Examiners Report

Principal Examiner Feedback

Summer 2025

Pearson Edexcel
GCSE Astronomy 1AS0/01
Paper 1: Naked-eye Astronomy

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General Comments

Summary

Responses to this year's examination questions show clearly that centres and their candidates have more than risen to the challenges of the broad specification and demanding examination papers.

The enthusiasm and commitment which have always characterised those involved with the teaching and learning of GCSE Astronomy continue to be clearly 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.

The depth with which many candidates have mastered much of the specification has been very impressive. As is often the case with this subject, it is clear that for many candidates it represents a wider interest, extending well beyond the requirements of the qualification.

It was also evident that, for some candidates, questions on some areas of the specification seemed 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 these new 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. In particular, 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 involved to be stated for full marks.
- Questions which ask candidates to 'Evaluate…' will require them to come to a judgement or conclusion after having looked at both sides of the information presented.

A full list of the Command Words used in the GCSE Astronomy examination and their specific requirements can be found in the Specification.

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 work 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 curves representing important items such as the horizon, meridian, path of a planet etc 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 this is something which candidates should practise beforehand as it can present something of 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 clearly labelled can make this a more straightforward task.

Calculations

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 and structured working is very important.
- The provision of clear working is even more 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.
- 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

Q1ai-iii

Almost all candidates were able to identify the indicated lunar features from the naked-eye sketch provided in Figure 1.

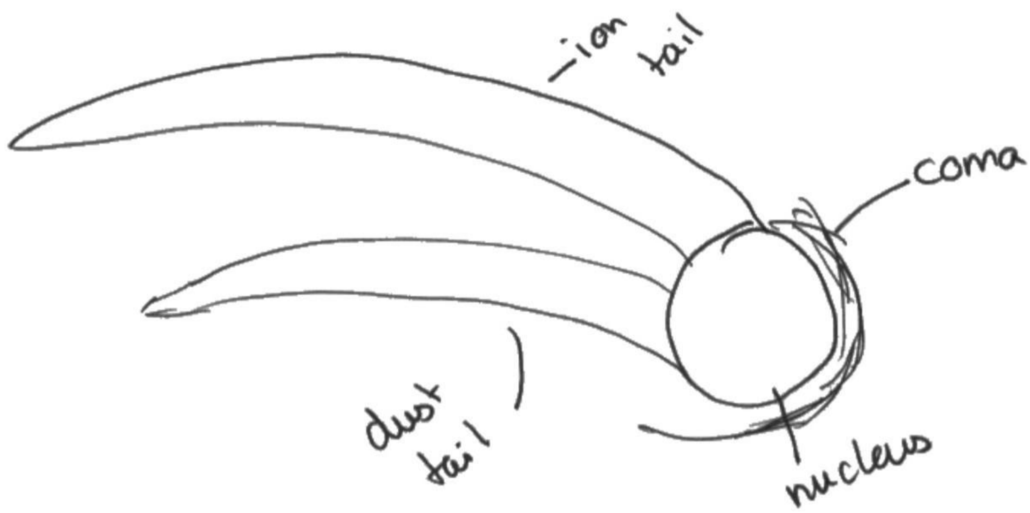
Q1bi-ii

Almost all candidates were able to differentiate between the meteor (i) and the aircraft (ii), based on the naked-eye descriptions provided.

Q1c

Almost all candidates provided a convincing naked-eye sketch of a comet with many including detailed features and taking account of the information about size in Brahe’s description, in order to gain full marks.

Example



The sketch shown above has a clear cometary shape and features. It also comfortably covers the distance between two adjacent compass points, i.e. a quarter of the sky. It therefore scores all three of the marking points for this question. This high-quality example also includes all the key features of a comet, with a label for each one, even though this was not required by the question.

Q2

Candidates demonstrated a wide range of skills when completing these questions, drawn from across the specification. Of these, predicting changes to the size of the force of gravity (c) and converting between time zones (f) proved to be the most demanding.

Q3ai/ii

The majority of candidates were aware of the 'handle' and 'blade' structure of The Plough, with many producing sketches which included the approximate proportions of the asterism. For the arrow required by (ii) to be correct, it needed to pass through the two 'pointer' stars at the end of the blade. Some candidates drew arrows parallel to the correct direction but significantly displaced sideways, which did not gain the mark.

Example

This candidate scored full marks on this question, with correctly positioned and spaced stars and an arrow closely aligned with the line through the two 'pointer' stars of The Plough.

Q3bi-iii

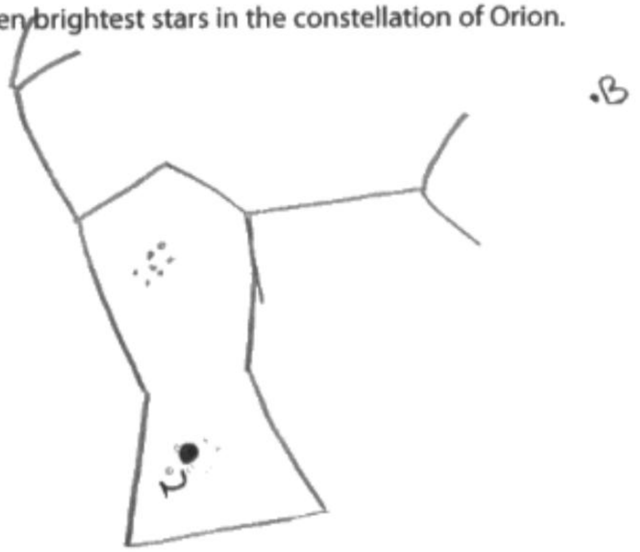
As with Q3a, the majority of candidates were clearly aware of the approximate shape of the central part of the Orion constellation and a pleasing number drew sketches that were correctly proportioned.

As always, candidates are advised to read all parts of the question carefully. The question specified the ‘seven brightest stars’ in Orion. Candidates who drew additional stars could still gain full marks, as long as these additional stars were correctly placed.

Example

(b) (i) Draw a sketch of the seven brightest stars in the constellation of Orion.

(2)



This candidate has produced a correctly proportioned outline of the central part of the Orion constellation but has not followed the requirements exactly. The additional parts of the constellation do not detract from the sketch, as they are broadly correct. However, the central star of Orion’s ‘belt’ is not marked and this is one of the seven stars required by the question. A mark is therefore lost for the sketch, despite its overall correct appearance.

The Orion Nebula (N) is in an acceptable position, although the identity of the cluster of stars in the upper half of Orion’s body is unclear.

The star Betelgeuse (B) which should be in the upper left-hand corner of Orion’s body is obviously incorrect.

Q3biv

A number of candidates thought that the answer to this question lay in the fact that Orion was a very large constellation, supplying sketches that showed it occupying almost the full range of declination from the north to the south celestial pole.

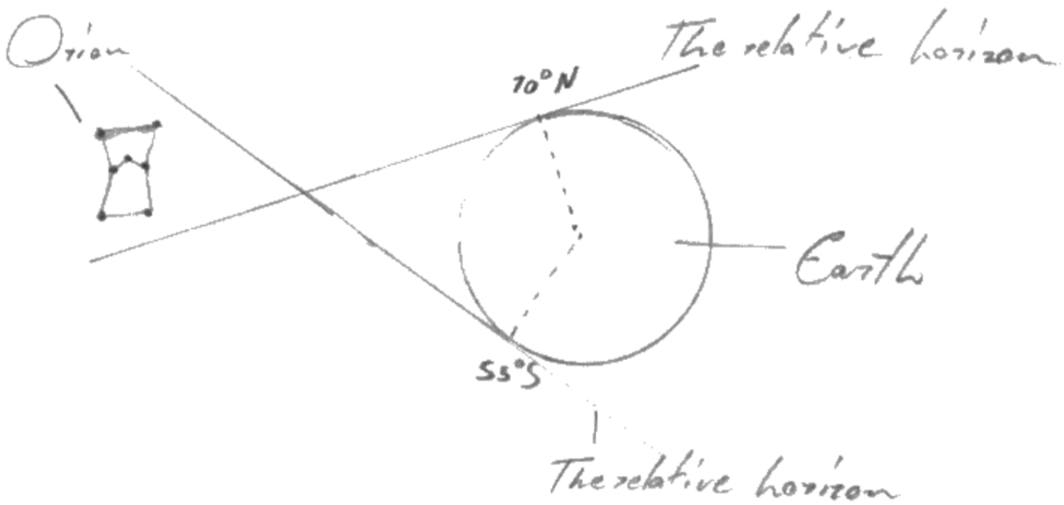
Many candidates correctly explained (most effectively with a diagram) that Orion is close to the celestial equator, placing it above the horizon for both northerly and southerly observers on the Earth.

This question was a good example of one where clearly labelled diagrams are much more effective than text alone. Almost all candidates scoring two marks on this question made use of diagrams.

Example

You may include a clearly labelled diagram in your answer.

(2)



In common with many candidates who scored marks on this question, this candidate has included a labelled diagram which shows clearly the approximate position of the constellation of Orion relative to the Earth – i.e. above the Equator.

The inclusion of a labelled equator or poles on the Earth would have made this marking point even clearer but the labelled positions of the two sets of observers in the question is sufficient.

The horizons of the two groups of observers have been carefully included to show that Orion is above each group's horizon.

Q4ai-iii

This question examined candidates' understanding of the relative positions of the Sun and Moon at various lunar phases. The use of their relative rising and setting times was clearly novel to a number of candidates, with only a small minority able to answer all three questions correctly.

Q4b

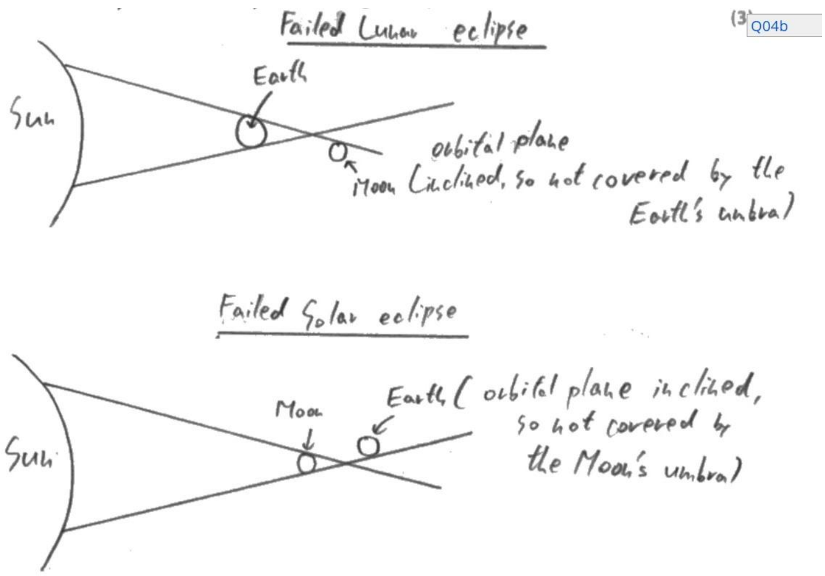
A surprisingly small number of candidates were clear that the tilt of the plane of the Moon's orbit relative to that of the Earth around the Sun (ecliptic) is the main reason behind the rarity of eclipses. A sizeable number of candidates explained that eclipses require the Sun, Moon and Earth to be in exact alignment but this alone was not sufficient for the award of all three marks.

Similarly, a number of candidates simply drew diagrams showing the positions of the Earth, Moon and Sun during an eclipse.

Some candidates who had correctly based their answer around the tilt of the Moon's orbit were in danger of losing this marking point due to the expression of this key idea. Responses such as 'The Moon is tilted…' were difficult to credit in this question as it is the tilt of the Moon's orbit that is creditworthy, not the tilt of the Moon itself.

Candidates should also be reminded that a 'tilt' is always between two lines or planes. Responses such as 'The Moon's orbit is tilted…' were also borderline, unless supported by a clear diagram. In this question, the fully correct expression would be 'The Moon's orbit is tilted ***relative*** to the (plane of the) Earth's orbit/ecliptic…'.

Example



This candidate has made very effective use of diagrams to explain their answer to this question. In each diagram of a "failed" eclipse, they show how the Moon or the Earth is slightly above or below the relevant cone of shadow. As always, carefully thought out, drawn and labelled diagrams are often at the heart of the highest quality answers.

Q4ci

Many candidates gave the impression that they understood the reasons behind this question but lacked the specific language necessary to explain it clearly. Although some credit was given for stating that the first crescent Moon is "easier to see", candidates hoping for full marks needed to be clear that the first sight of the crescent Moon lasted for a much shorter time than the period for which the Moon may be judged to be 'full', to a naked eye observer.

Given that this question required candidates to write very precisely about the changing phase of the Moon, it was surprising to see how few candidates included diagrams or sketches of the Moon's shape and attempted to answer the question completely by text.

Example

because the moon may appear to look full in the sky over numerous nights. Whereas ~~as~~ there is only one day were the cresent moon is first seen because before that there was no visible Moon in the sky

This response explains clearly that the Moon may appear to be 'full' over a period of several nights whereas the end of the New Moon phase could only ever be seen to occur on one night.

Q4cii

This question was answered well, with most candidates attributing the changing date to the motion of the Moon, whose orbital period does not coincide with the 365 days of the calendar. A few, very well prepared, candidates embellished their answers with mention of the Gregorian and lunar calendars.

Example

Because the lunar cycle doesnt excactly match up with months of the year because the lunar cycle is about 28 days and a month is often 30 or 31 days

(Total for Question 4 = 11 marks) Q04_Total

The response shown above gains full marks as it explains clearly how the lunar cycle of 28 days does not align with calendar months of 30 or 31 days. Some candidates explained this point by dividing 365 by 28 and showing that it did not equal a whole number.

Q5a

Although this question asked for an explanation and offered two marks, most candidates simply gave the equation linking the Equation of Time, Apparent and Mean Solar Time. If the question's command word had been 'State…' then this would have been sufficient. However, for this 'Explain…' question, this was sufficient for the award of only one mark. As shown in the Mark Scheme, further detail or some indication of the cause of the Equation of Time was required to gain the second marking point.

Q5bi

Almost all candidates were able to subtract the Sunrise Time from the Sunset Time to calculate the Length of Daylight on these two days. However, the sexagesimal format of the numbers in Table 3 caused difficulties for a few candidates.

Q5bii

There was widespread appreciation of the everyday phrase 'shortest day' and its more exact astronomical meaning in terms of hours of daylight. Optimistic candidates who referred to 'hours of sunlight' were also allowed credit on this question.

Q5biii

This question proved to be one of the most demanding on the paper as it required candidates to weigh the relative effect of increasing daylight length against that of a more rapidly decreasing Equation of Time. As a result, only a small number of candidates scored full marks on this question, although some scored a mark by pointing out that the sunrise time does get steadily later in the days immediately after the winter solstice.

Q5ci-iii

Most candidates were able to identify correctly the various significant points in the orbit of Venus. The most demanding proved to be (iii) – the point where Venus is best placed for observation from Earth. A number of candidates chose point C, where Venus would be at quarter phase but slightly closer to the Sun than when at point D (maximum elongation).

Q6ai

It was pleasing to see such a large number of candidates who were able to devise a suitable pair of labelled axes, plot the points correctly and include a line of best fit, thus achieving full marks on this question. However, once again the sexagesimal format of the azimuth values proved problematic for a small number of candidates, both in this question and in Q6aii below.

Q6aii

Most candidates were able to interpolate the value of the azimuth of sunrise on 9th April from the data provided. The sexagesimal format of the data caused problems for some, resulting in some impossible answers such as 76° 75′. Centres are reminded that, as part of the Specification, sexagesimal notation for angular measurement will be used where necessary, in the GCSE Astronomy papers.

Q6b

This question provided a number of points for candidates to discuss in this longer-answer question. The approximate alignment between the rising Sun shortly after the vernal equinox on 9th April and the direction of the railway tunnel was clearly grasped by most candidates. A number realised that every springtime sunrise direction is paired with an autumn sunset direction, meaning that the Sun must shine through the tunnel on two days each year. A small number of candidates commented that, given the width of the railway tunnel, the Sun is likely to shine through at sunrise over a period of several days.

Q7a

This question simply required two specific points about the Milky Way galaxy, as it appears to a naked eye observer on the Earth – which most candidates were able to supply.

Q7bi

It is clear that almost all candidates are familiar with the use of a planisphere and were able to read the date of observation from the scale provided in Figure 6.

Q7bii

A number of candidates provided two points but only scored one mark on this question. Credit was given for stating the two distinct advantages of a planisphere:

- it shows which parts of the sky will actually be visible
- it can be set up for a particular observation time, date and location.

A surprising number of candidates gave vague responses linked to accuracy or precision, such as 'a planisphere is more accurate'. Actual use of a planisphere is an excellent learning experience for students preparing for the GCSE Astronomy examination.

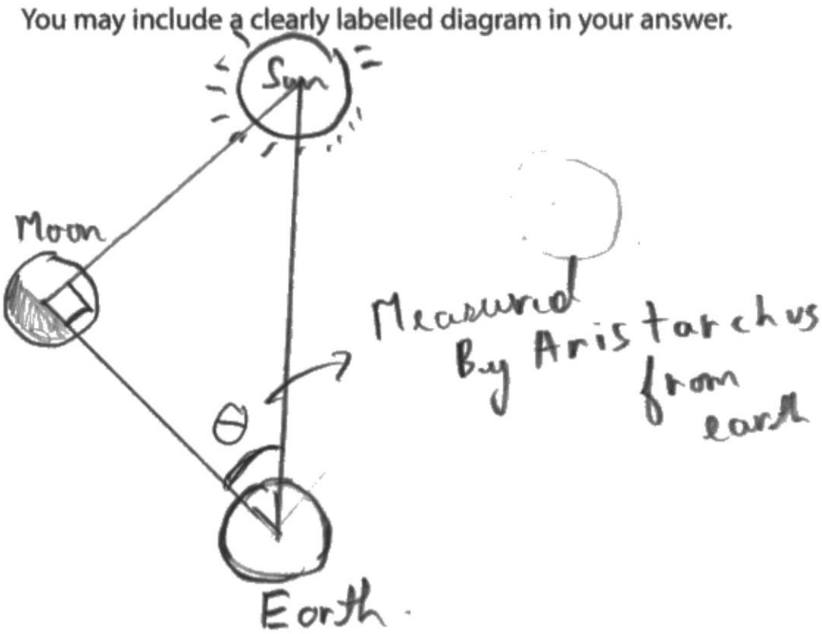
Q7c

The situation described in this question gave candidates plenty of material to interpret and evaluate in the production of their observational programmes. The majority of candidates clearly understood the need to minimise light pollution when observing a faint object such as the Milky Way and chose locations in Figure 7 well away from artificial lighting. Clear lines of reasoning were generally established between these considerations and their proposed observational programmes.

Q8a

A high proportion of candidates were aware that this observation needed to be made at the Moon’s quarter phase, with the Earth and Sun forming a right angle at the Moon. A large number of candidates correctly decided that a clearly labelled diagram, drawn with a ruler, would be the best format for their explanation, resulting in many high-scoring answers.

Example



The diagram above was the central feature in a high-scoring response to this question. It clearly shows the right-angled triangle formed by the three bodies at the quarter moon, with all bodies and relevant angles labelled clearly. Particular attention has been paid to identifying the angle that Aristarchus would have measured between the Sun and Moon in the sky.

Some candidates who were clearly familiar with Aristarchus’s method placed the right angle of their triangle at the Earth, rather than the Moon, resulting in the loss of two of the marking points in this question.

Q8bi

As with many of the ancient naked-eye determinations of distances in the solar system, this calculation required scaling from one distance to the next. The only difficulty with the data presented in Table 5 was that the Earth’s radius needed to be doubled to produce its diameter. As was the case in ancient times, this calculation produces a value for the Earth-Sun distance (2 394 000km) that is very different to the true value.

Q8bii

Candidates who had correctly calculated a value for the Earth-Sun distance from the data in Table 5 would arrive at a very high value for its percentage error (98%). Full credit was available in this question for candidates who correctly calculated the percentage error for their incorrect answer to Q8bi. Clearly set out working was obviously helpful to examiners attempting to award these 'error carried forward' marks in this question.

Q8biii

A disappointingly high proportion of candidates were convinced that the inaccuracy of ancient estimates for the astronomical unit was due to their lack of computers and modern technology. The 'chain' of naked-eye measurements from Eratosthenes' determination of the size of the Earth to Aristarchus's estimate for the astronomical unit presented in the specification is a clear illustration of how a sequence of accurate observations can result in an inaccurate final result. There are many examples showing the precision of ancient astronomical observations so candidates who wrote about their inaccuracy did not score either of the marking points. For credit in this question, candidates had to explain that the determination of the astronomical unit was reliant on a handful of previous determinations, each of whose errors it also inherited.

In the case of Aristarchus's quarter-moon observation in this question, some credit was given for pointing to the difficulty of measuring angles very close to 90^{o}.

Q9a

Although solved by a simple calculation, this question required the use of several astronomical concepts and thus rewarded candidates who presented their working clearly and in a logical sequence. Responses with unexplained calculations dotted around the page struggled to receive any marks if their final answer was not correct.

With the equinoctial Sun on the Celestial Equator, its altitude was therefore simply the altitude of the Celestial Equator or the co-latitude of Sydney (90^{o}-34^{o}=56^{o}).

Given that the majority of GCSE Astronomy candidates are from the northern hemisphere, it was pleasing to see a large proportion realising that in the southern hemisphere, the Sun is due north at noon and thus has an azimuth of 0^{o}. The sunlit northern side of the observatory and its weather vane in Figure 8 was also a clue to this.

Q9b

This question centred around finding the time difference between Greenwich and Sydney. It gave apparent solar time in Sydney (noon) and Mean Time in Greenwich. Candidates therefore had to either calculate the Mean Time in Sydney or the Apparent solar time in Greenwich, using the Equation of Time provided.

Once again, this question rewarded candidates who set out their working clearly as there were still a large number of marks available to candidates who had not found the correct answer.

Example

Give your answer to the nearest degree.

(4)

$EOT = AST - MST$

$+2 = 12{:}00 - MST$

$MST = 12{:}00 - 2$

$= 11{:}58$

$long = \frac{\Delta T}{4 min/deg}$

$\Delta T = MST - GMT$

$= 11{:}58 - 01{:}53$

$= +10{:}05$

$\Delta T = +605 \text{ mins}$

$long = \frac{605 min}{4 min/deg} = 151.25 = 151^\circ 15'$

Longitude of Sydney = 151 E °

An important feature of the correct response shown above is that it provides very clear working throughout. If the final answer had been calculated incorrectly, then this candidate would still have been awarded several marks as each stage in the solution – LMT in Sydney, time difference, final longitude – is presented in the correct sequence and labelled.

Q9c

This question centred around candidates comparing the altitude of Canopus with the altitude of either the SCP or the Celestial Equator in the sky from Sydney. The angle between Canopus and the Celestial Equator thus allowed for the determination of its declination. As might be expected, a number of candidates with correct solutions lost a mark by forgetting that declinations south of the Celestial Equator need to be given as negative numbers.

Q10a

The fact that the apparent daily east to west motion of all astronomical objects in the sky is called diurnal motion was recalled by the majority of candidates.

Q10b

The majority of candidates were aware that retrograde motion was related to a 'backward' section or 'loop' in the motion of a planet. However, far fewer fully explained this by reference to the motion being relative to the 'background' of stars or an 'apparent' motion for observers on the Earth. This level of precision is obviously expected for full marks on questions towards the end of the examination paper.

Q10ci

Although many candidates gained a mark by referring to Kepler's Third Law, relatively few understood clearly that this law means that sidereal period and orbital radius are not proportional to each other.

Q10cii

This question required candidates to complete a relatively straightforward use of Kepler's Third Law, to determine the sidereal period of a comet. Given the substantial number of marks available, clear working was obviously important in this question, helping to ensure that candidates who arrived at the wrong answer did not lose all three marks.

Q10ciii

Many candidates suspected that the solution to this question was related to Kepler's Third Law and thus correctly calculated a value of T^2/r^3 for one of the stars.

Example

Give your answer in solar masses.

(3)

$T^2/r^3 = K$

$\frac{0.64^2}{1.5^3} = 0.121$

$\frac{1.81^2}{3^3} = 0.121$

$\frac{3.33^2}{4.5^3} = 0.121$

Mass of star = 0.121 solar ma

Like the candidate whose response is shown above, a significant number of candidates presented this as their final answer of 0.12 solar masses. The value of T^2/r^3 in Kepler's Third Law is inversely proportional to the mass of the central star, meaning that the correct answer is 1/0.12 = 8.2 solar masses.

The data given in Table 6 provide several clues that 0.12 solar masses cannot be the correct answer. For instance, Exoplanet A orbits further from its star than the Earth (1.5AU) but orbits in less than a year, i.e. much more quickly than the Earth around the Sun. The star in this question is clearly creating a much stronger gravitational field than the Sun and must therefore have a higher, not a lower, mass than the Sun.