ResultsPlus edexcel

Examiners' Report
June 2014

GCSE Astronomy 5AS01 01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk.

Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

ResultsPlus

Giving you insight to inform next steps

ResultsPlus is Pearson's free online service giving instant and detailed analysis of your students' exam results.

- See students' scores for every exam question.
- Understand how your students' performance compares with class and national averages.
- Identify potential topics, skills and types of question where students may need to develop their learning further.

For more information on ResultsPlus, or to log in, visit www.edexcel.com/resultsplus. Your exams officer will be able to set up your ResultsPlus account in minutes via Edexcel Online.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk.

June 2014

Publications Code UG038098

Introduction

This is now the fourth year that this specification has been examined and the intended emphasis on reflecting the central themes of the work of professional astronomers continues to provide an effective focus for the examination.

The updating of the specification has allowed for questions on the latest developments and advances in astronomy and it is clear that centres are now preparing their candidates fully for this.

As in previous years, a number of items were designed to explore the extent to which candidates had completed some actual astronomical observations – 1 (stars), 4b (Moon), 8 (observing programme) and 10(a) (meteor shower).

Candidates were able to use their mathematical and graphical skills to give convincing answers to items such as 13 (shadow stick data), 17c (calculating apparent magnitude) and 18 (calculating the Hubble Constant from graphical data).

There was continued opportunity in 2014 for candidates to demonstrate their awareness of How Science Works in many items such as 7 (astronomical discoveries and theories), 14 (Eratosthenes' determination of the circumference of the Earth), 16 (the discovery of the CMB) and 19 (the use of the stellar spectrum).

The variety of question styles continued this year in the same vein as in recent years: objective questions, tasks requiring short explanations, completion of diagrams or using them to aid an explanation, mathematical calculation and/or reasoning and more open-ended tasks were all present.

In line with previous examinations, there was a gradual increase in difficulty through the paper with relatively straightforward tasks on familiar topics at the start progressing to quite challenging questions on more complex material towards the end.

Question 1 (a)

It was pleasing to see that most candidates knew the difference between a constellation and an asterism, with only a small number falling into the trap of giving the constellation name of Ursa Major

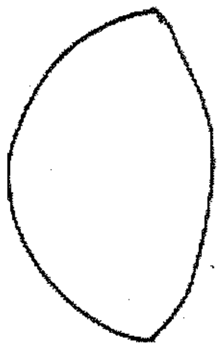
Question 3 (e)

Most candidates were able to give the correct answer to this question with a few giving the more general answer of Doppler Shift.

Question 4 (b)

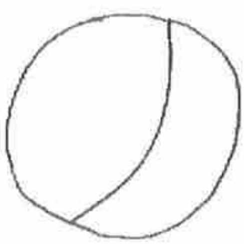
The vast majority of candidates were able to draw a gibbous Moon, with somewhere between half and all the Moon's surface illluminated.

(b) In the space below, sketch a **gibbous** Moon. **(1)**



ResultsPlus
Examiner Comments
This candidate scored 1/1 since their drawing is clearly of a lunar phase which is past Quarter but has not reached Full.

(b) In the space below, sketch a **gibbous** Moon. **(1)**



ResultsPlus
Examiner Comments
Although marks were not deducted for additionally showing the darkened part of the Moon, this candidate has not made it clear which of the two parts of the lunar surface is illuminated, resulting in an ambiguous answer which scored 0/1.

Question 4 (d)

The correct answer of corona was much in evidence for this question with only a few candidates confusing this with the photosphere.

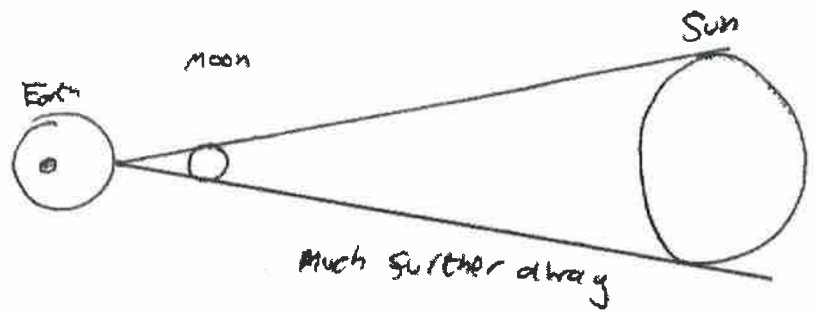
Question 4 (e)

This question required candidates to show clearly that the Moon and Sun subtend equal angles when viewed from the Earth. Most candidates showed that the Moon was smaller and closer to the Earth than the Sun, which gained the first mark. For full marks lines identifying these two identical angles was required.

(e) Although the Sun is much larger than the Moon, they appear to be the same size in the sky.

In the space below, draw a labelled diagram to explain this.

(2)



ResultsPlus
Examiner Comments

This answer shows clearly both points required for 2 marks.

ResultsPlus
Examiner Tip

Always ensure that all items in your diagrams are clearly labelled and that all straight lines are drawn with a ruler.

Question 5 (a) (i)

The vast majority of candidates were aware that a white dwarf star is left at the centre of a planetary nebula.

Question 5 (a) (ii)

Almost all candidates were aware that a white dwarf star is extremely small by stellar standards, with some even giving exact proportions in their answers.

Question 5 (a) (iii)

Most candidates were able to recall that a planetary nebula is a post-Main Sequence stage in the evolution of a star.

(iii) Which stage of stellar evolution is shown in Figure 2? (1)

Death of a star.

ResultsPlus
Examiner Comments
This answer scored 1/1 as it clearly indicates the later stages of the evolution of a star.

(iii) Which stage of stellar evolution is shown in Figure 2? (1)

~~Stage 1~~ Stage 2

ResultsPlus
Examiner Comments
Answers such as these scored 0/1 since merely giving a numbered stage in this way does not specify any particular part of a star's evolution.

Question 5 (b)

Most candidates were able to recall that an absorption nebula is a pre-Main Sequence stage in the evolution of a star.

(Source: NASA)

Figure 3

Which stage of stellar evolution is shown in Figure 3?

(1)

The beginning, when stars begin to form.

ResultsPlus

Examiner Comments

This answer scored 1/1 as it clearly indicates the later stages of the evolution of a star.

Question 5 (c) (i)

Most candidates were aware that neutron stars give out pulses of radio waves - hence their previous name of 'pulsars'.

Question 5 (c) (ii)

The majority of candidates were aware that the principal means for studying black holes is via the X-rays emitted by material around them.

Question 6 (a) (i)

The familiar 'seas' or 'maria' were correctly named here by most candidates.

Question 6 (a) (ii)

Although most candidates were aware of the nature of the dark lunar maria, the lighter terrae were less well known.

(ii) light grey areas? (1)

Highland

ResultsPlus
Examiner Comments

This answer scored 1/1 for correctly identifying them with the highland areas of the Moon.

(ii) light grey areas? (1)

mara

ResultsPlus
Examiner Comments

This answer scored 0/1 by confusing them with the darker maria or 'seas'.

Question 6 (b)

Most candidates understood that the lower numbers of craters in the lunar maria indicated that they were formed more recently than the lighter highland areas.

(b) What evidence is there that the dark grey areas are younger in age? (1)

They are not as heavily cratered

ResultsPlus
Examiner Comments

This answer scored 1/1 by referring to the less heavy cratering on the maria.

(b) What evidence is there that the dark grey areas are younger in age? (1)

They occured sooner.

ResultsPlus
Examiner Comments

This answer scored 0/1 as it does not provide any physical evidence for the difference in ages and simply restates information given in the question.

Question 6 (c)

Most candidates were aware that this is due to the Moon's insufficient gravitational field strength resulting from its relatively low mass.

(c) The Moon does not possess an atmosphere.

Why is this?

(1)

It doesn't have enough gravity to support one

ResultsPlus

Examiner Comments

This answer scored 1/1 as a result of its clear identification of the insufficient gravitational pull.

(c) The Moon does not possess an atmosphere.

Why is this?

(1)

It has no gravitational pull of its own.

ResultsPlus

Examiner Comments

Along with a number of similar responses, this answer scored 0/1 since it suggested that the Moon has **no** gravitational pull.

(c) The Moon does not possess an atmosphere.

Why is this?

(1)

As it's gravitational field is too weak

ResultsPlus

Examiner Comments

This answer scored 2/2 by correctly listing these two discoveries from the Mark Scheme.

Question 6 (d) (i)

As in previous years, the exact nature of the less well-known lunar features was not well recalled.

(d) Rilles and wrinkle ridges are features on the surface of the Moon.

(i) Describe briefly the nature of rilles.

(1)

They are deep narrow trench-like ~~[illegible]~~ features

ResultsPlus
Examiner Comments

This answer correctly establishes that rilles are trenches or grooves in the lunar surface.

Question 6 (d) (ii)

Many candidates were clearly not exactly sure of the nature of wrinkle ridges and rilles, making this comparison difficult. Many candidates attempted much more involved comparisons than the simple fact that wrinkle ridges stand above the lunar surface while rilles lie below it.

(ii) State **one** way in which a wrinkle ridge is different from a rille.

(1)

More ~~ridged~~ rocky.

(Total for Question 6 = 6 marks)

ResultsPlus
Examiner Comments

This very vague statement gained no marks for this question.

ResultsPlus
Examiner Tip

Always ensure that your answers are as specific as possible.

Question 7 (b)

Although most candidates had some awareness of Galileo's early telescopic discoveries in the Solar System, a disappointing number were able to clearly specify two which related directly to the geo-/helio-centric debate of the time.

(b) In 1609 Galileo made some important discoveries to confirm that the Earth was **not** at the centre of the known Universe.

State **two** of these discoveries.

(2)

1 Jupiters Moons orbited around Jupiter not earth

2 The planets Orbited around the Sun

ResultsPlus

Examiner Comments

This answer only gained credit for the first response, thus scoring 1/2. It confuses evidence for a heliocentric Solar System (1) with a description of a heliocentric system (2).

Question 7 (c)

Quite a number of candidates associated the description given in this question with **Kepler**'s Laws of Planetary Motion. Although these laws gave the first quantitative description of how the planets orbit the Sun, they did not explain this motion. This had to wait until the inverse square law of **Isaac Newton**'s theory for gravity.

Question 8 (a)

The majority of candidates were able to recall that a red filter on a torch ensures that the light does not affect the dark adaptation of the human eye, hopefully indicating that most candidates had completed a programme of actual outdoor observation as part of their GCSE Astronomy course.

8 A group of students was planning a naked-eye observing session.

They made a list of some equipment they would need:

warm clothes

torches fitted with red filters

planispheres

(a) Why did the students plan to use red filters with their torches? (1)

To Filter out light pollution

ResultsPlus
Examiner Comments

This type of answer was not uncommon and was based around reducing the light pollution impact which an unfiltered light would have, scoring 0/1.

8 A group of students was planning a naked-eye observing session.

They made a list of some equipment they would need:

warm clothes

torches fitted with red filters

planispheres

(a) Why did the students plan to use red filters with their torches? (1)

because red light doesn't affect dark ~~dar~~ adaptation

ResultsPlus
Examiner Comments

This answer correctly identified this point, scoring 1/1.

Question 8 (b)

It was clear from the answers to this question that many candidates had not used a planisphere, assuming it to be a star chart. Others assumed that it simply showed the night sky at any instant and therefore suggested that the positions of planets could be found on it.

As with several other questions on this paper, the use of general terms such as 'objects' and 'locations' were insufficient for the award of a mark. Higher-scoring candidates replaced these terms with 'stars' and 'positions in the sky' respectively.

(b) State two key pieces of information that the students would obtain from their planispheres.

1 The declination & right ascention of the stars.

2 which stars would be visible on that day.

ResultsPlus
Examiner Comments

This candidate is very clear about how a planisphere shows celestial coordinates for stars rather than just 'locations' and how it can be used to identify which stars are above the horizon at any given time of the year.

Question 8 (c)

Once again, this question revealed a number of students who had not come across the Messier catalogue, with a wide range of incorrect items offered by students who assumed that it simply listed all celestial objects, even planets and meteor showers!

(c) The students also referred to the Messier Catalogue to aid their planning.

State **two** different **types** of astronomical object contained in the Messier Catalogue.

(2)

1 Planetary nebulae

2 Galaxies

ResultsPlus
Examiner Comments

This answer was adequate for the award of 2 marks. The over-specification of nebulae to 'planetary' nebulae does not negate the mark although the candidate would only have scored one mark overall if they had listed two types of nebula.

ResultsPlus
Examiner Tip

Make sure that you have revised all the items listed in the Specification for GCSE Astronomy before the examination.

Question 9 (a)

Most candidates were aware of the approximate position of the Sun within the Milky Way galaxy but were less clear about the positions of globular clusters.

9 A student sketched a side view of the Milky Way galaxy.

This is shown in Figure 5.

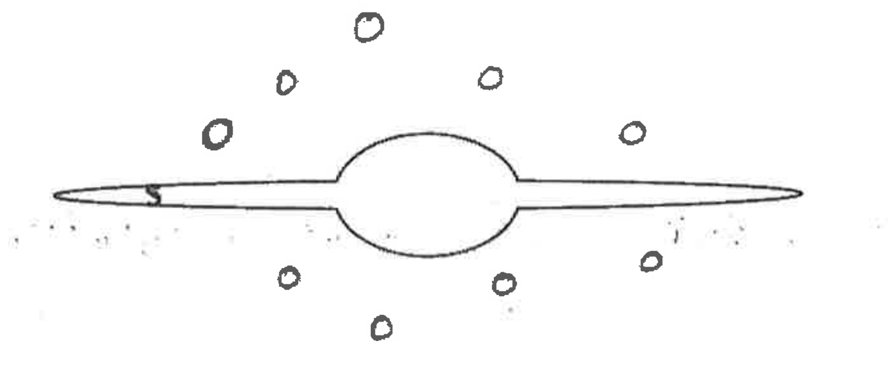


Figure 5

(a) (i) On Figure 5, indicate the approximate location of the Sun. Use the letter **S**.

(1)

(ii) On Figure 5, draw about 10 **small circles** to show the distribution of globular clusters.

(1)

ResultsPlus
Examiner Comments

Although this answer was adequate for the award of 2 marks, the 'halo' of globular clusters is becoming rather distant from the central hub of the galaxy and would benefit from being more tightly centred.

Question 9 (c) (i)

This feature of our Milky Way galaxy was substantially less well-known than the location of globular clusters.

(c) Name the part of the Milky Way Galaxy where:

(i) young stars are located;

(1)

Around the central bulge

ResultsPlus

Examiner Comments

A number of answers confused this location with that of globular clusters, thus scoring 0/1.

(c) Name the part of the Milky Way Galaxy where:

(i) young stars are located;

(1)

the spiral arms

ResultsPlus

Examiner Comments

This answer scored 1/1 by correctly identifying the spiral arms as areas populated by young stars, scoring 1/1.

Question 9 (c) (ii)

This feature of the Milky Way galaxy was not universally known, with a number of very general/vague answers.

(ii) dust is found.

(1)

Spiral arms

ResultsPlus

Examiner Comments

This answer scored 1/1 by correctly identifying the spiral arms as areas containing dust.

Question 9 (d) (ii)

Although many candidates were clearly aware of the use of 21cm radio waves to map the spiral arms, a significant number gave answers which did not fully show an understanding of the reason why.

(ii) Why is it not possible to map the spiral arms using visible light?

(1)

Visible light waves won't penetrate past the dust particles in the spiral arms

(Total for Question 9 = 7 marks)

ResultsPlus

Examiner Comments

This answer correctly establishes the blocakge of visible light by dust particles as the cause, scoring 1/1.

(ii) Why is it not possible to map the spiral arms using visible light?

(1)

Too vivid.

(Total for Question 9 = 7 marks)

ResultsPlus

Examiner Comments

Some answers were directed towards the very high intensity of light along the spiral arms but few were able to explain their ideas in sufficient depth to gain anything other than 1 mark.

Question 10 (a) (i)

Most candidates showed an understanding of the meaning of the term radiant and traced the meteor trails back to an area within that shown in the Mark Scheme.

10 (a) A student observed the Perseid meteor shower in August 2012 and drew some meteor trails on a star chart, as shown in Figure 6.

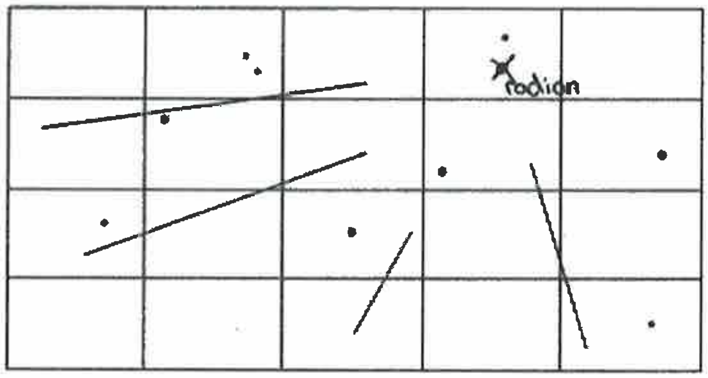


Figure 6

(i) On Figure 6, mark the position of the radiant.

Use the letter **X**.

(1)

ResultsPlus
Examiner Comments
This answer shows a radiant point consistent with a correct projection of the meteor trails and thus scores 1/1.

Question 10 (a) (ii)

Although many candidates were aware that its name was the result of its radiant falling within the constellation of Perseus, a number of candidates mis-phrased this by stating that the meteor shower itself took place within the constellation of Perseus.

(ii) Why is the Perseid meteor shower so-named?

(1)

~~These~~ Its radiant is nearest to/in the constellation of Perseus.

ResultsPlus
Examiner Comments
This was a typical 1/1 response, clearly placing the radiant and not the shower itself in the constellation of Perseus.

(ii) Why is the Perseid meteor shower so-named?

(1)

A man called persid was the first to ~~observ~~ observe that ~~[illegible]~~ meteor shower.

ResultsPlus
Examiner Comments

Several candidates who scored 0/1 on this question suggested, as is often the case in astronomy, that it was named for the person who first observed it!

Question 10 (a) (iii)

The central point required by this question was that meteor showers occur as a result of the Earth reaching a particular point in its orbit. Many candidates went on to explain that this was the result of the Earth crossing the path of a former comet.

Some candidates realised that the most effective way to answer this question was by means of a labelled diagram.

(iii) Why does this meteor shower occur every August?

(2)

The earth has reached the point of its orbit in August where the constellation is visible

ResultsPlus
Examiner Comments

Although this candidate has established that the annual nature of the shower is related to the earth's orbit, they have confused this with the annual visibility of the constellation Perseus, thus gaining 1 mark only.

ResultsPlus
Examiner Tip

Even when not prompted by the question, a small labelled diagram may be a very effective way of answering questions related to the motion of astronomical objects.

Question 10 (b) (i)

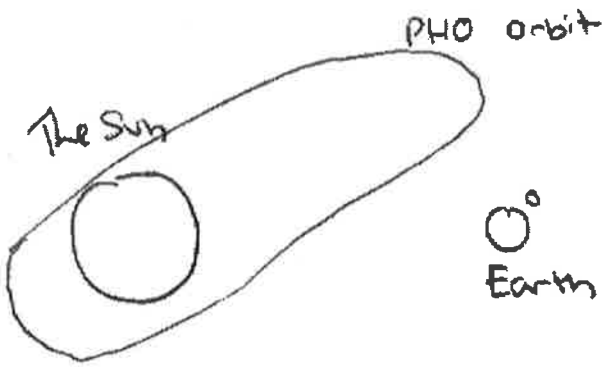
A successful diagram in this question would show the PHO in orbit around the Sun and passing close to or crossing the Earth's orbit. With three objects needing to be included, the need for clear labelling was highlighted by this question.

Although it was not necessary to draw this diagram to scale, some candidates left their PHO passing only about half an Astronomical Unit from the Earth, which was not close enough.

(b) There have been recent concerns about Potentially Hazardous Objects (PHOs).

(i) Sketch a labelled diagram showing the orbit of a PHO. Include the Sun and Earth on your diagram.

(2)



ResultsPlus

Examiner Comments

This answer gained only one mark. Although it clearly shows the PHO orbiting the Sun, it does not pass close enough to the Earth to be 'hazardous'.

Question 10 (b) (ii)

The key distinction for the award of a mark in this question was between establishing that PHO orbits need to be determined and monitored in order to predict any future close encounters with Earth, and that of simply listing the disastrous consequences of such an event.

(ii) Why is it important to monitor the motion of PHOs?

(1)

If it hits the earth all life will sese to exist.

ResultsPlus

Examiner Comments

This answer simply lists some of the consequences of a close encounter with a PHO, thus scoring 0/1.

Question 11 (a) (i)

This question was designed to test whether students appreciated that X-rays do not penetrate the Earth's atmosphere and therefore to be effective, X-ray telescopes need to be sited above the atmosphere. As well as the most common correct answer of 'in outer space', answers such as 'on the Moon' were also accepted, even though there is no such telescope placed there at present.

11 (a) Figure 7 shows an X-ray image of the Sun.

(Source: NASA)

Figure 7

(i) Where should X-ray telescopes be located?

(1)

on the moon

ResultsPlus

Examiner Comments

This answer was accepted since it demonstrates that the candidate appreciates the need for the telescope to be outside the Earth's atmosphere.

Question 11 (a) (ii)

Many candidates confused these patches with sunspots rather than areas of high X-ray activity. Others made very vague statements such as they were 'hot', which has very little meaning on the surface of the Sun!

(b) A group of students observed the Sun with the aid of a H-alpha filter fitted to their telescope.

(i) Why does the H-alpha filter improve observations of the Sun? **(1)**

It can distinguish sun-spots

~~It makes the sun not seem as brig~~

ResultsPlus

Examiner Comments

Confusion with sunspots was quite common in this question.

Question 11 (b) (i)

This question tested candidates' understanding that an H-alpha filter allows only a specific band of frequencies to pass through and is not simply a piece of darkened glass to reduce the intensity of the image. Similarly, answers which commented only on safety benefits were also not sufficient.

As always, very general statements about the filter simply 'improving' the image were not adequate.

(b) A group of students observed the Sun with the aid of a H-alpha filter fitted to their telescope.

(i) Why does the H-alpha filter improve observations of the Sun? **(1)**

Because it prevents damage to the observer's eyes

ResultsPlus

Examiner Comments

This question required candidates to show specific knowledge of the H-alpha filter as opposed to a piece of darkened glass and so answers which simply commented on safety benefits were not sufficient (0/1).

Question 11 (b) (ii)

As shown in the Mark Scheme, a wide range of solar features were acceptable here. However, events such as transits of Venus or Mercury were not allowed.

(ii) Name **one** feature in the solar atmosphere that the students might observe using this filter. eyes

(1)

Comets

(Total for Question 11 = 4 marks)

ResultsPlus
Examiner Comments

Objects which were not part of the solar atmosphere were not allowed - 0/1.

Question 12 (a) (i)

A complete answer to this question required candidates to mention the large distance which the radio signal would need to travel and the long time delay which this would introduce into communications.

Some candidates established the first of these points but then suggested that the large distances would cause problemns due to the very low intensity of the received signals.

12 (a) Despite the recent interest in space travel, manned exploration of the Solar System has so far been restricted to the Moon.

(i) Explain why radio communication between astronauts and Earth would be a major problem on a space mission to Mars.

(2)

Because of the long distance radio communications can have a very large delay of weeks at a time, meaning that emergencies won't be found until too late

ResultsPlus
Examiner Comments

Despite this candidate's substantial over-estimate of the time delay involved, they have clearly mentioned both points in the Mark Scheme for this question - 2/2.

ResultsPlus
Examiner Tip

Make sure that you have answered in sufficient detail to gain full marks, particularly on questions which ask you to **'Explain'.**

Question 12 (a) (ii)

Answers to this question showed a good understanding by students of the problems for humans of long periods of time in space, both physical and psychological.

(ii) Describe **two** further problems that astronauts might encounter on such a space mission.

(2)

1 Lack of oxygen

2 Hazardous objects in the universe.

ResultsPlus

Examiner Comments

Although this answer shows some understanding of the problems involved, answers such as the second one are much too vague to gain credit.

Question 12 (a) (iii)

For the award of a mark in this question, candidates needed to give a specific property of conditions on the surface of Venus which would make it unsuitable for humans, rather than simply stating that it would be 'dangerous' or 'inhospitable'.

(iii) Why would Venus be an unsuitable destination for manned exploration?

(1)

Because its atmosphere is extremely polluted, and toxic to humans.

ResultsPlus

Examiner Comments

This answer gained 1/1 as it identified the highly toxic Venusian atmosphere as a problem for manned expeditions.

Question 12 (b)

As set out in the Mark Scheme, effective answers needed to establish the idea of sending a probe to the planet to check for liquid water or a suitable atmosphere.

The third mark in this question was for sufficiently accurate spelling, punctuation and grammar to support clear meaning.

*(b) Describe some of the methods used to obtain evidence for extraterrestrial life in the Solar System.

(3)

Astronomers need to search for liquid water & the planet needs to have an atmosphere

ResultsPlus

Examiner Comments

This answer mentions the need for liquid water but does not establish that a visit by a probe might be needed to test definitively for this. Spelling, punctuation and grammar are adequate for the meaning of the sentence to be clear (2/3).

ResultsPlus

Examiner Tip

Always re-read your answer to any question marked with an asterisk (*) to ensure that it is clear and legibile.

Question 13 (a)

The marking of this question was organised around the same key areas required for putting any set of numerical data onto a graph:

- correctly chosen and labelled axes
- accurately plotted points
- a smooth line or curve through the points.

Most common errors with this task were:

- not realising that Time was the independent variable and should be plotted on the horizontal axis
- missing units on either axis
- poorly chosen scales which did not allow the points to cover at least half the graph paper in both directions
- incorrectly plotted points
- points plotted with too large a dot or cross, making their exact position unclear
- curve of best fit drawn without full regard for the positions of the points - some candidates even attempted to draw a straight line through the points!

Table 1 gives her results.

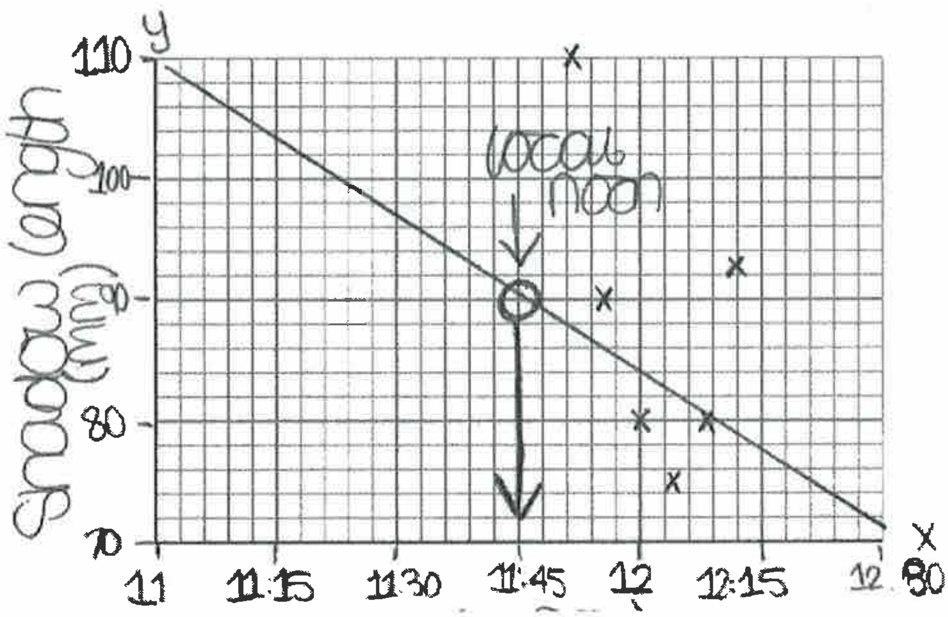
time (GMT)	shadow length / mm
11:52	110
11:56	90
12:00	80
12:04	75
12:08	80
12:12	93

Table 1

(a) Use Lucy's data to plot a suitable graph of shadow length against time.

Label the axes and draw a smooth line-of-best-fit through the data.

(3)



ResultsPlus
Examiner Comments

This answer gains only one mark out of the three available:

- the horizontal scale has not been chosen correctly and the points do not spread out to cover at least half the width of the graph paper
- although quite large crosses are used, the points are generally plotted correctly
- the straight line through the points is not a correct line/curve of best fit - a smooth U-shaped curve is required here.

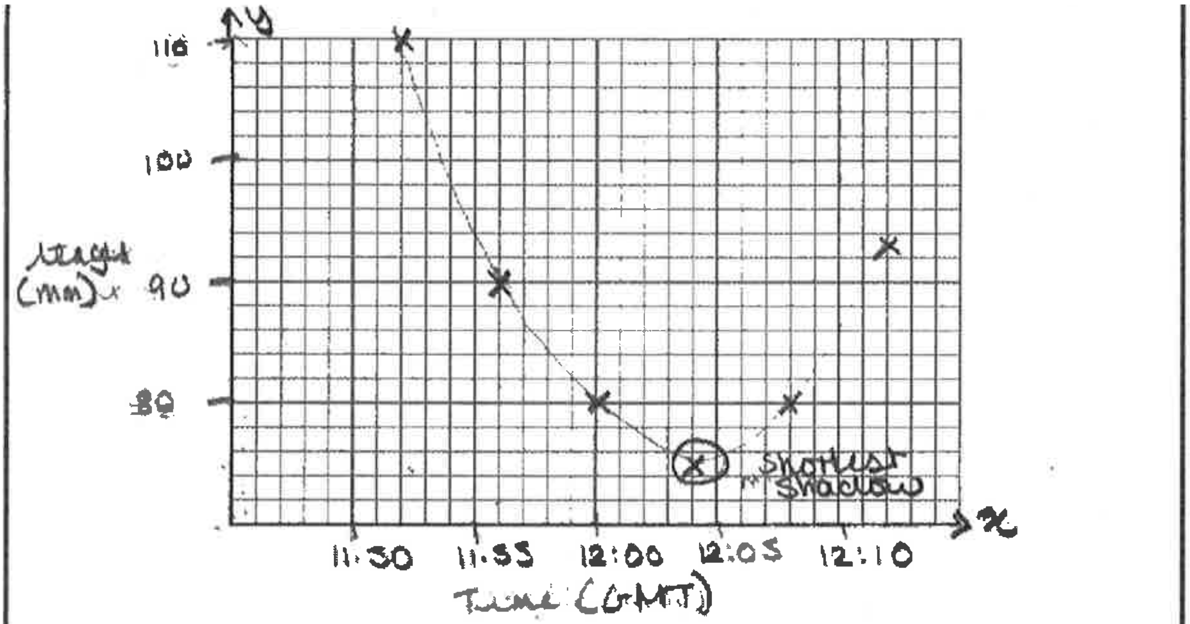
ResultsPlus
Examiner Tip

Always bring a sharp pencil and a ruler to the GCSE Astronomy examination.

Question 13 (b)

This question simply required students to estimate the time of shortest shadow from the graph drawn in part 13(a). The question also clearly required candidates to show their estimated position on their graph.

Many candidates correctly estimated their shortest shadow time but forgot to mark its position on the graph, thus gaining only one of the two marks available.



(b) Use the graph to determine the time (GMT) of local noon to the nearest minute.

Show clearly on the graph how you determined the time of local noon.

(2)

Time = 12:04

ResultsPlus

Examiner Comments

Here the correct time has been obtained and marked on the graph for 2 marks.

ResultsPlus

Examiner Tip

Make sure that you follow all the instructions in the question such as this one where there was a mark for indicating the shortest shadow time on the graph, as well as writing it down.

Question 13 (c)

Ths question required students to adjust the time of shortest shadow from the previous section using the Equation of Time. The remaining difference from 12:00 could then be used to find the observer's longitude. A mark was available for each of these parts and a third mark for correctly presenting the final answer as an angle West of Greenwich.

Despite the fact that marks were available for correct stages within the final solution, many candidates did not present their working with sufficient clarity to allow the markers to give partial credit.

(c) On the date that Lucy carried out her experiment, the Equation of Time was +2 min.

Determine Lucy's longitude.

Use the formula:

Equation of Time = Apparent Solar Time – Mean Solar Time

(3)

+2 = x - 12:04   x = 12:06   6 ÷ 4 = 1.5

[illegible] 1.5° west.

ResultsPlus

Examiner Comments

Although this answer gains full marks for a correct answer, the working could be made a little more 'marker friendly' with the addition of some labels showing where each number has come from. This would ensure some partial credit could be awarded if the final answer was incorrect.

Question 14 (b)

Although ostensibly a straightforward question related to basic observations of the Earth's surface on which we all live, this question proved to be an effective discriminator, with surprisingly few candidates gaining 2/2. Some candidates also confused the question with evidence for the Earth orbiting the Sun instead.

Ancient observations such as circumnavigation and ships disappearing graduallly over the horizon as well as modern evidence such as satellite orbits and images were equally acceptable, such as in this answer which gained 2/2.

(b) Give two pieces of evidence that show that the Earth is not flat. **(2)**

1 A Ship disappers over the horizon

2 We have pictures from Satellites to prove it

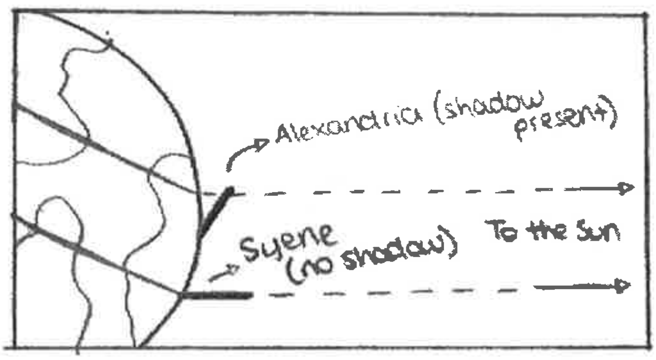
Question 14 (c)

As explained in the Mark Scheme, this question required students to explain how Eratosthenes' simultaneous observations of shadow lengths at two places of different latitude were used to estimate the circumference of the Earth.

There was a widespread recollection of the basic idea of Eratosthenes' method, although some candidates made things difficult for themselves by starting with a roughly drawn sketch instead of a clearly labelled diagram. The mark awarded for this question was almost always closely aligned with the quality of the initial diagram.

(c) Describe how the circumference of the Earth was first calculated by the Greek mathematician Eratosthenes.

You may use a diagram if you wish. **(3)**



Eratosthenes observed the angle of shadows at two different latitudes. The places at which he did so were Alexandria and Syene. He then found out the difference between the angles using information he already knew regarding how far away the cities were from each other.

ResultsPlus

Examiner Comments

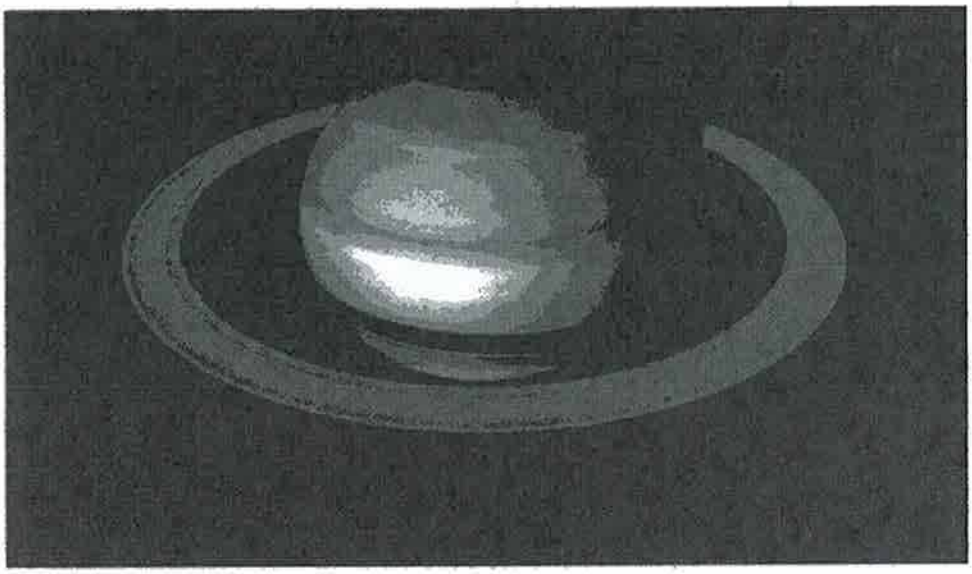
Although this answer contains many of the elements of the required method, it gains two marks out of three as it does not establish the link between the distance and the two locations and the difference in solar angle. This is due to the diagram which does not make it clear that the lines of the sticks at the two locations will eventually meet at the centre of the Earth to make an angle. Consequently, the written description is also rather vague about how the difference in shadow length is to be used to calculate the circumference of the Earth.

Question 15 (a)

Most candidates returned the correct response of Mercury and Venus for this question, although there was a small group who suggested Uranus and Neptune as well.

Question 15 (b)

This question probed students' detailed understanding of the structure of Saturn's rings, requiring them to know that it was not a single solid structure and was composed of chemicals such as water ice for 2 marks. Many candidates wrote about physical properties under Chemical Composition or vice versa but were not penalised for this.



(Source: NASA)

Figure 8

Describe the physical nature and chemical composition of the rings.

(2)

Physical nature

Small comets and asteroids trapped in orbit by saturns gravity.

Chemical composition

mostly water in the form of ice

ResultsPlus

Examiner Comments

This response only gained 1/2 as the suggestion that Saturn's rings are composed of comets or asteroids is not acceptable. 'Fragments of..' asteroids/comets would have made this an acceptable statement about the physical nature of the rings.

Question 15 (c)

As the question clearly states, it requires candidates to contrast the possible origns of the moons of these two planets. Although both are most likely to have obtained their moons via gravitational capture, Mars is likely to have obtained Phobos and Deimos from the Asteroid Belt whereas Neptune's Triton is thought to have originated in the Kuiper Belt.

Most candidates simply described the origins of each planet's moons.

(c) Contrast possible origins of the moons of Mars and Neptune.

(2)

Mars' moons are suspected to be captured asteroids because they look familiar to asteroids. Neptune's moons could've been formed by the matter in it's ring system being attracted ~~[illegible]~~ together to form a moon.

ResultsPlus

Examiner Comments

This candidate scores one out of two marks available as they have only described correctly the formation of the moons of Mars as captured asteroids.

ResultsPlus

Examiner Tip

Pay close attention to the first word of a question and make sure that you follow its instruction, ie describe, explain, compare etc.

Question 16 (a)

This question allowed two marks for relevant points related to the discovery of the Cosmic Microwave Background radiation, combined with a third QWC mark for handling the complex subject matter effectively, making the ideas comprehensible.

Although many candidates remembered some specific details such as the date or the name of one of the discoverers, or the need to clear birds from the receiving dish beforehand, quite a number did not explain the key astronomical points behind its discovery such as its isotropic profile or the significance of its wavelength.

16*(a) Describe how the Cosmic Microwave Background (CMB) radiation was discovered.

(3)

Scientists built a microwave telescope and observed the same interfering 'hiss' no matter what direction they pointed the telescope. After carefully ruling out possible construction errors, the scientists thought to map the signal and discovered what we now call the CMB, the echo of the hot Big Bang.

ResultsPlus

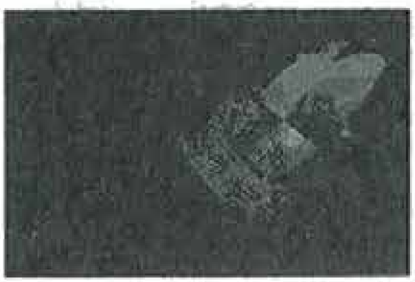
Examiner Comments

This is an example of an answer which gained three marks, containing several points about the discovery and explaining them with clear and appropriate language.

Question 16 (b) (i)

This question on the specific purpose of WMAP was not well answered with many candidates simply stating that it was designed to study the CMB. Despite the clue in its name, very few candidates were awarded one mark for stating that it was designed to look for variations or ripples in the CMB.

(b) Figure 9 shows an artist's impression of the Wilkinson Microwave Anisotropy Probe (WMAP) which was launched in 2001 to study the CMB radiation.



(Source: NASA)

Figure 9

(i) Describe the specific purpose of WMAP.

(1)

To study CMB radiation and send back records to Earth from outside our solar system.

ResultsPlus

Examiner Comments

In common with many answers, this response scored zero marks, as explained above.

Question 16 (b) (ii)

Following the large number of vague answers to the previous question, a similar performance was seen here. Many candidates confused WMAP's results with the original discovery of the CMB, stating that it helped to prove the Big Bang Theory. Very few candidates mentioned that WMAP's results have helped to refine and quantify our models of the early universe.

(ii) Explain the significance of WMAP's observations to cosmologists.

(2)

The CMB radiation is thought to originate from the Big Bang. This has helped us to understand the universe.

ResultsPlus

Examiner Comments

This answer was not untypical of the rather vague responses to this question which gained no marks.

Question 17 (a)

As explained in the Mark Scheme, this question required two elements for full marks - mention of a parallax angle and then at one second of arc. Stating the size of the parsec in light years or that 10 parsecs is the distance from which absolute magnitude is determined are not part of its definiton and scored no marks.

17 (a) Define the parsec.

(2)

A parsec is the distance of 3.26 light years, 10 of which is the distance that absolute magnitude is measured from

ResultsPlus

Examiner Comments

This answer gives two facts about the parsec (one of which is correct) but does not give any part of its definition and thus scores 0/2.

Question 17 (b) (i)

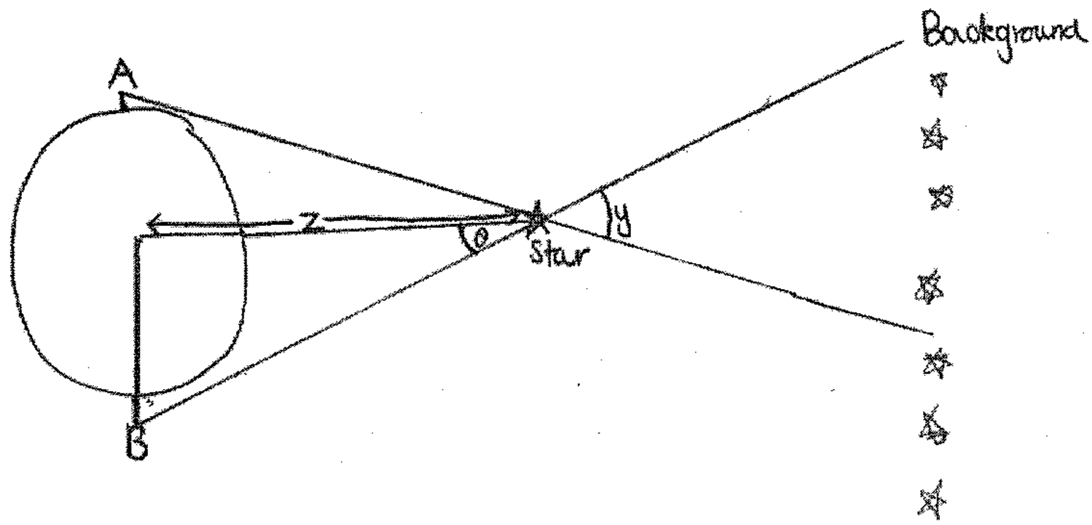
Many students produced strong responses to this question, only occasionally missing one of the three elements in a correct answer:

- Earth - Sun baseline
- distant stars included
- parallax angle correctly labelled

and this was sometimes as the result of insufficient labelling.

(b) (i) With the aid of a diagram, describe how distances to nearby stars are determined using heliocentric parallax.

(3)



A star is observed from positions A and B on the Earth, and appears different from each place against the background. This difference in position is used to determine angle y, which then gives astronomers angle θ. Trigonometry is then used to find distance z.

ResultsPlus
Examiner Comments

This answer gained two marks out of three as it has clearly set up the diameter of the Earth as the baseline rather than the Earth's orbit around the Sun. Allowing for this error, the other two elements required by the Mark Scheme are clearly evident.

Question 17 (b) (ii)

Although many candidates appreciated that the majority of stars are too far away for there to be any measurable heliocentric parallax, a number presented answers based around the low brightness of very distant stars which does not relate to this question.

(ii) Why is this method only suitable for nearby stars?

(1)

You wouldn't observe much movement in the sky from very distant stars.

ResultsPlus

Examiner Comments

Although the term 'movement' is a little vague, this answer was sufficient for the award of 1/1 as it identifies the problem of not seeing any measurable parallax shift when viewing distant stars from Earth.

Question 17 (c)

Correct substitution of the figures given the question and manipulation of the formula gives an apparent magnitude of +8, in line with placing this object at the very large distance of 10 million parsecs.

A number of candidates did not notice the M in 10Mpc and therefore obtained an apparent magnitude identical to the absolute magnitude of -22.

As always with calculation questions, partial credit was given wherever possible, where working was set out with sufficient clarity for the maker to follow.

(c) Some data for a galaxy are given below:

absolute magnitude = -22.0

distance = 10 Mpc

Use this data to calculate the apparent magnitude of this galaxy.

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

(2)

$-22.0 = m + 5 - 5 \times 7$ 10 Mpc = 10,000,000 pc

$-22.0 = m + 5 - 35$

$-22.0 = m - 30$ $m = 8$

$+30$ $+30$

(Total for Question 17 = 8 marks)

ResultsPlus

Examiner Comments

This is an example of a correct solution presented with very clear working. If this candidate's final answer had been incorrect, then partial credit for corrrect working could easily have been awarded.

ResultsPlus

Examiner Tip

Aways check the final answer from your calculation against the data in the question. It's very unlikely that anything at a distance of 10Mpc could have an apparent magnitude of -22, ie close to that of the Sun! This will allow you to spot and correct any mistakes.

Question 18 (a)

As well as requiring candidates to obtain a value for the gradient of the straight line shown on the graph, this question also rewarded candidates who followed its instructions and showed attention to the details of correct scientific notation such as significant figures and units.

18 (a) Maxwell plotted a graph of radial velocity of some distant galaxies (v) against their distance from Earth (d) and drew a line-of-best-fit.

Figure 10 shows Maxwell's graph.

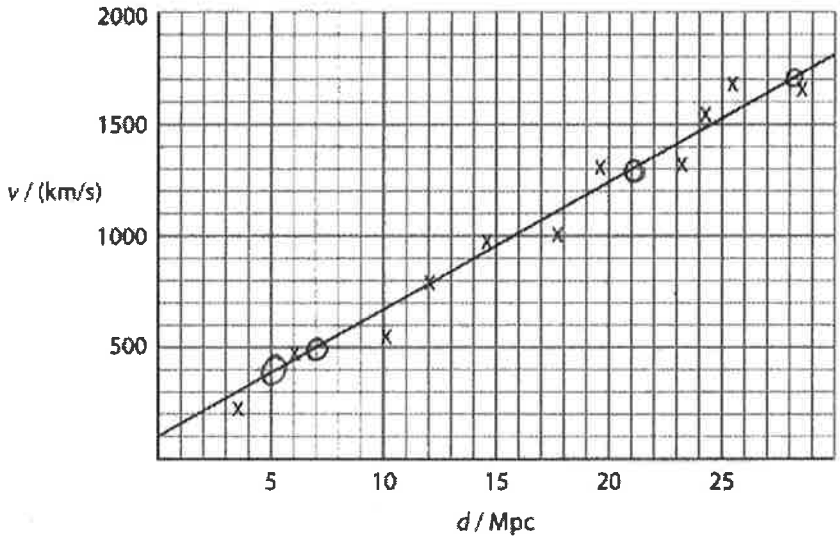


Figure 10

Use the graph to determine the Hubble Constant.

Write the value correct to **two** significant figures and give the unit.

Show clearly on the graph how you determined the Hubble Constant.

(4)

V = Hd or H = V/d

H = 500/7

H = 71.428571

H = 71 Km/S/mpc

Hubble Constant = 71 Km/S/mpc

ResultsPlus

Examiner Comments

This candidate unfortunately only scores one mark out of four. The candidate has not shown a suitably large triangle on the graph as requested. They have not obtained a value in the correct range given in the Mark Scheme and have given incorrect units by using the milli- (m) instead of the Mega- (M) parsec. The candidate has given the answer to two significant figures however.

Question 19 (a)

Given that almost all properties of a star are determined either directly or indirectly from its spectrum, there was a wide range of possible answers to this question, as set out in the Mark Scheme.

Candidates who did not score three marks for this question tended to repeat an answer (eg Luminosity and Brightess) or to give an insufficiently precise property (eg how big the star is).

19 (a) State three pieces of information that astronomers can obtain by studying the spectrum of a star.

(3)

1 The chemical composition of the star.

2 Its relative movement, towards/away from us.

3 Its classification (temperature).

ResultsPlus

Examiner Comments

This is an example of a strong three mark answer, with the possible improvement of the third item with Spectral Class instead of classification.

Question 19 (b)

This question was not well answered with many candidates thinking that Spectral Class is determined (for Main Sequence stars) by using the H-R diagram to convert their absolute magnitude into a corresponding Spectral Class. Only a relatively small number of candidates mentioned analysis of the absorption lines in the spectrum for two marks.

The third mark was awarded to candidates who used the correct scientific teminology in their answer.

***(b) Explain how astronomers use the spectrum of a star to classify its spectral type.**

(3)

You can use the spectrum of a star to find it's chemical composition, which could be used to determine what evolutionary stage the star is in, which could indicate spectral type. The temperature & colour of a star can also be used to determine spectral type, with hot, white stars being spectral type O & cool, brown dwarfs being closer to M.

(Total for Question 19 = 6 marks)

ResultsPlus

Examiner Comments

This candidate scored two marks. Although they have followed the common strategy of pointing out the correlation between temperature, colour and spectral class they have referred to the star's chemical composition (from its spectrum) for one mark. They have also introduced several scientific terms in their answer in order to secure the QWC mark.

Question 20 (b) (i)

Although most candidates knew that these letters were related to the brightness of the stars in the night sky, many left out the idea of 'relative' or 'order of' from their answers, resulting in them losing the mark for the question.

(b) (i) What is the significance of the Greek letters α, β etc?

(1)

To show the brightness of different stars.

Examiner Comments

This answer establishes that the letters are related to the brightness of the stars but not that they show the **order** of brightness. (0/1)

Question 20 (b) (ii)

Answers related to the apparent path of the Sun across the sky or the plane of the planets in the Solar System were both acceptable in this question.

(ii) What is the significance of the ecliptic on a star chart?

(1)

The ecliptic shows the path of the Sun.

Examiner Comments

The words 'annual' or 'apparent' would have improved this answer which was sufficient for the award of 1/1.

Question 20 (b) (iii)

The mark for this question was awarded for correctly placing the S at the First Point of Aries (RA = 0h, Dec = 0°)m as shown in this correct example.

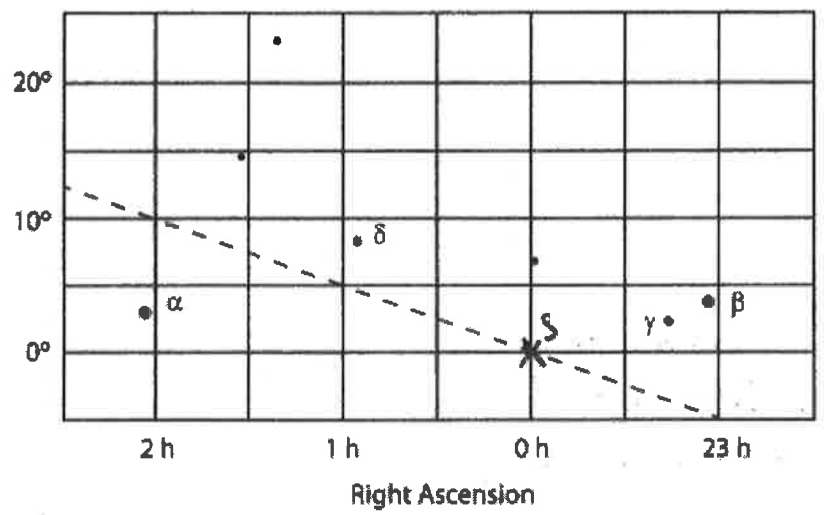


Figure 11

(a) Which quantity is represented on the vertical axis? (1)

- ☒ **A** declination
- ☒ **B** elongation
- ☒ **C** elevation
- ☒ **D** opposition

(b) (i) What is the significance of the Greek letters α, β etc? (1)

which star is brightest

(ii) What is the significance of the ecliptic on a star chart? (1)

gives us a relative idea where it is on the sky

(iii) Indicate on Figure 11 the position of the Sun on March 21st.

Use the letter **S**. (1)

Question 20 (c) (i)

This question explored candidates' ability to convert differences in longitude into time delays in celestial events. Candidates who could convert the 4° longitude difference into a 16 minute time delay gained 1/2 whilst those who could go on to correctly add this to 01:20 to get 01:36 gained 2/2.

(c) (i) An observer at longitude 3°E observes the culmination of star δ at 01:20 GMT.

At what time would an observer at longitude 1°W observe the culmination of δ? (2)

4 mins = 1°, 4° = 16 mins = time of 01:04

ResultsPlus
Examiner Comments

This candidate has calculated the correct time difference of 16 minutes but has deducted it rather than adding it to 01:20, thus gaining 1/2.

Question 20 (c) (ii)

This question tests the simple relationship between the observer's latitude and the declination of objects at their zenith. However, a number of candidates with the correct numerical answer to this question did not obtain full marks as they forgot the conventions for writing latitudes as opposed to those for writing declinations, ie North and South rather than + and -.

(ii) Estimate the latitude, to the nearest degree, from which star α could be observed at an observer's zenith.

(2)

3°

ResultsPlus

Examiner Comments

This candidate has the correct numerical answer but has only gained 1 mark out of 2 as the **N** to indicate a northern latitude is missing.

ResultsPlus

Examiner Tip

Always check all numerical answers for units or other letters or symbols which need to go after them.

Paper Summary

Paper Summary

Based on the performance of candidates on this year's examination paper, candidates are offered the following points of advice:

- candidates should pay close attention to the instruction words at the start of each question and ensure that their answers follow them, eg State, Describe, Explain, Compare
- candidates should ensure that they write in sufficient depth to obtain full marks, using the number of marks awarded for the question as a guide
- candidates should show all stages in the working of calculation questions, ensuring that it is clear to the marker why each calculation is being completed
- candidates should ensure that diagrams are drawn with a sharp pencil and a ruler (where necessary) and are fully labelled, particularly in questions where a diagram is specifically requested
- candidates should take care to ensure that all numerical answers are accompanied by any necessary units or other suffixes such as N, S, E or W.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning