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Examiners' Report
June 2015

GCSE Astronomy 5AS01 01

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Introduction

As in previous years, the Unit 1 examination paper required candidates to demonstrate knowledge and understanding of a wide range of astronomical phenomena, as well as applying their understanding to some unfamiliar situations.

It was clear from the responses of candidates to this paper that many centres work very hard to ensure that their candidates are not only aware of the key astronomical principles within the specification but also have a thorough understanding of them. This was evident in questions where candidates were asked to consider a new or unfamiliar situation. Generally, they showed considerable flexibility and understanding. It was also clear that a number of centres ensured that their candidates were extremely well-informed on astronomical developments and discoveries, often well beyond the requirements of the GCSE Specification.

This paper identified a few areas where candidates' understanding was a little uncertain. These included the location of the Ocean of Storms on the lunar surface (Q3), the types and details of active galaxies (Q4), the details of how the atmosphere affects astronomical observations (Q11), the stages in the determination of the distance to a Cepheid variable star (Q12), the correct labelling of the axes of a Hertzsprung-Russell Diagram (Q14), the details of the discovery of quasars (Q16) and of Ceres and Pluto (Q18) and the use of significant figures (Q3 and Q20). Detailed information on these areas can be found in the relevant sections of this report.

Question 1 (e) (i)

Most candidates were able to recall that Nitrogen is the most common gas in the Earth's atmosphere.

(e) The Earth and the planet Venus are of similar size but their atmospheres are very different. Give the name of the **most common** gas found in the atmospheres of:

(i) Earth

(1)

Oxygen

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Examiner Comments

Although Oxygen is arguably the most important gas in the Earth's atmosphere for human beings, the question was clear that it wanted the most **common** gas, ie Nitrogen.

0 marks

Question 1 (e) (ii)

Most candidates were able to recall that the most common gas in Venus' atmosphere is carbon dioxide.

(ii) Venus

(1)

SULPHIRIC ACID

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Examiner Comments

Although Venus' clouds of sulfur dioxide and sulfuric acid are a well-known feature of its atmosphere, these two chemical compounds represent only a tiny percentage of the planet's atmosphere as a whole.

0 marks

Question 2 (a) (ii)

This question examined candidates' understanding that since the solar wind causes the formation of comets' tails, they generally point away from it. Most candidates were, therefore, able to provide an arrow pointing away from one or other of the tails.

2 (a) Figure 1 shows a sketch of a comet.

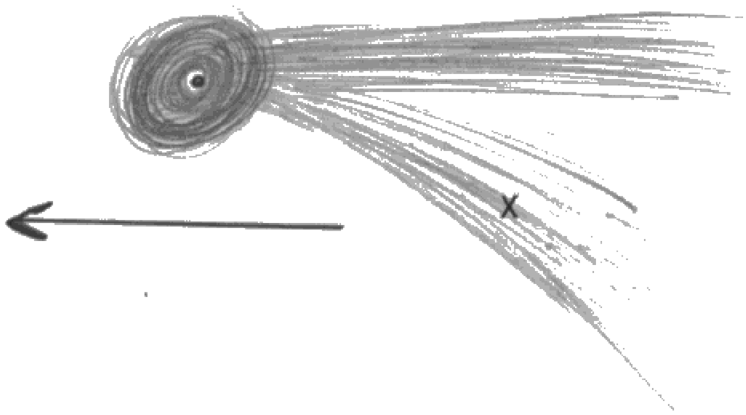

Figure 1

(i) What is the name of the curved tail labelled X?

(1)

☒ **A** dust tail

☒ **B** gas tail

☒ **C** ion tail

☒ **D** vapour tail

(ii) On Figure 1, draw an arrow to show the direction of the Sun.

(1)

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Examiner Comments

A significant minority of candidates assumed that the question required an arrow showing the direction of the Solar Wind.

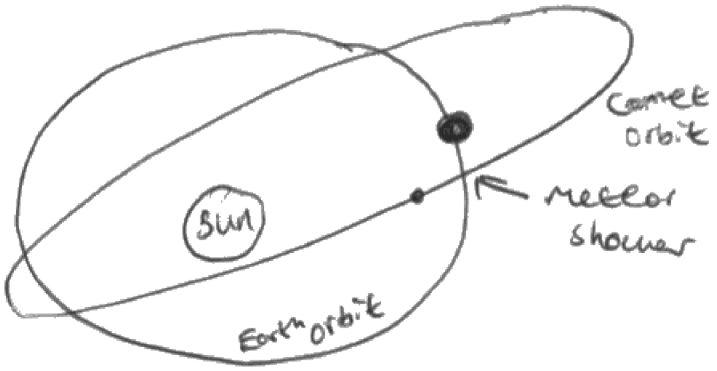
0 marks

Question 2 (b) (ii)

Success in this question required candidates to establish that the meteor shower was due to the Earth passing through something on its annual orbit of the Sun. Higher quality answers went on to explain that the shower was caused by the Earth passing through rocks and dust left behind by a comet.

(ii) Why do annual meteor showers occur on roughly the same date every year?
You may use a labelled diagram in your answer.

(2)



Meteor showers happen when the orbit of a comet crosses earth's orbit. The trail of dust lef behind by the comet burns up in Earth's atmosphere. Earth's orbit crosses the orbit of the comet at the right poi every year at roughly the same time.

(Total for Question 2 = 5 marks)

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Examiner Comments

Many candidates found that a labelled diagram was the best way to present their answer.

2 marks

Question 3 (a)

This question required candidates to identify three prominent lunar features from the list given in the specification.

3 (a) Figure 2 shows the Moon's nearside.

(Source: © NASA)

Figure 2

On Figure 2, indicate the location of the:

(i) Ocean of Storms (Use the letter **S**)

(ii) Apennine mountains (Use the letter **A**)

(iii) Tycho crater (Use the letter **T**)

(3)

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Examiner Comments

For some reason, although the crater Tycho and the Apennine mountains were identified accurately by the majority of students, the Ocean of Storms (Oceanus Procellarum) was not well known, with many candidates confusing it with the Mare Imbrium (Sea of Storms).

2 marks

Question 3 (b) (ii)

The vast majority of candidates were able to recall that the Moon's far side has more craters, fewer *maria* and more highland areas (*terrae*) than the near side.

Question 4 (b) (i)

This question required candidates to recall two examples of active galaxies from the list given in the specification.

(b) (i) There are numerous types of **active galaxy**. Name **two** of these types. **(2)**

1 Spiral

2 Barred Spiral

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Examiner Comments

Quite a number of candidates thought that this question was asking for two types of galaxy.

0 marks

Question 4 (b) (ii)

This question asked candidates for the features that distinguish an active galaxy from one without an active nucleus.

(ii) State **one** way in which an active galaxy is different from a normal galaxy. **(1)**

Has a black hole at the centre

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Examiner Comments

Many galaxies, which are not active galaxies, are also thought to have black holes at their centre.

0 marks

Question 6 (b)

This question examined candidates' awareness of the cultural influence on the choice of constellation shapes and names, with different cultures seeing different mythological figures in broadly similar sets of stars.

Question 6 (c)

Although many candidates could give examples of asterisms and constellations, providing a generalised distinction proved more difficult.

(c) There are now 88 recognised constellations and numerous asterisms. In what way does an asterism differ from a constellation?

(2)

An asterism is a group of stars which look as if they make a shape/symbol, a constellation is simply an ~~raw~~ area of the sky

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Examiner Comments

Some candidates appreciated the fact that an asterism is a pattern of stars but an official constellation actually refers to a part of the sky around the stars as well.

2 marks

(c) There are now 88 recognised constellations and numerous asterisms. In what way does an asterism differ from a constellation?

(2)

An asterism is a part of a constellation that can be used to recognise or find the constellation, ~~for example the plough~~

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Examiner Comments

Other candidates attempted a distinction based around the fact that many asterisms are sub-groups of the stars in a constellation, although asterisms such as the Summer Triangle did not fit in with this type of response.

1 mark

Question 6 (d) (i-ii)

Almost all candidates were able to give an example of an asterism and a constellation, with only a few giving them in the wrong order.

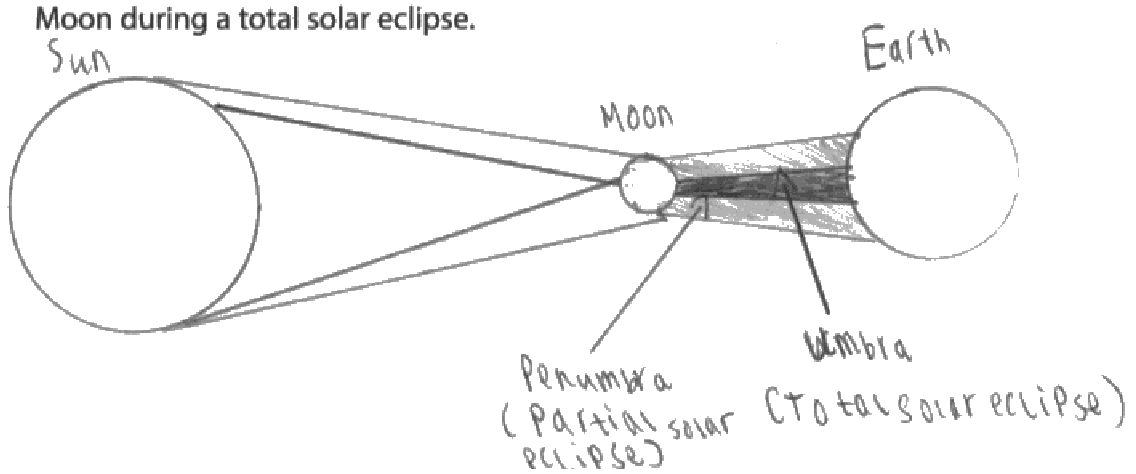
Question 7 (a)

Although many candidates went to great lengths drawing cones of umbral and penumbral shadows, this question simply required the three objects (Earth, Moon and Sun) to be placed in line, with the Moon in the middle.

Candidates were not required to include any suggestion of scale in their diagrams.

7 (a) Draw a labelled diagram to show the relative positions of the Sun, Earth and Moon during a total solar eclipse.

(2)



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Examiner Comments

Although an excellent diagram, the details of the shadows were not required by this question.

2 marks

Question 7 (b)

As set out in the mark scheme, to obtain full marks, candidates needed to establish a tilt between the orbital planes of the Earth (ie the ecliptic) and that of the Moon. Many candidates were clearly well on the right track but simply referred to the orbit of the Moon as being 'tilted' without stating the plane to which this tilt was orientated.

(b) Explain why solar eclipses do not occur every month.

(2)

becase the orbit of the moon is tilted by 5°

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Examiner Comments

This candidate has some quite detailed knowledge about the tilt of the Moon's orbit, supporting their answer with precise angles. However, they have not established the **two** planes between which this five-degree angle exists.

1 mark

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Examiner Tip

When writing about 'tilted' planes or giving angles between planes, it is essential to establish **both** planes. Objects in space cannot simply be 'tilted'.

Question 7 (c) (i)

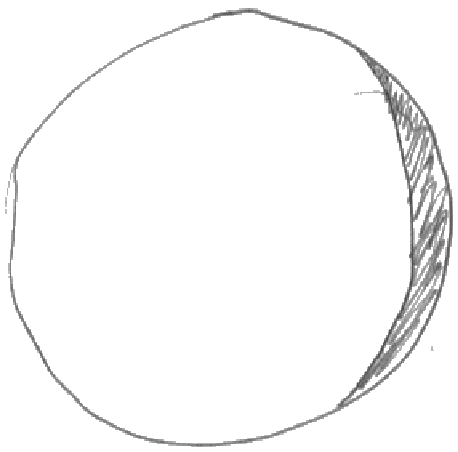
Almost all candidates were able to identify the Moon as being gibbous in this photograph.

Question 7 (c) (ii)

Although most candidates drew a crescent Moon, some drawings were rather ambiguous in terms of which part of the Moon's face was in shadow and which was illuminated.

(ii) Sketch how the Moon would have appeared 8 days earlier.

(1)



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Examiner Comments

Although this candidate has drawn the shadow terminator in the correct position for a crescent Moon, they have not indicated clearly which section of the circle is illuminated and which is in shadow.

In this 1-mark question, in the absence of any further indication in the candidate's answer, the marker must unfortunately assume that the crescent section is in shadow, resulting in a mark of zero.

0 marks

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Examiner Tip

When drawing lunar phases, always make it very clear in your answer which parts are illuminated and which are in shadow.

Question 8 (a) (i)

Any substantial source of unwanted illumination was acceptable here.

8 Figure 5 shows a photograph of the Milky Way, taken at an observatory in the southern hemisphere.

(Source: © Roger Smith/NOAO)

Figure 5

(a) On a clear night when there is very little light pollution, the Milky Way appears as a faint band of light across the sky.

(i) Name **one** source of light pollution.

(1)

The moon

ResultsPlus
Examiner Comments

This included natural sources such as the Moon, which, when full, can be a significant obstacle to astronomical observation.

1 mark

Question 8 (a) (ii)

For the mark to be awarded, some mention of our galaxy's broadly planar shape was required. Simply stating that we are inside the galaxy was not sufficient.

(ii) Why does the Milky Way appear as a band?

(1)

We are inside of the Milky Way.

ResultsPlus
Examiner Comments

This, on its own, is not sufficient to account for the band-like appearance of the Milky Way.

0 marks

Question 8 (a) (iii)

Confusion with objects such as black holes and dark matter characterised the incorrect responses to this question.

Question 8 (b)

For the award of either mark candidates needed to use particular scientific terms for the improved quality of the image. Simply stating that the image was 'better' or 'clearer' was insufficient.

(b) State **two** ways in which a pair of binoculars or a small telescope improve an observer's view of the Milky Way.

(2)

1 higher resolution

2 more light

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Examiner Comments

'Higher resolution' is obviously sufficiently precise for the award of a mark.

Although 'more light' is not incorrect, the mark scheme requires something more closely related to the observer's actual view (as requested in the question) such as 'brighter'.

1 mark

(b) State **two** ways in which a pair of binoculars or a small telescope improve an observer's view of the Milky Way.

(2)

1 Closer view of the milky way

2 clearer view of it.

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Examiner Comments

Terms such as 'closer' or 'clearer', although suggestive of the improvements in the image quality, relate more closely to the use of binoculars for viewing terrestrial objects and were insufficient in this question.

ResultsPlus
Examiner Tip

When writing about things such as image quality, always use precise astronomical terms such as 'brighter', 'sharper' or 'higher resolution'.

Question 8 (c)

Most candidates were able to identify another of the smaller members of the Local group.

Question 9 (a) (i)

Almost all candidates identified the two planets that are closer to the Sun than the Earth, ie Mercury and Venus, both of which were required for the award of the single mark in this question.

Question 9 (a) (ii)

Almost all candidates were able to calculate the correct answer of 52, with the units not required by this question.

Question 9 (a) (iii)

Almost all candidates were able to calculate the correct answer of 9.5, with the unit not being required by this question.

Question 9 (b) (ii)

Almost all candidates calculated the correct answer of 5m, with the correct unit being required for the award of a full three marks.

Question 10 (a) (i)

Two marks were available for this question to reward candidates who knew that a declination of 90 degrees should not be accompanied by a letter 'N' - a confusion with the notation for latitudes on the Earth's surface.

10 Nigel and Ruth were observing the stars around Polaris from a latitude of 58°N.

(a) (i) State the declination of Polaris (to the nearest degree).

(2)

90° N

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Examiner Comments

The ‘N’ here is not needed. Declinations are given as positive numbers in the northern half of the Celestial Sphere and as negative numbers in the southern half. Hence 90° is sufficient to indicate the point at the North Celestial Pole (the approximate position of the star Polaris).

1 mark

Question 10 (a) (ii)

The altitude of Polaris is equal to the observer's latitude, ie 58° in this question.

Question 10 (b)

To gain the mark in this question, candidates needed to refer to the Earth's rotation on its axis, rather than its orbital motion around the Sun. Candidates who referred ambiguously to the Earth's 'motion' were, therefore, not awarded this mark.

Question 10 (c)

Almost all candidates were able to supply the correct scientific term of 'circumpolar' for this question.

Question 10 (d)

Since the star has a declination of 34°, which is greater than the co-latitude of the observer (32°), it will be circumpolar and will therefore **not** set when observed by Nigel.

Question 11 (a) (i)

It was important to provide a reason specific to the observation of infrared radiation in this question, so potentially very general answers, such as 'light pollution', were not sufficient.

Question 11 (a) (ii)

A number of candidates simply listed gases present in the Earth's atmosphere, whereas the question specifically required those that absorb infrared radiation strongly.

Question 11 (b) (i)

Once again, very general answers could not be given credit and higher quality answers included specific terms.

(b) (i) The Earth's atmosphere has some benefits for humans. State **two** of these benefits.

(2)

1 ~~The~~ It absorbs harmful x-ray, Gamma and UV radiation

2 It regulates temperature so that water can stay in its liquid form

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Examiner Comments

This was an excellent answer, fully deserving of two marks. Instead of saying simply that the atmosphere protects us from 'radiation' or 'harmful radiation' it gave some of the specific wavebands that are fortunately blocked.

The second response went well beyond the atmosphere's importance in providing liquid water on the Earth's surface, to explain something of the process behind it.

2 marks

Question 11 (b) (ii)

As in several other questions, overly general answers were insufficient. A specific observational difficulty was needed for the award of the mark.

(ii) In addition to absorbing infrared radiation, the Earth's atmosphere has further drawbacks for astronomers. State **one** of these drawbacks.

(1)

Makes fainter stars impossible to see

ResultsPlus
Examiner Comments

This answer gave a specific observational problem caused by the atmosphere and thus gained the mark.

1 mark

(ii) In addition to absorbing infrared radiation, the Earth's atmosphere has further drawbacks for astronomers. State **one** of these drawbacks.

(1)

it absorBs all x-ray radiation

ResultsPlus
Examiner Comments

This was an example of another specific observational difficulty associated with the Earth's atmosphere, ie that observation of some regions of the EM spectrum must take place above the atmosphere.

1 mark

Question 12 (a) (i)

Most candidates were able to find a period between 6 and 8 days from the graph provided but a number lost a mark by not providing the correct unit (days).

Question 12 (a) (ii)

The three clear stages in this process, as set out in the mark scheme, were appreciated by many candidates, although some neglected to mention the first step of determining the period of the variable star from its light curve.

(ii) Explain how astronomers determine the distance to a Cepheid variable star.

(3)

Cephid Variable Stars have their ~~rotational~~ time period measured, which can be put on a graph to work out the Apsolute magnitude Then you take the average apparent magnitude and rearrange the equation $M=m+5-5\log d$ to work out the distance.

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Examiner Comments

This was an example of a sound 3-mark answer, despite the spelling error in 'Absolute'.

3 marks

Question 12 (b) (i)

For some reason, a number of candidates simply copied the numerical labels from Figure 7 and did not appreciate the need for a 10-day period between each mark on the axis of Figure 8.

(b) Figure 8 shows the light curve for an eclipsing binary star.

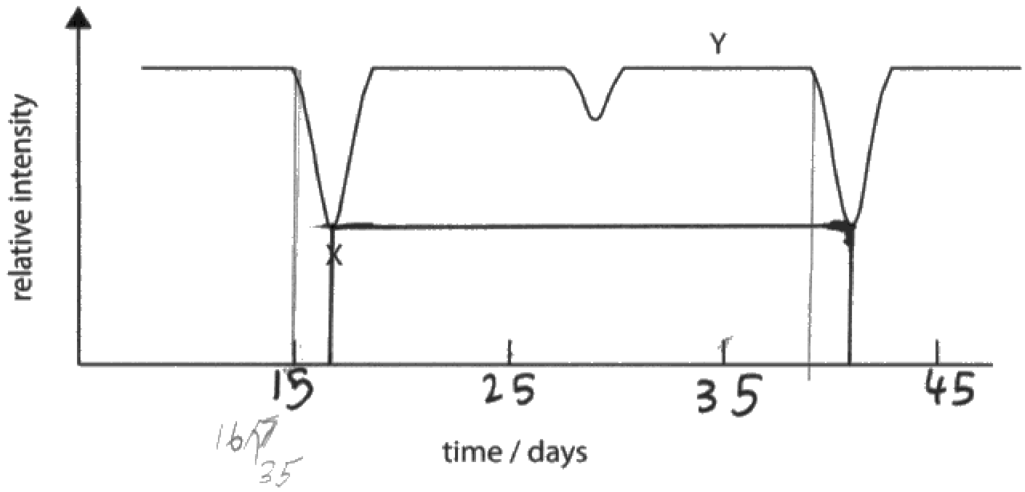

Figure 8

(i) The time period of this eclipsing binary is 26 days. Add the correct numbers to the horizontal scale to show this.

(1)

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Examiner Comments

Since the zero on the horizontal axis of Figure 8 was not established, this answer was acceptable as it clearly establishes a value of ten days to each division on the scale.

1 mark

Question 12 (b) (ii)

Most candidates were able to correlate correctly between the light curve and the orbital positions in this eclipsing binary system.

Question 13 (a) (i)

A few candidates confused aphelion and perihelion in this question.

13 (a) Figure 9 shows the orbit of a short-period comet around the Sun.

Figure 9

(i) On Figure 9 indicate the position of the comet when it is at perihelion. Use the letter **P**.

(1)

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Examiner Comments

Perihelion is the point of **closest** approach to the Sun whereas this candidate has labelled the point **furthest** from the Sun - aphelion.

0 marks

Question 13 (a) (ii)

There was some confusion in the minds of some candidates between the words *ellipse*, *ecliptic* and *eclipse* - all of which have very different meanings in astronomy.

Question 13 (b)

A clear explanation of a safe method for observing the solar disc was required here, with filtering and projection being the most popular successful answers.

Question 13 (c)

Although most candidates placed Mars correctly at the 9 o'clock position in its orbit for it to appear in Conjunction from Earth, some confused this with Opposition (3 o'clock) and some drew the letter C on the **Earth's** orbit.

Question 13 (d) (i)

The correct value of 2.5 AU was given by the majority of candidates.

Question 13 (d) (ii)

A number of candidates used the equation correctly but forgot to round their answer to 2 significant figures as requested by the question. This resulted in only one mark being awarded from the possible two.

(ii) Calculate the orbital period of Mars.

Use the formula

$T^2 = r^3$

Give your answer to 2 significant figures and state the unit.

(2)

$T^2 = 1.5^3$

$T^2 = 3.375$

$T = \sqrt{3.375}$

$T = 1.84$ years

(Total for Question 13 = 8 marks)

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Examiner Comments

Always follow **all** of the instructions in the question, in order to obtain full marks.

Use the formula

$T^2 = r^3$

Give your answer to 2 significant figures and state the unit.

(2)

$T^2 = 1.5^3$

$T = \sqrt{1.5^3}$

$T = 1.8$ years

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Examiner Comments

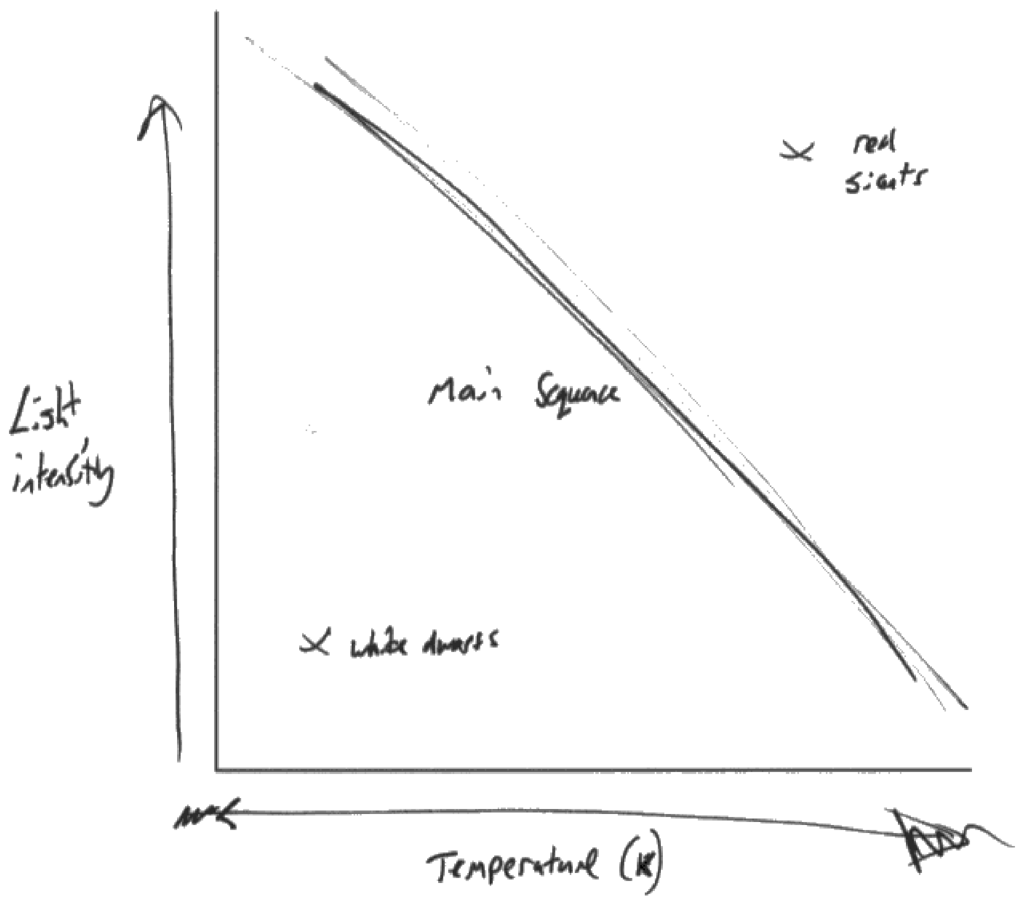
This is an example of a strong 2-mark response, with all stages shown in the calculation and the final answer rounded correctly.

2 marks

Question 14

This question identified the small number of candidates who could not recall seeing the Hertzsprung-Russell diagram, although the majority of candidates could place the Main Sequence, White Dwarf and Red Giant regions, on the axes. However, a significant number of candidates did not gain full marks because they used imprecise labels for the vertical axis, such as 'brightness' or 'magnitude'. A specific measure of the star's intrinsic luminosity, such as Absolute Magnitude, was required here.

14 In the space below, draw a sketch of the Hertzsprung-Russell Diagram.



Label the axes.

Indicate and label the Main Sequence.

Indicate and label the locations of White Dwarf stars and Red Giant stars.

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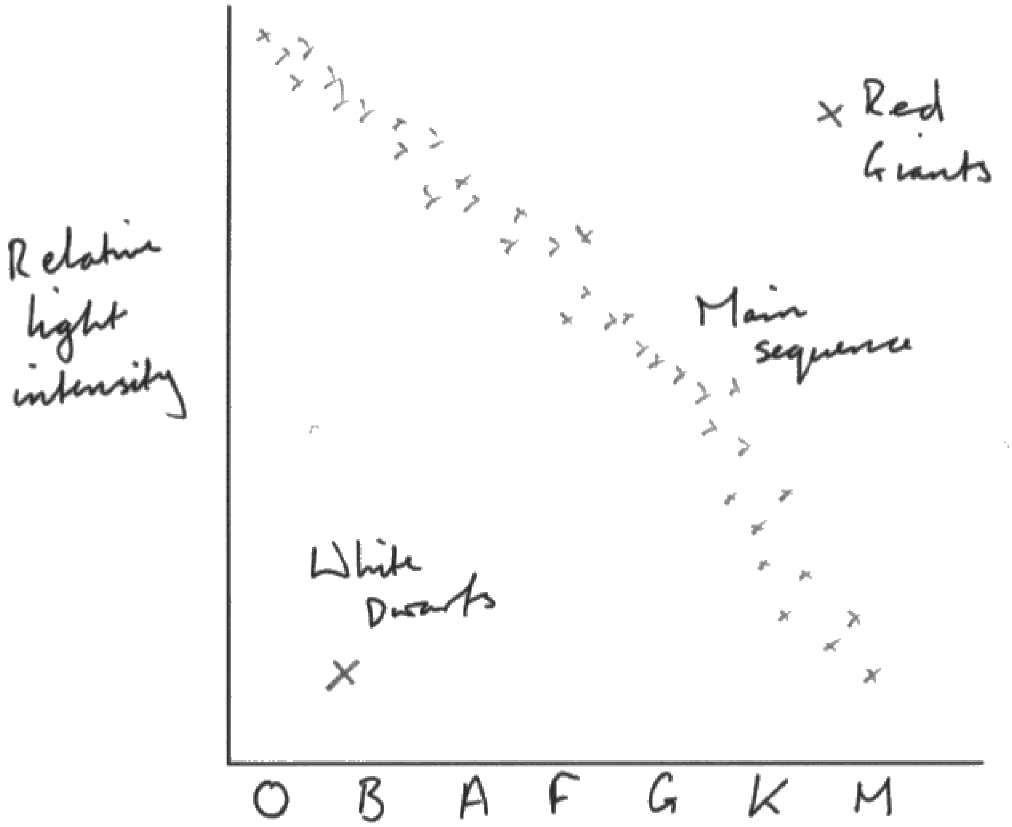
Examiner Comments

This candidate gains only four marks because their label for the vertical axis 'light intensity' is ambiguous. It could refer to the star's brightness as measured from Earth.

4 marks

14 In the space below, draw a sketch of the Hertzsprung-Russell Diagram.



Label the axes.

Indicate and label the Main Sequence.

Indicate and label the locations of White Dwarf stars and Red Giant stars.

ResultsPlus
Examiner Comments

This answer also loses a mark because 'Relative Light Intensity' could refer to a number of things that are not the star's intrinsic luminosity or Absolute Magnitude.

The lack of a labelled quantity on the horizontal axis (Spectral Class) is also undesirable, although the correct sequence of letters saves the candidate from losing a further mark.

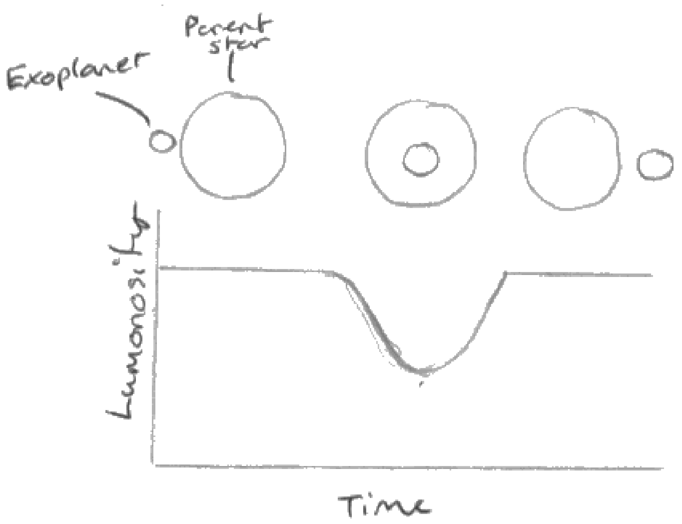
4 marks

Question 15 (b)

For full marks in this question, candidates were required to identify a valid method for determining the existence of exoplanets and explain in detail how this method could be carried out. Although a diagram was not required by the question, it was a consistent characteristic of the higher-scoring answers.

*(b) Name and describe **one** method that astronomers use to detect exoplanets. You may draw a labelled diagram to support your answer.

(4)



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Examiner Comments

This answer gives the Transit method correctly for discovering exoplanets and explains how the method works, enhancing the quality of the explanation with clearly-labelled diagrams and specific figures.

Good use is made of scientific terms and the explanation is lucid.

4 marks

Question 16 (a)

A number of candidates discussed the significance of redshift for a star's motion, rather than explaining what is meant by the term.

16 (a) Explain what is meant by the term **redshift**.

(2)

When an object (e.g. Galaxy) moves away the light wavelength stretches and ^ moves to the red spectrum. The more red, the further away it is?

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Examiner Comments

In a slightly roundabout way, this answer establishes sufficiently the increase of wavelength required for the award of two marks.

2 marks

Question 16 (b)

Marks were awarded in this question for valid and specific points about the discovery of quasars, as listed in the mark scheme. Credit was not given for very general statements such as 'they were discovered using a telescope', 'they were very bright stars', 'they were discovered by accident' etc.

*(b) Describe how quasars were discovered.

(4)

Quasars emit radio waves, so someone was looking for something else that emitted radio waves and came across it.

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Examiner Comments

The only point this answer makes that is specific to the discovery of quasars is the identification of strong radio sources. The answer thus scores only one mark.

1 mark

*(b) Describe how quasars were discovered.

(4)

The strong radio sources of 3C273 was detected in 1965 using a radio telescope. This was matched to a faint star like object by optical astronomers and was found to have a very high redshift that astronomers named a quasar.

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Examiner Comments

This answer provides several clear and specific points that could relate only to the discovery of quasars. It expresses them clearly and with specific scientific terms and thus scores full marks.

4 marks

Question 17 (a)

Although some candidates offered answers of 2 and 2 x 2.5 = 5 for this question, the majority knew that two magnitudes equate to a brightness difference of approximately $2.5^2 = 6.25$ times.

Question 17 (b)

Most candidates identified the star delta correctly.

Question 17 (c) (i)

Most candidates identified the star delta correctly.

Question 17 (c) (ii)

Most candidates identified the star epsilon correctly.

Question 17 (c) (iii)

Most students identified the star alpha correctly.

Question 18

Although these two discoveries are listed in the specification, a large number of candidates was unprepared to write about them in any detail. There was a large number of answers that could have applied to almost any astronomical discovery and thus gained no credit, eg 'discovered with a telescope', 'discovered by accident', 'thought it was a star' etc.

The names of the discoverers were recalled very poorly by the majority of candidates. Even amongst those who recalled that Ceres was discovered by Giuseppe Piazzi, a majority rendered his surname as Piazza and the inevitable 'Pizza' was also seen frequently. Some latitude was allowed for such candidates who obviously were trying to refer to the correct astronomer.

*18 Describe the discoveries of the two dwarf planets Ceres and Pluto. Name the astronomers who discovered them and the method of discovery.

Ceres

discoverer

Galileo

method of discovery

He was looking through his refracting telescope and he saw what he thought was a moon of ~~the~~ ~~Mercury~~ Venus. Though its orbital path showed otherwise and was orbiting the sun not a planet.

Pluto

discoverer

Copernicus

method of discovery

Because of its highly elliptical orbit, Pluto was at first thought to be a comet. However it was then realised that Pluto was too big to be a comet. ~~and that it~~ This then led to belief that this was a planet.

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Examiner Comments

Although this candidate has written a comprehensive answer, almost none of the details in the answer relates specifically to Ceres or Pluto, resulting in a correspondingly low mark.

1 mark

*18 Describe the discoveries of the two dwarf planets Ceres and Pluto. Name the astronomers who discovered them and the method of discovery. presence

Ceres ~~Piazzi~~

discoverer

~~Piazzie~~ Piazzi

method of discovery

Ceres was discovered in the Asteroid Belt after predictions of the ~~precen of~~ presence of a dwarf planet were calculated when the Asteroids in the belt were being observed.

Pluto

discoverer

method of discovery

Pluto was discovered ~~when~~ when photogra[phs] of the Kuiper Belt showed an object w[hich] over many photos, appeared to have an orb[it] around the Sun.

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Examiner Comments

Although Clyde Tombaugh's name has been forgotten, this candidate has provided a specific detail about each discovery, viz that a planet had been predicted to lie between Mars and Jupiter, which led to the eventual telescopic location of Ceres and that Pluto was identified from a series of photographs.

4 marks

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Examiner Tip

Always ensure that you have revised fully the **details** of any object, process or discovery, which is mentioned in the specification, such as the discoveries of Ceres and Pluto.

Question 19 (a) (i)

The majority of candidates identified the star alpha.

Question 19 (a) (ii)

The majority of candidates identified the star alpha.

Question 19 (b) (i)

Most candidates associated the term **culmination** with an object reaching its highest point in the sky, although some confused this with reaching the observer's zenith.

Question 19 (b) (ii)

The correct answer of 00:15 was provided by the majority of candidates, with markers instructed to allow the answer of 24:15.

Question 19 (b) (iii)

Working through to the correct two-mark answer of 22:52 proved to be a challenge for candidates. A number of candidates calculated correctly that the two-night difference would produce a time difference in the culmination of eight minutes but chose to add this time difference, rather than subtracting it. This led to the one-mark answer of 23:08.

Question 20 (a)

This question not only required candidates to operate the Doppler Shift formula but also required them to round their answer to two significant figures. Not all candidates with the correct numerical answer were able to do this.

20 (a) Data for a spectral line in the light from a distant galaxy are given below.

observed wavelength = 420 nm

rest wavelength = 380 nm

Calculate the radial velocity of the galaxy.

Use the formula

$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$$

The speed of light is 300 000 km/s.

Give your answer to 2 significant figures and give the unit.

(3)

$$\frac{420 - 380}{380} = \frac{v}{300000}$$

$$\frac{420 - 380}{380} \times 300\,000 = v = 31578.94737$$

$v = 31578.95$ km/s

ResultsPlus

Examiner Comments

This candidate has calculated the correct answer but has provided it to **seven** significant figures, instead of the two required by the question.

2 marks

ResultsPlus

Examiner Tip

Even in questions where the number of significant figures is not specified, it is good practice to leave your answer to a similar number of figures to the data given in the question.

20 (a) Data for a spectral line in the light from a distant galaxy are given below.

observed wavelength = 420 nm

rest wavelength = 380 nm

Calculate the radial velocity of the galaxy.

Use the formula

$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$$

The speed of light is 300 000 km/s.

Give your answer to 2 significant figures and give the unit.

(3)

$\frac{420 - 380}{380} = \frac{0.101}{C}$

0.11 × 300,000 = 63157.89 km/s

ResultsPlus
Examiner Comments

This candidate has not manipulated the formula correctly and has arrived at an incorrect answer. However, since the working is clear, they are able to gain one mark for substituting correctly the values from the question into the formula.

1 mark

ResultsPlus
Examiner Tip

Always ensure that it is clear what you have done with the numbers in the question so that you can gain marks for working, even if your final answer is incorrect.

Question 20 (b)

Although this question involved a relatively straightforward application of the Hubble's Law equation, full marks could only be achieved by considerable attention to detail. Once again, the final answer had to be given to two significant figures and the correct units were also required. This resulted in some candidates who had used the equation correctly, losing one or two of the three marks available because they did not follow these instructions.

In addition, some candidates who had the correct final answer were careless with their writing of the unit, giving mpc (milli-parsecs) instead of Mpc (mega-parsecs).

(b) Astronomers determine that a different galaxy has a recession velocity of 1.2×10^5 km/s. Calculate the distance to this galaxy.

Use the formula

$v = Hd$

The Hubble constant is 77 km/s/Mpc.

Give your answer to 2 significant figures and give the unit.

(3)

$1{\cdot}2 \times 10^5 = 120000$

$V = 120000$

$V \div 77 = 1558.441558$ d = 1558·4

~~D=158~~

ResultsPlus

Examiner Comments

Although this candidate has manipulated the equation, they have not rounded their answer as required and have quoted incorrect units, resulting in only one mark out of a possible three.

1 mark

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Always ensure that numerical answers are given to a sensible number of significant figures, using the data given in the question as a guide. This is particularly important when the question specifies a particular number of significant figures.
- Where the specification lists specific items, such as the discovery of Ceres and Pluto for example, ensure that you are able to give specific details in your answers such as the name of the discoverer and the particular method used.
- Avoid very general terms, which are potentially ambiguous in astronomy, such as bright, distant, hot etc. The subject has more precise terms for all of these examples and they should be used at all times.
- Ensure that working for calculations is shown clearly so that the marker can follow how the final answer has been obtained. There are often marks for working, even if the final answer is incorrect.
- Ensure that you are able to spell correctly all technical terms given in the specification. A good example of where imprecise spelling can lead to confusion is with the words *ecliptic*, *ellipse* and *eclipse*, each of which mean quite different things in astronomy.
- In the longer written answers it may be useful to jot down a list of key points as a rough plan, before starting to write the final answer. This will ensure that your answer remains focused on the question at hand.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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