

Mathematics General 2

**General
Instructions**

- Reading time – 5 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using black pen
- NESA approved calculators may be used
- A formulae and data sheet is provided at the back of this paper
- In Questions 26–30, show relevant mathematical reasoning and/or calculations

**Total marks:
100**

Section I – 25 marks (pages 2–12)

- Attempt Questions 1–25
- Allow about 35 minutes for this section

Section II – 75 marks (pages 13–36)

- Attempt Questions 26–30
- Allow about 1 hour and 55 minutes for this section

Section I

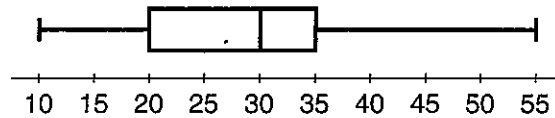
25 marks

Attempt Questions 1–25

Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–25.

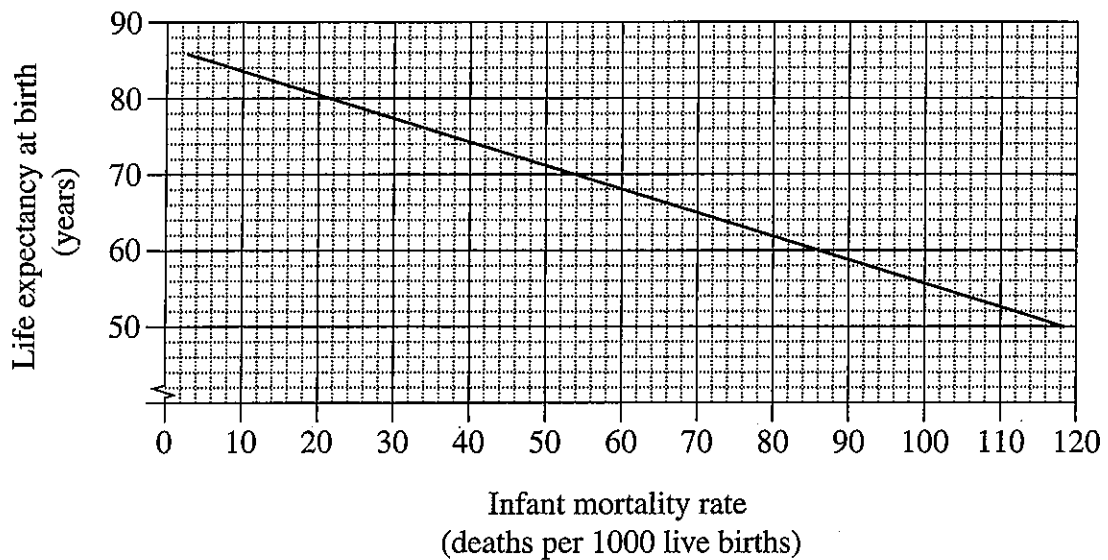
- 1 The box-and-whisker plot for a set of data is shown.



What is the median of this set of data?

- A. 15
 - B. 20
 - C. 30
 - D. 35
- 2 A car is travelling at 95 km/h.
- How far will it travel in 2 hours and 30 minutes?
- A. 38 km
 - B. 41.3 km
 - C. 218.5 km
 - D. 237.5 km

- 3 The graph shows the relationship between infant mortality rate (deaths per 1000 live births) and life expectancy at birth (in years) for different countries.



What is the life expectancy at birth in a country which has an infant mortality rate of 60?

- A. 68 years
B. 69 years
C. 86 years
D. 88 years
- 4 A factory's quality control department has tested every 50th item produced for possible defects.

What type of sampling has been used?

- A. Random
B. Stratified
C. Systematic
D. Quantitative

- 5 In a survey of 200 randomly selected Year 12 students it was found that 180 use social media.

Based on this survey, approximately how many of 75 000 Year 12 students would be expected to use social media?

- A. 60 000
- B. 67 500
- C. 74 980
- D. 75 000

- 6 Tom earns a weekly wage of \$1025. He also receives an additional allowance of \$87.50 per day when handling toxic substances.

What is Tom's income in a fortnight in which he handles toxic substances on 5 separate days?

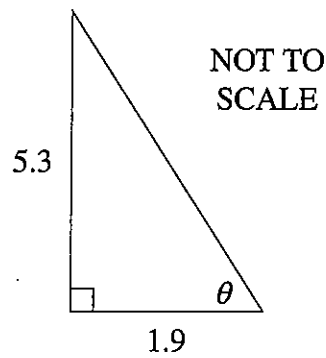
- A. \$1112.50
- B. \$1462.50
- C. \$2225.00
- D. \$2487.50

- 7 It is given that $I = \frac{3}{2}MR^2$.

What is the value of I when $M = 26.55$ and $R = 3.07$, correct to two decimal places?

- A. 375.35
- B. 3246.08
- C. 9965.45
- D. 14 948.18

- 8 The diagram shows a right-angled triangle.



What is the value of θ , to the nearest minute?

- A. $70^{\circ}16'$
B. $70^{\circ}17'$
C. $70^{\circ}27'$
D. $70^{\circ}28'$
- 9 What is the value of x in the equation $\frac{5-x}{3} = 6$?
- A. -13
B. -3
C. 3
D. 13
- 10 A single amount of \$10 000 is invested for 4 years, earning interest at the rate of 3% per annum, compounded monthly.

Which expression will give the future value of the investment?

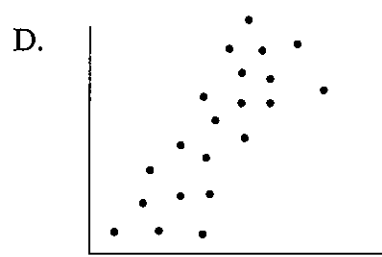
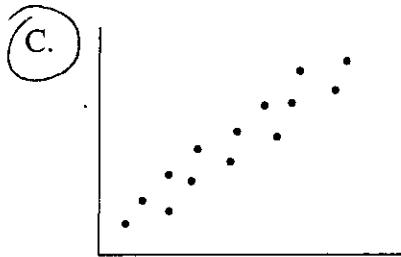
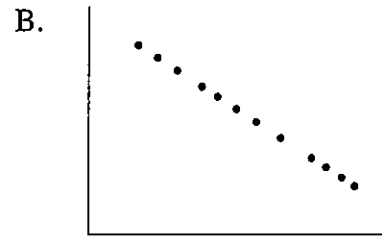
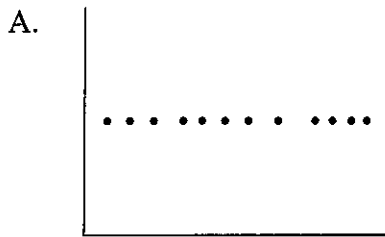
- A. $10\,000 \times (1 + 0.03)^4$
B. $10\,000 \times (1 + 0.03)^{48}$
C. $10\,000 \times \left(1 + \frac{0.03}{12}\right)^4$
D. $10\,000 \times \left(1 + \frac{0.03}{12}\right)^{48}$

- 11 A new car was bought for \$19 900 and one year later its value had depreciated to \$16 300.

What is the approximate depreciation, expressed as a percentage of the purchase price?

- A. 18%
- B. 22%
- C. 78%
- D. 82%

- 12 Which of the data sets graphed below has the largest positive correlation coefficient value?



- 13 The heights of Year 12 girls are normally distributed with a mean of 165 cm and a standard deviation of 5.5 cm.

What is the z-score for a height of 154 cm?

- A. -2
B. -0.5
C. 0.5
D. 2

- 14 Kate is comparing two different models of car. Car A uses fuel at the rate of 9 L/100 km. Car B uses 3.5 L/100 km.

Suppose Kate plans on driving 8000 km in the next year.

How much less fuel will she use driving car B instead of car A?

- A. 280 L
 B. 440 L
C. 720 L
D. 1000 L

- 15 The faces on a twenty-sided die are labelled \$0.05, \$0.10, \$0.15, ..., \$1.00.

The die is rolled once.

What is the probability that the amount showing on the upper face is more than 50 cents but less than 80 cents?

- A. $\frac{1}{4}$
B. $\frac{3}{10}$
C. $\frac{7}{20}$
D. $\frac{1}{2}$

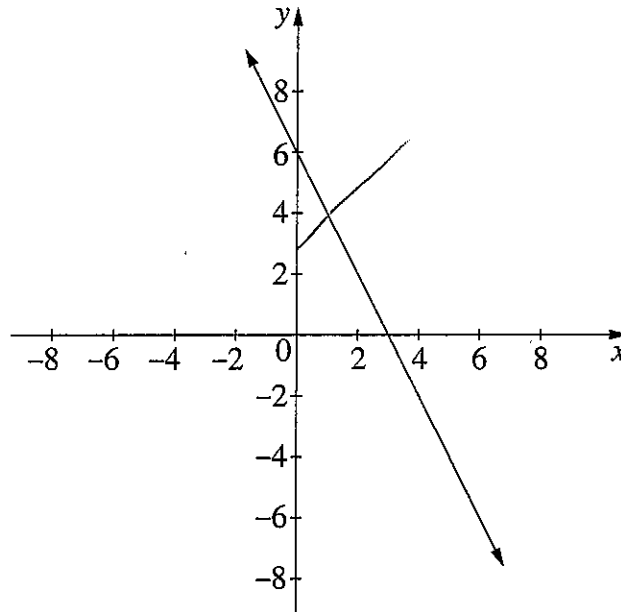
- 16 The benchmark for annual greenhouse gas emissions from the residential sector is 3292 kg of carbon dioxide per person per year.

A new building, planned to house 6 people, has been designed to achieve a 25% reduction on this benchmark.

What is the maximum amount of carbon dioxide per year, to the nearest kilogram, that this building is designed to emit when fully occupied?

- A. 823 kg
- B. 2469 kg
- C. 4938 kg
- D. 14 814 kg

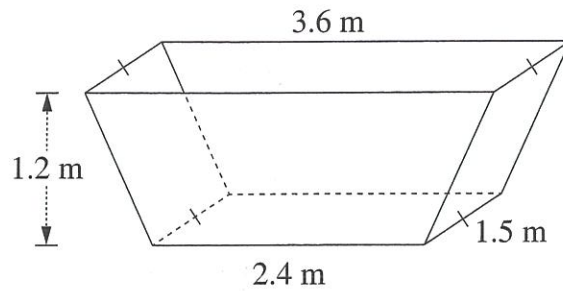
- 17 The graph of the line with equation $y = 6 - 2x$ is shown.



When the graph of the line with equation $y = x + 3$ is also drawn on this number plane, what will be the point of intersection of the two lines?

- A. (0, 6)
- B. (1, 4)
- C. (2, 2)
- D. (3, 0)

- 18 A skip bin is in the shape of a trapezoidal prism, with dimensions as shown.



What is the volume of the skip bin?

- A. 5.4 m^3
B. 7.776 m^3
C. 10.8 m^3
D. 15.552 m^3
- 19 Young's formula, shown below, is used to calculate the dosage of medication for children aged 1–12 years based on the adult dosage.

$$D = \frac{yA}{y + 12}$$

where D = dosage for children aged 1–12 years
 y = age of child (in years)
 A = adult dosage

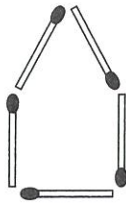
A child's dosage is calculated to be 20 mg, based on an adult dosage of 40 mg.

How old is the child in years?

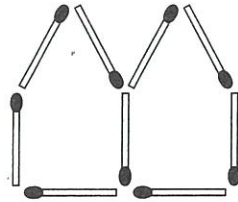
- A. 6
B. 8
C. 10
 D. 12

$$20 = \frac{y \times 40}{y + 12}$$
$$20y + 240 = 40y$$
$$20y = 240$$
$$y = 12$$

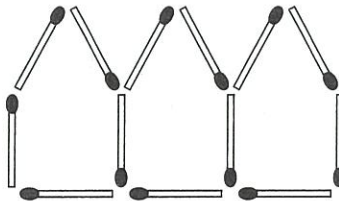
- 20 A pentagon is created using matches.



By adding more matches, a row of two pentagons is formed.



Continuing to add matches, a row of three pentagons can be formed.



Continuing this pattern, what is the maximum number of complete pentagons that can be formed if 100 matches in total are available?

- A. 25
- B. 24
- C. 21
- D. 20

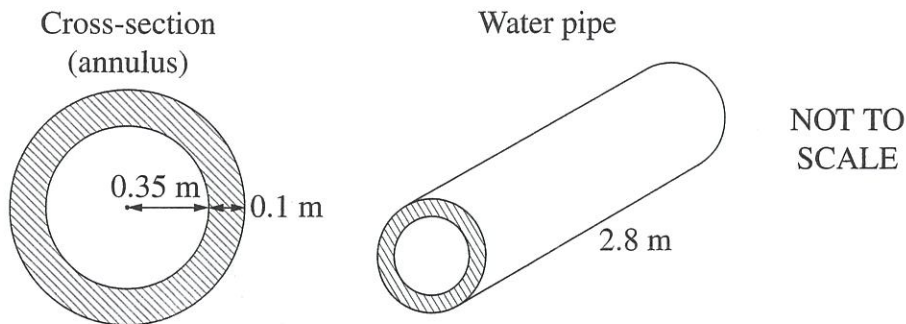
$$\begin{aligned}4P + 1 &= 100 \\4P &= 99 \\P &= 24\end{aligned}$$

- 21 The length of a netball court is measured to be 30.50 metres, correct to the nearest centimetre.

What is the lower limit for the length of the netball court?

- A. 30.45 m
- B. 30.49 m
- C. 30.495 m
- D. 30.499 m

- 22 A concrete water pipe is manufactured in the shape of an annular cylinder. The dimensions are shown in the diagrams.



What is the approximate volume of concrete needed to make the water pipe?

- A. 0.06 m^3
 B. 0.09 m^3
 C. 0.70 m^3
 D. 0.99 m^3
- 23 How many bits are there in 2 terabytes?

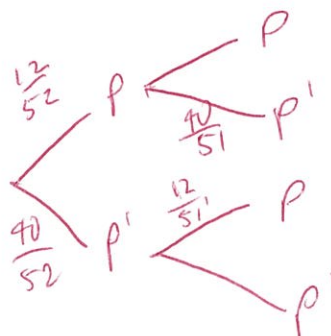
$$\begin{aligned}
 &2 \text{ TB} \\
 &\text{GB} \times 1024^4 \times 2^3 \\
 &\text{MB} \\
 &\text{KB} \quad 2 \times (2^{10})^4 \times 2^3 \\
 &\text{B} \\
 &b
 \end{aligned}$$

- A. 2^{40}
 B. 2^{41}
 C. 2^{43}
 D. 2^{44}

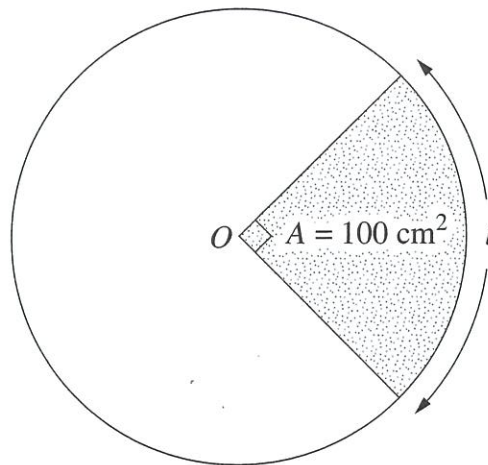
- 24 A deck of 52 playing cards contains 12 picture cards. Two cards from the deck are drawn at random and placed on a table.

What is the probability, correct to four decimal places, that exactly one picture card is on the table?

- A. 0.0498
 B. 0.1810
 C. 0.3550
 D. 0.3620



- 25 In the circle, centre O , the area of the quadrant is 100 cm^2 .



What is the arc length l , correct to one decimal place?

- A. 8.9 cm
- B. 11.3 cm
- C. 17.7 cm
- D. 25.1 cm

$$\frac{\pi r^2}{4} = 100$$

$$r^2 = \frac{400}{\pi}$$

$$\frac{2\pi r}{4} =$$

$$\frac{\pi r}{2}$$

$$\frac{\pi}{2} \times \sqrt{\frac{400}{\pi}}$$

2017

HIGHER SCHOOL CERTIFICATE
EXAMINATION

830

Centre Number

Mathematics General 2
Section II Answer Booklet

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Student Number

75 marks

Attempt Questions 26–30

Allow about 1 hour and 55 minutes for this section

Instructions

- Write your Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 26 (15 marks)

- (a) Electricity costs \$0.27 per kWh.

1

How much does 20 kWh cost?

$$20 \times 0.27 = \$5.40$$

- (b) Toby's mobile phone plan costs \$20 per month, plus the cost of all calls. Calls are charged at the rate of 70 cents per 30 seconds, or part thereof. There is also a call connection fee of 50c per call.

2

Here is a record of all his calls in July.

Date	Call duration
5 July	20 seconds
12 July	40 seconds
23 July	2 minutes 15 seconds

$$\begin{array}{l}
 70 + 50 \\
 2 \times 70 + 50 \\
 5 \times 70 + 50 \\
 \hline
 \$7.10
 \end{array}$$

How much is Toby's mobile phone bill for July?

$$\begin{array}{l}
 20 + 7.10 \\
 = \$27.10
 \end{array}$$

- (c) A farmer needed to estimate the number of goats on his property. He tagged 80 of his goats. Later, he collected a random sample of 45 goats and found that 16 of these had tags.

2

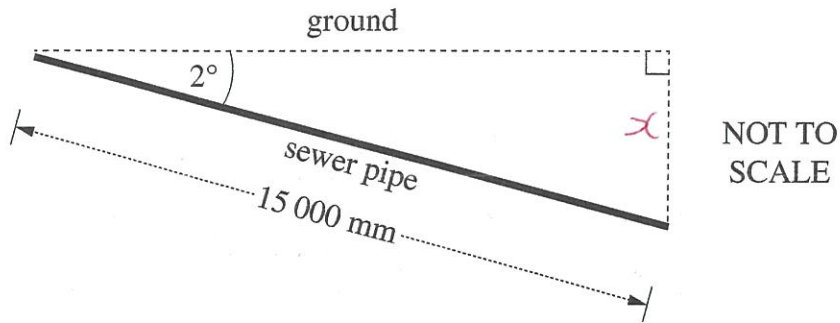
Estimate the number of goats the farmer has on his property.

$$\begin{array}{l}
 \frac{T}{80} = \frac{45}{16} \\
 = 225
 \end{array}$$

Question 26 continues on page 15

Question 26 (continued)

- (d) A sewer pipe needs to be placed into the ground so that it has a 2° angle of depression. The length of the pipe is 15 000 mm. 2



How much deeper should one end of the pipe be compared to the other end?
Answer to the nearest mm.

$$\sin 2 = \frac{x}{15000}$$

$$x = 15000 \sin 2$$

$$= 523 \text{ mm}$$

- (e) Sam purchased 500 company shares at \$3.20 per share. Brokerage fees were 1.5% of the purchase price. 3

Sam is paid a dividend of 26 cents per share, then immediately sells the shares for \$4.80 each.

If he pays no further brokerage fees, what is Sam's total profit?

$$500 \times 3.2 = \$1600$$

$$1.5\% \times 1600 = \$24$$

$$0.26 \times 500 = \$130$$

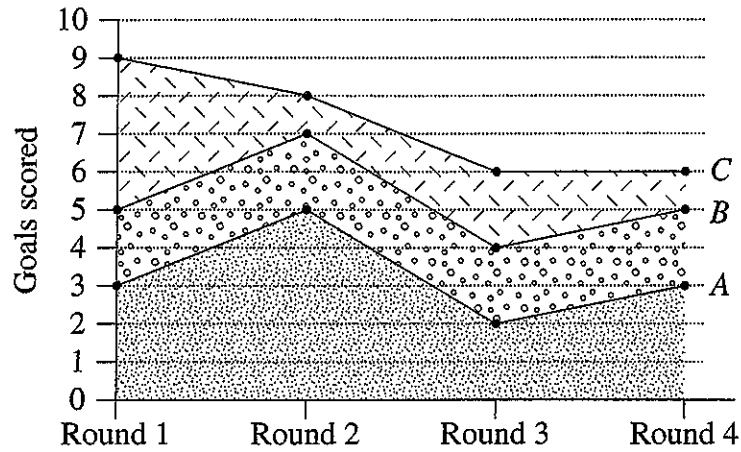
$$500 \times 4.8 = \$2400$$

$$2400 + 130 - 1600 - 24 = \$906$$

Question 26 continues on page 16

Question 26 (continued)

- (f) The area chart shows the number of goals scored by three hockey teams, A, B and C, in the first 4 rounds.



- (i) How many goals were scored by team C in round 1? 1

.....
 4

- (ii) In which round did all three teams score the same number of goals? 1

.....
 3

Question 26 continues on page 17

Do NOT write in this area.

Question 26 (continued)

- (g) Rachel bought a motorcycle advertised for \$7990. She paid a \$500 deposit and took out a flat-rate loan to repay the balance. Simple interest was charged at a rate of 7% per annum on the amount borrowed. She repaid the loan over 2 years, making equal weekly repayments.

3

Calculate the weekly repayment.

$$7990 - 500 = 7490$$

$$7490 \times 0.07 \times 2 = \$1048.60$$

$$\frac{7490 + 1048.6}{52 \times 2} = \$82.10$$

End of Question 26

Do NOT write in this area.

Question 27 (15 marks)

- (a) Jamal surveyed eight households in his street. He asked them how many kilolitres (kL) of water they used in the last year. Here are the results.

220, 105, 101, 450, 37, 338, 151, 205

- (i) Calculate the mean of this set of data. 1

..... 200.875
.....

- (ii) What is the standard deviation of this set of data, correct to one decimal place? 1

..... 127.4
.....

- (b) How many 20 megabyte files can fit on a 3 terabyte external hard disc? 2

..... $3 \times 1024^2 = 3145728$
..... $ANS \div 20 = 157286.4$
.....
..... 157286 files

Question 27 continues on page 19

Do NOT write in this area.

Question 27 (continued)

(c) A table of future value interest factors for an annuity of \$1 is shown.

Table of future value interest factors					
Period	Interest rate per period				
	1%	2%	3%	4%	5%
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019

An annuity involves contributions of \$12 000 per annum for 5 years. The interest rate is 4% per annum, compounded annually.

- (i) Calculate the future value of this annuity. 1

$$12000 \times 5.4163 = \$64995.60$$

- (ii) Calculate the interest earned on this annuity. 1

$$12000 \times 5 = 60000$$

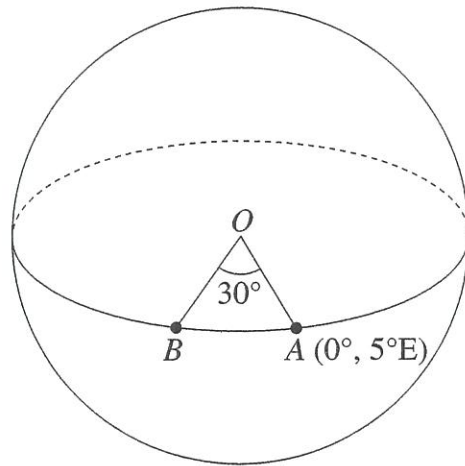
$$I = \$4995.60$$

Question 27 continues on page 20

Do NOT write in this area.

Question 27 (continued)

- (d) Island A and island B are both on the equator. Island B is west of island A. The longitude of island A is 5°E and the angle at the centre of Earth (O), between A and B, is 30° .



NOT TO SCALE

- (i) What is the longitude of island B? 1

25°W

- (ii) What time is it on island B when it is 10 am on island A? 1

$30^\circ = 2\text{ hrs}$

8am

- (iii) A ship leaves island A and travels west along the equator to island B. It travels at a constant speed of 40 km/h. 3

How long will the ship take to arrive at island B? Give your answer in days and hours to the nearest hour.

$$\frac{30}{360} \times 2\pi \times 6400 = 3351 \text{ km}$$

$$\text{ANS} = \frac{3351}{40} = 83.7758$$

3 days 12 hrs

Question 27 continues on page 21

Question 27 (continued)

- (e) Rhys is drinking low alcohol beer at a party over a five-hour period. He reads on the label of the low alcohol beer bottle that it is equivalent to 0.8 of a standard drink.

4

Rhys weighs 90 kg.

What is the maximum number of complete bottles of the low alcohol beer he can drink to remain under a Blood Alcohol Content (BAC) of 0.05?

$$\text{BAC} = \frac{10N - 7.5H}{6.8M}$$

$$0.05 \text{ BAC} = \frac{10N - 7.5 \times 5}{6.8 \times 90}$$

$$N = 6.81 \text{ standard drinks}$$

$$6.81 \div 0.8 = 8.5125$$

8 bottles

End of Question 27

Do NOT write in this area.

Question 28 (15 marks)

(a) Temperature can be measured in degrees Celsius (C) or degrees Fahrenheit (F).
The two temperature scales are related by the equation $F = \frac{9C}{5} + 32$.

- (i) Calculate the temperature in degrees Fahrenheit when it is -20 degrees Celsius. 1

$$\begin{aligned} F &= \frac{9(-20)}{5} + 32 \\ &= -40 + 32 \\ &= -8 \end{aligned}$$

- (ii) Solve the following equations simultaneously, using either the substitution method or the elimination method. 2

$$F = \frac{9C}{5} + 32$$

$$F = C$$

$$\begin{aligned} C &= \frac{9C}{5} + 32 \\ 5C &= 9C + 160 \\ -4C &= 160 \\ C &= -40 \\ F &= C = -40 \end{aligned}$$

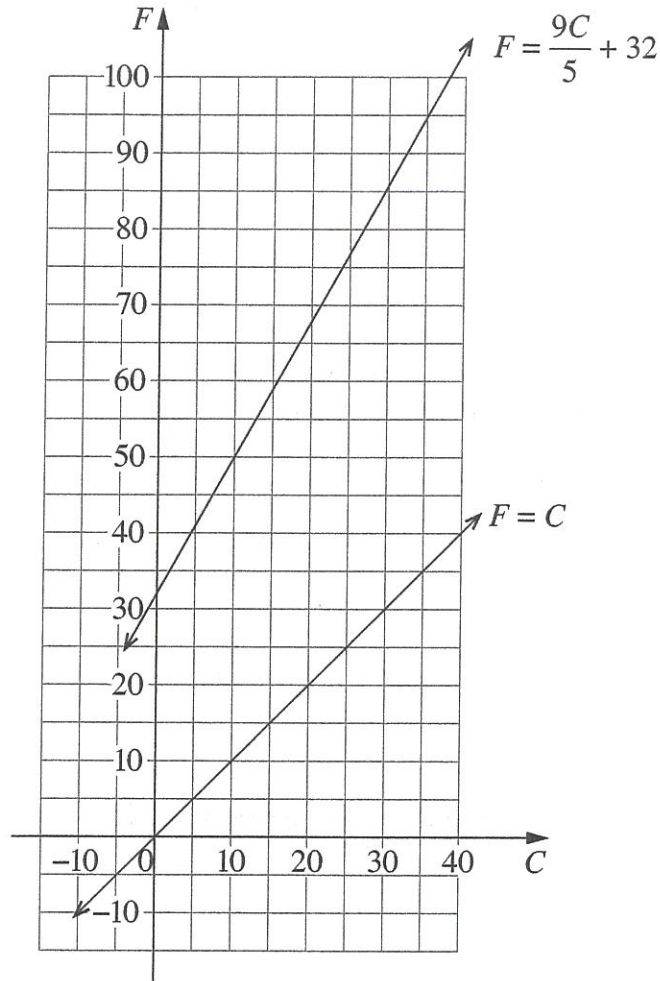
Question 28 continues on page 23

Do NOT write in this area.

Question 28 (continued)

- (iii) The graphs of $F = \frac{9C}{5} + 32$ and $F = C$ are shown below.

1



What does the result from part (ii) mean in the context of the graph?

Point of intersection
-40°F = -40°C (At what temp they'll be equal)

Question 28 continues on page 24

Question 28 (continued)

(b) Five people are in a team. Two of them are selected at random to attend a competition.

(i) How many different groups of two can be selected? 1

${}^5C_2 = 10$
.....
.....
.....
.....

(ii) If Mary is one of the five people in the team, what is the probability that she is selected to attend the competition? 1

$\frac{1}{5}$
.....
.....
.....
.....

Question 28 continues on page 25

Do NOT write in this area.

Question 28 (continued)

- (i) What ticket price should be charged to maximise the income from a movie session? 1

$$\$6 + \$8 = \$14$$

- (ii) What is the number of tickets sold when the income is maximised? 1

$$200 - 6 \times 10 = 140 \text{ tickets}$$

- (iii) The cost to the theatre owners of running each session is \$500 plus \$2 per ticket sold. 2

Calculate the profit earned by the theatre owners when the income earned from a session is maximised.

$$1960 - (500 + 2 \times 140)$$

$$\$1180$$

End of Question 28

Do NOT write in this area.

Question 28 (continued)

- (c) Michelle borrows \$100 000. The interest rate charged is 12% per annum compounded monthly. The monthly payment is \$1029 and the first repayment is made after one month.

3

What is the amount outstanding immediately after the SECOND monthly repayment is made?

$$100000(1.01) - 1029$$

$$\text{ANS}(1.01) - 1029$$

$$\$99941.71$$

- (d) Make y the subject of the equation $x = \sqrt{yp - 1}$.

2

$$x^2 = yp - 1$$

$$yp = x^2 + 1$$

$$y = \frac{x^2 + 1}{p}$$

Question 28 continues on page 26

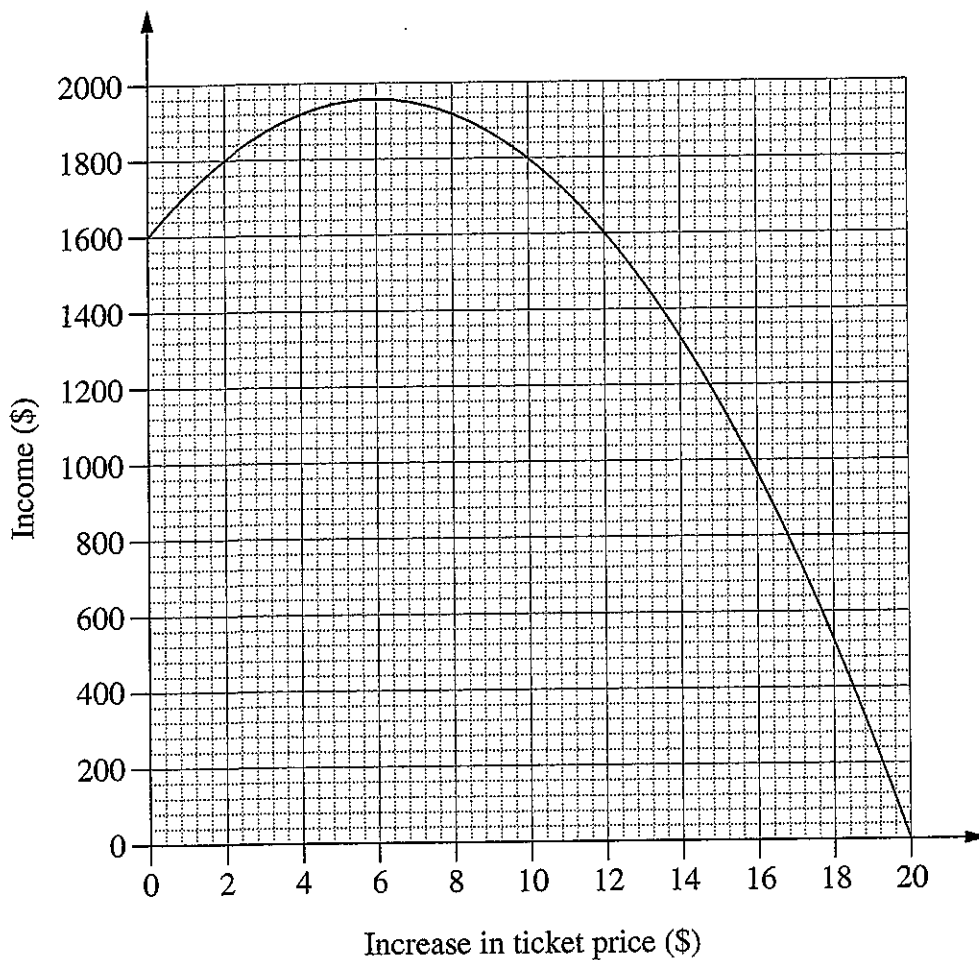
Question 28 (continued)

- (e) A movie theatre has 200 seats. Each ticket currently costs \$8.

The theatre owners are currently selling all 200 tickets for each session. They decide to increase the price of tickets to see if they can increase the income earned from each movie session.

It is assumed that for each one dollar increase in ticket price, there will be 10 fewer tickets sold.

A graph showing the relationship between an increase in ticket price and the income is shown below.

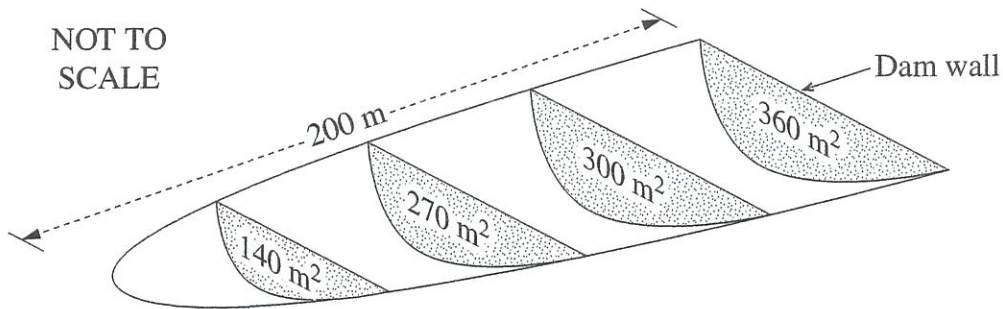


Question 28 continues on page 27

Question 29 (15 marks)

(a) A new 200-metre long dam is to be built.

The plan for the new dam shows evenly spaced cross-sectional areas.



(i) Using TWO applications of Simpson's rule, show that the volume of the dam is approximately 44 333 m³. 2

$$\frac{50}{3}(0 + 4 \times 140 + 270) + \frac{50}{3}(270 + 4 \times 300 + 360)$$

$$= 44333.3 \text{ m}^3$$

$$\approx 44333 \text{ m}^3$$

(ii) It is known that the catchment area for this dam is 2 km². 2

Calculate how much rainfall is needed, to the nearest mm, to fill the dam.

$$2 \text{ km}^2 = 2000000 \text{ m}^2$$

$$44333 \div 2000000 = 0.0221665 \text{ m}$$

$$= 22 \text{ mm}$$

Question 29 continues on page 29

Question 29 (continued)

- (b) Sabrina's taxable income is \$86 725 in a particular year.

3

The table below is used to calculate her tax payable. In addition, she pays the Medicare levy, which is 2% of her taxable income.

<i>Taxable income (\$)</i>	<i>Tax payable</i>
\$0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$87 000	\$3572 plus 32.5c for each \$1 over \$37 000
\$87 001 – \$180 000	\$19 822 plus 37c for each \$1 over \$87 000
\$180 001 and over	\$54 232 plus 45c for each \$1 over \$180 000

Calculate Sabrina's net income in that year.

M.C. $86725 \times 2\% = \$1734.50$
 Tax $3572 + 0.325(86725 - 37000)$
 $= \$19732.625$

Net = $86725 - 1734 - 19732.625$
 $= \$65258.38$

Question 29 continues on page 30

Do NOT write in this area.

Question 30 (15 marks)

- (a) A set of data has a lower quartile (Q_L) of 10 and an upper quartile (Q_U) of 16. 2

What is the maximum possible range for this set of data if there are no outliers?

$$IQR = 6$$

$$1.5 \times 6 = 9$$

$$1 - 25$$

- (b) The cost of a jewellery box varies directly with the cube of its height. 2

A jewellery box with a height of 10 cm costs \$50.

Calculate the cost of a jewellery box with a height of 12 cm.

$$C = kh^3$$

$$50 = k \times 10^3$$

$$k = \frac{5}{1000}$$

$$= \frac{1}{200}$$

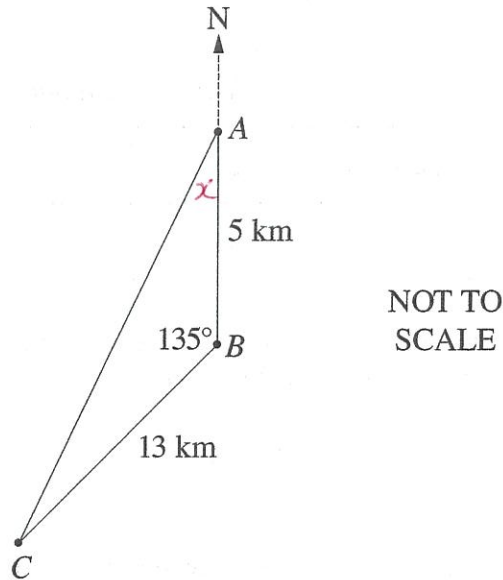
$$C = \frac{1}{200} \times 12^3$$

$$= \$86.40$$

Question 30 continues on page 33

Question 30 (continued)

- (c) The diagram shows the location of three schools. School A is 5 km due north of school B, school C is 13 km from school B and $\angle ABC$ is 135° .



- (i) Calculate the shortest distance from school A to school C, to the nearest kilometre. 2

$$x^2 = 5^2 + 13^2 - 2 \times 5 \times 13 \cos 135$$

$$x = 17 \text{ km}$$

- (ii) Determine the bearing of school C from school A, to the nearest degree. 3

$$\frac{\sin x}{13} = \frac{\sin 135}{17}$$

$$x = 32.7^\circ$$

$$\text{Bearing} = 213^\circ$$

Question 30 continues on page 34

Question 29 (continued)

- (c) A group of Year 12 students was surveyed. The students were asked whether they live in the city or the country. They were also asked if they have ever waterskied.

The results are recorded in the table.

	Have waterskied	Have never waterskied
Live in the city	150	2500
Live in the country	70	800

- (i) A person is selected at random from the group surveyed. 2

Calculate the probability that the person lives in the city and has never waterskied.

$$\frac{2500}{3520} = \frac{125}{176}$$

or 0.71 (2 d.p.)

- (ii) A newspaper article claimed that Year 12 students who live in the country are more likely to have waterskied than those who live in the city. 2

Is this true, based on the survey results? Justify your answer with relevant calculations.

country	$\frac{70}{870}$	city	$\frac{150}{2650}$
	0.08045977		0.0566...

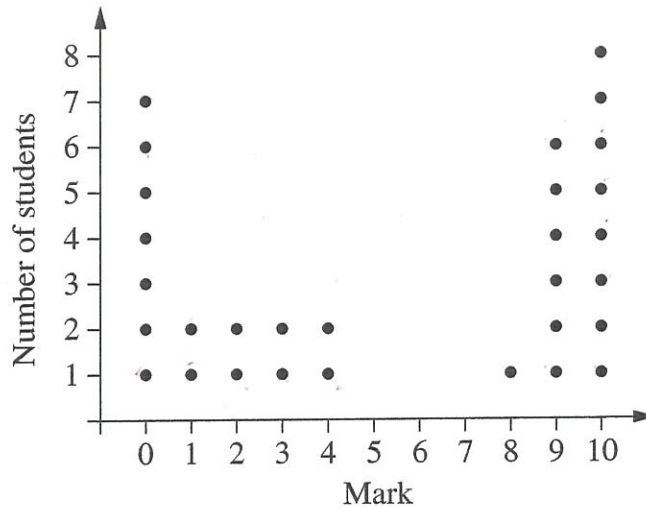
True

Question 29 continues on page 31

Question 29 (continued)

(d) All the students in a class of 30 did a test.

The marks, out of 10, are shown in the dot plot.



(i) Find the median test mark. 1

..... 6

(ii) The mean test mark is 5.4. The standard deviation of the test marks is 4.22. 2

Using the dot plot, calculate the percentage of the marks which lie within one standard deviation of the mean.

..... 1.18 - 9.62

..... $\frac{13}{30} = 43.3\%$

(iii) A student states that for any data set, 68% of the scores should lie within one standard deviation of the mean. 1

With reference to the dot plot, explain why the student's statement is NOT relevant in this context.

..... This is only true for normally distributed data, the dot plot is not normally distributed.

End of Question 29

Question 30 (continued)

- (d) In an investigation, students used different numbers of identical small solar panels to power model cars. The cars were then tested and their speed measured in km/h. The results are summarised in the table.

	Mean	Standard deviation
Number of solar panels (x)	2.9	0.8
Speed (y)	8.2	2

The equation of the least-squares line of best fit, relating the speed and the number of solar panels, has been calculated to be

$$y = 2.125x + 2.0375.$$

- (i) What would be the speed of a car powered by 5 solar panels, based on this equation? 1

$$\begin{aligned} & \dots\dots\dots 2.125 \times 5 + 2.0375 \\ & \dots\dots\dots = 12.6625 \end{aligned}$$

- (ii) Calculate the correlation coefficient, r , between the number of solar panels and the speed of a car. 2

$$\begin{aligned} & \dots\dots\dots 2.125 = r \frac{2}{0.8} \\ & \dots\dots\dots r = 0.885 \end{aligned}$$

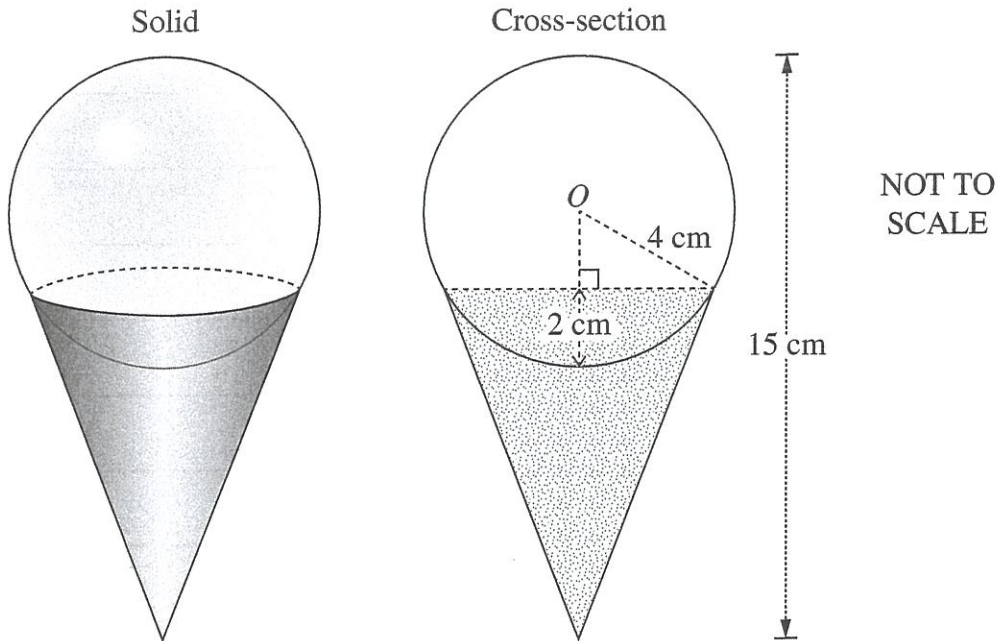
Question 30 continues on page 35

Question 30 (continued)

- (e) A solid is made up of a sphere sitting partially inside a cone.

3

The sphere, centre O , has a radius of 4 cm and sits 2 cm inside the cone. The solid has a total height of 15 cm. The solid and its cross-section are shown.



What is the volume of the cone, correct to the nearest cm^3 ?

$$\frac{\pi r^2 h}{3}$$

$$\frac{\sqrt{4^2 - 2^2}}{\sqrt{12}}$$

$$\frac{\pi \times \sqrt{12}^2 \times 9}{3}$$

$$= 113.097\dots$$

$$= 113 \text{ cm}^3$$

End of paper

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Lined writing area with 20 horizontal lines.

Do NOT write in this area.