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Examiners' Report
June 2022

GCSE Astronomy 1AS0 01

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June 2022

Publications Code 1AS0_01_2206_ER

Introduction

The GCSE Astronomy 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 mirrors a similar division of material within the Specification.

The central focus on observational astronomy was very evident in these examination papers, where many questions were designed around presenting candidates with the results of an astronomical observation. Candidates were asked to process the information and arrive at scientific conclusions.

Others questions asked them to comment on the conclusions that others, 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.

The 2022 examination papers represented a very welcome return to a structure where candidates were able to express their full knowledge and understanding in the two full examination papers, supported by the guidance from the Advance Information documents.

It is clear from this year's examination that centres and their candidates have worked extremely hard on their astronomical studies, despite the inevitable disruption from the unprecedented events of recent years.

The enthusiasm and commitment, which have always characterised those involved with the teaching and learning of GCSE Astronomy, continue 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), which clearly went into the preparation of this year's cohort.

Across both examination papers, this year's candidates demonstrated a number of impressive qualities, reflecting high quality teaching and learning throughout their courses:

- Candidates continue to show good flexibility when dealing with the wide range of data that the subject generates
- Many candidates coped very well with the often very demanding mathematical skills required by the questions in this year's papers, including skills such as squaring, cubing and logarithmic scales
- Strong graphical skills were demonstrated in both the creation and use of graphs.

Many candidates showed excellent background knowledge in the subject, allowing them to enhance the depth and detail of their answers.

It was evident that, for some candidates, questions on some topic areas were rather unexpected. Centres are reminded of the need for candidates to have been exposed to all parts of the Specification before the examination.

Comprehensive Topic Support Guides have been produced to support teaching and learning in several areas and these can 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.

Question requirements

Although it may seem an obvious point, it is clear that significant numbers of candidates are losing marks because they have not understood the requirements of the question fully. In particular, candidates must pay close attention to the Command word used at the start of each question, because these invariably determine the structure of the mark scheme.

- Questions that ask candidates to Explain will not award any marks for a description. When answering these questions candidates must be clear that they are explaining **why** something happens and not simply describing **what** happens. Candidates should ensure that their answer gives material additional to that in the question and that they are not just repeating the question.
- Questions that ask candidates to 'Compare…' will require both sides of the particular argument to be stated for full marks.
- Questions that ask candidates to 'Evaluate…' will require them to come to a judgement or conclusion, after having looked at both sides of the information presented.
- Questions that ask candidates to 'Show…' will award marks for each step of astronomical reasoning in the working. Marks will not be awarded for unexplained numbers or calculations.

Diagrams

By the nature of the subject, almost every GCSE Astronomy examination question involves the use of a diagram either in the question, the answer or in the mind of the candidate answering it.

- Most concepts in astronomy are expressed more clearly using a diagram. Candidates are advised to use a fully-labelled diagram whenever it will make their answer clearer. Obviously, a diagram is required by the mark scheme in questions that state 'Use a diagram…'. Although it is optional in questions stating 'You may use a diagram…' ,it is still strongly recommended. The use of diagrams to clarify answers was definitely a hallmark of the higher-achieving candidates in this examination.
- It is essential that all the key parts of a diagram are labelled clearly. A number of 'diagrams' seen by this year's Examiners contained lines and curves representing important items but which had no label, often rendering the diagram insufficient for the award of marks.
- Candidates are advised to use a ruler whenever possible in their diagrams. Diagrams drawn without the use of a ruler can easily descend into becoming rough sketches
- Diagrams in GCSE Astronomy often involve drawing an area of the night sky. Given its apparently 'domed' appearance, candidates should practise drawing it beforehand, because it can present a drawing challenge. Nevertheless, regarding each small section of the sky as a piece of flat graph paper, with lines drawn with a ruler and labelled clearly, can make this a more straightforward task.

Calculations

In both examination papers, calculations often represent a significant number of marks and it is important that each candidate shows the full extent of their ability in these questions.

- Candidates must bring an adequate calculator to both examination papers so that they can meet all its mathematical demands. As well as basic arithmetical functions, astronomical calculations can often involve more complex operations such as squaring, cubing, taking logarithms etc.
- Candidates should ensure that they are familiar with the operation of their chosen calculator
- Given that some calculations are now worth three or even four marks, the provision of clear, structured working is more important than ever.
- The provision of clear working is essential in questions that require candidates to 'Show…' rather than 'Calculate…'. In these questions, there are obviously no marks for the final answer (given on the paper) and all marks are for the steps in the working and their astronomical justification.
- It is recommended that candidates give their final answers to a sensible number of significant figures. They should take their cue from the data given in the question, in addition to the precise answer resulting from their calculation.
- Questions asking candidates to 'Analyse…' will require them to use the numerical data provided within the question as part of their answer. These data can be provided in a table, graph or other form but must be used in the candidates' calculations, if full marks are to be obtained.

Question 1 (b)(i)

Questions referring to, or requiring telescopes/binoculars, will not appear in Paper 1 (1AS0 01).

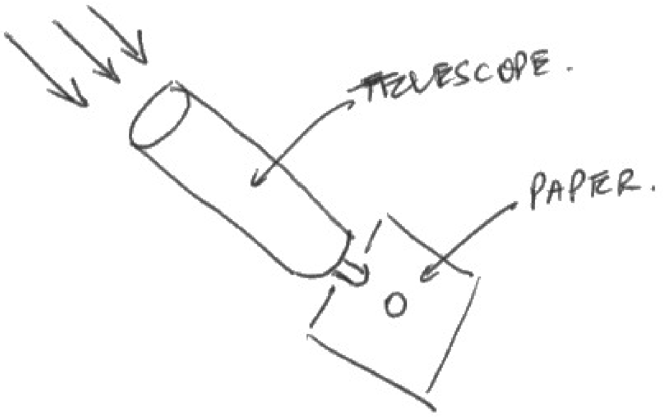
Some responses incorporated either a telescope or binoculars.

(b) Pinhole projection can be used to observe the Sun safely.

(i) Describe the pinhole projection method.

You may include a clearly labelled diagram in your answer.

(2)



USING A TELESCOPE, SET UP WITH THE SUN AS IT'S FOCUS. AT EYEPIECE PLACE A PAPER AT THE RIGHT DISTANCE SO THE IMAGE IS IN FOCUS. NEAR LOOK DIRECTLY AT THE SUN NOR DOWN THE EYEPIECE

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Examiner Comments

However, if a screen for projection were to be included in the answer (as in this example), then 1 mark could be awarded.

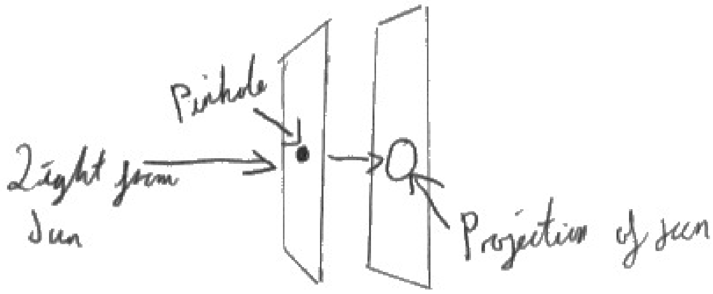
Total: 1 Mark

(b) Pinhole projection can be used to observe the Sun safely.

(i) Describe the pinhole projection method.

You may include a clearly labelled diagram in your answer.

(2)



When the ~~weather is~~ sky is clear. Put a hole through a piece of paper. Position a 2nd Sheet behind and ~~adjus~~ adjust distance between them to bring the Sun into focus.

ResultsPlus
Examiner Comments

This is a good example of a 2-mark response.

Total: 2 Marks

Question 1 (b)(ii)

There was a broad range of descriptions for the Milky Way.

(ii) Describe the appearance of the Milky Way when observed with the naked eye from Earth.

(1)

A faint Patch / Cluster of light

ResultsPlus

Examiner Comments

This example demonstrates enough information to be awarded the mark.

Total: 1 Mark

(ii) Describe the appearance of the Milky Way when observed with the naked eye from Earth.

(1)

The Milky way would look like a fuzzy star in the distance.

ResultsPlus

Examiner Comments

This description was not good enough to award the mark.

Total: 0 Marks

(ii) Describe the appearance of the Milky Way when observed with the naked eye from Earth.

(1)

~~a galaxy that is~~ nothing since you cant see the milky way with the naked eye

ResultsPlus
Examiner Comments

An example of a zero-mark response.

Total: 0 Marks

Some candidates confused the appearance of the Milky Way (when observed from Earth), and what the Milky Way galaxy looks like (ie a spiral galaxy).

(ii) Describe the appearance of the Milky Way when observed with the naked eye from Earth.

(1)

as we are in the milky way we usually just see ~~x~~ the spirals from earth.

ResultsPlus
Examiner Comments

No marks were awarded for this response.

Total: 0 Marks

Question 1 (b)(iii)

The question was answered correctly by the majority of candidates.

However, the most common misconception was the incorrect fact that the Milky Way was too large to be able to project an image.

(iii) Give **one** reason why the pinhole projection method may **not** be suitable when observing the Milky Way.

(1)

Because the milkyway is so big.

ResultsPlus
Examiner Comments

This response demonstrates the point made in the introduction to this question.

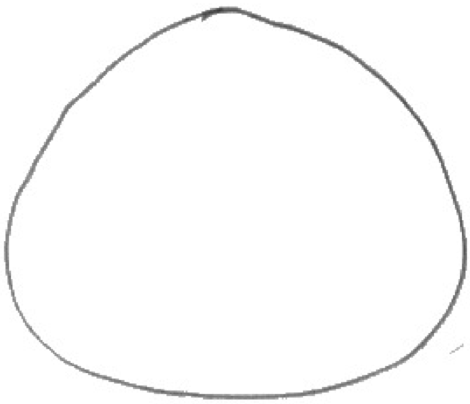
Total: 0 Marks

Question 2 (b)

(b) The Earth's shape can be described as an oblate spheroid.

Draw an 'oblate spheroid'. (Squashed circle)

(2)



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Examiner Comments

This is an example of a 1-mark response – it has symmetry only on one axis.

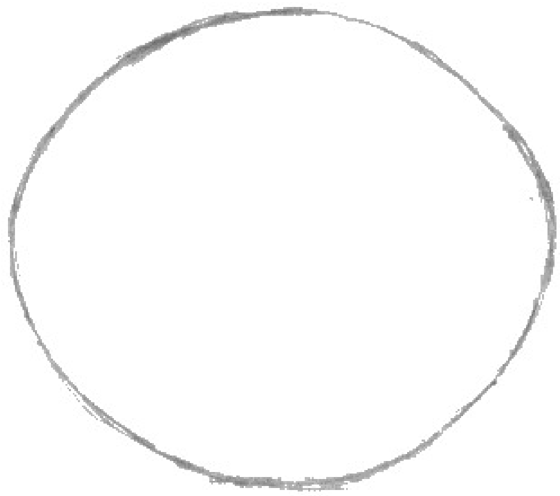
Total: 1 Mark

(b) The Earth's shape can be described as an oblate spheroid.

Draw an 'oblate spheroid'.

a slightly 'squashed' sphere

(2)



ResultsPlus
Examiner Comments

This is a good example of a 2-mark response.

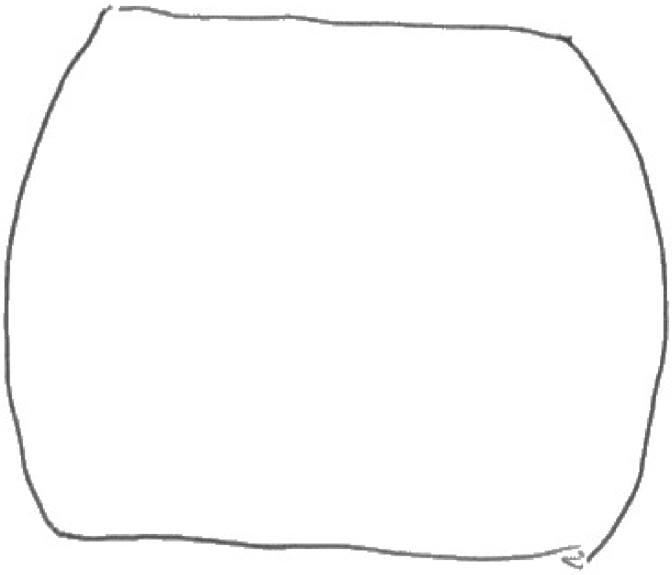
Note that the orientation of the oblate spheroid is not a marking point. Candidates have not been asked to draw what the Earth looks like.

Total: 2 Marks

(b) The Earth's shape can be described as an oblate spheroid.

Draw an 'oblate spheroid'.

(2)



ResultsPlus
Examiner Comments

This is an example of a zero-mark response.

Total: 0 Marks

Question 3 (a)(i-iii)

This question differentiated well, with the full range of marks awarded.

3 Figure 3 shows the orbits of Venus, Earth and Mars around the Sun.

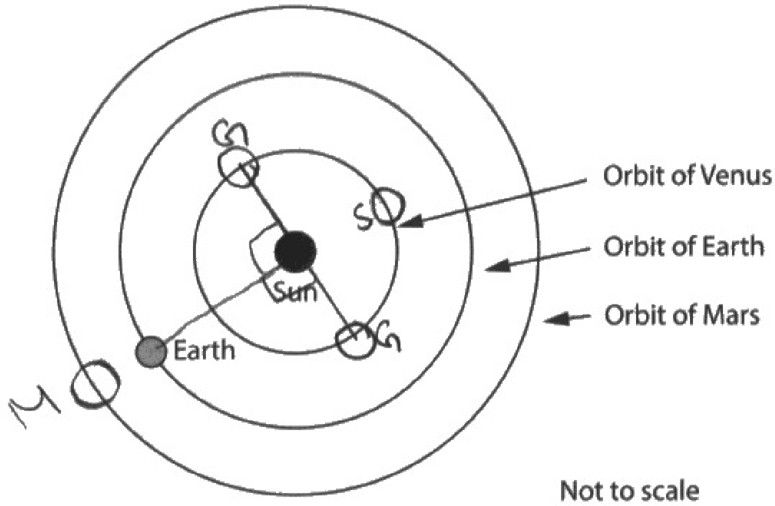


Figure 3

(a) (i) Label on Figure 3 the position of Mars when it is seen to be in opposition for an observer on Earth.

Use the label **M**.

(1)

(ii) Label on Figure 3 the position of Venus when it is seen to be in superior conjunction for an observer on Earth.

Use the label **S**.

(1)

(iii) Label on Figure 3 the **two** possible positions of Venus when it is seen to be at greatest elongation for an observer on Earth.

Use the label **G**.

(1)

ResultsPlus
Examiner Comments

The most frequent error for 3(a)(iii) is shown in this example. The positions of Venus were often positioned, incorrectly, perpendicular to the Earth-Sun line.

The perpendicular should lie between Earth-Venus-Sun.

Total: 2 Marks

3 Figure 3 shows the orbits of Venus, Earth and Mars around the Sun.

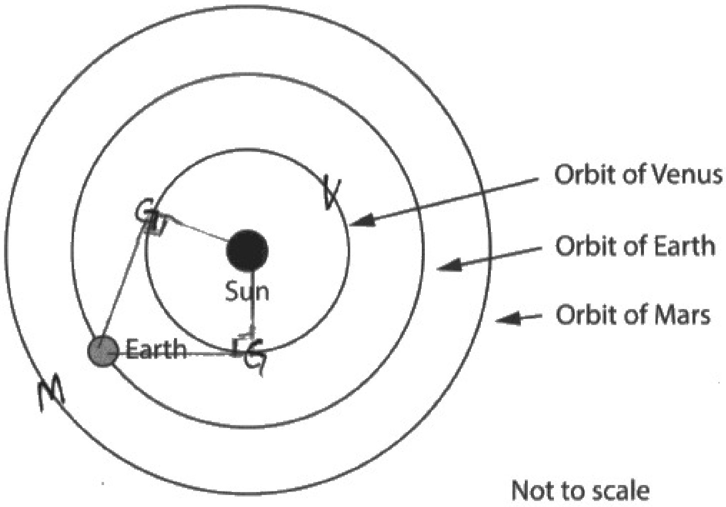


Figure 3

(a) (i) Label on Figure 3 the position of Mars when it is seen to be in opposition for an observer on Earth.

Use the label **M**.

(1)

(ii) Label on Figure 3 the position of Venus when it is seen to be in superior conjunction for an observer on Earth.

Use the label **S**.

(1)

(iii) Label on Figure 3 the **two** possible positions of Venus when it is seen to be at greatest elongation for an observer on Earth.

Use the label **G**.

(1)

ResultsPlus
Examiner Comments

In this example, the position of Venus was labelled incorrectly, with the letter 'V' and not the letter 'S', as stated in the question.

ResultsPlus
Examiner Tip

Pay particular attention to what labels are requested.

Follow the instructions carefully.

Question 4 (a)(i)

Candidates found this question difficult to answer and although many were able to score one mark, few went on to justify their response fully, and gain maximum marks. Weaker responses tended to focus on the clock time being appropriate or convenient.

Answers that referred to the Earth-Sun orbital properties also often scored low marks.

4 (a) (i) Explain why time zones are used on the Earth.

(2)

because the Sun isn't always in the same position ~~[illegible]~~ ~~[illegible]~~ over earth

ResultsPlus
Examiner Comments

This is a typical example of a response that scores no marks.

There is not enough detail linking the position of the Sun in the sky to the clock time at that location on Earth.

Total: 0 Marks

4 (a) (i) Explain why time zones are used on the Earth.

(2)

Time zones are used to standardise sunrise and sunset hours for people living in locations which recieve light from the sun at different times.

ResultsPlus
Examiner Comments

This is a model answer, which gains full marks.

Total: 2 Marks

Question 4 (a)(iii)

Many candidates calculated the number of times zones successfully, by dividing the difference in Longitude by 15 degrees. This yields an answer of 4.13.

However, candidates often, then, incorrectly rounded this number up to 5 time zones when, in fact, the smallest number of time zones should be rounded down to 4.

(iii) An aircraft flies in a straight line from Mogadishu, which has a longitude of 45°E to Jakarta which has a longitude of 107°E.
It takes the shortest route possible.

Calculate the smallest number of time zones that the aircraft could pass through on this journey.

(2)

107 − 45 = 62°

62 ÷ 15 = 4.13

Meaning that Smallest Number of Time Zones = 5

Smallest number of time zones = 5

ResultsPlus
Examiner Comments

This response is typical.

Total: 1 Mark

ResultsPlus
Examiner Tip

Questions can often require candidates to round to the nearest integer.

Take care as to whether your answer has to be rounded either up or down.

Question 4 (b)(i-ii)

This question proved slightly harder for some candidates because the sundial was located in the southern hemisphere.

Candidates should have the opportunity to solve problems in both the northern and southern hemispheres.

One of the more frequent mistakes was for candidates to describe how to determine the latitude of the sundial by using shadow lengths or gnomon heights.

(b) Figure 4 shows a sundial located in the Earth's southern hemisphere.
It is correctly sited and aligned.

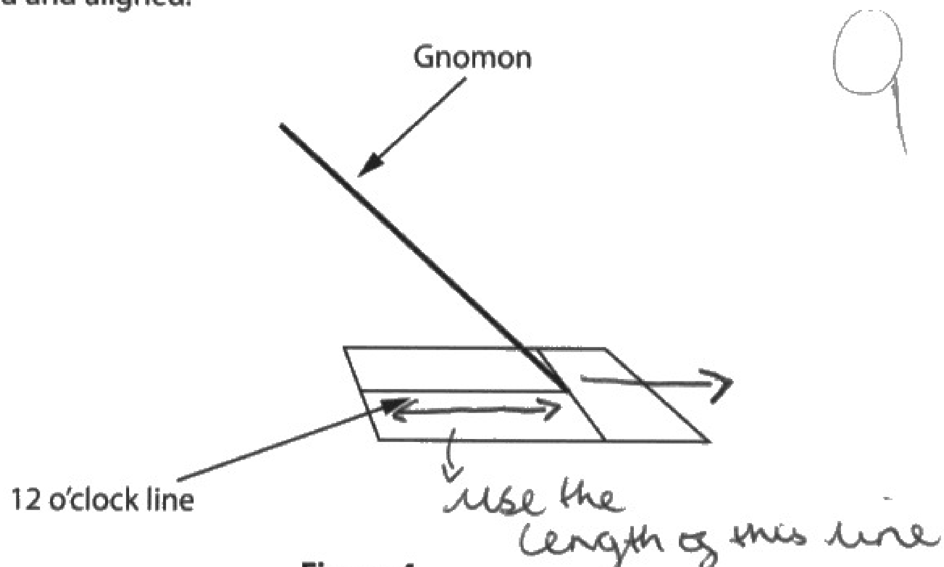


Figure 4

(i) Draw an arrow to show how the sundial can be used to determine the direction of north on Figure 4.

(1)

(ii) Label Figure 4 to show how the sundial can be used to determine the latitude at which this sundial is being used.

(1)

ResultsPlus
Examiner Comments

This response is an example of the point above.

1 mark is awarded for the arrow showing the correct direction for north.

Total: 1 Mark

Question 4 (b)(iii)

The responses to this question proved to be well-differentiated.

The majority of candidates attempted to correct the sundial time by using the equation of time. The most frequent mistake here was to add (rather than subtract) – 12 minutes.

Fewer candidates attempted to correct for longitude, and again, the correction was subsequently subtracted, rather than added.

(iii) Ruhee uses a sundial to determine Greenwich Mean Time (GMT).

She records the following data:

Time on her sundial = 11 am
Equation of Time = -12 minutes
Longitude of the sundial = 8° West

Calculate the Greenwich Mean Time (GMT) at the time of her observations.

(2)

EOT = AST - MST   GMT = MST

AST = 11:00
EOT = -12
LONGITUDE = 8°W.

-12 = 11:00 - MST

MST = 11:12
GMT = 11:12.

GMT = 11:12 h:min

ResultsPlus
Examiner Comments

One mark is awarded for subtracting the equation of time correctly.

Total: 1 Mark

ResultsPlus
Examiner Tip

Be careful when subtracting negative values for the equation of time!

(iii) Ruhee uses a sundial to determine Greenwich Mean Time (GMT).

She records the following data:

Time on her sundial = 11 am
Equation of Time = -12 minutes
Longitude of the sundial = 8° West

Calculate the Greenwich Mean Time (GMT) at the time of her observations.

(2)

1° = 4 mins
× 8 = 32 mins   west → +

11:00 - 12 = 10.48

10.48 + 32 =

11.20

GMT = 11.20 h:min

ResultsPlus
Examiner Comments

This is a one-mark example, where the longitude correction is applied successfully, but unfortunately there is an error when subtracting the equation of time.

Total: 1 Mark

(iii) Ruhee uses a sundial to determine Greenwich Mean Time (GMT).

She records the following data:

Time on her sundial = 11 am
Equation of Time = -12 minutes
Longitude of the sundial = 8° West

Calculate the Greenwich Mean Time (GMT) at the time of her observations.

(2)

8° west means she is (8×4) 32 minutes west because 1° = 4 mins,
EOT = Apparent solar time − Mean solar time.
−12 = 11 am − Mean solar time.
mean solar time = 11 am + 12 mins
= 11:12 am
11:12 am − 32 mins. = 10:40 am

GMT = 10:40 h:min

ResultsPlus
Examiner Comments

This response receives one mark – the equation of time correction has been correctly used but unfortunately the longitude correction has been subtracted rather than added.

Total: 1 Mark

(iii) Ruhee uses a sundial to determine Greenwich Mean Time (GMT).

She records the following data:

Time on her sundial = 11 am
Equation of Time = -12 minutes
Longitude of the sundial = 8° West

Calculate the Greenwich Mean Time (GMT) at the time of her observations.

(2)

EoT = AST - MST

8 x 4 min = 32 min

MST = AST - EOT

MST = 11:12

GMT = 11:12 + 32

GMT = 11:44

GMT = 11:44 h:min

ResultsPlus
Examiner Comments

This response receives both marks.

Total: 2 Marks

Question 5 (a)(i)

It was noted in this question that many candidates were unable to name the phases of the Moon correctly.

5 Figure 5 is a diagram of the Moon's orbit around the Earth.

Four positions in the Moon's orbit are labelled A, B, C and D.

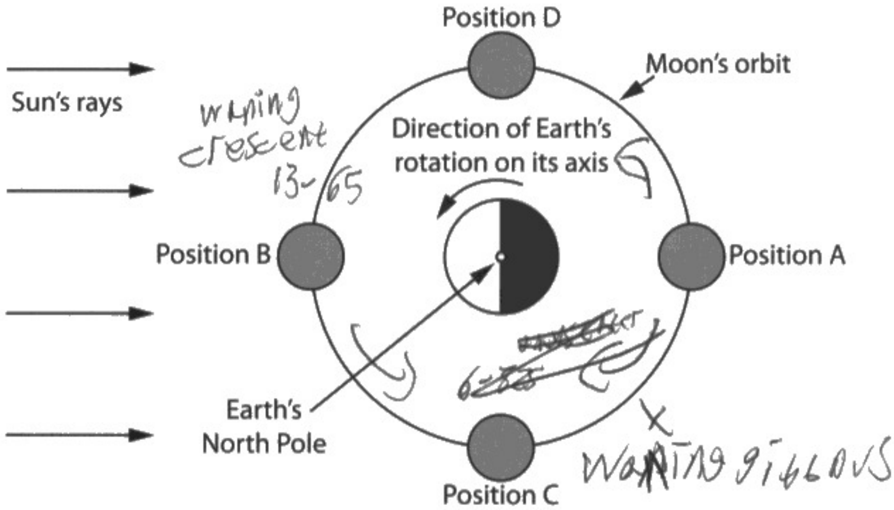


Figure 5

Table 1 shows details of three positions (A, B and C) in the Moon's orbit.

Position	Name of the Moon's phase when seen from Earth	Time at which the Moon will cross the observer's meridian
A	Full	00:00 (midnight)
B	waning crescent	~~12:00~~ 12:00
C	waxing gibbous	~~18:00~~ 18:00

Table 1

(a) (i) Using Figure 5, complete Table 1 to determine the Moon's phase when seen from Earth and the time at which the Moon will cross the observer's meridian.

(4)

27.3 orbit

29.5 phases

$\frac{27.3}{4} = 6.825$

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Examiner Comments

This response is awarded 2 marks for the correct times but, unfortunately, the phases are not named correctly.

Total: 2 Marks

The first quarter phase was often incorrectly named as "half" or “half-moon”, thus dropping one mark.

5 Figure 5 is a diagram of the Moon's orbit around the Earth.

Four positions in the Moon's orbit are labelled A, B, C and D.

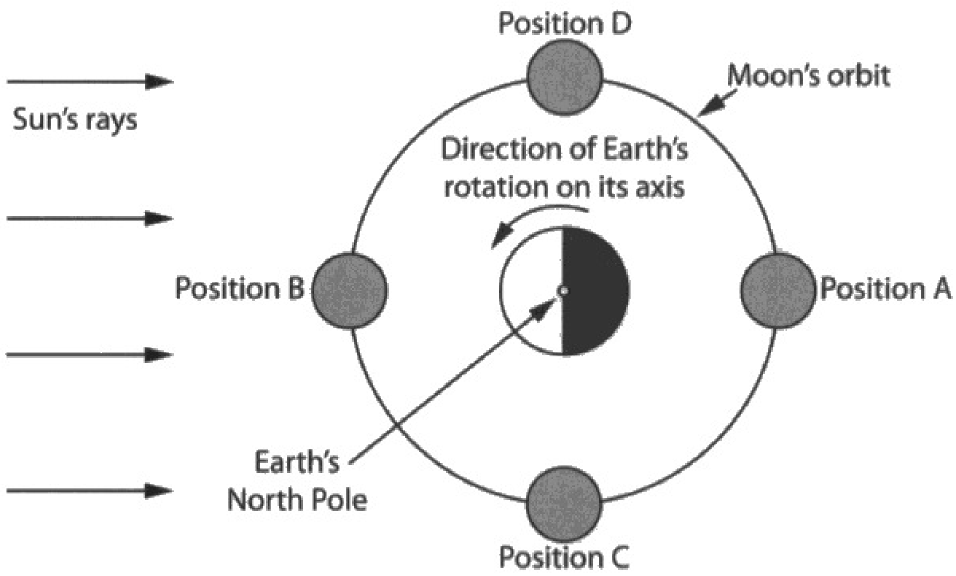

Figure 5

Table 1 shows details of three positions (A, B and C) in the Moon's orbit.

Position	Name of the Moon's phase when seen from Earth	Time at which the Moon will cross the observer's meridian
A	Full	00:00 (midnight)
B	new	12:00 (midday)
C	Half	18:00

Table 1

(a) (i) Using Figure 5, complete Table 1 to determine the Moon's phase when seen from Earth and the time at which the Moon will cross the observer's meridian.

(4)

ResultsPlus
Examiner Comments

This is a 3-mark response, losing a mark for the reason above.

Total: 3 Marks

Question 5 (b)

(b) Figure 6 shows the Earth when viewed from above the North Pole. The directions of the Moon and Sun are also shown.

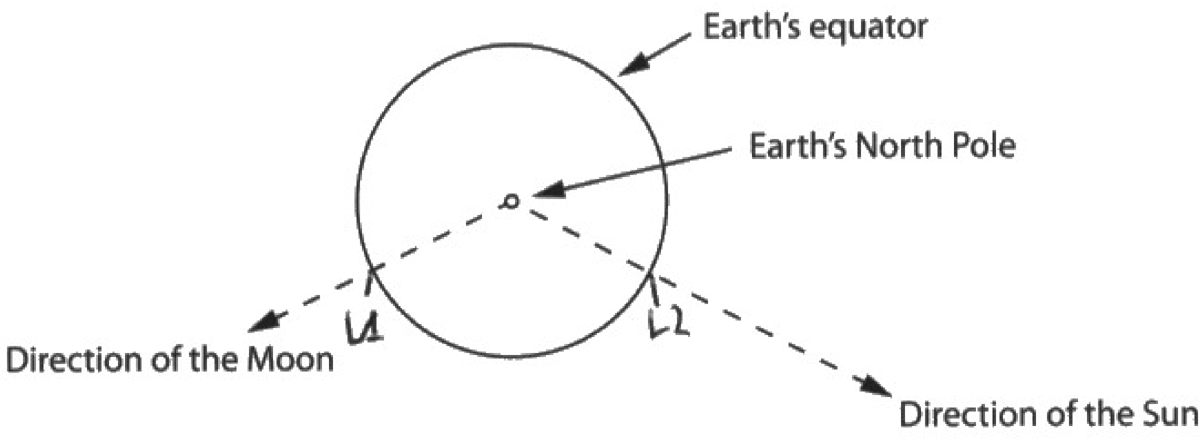

Figure 6

Label on Figure 6 **two** positions on the Earth's equator where a low tide is most likely to occur.

Use the labels **L1** and **L2**.

(2)

ResultsPlus
Examiner Comments

This is a zero-mark response, where the candidate assumes that the low tides occur in line with the Sun and the Moon.

Total: 0 Marks

It was pleasing to note that many candidates know that there are two low tide points on the Earth and that they are opposite each other.

(b) Figure 6 shows the Earth when viewed from above the North Pole. The directions of the Moon and Sun are also shown.

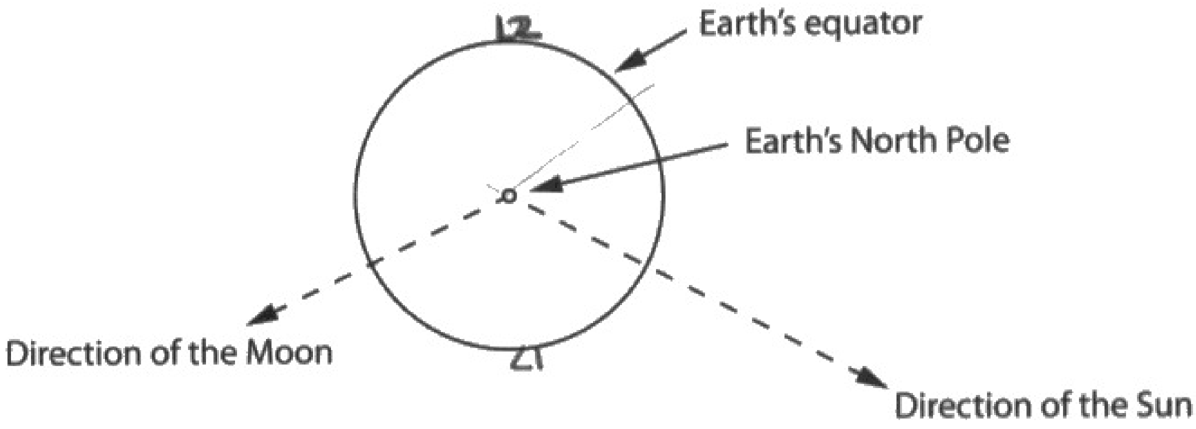

Figure 6

Label on Figure 6 **two** positions on the Earth's equator where a low tide is most likely to occur.

Use the labels **L1** and **L2**.

(2)

ResultsPlus
Examiner Comments

This response is awarded one mark, even if the positions are incorrect, as demonstrated in this example.

Total:1 Mark

Question 5 (c)

(c) The first column in Figure 7 shows a sketch of the Moon's phase when observed from a latitude of 60° N.

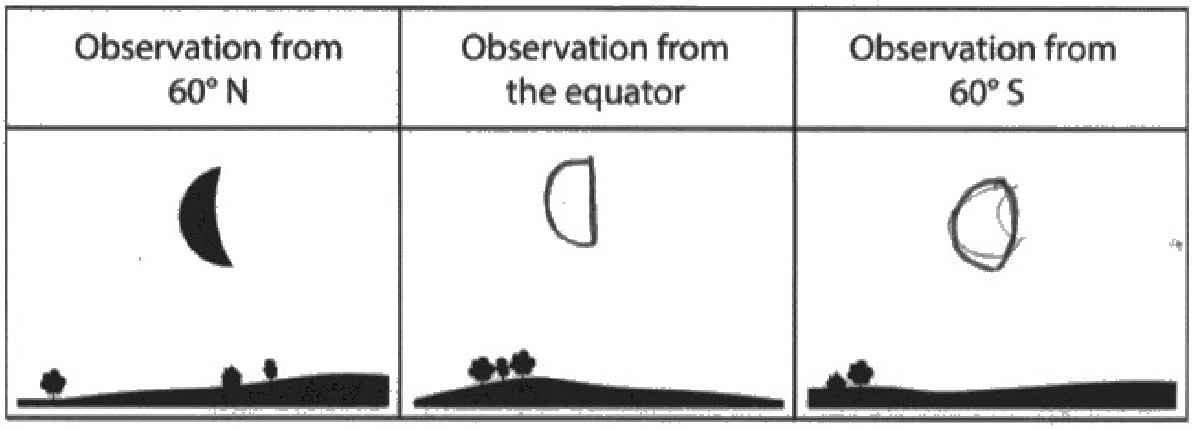

Figure 7

On the same night, the Moon is also observed from the equator and from a latitude of 60° S.

Draw on Figure 7 how the Moon would appear on the same night when observed from the equator and from a latitude of 60° S.

(2)

ResultsPlus
Examiner Comments

This is an example of a common misconception, where the Moon's phases change depending on observer's latitude. No marks are awarded.

Total: 0 Marks

Frequently, candidates correctly identified how the Moon appears in the southern hemisphere, but very few candidates could sketch correctly the appearance of the Moon at the equator.

(c) The first column in Figure 7 shows a sketch of the Moon's phase when observed from a latitude of 60° N.

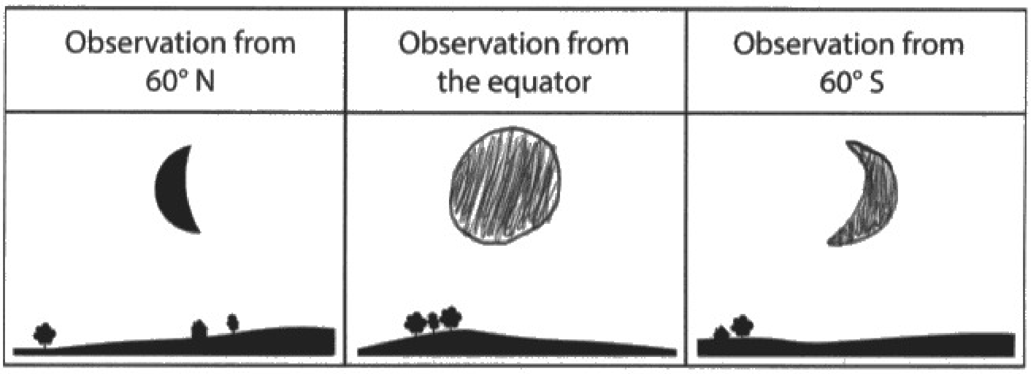

Figure 7

On the same night, the Moon is also observed from the equator and from a latitude of 60° S.

Draw on Figure 7 how the Moon would appear on the same night when observed from the equator and from a latitude of 60° S.

(2)

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Examiner Comments

This example scores 1 mark for the observation from 60^{o} S.

Total: 1 Mark

Another frequent misconception was that the Moon's altitude changes depending on the observer's latitude. Many candidates drew the Moon either rising or setting in the sky.

(c) The first column in Figure 7 shows a sketch of the Moon's phase when observed from a latitude of 60° N.

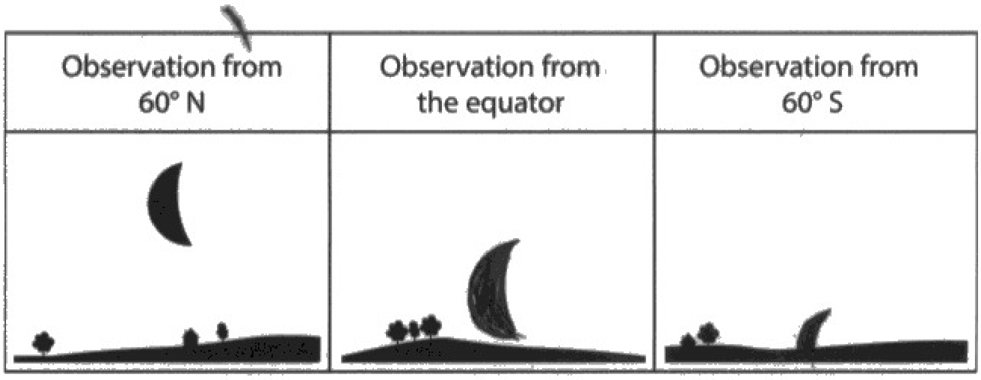


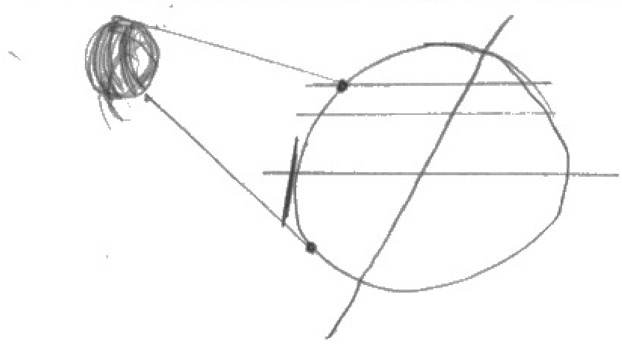
Figure 7

On the same night, the Moon is also observed from the equator and from a latitude of 60° S.

Draw on Figure 7 how the Moon would appear on the same night when observed from the equator and from a latitude of 60° S.

(2)

(Total for Question 5 = 9 marks)



ResultsPlus
Examiner Comments

This response demonstrates the misconception cited above. No marks could be awarded.

Total: 0 Marks

(c) The first column in Figure 7 shows a sketch of the Moon's phase when observed from a latitude of 60° N.

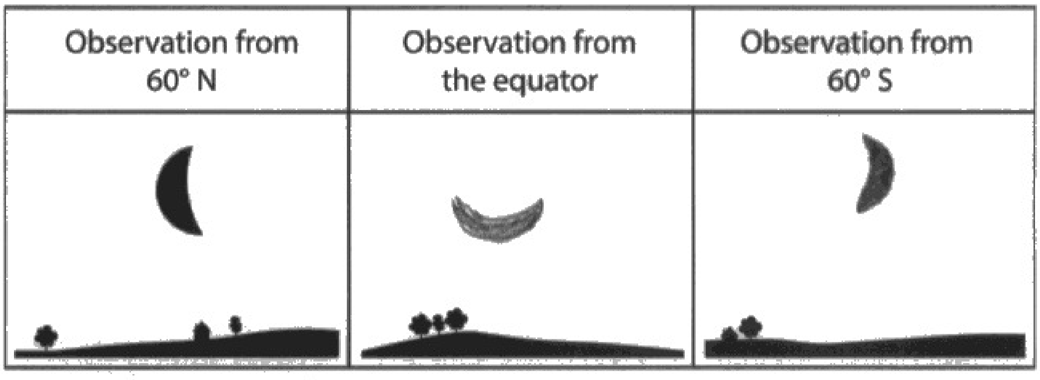


Figure 7

On the same night, the Moon is also observed from the equator and from a latitude of 60° S.

Draw on Figure 7 how the Moon would appear on the same night when observed from the equator and from a latitude of 60° S.

(2)

ResultsPlus
Examiner Comments

This is a model answer that was awarded 2 marks.

Total: 2 Marks

Question 6 (b)(i)

This question was answered very well, with the vast majority of candidates being able to name Polaris.

Question 6 (b)(iii)

The most usual mistake that candidates made in this question, was to assume that the star will culminate at the zenith.

Although the zenith has the maximum altitude on the celestial sphere, this is not necessarily where a star will culminate (and thus reach its greatest altitude).

(b) Figure 8 shows a cross-section of the celestial sphere and an astronomer.

Point **X** on Figure 8 is located directly above the astronomer.

The astronomer measures the angle between the North celestial pole and X as 32°.

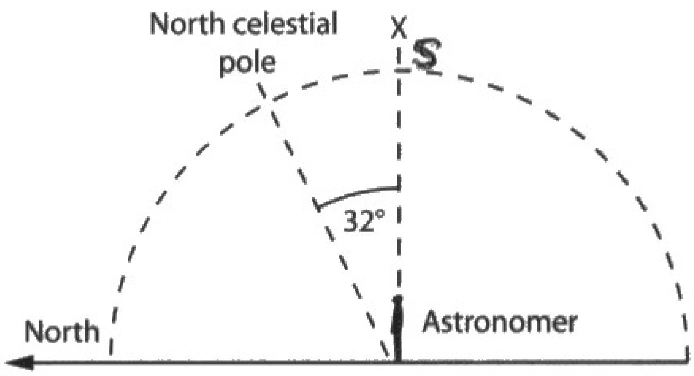


Figure 8

(iii) A star located on the celestial equator is culminating.

Draw the position of this star on Figure 8.

Use the label **S**.

(1)

ResultsPlus
Examiner Comments

This example demonstrates the point made in the introduction.

Total: 0 Marks

Question 6 (c)(ii)

(ii) Calculate the altitude of the star above the astronomer's northern horizon during its upper transit.

(2)

90 − 70 = 20

20 + 90

68 + 70 = 138°

Altitude = 138 °

ResultsPlus
Examiner Comments

In this one-mark response, the candidate has calculated the difference correctly between 90° (the zenith) and 70° (the declination of the star).

Unfortunately, this was not then used correctly to calculate the altitude of the star during its upper transit.

Total: 1 Mark

Question 6 (d)

This question was very well-answered, with many candidates noting that the Plough is, in fact, an asterism.

Question 7 (a)(i)

This question had a broad range of correct answers and the majority of candidates were successful.

Question 7 (a)(ii)

This question allowed for many varied responses, and the majority of candidates were able to answer it question correctly.

(ii) State **one** effect that light pollution has on observations of objects in the night sky.

(1)

It makes it harder to see dimmer objects (bright light [illegible]

ResultsPlus
Examiner Comments

This is an example of a typical 1-mark response.

Total: 1 Mark

Question 7 (a)(iii)

(iii) Astronomers in ancient times did not have to overcome the problems associated with light pollution.

Give **one** reason for this.

(1)

There were no artificial light sources at night time to provide light pollution.

ResultsPlus
Examiner Comments

This illustrates a model answer to a question that was answered well by the majority of candidates.

Total: 1 Mark

(iii) Astronomers in ancient times did not have to overcome the problems associated with light pollution.

Give **one** reason for this.

(1)

Light wasn't common/invented

ResultsPlus
Examiner Comments

This response was awarded no marks because it is too vague.

Total: 0 Marks

ResultsPlus
Examiner Tip

Be specific in your responses.

Support your answer by giving an example.

(iii) Astronomers in ancient times did not have to overcome the problems associated with light pollution.

Give **one** reason for this.

(1)

~~tek~~ technology not available

ResultsPlus
Examiner Comments

This is another example of a candidate being too vague and therefore did not achieve the mark.

If they had given an appropriate example (eg no street lights), then they would have received credit.

Total: 0 Marks

Question 7 (b)(i)

In this question, it was apparent that many candidates had not experienced or used a planisphere. Many misconceptions about planispheres included that it:

- did not incorporate right ascension/declination
- it was an app/software program
- it was 3-dimensional, mirroring the celestial sphere

However, candidates were well-versed in the use of a star chart.

Centres are advised that candidates should experience a range of stellar cartography methods, including a star chart (both equatorial and polar projection), a planisphere and apps such as Stellarium.

(b) An astronomer makes observations of the night sky with the aid of a star chart.

He then decides to replace the star chart with a planisphere.

(i) Give **two** observational **advantages** of using a planisphere instead of a star chart.

(2)

1 A planisphere is clearer than a star chart. –

[illegible]

2 It is 3D so it is easier to locate objects drawn from the planisphere on the celestial sphere.

ResultsPlus
Examiner Comments

It is clear in this response that the candidate has not used a planisphere, thus being unable to score any marks.

Total: 0 Marks

(b) An astronomer makes observations of the night sky with the aid of a star chart.

He then decides to replace the star chart with a planisphere.

(i) Give **two** observational **advantages** of using a planisphere instead of a star chart.

(2)

1 It's more detailed, making it more accurate.

2

ResultsPlus
Examiner Comments

This is another example of a common misconception suggesting that planispheres are either more accurate or more detailed than a star chart.

Total: 0 Marks

(b) An astronomer makes observations of the night sky with the aid of a star chart.

He then decides to replace the star chart with a planisphere.

(i) Give **two** observational **advantages** of using a planisphere instead of a star chart.

(2)

1 ~~[illegible]~~ shows where the horizon is so you can tell what is visible

2 shows what is visible for a specific date

ResultsPlus
Examiner Comments

This is a good answer, deserving both marks.

Total: 2 Marks

Question 7 (b)(ii)

It was apparent that few candidates had experienced or used a planisphere and therefore only a minority of responses made reference to the fact that planispheres are designed for a specific latitude.

(ii) Give **one** observational **disadvantage** of using a planisphere instead of a star chart.

(1)

Can only be used at their specific latitude

ResultsPlus Examiner Comments

This example gains the mark.

Total: 1 Mark

(ii) Give **one** observational **disadvantage** of using a planisphere instead of a star chart.

(1)

May be more complex to use and understand.

ResultsPlus Examiner Comments

One of the usual incorrect reponses was to suggest that planispheres are more complicated/difficult to use, as here.

Total: 0 Marks

Question 7 (c)

Evaluate the suitability of her suggested objects in Figure 10.

Where necessary, suggest alternative objects that could fit her observations.

(6)

- Observation 1 made by the student is clear and correct - a meteor is a fast, bright streak of light and is therefore very suitable to suggest it as such

- Observation 2 also offers a suitable suggestion of a galaxy given by the description, however it could also be considered a nebula
- giving a specified name to the object (such as Andromeda galaxy) may be more suitable

- Observation 3 is incorrect - Uranus is not visible to the naked eye, and would appear as dim. Venus is much more suitable, as it is the brightest planet when visible, and due to it being an inner planet it would make more sense to be visible on the horizon 'just after sunset'

- Observation 4 has the same suitability as 2 - specific on whether the cluster is open or globular, alongside its name (for example, the Pleiades) would make this more suitable

- Observation 5 is unclear, so many other objects such as satellites, (the ISS) or helicopters would be suitable here too

ResultsPlus
Examiner Comments

This example is a Level 3 response.

The alternative objects suggested are plentiful and correct.

Moreover, this response makes much use of astronomical vocabulary/names.

Total: 6 Marks

Evaluate the suitability of her suggested objects in Figure 10.

Where necessary, suggest alternative objects that could fit her observations.

(6)

- ~~Her~~ Observation 1 is correctly suggested as it is only meteors which disappear that quickly.
- Observation 2 is most likely correct as galaxies will appear as fuzzy patches, however galaxies are typically smaller than the object she viewed.
- Observation 3 is likely to be a planet as it remains close to the Sun's path (the ecliptic) however, Uranus would be much fainter. This object would be more likely to be Mars or Jupiter.
- Observation 4 is probably correct ~~how~~ but she could specify that it is an open cluster rather than a globular cluster.
- Observation 5 is definitely wrong as aeroplanes have flashing lights, typically red or green. The student actually observed an artificial satellite moving across the sky.

ResultsPlus
Examiner Comments

This is a good example of a Level 2 response.

It is clear and easy to follow, and there are quite a few alternative suggestions for alternative objects (although some of them are incorrect).

Total: 4 Marks

Evaluate the suitability of her suggested objects in Figure 10.

Where necessary, suggest alternative objects that could fit her observations.

(6)

1 could be a fireball or a fire fly

2 could be a cluster too

3 could also be a star like sirius or polaris

4 could be a constellation

5 could ~~thus~~ be a ~~[illegible]~~ comet based off the description as it said > nothing about flashing

ResultsPlus Examiner Comments

This is a Level 2 response.

There is insufficient detail and few alternative examples, which are often incorrect.

Total: 2 Marks

Question 8 (a)(ii)

The most usual mistake in this question was for candidates to show the position of the star two hours later, rather than two hours earlier, as the question required.

In Figure 11, the astronomer's meridian is due south. Stars rise in the East (to the left of the meridian) and set in the west (to the right). Candidates should appreciate that the right ascension of a star does not change as it rotates around the celestial pole.

8 Figure 11 shows a simplified sketch made by an astronomer observing the apparent path taken by a star during the night.

The position of the star is shown when the astronomer's local mean time was 01:30.

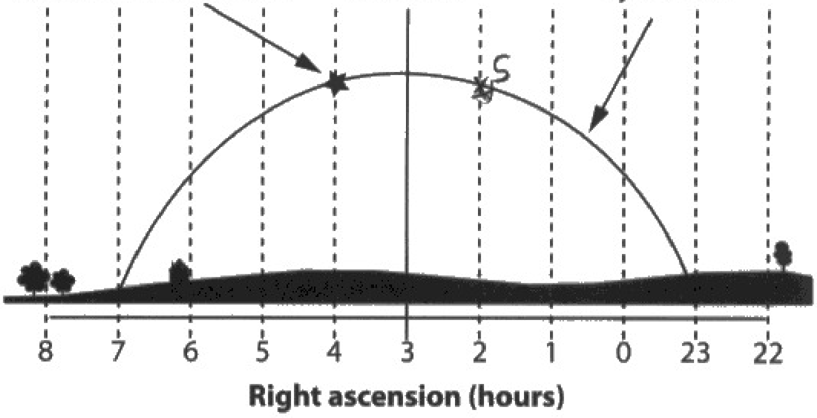


Figure 11

(a) (i) State the right ascension of the star.

(1)

Right ascension = ...4............ hours

(ii) Draw the position of the star two hours earlier on Figure 11.

Use the label **S**.

(1)

This response demonstrates the mistake referenced in the introduction to the question.

Total: 0 Marks

Question 8 (b)(i)

This question differentiated well. Candidates were more likely to conclude correctly that Bob was south of London, but found it more challenging to explain why.

For candidates that identified correctly that Bob was east of London, the majority were also able to explain why they came to this conclusion.

Some candidates attempted this question incorrectly, by performing calculations based on the data.

(b) The apparent motion of the Sun can be used to help find positions on the surface of the Earth.

Alice and Bob make observations of sunrise times and day lengths from two different locations.

Alice makes her observations from London.

Bob makes his observations from another European city.

Table 2 shows their results.

	Alice (London)		Bob (European city)	
Date	Time of sunrise (GMT)	Day length (h:m)	Time of sunrise (GMT)	Day length (h:m)
Feb 1	07:39	09:09	05:30	10:17
Mar 1	06:44	11:00	04:56	11:22
Apr 1	06:35	12:59	04:09	12:38
May 1	05:31	14:53	03:28	13:47

Table 2

(i) Analyse Table 2 in order to determine the location of Bob.

Include in your answer whether he is:

- north or south of London
- east or west of London.

(3)

07 : 39 - 5 : 30 = 2 hour 9 min

129 min ÷ 4 = 32.25° W

4 minutes = 1°

ResultsPlus
Examiner Comments

This example is awarded no marks.

Total: 0 Marks

(i) Analyse Table 2 in order to determine the location of Bob.

Include in your answer whether he is:

- north or south of London
- east or west of London.

(3)

Bob is south as the sunrises earlier than alice meaning that it hasnt got to Alice.
Bob is West of London as his day length is longer to start with but gets shorter as the moths come along.

ResultsPlus
Examiner Comments

In this response, south is correct, but the explanation is incorrect.

Total: 1 Mark

(i) Analyse Table 2 in order to determine the location of Bob.

Include in your answer whether he is:
- north or south of London
- east or west of London.

(3)

He is East of Alice ~~to 30°,~~ because his Sunrise is earlier. He is North ~~South~~ of Alice because his day length is longer near the Summer Solstice.

2:09 $\frac{129}{4} = 30$

ResultsPlus
Examiner Comments

A 2-mark response.

The candidate identifies correctly that Bob is east and gives the reason why.

However, they are unable to score any more marks because they identify Bob, incorrectly, as being north of London.

Total: 2 Marks

(i) Analyse Table 2 in order to determine the location of Bob.

Include in your answer whether he is:
- north or south of London
- east or west of London.

(3)

Bob is East of London. This is because sunrise is earlier in the East. Also, it is because their GMT is earlier than to more Western countries. Bob is South of London as daylengths are longer near the poles and become shorter and more equal with night length near the equator.

ResultsPlus
Examiner Comments

This is a model answer.

Total: 3 Marks

Question 8 (b)(ii)

Many candidates attempted this question by referring incorrectly to:

- the Earth's orbit around the Sun
- the apparent Sun's motion being different to the mean Sun
- the need to use the equation of time

All these responses made the question more complicated than was intended, and scored no marks.

(ii) Suggest a practical problem with using the apparent motion of the Sun to determine your latitude.

(2)

Due to Earth's elliptical orbit, the Sun sometimes appears either 'fast' or 'slow' depending on whether Earth is at perihelion or aphelion of its orbit.

ResultsPlus Examiner Comments

Total: 0 Marks

Few candidates realised that this was, in fact, a relatively straight-forward question.

(ii) Suggest a practical problem with using the apparent motion of the Sun to determine your latitude.

(2)

If it is cloudy you cannot see the exact location of the Sun. You can also only see the sun during the day. ~~So would be limited on when you could~~ The Sun is also very big and bright so it is hard to look at it for long periods of time.

(Total for Question 8 = 11 marks)

ResultsPlus
Examiner Comments

This example is a model answer and is awarded 2 marks.

Total: 2 Marks

Question 9 (a)(i)

(a) (i) Determine the date in January 2018 on which the first full moon of the month occurred.

(1)

31-28=3 Jan 3rd

ResultsPlus Examiner Comments

This response scores no marks.

The candidate uses a lunar phase cycle of 28 days incorrectly, thus calculating the first full moon of the month on the 3rd January. This was a frequent mistake.

Total: 0 Marks

Question 9 (a)(ii)

In this question, candidates were required to comprehend that 'perigee' is when the Moon is at its closest to Earth. Thus, the Moon will appear larger and brighter. Some candidates focussed incorrectly on the fact that there was also a lunar eclipse.

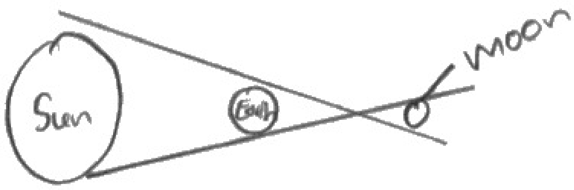
Question 9 (a)(iii)

Detailed ray diagrams of the eclipse were not required in this question.

(iii) Analyse this extract in order to determine the orbital positions of the Earth, Moon and Sun at the time of the blue moon.

You may include a clearly labelled diagram in your answer.

(3)



The Sun was being blocked out by the Earth so did not reach the moon. So the order went Sun, Earth and then the Moon as in a lunar eclipse.

ResultsPlus
Examiner Comments

In this example, worth 1 mark, the candidate focusses on the fact that there was a lunar eclipse but ignores the fact that the Moon is also at perigee.

Total: 1 Mark

Candidate diagrams often did not show the Moon at its closest point to Earth (which understandably can be difficult when drawing elliptical orbits). Therefore, it is advisable that candidates also label this feature, to gain the mark.

(iii) Analyse this extract in order to determine the orbital positions of the Earth, Moon and Sun at the time of the blue moon.

You may include a clearly labelled diagram in your answer.

(3)

The Moon is at perigee and therefore the closest to Earth in its orbit. As it is a full moon, it is the opposite side of Earth from the Sun.

ResultsPlus
Examiner Comments

This example is worth 3 marks.

It shows and labels the three marking points:

- the Moon is in an elliptical orbit around the Earth
- it is at perigee (closest point to Earth)
- the Sun-Earth-Moon are in alignment

Total: 3 Marks

Question 9 (b)

In this question, the second marking point was more accessible to candidates than the first.

(b) An astronomer sketched the Moon from the same location on two dates.

One date was near the summer solstice and the other was near the winter solstice.

He noted that the Moon had the same phase on both dates.

Figure 12 shows the astronomer's sketches.

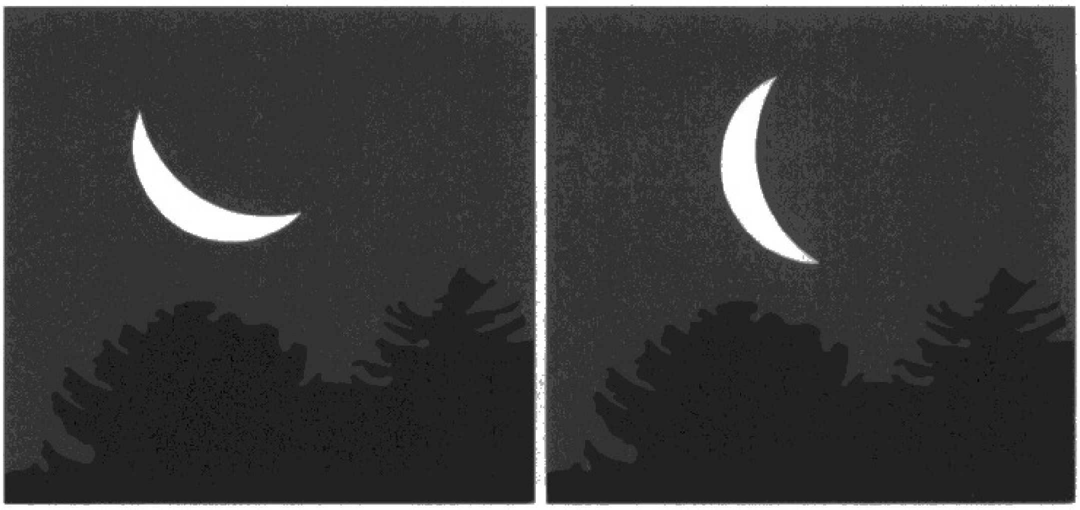


Figure 12

Explain the Moon's differing appearance when observed on these two dates.

You may include a clearly labelled diagram in your answer.

(2)

During summer solstice, the sun is hugher in the sky and 'lower' under the ground. In winter solstice, the sun is lower in the sky and 'closer to the horizon' under the ground, hence casting different light from different angle.

ResultsPlus
Examiner Comments

This one-mark example demonstrates the point above.

Reference to the Moon being illuminated at different angles gains one mark. However, the candidate states incorrectly that the Sun is "lower under the ground" in the summer, when, in fact, this is true for the winter.

Total: 1 Mark

(b) An astronomer sketched the Moon from the same location on two dates.

One date was near the summer solstice and the other was near the winter solstice.

He noted that the Moon had the same phase on both dates.

Figure 12 shows the astronomer's sketches.

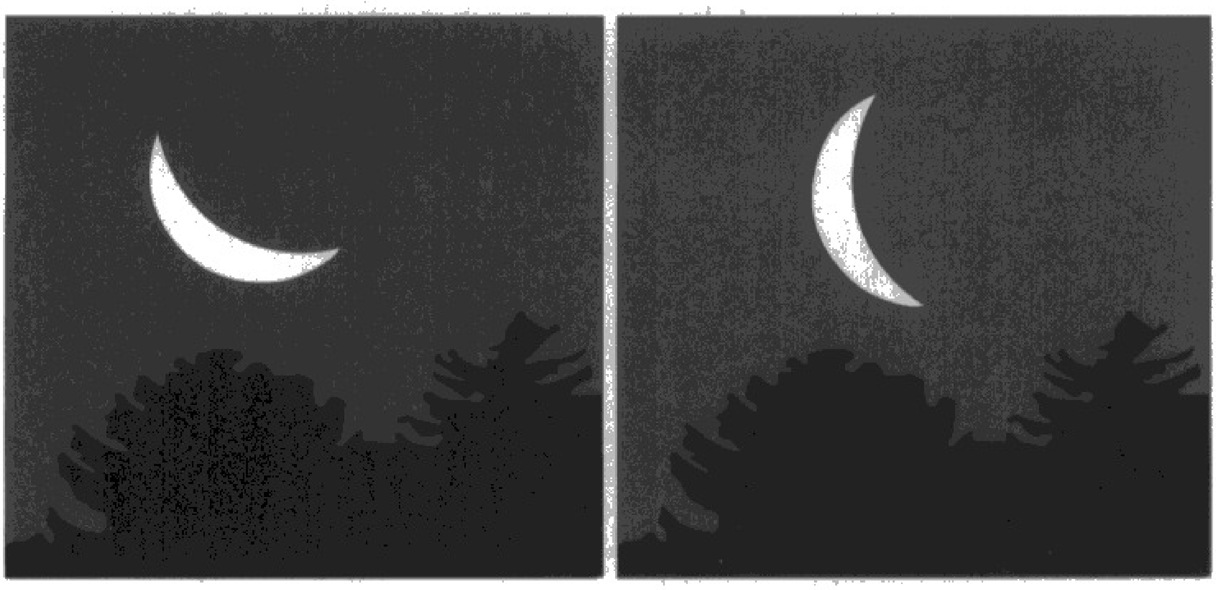


Figure 12

Explain the Moon's differing appearance when observed on these two dates.

You may include a clearly labelled diagram in your answer.

(2)

The ~~m~~ Moons plane of orbit is tilted towards Earth at an approximate angle between 6° and 8° meaning that as it moves along that plane ~~o~~ as it orbits it will appear ~~a~~ in different positions in the ~~t~~ sky.

ResultsPlus
Examiner Comments

In this response, the candidate refers to the Earth-Moon orbit, but gains no mark because there is no reference to the position of the Sun. This was quite a frequent mistake.

Total: 0 Marks

(b) An astronomer sketched the Moon from the same location on two dates.

One date was near the summer solstice and the other was near the winter solstice.

He noted that the Moon had the same phase on both dates.

Figure 12 shows the astronomer's sketches.

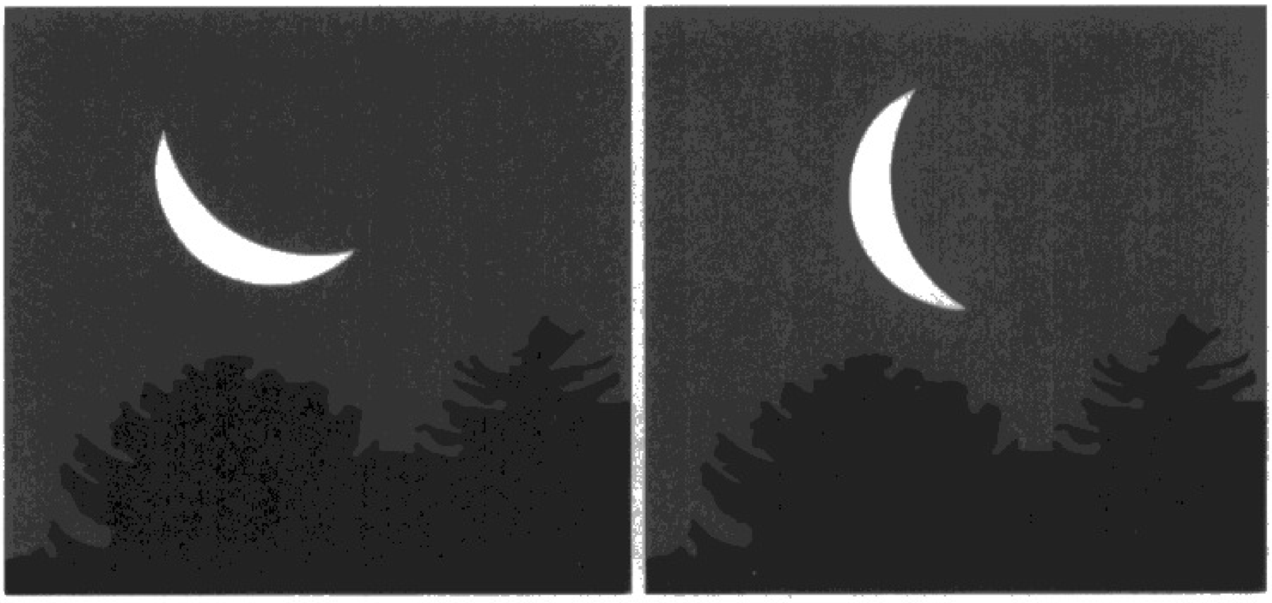
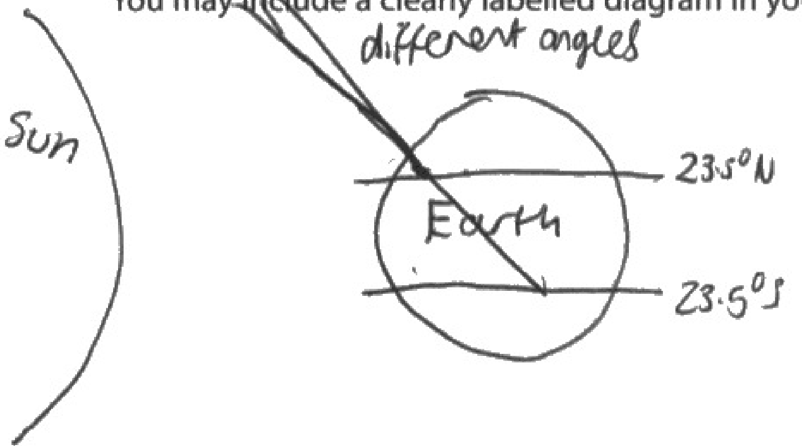


Figure 12

Explain the Moon's differing appearance when observed on these two dates.

You may include a clearly labelled diagram in your answer.

(2)



At the summer solstice the sun reaches its maximum declination (23.5° N). At the summer solstice, the sun reaches its minimum declination (23.5°S) so the lunar disc is being lit from different positions.

ResultsPlus
Examiner Comments

This is an example of a 2-mark response.

Both the position of the Sun and how it illuminates the Moon are described correctly.

Total: 2 Marks

Question 9 (c)

This is a Level 2 response that links the location of the feature on the Moon to when this location was illuminated, and thus visible.

However, a Level 3 response would refer to the relief of the feature and whether it was best observed in shadow or in direct sunlight.

Furthermore, Level 3 responses use a greater astronomical vocabulary, including words like terminator, waxing/waning Moon, shadow length and contrast.

The Sea of tranquillity is situated on the right side of the moon's near side, this should be visible from around the 4th of November until about the 16th. The appennine mountain range will be visible during the middle of the month from around the 9th until the 20th as it is found in the central region of the moon's near side. The crater Tycho is situated toward the left side of the moon's near side, this should be visible from around the 11th until the 22nd. The best time to view these features being on the 12th, 13th and 14th during near the moon's full moon phase. Avoid the beginning and end of the month during the new moon phase.

ResultsPlus
Examiner Comments

This example gains 3 marks – the candidate links the location of the feature solely to when that part of the Moon would be illuminated.

Total: 3 Marks

Many candidates spend a lot of effort describing dark adaption, seeing conditions, suitable weather, best location for observations, how to record the data etc. Although often good science, this is not answering the question and is given no credit.

~~Eles~~ For each day of the following month Patrick should observe the moon's surface in an area with the least amount of light pollution possible to make his results more accurate. He could also use dark adaptation every day before hi's observatio-ns to make his results precise. Every day Patrick should record which of the 3 features he can see and he could also draw an accurate image of the part of the moon he can observe. He should also take note of any restriction during his ~~exp~~ observations such a change in the time the moon was observed every day since this may alter his results. Also he should observe the moon at the same area and at the same time daily. He should also take note of ~~the~~ whether or not he was able to a whole of the feature and ~~a~~ if not approximately how much. I think that the best ~~8~~ days to observe the features Patrick wants to see would be during the full moon which occurs from the 11th of November to the 15th ~~of~~ of November. This would be the best time to observe the features since all of the near side would be visible to Patrick and he can make his notes and observations much more accurately.

ResultsPlus
Examiner Comments

This is a Level 2 response.

Total: 3 Marks

ResultsPlus
Examiner Tip

Do not give excessive descriptions on astronomical observing techniques unless asked to do so specifically.

~~Patrick should focus on the days when the right side of the moon can be seen.~~

Patrick should observe the days when the right side of the moon is in quarter phase, - days 5-12. For looking at the ~~sea of tranq~~ appenine mountain range as they are located north east on the moon. Patrick should observe tycho when ~~the~~ it is the full moon so ~~to~~ he can clearly see all of the ~~south~~ bottom of the moon. Patrick should observe the sea of tranquility closer to the full moon days 7 - 12 as it is on the ~~southern~~ south eastern side of the moon.

(Total for Question 9 = 14 marks)

ResultsPlus
Examiner Comments

This is another example of a Level 2 response, where the candidate does not make reference to the relief of the feature and whether it should be observed in shadow or not.

Other than naming the features, there is a lack of astronomical vocabulary.

Total: 3 Marks

Day ~~nine~~ 9 and 10 would be good days to observe the Moon as the Apennine Mountain range ~~would be~~ a, the sea of tranquility and the crater tycho can be seen.

Day 11 to 14 would be good to observe these features as it is a full moon and the whole surface can be seen including the ~~entirity~~ all of the Sea of tranquility. The Moon would also have a higher brightness as the whole surface recieves light.
Day 19 would be a good day to observe Tycho due to libration in latitude meaning you could see more of Tycho on the underside of the Moon.

Libration in ~~both~~ longitude means you would be able to see more of the East and West of the Moon like on day 8 where the Sea of tranquility would be easily visible.

ResultsPlus Examiner Comments

Another Level 2 example.

Libration was often incorrectly referred to in the answers, and was awarded no credit.

Total: 3 Marks

Not all features are best observed on the terminator. For example, features that lack relief (maria and rayed craters) are often best observed at full moon when their contrast is at their greatest.

The best times to observe these three features will be from the 7th to the 9th of November 2008, this is because the moon is ~~at~~ waxing at this point and in its gibbous phase. This means the right side of the moon as well as some of its central parts will be seen. This is ideal as all of these features are located ~~at~~ either at the centre, or the right (east) of the moon's disk. The Apennine Mountains and Tycho crater are more difficult to observe than the Sea of Tranquility as they are smaller in size. They are also located close to the centre of the moon's disk, where the terminator will be on these nights.
Near the terminator, the sun's angle of sunlight is very low. This is advantageous as it allows the features located close to the terminator to be observed in more detail and resolution such as the Tycho crater and Apennine Mountains.

ResultsPlus
Examiner Comments

This example is at the higher end of Level 2.

The candidate appreciates that some features are best observed when located on the moon's terminator.

Total: 4 Marks

• For the sea of tranquility, between the 1st and 4th, ~~and also the 30th~~ 15th - 18th and 30th would be best as the terminator is on it allowing for ~~a~~ the light to reflect better.

• For the crater Tycho, 8th - 9th and 23rd - 24th would be best as it is close to the terminator, creating shadows which allows contrast.

• For the Apennine mountain range, 6th and 20th as this provides the best contrast due to them ~~both~~ being near the terminator

ResultsPlus
Examiner Comments

This is a Level 2 response where the candidate suggests that all of the named features are best observed on the lunar terminator.

Total: 4 Marks

To observe the sea of tranquility the best days would be ~~days~~ 11th November to the 14th ~~of~~ November as the maria of the moon are ~~often~~ dark so the days when the moon is brightest would be most suitible to observe. To observe the crater Tycho the best days would be the 8th, 9th, ~~10th~~ 21st and 22nd because when the moon is in more of a cresent phase the craters cast shadows allowing the observation to be much clearer and accurate as from the shadows you can also dermine the depth. ~~Ea~~ For the Appenine mountain range the best days to observe it would be 9th and 18th as these days show ~~are~~ the moon to be darker and as the mountain range is a highland it is also lighter than the rest of the moon so it is easier to observe. These days will also ~~cast the best ash~~ allow the observer to observe both sides of the mountain range.

ResultsPlus
Examiner Comments

This is a Level 3 response.

The candidate appreciates that some (but not all) of the features have relief and that they are best observed in shadow.

They justify this by going on to say that it is possible to measure the depth of the feature. They also make reference to features with differing contrast.

Total: 5 Marks

The sea of Tranquility is located near to the centre of the Moon and so Patrick should observe this feature when the Moon's central portion will be visible (from the 11th - 15th). Observing at full moon will be very useful for Patrick because the disk will be at its brightest which will make the dark lunar maria stand out more against the lighter terrae so the 12th 13th and 14th will be the best days for this observation.

The Apennine mountain range is very near the centre and therefore should be observed when the centre is visible (from the 6th to 20th). This can be best observed when the light has just passed the mountains to bring out the best detail in the mountains and in an attempt to see the light shining through the valleys and therefore the 7th and 8th will be good times to observe it.

Tycho's crater is near to the left of the Moon and therefore should be observed from the 18th to 21st when it is clearly visible. However, there are some ejecta stretching for miles from the crater across the Moon so in order to observe these too, he should observe during full moon (the 12th, 13th and 14th) when they will be most visible.

ResultsPlus
Examiner Comments

This is an example of full-mark response.

Total: 6 Marks

Question 10 (a)(i)

One of the most frequent mistakes was to plot the third data point incorrectly (the axes were reversed).

(a) (i) Using the data in Table 3, plot a graph of T^2 (vertical axis) against r^3 (horizontal axis) on Figure 14.

Draw a line of best fit for your data points.

(3)

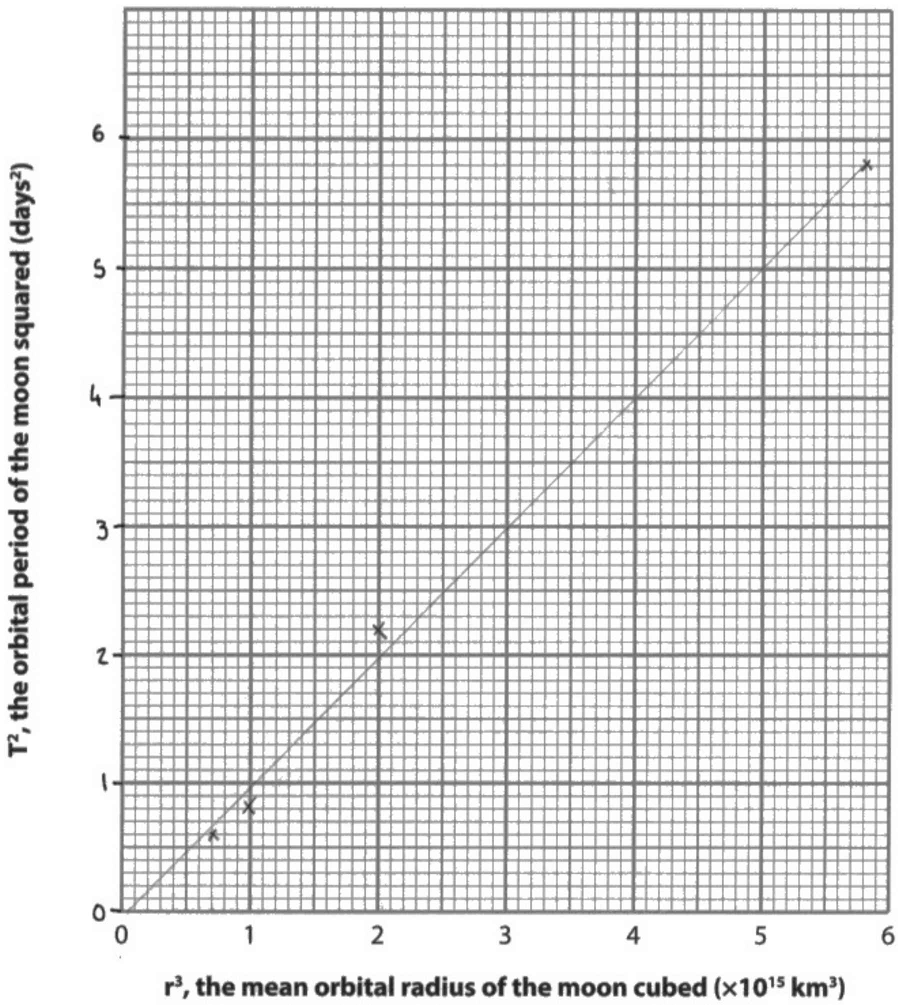


Figure 14

ResultsPlus
Examiner Comments

This is an example of such a response

Total: 2 marks

Candidates should be reminded that the points are often joined with a best fit straight line and that a ruler should be used to clearly produce this. Free-hand lines are only acceptable when drawing curves.

(a) (i) Using the data in Table 3, plot a graph of T^2 (vertical axis) against r^3 (horizontal axis) on Figure 14.

Draw a line of best fit for your data points.

(3)

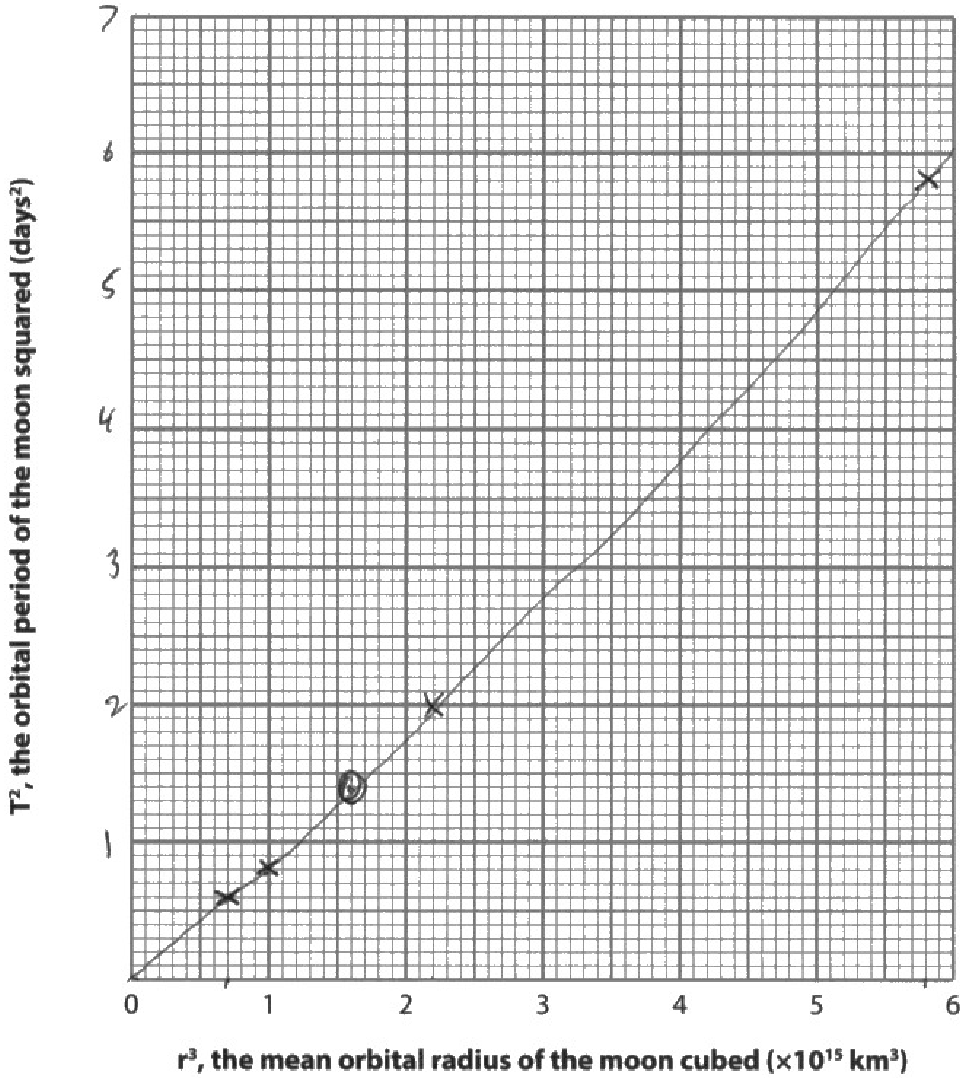


Figure 14

ResultsPlus
Examiner Comments

In this example, a best-fit straight line is not drawn.

Total: 2 Marks

(a) (i) Using the data in Table 3, plot a graph of T^2 (vertical axis) against r^3 (horizontal axis) on Figure 14.

Draw a line of best fit for your data points.

(3)

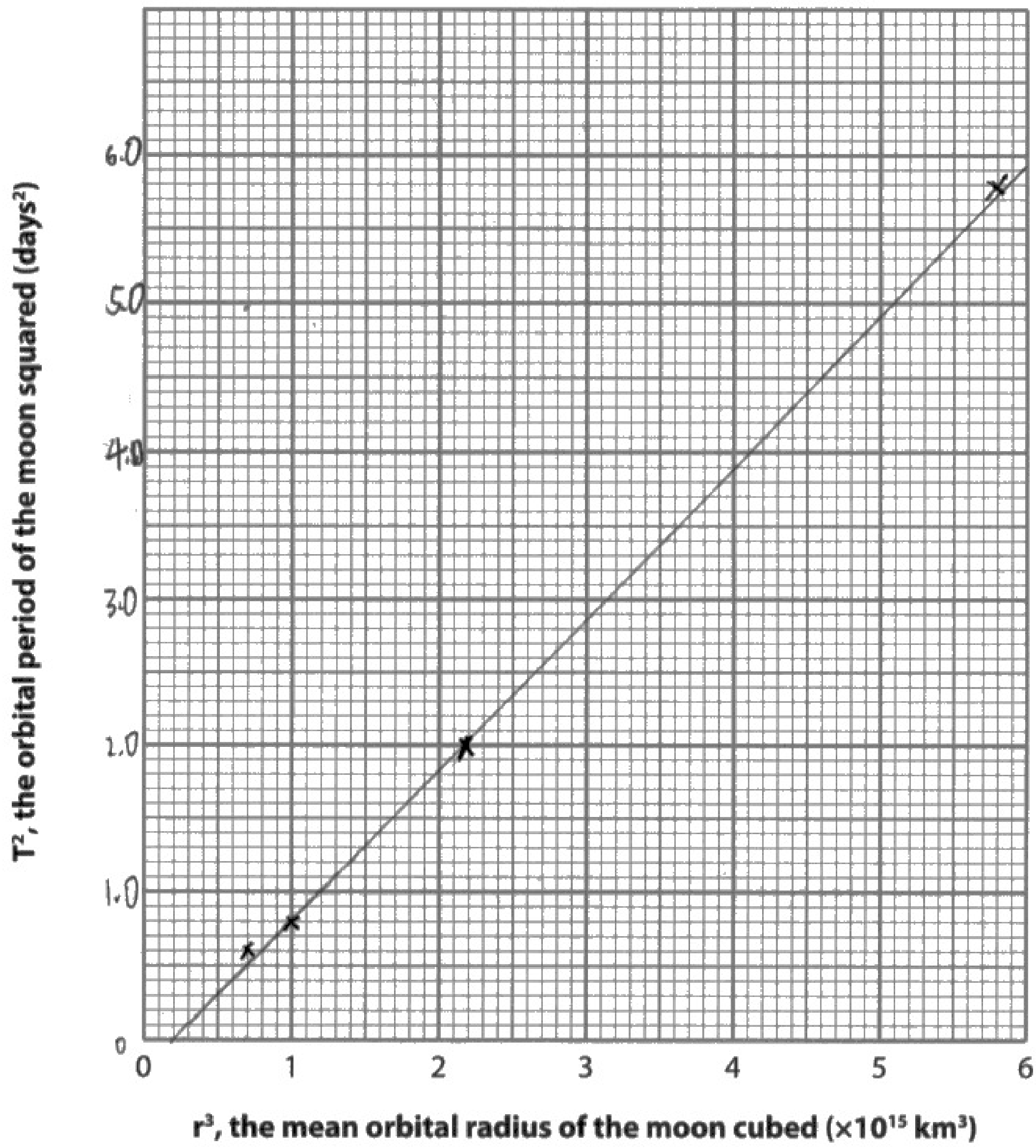


Figure 14

ResultsPlus Examiner Comments

This is an example of a full-mark response.

Total: 3 Marks

Question 10 (a)(ii)

(ii) Another moon of Uranus has a mean orbital radius of 1.6×10^5 km.

Calculate the orbital period of this moon.

Use the graph in Figure 14.

Give your answer in days.

(3)

$(1.6 \times 10^5)^3 = 4.096 \times 10^{15}$

$= 4.1 \times 10^{15}$

$\sqrt{3.95}$

$= 1.987$ days

$= 2$ days

Orbital period = 2 days

ResultsPlus
Examiner Comments

In this example it can be seen that:

- the radius is cubed
- this value is used to read T^2 from the graph (3.95)
- T is calculated from T^2

Total: 3 Marks

(ii) Another moon of Uranus has a mean orbital radius of 1.6×10^5 km.

Calculate the orbital period of this moon.

Use the graph in Figure 14.

Give your answer in days.

(3)

$(1.6 \times 10^5)^3$

$4.096 \times 10^{15} = T^2$

$T = 64{,}000{,}000$

$T^2 = r^3$

$r^3 = T^2$

$r = \sqrt[3]{T^2}$

Orbital period = 64,000,000 days

ResultsPlus
Examiner Comments

In this example the radius is cubed, but this value is then square-rooted, instead of taking values from the graph.

Total: 1 Mark

Question 10 (b)(i)

Incorrect responses often referred to the proportionality of the graph, but there was no reference as to how the constant can be calculated from the graph.

However, many responses did appreciate the fact that the gradient of the best-fit line would yield the constant.

(b) Astronomers can use Kepler's Third Law to calculate the orbital period of moons around planets in the Solar System.

Kepler's Third Law can be written in the form:

$$\frac{T^2}{r^3} = \text{a constant}$$

(i) State how this constant can be determined from the graph drawn in Figure 14.

(1)

T^2 ~~=~~ is proportional to r^3

ResultsPlus
Examiner Comments

This response is awarded no marks.

Total: 0 Marks

Question 10 (b)(ii)

(ii) For the moons of Uranus, this constant is equal to 0.91×10^{-15} day^2/km^3.

However, this constant **cannot** be used to calculate the orbital periods of the moons orbiting Saturn.

Explain this statement.

(2)

Because saturn has a different mass so it's gravitational pull will be greater so the orbits and radii will not follow the same constant as for Uranus

ResultsPlus
Examiner Comments

Both the change in constant and the reason why, are identified in this response

Total: 2 Marks

(ii) For the moons of Uranus, this constant is equal to 0.91×10^{-15} day^2/km^3.

However, this constant **cannot** be used to calculate the orbital periods of the moons orbiting Saturn.

Explain this statement.

(2)

Saturn will have a different constant due to the orbital radius & distance being different

ResultsPlus
Examiner Comments

The candidate states that the constant will be different but unfortunately does not give the correct reason why.

Total: 1 Mark

(ii) For the moons of Uranus, this constant is equal to 0.91×10^{-15} day^2/km^3.

However, this constant **cannot** be used to calculate the orbital periods of the moons orbiting Saturn.

Explain this statement.

(2)

The moons orbiting Saturn have different orbital radius and a different orbital Period.

ResultsPlus
Examiner Comments

This is an example of a zero-mark response, where no reference to the change in constant is attempted.

Total: 0 Marks

Question 10 (b)(iv)

By far the most frequent mistake made by candidates was the Uranus constant multiplied by 6.3, rather than divided.

(iv) Calculate the constant used in Kepler's Third Law for Saturn.

Use the constant for the moons of Uranus, equal to 0.91×10^{-15} day^2/km^3.

Use the ratio of the mass of Saturn to the mass of Uranus which is equal to 6.3.

Give your answer in $\times 10^{-15}$ days^2/km^3.

(2)

$(0.91 \times 10^{-15}) \times 6.3 = 5.733 \times 10^{-15}$

Constant for Saturn = 5.733 $\times 10^{-15}$ days^2/km^3

ResultsPlus Examiner Comments

This response is typical.

Total: 0 Marks

On occasion, the Saturn constant was correctly calculated by dividing by 6.3. However, this number was then incorrectly quoted when manipulating the standard form.

(iv) Calculate the constant used in Kepler's Third Law for Saturn.

Use the constant for the moons of Uranus, equal to 0.91×10^{-15} day^2/km^3.

Use the ratio of the mass of Saturn to the mass of Uranus which is equal to 6.3.

Give your answer in $\times 10^{-15}$ days^2/km^3.

(2)

$$\frac{k_1}{k_2} = \frac{M_2}{M_1} \qquad \frac{0.91 \times 10^{-15}}{k_2} = \frac{19}{3}$$

$$\frac{0.91 \times 10^{-15}}{6.3} = k_2 = 1.45 \times 10^{-16}$$

Constant for Saturn = 14.5 ~~[illegible]~~ $\times 10^{-15}$ days^2/km^3

ResultsPlus
Examiner Comments

This response receives one mark.

Total: 1 Mark

ResultsPlus
Examiner Tip

Candidates should practice handling large and small numbers using standard form.

(iv) Calculate the constant used in Kepler's Third Law for Saturn.

Use the constant for the moons of Uranus, equal to 0.91×10^{-15} day^2/km^3.

Use the ratio of the mass of Saturn to the mass of Uranus which is equal to 6.3.

Give your answer in $\times 10^{-15}$ days^2/km^3.

(2)

$$\frac{0.91 \times 10^{-5}}{6.3} = 0.1444\ldots \times 10^{-15}$$

$$= 0.14 \times 10^{-15} \quad (2dp)$$

Constant for Saturn = 0.14 $\times 10^{-15}$ days^2/km^3

ResultsPlus
Examiner Comments

This is a model answer, receiving both marks.

Total: 2 Marks

Paper Summary

Based on this year's examination, the following points have been identified as areas where future candidates could strengthen their performance in this qualification:

- 'Explain' means **why** something happens, not 'what'
- 'Compare' requires both sides of the argument
- 'Evaluate' means arrive at a judgment
- 'Show' – needs each step of reasoning in the working
- Label diagrams fully
- Bring a suitable calculator
- Know how to operate the calculator
- Show your working in a structured way
- Round your answer to a sensible number of significant figures
- Use given data when required to do so

Grade boundaries

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