine and the Varicella vaccine,

- ❖ **Killed (inactivated) vaccines** are killed or inactivated by heat and other methods.

**E.g :** Salk's polio vaccine.

- ❖ **Toxoid vaccines** contain a **toxin or chemical** secreted by the bacteria or virus.

**E.g :** DPT vaccine (Diphtheria, Pertussis and Tetanus).

2. **Second generation vaccine** contains the **pure surface antigen of the pathogen.**

**E.g :** Hepatitis-B vaccine.

3. **Third generation vaccine** contains the **purest and the highest potency vaccines** which are synthetic in generation.

- ❖ The latest revolution in vaccine is **DNA vaccine** or **recombinant vaccine.**

**23. A person is infected by HIV. How will you diagnose for AIDS?**

- ❖ A simple blood test is available to diagnose HIV.
- ❖ **ELISA** test (Enzyme Linked Immuno Sorbent Assay) detects the presence of HIV antibodies.
- ❖ It is a preliminary test.
- ❖ **Western blot** test is **more reliable and a confirmatory test.**
- ❖ It detects the **viral core proteins.**

**24. Autoimmunity is a misdirected immune response. Justify.**

- ❖ Autoimmunity is due to an **abnormal immune response** in which the immune system **fails to properly distinguish** between self and non-self and attacks its own body.

- ❖ Our body produces antibodies (**auto antibodies**) and **cytotoxic T cells** that destroy our own tissues.

- ❖ If a disease-state results, it is referred to as **auto-immune disease.**

- ❖ Thus, autoimmunity is a **misdirected immune response.**

- ❖ **E.g :** Hashimoto's thyroiditis, Graves' disease, Addison's disease, Rheumatoid arthritis and multiple sclerosis.

**25. List the causative agent, mode of transmission and symptoms for Diphtheria and Typhoid.**

S. No	Diseases	Causative agent	Mode of transmission	Symptoms
1	Diphtheria	Corynebacterium diphtheriae	Droplet Infection	Fever, sore throat, hoarseness and difficulty in breathing
2	Typhoid (Enteric fever)	Salmonella typhi	Through contaminated food and water	Headache, abdominal discomfort, fever and diarrhoea

**26. A patient was hospitalized with fever and chills. Merozoites were observed in her blood. What is your diagnosis?**

- ❖ Merozoites in the blood indicate the presence of **Malaria parasite**
- ❖ Hence he/she is suffering from **Malaria fever**

**27. i) Write the scientific name of the filarial worm that causes filariasis.**

**ii) Write the symptoms of filariasis.**

**iii) How is this disease transmitted?**

- i) **Filariasis** is caused by **Wuchereria bancrofti**, commonly called **filarial worm.**

ii) **Symptoms :**

- ❖ **Inflammation of the lymph node** due to accumulation of the worms block the lymphatic system In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the **limbs, scrotum** and **mammary glands.**

iii) It is transmitted by Female Culex mosquito

28. List the common withdrawal symptoms of drugs and alcohol abuse.

- ✓ **Short term effects :**
  - ❖ **Euphoria, (Joy)**
  - ❖ **Pain,**
  - ❖ **Dullness of senses,**
  - ❖ **Alteration in behaviour,**
  - ❖ **Blood pressure,**
  - ❖ **Narcosis (deep sleep),**
  - ❖ **Nausea and vomiting.**
- ✓ **Long-term effect :**
  - ❖ The physical and mental disturbance
  - ❖ Damage in **liver and brain.**
  - ❖ **Fat accumulation and high levels of alcohol destroy the liver cells** and a scar tissue grows in the place of dead cells. This scarring of the liver is called "**Liver cirrhosis**".
  - ❖ **Alcohol irritates the stomach** lining due to the production of excess acid leading to ulcers.
  - ❖ weakens the **heart muscle, causing scar tissue to build up in the cardiac muscle fibers.**
  - ❖ **High blood pressure, stroke, coronary artery disease and heart attack.**
  - ❖ **Korsakoff syndrome, a chronic memory disorder** is most commonly caused by alcohol misuse.

29. Why do you think it is not possible to produce vaccine against 'common cold'?

- ❖ It is not possible to produce vaccine against 'common cold' because **more than 200 different types of viruses that can cause common cold.**

**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

1. **What is the location of Salmonella typhi during diseased condition ?**
  - a) Stomach
  - b) Kidney
  - c) Liver
  - d) Intestine **Ans: d**
2. **Which test is carried out if disease is occurred by salmonella typhi ?**
  - a) Widal test
  - b) Lisman test
  - c) Blood test
  - d) Barium test **Ans: a**

3. **Generally streptococcus pneumoniae causes pneumonia but which bacteria is responsible for this disease ?**

- a) Pneumococcus
- b) Tuberculosis
- c) Haemophilus influenzae
- d) Salmonella typhi **Ans: c**

4. **A is suffering from severe fever, then which kind of organism responsible for it ?**

- a) Plasmodium vivax
- b) Plasmodium malarie.
- c) Plasmodium falciparum
- d) All of the given. **Ans: c**

5. **Duration of fever occurred by plasmodium malaria is \_\_\_\_\_**

- a) Every 24 hours
- b) Every 48 hours
- c) Every 36 hours
- d) Every 72 hours. **Ans: d**

6. **From which kind of host life cycle of plasmodium passes ?**

- a) Male of Human & of Anopheles mosquito.
- b) Male of Human & Male of Anopheles mosquito.
- c) Human & Female Anopheles mosquito.
- d) Human & Male Anopheles mosquito. **Ans: d**

7. **What is responsible for malaria...?**

- a) All Anopheles mosquitoes.
- b) All Culex mosquitoes.
- c) Only male Anopheles mosquitoes
- d) Only female Anopheles mosquitoes **Ans: d**

8. **Plasmodium lives in the RBC of human in its mature condition it is called as**

- a) Sporozoites
- b) Cryptoschizont
- c) Trophozoite
- d) Gamete cyte **Ans: c**

9. **What is improper for ringworm disease.**

- a) It is done by Trichophyton fungi.
- b) Appearance of dry, scaly lesions on the skin
- c) It is done by using infected persons comb
- d) It is done by secretion of serotonin chemical. **Ans: d**

10. **At Which time interferon is secreted ?**

- a) When antibody reacts with antigen in our

body.

- b) When serotonin become active
  - c) When lymphocytes become active
  - d) When our body cell's are infected by virus then that cell's secret this chemical
- Ans: d**

**11. Which is the process of biological control, which is for controlling to spread the disease caused by mosquitoes.?**

- a) Masquito net
  - b) Spreading & chemicals
  - c) Fish like Gambusia
  - d) Net in doors & windows
- Ans: c**

**12. Give the location of Ig G.**

- a) Nucleus
- b) Cytoplasm
- c) Blood
- d) Mitochondria

**Ans: c**

**13. Give the correct sequence from pre erythrocytic cycle ?**

- a) Saliva Sporozoites-Blood-liver-Cryptoschizont-Cryptomerozoites.
  - b) Sporozoites-Saliva-Blood-Liver-Cryptoschizont-Cryptomerozoites.
  - c) Saliva-Cryptoschizont-Blood-Liver-Sporozoites-Cryptomerozoites.
  - d) Saliva-Sporozaites-Liver-Blood-Cryptoschizont-Cryptomerozoites.
- Ans: a**

**14. Which one is odd ?**

- a) Opium popy -gives pleasant feeling
  - b) Claviceps Purpurea-Hallucinogenic
  - c) Erythrolum Coca-Potent stimulating action
  - d) Cannabis Sativa-give pain
- Ans: d**

**15. Which one is odd ?**

- a) Malaria
  - b) Pneumonia
  - c) HIV
  - d) Typhoid.
- Ans: c**

**16. Which one is odd ?**

- a) Cannabinoids
  - b) Marjuana
  - c) Ganja
  - d) Morphin
- Ans: d**

**17. According to their production which one is odd ?**

- a) Cannabinoids
  - b) Marjuana
  - c) Ganja
  - d) Charas
- Ans: b**

**18. Mark odd one.**

- a) Chicken gunia
  - b) Elephantiasis
  - c) Diphtheria
  - d) Malaria
- Ans: c**

**19. Mark odd on.**

- a) Retro virus
  - b) Oncogenic virus
  - c) Rhino virus
  - d) Haemophilis influenza
- Ans: d**

**20. Give the location for storage of erythrocytes**

- a) Pancreas
  - b) Spleen
  - c) Liver
  - d) Stomach
- Ans: b**

**21. From the following sentences which one is appropriate for pneumoia ?**

- (P) Burning is felt in alveloar wall
  - (Q) There is obstuction of wind pipe
  - (R) Pain in inhalation,cough & headache are seen
  - (S) Incubation period is of 1 to 3 days.
  - a) P,Q,R,S all are improper
  - b) P,Q,R,S proper & S is improper
  - c) P,Q are proper & R & S are improper
  - d) P,Q,R,S all are proper
- Ans: d**

**22. Which is the hereditary material in retro virus?**

- a) DNA
  - b) RNA
  - c) Lipoprotein
  - d) Vitamin
- Ans: b**

**23. \_\_\_\_\_ is an unclear byproduct of heroin?**

- a) Smack
  - b) Delta-9-THC
  - c) LSD
  - d) Cannabinoids
- Ans: a**

**24. Which one is matched with LSD ?:**

- a) Fungi
  - b) Bacteria
  - c) Virus
  - d) Protozon
- Ans: a**

**25. What is formed during Innate immunity ?**

- a) Body prepare Antibodies against antigen
  - b) Antibodies are present in body from birth
  - c) Prepare antibodies are introduced into body.
  - d) All of the given.
- Ans: b**

**26. What is reason for causing AIDS?**

- a) Cereto immunity
- b) Interferon
- c) Destroying & T Helper cells

- d) Destroying of killer T cells **Ans: c**
- 27. From what Lysergic acid is formed ?**  
 a) Ergot fungi                      b) Cannabinoids plants  
 c) Heroine                              d) THC **Ans: a**
- 28. Which one is right sequence for lifecycle of Anopheles mosquito ?**  
 a) Oocyst → ookinete → sporozoites → gamatocyte  
 b) Ookinete → oocyst → gametocyte → sporozoites  
 c) Gamatocyte → oocyst → sporozoites → ookinete  
 d) Gamatocyte → ookinete → oocyst → sporozoites **Ans: d**
- 29. Genetic material of virus in macrophege is regenerated in DNA by using**  
 a) Transcriptase                      b) Reverse Transcriptase  
 c) RNA polymerase                  d) DNA polymerase **Ans: b**
- 30. Which plant is responsible for doing hallucination ?**  
 a) Atropa Baladona                  b) Datura  
 c) Erythroxyllum coca              d) All of the given **Ans: d**
- 31. Because of smoking which kind of changes occurs in blood ?**  
 a) Proportion of CO<sub>2</sub> decreases and propertion decreases  
 b) Proportion of CO<sub>2</sub> decreases and propertion of O<sub>2</sub> increases  
 c) Proportion of CO<sub>2</sub> increases and propertion of O<sub>2</sub> increases.  
 d) Proportion of CO<sub>2</sub> increases and propertion of O<sub>2</sub> decreases.  
 a) ↓ CO<sub>2</sub> and O<sub>2</sub> ↓  
 b) CO<sub>2</sub> ↓ and O<sub>2</sub> ↑  
 c) CO<sub>2</sub> ↑ and O<sub>2</sub> ↑  
 d) CO<sub>2</sub> ↓ and O<sub>2</sub> ↓ **Ans: d**

- 32. From which plant and from which part of that plant Cocain drug is obtained ?**  
 a) Ergot-fruit  
 b) Erythroxyllum coca-leaf  
 c) Papaver somniferum-leaf  
 d) Erythroxyllum coca-Flower **Ans: b**
- 33. Contagious disease- Typhoid. Non-contagious disease \_\_\_\_\_**  
 a) AIDS                                  b) Hepatitis  
 c) Malaria                              d) Cancer **Ans: d**
- 34. Cold-Rhino virus. AIDS.**  
 a) Retrovirus                          b) Retro bacteria  
 c) HMV                                  d) Oncogenic virus **Ans: a**
- 35. Cancer of Muscle : Sarcoma. Cancer of Skin : \_\_\_\_\_**  
 a) Sarcoma                              b) Lerkemia  
 c) Melenoma                          d) Glucoma **Ans: c**
- 36. Anti-allergens : Ig E Colastrum : \_\_\_\_\_**  
 a) Ig-G                                  b) Ig M  
 c) Ig-A                                  d) Ig-D **Ans: c**
- 37. Malaria-Anopheles female mosquito. Dengue- \_\_\_\_\_**  
 a) Culex                                  b) Aedes  
 c) falsciparum                      d) Anopheles male mosquito **Ans: b**
- 38. Interferon : cytokine barrier. Acid in stomach: \_\_\_\_\_**  
 a) Physical Barriere                  b) Physiological Barrier  
 c) Cellular Barrier                      d) Cytokine Barrier **Ans: b**
- 39. Tears in eye : Physiological Barrier. Skin : \_\_\_\_\_**  
 a) Physical Barriere                  b) Physiological Barrier  
 c) Cellular Barrier                      d) Cytokine Barrier **Ans: a**
- 40. Opium : Morphine - Pain reliever medicine. Cannabinoid : \_\_\_\_\_ - \_\_\_\_\_**  
 a) Tobacco, Nicotine  
 b) Cocain, Erthroxyllum  
 c) Marijuana, Produce more quantity of urine  
 d) Ergot, change mood **Ans: c**



**41. W.B test : AIDS - Immuno deficiency syndrome. WIDAL test : \_\_\_\_\_ / \_\_\_\_\_**

- a) Typhoid, increase in size of spleen & liver
- b) Typhoid, pain in stomach
- c) Typhoid, Burning in felt in intestine
- d) All of the given

**Ans: d**

**42. Match the column-I, column-II & column-III.**

Column-I	Column-II	Column-III
P. Ergot fungi	i. Latex of unripened fruit	I. Morphine
Q. Erthroxyllum	ii. Dry leaves & Inflorescenc of plant	II. Crack
R. Cannabis Sativa	iii. Top of dry flower	III. LSD
S. Opium Poppy	iv. Fruit	IV. Marijuana

- a) P-(iv)-(III), Q-(ii)-(II), R-(iii)-(IV), S-(i)-(I)
- b) P-(iii)-(II), Q-(ii)-(I), R-(iv)-(III), S-(i)-(IV)
- c) P-(ii)-(I), Q-(iii)-(III), R-(i)-(IV), S-(iv)-(II)
- d) P-(i)-(IV), Q-(iv)-(III), R-(iii)-(II), S-(ii)-(I)

**Ans: a**

**43. Match the column-I & column-II.**

Column-I	Column-II
P. Cold	i. Rhino Virus
Q. Pneumonia	ii. HIV
R. AIDS	iii. Salmonella typhi
S. Typhoid	iv. H a l m o p h i l u s Influenza
	v. Plasmodium Vivax

- a) P - i, Q - iv, R - v, S - ii
- b) P - i, Q - iv, R - ii, S - v
- c) P - i, Q - iv, R - ii, S - iii
- d) P - i, Q - iii, R - ii, S - iv

**Ans: c**

**44. Match the following:-**

Column-I	Column-II
P. CMI	i. Virus of AIDS
Q. PMNL	ii. Mucosal Associated Lymphoid Tissue
R. MALT	iii. Cell Mediated Immunity
S. HIV	iv. Leucocytes

- a) P - iii, Q - iv, R - ii, S - i
- b) P - ii, Q - iii, R - iv, S - i
- c) P - iii, Q - ii, R - iv, S - i
- d) P - ii, Q - iv, R - i, S - iii

**Ans: a**

**45. Match the column I & II**

Column-I	Column-II
P. Primary lymphoid organ	i. Thymus
Q. MALT	ii. Spleen
R. Lobe like organ near the heart	iii. Bone Marrow
S. Organ like bean shape	iv. Digestive tract
	v. It constitutes 50% of lymphoid tissue

- a) P - iii, Q - v, R - i, S - ii
- b) P - iii, Q - iv, R - v, S - i
- c) P - ii, Q - i, R - v, S - iv
- d) P - v, Q - iv, R - i, S - ii

**Ans: a**

**46. Match the column I & II.**

Column-I	Column-II
P. AIDS reported first	i. HIV
Q. Diagnosis test of AIDS	ii. USA
R. Group of Retrovirus	iii. Sarcoma
S. Cancer of lymph gland	iv. ELISA
	v. Tamilnadu

- a) P - v, Q - iv, R - i, S - iii
- b) P - ii, Q - iv, R - v, S - iii
- c) P - ii, Q - iv, R - v, S - iii
- d) P - ii, Q - iv, R - i, S - iii

**Ans: d**

**47. Match the column I & II.**

Column-I	Column-II
P. Cellular Barrier	i. Tears from eye
Q. Physiological Barrier	ii. Epithelial lining in urinogenital tract
R. Physical Barrier	iii. Certain types of Leucocytes
S. Cytokine Barrier	iv. Virus infected cell

- a) P - ii, Q - iii, R - i, S - iv
- b) P - iii, Q - i, R - ii, S - iv
- c) P - i, Q - ii, R - iii, S - iv
- d) P - iv, Q - i, R - iii, S - ii

Ans: b

48. Match the column I & II.

Column-I	Column-II
P. Malaria	i. Plasmodium
Q. Ringworm	ii. Rhino Virus
R. Cold	iii. Retro Virus
S. AIDS	iv. Filarial worm
T. Elephantiasis	v. Microspore

- a) P - i, Q - iii, R - ii, S - iv, T - v
- b) P - i, Q - iv, R - ii, S - iii, T - v
- c) P - i, Q - v, R - ii, S - iii, T - iv
- d) P - ii, Q - v, R - iii, S - iv, T - I

Ans: c

49. Which Kind of Sedative chemical is obtained from given plant ?

- a) Hashish
- b) Cannabinoids
- c) Cocaine
- d) Opium

Ans: c

50. Give the correct sentences.

- (i) Passive immunity - Antibody are directly introduces in body
- (ii) Lactation - Secretion of yellowish fluid colostrums
- (iii) Hepatitis B - Made from fungi
- (iv) Histamine - Produce from Heparin
- a) ii & iii
- b) i & iii
- c) i, ii & iii
- d) i, ii, iii & iv

Ans: c

51. Which kind of drug are obtained from Cannabinoids ?

- a) Bhang
- b) Charas
- c) Ganja
- d) All of these

Ans: d

52. What is there as a genetic material in HIV in addition to protein layer ?

- a) The chains containing DNA
- b) One chain containing DNA
- c) Two chains containing RNA
- d) One chain containing RNA

Ans: d

53. Which is Responsible for typhoid ?

- a) Vibrio Cholerae
- b) Salmonella
- c) Shingella
- d) Eschericia Coli

Ans: b

54. AIDS is spread by....

- a) Blood Transfusion
- b) Shaking Hands
- c) HIV infected blood transfusion
- d) All of above

Ans: c

55. Which is blood cancer ?

- a) Chloremia
- b) Leukemia
- c) Uremia
- d) Protemia

Ans: b

56. HIV decreases.

- a) Helper T-Cells
- b) All T-Cells
- c) Only B-Cells
- d) B-Cell & T-Cell

Ans: a

57. The molecule, which stimulates the immune response is...

- a) Antibody
- b) Antigen
- c) Mutant
- d) Carcinogen

Ans: b

58. Response against allergic inflammation, is given by which substance produced by mast cells ?

- a) Histamine
- b) Antibody
- c) Antigen
- d) None

Ans: a

59. What are interferons ?

- a) Antiviral Protien
- b) Antibacterial Protien
- c) Anticancer Protien
- d) Conjugated Protien

Ans: a

60. The growing immunity, after getting the disease free body

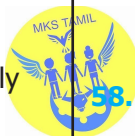
- a) Active acquired immunity
- b) Passive acquired immunity
- c) a & b both
- d) None

Ans: a

61. Cancer is associated with....

- a) Uncontrollable growth of tissue
- b) Ageing procers
- c) Controlled division of tissue
- d) None

Ans: a



**62. Vaccination protects from disease, Because...**

- a) It helps in digestion
  - b) It increases the no. of RBCs
  - c) It produces antibodies
  - d) It maintains heat system of the body
- Ans: c**

**63. Whose number increase during allergy ?**

- a) Ig A
  - b) Ig E
  - c) Ig G
  - d) Ig M
- Ans: b**

**64. Where salmonella is associated ?**

- a) Typhoid
  - b) Polio
  - c) TB
  - d) Tetanus
- Ans: a**

**65. Which is most infectious disease ?**

- a) Hepatitis - B
  - b) AIDS
  - c) Cough & Common Cold
  - d) Malaria
- Ans: c**

**66. Influenza is caused by**

- a) Virus
  - b) Bacteria
  - c) Fungi
  - d) Protista
- Ans: a**

**67. Antibodies are made up of**

- a) RBCs
  - b) Thrombocytes
  - c) Monocytes
  - d) Lymphocytes
- Ans: d**

**68. Carcinoma refer to...**

- a) Malignant tumours of the connective tissue
  - b) Malignant tumours of the skin or mucous membrane
  - c) Malignant tumours of the colon
  - d) Benign tumours of the connective tissue
- Ans: a**

**69. Which cancer affects lymph gland and spleen?**

- a) Carcinoma
  - b) Sarcoma
  - c) Leukemia
  - d) Lymphoma
- Ans: b**

**70. Where memory cells are formed ?**

- a) Monocytes
  - b) Eosinophils
  - c) Neutrophils
  - d) Lymphocytes
- Ans: d**

**71. By what we get passive immunity ?**

- a) Antibody
  - b) Antigen
  - c) Antibiotic
  - d) Vaccination
- Ans: a**

**72. Antibodies in our body are complex of**

- a) Steroid
  - b) Prostaglandins
  - c) Glycoproteins
  - d) Lipoprotein
- Ans: c**

**73. What is antibody ?**

- a) Phagocyte
  - b) Protein which inactivate antigen
  - c) A part of RBCs
  - d) A part of Plasma
- Ans: b**

**74. Barrier preventing entry of pathogens**

- a) Skin
  - b) Mucous layer
  - c) Mucous secretion
  - d) Cilia
- Ans: b**

**75. In which of the following situation infection of AIDS do not occur ?**

- a) Breast feeding to children by AIDS infected mother
  - b) Foetus of AIDS infected mother
  - c) Utilization of clothes used by AIDS patient
  - d) Utilization of syringe used by AIDS patient
- Ans: c**

**76. An ovoviviparous parasite is....**

- a) Ascaris
  - b) Taenia
  - c) Wuchereria
  - d) Plasmodium
- Ans: c**

**77. Which one of the following is not correctly matched ?**

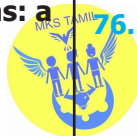
- a) Anopheles culifacies - Leishmaniasis
  - b) Glossina palpalis - Sleeping sickness
  - c) Culex pipiens - Filariasis
  - d) Aedes aegypti - Yellow fever
- Ans: a**

**78. The function of Ig E is...**

- a) To mediate in allergic response
  - b) Activation of B-Cells
  - c) Protection from inhaled and ingested pathogen
  - d) Stimulation of complement system, passive immunity to foetus.
- Ans: a**

**79. An auto immune disease is...**

- a) Cancer
  - b) Erythroblastosis foetalis
  - c) Asthma
  - d) Rheumatoid arthritis
- Ans: d**



**80. Sporogony of malarial parasite occurs in...**

- a) Liver of man
  - b) Stomach wall of mosquito
  - c) RBCs of man
  - d) Salivary gland of mosquito
- Ans: b**

**81. Incubation period for plasmodium falciparum is...**

- a) 12 days
  - b) 15 days
  - c) 20 days
  - d) 30 days
- Ans: a**

**82. ELISA is...**

- a) Enzyme linked immuno sorbant assay
  - b) Enzyme linked ions assay
  - c) Enzyme linked inductive assay
  - d) None of the above
- Ans: a**

**83. Confirmatory test for AIDS is...**

- a) Western blot
  - b) ESR
  - c) ELISA
  - d) PCR
- Ans: a**

**84. Carcinoma refers to...**

- a) Malignant tumours of the connective tissue
  - b) Malignant tumours of the skin or mucous membrane
  - c) Malignant tumours of the colon
  - d) benign tumours of the connective tissue
- Ans: b**

**85. Post erythrocytic part of life cycle of plasmodium is called....**

- a) Golgi cycle
  - b) Short cycle
  - c) Krebs cycle
  - d) Ross cycle
- Ans: d**

**These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.**

- a) **If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.**
- b) **If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.**
- c) **If Assertion is True but the Reason is False.**

**If both Assertion & Reason are false**

**86. Assertion - The number of WBC decreases in leukemia.**

**Reason** - Leukemia means blood cancer  
 a) A      b) B      c) C      d) D **Ans: c**

**87. Assertion - Barbiturates is a synthetic drug which gives pleasure.**

**Reason** - By taking barbiturates the adrenal increase in blood.  
 a) A      b) B      c) C      d) D **Ans: c**

**88. Assertion - Macrophage act as a factory of HIV.**

**Reason** - Macrophage continuously produces molecules of HIV.  
 a) A      b) B      c) C      d) D **Ans: a**

**PART-B**

**ADDITIONAL QUESTIONS (2 MARKS)**

**1. Define health.**

❖ The World Health Organization defines health as 'a **state of complete physical, mental and social well being** and not merely absence of diseases'.

**2. Define disease. Classify disease.**

- ❖ Disease is a **disorder or malfunction of the mind or body.**
- ❖ It involves **morphological, physiological and psychological disturbances** which may be due to **environmental factors or pathogens or genetic anomalies or life style changes.**
- ❖ Types : **infectious and non infectious disease**

**3. List out bacterial /viral/protozoan disease.**

- ✓ **Bacterial disease**
  - ❖ Dysentery
  - ❖ Plague
  - ❖ Diphtheria
  - ❖ Cholera
  - ❖ Typhoid
  - ❖ Pneumonia
- ✓ **Viral Disease**
  - ❖ Common cold
  - ❖ Mumps



- ❖ Measles
- ❖ Viral hepatitis
- ❖ Dengue fever
- ❖ Chikungunya
- ❖ Chicken pox
- ❖ Poliomyelitis

✓ **Protozoan disease :**

- ❖ Malaria
- ❖ Amoebiasis
- ❖ African sleeping sickness
- ❖ Kala-azar

**4. Define pathogenic bacteria**

❖ Bacteria that are **associated with human diseases** and are called **pathogenic bacteria**.

**5. Difference between pathogen & normal flora.**

S.No	Pathogen	Normal flora
1.	They are associated with disease	They won't cause disease
2.	They are known as pathogenic organisms	They are known as commensals or useful bacteria

**6. What are the bacterial diseases that affect lungs? List out its symptoms.**

Disease	Pathogen	Target organ	Mode of transmission	Symptoms
Pneumonia	Streptococcus pneumoniae	Lungs	Droplet infection	Fever, cough, painful breathing and brown sputum
Tuberculosis	Mycobacterium tuberculosis	Lungs	Droplet infection	Thick Mucopurulent nasal discharge

**7. Is it possible to reduce bacterial resistance? If it is possible then tell how?**

❖ **Yes it is possible** to reduce bacterial resistance

✓ **Methods to reduce.**

- ❖ Avoid using **antibiotics to treat minor infections** that can be taken care by our immune system.
- ❖ Do not use an antibiotic to treat viral infections such as **common cold or flu**.
- ❖ **Always follow the prescription.**

**8. List out the symptoms of Dengue fever.**

- ❖ **Severe flu like illness with a sudden onset of fever**
- ❖ **Painful headache**
- ❖ **Muscle and joint pain**

**9. List out the symptoms of Chikungunya.**

- ❖ **Fever**
- ❖ **Joint pain,**
- ❖ **Headache**
- ❖ **Joint swelling**

**10. Write notes on poliomyelitis.**

- ❖ **Fever**
- ❖ **Muscular stiffness and weakness**
- ❖ **Paralysis**
- ❖ **Respiratory failure**

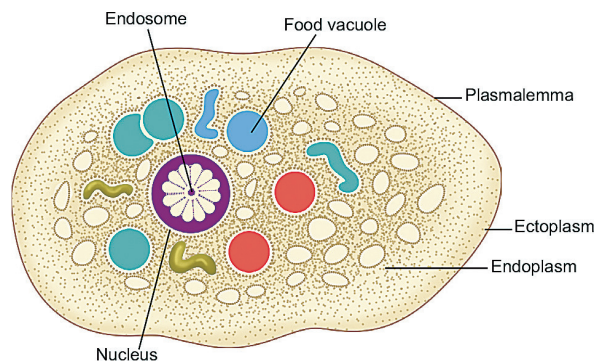
**11. Write short notes on viral hepatitis.**

- ❖ **Liver damage**
- ❖ **Jaundice**
- ❖ **Nausea**
- ❖ **Yellowish eyes**
- ❖ **Fever and pain in the abdomen**

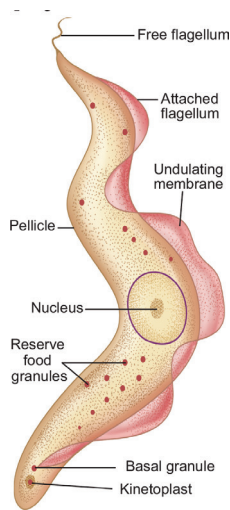
**12. List out the symptoms and causes of swine flu.**

- ❖ Swine flu is caused by the **H<sub>1</sub>N<sub>1</sub> virus strain**.
- ❖ **Symptoms :** fever, cough, sore throat, chills, weakness and body aches.

**13. Draw and label the structure of entamoeba histolytica.**



**14. Draw and label the structure of trypanosoma gambiense**



**15. Explain difference types of sleeping sickness.**

- Three species of Trypanosoma cause **sleeping sickness in man.**
- 1. T. gambiense is transmitted by **Glossina palpalis** and causes **Gambian or Central African sleeping sickness.**
- 2. T. rhodesiense is transmitted by **Glossina morsitans** causing **Rhodesian or East African sleeping sickness.**
- 3. T. cruzi is transmitted by a bug called **Triatoma megista** and causes **Chagas disease or American trypanosomiasis.**

**16. What is haemozoin? Write its significance.**

- ❖ When **erythrocyte lyses due to malaria, haemozoin toxin released** from the merozoites into the blood stream to infect other erythrocytes
- ❖ **Haemozoin toxin** and erythrocyte debris into the blood stream resulting in **malarial attacks – shivering chills, high fever followed by sweating.**

**17. Write the possible preventive measures for malaria.**

**Preventive measure include :**

- ✓ It is possible to **break the transmission cycle** by killing the insect vector.
- ✓ **Oil can be sprayed over the water surface**, to make it impossible for mosquito larvae and pupae to breathe.

**18. What are the causes of failure of malaria eradicating programme by WHO.**

- ❖ In the 1950's the World Health Organisation (WHO) introduced the **Malaria eradication programme.**
- ❖ This programme was not successful **due to the resistance of Plasmodium to the drugs** used to treat it and **resistance of mosquito's to DDT and other insecticides.**

**19. Define helminthiasis.**

- ❖ Disease caused by Helminthes are called as **helminthiasis.**
- e.g Ascariasis and Filariasis.

**20. Define ascariasis.**

- ❖ **Ascariasis** is a disease caused by the intestinal endoparasite **Ascaris lumbricoides** commonly called the **roundworms.**

**21. List out the organism that causes Dermatomycosis.**

- ❖ Dermatomycosis is a cutaneous infection caused by fungi belonging to the genera **Trichophyton, Microsporum and Epidermophyton.**

**22. What do you mean by personal hygiene?**

- "**Personal hygiene** refers to **maintaining one's body clean** by bathing, washing hands, trimming fingernails, wearing clean clothes
- It also includes keeping surfaces in the home and workplace, including toilets, bathroom facilities, **clean and pathogen-free.**

**23. Define Immunology.**

- ❖ **Immunology** is the study of **immune system.**
- ❖ This system **protects an individual** from various infective agents.
- ❖ It refers to all the mechanisms used by the **body for protection from environmental agents** that are foreign to the body.

**24. Define the term immunity.**

- ❖ The overall **ability of body to fight against the disease** causing pathogen is called **immunity.**
- ❖ It is also called **disease resistance** and the lack of immunity is known as **susceptibility.**

**25. Define the term antigen.**



- ❖ Any substance **capable of eliciting immune response** is called an **antigen (ANTIbody GENERator)**

### 26. Why innate immunity called as non-specific immunity?

- ❖ Innate immunity is the **natural phenomenon of resistance to infection** which an individual possesses right from the birth.
- ❖ The innate defense mechanisms are non-specific in the sense that **they are effective against a wide range of potentially infectious agents.**
- ❖ It is otherwise known as **non-specific immunity** or **natural immunity.**

### 27. What are lymphoid organs?

- ❖ The organs involved in the **origin, maturation and proliferation of lymphocytes** are called **Lymphoid organs.**
- ❖ Based on their functions, they are classified into **primary or central lymphoid organs** and **secondary or peripheral lymphoid organs**

### 28. List out the functions of a) Primary lymphoid organ b) Secondary lymphoid organ.

- ❖ **The primary lymphoid organs** - provide appropriate environment for lymphocytic maturation.
- ❖ **The secondary lymphoid organs** - trap antigens and make it available for mature lymphocytes, which can effectively fight against these antigens.

### 29. What are peyer's patches.

- ❖ Peyer's patches are **oval-shaped areas of thickened tissue** that are embedded in the mucus-secreting lining of the **small intestine of humans and other vertebrate animals.**
- ❖ Peyer's patches contain a variety of immune cells, including **macrophages, dendritic cells, T cells, and B cells.**

### 30. Difference between epitope and paratope.

- ❖ **Epitope** is an antigenic determinant and is the **active part of an antigen.**
- ❖ A **paratope** is the antigen – **binding site and is a part of an antibody** which recognizes and binds to an antigen.

### 31. Define haptens.

- **Haptens** are substance that are **non-immunogenic** but can react with the products of a specific immune response.

### 32. Classify antigen.

- ❖ On the basis of origin, antigens are classified into **exogenous antigens** and **endogenous antigens**

#### (i) Exogenous antigens :

- ❖ The antigens which **enter the host from the outside**

**E.g : Microorganisms, pollens, drugs, or pollutants.**

#### (ii) Endogenous antigens :

- ❖ The antigens which are **formed within the individual** are **endogenous antigens.**

**E.g : Blood group antigens.**

### 33. Classify Antibodies.

- ❖ The antibodies are classified into five major categories, based on their physiological and biochemical properties.
- ❖ They are **IgG** (gamma), **IgM** (mu), **IgA** (alpha), **IgD** (delta) and **IgE** (epsilon).

### 34. Functions of free antibodies.

- ❖ **The functions of immunoglobulin** are **agglutination, precipitation, opsonisation, neutralization** etc.

### 35. Differentiate soluble Antigen of particulate Antigen.

- ❖ The reaction between **soluble antigen** and antibody leads to visible precipitate formation, which is called **precipitin reaction.**
- ❖ Antibodies that bring about precipitate formation on reacting with antigens are called as **precipitins.**
- ❖ Whenever a **particulate antigen** interacts with its antibody, it would result in **clumping or agglutination** of the particulate antigen, which is called **agglutination reaction.**
- ❖ The antibody involved in bringing about agglutination reaction is called **agglutinin.**

### 36. Define precipitins.

- ❖ Antibodies that bring about **precipitate formation** on reacting with antigens are called as **precipitins.**



**37. What is Allergy?**

- ❖ The exaggerated response of the immune system to certain antigens present in the environment is called **allergy (allo-altered, erg-reaction)**.

E.g. Hay fever and asthma.

- ❖ Allergy is a form of **over active immune response** facilitated by **IgE** and **mast cells**

**38. What is Anaphylaxis?**

- ❖ **Anaphylaxis** is the classical **immediate hypersensitivity reaction**.
- ❖ It is a **sudden, systematic, severe and immediate hypersensitivity** reaction occurring as a result of rapid generalized mast-cell degranulation.

**39. How HIV virus synthesis DNA**

- ❖ After getting into the body of the person, the **virus enters into macrophages** where **RNA genome** of the virus replicates to form **viral DNA** with the help of the enzyme **reverse transcriptase**.
- ❖ This **viral DNA gets incorporated into the DNA** of host cells and directs the infected cells to produce viral particles.

**40. What is the diagnosis method for AIDS?**

- ❖ **Test 1 : ELISA** test (Enzyme Linked Immuno Sorbent Assay)
- ❖ It detects the presence of HIV antibodies.
- ❖ It is a preliminary test.
- ❖ **Test 2 : Western blot** test
- ❖ **It is more reliable and a confirmatory test.**
- ❖ It detects the **viral core proteins**.

**41. List out the methods to prevent AIDS.**

- ❖ **Advocating safe sex** and promoting regular check-up
- ❖ **Safe blood for transfusion**
- ❖ Use of **disposable needles**
- ❖ **Use of condoms** during sexual contact
- ❖ **Prevention of drug abuse**
- ❖ **AIDS awareness programme** by **NACO** (National AIDS Control Organisation), **ngos** (Non-Governmental Organisations) and **WHO** are to prevent the spreading of AIDS

**42. What is Auto antigen.**

- ❖ When the cells **act as antigens in the same body**, they are called auto antigens.

**43. What is non organ specific disorder?**

- In non-organ specific (systemic) disorders, autoimmune activity is **widely spread throughout the body**.

**44. What is Metastasis?**

- ❖ When **cancer cells spread to other parts** of the body from the tumour and give rise to secondary tumour.
- ❖ This is known as **metastasis**

**45. What is immunotherapy?**

- ❖ **Immunotherapy** also called **biological therapy** uses substances made by the body or in a laboratory (monoclonal antibodies) **to improve or to resist** the immune system function.

**46. What is Korsakoff syndrome?**

- ❖ **Korsakoff syndrome**, a **chronic memory disorder** is most commonly caused by alcohol misuse.



**PART-C**

**ADDITIONAL QUESTIONS (3 MARKS)**

**1. Classify viral diseases based on their symptoms.**

- Viral diseases are generally grouped into four types on the basis of the symptoms produced in the body organs.
- **Pneumotropic diseases** (respiratory tract infected by influenza)
- **Dermotropic diseases** (skin and subcutaneous tissues affected by chicken pox and measles)
- **Viscerotropic diseases** (blood and visceral organs affected by yellow fever and dengue fever)
- **Neurotropic diseases** (central nervous system affected by rabies and polio).

## 2. Classify different types of malaria.

S. No.	Types of Malaria	Causative agent	Duration of Erythrocytic cycle
1	Tertian, benign tertian or vivax malaria	P. vivax	48 hours
2	Quartan malaria	P. malariae	72 hours
3	Mild tertian malaria	P. ovale	48 hours
4	Malignant tertian or quotidian malaria	P. falciparum	36 – 48 hours

## 3. Write short notes on fungal disease.

- ❖ Fungi was recognized as a **causative agent** of human diseases much earlier than bacteria.
- ❖ Dermatomycosis is a cutaneous infection caused by fungi belonging to the **genera Trichophyton, Microsporum and Epidermophyton**.
- ❖ **Ringworm** is one of the most common fungal disease in humans.
- ❖ **Appearance of dry, scaly lesions on the skin, nails and scalp** are the main symptoms of the disease.
- ❖ **Heat and moisture** help these fungi to grow and makes them to grow in skin folds such as those in the groin or between the toes.
- ❖ Ringworms of the feet is known as **Athlete's foot** caused by **Tinea pedis**.
- ❖ Ringworms are generally **acquired from soil or by using clothes, towels and comb** used by infected persons.

## 4. Write short notes on filariasis.

- ❖ **Filariasis** is caused by **Wuchereria bancrofti**, commonly called **filarial worm**.
- ❖ It is found in the **lymph vessels** and **lymph nodes** of man.
- ❖ **Wuchereria bancrofti** is sexually dimorphic, viviparous and digenic.
- ❖ The life cycle is completed in two hosts, **man and the female Culex mosquito**.
- ❖ The female filarial worm gives rise to **juveniles** called **microfilariae larvae**.
- ❖ In the lymph glands, the **juveniles develop into adults**.

- ❖ The accumulation of the **worms block the lymphatic system** resulting in inflammation of the lymph node.
- ❖ In some cases, the **obstruction of lymph vessels causes elephantiasis** or filariasis of the **limbs, scrotum** and **mammary glands**.

## 5. Explain the Components of acquired Immunity.

Acquired immunity has two components – **cell mediated immunity (CMI)** and **antibody mediated immunity or humoral immunity**.

### 1. Cell mediated immunity

- ❖ When **pathogens are destroyed by cells without producing antibodies**, then it is known as cell mediated immune response or cell mediated immunity.
- ❖ This is brought about by **T cells, macrophages and natural killer cells**.

### 2. Antibody mediated immunity or humoral immunity

- ❖ When **pathogens are destroyed by the production of antibodies**, then it is known as antibody mediated or humoral immunity.
- ❖ This is brought about by **B cells with the help of antigen presenting cells and T helper cells**.
- ❖ Antibody production is the characteristic feature of **vertebrates** only.

## 6. Expand and Explain the term.

- a) **MALT** - Mucosal-Associated Lymphoid Tissue
  - b) **GALT** - Gut-Associated Lymphoid Tissue
  - c) **BALT** - Bronchial Associated Lymphoid Tissue
- ❖ **These are Secondary or peripheral lymphoid organs**
  - ❖ In secondary or peripheral lymphoid organs, **antigen is localized** so that it can be effectively exposed to mature lymphocytes.
  - ❖ The best examples are **lymph nodes, appendix, Peyer's patches of gastrointestinal tract, tonsils, adenoids, spleen, MALT** (Mucosal-Associated Lymphoid Tissue), **GALT** (Gut-Associated Lymphoid Tissue), **BALT** (Bronchial / Tracheal-Associated Lymphoid Tissue).

**7. Explain different types of vaccine.**

- ❖ Vaccine **initiates the immunization process.**
- ❖ The vaccines are classified as **first, second and third generation vaccines.**

**1. First generation vaccine**

- ❖ It is further subdivided into **live attenuated vaccine, killed vaccine and toxoids.**
- ❖ **Live attenuated vaccines** use the **weakened (attenuated), aged, less virulent** form of the virus.

E.g. Measles, mumps and rubella (MMR) vaccine and the Varicella (chickenpox) vaccine,

- ❖ **Killed (inactivated) vaccines** are killed or inactivated by heat and other methods.

E.g. **Salk’s polio vaccine.**

- ❖ **Toxoid vaccines** contain a **toxin or chemical** secreted by the bacteria or virus.
- ❖ They **make us immune to the harmful effects** of the infection, instead of to the infection itself.

E.g. DPT vaccine (Diphtheria, Pertussis and Tetanus).

**2. Second generation vaccine**

- ❖ It contains the **pure surface antigen of the pathogen.**

E.g. Hepatitis-B vaccine.

**3. Third generation vaccine**

- ❖ It contains the **purest and the highest potency vaccines** which are synthetic in generation.
- ❖ The latest revolution in vaccine is **DNA vaccine** or **recombinant vaccine.**

**8. Structure of HIV virus.**

- ❖ The human immunodeficiency virus belongs to the genus **Lentivirus.**
- ❖ HIV is seen as a **spherical virus, 100-120 nm** in diameter, containing a **dense core surrounded by a lipoprotein envelope.**
- ❖ The envelope has **glycoprotein(gp)** spikes termed gp 41 and gp 120.
- ❖ At the core, there are two large **single stranded RNA.**
- ❖ Attached to the RNA are molecules of **reverse transcriptase.**
- ❖ It also contains enzymes like **protease and ribonuclease.**

- ❖ The **core is covered by a capsid** made of proteins.
- ❖ This is followed by another layer of **matrix proteins.**

**9. Differences between normal cell and cancer cell**

Normal cells	Cancer cells
<b>Small, uniformly shaped nuclei</b> Relatively <b>large cytoplasmic volume.</b>	<b>Large, variable shaped nuclei</b> Relatively <b>small cytoplasmic volume</b>
<b>Conformity</b> in cell size and shape Cells arranged <b>into discrete tissues</b>	<b>Variation</b> in cell size and shape <b>Disorganised arrangement</b> of cells
May possess <b>differentiated cell structures</b> <b>Normal presentation</b> of cell surface markers	Loss of normal <b>specialised features</b> <b>Elevated expression</b> of certain cell markers
<b>Lower levels of</b> dividing cells Cell tissues <b>clearly demarcated</b>	<b>Large number of</b> dividing cells Poorly defined tumor boundaries



**10. Write short notes on Autoimmune diseases**

- It is due to an **abnormal immune response**
- It occurs when immune system **fails to distinguish self and non-self.**
- Our body produces antibodies (**auto antibodies**) and **cytotoxic T cells** that destroy our own tissues.
- If a disease-state results, it is referred to as **auto-immune disease.**
- Thus, autoimmunity is a **misdirected immune response.**
- Autoimmunity is evidenced by the **presence of auto antibodies and T cells** that are reactive with host antigens.
- When the cells **act as antigens in the same body**, they are called auto antigens.
- Types of Autoimmune diseases - **organ-specific and non-organ-specific** (systemic)
- **In organ-specific disease**, the autoimmune process is **directed mostly against one organ.**
- The autoantibodies **may block the functions of that organs.**

**E.g :** Hashimoto's thyroiditis, Graves' disease (thyroid gland) and Addison's disease (adrenal glands).

- In non-organ specific (systemic) disorders, autoimmune activity is widely spread throughout the body.

**E.g :** Rheumatoid arthritis and multiple sclerosis

### PART-D

#### ADDITIONAL QUESTIONS (5 MARKS)

##### 1. Write short notes on any two protozoan disease.

###### Amoebiasis

- It is also called **amoebic dysentery or amoebic colitis** is caused by *Entamoeba histolytica*, which lives in the human large intestine and feeds on food particles and bacteria.
- Infective stage of this parasite is the **trophozoite**
- **Trophozoite** penetrates the walls of the host intestine (colon) and **secretes histolytic enzymes** causing **ulceration, bleeding, abdominal pain** and stools with excess mucus.
- **Symptoms** - range from **diarrhoea to dysentery** with blood and mucus in the stool.
- **House flies** acts as a **carrier for this disease**.

###### African sleeping sickness

- It is caused by **Trypanosoma species**.
- Trypanosoma is generally transmitted by the blood sucking **Tsetse** flies.
- Three species of Trypanosoma cause sleeping sickness in man.
- ❖ **T. gambiense** is transmitted by **Glossina palpalis (Tsetse fly)** and causes **Gambian or Central African sleeping sickness**.
- ❖ **T. rhodesiense** is transmitted by **Glossina morsitans** causing **Rhodesian or East African sleeping sickness**.
- ❖ **T. cruzi** is transmitted by a bug called **Triatoma megista** and causes **Chagas disease or American trypanosomiasis**.
- **Kala – azar** or visceral leishmaniasis is caused by *Leishmania donovani*, which is transmitted

by the **vector Phlebotomus (sand fly)**.

- Infection may occur in the **endothelial cells, bone marrow, liver, lymph glands** and blood vessels of the spleen.
- Symptoms - **weight loss, anaemia, fever, enlargement of spleen and liver**.

##### 2. Write short notes on life cycle of plasmodium.

- The life cycle of Plasmodium involves three phases namely **schizogony, gamogony and sporogony**.
- The parasite **first enters the human blood stream** through the bite of an infected **female Anopheles** mosquito.
- As it feeds, the **mosquito injects the saliva** containing the **sporozoites**.
- The sporozoite within the **blood stream immediately enters** the hepatic cells of the liver.
- Further in the liver they undergo multiple asexual fission (**schizogony**) and produce **merozoites**.
- After being released from liver cells, the **merozoites penetrate the RBC's**.
- Inside the RBC, the merozoite begins to develop as **unicellular trophozoites**.
- The **trophozoite grows in size** and a central vacuole develops pushing them to one side of cytoplasm and becomes the **signet ring stage**.
- The trophozoite nucleus then **divides asexually** to produce the **schizont**.
- The large schizont shows **yellowish - brown pigmented granules** called **Schuffners granules**.
- The schizont divides and produces **mononucleated merozoites**.
- Eventually the **erythrocyte lyses, releasing the merozoites** and haemozoin toxin into the blood stream to infect other erythrocytes.
- Lysis of red blood cells results in cycles of **fever and other symptoms**.
- This erythrocytic stage is cyclic and repeats itself approximately every **48 to 72 hours** or longer depending on the species of Plasmodium involved.
- The sudden release of **merozoites triggers an attack on the RBCs**.
- Occasionally, merozoites differentiate into **macrogametocytes** and **microgametocytes**.

- When these are ingested by a mosquito, they **develop into male and female gametes respectively.**
- In the mosquito's gut, the infected erythrocytes lyse and male and female gametes fertilize to form a diploid zygote called **ookinete.**
- The **ookinete migrates to the mosquito's gut wall** and develop into an **oocyte.**
- The oocyte undergoes meiosis by a process called **sporogony** to form **sporozoites.**
- These **sporozoites migrate to the salivary glands** of the mosquito.
- The cycle is now completed and when the **mosquito bites another human host, the sporozoites are injected and the cycle begins a new.**

3. List out various barriers of innate immunity and their mechanism.

Type of innate immunity	Mechanism
<b>1. Anatomical barriers</b>	
Skin	Prevents the entry of microbes. Its acidic environment (pH 3-5) retards the growth of microbes.
Mucus membrane	Mucus entraps foreign microorganisms and competes with microbes for attachment.
<b>2. Physiological barriers</b>	
Temperature	Normal body temperature inhibits the growth of pathogens. Fever also inhibits the growth of pathogens.
Low pH	Acidity of gastric secretions (HCl) kills most ingested microbes.
Chemical mediators	Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.
<b>3. Phagocytic barriers</b>	Specialized cells (Monocytes, neutrophils, tissue macrophages) phagocytose, and digest whole microorganisms.
<b>4. Inflammatory barriers</b>	Tissue damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins. They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis.

4. Difference between Active of Passive Immunity.

Sl. No.	Active Immunity	Passive Immunity
1	Active immunity is produced actively by <b>host's immune system.</b>	Passive immunity is received passively and there is <b>no active host participation.</b>
2	It is produced <b>due to contact with pathogen or by its antigen.</b>	It is produced due to <b>antibodies obtained from outside.</b>
3	It is <b>durable and effective in protection.</b>	It is <b>transient and less effective.</b>
4	Immunological <b>memory is present.</b>	<b>No memory.</b>
5	Booster effect on <b>subsequent dose is possible.</b>	Subsequent <b>dose is less effective.</b>
6	Immunity is effective only <b>after a short period.</b>	<b>Immunity develops immediately.</b>

## 5. Difference between primary and secondary Immune response.

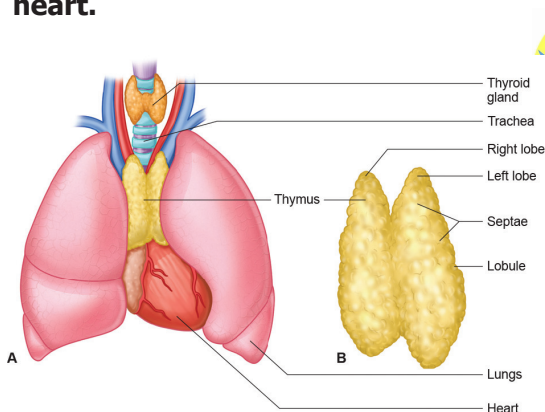
Sl. No.	Primary Immune Response	Secondary Immune Response
1	It occurs as a result of <b>primary contact with an antigen.</b>	It occurs as a result of <b>second and subsequent contacts with the same antigen.</b>
2	Antibody level reaches peak in <b>7 to 10 days.</b>	Antibody level reaches peak in <b>3 to 5 days.</b>
3	<b>Prolonged period is required</b> to establish immunity.	It establishes <b>immunity in a short time.</b>
4	There is <b>rapid decline in antibody level.</b>	Antibody level remains <b>high for longer period.</b>
5	It appears <b>mainly in the lymph nodes and spleen.</b>	It appears <b>mainly in the bone marrow</b> , followed by the spleen and lymph nodes.

## 6. Write short notes on primary lymphoid organ.

- In mammals, **B cell maturation occurs in the bone marrow** and **T cells maturation occurs in the thymus.** Hence they are called as **primary lymphoid organ.**

**Thymus**

- The thymus is a **flat and bilobed organ** located **behind the sternum, above the heart.**



- Each lobe of the thymus contains **numerous lobules**, separated from each other by connective tissue called septa.
- Each lobule is **differentiated into two compartments**, the outer compartment or **outer cortex**, is densely packed with **immature T cells called thymocytes**, whereas the inner compartment or medulla is sparsely populated with thymocytes.
- One of its main secretions is the hormone **thymosin.**
- It stimulates the **T cell to become mature and immunocompetent.**
- By the early teens, the thymus begins to atrophy and is replaced by adipose tissue.

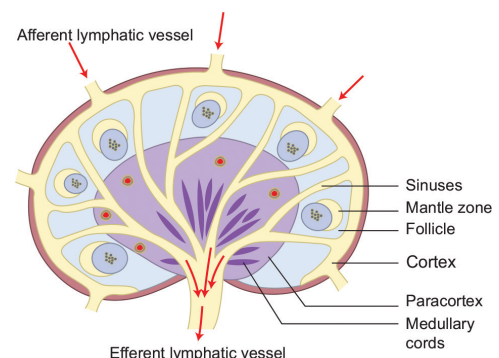
- Thus thymus is **most active** during the **neonatal and pre-adolescent periods.**

**Bone marrow**

- Bone marrow is a **lymphoid tissue found within the spongy portion** of the bone.
- Bone marrow contains stem cells known as **haematopoietic cells.**
- These cells have the potential to **multiply through cell division** and either remain as stem cells or differentiate and mature into different kinds of blood cells.

## Write short notes on structure of Lymphnode.

- Lymph node is a **small bean-shaped structure** and is part of the body's immune system.
- It is the **first one to encounter** the antigen that enters the tissue spaces.
- Lymph nodes **filter and trap substances** that travel through the lymphatic fluid.



- Lymph node has three zones. They are the **cortex, paracortex and medulla.**
- **Cortex** : The **outer most layer** of the lymph node is called cortex, which consists of

**B-lymphocytes**, macrophages, and follicular dendritic cells.

- The **paracortex** zone is **beneath the cortex**, which is richly populated by T lymphocytes and Inter digitating dendritic cells.
- The **inner most zone** is called the medulla which is **sparsely populated by lymphocytes**, but many of them are plasma cells, which actively secrete antibody molecules.
- As the lymph enters, it slowly percolates through the **cortex, para cortex and medulla, giving sufficient chance for the phagocytic cells** and dendritic cells to trap the antigen brought by the lymph.
- The lymph leaving a node carries enriched antibodies secreted by the medullary plasma cells against the **antigens that enter the lymph node**.

#### 8. Write short notes on a) Payer patches b) Tonsils c) Spleen

##### Peyer's patches

- ❖ They are **oval-shaped areas of thickened tissue** that are embedded in the mucus - secreting lining of the small intestine of humans and other vertebrate animals.
- ❖ Peyer's patches contain a variety of immune cells, including **macrophages, dendritic cells, T cells, and B cells**.

##### The tonsils (palatine tonsils)

- ❖ They are a pair of soft tissue masses **located at the back of the throat** (pharynx).
- ❖ The tonsils are **part of the lymphatic system**, which help to fight infections.
- ❖ They **stop invading germs** including bacteria and viruses.

##### Spleen

- ❖ It is a secondary lymphoid organ **located in the upper part of the abdominal cavity** close to the diaphragm.
- ❖ Spleen contains **B and T cells**.
- ❖ It brings **humoral and cell mediated immunity**.

#### 9. Write short notes on lymphocytes.

- About **20-30%** of the white blood cells are lymphocytes.
- They have a **large nucleus** which is surrounded by a little cytoplasm.
- Types : **B and T lymphocytes**.

- Both these are **produced in the bone marrow**.
- B lymphocytes (**B cells**) **stay in the bone marrow** until they are mature.
- Then they **circulate around the body**.
- Some remain in the blood, while others **accumulate in the lymph nodes and spleen**.
- **T lymphocytes leave the bone marrow and mature in the thymus gland**.
- Once mature, **T cells also accumulate in the same areas** of the body as B cells.
- Lymphocytes have **receptor proteins** on their surface.
- When receptors on a B cell bind with an antigen, the **B cell becomes activated and divides rapidly to produce plasma cells**.
- The plasma cells produce antibodies.
- Some **B cells do not produce antibodies** but become memory cells.
- These cells are **responsible for secondary immune response**.
- T lymphocytes do not produce antibodies.
- They **recognize antigen-presenting cells** and destroy them.
- Types of T cells - **Helper T cells and Killer T cells**.
- Helper T cells **release a chemical called cytokine** which activates B cells.
- Killer cells move around the body and **destroy cells which are damaged or infected**.
- Apart from these cells **neutrophils and monocytes** destroy foreign cells by **phagocytosis**.

#### 10. Write short notes on Prevention and control for drug and alcohol abuse :-

Ways to **prevent drug and alcohol abuse**.

##### 1. Effectively dealing with peer pressure

- The biggest reason for teens to start on drugs is **due to their friends / peer groups** imposing pressure on them.
- Hence, it is important to **have a better group of friends** to avoid such harmful drugs and alcohol.

##### 2. Seeking help from parents and peers

- Help from parents, friends and peer group **should be required immediately** so that they can be guided appropriately.

- Getting proper advice to sort out their problems would help the **young to vent their feelings of anxiety and guilt.**
- 3. **Education and counselling**
- Education and counselling **create positive attitude to deal** with many problems and to accept disappointments in life.
- 4. **Looking for danger signs**
- Teachers and parents need to look for sign that **indicate tendency to go in for addiction.**
- 5. **Seeking professional and medical assistance**
- Assistance is available in the form of **psychologists, psychiatrists**
- **De-addiction and rehabilitation programmes** to help individuals to overcome their problems.

### 11. Write an essay on cancer.

- A **tumour or neoplasm** is a group of cells whose growth has gone unchecked.
- When a **tumour continues to grow and invades healthy tissue**, it is called cancer.
- They **spread to other parts of the body from the tumour** and give rise to secondary tumour.
- This is known as **metastasis.**
- Tumour may be **benign or malignant** depending on its characteristics.
- **Benign or non-cancerous tissues** are capable of indefinite growth and do not invade other body parts.
- In the **malignant tumour**, the cells grow indefinitely, detach and **migrate into healthy surrounding tissues.**
- In normal cells, cell growth and differentiation is **highly controlled and regulated.**



- But in cancer cells, **there is breakdown** of this regulatory mechanism.
- Normal cells show a property called **contact inhibition**, which inhibits uncontrolled growth.
- Cancer cells **do not have this property.**
- As a result, cancerous cells **divide continuously giving rise to mass of tissues called tumours.**
- When a cell undergoes malignant transformation, it **acquires new surface antigen** and may also lose some normal antigens.
- These antigens are present on the membranes of malignant cells and **they induce an immune response.**
- **Both humoral and cellular responses** can be observed in malignancy.
- Cancer cells can **avoid immune detection** as they are not foreign bodies but are abnormally functioning body cells.
- This makes them **difficult to treat.**
- The concept of immunological surveillance postulates that the **primary function of the immune system is to "seek and destroy"** malignant cells that arise by somatic mutation.
- The efficiency of the surveillance mechanism reduces either as a result of **ageing or due to congenital or acquired immune deficiencies**, leads to increased incidence of cancer.
- Thus, if immunological surveillance is effective, **cancer should not occur.**
- The development of tumour represents a **break in surveillance.**

### 12. Classify drugs based on their mode of action

Group	Drugs	Effects
<b>Stimulants</b>	Amphetamines, cocaine, nicotine and tobacco	Accelerates the <b>activity of the brain</b>
<b>Depressants</b>	Alcohol, Barbiturates, Tranquilizers	Slows down the <b>activity of the brain</b>
<b>Narcotic/ Analgesics</b>	Opium, Morphine	<b>Act as depressants</b> on the Central Nervous System
<b>Cannabis</b>	Bhang (Marijuana), Ganja, Charas	<b>Affects the cardiovascular system.</b>
<b>Hallucinogens</b>	Lysergic acid diethylamide (LSD), Phencyclidine	<b>Distorts the way</b> one sees, hears and feels

## POINTS TO REMEMBER

- Microbes are **present everywhere** like soil, water, acidic and alkaline environment, inside human, etc
- Microbes can be grown on culture nutritive media to form colonies which are used for mass production of certain desirable products
- **LAB is lactic acid bacteria** which is used to convert Milk into curd, yoghurt & cheese etc.
- Antibiotics are chemical substances, which are **produced by some microbes and can kill or retard growth of other** disease causing microbes.
- Fermentation is **an anaerobic respiration process** in which carbohydrates are converted into **ethanol and carbon di oxide**
- Fermented products include - **wine, beer, whisky, brandy and rum.**
- **Penicillin** was the first antibiotic to be discovered by Alexander Fleming while working on *Staphylococci*
- *Penicillium notatum* produces **penicillin.**
- Antibiotics have been extensively used for treatment of certain epidemic diseases like **diphtheria, leprosy, plague, etc.**
- Ethanol is the alcohol found in **alcoholic beverages.** It is produced with the help of yeast - *Saccharomyces cerevisiae.*
- **Streptokinase** produced by bacterium *Streptococcus* is used as **clot buster** for removing blood clot
- **Cyclosporin A,** a **bioactive immunosuppressive agent** is used in organ transplant patient, produced by **Trichoderma polysporum.**
- **Statin** is **blood cholesterol lowering agent** produced by yeast *Monascus*
- Wastewater treatment is the process used to **reduce organic and inorganic components** in wastewater and also **eliminate toxic materials.**
- Sewage treatment include three stages.
  1. **Primary Treatment**
  2. **Secondary Treatment**
  3. **Tertiary Treatment**
- Biogas is a mixture of different **gases produced by the breakdown of organic matter** in the absence of oxygen.
- Biogas can be produced from **agricultural wastes, manure, municipal wastes, plant material, sewage, food waste, etc.,**
- Methane producing bacteria are called **methanogens** and one such common bacterium is Methanobacterium.
- Controlling the growth of microbes by using another microbes is possible. This method is known as **Bio control.**
- Biocontrol is a method of **controlling pest by use of microbes** such as fungi, bacteria, viruses or by naturally occurring substances derived from plants and animals.
- The use of a microbes or other biological agents to control a specific pest is called a **biopesticide.**
- **Biopesticides are used to control insect pests.**
- Bio-fertilisers are **formulation of living microorganisms** that enrich the nutrient quality of the soil.  
They **increase physio – chemical properties of soils** such as soil structure, texture, water

## PART-A

## TEXTUAL QUESTIONS (1 MARK)

1. Which of the following microorganism is used for production of citric acid in industries?

- a) Lactobacillus bulgaris    b) Penicillium citrinum  
c) Aspergillus niger        d) Rhizopus nigricans

Ans : c

2. Which of the following pair is correctly matched for the product produced by them?

- a) Acetobacter aceti        - Antibiotics  
b) Methanobacterium       - Lactic acid  
c) Penicillium notatum     - Acetic acid  
d) Saccharomyces cerevisiae - Ethanol

Ans : d

3. The most common substrate used in distilleries for the production of ethanol is

- a) Soyameal                    b) Groundgram  
c) Molasses                    d) Corn meal

Ans : c

4. Cry toxins obtained from Bacillus thuringiensis are effective against for

- a) Mosquitoes                b) Flies  
c) Nematodes                 d) Bollworms

Ans : d

5. Cyclosporin – A is an immunosuppressive drug produced from

- a) Aspergillus niger  
b) Monascus purpureus  
c) Penicillium notatum  
d) Trichoderma polysporum

Ans : d

6. Which of the following bacteria is used extensively as a bio-pesticide?

- a) Bacillus thuringiensis  
b) Bacillus subtilis  
c) Lactobacillus acidophilus  
d) Streptococcus lactis

Ans : a

7. Which of the following is not involved in nitrogen fixation?

- a) Pseudomonas                b) Azotobacter  
c) Anabaena                    d) Nostoc

Ans : a

8. CO<sub>2</sub> is not released during

- a) Alcoholic fermentation  
b) Lactate fermentation  
c) Aerobic respiration in animals  
d) Aerobic respiration in plants

Ans : b

9. The purpose of biological treatment of waste water is to

- a) Reduce BOD  
b) Increase BOD  
c) Reduce sedimentation  
d) Increase sedimentation

Ans : a

10. The gases produced in anaerobic sludge digesters are

- a) Methane, oxygen and hydrogen sulphide.  
b) Hydrogen sulphide, methane and sulphur dioxide.  
c) Hydrogen sulphide, nitrogen and methane.  
d) Methane, hydrogen sulphide and CO<sub>2</sub>.

Ans : d

## PART-B, C AND D

## TEXTUAL QUESTIONS (2,3 AND 5 MARKS)

11. How is milk converted into curd? Explain the process of curd formation.

- A small amount of curd added to fresh milk as a **starter or inoculum** contains millions of Lactobacilli, which under suitable temperature ( $\leq 40^{\circ}\text{C}$ ) multiply and **convert milk into curd**.
- Curd is more **nutritious than milk** as it contains a number of organic acids and vitamins.

12. Give any two bioactive molecules produced by microbes and state their uses.

- **Lipases** – used in **detergent formulations** and **removal of oily stains**.
- a) **Pectinase, protease** and **cellulase** - Used as a clarifier in Bottled juices
- b) **Rennet** - used to **separate milk into solid curds** for cheese making.

13. What is biological oxygen demand?

- BOD refers to the **amount of the oxygen**

that would be consumed, if all the organic matter in one litre of water were oxidized by bacteria.

- The **greater the BOD** of the waste water indicate it is more polluted.

#### 14. Explain the role of cry-genes in genetically modified crops.

- **Cry toxin** is a toxin produce by *Bacillus thuringiensis* and used as a biopesticide
- During sporulation ***Bacillus thuringiensis* produces crystal proteins** called **Delta-endotoxin** which is encoded by **cry genes**.
- Delta-endotoxins used against the insects of the orders **Lepidoptera, Diptera, Coleoptera** and **Hymenoptera**.
- When the insects ingest the toxin crystals these toxin inserted into the **gut cell membrane and paralyzes the digestive tract**.
- The insect then **stops eating and starves to death**.

#### 15. Write the key features of organic farming.

- **Protecting soil quality** using organic materials and encouraging biological activity.
- Indirect **provision of crop nutrients** using soil microorganisms.
- **Nitrogen fixation in soils** using legumes.
- **Weed and pest control** based on methods like crop rotation, biological diversity, natural predators, organic manures and suitable chemical, thermal and biological interventions.

#### 16. Justify the role of microbes as a bio-fertilizer.

- **Bacteria, fungi and cyanobacteria** used as a biofertilisers.
- Eg. **Rhizobium** is a symbiotic nitrogen fixing bacteria.
- This bacterium infects the root nodules of leguminous plants and **fixes atmospheric nitrogen into organic forms**.
- **Azospirillum and Azotobacter** are free living bacteria that fix atmospheric nitrogen and enrich the nitrogen content of soil.
- A symbiotic association between a fungus and the roots of the plants is called **mycorrhiza**.
- The fungal symbiont in these associations **absorbs the phosphorus from soil and transfers to the plant**.

Uses :

- **Resistance to root-borne pathogens, tolerance to salinity, drought, enhances plant growth and developments.**
- **Cyanobacteria** (or) blue green algae (BGA) are also fix nitrogen.
- Eg. **Oscillatoria, Nostoc, Anabaena, Tolypothrix**
- In water logged paddy fields, **Cyanobacteria multiply and fix molecular nitrogen**.
- Cyanobacteria secrete growth promoting substances like **indole-3-acetic acid, indole-3-butyric acid, naphthalene acetic acid, amino acids, proteins, vitamins** which promotes plant growth and production.

#### 17. Write short notes on the following.

- Brewer's Yeast :**
- Saccharomyces cerevisiae** commonly called brewer's yeast is used for fermenting malted cereals and fruit juices to **produce various alcoholic beverages**.
- Ideonella sakaiensis :**
  - *Ideonella sakaiensis* is currently tried for **recycling of PET plastics**.
  - These bacteria use **PETase and MHETase** enzymes to **breakdown PET plastic into terephthalic acid and ethylene glycol**.
- Microbial fuel cells**
  - A microbial fuel cell is a bio-electrochemical system that **drives an electric current** by using bacteria
  - Microbial fuel cells work by **allowing bacteria to oxidize and reduce organic molecules**.
  - Microbes at the **anode oxidize the organic fuel** generating protons which pass through the membrane to the cathode and the **electrons pass through the anode to the external circuit** to generate current.

#### 18. List the advantages of biogas plants in rural areas.

1. Biogas is **used for cooking and lighting**
2. The slurry is drained through another outlet and is **used as fertilizer**.
3. The technology of biogas production was developed by **Indian Agricultural Research Institute (IARI)** and **Khadi and Village Industries Commission (KVIC)**.

**19. When does antibiotic resistance develop?**

- Antibiotic resistance occurs when **bacteria develop the ability to defeat the drug.**
- It is one of the most **acute threat to public health.**
- When the **bacteria become resistant**, antibiotics cannot fight against them and the bacteria multiply.
- **Narrow spectrum antibiotics are preferred** over broad spectrum antibiotics.
- **Narrow spectrum antibiotics** are less chance to cause antibiotic resistance.

**20. What is the key difference between primary and secondary sewage treatment?**

S. No.	Primary sewage treatment	Secondary sewage treatment
1.	It is a <b>physical method of treatment</b>	It is a biological method of treatment
2.	It involves in <b>removal of large particles and floating materials</b>	It involves the <b>removal of fine suspended and dissolved organic matter.</b>
3.	It makes the use of <b>sedimentation and filtration process</b>	It makes the use of <b>aerobic or anaerobic biological units</b>
4.	It is relatively <b>simple and less time consuming process</b>	It is relatively <b>complex and takes a long time for its completion</b>

**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

- Antibiotics are mostly obtained from**  
 a) Bacteria                      b) Actionmycetes  
 c) Cyanobacteria              d) a) & b)                      **Ans: d**
- Which one of the microorganism is used for production of citric acid in industries?**  
 a) Lactobacillus bulgaricus  
 b) Penicillium citrinum  
 c) Aspergillus niger  
 d) Rhizopus nigricans                      **Ans: c**

**3. Formation of vinegar from alcohol is caused by**

- a) Bacillus subtilis                      b) Clostridium  
 c) Acetobacter aceti                      d) Azotobacter                      **Ans: c**

**4. Biogas consist of**

- a) Carbon monoxide, methane and hydrogen  
 b) Carbon dioxide, methane and hydrogen  
 c) Carbon monoxide, ethane and hydrogen  
 d) Carbon dioxide. Ethane and hydrogen                      **Ans: b**

**5. Beer is obtained from**

- a) Molasses                                      b) Gin  
 c) Barley    d) Rye                                      **Ans: c**

**6. Maximum percentage of alcohol present in the product of yeast fermentation**

- a) Brandy    b) Gin  
 c) Rum    d) Wine                                      **Ans: a**

**7. Which of the following microorganisms use for swiss chess:**

- a) Propioni bacterium                      b) Geotrichum  
 c) Penicillium                                      d) Streptococcus                      **Ans: a**

**8. Cheese and Yoghurt are products of**

- a) Pasteurisation                              b) Distillation  
 c) Dehydration                                      d) Fermentation                      **Ans: d**

**9. Milk is changed into curd by -**

- a) Bacillus Megatherium  
 b) Acetobacter aceti  
 c) Xanthomonas citri  
 d) Lactobacilus acidophilus                      **Ans: d**

**10. Modern farmer's can increase the yield of Paddy upto 50% by the use of**

- a) Cyanobacteria                              b) Rhizobium  
 c) Mycorrhiza                                      d) Farm yard manure                      **Ans: a**

**11. Saccharomyces cerevissae is used in the formation of**

- a) Ethanol    b) Methanol  
 c) Acetic acid                                      d) antibiotics                      **Ans: a**

**12. Which one produce gas by decomposing the gobar (Dung) in gobar gas:**

- a) Fungus
- b) Virus
- c) Methanogenic bacteria
- d) Algae

**Ans: c**

**13. Which of the following is used to manufacture ethanol from starch**

- a) Penicillin
- b) Saccharomyces
- c) Azotobactor
- d) Lactobacillus

**Ans: b**

**14. Which bacteria is utilized in Gobar gas plant:**

- a) Methanogens
- b) Nitrifying bacteria
- c) Ammonifying bacteria
- d) Denitrifying bacteria

**Ans: a**

**15. The term "antibiotic" was coined by \_\_\_\_\_**

- a) Edward Jenner
- b) Louis Pasteur
- c) Selman waksman
- d) Alexander Fleming

**Ans: c**

**16. Which one is not used in the production of yoghurt:**

- a) Streptococcus lactis
- b) Streptococcus thermophilous
- c) Lactobacillus bulgaris
- d) Both (2) & (3)

**Ans: a**

**17. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?**

- a) Glumous
- b) Trichoderma
- c) Azotobacter
- d) Aspergillus

**Ans: a**

**18. Lactic acid bacteria (LAB) grow in milk and convert it to curd and also improve its nutritional quality by increasing:**

- a) Vitamin A
- b) Vitamin B<sub>12</sub>
- c) Vitamin B<sub>6</sub>
- d) Vitamin C and A

**Ans: b**

**19. Which of the following fermented baverage will not be produced by distillation of fermented broth**

- a) Whisky
- b) Brandy
- c) Rum
- d) Wine

**Ans: d**

**20. Which of the following is the examples of biofertilizers?**

- a) Green manure
- b) Compost manure
- c) BGA and VAM
- d) Green manure & chemical fertilizers

**Ans: d**

**21. The use of predator to control a pest is called**

- a) Genetic engineering
- b) Biological control
- c) Chemical control
- d) Artificial control

**Ans: b**

**22. Bio pesticide include:**

- a) Only bioinsecticide
- b) Only bioherbicide
- c) Bioinsecticide & bioherbicide
- d) Bioinsecticide, bioherbicide & bio fertilisers

**Ans: b**

**23. Bacillus thuringensis is used to control:-**

- a) Moth
- b) Files
- c) Mosquito
- d) All theabove

**Ans: d**

**24. The material of biological origin, which is used to maintain and improve soil fertility is**

- a) Bio pesticide
- b) Bionutrient
- c) Cheneal fertilizers
- d) Green manure

**Ans: d**

**25. Yeast is used in the production of \_\_\_\_\_**

- a) Bread and beer
- b) Cheese and butter
- c) Citric acid and lactic acid
- d) Lipase and pectinase

**Ans: a**

**26. In gobar gas, the maximum amount is that of**

- a) Propane
- b) Carbon dioxide
- c) Butane
- d) Methane

**Ans: d**

**27. A good producer of citric acid is**

- a) Saccharomyces
- b) Aspergillus
- c) Pseudomonas
- d) Clostridium

**Ans: b**

**28. Biological control agent obtained from**

- a) Bacillus thuringiensis
- b) E.Coli
- c) Agrobacterium tumifaciens
- d) Meloidogyne incognitia

**Ans: a**



**29. Wastewater treatment generates a large quantity of sludge, which can be treated by:**

- a) anaerobic digesters    b) floc  
c) chemicals                d) oxidation pond.

**Ans: a**

**30. Methanogenic bacteria are not found in:**

- a) rumen of cattle  
b) gobar gas plant  
c) bottom of water-logged paddy fields  
d) activated sludge.

**Ans: d**

**31. Match the following list of bacteria and their commercially important products:**

**Bacterium Product**

- |                                    |                 |
|------------------------------------|-----------------|
| (i) <i>Aspergillus niger</i>       | a) Lactic acid  |
| (ii) <i>Acetobacter aceti</i>      | b) Butyric acid |
| (iii) <i>Clostridium butylicum</i> | c) Acetic acid  |
| (iv) <i>Lactobacillus</i>          | d) Citric acid  |

Choose the correct match:

- a) (i) b), (ii) c), (iii) d), (iv) a)  
b) (i) b), (ii) d), (iii) c), (iv) a)  
c) (i) d), (ii) c), (iii) b), (iv) a)  
d) (i) d), (ii) a), (iii) c), (iv) b)

**Ans: c**

**32. The primary treatment of waste water involves the removal of:**

- a) dissolved impurities    b) stable particles  
c) toxic substances        d) harmful bacteria.

**Ans: b**

**33. BOD of waste water is estimated by measuring the amount of:**

- a) total organic matter  
b) biodegradable organic matter  
c) oxygen evolution  
d) oxygen consumption.

**Ans: d**

**34. The free-living fungus *Trichoderma* can be used for:**

- a) killing insects  
b) biological control of plant diseases  
c) controlling butterfly caterpillars  
d) producing antibiotics

**Ans: b**

**35. Mycorrhiza does not help the host plant in:**

- a) Enhancing its phosphorus uptake capacity  
b) Increasing its tolerance to drought  
c) Enhancing its resistance to root pathogens  
d) Increasing its resistance to insects.

**Ans: d**

**36. Big holes in Swiss cheese are made by a:**

- a) a machine  
b) a bacterium that produces methane gas  
c) a bacterium producing a large amount of carbon dioxide  
d) a fungus that releases a lot of gases during its metabolic activities.

**Ans: c**

**37. Methanogens do not produce:**

- a) oxygen                      b) methane  
c) hydrogen sulfide        d) carbon dioxide.

**Ans: a**

**38. Which one of the following alcoholic drinks is produced without distillation?**

- a) Wine                        b) Whisky  
c) Rum                        d) Brandy

**Ans: a**

**39. The free-living fungus *Trichoderma* can be used for:**

- a) killing insects  
b) biological control of plant diseases  
c) controlling butterfly caterpillars  
d) producing antibiotics

**Ans: b**

**40. Mycorrhiza does not help the host plant in:**

- a) Enhancing its phosphorus uptake capacity  
b) Increasing its tolerance to drought  
c) Enhancing its resistance to root pathogens  
d) Increasing its resistance to insects.

**Ans: d**

**41. Big holes in Swiss cheese are made by a:**

- a) a machine  
b) a bacterium that produces methane gas  
c) a bacterium producing a large amount of carbon dioxide  
d) a fungus that releases a lot of gases during its metabolic activities.

**Ans: c**



**42. Methanogens do not produce:**

- a) oxygen                                      b) methane  
c) hydrogen sulfide                      d) carbon dioxide.

Ans: a

**PART-B****ADDITIONAL QUESTIONS (2 MARKS)****1. Explain the TERM LAB.**

- Bacteria like *Lactobacillus acidophilus*, *L. lactis* and *Streptococcus lactis* commonly called **lactic acid bacteria (LAB)**
- They play a vital role in curd formation.

**2. What are probiotics?**

- Probiotics are **useful bacteria**
- Eg. LAB because they **inhibit the growth of pathogenic microbes** in the stomach and other parts of the digestive tract.

**3. List out the organisms used for the production of Yogurt, Cheese, Panner**

- Yogurt - *Streptococcus thermophilus* and *Lactobacillus bulgaricus*
- Cheese - *Lactococcus*, *Lactobacillus* or *Streptococcus*
- Panner - *Propionibacterium shermanii*.

**4. List the uses of dough.**

- The dough used in the preparation of **idlis and dosas** by using *Leuconostoc mesenteroides*
- Dough also used in **bread making** by using *Saccharomyces cerevisiae* (Baker's Yeast).

**5. Define SCP**

- Single cell protein refers to **edible unicellular microorganisms** like *Spirulina*.

**6. Significance of a Bioreactor.**

- A fermentor (bioreactor) is a **closed vessel**.
- It provide proper **aeration, agitation, temperature, pH control**
- It also **drain or remove the waste biomass of cultured microorganisms** along-with their products

**7. Define Antibiotics.**

- Antibiotic means **"against life"**.
- Antibiotics are **chemical substances**

**produced by microorganisms** which can kill or inhibit the growth of other disease causing microbes even in low concentration.

**8. Classify Antibiotics.**

- Antibiotics are two types they are
- **Broad-spectrum antibiotics** act against a wide range of disease-causing bacteria.
- **Narrow-spectrum antibiotics** are active against a selected group of bacterial types.

**9. Why penicillin known as queen of Antibiotics?**

- Penicillin is also referred as the **"queen of drugs"** because **its a full potential as an effective antibiotic** which is used to **treated the wounded soldiers in World War II**.
- It is **bactericidal (antibiotics that kill bacteria in action** and inhibits the synthesis of the bacterial cell wall)

**10. Differentiate Bactericidal and Bacteriostatic Antibiotic.**

**Bactericidal Antibiotic** – kill the bacteria

**Bacteriostatic Antibiotic** - inhibits the growth of bacteria by inhibit the synthesis of the bacterial cell wall.

**11. What is Hypersensitivity Reaction?**

- It is an **excessive immune reaction** against an antigen
- Hypersensitivity reaction is a **major problem with the use of penicillin**, resulting in nausea, vomiting, wheezing and ultimately cardiovascular collapse.

**12. What is super bug?**

- **"Superbug"** is a term used to describe **strains of bacteria** that are resistant to the majority of antibiotics

**13. Define zymology.**

- Zymology is an applied science which deals with the **biochemical process of fermentation and its practical uses**.

**14. Define oenology.**

- **Oenology** is the science and study of **wine and wine making**.

**15. What is toddy?**

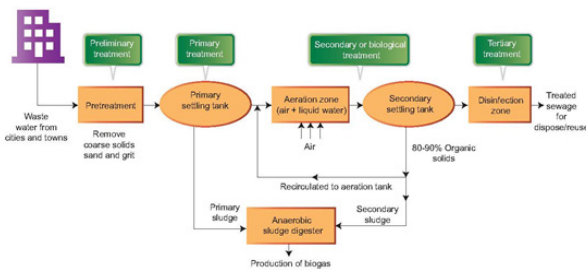
- When **pathaneer is left undisturbed for few hours** it gets fermented to form **toddy** with the help of naturally occurring yeast.

- It contains 4 percent alcohol.
- After 24 hours **toddy becomes indigestible** and is used for the production of vinegar.

**16. What is Bio-diesel or Bio fuel?**

- Biodiesel is a fuel **made from vegetable oils, fats or greases.**
- Biodiesel fuel can be **used in diesel engines without altering the engine.**
- Pure biodiesel is **non-toxic, biodegradable and produces lower level of air pollutants** than petroleum-based diesel fuel.

**17. Write an equation of fermentation process.**



**18. List out the Acid produced by microbes and organism involved in it.**

Microbe	Acid produced
1. Aspergillus niger	- Citric acid,
2. Acetobacter aceti	- Acetic acid,
3. Rhizopus oryzae	- Fumaric acid,
4. Clostridium butyricum	- Butyric acid and
5. Lactobacillus	- Lactic acid.



**19. What is cyclosporine A?**

- **Cyclosporin A**, an **immunosuppressant** used in organ transplantation is produced from the fungus **Trichoderma polysporum.**
- It is also used for its **anti-inflammatory, anti-fungal and anti-parasitic properties.**

**20. Write the significance of E.Coli and Saccharomyces cerevisiae**

- a) E. coli - Recombinant **human insulin** has been produced predominantly using E. coli
- b) **Saccharomyces cerevisiae** used as **therapeutic agent** in human.

**21. Explain primary treatment in sewage treatment.**

- Primary treatment involves the **physical**

**removal of solid and particulate organic** and inorganic materials from the sewage through filtration and sedimentation.

- Floating debris is removed by **serial filtration.**
- Then soil and small pebbles are removed by **sedimentation.**

**22. What is Activates sludge?**

- Once the BOD of sewage water is reduced significantly, the **effluent is then passed into a settling tank** where the bacterial "**flocs**" are allowed to sediment.
- This sediment is called **activated sludge.**

**23. Define the term MFC.**

- A **microbial fuel cell** is a bio-electrochemical system that **drives an electric current by using bacteria** and mimicking bacterial interaction found in nature.
- Microbial fuel cells work by **allowing bacteria to oxidize and reduce organic molecules.**
- A MFC **consists of an anode and a cathode** separated by a proton exchange membrane.
- Microbes at the **anode oxidize the organic fuel** generating protons which pass through the membrane to the cathode and the electrons pass through the anode to the **external circuit to generate current.**

**24. Define methanogens. List the organism involved in it.**

- Methane producing bacteria are called **methanogens**
- Eg. **Methanobacterium.**
- The Methanogens are also present in **anaerobic sludge and rumen of cattle.**
- In rumen, these bacteria **help in the breakdown of cellulose.**

**25. What is Biogas?**

- Biogas is a mixture of different **gases produced by the breakdown of organic matter** in the absence of oxygen.
- Biogas can be produced from **agricultural wastes, manure, municipal wastes, plant material, sewage, food waste, etc.,**
- Biogas is **produced under anaerobic condition**, when the organic materials are converted through microbiological reactions

into gas and organic fertilizer.

- Biogas primarily consists of **methane (63 percent, along with CO<sub>2</sub> and hydrogen.**

#### 26. What is delta-endotoxin?

- It is a chemical produced by **Bacillus thuringiensis**
- Delta-endotoxins have specific activities against the insects of the orders **Lepidoptera, Diptera, Coleoptera** and **Hymenoptera.**
- It is used as a **biological control**

#### 27. Define weedicides.

- Weedicides are substances, which **destroy weeds without harming the useful plants.**
- Bioweedicides are secondary metabolites **derived from microbes such as fungi, bacteria or protozoa.**

#### 28. What is mycorrhiza?

- A **symbiotic association** between a fungus and the roots of the plants is called **mycorrhiza.**
- The fungal symbiont in these associations **absorbs the phosphorus from soil and transfers to the plant.**
- Mycorrhiza provide **resistance to root-borne pathogens, tolerance to salinity, drought,** enhances plant growth and developments.

#### 29. What are Nitrogen fixing cyanobacteria.

- **Cyanobacteria** (or) blue green algae (BGA) are **prokaryotic free-living organisms** which can fix nitrogen.
- Eg. **Oscillatoria, Nostoc, Anabaena, Tolypothrix**
- In the water logged paddy fields, **Cyanobacteria** multiply and fix molecular nitrogen.

#### 30. Define Bio remediation.

- The use of naturally occurring or **genetically engineered microorganisms to reduce or degrade pollutants** is called bioremediation.
- Bioremediation is **less expensive and more sustainable** than other remediations available.

#### 31. What is GEM?

- It is **Genetically Engineered Microorganism.**
- They mainly **degrade pesticides and hydrocarbons.**
- Eg. **Pseudomonas putida** - It is multi-plasmid hydrocarbon-degrading bacterium which can **digest the hydrocarbons in the oil spills.**
- **Nitrosomonas europaea** – it can **degrading benzene** and halogenated organic compounds
- **Ideonella sakaiensis** - is used in **recycling of PET plastics.**

#### 32. Name any two free living bacteria that fix atmospheric nitrogen and increase nitrogen content in the soil.

*Azospirillum* and *Azotobacter*

#### 33. Expand the abbreviations a LAB b BOD

a **LAB – Lactic Acid Bacteria**

b **BOD – Biochemical Oxygen Demand**

#### 34. Name a microbe used for statin production. How do Statin lower the blood cholesterol?

- **Statins** produced by the yeast **Monascus purpureus** have been used to lower blood cholesterol levels.
- It acts by **competitively inhibiting the enzyme** responsible for the synthesis of cholesterol.

#### 35. Name the source of streptokinase. How does this bioactive molecule function in our body?

- Streptokinase produced by the bacterium **Streptococcus** and genetically engineered Streptococci
- They are used as “**clot buster**” for **removing clots from the blood vessels** of patients who have undergone myocardial infarction.

#### 36. How does anabaena and mycorrhiza act as biofertilisers?

- Anabaena fix atmospheric nitrogen
- Mycorrhiza absorbs phosphorus from soil and passes it to the plant.

#### 37. Why is Rhizobium called as 'symbiotic bacterium'? How does it act as a biofertiliser?



- Rhizobium is present in the root nodules of leguminous plants.
- These bacteria fix atmospheric nitrogen into nitrate.

**38. Name any two distilled and undistilled alcoholic beverages.**

- a) Distilled alcoholic beverages: Whisky, Rum, Brandy
- b) Undistilled alcoholic beverages: Beer and Wine

**39. Write any two advantages of biofertilisers.**

- a) Biofertiliser do not cause pollution
- b) These are not expensive

**40. Mention the importance of lactic acid bacteria to human other than setting milk into curd.**

- Lactic acid bacteria is beneficial to us in the following ways other than helping in curdling of milk:
  - i) Increases nutritional quality of curd by **increasing vitamin B<sub>12</sub> content.**
  - ii) **Inhibits the growth** of disease-causing microbes in the gut.

**41. Name the organism that causes large holes in 'Swiss cheese' How are these holes caused?**

- Bacterium responsible for large holes in swiss cheese is **Propionibacterium sharmanii.**
- Large holes in swiss cheese are due to **CO<sub>2</sub> gas produced by these bacteria.**

**42. Name the blank spaces a,b,c and d in the table given below:**

Type of Microbe	Scientific Name	Commercial product
Bacterium	a	Clot buster enzyme
B	<i>Aspergillus niger</i>	Citric acid
Fungus	<i>Trichoderma poysporum</i>	c
Bacterium	d	Butyric acid

a - *Streptococcus*

b - Fungus

c - Cyclosporin A

d - *Clostridium acetobutylicum*

**43. Explain the significant role of the genus Nucleopolyhedrovirus in an ecological**

**sensitive.**

- The genus **Nucleopolyhedrovirus** is used as a biocontrol agent.
- These viruses are species specific and have **narrow spectrum insecticidal applications.**
- There is **no side effects on plants, mammals, birds, fish and non-target insects.**
- Therefore, they serve as an important component of **integrated pest management** programme in dealing with ecological sensitive areas.

**44. Name the states involved in Ganga action plan.**

- Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal

**45. How has the bacterium *Bacillus thuringiensis* helped us in controlling caterpillars of insect pests?**

- *Bacillus thuringiensis* produces a **delta endotoxin** which when ingested and released in the gut of the larvae of insect pest distrupts its gut lining and thus caterpillars are killed.
- By killing the caterpillars, **it helps in pest control.**

**46. Why are cyanobacteria considered useful in paddy fields?**

- Cyanobacteria are important **biofertiliser in paddy fields.**
- They **add organic matter to the soil** and enhance soil fertility.
- Hence, they are considered useful in paddy fields.

**47. What is the chemical nature of biogas. Name an organism which is involved in biogas production?**

- Biogas is mainly composed of **methane, other gases are CO<sub>2</sub> and H<sub>2</sub>.**
- It is highly **inflammable and is used as fuel**; especially in rural areas.
- **Methanogen bacteria** are involved in production of biogas.



**PART-C**

**ADDITIONAL QUESTIONS (3 MARKS)**

**1. Write short notes on Antibiotic resistance.**

- Antibiotic resistance occurs **when bacteria develop the ability to defeat the drug** designed to kill or inhibit their growth.
- It is one of the most **acute threat to public health**.
- It is due to **misuse and over use of antibiotics, as well as poor infection prevention control**.
- Antibiotics should be **used only when prescribed** by a certified health professional.
- When the bacteria become resistant, **antibiotics cannot fight against them**.
- So **Narrow spectrum antibiotics are preferred** over broad spectrum antibiotics.
- They **effectively and accurately target specific pathogenic** organisms and are less likely to cause resistance.
- **“Superbug”** is a **strains of bacteria that are resistant** to the majority of antibiotics.

**2. Write an essay on microbes used in Chemical Industry.**

- Microbes are not only used for commercial and industrial production of alcohol, but also used for **production of chemicals like organic acids and enzymes**.

Microbes	Chemical produced
1. Aspergillus niger	- <b>citric acid</b> ,
2. Acetobacter aceti	- <b>acetic acid</b> ,
3. Rhizopus oryzae	- <b>fumaric acid</b> ,
4. Clostridium butyricum	- <b>butyric acid</b>
5. Lactobacillus	- <b>lactic acid</b> .
6. Yeast and bacteria	- <b>commercial production of enzymes</b> .
7. Streptococcus	- <b>Streptokinase</b>
8. Trichoderma polysporum	- <b>Cyclosporin A</b> , (immunosuppressant)
9. yeast Monascus purpureus	- <b>Statins</b> (used to lower blood cholesterol level)
10. <b>E.Coli</b>	- <b>human insulin</b>

**3. List out the various methods taken by the government to conserve water bodies.**

**National river conservation plan (NRCP)** was enacted in 1995 to improve the water quality of the rivers,

**Aims of NRCP includes,**

1. To **capture the raw sewage flowing** into the river through open drains and divert them for treatment.
2. **Setting up sewage treatment plants** for treating the diverted sewage.
3. Construction of **low cost sanitation toilets** to prevent open defecation on river banks.
4. The ministry for environment, forest and climate change has initiated the **Ganga action plan and the Yamuna action plan** to save the major rivers of the country.

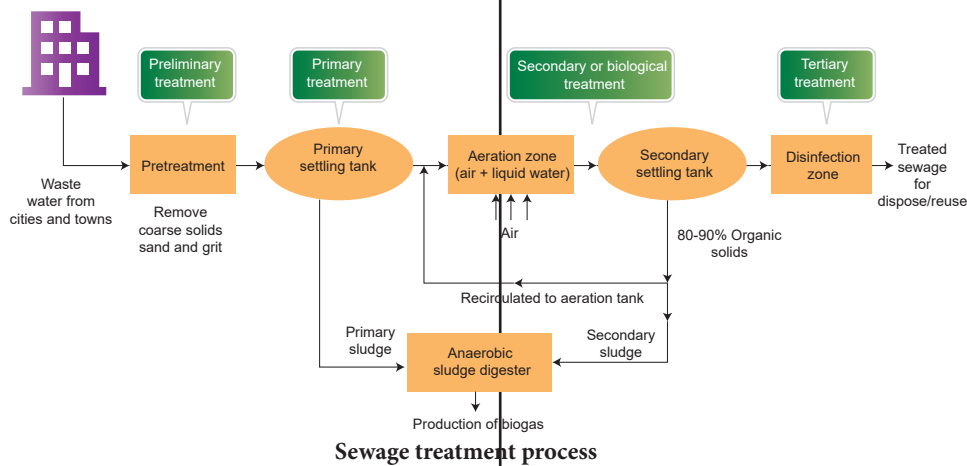
**4. What is organic farming ? list out the key feature of organic farming.**

- Organic farming is a **technique, which involves cultivation of plants and rearing of animals** in natural ways.
- This process involves the use of biological materials, avoiding synthetic substances **to maintain soil fertility and ecological balance** thereby minimizing pollution and wastage.

➤ **Key features of organic farming**

1. **Protecting soil quality** using organic materials and encouraging biological activity.
2. Indirect **provision of crop nutrients** using soil microorganisms.
3. **Nitrogen fixation** in soils using legumes.
4. Weed and pest control based on methods like **crop rotation, biological diversity, natural predators, organic manures and suitable chemical**, thermal and biological interventions.

5. Draw a schematic outline of sewage treatment process.



6. List out the important antibiotics and its role.

- Antibiotics are **chemical substances produced by microorganisms which can kill** or retard the growth of other disease causing microbes even in low concentration.
- Antibiotic means **“against life”**.

S. No.	Antibiotic	Source	Use
1	<b>Tetracycline</b>	Streptomyces aureofaciens	inhibits microbial protein synthesis
2	<b>Streptomycin</b>	Actinomycetes, Streptomyces griseus	used against both gram positive and gram negative bacteria, especially against Mycobacterium tuberculosis.
3	<b>Erythromycin, Chloramycetin, Griseofulvin, Neomycin, Kenamycin, Bacitracin</b>	Many microbes	

7. Write short note on the following

- The Ganga action plan
- The Yamuna action plan

**a The Ganga action**

- This plan was launched **on 14th January 1986**.

- The main objective of the programme is to **improve the water quality of River Ganges** by capture, change and treatment of domestic sewage
- By this plan **identify total polluting units** to prevent pollution.

**b The Yamuna Action Plan**

- It is a bilateral project between the **Government of India and Japan**.
- It was formally launched in **April 1993**.
- It was proposed to **build large number of sewage treatment plants** to discharge treated wastewater into the rivers.

8. State The medicinal value and the bioactive molecules produced by Streptococcus . Monascus and Trichoderma.

- Streptokinase is an enzyme **obtained from Steptococcus** which is modified genetically to function as **clot buster**.
- It has **fibrinolytic effect** hence, it **helps in clearing blood clots inside the blood vessels** through dissolution of intravascular fibrin.
- Bioactive compounds are **those compounds that have an effect on living organisms** tissues or cells.
- Bioactive compounds are **found in both plant and animal products** or can be synthetically produced.
- Two examples of bioactive compounds are **cyclosporin A and statins**.

**9. What are the properties of an antibiotic?**

- Antibiotics are **chemical substances produced by microorganisms which can kill** or retard the growth of other disease causing microbes even in low concentration.
- **Broad spectrum antibiotic** can kill or destroy a number of pathogens that belong to different groups with different structures and wall compositions.
- **Narrow spectrum antibiotic** are effective only against limited type of pathogen.
- Good antibiotics should be **harmless to host with no side effects**.
- They should be **harmless to beneficial microorganism** of alimentary canal
- They should be **effective against all strains of pathogen**.
- They should also be **quick in action** in low concentration

**10. What are methanogens? How do they help to generate biogas?**

- Methanogens are a group of anaerobic bacteria which obtain their energy by reducing carbondioxide and oxidising hydrogen with the production of methane.
- They are found in oxygen deficient environment such as marshes, swamps, sludge and digestive systems of ruminant animals like cow, buffalo etc.
- These microorganism are present in anaerobic sludge digester where they digest organic mass as well as aerobic microbes of the sludge to produce mixture of gases containing methane, H<sub>2</sub>S and CO<sub>2</sub> called biogas.

**11. Given below is a list of six microorganisms. State their usefulness to humans:**

- a. **Nucleopolyhedrovirus**
- b. **Saccharomces cerevisiae**
- c. **Monascus purpureus**
- d. **Trichoderma polysporum**
- e. **Penicilium notatum**
- f. **Propionibacterium sharmanii**

**Nucleopolyhedrovirus :**

- It is a **baculovirus which is an effective biocontrol agent** as it is useful in controlling insects

- It serves as a **bioinsecticide**.

**Saccharomyces cerevisiae :**

- It is used to **ferment dough**, in order to **make bread**.
- It is also used for the **preparation of ethanol**.

**Monascus purpureus :**

- Its fermentation activity produces statins which inhibits cholesterol synthesis and is therefore used in lowering blood cholesterol.

**Trichoderma polysporum :**

- It is a fungus that **produces cyclosporin-A**, which is used as **immunosuppressive agent** in organ-transplantation.

**Pencillium notatum :**

- It secretes the **antibiotic, penicillin**.

**Propionibacterium sharmanii :**

- It is used in **processing of 'Swiss cheese'**.
- The large holes in Swiss cheese are due to production of a **large amount of CO<sub>2</sub> by this bacterium**.



**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

**1. List any three useful microbes in household products.**

**Curd :**

- The **LAB** bacteria **grows in milk and convert it into curd**, thereby digesting the milk protein casein.
- Bacteria like Lactobacillus acidophilus, L. lactis and Streptococcus lactis commonly called **lactic acid bacteria (LAB)**
- Curd is **more nutritious than milk** as it contains a number of **organic acids and vitamins**.

**Yogurt :**

- Yogurt is produced by bacterial **fermentation of milk, and lactic acid** is produced as a byproduct.
- Microorganisms such as **Streptococcus thermophilus** and **Lactobacillus bulgaricus** coagulate the milk protein and convert the lactose in the milk to lactic acid.

- The flavour in yogurt is **due to acetaldehyde**.

#### Cheese :

- Cheese is a dairy product produced in a **wide range of flavours, textures** and is formed by coagulation of the milk protein, casein.
- During cheese production, **milk is usually acidified and the enzyme rennet** is added to cause coagulation.
- The solids are separated and **pressed to form cheese**.
- Organism used - **Lactococcus, Lactobacillus or Streptococcus**.

#### Panner :

- Paneer (**cottage cheese**) is fresh cheese common in South Asia, especially in India.
- It is made by **curdling milk with lemon juice, vinegar** and other edible acids.
- Large holes in Swiss cheese is due to the **production of large amount of carbon-di-oxide by the bacterium Propionibacterium shermanii**.

## 2. Define fermentation. Explain any three fermented beverages.

- Fermentation is **an anaerobic respiration process** in which carbohydrates are converted into **ethanol and carbon di oxide**
- Fermented products include - **wine, beer, whisky, brandy and rum**.

#### Wine :

- Wine is among the **oldest alcoholic beverages** known and is produced by fermentation of fruit juice by yeast.
- Wine is made from the **fermentation of grape juice**.
- Grape juice is fermented by various strains of **Saccharomyces cerevisiae** into alcohol.
- Grape wine is of two types, **red wine and white wine**.

#### Beer

- It is produced from **germinated barley malt grain** by **Saccharomyces carlsbergensis or Saccharomyces cerevisiae**.

#### Rum :

- Rum is made from **fermented sugarcane or molasses** or **directly from sugarcane juice** by **Saccharomyces cerevisiae**.

#### Whisky :

- **Whisky** is a type of **distilled alcoholic beverage** made from fermented grain mash by **Saccharomyces cerevisiae**.

## 3. Explain the process of sewage treatment.

- The main objective of a wastewater treatment process is to **reduce organic and inorganic components** in wastewater to a level that it **no longer supports microbial growth** and to **eliminate toxic materials**.
- Bacteria and some protozoa play an essential part in the treatment of sewage to make it harmless.
- Sewage contains **pathogenic bacteria**.
- These **bacteria must be destroyed in order** to prevent the spread of diseases.
- Sewage treatment include three stages.

### 1. Primary Treatment

### 2. Secondary Treatment

### 3. Tertiary Treatment

#### Primary treatment

- Primary treatment involves the **physical removal of solid and particulate organic and inorganic materials** from the sewage through filtration and sedimentation.
- Floating debris is removed by **sequential filtration**.
- Then the grit (**soil and small pebbles**) are removed by **sedimentation**.
- All solids that settle form the primary sludge and the supernatant forms the effluent.
- Then **effluent is taken for secondary treatment**.

#### Secondary treatment or biological treatment

- Effluent is **passed into large aeration tanks** where it is constantly agitated mechanically and air is pumped into it.
- This allows **vigorous growth of useful aerobic microbes** into floc (masses of bacteria associated with fungal filaments to form mesh like structures).
- While growing, these **microbes consume the major part of the organic matter** in the effluent.



- This **significantly reduces the BOD** (Biochemical oxygen demand or Biological oxygen demand)

**Tertiary treatment**

- Tertiary treatment is **the final process** that improves the quality of the waste water before it is reused, recycled or released into natural water bodies.
- This treatment **removes the remaining inorganic compounds and substances**, such as nitrogen and phosphorus.
- UV is an **ideal disinfectant** for wastewater since it does not alter the **water quality – except for inactivating microorganisms**.
- UV is a chemical- free process that can **completely replace the existing chlorination system** and also inactivates chlorine-resistant microorganisms like **Cryptosporidium and Giardia**.

**4. Is it possible to kill microbes using another microbe? Explain this process in detail.**

- Controlling the growth of microbes by using another microbes is possible. This method is known as **Bio control**.
- Biocontrol is a method of **controlling pest by use of microbes** such as fungi, bacteria, viruses or by naturally occurring substances derived from plants and animals.
- The use of a microbes or other biological agents to control a specific pest is called a **biopesticide**.
- **Biopesticides are used to control insect pests**.
- The **lady bird beetle** and **dragonflies** are useful to control aphids and mosquito larvae respectively.
- **Bacillus thuringiensis** is used as a **biopesticide** and contains a toxin called **cry toxin**.
- Scientists have introduced this toxin producing genes into plants and have raised genetically engineered **insect resistant plants**. e.g. Bt-cotton.
- Bacillus thuringiensis produces crystal proteins called **Delta-endotoxin** which is encoded by **cry genes**.



- Delta-endotoxins have specific activities against the insects of the orders **Lepidoptera, Diptera, Coleoptera** and **Hymenoptera**.
- Weedicides are substances, which **destroy weeds without harming** the useful plants.
- Bioweedicides are compounds and secondary metabolites derived from microbes such as fungi, bacteria or protozoa.
- The first bioherbicide developed in 1981 was a **Mycoherbicide** derived from the fungus **Phytophthora palmivora**.
- It controls the growth of **strangler vine in citrus crops**.
- **Trichoderma** species are free living fungi that are very common in the root ecosystem.
- They are effective biocontrol agents for several plant pathogens.
- **Buculoviruses** are pathogens that attack insects and other arthropods.
- The genus **Nucleopolyhedrovirus** is used as a **biocontrol agent**.
- These viruses are species specific and have **narrow spectrum** insecticidal applications.

**Define bio remediation. How microbes used in this field.**

- The use of naturally occurring or genetically engineered microorganisms to **reduce or degrade pollutants** is called bioremediation.
- Bioremediation is **less expensive and more sustainable** than other remediations available.

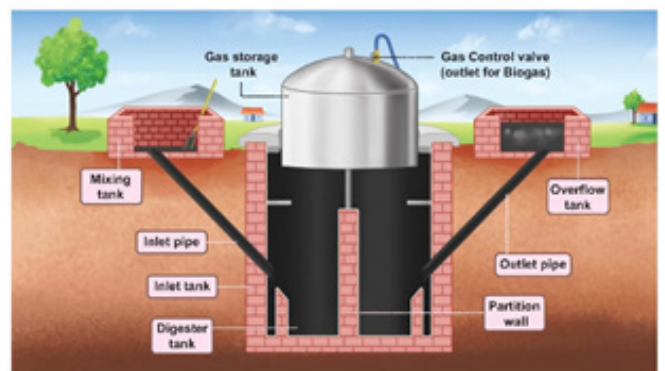


Fig. 8.4 Biogas unit

**Types :**

- **In situ bioremediation** - treatment of contaminated soil or water in the site

- **Ex situ bioremediation** - treatment of contaminated soil or water that is removed from the site and treated).

#### Microorganisms involved in bioremediation

- **Pseudomonas putida** is a genetically engineered microorganism (GEM).
- It is **multi- plasmid hydrocarbon-degrading bacterium** which can digest the hydrocarbons in the oil spills.
- **Nitrosomonas europaea** - **degrading benzene and a variety of halogenated organic compounds** including trichloroethylene and vinyl chloride.
- **Ideonella sakaiensis** is currently tried for **recycling of PET plastics**.
- **Dechloromonas aromatica** has the ability to **degrade benzene anaerobically and to oxidize toluene and xylene**.
- **Phanerochaete chrysosporium** an anaerobic fungus exhibits strong potential for bioremediation of **pesticides, polyaromatic hydrocarbons, dyes, trinitrotoluene, cyanides, carbon tetrachloride**, etc.,
- **Dehalococcoides species** - bioremediation of toxic **trichloroethene to non- toxic ethane**.
- **Pestalotiopsis microspora** - bioremediation of polyurethane.

#### 6. Explain the process of Biogas production.

- Biogas is a mixture of different **gases produced by the breakdown of organic matter** in the absence of oxygen.
- Biogas can be produced from **agricultural wastes, manure, municipal wastes, plant material, sewage, food waste, etc.,**
- Biogas is **produced under anaerobic condition**, when the organic materials are converted through microbiological reactions into gas and organic fertilizer.
- Biogas primarily consists of **methane (63 percent, along with CO<sub>2</sub> and hydrogen**.
- Methane producing bacteria are called **methanogens** and one such common bacterium is Methanobacterium.
- Biogas is **devoid of smell and burns** with a blue flame without smoke.

- The Methanogens are also **present in anaerobic sludge and rumen of cattle**.
- In rumen, these bacteria help in the **breakdown of cellulose**.
- The excreta of cattle called dung is commonly called "**Gobar**".
- In a biogas plant, **anaerobic digestion** is carried out in an air tight cylindrical tank known as **digester**.
- It is made up of **concrete bricks and cement or steel**.
- Bio-wastes are collected and **slurry of dung is fed into this digester**.
- It has a side opening into which organic materials for digestion are **incorporated for microbial activity**.
- Anaerobic digestion is accomplished in three stages: **solubilisation, acidogenesis and methanogenesis**.
- The outlet is connected to a **pipe to supply biogas**.
- The slurry is drained through another outlet and is **used as fertilizer**.
- Biogas is used for **cooking and lighting**.

#### 7. Explain the role of any five microbes which enriches soil nutrients.

- Biofertilisers are **formulation of living microorganisms** that enrich the nutrient quality of the soil.
- They **increase physico – chemical properties of soils** such as soil structure, texture, water holding capacity, cation exchange capacity and pH by providing several nutrients and sufficient organic matter.
- The main sources of biofertilisers are **bacteria, fungi and cyanobacteria**.

##### a. Rhizobium

It form **root nodules in leguminous plants** and fix atmospheric nitrogen into organic forms which is used by the plant as nutrient.

##### b. Azospirillum

*Azospirillum* is living bacteria **fix atmospheric nitrogen** and thus increasing nitrogen content of the soil.

##### c. Azotobacter

*Azotobacter* is **free living bacteria fix atmospheric nitrogen** and thus increasing nitrogen content of the soil.

d. **Mycorrhiza**

Mycorrhiza fungi **symbiotically associated with root of plants.**

It **provides phosphorus to the plants** from the soil.

Make the **plant resistant to root-borne pathogen** and increase tolerance to salinity and drought.

e. **Cyanobacteria**

Cyanobacteria are **autotrophic microbes** widely distributed in aquatic and terrestrial habitats.

Many of which **fix atmospheric nitrogen.**

They help in nitrogen fixation, add organic matter to the soil and **increase soil fertility.**

Ex. *Anabaena*, *Nostoc*, and *Oscillatoria* etc.

8. **Write the scientific name of a microbe from which following product is obtained. Write one function each on the products.**

a **Statins**

b **Penicillin**

c **Acetic acid**

d **Streptokinase**

e **Cyclosporin – A**

**Statins**

- **Produced from** - *Monascus purpureus*
- **Function:** Used as **blood cholesterol lowering agents.**
- It acts as competitive **inhibitor for the enzyme responsible for the synthesis of cholesterol.**

**Penicillin**

- **Produced from** - *Penicillium notatum*
- **Function:** Used to **cure many bacterial diseases.**

**Acetic acid**

- **Produced from** - *Acetobacter aceti*
- **Function:** Used as **food preservative.**

**Streptokinase**

- **Produced from** - *Streptococcus*
- **Function:** used as a '**clot buster**', for removing clots from the blood vessels of patients who have undergone myocardial infarction.

**Cyclosporin – A**

- **Produced from** *Trichoderma polysporum*
- **Function:** used as **immunosuppressive agent** during organ transplantation.



## POINTS TO REMEMBER

- Biotechnology is defined as “any technological application that uses biological systems, living organisms or derivatives there of, to make or modify products or processes for specific use”.
- The DNA produced through Genetic engineering is referred to as **recombinant DNA (rDNA)** and this technique as **recombinant DNA technology**.
- Biotechnology has application in four major industrial areas, including **health care (medical) agriculture, industrial and environment**.
- Biotechnology techniques are used in the field of **medicine for diagnosis, prevention and treatment of different diseases**.
- The Human insulin is synthesized by the  $\beta$  cells of Islets of Langerhans in the pancreas.
- Deficiency of insulin leads to **diabetes mellitus** which is characterized by **increased blood glucose concentration** and a complex of symptoms which may lead to death, if untreated.
- In the early years, **insulin isolated and purified from the pancreas of pigs and cows** was used to treat diabetic patients.
- In 1986 human insulin was marketed under the trade name **Humulin**.
- *E. coli*, also used to produce human growth hormones **somatostatin and somatotropin**.
- Using recombinant DNA technology **hGH can be produced**.
- The gene for **hGH is isolated from the human pituitary gland cells**.
- Many factors are required for **normal blood clotting** process and the **factor VIII is one of them**.
- The genes for the formation of **factor VIII is located in the X chromosome**.
- A genetic defect in the synthesis of **factor VIII results in Haemophilia A, a sex-linked disease** characterized by prolonged clotting time and internal bleeding.
- Interferons are **proteinaceous, antiviral, species specific** substances produced by mammalian cells when infected with viruses.
- Interferons were discovered by **Alick Isaacs and Jean Lindemann** in 1957.
- Based on the structure of interferons they are classified as  **$\alpha$ ,  $\beta$  and  $\gamma$  interferons**.
- Interferons are antiviral enzymes which inhibit viral replication and protect the cells.
- The yeast ***Saccharomyces cerevisiae*** is more suitable for production of recombinant interferons than *E.coli*, since ***E.coli* does not possess the machinery for glycosylation of proteins**.
- Recombinant DNA technology has been used to **produce new generation vaccines**.
- Recombinant vaccines have been **used to prevent various diseases**.
- Types of recombinant vaccines - **subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines**.
- Vaccines that use **components of a pathogenic organism** are called **subunit vaccines**;
- Some Genetically engineer the organisms (bacteria or viruses) and use them as live vaccines and such vaccines are referred to as **attenuated recombinant vaccines**.
- Edible vaccines are prepared by **molecular pharming** using the science of genetic engineering.
- A DNA vaccine consists of a **gene encoding an antigenic protein, inserted onto a plasmid**, and then incorporated into the cells in a target animal.
- Recombinant **hepatitis B vaccine as a subunit vaccine** is produced by cloning hepatitis B surface antigen (HbsAg) gene in the yeast, *Saccharomyces cerevisiae*.
- Genetic defects could be corrected by a process called **Gene therapy**. It is of two types **somatic cell gene therapy and germline gene therapy**

- There are two strategies involved in gene therapy namely; **Gene augmentation and Gene inhibition** therapy.
- The two approaches to achieve gene therapy are **somatic cell and germ line gene therapy**.
- Somatic cell therapy involves the insertion of a fully functional and expressible gene into a target **somatic cell to correct a genetic disease permanently**.
- Germline gene therapy involves the **introduction of DNA into germ cells** which is passed on to the successive generations.
- Stem cells are **undifferentiated cells** found in multi cellular animals.
- **Totipotency** - is the ability of a **single cell to divide and produce all of the differentiated cells** in an organism.
- **Pluripotency** - refers to a stem cell that has the potential to differentiate into any of the three germ layers-**ectoderm, endoderm and mesoderm**.
- **Multipotency** -refers to the **stem cells that can differentiate into various types of cells** that are related.
- **Oligopotency** - refers to **stem cells that can differentiate into few cell types**.
- **Unipotency** - refers to the ability of the stem cells to differentiate into only one cell type.
- Stem cell banking is the **extraction, processing and storage of stem cells**, so that they may be used for treatment in the future, when required.
- Amniotic cell bank is a facility that **stores stem cells derived from amniotic fluid** for future use.
- **Recombinant DNA technology, Polymerase Chain Reactions (PCR) and Enzyme Linked Immuno sorbent Assay (ELISA)** are some of the techniques that are reliable and help in early diagnosis.
- ELISA is a tool for **determining serum antibody concentrations** and also for detecting the presence of specific antigens and hormones such as human chorionic gonadotropins.
- Types of ELISA - **Direct ELISA, Indirect ELISA, sandwich ELISA and competitive ELISA**.
- It is a **highly sensitive and specific method** used for diagnosis.
- The **polymerase chain reaction (PCR)** is an invitro amplification technique used for **synthesising multiple identical copies** (billions) of DNA of interest.
- The technique was developed by **Kary Mullis**.
- The specificity and sensitivity of PCR is useful for the **diagnosis of inherited disorders** (genetic diseases), viral diseases, bacterial diseases, etc.,
- Diseases like **sickle cell anemia, β-thalassemia and phenylketonuria** can be detected by PCR.
- Cancers also can be **detected by PCR**.
- PCR technique is also **used to detect sex-linked disorders** in fertilized embryos.
- PCR is very important in the **study of evolutions, more specifically phylogenetics**.
- As a technique which can amplify even minute quantities of DNA from any source, like hair, mummified tissues, bones or any fossilized materials.
- PCR technique can also be used in the field of forensic medicine.
- **Transgenesis** is the process of introduction of extra (foreign/ exogenous) DNA into the genome of the animals to create and maintain stable heritable characters.
- The foreign DNA that is introduced is called the transgene and the animals that are produced by DNA manipulations are called **transgenic animals** or the **genetically engineered** or genetically modified organisms.
- Transgenesis is a **powerful tool to study gene expression** and developmental processes in higher organisms.
- Transgenic animals are **used to produce proteins** which are important for medical and pharmaceutical applications.
- Cloning is the process of producing **genetically identical individuals** of an organism either naturally or artificially.
- In nature many organisms produce **clones through asexual reproduction**.
- Dolly was the first mammal (Sheep) **clone developed by Ian Wilmut and Campbell** in 1997.
- Biotechnology help to produce **cheap drugs, better fruits and vegetables, pest resistant crops**, indigenous cure to diseases and lot of controversy.





- **Source organism - Thermophilic bacterium - thermus aquaticus**

**12. How is the amplification of a gene sample of interest carried out using PCR?**

- Taq DNA polymerase used in polymerase chain reaction (PCR).
- During the polymerisation step in PCR, **repeated amplification is achieved by the use of Taq DNA polymerase**, which remains active even at the high temperature induced denaturation of dsDNA.

**13. What is genetically engineered Insulin?**

- Artificial Production of insulin by recombinant DNA technology is known as **genetically engineered Insulin**
- This technique involved the **insertion of human insulin gene** on the plasmids of E.coli.
- This genetically engineered bacteria start producing insulin.
- This kind of insulin is known as **humulin**

**14. Explain how "Rosie" is different from a normal cow.**

- Rosie is the **first transgenic cow** which contains human gene coding for protein **alpha-lactalbumin**. The gene is expressed in mammary tissues and the protein is secreted in milk.
- This milk is **nutritionally a more balanced product** for human babies than natural cow milk.
- This is **protein rich milk** (2.4 gm/litre)

**15. How was Insulin obtained before the advent of rDNA technology? What were the problems encountered?**

- In the early years, **insulin isolated and purified from the pancreas of pigs and cows** was used to treat diabetic patients.
- This animal insulin result in the **occurrence of allergic reactions in some diabetic patients.**

**16. ELISA is a technique based on the principles of antigen-antibody reactions. Can this technique be used in the molecular diagnosis of a genetic disorder such as Phenylketonuria?**

- ELISA is **highly sensitive and can detect antigens** in the range of a nanogram.
- It is a **highly sensitive and specific method** used for diagnosis.
- **This technique will not be used to diagnose Phenylketonuria**
- Genetic disorder like sickle cell anemia,  $\beta$ -thalassemia and phenylketonuria can be **detected by PCR** in these samples.

**17. Gene therapy is an attempt to correct a Genetic defect by providing a normal gene into the individual. By this the function can be restored. An alternate method would be to provide gene product known as enzyme replacement therapy, which would also restore the function. Which in your opinion is a better option? Give reasons for your answer.**

- **Gene therapy** is the better option because
- Because Enzyme replacement therapy works on **artificially administering the required enzyme** into the patient's body.
- This helps in **management of the disease.**
- But this needs **frequent re-administration of enzyme** and other necessary drugs to continue the therapy.
- Enzyme replacement **therapy is more costly**
- Using **gene correction is a permanent solution.**
- E.g. a person with **ADA deficiency can be permanently cured** if the required gene is introduced during the embryo stage.
- This will **ensure a better quality of life** for the patient.

**18. What are transgenic animals? Give examples.**

- Transgenic animals are those **animals which contain a foreign gene in their genome**, introduced by recombinant DNA technology.
- Such gene is called **transgene.**

E.g. **Transgenic mice and transgenic rabbit** etc.



**19. If a person thinks he is infected with HIV, due to unprotected sex, and goes for a blood test. Do you think a test such as ELISA will help? If so why? If not, why?**

- ELISA is based on the principle of **antigen - antibody interaction**.
- **ELISA test can be used in diagnose of AIDS**
- HIV Infection by pathogen can be detected by the **presence of very small amount of proteins, glycoproteins**, or by detecting the **antibodies synthesised** against the pathogen

**20. Explain how ADA deficiency can be corrected?**

#### **Bone marrow transplantation**

- ADA deficiency could be cured by **bone marrow transplantation**, where defective immune cells could be replaced with healthy immune cells from a donor.

#### **Enzyme replacement therapy**

- In some patients it can be **treated by enzyme replacement therapy**, in which **functional ADA is injected into the patient**.

#### **Gene therapy**

- It also **treated by gene therapy, in which** lymphocytes from the blood of the patient are removed and grown in a nutrient culture medium.
- A **healthy and functional human gene**, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
- The genetically engineered lymphocytes are **subsequently returned to the patient**.
- The disease could be **cured permanently if the gene for ADA isolated from bone marrow cells** are introduced into the cells of the early embryonic stages.

**21. What are DNA vaccines?**

- DNA vaccine are the type of **vaccine which contain genetic material**
- If the immune response of the body is **stimulated by a DNA molecule which inserted into organisms**.
- The DNA vaccine **cannot cause the disease as it contains only copies** of a few of its genes.

- DNA vaccines are **relatively easy and inexpensive to design and produce**.

**22. Differentiate between Somatic cell gene therapy and germline gene therapy.**

<b>SOMATIC CELL GENE THERAPY</b>	<b>GERM LINE GENE THERAPY</b>
Therapeutic genes <b>transferred into the somatic cells</b>	Therapeutic genes <b>transferred into the germ cells</b>
Introduction of genes into <b>bone marrow cells, blood cells, skin cells etc.,</b>	Genes introduced <b>into eggs and sperms</b> .
<b>Will not be inherited</b> in later generations.	<b>Heritable and passed</b> on to later generations.

**23. What are stem cells? Explain its role in the field of medicine.**

- Stem cells are **undifferentiated cells** found in most of the multi cellular animals.
- These cells **maintain their undifferentiated state** even after undergoing numerous mitotic divisions.
- Stem cells have the **ability to regenerate damaged and diseased organs**, this is the important key feature of stem cell which is used in medicine.

#### **Other feature of stem cell are :**

- Stem cells are capable of **self renewal and exhibit 'cellular potency'**.
- Stem cells can **differentiate into all types of cells**

**24. One of the applications of biotechnology is 'gene therapy' to treat a person born with a hereditary disease. What does "gene therapy" mean?**

#### **Gene therapy :**

- It is treatment process for a person is born with a hereditary disease
- Principle : **Replacement of healthy gene in place of defective / mutant alleles**
- This process involves the **transfer of a normal gene into a person's cells** that carries one or more mutant alleles.
- Expression of **normal gene in the person results in a functional gene product** whose action produces a normal phenotype.



- Delivery of the **normal gene is accomplished by using a vector.**
- Strategies involved in gene therapy - **Gene augmentation therapy and Gene inhibition therapy**

**25. Name the hereditary disease for which the first clinical gene therapy was used. Mention the steps involved in gene therapy to treat this disease.**

- The first clinical gene therapy was **given in 1990** by **French Anderson** to a four year old girl with **adenosine deaminase (ADA) deficiency.**
- **ADA deficiency or SCID** (Severe combined immunodeficiency) is an **autosomal recessive metabolic disorder.**
- It is caused by the deletion or dysfunction of the gene coding for ADA enzyme.
- In these patients the **non functioning T-Lymphocytes cannot elicit immune responses** against invading pathogens.
- The right approach for SCID treatment would be to **give the patient a functioning ADA** which breaks down toxic biological products.
- In some children ADA deficiency could be **cured by bone marrow transplantation**, where **defective immune cells could be replaced with healthy immune cells from a donor.**
- In some patients it can be **treated by enzyme replacement therapy**, in which **functional ADA is injected into the patient.**
- It also **treated by gene therapy**, in which lymphocytes from the blood of the patient are removed and grown in a nutrient culture medium.
- A **healthy and functional human gene**, ADA cDNA encoding this enzyme is introduced into the lymphocytes using a retrovirus.
- The genetically engineered lymphocytes are **subsequently returned to the patient.**
- Since these cells are **not immortal**, the **patient requires periodic infusion** of such genetically engineered lymphocytes.
- The disease could be **cured permanently if the gene for ADA isolated from bone marrow cells** are introduced into the cells of the early embryonic stages.

**26. PCR is a useful tool for early diagnosis of an Infectious disease. Elaborate.**

- The specificity and sensitivity of PCR is useful for the **diagnosis of inherited disorders** (genetic diseases), **viral diseases, bacterial diseases**, etc.
- The diagnosis and treatment of a particular disease often **requires identifying a particular pathogen.**
- Traditional methods of identification involve **culturing these organisms from clinical specimens** and performing metabolic and other tests to identify them.
- The concept behind PCR based diagnosis of infectious diseases is simple – **if the pathogen is present in a clinical specimen its DNA will be present.**
- Its **DNA has unique sequences** that can be detected by PCR, often using the clinical specimen (for example, blood, stool, spinal fluid, or sputum) in the PCR mixture.
- PCR is also employed in the **prenatal diagnosis of inherited diseases** by using chorionic villi samples or cells from amniocentesis.
- Diseases like **sickle cell anemia,  $\beta$ -thalassemia and phenylketonuria** can be detected by PCR in these samples.
- cDNA from PCR is a valuable tool for **diagnosis and monitoring retroviral infections**
- **Cervical cancer** caused by Papilloma virus can be detected by PCR.

**27. What are recombinant vaccines?. Explain the types.**

- Recombinant DNA technology has been used to **produce new generation vaccines.**
- The recombinant vaccines are **generally of uniform quality and produce less side effects** as compared to the vaccines produced by conventional methods.
- **Types of recombinant vaccines - subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines**

**28. Explain why cloning of Dolly, the sheep was such a major scientific breakthrough?**

- Dolly was the first animal to be cloned from a differentiated somatic cell taken from an adult animal **without the process of fertilization.**

**It is a major scientific breakthrough because it**

- Offers benefits for clinical trials and medical research.
- It can help in the production of proteins and drugs in the field of medicine.
- Aids stem cell research.

**29. Mention the advantages and disadvantages of cloning.**

**Advantages**

- Offers benefits for clinical trials and medical research.
- It can help in the production of proteins and drugs in the field of medicine.
- Aids stem cell research.
- Animal cloning could help to save endangered species.
- It is used to save endangered animals

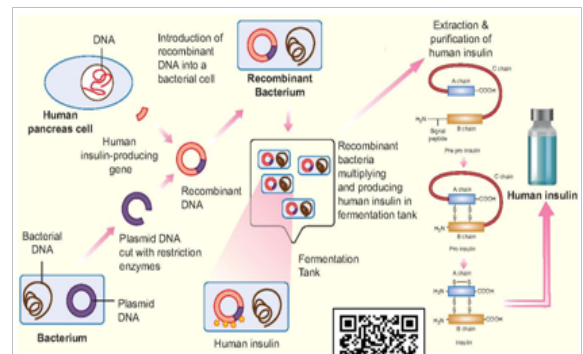
**Disadvantages :**

- The process is tedious and very expensive.
- It can cause animals to suffer.
- Cloned animals were affected with disease and have high mortality rate.
- Human health affected through consumption of cloned animal meat.
- Cloned animals age faster than normal animals and are less healthy than the parent organism as discovered in Dolly
- Cloning can lead to occurrence of genetic disorders in animals.
- More than 90% of cloning attempts fail to produce a viable offspring.

**30. Explain how recombinant Insulin can be produced.**

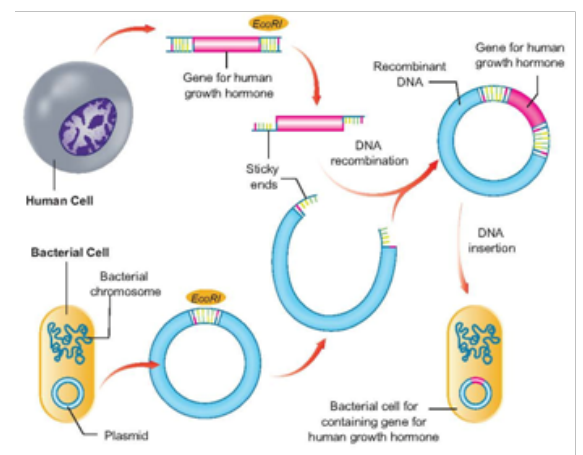
- The Human insulin is synthesized by the β cells of Islets of Langerhans in the pancreas.
- Production of insulin by recombinant DNA technology started in the late 1970s.
- This technique involved the insertion of human insulin gene on the plasmids of E.coli.
- The polypeptide chains are synthesized as a precursor called pre-pro insulin, which contains A and B segments linked by a third chain c) and preceded by a leader sequence.

- The leader sequence is removed after translation and the C chain is excised, leaving the A and B polypeptide chains.
- Insulin was the first ever pharmaceutical product of recombinant DNA technology administered to humans.
- In 1986 human insulin was marketed under the trade name Humulin.



**31. Explain the steps involved in the production of recombinant hGH.**

- Human growth hormones somatostatin and somatotropin are peptide hormones secreted by the pituitary gland.
- This hormone helps in the growth and development by increasing the uptake of amino acids and promoting protein synthesis.
- hGH can be produced using recombinant DNA technology.



- The gene for hGH is isolated from the human pituitary gland cells.
- The isolated gene is inserted into a plasmid vector and then is transferred into E. coli.

- The recombinant **E. coli then starts producing human growth hormone.**
- The recombinant E. coli are isolated from the culture and **mass production of hGH is carried out by fermentation technology.**
- A recombinant form of human growth hormone called **somatropin is used as a drug to treat growth disorders in children.**
- Deficiency of human growth hormone causes **dwarfism**, which could be treated by injecting hGH extracted from the human pituitary glands.

**PART-A**

**ADDITIONAL QUESTIONS (1MARK)**

1. **In which of the following industrial areas biotechnology is applicable?**
  - a) Health care                      b) Environment
  - c) Agriculture                        d) all of the above

**Ans : d**
2. **The organizations whose genetic material has been altered using genetic engineering is called as -**
  - a) Genetically mutant organism
  - b) Genetically modern organism
  - c) Genetically modified organism
  - d) Genetically transferred organism.

**Ans : c**
3. **Full form of GMO is**
  - a) Genetically mutant organism
  - b) Genetically modern organism
  - c) Genetically modified organism
  - d) Genetically transferred organism

**Ans : c**
4. **Which of the following techniques use genes and DNA molecules for diagnoses of diseases?**
  - a) Gene therapy
  - b) Recombinant gene technology
  - c) Polymerase chain reaction
  - d) All the above

**Ans : d**
5. **What were the earlier sources of Insulin?**
  - a) cattle and pig                      b) camel and pig
  - c) cattle and dog                      d) goat and pig

**Ans : a**

6. **Which technology was used to produce human Insulin in E. coli ?**
  - a) Gene therapy
  - b) Recombinant gene technology
  - c) Polymerase chain reaction
  - d) All the above

**Ans : b**
7. **Which therapy is used for modification of germ cells (sperms and eggs)?**
  - a) spermline therapy
  - b) Germ line therapy
  - c) Egg line therapy
  - d) Germ line gene therapy

**Ans : d**
8. **Modifications by germ line gene therapy are heritable as -**
  - a) The Functional gene is incorporated into to their genome.
  - b) The Functional gene is incorporated into one of the gene.
  - c) The Functional gene is incorporated into somatic cells.
  - d) All the above

**Ans : a**
9. **In which therapy, vectors are used to introduce desired gene into the body of patients?**
  - a) In vivo, gene therapy
  - b) Germ line therapy
  - c) Ex vivo gene therapy
  - d) Foreign gene therapy

**Ans : a**
10. **The method during which genetic characteristics of animals are improved by mating of selected breeds is known as**
  - a) Improved breeding                b) selective breeding
  - c) mating                                d) Breeding

**Ans : b**
11. **The Phenomenon of introduction of exogenous DNA into the genome of animals is -**
  - a) In vivo, gene therapy
  - b) Foreign gene therapy
  - c) Ex vivo gene therapy
  - d) Transgenesis

**Ans : d**

- 12. The animals whose genome is altered by introduction of transgene is known as -**  
 a) modified animals  
 b) Hybrid animals  
 c) cross breed animals  
 d) Transgenic animal **Ans : d**
- 13. Transgene introduced in the first transgenic cow was responsible for the production of**  
 a) Albumin enriched milk  
 b) Protein enriched milk  
 c) Human protein enriched milk  
 d) Vitamins enriched milk **Ans : c**
- 14. What was the amount of Alpha-lactalbumin in the milk of transgenic cow ?**  
 a) 4.2 grams per litre    b) 2.4 grams per litre  
 c) 3.4 grams per litre    d) 4.2 grams per litre  
**Ans : b**
- 15. Earlier which animals were used to test the safety of Polio Vaccine**  
 a) Transgenic rat            b) Transgenic pigs  
 c) Transgenic mice        d) Transgenic sheep  
**Ans : c**
- 16. Which technology facilitates the production of novel DNA molecule by combining sequences from DNA from two different organisms?**  
 a) gene therapy  
 b) Recombinant DNA technology  
 c) DNA hybridization  
 d) Cloning  
**Ans : b**
- 17. Transgenic animals are produced by incorporation of Foreign gene into the -**  
 a) Nucleus of fertilized egg  
 b) Nucleus of sperm  
 c) Nucleus of unfertilized egg  
 d) Egg cell **Ans : a**
- 18. The insulin prepared through genetic engineering is called**  
 a) Human insulin            b) microbial insulin  
 c) Bio insulin                d) Humulin **Ans : d**
- 19. First progress in field of genetic engineering, in 1978 by Cohen, Berg and Boyer by synthesis of through E. coli**  
 a) Insulin                      b) growth hormone  
 c) Somatostatin              d) both b and c  
**Ans : d**
- 20. Which was the first product contributed to human kind by science of Biotechnology in early 1972**  
 a) somatotropin              b) Insulin  
 c) cytokines                  d) erythropoietin  
**Ans : a**
- 21. The main use of recombinant DNA technology is**  
 a) production of transgenic humans.  
 b) the creation of cells capable of synthesizing economically important molecules.  
 c) the efficient reduction of useful proteins.  
 d) both b and c **Ans : d**
- 22. Bio augmentation is**  
 a) The addition of commercially prepared bacterial strain  
 b) Production of fertilizers by using bacteria  
 c) The metals are deposited as insoluble oxides and sulphides by activities of bacteria  
 d) Removal of pests **Ans : a**
- 23. Which of the following animal is best known genetically ?**  
 a) Planaria                      b) Domestic dog  
 c) Musca domestica        d) Drosophila melanogaster  
**Ans : d**
- 24. One of the following is the correct sequence to make a transgenic animals.**  
 a) Transomics – transfection – micro infection – electro portion – retroviralvectors  
 b) Micro injection - transfection - electro portion - retroviral vectors - transomics  
 c) Transfection – micro injection - transomics - electro portion - retroviral vectors  
 d) None of these **Ans : b**

**25. Vaccine is a**

- a) collection of antibiotics
  - b) collection of life saving drugs
  - c) collection of killed disease causing bacteria and virus
  - d) collection of lysins
- Ans : c**

**26. The foods made from genetically modified crops required to pass human testing because**

- a) they may cause allergies
  - b) they may alter genes
  - c) they may cause mutations and release toxins
  - d) all above
- Ans : d**

**27. There are set of health care products. Match them with organisms which are genetically engineered for respective products.**

- |                 |                                     |
|-----------------|-------------------------------------|
| A. Insulin      | 1. Escherichia coli / saccharomyces |
| B. Somatotropin | 2. Escherichia coli / yeast         |
| C. Interferon   | 3. G M E coli                       |
| D. Interleukins | 4. hGH in E. coli                   |
|                 | 5. Humulin through E. coli          |

	A	B	C	D
a)	5	4	1	2
b)	5	1	1	4
c)	5	3	4	1
d)	5	4	3	2

**Ans : a**

**28. Which is not an application of modern in technology?**

- a) Production of humulin
  - b) Developing a DNA vaccine
  - c) Gene therapy
  - d) Production of cheese and butter
- Ans: d**

**29. Genetically engineered bacteria have been used in commercial production of**

- a) Thyroxin
  - b) Testosterone
  - c) Human insulin
  - d) Melatonium
- Ans: c**

**30. The name of drug used in cancer treatment produced by biotechnology is**

- a) Interferon
  - b) (HGH) Human growth hormone
  - c) TSH
  - d) Insulin
- Ans: a**

**31. First artificially synthesised hormone is**

- a) Secretin
  - b) Insulin
  - c) Glucagen
  - d) Renin
- Ans: b**

**32. Transgenic animal has**

- a) Foreign DNA is all its cells
  - b) Foreign RNA is all its cells
  - c) Foreign DNA is some of the cells
  - d) Both 2 and 3
- Ans: a**

**33. During the processing of the prohormone "proinsulin" into the mature "insulin".**

- a) C-peptide is added to proinsulin
  - b) C-peptide is removed from proinsulin
  - c) B-peptide is added to proinsulin
  - d) B-peptide is removed from proinsulin
- Ans: b**

**34. E-coli are used in production of**

- a) Rifampicin
  - b) LH
  - c) Ecdyson
  - d) Interferon
- Ans: d**

**35. Gene therapy first used in the treatment of**

- a) Albinism
  - b) Haemophilia
  - c) SCID
  - d) LIQID
- Ans: c**

**36. DNA probe is used for**

- a) DNA finger printing
  - b) Detection of pathogenic bacteria
  - c) Medical genetics to find whether a person carries a particular gene or not
  - d) All of the above
- Ans: d**

**37. Genetically engineered human insulin is called**

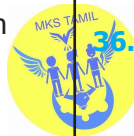
- a) Humalin
  - b) Hybrid
  - c) Hybridoma
  - d) Haematin
- Ans: a**

**38. The C- peptide is**

- a) Not present in proinsulin
  - b) Present in mature insulin
  - c) Removed during maturation of insulin
  - d) Also present in artificial insulin
- Ans: c**

**39. Restriction endonuclease-**

- a) Cuts the DNA molecule randomly
  - b) Cuts the DNA molecule at specific sites
  - c) Restricts the synthesis of DNA inside the nucleus
  - d) Synthesis DNA
- Ans: b**



**40. Human insulin is being commercially produced from a transgenic species of**

- a) Mycobacterium      b) Rhizobium  
c) Saccharomyces      d) Escherichia

**Ans: d**

**41. The first human hormone produced by recombinant DNA technology is**

- a) Insulin                      b) Estrogen  
c) Thyroxin                  d) Progesterone

**Ans: a**

**42. Yeast is a good source of**

- a) Carbohydrates          b) Vitamin B  
c) Proteins                      d) both b and c

**Ans : c**

**43. Antibiotics inhibits the growth or destroy**

- a) Bacteria and fungi  
b) Bacteria and viruses  
c) Bacteria algae and viruses  
d) Bacteria, fungi and viruses

**Ans : d**

**44. Which of the following is not concerned with biotechnology ?**

- a) Biogas Production      b) Sewage treatment  
c) Biofertilizers              d) Wood seasoning

**Ans : d**

**45. A probe which is a molecule used to locate specific sequences in a mixture of DNA or RNA molecules could be:**

- a) A single stranded RNA  
b) A single stranded DNA  
c) Either RNA or DNA  
d) Can be ss DNA but not ss RNA

**Ans : c**

**46. The site of production of ADA in the body is:**

- a) Erythrocytes              b) Lymphocytes  
c) Blood plasma              d) Osteocytes

**Ans : b**

**47. A protoxin is:**

- a) A primitive toxin  
b) A denatured toxin  
c) Toxin produced by protozoa  
d) Inactive toxin

**Ans : d**

**48. The first clinical gene therapy was done for the treatment of:**

- a) AIDS  
b) Cancer  
c) Cystic fibrosis  
d) SCID (Severe Combined Immuno Deficiency resulting from deficiency of ADA)

**Ans : d**

**49. ADA is an enzyme which is deficient in a genetic disorder SCID. What is the full form of ADA?**

- a) Adenosine deoxy aminase  
b) Adenosine deaminase  
c) Aspartate deaminase  
d) Arginine deaminase

**Ans : b**

**These questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any one of the following four response.**

- i. If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion
- ii. If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
- iii. If Assertion is True but the Reason is False.
- iv. If both Assertion & Reason are false.

**50. Assertion : A thermostable DNA polymerase is used in PCR for repeated amplification**

**Reason :** It remain active during high temperature induced denaturation of ds DNA

- a) A                      b) B                      c) C                      d) D **Ans: a**

**51. Assertion : ADA deficiency can not be cured permanently by gene therapy**

**Reason :** The genetically engineered lymphocyte are immortal only in culture conditions

- a) A                      b) B                      c) C                      d) D **Ans: d**

**52. Assertion : Gene therapy is a collection of methods that allows correction of a gene defect diagnosed in a child or embryo**

**Reason :** It involves delivery of normal gene into the individual or embryo to take over the function of the non functional gene.

- a) A                      b) B                      c) C                      d) D **Ans: a**



**53. Assertion : In gene therapy of SCID, a patient requires periodic infusion of genetically engineered lymphocytes**

**Reason :** If the ADA gene is introduced into cells at early embryonic stage, it could be permanent

- a) A      b) B      c) C      d) D **Ans: b**

**54. Assertion : For effective treatment of a disease, early diagnosis & understanding its pathophysiology is very important**

**Reason :** r – DNA technique, PCR & ELISA are used for early diagnosis

- a) A      b) B      c) C      d) D **Ans: b**

**55. Assertion : Second generation vaccines are safer to use.**

**Reason :** They are produced by genetic engineering.

- a) A      b) B      c) C      d) D

**Ans : b**

**PART-B**

**ADDITIONAL QUESTIONS**

**(2 MARKS)**

**1. Define biotechnology.**

- Biotechnology can be defined as the **applications of scientific and engineering principles** to the processing of material by **biological agents to provide goods and services.**

**2. Write short notes on structure of insulin and its importance**

- Insulin is formed of **51 aminoacids** which are arranged in **two polypeptide chains, A and B.**
- The polypeptide chain **A has 21 amino acids** while the polypeptide chain **B has 30 amino acids.**
- Both A and B chains are attached together by **disulphide bonds.**

**3. State the role of insulin in our body**

- Insulin **controls the levels of glucose** in blood.
- It facilitates the **cellular uptake and utilization of glucose** for the release of energy.

**4. What are the uses of recombinant hGH?**

- Recombinant hGH used to **treat dwarfism.**
- Using recombinant DNA technology hGH can be produced.

**5. What is somatropin? Write its significance.**

- A recombinant form of **human growth hormone called somatropin** is used as a **drug to treat growth disorders in children.**
- E.g. used to treat dwarfism

**6. What is interferon? Add its types.**

- Interferons are **proteinaceous, antiviral,** species specific substances produced by mammalian cells when infected with viruses.
- They **stimulate the cellular DNA to produce antiviral enzymes** which inhibit viral replication and protect the cells.

Types :  $\alpha$   $\beta$  and  $\gamma$  interferons.

**7. Why yeast is more suitable than E. Coli for Interferon production?**

- The yeast *Saccharomyces cerevisiae* is more suitable for production of recombinant interferons than *E.coli*, since **E.coli does not possess the machinery for glycosylation** of proteins.

**8. List out the uses of interferon?**

- Interferons are used for the treatment of various diseases like **cancer, AIDS, multiple sclerosis, hepatitis C and herpes zoster.**

**9. What are attenuated recombinant vaccine ?**

- It is now possible to **genetically engineer the organisms** (bacteria or viruses) and use them as live vaccines and such vaccines are referred to as attenuated recombinant vaccines.

**10. How edible vaccines are produced?**

- Edible vaccines are **prepared by molecular pharming** using the science of genetic engineering.
- **Selected genes are introduced into plants** and the transgenic plants are induced to manufacture the encoded protein.
- At present edible vaccines are produced for human and animal diseases like **measles, cholera, foot and mouth disease and hepatitis.**

**11. List out the Advantage of DNA vaccine.**

- They are **against proteins**,
- **Long lasting immunity**
- Trigger immune response **only against specific pathogens** with less toxic effects.

**12. What is Gene therapy?**

- It is treatment process for a person is born with a hereditary disease
- Principle : **replacement of healthy gene in place of defective/ mutant alleles**
- This process involves the **transfer of a normal gene into a person's cells** that carries one or more mutant alleles.

**13. What are the strategies involved in gene therapy**

- There are two strategies involved in gene therapy namely;
- **Gene augmentation therapy** - which involves **insertion of DNA into the genome to replace** the missing gene product
- **Gene inhibition therapy** - which involves **insertion of the anti sense gene which inhibits** the expression of the dominant gene.

**14. Define stem cells.**

- Stem cells are **undifferentiated cells** found in most of the multi cellular animals.
- These cells **maintain their undifferentiated state** even after undergoing numerous mitotic divisions.

**15. Define Totipotency.**

- **Totipotency (Toti-total)** is the ability of a single cell to divide and **produce all of the differentiated cells in an organism.**

**16. Define pluripotency.**

- **Pluripotency (Pluri-several)** refers to a stem cell that has the **potential to differentiate into any of the three germ layers-ectoderm, endoderm and mesoderm.**

**17. Define Multipotency.**

- **Multipotency (multi-Many)** refers to the stem cells that can **differentiate into various types of cells that are related.**
- E.g. blood stem cells can differentiate into **lymphocytes, monocytes , neutrophils** etc.,

**18. Define Oligopotency.**

- **Oligopotency (Oligo-Few)** refers to stem cells that **can differentiate into few cell types.**
- E.g. lymphoid or myeloid stem cells **can differentiate into B and T cells** but not RBC.

**19. Define Unipotency.**

- **Unipotency ( Uni- Single)** refers to the ability of the stem cells to **differentiate into only one cell type.**

**20. Difference between the stem cells bank & Amniotic cell bank**

- Stem cell banking is the **extraction, processing and storage** of stem cells, so that they may be used for treatment in the future, when required.
- Amniotic cell bank is a **facility that stores stem cells derived from amniotic fluid** for future use.

**21. List out the types of molecular diagnostics.**

- **Recombinant DNA technology**
- **Polymerase Chain Reactions (PCR)**
- **Enzyme Linked Immunosorbent Assay (ELISA)** are some of the techniques that are reliable and help in early diagnosis.

**22. List out the Types of ELISA.**

- There are four kinds of ELISA namely,

  1. **Direct ELISA**
  2. **Indirect ELISA**
  3. **Sandwich ELISA**
  4. **Competitive ELISA**

**23. What are the uses of ELISA**

- ELISA is a tool for **determining serum antibody concentrations** and also for detecting the **presence of specific antigens and hormones** such as human chorionic gonadotropins.

**24. What is Denaturation?**

- **Denaturation, renaturation or primer annealing and synthesis** or primer extension, are the three steps involved in PCR.
- The double stranded **DNA of interest is denatured to separate into two individual strands** by high temperature.
- This is called **denaturation.**



**25. What is PCR?**

- The polymerase chain reaction (PCR) is an **invitro amplification technique** used for synthesising multiple identical copies (billions) of DNA of interest.
- The technique was developed by **Kary Mullis** (Nobel laureate, 1993) in the year 1983.

**26. What is DNA Amplification?**

- The new strand of **each double stranded DNA extends** to a variable distance downstream.
- These steps are repeated again and again to **generate multiple forms of the desired DNA**.
- This process is also called **DNA amplification**.

**27. How PCR used in cancer Diagnosis and sex determination ?**

- **Cervical cancer** caused by Papilloma virus can be detected by PCR.
- **Sex of human beings and live stocks, embryos fertilized invitro** can be determined by PCR by using primers and DNA probes specific for sex chromosomes.
- PCR technique is also used to detect **sex-linked disorders in fertilized embryos**.

**28. Define Transgenesis.**

- **Transgenesis** is the process of **introduction of extra (foreign/ exogenous) DNA** into the genome of the animals to create and maintain stable heritable characters.

**29. List out the product of Recombination Technology.**

- Recombinant hormones like **Insulin, Human growth hormone, Recombinant vaccines and recombinant proteins** like **human alpha lactalbumin** are available today.

**30. Define Cloning.**

- Cloning is the process of **producing genetically identical individuals** of an organism either naturally or artificially.

**31. Name the bonds Connecting A-chain and B-Chain of functional insulin.**

- Disulphide bonds or Disulphide bridges

**32. Plasmids of which bacteria were used to produced the A-chain and B-chain separately**

- E.Coli or Escherichia coli

**33. Name the disease that can be cured through gene therapy.**

- **SCID** (Severe Combined Immuno Deficiency ) Due to absence of ADA

**34. Name the hormone produced by genetic engineering.**

- **Human insulin or humulin**

**35. Name the vector used to incorporate the cDNA of ADA into the lymphocytes in gene therapy.**

- Retrovirus.

**36. Insulin extracted from the pancreas of cow and pigs cannot be used why?**

- Insulin extracted from the pancreas of cow and pigs **causes allergy and other types of reactions**.

**37. Mention the four areas which have been responsible for the recent advances in biotechnology**

The areas in recent advances in biotechnology are

- I. **Agriculture**
- II. **Medicine**
- III. **Food industry**
- IV. **Environmental engineering.**

**38. Give the full form of ELISA. Which disease can be detected using it? Discuss the principle underlying the test.**

- ELISA stands for **Enzyme Linked Immunosorbent Assay**.
- AIDS can be detected using this procedure.
- **Principle** : Antigen-antibody reaction

**39. Can a disease be detected before its symptoms appear? Explain the principle involved.**

- Detection of a disease before the appearance of symptoms is now possible by **using biotechnology**.
- **PCR** (Polymerase Chain Reaction) helps in early diagnosis.
- Use of **PCR can amplify the nucleic acids** of bacteria or virus.
- This can help in **detecting their presence even when they are in low concentration**.

**40. Discuss the importance of transgenic animal models in understanding diseases,**

- Transgenic animals can **serve as models to understand** progression of various disease in humans.
- Transgenic models exist for many human diseases like **cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's.**
- These animals can be **observed to understand the causative gene** for a particular disease.
- This can help in **inventing suitable treatment** for a particular disease.

**41. Suggest any two possible treatments that can be given to a patient exhibiting adenosine deaminase deficiency.**

1. **Bone marrow transplantation**
2. **Enzyme replacement therapy.**

**42. List any two molecular diagnostic techniques and write one application of each of them.**

- **PCR** is polymerase chain reaction. It is used to **detect HIV infection and mutations** in genes in suspected cancer patient.
- **ELISA** is Enzyme- Linked Immuno sorbent Assay It is used to **detect many infections by pathogens.**

**PART-C****ADDITIONAL QUESTIONS (3 MARKS)****1. What are recombinant vaccine ? add its types.**

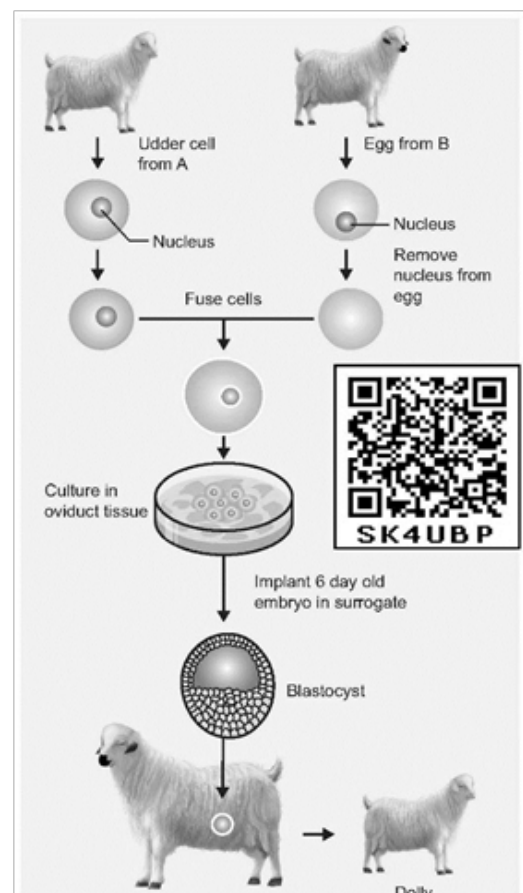
- Recombinant DNA technology has been used to produce **new generation vaccines.**
- The recombinant vaccines are generally of **uniform quality and produce less side effects** as compared to the vaccines produced by conventional methods.
- Types of recombinant vaccines are - **subunit recombinant vaccines, attenuated recombinant vaccines and DNA vaccines.**

**2. What is subunit recombinant vaccines? Write its significance**

- Vaccines that **use components of a pathogenic organism** rather than the whole organism are called **subunit vaccines.**
- Recombinant DNA technology is **very suited for developing new subunit vaccines.**
- It includes components like **proteins, peptides and DNAs of pathogenic organisms.**
- The advantages of these vaccines include their **purity in preparation, stability and safe use.**

**3. What are the types of stem cells in mammals?**

- In mammals there are two main types of stem cells – **embryonic stem cells (ES cells) and adult stem cells.**
- **Embryonic stem cells (ES cells) are pluripotent and can produce** the three **primary germ layers ectoderm, mesoderm and endoderm.**
- Embryonic stem cells are **multipotent stem cells** that can differentiate into a number of types of cells.
- ES cells are isolated from the epiblast tissue of the inner cell mass of a blastocyst.
- An **adult stem cell** or somatic stem cell **can divide and create another cell similar to it.**
- Most of the adult stem cells are **multipotent and can act as a repair system of the body,** replenishing adult tissues.

**4. Provide a Schematic diagram of cloning of Dolly.**

**5. Write short notes on ethical issues of biotechnology.**

- Biotechnology has given to the society **cheap drugs, better fruits and vegetables, pest resistant crops, indigenous cure** to diseases and lot of controversy.
- This is because **modern biotechnology deals with genetic manipulations.**
- People fear that these **genetic manipulations may lead to unknown consequences.**
- The major fear of recombinant DNA technology is that **unique microorganisms either carelessly or intentionally for the purpose of war** may be developed that could cause epidemics or environmental catastrophies.
- Although many are concerned about the **possible risk of genetic engineering**, the risks are in fact slight and the potential benefits are substantial.

**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

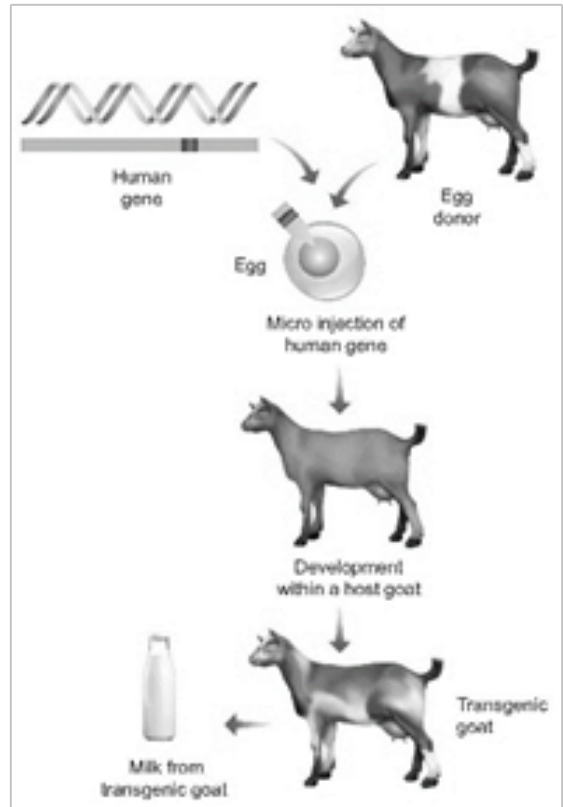
**1. Enumerate the Steps involved in ELISA.**

1. Sample is collected and immobilized on the surface of an ELISA plate.
2. The **antibody specific to this antigen is added** and allowed to react with the immobilized antigen.
3. The **anti-antibody is linked to an appropriate enzyme** like peroxidase.
4. The **unreacted anti-antibody is washed away** and the substrate of the enzyme (hydrogen peroxidase) is added with certain reagents such as **4-chloronaphthol**.
5. The activity of the **enzyme yields a coloured product** indicating the presence of the antigen.
6. The **intensity of the colour is directly proportional** to the amount of the antigen.

**2. List out the applications of PCR**

- The **differences in the genomes** of two different organisms can be studied by PCR.
- PCR is very important in the study of **evolutions, more specifically phylogenetics.**
- PCR technique used to **amplify even minute quantities of DNA** from any source, like hair, mummified tissues, bones or any fossilized materials.

- PCR technique can also be **used in the field of forensic medicine.**
- Thus, PCR is very useful for **identification of criminals.**
- PCR is also used in **amplification of specific DNA segment** to be used in gene therapy.



**3. What are the steps involved in the production of transgenic organisms**

The various steps involved in the production of transgenic organisms are :

1. **Identification and separation of desired gene.**
2. **Selection of a vector** (generally a virus) or direct transmission.
3. **Combining the desired gene** with the vector.
4. Introduction of **transferred vector into cells**, tissues, embryo or mature individual.
5. Demonstration of **integration and expression of foreign gene** in transgenic tissue or animals.
6. Transgenic animals such as **mice, rat, rabbit, pig, cow, goat, sheep and fish** have been produced.

**4. List out the uses of transgenesis**

- Transgenesis is a **powerful tool to study gene expression** and developmental processes in higher organisms.
- Transgenesis helps in the **improvement of genetic characters** in animals.
- Transgenic animals serve as **good models for understanding human diseases** which help in the investigation of new treatments for diseases.
- Transgenic animals are **used to produce medically important proteins**
- Transgenic mice are **used for testing the safety of vaccines**.
- Transgenic animals are used for **testing toxicity in animals** that carry genes which make them sensitive to toxic substances.
- Transgenesis is important for **improving the quality and quantity of milk, meat, eggs and wool**.

**5. Briefly explain the principle, procedure and role of ELISA.**

- Enzyme-linked immunosorbent assay (ELISA) is a **non-isotopic immunoassay**.
- Principles - **antigen antibody reaction**.
- It is **more rapid and simple process** hence is recommended for detection of antigens.

The stages of ELISA are summarised as follows:

- Sample is collected and immobilized on the surface of an ELISA plate.
- The **antibody specific to this antigen is added** and allowed to react with the immobilized antigen.
- The **anti-antibody is linked to an appropriate enzyme** like peroxidase.
- The **unreacted anti- antibody is washed away** and the substrate of the enzyme (hydrogen peroxidase) is added with certain reagents such as **4-chloronaphthol**.
- The activity of the **enzyme yields a coloured product** indicating the presence of the antigen.
- The **intensity of the colour is directly proportional** to the amount of the antigen.
- ELISA is widely used for the **determination of small quantities** of proteins (hormones, antigens, antibodies) and other biological substances.

- The most commonly used pregnancy test for the detection of **human chorionic gonadotropin (hCG)** in urine is based on ELISA.

- ELISA is also been used for **diagnosis of many infection**

**6. Define transgenic animals. Explain in detail any four areas where they can be utilised.**

- Transgenic animals are the animals in which a **foreign gene is expressed**.
- Transgenic **rats, pigs, cows, rabbits, sheep and fish** have been produced.
- However, more than **95% of all transgenic animals are mice**.
- Transgenic animals can be utilized are as follows:

**Fundamental Biological Processes:**

- Transgenic animals can be used to **understand insulin-like growth factors** in humans.
- A particular factor can be **introduced from another animal and then the behaviour** of this factor can be studied in the transgenic animal.

**Study of Diseases:**

- Many transgenic animals are **introduced with genes for certain disease**.
- Then progression and possible cure for such disease can be **studied using these animals**.
- Today, models of transgenic animals exist in which **cancer, cystic fibrosis, rheumatoid arthritis**, etc. can be studied.

**Biological Products:**

- A **transgenic cow Rosie** could produce human protein enriched milk.
- This milk contains **2.4 g of human algalactalbumin** per litre.
- This milk is **more nutritionally balanced** for babies than normal cow milk.

**Vaccine Safety:**

- Before approval for use in humans, any **vaccine needs to prove its safety on model animals**.
- Transgenic animals help in **preventing cruelty against animals**.



## POINTS TO REMEMBER

- The word '**ecology**' is derived from the Greek term '**oikos**', meaning '**house**' and **logos**, meaning '**study**'.
- The study of ecology includes different levels-**organism, population, community, ecosystem**, etc.,
- The community with living (**Biotic**) and **the non-living environment (Abiotic) function together** as an ecological system (or) ecosystem.
- Biome is a term in wide **use for a large regional or sub continental system** characterized by a major vegetation type.
- Influencing factors in any environment are **light, temperature, pressure, water, salinity**.
- A habitat can be considered as the '**address of the organism**'.
- The collection of all the habitat areas of a species **constitutes its geographical range**.
- As every organism has its unique habitat, so also it has an **ecological niche which includes the physical space occupied** by an organism and its functional role in the community.
- Temperature or **degree of hotness and coldness** is an essential and variable factor in any environment.
- It influences all forms of life by affecting many vital activities of organisms like **metabolism, behaviour, reproduction, development and even death** in the Biosphere.
- Organisms which can survive a **wide range of temperature** are referred to as **Eurytherms**.  
E.g cat, dog, tiger, human.
- Organisms which can **tolerate only a narrow range of temperature** are **Stenotherms** (E.g Fish, Frogs, Lizards and Snakes).
- **Hibernation (winter sleep)** and **Aestivation (Summer sleep)** are useful adaptations to overcome extreme winters and summers.
- Ecologically, **the quality (wavelength or colour), the intensity (actual energy in gram calories) and duration (length of day)** of light are considered significant for organisms.
- Light influences **growth, pigmentation, migration and reproduction**.
- **Phototaxis** - The movement of organism in response to light, either towards or away from light
- **Phototropism** - The **growth or orientation of an organism in response to light**,
- **Photokinesis** - A **change in the speed of locomotion** in a motile organism or cell in response to a light intensity.
- About **three-fourth of the earth's surface** is covered with water (hydrosphere).
- Water is found in three states: **gaseous, liquid, and solid**.
- **Types of water** - **Fresh water** (rivers, lakes, ponds) and **Salt water** (seas and oceans).
- Based on the dissolved salts, -**hard water** (sulphates/nitrates of Calcium/Magnesium) or **soft water**.
- Soil is a mixture of **organic matter, minerals, gases, liquids and organisms** that together support life.
- The soil zone is known as **Pedosphere**.
- Soil is formed from rocks by weathering and is called embryonic soil (**Pedogenesis**).
- Properties of Soil - **Texture of soil, Porosity, Permeability of soil, Soil Temperature, Soilwater**
- Wind is the **natural movement of air** of any velocity from a particular direction.



- Moisture in the form of **invisible vapor in the atmosphere** is called humidity.
- Humidity is generally expressed in terms of **absolute humidity, relative humidity or specific humidity**.
- Humidity is measured with a **Hygrometer**.
- Animals are known to **modify their response to environmental changes** (stress) in reasonably short time spans. This is known as **Acclimatization**.
- Biomes are **large regions of earth that have similar or common vegetation** and climatic conditions.
- **Aquatic Biomes** - occupy about 71% of the biosphere.
- **Types of Aquatic biomes of earth-Fresh water** (Lakes, ponds, rivers), **Brackish water** (Estuaries / Wetlands), **Marine** (Coral reefs, pelagic zones and abyssal zones)
- **Terrestrial biomes** include **grassland, tundra, desert, tropical rainforest, and deciduous and coniferous forests**.
- **Major Biomes - Tundra biome, Taiga biome, Grassland biome, Alpine biome, Forest biome and Desert**
- Tundra biome - **is the almost treeless plain in the northern parts of Asia, Europe and North America**.
- Precipitation - less than **250 mm per year**
- **Characteristics of tundra:**
  - Extremely cold climate, Low biotic diversity, Simple vegetation structure, Short season of growth and reproduction
- Taiga biome - **it is 1300-1450 km wide zone south of the Tundra**.
- This area has long and cold winters.
- Summer temperature ranges from **10° C to 21° C**.
- Precipitation ranges about **380-1000 mm annually**.
- **Grassland biome** – it occur in **temperate and in the tropical regions**.
- They have **hot summers, cold winters, and irregular rainfall**.
- Often they are characterized by **high winds**.
- **Alpine zone** – includes a sub-snow zone immediately below the snow zone, a meadow zone in the centre and a shrub zone which gradually merges into the timber zone.
- Forest biomes - **is a broad term used to describe areas** where there are a large number of trees.
- The major forest biomes are the **Tropical forests and the Temperate forests**.
- **Tropical forest - occur near the equator** (between latitudes 23.5° at north and 23.5° at south).
- The major characteristic of tropical **forests is their distinct seasons**.
- Only two seasons are present (rainy and dry). Winter is absent.
- The average annual temperature ranges between **20°C and 25°C**.
- Based on the seasonal distribution of rainfall, the types of tropical forests are
  1. **Evergreen rainforest** : no dry season.
  2. **Seasonal rainforest** : short dry period in a very wet tropical region.
  3. **Semi evergreen forest:** longer dry season
  4. **Moist/dry deciduous forest (monsoon):** very long dry season because of rainfall decreases
- **Temperate forest - occur in eastern North America, northeastern Asia and western and central Europe**.
- Have **well-defined seasons** with a distinct winter.
- Annual temperature varies from **-30° C to 30° C**.
- Precipitation (**750-1500 mm**) is distributed evenly throughout the year.
- Based on seasonal distribution of rainfall, the types of temperate forests are
  1. **Moist conifer and evergreen broad-leaved forests** - wet winters and dry summers.
  2. **Dry conifer forests** - low precipitation.
  3. **Mediterranean forests** - precipitation is concentrated in winter (<1000 mm /year).
  4. **Temperate coniferous forests** - high annual precipitation (> 2000 mm /year).

5. **Temperate broad-leaved rainforests:** mild, frost-free winters, high precipitation (> 1500 mm/year)
- Desert biomes – **it cover about one fifth of the earth's surface with rainfall is >500 mm/year.**
  - **Rainfall is usually very low and/or concentrated** in short bursts between long rainless periods.
  - Mean annual temperatures range from **20-25° C.**
  - **Hot deserts** have a **considerable amount of specialized vegetation** (xerophytes), aloe, agave, Opuntia species, Euphorbia royleana as well as specialized vertebrate and invertebrate animals.
  - **Cold deserts** are characterized by **cold winters with snowfall and high overall rainfall** throughout the winter and occasionally over the summer.
  - Every living **organism responds to its environment.**
  - **Regulate** Some organisms are **able to maintain homeostasis by physiological means** which ensures constant body temperature, ionic / osmotic balance.
  - **Conform** Most animals **cannot maintain a constant internal environment.**
  - Their body temperature changes with the ambient temperature ,Such animals are called **Conformers.**
  - **Migrate** Organisms **tend to move away temporarily from a stressful habitat** to a new, hospitable area and return when the stressful period is over.
  - **Suspend** In certain conditions, if the organisms is unable to migrate, it **may avoid the stress by becoming inactive.**
  - Bears going into **hibernation** during winter.
  - Some snails and fish go into **aestivation** to avoid summer
  - Some lower animals **suspend a certain phase of their life cycle**, which is referred to as **diapause.**
  - In biology, **adaptation** is a **dynamic evolutionary process that fits organisms** to their environment and enhancing their

evolutionary fitness.

- Structural adaptations - **The external and internal structures of** animals can help them to adapt better to their environment.
- Behavioural adaptations - **Animals develop** certain behavioural adaptations **for survival.**
- **Fleeing from a predator, hiding during sleep, seeking refuge from climate change or moving to find different food sources** are all behavioral adaptations.
- **Ethology** is the **scientific study of animal behavior.**
- Physiological adaptations - **help them to live and survive in their environment with unique niches.**  
**E.g** Lions have a **digestive system suitable for digesting raw meat.**
- **Stream lined** structure helps in the swift movement of the animals in water.
- **Respiration by gills** making use of gases dissolved in water.
- Presence of air-bladders filled with **air for buoyancy.**  
Earthworms, land Planarians **secrete a mucus coating to maintain a moist situation**
- Arthropods have an **external covering over the respiratory surfaces** and well developed tracheal systems.
- Population is defined as any **group of organisms of the same species which can interbreed among themselves**, and occupy a particular space and function as part of a biotic community.
- A population has various properties like **population density, natality (birth rate), mortality (death rate), age distribution, biotic potential, dispersion and 'r', 'K' selected growth forms.**
- The density of a population refers to its **size in relation to unit of space and time.**
- Population density is the **total number of that species** within a natural habitat.
- Natality is equivalent to **birth rate and is an actual production of new individuals** in the population

- Mortality can be expressed as a **loss of individuals in unit time or death rate.**
- Migration - **is a** movement from one place to another and back.
- Types of migrations - **Emigration & Immigration**
- Populations show **characteristic growth patterns or forms.**
- These patterns can be plotted and termed as **J-shaped growth form and S-shaped growth form**
- J shaped growth form- **When a** population increases rapidly in an exponential fashion **and then stops abruptly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form.**
- **Biotic potential** - is the **maximum reproductive capacity** of an organism under optimum environmental conditions.
- **Carrying capacity** -The **maximum number of organism** that a region can support without environmental degradation is called carrying capacity.
- **Environmental resistance** - Is the **sum total of the environmental limiting factors**, both biotic and abiotic, which together act to prevent the biotic potential of an organism from being realized.
- S-Shaped growth form (sigmoid growth)  
Some populations, as in a population of small mammals, **increase slowly at first then more rapidly and gradually slow down** as environmental resistance increases whereby equilibrium is reached and maintained. Their growth is represented by S shaped growth curve.
- Organisms belonging to different populations **interact for food, shelter, mating or for other necessities.**
- Interaction may be **intra specific** (interaction within the members of same species) or **inter specific** (among organisms of different species).
- Interspecific associations or interactions can be-
  1. **Neutral** - different species **live together but do not affect each other.**
  2. **Positive** - it is a **symbiotic relationship** in which no organism in association is harmed and either one or both may be benefitted.  
It is of two types **Mutualism and Commensalism.**
  3. **Negative** - **One or both of the interacting organisms will be affected**  
It is of three types - **competition, predation, parasitism.**

## PART –A

### TEXTUAL QUESTIONS (1 MARK)

1. **All populations in a given physical area are defined as**
  - a) Biome
  - b) Ecosystem
  - c) Territory
  - d) Biotic factors

**Ans : a**
2. **Organisms which can survive a wide range of temperatuer are called**
  - a) Ectotherms
  - b) Eurytherms
  - c) Endotherms
  - d) Stenotherms

**Ans : b**
3. **The interaction in nature, where one gets benefit on the expense of other is...**
  - a) Predation
  - b) Mutualism
  - c) Amensalism
  - d) Commensalism

**Ans : d**
4. **Predation and parasitism are which type of interactions?**
  - a) (+,+)
  - b) (+, 0)
  - c) (-, -)
  - d) (+, -)

**Ans : d**
5. **Competition between species leads to**
  - a) Extinction
  - b) Mutation
  - c) Amensalism
  - d) Symbiosis

**Ans : a**
6. **Which of the following is an r-species**
  - a) Human
  - b) Insects
  - c) Rhinoceros
  - d) Whale

**Ans : b**

7. Match the following and choose the correct combination from the options given below.

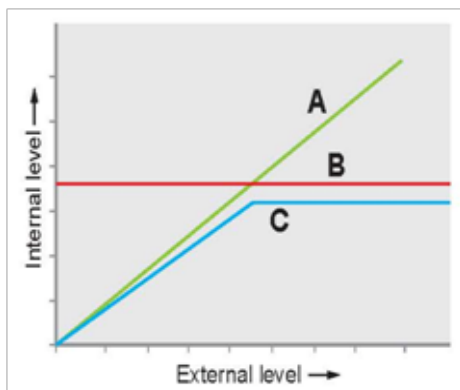
Column I	Column II
A) Mutualism	1. Lion and deer
B) Commensalism	2. Round worm and man
C) Parasitism	3. Birds compete with squirrels for nuts
D) Competition	4. Sea anemone on hermit crab
E) Predation	5. Barnacles attached to Whales.

**Dispersal**

- a) A- 4, B-5, C-2, D-3, E-1
- b) A- 3, B-1, C-4, D- 2, E-5
- c) A- 2, B-3, C-1, D- 5, E-4
- d) A- 5, B-4, C-2, D- 3, E-1

Ans : a

8. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do A, B and C represent respectively.



S. No.	A	B	C
a.	Conformer	Regulator	Partial Regulator
b.	Regulator	Partial Regulator	Conformer
c.	Partial Regulator	Regulator	Conformer
d.	Regulator	Conformer	Partial Regulator

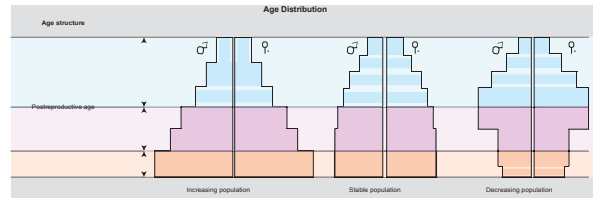
Ans : a

9. The relationship between sucker fish and shark is.....

- a) Competition
- b) Commensalism
- c) Predation
- d) Parasitism

Ans : b

10. What type of human population is represented by the following age pyramid?



- a) Vanishing population
- b) Stable population
- c) Declining population
- d) Expanding population

Ans : b

11. Which of the following is correct for r-selected species

- a) Large number of progeny with small size
- b) large number of progeny with large size
- c) small number of progeny with small size
- d) small number of progeny with large size

Ans : a

12. Animals that can move from fresh water to sea called as.....

- a) Stenothermal
- b) Eurythermal
- c) Catadromous
- d) Anadromous

Ans : c

13. Some organisms are able to maintain homeostasis by physical means ...

- a) Conform
- b) Regulate
- c) Migrate
- d) Suspend.

Ans : b

**PART – B,C,D**

**TEXTUAL QUESTIONS (2,3 AND 5 MARKS)**

14. What is a Habitat?

- A habitat can be considered as the 'address' of the organism.
- The collection of all the habitat areas of a species constitutes its **geographical range**.

**E.g. Xerophytic habitat.**

**15. Define ecological niche.**

- As every organism has its unique habitat, so also it has an ecological niche which includes the physical space occupied by an organism and its functional role in the community.
- The ecological niche of an organism not only depends on where it lives but also includes the sum total of its environmental requirements.

**16. What is Acclimatisation?**

- Animals are known to **modify their response to environmental changes** (stress) in reasonably short time spans. This is known as **Acclimatization**
- Acclimatization occurs in a **short period of time**, and **within the organism's life**

**17. What is Pedogenesis?**

- The soil zone is known as **Pedosphere**.
- Soil is formed from **rocks which are the parent materials of soil, by weathering** and is called embryonic soil (Pedogenesis).

**18. What is Zero Stress?**

- Animals are known to modify their response to environmental changes (stress) in reasonably short time spans. This is known as **Acclimatization**.
- **Constant environmental conditions** is known as Zero Stress

**19. What is soil permeability?**

- The characteristic of **soil that determines the movement of water** through pore spaces is known as soil permeability.
- Soil permeability is **directly dependent on the pore size**.

**20. Differentiate between Eurytherms and Stenotherms.**

S. No.	Eurytherms	Stenotherms
1.	Organisms which can survive a wide range of temperature are referred to as <b>Eurytherms</b>	Organisms which can tolerate only a narrow range of temperature are <b>Stenotherms</b>
2.	Eurythermy can be an <b>evolutionary advantage</b>	<b>No relationship with evolution</b>
3.	<b>E.g</b> : Cat, dog, tiger, human.	<b>E.g</b> : Fish, Frogs, Lizards and Snakes

**21. Explain hibernation and aestivation with examples.**

- **Hibernation is a winter sleep** which is useful adaptations to overcome extreme winters squirrel, bears.
- **Aestivation is referred as Summer sleep** which is useful adaptations to overcome extreme summers. **E.g** : **Crocodile, Lemurs.**

**22. Give the diagnostic characters features of a Biome?**

- Location, Geographical position (**Latitude, Longitude**)
- **Climate and physiochemical** environment
- **Predominant plant** and animal life
- Boundaries between **biomes are not always sharply defined**.
- **Transition or transient zones** are seen as in case of grassland and forest biomes

**23. Classify the aquatic biomes of Earth.**

1. **Freshwater** (Lakes, ponds, rivers)
2. **Brackish water** (Estuaries / Wetlands)
3. **Marine** (Coral reefs, pelagic zones and abyssal zones)

**24. What are the ways by which organisms respond to abiotic factors?**

**Regulate:**

- Some organisms are **able to maintain homeostasis** by physiological means which ensures **constant body temperature, ionic / osmotic balance**.
- E.g** : **Birds, mammals and a few lower vertebrate and invertebrate species.**

**Conform:**

- Most animals **cannot maintain a constant internal environment**.
- Their **body temperature changes** with the ambient temperature.
- In aquatic animals like fishes, the **osmotic concentration of the body fluids changes** with that of the ambient water osmotic concentration.
- Such animals are called **Conformers**.
- In case of extreme condition, the **inhabitants relocate themselves as in migration**.



**Migrate:**

- Organisms tend to **move away temporarily from a stressful habitat** to a new, hospitable area and return when the stressful period is over.

**E.g :** Birds migrate from Siberia to Vedanthangal in Tamilnadu to escape from the severe winter periods.

**Suspend:**

- In certain conditions, if the **organisms is unable to migrate**, it may avoid the stress by becoming inactive.
- This is seen commonly in bears going into **hibernation** during winter.
- Some snails and fish go into **aestivation to avoid summer related problems** like heat and desiccation.
- Some lower animals **suspend a certain phase of their life cycle**, which is referred to as **diapause**

**25. Classify the adaptive traits found in organisms.**

- The adaptive traits may be **structural adaptation, behavioral adaptation and physiological adaptation.**

**Structural adaptations :**

- The external and internal structures of animals can help them to **adapt better to their environment.**  
**E.g :** Mammals growing **thicker fur to survive freezing climates.**
- Some of the most attractive **adaptations in nature occur for reasons of crypsis** (e.g. camouflage) and **mimicry.**
- Cryptic animals are those which **camouflage perfectly with their environment** and are almost impossible to detect.
- Certain reptiles and insects such as **chameleons and stick insects show this type of adaptation**, which helps in prey capture or to evade from predators.
- Likewise, **horse legs are suitable for fast running** and **adapted for grasslands** and similar terrestrial environments.



**Behavioural adaptations :**

- Action and behaviour of animals are **instinctive or learned.**

- Animals develop certain **behavioural traits or adaptations for survival.**

**E.g :** Fleeing from a predator, hiding during sleep, seeking refuge from climate change or moving to find different food sources

- Important Behavioral adaptations are **migration and courtship.**
- Migration allows the **animals to find better resources** or evade threat.
- Courtship is a set of **behavioral patterns to find a mate to reproduce.**
- Most nocturnal animals **remain underground or inactive during daytime.**
- This is a modification of their **feeding and activity pattern or habit or behaviour.**
- **Ethology** is the scientific **study of animal behaviour, under natural conditions.**

**Physiological adaptations :**

- These are adaptations of organisms that **help them to live and survive in their environment** with unique niches.

**E.g :** Lions have **sharp canines to hunt and tear** meat and a digestive system suitable for digesting raw meat.

- The two most well-known physiological adaptations are **hibernation and aestivation.**
- These are two different **types of inactivity where the metabolic rate slows down** so much that the animal can survive without eating or drinking.

**26. Differentiate Natality and Mortality.**

S. No.	Natality	Mortality.
1.	It define as a <b>birth of individual in unit time.</b>	It define as a <b>death of individuals in unit time.</b>
2	It is also known as <b>Birth rate</b>	It is also known as <b>death rate</b>

27. Differentiate J and S shaped curve.

S. No.	J shaped curve	S shaped curve
1.	In this kind <b>population increases rapidly</b> in an exponential fashion then <b>stops shortly due to environmental resistance</b> or due to sudden appearance of a limiting factor,	In this kind <b>population of small mammals, increase slowly</b> at first then <b>more rapidly and gradually slow down</b> as environmental resistance increases.
2	Their growth is <b>represented by J-shaped growth form.</b>	Their growth is <b>represented by S shaped growth curve</b>

28. Give an account of population regulation.

- The inherent tendency of all animal populations is to **increase in number**.
- But it does **not increase indefinitely**.
- Once the carrying capacity of the environment is reached, population numbers remain static or fluctuate depending on environmental conditions.
- This is regulated by many factors which are
  1. **Density independent - Extrinsic factors**
  2. **Density dependent - Intrinsic factors**
- Extrinsic factors include **availability of space, shelter, weather, food**, etc.
- Intrinsic factors include **competition, predation, emigration, immigration and diseases**.

29. What is ecological density, crude density and population density?

S. No.	Indices of Density	Keys
1	<b>Population density</b>	It is usually expressed as the <b>number of individuals per unit area or volume</b> . Eg. <b>100 trees/acre</b>
2	<b>Crude density</b>	It is the size of a population in <b>relation to the numbers per unit of total space</b> . Eg. <b>1000 fish in a pond</b> .

S. No.	Indices of Density	Keys
3	<b>Ecological density</b>	It is the size of a population in <b>relation to the numbers per unit of habitat space</b> . (Available area or volume that can be colonized by a population). Eg. <b>1000 fish in the volume of water</b> in the pond.

30. Give an account of the properties of soil.

**Texture of soil**

- The texture of soil is determined by the **size of the soil particles**.
- The types of soil include **sand, silt and clay** on the basis of their size differences.

**Porosity**

- The **space present between soil particles** in a given volume of soil are called pore spaces.
- The percentage of soil volume occupied by pore space or by the interstitial spaces is called **porosity of the soil**.

**Permeability of soil**

- The characteristic of soil that **determines the movement of water through pore spaces** is known as soil permeability.
- Soil permeability is **directly dependent on the pore size**.
- Water holding capacity of the soil is **inversely dependent on soil porosity**.

**Soil Temperature**

- Soil gets its heat energy from **solar radiation, decomposing organic matter, and heat** from the interior of earth.
- Soil temperature effects the **germination of seeds, growth of roots and biological activity** of soil-inhabiting micro-and macro-organisms.

**Soil water**

- In soil, water is not only important as a solvent and transporting agent, but also **maintains soil texture, arrangement and compactness of soil particles**, making soil habitable for plants and animals.

31. Differentiate between Tundra and Taiga Biomes.

S. No.	Tundra Biomes	Taiga Biomes
1.	It extends beyond the <b>Arctic and Antarctic circle</b> (66.6° to the poles)	It extends in the <b>sub polar belt of North America and Eurassia</b> (55° to 66.5° North)
2.	The winters are very long and severe. <b>Summers are very short and warm</b>	The winters are <b>long and cold. Summers are short and warm</b>
3.	Precipitation is <b>less than 250 mm</b> per year.	Precipitation ranges about <b>380-1000 mm</b> annually.
4.	This is the almost <b>treeless plain in the northern parts</b> of Asia, Europe and North America.	The Taiga is a <b>forest of coniferous trees</b> such as spruce, fir and pine.
5.	<b>Reindeer, arctic hare, musk ox, lemmings</b> are important Tundra herbivores <b>E.g : ducks and geese, nest</b> in the Tundra during the summer and migrate south for the winter.	Important migratory herbivores include <b>moose, elk, deer and reindeer.</b> The common smaller mammals are herbivorous <b>squirrels, snowshoe hare</b> and predatory pine martens. Important predators include the <b>timber wolf, grizzly bear, black bear, bobcat and wolverines.</b>

32. List the adaptations seen in terrestrial animals.

Adaptations of terrestrial animals :

- Earthworms, land Planarians à **secrete a mucus coating to maintain a moist situation**
- Arthropods à have an **external covering over the respiratory surfaces** and well-developed tracheal systems.

- In vertebrate skin, there are many cellular layers besides the **well protected respiratory surfaces that help in preventing loss of water.**
- Some animals obtain their water requirement from food as **partial replacement of water lost through excretion.**
- Birds à make nests and **breed before the rainy season** as there is availability of abundant food. But **during drought birds rarely reproduce.**
- Camels are able to **regulate water effectively for evaporative cooling** through the skin and respiratory system and **excrete highly concentrated urine, and can also withstand dehydration** up to 25% of their body weight.

33. Describe Population Age Distribution.

- The **proportion of the age groups** (pre- reproductive, reproductive and post reproductive) in a population is its age distribution attribute.
- This determines the **reproductive status of the population at the given time** and is an indicator of the future population size.
- Usually a rapidly growing population will have **larger proportion of young individuals.**
- A stable population will have an **even distribution of various age classes.**
- A **declining population** tends to **have a larger proportion of older individuals.**

34. Describe Growth Models/ Curves.

- Populations show **characteristic growth patterns or forms.**
- These patterns can be plotted and termed as **J-shaped growth form and S-shaped growth form (Sigmoid form).**

**PART –A**

**ADDITIONAL QUESTIONS (1 MARK)**

1. Biome is

- a) sum of ecosystems in a geographical area.
- b) sum of ecosystems of the whole earth.
- c) biotic component of an ecosystem.
- d) biotic potential of a population.

Ans : a

- 2. Keystone species in an ecosystem are those**  
 a) present in maximum number.  
 b) that are most frequent.  
 c) attaining a large biomass.  
 d) contributing to ecosystem properties.  
**Ans : d**
- 3. What is the most important factor for the success of animal population?**  
 a) Natalty  
 b) Unlimited food  
 c) Adaptability  
 d) Inter-species activity  
**Ans : c**
- 4. In a population, unrestricted reproductive capacity is called**  
 a) Biotic potential  
 b) Fertility  
 c) Carrying capacity  
 d) Birth rate  
**Ans: a**
- 5. Which part of the world has a high density of organisms?**  
 a) Grasslands  
 b) Savannahs  
 c) Deciduous forests  
 d) Tropical rain forests  
**Ans : d**
- 6. Which one of the following pairs is correctly matched?**  
 a) Tundra - Low biotic diversity  
 b) Savanna - *Acacia* trees  
 c) Prairie – Grassland  
 d) Coniferous forest - Evergreen trees  
**Ans: a**
- 7. Which is not a part of atmosphere ?**  
 a) Light  
 b) Temperature  
 c) Edaphic factor  
 d) Precipitation  
**Ans : c**
- 8. Which biological factors is responsible for poor vegetation in deserts ?**  
 a) Grazing by animals and goats  
 b) Low rainfall  
 c) Poor fertility of soil  
 d) Native mankind  
**Ans : b**
- 9. The most important factor which determined the increase in human population**  
 a) Natalty  
 b) Mortality  
 c) Immigration  
 d) Emigration  
**Ans : a**
- 10. A majority of organisms are restricted to a narrow range of temperature, and are called**  
 a) Stenothermal  
 b) Endothermal  
 c) Ectothermal  
 d) Eurythermal  
**Ans : a**
- 11. The foraging, reproductive and migratory activities of the organisms are primarily dependent upon**  
 a) Light  
 b) Temperature  
 c) Water  
 d) Soil  
**Ans : a**
- 12. Mark the correct statement**  
 a. The case of bear, going into hibernation during winter, is an example of 'escape in time'  
 b. To prevent desiccation some snails and fishes enter into diapause  
 c. Under un-favourable conditions many zooplankton species go into aestivation  
 d. All of these  
**Ans : a**
- 13. Bell-shaped polygonal pyramid indicates**  
 a) High percentage of young individuals  
 b) Moderate percentage of young individuals  
 c) Low percentage of young individuals  
 d) Low percentage of old individuals  
**Ans : b**
- 14. Sparseness of animal groups is characteristic feature of-**  
 a) Gangetic plains  
 b) Tropical zone  
 c) Alpine zone  
 d) Mangrove zone  
**Ans : c**
- 15. A population would grow exponentially**  
 a) if it were limited only by density-dependent factors.  
 b) until it reaches carrying capacity.  
 c) if there were no limiting factors.  
 d) if it were a population with an equilibrial life history.  
**Ans : c**
- 16. The effects of which of the following environmental factors would probably not change as a population grows?**  
 a) Disease  
 b) Limited food supply  
 c) Competition for nesting sites  
 d) Weather  
**Ans : d**

- 17. A broad-based, pyramid-shaped age-structure diagram is characteristic of a population that is**
- growing rapidly.
  - at carrying capacity.
  - stable.
  - limited by density-dependent factors.

**Ans : a**

- 18. If birth rate is 100, death rate is 10 and number of individual in population group is 1000, then what will be the percentage of natural growth rate?**
- 0.09%
  - 9.0%
  - 0.9%
  - 90%

**Ans : b**

- 19. An ecologist would suspect that a population is growing rapidly if it**
- contains many more pre-reproductive than reproductive individuals.
  - is near its carrying capacity.
  - is limited only by density-dependent factors.
  - shows a clumped pattern of dispersion.

**Ans : a**

- 20. When birth rate equals death rate,**
- A population grows rapidly.
  - The size of a population remains constant.
  - Density-dependent limiting factors do not affect the population.
  - Population is in danger of extinction.

**Ans : b**

- 21. From an ecologist's point of view, population structure does not include the**
- distribution of genotypes within a population.
  - population density.
  - spacing of population members.
  - biomass of the population.

**Ans: d**

- 22. Human population growth \_\_\_\_\_.**
- has an S-shaped curve
  - is currently in a logistic phase
  - is currently exponential
  - has reached carrying capacity

**Ans : c**

- 23. The age-structure diagram of a country like India, has the shape of \_\_\_\_\_.**
- a triangle with the point at the bottom
  - a rectangle tapered at the top
  - a pyramid
  - an hour glass

**Ans : c**

- 24. The number of individuals per unit area or volume is known as ...**
- population density
  - population growth
  - community ecology
  - population distribution

**Ans : a**

- 25. A population of 500 that experiences 55 births and 5 deaths during a one-year period. What is the reproductive rate for the population during the one-year period ?**
- 0.01/year
  - 0.05/year
  - 0.1/year
  - 50/year

**Ans : c**

- 26. A population of 600 that experiences 65 births and 5 deaths during a one-year period. If the population maintains the current growth pattern, a plot of its growth would resemble**
- exponential growth
  - fluctuating growth
  - K-selected growth
  - logistic growth

**Ans : a**

- 27. The maximum expansion rate of a population under the best conditions is referred to as \_\_\_\_\_. There are abundant resources that last forever and no limits on growth.**
- biotic potential
  - cohort
  - mortality rate
  - biome

**Ans: a**

- 28. Which one of the following ecosystem types has the highest annual net primary productivity?**
- Tropical deciduous forest
  - Temperate evergreen forest
  - Temperate deciduous forest
  - Tropical rain forest.

**Ans : d**

- 29. In an age pyramid, the number of individuals of reproductive age is lesser than pre reproductive but higher than post reproductive ones. The population is**
- Growing
  - Declining
  - Stable
  - Can not be predicted

**Ans : a**



**30. The term 'precipitation' includes**

- a) Rain      b) Hails  
c) Snow      d) All forms of water that fall to the ground

**Ans : d****31. Ratio of natality and mortality of a population is expressed in percentage as**

- a) Vital index      b) Growth rate  
c) Survival rate      d) Biotic potential

**Ans : a****32. In which animal green foliage type of mimic is found ?**

- a) honey bee      b) horse  
c) chameleons      d) snake

**Ans: c****33. In commensalism –**

- a. Population of commensal and host remains unaffected  
b. Population of commensal may increase while that of host remains unaffected  
c. Population of both commensal and host increases  
d. Population of commensal increases while the population of host gradually decreases

**Ans : b****34. A bird eats the fruit of a plant species. The seeds are not digested and germinate in the bird's excreta at some distance from the parent plant. This is an example of**

- a) predation      b) competition  
c) commensalism      d) mutualism

**Ans : d****35. According to the principle of competitive exclusion, two species cannot continue to occupy the same . . .**

- a) biome      b) ecological niche  
c) environmental habitat      d) range

**Ans : b****36. Which of the following type of interactions occur in mutualism ?**

- a) (+, +)      b) (+, 0)  
c) (+, -)      d) (-, -)

**Ans : a****37. Interactions in which the consumer lives within the host and does slow damage to the host are referred to as**

- a) commensalism.      b) parasitism.  
c) mutualism.      d) competition.

**Ans : b****38. The relationship between hermit crab and sea anemone is**

- a) symbiosis      b) mutualism  
c) parasitism      d) commensalism

**Ans : d****39. Small fish get stuck near the bottom of a shark and derives its nutrition from it. This kind of association is called as**

- a) Symbiosis      b) Commensalism  
c) Predation      d) Parasitism

**Ans: b****40. An association between two individuals or population where both the benefitted and where neither can survive without the other is**

- a) Commensalism      b) Amensalism  
c) Proto-cooperation      d) Mutualism

**Ans : d****41. Pedology is the study of –**

- a) Locomotion of animals      b) Rocks  
c) Soil      d) Reproduction

**Ans : c****42. Soil is composed of –**

- a) Mineral + Water + Air  
b) Mineral + Organic matter + Water  
c) Mineral + Organic matter + Air + Water  
d) Organic matter + Water

**Ans : c****43. Biotic factors are –**

- a. Chemical factors of soil which effect life  
b. Physical factors of soil which effect life  
c. All living organisms which influence other organisms  
d. Atmospheric factors which influence life

**Ans : c****44. The age of pyramid with broad base indicates**

- a) High percentage of young individuals  
b) Low percentage of young individuals  
c) High percentage of old individuals  
d) Low percentage of old individuals

**Ans : a****45. Permafrost is the most distinctive feature of**

- a) Taiga      b) Temperate grasslands  
c) Tundra      d) Pacific northwest

**Ans : c**

46. Desert regions are characterized by \_\_\_ mm of rainfall per year.

- a) less than 50
  - b) less than 150
  - c) less than 500
  - d) over 50
- Ans : c**

47. For plants inhabiting a tropical rain forest, the critical competition is for

- a) soil nutrients
  - b) water
  - c) space
  - d) light
- Ans : d**

48. Resemblance of one organism to another for protection and hiding is known as

- a) Mimicry
  - b) Predation
  - c) Adaptation
  - d) Camouflage
- Ans :**

49. Which animal is capable of obtaining water by oxidation of lipid.

- a) Rat
  - b) Earthworm
  - c) Mole
  - d) Kangaroo rat
- Ans : d**

50. Which is the example of intraspecific competition for food ?

- a) Barnacle on rocks of the submerged water
  - b) between dogs
  - c) Various types of lichens
  - d) Paramecium caudatuns and P.aurelia in laboratory.
- Ans : d**

51. Parasitic animal which is part of bio-geo community and included as zoo planktons and mesofauna of terrestrial ecosystem is ....

- a) Moles
  - b) mites
  - c) Earthworms
  - d) leech
- Ans : b**

52. If marine fish is kept in fresh water, will it survive

- a. Yes, If chlorine cells are placed in its kidney
  - b. Yes, If chlorine cells are placed in its green gland
  - c. No, Because it can not adapt
  - d. No, they can not survive but of young ones hatching out of their eggs can survive
- Ans : c**

53. What is true for both the organism showing interspecific competition ?

- a) Both are benefited
  - b) more or less harmful effect to both
  - c) one is benefited where as other is at loss
  - d) None of these
- Ans : b**

54. Water holding capacity of land depends on ?

- a) Soil composition
  - b) Grain size
  - c) Aggregation of grain
  - d) All of these
- Ans : d**

55. In which of the following organism water is stored in its transformed form and not water as such ?

- a) camel
  - b) Uromatrix
  - c) Spiny tailed lizard
  - d) rat
- Ans : a**

56. Match column I with column II

**Column - I**

**Column - II**

- |                |                 |
|----------------|-----------------|
| 1. Mutualism   | (p) Barnacles   |
| 2. Competition | (q) Tiger       |
| 3. Predation   | (r) Mites       |
| 4. Parasitism  | (s) Sea anemone |

- a) (1-s), (2-r), (3-p) (4-q)
  - b) (1-r), (2-s), (3-q) (4-p)
  - c) (1-s), (2-p), (3-q) (4-r)
  - d) (1-q), (2-r), (3-s) (4-p)
- Ans : c**

57. Which of the following is not included as the climax community of general process of succession ?

- a) Sedge-meadow stage
  - b) phytoplanktones
  - c) Forest
  - d) Grassland
- Ans : b**

58. What is the composition of soil with high waterlogging capacity ?

- a) Sandy soil
  - b) Black soil
  - c) Rocky soil
  - d) red soil
- Ans : b**

59. What is correct for the given statement ?

**Statement X : Ascaris are permanent parasites**  
**Statement Y : Ascaris lives inside the host's body**

- a) Both X&Y are correct
  - b) Both x & Y are wrong
  - c) X is wrong Y is true
  - d) X is correct & Y is true
- Ans : a**



60. Biological control as pest control in agriculture is an example of

- a) Predation                      b) Competition  
c) Emigration                    d) diseases      **Ans : a**

61. The turtle of Galapagos island and the goats living there both were eating tender grass, state the relationship.

- a) Interspecific competition  
b) Emigration  
c) predation  
d) None of these                      **Ans : a**

62. Carrying capacity of a population is determined by

- a) Birth rate                      b) Death rate  
c) limiting resources          d) Reproductive ability  
**Ans : c**

63. Biotic community means

- a) Group of Birds  
b) Group of species  
c) Group of interrelated population  
d) Groups of interrelated ecosystem      **Ans : c**

64. What is true for the given statements ?

**Statement X : Protopterus aestivate during winter to overcome dry period**  
**Statement Y : The process of aestivation in protopterus is to overcome unfavourable condition**

- a) Both statements are true  
b) X-Correct Y- wrong  
c) Both statements are wrong  
d) X- wrong Y- correct                      **Ans : d**

65. What is true for the given statement ?

**Statement X : Most of the animals and almost all the plants cannot keep up their internal environment constant**  
**Statement Y : process of osmoregulation in plants is an example of this**

- a) Both statements are true  
b) X - correct, Y- wrong  
c) Both statements are wrong  
d) X- wrong, Y- correct                      **Ans : a**

66. What is correct for the given statement regarding environment ?

**Statement X : Environmental study is linked with ecology**

**Statement Y : Ecology is included in environmental study.**

- a) Both statement are true  
b) Both statement are wrong  
c) P is right and Q is wrong  
d) P is wrong and Q is right                      **Ans : a**

67. What is true for the following statements ?

**Statement X : Migration of birds is influenced by light.**

**Statement Y : Reproduction of birds is influenced by light.**

**Statement Z : In all birds gonads are activated due to increase in intensity of light during summer.**

- |    |       |       |       |
|----|-------|-------|-------|
|    | X     | Y     | Z     |
| a) | True  | False | False |
| b) | False | True  | False |
| c) | True  | True  | True  |
| d) | True  | True  | False |
- Ans : a**

68. Which is true statements in the following

**Statement 1: Birds and Mammals obtain greater body size in cold region than in warm regions.**

**Statement 2 : Birds and Mammals are Homeothermic (warm blooded) animals.**

**Statement 3 : Reptiles are smaller in cold region.**

- a) 1,3                      b) 1,2                      c) 1,2,3                      d) 2,3  
**Ans : d**

## PART –B

### ADDITIONAL QUESTIONS

(2 MARKS)

1. Define Ecology.

- The word 'ecology' is derived from the Greek term 'oikos', meaning 'house' and logos, meaning 'study'.

2. Define population.

- In ecology, the term population, originally coined to denote a group of people is broadened to include groups of individuals of any one kind of organism.

**3. Define ecosystem**

- The **community with living (Biotic) and the non-living environment (Abiotic)** function together as an ecological system (or) ecosystem.
- Biome is a term in **wide use for a large regional or sub continental system** characterized by a major vegetation type.

**4. List out the components of ecosphere .**

- Ecosphere, includes **all the living organisms of the Earth, interacting with the physical environment** to regulate their distribution, abundance, production and evolution.

**5. What is environment ?**

- Environment is a collective term **which includes the different conditions** in which an organism lives or is present.
- The common and influencing factors of environment are **light, temperature, pressure, water, salinity.**

**6. List out the adaptations of camel.**

- Camel is **able to use water efficiently and effectively for evaporative cooling through their skin and respiratory system.**
- They excrete **highly concentrated urine** and can also **withstand dehydration upto 25%** of the body weight.
- The **hoofs and hump are also suitable adaptations** for survival in this dry sandy environment.

**7. List out the adaptations of fish**

- **Fins** (locomotion),
- **Streamlined body** (aerodynamic),
- **Lateral line system** (sensory),
- **Gills** (respiration),
- **Air sacs** (floatation)
- **Kidneys** (excretion).

**8. Define Niche and Guilds**

- The **life style of an individual population** in the habitat is known as its niche or
- Niche of an organism can be defined as the **total position and function of an individual** in its environment.
- E.g **crickets and grasshoppers** are closely related insects that live in the same habitat, yet they occupy different ecological niches.

**9. State van't Hoff 's rule**

- van't Hoff proposed that, with the **increase of every 10°C, the rate of metabolic activity doubles** or the reaction rate is halved with the decrease of 10°C.
- This rule is referred as the **van't Hoff 's rule.**

**10. Define Bergmann's rule**

- This rule state that, In certain environments, the **size and colouration of animals are influenced by temperature.**
- Birds and mammals **attain greater body size in colder regions** than warmer regions
- This is known as **Bergmann's rule**

**11. Define Allen's rule**

- Warm blooded animals, **living in colder climates, tend to have shorter limbs, ears and other appendages** when compared to the members of the same species in warmer climates (**Allen's rule**).

**12. Define Jordon's rule.**

- In some aquatic environments, there an **inverse relationship between water temperature and fish meristic**
- This is known as Jordon's rule

**13. Define phototaxis.**

- The **movement of organism in response to light**, either towards the source of light as in Moths (positive phototaxis) or away from light (Euglena, Volvox, earthworm (negative phototaxis).

**14. Define phototropism.**

- The **growth or orientation of an organism in response to light**, either towards the source of light (**Positive phototropism**) as seen in Sunflower, or a way from light (**negative phototropism**) as in case of the root of plants.

**15. Define photokinesis.**

- A change in the **speed of locomotion (or frequency of turning) in a motile organism** or cell which is made in response to a change in light intensity is called Photokinesis.
- It involves undirected random movement in response to light.

**16. What are the types of water ?**

- Water are two types. They are
  1. **Fresh water** (rivers, lakes, ponds)
  2. **Salt water** (seas and oceans).
- Based on the dissolved salts, water can be **hard water** (sulphates/nitrates of Calcium/Magnesium) or **soft water**.

**17. Define pedosphere.**

- Soil is a **mixture of organic matter, minerals, gases, liquids** and organisms that together support life.
- The soil zone is known as **Pedosphere**.

**18. List out the functions of soil.**

- **Medium** for plant growth
- Means for **water storage and purification**
- **Modifier of earth's** atmosphere
- **Habitat for many organisms**, which in turn modify the soil

**19. What is Soil Profile**

- Soil is formed of **many horizontal layers** called as Soil Profile.

**20. Define humidity**

- Moisture in the form of **invisible vapor in the atmosphere** is called humidity.
- **Humidity** is generally expressed in terms of absolute humidity, relative humidity or specific humidity.

**21. Define Absolute humidity**

- Absolute humidity is the **total mass of water vapour** present in a given volume or mass of air.
- It does not take temperature into consideration.

**22. Define Relative humidity**

- Relative humidity is the **amount of water vapour present in air** and is **expressed as a percentage of the amount** needed for saturation at the same temperature
- Relative humidity is expressed as a percentage;

**23. List out the major biomes of the earth**

- **Tundra biome,**
- **Taiga biome,**
- **Grassland biome,**
- **Alpine biome,**
- **Forest biome,**
- **Desert biome.**

**24. List out the epidemic plant of hot desert**

- Hot desert have a considerable amount of specialized vegetation (xerophytes), **aloe, agave, Opuntia species, Euphorbia royleana** as well as specialized vertebrate and invertebrate animals.

**25. What are conformers?**

- Most animals cannot maintain a constant internal environment.
- In aquatic animals like fishes, the **osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration**.
- Such animals are called **Conformers**.

**26. Why organisms migrate?**

- Organisms tend to **move away temporarily from a stressful habitat** to a new, hospitable area and **return when the stressful period is over**.

**E.g :** Birds migrate from **Siberia to Vedanthangal** in Tamilnadu to escape from the severe winter periods.

**27. Define diapause**

- Some **lower animals suspend a certain phase** of their life cycle, which is referred to as **diapause**.

**28. What is known as Adaptations.**

- In biology, **adaptation** is a dynamic evolutionary process that fits organisms to their environment and enhancing their evolutionary fitness.
- Adaptations can be a phenotypic or **adaptive trait** with a functional role in each individual organism that is maintained and has been evolved by natural selection.

**29. Define ethology.**

- **Ethology** is the scientific study of animal behaviour, under natural conditions.

**30. Define Population.**

- Population is defined as **any group of organisms of the same species** which can interbreed among themselves, and occupy a particular space and function as part of a biotic community.



**31. Define Population density.**

- The density of a population refers to its **size in relation to unit of space and time.**
- Population density is the **total number of that species** within a natural habitat.

**32. What is Natality?**

- Natality is equivalent to **birth rate** and is an expression of the **production of new individuals** in the population by birth, hatching, germination (or) fission.

**33. How will you calculate Birth rate and death rate ?**

$$\text{Birth rate (b)} = \frac{\text{number of birth per unit time}}{\text{average population}}$$

$$\text{Death rate (d)} = \frac{\text{number of deaths per unit time}}{\text{average population}}$$

**34. What is J shaped growth form?**

- When a population **increases rapidly in an exponential fashion** and then stops shortly due to environmental resistance or due to sudden appearance of a limiting factor, they are said to exhibit J-shaped growth form.

**35. Define Biotic potential**

- It is the **maximum reproductive capacity** of an organism under optimum environmental conditions.

**36. Define Carrying capacity**

- The maximum **number of organism that a region can** support without environmental degradation is called carrying capacity.

**37. Define Environmental resistance**

- Is the sum total of the environmental limiting factors, **both biotic and abiotic**, which together act to prevent the biotic potential of an organism from being realized.

**38. Define the term, 'Ecology'.**

- Ecology is defined as the branch of biology that deals with the **study of interaction among organisms and between the organism** and its physical (abiotic) environment.

**39. Mention the factors that account for the formation of major biomes in the earth.**

- **Intensity and duration of temperature** along with **annual variations in precipitation** are responsible for the formation of major biomes.

**40. Define the term, Homeostasis.**

- Homeostasis is the process by which the **organisms maintain a constant internal environment** in respect to changing external environment.

**41. Define the term, Regulate.**

- Some organisms are **able to maintain homeostasis** by physiological means which ensures **constant body temperature, ionic / osmotic balance.**
- This is called **Regulate.**  
**E.g : Birds, mammals and a few lower vertebrate and invertebrate species.**

**42. What is migration?**

- The organism **can move away temporarily from the stressful habitats** to a more hospitable area and return when stressful period is over. This is called **migration.**

**43. What is an age pyramid?**

- It is the graphical representation of **population of an area at a given time**, in which percentage of individuals of an age group is plotted for the population the resulting structure is called pyramid.

**44. Define Birth rate**

- The birth rate is the **total number of births per 1000** of a population each year

**45. Define death rate**

- Mortality rate is a measure of the **number of deaths per 1000** of a population each year.

**46. Define Immigration**

- Immigration refers to the number of **individuals of same species that have come into the habitat** during a given period of time.

**47. Define emigration.**

- Emigration refers to the **number of individuals of the population who move from the habitat** during a given time period.



- 48. Define the term "competition" in terms of ecological interaction.**
- Direct **inhibition of a particular species** by the other
  - **Birds compete with squirrels** for nuts and seeds.
- 49. What is commensalism?**
- This is the interaction in which **one species benefits and the other is neither harmed nor benefited.**
- 50. What is mutualism?**
- This interaction confers **benefits on both the interacting species/both the organisms are benefited.**  
E.g : Relationship between **crocodile and birds**
- 51. What is the meaning of "carrying capacity"?**
- In nature, a given habitat has **enough resources to support a maximum possible number**, beyond which no further growth is possible
- 52. What is ammensalism?**
- In amensalism the most powerful animal or **large organisms inhibits the growth of other lower organisms**
- 53. People living in higher altitudes have higher RBC count. Give reasons**
- Due to low atmospheric pressure at higher altitudes body compensates **low oxygen availability by increasing red blood cell production**, decreasing the binding affinity of hemoglobin and by increasing breathing rate.
- 54. Write a note on suspend.**
- **Suspend:** In certain conditions, if the organisms is unable to migrate, it may avoid the stress by becoming inactive.
  - This is seen commonly in bears going into **hibernation** during winter.
  - Some snails and fish go into **aestivation** to avoid summer related problems like heat and desiccation.
  - Some lower animals suspend a certain phase of their life cycle, which is referred to as **diapause**.
- 55. List the adaptation seen in animals for cold climate.**
- Mammals from colder climates generally have **shorter ears and limbs to minimize heat loss.**
  - **Seals of polar aquatic seas** have a thick layer of fat called blubber below their skin that acts as insulator and reduces loss of body heat.
- 56. What are the symptoms of altitude sickness?**
- Symptoms developed are nausea, fatigue and heart palpitations.
- 57. Mention the four basic processes, because of which density of a population in a given habitat during a given period, fluctuates.**
- **Natality, Mortality, Immigration, Emmigration.**
- 58. When and why do some animals like snails undergo aestivations?**
- Summer. To survive from heat to avoid desiccation.
- 59. What are the four ways through which the living organisms respond to abiotic factors?**
- **Regulate**
  - **Conform**
  - **Migrate**
  - **Suspend**
- 60. Bear hibernates whereas some species of zooplankton enter diapause to avoid stressful external conditions. How are these two ways different from each other?**
- **Bears suppress their metabolic activity in winter** and avoid stressful conditions in winter, where as **zooplanktons suspend their development** during unfavorable conditions.
- 61. What is the significant of age pyramids? List the different types of age pyramids.**
- The shape of the pyramids **reflects the growth status** of the population.  
E.g : **growing, stable** or **declining population.**

**PART –C**

**ADDITIONAL QUESTIONS (3 MARKS)**

**1. How Temperature affect an organisms ?**

- Temperature or **degree of hotness and coldness** is an essential and variable factor in any environment.
- It influences all forms of life by affecting many vital activities of organisms like **metabolism, behaviour, reproduction, development and even death in the Biosphere.**
- In many organisms, **determination of sex and sex ratio, maturation of gonads, gametogenesis** and reproduction is influenced by temperature.

**2. What are the advantage of Eurythersms?**

- Organisms which **can survive a wide range of temperature** are referred to as **Eurytherms**  
**E.g : cat, dog, tiger, human**

**Advantages :**

- **Adaptations to cold temperatures** are seen as essential for the survival of species during ice ages.
- In addition, the **ability to survive in a wide range of temperatures** increases a species' ability to inhabit other areas, an advantage for natural selection.
- Eurythermy is an aspect of **thermoregulation in organisms.**

**3. List out the influence of light on organisms.**

- Light influences **growth, pigmentation, migration and reproduction.**
- The intensity and frequency of light influences **metabolic activity, induce gene mutations** (UV, X- rays).
- **Diapause is also influenced** by light in animals.
- Gonads of birds become **more active with increasing light in summer.**
- Light influences the **locomotion and movement** of lower animals.

**4. Classify tropical forests.**

Based on the seasonal distribution of rainfall, the types of tropical forests are

- I. **Evergreen rainforest:** no dry season.

II. **Seasonal rainforest:** short dry period in a very wet tropical region.

III. **Semi evergreen forest:** longer dry season (the upper tree storey consists of deciduous trees, while the lower storey is still evergreen).

IV. **Moist/dry deciduous forest (monsoon):** the length of the dry season increases further as rainfall decreases (all trees are deciduous).

**5. What are the types of temperate forests?**

- Based on seasonal distribution of rainfall, the types of temperate forests are

I. **Moist conifer and evergreen broad-leaved forests:**

Wet winters and dry summers.

II. **Dry conifer forests:**

Dominate higher elevation zones; low precipitation.

III. **Mediterranean forests:**

Precipitation is concentrated in winter (<1000 mm /year).

IV. **Temperate coniferous forests:**

Mild winters, high annual precipitation (> 2000 mm /year).

V. **Temperate broad-leaved rainforests:**

Mild, frost-free winters, high precipitation (> 1500 mm/year), evenly distributed throughout the year.

**6. Write a note on temperature as abiotic factor.**

- Temperature is the most **ecologically relevant ecological factor.**
- Temperature affects the **kinetics of enzymes, BMR** (Basic Metabolic Rate) and other physiological actions in organisms.
- **Eurythermal:** A few organisms which **can tolerate wide range of temperatures.** They are called eurythermal organisms.
- **Stenothermal:** Many organisms which **can tolerate narrow range of temperatures** are called stenothermal organisms.

**7. Write a note on water as abiotic factor.**

- Life is originated in water and it is **unsustainable without water.**
- The productivity and distribution of **plants is also heavily dependent on water.**

- For aquatic organisms, the quality (**chemical composition, pH**) is very important.
- **Euryhaline** : The organisms which **can tolerate wide range of salinity** are called euryhaline organisms.
- **Stenohaline** : The organisms which **can tolerate narrow range of salinity** stenohaline organisms.

**8. How do organisms cope with stressful external environmental conditions which are localized or for short duration?**

If the stressful external environmental conditions which are localized or for short duration, the animals have two options.

**Migrate:**

- Organisms **tend to move away temporarily from a stressful habitat** to a new, hospitable area and return when the stressful period is over.
- Birds **migrate from Siberia to Vedanthangal in Tamilnadu** to escape from the severe winter periods.

**Suspend:**

- In certain conditions, if the **organisms is unable to migrate, it may avoid the stress** by becoming inactive.
- This is seen commonly in bears going into **hibernation** during winter.
- Some snails and fish go into **aestivation** to avoid summer related problems like heat and desiccation.
- Some lower animals suspend a certain phase of their life cycle, which is referred to as **diapause**

**PART –D**

**ADDITIONAL QUESTIONS (5 MARKS)**

**1. List out the Essential properties of water**

- ◆ Water is one of the main **agents in Pedogenesis** 6 (soil formation).
- ◆ It is the **medium for different ecosystems**.
- ◆ **Water is heavier than air** and imparts **greater buoyancy** to the aquatic medium.
- ◆ Water has **high heat capacity and latent heat**, due to which it can withhold large amounts of heat.

- ◆ **Water is physically unique** because it is less dense as a solid (ice) than as a liquid.
- ◆ **Water freezes at 0°C**, (contracts)
- ◆ The **maximum density of liquid water occurs at 4°C**.
- ◆ Water is considered as the **Universal solvent**.
- ◆ It is the **main medium by which chemical constituents are transported**
- ◆ Water has **high surface tension**.

**2. List out the characteristics of tundra.**

- **Extremely cold climate**
- **Low biotic diversity**
- **Simple vegetation structure**
- **Limitation of drainage**
- **Short season of growth and reproduction**
- **Energy and nutrients** in the form of dead organic material
- **Large population oscillations**

**3. Write short notes on taiga biome.**

- It is **1300-1450 km wide zone** south of the Tundra.
- This area has **long and cold winters**.
- Summer temperature ranges from **10° C to 21° C**.
- Precipitation ranges about **380-1000 mm annually**.
- Plant of taiga biome : **spruce, fir and pine**.
- This is a major **source for the logging industry**.
- It has herbivorous animal like **moose, elk, deer and reindeer**.
- It also has herbivorous **squirrels, snowshoe hare and predatory pine martens**.
- It has predators like **timber wolf, grizzly bear, black bear, bobcat and wolverines**.

**4. List out the characters of grassland biome.**

- Grasslands **occur in temperate and in the tropical regions**.
- They have **hot summers, cold winters**, and irregular rainfall.
- Often they are **characterized by high winds**.

- The **low irregular rainfall** is the factor which makes the difference between a temperate deciduous forest and a temperate grassland.
- Herbivores like **antelope, bison, wild horse, jack rabbit, ground squirrel and prairie dogs** are abundant.
- Predators include **coyotes, foxes, hawks and snakes**.
- In India, fauna of grasslands includes **Elephant, Gaur, Rhino, Antelope**.
- Flora of grasslands include **purple needle grass, wild oats, foxtail, ryegrass and buffalo grass**.

**5. What are the characteristics feature of Alpine biome?**

- The alpine zone includes, **a sub-snow zone immediately below the snow zone, a meadow zone in the centre and a shrub zone** which gradually merges into the timber zone.
- Alpine zone exists at a **height of 3600m**.
- The zone above the limits of tree growth (timber line) **exhibits extreme environmental conditions which greatly influence the biota of this region**.
- Alpine zone of Himalayas is **characterized by sparseness of animal groups**.
- Many invertebrates of alpine zone are **predatory** and occur in lakes, streams and ponds.
- **Reptilian fauna is greatly impoverished**.
- Flora of alpiners includes **alpine phacelia, bear grass, bristlecone pine, moss campion, polylepis forest, pygmy bitterroot, and wild potato**.

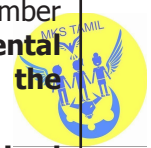
**6. List out the characteristics feature of Tropical forest.**

- They **occur near the equator** (between latitudes 23.50 at north and 23.50 at south).
- The major characteristic of tropical forests is their **distinct seasons**.
- Only two seasons are present (**rainy and dry**).
- **Winter is absent**.
- The length of **daylight is about 12 hours** and varies little.

- The average annual temperature - **200°C and 250°C**.
- Precipitation is **evenly distributed throughout the year** with annual rainfall exceeding 2000 mm.
- **Soil is nutrient-poor and acidic**.
- **Decomposition is rapid** and soils are **subject to heavy leaching**.
- **Tree cover is multilayered and continuous**, allowing little light penetration.
- **Flora is highly diverse:** 100 different tree species /one square kilometer
- Trees are **25-35 mt** all, with **buttressed trunks and shallow roots, mostly evergreen**, with large dark green leaves.
- Common vegetation are **orchids, bromeliads, vines (lianas), ferns, mosses, and palms**.
- They are characterized by **birds, bats, small mammals, and insects**.

**7. List out the characteristics feature of Temperate forest.**

- These forests occur in eastern North America, northeastern Asia and western and central Europe.
- Have well-defined seasons with a distinct winter.
- Moderate climate and a growing season of 140-200 days during 4-6 frost- free months distinguish temperate forests.
- Annual temperature varies from -30°C to 30°C.
- Precipitation (750-1500 mm) is distributed evenly throughout the year.
- Soil is fertile, enriched with decaying litter.
- Canopy is moderately dense and allows light to penetrate, resulting in well-developed and richly diversified understorey vegetation and stratification of animals.
- Flora is characterized by 3-4 tree species per km<sup>2</sup>.
- Trees have broad leaves that are lost annually such as oak, hickory, beech, hemlock, maple, basswood, cottonwood, elm, willow, and spring-flowering herbs.
- Fauna consists of squirrels, rabbits, skunks, birds, deer, mountain lion, 5bobcat, timber wolf, fox, and black bear.



**8. List out the characters of Desert biomes.**

- Deserts cover about **one fifth of the earth's surface**
- Rainfall is **>500 mm/year**.
- Rainfall is usually **very low and/or concentrated in short bursts** between long rainless periods.
- **Evaporation rates regularly exceed rainfall rates.**
- Soils are **course-textured, shallow, rocky or gravely** with good drainage and have no subsurface water.
- The **finer dust and sand particles are blown** elsewhere, leaving heavier pieces behind.
- **Sand mounds** are common.
- Average annual temperatures range from **20-25° C**.
- **Maximum range - 43.5 - 49° C.**
- **Minimum range -18° C.**
- Based on the temperature range, deserts can be **Hot deserts and Cold deserts.**
- **Soils often have abundant nutrients** because they need only water to become very productive and have little or no organic matter.
- Animals which **capable of storing sufficient water and withstand the heat** can survive in the desert.
- The mean annual precipitation ranges from **150- 250 mm**.
- The soil is **heavy, silty and salty**.
- Widely distributed animals are **jack rabbits, kangaroo rats, kangaroo mice, pocket mice, grasshopper mice, antelope and ground squirrels.**

**9. What are the Adaptations of aquatic animals?**

1. The **pectoral fins and dorsal fins act as stabilizers or balancers** and the caudal fin helps in changing the direction as a rudder.

2. Arrangement of body muscles in the form of **bundles (myotomes) help in locomotion.**
3. **Stream lined structure helps in the swift movement** of the animals in water.
4. **Respiration by gills** making use of gases dissolved in water.
5. **Presence of air-bladders** filled with air for buoyancy.
6. Presence of **lateral-line system.**
7. They function as **rheo receptors which is helpful in echolocating** objects in water.
8. Integuments rich in **mucous glands are protected by scales.**
9. **Maintain water and ionic balance** in its body with excretory structures.

**10. List out the Differences between r- selected and K selected species.**

r selected species	K selected species
<b>Smaller sized organisms.</b>	<b>Larger sized organisms.</b>
Produce <b>many offspring.</b>	Produce <b>few offspring.</b>
<b>Mature early.</b>	<b>Late maturity</b> with extended parental care.
<b>Short life expectancy.</b>	<b>Long life expectancy.</b>
Each individual <b>reproduces only once or few times</b> in their life time.	<b>Can reproduce more than once in lifetime.</b>
<b>Only few reach adulthood.</b>	<b>Most individuals reach maximum life span.</b>
<b>Unstable environment, density independent.</b>	<b>Stable environment, density dependent.</b>



11. Analysis of two species population interactions

S. No.	TYPES OF INTERACTION	SPECIES 1	SPECIES 2	GENERAL NATURE OF INTERACTION	EXAMPLES
1	<b>Amensalism</b>	--	0	The most powerful animal or <b>large organisms inhibits the growth of other</b> lower organisms.	<b>Cat and Rat.</b>
2	<b>Mutualism</b>	+	+	<b>Interaction favorable to both</b> and obligatory.	<b>Between crocodile and bird.</b>
3	<b>Commensalism</b>	+	0	<b>Population 1, the commensal benefits, while 2 the host is not affected.</b>	<b>Sucker fish on shark.</b>
4	<b>Competition</b>	--	--	<b>Direct inhibition of each species</b> by the other.	<b>Birds compete with squirrels</b> for nuts and seeds.
5	<b>Parasitism</b>	+	--	<b>Population 1, the parasite, generally smaller than 2, the host.</b>	<b>Ascaris and tapeworm</b> in human digestive tract.
6	<b>Predation</b>	+	--	<b>Population 1, the predator, generally larger than 2, the prey.</b>	Lion predatory on deer.

12. Write short notes on Population Interaction

- Organisms belonging to different populations **interact for food, shelter, mating or for other necessities.**
- Interaction may be **intra specific** (interaction within the members of same species) or **inter specific** (among organisms of different species).
- Intra specific association is observed for all livelihood processes like **feeding, territoriality, breeding and protection.**
- Interspecific associations or interactions can be:
  - Neutral:**
    - Where different species **live together but do not affect** each other.
  - Positive:**
    - It is a **symbiotic relationship in which no organism in association is harmed** and either one or both may be benefitted.



- It is of two types **Mutualism and Commensalism.**

**Negative:**

- One or both of the **interacting organisms will be affected** as in case of **competition, predation, parasitism.**

13. Differentiate between the following inter-specific interactions in a population:

- i) Mutualism and Competition**
- ii) Commensalism and Amensalism**

**Ans :**

- i) In mutualism **both the species benefit = 1**  
In competition - **survival of both challenged / struggle for existence = 1**
- ii) Commensalism **One is benefitted.** The other is **neither benefitted nor harmed = 1**  
Amensalism – **One is harmed and the other is unaffected = 1**

**14. What is altitude sickness? What its causes and symptoms? How does human body try to overcome altitude sickness?**

**Breathlessness at high altitudes is known as altitude sickness.**

**Cause :**

**Low atmospheric pressure** at high altitudes due to which body does not get enough oxygen.

**Symptoms:**

**Nausea, fatigue and heart palpitations.**

**Body adapts by:**

- a) Increasing **red blood cell production**
- b) **Decreasing binding affinity of haemoglobin**
- c) **By increasing breathing rate.**

**15. Name the type of interactions seen in each of the following examples:**

- a) Ascaris worms living in the intestine of Human - **Parasitism**
- b) Wasp pollinating fig inflorescence - **Mutualism**
- c) Clown fish living among the tentacles of Sea anemone - **Commensalism**
- d) Mycorrhizae living on the roots of higher plants - **Mutualism**
- e) Orchid growing on the branch of a Mango tree.- **Commensalism**



## POINTS TO REMEMBER

- Biodiversity is the **variety of all life on Earth**, encompassing genetic, species and ecosystem diversity.
- Today's biodiversity is the **fruit of billions of years of evolution, shaped** by natural processes and, increasingly, by the influence of humans.
- The survival of human race depends on the **existence and wellbeing of all life forms** in the biosphere.
- The term biodiversity was introduced by **Walter Rosen**.
- **Edward Wilson** popularized the term 'Biodiversity'.
- Three levels of biodiversity - **Genetic diversity, Species diversity and Community/Ecosystem diversity**.
- **Genetic diversity** refers to the differences in genetic make-up between distinct species.
- India has more than **50,000 genetic variants of Paddy** and **1000 variants of Mango**.
- **Species diversity** refers to the **variety in number and richness** of the species in any habitat.
- The three types of species diversity are - **Alpha, Beta and Gamma diversity**
- **Alpha diversity** - It is measured by **counting the number of taxa** within a particular area or ecosystem.
- **Beta diversity**: It is **species diversity between two adjacent ecosystems** and is obtained by comparing the number of species unique to each of the ecosystem.
- **Gamma diversity** refers to the **diversity of the habitats over the total landscape or geographical area**.
- **Ecosystem diversity** is the **variety of habitats, biotic communities, and ecological processes** in the biosphere.
- India has a variety of ecosystems, biomes with its varied habitats like, **hills, valleys, plateaus, sea shores, mangroves, estuaries, glaciers, grasslands and river basins**.
- India is one of the **17 mega biodiversity countries** of the world
- **Temperature, precipitation, distance from the equator, altitude from sea level** are some of the factors that determine biodiversity distribution patterns.
- The relationship between species richness and area for a wide variety of taxa (**angiosperm plants, birds, bats, freshwater fishes**) turned out to be the rectangular hyperbola.
- The importance of biodiversity can be viewed and measured as **a) Ecosystem services b) Biological resources c) Social benefits of biodiversity**.
- India can be divided into ten different biogeographic zones, namely:
  - **Trans Himalayan Region** - An extension of the **Tibetan plateau, high-altitude cold desert in Ladakh (J&K) and Ladhak Spiti (H.P)** comprising **5.7% of the country's landmass**.
  - **Himalayas** - The entire mountain chain running from north-western to north-eastern India, comprising a diverse range of biotic provinces and biomes and covers **7.2% of the country's landmass**.
  - **Indian Desert**: The extremely arid area west of the Aravalli hill range, comprising both the **salty desert of Gujarat and the sand desert of Rajasthan**.
  - **Semi – Arid Zones** - This zone is between the desert and the Deccan plateau, including the **Aravalli hill range covering 15.6% of the country's landmass**.
  - **Western Ghats** - Western Ghats are mountain ranges along the **west coast of India, extending over almost 1,500km** from Satena in south Gujarat to the southern most tip of Kerala.

- **Deccan Peninsula** - This covers much of the **southern and south-central plateau** with a predominantly deciduous vegetation and **4.3% of the country's landmass**.
  - **Gangetic Plains:** These plains are relatively homogeneously defined by the **Ganges river system and occupy about 11% of the country's landmass**.
  - **North-East India:** The **plains and non-Himalayan hill ranges** of north eastern India are home to a wide variety of vegetation.
  - **Coastal Region:** Coastal region of India with **sandy beaches, mud flats, coral reefs, mangroves constitutes 2.5% of the total geographical area**.
  - **Andaman and Nicobar Islands** - The Andaman and Nicobar Islands in the **Bay of Bengal have highly diverse set of biomes, constituting 0.3% of the total geographical area**.
  - **Threats to biodiversity** Even though India is one of the **17 identified mega diverse countries of the world, it faces lots of threats to its biodiversity**.
  - Fragmentation and degradation due to **agricultural practices, extraction and development** leads to habitat loss
  - The major causes for biodiversity decline are:
    - Habitat loss, fragmentation and destruction, Pollution and pollutants, Climate change ,etc.,
    - The Amazon rainforest, a vast area, **harbouring millions of species**, also called "**Lungs of the planet**" is destroyed and being replaced for agriculture and human settlements.
    - **Kodaikanal and Nilgiri hills** of Tamil Nadu have been destroyed rapidly for human occupancy.
    - Excessive exploitation of a species, **reduces the size of its population** to such a level that it becomes vulnerable to extinction.
    - **Dodo, passenger pigeon and Steller's sea cow** have become extinct in the last 200-300 years due to over exploitation by humans.
    - Overfishing due to population **pressure leads to many marine fish declining** around the world.
    - Exotic species are organisms **often introduced unintentionally or deliberately for commercial purpose**, as biological control agents and other uses.
    - Exotic species have proved **harmful to both aquatic and terrestrial ecosystems**.
- E.g : Amazon sailfin catfish** is responsible for destroying the fish population in the wetlands of Kolkata.
- **African apple snail** (*Achatina fulica*) is the most invasive among all alien fauna in India.
  - This **mollusc was first reported** in the Andaman and Nicobar Islands.
  - **Industrialization is a major contributor to climate change** and a major threat to biodiversity.
  - In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2-3 seasons, after which their **fertility reduces to a point where crop production is no longer profitable**.
  - Extinction of one will automatically cause extinction of the other known as **Co-extinction**
  - **Pollutants and pollution** are a major cause for biodiversity loss.
  - There is a tendency to **grow economically important and viable trees** like Teak, Sandal, Oak, Sal in forests resulting in loss of other forest trees.
  - These include **spontaneous jungle fires, tree fall, land slide, defoliation by insects or locust attack**.
  - **Human activities greatly contribute** to the loss of biodiversity.
  - Direct human activities like change in **local land use, species introduction or removal, harvesting, pollution and climate change** contribute a greater pressure on loss of biodiversity.
  - Indirect human drivers include **demographic, economic, technological, cultural and religious factors**.
  - **Monsoon failure, global warming, depletion in ozone layer, landslides in hilly states, pollution** are a few indirect effects of human activities which results in the loss biodiversity.
  - Hotspots are areas characterized with **high concentration of endemic species experiencing unusual rapid rate of habitat modification loss**.
  - Norman Myers defined hot spots as "**regions that harbour a great diversity of endemic species and at the same time, have been significantly impacted and altered by human activities.**"

- There are **35 biodiversity hotspots in the world. India is home to four biodiversity hotspots.**
- They are **Himalaya, Western Ghats, Indo-Burma, Sundalands.**
- A species that has been categorized as **very likely to become extinct is an Endangered species.**
- There are three types of Extinctions - **Natural extinction , Mass extinction ,Anthropogenic extinctions.**
- **Amphibians seem to be at higher risk of extinction** because of habitat destruction.
- The International Union for Conservation of Nature (**IUCN**) is an organization working in the field of **nature conservation and sustainable use of natural resources.**
- **Red Data book or Red list** is a catalogue of taxa facing risk of extinction.
- The concept of **Red list was mooted in 1963.**
- Red list has eight categories of species  
**i) Extinct ii) Extinct in wild iii) Critically Endangered iv) Endangered v) Vulnerable vi) Lower risk vii) Data deficiency viii) Not evaluated.**
- **Conservation of biodiversity is protection and scientific management of biodiversity** so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations.
- There are two aspects of conservation strategies - In-situ **conservation & Ex-situ conservation.**
- In-situ **Conservation** is Conservation in the natural habitat.
- This is the conservation of genetic resources through their protection within a **natural or manmade ecosystem in which they occur.**
- Protected areas are **biogeographical areas where biological diversity** along with natural and cultural resources is protected, maintained and managed through legal measures.
- India has about **771 protected areas** covering 162099 km<sup>2</sup> comprising of **National Parks (104), Wild Life Sanctuaries (544),** biosphere reserves and several sacred groves.
- The Government of India launched the '**Project Tiger**' in **1973** to protect our national animal.
- From **9 tiger reserves since its inception,** the Project Tiger coverage **has increased to 50 at present.**
- **National Parks (NP)** - It is a natural habitat that is notified by the state government to be constituted as a National Park due to its **ecological, faunal, floral, geomorphological, or zoological association** of importance.
- There are **104 existing national parks** in India covering an area of **40,501 km<sup>2</sup>,** which is **1.23% of the geographical area of the country.**
- National Park is an area which is **strictly reserved for the betterment of wildlife and biodiversity** and where activities like **development, forestry, poaching, hunting, grazing and cultivation are not permitted.**
- **Wild Life Sanctuaries** - Any area other than the area comprised with **any reserve forest or the territorial waters can be notified by the State Government** to constitute as a sanctuary if such area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance.
- **Biosphere Reserve (BR)** is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of **terrestrial or coastal/ marine ecosystems or a combination thereof.**
- There are **18 Biosphere Reserves in the country.** **Agasthyamalai** (Karnataka - Tamil Nadu - Kerala), **Nilgiri** (Tamil Nadu - Kerala), **Gulf of Mannar** (Tamil Nadu) are the BRs notified in Tamil Nadu.
- **A sacred grove or sacred woods** are any grove of trees that are of special religious importance to a particular culture.
- Sacred groves **feature in various cultures** throughout the world.
- Ex-Situ **Conservation** is **conservation of selected rare plants/ animals in places outside their natural homes.** It includes offsite collections and gene banks.
- **Offsite Collections-** They are **live collections of wild and domesticated species in Botanical gardens, Zoological parks, Wildlife safari parks, Arborata (gardens with trees and shrubs).**
- Gene banks are a **type of bio repository** which preserve genetic materials.





**13. Name the active chemical found in the medicinal plant Rauwolfia vomitoria. What type of diversity it belongs to?**

- **Reserpine** is the active chemical found **Rauwolfia vomitoria**.
- It belongs to **genetic diversity**.
- Genetic diversity helps to **develop adaptations**.

**14. "Amazon forest is considered to be the lungs of the planet"-Justify this statement.**

- Amazon covers a vast area, and sheltering millions of species.
- **More over it has numerous plants which involve in reduction of CO<sub>2</sub> by photosynthesis**, hence it is called as "Lungs of the planet"

**15. 'Red data book'-What do you know about it?**

- Red Data book or Red list is a **catalogue of taxa facing risk of extinction**.
- Red Data book is maintained by **WCU – World Conservation Union** (early known as **IUCN – International Union of Conservation of Nature and Natural Resources**)
- The concept of Red list **was suggested in 1963**.

The purpose of preparation of Red List are:

1. **To create awareness** on the degree of threat to biodiversity.
  2. **Identification and documentation** of species at high risk of extinction.
  3. **Provide global index** on declining bio diversity.
  4. Preparing conservation priorities and **help in conservation of action**.
  5. Information on **international agreements on conservation** of biological diversity
- **Red list has eight categories of species**  
 i) Extinct ii) Extinct in wild iii) Critically Endangered iv) Endangered v) Vulnerable vi) Lower risk vii) Data deficiency viii) Not evaluated.

**16. Extinction of a keystone species led to loss of biodiversity – Justify.**

- Keystone species is a species that has a **excessively large effect on its natural environment to its abundance**.

- Keystone species is an organism that **helps define an entire ecosystem**.

- **Extinction of a keystone species leads to the extinction of another/cease another organisms.**

**E.g : orchid bees** and forest trees by cross pollination

- Extinction of one will automatically cause extinction of the other.

**E.g : Dodo** in Mauritius Island

- There is a direct relationship between **Calvaria tree and the extinct bird of Mauritius Island, the Dodo**.

- The Calvaria tree is **dependent on the Dodo bird** for completion of its life cycle.

- **Tough horny endocarp of the seeds of Calvaria tree are made permeable by the actions of the large stones in birds gizzard and digestive juices** thereby facilitating easier germination.

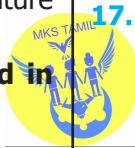
- The **extinction of the Dodo bird led to the extinction of Calvaria tree**.

**17. Compare and Contrast the insitu and exsitu conservation.**

Insitu Conservation	Exsitu Conservation
1. It is the <b>on-site conservation</b> of plant or animal species.	1. It is a conservation of threatened animals and plants in <b>special care locations</b> .
2. It is the process of <b>protecting an endangered plant or animal species in its natural habitat</b> .	1. It helps in recovering populations or <b>preventing their extinction under simulated conditions</b> .
<b>E.g : National Parks, Biosphere Reserve</b>	<b>E.g : Zoological parks and Botanical gardens</b>

**18. What are called endangered species? Explain with examples.**

- A species that are **likely to become extinct in future** are known as Endangered species.
- Endangered species are categorized by **IUCN**  
**E.g : Dodo bird, orchid bees, Sparrow, White tiger.**



### 19. Why do we find a decrease in biodiversity distribution, if we move from the tropics towards the poles?

#### Reason for decrease in biodiversity distribution in polar region :

1. **Very harsh (too cold)** conditions prevail for most of the year in polar regions that will reduce bio diversity.
2. Organisms need a range of **temperatures between 25°C to 35°C**, for most of the metabolic activities, which is absent in polar region
3. **Climate, seasons, temperature, humidity, photoperiods** are not support the growth of variety of organism.

### 20. What are the factors that drive habitat loss?

- Mining
- Construction of highways
- Over population
- Urbanization, industrialization
- Agricultural advancements
- Filling wetlands
- Ploughing grasslands
- Cutting down trees
- Deforestation
- Caving mountains
- Changing the course of rivers and filling of seashore.

### 21. Where are biodiversity hotspots normally located? Why?

- Hotspots are located in areas where **high concentration of endemic species** experiencing **unusual rapid rate of habitat modification loss**.

### 22. Why is biodiversity so important and worthy of protection?

- Biodiversity is essential for **stability of an ecosystem**.
- Biodiversity serves as **source of food and provides source material** for new improved varieties.
- Biodiversity has **scientific value also**, as different animal species are used **for biological and medical research**.

- **Various products** of human use can be obtained from rich biodiversity.

**E.g :** gums, resins, dyes, paper, fibres, etc.

- Variety of **plant species provide innumerable drugs and medicines**.

**E.g :** Morphine, Quinine,

### 23. Why do animals have greater diversification than plant diversity?

- ❖ Plants are **self dependent (Autotroph)** for their nutrition so there is no need of variation and adaptation by the plant, this lead to the **limited diversity in plant**.
- ❖ Plant can **withstand in any kind of environment condition** but animal need adaptation to suit different environment.
- ❖ This also result in **more diversity in animal than plants**.

### 24. Alien species invasion is a threat to endemic species – substantiate this statement.

- Exotic species are organisms often **introduced unintentionally or deliberately** for commercial purpose, as biological control agents and other uses.
- They often become **invasive and drive away the local species** and is considered as the second major cause for extinction of species.
- Exotic species have proved **harmful to both aquatic and terrestrial ecosystems**.
- **E.g Tilapia fish (Jilabi, kendai) (Oreochromis mosambicus)** introduced from South Africa for its high productivity into Kerala's inland waters, became invasive, due to which the native species such as **Puntius dubius and Labeo kontius face local extinction**.
- **Amazon sailfin catfish** is responsible for destroying the fish population in the wetlands of Kolkata.
- **African apple snail (Achatina fulica)** is the most invasive among all alien fauna in India.
- **Papaya Mealy Bug (Paracoccus marginatus)** is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and TamilNadu.



**25. Mention the major threats to biodiversity caused by human activities. Explain.**

- **India is one of the 17 identified mega diverse countries** of the world, but it faces lots of threats to its biodiversity.
- Apart from natural causes, **human activities, both directly and indirectly** are today's main reason for habitat loss and biodiversity loss.
- Fragmentation and degradation due to **agricultural practices, extraction** (mining, fishing, logging, harvesting) **and development** (settlements, industrial and associated infrastructures) leads to **habitat loss and fragmentation** leads to formation of isolated, small and scattered populations and as endangered species.
- Some of the other threats include **specialised diet, specialized habitat requirement, large size, small population size, limited geographic distribution and high economic or commercial value.**
- **Large mammals by virtue of their size require larger areas** to obtain the necessities of life - food, cover, mates than do smaller mammals.

**E.g : Single Lion need about 100 square Km.**



**26. What is mass extinction? Will you encounter one such extinction in the near future. Enumerate the steps to be taken to prevent it.**

- The **extinction of large number of species** within a short period of time is known as **mass extinction**.
- In the 450 million years of life on Earth, there had been 5 mass extinctions, which had eliminated at least 50% of the species of flora and fauna on the globe.
- The extinction of species is mainly due to drastic environmental changes and population characteristics.
- Extinctions are three types. It include,
- **Mass extinction:** The earth has experienced quite a few mass extinctions due to environmental catastrophes.
- A mass **extinction occurred about 225 million years ago** during the Permian, where 90% of shallow water marine invertebrates disappeared.

**27. In north eastern states, the jhum culture is a major threat to biodiversity – substantiate.**

- In shifting cultivation, plots of **natural tree vegetation are burnt away** and the cleared patches are farmed for 2-3 seasons, after which their **fertility reduces to a point where crop production is no longer profitable.**
- The farmer then **abandons this patch and cuts down a new patch of forest trees** elsewhere for crop production.
- This system is practiced in **north-eastern regions of India.**
- When vast areas are cleared and burnt, it **results in loss of forest cover, pollution and discharge of CO<sub>2</sub>** which in turn attributes to loss of habitat and climate change which has **an impact on the faunal diversity of that regions.**

**28. List out the various causes for biodiversity losses.**

**The major causes for reduction in biodiversity are:**

1. **Habitat loss, fragmentation and destruction** (affects about 73% of all species)
2. **Pollution and pollutants** (smog, pesticides, herbicides, oil slicks, GHGs)
3. **Climate change**
4. Introduction of **alien/exotic species**
5. **Over exploitation of resources** (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
6. **Intensive agriculture and aqua cultural practices**
7. **Hybridization** between native and non-native species and loss of native species
8. **Natural disasters** (Tsunami, forest fire, earth quake, volcanoes)
9. **Industrialization, Urbanization, infrastructure development, Transport, communication towers, dam construction, unregulated tourism** are areas of specific threats
10. **Co-extinction**

**29. How can we contribute to promote biodiversity conservation?**

We can conserve biodiversity by

1. **Identify and protect** all threatened species
2. Identify and conserve in protected areas the wild relatives of all the **economically important organisms**
3. Identify and protect critical habitats for **feeding, breeding, nursing, resting of each species**
4. **Resting, feeding and breeding places** of the organisms should be identified and protected.
5. **Air, water and soil should be conserved** on priority basis.
6. **Wildlife protection** act should be implemented.

**30. Stability of a community depends upon its species diversity' Justify the statement.**

- Communities with **more species tend to be more stable** than those with less species as it is able to resist occasional disturbance.
- This has been confirmed experimentally by **David Tilman's**.
- He raised **plots with different diversities in Minnesota grassland** and subjected them various stresses.
- He found that **plots with more species showed less year to year variation** in total biomass.
- He also showed that in his experiments, increased diversity contributed to higher productivity.

**31. Write a note on**

**i) Protected areas, ii) Wild life sanctuaries, iii) WWF.**

**i) Protected areas :-**

- These are **biogeographical areas** where biological diversity along with natural and cultural resources is protected, maintained and managed through legal measures.
- Protected areas include **national parks, wild life sanctuaries, community reserves and biosphere reserves.**
- World Conservation monitoring centre has

recognized **37,000 protected areas world-wide.**

- India has about **771 protected areas covering 162099 km<sup>2</sup>** comprising of **National Parks (104), Wild Life Sanctuaries (544)**, biosphere reserves and several sacred groves.

**ii) Wild Life Sanctuaries (WLS):**

- Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government to **constitute as a sanctuary** if such area is of **adequate ecological, faunal, floral, geomorphological, natural or zoological significance.**
- This is for the purpose of **protecting, endangered factual species.**
- **Some restricted human activities are allowed inside** the Sanctuary area under Wildlife Protection Act (WPA) 1972.
- **Ecotourism is permitted**, as long as animal life is undisturbed.
- There are **544 existing wildlife sanctuaries in India** covering an area of 118,918 km<sup>2</sup>, which is **3.62 % of the geographical area of the country** (National Wildlife Database, 2017).
- Sanctuaries are tracts of land where **wild animals and fauna can take refuge** without being hunted or poached.
- **Collection of forest products, regulated harvesting of timber, private ownership of land** are also permitted.
- E.g Periyar wild life sanctuary in Kerala is famous for the Indian Tiger and Asiatic Elephant.

**iii) WWF**

**WWF – World Wide Fund for Nature**

- It is an **international non- government organization** founded in 1961, working in the field of the **wilderness preservation**, and the **reduction of human impact** on the environment.



**PART-A**

**ADDITIONAL QUESTIONS (1 MARK)**

- Which one is odd for species diversity ?  
 a) diversity                      b)  $\gamma$  diversity  
 c)  $\beta$  diversity                      d)  $\lambda$  diversity      **Ans : d**
- How many biosphere reserves are present in India ?  
 a) 41              b) 34              c) 18              d) 43  
**Ans : c**
- In which region of South America maximum species of birds can be found ?  
 a) Equador                      b) Brazil  
 c) Colombia                      d) Peru      **Ans : c**
- Which can be used for cryopreservation at 196°C temperature ?  
 a) liquid N<sub>2</sub>                      b) Free N<sub>2</sub>  
 c) liquid CO<sub>2</sub>                      d) Solid N<sub>2</sub>      **Ans : a**
- How many protected areas are present in India ?  
 a) 89              b) 771              c) 492              d) 34  
**Ans : b**
- Which type of relation is found in between richness of species and variety of phylum ?  
 a) Hyperbola                      b) Circular hyperbola  
 c) Rectangular hyperbola      d) Reciprocal  
**Ans : c**
- Which is the right option for national animal and bird of India ?  
 a) Peacock & Lion              b) Flamingo & Tiger  
 c) Peacock & Tiger              d) Flamingo & Lion  
**Ans : c**
- Which is the right sequence for Ecological diversity?  
 a) Biomes →habitat →Ecosystem → population  
 b) Biomes→ Ecosystem → habitat →niches  
 c) Biomes →Ecosystem →population →niches  
 d) Biomes → habitat →niches →Ecosystem  
**Ans : b**
- Where the knowledge of biodiversity is applicable ?  
 a) To study, classification of animals and plants  
 b) To study, Ecosystem  
 c) To study, Biogeological region  
 d) all the given      **Ans : d**

- Which information is correct for our country ?  
 a) India is one of the seventeen mega biodiversity countries of the world.  
 b) India comprises 2.4% biodiversity of world.  
 c) India contains more than 7 % plant species of world.  
 d) India stands at 7th rank in traditional crop varieties.  
**Ans : a**
- Species diversity is responsible for which phenomena?  
 a) process of Evolution  
 b) speciation  
 c) For alternative types (allele) of gene.  
 d) richness of the species in any habitat  
**Ans : d**
- Biodiversity of which organism is more in Eastern Ghat in comparison to Western Ghat ?  
 a) Reptilia                      b) Amphibian  
 c) Aves                      d) Mammals      **Ans : b**
- What is Ecosystem diversity ?  
 a) Similarity of species diversity in Ecosystem  
 b) Variation in species diversity in Ecosystem  
 c) Mutation in species diversity in Ecosystem  
 d) Homozygosity in species diversity in Ecosystem  
**Ans : b**
- How can the biodiversity can be conserved ?  
 a) By maintenance of different species  
 b) By maintenance of genes of different species  
 c) By maintenance of different Ecosystem  
 d) all of the given      **Ans : d**
- Which regions are included in Biodiversity Hot-spot?  
 a) Sanctuary                      b) National park  
 c) Only Hotspot                      d) all the given  
**Ans : a**
- For which animal sunderbans is declared as a National Park ?  
 a) Lion                      b) Rhino  
 c) Tiger                      d) Wild ass      **Ans : c**

- 17.** Among the recently extinct animal(2012) which is correct  
 a) 3079 animal                      b) 2079 animal  
 c) 7039 animal                      d) 9073 animal  
**Ans : a**
- 18.** Which reason is responsible for extinction of host fish and parasites.  
 a) co-extinctions  
 b) Alien species invasions  
 c) over exploitation  
 d) loss of habitat  
**Ans : a**
- 19.** Which organisation is active for conservation of biodiversity at world level ?  
 a) WWF                                  b) WCU  
 c) a and b both                      d) EE  
**Ans : c**
- 20.** Which statements are true?  
 1. At present there are 17 biosphere reserves in India.  
 2. Biospheres includes 3 zones.  
 3. Bandipur, Periyar, Kaziranga and Hazirabaugh are biosphere reserve  
 4. UNO has formulated the concept of biosphere reserve.  
 5. Core Zone is the inner most region of biosphere reserve.  
 a) 1, 2, 4                                  b) 3, 5, 2  
 c) 1, 3, 4, 5                              d) 1, 2, 5  
**Ans : d**
- 21.** Find odd one out :-  
 a) Project Elephant                  b) Tiger Project  
 c) Gir Lion Project                    d) Project Wild ass  
**Ans : d**
- 22.** Which one is correct for individual of the same species ?  
 a) Population                          b) Biotic Community  
 c) Ecosystem                            d) All the given  
**Ans : a**
- 23.** Which animal is endemic to Indian desert?  
 a) Flamingo                              b) Painted Frog  
 c) Wild ass                                d) Spring tailed Lizard  
**Ans : c**
- 24.** Animals and plants are used as a food that means.....  
 a) Destruction value of biodiversity  
 b) Utility value of biodiversity  
 c) Ecosystem services  
 d) all the given  
**Ans : a**
- 25.** Which is the example of ex-situ conservation ?  
 a) National park                      b) Sanctuary  
 c) Biosphere reserve                d) Zoo  
**Ans : d**
- 26.** Which type of information is obtained form Red-List?  
 a) Red coloured fishes  
 b) Red eyed birds  
 c) Endangered plants and animals  
 d) Red coloured insects  
**Ans : c**
- 27.** Which is true for wild life conservation?  
 a) Hunting of prey  
 b) ex-situ conservation  
 c) In-situ conservation  
 d) b and c both  
**Ans : d**
- 28.** Which is the main cause of extinction of wild life ?  
 a) Destruction of habitat  
 b) Hunting for flesh  
 c) Pollution of medicine and water  
 d) All the given  
**Ans : a**
- 29.** At which place animals and plants are most protected?  
 a) Botanical gardens                b) National Park  
 c) Zoos                                    d) Sanctuary  
**Ans : b**
- 30.** For which animal Gir National Park is famous ?  
 a) Tiger                                    b) Asiatic Lion  
 c) Leopard                                d) Deer  
**Ans : b**
- 31.** Which one is protected in national park ?  
 a) Micro organism                    b) Only plants  
 c) Plants and animals                d) None  
**Ans : c**
- 32.** What is called the biodiversity of different ecosystem of geographical area ?  
 a)  $\alpha$  diversity                      b)  $\delta$  – diversity  
 c)  $\beta$  diversity                            d)  $\gamma$  diversity  
**Ans : d**

- 33.** Which is the Hot spot of India ?  
 a) Gangatic plain                      b) Western Ghat  
 c) Eastern Ghat                         d) Arravali mountain  
**Ans : b**
- 34.** Which is included in types of biodiversity ?  
 a) Genes                                    b) Species  
 c) Ecosystem                            d) All the given  
**Ans : d**
- 35.** Which is the most appropriate method for conservation of wild life ?  
 a) Vaccination  
 b) Hybridization  
 c) conservation in natural habitat  
 d) Killing of predator  
**Ans : c**
- 36.** Where is the genes of rare plants species to stored ?  
 a) Gene bank                            b) Gene Library  
 c) Herberium                            d) none of them  
**Ans : a**
- 37.** Which is the Hotspot region ?  
 a) Region which is having volcanoes  
 b) Region which is having possibility of earth quake  
 c) Coastal region which is having species diversity  
 d) Region which is having Tsunami  
**Ans : c**
- 38.** MAB means .....  
 a) Man and biosphere programme  
 b) Mammal and biological programme  
 c) Mammal and biosphere programme  
 d) Men and biological programme  
**Ans : a**
- 39.** Who published Red-list?  
 a) WWF                      b) IUCN                      c) MAB                      d) IBWL  
**Ans : b**
- 40.** Which pair contains maximum diversity and endemic species in India ?  
 a) Sunderban and runn of Kutch  
 b) Eastern Ghat and West Bangal  
 c) East Himalaya and Western Ghat  
 d) Kerala and Punjab  
**Ans : c**

- 41.** Which number is correct for Indentified popular species ?  
 a) 1.1 to 1.1 million                      b) 0.5 to 1.0 million  
 c) 2.5 to 3.0 million                      d) 1.7 to 1.8 million  
**Ans : d**
- 42.** IUCN means .....  
 a) International union for conservation of nature and natural resources  
 b) Indian union for conservation of nature and natural resources  
 c) International union for conservation of nature and nutrients resources  
 d) Indian Union chemical nomenclature  
**Ans : a**
- 43.** In India, Western ghat is known as Hot-spot because of .....  
 a) Evergreen forest                      b) High endemism  
 c) More height                            d) Topical climate  
**Ans : b**
- 44.** What is important of gene diversity ?  
 a) Maintenance of species  
 b) Speciation  
 c) Research of genetic code  
 d) Maintenance and research of spices  
**Ans : b**
- 45.** What is called the biodiversity of habitat ?  
 a)  $\alpha$  diversity                            b)  $\beta$  diversity  
 c)  $\gamma$  diversity                            d) Biosphere  
**Ans : a**
- 46.** Which is the modern concept of conservation ?  
 a) Biosphere reserve                      b) sanctuary  
 c) National park                            d) Protected forest  
**Ans : a**
- 47.** Match the following:-
- | Column - 1        | Column - 2                   |
|-------------------|------------------------------|
| p) Assam          | i) Corbatt National Park     |
| q) Uttar Pradesh  | ii) Marine National Park     |
| r) Gujarat        | iii) Kaziranga National Park |
| s) Madhya Pradesh | iv) Kanha Patiala Park       |
- a) (p - i), (q - ii), (s - iii), (r - iv)  
 b) (r - i), (s - ii), (q - iii), (p - iv)  
 c) (s - i), (q - ii), (r - iii), (p - iv)  
 d) (q - i), (r - ii), (p - iii), (s - iv)  
**Ans : d**



48. Match the following:-

Column – 1	Column – 2
p) Biosphere reserve	i) Eastern Himalayan
q) Hot-spot	ii) Amazon
r) Biodiversity of Gujarat	iii) Great Nicobar
s) Greatest biodiversity	iv) Marine National Park

- a) (r - i), (p - ii), (s - iii), (q - iv)  
 b) (r - i), (q - ii), (p - iii), (s - iv)  
 c) (p - i), (r - ii), (q - iii), (s - iv)  
 d) (q - i), (s - ii), (p - iii), (r - iv)      **Ans : d**

49. Match the following:-

Column – 1	Column – 2
p) Endemic species	i) SpingTailedLizard
q) Alien species	ii) Nilgiri pipit
r) Habitat loss	iii) African cat fish
s) over exploitation	iv) Lion tailed Macaque

- a) (p - i), (q - ii), (r - iii), (s - iv)  
 b) (q - i), (r - ii), (s - iii), (p - iv)  
 c) (q - i), (r - ii), (p - iii), (s - iv)  
 d) (s - i), (p - ii), (q - iii), (r - iv)      **Ans : d**

50. Match the following:-

Column – 1	Column – 2
p) $\alpha$ diversity	i) Richness of different species in a habitat
q) $\beta$ diversity	ii) Richness of different species along with a gradient from one habitat to another habitat within the community
r) $\gamma$ diversity	iii) Richness of different species in different habitat

- a) (p - i), (r - ii), (q - iii)  
 b) (p - i), (q - ii), (r - iii)  
 c) (q - i), (p - ii), (e - iii)  
 d) (r - i), (q - ii), (p - iii)      **Ans : b**

**Assertion and reasoning questions:**

In each of the following questions there are two statements. One is assertion (a) and other is reasoning (R). Mark the correct answer as

- a) Both A and R are true and R is correct explanation of A  
 b) Both A and R are true but R is not correct explanation of A  
 c) A is true but R is false  
 d) A is false but R is true

51. Assertion :- There is threat to the indigenous cat fish in our rivers

**Reason :- African cat fish (alien species) producestoxic effect for agriculture**

- a) A      b) B      c) C      d) D      **Ans : a**

52. Assertion :- In-situ conservation is a type of biodiversity conservation.

**Reason :- It is the conservation of resources out side their natural habitat.**

- a) A      b) B      c) C      d) D      **Ans : c**

53. Assertion :- Biodiversity is important to maintain ecosystem and biosphere of the world

**Reason :- Biodiversity provides food for mankind and their pets.**

- a) A      b) B      c) C      d) D      **Ans : b**

54. Assertion :- In National Park Wild life is strictly protected

**Reason :- In National Park, activity such as forestry, grazing, cultivation are not allowed.**

- a) A      b) B      c) C      d) D      **Ans : a**

55. Assertion:- The biodiversity is not uniform throughout the world

**Reason :- Biodiversity increases as we move from equator to polar region.**

- a) A      b) B      c) C      d) D      **Ans : c**

**PART-B**

**ADDITIONAL QUESTIONS (2 MARKS)**

- Define biodiversity.**
  - The totality of all living organisms or **variability among living organisms are known as Biodiversity.**
- Enumerate the significance of biodiversity.**
  - It provides an **index of health of an ecosystem.**

- The survival of human race depends on the **existence and wellbeing of all life forms** (plants and animals) in the biosphere.
3. **List out the types of biodiversity.**  
There are three levels of biodiversity
    1. **Genetic diversity**
    2. **Species diversity**
    3. **Community/Ecosystem diversity**
  4. **Define genetic diversity.**  
➤ **Genetic diversity** refers to the **differences in genetic make-up** between distinct species and to the **genetic variation within a single species**, also **genetic variation between distinct populations** of the same species.
  5. **How genetic diversity has been useful ?**  
➤ Genetic diversity helps in **developing adaptation to changing environmental condition**
  6. **Define species diversity.**  
➤ **Species diversity** refers to the **variety in number and richness of the species** in any habitat.
  7. **Define species richness.**  
➤ The number of **species per unit area at a specific time** is called species richness
  8. **List out the types of species diversity.**  
➤ There are three types of species diversity are - Alpha, Beta and Gamma diversity
  9. **Define community.**  
➤ **Variety of habitats, biotic communities, and ecological processes** in the biosphere is known as Community/Ecosystem diversity
  10. **Define taxonomic impediment.**  
➤ The current estimate of different species on earth is around **8-9 million**.  
➤ However, we really **don't know the exact number** of our natural wealth.  
➤ This is called the '**The Taxonomic impediment**'
  11. **Why India is rich in biodiversity?**  
➤ India is very rich in biological diversity, this is due to its **unique bio-geographical location, diversified climatic conditions, enormous eco-diversity and geo-diversity**.



12. **List out the factors which determines biodiversity distribution pattern.**  
➤ Biodiversity distribution pattern is determined by **temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level** (altitudinal gradient)
13. **How biodiversity affected by different zone of earth?**  
➤ Diversity **increases as one moves towards the temperate zones** and reaches the maximum at the tropics.  
➤ Thus, **tropics have more biodiversity** than temperate or polar regions.
14. **What is habitat fragmentation?**  
➤ Habitat fragmentation is the process where a large, **continuous area of habitat is both, reduced in area and divided into two or more fragments**.
15. **What are the drastic effect climatic change affect biodiversity?**  
➤ Climate change result in **increases land and ocean temperature, changes precipitation patterns and raises the sea level**.  
➤ This inturn results in **melting of glaciers, water inundation, less predictability of weather patterns, extreme weather conditions, outbreak of squalor diseases, migration of animals and loss of trees in forest**.  
➤ Thus, climate change is an imminent danger to the existing biodiversity.
16. **How Intensive agriculture affect biodiversity?**  
➤ Intensive agriculture is based on **only few high yielding varieties**.  
➤ This result in **reduction in the genetic diversity**.
17. **What is Hotspots?**  
➤ Hotspots are areas characterized with **high concentration of endemic species experiencing unusual rapid rate of habitat modification loss**.
18. **Define Extinction.**  
➤ Species is considered extinct when **none of its members are alive** anywhere in the world.

### 19. List out some wildlife sanctuaries in Tamil Nadu.

Prominent WLS in Tamil Nadu	Year of establishment	Districts
➤ Vedanthangal Lake Birds WLS	➤ 1936	➤ Kanchepuram
➤ Mudumalai WLS	➤ 1942	➤ Nilgiris
➤ Point Calimere WLS	➤ 1967	➤ Nagapattinam
➤ Indira Gandhi (Annamalai) WLS	➤ 1976	➤ Coimbatore
➤ Mundanthurai WLS	➤ 1977	➤ Tirunelveli

### 20. What are Sacred Groves?

- A sacred grove or sacred woods are any grove of **trees that are of special religious importance to a particular culture.**

### 21. What is Ex-Situ Conservation?

- It is conservation of selected rare plants/animals **in places outside their natural homes.**
- It includes **offsite collections and gene banks.**

### 22. Define Offsite Collections.

- Offsite Collections are **live collections of wild and domesticated species** in Botanical gardens, Zoological parks, Wildlife safari parks, Arborata (gardens with trees and shrubs).

### 23. What are Gene Banks?

- Gene banks are a type of **bio repository** which **preserve genetic materials.**
- Seeds of different genetic strains of **commercially important plants can be stored in long periods** in seed banks, **gametes of threatened species can be preserved** in viable and fertile condition for long periods using cryopreservation techniques.

### 24. Define a species.

- A group of closely related organisms which can **interbreed to produce viable and fertile off springs.**

### 25. What are biodiversity hotspots ?

- Habitats with rich **endemism and the**

**species are prone to endanger** are known as **biodiversity hotspots.**

### 26. Why does tropical region contain rich species diversity than temperate region ?

- Tropical region have **lesser temperature fluctuations** and **receive more solar energy** which is favored the growth of organism.
- Hence tropical region are rich in biodiversity.

### 27. What do you mean by co-extinction ?

- Simultaneous **extinction of two or more species** where one is dependent on other species.

### 28. What are invasive species ? Give an example

- Invasive species are a **foreign species that grow and reproduce rapidly** causing major disturbance in the endemic species.

**E.g : Tilapia fish, Amazon sailfin catfish, African apple snail.**

### 29. What are keystone species ?

- Organisms which helps to **maintain species diversity within an ecosystem** are known as keystone species.

### 30. What is cryopreservation ?

- It is **cold preservation technique** for Seeds of different genetic strains of commercially important plants.
- Seeds can be stored in **seed banks, gametes of threatened species** can be preserved in viable and fertile condition for long periods.

### 31. What are endemic species ?

- A species which is **found only in a particular area** because of isolation and climatic condition.

### 32. What is species diversity?

- Variety of different species in a given geographical area.

## PART-C

### ADDITIONAL QUESTIONS

(3 MARKS)

#### 1. Explain different types of species diversity

##### Alpha diversity:

- It is measured by **counting the number of taxa** (usually species) within a particular area, community or ecosystem.

**Beta diversity:**

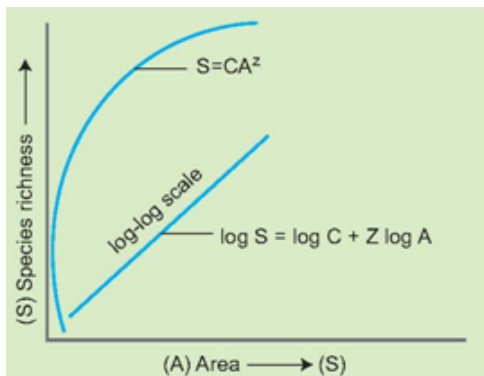
- It is species **diversity between two adjacent ecosystems** and is obtained by **comparing the number of species unique to each of the ecosystem.**

**Gamma diversity :**

- It refers to the **diversity of the habitats** over the total landscape or geographical area.

**2. Write short notes on species area relationship**

- German Naturalist and Geographer **Alexander von Humboldt** explored the wilderness of south American jungles and found that **within a region the species richness increased with increasing area** but upto a certain limit.
- The relationship between **species richness and area for a wide variety of taxa** (angiosperm plants, birds, bats, freshwater fishes) turned out to be the rectangular hyperbola.



- On a logarithmic scale, the relationship is a straight line described by the equation, **log S = log C + Z log A**

Where,

**S = Species richness**

**A = Area**

**Z = Slope** of the line (regression coefficient)

**C = Y-intercept.**

**3. Why sparrows are been in the state of extinct?**

- Common Sparrows are going extinct because of **mindless urbanization.**
- They are **losing not just their natural habitats** but also the essential human touch they need and thrive upon.
- The population of sparrows is decreasing due to the **use of packed food, insecticides**

**in farming and changing lifestyles** and matchbox-styled architecture resulting in an **inadequate availability of food and shelter for the birds.**

- Unlike pigeons that can make nests on ledges, sparrows need cavities to build their nests.

**4. Over exploitation led decline in biodiversity – justify.**

- **We depend on nature** for our basic needs such as food and shelter.
- However, when the **need becomes more, it leads to over exploitation of natural resources.**
- Excessive exploitation of a species, **reduces the size of its population** to such a level that it becomes susceptible to extinction.
- E.g. Dodo, have become **extinct** due to **over exploitation.**
- **Overfishing** due to population pressure leads to extinction of many marine fish

**5. How extinction of dodo bird affect calvaria tree?**

- There is a connection between the **extinction of Calvaria tree and the extinction of Dodo bird** in Mauritius Island.
- Because the **Calvaria tree is dependent on the Dodo bird** for completion of its life cycle.
- The mutualistic association is that the **tough horny endocarp of the seeds of Calvaria tree are made permeable** by the actions of the large stones in birds gizzard and digestive juices thereby facilitating easier germination.
- Hence, **extinction of the Dodo bird led to the imminent danger of the Calvaria tree.**

**6. List out the General strategies for biodiversity conservation.**

- **Identify and protect** all threatened species
- **Identify and conserve** in protected areas the wild relatives of all the **economically important organisms**
- Identify and protect critical **habitats for feeding, breeding, nursing, resting of each species.**
- **Resting, feeding and breeding places** of the organisms should be identified and protected.



- **Air, water and soil** should be conserved on priority basis.
  - **Wildlife protection act** should be implemented.
- 7. Interdependence of all living components – explain this term with an example.**
- The interrelationship and interdependence of all living components in a system can be seen from the example of the **fruit bats of Guam** (South East Asia).
  - The **fruit bats are a weak here**, and hence their population has decreased.
  - It results in **local fruit production has got affected**, then it was identified that the **bats served as pollinators**.
  - Hence there is a **need for conservation of diversity**.
- 8. How development of human society affect animal habitat?**
- **Development of human society is unavoidable.**
  - Natural habitats are **destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways.**
  - As a result species are forced to **adapt to the changes in the environment or move to other places.**
  - If not, they **become victim to predation, starvation, disease and eventually die** or results in human animal conflict.

## PART-D

## ADDITIONAL QUESTIONS (5 MARKS)

- 1. List out the Role of organization which involved in conservation of biodiversity.**
- ⊛ **Continuity of nutrient cycles** or biogeochemical cycles ( $N_2$ , C,  $H_2O$ , P, S cycles).
  - ⊛ **Soil formation, conditioning or maintenance of soil health** (fertility) by soil microbial diversity.
  - ⊛ **Increases ecosystem productivity and provide food resources.**
  - ⊛ Act as **water traps, filters, water flow regulators** and **water purifiers** (forest cover and vegetation).
- 2. List out the reason for the richness of biodiversity in the tropics.**
- Tropical regions are rich in biodiversity, because:
1. This region is present in between Cancer and Capricorn on **either side of equator which is congenial habitats for living organisms.**
  2. Environmental conditions of the **tropics are favourable not only for speciation but also for supporting both variety and number of organisms.**
  3. The temperatures vary between **25°C to 35°C, a range in which most metabolic activities** of living organisms occur with ease and efficiency.
  4. The average **rainfall is often more than 200 mm per year.**
  5. **Climate, seasons, temperature, humidity, photoperiods are more or less stable** and encourage both variety and numbers.
  6. **Rich resource and nutrient availability.**
- 3. List out and explain any three biogeographical region of india**
- Himalayas:**
- The entire mountain chain **comprising a diverse range of biotic provinces and biomes** and covers 7.2% of the country's landmass.
- 4. Climate stability** (forests are essential for rainfall, temperature regulation,  $CO_2$  absorption, which in turn regulate the density and type of vegetation).
- 5. Forest resource management and sustainable development.**
- 6. Maintaining balance between biotic components.**
- 7. Cleaning up of pollutants** – microbes are the biggest degraders of molecules including many anthropogenic ones which are present in effluents, sewage, garbage and agro-chemicals.
- 8. Ecological stability**– the varieties and richness of species contribute to ecological stability and survival of species.
- 9. To provide unique aesthetic value and hotspots** for Ecotourism.

- **Animals in this regions are - wild sheep, mountain goats, shrew, snow leopard and panda,**

**Indian Desert:**

- The extremely **arid area west of the Aravalli hill range**, comprising both the salty desert of Gujarat and the sand desert of Rajasthan.
- It comprises **6.9% of the country's landmass.**
- **Wild ass is endemic to this region.**
- **Animals in this regions are -** Indian Bustard, camel, foxes and snakes, many of which are endangered.

**Western Ghats:**

- Western Ghats are **mountain ranges along the west coast of India**, extending over almost 1,500km.
- The **annual rainfall is about 2000 mm.**
- **Animals in this regions are - Nilgiri tahr** (State animal of Tamil Nadu), **Nilgiri Langur, tiger, leopard, and Indian elephant.**
- The grizzled squirrel and lion tailed macaque are endemic to this region.

**Gangetic Plains:**

- These plains are relatively **homogenously defined by the Ganges river system** and occupy about **11% of the country's landmass.**
- This region is **very fertile and extends up to the Himalayan foothills.**
- **Animals in this regions are - Fauna includes rhinoceros, elephant, buffalo, swamp deer, hog-deer.**

**4. List out and explain the types of extinction.**

➤ Extinctions are three types, they are :

**1) Natural extinction**

- It is a **slow process of replacement of existing species** with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases.
- **A small population can get extinct sooner** than the large population due to inbreeding depression (less adaptivity and variation).

**2) Mass extinction:**

- The earth has experienced quite a few **mass extinctions due to environmental**

**catastrophes.**

- A mass extinction **occurred about 225 million years ago** during the Permian, where 90% of shallow water marine invertebrates disappeared.

**3) Anthropogenic extinctions:**

- These are assisted by human activities like **hunting, habitat destruction, over exploitation, urbanization and industrialization.**
- Some examples of extinctions are **Dodo of Mauritius and Steller's sea cow of Russia.**
- **Amphibians** seem to be at higher risk of extinction because of habitat destruction.

**5. Write short notes on IUCN.**

- The **International Union for Conservation of Nature (IUCN)** is an **organization working in the field of nature conservation and sustainable use of natural resources.**
- It was **established in 1948** and located at Gland VD, Switzerland.
- It is involved in **data gathering and analysis research, field projects and education on conservation, sustainable development and biodiversity.**
- IUCN's mission is to **influence, encourage and assist societies** throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable.
- It **influences governments and industries** through partnerships by providing information and advice.
- The **organization collects, compiles and publishes** the IUCN red list of threatened species and their conservation status in the world.
- It plays a vital role in the **implementation of several international conventions** on nature conservation and biodiversity.

**6. Write short on National Parks.**

- It is a natural habitat that is notified by the state government to be constituted as a National Park due to its **ecological, faunal, floral, geomorphological, or zoological association** of importance.



- **No human activity is permitted inside the national park** except the activities permitted by the Chief Wildlife Warden of the state under the conditions of the **Wildlife Protection Act (WPA) 1972**.

#### National Parks in Tamil Nadu

National Parks in Tamil Nadu	Year of establishment	District(s)
➤ <b>Guindy NP</b>	➤ 1976	➤ Chennai
➤ <b>Gulf of Mannar Marine NP</b>	➤ 1980	➤ Ramanathapuram and Tuticorin
➤ <b>Indira Gandhi (Anna-malai) NP</b>	➤ 1989	➤ Coimbatore
➤ <b>Mudumalai NP</b>	➤ 1990	➤ Nilgiris
➤ <b>Mukurthi NP</b>	➤ 1990	➤ Nilgiris

- There are **104 existing national parks** in India covering an area of **40,501 km<sup>2</sup>**, which is 1.23% of the geographical area of the country
- National Park is an area which is **strictly reserved for the betterment of wildlife and biodiversity** and where activities like **development, forestry, poaching, hunting, grazing and cultivation are not permitted**.
- They are large areas of scenic and **national beauty maintained for scientific educational and recreational use**.
- They are **not used for commercial extraction** of resources.
- **Kaziranga National park** is a protected area for the one Horned Rhinoceros in Assam.

#### 7. Write short notes on Biosphere Reserve (BR).

- BR is an **international designation** by UNESCO for representative parts of natural and cultural landscapes extending over large area of **terrestrial or coastal/ marine ecosystems or a combination thereof**.
- BRs are designated to deal with the **conservation of biodiversity, economic**

**and social development and maintenance of associated cultural values.**

- Biosphere Reserves are thus **special environments for both people and nature**
- The Biosphere Reserve Programme is guided by UNESCO's **Man And Biosphere (MAB)** programme.
- The scheme called Biosphere Reserve was **implemented by the Government of India in 1986**.
- There are **18 Biosphere Reserves in the country**.
- E.g. **Agasthyamalai** (Karnataka - Tamil Nadu - Kerala)
- **Nilgiri** (Tamil Nadu - Kerala)
- **Gulf of Mannar** (Tamil Nadu)

#### 8. Write short note on project tiger.

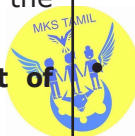
- The Government of **India launched the 'Project Tiger' in 1973** to protect our national animal.
- From 9 tiger reserves since its inception, the **Project Tiger coverage has increased to 50%**.
- Project Tiger is an **on going Centrally Sponsored Scheme** of the Ministry of Environment and Forests, providing central assistance to the states for tiger conservation in designated tiger reserves.
- Project Tiger was **launched in the Jim Corbett National Park**, Uttarakhand in 1973.
- The project **ensures a viable population of Bengal tigers** in their natural habitats, protecting them from extinction and preserving areas of biological importance as a natural heritage.
- **The National Tiger Conservation Authority (NTCA)** is a statutory body of the Ministry, created under the Wildlife (Protection) Act, 1972.
- **India holds over half the world's tiger population.**
- According to the latest tiger census report released on 20<sup>th</sup> January 2015 by NTCA, the **current tiger population is estimated at 2,212**.
- There are **50 tiger reserves in the country**.

## Points to Remember

- Earth is currently facing a lot of environmental problems like **air pollution, water pollution, noise pollution, global warming, acid rain, bio magnification, eutrophication, deforestation, waste disposal, ozone layer depletion and climate change.**
- It will result in **natural disasters which striking us more often** in the form of floods, tsunami and cyclones.
- **Pollution is any undesirable change in the physical, chemical and biological characteristics** of the environment due to natural causes and human activities.
- Pollutant are the **agents which cause pollution.**
- Types of pollution - **Air, Water and Soil Pollution.**
- Pollutants can be classified into two basic groups - **Non-degradable and degradable.**
- **Non-degradable pollutants** - These **cannot be degraded by natural processes.** E.g : - lead, mercury,
- **Degradable pollutants** - These **can be degraded** by natural processes - E.g :. Paper, wood,
- The alterations or changes in the composition of the earth's atmosphere by natural or human activities (anthropogenic factors) are referred as **Air Pollution.**
- **Air pollutants can be** - Discharge of dusts or particulate matter and Discharge of gases (**SO<sub>2</sub>, NO<sub>2</sub>, CO, CO<sub>2</sub>**)
- **CO<sub>2</sub>** From automobiles, aeroplanes, power plants and other human activities that involving the burning of fossil fuels (coal, oil etc.,) is the main pollutant that is leading to global warming.
- **Causes of acid rain** - **Sulphur dioxide and nitrogen oxides.**
- **Sources of air pollution** -Transport sources, Stationary sources area sources, Natural sources.
- **Air Pollution** causes **irritation in the throat, nose, lungs and eyes.**
- It causes breathing problems and aggravates existing health conditions such as **emphysema and asthma.**
- Smog is a **type of air pollution** caused by tiny particles in the air.
- The word comes from a **mixture of the words smoke and fog.**
- Smog also **affects plants and animals.**
- **Peroxyacetyl nitrate (PAN)** is a **secondary pollutant** present in photochemical smog.
- The **raised atmospheric temperature** by the increase in concentration of green house gases is known as **global warming.**
- **Ozone depletion: Thinning of the stratospheric ozone layer** is known as ozone depletion.
- Such depletion causes the '**ozone hole**', resulting in **poor screening of the harmful UV rays** and increase in incidences of skin cancer.
- Forests act as **carbon sinks and lungs of the planet.**
- **Catalytic converters** in vehicles help to reduce polluting gases drastically.
- **Air Quality Index (AQI)** is a number used by government agencies to communicate to the public how polluted the air is at a given time.
- Water pollution occurs when there is a **change in the chemical, physical or biological quality of water** that has harmful effect(s) on living organisms that consume it or live in it.
- There are three main types of sources: **point sources, non-point sources, leaks and spills.**
- Sources of water pollution can also be classified in three ways:
- **Municipal wastes, Industrial wastes, agricultural wastes.**
- Water pollution **can be lethal to aquatic organisms** and others that depend on these water bodies.

- Water pollution can cause eutrophication and algal bloom due to nutrient enrichment.
- Waste water can be **pretreated by scientific methods** before discharge to municipal treatment sources.
- **E.g : Setting up of Sewage Treatment Plants (STP) and Effluent Treatment Plants (ETP).**
- Sound that is **unwanted and undesirable or can disrupt one's quality** of life is called as Noise.
- When there is **lot of 'noise' in the environment**, it is termed as Noise Pollution.
- The intensity of noise is **measured in decibels (dB)**.
- **Sources of air pollution** - Vehicle engines, air horns, audio video systems, trains, low flying aircrafts, factory machines, sirens, motors, drillers and crushers, compressor machines, crackers, explosives, modern supersonic transports are the common sources of noise pollution.
- **Effect of Noise Pollution** - Heart disease, high blood pressure, stress related illness, sleep disruption, hearing loss (deafness), and productivity loss.
- **Planting trees** in and around noise sources is an **effective solution for noise pollution** as plants are known to absorb noise and bring down sound levels.
- **Chemicals which are used in agriculture** for growth of plants and pest control are called **agrochemicals or agrichemicals**.
- Overuse of agrochemicals have been observed to generate residues that cause **nutrient imbalance, and may kill beneficial bacteria and soil organisms**.
- When non-degradable substances enter the food chain, they **do not get metabolized or broken down or expelled and instead get transferred** up the trophic levels of the food chain.
- During this process, they show an increase in concentration which is referred to as **bio-magnification**.
- When water run-off from land containing **nutrients reaches water bodies like lakes, it results in dense growth of plant life**.
- This phenomenon is called **Eutrophication**.
- Pollutants from anthropogenic activities like effluents from the industries and homes can **radically accelerate the aging process**.
- This phenomenon is known as **Cultural or Accelerated Eutrophication**.
- Wastewater or sewage originates from **domestic waste waters, industrial wastes and animal wastes**.
- The treatment can be carried out - **Physical methods, Chemical methods and Biological methods**.
- It is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, so as to **keep the soil alive and in good health**.
- **G. Nammalvar** was a supporter and expert of organic farming.
- He was an **agricultural scientist, environmental activist** celebrated for his work on spreading Ecological farming & Organic farming.
- He was against the **use of chemical fertilizers and pesticides**.
- Solid waste management includes the **activities and action required to manage waste** from its inception to its final disposal.
- This includes the **collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process**.
- Dr. Sultan Ahmed Ismail is an **Indian soil biologist and ecologist** from Tamil Nadu.
- His work has centered on techniques for **recycling biodegradable waste into fertilizer using varieties of earthworms, and on soil bioremediation**.
- **Radioactive wastes** are generated during various operations of the **nuclear power plant**.
- Radioactive waste can be in **gas, liquid or solid form**, and its level of radioactivity can vary.
- The waste can **remain radioactive for a few hours or several months or even hundreds of thousands of years**.
- **Types** (Depending on the level and nature of radioactivity) Low and Intermediate and High Level Waste.
- Methods of disposal of radioactive wastes are

- **Limit generation, Dilute and disperse, Delay and decay, Concentrate and confine process.**
  - Three ways are employed to manage nuclear wastes:-
    - Spent Fuel Pools, Vitrification method, Geological Repositories.**
  - Any kind of waste that contains **infectious material generated by hospitals, laboratories, medical research centers, Pharmaceutical companies and Veterinary clinics** are called **medical wastes**.
  - Medical wastes contain body fluids like **blood, urine, body parts and other contaminants, culture dishes, glasswares, bandages, gloves, discarded needles, scalpels, swabs and tissues**.
  - Electronic waste or e-waste **describes discarded electrical electronic devices** as well as any refuse created by discarded electronic devices and components and substances involved in their manufacture or use.
  - Plastics are **low molecular weight organic polymers** that are non-degradable in the natural environment.
  - Plastic waste **constitutes a major part of municipal solid waste**.
  - **Remedies:** '4R'- Refuse, Reduce, Reuse and Recycle mantra is the best available remedy for plastic waste pollution.
  - **Causes of Global warming** -It is caused mainly due to **CO<sub>2</sub> from automobiles or burning coals by power plants, soil erosion, desertification, and CFC** etc.
- Effects of global warming**
- **Seasons will be longer** in some areas, Some types of **forests may disappear**, Storms are expected to be **more frequent and intense, Rise in the sea level** ,It causes **food & water shortage**.
  - **Control measures - Reforestation , Recycling of products, Using natural resources like wind energy, solar energy and wave energy.**
  - Reduce the **production of green house gases**.
  - Ozone is **found in the layer of the atmosphere** called the Stratosphere.
  - It acts as a **protective covering that absorbs ultraviolet (UV)** radiation from the sun.
- **CFCs, methyl chloroform, carbon tetrachloride, hydro chloro fluoro carbons, hydro bromo fluoro carbons and methyl bromide** are found to have direct impact on the depletion of the ozone layer.
  - **Effects: premature skin aging and wrinkling of skin; suppression of the immune system, skin cancer**
  - **Control-** Phase down or **ban the use of CFCs** (CFC free refrigerants).
  - Minimizing the use of chemicals such as **freons and halocarbons**.
  - Deforestation is the destruction of forests in order to clear the land and make it available for other uses.
  - **The Bishnois, who are known conservators of their forest**, were inspiration to many people's participatory movements for Environmental protection in India.
  - The **Chipko movement** resisted the destruction of forests of India **in the 1970s**.
  - **Sunderlal Bahuguna** was the leader of this movement.
  - The '**Forest man of India**', **Jadav Payeng** who created 1,360 acres of dense and defiant forest was born in **Arunasapori** (a river island on the Brahmaputra).
  - For his remarkable initiative, the **Jawaharlal Nehru University invited Payeng in 2012 on Earth Day and honoured him with the title of the 'Forest Man of India'**.
  - Ecological sanitation (EcoSan) is a **sustainable system for handling human excreta** by using dry composting toilets.
  - EcoSan toilets not only **reduce wastewater generation but also generate the natural fertilizer** from recycled human excreta, which forms an excellent substitute for chemical fertilizers.
  - 'EcoSan' toilets are being **used in several parts of India and Sri Lanka**.



**PART – A****TEXTUAL QUESTIONS (1 marks)**

- Right to Clean Water is a fundamental right, under the Indian Constitution**  
a) Article 12                      b) Article 21  
c) Article 31                      d) Article 41      **Ans : b**
- With which of the following, the agenda 21' of Rio Summit, 1992 is related to?**  
a) Sustainable development  
b) Combating the consequences of population  
c) Mitigation norms of Green House Gases (GHGs) emission.  
d) Technology transfer mechanism to developing countries for 'clean-energy' production.  
**Ans : a**
- Which among the following awards instituted by the Government of India for individuals or communities from rural areas that have shown extraordinary courage and dedication in protecting Wildlife?**  
a) Indira Gandhi Paryavaran Puraskar  
b) Medini Puruskar Yojana  
c) Amrita Devi Bishnoi Award  
d) Pitambar Pant National Award      **Ans : c**
- The 'thickness' of Stratospheric Ozone layer is measured in/on.**  
a) Sieverts units              b) Dobson units  
c) Melson units              d) Beaufort Scale      **Ans : b**
- Which among the following is the most abundant Green-House-Gas (GHG) in the earth's atmosphere?**  
a) Carbon dioxide              b) Water Vapour  
c) Sulphur Dioxide              d) Tropospheric Ozone  
**Ans : b**
- As per 2017 statistics, the highest per capita emitter of Carbon dioxide in the world is**  
a) USA                              b) China  
c) Qatar                              d) Saudi Arabia  
**Ans : b**
- The use of microorganism metabolism to remove pollutants such as oil spills in the water bodies is known as**

- a) Biomagnification      b) Bioremediation  
c) Biomethanation      d) Bioreduction      **Ans : b**

- The Ozone Day is observed every year on September 16 as on this day in 1987 the \_\_\_\_\_ was signed for launching efforts to arrest the depletion of the fragile ozone layer in the stratosphere that prevents the harmful ultra-violet rays of the sun from reaching the earth. Fill the correct word in blank.**  
a) Montreal Protocol              b) Geneva Protocol  
c) Kyoto Protocol              d) Nagoya Protocol      **Ans : a**
- Which among the following always decreases in a Food chain across tropic levels?**  
a) Number                      b) Accumulated chemicals  
c) Energy                      d) Force      **Ans : c**
- In the E-waste generated by the Mobile Phones, which among the following metal is most abundant?**  
a) Copper                      b) Silver  
c) Palladium                      d) Gold      **Ans : a**
- The Hydro chloro fluoro carbons (HCFCs) are the compounds which have the following molecules.**  
a) Hydrogen                      b) Carbon  
c) Chlorine                      d) Fluorine      **Ans : c**
- SMOG is derived from :**  
a) Smoke                      b) Fog  
c) Both A and B                      d) Only A      **Ans : c**
- Excess of fluoride in drinking water causes:**  
a) Lung disease                      b) Intestinal infection  
c) Fluorosis                      d) None of the above  
**Ans : c**

**PART – B,C AND D****TEXTUAL QUESTIONS (2,3 AND 5 MARKS)**

- Expand (i) CFC (ii) AQI (iii) PAN**  
i. **CFC** – Chloro Fluoro Carbon  
ii. **AQI** -Air Quality Index  
iii. **PAN** -Peroxyacetyl nitrate

**15. What is SMOG and how it is harmful for us?**

- Smog is a **type of air pollution** caused by tiny particles in the air.
- The word comes from a **mixture of the words smoke and fog**.
- Today, smog generally refers to **photochemical smog, which is created when sunlight reacts with nitrogen oxides and volatile organic compounds** found in fossil fuel emissions from automobiles, factories, and power plants.
- These reactions **create ground-level ozone and particulate matter, reducing visibility**.
- Smog can **make breathing more difficult**, especially for people with asthma.
- Smog also **affects plants and animals**.
- It **damages crops as well as causes health problems** in pets, farm animals and human beings.
- Smog has also been known to **cause corrosive damage to buildings and vehicles**.

**16. List all the wastes that you generate, at home, school or during your trips to other places. Could you very easily reduce the generation of these wastes? Which would be difficult or rather impossible to reduce?**

Waste category	Source
Residential	Food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes, tires, batteries, old mattresses
School	Wood, paper, metals, cardboard materials, electronics
During trip	Plastic water bottle, carry bag, Aluminium foils

- **Yes**, we can reduce the generation of waste by adopting some measure
- **Plastics and E –Waste** are very difficult to remove because they are **non biodegradable**.

**17. Discuss the causes and effects of global warming. What measures need to be taken to control global warming?**

- The **raised atmospheric average temperature** by the increase in concentration of green house gases is known as global warming.

**Causes of Global warming :**

- It is caused mainly due to **CO<sub>2</sub> from automobiles or burning coals by power plants, soil erosion, desertification, and CFC** etc.

**Effects**

1. **Seasons will be longer** in some areas
2. Some types of **forests may disappear**
3. Storms are expected to be **more frequent and intense**
4. Tropical diseases such as **malaria, dengue fever, yellow fever and encephalitis** will spread to other parts of the world
5. **Rise in the sea level**
6. It causes **food & water shortage**

**Control measures**

- ✓ **Reforestation**
- ✓ **Recycling of products**
- ✓ **Using natural resources like wind energy, solar energy and wave energy**
- ✓ Conservation of energy by **using eco-friendly bulbs, carpooling & adopting CFC free zone**
- ✓ **Carbon sequestration**
- ✓ Reduce the **production of green house gases**.

**18. What would Earth be like without the greenhouse effect?**

- Greenhouse gases in the air, **trap radiation from the Sun and act like a thermal blanket** around the planet.
- Without the greenhouse effect, the **Earth would have an average temperature of -18 °C** and be **covered in ice**.
- This makes living organisms **unable to survive**



**19. Write notes on the following:****a) Eutrophication :**

- **Overflow of nutrient rich water** from land to water bodies like lakes, it results in dense growth of plant life.
- This phenomenon is called **Eutrophication**.

**b) Algal Bloom:**

- An algal bloom is a **rapid increase in the population of algae** in an aquatic system.
- Algal blooms may **occur in freshwater as well as marine environments**.

**20. What effect can fertilizer runoff have on an aquatic ecosystem?**

- **Overflow of nutrient rich water** from land to water bodies like lakes, it results in dense growth of plant life.
- It will result in **Eutrophication and algal bloom**.

**21. How can we control eutrophication?**

- In order to control eutrophication first you **need to identify the sources**.
- **Depending on the sources**, you have to decide your management strategy.
- And also **reducing the usage of fertilizer** eutrophication can be controlled.

**22. Why does ozone hole form over Antarctica?**

- Chlorine reacts with ozone and **produce chlorine monoxide and diatomic oxygen**.
- These reactions are **most effective when they occur on the surface of ice crystals**, in the stratosphere.
- Antarctica is **colder than** other part of world
- Therefore **ozone hole form over Antarctica**.

**23. Mention the causes of enhanced use of ultraviolet radiation.**

- Ozone layer depletion decreases our atmosphere's natural protection from the sun's harmful ultraviolet (UV) radiation.

**Causes of Skin Cancer are**

1. **Skin cancer**
2. **Premature aging and other skin damage**
3. **Cataracts and other eye damage**
4. **Immune system suppression**

**24. Discuss the role of women in protection and conservation of forests.****Women play a vital role in conservation of forest.****Amrita Devi :**

- **Amrita Devi** was a brave lady from Khejarli Village of Jodhpur District, Rajasthan.
- She **sacrificed her life to maintain Bishnoi Dharma**.
- In 1730, Maharaja Abhay Singh, ruler of Marwar, Rajasthan state **wanted to log green Khejri (Prosopis cineraria) trees to burn lime** for the construction of his new palace.
- Since there was a **lot of greenery in the Bishnoi villages even in the middle of Thar Desert**, the king ordered his men to get the wood from Khejri trees.
- When **she came to know about the cutting of trees** by the King's men, **she and many others had hugged the Khejri trees to save from cutting**.
- But king's men **killed Amrita Devi along with more than 363 other Bishnois**.
- It was a Tuesday, **black Tuesday in Khejarli**.
- This incident took place to **save trees and is recorded in India's history**.
- To commemorate her bravery, the Government of Rajasthan and Madhya Pradesh have initiated the prestigious state level award named as '**Amrita Devi Bishnoi Smriti Award**' for excellent contribution to the protection and conservation of wildlife.

**Chipko movement :**

- The **Chipko movement** resisted the destruction of forests of India **in the 1970s**.
- **Sunderlal Bahuguna** was the leader of this movement.
- People in the movement **hugged the trees, and prevented felling of trees by contractors**.

**25. Discuss the role of an individual to reduce environmental pollution.**

- Installation of **proper sewage disposal methods**.
- Dumping of **non biodegradable wastes** in low lying areas.



- **Installation of gobar gas plants** in areas of high availability of cow dung.
- **Reduction of smoke emission and treatment of chimney smoke** to remove solid carbon particles.
- **Limited use of fertilizers, pesticides and detergents.**
- **Reforestation**

#### 26. How does recycling help reduce pollution?

- **Recycling** prevents the emissions of many green house gases and **pollutants**, and saves energy. Using recovered material generates less solid waste.
- **Recycling helps** to **reduce** the **pollution** caused by the extraction and processing of virgin materials.

#### 27. What is the primary purpose of the Kyoto Protocol?

- To **decrease the dependence on natural resources** in developing countries
- To limit and **decrease the world-wide emission** of greenhouse gases

#### 28. In what way Payang conserves the forest?

- **Jadav Payang** known as '**Forest man of India**'.
- He created 1,360 acres of dense and defiant forest was born in **Arunasapori**(a river island on the Brahmaputra).
- He had just completed his Class X exams in 1979 when **he started to sow the seeds and shoots** on the eroded island covered with sand and silt.
- Thirty-six years later he had **converted the once unproductive land into a forest.**
- Payang's forest is now home to **five Royal Bengal tigers, over a hundred deer, wild boar, vultures, and several species of birds.**
- For his remarkable initiative, the **Jawaharlal Nehru University invited Payang in 2012 on Earth Day and honoured him with the title of the 'Forest Man of India'.**
- Later, the President **APJ Abdul Kalam felicitated him with a cash award** in Mumbai.

- The same year, he received the '**Padma Shri**'.
- The Indian Constitution also **stresses on the importance of the role of the People in protecting their environment.**

#### 29. Discuss briefly the following :

##### a) Catalytic converter

- Catalytic converters in **vehicles help to reduce polluting gases** drastically

##### b) Greenhouse gases

- Gases which are **responsible for green house effect** is known as Greenhouse gases  
**E.g : Water vapour, carbon dioxide, methane, nitrous oxide, ozone** and chlorofluorocarbons (CFCs)

##### EcoSan :

- Ecological sanitation (EcoSan) is a **sustainable system for handling human excreta** by using dry composting toilets.
- EcoSan toilets not only reduce wastewater generation but also **generate the natural fertilizer from recycled human excreta**, which forms an excellent substitute for chemical fertilizers.

#### 30. What are some solutions to toxic dumping in our oceans?

- **Management and minimization of waste dumping** at the port
- **Education and awareness creation**
- **Regulations and laws**
- **Using reusable plastics**

#### 31. Describe how deforestation might contribute to global warming.

- Forests through photosynthesis **absorb carbon dioxide (CO<sub>2</sub>)** and release oxygen.
- The timber of the **trees also sequesters carbon.**
- Deforestation means result in **reduction in area of forest.**
- Hence, green leaves **no longer act as carbon sinks** to suck in CO<sub>2</sub>.
- By this way **deforestation contributes to the global warming.**







- c) Extraordinary courage and dedication in protecting wild animals  
 d) Extraordinary courage and dedication in Protecting Environment **Ans : a**
- 48. Which is the main factor of water pollution?**  
 a) Ammonia                      b) Smog  
 c) detergents                    d) None of these **Ans : d**
- 49. Which one of these has highest levels of DDT deposition?**  
 a) Eel                                b) Phytoplankton's  
 c) Sea gull, Eagle                d) Crab **Ans : c**
- 50. Exhaust of motor vehicles produces pollutants like**  
 a) CO                                b) Hydrocarbons  
 c) SO<sub>2</sub>                                d) All of these **Ans : d**
- 51. The stress reaction is caused by**  
 a) Air pollution                    b) Nuclear pollution  
 c) Water pollution                d) Noise pollution **Ans : d**
- 52. Deforestation may reduce the chances of**  
 a) Rain fall  
 b) Frequent cyclones  
 c) Erosion of surface soil  
 d) Frequent landslide **Ans : a**
- 53. Most severe environmental hazard to mankind is due to**  
 a) Air pollution                    b) Radioactive pollution  
 c) Water pollution                d) Noise pollution **Ans : b**
- 54. Which is biodegradable pollutant?**  
 a) Mercury salts                    b) Polythene bags  
 c) Domestic sewage                d) Aluminum canes **Ans : c**
- 55. Which is the native place of Bishnoi community?**  
 a) Bikaner                            b) Jodhpur  
 c) Jamshedpur                    d) Jaipur **Ans : b**
- 56. Formation of ozone hole is maximum over**  
 a) Antarctica                        b) Europe  
 c) Africa                                d) India **Ans : a**
- 57. What is importance of catalytic converter?**  
 a) They increases average of the vehicles  
 b) They reduces emission of harmful gases  
 c) They convert CO and nitric oxide into CO<sub>2</sub> and H<sub>2</sub>O  
 d) Both B and C **Ans : b**
- 58. How can we control global warming?**  
 a) By reducing the use of fossil fuel  
 b) Afforestation  
 c) By slowing down the growth of human population  
 d) All of these **Ans : d**
- 59. Ozone depletion in the stratosphere will cause**  
 a) Increased incidence of skin cancer  
 b) Forest fire  
 c) Global warming  
 d) None of these **Ans : a**
- 60. Eutrophication causes decrease in**  
 a) Dissolved oxygen                b) Dissolved salts  
 c) Dissolved hydrogen            d) All of these **Ans : a**
- 61. Green house effect is caused by**  
 a) Green plants                    b) Infra red rays  
 c) UV rays                            d) X-rays **Ans : b**
- 62. Ozone hole refers to**  
 a) Reduction in thickness of ozone layer in troposphere  
 b) Reduction in thickness of ozone layer in stratosphere  
 c) Hole in ozone layer in stratosphere  
 d) Increased concentration of ozone **Ans : b**
- 63. As it travels along the food chain the concentration of DDT**  
 a) Increases                            b) Stays constant  
 c) Decreases                            d) Fluctuates randomly **Ans : a**
- 64. In the coming year skin related disorders might be more common due to ...**  
 a) Use of detergents  
 b) Water pollution  
 c) Depletion of ozone layer  
 d) Air pollution **Ans : c**
- 65. Match the items given in column I and II (Kerala PMT 2011)**



Column-I	Column-II
P) Electrostatic precipitator	i) Removes gases like SO <sub>2</sub>
Q) Scrubber	ii) Removes impurities from exhaust of vehicles
R) Catalytic converter	iii) Removes particulate matter

- a) (p-i), (q-ii),(r-iii)      b) (p-iii),(q-i),(r-ii)  
 c) (p-iii),(q-ii),(r-i)      d) (p-ii),(q-i),(r-iii)  
**Ans : b**

66. Match the items given in column I and II

Column-I	Column-II
P) Biodegradable waste	i) Bottles, cans, metals
Q) Non-biodegradable waste	ii) Domestic waste, cow dung
R) Recyclable waste	iii) Mercury, DDT

- a) (p-iii) (q-ii),(r-i)      b) (p-ii),(q-i),(r-iii)  
 c) (p-ii),(q-iii),(r-i)      d) (p-i),(q-ii),(r-iii)  
**Ans : b**

67. Match the items given in column I and II

Column-I	Column-II
P) Global warming	i) Mercury, DDT
Q) Eutrophication	ii) Rise in sea level
R) Biological magnification	iii) CH <sub>4</sub> , CO <sub>2</sub>
S) Green house effect	iv) Algal bloom

- a) (p-iv), (q-i),(r-ii),(s-iii)  
 b) (p-i), (q-ii),(r-iii), (s-iv)  
 c) (p-ii), (q-iii), (r-i), (s-iv)  
 d) (p-ii), (q-iv), (r-i), (s-iii)  
**Ans : d**

68. Match the items given in column I and II

Column-I	Column-II
P) 1988	i) Noise pollution added in Air act
Q) 1974	ii) Concept of joint forest management
R) 1980	iii) Chipko movement
S) 1987	iv) National Forest policy

- a) (p-iv), (q-iii), (r-i), (s-ii)  
 b) (p-i), (q-ii),(r-iii), (s-iv)  
 c) (p-iv), (q-iii), (r-ii),(s-i)  
 d) (p-ii), (q-iv), (r-i), (s-iii)  
**Ans : c**

69. Which gas is responsible for increase in atmospheric temperature?

- a) O<sub>2</sub>      b) CO<sub>2</sub>      c) SO<sub>2</sub>      d) CO  
**Ans : b**

70. Slash and burn agriculture means

- a) Agriculture on desert land  
 b) Jhum cultivation  
 c) Cultivation on hills  
 d) Reforestation  
**Ans : b**

71. Which of the following is responsible for protection of living organism on earth?

- a) Ozone layer      b) Green house strategy  
 c) Troposphere      d) UV-rays  
**Ans : a**

72. Green house Effect is the cumulative result of the influence of certain gases. Identify the gas which is not involved in the influence ?

- a) CO      b) CFC      c) N<sub>2</sub>      d) CH<sub>4</sub>  
**Ans : c**

73. If fertilizers are added to fresh water

- a) Plants will die  
 b) Eutropication will occur  
 c) Fish population will decrease  
 d) Overall animal population will decrease  
**Ans : b**

74. Non-biodegradable pollutants are created by

- a) Nature      b) Excessive use of resources  
 c) Humans      d) Natural disasters  
**Ans : c**

75. According to the Central Pollution Control Board, particles that are responsible for causing great harm to human health are of diameter.

- a) 2.50 micrometers      b) 5.00 micrometers  
 c) 10.00 micrometers      d) 7.5 micrometers  
**Ans : a**

76. Which of the following causes biomagnification?

- a) SO<sub>2</sub>      b) sodium  
 c) DDT      d) Both b) & c)  
**Ans. c**



**77. The expanded form of DDT is:**

- a) dichloro diphenyl trichloro ethane
- b) dichloro diethyl trichloro ethane
- c) dichloro dipyrydyl trichloro ethane
- d) dichloro diphenyl tetrachloro acetate **Ans : a**

**78. The major source of noise pollution, worldwide is due to:**

- a) Office equipment
- b) Transport system
- c) Sugar, textile and paper industries
- d) oil refineries and thermal power plants **Ans: b**

**79. Match correctly the following and choose the correct option**

Column-I	Column-II
i) Environmental Protection Act	A. 1974
ii) Air Prevention & Control of Pollution Act	B. 1987
iii) Water Act	C. 1986
iv) Amendment of Air Act to include noise	D. 1981

The correct match is;

- a) (i)-C, (ii)-D, (iii)-A, (iv)-B
- b) (i)-A, (ii)-C, (iii)-B, (iv)-D
- c) (i)-D, (ii)-A, (iii)-B, (iv)-C
- d) (i)-C, (ii)-D, (iii)-B, (iv)-A **Ans : a**

**80. Which one of the following diseases is not due to contamination of water?**

- a) Hepatitis-B
- b) Jaundice
- c) Cholera
- d) Typhoid **Ans : a**

**81. Match the items in column I and column II and choose the correct option:**

Column-I	Column-II
A. UV	i) Biomagnifications
B. Biodegradable Organic Matter	ii) Eutrophication
C. DDT	iii) Snow blindness
D. Phosphates	iv) BOD

The correct match is:

- a) A (ii), B (i), C (iv), D (iii)
- b) A (iii), B (ii), C (iv), D (i)
- c) A (iii), B (iv), C (i), D (ii)
- d) A (iii), B (i), C (iv), D (ii) **Ans : c**

**82. For the given statement which option is correct?**

**Statement:**

**Assertion (a) : Air pollution causes injury to all living organisms.**

**Reason (R): The harmful effect depends on the concentration of pollutants, duration.**

- a) Both A and R are correct.R gives correct explanation for A
- b) Both A and R are correct.R does not give correct explanation for A
- c) A is correct, R is wrong
- d) A is wrong and R is correct **Ans : a**

**83. For the given statement which option is correct?**

**Statement:**

**Assertion :DDT and plastic both are non-biodegradable Waste**

**Reason :As the time passes, Pollutants of domestic sewage does not remain pollutants.**

- a) Both A and R are correct. R gives correct explanation for A
- b) Both A and R are correct. R does not give correct explanation for A
- c) A is correct, R is wrong
- d) A is wrong and R is correct **Ans : b**

**84. For the given statement which option is correct?**

**Statement**

**Assertion :Organic farming means agriculture with the help of chemicals.**

**Reason :500 members of Haryana Kissan welfare club have adopted this agricultural practice.**

- a) Both A and R are correct. R gives correct explanation for A
- b) Both A and R are correct. R does not give correct explanation for A
- c) A is correct, R is wrong
- d) A is wrong and R is correct **Ans : d**



85. For the given statement which option is correct?

**Statement**

**Assertion :** Deforestation is one of the important factor for global warming.

**Reason :** Green house gas CO<sub>2</sub> increases due to deforestation.

- Both A and R are correct. R gives correct explanation for A
- Both A and R are correct. R does not give correct explanation for A
- A is correct, R is wrong
- A is wrong and R is correct

**Ans : a**

### PART-B

#### ADDITIONAL QUESTIONS (2 MARKS)

1. Define Pollution.

- Pollution is any **undesirable change in the physical, chemical and biological characteristics** of the environment is known as pollution.

2. What are pollutants?

- The **agents which cause pollution** are called pollutants.
- Pollution is classified according to the types of environment that is affected.

3. List out the effects of pollution.

- The adverse effects of pollution **include depletion of Ozone** by Chlorofluorocarbons or CFCs, used as refrigerants and **global warming by elevated CO<sub>2</sub>**(industries, deforestation, and partial combustion).

4. Define air pollution.

- The **alterations or changes in the composition of the earth's atmosphere** by natural or human activities (anthropogenic factors) are referred as Air Pollution.

5. List out Air pollutants.

- SO<sub>2</sub>, NO<sub>2</sub>, CO, CO<sub>2</sub>.**

6. How Global warming arise ?

- By rapid urbanization, major amount of **carbon dioxide and sulphur dioxide (SO<sub>2</sub>)** is released in the atmosphere.

- CO<sub>2</sub> is also release from **automobiles, aeroplanes, power plants and burning of fossil fuels** which is leading to global warming.

7. List out the Sources of air pollution.

The main sources of air pollution are:

- Transport sources** - Cars, buses, airplanes, trucks, trains
- Stationary sources** - Power plants, incinerators, oil refineries, industrial facilities, and factories
- Area sources** - Agricultural - wood / stubble burning, fireplaces
- Natural sources** - Wind-blown dust, wildfires, volcanoes.

8. Define smog.

- Smog is a **type of air pollution** caused by tiny particles in the air.
- The word comes from a **mixture of the words smoke and fog.**

9. List out the effects of smog.

- Smog can make **breathing more difficult**, especially for people with asthma.
- Smog also **affects plants and animals.**
- It **damages crops as well as causes health problems** in pets, farm animals and human beings.
- Smog also cause **corrosive damages to buildings and vehicles.**

10. What is PAN?

- Peroxy acetyl nitrate (PAN)** is a **secondary pollutant present** in photochemical smog.
- It is **thermally unstable** and decomposes into peroxy ethanol radicals and nitrogen dioxide gas **causing eye irritation.**

11. What is Ozone depletion?

- Thinning of the stratospheric ozone layer** is known as ozone depletion.
- Such depletion are termed as '**ozone hole**',
- It resulting in **poor screening of UV rays** and increase chance of skin cancer.

12. What is Acid rain?

- Acid rain is a **form of precipitation that contains acidic components**, such as sulfuric acid or nitric acid.



- It damages **trees, crops and harms marine animals** (coral reefs) and induces corrosion.

### 13. What are the Legal Protection against air pollution ?

- The Air (**Prevention and Control of Pollution**) Act was enacted in **1981** and amended in **1987** for the prevention, control and abatement of Air pollution in India.
- **Traffic Emissions Standards:**
- The Government has decided to **enforce Bharat Stage VI norms** from 2020.
- **The Green Bench and the National Green Tribunal** (NGT) give judicial safeguard to environmental protection.

### 14. How quality can be defined?

- Water has two dimensions: **quantity and quality**.
- Water quality is commonly defined by its **physical, chemical, biological and aesthetic** (appearance and smell) characteristics.

### 15. How water pollution occur?

- Water pollution occurs when there is a change in the **chemical, physical or biological quality of water that has harmful effect(s)** on living organisms that consume it or live in it.

### 16. Define Noise & Noise Pollution.

- Sound that is **unwanted and undesirable or can disrupt** one's quality of life is called as Noise.
- When there is **lot of 'noise' in the environment**, it is termed as Noise Pollution.

### 17. What are Legal Protection for noise pollution ?

- **Article 48-A and Article 51-A** of the Constitution of India, Noise Pollution (Regulation and Control) Rules 2000, and **Tamil Nadu State Environment Policy 2017** are some of the legal relief from noise pollution.

### 18. Define Agrochemicals.

- Chemicals which are used in **agriculture for growth of plants and pest control** are called agrochemicals or agrichemicals.

### 19. What is Bio-magnification?

- When non-degradable substances enter the food chain, they **do not get metabolized or broken down or expelled and instead get transferred** up the tropic levels of the food chain.
- During this process, they show an **increase in concentration** which is referred to as bio-magnification.
- This results in **increased toxicity and may even be lethal**.

### 20. Define Accelerated Eutrophication.

- Pollutants from **anthropogenic activities like effluents** from the industries and homes can radically **accelerate the aging process**.
- This phenomenon is known as **Cultural or Accelerated Eutrophication**.

### 21. What is organic farming and its implementation?

- It is a method of farming system which **primarily aims at cultivating the land and raising crops** in such a way, so as to keep the soil alive and in good health **by use of organic wastes and other biological materials** along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment.

### 22. Classify radioactive waste?

- Depending on the **level and nature of radioactivity**, radioactive wastes can be classified as
  1. **Exempt waste**
  2. **Low level waste**
  3. **Intermediate level waste**
  4. **High level waste**

### 23. What are Medical waste? Give example.

- Waste material which are **obtain from medical field** such as hospital and laboratories are termed as Medical waste.
- Medical wastes contain **body fluids like blood, urine, body parts and other contaminants, culture dishes, glasswares, bandages, gloves, discarded needles, scalpels, swabs and tissues**.



**24. List out the Waste disposal methods.**

1. **Incineration**
2. **Chemical disinfection**
3. **Autoclaving**
4. **Encapsulation**
5. **Microwave irradiation**
6. **Landfill and burying**

**25. What is E-Waste?**

- E-Waste is the electronic waste which includes **irreparable components of electronic gadgets.**
- **It includes discarded electrical electronic devices and their components** or substances involved in their manufacture or use.

**26. Explain the term 4R.**

- Remedies: '4R' are the Remedies Against Pollution
- i. **Refuse**
- ii. **Reduce**
- iii. **Reuse and**
- iv. **Recycle** mantra is the best available remedy for plastic waste pollution.

**27. List out Green House gases .**

1. **Water vapour**
2. **Carbon dioxide**
3. **Methane**
4. **Nitrous oxide**
5. **Chlorofluorocarbons (CFCS)**

**28. Write the significance of Stratosphere.**

- **Ozone is found in the** stratosphere layer.
- It acts as a **protective covering that absorbs ultraviolet** (UV) radiation from the sun.

**29. How ozone is formed ?**

- The ozone molecule ( $O_3$ ) consists of **three oxygen atoms.**
- It is formed when **atmospheric oxygen ( $O_2$ ) on exposure to solar radiation** breaks into two oxygen atoms.

**30. What are ODS? Give an example.**

- ODS –**Ozone Depleting Substances.**

- **ODS include -CFCs, methyl chloroform, carbon tetrachloride, hydro chloro fluoro carbons, hydro bromo fluoro carbons and methyl bromide**

**31. What are the effects of ozone depletion?**

- UV rays may penetrate deep into the skin and can lead to **premature skin aging and wrinkling of skin, suppression of the immune system, skin cancer** (melanoma)
- In chronic **stages, it affects eye.**
- DNA damage can result from free radicals and reactive oxygen and photons can damage the DNA itself.

**32. How ozone depletion can be controlled?**

Ozone layer depletion can be controlled by :

- **Phase down or ban the use of CFCs** (CFC free refrigerants).
- **Minimizing the use of chemicals** such as halons and halocarbons.
- **Creating awareness** about ozone depleting agents.

**33. Define Deforestation.**

- Deforestation is the **destruction of forests in order to clear the land** and make it available for other uses.

**34. What are EcoSan toilets?**

- Ecological sanitation (EcoSan) is a **sustainable system for handling human excreta** by using dry composting toilets.
- EcoSan toilets not only reduce wastewater generation but also **generate the natural fertilizer from recycled human excreta**, which forms an excellent substitute for chemical fertilizers.

**35. What are the primary components of acid rain?**

- **Sulfuric acid or nitric acid.**

**36. Define water pollution.**

- An **undesirable change in the nature of water** rendering unfit for human consumption.

**37. What is ozone hole ?**

- **Decrease in the thickness of ozone in the stratosphere** due to CFC release is known as Ozone hole.



**38. How do algal blooms affect the life in water bodies?**

- Algal blooms are **toxic to animals and humans**.
- Algal blooms **cut off light from submerged plants** causing their death.
- There is **decrease in oxygen in water** that deteriorates the water quality and kills aquatic animals.

**39. List any two adverse effects of air pollution.**

1. **Asthma**
2. **Respiratory tract infection**

**40. What is reforestation?**

- **Restoring a previously existing forest** is called reforestation.
- It can happen naturally or can be **enhanced by human intervention**.

**PART-C****ADDITIONAL QUESTIONS (3 MARKS)****1. How can we Control of Air Pollution?**

- Control measures help in **remove pollutants, reduce their presence or prevent their entry** into the atmosphere.
1. **Trees are the best remedy** for urban particulate and gaseous pollution
  2. **Forests act as carbon sinks and lungs** of the planet
  3. **Catalytic converters** in vehicles help to reduce polluting gases drastically
  4. **Diesel exhaust filters** in automobiles cuts particulates
  5. **Electrostatic precipitators reduce release** of industrial pollutants.
  6. Cost effective air pollution treatment systems like **indoor plants and high performance bio-filters can improve indoor air quality**.

**2. List out the Control Measures for water pollution?**

- **Right to clean water** is a fundamental right under the Indian Constitution.
- Water (Prevention and Control of Pollution) **Act, 1974, sections 17 to 40 prohibit the pollution of a stream** or well by disposal of polluting matter.

- The Central/State Pollution Control Boards have the **power to advise the central/state government on various matters concerned** with the prevention and control of pollution of water.

- The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency of the Central Government for the **planning, promotion, co-ordination and for overseeing the implementation** of India's environmental and forestry policies and programmes.

**3. List out the Sources of Noise Pollution.**

- **Vehicle engines, air horns, audio video systems, trains, low flying aircrafts, factory machines, sirens, motors, drillers and crushers, compressor machines, crackers, explosives, modern supersonic transports** are the common sources of noise pollution.

**4. List out and explain the effect of water pollution on Ecosystems.****1. Destruction of ecosystems:**

- Ecosystems, especially **aquatic systems, can be severely affected or destroyed** by water pollution.
- Water pollutants **affect existing niches and habitats** and the survival of organisms.
- Soil fertility is affected and the **system becomes uninhabitable**.

**2. Disruption of food-chains:**

- Water pollution **disrupts the natural food chains** as well as food webs.
- Pollutants such as lead and cadmium are taken up by **primary consumers where they can be lethal or get stored**.
- Later, when these animals are **consumed by secondary consumers, the food chain can get disrupted** at any trophic level or result in enhanced concentration of these pollutants (bio-magnification).
- Hot water from industries when released into the **water bodies affects aquatic density and diversity**.



### 5. List out the Preventive measures against water pollution.

- **Regulate or control of pollutant(s) discharge** at the point of generation.
- Wastewater can be **pretreated by scientific methods before discharge** to municipal treatment sources.
- Setting up of **Sewage Treatment Plants (STP)** and **Effluent Treatment Plants (ETP)**.
- **Regulate or restrict the use of synthetic fertilizers and pesticides.**
- **Public awareness** and **people's involvement** is essential.

### 6. List out the Effect of Noise Pollution.

- According to the **USEPA (United States Environmental Protection Agency)** there are **direct links between noise and health.**
- Noise pollution result in **Heart disease, high blood pressure, stress related illness, sleep disruption, hearing loss (deafness),** and productivity loss.
- It also leads to **increase stress and tension, nervousness, irritability, anxiety, depression and panic attacks, Peptic ulcer, severe head ache, memory loss.**
- **Marine animals are affected by noise pollution** from offshore activities and port activities.
- **Fire crackers frighten animals.**
- **Birds are often affected** by increased air traffic.

### 7. How can we Control Noise pollution?

**We can control noise pollution by following methods :**

- **Planting trees in and around noise sources** is an effective solution for noise pollution as **plants are known to absorb noise and bring down sound levels.**
- **Regular servicing and tuning of automobile engines** can effectively reduce noise pollution by vehicles and machinery.
- Workers should be provided with **ear plugs and earmuffs at work sites** that generate high noise levels.

- **Lubrication of machinery** and **regular servicing** minimizes noise levels.
- Regulations should be imposed to **restrict the usage of loudspeakers in crowded areas and public places.**

### 8. Write short notes on contribution of Dr. Sultan Ahmed Ismail.

- Dr. Sultan Ahmed Ismail is an **Indian soil biologist and ecologist** from Tamil Nadu.
- His work has centered on techniques for **recycling biodegradable waste into fertilizer** using varieties of earthworms, and on soil bioremediation.
- Dr. Ismail received a D.Sc. in Zoology from the University of Madras for his research on the **role of earthworms in soil ecology and waste management.**
- He works on vermicomposting as a **sustainable ecological practice.**
- He has been instrumental in introducing as well as spreading awareness on **environmental issues, solid waste management, vermicomposting, organic farming, vermitech and waste management** to several educational institutions, industries and organic farmers in India and abroad.

### 9. List out the ways of Management of nuclear waste.

- Three ways are employed to manage nuclear wastes

#### Spent Fuel Pools:

- The spent **fuel discharged from the reactors** is temporarily stored in the reactor pool.
- ✓ The **Spent fuel rods** are used in stored cooling ponds.
- ✓ They **protect the surroundings from radiation and absorb the heat generated** during radioactive decay.

#### Vitrification method:

- This **prevents reaction or degradation of nuclear waste** for extended periods of time and encased in dry cement caskets.



**Geological Repositories:**

- A deep **geological repository is a nuclear waste** repository excavated deep within a stable geologic environment.

**10. Why is the load of biodegradable material dangerous to the water bodies?**

- When the large amount of sewage water enters into the ponds, rivers, lakes, seas and oceans, it **reduces the amount of free oxygen.**
- This **depletes the respiratory oxygen levels** and causes suffocation for aquatic fauna thereby killing aquatic life.
- In India at **Tarapur and Kalpakkam**, a wet storage facility of Spent Fuel is the main mode of storage.

**11. Why E-waste are known as hazardous waste ?**

- **Recycling and disposal of e-waste may involve significant risk** to the health of workers and communities in developed countries and **great care must be taken to avoid unsafe exposure** in recycling operations and leaking of materials such as heavy metals from landfills and incinerator ashes.
- Their disposal is a growing problem because **electronic equipment frequently contains hazardous substances.**
- In a personal computer, for example, there may be **lead (Pb) in the cathode ray tube (CRT) and soldering compound, mercury (Hg) in switches and housing, and cobalt (Co) in steel components**, among other equally toxic substances.
- E-wastes are basically **PCB (Polychlorinated biphenyl) based, which are non-degradable.**
- Unauthorized processing of e-waste in developing countries can **lead to adverse human health effects and environmental pollution.**

**12. Define Air Quality Index and add different air pollution level.**

- **Air Quality Index (AQI)** is a number used by government agencies to communicate to the public how polluted the air is at a given time.

Air Quality Index		
AQI	Air Pollution Level	Colour
0-50	Good	GREEN
51-100	Moderate	LIGHT GREEN
101-150	Unhealthy for Sensitive Groups	YELLOW
151-200	Unhealthy	ORANGE
201-300	Very Unhealthy	LIGHT RED
301+	Hazardous	DARK RED

**13. List out the Methods of disposal of radioactive wastes.**

**(i) Limit generation**

- **Limiting the generation of waste** is the first and most important consideration in managing radioactive wastes.

**(ii) Dilute and disperse**

- For wastes having low radioactivity, **dilution and dispersion are adopted.**

**(iii) Delay and decay**

- Delay and decay is frequently an important strategy because much of **the radioactivity in nuclear reactors and accelerators is very short lived.**

**(iv) Concentrate and confine process**

- Concentrating and containing is the objective of treatment activities for **longer lived radioactivity.**
- The waste is contained in **corrosion resistant containers and transported to disposal sites.**

**14. Mention the information that the health workers derive by measuring BOD of a water body.**

- **BOD (biochemical oxygen demand)** is the amount of the **oxygen required by micro organisms to decompose the organic matter** present in one litre of water during a particular time period.
- BOD test measures **degree of impurity of water.**



- As higher the BOD, **more will be the pollution.**
- Thus, indirectly **BOD is a measure of the organic matter present in the water.**

**15. Chlorofluorocarbons (CFCs) are widely used as collents. Then why it is suggested to reduce its emission as far as possible? Explain.**

- Chlorofluorocarbons (CFCs) are **greenhouse gases which contribute to 14% of global warming.**
- **CFCs cause ozone hole.**
- In the stratosphere, **chlorofluorocarbon is degraded in the presence of UV-radiation, releasing Cl atoms.**
- **Cl acts as catalyst in the degradation of ozone releasing molecular oxygen.**

**PART-D**

**ADDITIONAL QUESTIONS (5 MARKS)**

**1. Write short notes on classification of Pollutants.**

- In terms of eco-system, pollutants can be classified into two basic groups : Non-degradable and degradable.
  - Based on the time taken to breakdown into their ingredients, degradable pollutants are classified as rapidly degradable (non-persistent) and slowly degradable (persistent).
- a) **Rapidly degradable or non-persistent pollutants:**
- ✓ These can be broken down by natural processes.
  - ✓ Domestic sewage and vegetable waste are examples of such pollutants.
- b) **Slowly degradable or persistent pollutants:**
- ✓ These are pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade, as in the case of DDT.
- c) **Non-degradable pollutants:**
- ✓ These cannot be degraded by natural processes.
  - ✓ Once they are released into the environment, they are difficult to be eliminated and continue

to accumulate (bio-magnification).

- ✓ Toxic elements like lead, mercury, cadmium, chromium and nickel are such common pollutants.

**2. List out the Effects of Air Pollution.**

- Affects all organisms as they **depend on the atmosphere for respiration.**
- Air pollution causes **irritation in the throat, nose, lungs and eyes.**
- It causes **breathing problems** and aggravates existing health conditions such as **emphysema and asthma.**
- Contaminated air **reduces the body's defense mechanism** and decreases the body's capacity to fight other infections in the respiratory system.
- Frequent exposure to polluted air **increases the risk of cardiovascular diseases.**
- Breathing air that is filled with fine particulate matter can **induce hardening of the arteries, triggering cardiac arrhythmia or even a heart attack.**
- People who **exercise outdoors can be susceptible to adverse effects of air pollution** because it involves deeper and faster breathing.
- Hence it is advisable to **walk or jog in the mornings** in places with ample tree cover.
- Gas leaks can be **lethal or affect the quality of air in the affected area.**
- **CO in the atmosphere interferes with O<sub>2</sub> transport** since hemoglobin has greater affinity for carbon monoxide.
- At low concentration **it causes headache and blurred vision.**
- In higher concentration, it can **lead to coma and death.**

**3. List out the Steps taken by the Central and the State governments of India to control air pollution.**

- **Road traffic rationing, encourage public transport, carpooling.**
- **Increase green cover along side roads** (planting avenue trees).
- **Promoting Swachh Bharat Abhiyan**

- Enactment and Enforcement of **stricter environmental laws**
- **Maintenance of air standards** by proper enforcement and monitoring
- **Reducing carbon emissions**
- Encourage **use of renewable energy**
- **Limiting the sale of fire crackers** and **developing eco-friendly crackers**
- Make **Environmental Impact Assessment** compulsory

#### 4. What are the Effects of Water pollution on Organisms?

- Water pollution can be **lethal to aquatic organisms and others** that depend on these water bodies.
- Oil spills from tanker ships can cause **substantial environmental damage**.
- Oil spreads on the water surface, **prevents the entry of light and oxygen** into the water.
- This **increases BOD and COD**, resulting in mass death of organisms and degradation of water quality.
- It also **clogs fish gills and the feathers of aquatic birds**.
- In Humans it **causes hepatitis and typhoid** by consuming contaminated water and food.
- **Excess of fluoride** in drinking water causes **fluorosis**.
- **Outbreak of water borne diseases and epidemics diseases** are a result of contaminated water.
- Water pollution can cause **eutrophication** due to nutrient enrichment.
- This **causes algal blooms** which affect the quality of water bodies.

#### 5. List out the effects of over usage of agrochemicals.

- It may **kill beneficial bacteria and soil organisms**.
- Can cause **eutrophication** in water bodies.
- **Affect aquatic animals** and their productivity.
- Pesticide containing water, even in trace quantities is **unfit for human consumption**.
- Particles (aerosols) and residues of **these**

**chemicals cause air pollution.**

- Inhalation of contaminated air can **cause respiratory problems**.
- Consumption can lead to **poisoning, side effects and after effects**.
- Chemicals can cause **skin rashes and irritation of eyes**.
- Many of these **chemicals are carcinogenic**.
- They can trigger **hormonal disorders and neurotoxicity**.
- **Beneficial insects and animals can be affected**.

#### 6. Write an essay on waste water treatment.

- Waste water treatment can be carried out by three ways:
  - ✓ **Physical methods**
  - ✓ **Chemical methods**
  - ✓ **Biological methods**

##### Physical methods of wastewater treatment

- Wastewaters containing insoluble substances or colloids are treated through processes such as **flotation, sedimentation, filtration and centrifugal separation**.

##### Chemical methods of Wastewater treatment

- This method includes **Generation of insoluble solids**.
- **Produce an insoluble gas**.
- **Produce biologically degradable substances** from a non-biodegradable substance.
- Oxidize or reduce to produce a non-objectionable substance.

##### Biological methods of Wastewater treatment

- Bioremediation of wastewater includes the **aerobic treatment** (oxidation ponds, aeration lagoons) and **anaerobic treatment** (anaerobic bioreactors, anaerobic lagoons).
- Phytoremediation of wastewater includes constructed **wetlands, Root Zone Wastewater Treatment (RZWT), and Decentralized Waste Water Treatment System (DEWATS)**.



### 7. Write short notes on Sources of Water Pollution?

- Even though water bodies or sources can be polluted by **natural causes and human activities**.
- There are three main types of sources: **point sources, non-point sources, leaks and spills**.

#### Point sources:

- **Discharge of pollutants** at specific locations through pipelines or sewers into the water body.
- **Factory effluents, sewage, underground mines, oil wells, oil tankers and agriculture** are common point sources.

#### Non-point sources:

- Sources that cannot be traced to a single site of discharge like **acid rain, dumping of the plastics in water bodies, agriculture chemical run off** are common examples.

#### Leaks and Spills:

- This occurs mostly due to **ship collision, off shore oil rigs, oil leakages and discharges into sea**.
- Sources of water pollution can also be classified in three ways:
  - **Municipal wastes**
  - **Industrial wastes**
  - **Agricultural wastes**

#### Municipal wastes

- **Water is from homes and commercial establishments.**

#### Industrial wastes

- It may contain varieties of compounds such as **heavy metals (cadmium, chromium, lead), and organic / inorganic chemicals**

**containing waste water**, sometimes in toxic concentrations.

- These discharges can **affect temperatures of the water bodies as well as dissolved oxygen level**.

#### Agricultural wastes

- It include **fertilizer and pesticide runoff** from agricultural fields, food processing waste, tree and saw dust from logging operations and bacteria from sewage or livestock operations.
- Water pollutants reach water bodies like **rivers, streams and the marine system by precipitation, run-off and the groundwater by seepage or percolation**.

### 8. Write an essay on People's Participation in Conservation of Forests.

- **People's participation is vital in forest conservation**, especially those living in them or close to the forest.
- This is referred to as **Community forestry**, which varies widely in legal, political and cultural settings and the term covers a wide range of experiences and practices.
- **The Bishnois, who are known conservators of their forest**, were inspiration to many people's participatory movements for Environmental protection in India.
- The **Chipko movement** resisted the destruction of forests of India **in the 1970s**.
- **Sunderlal Bahuguna** was the leader of this movement.
- People in the movement **hugged the trees, and prevented felling of trees by contractors**.
- The '**Forest man of India**', **Jadav Payeng** who created 1,360 acres of dense and defiant



forest was born in **Arunasapori** (a river island on the Brahmaputra).

- He had just completed his Class X exams in 1979 when **he started to sow the seeds and shoots** on the eroded island covered with sand and silt.
- Thirty-six years later he had **converted the once unproductive land into a forest.**
- Payeng's forest is now home to **five Royal Bengal tigers, over a hundred deer, wild boar, vultures, and several species of birds.**
- For his remarkable initiative, the **Jawaharlal Nehru University invited Payeng in 2012 on Earth Day and honoured him with the title of the 'Forest Man of India'.**
- Later, the President **APJ Abdul Kalam felicitated him with a cash award** in Mumbai.
- The same year, he received the **'Padma Shri'.**
- The Indian Constitution also **stresses on the importance of the role of the People in protecting their environment.**

#### 9. Who is Nammalvar? Write his contributions?

- G. Nammalvar was a **supporter and expert of organic farming.**
- He was an **agricultural scientist, environmental activist** celebrated for his work on spreading Ecological farming & Organic farming.
- He was **against the use of chemical fertilizers** and pesticides.
- He **trained hundreds of farmers** in natural farming.
- Nammalvar was the author of several Tamil and English books on **natural farming, pesticides & fertilizers** and was featured

**in magazines & television programs.**

- He founded the **Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust** or simply Vaanagam at Karur, Tamilnadu.
- He developed social forest at **Ammankurai and the Kolunji Ecological Farm** in Pudukottai.
- He and his friends made a **10-acre barren** land into fertile cultivable land in the dry Pudukottai district.
- He planted **52 varieties of trees** in the same waste land extending in 20 acres.
- His organization **'Kudumbam'** **preserves and regenerates hundreds of native flora and fauna**, in order to ensure a sustainable livelihood.

#### 10. Write a short note on electronic waste. List the various sources of e-wastes and the problems associated with its disposal.

- **Discarded computers and other electronic items** comprise electronic waste.
- E-waste contains various metals like **copper, iron, nickel, gold, silver, etc.** and plastic.

#### Sources of E-waste:

- **Computers, printers, scanners, webcam, mobile phones, music players, e-reader,** etc.

#### Problems associated with disposal of e-waste:

- Dumping of e-waste will **result in accumulation of plastic on land.**
- Extraction of metals; like iron or gold involves **incineration of plastic components which creates many polluting substances.**
- **Manual handling of e-waste can be harmful for workers.**

### 11. What is organic farming? List the benefits of organic farming.

- Organic farming is a method of farming that **relies on various methods and inputs** so that no synthetic input is used in the process.
- **Green manure is used** instead of synthetic fertilizers.
- **Pesticides and weedicides from natural sources** are used and those from synthetic sources are not used.

#### Benefits of Organic Farming:

- ✓ Organic farming can be highly beneficial to the country; because organic farming is highly labour oriented.
- ✓ Majority of Indian farmers **still use cattles for farm operations**.
- ✓ This means good **availability of raw materials** for making green manure.
- ✓ Indian farmers have **traditional knowledge of many plants** which have pesticidal and weedicidal properties.
- ✓ This knowledge can be **harnessed to get maximum output** from organic farming.
- ✓ Organic farming will also help in **reducing soil pollution and groundwater pollution**; especially in rural areas.

### 12. List out different kind of waste and its sources

Waste category	Source
<b>Residential</b>	Food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes, tires, batteries, old mattresses
<b>Industrial</b>	Packaging wastes, ashes, chemicals, cans, plastics, metal parts
<b>Commercial</b>	Thin and thick plastics, food wastes, metals, paper, glass, wood, cardboard materials.
<b>Institutional</b>	Wood, paper, metals, cardboard materials, electronics.
<b>Construction and Demolition</b>	Steel materials, concrete, wood, plastics, rubber, copper wires, dirt and glass.
<b>Agriculture</b>	Agricultural wastes, spoiled food, pesticide containers
<b>Biomedical</b>	Syringes, bandages, used gloves, catheter, urine bags, drugs, paper, plastics, food wastes, sanitary napkins and diapers, chemicals.
<b>E-waste</b>	Electronic items like used TVs, transistors, tape recorders, computer cabinets, mother boards, CDs, cassettes, mouse, wires, cords, switches, chargers.



**Time Allowed: 1.15 Hours**

**Maximum Marks: 35**

**SECTION – A**

**8 X 1 = 8**

**Note: i. Answer all the questions.  
ii. Each question carries 1 mark.**

**I. Choose the most suitable answer from the given.**

1. **Type of binary fission occur in flagellates is \_\_\_\_\_**
  - a) Irregular binary fission
  - b) Transverse binary fission
  - c) Longitudinal binary fission
  - d) Oblique binary fission
2. **Mammalian egg is \_\_\_\_\_**
  - a) Mesolecithal and non cleidoic
  - b) Microlecithal and non cleidoic
  - c) lecithal and non cleidoic
  - d) Alecithal and cleidoic
3. **A contraceptive pill prevents ovulation by \_\_\_\_\_**
  - a) blocking fallopian tube
  - b) inhibiting release of FSH and LH
  - c) stimulating release of FSH and LH
  - d) causing immediate degeneration of released ovum.
4. **Non – sense codons take part in \_\_\_\_\_**
  - a) formation of unspecified aminoacids
  - b) Termination of protein synthesis
  - c) Releasing t-RNA from polynucleotide chain
  - d) Conversion of sense DNA in to non-sense one
5. **The age of fossils can be determined by \_\_\_\_\_**
  - a) electron microscope
  - b) weighing the fossils
  - c) carbon dating
  - d) analysis of bones
6. **Which one is not used in the production of yoghurt?**
  - (a) Streptococcus lactis
  - (b) Streptococcus thermophilous
  - (c) Lactobacillus bulgaris
  - d) Both (2) & (3)
7. **What type of human population is represented by the following age pyramid?**
  - a) Vanishing population
  - b) Stable population
  - c) Declining population
  - d) Expanding population



8. **What is importance of catalytic converter?**
- They increases average of the vehicles
  - They reduces emission of harmful gases
  - They convert CO and nitric oxide into  $\text{CO}_2$  and  $\text{H}_2\text{O}$
  - Both B and C

**SECTION – B**

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**II. ANSWER ANY FOUR OF THE FOLLOWING****4 X 2 = 8**

- Why is the offspring formed by asexual reproduction referred as a clone?**
- What is the role of Epidymis in reproduction ?**
- How will you calculate the size of DNA molecule?**
- What is Activates sludge?**
- List out the adaptations of camel.**
- Compare and Contrast the insitu and exsitu conservation.**

**SECTION – C**

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**III. ANSWER ANY THREE OF THE FOLLOWING. QUESTION NO. 18 IS COMPULSORY.****3 X 3 = 9**

- Write notes on accessory gland in male?**
- Differentiate between 'ZZ' and 'XY' type of sex-determination mechanisms.**
- State and explain any three factors affecting allele frequency in populations.**
- Write short notes on ethical issues of biotechnology?**
- List out the Effect of Noise Pollution.**

**SECTION – D**

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**IV. ANSWER ALL THE QUESTIONS****2 X 5 = 10**

- Explain any three Assisted Reproductive Technologies in detail.**  
(or)
- Why did Hershey and Chase use radioactively labelled phosphorous and sulphur only? Would they have got the same result if they use radiolabelled carbon and nitrogen?**
- Write short notes on a) Payer patches b) Tonsils c) Spleen?**  
(or)
- Write short notes on Population Interaction?**