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Examiners' Report
June 2012

GCSE Astronomy 5AS01 01

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June 2012

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Introduction

This is the second year that the new specification has been examined and the intended emphasis on observational and practical Astronomy has been continued. Items such as 2a (Orion), 2b (the Plough), 5b-c (eclipses), 9a (lunar features), 10b (the Sun's rotation), 16a (circumpolar stars) and 19 (observing Rigel and Polaris) allowed candidates to demonstrate their awareness of the night (and occasionally daytime) sky. In addition, candidates were given the opportunity to show their appreciation of work done by professional astronomers in other regions of the spectrum, as exemplified by items 6d, 13b and 15d (radio astronomy), 12b (X-ray astronomy) and 17a (microwave astronomy).

There was also continued opportunity for candidates to demonstrate their awareness of How Science Works in many items such as 8c (the use of heliocentric parallax to determine distances to stars), 9d (evidence for the Moon's formation), 13b (discovery of quasars) and 17a (discovery and significance of CMB radiation).

The variety of question styles continued in 2012 in the same vein as in recent years: objective questions, tasks requiring short explanation, diagram completion, mathematical reasoning and more open-ended tasks were all evident. In line with previous examinations, there was a gradual increase in difficulty through the paper with relatively straightforward tasks on familiar topics at the start progressing to quite challenging questions on more complex material towards the end. With no choice of questions in paper 01, it was the examiners' intention that a significant number of questions would be accessible to all candidates, and this strategy appeared to be generally successful.

The examiners were pleased with the overall standard of responses; this resulted in the mean mark being slightly higher this year than in 2011, with the same standard deviation. There was certainly a clear impression that candidates were generally well-prepared for the examination and appeared equally confident with subject material new to this specification and more 'traditional' astronomical topics.

The examiners hope that the hints and guidance given in this report will allow future candidates to be prepared further when answering questions of varying difficulty.

Question 1 (e)

This question was well answered by the majority of candidates who correctly identified Mars as the planet whose moons are thought to be captured asteroids.

Question 1 (f)

This item proved slightly more difficult despite the discovery of Uranus being specifically mentioned in the specification.

Question 2 (a) (i)

A large number of candidates correctly identified the constellation as Orion or The Hunter.

Question 2 (a) (ii)

Most candidates had no problem identifying Orion's Belt.

Question 2 (a) (iii)

There were a variety of responses, Polaris, Betelgeuse and Rigel being popular but incorrect stars indicated by V and W.

Question 2 (b) (i)

The majority of candidates correctly recognised the Plough, but some negated their answer by including Ursa Major in their response; the question quite clearly asks for candidates to identify the asterism in Figure 3.

(b) Figure 3 shows an asterism.

Three stars are labelled **X**, **Y** and **Z**.

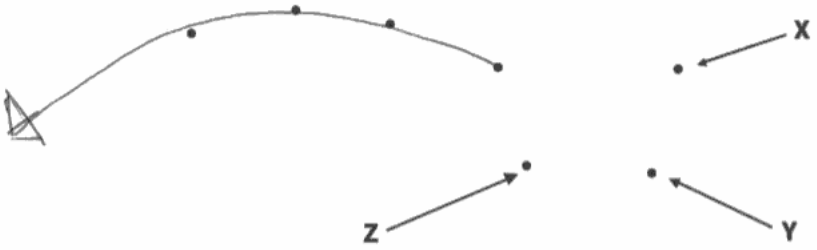

Figure 3

(i) What is the name of the asterism shown in Figure 3?

(1)

the plough

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Examiner Comments

The candidate has correctly identified the Plough.

ResultsPlus
Examiner Tip

Don't include too much information since it might negate your original answer (not in this case).

(b) Figure 3 shows an asterism.

Three stars are labelled **X**, **Y** and **Z**.

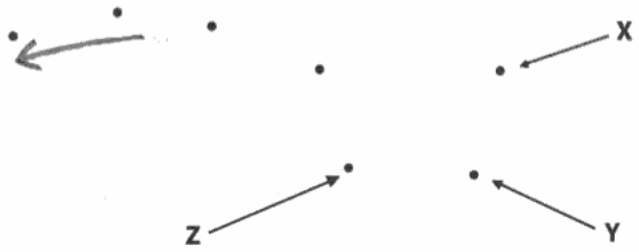


Figure 3

(i) What is the name of the asterism shown in Figure 3?

(1)

Ursa Major

ResultsPlus
Examiner Comments

Although the Plough is an asterism contained within Ursa Major/the Great Bear, this response was incorrect.

ResultsPlus
Examiner Tip

Read the question carefully. There are no 'tricks' and each question will state exactly what you are being asked to do, with no 'hidden extras'.

Question 2 (b) (ii)

Most candidates correctly labelled stars X and Y as pointing to the Pole star.

Question 2 (b) (iii)

This item was answered well by most candidates. Provided the arrow pointed 'along the arc to Arcturus', the examiners were not concerned if the arrow was straight or slightly curved.

(b) Figure 3 shows an asterism.

Three stars are labelled **X**, **Y** and **Z**.

Figure 3

(i) What is the name of the asterism shown in Figure 3?

(1)

The Plough.

(ii) Which **two** letters refer to stars that point to Polaris, the Pole Star?

(1)

Y and X

ResultsPlus
Examiner Comments

The arrow correctly points to Arcturus.

(b) Figure 3 shows an asterism.

Three stars are labelled **X**, **Y** and **Z**.

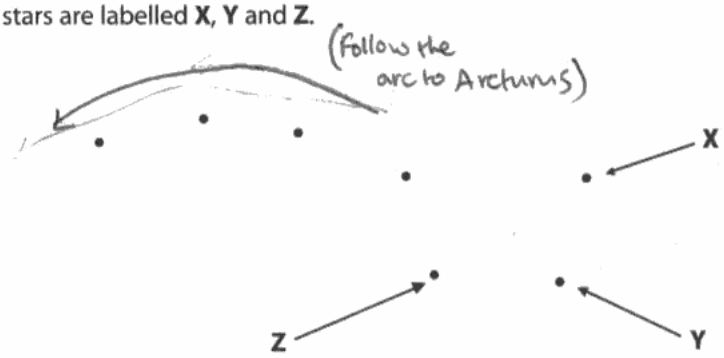


Figure 3

(i) What is the name of the asterism shown in Figure 3?

(1)

Plough

(ii) Which **two** letters refer to stars that point to Polaris, the Pole Star?

(1)

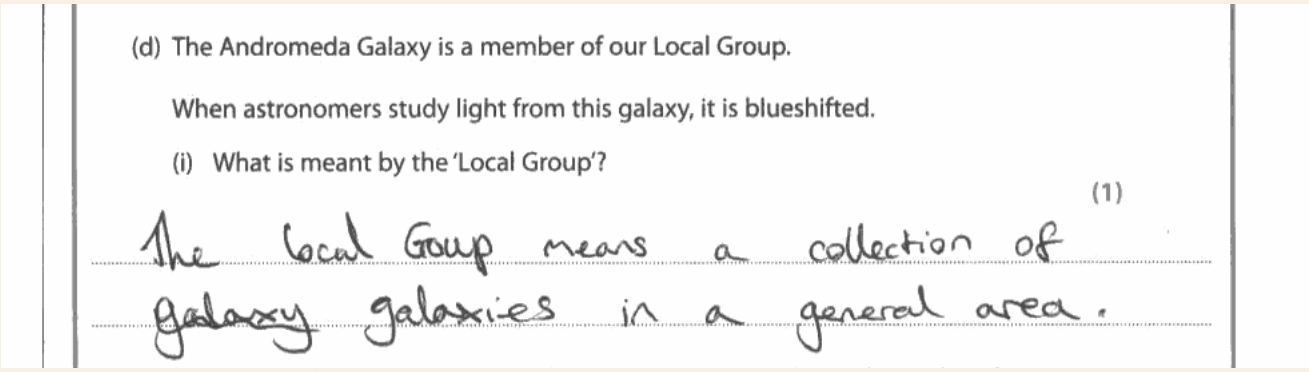
X and Y

ResultsPlus
Examiner Comments

A curved arrow this time, clearly giving directions to Arcturus.

Question 3 (d) (i)

The examiners were hoping that candidates would respond by mentioning galaxies and their relative proximity to ours. There were mixed responses from candidates, many of whom omitted that they were galaxies.



(d) The Andromeda Galaxy is a member of our Local Group.

When astronomers study light from this galaxy, it is blueshifted.

(i) What is meant by the 'Local Group'?

(1)

The local Group means a collection of galaxy galaxies in a general area.

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Examiner Comments

The candidate has referred to galaxies, but 'in a general area' does not tell the examiners that these galaxies are relatively close to us. Unfortunately for the candidate, there is nothing 'local' in this response.

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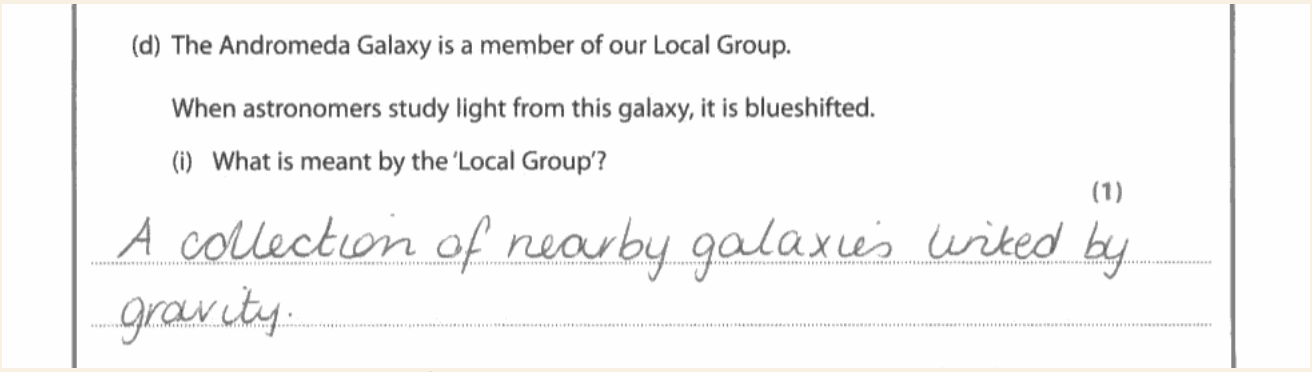
Examiner Tip

Don't be vague. Re-read your answer and ask yourself "What does 'in a general area' actually mean? Could it be worded better to make it clearer to the examiners?"



(d) The Andromeda Galaxy is a member of our Local Group.

When astronomers study light from this galaxy, it is blueshifted.

(i) What is meant by the 'Local Group'?

(1)

A collection of nearby galaxies linked by gravity.

ResultsPlus
Examiner Comments

This candidate clearly indicates that the Local Group consists of galaxies and that they are relatively close to ours.

Question 5 (a)

The majority of candidates correctly placed S and F in their correct positions.

5 Figure 5 shows the Moon's orbit around the Earth.

Rays of light from the Sun are shown by arrows.

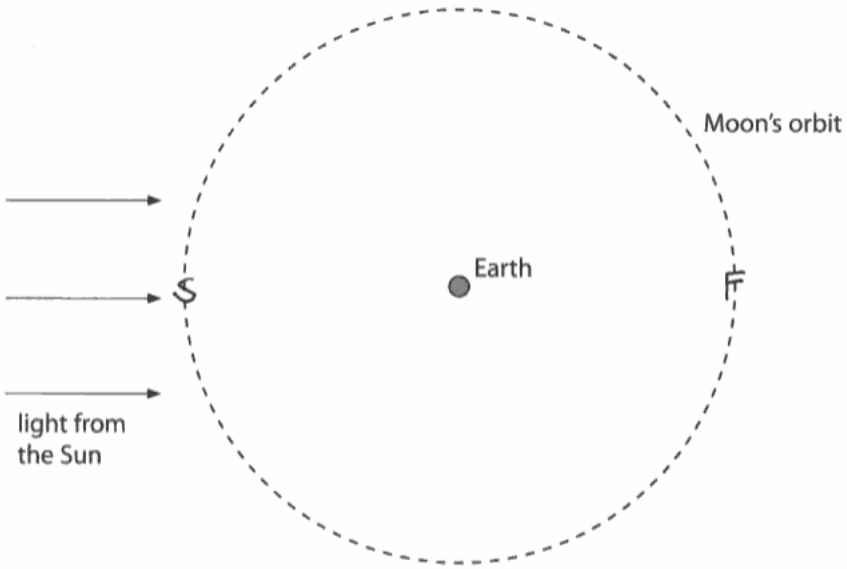


Figure 5

(a) On Figure 5, indicate the position of the Moon:

(i) during a solar eclipse.

Use the letter **S**.

(1)

(ii) at the time of a full Moon.

Use the letter **F**.

(1)

ResultsPlus
Examiner Comments

Letters S and F are positioned correctly; 2/2 marks are gained here.

5 Figure 5 shows the Moon's orbit around the Earth.

Rays of light from the Sun are shown by arrows.

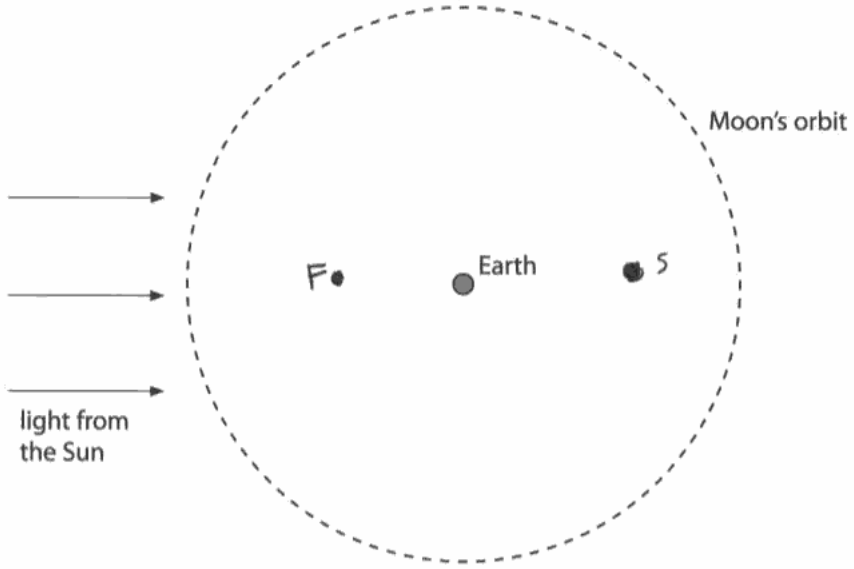


Figure 5

(a) On Figure 5, indicate the position of the Moon:

(i) during a solar eclipse.

Use the letter **S**.

(1)

(ii) at the time of a full Moon.

Use the letter **F**.

(1)

ResultsPlus
Examiner Comments

S and F have not only swapped positions but they are not indicated on the orbit of the Moon.

ResultsPlus
Examiner Tip

Look carefully at your answer. When labelling diagrams, ensure that the examiner is in no doubt of your intentions. Double check that you have distinguished between a solar eclipse and not a lunar one, and a full Moon, not a new Moon; these can easily be confused.

Question 5 (b)

There were some good sketches from a large number of candidates. However, a significant number sketched the Sun's corona and confused the partial with total solar eclipses.

(b) In the space below, sketch the appearance of the Sun during a partial **solar** eclipse.

(1)

ResultsPlus
Examiner Comments

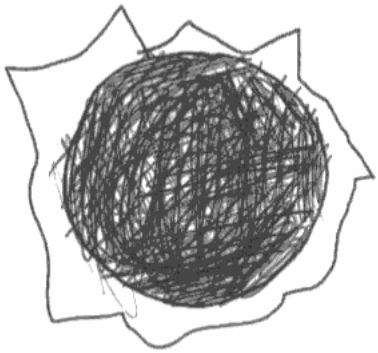
This candidate has correctly identified the eclipse as being partial, but has drawn a straight edge between the parts of Sun that can and can't be seen.

ResultsPlus
Examiner Tip

The examiners are not expecting works of art, but are looking for a little more accuracy in diagrams. Look carefully at diagrams that you have drawn to ensure that they are accurate.

(b) In the space below, sketch the appearance of the Sun during a partial **solar** eclipse.

(1)



ResultsPlus
Examiner Comments

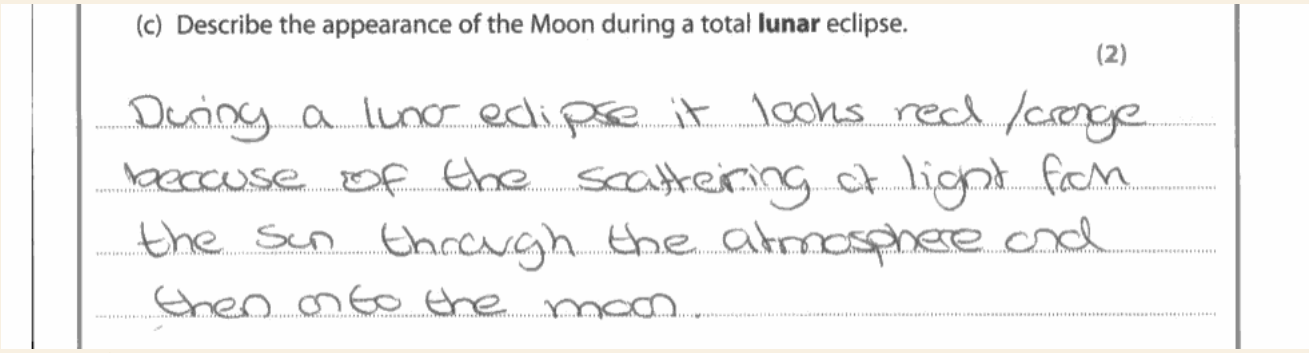
The candidate has drawn a total solar eclipse, which is not what the question asked.

ResultsPlus
Examiner Tip

Once again, the advice is to read the question carefully and double-check that you are sketching what is being asked.

Question 5 (c)

There were many pleasing responses in this item, but many candidates failed to answer the question and tried to explain *why* the Moon was copper-coloured during a total lunar eclipse, thus often missing out on a valuable mark. 2 marks were available for this item and the examiners were looking for 2 pieces of information that *described* the Moon's appearance.



(c) Describe the appearance of the Moon during a total **lunar** eclipse.

(2)

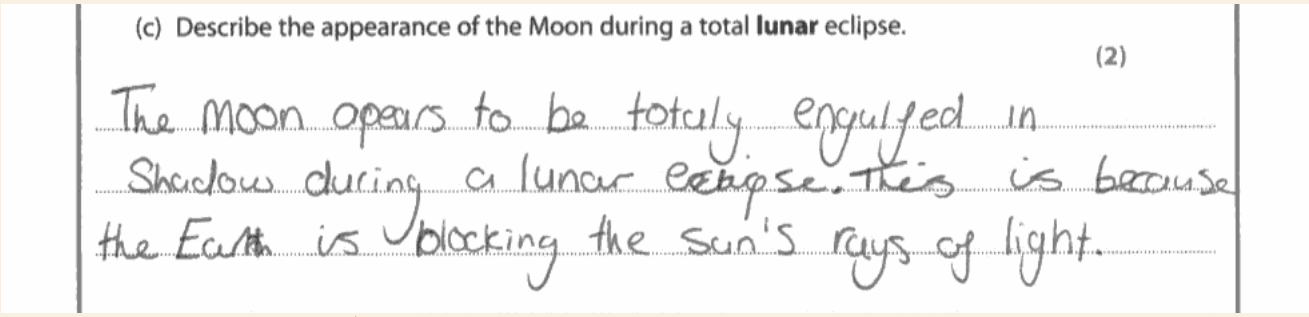
During a lunar eclipse it looks red / orange because of the scattering of light from the sun through the atmosphere and then onto the moon.

ResultsPlus
Examiner Comments

An excellent explanation but not what the question asked for. In explaining why the Moon appears red/orange, the candidate has only described one feature and therefore can only gain 1 mark.

ResultsPlus
Examiner Tip

Try to distinguish between command words *describe* and *explain*. Take the instructions at face value i.e. if the question asks you to Describe..., then no explanation is needed.



(c) Describe the appearance of the Moon during a total **lunar** eclipse.

(2)

The moon apears to be totaly engulfed in shadow during a lunar eclipse. This is because the Earth is blocking the sun's rays of light.

ResultsPlus
Examiner Comments

An incorrect response and the candidate seems to be unaware of the Moon's colour during totality.

Question 6 (a) (i)

The examiners were pleased that the majority of candidates correctly labelled the Main Sequence of the HR Diagram. Only a handful referred to 'negative correlation' or 'Zodiacal Band'.

Question 6 (b)

Letters R and W are often placed in the correct positions up to the right and down to the left of the HR Diagram. Some candidates shifted their red giants a little too far to the left (upon which they would not be red!) or white dwarfs too much to the right, but the examiners quite rightly tended to mark on the generous side if there was any doubt.

6 Figure 6 shows an incomplete Hertzsprung – Russell Diagram.

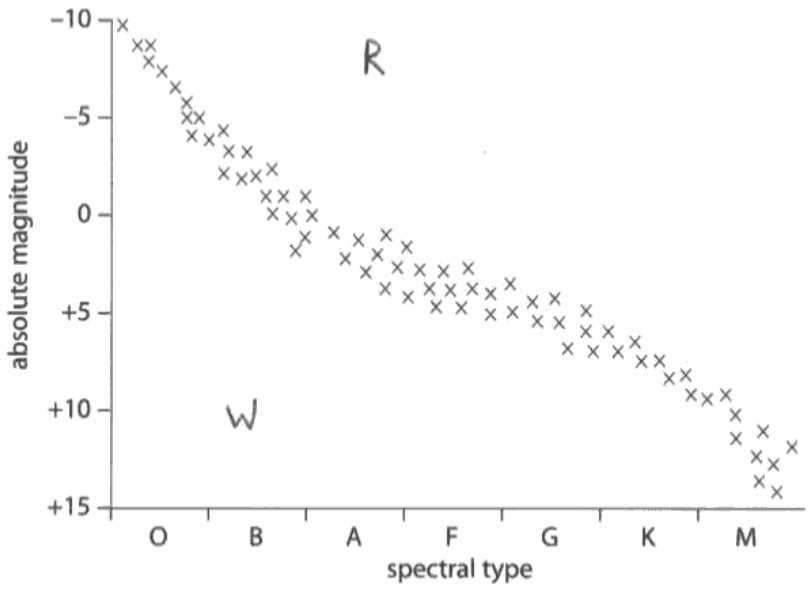


Figure 6

ResultsPlus
Examiner Comments

Although R is indicating a giant star, its location above the A-type band is too far left for it to appear red.

ResultsPlus
Examiner Tip

Remember that the Sun is a G-type star and is yellow. This might help to correctly locate R and W in future examinations.

6 Figure 6 shows an incomplete Hertzsprung – Russell Diagram.

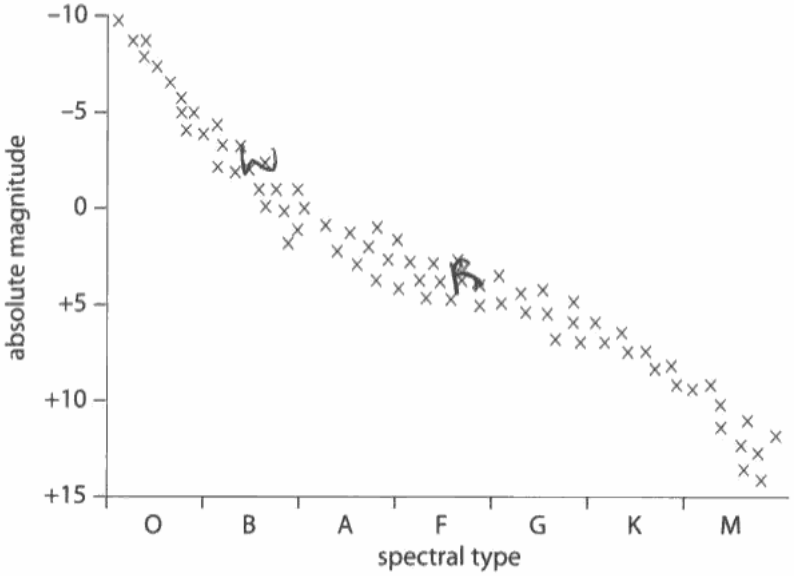


Figure 6

ResultsPlus

Examiner Comments

R and W have been incorrectly placed in the body of the main sequence and 0/2 marks can be awarded.

Question 6 (c)

The examiners were pleased that most candidates correctly circled black hole and neutron star. Only very few candidates hedged their bets and circled more than two objects.

Question 6 (d)

A surprising number of candidates did not associate neutron stars with pulsars and suggested that X-rays could be used to observe neutron stars.

(d) Describe briefly how astronomers observe neutron stars.

(2)

The poles of neutron stars emit pulses of radio waves. If one of the polar regions of a neutron star is pointing towards Earth, Astronomers can use radio telescopes to detect these regular pulses of radio waves.

ResultsPlus
Examiner Comments
A commendable response, mentioning radio waves and pulses.

(d) Describe briefly how astronomers observe neutron stars.

(2)

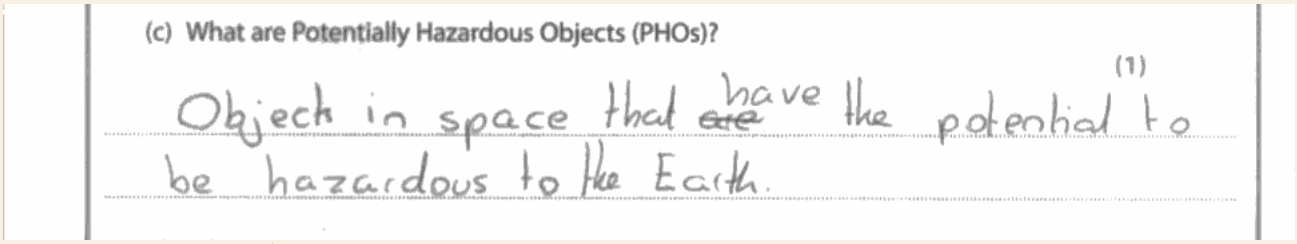
The accretion disk surrounding the core of a neutron star is at a very high temperature. The matter is hot enough to emit x-rays, so X-ray radiation is used as indirect observation of neutron stars. **(Total for Question 6 = 8 marks)**

ResultsPlus
Examiner Comments
This candidate has unfortunately confused neutron stars with black holes.

ResultsPlus
Examiner Tip
Read the question carefully. Although black holes and neutron stars are 'linked' by the correct responses in the previous item, it is important that just neutron stars are relevant in this case.

Question 7 (c)

Although actual sizes or distances from Earth were not expected here, the examiners were expecting candidates to refer to these points. Generally, most candidates indicated that they understood what a PHO is.


(c) What are Potentially Hazardous Objects (PHOs)?

(1)

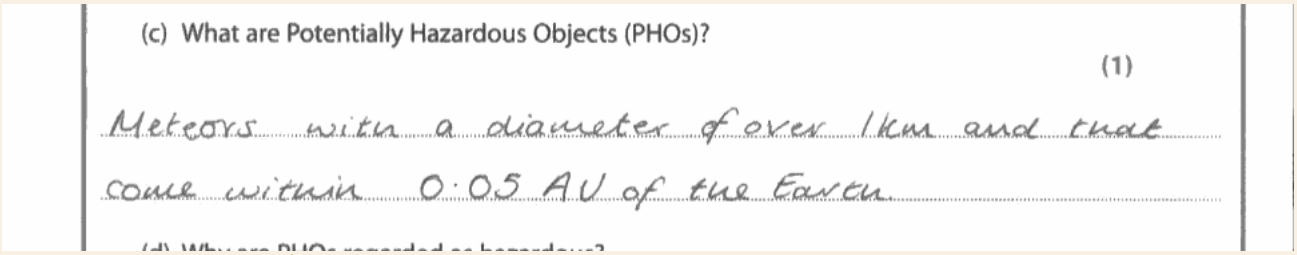
Objeck in space that ~~are~~ have the potential to be hazardous to the Earth.

ResultsPlus
Examiner Comments

This response was just a little too vague to merit a score. In effect, the response is merely a re-wording of the question!

ResultsPlus
Examiner Tip

Try to make sure that your description refers to the question (i.e. a PHO) and nothing else.


(c) What are Potentially Hazardous Objects (PHOs)?

(1)

Meteors with a diameter of over 1km and that come within 0·05 AU of the Earth

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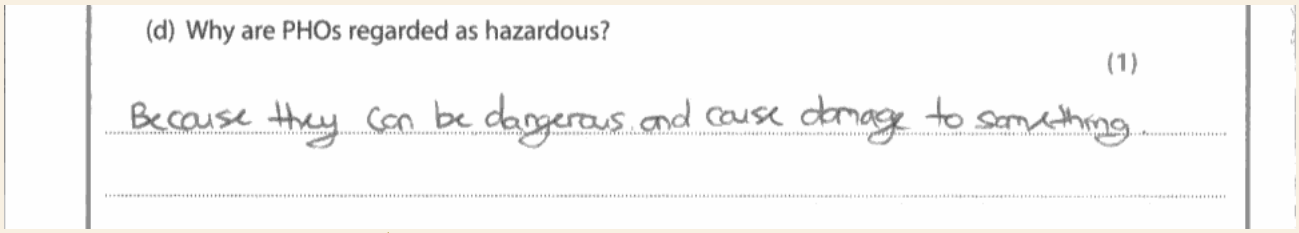
Examiner Comments

Although not actually meteors, but rather meteoroids, the examiners understood what this candidate's response was trying to convey and awarded the mark.

Question 7 (d)

There were often rather vague responses to this item. In order to distinguish between a hazard and an annoyance, they asked themselves: "Would what the candidate has written make the news headlines?" and if so, the mark was awarded.


(d) Why are PHOs regarded as hazardous?

(1)

Because they can be dangerous and cause damage to something.

ResultsPlus
Examiner Comments

This response is too vague and does not convey the fact that a PHO impact would be likely to cause devastating loss of life.

ResultsPlus
Examiner Tip

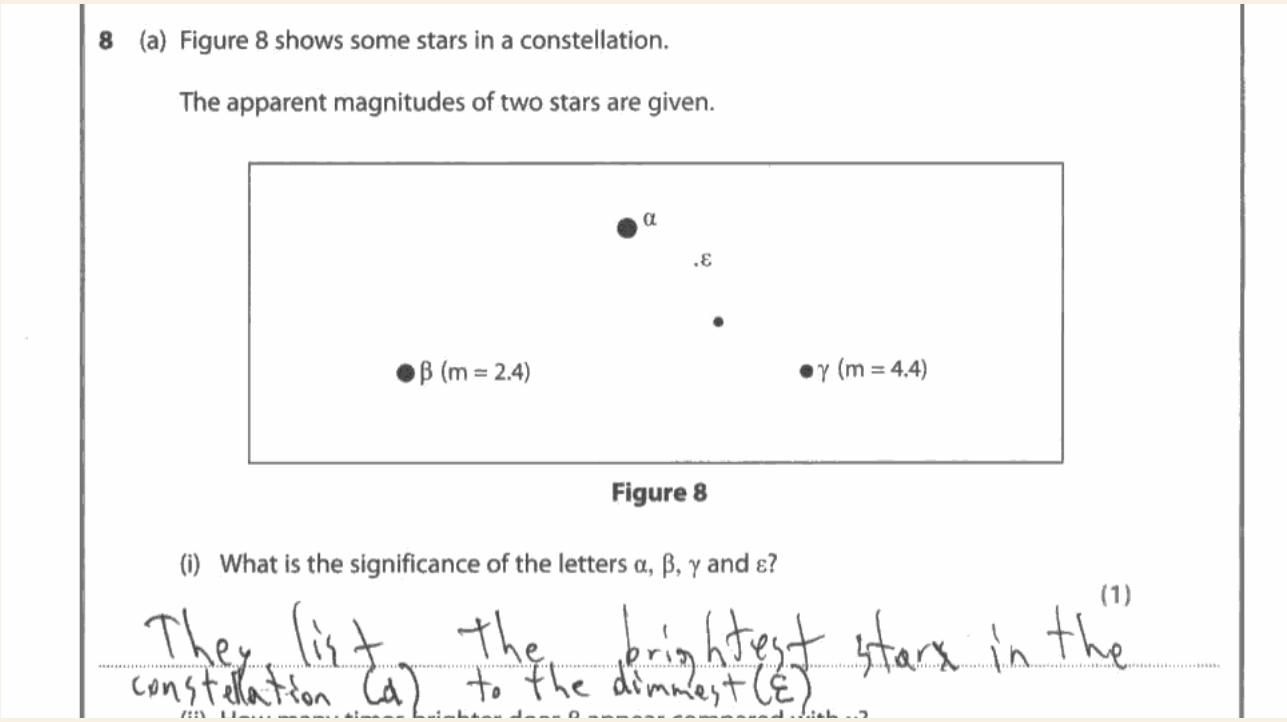
Once again, direct your answer to what is being asked and try not to be vague.

Question 7 (e)

Most candidates remembered to square the ratio of distances, gaining both marks for their answer of 25.

Question 8 (a) (i)

The examiners were pleased this year that only a few candidates incorrectly referred to the type of radiation being emitted from the stars. The majority of candidates included the relative brightness or used phrases such as 'alpha is the brightest, then beta etc.'



ResultsPlus
Examiner Comments
A nice way of describing the relative brightness of stars in a constellation.

Question 8 (a) (ii)

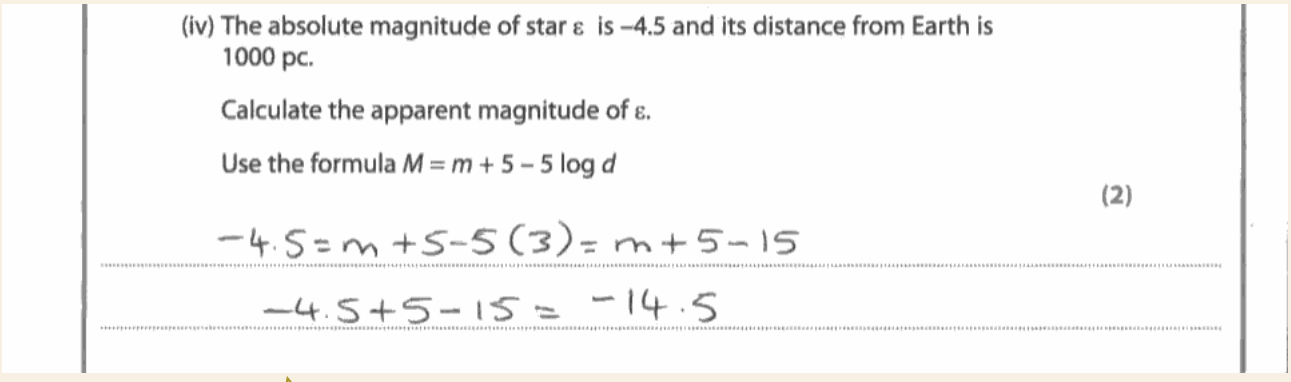
Manipulating magnitudes is a popular item and most candidates correctly squared 2.5 to give 6.25

Question 8 (a) (iii)

The examiners were expecting the Greek letter delta, and not the letter d.

Question 8 (a) (iv)

Responses were generally disappointing and many candidates incorrectly associated m and M with the wrong magnitudes.



(iv) The absolute magnitude of star ε is –4.5 and its distance from Earth is 1000 pc.

Calculate the apparent magnitude of ε.

Use the formula $M = m + 5 - 5 \log d$

(2)

$-4.5 = m + 5 - 5(3) = m + 5 - 15$

$-4.5 + 5 - 15 = -14.5$

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Examiner Comments

The candidate has confused m and M. Stars are not this bright and the apparent magnitude of -14.5 ought to have indicated to the candidate that an error had been made.

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Examiner Tip

Although all formulae that are needed are included with the question, you must ensure that you know what the symbols mean. It is easy to confuse m with M, so double-check that you are using the correct symbols. Also, look at the answer: stars 1000 pc away are simply not that bright!

Question 8 (b)

The majority of candidates clearly understood the concept of absolute magnitude and correctly indicated 10 pc. Only a few incorrectly gave km or AU as the unit.

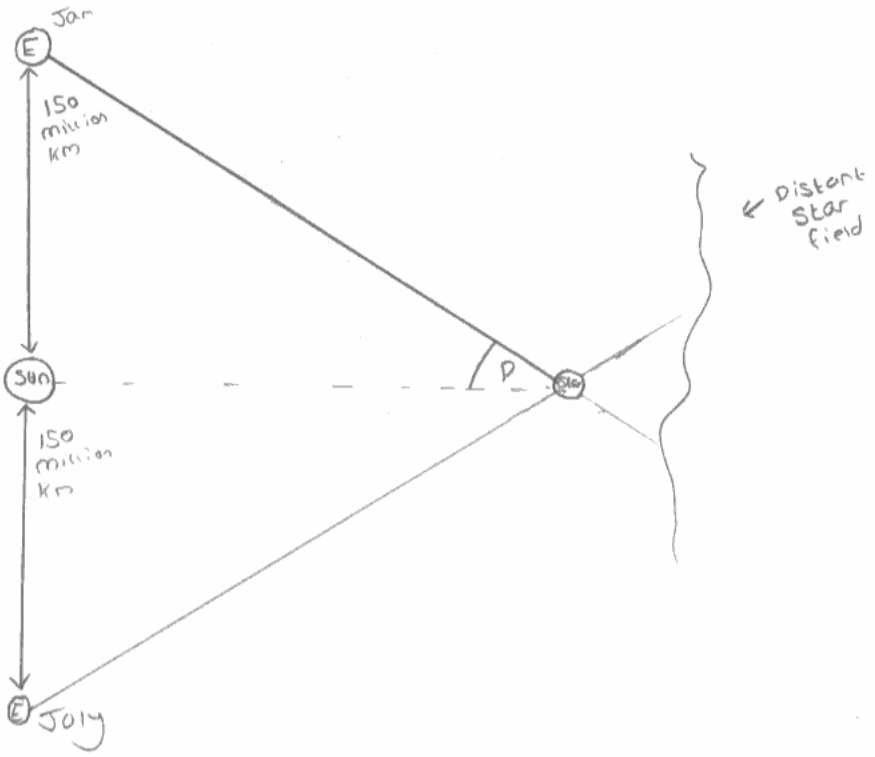
Question 8 (c)

The examiners were generally pleased with the quality and clarity of diagrams, and the parallax angle was often indicated correctly as being half of the angular shift of the nearby star.

(c) The method of heliocentric parallax can be used to determine the distance to a nearby star.

Describe this method with the aid of a diagram.

(2)



Two measurements are taken, January and July, which allow astronomers to work out angle P which then allows astronomers to work out the distan to the star.

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Examiner Comments

A diagram that is well-drawn and clearly labelled.

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Examiner Tip

Use rules to draw straight lines; this makes diagrams clear and difficult to misinterpret.

Question 9 (a) (i)

Most candidates correctly identified seas or *maria*.

Question 9 (a) (ii)

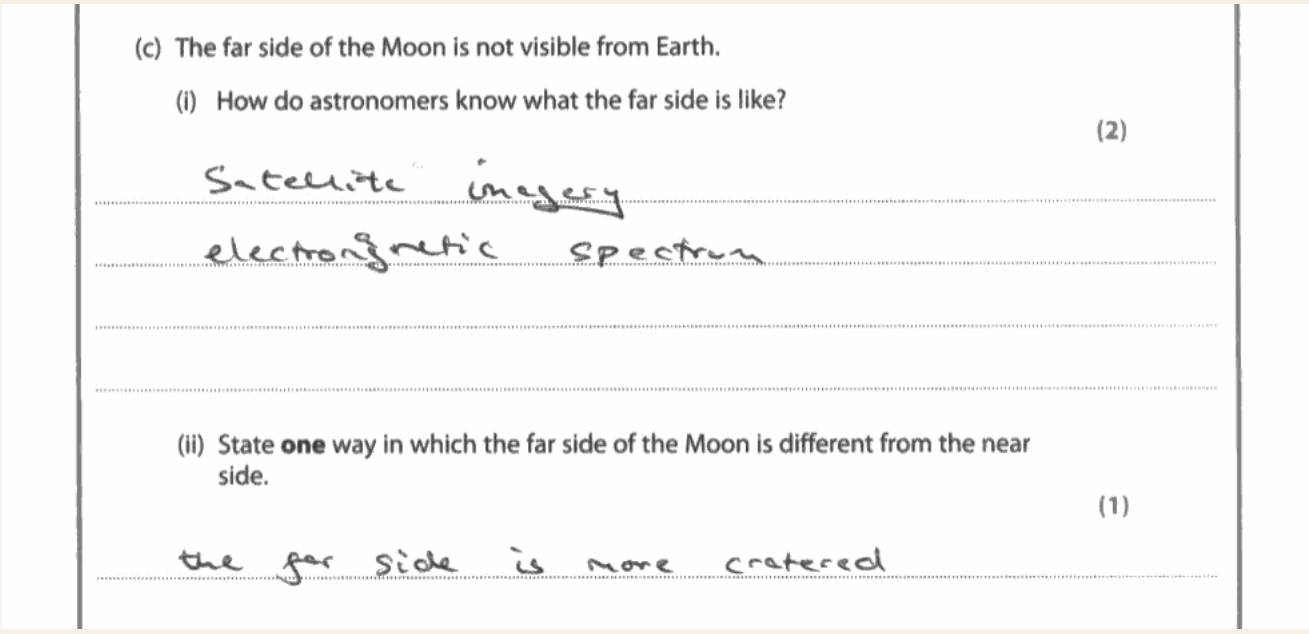
Similarly, most candidates correctly identified highlands or *terrae*; a relatively small number named the highlands as craters.

Question 9 (b)

There were mixed responses, with craters, mountains and seas being common incorrect answers.

Question 9 (c)

In (i), two marks were available here and the examiners were expecting a little more than 'satellites have gone round the back of it'. In (ii), most candidates indicated that there were fewer (although the word 'less' was commonly used!) craters on the far side compared with the near side.



(c) The far side of the Moon is not visible from Earth.

(i) How do astronomers know what the far side is like?

(2)

Satellite imagery

electromagnetic spectrum

(ii) State **one** way in which the far side of the Moon is different from the near side.

(1)

the far side is more cratered

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Examiner Comments

Rather brief and vague responses scored only 1/2 marks here for (i). The candidate's response to (ii) is correct and scores 1/1.

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Examiner Tip

It is probably better to write in sentences here and fill up the four lines. The number of lines is a guide as to how much you are expected to write.

(c) The far side of the Moon is not visible from Earth.

(i) How do astronomers know what the far side is like?

(2)

Photographs have been taken of the far side of the moon by probes, sent around to that side to do so.

(ii) State **one** way in which the far side of the Moon is different from the near side.

(1)

It has much less maria.

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Examiner Comments

Pleasing responses that are clearly correct, but 'far fewer' would be preferred to 'much less'!

Question 9 (d)

Only relatively few candidates were able to state one piece of evidence and many responses were either incorrect or too vague.

(d) Most astronomers believe that the Moon was formed when a large astronomical object collided with the Earth (the Giant Impact Hypothesis).

State **one** piece of evidence that allowed astronomers to develop this theory.

(1)

the study of the matter/debris/rock ~~of~~, on the moon discovered earth-like substances i.e. oxygen within the matter.

(Total for Question 9 = 7 marks)

ResultsPlus
Examiner Comments

It was not enough to mention the presence of oxygen; the examiners were looking for similar isotopic abundances of oxygen.

ResultsPlus
Examiner Tip

Obtaining evidence is an important part of the How Science Works part of GCSE Astronomy. Make sure that you study discoveries listed in the specification and are able to describe them, with evidence.

(d) Most astronomers believe that the Moon was formed when a large astronomical object collided with the Earth (the Giant Impact Hypothesis).

State **one** piece of evidence that allowed astronomers to develop this theory.

(1)

astronomers have tested material from the moon and found that it was the same material as on the Earth.

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Examiner Comments

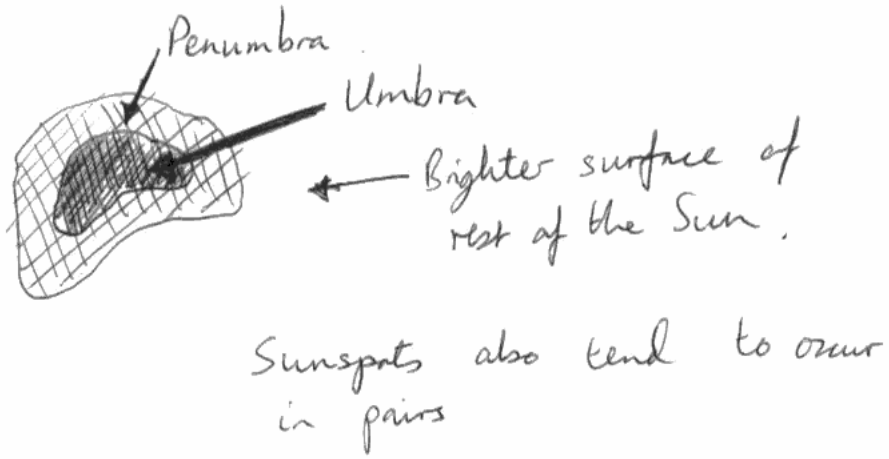
Again, this response is too vague and general to merit the mark.

Question 10 (a)

Most candidates sketched and labelled the umbra and penumbra of a typical sunspot correctly.

(a) In the space below, sketch and label a typical sunspot.

(2)



ResultsPlus
Examiner Comments

A pleasing, well drawn and labelled sunspot for full marks.

Question 10 (b)

There were some pleasing descriptions of how astronomers indicate that the Sun is rotating and the majority of candidates scored full marks.

(b) Explain briefly how astronomers use observations of sunspots to determine the Sun's rotation.

(2)

because when a sun spot appears they can follow it round the Sun to and work out its rotation

ResultsPlus
Examiner Comments

This candidate has omitted any reference to timing and scores just 1/2.

ResultsPlus
Examiner Tip

Think carefully about what you are going to write before putting pen to paper. There ought to be plenty of time to consider your response prior to writing it down, and this will probably mean that you are unlikely to miss out what might at first be an obvious point to include.

Question 11 (b)

Completed diagrams were generally drawn well; with two (or more) equal areas being indicated. There were some candidates that referred to the relative speeds of planets during their solar orbits and these responses were not deemed credit-worthy.

(b) Figure 11 shows the Sun and an elliptical orbit.

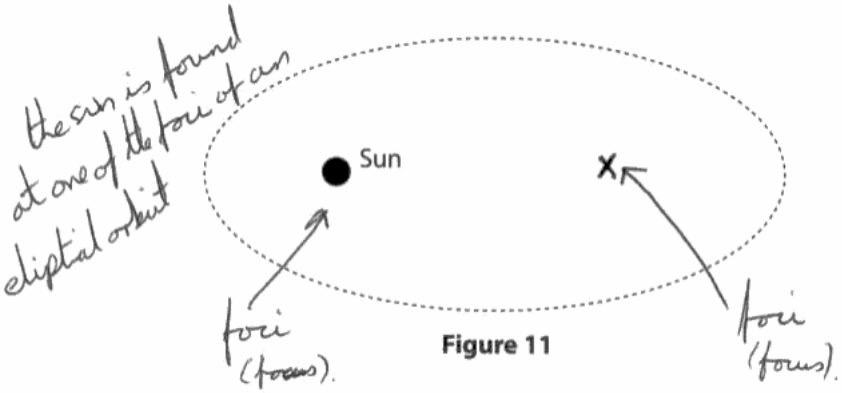


Figure 11

Complete Figure 11 to illustrate Kepler's second law of planetary motion.

(2)

ResultsPlus
Examiner Comments

This candidate seems to have mixed up two of Kepler's laws!

(b) Figure 11 shows the Sun and an elliptical orbit.

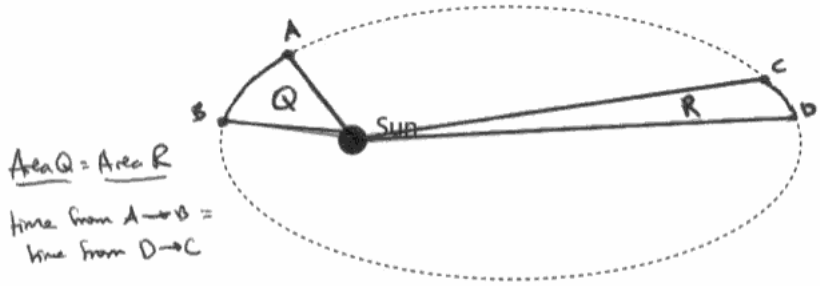


Figure 11

Complete Figure 11 to illustrate Kepler's second law of planetary motion.

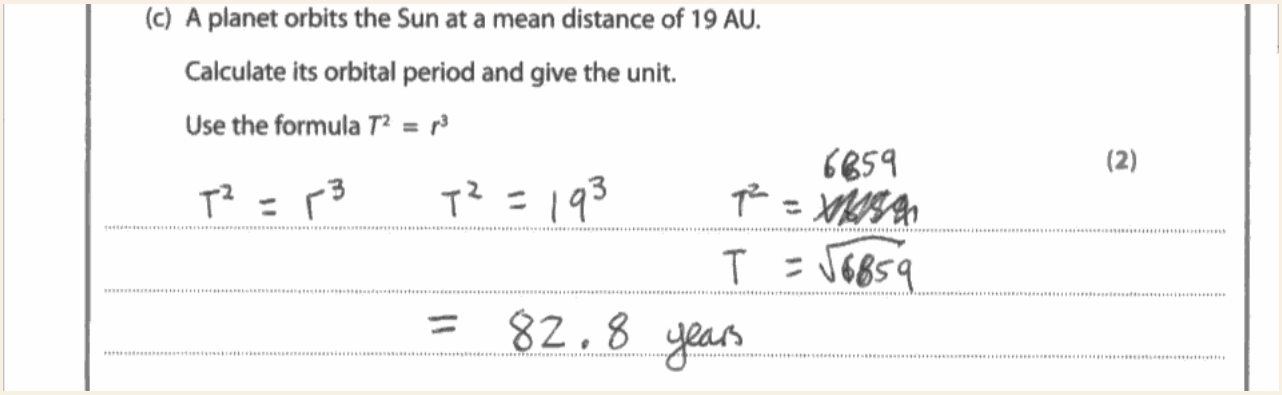
(2)

ResultsPlus
Examiner Comments

A much better response, with the equal areas being indicated as Q and R.

Question 11 (c)

There were mixed responses to this relatively straightforward calculation. Common errors included confusing T and r, and giving an incorrect unit (days being common) in the final answer.

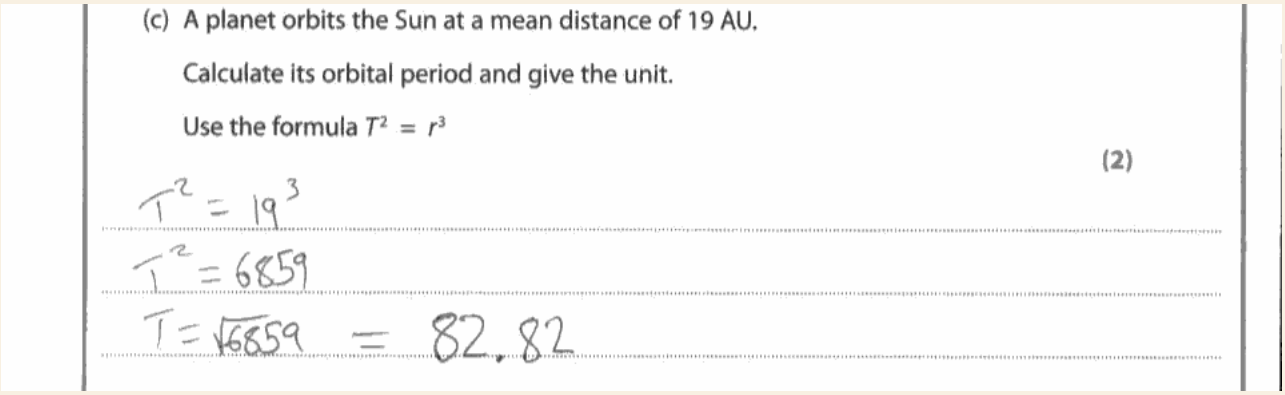


ResultsPlus
Examiner Comments

A perfect response, with full working being shown.

ResultsPlus
Examiner Tip

Once again, ensure that you know which quantities are represented by the symbols, and the units in which they are measured.



ResultsPlus
Examiner Comments

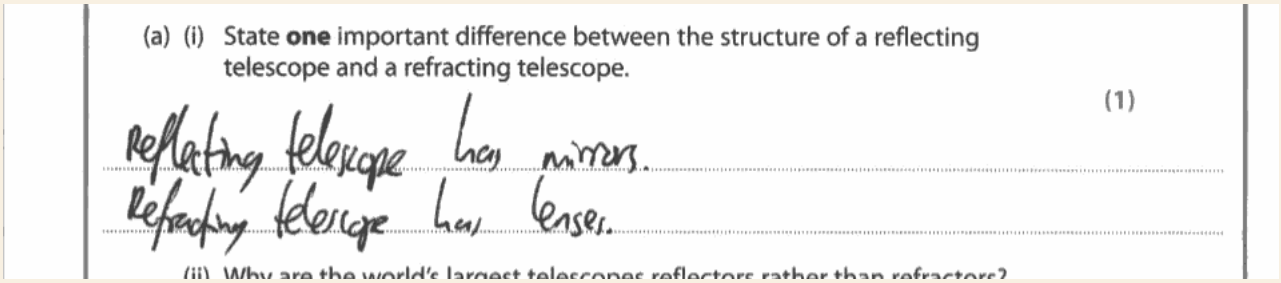
An excellent calculation, but no unit (despite a clear instruction to include one); a vital mark not scored.

ResultsPlus
Examiner Tip

You must realise that the unit is just as important as the numerical value when giving a numerical answer.

Question 12 (a) (i)

This question was generally answered well and most candidates described the mirror/lens difference in the telescopes' objective.


(a) (i) State **one** important difference between the structure of a reflecting telescope and a refracting telescope.

(1)

Reflecting telescope has mirrors.
Refracting telescope has lenses.

(ii) Why are the world's largest telescopes reflectors rather than refractors?

ResultsPlus
Examiner Comments

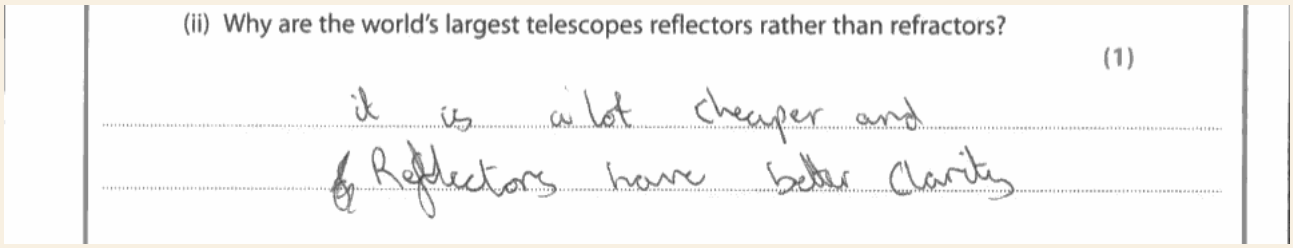
The examiners were not expecting the word 'objective' to be included, but had hoped that lens would be spelt correctly. However, this candidate has made the distinction and scores 1/1.

ResultsPlus
Examiner Tip

Be careful to answer the question; many candidates told the examiners that 'reflecting telescopes reflect light but refractors refract light' which did not address the question.

Question 12 (a) (ii)

The second item on telescopes was similarly well answered.


(ii) Why are the world's largest telescopes reflectors rather than refractors?

(1)

it is a lot cheaper and
& Reflectors have better clarity

ResultsPlus
Examiner Comments

Some responses were somewhat vague as this clip illustrates. The examiners were expecting candidates to realise that the objective of reflectors could be manufactured to be much larger and therefore collect more light and/or have better resolution.

ResultsPlus
Examiner Tip

Re-read your answer and look to see if you could make what you are trying to say clearer. Better still, think more carefully about your answer before writing it down.

Question 12 (b) (i)

Most candidates referred to the absorption of X-rays by the Earth's atmosphere and the examiners were generally impressed by their responses. A few candidates referred to background radiation and the dangers of X-rays, but these were in the minority.

(b) Some astronomers use X-ray telescopes.

(i) Explain why it would not be sensible for astronomers to use an X-ray telescope at sea-level.

(1)

Because light pollution, bad weather and the atmosphere would interfer and it wouldn't give a clear picture.

ResultsPlus
Examiner Comments

This candidate has clearly not studied the effects of the Earth's atmosphere on different wavelengths of EM radiation and has reverted to guessing.

(b) Some astronomers use X-ray telescopes.

(i) Explain why it would not be sensible for astronomers to use an X-ray telescope at sea-level.

(1)

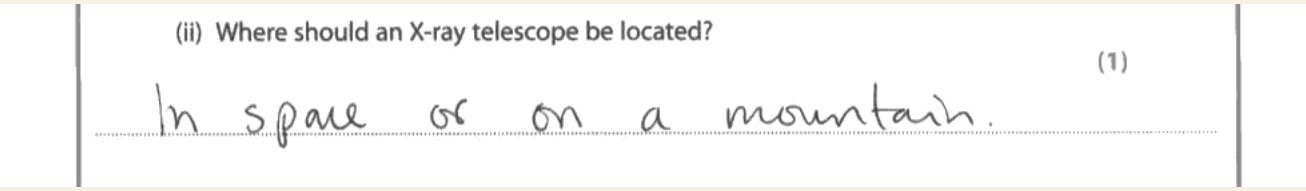
The atmosphere of the Earth does not allow harmful X-rays to pass through.

ResultsPlus
Examiner Comments

A much better response.

Question 12 (b) (ii)

A number of candidates indicated that X-ray telescopes should be located above our atmosphere in space (on a satellite), but many negated their response by adding another, incorrect, location such as 'on a mountain top'.


(ii) Where should an X-ray telescope be located?

(1)

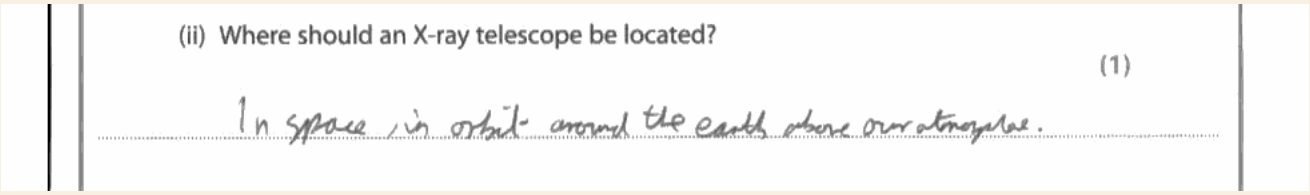
In space or on a mountain.

ResultsPlus
Examiner Comments

This response is partly correct and partly incorrect; unfortunately the candidate's response scores 0/1.

ResultsPlus
Examiner Tip

Don't give too much information that might negate your original answer. Again listing is not recommended.


(ii) Where should an X-ray telescope be located?

(1)

In space, in orbit around the earth above our atmosphere.

ResultsPlus
Examiner Comments

A much better response.

Question 12 (b) (iii)

There were some good responses to this item, including quasars, black holes and the Sun's corona.

(iii) Give an example of an astronomical object that an X-ray astronomer might observe.

(1)

The sun's Corona

ResultsPlus
Examiner Comments

This candidate has clearly identified which part of the Sun emits X-rays and scores 1/1.

Question 13 (a)

Most candidates showed that they had an understanding of quasars and gave some pleasing responses. There were some vague facts that included 'they are bright/a large distance from us/old' but most key facts impressed the examiners.

13 (a) State **two** key facts about quasars.

(2)

1 They are large

2 They are dense

ResultsPlus
Examiner Comments

A good example to illustrate vague answers that could refer to many objects, not just astronomical.

ResultsPlus
Examiner Tip

Make sure that your key facts are different from one another and that they refer to the subject in question, in this case quasars.

13 (a) State **two** key facts about quasars.

(2)

1 ~~caused by~~ very bright a black hole

2 very old

ResultsPlus
Examiner Comments

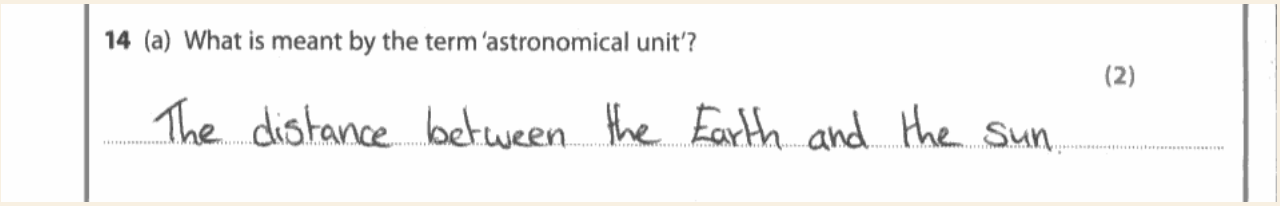
Another example of vagueness that did not impress the examiners.

Question 13 (b)

There were mixed responses to this open-ended question. A large number of candidates referred to strong sources of radio waves being identified with star-like optical images, but a significant number believed (incorrectly) that quasars were discovered by X-rays and many confused quasars with pulsars.

Question 14 (a)

This question proved a good discriminator. The majority of responses referred to the distance between the Earth and Sun, but only a half of these then added 'mean' or 'average' to gain the second mark.


14 (a) What is meant by the term 'astronomical unit'?

(2)

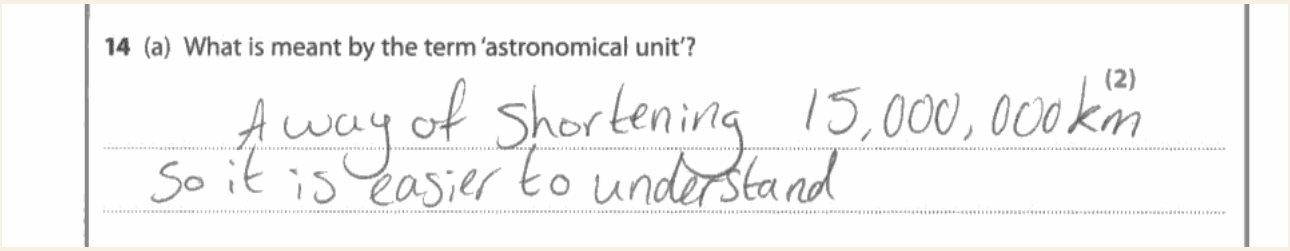
The distance between the Earth and the sun

ResultsPlus
Examiner Comments

Only 1 mark here due to the omission of that all-important word.

ResultsPlus
Examiner Tip

Think carefully before you write your answer whether there should be any detail in your answer. Look at the marks available; 2 marks should indicate that 2 points should be made.


14 (a) What is meant by the term 'astronomical unit'?

(2)

A way of shortening 15,000,000 km
So it is easier to understand

ResultsPlus
Examiner Comments

This response might have illustrated an alternative way of scoring 1/2 had the value in km been correct.

Question 14 (b) (i)

Most candidates placed their letter T directly between the Earth and Sun.

Question 14 (b) (ii)

Almost all the candidates correctly named Venus and Mercury as the two planets that might undergo a solar transit.

Question 14 (c) (i)

Some candidates confused conjunction with opposition, but this item was generally answered well.

Question 14 (c) (ii)

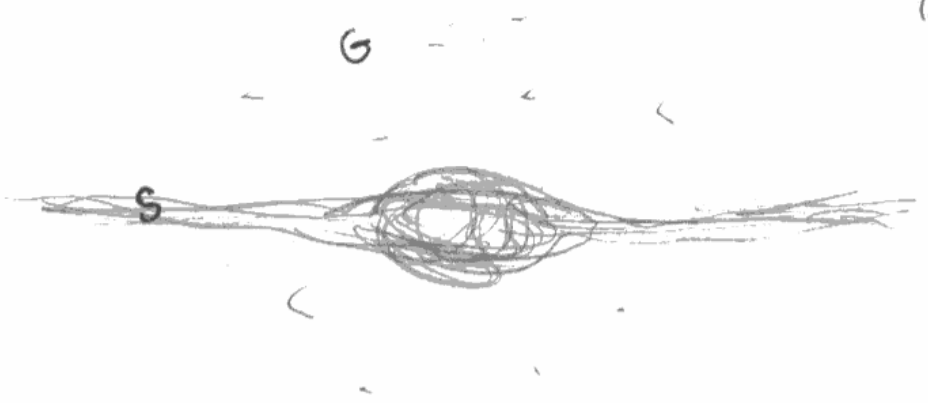
A difficult mathematical item that resulted in a variety of responses.

Question 15 (a) (b)

Although there were a number of plan views of the Milky Way, most candidates successfully sketched 'two fried eggs' and locates S in the spiral arms and G in the halo.

15 (a) Sketch an **edge on view** of the Milky Way galaxy.

(2)



(b) On your sketch, indicate the location of:

(i) a site of stellar formation. Use the letter **S**.

(1)

(ii) a typical globular cluster. Use the letter **G**.

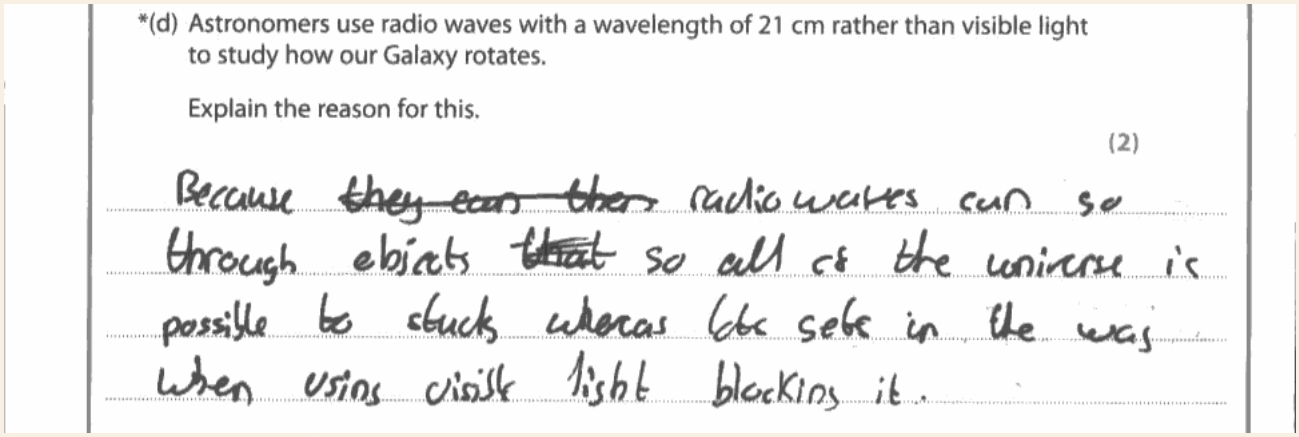
(1)

ResultsPlus
Examiner Comments

A rather 'sketchy' but perfectly adequate view for full marks.

Question 15 (d)

The examiners were pleased with a number of responses who explained that visible light was unable to penetrate dust. Incorrect responses included statements that radio waves travelled faster or were not distorted (a somewhat aloof term).



*(d) Astronomers use radio waves with a wavelength of 21 cm rather than visible light to study how our Galaxy rotates.

Explain the reason for this.

(2)

Because ~~they can then~~ radio waves can go through objects ~~that~~ so all of the universe is possible to study whereas the sets in the way when using visible light blocking it.

ResultsPlus
Examiner Comments

This candidate seems to be on the right lines at first, but with no mention of our Galaxy's spiral arms or dust, the response does not really convey the key explanation.

ResultsPlus
Examiner Tip

Think carefully about your answer before committing to it. Most answers need to be fairly short and there should be plenty of time to consider what you are going to write so that it is clear and refers to the question.

Question 16 (a) (i)

Almost all candidates correctly represented Cassiopeia by the familiar 'W' or 'M' of five stars.

16 (a) A student observes the main stars in the constellation Cassiopeia from a latitude of 58°N.

(i) Sketch the constellation Cassiopeia.

(1)

ResultsPlus
Examiner Comments

A good representation of the constellation of Cassiopeia.

16 (a) A student observes the main stars in the constellation Cassiopeia from a latitude of 58°N.

(i) Sketch the constellation Cassiopeia.

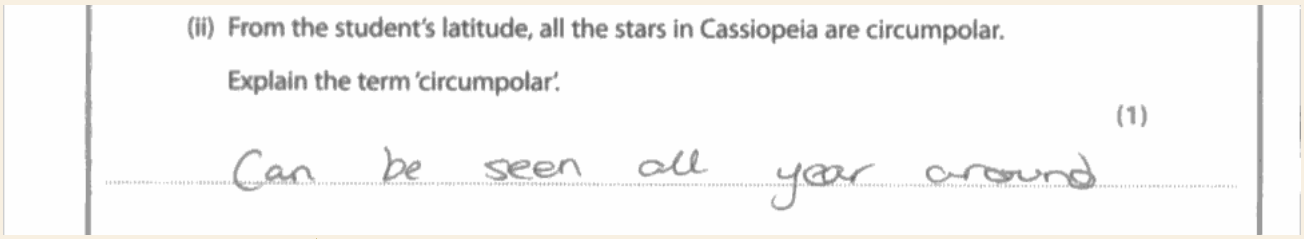
(1)

ResultsPlus
Examiner Comments

A nice life drawing of Cassiopeia, but not one that impressed the examiners astronomically!

Question 16 (a) (ii)

The majority of candidates explained circumpolar stars in terms of not setting from a given latitude.


(ii) From the student's latitude, all the stars in Cassiopeia are circumpolar.

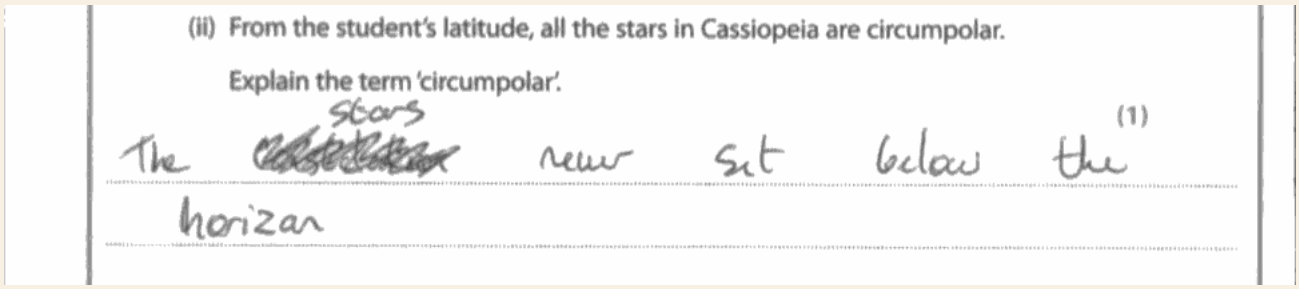
Explain the term 'circumpolar'.

(1)

Can be seen all year around

ResultsPlus
Examiner Comments

This clip shows a good example of a response not quite being correct. Many stars visible towards the north can be seen all year, but many of these set.


(ii) From the student's latitude, all the stars in Cassiopeia are circumpolar.

Explain the term 'circumpolar'.

(1)

The stars never set below the horizon

ResultsPlus
Examiner Comments

A better response that scores 1/1.

Question 16 (b) (i)

There were some disappointing responses to this item that hinted that many candidates had never used a planisphere. Many referred to planets or the phase of the Moon and not 'fixed' objects in the sky, as was hoped.

(b) A student uses a planisphere and the Messier Catalogue to plan some observations of the northern sky.

What information will the student obtain from

(i) the planisphere

(2)

Where planets will be at certain times of the year

ResultsPlus
Examiner Comments

This candidate has perhaps been persuaded by the name that the positions of planets are shown on a planisphere.

(b) A student uses a planisphere and the Messier Catalogue to plan some observations of the northern sky.

What information will the student obtain from

(i) the planisphere

(2)

Which stars and constellations are visible at the time of observing and where they will be in the sky.

ResultsPlus
Examiner Comments

A much better response, scoring 2/2.

Question 16 (b) (ii)

Most candidates referred to Messier objects without telling the examiners what these were; few responses included nebulae, galaxies, clusters or even faint, extended objects.

(ii) the Messier Catalogue?

(2)

This will give him everything he needs to know about Messier objects.

ResultsPlus
Examiner Comments

A response that clearly indicates that this candidate has not studied the Messier catalogue.

(ii) the Messier Catalogue?

(2)

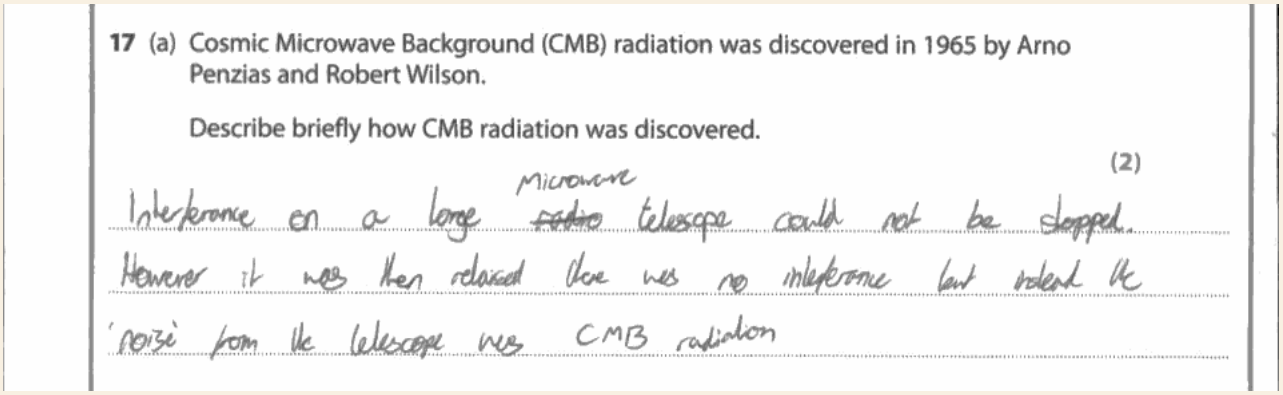
The Messier Catalogue ~~sho~~ is a list of Messier objects. ~~by and~~ They are represented by an M with the number of which they were found.

ResultsPlus
Examiner Comments

A slightly better attempt, but still this response does not convey the contents of the catalogue.

Question 17 (a)

Most candidates convinced the examiners with their description of the accidental discovery of CMB from all areas of the sky.



17 (a) Cosmic Microwave Background (CMB) radiation was discovered in 1965 by Arno Penzias and Robert Wilson.

Describe briefly how CMB radiation was discovered.

(2)

Interference on a large ~~radio~~ microwave telescope could not be stopped. However it was then released there was no interference but instead the 'noise' from the telescope was CMB radiation

ResultsPlus
Examiner Comments

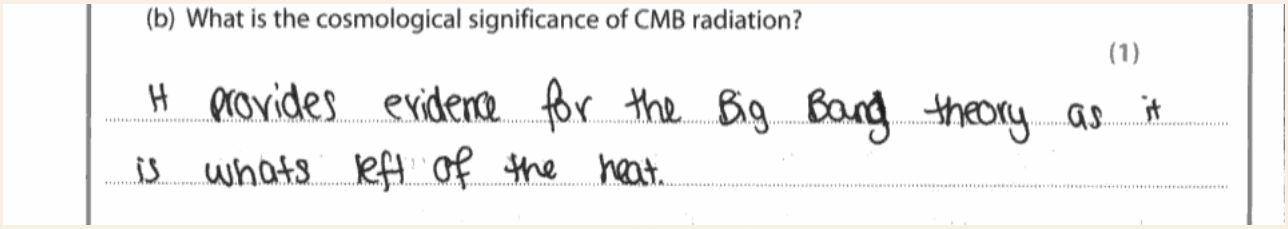
This response gives one relevant piece of information that is effectively repeated, and scores 1/2.

ResultsPlus
Examiner Tip

Look at the number of marks on offer and make sure that you write down the corresponding number of different, relevant points.

Question 17 (b)

The majority of candidates referred to the CMB as providing evidence for the Big Bang. Some went a little further and described it as actually *proving* the Big Bang, but these responses were accepted.



(b) What is the cosmological significance of CMB radiation?

(1)

It provides evidence for the Big Bang theory as it is whats left of the heat.

ResultsPlus
Examiner Comments

A typical response that scored 1/1.

Question 17 (c)

This was a difficult item for many candidates. A handful mentioned the formation of galaxies in the early-Universe, dark matter or dark energy.

Question 18 (a)

Collisions with comets early in the Earth's history were the theme of most responses and these impressed the examiners. Reference to meteors/meteoroids/meteorites/asteroids only gained candidates 1/2 mark, and descriptions of hydrogen and oxygen recombining in our oceans was not deemed astronomical.

18 (a) Describe briefly an astronomical theory which could explain the origin of water on Earth.

(2)

One theory is that early life would have synthesised a lot of water over time from chemicals from volcanos thought to be present early in the Earth's formation.

ResultsPlus
Examiner Comments

This response does not refer to the astronomical theory that is clear in the question.

ResultsPlus
Examiner Tip

Read the question carefully and interpret it at face-value.

18 (a) Describe briefly an astronomical theory which could explain the origin of water on Earth.

(2)

Comets containing ice crashed to Earth and brought water. This evaporated and spread over the world creating more water

ResultsPlus
Examiner Comments

A better response, correctly involving comets.

Question 18 (b)

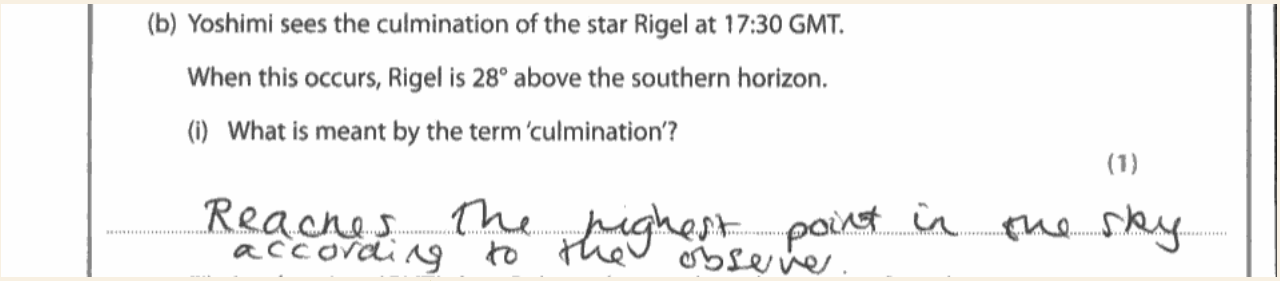
There were some excellent responses to this item and it was clear that candidates had been fully-prepared for a topic that is new to the current specification.

Question 19 (a)

The whole of question 19 proved a good discriminator and there were some mixed responses. This particular item was answered well and most candidates included the all-important 'east' in their answer.

Question 19 (b) (i)

Most candidates described culmination correctly, referring to the observer's meridian or the star being at its highest in the sky.


(b) Yoshimi sees the culmination of the star Rigel at 17:30 GMT.

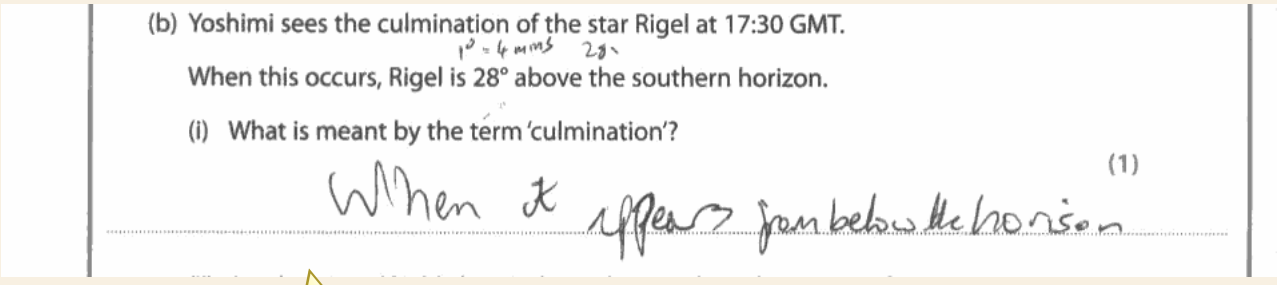
When this occurs, Rigel is 28° above the southern horizon.

(i) What is meant by the term 'culmination'?

(1)

Reaches the highest point in the sky according to the observer.

ResultsPlus
Examiner Comments
A correct response, typical of many.


(b) Yoshimi sees the culmination of the star Rigel at 17:30 GMT.

When this occurs, Rigel is 28° above the southern horizon.

(i) What is meant by the term 'culmination'?

(1)

When it appears from below the horizon

ResultsPlus
Examiner Comments
An example of the most common incorrect response.

Question 19 (b) (ii)

A simple 'thought' calculation that gave some pleasing responses.

Question 19 (b) (iii)

Most candidates realised that being further south meant that Rigel would be higher in the sky.

Question 19 (c) (i)

The declination of Polaris was well-known and only a few candidates negated their response by adding 'north'.

Question 19 (c) (ii)

Many candidates seemed unaware that the elevation of Polaris from a given location is equal to the observer's latitude. There were a variety of responses, mostly incorrect.

Question 20 (a) (i)

The examiners were hoping that most candidates would refer to the gradient of this graph. Many candidates misinterpreted the 'How' as 'Why' and referred to positive correlations.

20 (a) An astronomer obtained some values for the radial velocity (v) of some distant galaxies and their distance (d) from us.

Figure 15 shows a graph of the astronomer's results.

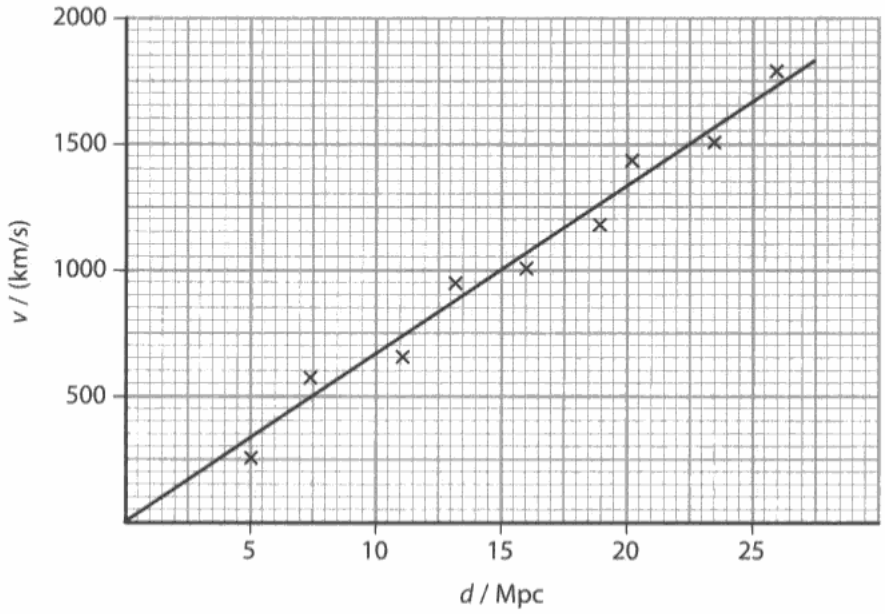


Figure 15

(i) How can the Hubble constant be determined from the graph?

(1)

By finding the gradient of the line of best fit.

ResultsPlus
Examiner Comments

A perfect response.

20 (a) An astronomer obtained some values for the radial velocity (v) of some distant galaxies and their distance (d) from us.

Figure 15 shows a graph of the astronomer's results.

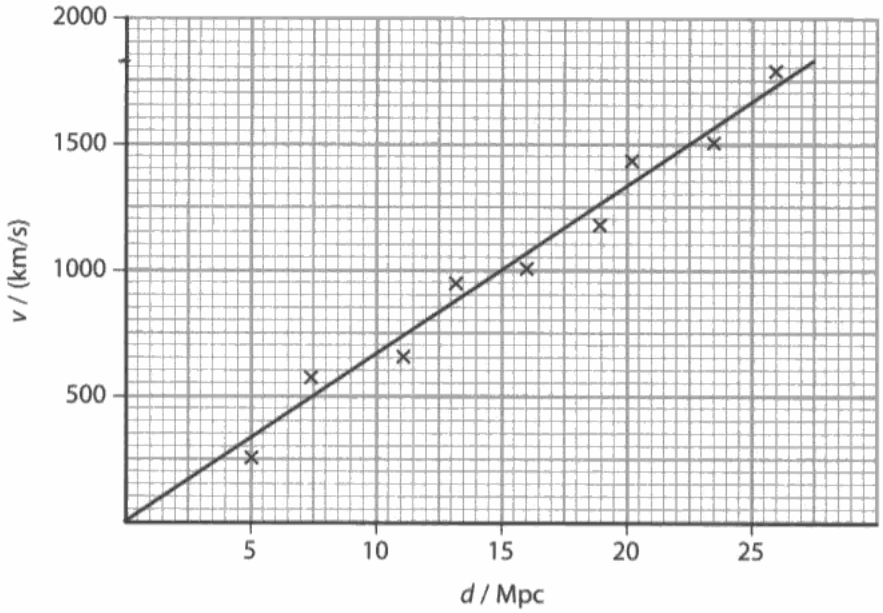


Figure 15

(i) How can the Hubble constant be determined from the graph?

(1)

That's a good question...

By looking at the graph with astronomical eyes, knowledge and a calculator.

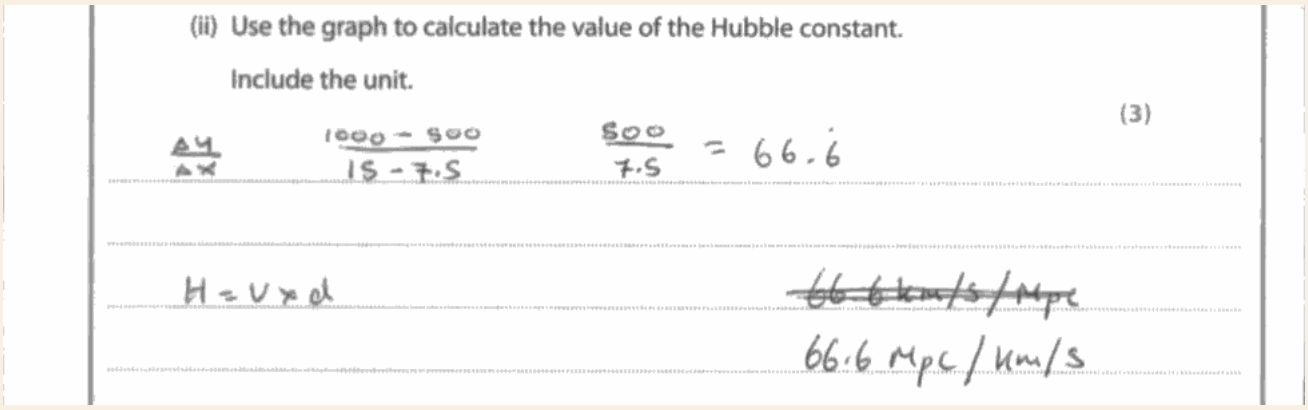
(ii) Use the graph to calculate the value of the Hubble constant

ResultsPlus
Examiner Comments

An inspired guess, but sadly no marks.

Question 20 (a) (ii)

The examiners were pleased not only with the calculation of Hubble's constant but also the inclusion of the correct unit.



ResultsPlus
Examiner Comments

An admirable calculation. It was a pity that the unit in this response was incorrect.

ResultsPlus
Examiner Tip

In calculations, show all of your working out (as this candidate has done). You may gain some credit for this even if your final answer is incorrect. Always include a (correct) unit.

Question 20 (b)

This explanation proved difficult for some candidates but there were some pleasing attempts to manipulate the units of the Hubble constant and then invert to give a time.

(b) Explain how the value of the Hubble constant can be used to estimate the age of the Universe in years.

(2)

We can see how fast objects have been moving so we can see how far they have come and how long it took.

ResultsPlus
Examiner Comments

A nice try, but impractical!

(b) Explain how the value of the Hubble constant can be used to estimate the age of the Universe in years.

(2)

Velocity and distance both have distance units so if you change Km to Mpc you can cancel the distance unit out leaving how long the Universe has existed (/s) $\left(T=\frac{1}{H}\right)$

(Total for Question 20 = 6 marks)

ResultsPlus
Examiner Comments

A more impressive account, worthy of 2/2.

Paper Summary

Comments on individual questions have revealed a number of pointers to indicate how candidates can improve their performance:

Candidates should read all questions carefully in order to ensure that they understand fully what is being asked. It is important that they distinguish between commands such as 'How' and 'Why', and 'Describe' and 'Explain';

Candidates should note the number of marks available for each item; if 2 marks are available, then there should be 2 individual and distinct points made; if only 1 mark is available, candidates should give just one piece of information and not two, since one of these may be incorrect and negate their response;

In calculations, candidates should show all their working and make their final answer clear; they should pay particular attention to the unit (or lack of) and give a sensible number of significant figures;

Although mathematical formulae are given when needed, candidates must be able to interpret the symbols and relate them to the correct quantities;

In questions asking candidates to list, for example two key facts about quasars, it is important to avoid repetition i.e. give two important facts; these should not be vague (e.g. 'they are bright/large/hot/a long way from us' etc) and wherever possible, relate to quasars and no other astronomical body;

Unit 1 consists of a 2-hour written paper but candidates should not be writing for all this time; it is important that candidates pause to consider their answers before putting pen to paper, and there ought to be plenty of time for them to re-read the question and ask themselves 'Have I actually answered what the question has asked?'. The examiners firmly believe that this technique would help to reduce vague responses that could be misinterpreted; it is also likely to reward candidates with higher marks!

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