



Pearson
Edexcel

Examiners Report
Principal Examiner Feedback

Summer 2024

Pearson Edexcel

GCE Astronomy 1AS0 01

Paper 1: Naked-eye Astronomy

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General Comments

Summary

The enthusiasm and commitment which has always characterised those involved with the teaching and learning of GCSE Astronomy continues to be evident in candidates' responses to the examination papers. 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.
- Strong graphical skills were demonstrated in both the creation and use of graphs.

It was also evident that, for some candidates, questions on some topic areas were rather unexpected and 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 topic 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 a significant number of candidates are losing marks because they have not fully understood the requirements of the question. Candidates must pay close attention to the command word used at the start of each question as these invariably determine the structure of the mark scheme:

- Questions which 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 which ask candidates to 'Compare...' will require both sides of the particular argument to be stated for full marks.
- Questions which ask candidates to 'Evaluate...' will require them to come to some kind of 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, rather than 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 more clearly expressed using a diagram and so 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 which 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-scoring candidates in this examination.
- It is essential that all the key parts of a diagram are clearly labelled. A number of 'diagrams' seen by this year's examiners contained lines and shapes 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.

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.

- It is important that candidates 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 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 which 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, taking 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.

Comments on Individual Questions

Q2biii

This question was answered well by the majority of candidates and showed that they had seen or used a pinhole camera.

Q3cii

This proved to be a difficult question. A common incorrect answer was 15 degrees. This is the angle through which the Sun/stars move in one hour relative to the observer. Few candidates appreciated that the angle required was based on the orbit of the Moon around the Earth rather than the spin of the Earth's axis.

Q3ciii

Candidates found this question challenging and few were able to score two marks.

Surprisingly, many candidates thought that the Moon was too faint against the bright (background) stars, and many made reference to the stars movement making measurement difficult.

There was misunderstanding that the Moon's motion is being measured relative to the stellar background.

A successful response scoring 2 marks is shown below:

1. It moves across the sky very slowly.
 2. The moon is bright, making stars close to it difficult to observe, making it hard to tell the position of the moon compared to stars.
- (Total for Question 3 = 7 marks)

Q4bi

Candidates sometimes determined the coordinates by drawing vertical and horizontal lines as shown in the example below. However, this negates the fact that the lines of declination are curved and resulted in declination readings of 24 – 25 degrees.

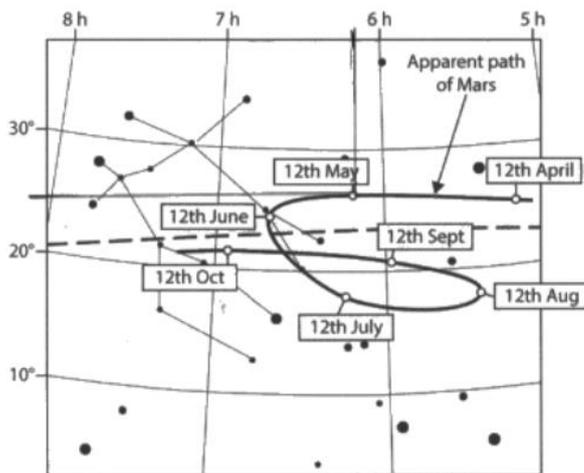


Figure 2

(i) State the Right Ascension and Declination of Mars on 12th May.

Use information from Figure 2.

Right Ascension = 6 h 10 min ⁽²⁾
 Declination = 24 °

Candidates should note that lines of declination are often curved and that this needs to be accounted for when reading or plotting coordinates.

It was pleasing to note that the majority of candidates were able to read the right ascension axis from right to left. However, a few did read the axis in the more conventional left to right orientation (as shown below) resulting in an incorrect response.

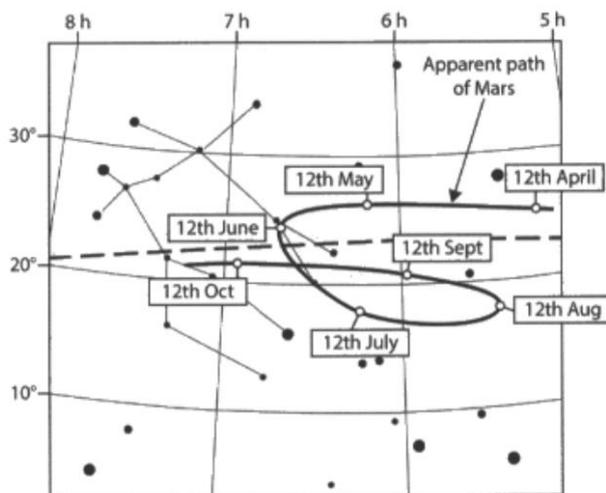


Figure 2

(i) State the Right Ascension and Declination of Mars on 12th May.

Use information from Figure 2.

Right Ascension = 7 h 48 min ⁽²⁾

Q4bii

Candidates need to be careful not to confuse the word "ecliptic" with "elliptical".

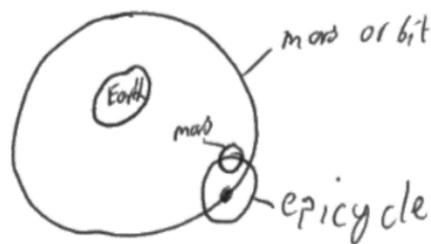
Q4biii

The majority of candidates correctly stated 2 months, although common wrong answers included 3 or even 4 months.

Q4c

This proved a difficult question for candidates. The example shown scored 1 mark.

It is clear that the candidate understands both geostationary and epicycles. However, they have not gone on to clearly explain why this model was used to explain the retrograde movement of Mars. The addition of arrows showing the rotation of Mars' orbit and the rotation of the epicycle would have gained a second mark.



The addition of epicycles allows retrograde motion to be explained with a geocentric model. It added an individual orbit around a point that moves along the actual orbit for Mars. This allowed Mars to appear to move backwards during its epicycle orbit.

Q5ai

The first marking point was accessed by the majority, who appreciated that the Earth has two tidal bulges. However, care needed to be taken because referring to 'two high tides' was often insufficient because this has been stated in the question.

Although a diagram was optional, it is often the simplest method of conveying a correct answer and candidates should take the opportunity to illustrate answers with labelled diagrams when given the opportunity.

Fewer candidates appreciated that the Earth rotates through these two bulges and this mark was often lost.

Q5aii

Some candidates mis-read this question and thought they were being asked to determine the phase of the Moon rather than to determine the date, as demonstrated in the example below:

(ii) Analyse the data in Table 1 in order to determine the date when the Moon's phase was either first or last quarter.

(2)

Last quarter, because it's towards the end of the month.

Q5b

Given the complexity of this question, it was pleasing to note that many candidates could successfully gain full marks on this question. It was noted that weaker responses stated a diameter of 3 500 km with no calculation.

This value had probably been lifted from the formulae and data sheet. When candidates are asked to analyse or perform calculations from experimental data, the resulting (correct) answer it yields could be inaccurate.

Q5c

The majority of candidates scored 1 mark on this question, but few were able to think of a second correct response. A common misconception was the notion that the distance between the three bodies played some part in the explanation, as illustrated below:

1. The moon is much closer to the Earth than the sun is.

2. The ~~moon~~ Earth's shadow is much greater than the moon.

Q6a

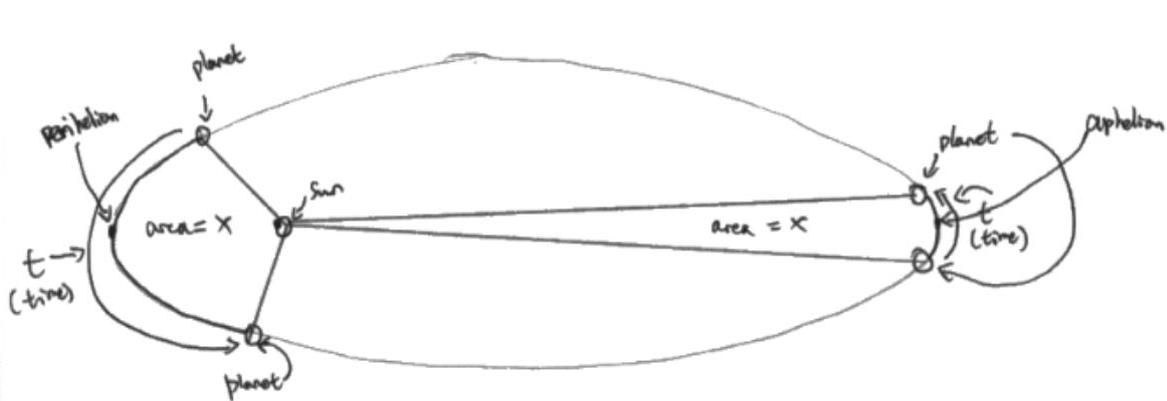
Examples of a 2-mark response:

This is because Kepler was Brahe's student and ^{Kepler} used Tycho Brahe's observations to come up with his three laws of planetary motion.

Tycho tracked and observed the position of Mars in the Earth's night sky for numerous years, allowing Kepler to use the data to try and explain it and other planets' behaviour.

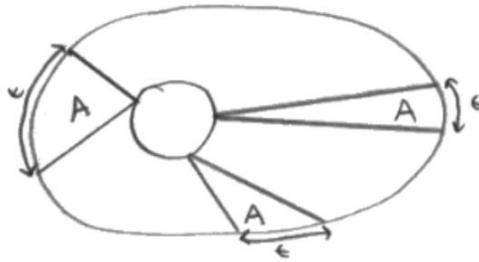
Q6b

Many responses went over and above the mark scheme describing in detail why a planet moves faster at perihelion.



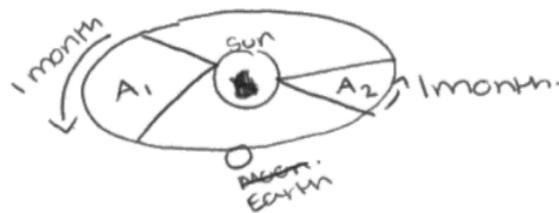
With the Sun at one focus, when a planet in its elliptical orbit comes closer to the Sun, the planet will move ~~far~~ faster in the same amount of time. So the orbital speed of a planet increases as it reaches perihelion and decreases as it moves to aphelion.

However, the following response also scored full marks:



This shows how when a planet is at aphelion, it moves slower. The closer it gets to the sun, the faster it moves. This is because in order to create the same area, the planet must move quicker as the distance between the sun and the planet is shorter.

A common mistake was to place the Sun at the centre of the ellipse, rather than at one focus. Marking was lenient, provided the Sun was off-centre and obviously not located at the centre of the ellipse. The following example demonstrates a 1-mark response – a diagram just showing two equal areas in the planetary orbit.



It is believed that ~~because~~ because of the elliptical orbit that it can be a faster orbital period.

Q6c

The majority of candidates who were able to calculate the constant subsequently went on to correctly calculate the period Ganymede. A small range of answers were allowed due to rounding error and candidates should be encouraged to give answers to 3 significant figures unless otherwise stated.

Q6d

Some candidates were able to fully describe the inverse relationship between a planets mass and the Kepler constant. This is to be applauded, but it is worth noting that this level of detail was not required to score full marks. An example follows:

Saturn has a different mass to Jupiter
and the constant for moons orbiting a
body is inversely proportional to the mass
of the central body. This means Saturn
has a different orbital constant.

(Total for Question 6 = 10 marks)

Candidates should be aware that referring to planets being bigger/smaller was not accepted. This language is often rejected, and candidates need to specify what is increasing or decreasing – in this case, the planet's mass.

Q7ai-ii

Many candidates appreciated where both Polaris and Arcturus were located relative to The Plough. However, a common mistake occurred by placing these stars too near (horizontally) to the asterism. This example unfortunately scored no marks for this reason:



Figure 4

Q7aiii

This question was answered well by the majority of candidates. Here is an example of a good response:

(1)

Stars within a constellation creating
a pattern or picture.

Q7bi

The first marking point in this question was achieved by the majority of candidates who stated that the conclusion was inaccurate. However, fewer candidates then went on to give a sufficient explanation as to why. The command word 'analyse' required candidates to quantitatively interpret the data.

Stating that the observations were performed for different lengths of time was not sufficient – although true, this does not necessarily preclude the fact that the night of the 12th had the worst seeing conditions.

Q7bii

A well answered question, possibly helped by the fact that there are many possible correct answers. However, it was surprising to note that many of the rejected responses stated that Polaris is the brightest star in the sky. This is obviously not the case and probably indicates that these candidates have not actually looked up in the night sky to find the pole star.

Q7c

Most candidates scored within the Level 2 descriptors (3 - 4 marks). Level 3 (5 - 6 marks) was hard to access, requiring well developed, sustained lines of scientific reasoning leading to a supported conclusion.

Weaker responses tended to focus on generalised scientific techniques including repeating and averaging and dark adaptation. High grade responses would reference that the angle should be measured (not approximated) and state a suitable method (e.g. using a protractor).

The following example was awarded 6 marks:

This method would be reasonably suitable for observing skyglow. The student would need an accurate way to determine their zenith and a more accurate way to measure 10 degrees.* Using a cardboard tube would work but could be a little unsteady causing some anomalies in the results so the student might be better positioning the tube on a tripod for better control.* The student could use a digital app to ensure it is exactly 10 degrees or position a protractor to their tripod. This experiment could be successful but the student should attempt to repeat the experiment in different areas such as cities and the countryside to see how skyglow impairs visibility. The student should also ensure before they begin the experiment that they allow their eyes to adjust to the dark for 20 - 30 minutes to maximise their visibility and prevent anomalous results. Plot the graph of various areas and examine the levels of visibility in each one.

A 3-mark exemplar:

This method of evaluating the effect of skyglow may be ~~inaccurate~~, inaccurate, as the amount the tube is lowered by each time is only approximate, so if the student repeated the experiment on a different day, they may not be looking at the same FOV in the sky, rendering the comparison inaccurate and not useful data.

In addition, the number of stars counted by the student may not be an accurate assessment of how many stars are visible in the sky, as the student may miss stars.

Therefore, the experiment should be repeated by multiple people in order to compare results.

However the student's results will show the effect of light pollution, as less stars are visible when ~~light pollution~~ there is more light pollution.

The student should repeat the experiment in places with different amounts of light pollution.

Q8a

This question was answered well by the majority of candidates.

A common incorrect response often made reference to accuracy or precision, as shown in the following example which scored no marks.

So that they are much more precise and
accurate. (1)

Q8bi

This question was answered well by the majority of candidates who successfully managed to calculate the correct distance. Unfortunately, many candidates subsequently lost the last mark by not stating the answer to three significant figures. This is one of the mathematical requirements for GCSE Astronomy.

Q8bii

The first mark was achieved by the majority of candidates, but the quantitative calculation proved harder and was only successfully achieved by the more able candidates. The answer was acceptable in many different units. However, it would be worth reminding centres to encourage students to write large numbers in standard form.

Q8c

The majority of candidates scored full marks on this question. The command word 'determine' is similar to 'calculate' because the answer must have an element which is quantitative from the stimulus provided or must show how the answer can be reached quantitatively.

Q8d

Most candidates scored within the Level 2 descriptors (3 – 4 marks). Level 3 (5 - 6 marks) was hard to access, requiring a well-developed plan that showed a sustained line of scientific reasoning which could successfully result in the calculation of the Earth's diameter.

Often, plans had indicative content missing which meant that it would be impossible to calculate the Earth's diameter if performed as described. This limited the mark to a Level 2. An example is shown below, which scored 4 marks:

The first astronomer must set up a shadow stick at a latitude between the Tropic of Cancer and Capricorn, and place the stick such that it does not cast a shadow. The second astronomer must set up another shadow stick at another latitude, but at the same longitude, letting the Sun to cast a shadow on this one. They must find out the distance between these two place, and work out the angular distance. The second astronomer must measure the length of the casted shadow, and therefore the angle of it. They must use trigonometry to ~~work~~ work out the radius of the Earth, and multiply it by 2 to find diameter of Earth.

In this example, the majority of indicative content is present but unfortunately, the candidate did not clearly describe how to analyse the data and calculate the Earth's circumference and thus diameter.

Weaker responses tended to get confused, and instead of applying Eratosthenes' method, they described the shadow stick experiment where the longitude of the observer can be determined by measuring the time of local noon.

Q9a

Candidates found this question very hard, and few were able to score 2 marks.

Weaker responses neglected to answer the question by ignoring the fact that they were describing the **design** similarities and differences. No marks were awarded for stating that they both cast a shadow because this does not refer to a sundial design.

Some candidates were able to successfully describe a similarity between the two dials (primarily that they have a gnomon or shadow caster) and scored 1 mark.

Virtually no candidates were able to clearly describe a difference between the two dials. Common misconceptions (which are incorrect) were:

- the alignment of the gnomons was different
- equatorial dials could only be used at the equator
- equatorial dials were vertical (because horizontal dials were obviously horizontal).

Q9bi

Given the difficulty of this question, it was pleasing to note how many candidates were able to correctly deduce 15th April.

Q9bii

Candidates could successfully identify that the equation of time had its largest value during this month scoring 1 mark. However, fewer then went on to explain the significance of this, thus losing the second mark. Centres should remind students that when the command word 'explain' is used, the answer must contain some element of reasoning or justification.

Q9c

This question was able to differentiate between candidate abilities. Most were able to determine the equation of time (5 mins) from the graph. Some candidates could either successfully subtracted this from the sundial time or performed the longitude correction by subtracting 10 mins from the sundial time. However, only the most able candidates performed all these operations and then finally calculated the accuracy of the sundial.

Q9di

A common misconception was that the Earth's axial tilt and the Earth's elliptical orbit both had zero values on the same day, when in fact they just cancelled out. Many candidates scored one of the marking points, but fewer scored two marks, and their explanations lacked the required detail.

Q9dii

The majority of candidates could correctly state that the Earth's axial tilt gives the greatest contribution to the annual variation of the Equation of Time. However, many candidates struggled with sufficient clarity or scientific vocabulary to give a clear explanation as to why.

The following examples (both scoring 1 mark) achieved the first marking point but failed to gain the second marking point.

The Earth's axial tilt because it changes
mod⁽²⁾

Earth's axial tilt has the greater contribution to the annual variation
of the equation of time as it fluctuates more frequently over the course of the
year⁽¹⁾

Q10a-c

The majority of candidates were able to correctly plot the data points, even if a scale was not added to the vertical axis. The best-fit curves were good, with few attempting to draw a best-fit straight line. Some candidates did encounter difficulties scaling the vertical axis and did not realise that it required a false origin. This could also result in non-linear scales which started at zero and then jumped to 20, 30, 40 etc.

It was pleasing to note how many students were able to correctly determine the time at which star A culminated.

Very few candidates were then able to determine the hour angle of star A at 02:00. Hour angle is a difficult concept and one which candidates struggle with.

Q10e

In this question candidates were asked to explain why star A's altitude changed over the course of the observation. The observation took place over the course of one night and was thus due to the rotation of the Earth (diurnal motion) rather than orbital motion around the Sun. Reference to orbital motion scored no marks as in the following example:

Due to the Earth moving (orbitting) and the star also appearing to move moving[^] along the ecliptic.

A two-mark response was relatively simple to explain as shown in the next example:

The Earth rotates, making all stars appear to move around the NCP.

Q10f

The first marking point was achieved by the majority of candidates who could extrapolate from the data and appreciated that star A rises above and/or sets below the horizon. However, fewer candidates gained the second mark. They failed explain how this is linked to the star not being circumpolar i.e. defining or linking the word 'circumpolar' with the fact that these stars do not move below the horizon.

Q10g

This question was answered well by the majority of candidates.

Q10h

Most candidates appreciated that the curve drawn in part (a) was approximately translated vertically in this question. However, many candidates drew the curve for star B above (at a higher altitude) to star A and unfortunately scored no marks.

Care needs to be taken when drawing the turning point for this curve.