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Examiners' Report
June 2019

GCSE Astronomy 1AS0 02

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Introduction

The 2019 set of papers for GCSE Astronomy represents the first examination of the new 9-1 GCSE Specification for the subject.

Whilst the majority of the subject content remains the same as in the previous specification, a number of new topics have been introduced in order to:

- provide greater challenge within the new 9-1 qualification, although some of the most challenging questions in the examination are set on existing material.
- improve the coherence and breadth of the material covered in several topic areas, thus helping to support high quality teaching and learning.
- strengthen the observational thread which runs throughout the subject, as emphasised by the group of leading UK astronomers who were consulted from the outset in the development of this Specification.

The examination continues to be centred around non-tiered examination papers with the 3½ hours of examination time split between two papers:

- Paper 1 – Naked-eye Astronomy
- Paper 2 – Telescopic Astronomy

The subject content of each paper mirroring a similar division of material within the Specification.

The central focus on observational astronomy is very evident in these examination papers. Many questions are designed around presenting candidates with the results of an astronomical observation and asking them to process the information and arrive at scientific conclusions.

Other questions ask candidates to comment on the conclusions which other people, such as archaeoastronomers, have placed on astronomical data.

Uniquely amongst the scientific subjects studied at GCSE level, Astronomy allows candidates to experience working with a truly observational science, where some of the most incredible scientific advances in human history have been made despite the fact that basic scientific strategies, such as control of variables, are usually impossible.

It is clear from this year's examination that centres and their candidates have more than risen to the challenges of the broader specification and more demanding examination papers.

Despite the changes to the qualification, the enthusiasm and commitment that have always characterised those involved in the teaching and learning of GCSE Astronomy continues to be evident. Centres and their candidates are to be commended for the conspicuous hard work and dedication – often as part of an extra-curricular provision – that went into the preparation of this year's cohort.

Examiners were particularly impressed by the depth with which some candidates have mastered much of the material – and within a relatively short period of time. As is often the case with this subject, it is clear that for many candidates it represents a wider interest extending well before the examination.

Comprehensive *Topic Support Guides* have been produced to support teaching and learning in these new areas. These may be downloaded from the GCSE Astronomy pages of the Pearson website. As well as providing detailed subject background, they contain worked examples and practice examination questions.

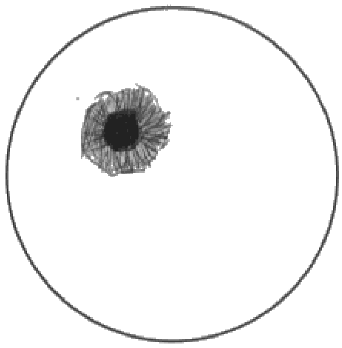
Although it may seem an obvious point, it was clear that a significant number of candidates lost marks because they did not understand the requirements of the question. In particular, candidates must play close attention to the 'command' word used at the beginning of each question. The command words invariably determine the structure of the mark scheme. Candidates should also note that the number of marks indicates the complexity required of the response: the more marks, the more lengthier or complex the response.

Question 1 (c)

Very few candidates scored zero marks on this question. The marks were differentiated between those candidates that did and did not show two distinct regions within the sunspots.

(c) Sketch the appearance of a sunspot as seen through a powerful telescope.

(2)



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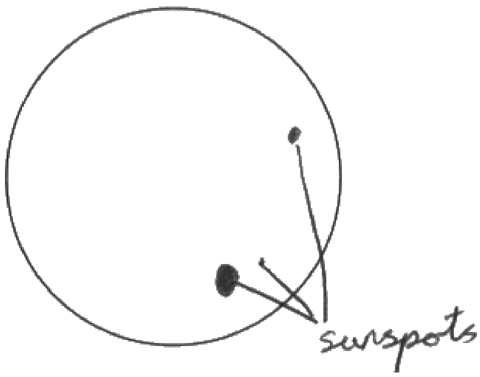
Examiner Comments

A typical 2 mark response. The 'umbra' and 'penumbra' do not need to be named.

(c) Sketch the appearance of a sunspot as seen through a powerful telescope.

(2)



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Examiner Comments

1 mark gained for candidates that only showed a dot.

Question 2 (c)

(c) Only one side of the Moon is ever visible from Earth. Explain how astronomers have observed the other side of the Moon.

(2)

By putting ~~stages~~ probes in orbit around the moon then taking photos when it reaches the other side.

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Examiner Comments

A typical 2 mark response. 'Probes' was only just sufficient, although spacecraft/satellites would be preferred.

(c) Only one side of the Moon is ever visible from Earth. Explain how astronomers have observed the other side of the Moon.

(2)

It has been observed by satelites or probes

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Examiner Comments

Candidates were often awarded 1 mark because they named the use of a satellite, but did not go on to explain that to observe the Moon's far side the satellite must then travel to (and orbit) the Moon.

(c) Only one side of the Moon is ever visible from Earth. Explain how astronomers have observed the other side of the Moon.

(2)

Astronomers observed the other side of the Moon by libration because they can see more of the moon by 59%.

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Examiner Comments

Reference to libration was awarded no marks.

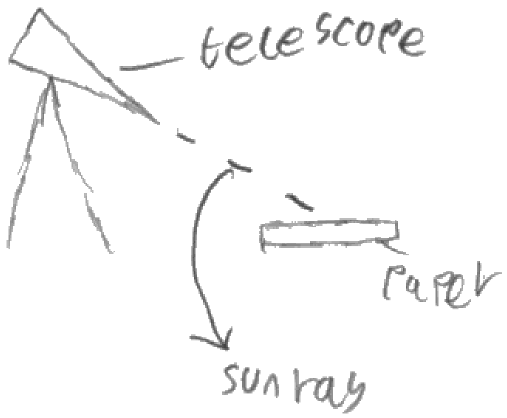
Question 3 (e)

Most candidate responses referred to either the use of filters or projection. However, it was often not clearly explained (in words or diagram) how to implement this method. If on reading the method, a person unfamiliar with this technique could successfully attempt it, then the second mark was awarded.

(e) Describe a safe method of observing the Sun when using a telescope.

You may include a carefully labelled diagram in your answer.

(2)



let the light of the telescope go onto the paper, and observe the paper

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Examiner Comments

1 mark awarded because 'projection method' was not stated.

*

(e) Describe a safe method of observing the Sun when using a telescope.

You may include a carefully labelled diagram in your answer.

(2)

Use a alpha-filter which makes sure that the observer doesn't get eye damage when observing the sun through a telescope.

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Examiner Comments

1 mark awarded because although the candidate named the method, it is not clear where the filter should be placed (over the objective). 'Alpha filter' was condoned in this instance.

Question 4 (a) (i)

This question was answered well by candidates. If they correctly identified the orbiter as the most suitable probe, then they usually went on to give a correct reason. Few candidates therefore scored only 1 mark.

4 (a) A group of astronomers wish to take high resolution images of Mars.

Figure 3 compares three types of space probe that could be used for this mission.

	Fly-by	Orbiter	Impactor
Journey time (days)	70	275	125
Journey distance (million km)	65	160	85
Distance at closest approach (km)	2500	300	0
Number of orbits around Mars	0	200	1

Figure 3

(i) Analyse the data in Figure 3 in order to explain which is the most suitable space probe for this mission.

(2)

I think that the most suitable probe would be the orbiter. This is because, unlike a fly-by, it gets much closer to the planet, allowing high resolution images to be taken easier. Impactors would not be suitable as the astronomers are not studying ~~the~~ beneath Mars surface.

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Examiner Comments

A typical 2 mark response.

Question 4 (a) (ii)

(ii) Calculate the minimum distance between Earth and Mars. Give your answer in km.

Use information from the Formulae and Data Sheet.

(2)

Difference between 1 AU and. 1.5 AU

= 0.5AU

= 150 000 000 / 2 =

75000000

distance = 75 000 000 km

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Examiner Comments

A typical 2 mark response.

(ii) Calculate the minimum distance between Earth and Mars. Give your answer in km.

Use information from the Formulae and Data Sheet.

(2)

Mean distance of Mars from the Sun is 1.5 A.U

Mean distance of Earth from Sun is 1.0 A.U

1 A.U is 1.5×10^8 Km

∴ 0.5 A.U is 75 0,000,00 Km

distance = 750,000,000 km

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Examiner Comments

Many candidates who scored 1 mark appreciated that the distance was 0.5 AU. However, they then went on to make a numerical calculation error.

Question 4 (a) (iii)

Candidates found this question very difficult and there were very few responses that gained 2 marks. Most candidates neglected the simple fact that the journey distance between Earth and Mars may not happen at opposition. However, some candidates did state that the orbiter may not fly in a straight line and even went on to explain why, in terms of dropping successfully into an orbit around Mars.

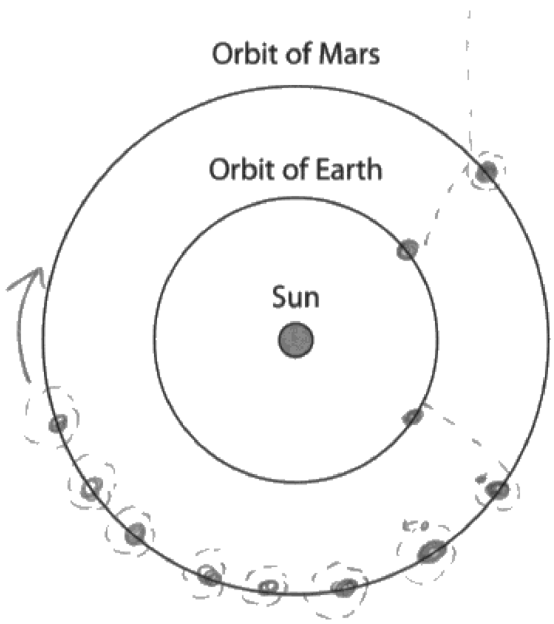
The most common mistake was the suggestion that the orbiter journey distance would be greater because on arrival it would then go into orbit (200 times) around Mars.

(iii) The distance travelled by the orbiter space probe is much larger than the fly-by space probe.

State **two** reasons for this difference.

Complete the diagram below to illustrate your reasons.

(2)



1 The orbiter enters Mars's orbit and re-orbits ~~Mars~~ ~~for~~ many times (200)

2 Because The orbiter is re-orbiting mars as mars is ~~rotating~~ orbiting the sun it must do a little extra distance each ~~rota~~ rotation.

ResultsPlus
Examiner Comments

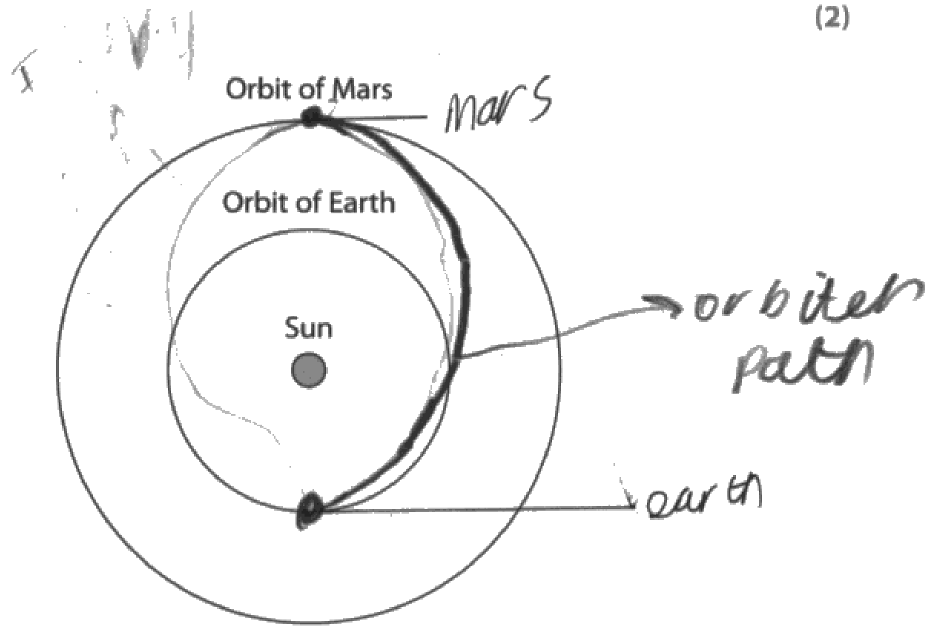
A very common candidate response that referred to multiple orbits around Mars increasing the distance travelled. No marks awarded.

(iii) The distance travelled by the orbiter space probe is much larger than the fly-by space probe.

State **two** reasons for this difference.

Complete the diagram below to illustrate your reasons.

(2)



1 The distance between the 2 planets may be at its maximum. ~~The~~ Therefore it will have to fly around the Sun to get to Mars.

2 The orbiter is heavier and requires more energy to power it to mars.

ResultsPlus
Examiner Comments

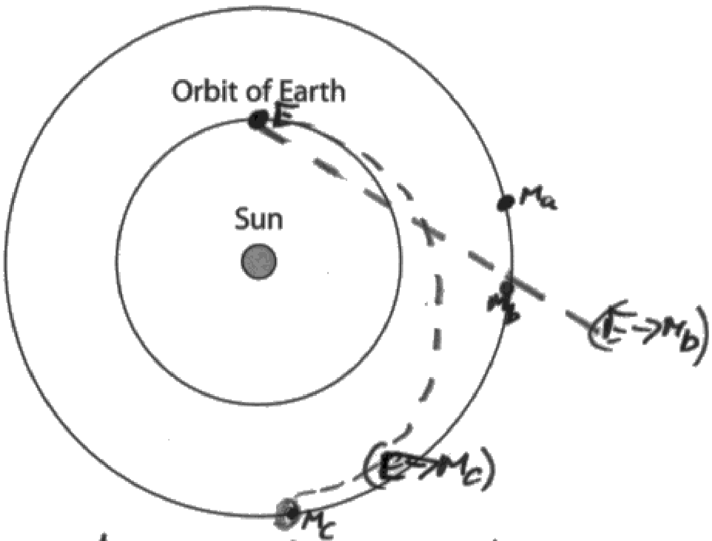
Often 1 mark was awarded where one of the reasons was correct and also supported by a suitable diagram. Few candidates were able to correctly identify two correct reasons.

(iii) The distance travelled by the orbiter space probe is much larger than the fly-by space probe.

State **two** reasons for this difference.

Complete the diagram below to illustrate your reasons.

(2)



1 The flyby probe only needs to go past, so can take a direct route to where Mars will be. (E->Mb)

2 The orbiter drone needs to get into orbit, so needs to come in at a shallower angle so more distance (E->Mc)

ResultsPlus
Examiner Comments

A 2 mark response.

Question 4 (b) (i)

(b) (i) The closest distance between Venus and the Earth is less than the closest distance between the Earth and Mars.

State **two** reasons why there are no future plans to send a manned mission to Venus.

(2)

1 The atmospheric pressure is too great.

2 The temperature is too high.

ResultsPlus
Examiner Comments

A typical 2 mark response.

(b) (i) The closest distance between Venus and the Earth is less than the closest distance between the Earth and Mars.

State **two** reasons why there are no future plans to send a manned mission to Venus.

(2)

1 Because its surface temperature is too hot

2 You would burn/melt before reaching the planet.

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Examiner Comments

Some candidates only scored 1 mark because they repeated the reason.

(b) (i) The closest distance between Venus and the Earth is less than the closest distance between the Earth and Mars.

State **two** reasons why there are no future plans to send a manned mission to Venus.

(2)

1 It's too close to the Sun

2 It's too far away.

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Examiner Comments

This response was awarded no marks. It highlights some of the most common mistakes which were:

- too close to the sun
- too expensive
- too far away

Question 5 (b)

For Q5(b)(i) some allowance was made for the Label S. Candidates who placed the label either just above or below the main sequence but with a spectral type G were given the mark in light of the fact that it would be difficult to see the label S if it were written inside the main sequence band.

Question 5 (c)

5 Figure 4 shows a simplified Hertzsprung-Russell diagram.

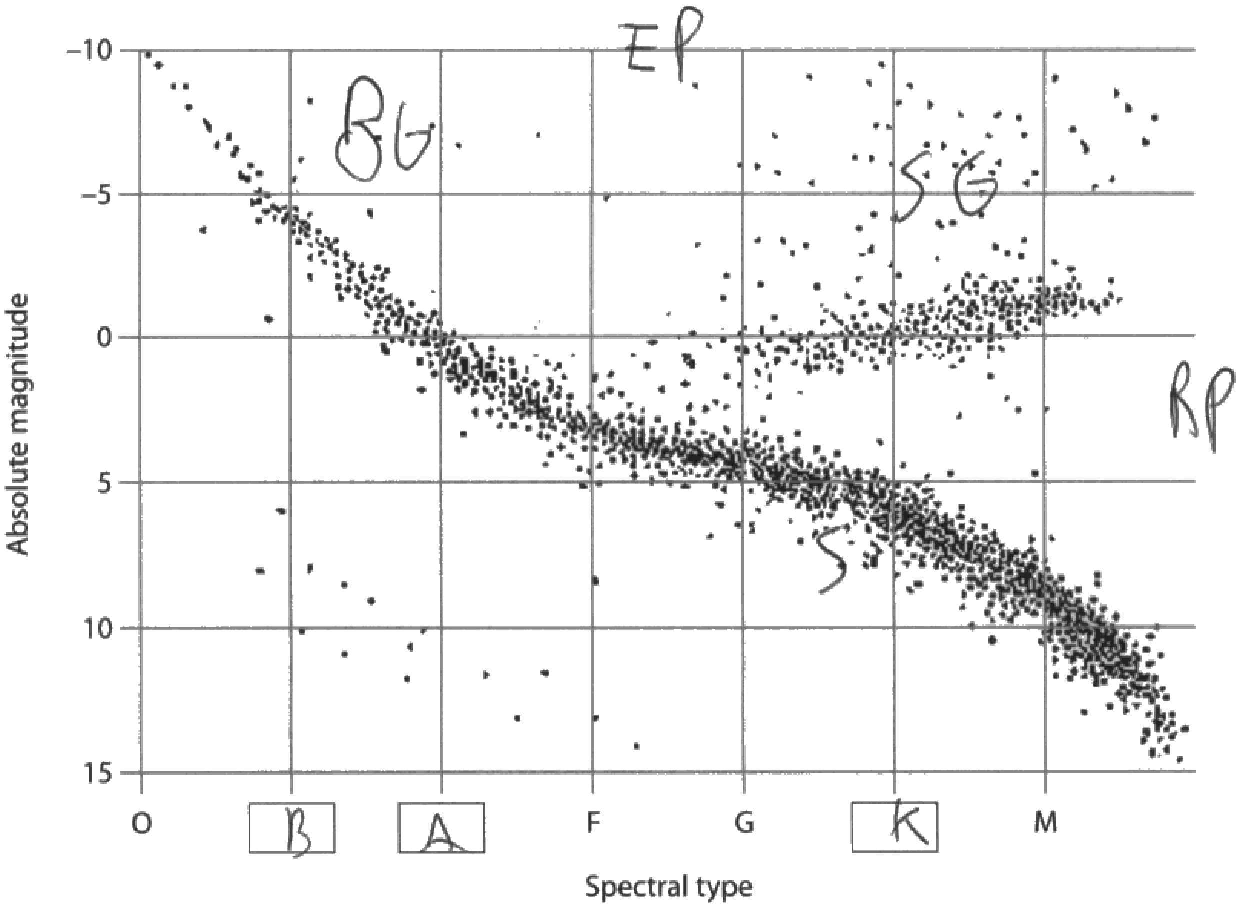

Figure 4

(c) Label Figure 4 with the positions of a star that has its gravitational collapse balanced by:

(i) radiation pressure. Use the label **RP**.

(1)

(ii) electron pressure. Use the label **EP**.

(1)

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Examiner Comments

Some candidates just guessed the position of the labels, including positions in which stars are not found on the HR diagram. Many candidates do not know that radiation pressure is the balance against gravity for main sequence stars. This response was awarded zero marks.

Question 5 (d)

Many responses to this question indicated that candidates were unaware that neutron stars cannot be classified with a spectral type because they do not emit visible light.

(d) State why neutron stars are **not** plotted on the Hertzsprung-Russell diagram.

(1)

they are not bright enough

ResultsPlus
Examiner Comments

A common misconception was that neutron stars cannot be plotted on the HR diagram because they are too faint. This response gained no marks.

(d) State why neutron stars are **not** plotted on the Hertzsprung-Russell diagram.

(1)

They are not visible, but are instead detected in other ~~to~~ wavelengths of the electromagnetic spectrum.

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Examiner Comments

This candidates response shows just enough understanding to be awarded the mark.

Question 5 (e)

(e) By studying the mass of the Sun astronomers predict that it will eventually become a planetary nebula.

Explain this prediction.

(2)

The Sun is growing and burning up all of its hydrogen. ~~This~~ As it grows, it begins to cool into a red giant, and begins to shrink. It then heats up, becomes a white dwarf, and begins to grow. This process repeats itself until all of the hydrogen has been burnt out, and it becomes a planetary nebula.

(Total for Question 5 = 9 marks)

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Examiner Comments

Many candidates described the life cycle of a (low mass) star but did not explain why. This common mistake was awarded no marks. Weaker candidates were able to recall the name and order the stages of stellar evolution but were not able to describe why these changes occur in terms of mass or balances within the star.

(e) By studying the mass of the Sun astronomers predict that it will eventually become a planetary nebula.

Explain this prediction.

(2)

The Sun is bellow the Chandrasekhar limit and therefore is a low mass star. According to the stellar evolution of low mass stars the sun will become a red giant then a white dwarf star in a planetary nebula eventually cooling to a black dwarf in a planetary nebula.

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Examiner Comments

It was pleasing to note that many centres have successfully taught the Chandrasekhar limit, which is new content for GCSE Astronomy. This response was awarded 2 marks.

Question 6 (a)

6 (a) There is observational evidence for both the Big Bang theory and the Steady State theory.

Complete Figure 5 below. Use a tick (✓) to indicate that the observational evidence supports the theory or a cross (✗) to indicate that it proves the theory wrong.

(3)

	Observational evidence for the Steady State theory	Observational evidence for the Big Bang theory
Hubble Deep Field image		✓
Quasars	✓	✓
Redshift of distant galaxies	✓	✓
The expanding Universe		✓

Figure 5

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Examiner Comments

Quite a few candidates placed either ticks (or crosses) in the boxes, but not both. The question clearly stated that both were required and subsequently these responses were marked incorrect. This candidate received no marks for this response.

Question 6 (c)

(b) Figure 6 illustrates two possible evolutionary paths of the Universe.

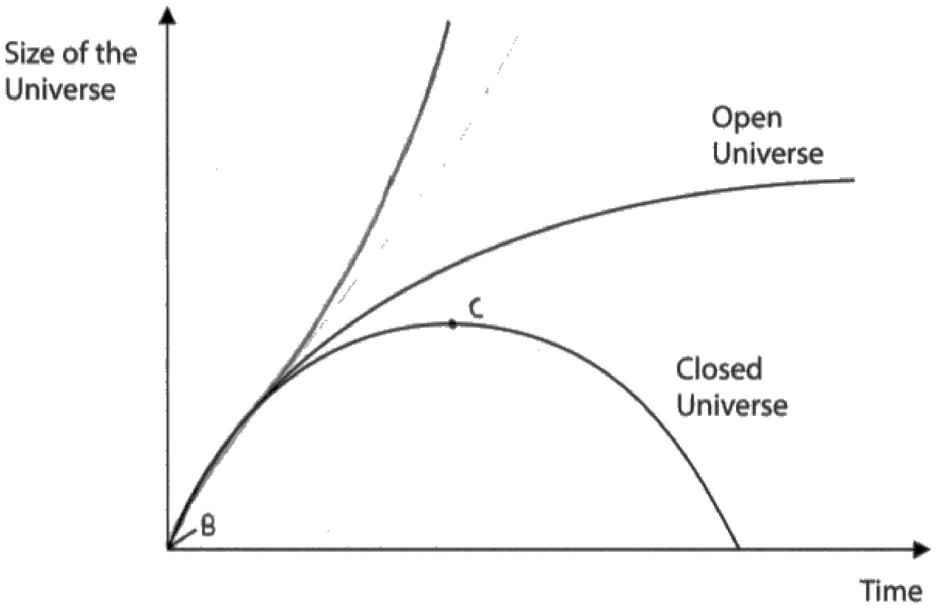

Figure 6

Label Figure 6 with the positions of:

(i) the Big Bang. Use the label **B**.

(1)

(ii) the Big Crunch. Use the label **C**.

(1)

(c) The existence of Dark Energy has been proposed.

Complete Figure 6 to show the future evolutionary path of the universe due to Dark Energy.

(2)

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A typical 2 mark response showing an Open Universe and rate of expansion increasing.

(b) Figure 6 illustrates two possible evolutionary paths of the Universe.

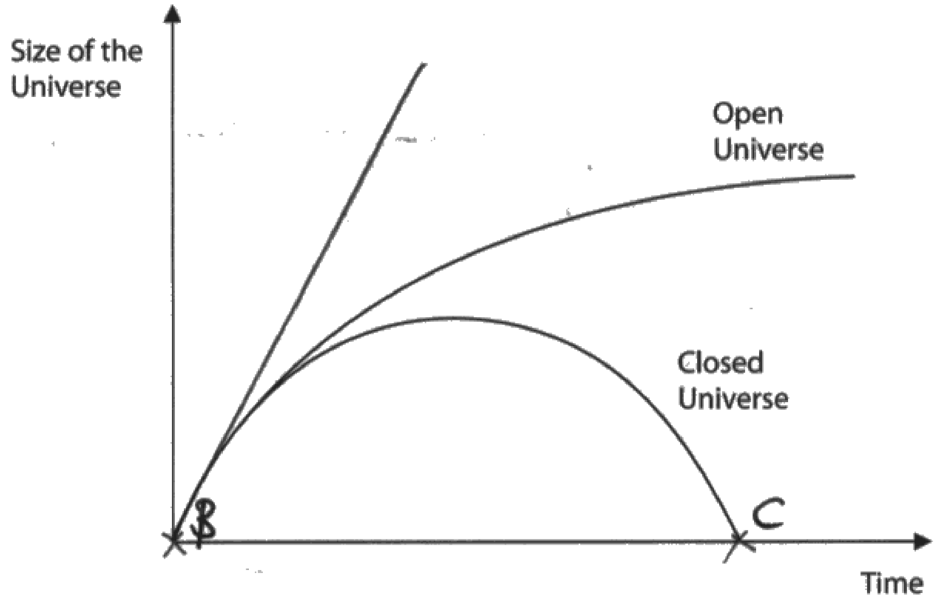

Figure 6

Label Figure 6 with the positions of:

(i) the Big Bang. Use the label **B**.

(1)

(ii) the Big Crunch. Use the label **C**.

(1)

(c) The existence of Dark Energy has been proposed.

Complete Figure 6 to show the future evolutionary path of the universe due to Dark Energy.

(2)

ResultsPlus
Examiner Comments

This response gains 1 mark – it shows an Open Universe only.

Question 6 (d)

(d) The Andromeda galaxy is approximately 0.78 Mpc from Earth.

Calculate the time in years it takes for the light from this galaxy to reach Earth.

Use the Formulae and Data Sheet.

(2)

0.78 Mpc = 780 pc

1pc = 3.26 l.y.

780 × 3.26 = 2542.8

time taken = 2542.8 years

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It was quite common for candidates to attempt a conversion from parsecs to light years but neglected to appreciate the value of the standard prefix mega in Mpc. This response received 1 mark due to this error.

Question 7 (b)

Candidates were able to give many of the stated advantages/disadvantages. However, to gain full marks the question required candidates to give both sides of the argument which some neglected to do. Candidates should appreciate the meaning of the command word 'compare' when writing an argument.

One common misconception was that landers have to return back to Earth whereas orbiters stay within the system.

Question 7 (c)

(c) The energy requirements for sending a space probe to Europa or Enceladus are much greater than those required to orbit the Earth.

State a reason for this.

(1)

Europa and Enceladus are much further away from Earth, so require a lot more energy to get the probes to travel there.

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By far the most common answer was that Europa and Enceladus are 'far away'. The majority of candidates did not appreciate that once a craft has left Earth's orbit, the distance travelled does not affect the energy requirements. This response gained no marks.

(c) The energy requirements for sending a space probe to Europa or Enceladus are much greater than those required to orbit the Earth.

State a reason for this.

(1)

The space probe has to have enough energy to get out of the Earth's atmosphere and gravitational field.

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Leaving Earth's gravitational field was sufficient to gain the mark.

Question 7 (d) (i)

(d) Comets are made of water ice. Figure 9 gives some data about the two moons Enceladus and Europa and the nucleus of the comet 67P.

	Enceladus	Europa	Nucleus of the comet 67P
Recorded Surface Temperature (°C)	−200	−220	−70
Diameter (km)	500	6200	4
Distance from parent planet (km)	238 000	671 000	Does not orbit a parent planet
Type of parent planet	Gas giant	Gas giant	None
Presence of liquid water below the surface	Yes	Yes	No

Figure 9

(i) It is possible for water to exist as a liquid below the surface of Enceladus and Europa.

Analyse the data in Figure 9 in order to explain this statement.

(2)

Above it shows that ~~at the~~ on the surface the

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Examiner Comments

It was a very common misconception that liquid water could exist in the moon's interior due to the presence of a hot core. This was awarded no marks. These responses did not appreciate that the moons are orbiting a gas giant.

(d) Comets are made of water ice. Figure 9 gives some data about the two moons Enceladus and Europa and the nucleus of the comet 67P.

	Enceladus	Europa	Nucleus of the comet 67P
Recorded Surface Temperature (°C)	−200	−220	−70
Diameter (km)	500	6200	4
Distance from parent planet (km)	238 000	671 000	Does not orbit a parent planet
Type of parent planet	Gas giant	Gas giant	None
Presence of liquid water below the surface	Yes	Yes	No

Figure 9

(i) It is possible for water to exist as a liquid below the surface of Enceladus and Europa.

Analyse the data in Figure 9 in order to explain this statement.

(2)

Figure 9 ~~shades~~ shows that Enceledus and Europa

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Examiner Comments

A typical 2 mark response.

Question 7 (d) (ii)

(ii) Liquid water is not thought to exist in the nucleus of the comet 67P.

Analyse the data in Figure 9 in order to explain this statement.

(2)

Comet 67P doesn't have liquid water as it doesn't orbit a parent body and it is very small causing no tidal bulges so no tidal heating to heat up the ice on its inside

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Examiner Comments

A typical 2 mark response.

(ii) Liquid water is not thought to exist in the nucleus of the comet 67P.

Analyse the data in Figure 9 in order to explain this statement.

(2)

Because it is only 4 km in diameter, it maybe unable to hold the water on itself due to a weak gravity being unable to keep it on its surface

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Examiner Comments

A typical 0 mark response often referred to no/low gravity.

(ii) Liquid water is not thought to exist in the nucleus of the comet 67P.

Analyse the data in Figure 9 in order to explain this statement.

(2)

its diamiter is to small to create enought presure for keeping the ~~watte~~ water liqiid

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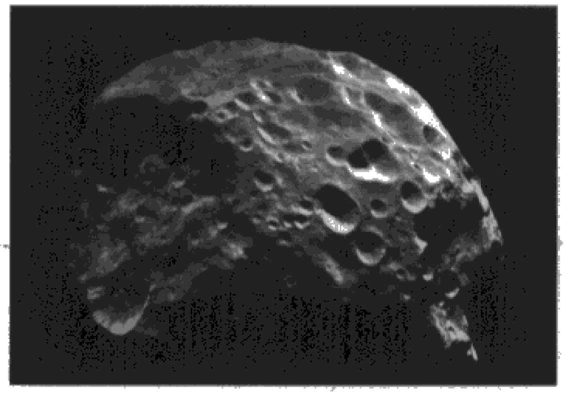
Examiner Comments

Another typical 0 mark response which refers to internal pressure.

Question 7 (f)

(f) Figure 10 shows Phoebe, one of the moons of Saturn. It has a much smaller mass than Europa.



(Source: NASA)

Figure 10

Explain why Europa is spherical but Phoebe has an irregular shape.

(2)

phoebe has been bombarded with meteors that have come close from Saturns asteroid belt due to the Sun, causing masses of craters, deforming its shape, while europa hasn't.

(Total for Question 7 = 12 marks)

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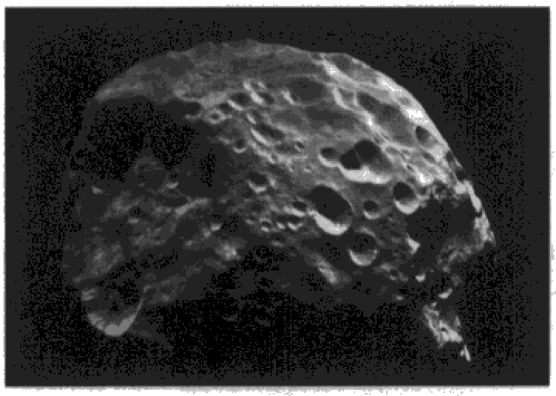
Examiner Comments

Many candidates thought that Phoebe's irregular shape was caused by bombardment or that it had been fractured/broken due to impact. The question attempted to steer candidates away from this type of response by pointing out that Phoebe has a much smaller mass than Europa. This was awarded no marks.

(f) Figure 10 shows Phoebe, one of the moons of Saturn. It has a much smaller mass than Europa.



(Source: NASA)

Figure 10

Explain why Europa is spherical but Phoebe has an irregular shape.

(2)

Europa's force of gravity is greater than its elastic forces, meaning it can pull itself into a spherical shape. Phoebe's force of gravity, however, is smaller than its elastic forces, meaning it can't pull itself into a spherical shape and remains irregular in shape.

(Total for Question 7 = 12 marks)

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Examiner Comments

A typical 2 mark response. It was encouraging to see that centres have successfully taught about the balance between gravity and elastic forces which is new to this syllabus.

Question 8 (a) (i)

8 Figure 11 shows a sketch of a binary star system made by an astronomer using a small telescope.

The two stars in the binary system are just resolved and labelled A and B.

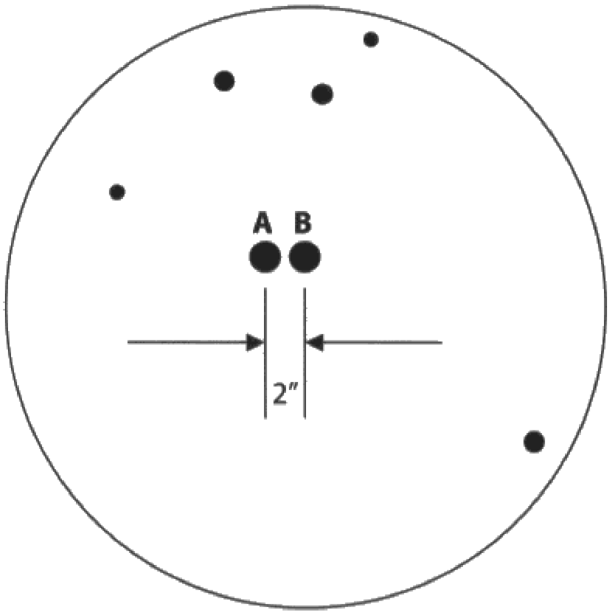

Figure 11

(a) (i) Define the term 'binary star system'.

(1)

when 2 stars are very close together.

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Examiner Comments

This question was well answered by candidates in a variety of different ways including gravitationally bound stars or stars orbiting each other. However, this is an example of the most common incorrect answer and was awarded no marks.

Question 8 (a) (ii)

(ii) Define the term 'field of view' of a telescope.

(1)

Field of View is the amount of Space a telescope can view at a time.

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Examiner Comments

This is an example of a typical response that gained no marks. Candidates frequently referred to 'the amount of space that can be seen'. It was disappointing to note that very few candidates knew that field of view is an angular measurement, and it is hoped that centres will make this clear in the future.

(ii) Define the term 'field of view' of a telescope.

(1)

The area of the sky you can see.

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Examiner Comments

This was just awarded the mark, although in future series it is hoped that candidates will know that field of view is an angular measurement rather than an area.

Question 8 (a) (iii)

Most candidates successfully took and recorded the measurements required. The number of candidates who could then apply this data to calculating an angular field of view reduced substantially. The majority who went on to calculate the field of view were also able to convert this answer into arc minutes. Not many responses were left unconverted in arc seconds.

Question 8 (a) (iv)

(iv) Figure 12 shows some data about this telescope.

Diameter of objective (cm)	20
Focal length of objective (m)	1.50
Magnification	50×

Figure 12

Calculate the focal length of the eyepiece that produces this magnification.

Give your answer in mm.

(2)

$\frac{fo}{fe}$ = magnification

$\frac{1.5}{50}$ = fe

0.03

focal length = 0.03 mm

ResultsPlus
Examiner Comments

Some candidates neglected to ensure that the focal length of the telescope was given in metres but the focal length of the eyepiece was required in mm. Candidates need to look closely at the units in numerical questions. This candidate received 1 mark for the correct calculation but lost a mark because the answer was in the wrong unit.

Question 8 (b)

(b) The stars A and B are observed with a naked-eye.

Describe **two** ways in which their appearance differs from that shown in Figure 11.

(2)

1 They appear extremely close together

2 They appear dimmer

ResultsPlus
Examiner Comments

Many candidates did not appreciate that if binary stars were just resolved with the aid of a telescope, then it would not be possible to resolve them with the naked eye. This candidate's response was common: the two stars would appear closer together, when in fact they would appear as one star. Centres need to stress that binary systems when viewed with the naked eye appear unresolved and look like one star. This response received 1 mark.

(b) The stars A and B are observed with a naked-eye.

Describe **two** ways in which their appearance differs from that shown in Figure 11.

(2)

1 They will appear like one star as, ~~the~~ from Earth, they appear very close.

2 Because they will look like one star, they will appear brighter.

ResultsPlus
Examiner Comments

It was a surprise to note that many candidates thought that the binary system would appear brighter (instead of fainter) when viewed with the naked eye. It must be assumed that these candidates were under the impression that when the two stars appear closer together, their brightness would combine and thus increase.

Question 8 (c) (i)

(c) Another method of observing these stars is with a radio telescope.

(i) Explain why radio telescopes need very large apertures to maintain a useful resolution.

(2)

As radio wave are quite large, radio telescopes need to be large to get as much of the waves as possible to get a high resolution image

ResultsPlus
Examiner Comments

A typical response for 1 mark. Many candidates identified that radio waves are longer than visible light, but unfortunately very few then went on to clearly explain that an increase in wavelength will result in a decrease in resolution for a fixed diameter objective. The question had already stated that radio telescopes need large apertures; the answer required why this is true.

Question 9 (a) (iii)

(iii) Evaluate ways of improving the accuracy of these measurements based on the observational procedures that were used.

(6)

→ Both observations should have been carried out at the same time of year, so the same area of sky was being seen with the same conditions.

→ Both observations should have been carried out at the same time of day rather than one at 1:20 GMT and one at 21:30 GMT, because all other variables other than the plane of the milky way should be kept the same to increase the accuracy. ~~S~~

→ The exposure for both photos should have been the same amount of time, because photo A had a longer exposure of 30 seconds compared to 10 seconds. This makes the measurements unfair as photo A had longer to collect light from more faint stars, possibly distorting the results. If both had been for the same time, the number of stars visible may have been more similar, making the stellar densities less different.

→ Both photos should have been taken without artificial light pollution as shown in photo B of the house lights, as these mean less bright stars are not visible as there is less contrast and this makes the accuracy of the measurements less reliable.

ResultsPlus
Examiner Comments

A typical Level 3 response (5 marks). This response is easy to read and comprehend and contains many of the improvements which could be implemented. Level 2 responses were often able to identify improvements. In addition, Level 3 responses gave clear, scientific/astronomical reasoning as to why these improvements should be made.

Question 9 (b) (i)

Few candidates appreciated that the band of light (the Milky Way) is also observational evidence that our galaxy is spiral, and that we are in fact looking down the plane of our galaxy where more stars are observed. Centres should clearly show the link between the Milky Way as a band of light in the night sky and the Milky Way as our spiral galaxy and the fact that we are observing down its plane.

(b) (i) Describe the observational evidence that the Milky Way galaxy is classified as spiral rather than elliptical.

(2)

Milky Way is a disc shaped band with a central bulge. This is the convention of a spiral galaxy, not an elliptical one. Milky Way also have all stars orbiting in the same direction around a possible black hole and has 3 named spiral arms!

ResultsPlus
Examiner Comments

Many candidates described the structure of a spiral galaxy rather than the observational evidence that we live in one. This response received no marks.

(b) (i) Describe the observational evidence that the Milky Way galaxy is classified as spiral rather than elliptical.

(2)

You can see it spiral arms from Earth

ResultsPlus
Examiner Comments

A common misconception which received no marks.

(b) (i) Describe the observational evidence that the Milky Way galaxy is classified as spiral rather than elliptical.

(2)

It appears as a band across the night sky so it is ~~flat~~ flat so it cannot be ~~elep~~ elliptical as that is more spherical

ResultsPlus
Examiner Comments

This candidate's response showed just enough evidence to gain 2 marks.

Question 10 (a) (iii)

The majority of candidates knew that the distance modulus formula was required to answer this question. However, substitution into the equation was poor and often candidates were awarded only 1 mark. Those candidates that substituted in the correct values usually then went on to correctly calculate the stars distance and were awarded all 3 marks.

(iii) The Cepheid variable star shown in Figure 14 has an average apparent magnitude of +1.0.

Calculate the distance to this star in parsecs.

(3)

$M = m + 5 - 5\log d.$

$-4 = 1 + 5 - 5\log d$

$-10 = -5\log d$

$\div -5$

$2 = \log d$

$\log(2)^{-1} = 100$

distance = 100 pc

ResultsPlus
Examiner Comments

An example of a model answer which received 3 marks.

Question 10 (b) (i) - (ii)

(b) (i) Name **one other** method that astronomers use to measure stellar distances.

(1)

Redshift

(ii) Describe this method.

(2)

Scientists compare the wavelengths in a spectrum of a star to the wavelengths from a spectrum of the elements measured in a lab. The radial velocity is then calculated using the redshift formula and the distance is calculated using Hubbles law.

ResultsPlus
Examiner Comments

Many responses to this question referred to Hubble's Law/red shift/spectroscopy and were awarded no marks. Hubble's Law is used to measure distances to galaxies, not to individual stars. Centres should highlight that Hubble's Law is not a viable method for measuring stellar distance. This response gained no marks.

(b) (i) Name **one other** method that astronomers use to measure stellar distances.

(1)

heliocentric parallax

(ii) Describe this method.

(2)

Observing a Star from two observation points and using 'fixed' stars behind to calculate a parallax angle and work out the distance

ResultsPlus
Examiner Comments

By far the most common correct response was the parallax method. This candidate gained only 1 mark for 10(b)(ii) because their description of the method lacked detail specifically the time taken between observations.

(b) (i) Name **one other** method that astronomers use to measure stellar distances.

(1)

Use the spectral type of the star (Hertzsprung – Russel diagram).

(ii) Describe this method.

(2)

If the spectral type of the ~~star is~~ main sequence / giant star is known and ~~star~~ type, the ~~st~~ Hertzspring Russel diagram can be used to determine the absolute magnitude. If the apparent magnitude is measured the distance modulus equation can be used to calculate distance.

ResultsPlus
Examiner Comments

This response was awarded full marks. Very few candidates selected the use of HR diagram as a method for measuring stellar distance. This is new to the syllabus and possibly suggests that it is not being stressed in centres.

Question 10 (c)

(c) Delta Cephei, a star that can be seen with the naked-eye, is a Cepheid variable star in the circumpolar constellation of Cepheus.

Design an observational procedure to determine the distance to this star.
Your design should include the following:

- the observations that should be made
- how you could process and analyse these observations to find the distance to the star.

(6)

measure the apparent magnitude of the star every day if possible over multiple weeks then I would use that data to create a graph. I would measure the apparent magnitude by making ~~week~~ naked eye observations and comparing it to nearby stars of known magnitude to improve the accuracy of my observations. I would the graph I drew to work out the period of the cepheid variable and its average Magnitude (apparent). I would use the graph on the previous page to then work out the absolute magnitude. I would then use the formula M (absolute magnitude) = m (apparent magnitude) ~~+5~~ + 5 - 5log(distance). This would tell me the distance to this star. I would make sure my estimations were accurate by using a real sifted torch and by turning nightmode on on my phone to maintain my dark adaption. I would also make sure to observe the star from the same place every time so as to maintain roughly the same levels of skyglow and I would also always observe the star while it is at culmination.

ResultsPlus
Examiner Comments

A typical Level 3 response (6 marks). This response is easy to read and comprehend. It has all the stages necessary to successfully calculate the distance to Delta-Cephei and contains extensive astronomical vocabulary. Many candidates were able to perform to this level with one exception: very few responses stated how the magnitude of Delta-Cephei would be measured (i.e. with the use of reference stars). Candidates that referred to the use of reference stars often went on to achieve the full 6 marks.

(c) Delta Cephei, a star that can be seen with the naked-eye, is a Cepheid variable star in the circumpolar constellation of Cepheus.

Design an observational procedure to determine the distance to this star.
Your design should include the following:

- the observations that should be made
- how you could process and analyse these observations to find the distance to the star.

(6)

To observe Delta Cephei, you might need to use a telescope, although it's a star that but can be seen with naked-eye, never sets. ~~It's quite [illegible] for a telescope to be used to observe it.~~ To work out the distance to the star, the observations that will be used will be to work out the apparent and absolute magnitudes of the star. To work out the apparent magnitude, you would need to look at the star (naked-eye observation) without using a telescope and estimate what the apparent magnitude is. To work out the absolute magnitude, you would need to estimate the magnitude of the star using a telescope. Once the observations have been made, the distance can be worked out using the formula: $d = 10^{(m - M + 5)/5}$, where d = Distance, m = apparent magnitude, and

M = absolute magnitude. Now the distance to the star has been worked out.

ResultsPlus
Examiner Comments

A typical Level 2 response (3 marks). This response can be comprehended but is not complete. It demonstrates some of the stages needed to calculate the distance to Delta-Cephei.

Paper Summary

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

- Ensure that candidates have been exposed to all parts of the Specification before the examination.

- Remember to use the *Topic Support Guides* – download from the GCSE Astronomy pages of the Pearson website.

- Review worked examples in the support material.

- Practice examination questions under timed conditions.

- Read the question carefully, then read it again. Notice the command word.

- Check how many marks a question is worth – the more marks, the longer or more complex your response will need to be.

Grade Boundaries

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