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# Examiners' Report
# June 2011

## GCSE Astronomy 5AS01 01

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## Introduction

This is the first year that the new specification has been examined. The major change to the content of Unit 1 was a greater emphasis on real, observational Astronomy at the expense of more traditional, astrophysical concepts such as the structure of telescopes and detailed accounts of stellar evolution; this was particularly exemplified in items 3a, 3b, 4a, 4b, 6b, 7a, 8d, 10a-e, 13a, 15a, 15d and 16bi. There was also an increased opportunity for candidates to demonstrate their awareness of How Science Works in many items such as Q17b involving Eratosthenes' determination of the Earth's circumference and Q20a on the discovery of quasars.

Although the actual astronomical content has been made more relevant to pupils studying Astronomy, the length and style of the examination paper has not changed, and a variety of styles of questioning was employed; objective questions, tasks requiring short explanation, mathematical reasoning and more open-ended tasks were all evident. In line with the previous examination, 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.

The examiners were keen to allow candidates to demonstrate their awareness and understanding of the night sky and to being able to explain the nature of phenomena such as aurorae, fireballs and Cosmic Microwave Background radiation. Candidate responses to a number of the observational questions were less successful than the examiners had hoped and these will be addressed in this report. On the other hand, they were very pleased with responses to items that covered newly-introduced material such as the discovery of exoplanets and use of the Doppler formula with distant galaxies, and it is clear that teachers have successfully incorporated this new material into their schemes of work.

It is hoped that the hints and guidance given in this report will allow future candidates to be more prepared for questions of varying difficulty. It is the examiners' intention that the full range of topics will be covered in future examination papers so that candidates will not only be able to demonstrate their understanding of astronomical observations, discoveries and concepts, but also gain personal success in doing so.

## *Question 1 (d)*

Although the majority of candidates correctly stated Ceres as the closest dwarf planet to the Sun, a significant number incorrectly stated Pluto.

## *Question 2 (d)*

Candidates were generally aware that the Earth rotates in 23 h 56 min.

## *Question 3 (a)*

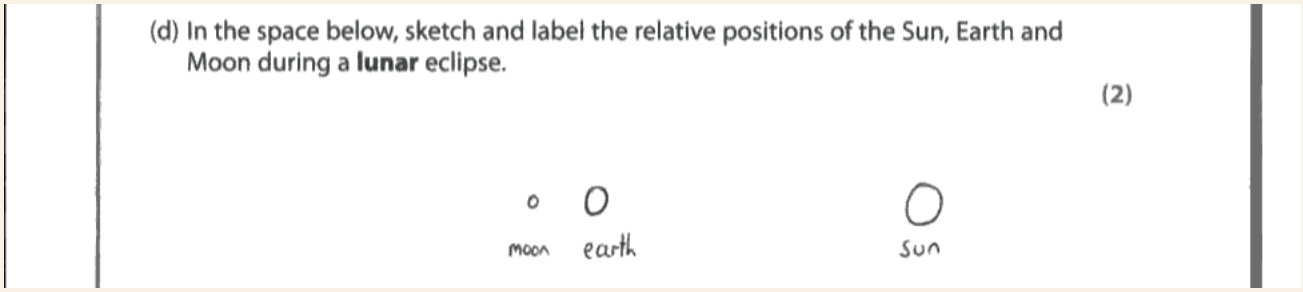
Although the sketch clearly showed the Moon in its gibbous phase, many candidates incorrectly stated the phase as 'crescent' or 'first quarter'.

## *Question 3 (c)*

The majority of candidates understood that the Moon was full during a lunar eclipse.

## *Question 3 (d)*

The majority of candidates drew the Earth, Sun and Moon in a straight line and correctly placed the Earth in the middle.




**ResultsPlus**
**Examiner Comments**
This candidate has correctly shown the Earth in between the Moon and Sun.

**ResultsPlus**
**Examiner Tip**
It is easy to confuse lunar and solar eclipses. Double-check that you have placed the Earth, Sun and Moon in the correct order.

## *Question 4 (c)*

Candidates had no difficulty labelling the Apennine mountains in between the two *maria*.

4 Figure 2 shows the near side of the Moon.

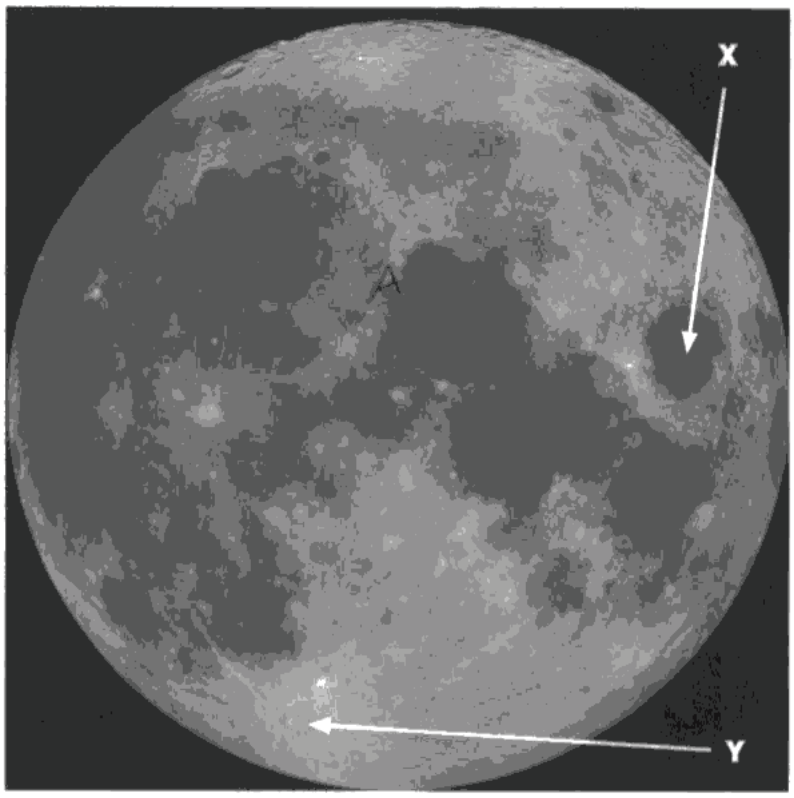



Figure 2

**ResultsPlus**
**Examiner Comments**
This candidate has placed the 'A' correctly between the Sea of Serenity and the Ocean of Storms.

**ResultsPlus**
**Examiner Tip**
The new specification lists those lunar features that you might need to label or identify. Ensure that you are familiar with them, or better still, go out and observe the Moon through binoculars.

## *Question 4 (d)*

There were some pleasing responses to this question; most candiates were able to show awareness of the Luna 3 or Apollo missions.

(d) The Moon's far side is not visible from the Earth.

How do astronomers know what the far side looks like?

(1)

A space shuttle.

**ResultsPlus**
**Examiner Comments**
This candidate does not appear to realise that the Space Shuttle operates in near-Earth orbit and has not visited the Moon.

**ResultsPlus**
**Examiner Tip**
Make sure that you are aware of the first mission to the far side of the Moon.

(d) The Moon's far side is not visible from the Earth.

How do astronomers know what the far side looks like?

(1)

Satellite images and Apollo 11

**ResultsPlus**
**Examiner Comments**
This response clearly lists Apollo 11 and scores the mark. The inclusion of 'satellite images' does not negate this mark, but without the inclusion of Apollo, would not by itself have gained credit.

## Question 4 (e)

Most candidates were able to state two ways in which the Moon's far side differs from its near side. The Quality of Written Communication was, however, disappointing.

*(e) State **two** ways in which the appearance of the Moon's far side differs from the near side.

(3)

There are Lots more craters on the moons far side, but very little more [redacted] or seas there.

**ResultsPlus**

**Examiner Comments**

This response clearly indicates the differences between the near and far side, but has failed to use a capital M for the Moon.

## Question 5 (a)

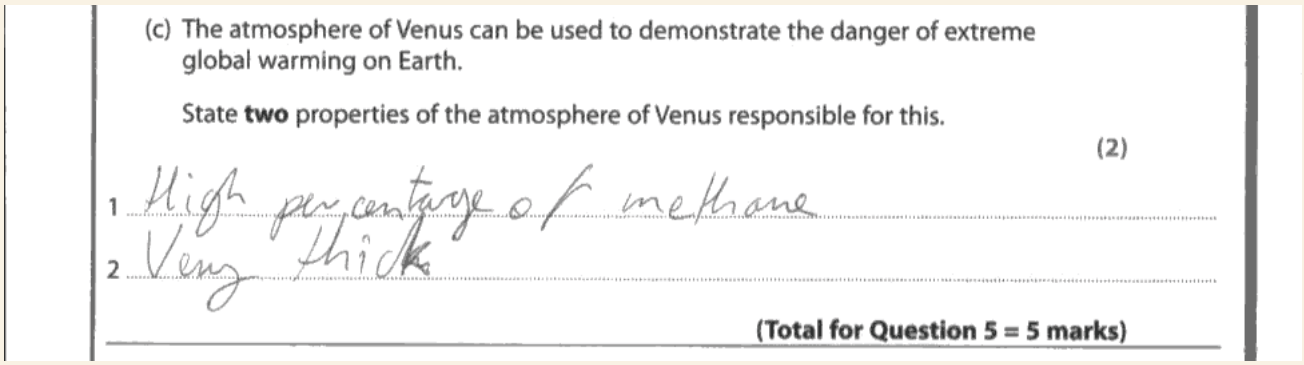
This item was answered well.

## Question 5 (b)

Although most candidates correctly stated Mars as the planet with captured asteroids as moons, there were some surprising answers, with Neptune being the most common incorrect response.

## *Question 5 (c)*

There was some degree of uncertainty concerned with greenhouse gases here. Many candidates merely listed cardon dioxide and sulfur dioxide but gained credit for the first of these only. The examiners were hoping for 'dense' as opposed to 'think' atmosphere, and the word 'temperature' by itself was insufficient for a mark.



(c) The atmosphere of Venus can be used to demonstrate the danger of extreme global warming on Earth.

State **two** properties of the atmosphere of Venus responsible for this.

**(2)**

1 High percentage of methane

2 Very thick

**(Total for Question 5 = 5 marks)**

**ResultsPlus**

**Examiner Comments**

Although this candidate's response seems convincing, the first point is actually incorrect and the 'thick' tells the examiners very little.

**ResultsPlus**

**Examiner Tip**

Try to give convincing answers and don't be vague.

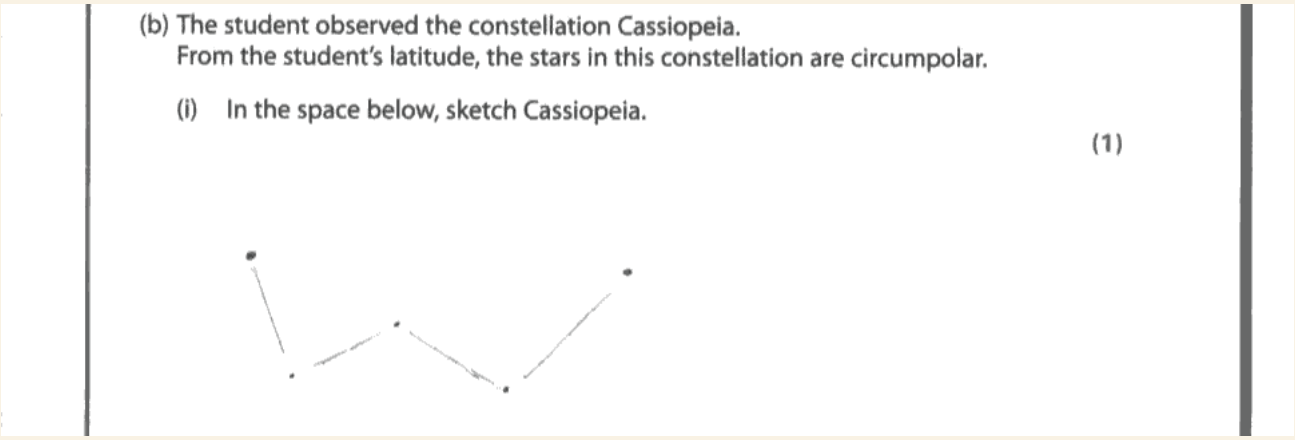
## Question6 (a) (ii)

The declination of Polaris was stated correctly by the majority of candidates.

## Question 6 (a) (iii)

This item posed a few problems. Many candidates were not aware that the angle of elevation of Polaris was equal to the observer's latitude; many subtracted 55 degrees from 90 degrees to obtain an incorrect answer of 35 degrees.

## Question 6 (b) (i)


(b) The student observed the constellation Cassiopeia.
From the student's latitude, the stars in this constellation are circumpolar.

(i) In the space below, sketch Cassiopeia.

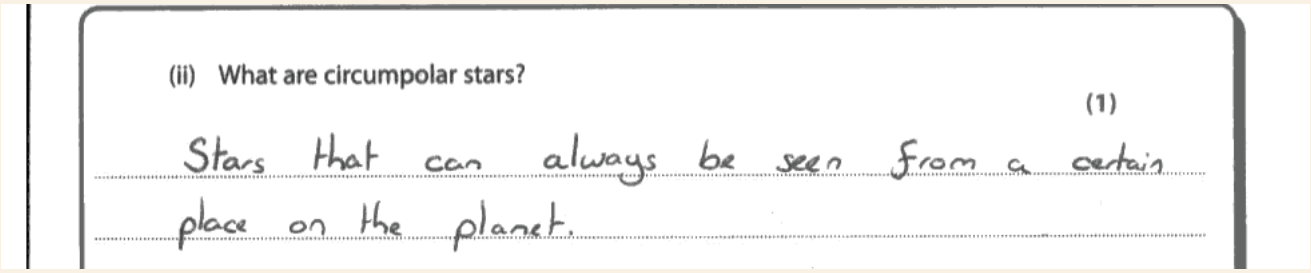
(1)

**ResultsPlus**
**Examiner Comments**
A convincing sketch of Cassiopeia, with the stars shown clearly.

**ResultsPlus**
**Examiner Tip**
The specification lists four star patterns that you ought to be able to sketch.

## *Question 6 (b) (ii)*

Common errors here included 'visible all year' and 'always visible'. The examiners were specifically looking for responses that indicated that circumpolar stars do not set below the horizon.



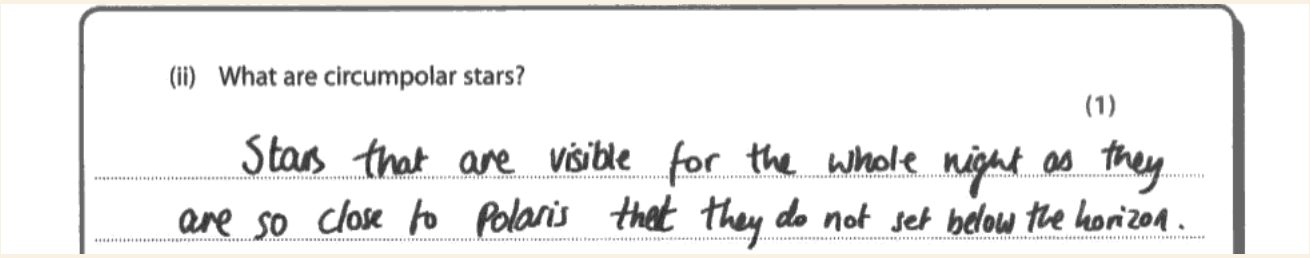
(ii) What are circumpolar stars?

(1)

Stars that can always be seen from a certain place on the planet.

**ResultsPlus**
**Examiner Comments**
This response fails to mention the horizon or rising and setting.

**ResultsPlus**
**Examiner Tip**
Think carefully about what you are going to write before answering a question. This response is 'nearly' correct but lacks clarity.



(ii) What are circumpolar stars?

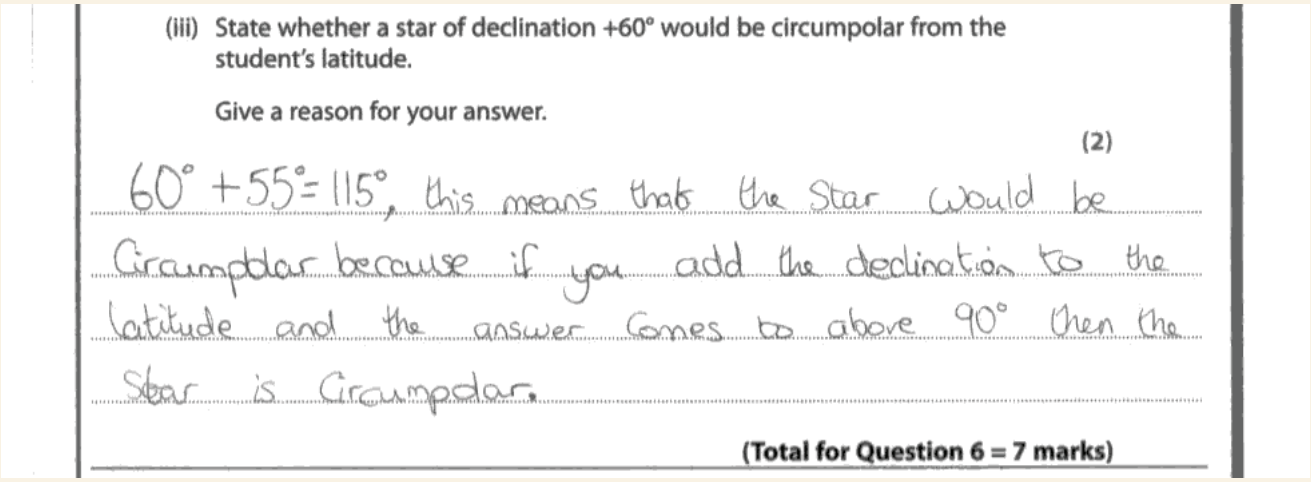
(1)

Stars that are visible for the whole night as they are so close to Polaris that they do not set below the horizon.

**ResultsPlus**
**Examiner Comments**
A peffect response!

## Question 6 (b) (iii)

This was generally answered well. Candidates either used the inequality quoted in the specification or used reasoning to show that this star would be circumpolar.



(iii) State whether a star of declination +60° would be circumpolar from the student's latitude.

Give a reason for your answer.

(2)

60° + 55° = 115°, this means that the star would be Circumpolar because if you add the declination to the latitude and the answer comes to above 90° then the star is Circumpolar.

**(Total for Question 6 = 7 marks)**

**ResultsPlus**

**Examiner Comments**

An unusual response, but one which is perfectly correct.

**ResultsPlus**

**Examiner Tip**

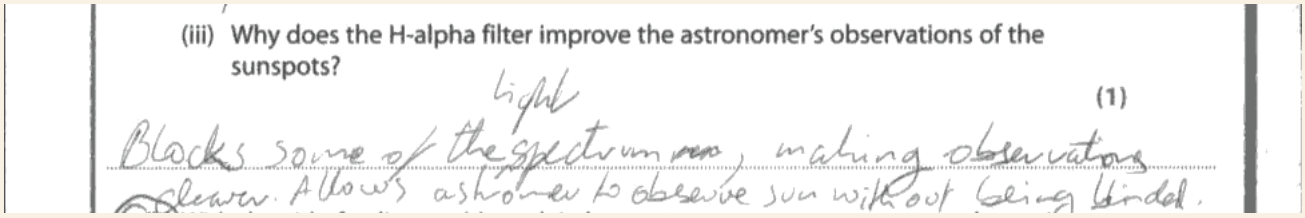
If you add the declination to the latitude and the result is greater than 90 degrees, the star will be circumpolar. Convince yourself that this is true and you will gain a better understanding of declination and latitude.

## Question 7 (a) (i)

The examiners were pleased that candidates knew that sunspots were darker than the photosphere.

## *Question 7 (a) (iii)*

Many candidtes confused the 'Why' with 'How' and described what the H-alpha filter does. The reason why is that it improves contrast.


(iii) Why does the H-alpha filter improve the astronomer's observations of the sunspots?

(1)

light

Blocks some of the spectrum, making observations clearer. Allows astronomer to observe sun without being blinded.

**ResultsPlus**

**Examiner Comments**

The response makes no reference to improved contrast. It is interesting that the candidate correctly mentions the safety issue, but this is irrelevant here.

**ResultsPlus**

**Examiner Tip**

When distinguishing between 'How' and 'Why', continue words such as 'How does it do it? and 'Why i.e. what is the reason for it'.

## *Question 7 (b)*

Many candidates confused the use of sunspots to determine the solar rotation period (at a given latitude) with the solar cycle.

(b) With the aid of a diagram(s), explain how astronomers use sunspots to determine the Sun's rotation period.

**(2)**

They measure the position of the sunspot over a short period of time to see how far it moves around the Sun. They then use this to calculate how long 1 full rotation would take.

**ResultsPlus**

**Examiner Comments**

This is a good answer with a diagram that clearly shows the movement of a sunspot over a few days.

**ResultsPlus**

**Examiner Tip**

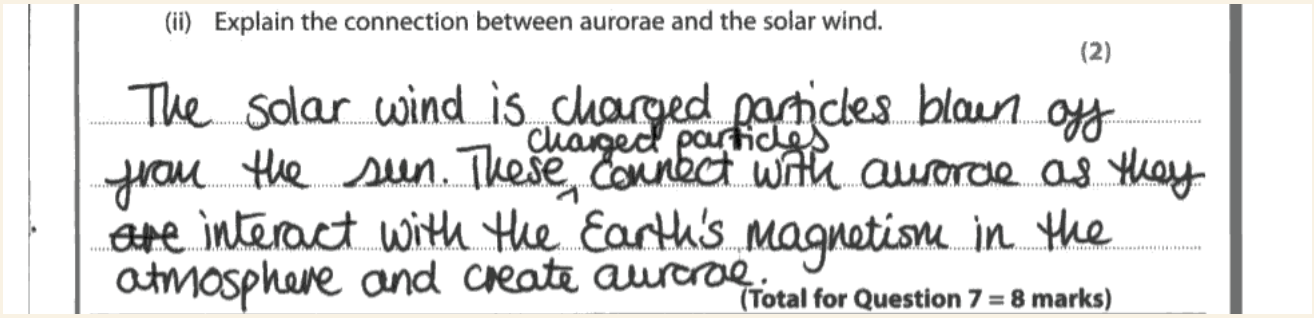
Diagrams that include labels are often more convincing than those without.

## *Question 7 (c) (i)*

There were some good descriptions of aurorae with only a few vague responses.

## *Question 7 (c) (ii)*

Convincing responses clearly indicated that charged particles in the solar wind interacted with molecules of air in the atmosphere.



(ii) Explain the connection between aurorae and the solar wind.

(2)

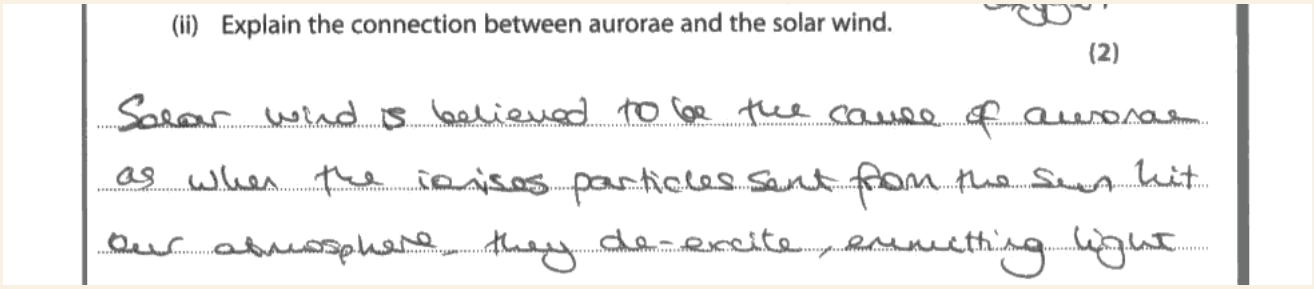
The solar wind is charged particles blown off from the sun. These charged particles connect with aurorae as they ~~are~~ interact with the Earth's magnetism in the atmosphere and create aurorae.

**(Total for Question 7 = 8 marks)**

**ResultsPlus**

**Examiner Comments**

Unfortunately this reponse fails to mention the atoms or molecules that are emitting light. The 1/2 mark is scored for the reference to the particles being charged.



(ii) Explain the connection between aurorae and the solar wind.

(2)

Solar wind is believed to be the cause of aurorae as when the ionises particles sent from the Sun hit our atmosphere, they de-excite, emmetting light

**ResultsPlus**

**Examiner Comments**

A better response that indicates the de-excitation of (implied) molecules in the atmosphere.

## Question 8 (b)

There were some convincing ellipses with P labelled correctly at one (or more) point of intersection of orbits.

(b) Figure 3 shows the Earth's orbit around the Sun.

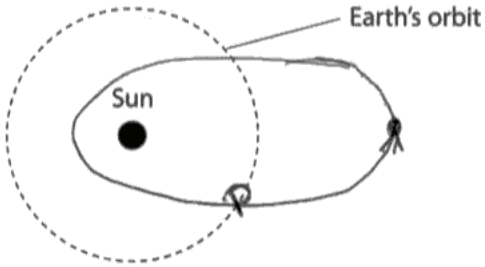



**Figure 3**

(i) On Figure 3, draw the orbit of a typical short-period comet.

(ii) On Figure 3, indicate a point at which this meteor shower could occur. Use the letter **P**.

**ResultsPlus**
**Examiner Comments**
A convincing response worthy of 3/3 marks.

**ResultsPlus**
**Examiner Tip**
Make sure that you distinguish between short-period comets with elliptical orbits and long-period ones with parabolic or hyperbolic orbits. Double-check the question once you have drawn the orbit.

## Question 8 (c) (i)

A surprising number of candidates failed to name the radiant correctly.

## *Question 8 (c) (ii)*

Even fewer candidates related the Perseid meteor shower to the constellation Perseus, Ursa Major being a common error.

## *Question 8 (d)*

The examiners were pleased that a large number of candidates knew that a fireball was a bright meteor. There appears to be confusion between these observational phenomena and actual bodies (meteoroids and meteorites).

This response appears to be guesswork!

(d) During their observations, the students also saw a fireball.

What is the difference between a fireball and a meteor?

(1)

A fireball is very hot meteor.

**ResultsPlus**

**Examiner Comments**

Confusion between meteors and meteoroids is common. Make sure that you appreciate that one is something you see and the other is a piece of rock!

(d) During their observations, the students also saw a fireball.

What is the difference between a fireball and a meteor?

(1)

The difference between a fireball and a meteor is that they both go a different speed and there's more light on a fireball than a meteor and that meteors burn into the atmosphere.

**(Total for Question 8 = 7 marks)**

**ResultsPlus**

**Examiner Comments**

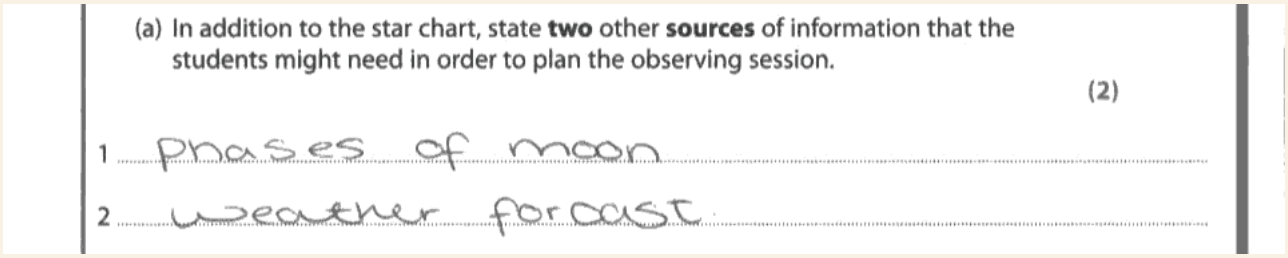
Another response that confuses meteors with meteoroids.

## Question 9 (b)

There were some good placings of globular clusters on (above) the nucleus and of the Sun about 2/3 out from the centre of our galaxy.

## Question 10 (a)

Many candidates failed to read this well enough, ignoring the word sources in bold type. There were many responses that listed 'the phase of the Moon' and 'where there is no light pollution' instead of addressing the question. 'A lunar phase chart' or 'a map to show where there is countryside' would have been credit-worthy. Since all candidates are required to plan observing sessions in Unit 2 of the examination, it was hoped that responses to this question would have built on this experience.



(a) In addition to the star chart, state **two** other **sources** of information that the students might need in order to plan the observing session.

**(2)**

1 phases of moon

2 weather forcast

**ResultsPlus**
**Examiner Comments**

By itself, 'phases of the Moon' was not regarded as a source of information.

**ResultsPlus**
**Examiner Tip**

Reading questions carefully and answering what is asked is a simple but often-overlooked skill to practise.

## *Question 10 (b)*

The use of these pointer stars is an addition to the specification and the examiners were disappointed that very few candidates drew the correct arrow.

## *Question 10 (d)*

Averted vision involves looking slightly to the side of a faint object and not 'out of the corner of the eye' - a common error.

(d) The group of students observed object **X** with **averted vision**.

What is averted vision?

(1)

When you look at something slightly to the side of the object.

**ResultsPlus**
**Examiner Comments**
This was a good, credit-worthy response.

(d) The group of students observed object **X** with **averted vision**.

What is averted vision?

(1)

Where you look out of the corner of your eye.

**ResultsPlus**
**Examiner Comments**
Sadly incorrect!

## *Question 10 (e)*

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## *Question 10 (f)*

There were many responses that refered to, or implied better resolution, but disappointingly, few candidates mentioned the ability to store or process images. The use of robotic telescopes is becoming more popular and candidates should be encouraged to make use of the facilities that are available.

(f) The students planned to observe object **X** on a future date using a robotic telescope.

State **two** reasons why the use of such a telescope might improve their observations.

**(2)**

1 you can zoom in on the object

2 see it in much more detail.

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**Examiner Comments**

'Zooming in' did not impress the examiners, but the implied higher resolution scored 1/2 marks.

## *Question 11 (a)*

The examiners were pleased that the majority of candidates were able to relate the images with different stages of stellar evolution; the modal mark was 3/3.

## *Question 11 (b)*

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## *Question 11 (c) (i)*

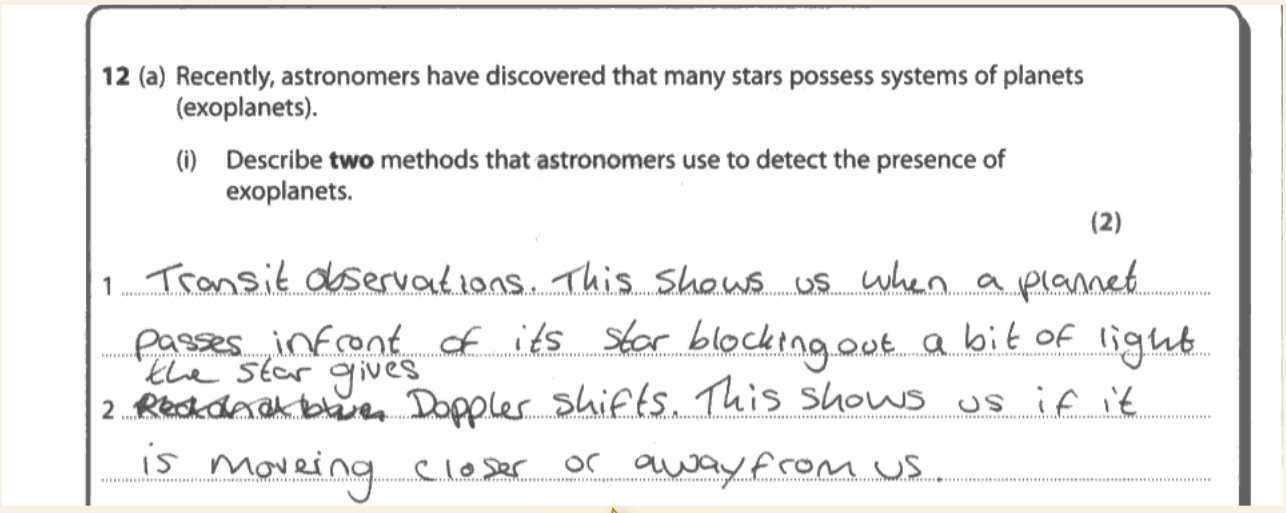
This report will provide exemplification of candidates' work, together with tips and/or comments, for aselection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## *Question 11 (c) (ii)*

Neutron stars and black holes were given credit here, and the majority of candidates scored 1/1.

## Question12 (a) (i)

The examiners were pleased that new material was answered well. Some candidates merely stated the methods and that is clearly not asked for in this question.



12 (a) Recently, astronomers have discovered that many stars possess systems of planets (exoplanets).

(i) Describe **two** methods that astronomers use to detect the presence of exoplanets.

**(2)**

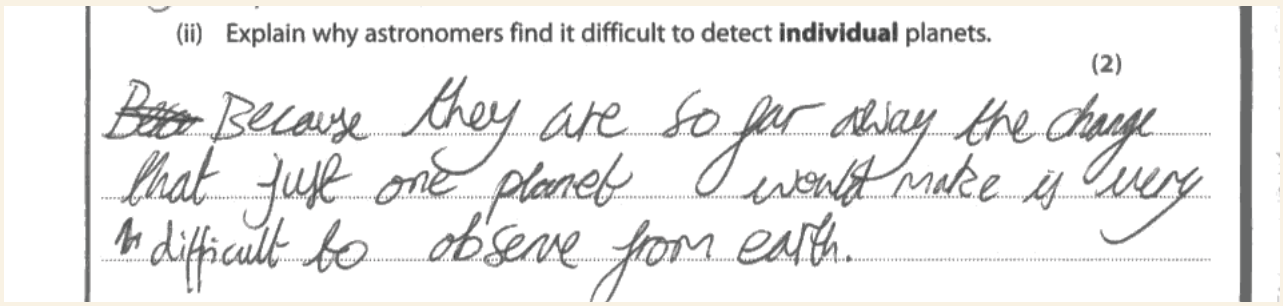
1 Transit observations. This shows us when a planet passes infront of its star blocking out a bit of light the star gives

2 ~~Redshift blue~~ Doppler shifts. This shows us if it is moveing closer or away from us.

**ResultsPlus**
**Examiner Comments**
This response included two convincing descriptions of what astronomers look for when discovering exoplanets.

## Question 12 (a) (ii)

This was a challenging question. Most candidates indiced that planets reflect little light compared with the light emiotted by the parent star. Only a few commented on the lack of precise measurements due to, for example, atmospheric turbulence.



(ii) Explain why astronomers find it difficult to detect **individual** planets.

**(2)**

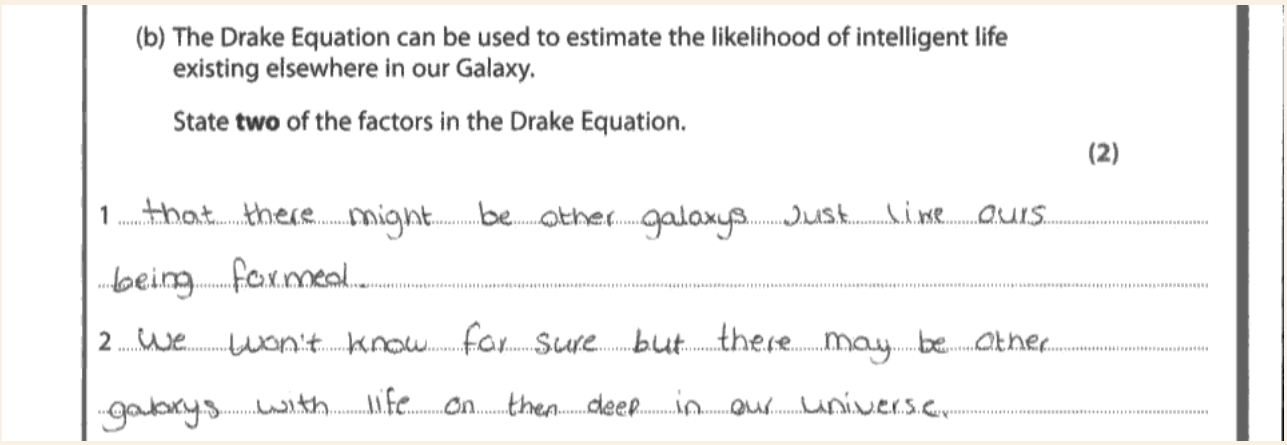
~~Beta~~ Because they are so far away the change that just one planet would make is very difficult to observe from earth.

**ResultsPlus**
**Examiner Comments**
This response was a little vague and not quite convincing enough to gain credit.

**ResultsPlus**
**Examiner Tip**
Another opportunity to think and consider a response before writing it down. What exactly does 'very difficult to observe' mean?

## *Question 12 (b)*

There were some pleasing responses, but candidates should be aware that quantities with numerical values are factors in equations; despite being on the right track, responses such as 'whether the conditions are right for life' did not gain marks.



(b) The Drake Equation can be used to estimate the likelihood of intelligent life existing elsewhere in our Galaxy.

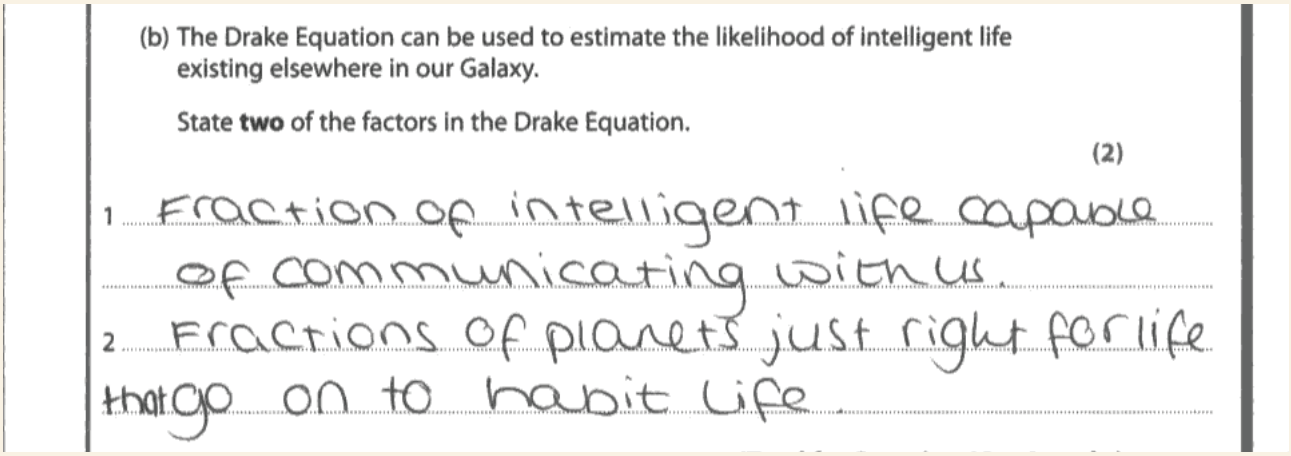
State **two** of the factors in the Drake Equation.

**(2)**

1 that there might be other galaxys just like ours being formed.

2 We won't know for sure but there may be other galaxys with life on them deep in our universe.

**ResultsPlus**
**Examiner Comments**
An example of rather vague, unconvincing statements.



(b) The Drake Equation can be used to estimate the likelihood of intelligent life existing elsewhere in our Galaxy.

State **two** of the factors in the Drake Equation.

**(2)**

1 Fraction of intelligent life capable of communicating with us.

2 Fractions of planets just right for life that go on to habit life.

**ResultsPlus**
**Examiner Comments**
These were convincing factors and the candidates scored 2/2 marks.

## Question 13 (a) (i)

This report will provide exemplification of candidates' work, together with tips and/or comments, for aselection of questions. The exemplification will come mainly from questions which required more complex responses from candidate*s*

## Question 13 (a) (ii)

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## Question 13 (b)

The examiners had hoped that candidates would mention that the Earth would be on the opposite side of the Sun in June and that Orion would be in roughtly the same area of sky as the Sun, rendering it invisible during daylight. Some candidates responded in this way, but many tried to convince the examiners that the low declination of Orion would take it below the horizon.

(b) Explain why the astronomer would not be able to observe Orion from the UK in June.

(2)

Orion is a seasonal constellations and we cannot see it in the sky in June

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**Examiner Comments**

The candidate has stated that this is a seasonal constellation and this has gained 1/2 marks (the 'opposite side of the Sun' is implied), but the (lack of) visibility during daylight hours is omitted.

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**Examiner Tip**

This response is only just worthy of 1 mark. Explanations do need much careful thought; two marks means that two points ought to be included, and this candidate has only really given one.

## Question 13 (c) (i)

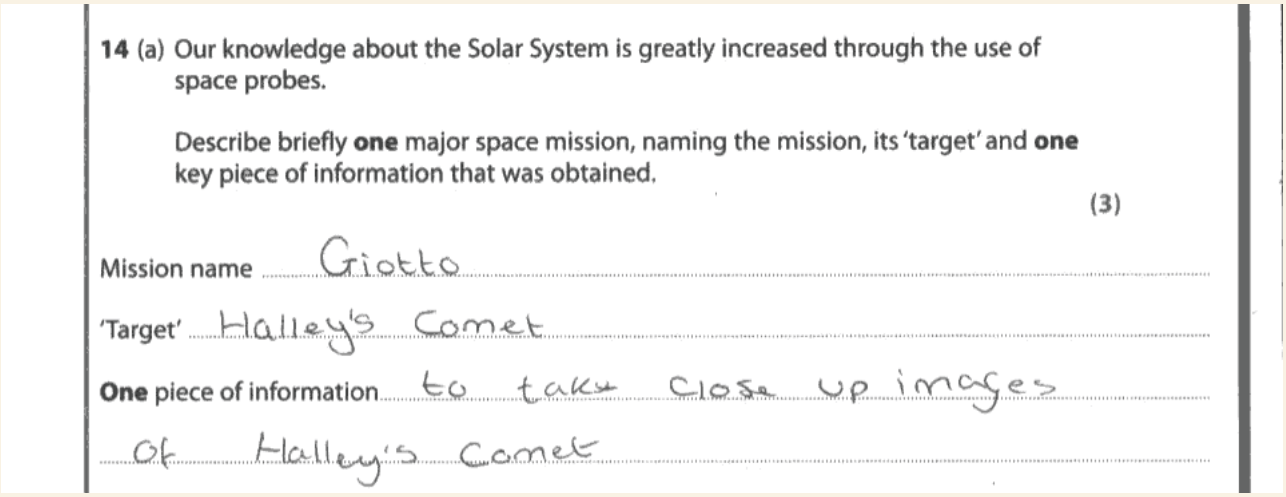
Despite the stem of this item, many candidates associated their meridian with longitude.

## Question 13 (c) (ii)

This was a difficult concept but answered well by a significant number of candidates.

## Question 14 (a)

This was a relatively open-ended question that gave candidates the opportunity to describe one space mission and its main discovery(ies). A handful of candidates did not describe a mission related to our Solar System, but most appeared to enjoy describing Apollo, Viking, Magellan etc.



**14** (a) Our knowledge about the Solar System is greatly increased through the use of space probes.

Describe briefly **one** major space mission, naming the mission, its 'target' and **one** key piece of information that was obtained.

**(3)**

Mission name Giotto

'Target' Halley's Comet

**One** piece of information to take close up images of Halley's Comet

**ResultsPlus**

**Examiner Comments**

This response fails to gain the 'information' mark since taking close-up images is hardly information. This was a pity since the candidate seems to indicate an awareness of the Giotto mission.

**ResultsPlus**

**Examiner Tip**

This style of question was a key element in the published Sample Assessment Material. You don't need to study lots of space missions, but would be expected to describe one (of your choice) in a little detail, listing key observations.

## *Question 14 (b)*

We would hope that space agencies would equip future astronauts with enough food and fuel to complete their mission. The examiners were expecting responses such as boredom, muscle fatigue or phsycological problems.

(b) Manned exploration of the Solar System has so far been restricted to our immediate neighbourhood.

State **two** problems that astronauts are likely to face during a manned expedition to a planet such as Mars.

**(2)**

1 Muscle fatigue and Brittle bones ~~due to Zero gravity exposure~~ &

2 Boredom

3 Space Adaptation Syndrome.

**(Total for Question 14 = 5 marks)**

**ResultsPlus**
**Examiner Comments**

An excellent response.

**ResultsPlus**
**Examiner Tip**

In this case, the additional (third) problem is correct and does not negate the other resonses. Take care in giving too much informationc - the examiners might think you are hedging your bets and not award full marks.

(b) Manned exploration of the Solar System has so far been restricted to our immediate neighbourhood.

State **two** problems that astronauts are likely to face during a manned expedition to a planet such as Mars.

**(2)**

1 It would take a lot of fuel to get there which is expensive

2 It would take too long to get there and back

**ResultsPlus**
**Examiner Comments**

The question is really asking 'What is the problem with the journey taking so long?' This response does not really address the human issues involved in spaceflight.

## *Question 15 (a-b)*

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## *Question 15 (c)*

Some pleasing responses showing competent analysis of shadow stick data.

## *Question 15 (d)*

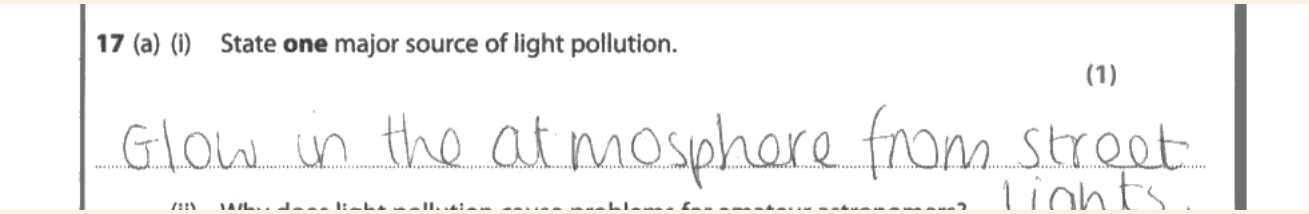
Again, some pleasing responses, but many candidates were a little careless and did not realise that Jojo was only 2 degrees of longitude from Martha.

## *Question 16 (a)*

A more 'traditional' question. All parts were generally well-answered and many candidates scored 6/6.

## *Question 17 (a) (i)*

Although there were some fine examples of sources of light pollution (the Moon, street lights, car headlights etc.), many candidates failed to score by responses such as 'cities' and 'lamp posts'.


17 (a) (i) State **one** major source of light pollution.

(1)

Glow in the atmosphere from street lights

**ResultsPlus**
**Examiner Comments**
An example of a good response.

## *Question 17 (a) (ii)*

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## *Question 17 (b)*

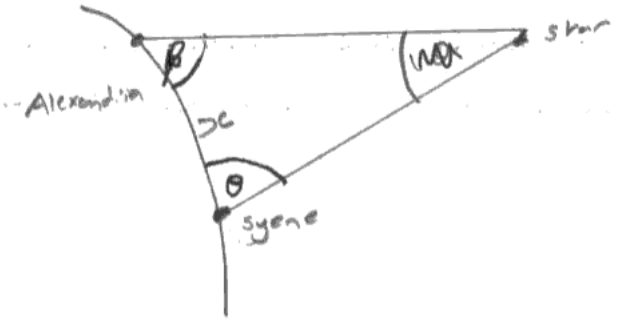
This was another open-ended HSW question that realised a range of marks. generally, most candidates had an awareness of Eratosthenes' method, but their explanations lacked a little clarity and diagrams were often unclear and poorly labelled.

*(b) The Greek mathematician Eratosthenes was the first person to determine the circumference of the Earth.

Describe the observations and the method used by Eratosthenes to determine the Earth's circumference.

You may draw a diagram.

(5)




Observations the circumference of earth

Method travelled to Syene found angle then also travelled to Alexandria measured angle again found out circumference of Earth

**ResultsPlus**

**Examiner Comments**

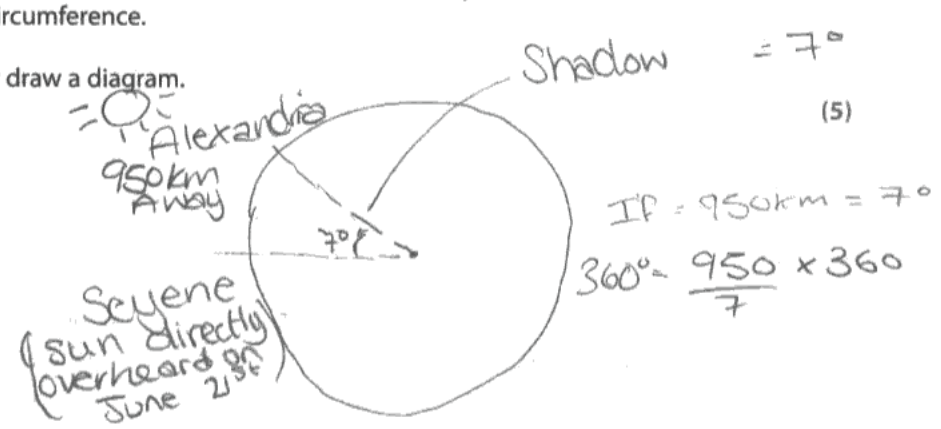
The diagram gets the response off to a fine start, but then tends to peter out. TAklthough the names of the two cities are given, there is no mention of shadows or what was done with the data. 2/5 marks.

*(b) The Greek mathematician Eratosthenes was the first person to determine the circumference of the Earth.

Describe the observations and the method used by Eratosthenes to determine the Earth's circumference.

You may draw a diagram.

(5)




Observations Eratosthenes knew that the sun was directly overhead on June 21st in Seyene and in Alexandria 950km the shadow would be at an 7° angle.

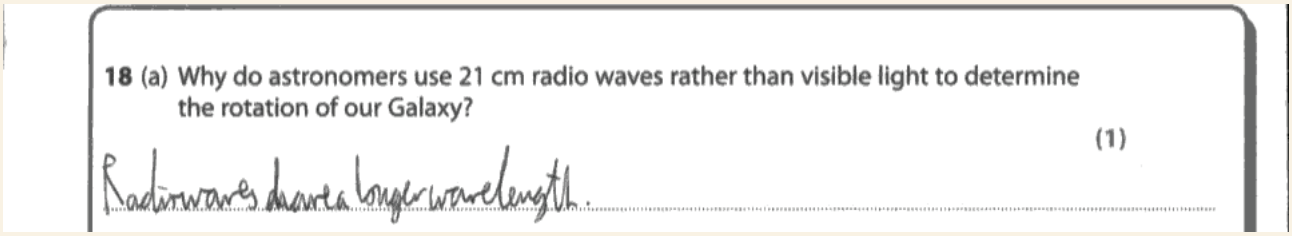
Method Using this he divided 950 by 7 and multiplied the answer by 360° to find the circumference of the Earth.

**ResultsPlus**
**Examiner Comments**

A much better response that just misses out on 5/5 due to the relatively poor explanation of how Eratosthenes used his data to determine the circumference.

## Question 18 (a)

There were some disappointing responses indicating that many candidates did not realise that radio waves penetrate dust (in the spiral arms of our galaxy)and visible light does not.



18 (a) Why do astronomers use 21 cm radio waves rather than visible light to determine the rotation of our Galaxy?

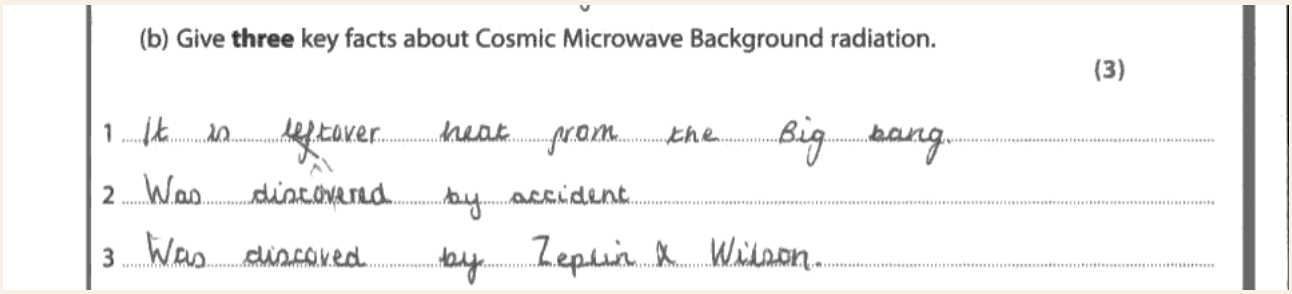
(1)

Radiowaves have a longer wavelength.

**ResultsPlus**
**Examiner Comments**
True, but not the correct answer.

## Question 18 (b)

This question discriminated well and there was a range of marks scored. vague answers to be avoided included 'It is everywhere' and 'You can pick it up on your TV'. Hardly convincing!



(b) Give **three** key facts about Cosmic Microwave Background radiation.

(3)

1 It is leftover heat from the Big bang.

2 Was discovered by accident

3 Was discoved by Zepzin & Wilson.

**ResultsPlus**
**Examiner Comments**
Only the first point is credit-worthy. A little more detail about the actual discovery (point 2) would have gained 2/3.

**ResultsPlus**
**Examiner Tip**
In this type of question, it is important that you do not overlap answers; ensure that your 3 responses are different from each other.

## *Question 18 (c)*

This concept was another addition to the specification. The majority of candidates incorrectly explained how Hubble's Law could be used to determine age, and very few indicated that once distance units are manipulated, Hubble's constant has the unit of 'per second'.

(c) Describe how astronomers use the value of the Hubble Constant to determine the age of the Universe.

(2)

if you look at the hubble Constant you can see how galaxies are formed. The stage that galaxies are at will show the age of the universe.

**ResultsPlus**
**Examiner Comments**
This example typifies those responses that were Hubble-related but complete guesses.

(c) Describe how astronomers use the value of the Hubble Constant to determine the age of the Universe.

(2)

The hubbles constant determines the rate at which the universe is expanding, they work that out, and then worked backwards to when there would be nothing and find how many years that would take.

**ResultsPlus**
**Examiner Comments**
This appears to be a more convincing response but again fails to address how age can be calculated from Hubble's constant.

## Question 19 (a) (i)

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates

## Question 19 (b)

Most candidates chose the Small Magellanic Cloud and Triangulum galaxy and scored 2/2. A few candidates merely repeated those in the images and failed to score.

## Question 19 (c)

Relatively few candidates scored 2/2 ojn this difficult topic. Many associated the word 'active' with star formation and other similar concepts.

(c) Some galaxies are described as 'active'.

Give **two** key facts about active galaxies.

(2)

1 have a black hole that lies in the centre.

2 has planets that orbit and stars that orbit around in the centre

**(Total for Question 19 = 6 marks)**

**ResultsPlus**

**Examiner Comments**

The first point regarding the black hole (or in other cases an AGN) is a good example of a correct response. Sadly, the second point is incorrect.

**ResultsPlus**

**Examiner Tip**

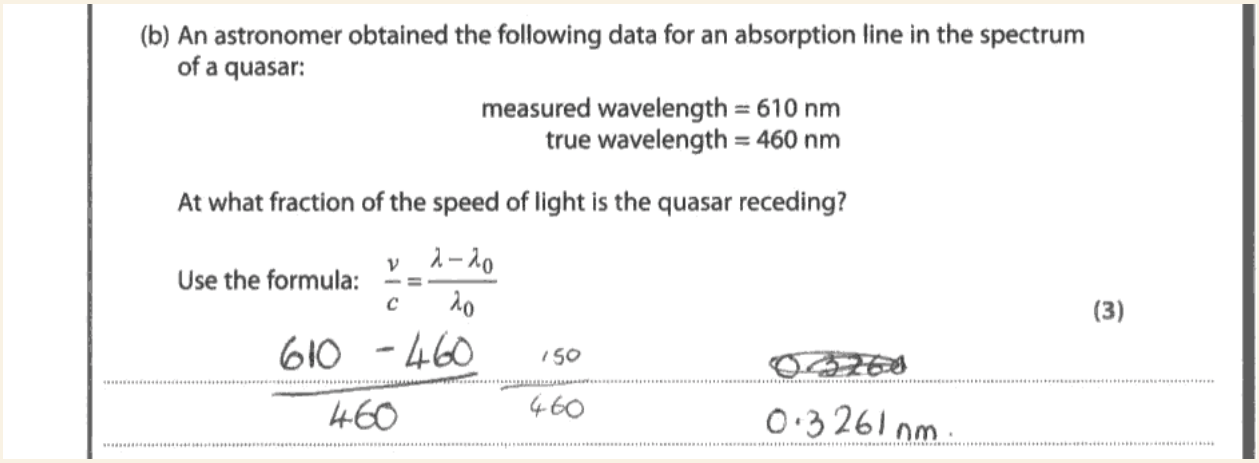
Again, make your answers different and don't overlap. Many candidates' answers included 'has an AGN at the centre' and 'has a black hole at the centre' and these were though too similar in nature. X-ray and radio emission, jets and similar structural features could have been included.

## Question 20 (a)

Although most candidates mentioned powerful sources of radio waves, few actually described their subsequent association with bright compact optical sources.

## Question 20 (b)

This calculation involving the Doppler formula was generally well-answered and many candidates scored full marks. It was unfortunate that a handful did not realise that their value of 0.32 was the fraction of the speed of light (asked for in the questions) and many went on to calculate the actual recession velocity of the quasar and scored only 2/3.



(b) An astronomer obtained the following data for an absorption line in the spectrum of a quasar:

measured wavelength = 610 nm
true wavelength = 460 nm

At what fraction of the speed of light is the quasar receding?

Use the formula: $\frac{v}{c} = \frac{\lambda - \lambda_0}{\lambda_0}$ (3)

610 − 460 = 150

150 / 460

0·3261 nm.

**ResultsPlus**
**Examiner Comments**

This candidate does not appear to realise that the numerical answer is what is required and that the unit is incorrect.

## *Summary*

Comments on individual questions have revealed a number of pointers to indicate how candidates can improve their performance:

Candidates should read all questions carefully in order to ensure that they understand fully what is being asked. It is important to distinguish between 'How' and 'Why';

In questions asking candidates to list, for example three key facts about quasars, it is important to avoid repetition i.e. give three, distinct, important facts;

Descriptions of, for example aurorae, should focus on what is actually being observed; candidates should avoid vague responses such as 'lights in the sky' and ask themselves 'Does my response actually describe what the questions asks for or could it describe something else?'

In calculations, candidates should show all working and make the final answer clear; they should pay particular attention to the unit (or lack of) and give a sensible number of significant figures;

It would be beneficial to actually carry out some of the observational tasks referred to in the specification such as observing the Moon and naming its key features, carrying out a simple shadow stick experiment to determine longitude, and using the celestial co-ordinates of stars to predict the time at which a particular star will cross the meridian. Having first-hand experience of observing and recording the night sky would not only boost confidence before the examination, but also enhance candidates' responses;

Although this is a 2-hour written paper, not all the time should be spent writing; it is important that candidates pause to consider their answer before putting pen to paper, and the examiners believe that this would lead to less vague responses that could be misinterpreted.

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