GCSE (9-1) Astronomy

Exemplars for Paper 1 and Paper 2 from Summer 2019

Includes Examiner comments and teaching and learning points.

Produced: August 2020

GCSE Astronomy – Summer 2019

Exemplars

The exemplars in this booklet are in numerical order. Below, the table shows which questions meet each different question type. Each question is labeled with the assessment objectives met.

	Paper 1:		**Paper 2:**	
6-mark tiered Q	**Q8b**	Latitude method	**Q10c**	Delta Cephei
Short Answer	**Q6aii**	Altitude of Canopus	**Q2d**	Near & far side of Moon
Long Answer	**Q4d**	Precession of Ecliptic	**Q5e**	Evolution of the Sun
Astronomical drawing	**Q4b**	Sun at Tropics	**Q3e**	Observing the Sun
Observations	**Q5a**	Lunar features	**Q8aiii**	Binary stars
Calculation / Maths.	**Q8ci**	Finding Longitude	**Q6d**	Andromeda Galaxy

Q4(b): Sun at the Tropic of Cancer

(b) Alice decides to observe the Sun throughout the day on June 21st.

Her location has a latitude of 23½° N.

Describe how the Sun appears to move across the sky from Alice's location on June 21st.

You may include a carefully labelled diagram in your answer.

(2)

Specification coverage:

1.5 Be able to use the major divisions of the Earth's surface as astronomical reference points, including the Tropic of Cancer.

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific techniques and procedures.

Mark Scheme:

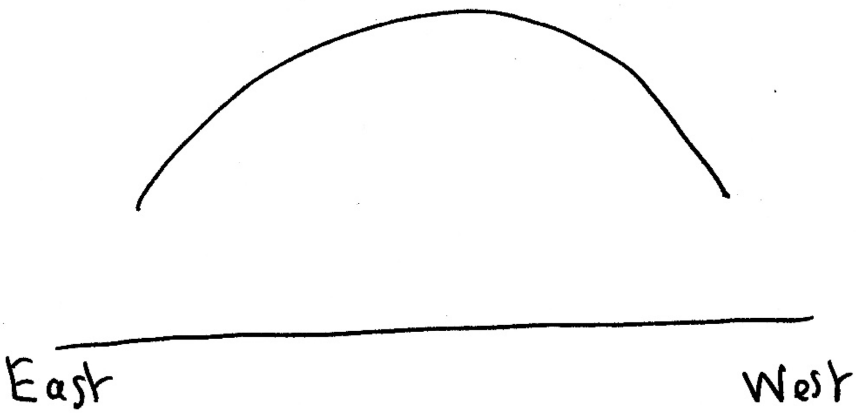
Question number	Answer	Mark
4(b)	Rises and sets / Travels East to West Through Alice's overhead point/zenith	**(1)** **(1)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

The first mark in this question was simply for describing that the Sun would rise and set as usual, whilst the second required candidates to appreciate that the date and Alice's latitude would mean that the Sun would pass directly overhead at noon.

Although a diagram was optional, it was by far the most effective way of answering the question, although showing the Sun passing overhead is not straightforward in a diagram on a flat piece of paper and this tested the artistic skills of many candidates.

Sample Candidate Response #A:



Mark Awarded: 0

Examiner's Comments:

Although it is clear that Candidate A has some understanding of the correct answer to this question and is close to being awarded the first mark from the mark scheme, their response shows the importance of drawing carefully-labelled diagrams as opposed to unlabelled sketches.

Although the East and West compass points are labelled on (what must be assumed to be) the horizon, the curve in the (presumed) sky has no indication of direction (such as a single arrow) and thus this response cannot be awarded the first marking point.

Although the unlabelled curve has a definite peak in the middle, which is suggestive of the second marking point, the lack of any identifying labels means that this mark cannot be awarded either.

The candidate has also not taken the opportunity to support their attempted diagram with any text which might have clarified either of the above points – hence their score of zero.

Sample Candidate Response #B:

The Sun rises + sets getting to its highest point at midday.

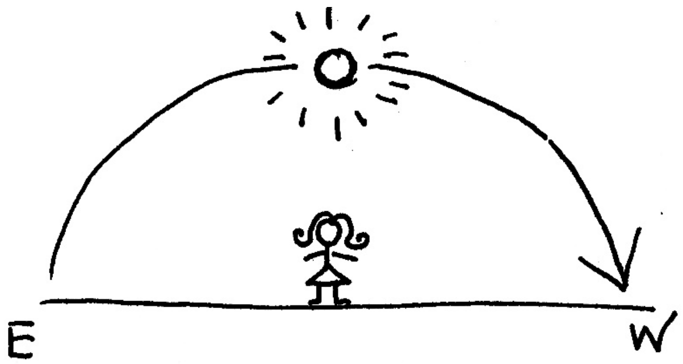
Mark Awarded: 1

Examiner's Comments:

This candidate's response clearly achieves the first marking point of the Sun rising and setting, even without the use of a diagram.

Although the second part of their answer is consistent with the second marking point it is too vague since it does not specifically identify the observer's overhead point or zenith. A simple diagram would have resolved this uncertainty and made this a secure two-mark response.

Sample Candidate Response #C:



The sun rises in the morning and sets in the evening, and is at its highest point at noon.

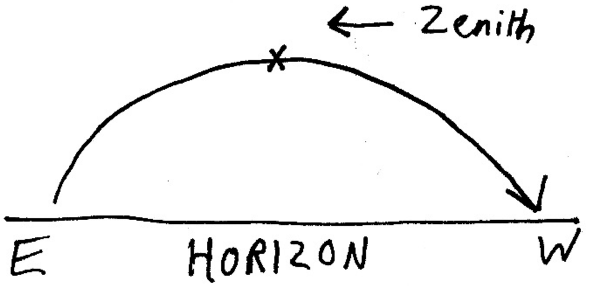
Mark Awarded: 2

Examiner's Comments:

The text of Candidate C's response is essentially the same that of Candidate B, which scored one mark. However, in this case it is accompanied by a partially-labelled diagram which allows the response to gain the second marking point as well.

Although it is not labelled, the Sun's 'highest point' is established by the diagram as being directly above Alice, the observer. This illustrates clearly the value of including a diagram when answering many, if not most, GCSE Astronomy questions.

Sample Candidate Response #D:



The sun moves across the sky each day.

Mark Awarded: 2

Examiner's Comments:

Candidate D's response shows clearly the power of a carefully-labelled diagram, particularly when combined with specific astronomical terms. The diagram provided, with its effective labels and arrow to show the direction of the Sun's motion, easily achieves both marking points.

Drawing the motion of an object across the three-dimensional sky can be tricky on a flat piece of paper but the use of accurate and specific labelling can convey ideas which are hard to draws, as in the case of the 'zenith' labelled by this candidate.

In fact, both marks are awarded on the basis of the diagram itself!

Teaching & Learning Points:

- Concepts in GCSE Astronomy often require candidates to describe the motion of astronomical objects across the 'curved surface' of the sky. This skill can be difficult on a flat piece of paper and should be fully practised before the examination.
- There is often a substantial difference in the narks awarded for responses accompanied by an accurate diagram, clearly labelled with specific astronomical terms and those accompanied by a rough sketch or drawing.

GCSE Astronomy Exemplars

Summer 2019

Paper 1

Q4(d): Precession of Ecliptic

(d) Explain why the point 'S' is not in the constellation of Cancer.

(2)

Specification coverage:

3.6 *Understand how the gradual precession of the Earth's axis affects the appearance of the Sun, Moon and stars, when observed from Earth, and its use in archeoastronomy.*

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific techniques and procedures.

Mark Scheme:

Question number	Answer	Mark
4(d)	Precession moves the stars relative to/'behind' point 'S' (on ecliptic).	**(1)** **(1)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

'Many candidates realised that point 'S' had moved from the constellation of Cancer to that of Gemini as the result of precession, although only a minority could explain clearly ***how*** *it caused this shift. The question already states that point 'S' is not in the constellation of Cancer and so no marks were available for re-stating this.*

Once again, the second mark proved to be a demanding one, requiring candidates to talk about the shift between the celestial poles/equator/ecliptic (and thus point 'S') and the background of the stars and their constellations. Centres preparing candidates for this examination in the future should ensure that this point is fully explored.'

Sample Candidate Response #A:

'This is caused by precession.'

Mark Awarded: 1

Examiner's Comments:

Although Candidate A has identified the correct astronomical phenomenon, they have not explained how it relates to the drift of point S, as required by the question's command word ('explain'). The need to give a more extended answer is further indicated by the two marks available

Sample Candidate Response #B:

'Precession is the reason why point S keeps moving every year.'

Mark Awarded: 1

Examiner's Comments:

In a similar way to Candidate A, Candidate B has really only provided the name of the correct astronomical phenomenon ('precession'), with the rest of their answer effectively repeating the text of the question. Consequently, they have effectively 'Stated' the reason for the gradual drift of point S, without explaining it in any way. Therefore, once again, only the first mark of the mark scheme has been achieved.

Sample Candidate Response #C:

'The constellations of the zodiac move along the ecliptic every year so that point S will move too. This effect is called precession.'

Mark Awarded: 2

Examiner's Comments:

Candidate C has not only identified the correct astronomical phenomenon (1) but they have also given a brief explanation (1) of how precession results in the shift of point S. They have therefore achieved both marking points in the mark scheme thus producing a two-mark response. The inclusion of specific and correctly used astronomical terms such as 'zodiac' and 'ecliptic' is also characteristic of a high-scoring response.

Sample Candidate Response #D:

'This is because of the tilt of the Earth's axis, relative to the ecliptic.'

Mark Awarded: 0

Examiner's Comments:

Although Candidate D's response talks about an astronomical phenomenon which is closely related to the answer to this question (i.e. the tilt of the Earth's axis), precession is the gradual **change** of this tilt, which is not mentioned anywhere in this response. It is always pleasing to see answers from candidates who understand that astronomical bodies cannot be tilted but they must be tilted relative to something, such as the ecliptic. However, no matter how clearly expressed, this candidate is not writing about the correct piece of astronomy and thus scores no marks.

Teaching & Learning Points:

- Candidates must always look closely at the command word for the question. Many candidates who knew the correct astronomy for this question scored one mark instead of two because they simply 'Stated' rather than 'Explained'.
- The number of marks available for a question is also a guide to the level of exposition required. Full marks on a two-mark question are unlikely to be achieved with little more than a single word ('precession').
- Use of correct astronomical terms always improves the quality of an answer, particularly in this question which concerns quite a specific phenomenon.

GCSE Astronomy Exemplars

Summer 2019

Paper 1

Q5(a): Lunar Features

5 (a) Figure 4 shows a student's sketch of the Moon's surface.

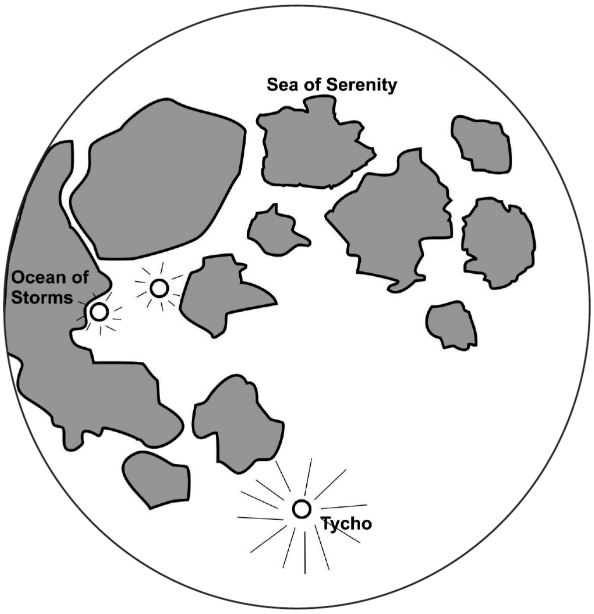


Figure 4

Label the following features on Figure 4.

(i) The Sea of Tranquillity – use the letter '**T**'. **(1)**

(ii) The crater Copernicus – use the letter '**C**'. **(1)**

(iii) The Apennine mountain range – use the letter '**A**'. **(1)**

Specification coverage:

2.5 Be able to identify the following features on the lunar disc:

a. Sea of Tranquility

b. Ocean of Storms

c. Sea of Crises

d. Tycho

e. Copernicus

f. Kepler

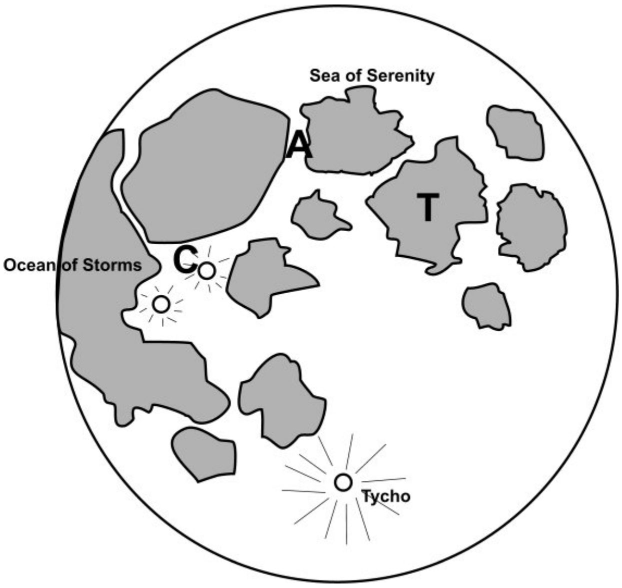
g. Apennine mountain range.

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific ideas

Mark Scheme:

Question number	Answer	Mark
5(a)	 i) T ii) C iii) A	(1) (1) (1)

Sample Candidate Response #A:

5 (a) Figure 4 shows a student's sketch of the Moon's surface.

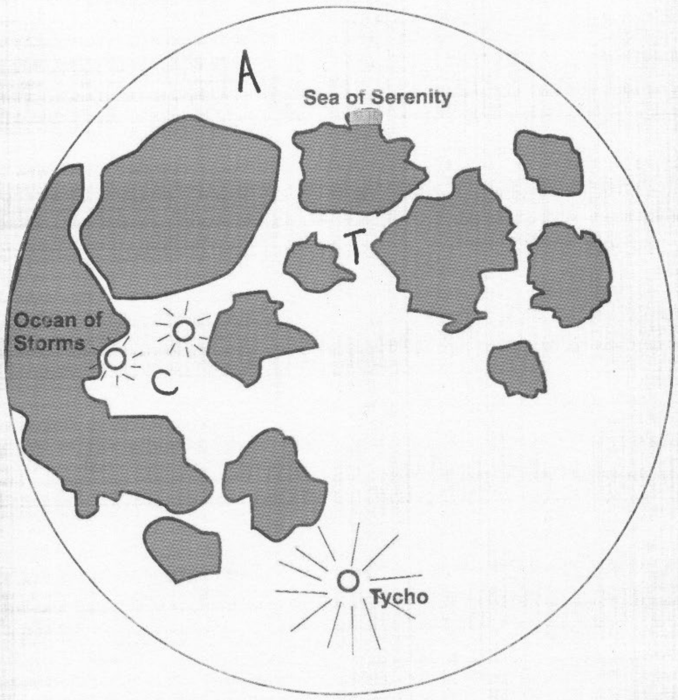


Figure 4

Mark Awarded: 0

Examiner's Comments:

Although it is clear that Candidate A knows the correct general position of each of the three named lunar features required by this question, vague and ambiguous labelling has resulted in them gaining no marks.

The label T has been placed close to the Sea of Tranquillity but unfortunately in an area which is close to two other seas on the sketch. It is not possible to be certain which of these three seas is being indicated an so this mark could not be awarded.

The label C, although in the correct general area, is equidistant between the two unlabelled craters on the sketch and thus gains no marks.

Label A is in the correct general area but is too far north of the correct position to gain a mark.

Sample Candidate Response #B:

5 (a) Figure 4 shows a student's sketch of the Moon's surface.

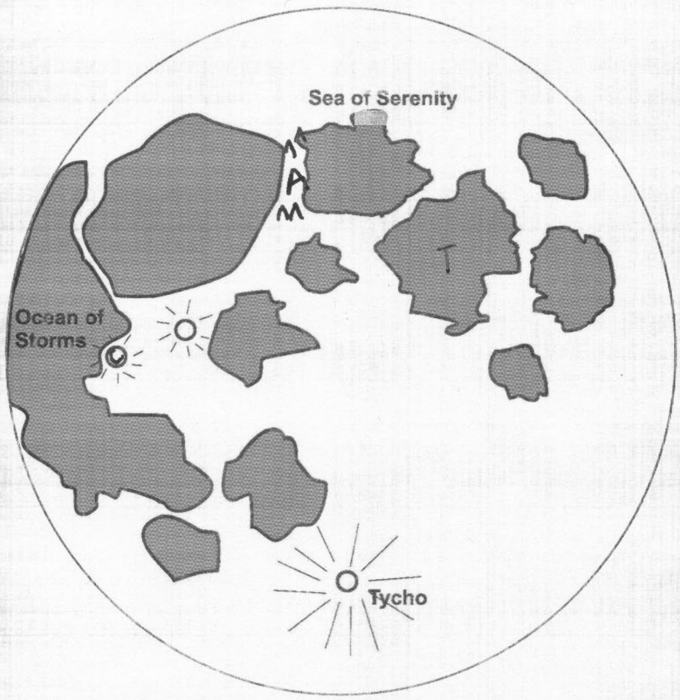


Figure 4

Mark Awarded: 2

Examiner's Comments:

Candidate B is considerably more precise with their labelling than Candidate A and thus scores a higher mark. It is clear from all three of their labels which feature is intended and thus they can be given full credit for each one although unfortunately label C is on the incorrect crater.

The addition of small mountain symbols to label A, whilst very decorative, is not recommended, particularly as two of them look rather like the letter 'M'! As always, candidates are advised to follow the instructions given in the question exactly.

Sample Candidate Response #C:

5 (a) Figure 4 shows a student's sketch of the Moon's surface.

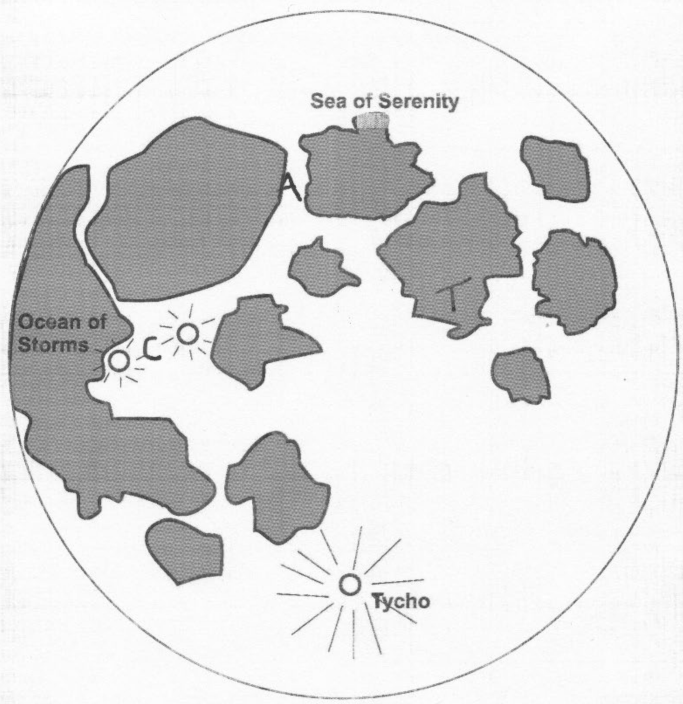


Figure 4

Mark Awarded: 2

Examiner's Comments:

Candidate C has placed labels A and T quite unambiguously but label C could reasonably refer to either of the unlabelled craters on the sketch and thus does not gain a mark.

Sample Candidate Response #D:

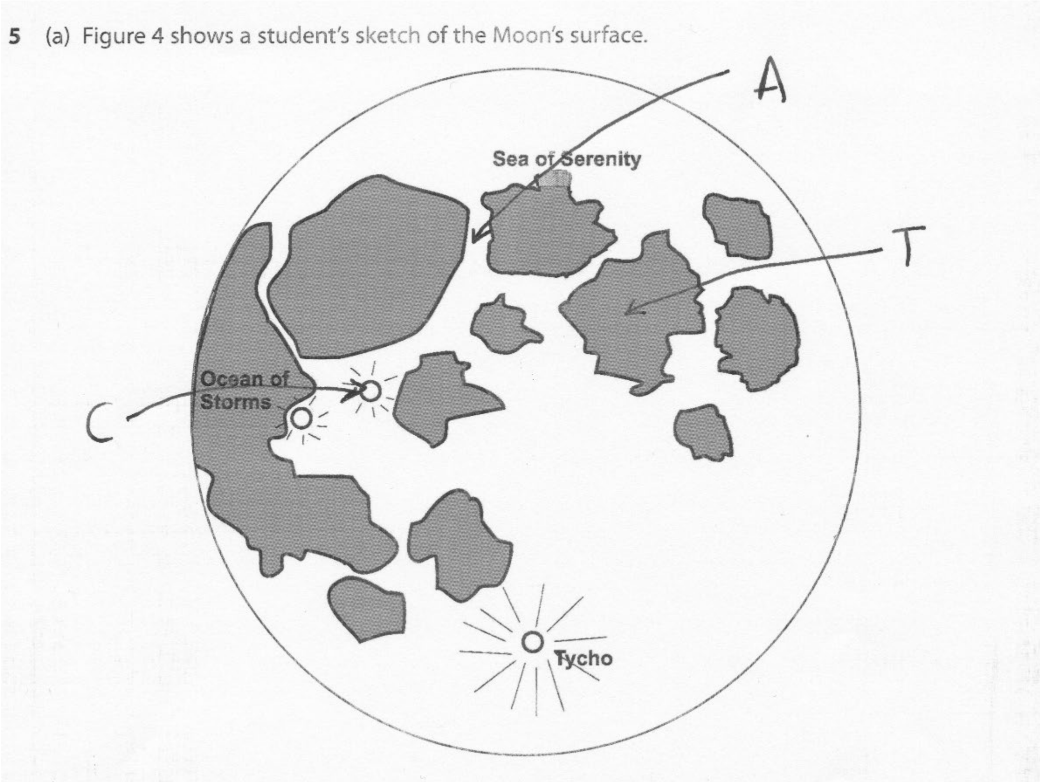


Figure 4

Mark Awarded: 3

Examiner's Comments:

An excellent strategy to ensure accurate and unambiguous labelling has been employed by Candidate D through using arrows. The arrowheads obviously allow them to identify a single point on the diagram and the actual placing of the letters outside the lunar disc means that they cannot become inadvertently associated with any other features.

Teaching & Learning Points:

- When labelling diagrams, sketches or photographs, candidates must ensure that they unambiguously indicate only one item - to avoid the confusion which cost Candidates A and C a number of marks.
- The use of arrows can be a very effective strategy in questions of this kind.

GCSE Astronomy Exemplars

Summer 2019

Paper 1

Q6(a)ii: Altitude of Canopus

(ii) State the reason for Canopus appearing at different altitudes in the sky, when viewed from Rhodes compared with Alexandria.

(1)

....

Specification coverage:

6.9 *Understand the use of the horizon coordinate system(altitude and azimuth).*

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific ideas

Mark Scheme:

Question number	Answer	Mark
6(a) ii	Curved (non-flat) surface of Earth. *Allow:* different latitudes	**(1)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

'Most candidates identified that Canopus's differing altitude was due to the curvature of the Earth, i.e. the different latitudes of Rhodes and Alexandria, although some confused this with longitude or the cities' different altitudes.'

Sample Candidate Response #A:

'This is caused by their different altitudes.'

Mark Awarded: 0

Examiner's Comments:

Candidate A's response is an example of a surprisingly common incorrect answer, resulting either from a misunderstanding of the small effect which geographic altitude has on the altitude of celestial objects or from a misspelling of the word 'latitude'.

Sample Candidate Response #B:

'The Earth's surface is not flat.'

Mark Awarded: 1

Examiner's Comments:

Although Candidate B's answer is quite brief, it does identify the correct feature of the Earth required by the question and thus secures the one mark available.

Sample Candidate Response #C:

'The different longitudes of the two places.'

Mark Awarded: 0

Examiner's Comments:

Candidate C is clearly on the right track in referring to the geographical coordinates of Rhodes and Alexandria. Unfortunately, they have chosen the incorrect coordinate and thus gain no marks.

Sample Candidate Response #D:

'The altitude of the star Canopus is its height above the observer's horizon, as viewed from the Earth's surface. It is measured in degrees vertically upwards from the horizon – 0° at the horizon and 90° at the observer's zenith.'

Mark Awarded: 0

Examiner's Comments:

Although Candidate D's response provides a clear and correct description of what is meant by the term 'altitude' in astronomy, it gains no marks as this is not what the question asked. Despite its use of correct astronomical terminology throughout, it provides no reason for the different altitudes of the star Canopus. The candidate has also not noticed the clues in the question that it should not need a lengthy written answer, viz.:

- the use of the command phrase 'State the reason…'
- the provision of only one line for the answer
- the provision of only one mark for the question.

Teaching & Learning Points:

- Candidates must ensure that they are answering the exact question, as stated on the examination paper. Writing 'around' the question may help to enhance the quality of their answer in questions requiring an extended written answer, but is almost certain to result in the award of no marks in shorter questions
- Candidates must revise very carefully a number of astronomical terms that have very similar spellings, e.g. altitude and latitude; ecliptic, eclipse and ellipse etc.

GCSE Astronomy Exemplars

Summer 2019

Paper 1

Q8(b): Method for Finding Latitude

(b) Evaluate the accuracy of the astronomer's value for his ship's latitude, based on the observational procedures he has used.

(6)

....

....

....

....

....

Specification coverage:

6.10 *Understand how the observer's latitude can be used to link the equatorial and horizon coordinates of an object for the observer's meridian.*

Assessment objectives:

AO3 - Analyse information and ideas to:

- interpret and evaluate astronomical observations, data and methods
- make judgements and draw conclusions
- develop and improve observational procedures

Mark Scheme:

Question number	**Indicative content**	**Mark**
8(b)	• Readings taken either side of local noon • Measurements taken on whole numbers of minutes • Intervals in readings are too large • Around noon, the Sun is moving one or two degrees between readings • An error of even one degree in latitude represents a substantial distance at sea [~70 miles] • Using the Sun's altitude as the **in**dependent variable may have been a more effective method • Altitude of Sun at noon correctly assessed from data (42°) • Latitude calculation is incorrect: **Co-**latitude + 8° = 42°, giving correct latitude of 56°**.**	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• A few inadequacies in the data are noted • A few shortcomings of the method used are identified • Some mention of relevant astronomical theory is made • At least one feasible suggestion for improving the method is made.
Level 2	3–4	• The major inadequacies in the data are noted • These are each linked to a particular shortcoming of the method used are identified • Relevant astronomical theory is used • Feasible suggestions for improving the method are made.
Level 3	5–6	• All inadequacies in the data are noted • These are each linked to a particular shortcoming of the method used are identified • Relevant astronomical theory is used to justify each of the above points • Detailed suggestions for improving the method are made by systematically addressing each of the identified issues.

Sample Candidate Response #A:

'The astronomer has made very careful measurements of the altitude of the Sun on his meridian from the ship. There are plenty of measurements and they show a clear pattern for his latitude. They have allowed him to calculate his latitude very well and thus the position of the ship.'

Mark Awarded: 1

Examiner's Comments:

Candidate A's answer is characteristic of the lower-scoring responses which questions of this kind often attract. Although not incorrect, it is couched in very general language ('very careful…', 'plenty of…', 'very well…') and therefore does not contain many points in alignment with the mark scheme, with its much more specific content.

This answer largely provides a commentary of what the astronomer has done without any awareness of the keyword in the question stem – 'Evaluate…'.

Candidate A has not identified any shortcomings of the astronomer's method or their data and has not noticed the mistake in their calculation of latitude.

There are almost no specific astronomical terms beyond those supplied by the question, apart from the correct use of 'meridian' which thus gains the sole mark for Candidate A.

Sample Candidate Response #B:

'The astronomer has taken some accurate readings of the Sun but his graph would be better if there were more readings, e.g. every minute. His results show a clear pattern, allowing him to decide on the altitude at noon from the maximum of the curve.

He has used the Sun's altitude at noon to work out the latitude very well, in a similar way to using the Pole Star to find it at night, although his answer seems a little small.

His results are good but he could improve the reliability of his readings by repeating them several times and taking an average.'

Mark Awarded: 3

Examiner's Comments:

Firstly, Candidate B's answer attempts to address all the key areas required by the mark scheme (Evaluation of method & data, use of astronomical terms and suggestions for improvement) and thus scores much more positively than Candidate A's. This response still suffers in places from rather vague and general language ('very well…', 'good…') but overall is much more specific about the points made.

Candidate B has expressed a suspicion that the calculation of latitude is not correct but provides no specific information on this.

There is some use of specific astronomical terms throughout along with a specific suggestion for improving the readings (e.g. '…every minute.'). The comment about this method being similar to that for determining latitude using the Pole Star at night is correct but not strictly relevant. However, it does introduce further specific astronomical terms into the response.

The final sentence, although technically correct, could apply to almost any scientific experiment and would actually be impractical in the context of determining a moving ship's current position at sea. It therefore does not really add to Candidate B's score in this area of the mark scheme.

This is clearly a Level 2 response but with only a few specific points from the Indicative Content mentioned, gains a mark of 3.

Sample Candidate Response #C:

'These measurements are accurately taken without any anomalies. Although they show a clear upside-down U-shaped curve as expected, the readings are taken at quite large intervals (every 15 minutes). This could be improved to every minute or so. The time of 'shortest shadow' is easy to assess from the graph and this can then be used along with the Sun's declination (42^o – 8^o) to find the ship's latitude.'

Mark Awarded: 3

Examiner's Comments:

Candidate C's response addresses all areas of the mark scheme to some degree but could still be improved with more specific comments and astronomical terminology.

They have correctly identified the large gaps in the solar altitude readings and that the method could be improved by reducing them.

They have provided a commentary on the calculation but no real evaluation or identification of the error within.

This is a Level 2 response, providing correct answers in all areas of the mark scheme. It is still a little unspecific and short on detail in some places and there is no meaningful evaluation of the calculation. It therefore scores three marks.

Sample Candidate Response #D:

'The solar altitude measurements are not really sufficient for an accurate measurement of the observer's latitude, as an observer on a ship would need. They are too widely spaced, with an interval of fifteen minutes. Taking readings every five minutes (or even every minute as the Sun approaches its zenith) would be much better.

The Sun's altitude at local noon gives the altitude of the Celestial Equator minus its declination and thus the latitude is 42° – 8° = 34°.

To improve this method, I would try to repeat it several times and take an average. Obviously, this is hard to do when the Sun only reaches local noon once each day! However, three people on the ship could take their measurements independently and then an average could be calculated from them.

Mark Awarded: 5

Examiner's Comments:

Candidate D's response is clearly at Level 3. It addresses all areas of the mark scheme in depth, with specific comments, and uses specific astronomical terms throughout. It provides a particularly coherent evaluation of the observational method and the data and gives specific suggestions on how they could be improved.

Unfortunately, it contains a mistake when referring to the Sun being at its zenith (i.e., altitude = 90°) and mirrors the question's incorrect account of how the latitude is to be calculated.

Consequently, it would be awarded a mark of 5.

Teaching & Learning Points:

- Candidates should ensure that they pay close attention to the keyword in the question as this will dictate the entire structure of the mark Scheme.
- Questions which ask candidates to 'Evaluate…' require them to describe both strengths and weaknesses of the observational method involved, being as specific as possible.
- Candidates are expected to suggest improvements to the observational method.
- Using specific astronomical terms in their answers, many of which will be provided in the question, has a significant effect on the final mark for any answer.
- Candidates should check carefully that any calculations or deductions presented in the question are actually correct!

GCSE Astronomy Exemplars

Summer 2019

Paper 1

Q8(c)i: Finding longitude

(c) The astronomer's ship has been sailing for several days.

When it is local noon at the ship's location, an accurate clock on board shows that it is 13:20 at its home port.

(i) Calculate how many degrees of longitude the ship has covered since leaving its home port.

(2)

Answer = ... °

Specification coverage:

4.15 *Understand the difference in local time for observers at different longitudes*

Assessment objectives:

AO2- Apply knowledge and understanding of:

- scientific ideas

Mark Scheme:

Question number	Answer	Additional guidance	Mark
8(c)	**(i) 20°** *Any 1 from:* 13:20 – 12:00 = 1h 20m 1h 20m x 15 (= 20°)	(ignore any indication of +/- or direction of longitude difference)	**(2)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

Most candidates were able to perform the conversion between time difference (between mean and solar time) and longitude in part (i).

Sample Candidate Response #A:

'The ship has a longitude of 1:20'

Mark Awarded: 1

Examiner's Comments:

Candidate A's answer suggests that s/he has taken the first step in solving this problem – finding the time difference between 13:20 and 12:00 and thus gains the first marking point in the mark scheme. Although they have incorrectly applied the word 'longitude' to their answer, the time difference of one hour and twenty minutes (1:20) is clear and their answer thus gains one mark.

Sample Candidate Response #B:

'12:00° '

Mark Awarded: 0

Examiner's Comments:

Candidate B's answer illustrates the importance of providing clear working with even the simplest of calculations. Although the answer is suggestive of some correct working (preparing to subtract 'noon') there is no way of knowing the astronomical thinking behind it and thus no evidence for awarding the first of the 'working' marks in the mark scheme.

Sample Candidate Response #C:

'20" E'

Mark Awarded: 2

Examiner's Comments:

Candidate C has made a number of mistakes but has also clearly made the two correct astronomical steps required by the Mark Scheme. To arrive at the numerical answer of 20, they will have needed to subtract the ship's local time from noon (1h 20m) and multiplied their result by 15. This answer thus scores (a rather fortunate) two marks.

Their incorrect unit (") is ignored as the correct unit (o) is provided by the question and the incorrect direction (E) is also not required by this question which asks only for longitude difference.

Sample Candidate Response #D:

' 13:20 – noon = 1h 20m

X 15 = <u>22.5°</u> '

Mark Awarded: 1

Examiner's Comments:

Candidate D's response is an example of an answer which is not quite correct but which provides clear working at each stage. Even though the final answer is incorrect, Candidate D's first line clearly gains the first marking point, despite the arithmetical slip in the second line .

Placing each result along the way to the final answer on a separate line is particularly helpful to the marker, once again ensuring that the highest possible mark will be awarded.

Teaching & Learning Points:

- The marks awarded to the four candidates above show how important it is for candidates to set out their working clearly in calculations, especially when their final answer is not correct.
- Candidates should be careful when using numbers in sexagesimal format. It is quite likely that this is the cause of the incorrect final answer for Candidate D above, who seems to have used a value of 1.5 hours in their calculation.
- As always in calculation questions, attention should always be given to the units which accompany each numerical result.

GCSE Astronomy Exemplars

Summer 2019

Paper 2

Q2(d): Near & Far Side of Moon

(d) State **two** differences between the appearance of the Moon's near and far side.

(2)

1 ....

2 ....

Specification coverage:
9.2: Understand the major differences between the appearance of the Moon's near and far sides

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific ideas

Mark Scheme

Question number	Answer	Mark
2(d)	*Any **TWO** from:* • Very few / no maria on far side • More craters on far side • Lighter on far side (due to lack of maria) • No rilles / wrinkle ridges (or other maria features) on far side	**(2)**

Sample Candidate Response #A:

'1. There are more craters on the far side.

2. Fewer craters in the near side.'

Mark Awarded: 1

Examiner's Comments:

Although this candidate has correctly understood that there are more craters on the far side of the Moon, they have essentially made this same point twice. Although the question simply asks for 'two differences', it must be understood that they need to be **different** differences!

Candidate A's response therefore gains one mark.

Sample Candidate Response #B:

'1. It has more maria

2. It has fewer craters.'

Mark Awarded: 2

Since the question asks for two **differences** between the near and far sides of the Moon, each of the points in Candidate B's response is acceptable. The response has essentially identified two correct differences between the lunar faces – the number of craters and the number of maria.

The fact that the candidate has not identified **which** face has more maria and fewer craters does not affect their mark as it is not specifically required by this question.

Sample Candidate Response #C:

'1. The near side has much more maria but less craters.

2. ………'

Mark Awarded: 2

Examiner's Comments:

Candidate C has correctly identified two key differences between the Moon's near and far sides and therefore scores two marks.

However, putting both differences in a single sentence on the first numbered answer line is not following the guidance offered by the question and thus makes it more difficult for the marker to award the marks. At first glance, Candidate C's response looks as though it is only submitting one difference.

Sample Candidate Response #D:

> '1. It always faces the Earth.
>
> 2. It has been much more heavily effected by cratering.'

Mark Awarded: 1

Examiner's Comments:

Although highly knowledgeable about the Moon and its appearance, Candidate D has not responded to the exact wording of the question and has thus lost a mark unnecessarily.

Their first point about one side of the Moon always facing the Earth is correct but is not strictly a statement about its **appearance**, as one would see by comparing photographs of the near and far sides.

Their second point is worded slightly at a tangent to the question but correctly identifies the number of craters and thus gains a mark.

The slight grammatical slip in their second point ('**e**ffected') does not obscure the meaning of their answer and thus does not affect their score.

Teaching & Learning Points:

- Whenever a question asks for more than one answer, it is important to ensure that each of these answers is different!
- Whenever a question provides guidelines for the organisation of answers (such as providing a numbered list) candidates are well advised to follow them exactly.
- It is essential that candidates answer the question exactly as it is phrased, instead of simply writing down facts about the astronomical body in the question.

GCSE Astronomy Exemplars

Summer 2019

Paper 2

Q3e: Observing the Sun

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

You may include a carefully labelled diagram in your answer.

(2)

Specification coverage:

10.1: *Understand methods of observing the Sun safely, including:*

a telescopic projection

b H-alpha filter

Assessment objectives:

AO1 - Demonstrate knowledge and understanding of:

- scientific techniques and procedures

Mark Scheme

Question number	**Answer**	**Mark**
3(e)	Suitable diagram (1) Showing projection method or use of H-alpha filter (or neutral density filter) at objective end(1)	**(2)**

Sample Candidate Response #A:

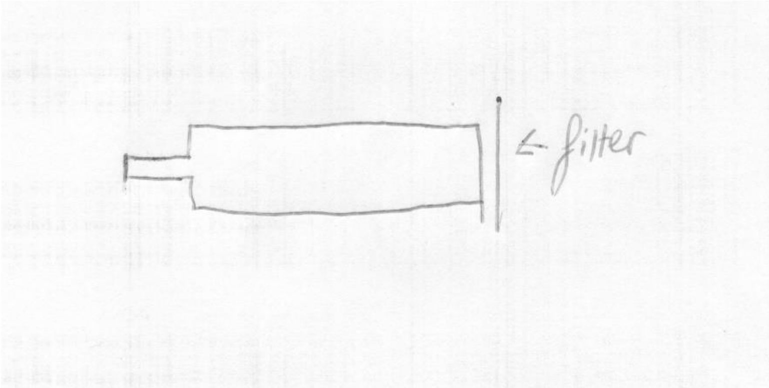
'I would put a filter on my telescope so that it would be safe to look through it at the Sun.'

Mark Awarded: 0

Examiner's Comments:

As is often the case with questions inviting the use of a diagram, it is difficult to score highly on this question without one. Although Candidate A is clearly aware of a correct method for solar observation, they do not provide sufficient specific detail nor a labelled diagram. The latter half of their answer is largely a repetition of the question itself and thus they score zero for this response.

Sample Candidate Response #B:



'I would place a suitable filter over the front of the telescope (objective) in order to reduce the danger from the Sun's rays. It could then be viewed through the eyepiece as normal.'

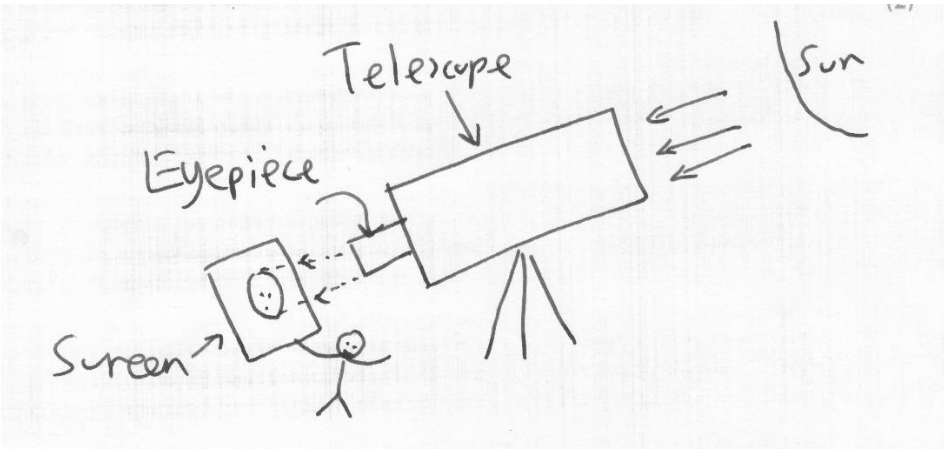
Mark Awarded: 1

Examiner's Comments:

Although Candidate B has wisely accompanied their answer with a diagram, it is not of a high quality with only one rather vague label and some parts left unlabelled. Their written answer sheds a little more light on the procedure to be used but is again lacking in specific terms. Although it does not satisfy either point in the mark scheme very effectively, in combination the response is worth one mark.

Candidate B's response, in common with many others each year, relies too heavily on the imagination of the marker who is expected to know what the unlabelled part of the diagram represents and exactly which type of filter is intended!

Sample Candidate Response #C:



- 'Firstly, point your telescope at the Sun without looking directly at the Sun (move it until the telescope's shadow on the ground is the smallest).
- Then place a piece of card in front of the eyepiece (Do NOT look into the eyepiece). You should see a bright circle on your piece of card which is an image of the Sun's disc. This is the Solar Projection method.
- A piece of black card around the sides of the telescope can make it easier to see.'

Mark Awarded: 2

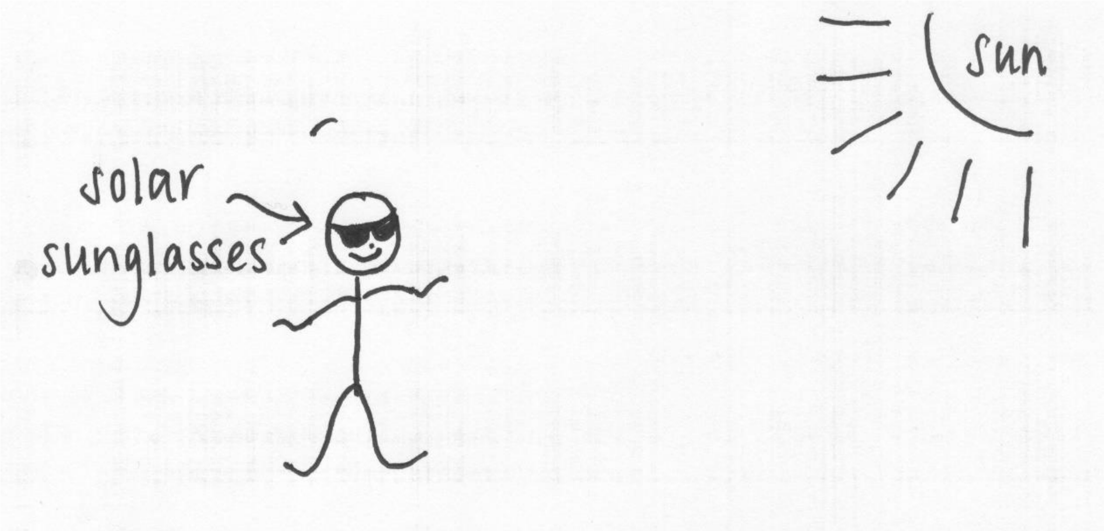
Examiner's Comments:

Candidate C's answer comfortably meets the requirements of both points in the mark scheme. Their diagram is clearly drawn and has all important items labelled. The equipment to be used and the practical set-up are both clear from the diagram. The written section of the response explains clearly how the equipment is to be used along with some suggestions for added safety and an improved solar image.

The use of bullet points, rather than extended continuous prose, makes it much easier for the marker to identify the two marks to be awarded here.

A very secure two-mark response.

Sample Candidate Response #D:



'To observe the Sun safely you need to make sure that you never stare directly at it. You should get a set of special solar sunglasses with very dark lenses which block out most of the Sun. When you put these on, you will be able to see the Sun's disc clearly and safely. Even so, you should not use them for long periods – just long enough to complete your observations.'

Mark Awarded: 0

Examiner's Comments:

Although Candidate D has provided a very clear set of written instructions accompanied by a fully-labelled diagram, their response scores no marks as it does not answer the question set. This question clearly asks for a method for solar observation when **using a telescope**. In addition, the title on the front of the examination paper is '**Telescopic** Astronomy'!

Candidate D's suggestions are all practicable but unfortunately do not satisfy any of the points in the mark scheme. In addition, their method cannot be considered a safe way of observing the Sun for any length of time.

Although it might seem a very obvious point, the number of candidates each year who submit responses showing that they have not read the question in full is surprisingly high.

Teaching & Learning Points:

- Although it might seem an obvious point, candidates should be encouraged to read through the entire question before starting to write their answer. A vital word or phrase may be used towards the end of a sentence in the question stem – such as the word 'telescope' in this question.
- A highly-advisable practice is for candidates to highlight or underline key words in a question, often starting with the command word at the start. This can help them to ensure that their answer is always focused closely on points which will be in the Mark Scheme.
- It is very common for candidates to accompany their answers with roughly-drawn sketches when the question asks for or suggests a 'clearly labelled diagram'. All objects drawn in a diagram should be labelled, rather than relying on the marker's imagination to provide these details.
- Questions which ask for an observational procedure can often be answered more effectively using bullet points than by a single piece of continuous prose. Rather in the style of a cookery recipe, bullet points are a very effective way of describing a sequence of actions, helping the candidate to express themselves more clearly and thus to gain the maximum credit for their astronomical understanding.

Q5(e): Evolution of the Sun

(e) It has been predicted that the Sun will eventually become a planetary nebula.

Explain in terms of the Chandrasekhar Limit how this prediction can be made.

(3)

....

....

....

....

Specification coverage:
14.8: *Understand the effect the Chandrasekhar Limit has on the outcome on the final stages of the life cycle of a star*

Assessment objectives:

AO2 - Apply knowledge and understanding of:

- scientific ideas

Mark Scheme

Question number	Answer	Mark
5(e)	The Sun's core mass (1) is below the Chandrasekhar Limit (1) and therefore will not go supernova / will form a planetary nebula (1)	**(3)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

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

Sample Candidate Response #A:

'Because of the Sun's mass, the Chandrasekhar Limit means that the Sun will evolve through the red giant and white dwarf stages to become a planetary nebula as the final stage of its evolution.'

Mark Awarded: 1

Examiner's Comments:

Although Candidate A presents a clear **description** of the later stages of the evolution of the Sun, there is only one point of explanation ('mass') in their response.

This response correctly offers the red giant and white dwarf stages but these do not **explain** why the Sun is destined to become a planetary nebula (as required by the question) and thus they gain no credit.

The candidate has correctly repeated the Chandrasekhar Limit from the question stem but once again, offers no explanation of **how** it affects the evolution of the Sun.

Sample Candidate Response #B:

'It's because the mass of the Sun's core is below the Chandrasekhar Limit and so it can only become a planetary nebula.'

Mark Awarded: 2

Although relatively short, Candidate B's response clearly identifies the first two points on the mark scheme for this question and thus scores two marks.

A clear indication that this response is focused on the 'Explain…' rather than the 'Describe…' keyword is the use of the word 'because…' near the start.

It suggests the existence of other evolutionary stages to which the Sun will not have access ('only') but gives no further details of these, as required by the third mark on the mark scheme.

Sample Candidate Response #C:

'The Sun is below the Chandrasekhar Limit and so it can only be a planetary nebula and not a black hole or supernova.'

Mark Awarded: 2

Examiner's Comments:

Candidate C has given a largely sound explanation of the Sun's route to becoming a planetary nebula but has missed the vital element of explaining that the Chandrasekhar Limit relates to the **mass** of a star, which is the heart of the first point on the mark scheme.

This response highlights the importance of mentioning specific physical quantities whenever possible. 'The Sun's mass is below…' will always score more highly than 'The Sun is below…'.

Candidate C therefore gains the second and third points from the mark scheme and thus two marks in total.

Sample Candidate Response #D:

'The Sun is not able to become anything like a supernova, neutron star or black hole because its mass is below the Chandrasekhar Limit of $1.4M_{\odot}$.'

Mark Awarded: 3

Examiner's Comments:

In a similar way to Candidate B's response, it is clear from the pivotal use of the word 'because' that this response is focused on the question's 'Explain…' keyword.

All three points on the mark scheme are addressed in this response which focuses clearly on the statement provided in the question and gives the astronomical reasons which cause it – an excellent model for answering any questions beginning 'Explain…'.

Teaching & Learning Points:

- Although it may seem obvious, it is essential that candidates answer the question exactly as it is stated. Particularly in questions requiring an extended answer, candidates should check regularly throughout their answer that it is addressing exactly the points required by the question.
- The particular command word used by the question should set the tone for the candidate's answer. In particular, questions asking candidates to 'Explain…' will generally award no marks for description, no matter how detailed. They should address the question of 'Why?' something is happening and are best started with words like 'Because…'.
- Specific astronomical quantities should be used in answers whenever possible, as they almost always improve the mark awarded. In this question, referring to the Sun's mass scores more highly than simply referring to the Sun.

GCSE Astronomy Exemplars

Summer 2019

Paper 2

Q6(d): Andromeda Galaxy

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

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

Use the Formulae and Data Sheet.

(2)

time taken = ... years

Specification coverage:
11.9: *Be able to use the astronomical unit (1 AU = 1.5 × 10^8 km), light year (l.y.) and parsec (pc)*

Assessment objectives:

AO2 - Apply knowledge and understanding of:

- scientific ideas

Mark Scheme

Question number	Answer	Mark
6(d)	Convert 0.78 Mpc into light years 0.78 x 3.26 = 2.54 Mly (1) Time taken = 2.5 million years (1) Allow 2.5 x 10^6 years or 2 500 000 years	**(2)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

It was quite common for candidates to attempt a conversion from parsecs to light years but neglected to appreciate the value of the standard prefix mega in Mpc.

Sample Candidate Response #A:

'25.4'

Mark Awarded: 0

Examiner's Comments:

Candidate A's response illustrates the importance of showing working in all calculation questions. The first stage in answering this question is to convert 0.78Mpc into 2.54 million light years. Although this candidate's answer is incorrect it has exactly the same digits as the correct answer, suggesting that the candidate has attempted to apply the correct conversion between parsecs and light years of 3.26. However, without any further indication of how the figure of 25.4 has been obtained, there is insufficient evidence for the award of this first mark.

Candidate A therefore scores zero.

If Candidate A had simply written down the multiplication which they presumably performed (incorrectly), e.g.:

'0.78 X 3.26 = 25.4'

…then the clear 'x 3.26' in their working would have secured the first mark for this question.

Sample Candidate Response #B:

'2.54 years'

Mark Awarded: 1

Although an incorrect answer, Candidate B's response is the answer generated by multiplying the number in the question by the correct conversion factor (x 3.26) and thus represents the successful completion of the first stage towards the correct answer. It therefore scores one mark.

Candidate B has forgotten to address the fact that Andromeda's distance has been given in **M**pc (**millions of** parsecs) rather than parsecs and thus does not gain the second mark.

This simple mathematical slip has produced an answer which is incorrect by six powers of ten and it is to be hoped that many candidates would have spotted this when checking their paper, i.e. the time for light to reach us from another galaxy being just over half the time it takes to reach us from the nearest star!

Sample Candidate Response #C:

'0.78 Mpc = 780 000pc

780 000pc x 3.26 = 2 540 000 (3.26 ly in a pc)

2 500 000 years'

Mark Awarded: 2

Examiner's Comments:

Candidate C has arrived at the correct answer and has shown full working at each stage in their calculation.

They have taken a slightly different route to the mark scheme, by converting 0.78Mpc into parsecs first, but the working shows their route clearly and unambiguously. The marker is never left in any doubt as to how numbers are obtained (in contrast to Candidate A).

Particularly effective is the inclusion of explanation for any new numbers introduced '(3.26 ly in a pc)' which again helps to leave the marker in no doubt about the path being taken. If Candidate C had arrived at an incorrect final result, their style of answering would have ensured the maximum working marks for their response.

Sample Candidate Response #D:

'0.78 × 3.26 × 1 000 000 = 2.54×10^6 km'

Mark Awarded: 2

Examiner's Comments:

Candidate D is fortunate to score two marks. They have correctly converted between parsecs and light years and taken account of the Mpc unit given in the question. Consequently, they have produced the correct answer (2.5×10^6) but have given it an incorrect unit (km).

In this particular question, the unit is stated in the question stem and repeated in the answer line at the foot of the question. Consequently, no mark is awarded in this question for the unit and thus the incorrect unit is ignored.

In questions where the unit is not provided, there is often a mark for including the correct unit and in a question like that, Candidate D would have lost a mark.

Teaching & Learning Points:

- A number of the responses above show the importance of including full working with all calculations performed on the GCSE Astronomy paper. It is often very difficult to award marks for unexplained numbers, even if they are the result of a partially correct calculation.
- The best practice in calculation questions involves showing clearly how numbers from the question are being manipulated and where any other numbers have been obtained from.
- Candidates should take care to ensure that their answers are always accompanied by correct units or are consistent with the units required in some questions.
- The distance and time scales of astronomy and cosmology often allow candidates to check their final answers and thus identify arithmetical slips. For example, a time calculated for light to travel an inter-galactic distance should not be just a few years!

GCSE Astronomy Exemplars

Summer 2019

Paper 2

Q8(a)iii: Binary Stars

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

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

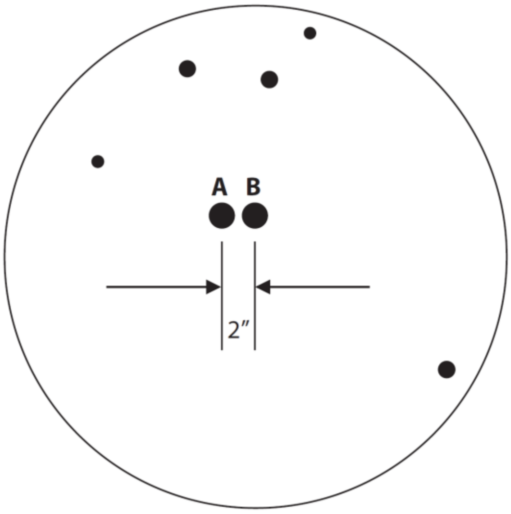


Figure 11

(iii) The angular separation of stars A and B is 2 seconds of arc (2″).

Estimate the field of view of this telescope.

Take suitable measurements from Figure 11 and give your answer in minutes of arc.

(3)

field of view = ... minutes of arc

Specification coverage:
11.21: *Know that the field of view is the circle of sky visible through the eyepiece, measured in degrees or arcmin*

Assessment objectives:

AO2 - Apply knowledge and understanding of:

- scientific ideas

Mark Scheme

Question number	Answer	Mark
8(a)(iii)	Measure separation between lines and diameter of circular field of view (1) Calculate $\frac{Diameter\ of\ circle}{Distance\ between\ lines} \times 2''$ = 33′′ (1) Convert to arc minutes = 33′′ / 60 = 0.55′ (1)	**(3)**

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

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

Sample Candidate Response #A:

'A-B = 7 mm and circle = 78

So field of view = 78 / 7 x 2" = 22"

22 / 60 = **0.37'** '

Mark Awarded: 2

Examiner's Comments:

Although Candidate A has arrived at an incorrect answer, the adequate working which they have provided allows the awarding of two marks for a correct calculation and a correct conversion between arcseconds and arcminutes.

The source of the substantial error in their final value for the field of view appears to stem from sloppy measurement from Figure 11. An over-estimation of the A-B distance and an under-estimation of the width of the telescope's field of view have been compounded to produce a figure well below the correct value.

However, both stages in the processing of their inaccurate data have been completed correctly and this can be seen clearly from the working which they provide, allowing these two marks to be awarded.

This illustrates the importance of providing working in all calculation questions. An answer of 0.37' on its own would have scored zero in this question.

Sample Candidate Response #B:

' AB/FoV = 5 / 80 and this is 2"

So Total FoV = 2" x 80 / 5 = **32"** '

Mark Awarded: 2

Candidate B has combined sufficiently accurate measurements with a correct method to calculate the field of view in arcseconds. They have also included sufficient working to make their reasoning clear.

However, they have not remembered the instruction in the question stem or noticed the reminder in the answer line that the final answer is required in arcminutes

Consequently they lose a mark and score two marks for their response.

Sample Candidate Response #C:

' **0.0000619'** '

Mark Awarded: 0

Examiner's Comments:

Candidate C has provided a completely incorrect answer without any working shown at all and must therefore score zero.

However, their particular answer of 0.0000619 can only be obtained by performing the calculation 5 / 82 x 2" / 60, suggesting that they have performed accurate measurements and then simply transposed the figures in their initial division. Arguably, their response is worthy of two marks but none can be awarded due to the lack of any working.

Sample Candidate Response #D:

' A-B is 5mm : Field = 82mm across

A-B is therefore 82/5 = 16.4 i.e. 1/16.4th of the whole field of view

Hence it will be 16.4 times bigger than 2", i.e. 16.4 x 2" = 32.8"

In arcminutes this is 32.8/60 = 0.547 or **0.55'**

(since there are 60" in one arcminute (')) '

Mark Awarded: 3

Examiner's Comments:

Candidate D's response is an example of best practice when answering calculation questions in GCSE Astronomy. They have performed accurate measurements, combined them using a correct procedure and ensured that a clear narrative runs through all stages of their working.

As well as writing out the steps in their calculation, they have included short sentences or phrases to explain to the marker what they are doing. If Candidate D had made any arithmetical slips in their solution, it would have been very straightforward to award them the maximum number of working marks available – in stark contrast to Candidate C!

This style of answer, which shows an awareness that another human being needs to be able to follow the candidate's thought processes if they are to give it credit, is characteristic of the highest-scoring candidates.

Teaching & Learning Points:

- Although the GCSE Astronomy examination only requires simple measurements, these must be completed accurately, i.e. to the nearest millimetre.
- It is essential that all stages in the working of calculations are shown clearly. If marks for working are to be awarded then then it must be clear at each stage what mathematical operations have been performed.
- Candidates should be encouraged to check the size of their final answer in relation to the data given in the question. A telescopic field of view which contains two objects separated by 2” cannot possibly be less than one thousandth of an arcminute, for example.

Q10(c): Delta Cephei

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

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

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

(6)

....

....

....

Specification coverage:
13.16: *Understand how Cepheid variables can be used to determine distances*

Assessment objectives:
AO3 - Analyse information and ideas to:
- interpret and evaluate astronomical observations, data and methods
- make judgements and draw conclusions
- develop and improve observational procedures

Mark Scheme

Question number	Indicative content:	Mark
10(c)	Measure apparent magnitude of Delta-Cephei (1) With the aid of reference stars (1) Repeat on many (consecutive) nights (1) Plot a light curve of Delta-Cephei and determine its period (1) Determine absolute magnitude from period-luminosity relationship (1) Calculate distance using distance modulus formula and average apparent magnitude of Delta-Cephei (1)	**(6)**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1–2	• Some mention of relevant astronomical theory is made • At least one feasible suggestion for improving the method is made.
Level 2	3–4	• Relevant astronomical theory is used • Feasible suggestions for improving the method are made.
Level 3	5–6	• Relevant astronomical theory is used to justify each of the above points • Detailed suggestions for improving the method are made by systematically addressing each of the identified issues.

Feedback from Summer 2019 Examination (ERA/Results Plus)**:**

Very few responses stated how the magnitude of Delta-Cephei would be measured (i.e. with the use of reference stars). Candidates that referred to the use of reference stars often went on to achieve the full 6 marks.

Sample Candidate Response #A:

'You can tell by how quickly the variable star changes its brightness how bright it must be and therefore how far away it is.'

Mark Awarded: 1

Examiner's Comments:

Candidate A clearly has some awareness of the link between the period of variation and luminosity of a Cepheid variable star. However, they have not included any specific astronomical terms or theory in their explanation and have only talked in very general terms about which measurements should be taken.

This is an example of a Level 1 response, with only one item from the Indicative Content implied and thus would gain only one mark.

Sample Candidate Response #B:

'You should watch carefully how the brightness of the star varies with time and plot this out on a graph. From this you can measure how many days it takes for the brightness to do a complete change. This can then be used to look up the star's actual brightness and hence its distance from its brightness in the sky.'

Mark Awarded: 2

Candidate B has essentially correctly described the process for using a Cepheid variable to determine distance. However, they have managed to do this with the use of almost no specific astronomical terminology. They have also talked only in very general terms about how measurements and observations are connected, without really providing any specific instructions about actual observations.

This has kept their response firmly at Level 1, although the strong implication of at least two items from the Indicative Content makes this response worth two marks.

Candidate B's response also illustrates the danger of using the word 'brightness' on its own when explaining ideas in GCSE Astronomy. It is used several times in this response and with a slightly different meaning on almost every occasion. Importantly for this question, it is sometimes used to mean **apparent** magnitude and on others to mean **absolute** magnitude. Obviously, confusing these two concepts has a disastrous effect on the overall meaning (and thus mark awarded) of the response.

Sample Candidate Response #C:

'The first step is to plot a graph of the brightness of Delta Cephei as it varies regularly over time. From this plot you can determine how quickly its brightness is varying and this will allow you to look up its absolute magnitude.

Comparing its absolute and apparent magnitudes (measured from here on Earth) will allow you to calculate its distance.'

Mark Awarded: 3

Examiner's Comments:

Candidate C clearly understands the basic process by which the distance of a Cepheid variable can be calculated. However, their lack of specific astronomical terminology and rather vague descriptions at some key points have meant that their answer is only at Level 2.

The response has the correct measurements in the correct order and thus represents a 'feasible suggestion' but it is lacking in 'detail' in several places where the instruction is just to 'measure', 'determine' or 'look up' something without any detailed specific guidance on what exactly to observe or calculate.

The response contains some specific astronomical vocabulary but this is not the case throughout with the always ambiguous word 'brightness' creeping in at some key points.

Although much of the Indicative Content is implied, very little is specifically detailed and thus this response would be awarded three marks.

Sample Candidate Response #D:

'In order to determine the distance to the star Delta Cephei, you should first determine its light curve. This is done by taking careful measurements of its apparent magnitude at regular intervals, e.g. every few hours for a few weeks. Use a telescope and reference stars to help estimate the apparent magnitude of the star accurately.

Since this star is a Cepheid variable, its light curve will show regular variations.

Measure the time period of these variations, i.e. the time it takes to vary from a certain apparent magnitude and back again.

For all Cepheid variables, there is a direct proportionality between its Period and its light output, as measured by its absolute magnitude. Use this Period-Luminosity law to find the absolute magnitude of the star.

Then compare its absolute magnitude (M) with its average apparent magnitude (m), as viewed from Earth. The difference between them will tell you how far away the star is, using the distance-modulus formula $M = m - 5 + 5\log d$, where d is the distance of the star in parsecs.

Repeating this process several times will allow you to take an average and thus get a more reliable value for d.

Mark Awarded: 6

Examiner's Comments:

Candidate D's response is an example of a secure Level 3 answer in terms of its style. In addition, it contains all of the items listed under the Indicative Content along with some other astronomical terms, resulting in a mark of six.

All key quantities and measurements are described in terms of their correct astronomical names, rather than more general terms. For example, apparent and absolute magnitude are used correctly throughout, in place of the ambiguous 'brightness' term which so often appears in answers to questions like this.

Descriptions of measurements to be taken are very specific, explaining exactly what needs to be done and avoiding general points such as 'measure the time period', 'find its distance' etc.

The procedure to be followed is set out in a logical order, with additional explanation added in several places. Additional advice designed to improve accuracy is also included.

Teaching & Learning Points:

- The range of marks gained by candidates with broadly similar astronomical understanding illustrates the importance of including the correct astronomical terms and vocabulary whenever possible. As can be seen from the mark scheme, answers explaining broadly similar astronomical observatio programmes can gain very different marks depending on how fully they have used the correct astronomical terms.
- It is much easier to satisfy the criterion in the mark scheme for ‘feasible suggestions’ if the observations and calculations are presented in a logical order.
- Level 3 responses usually give very specific details of exactly what measurements or calculations are to be done rather than using very general terms such as ‘measure the brightness’ or ‘calculate the distance’.