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Examiners' Report
March 2012

GCSE Physics 5PH1H 01

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March 2012

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Introduction

This is the second exam of the first unit of the new specification. The unit is divided into six topics and all six topics are tested in the exam.

It is intended that the exam paper will allow every student to show what they know, understand and are able to do. To achieve this, each question increases in difficulty as the question progresses. This allows students of all abilities within the higher tier to have access to all the questions. Within the questions, a variety of question types are included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three, four or five marks each. The two six mark questions are used to test quality of written communication.

Successful candidates were

- well grounded in the fundamental knowledge required
- willing to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations
- able to tackle calculations methodically and show the stages in their working
- able to construct their explanations in a logical order, using the marks at the side of the questions as a guide.

Less successful candidates

- had gaps in their knowledge
- found difficulty in applying their knowledge to new situations
- did not do well in calculations involving changing the subject of an equation and did not show the stages in their working.

The quality of written communication was generally appropriate to the level of response.

Question 1 (b)

Most candidates were able to calculate the power from the values provided and give the correct unit.

Question 1 (c) (i)

Candidates were able to use conservation of energy to correctly find the amount of wasted energy represented in the diagram.

Question 1 (c) (ii)

Full marks are obtained for the correct calculation of efficiency. However, as in most calculation questions, partial credit can be given if the candidate shows correct working of the values but then makes an error in the final evaluation.

Question 1 (d)

Although many candidates realised that a black surface would radiate the wasted thermal energy away from the motor, a large number seemed to think that it was important to absorb the heat into the motor.

Question 2 (b) (i)

It was pleasing to see that a large majority were able to gain the mark by stating that there was decrease in speed at the core-mantle boundary. Credit was also given to candidates who realised that this would cause a change in direction or identified the effect as refraction without explicitly mentioning a decrease in speed.

(i) State what happens to a P-wave when it crosses from the mantle into the core.

(1)

The Pwave slows down and changes direction because of refraction

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Examiner Comments

This is an excellent answer. Any one of the three statements here on their own would have gained the mark.

Question 2 (b) (ii)

A large number of candidates correctly identified an increase in velocity between the two depths for one mark. About half of those gained the second mark by describing **how** it increased; either by describing a linear change or by reading values from the graph.

(ii) Describe how the speed of a P-wave changes between a depth of 1000 km and 2500 km.

(2)

it accelerates from about 11.5Km/s to about 13.5 Km/s

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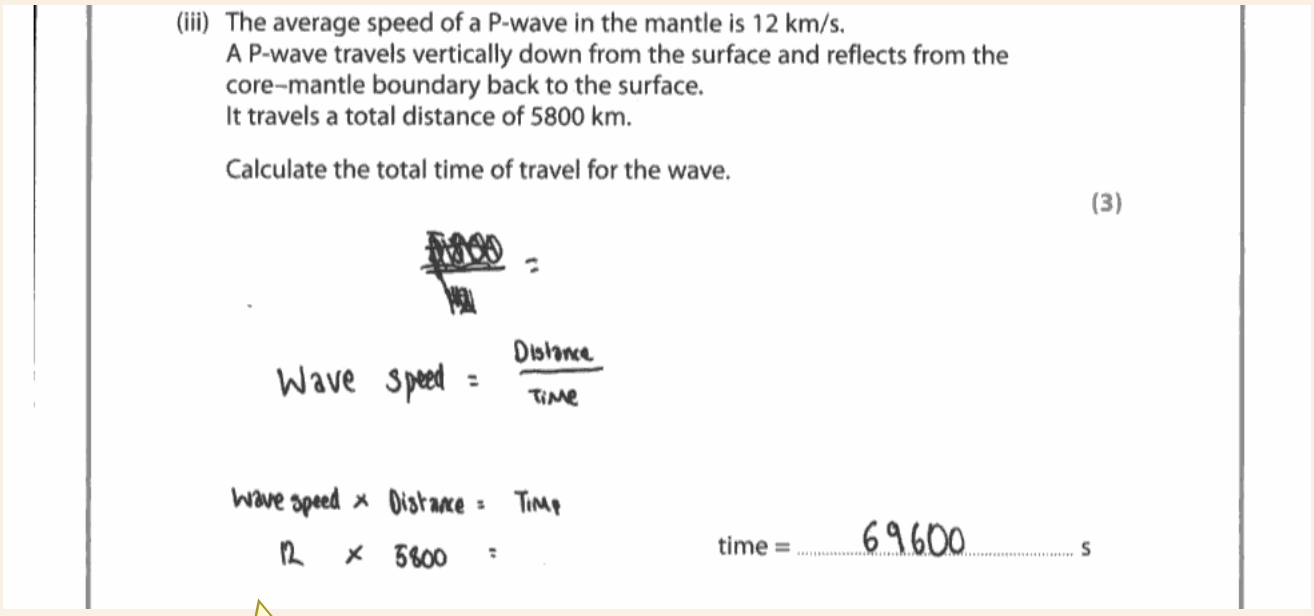
Examiner Comments

A short, but accurate answer which gains two marks.

Question 2 (b) (iii)

Here candidates had to substitute the given values into the correct equation and then transpose the expression before evaluating it. A mark is awarded for each of the three steps and the transposition and substitution marks could be gained in either order. A large number of candidates scored all three marks, but very many more could have gained at least one mark if they had shown the steps in their working.



(iii) The average speed of a P-wave in the mantle is 12 km/s.
A P-wave travels vertically down from the surface and reflects from the core–mantle boundary back to the surface.
It travels a total distance of 5800 km.

Calculate the total time of travel for the wave.

(3)

Wave speed = Distance / Time

Wave speed × Distance = Time

12 × 5800 =

time = 69600 s

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Examiner Comments

This scores one mark. The candidate did not transpose the equation correctly but did clearly show substitution of the correct values for both quantities.

There is no mark for evaluation of an incorrect expression.

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Examiner Tip

Always show your working. You can get marks even if your final answer is wrong.

5800 km ÷ 12 km/s = 233.3 s

wavespeed = distance / time

distance ÷ wavespeed = time

time = 233.3 s

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Examiner Comments

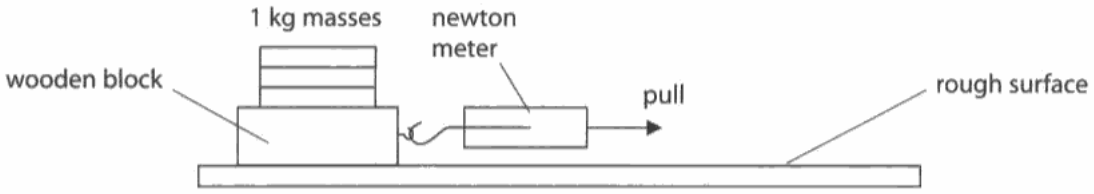
The candidate has correctly re-arranged the equation and shown substitution of the correct values for the two quantities. Even though the evaluation was incorrect, it scores two out of three marks.

Question 2 (c)

Although many candidates knew that earthquakes were unpredictable, very many thought that this experiment is a model of the different strengths of earthquakes rather than the difficulty of predicting when they would occur.

(c) A class investigates the force needed to start a wooden block moving on a rough surface.

They use the apparatus shown.



Each student repeats the experiment five times.

A set of results for one student is shown in the table.

attempt	force needed to start block moving / N
1	30
2	57
3	26
4	48
5	39

All the students in the class get a similar wide range of results.

Explain what the results show about predicting earthquakes.

(2)

The results show that it is hard to predict earthquakes because the 5 results that were used were all very different and had a 31 difference between the highest and lowest.

(Total for Question 2 = 9 marks)

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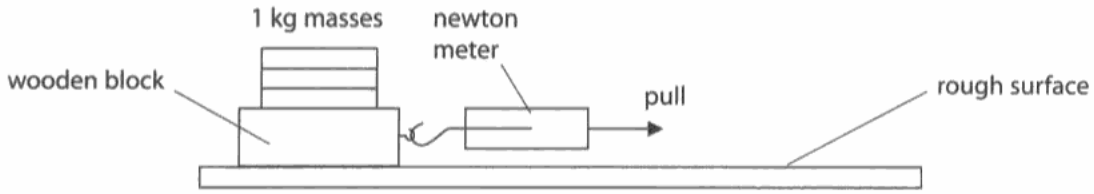
Examiner Comments

This scores both marks. It explains the significance of the results.

(c) A class investigates the force needed to start a wooden block moving on a rough surface.

They use the apparatus shown.



Each student repeats the experiment five times.

A set of results for one student is shown in the table.

attempt	force needed to start block moving / N
1	30
2	57
3	26
4	48
5	39

All the students in the class get a similar wide range of results.

Explain what the results show about predicting earthquakes.

(2)

They are unpredictable and can happen at any time. It is unlikely that you can predict them, but a time frame may be worked out.

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Examiner Comments

This response gains one mark for writing that earthquakes are unpredictable but did not explain how the results showed this.

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Examiner Tip

Underline key words in the question. Explain.. results show ... predicting earthquakes.

Question 3 (b) (i)

Marks could be obtained by describing DC and AC in terms of the direction of the current. Reference to charge was not necessary. Marks could also be obtained by accurate description of oscilloscope traces such as AC swinging between positive and negative. Although very many candidates had clearly seen these traces, fewer were clear about their significance and simply wrote about AC changing.

(b) A solar panel generates direct current.

(i) Describe the difference between direct current and alternating current.

(2)

direct current stays the same alternating current is when the current changes all the time.

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Examiner Comments

In this response it is not clear what is "changing". A current can change in size without changing direction.

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Examiner Tip

Make sure that the examiner can see exactly what you mean.

(b) A solar panel generates direct current.

(i) Describe the difference between direct current and alternating current.

(2)

Direct current never changes it's direction stays the same all the time whereas alternating current changes direction and alternates

ResultsPlus
Examiner Comments

A much better answer.

Question 3 (b) (ii)

Few candidates seemed to realise that transformers work with an alternating current and cannot increase a DC voltage such as that produced by a solar panel.

Question 3 (c)

Most candidates were able to fully engage with this question and could write clearly about the environmental advantages of domestic solar power generation. Most responses centered around the reduction in need for fossil fuel energy sources and the reduction in pollution which could follow. Credit was also given for identifying solar energy as being renewable.

Question 3 (d)

Here candidates had to first calculate the annual income from the solar panel for two marks. Most candidates who completed this step were then able to gain the third mark by correctly dividing the total cost by the annual income to find the payback time. A large number of candidates seemed well practised in this and could tackle the question with confidence, moving smoothly through the steps to their answer.

Question 4 (a) (i)

The vast majority of candidates recognised this diagram as an illustration of wave refraction.

Question 4 (a) (iii)

Most candidates correctly described a change in direction of the wavefronts. There were many good answers which explained this in terms of decrease in speed. Some described how the different arrival times at the shallow water along the wavefront would cause a change in direction without specifically mentioning a decrease in speed. Credit was given for this.

There were a significant number of incorrect responses which either attempted to explain the refraction in terms of different densities of water or a change in frequency.

(iii) Explain another change which can be seen from the diagram when the waves go from deep water to shallow water.

(2)

They change direction, this is because ~~the~~ the part of the wave that hits the shallow water first slows down first, causing the waves to change direction.

ResultsPlus
Examiner Comments

A well written explanation.

(iii) Explain another change which can be seen from the diagram when the waves go from deep water to shallow water.

(2)

The change in direction can be seen from the diagram, as well as the wavelength decreasing in size.

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Examiner Comments

This response scored one mark for identifying a change in direction.

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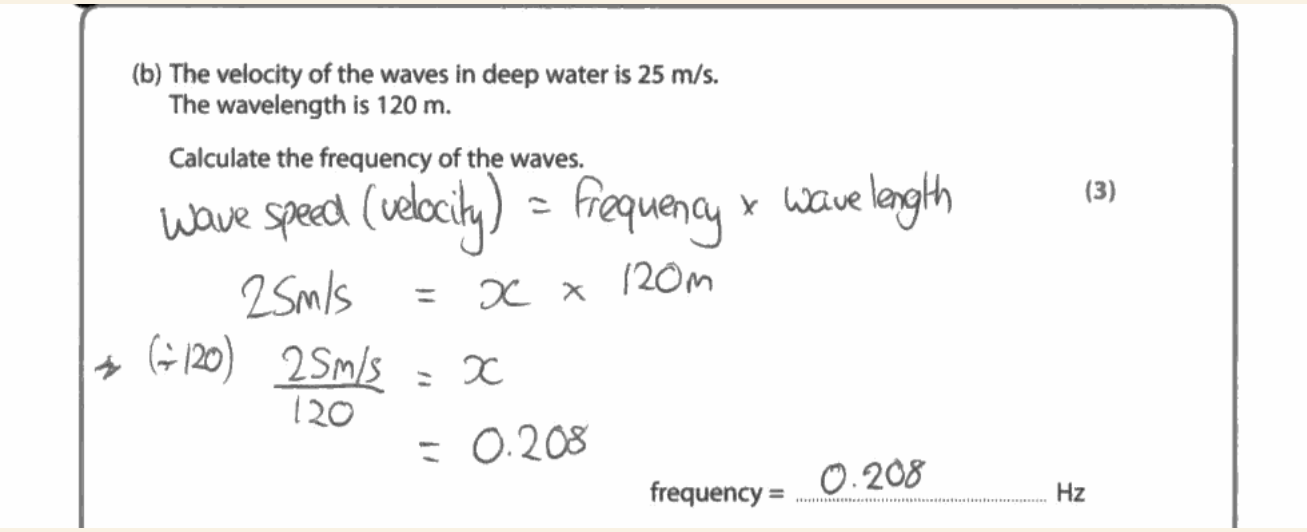
Examiner Tip

If a question asks you to explain something then you need to give a reason **why** in your answer.

Question 4 (b)

Once again, candidates had to first substitute the correct values into an expression and then transpose before evaluating. The most common error was in the rearrangement of the expression. As before, marks could be obtained by showing correct working. It was a shame that so few candidates were able to score those marks, however.



(b) The velocity of the waves in deep water is 25 m/s.
The wavelength is 120 m.

Calculate the frequency of the waves. (3)

wave speed (velocity) = frequency × wave length

25 m/s = x × 120 m

(÷120) $\frac{25 \text{ m/s}}{120} = x$

$= 0.208$

frequency = 0.208 Hz

ResultsPlus
Examiner Comments

A well laid out answer scoring all three marks.

Question 4 (c)

The specification requires candidates to be able to differentiate between longitudinal and transverse waves by referring to sound and electromagnetic waves such as light. Examiners were looking for evidence of this differentiation in terms of the direction of oscillations with respect to direction of travel (or energy propagation). It was acceptable for candidates to express this in terms of side-to-side and backwards-and-forwards vibrations. Although many candidates were able to do so, a large number lost marks by writing about waves travelling from side to side as they move along. A third mark was for simply stating that sound travels as longitudinal waves or light is a transverse wave. It was rare to find three marks scored in this question.

Question 5 (a) (ii)

Marks could be scored by recognising that this would not be an effective precaution because of the high penetrating ability of X-rays.

Question 5 (a) (iii)

Almost all candidates could state one effect of large doses of x-rays

Question 5 (a) (iv)

This was answered well by most candidates. It was commonly appreciated that people who did not have full knowledge of risks were willing to use technology if it gave a benefit.

(iv) The device was advertised as 'harmless'.

Suggest why people used this device for many years.

(2)

It worked very well and the illness didn't come straight away.

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Examiner Comments

A short answer which scores two marks.

Question 5 (b)

To gain full marks candidates would have to reach a conclusion based on a comparison of risks or dangers of the two types of devices based on their knowledge of the properties of the types of radiation involved. Credit was also given for responses which considered possible incorrect use of the infrared laser device when taken out of a controlled environment. It was pleasing to see so many candidates being engaged by this question and displaying good understanding of these two regions of the electromagnetic spectrum. The overwhelming recommendation was one of caution in releasing the infrared laser device for public use, but full credit was given for a different, well supported conclusion.

*(b) There is a hair removal device which is currently available in some specialist clinics. It uses a low energy infrared laser beam. The makers say that this is much less dangerous than the X-ray device.

By considering the dangers associated with both devices, discuss whether the infrared laser device should be put on general sale to the public.

(6)

An advantage of a hair removal device that uses infrared rather than x-rays, is that infrared has a lower frequency, so it has less energy, which makes it less harmful. However this might make it less effective in removing hair. Exposure to x-rays for a long period of time is dangerous because it can damage the cells in the body. Although infrared is less harmful, if people can freely buy the treatment they may use it too much and Infrared can cause burns. In the long term infrared could seriously damage peoples skin and health, so even though it is less dangerous than x-rays. I don't think it should go on sale to the public.

(Total for Question 5 = 12 marks)

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Examiner Comments

A good level 3 answer (scoring full marks) which links facts about the two devices to reach a justified conclusion.

Communication skills are appropriate for this level.

Scores full marks.

*(b) There is a hair removal device which is currently available in some specialist clinics. It uses a low energy infrared laser beam. The makers say that this is much less dangerous than the X-ray device.

By considering the dangers associated with both devices, discuss whether the infrared laser device should be put on general sale to the public.

(6)

I don't think that the new device should be put on general sale because even though it uses infrared instead of x-rays, there are still dangers accosiated with using infrared. It can damage skin cells and interfer with the cells. It is much safer if people dont use radiation devices on their bodies. The only reason that the device removes hair permenantly is because it is damaging the cell so badly that it is unable to grow hair.

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Examiner Comments

This is a level 1 answer. It gives a fact about infrared radiation being able to damage skin and reaches a conclusion but there is no consideration of X-rays.

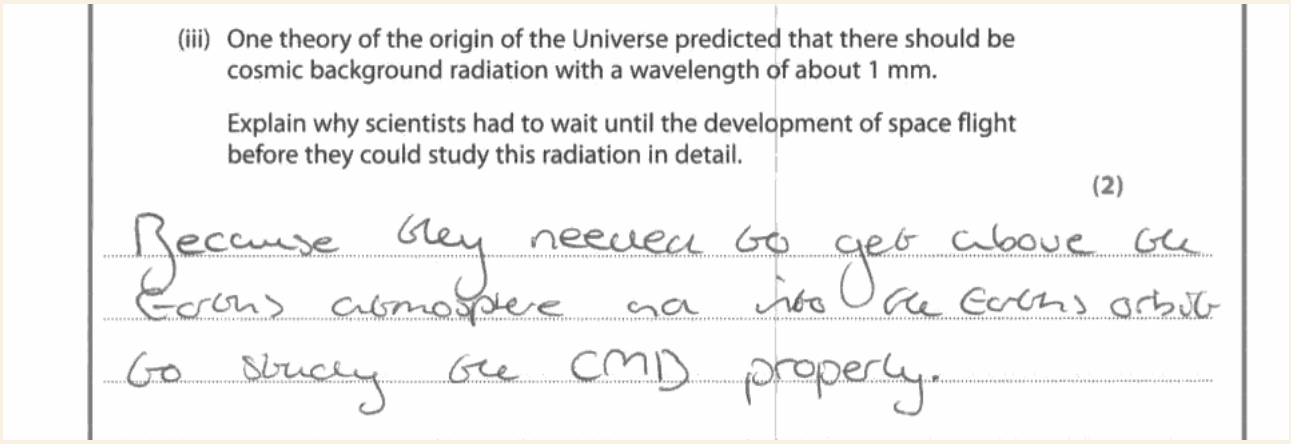
Once again, communication skills are suitable for the level.

Question 6 (a) (ii)

Over half of the candidates either used the data in the diagram or drew on their knowledge to state that radio waves are not sufficiently affected by the Earth's atmosphere to require radio telescopes to be placed on a mountain.

Question 6 (a) (iii)

A good number of candidates used the diagram to identify 1 mm waves as microwaves which would be absorbed by the Earth's atmosphere and so gained two marks. One mark was available for writing that space flight enabled telescopes to be put above the Earth's atmosphere. Many more candidates scored this mark only.



(iii) One theory of the origin of the Universe predicted that there should be cosmic background radiation with a wavelength of about 1 mm.

Explain why scientists had to wait until the development of space flight before they could study this radiation in detail.

(2)

Because they needed to get above the Earths atmosphere and into the Earths orbit to study the CMB properly.

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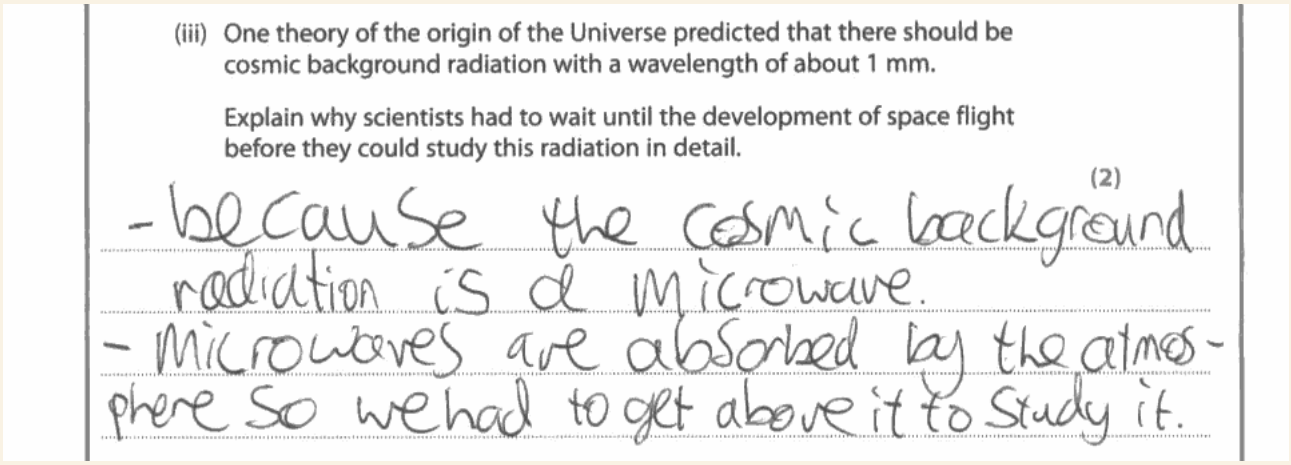
Examiner Comments

One mark for "get above the Earth's atmosphere".



(iii) One theory of the origin of the Universe predicted that there should be cosmic background radiation with a wavelength of about 1 mm.

Explain why scientists had to wait until the development of space flight before they could study this radiation in detail.

(2)

- because the cosmic background radiation is a microwave.
- Microwaves are absorbed by the atmosphere so we had to get above it to study it.

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One mark for identifying CMBR as microwaves and the second mark for recognising that these are absorbed by the atmosphere.

Indeed, both marks could also have been scored by the second sentence alone.

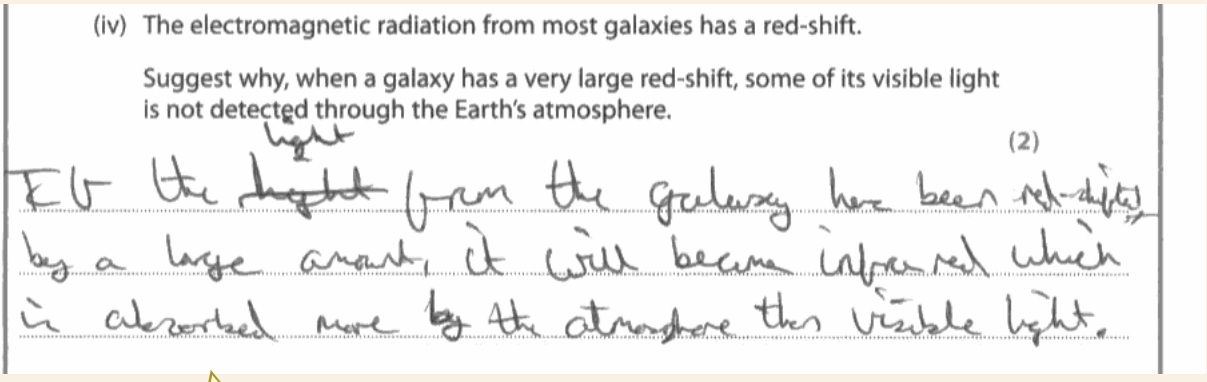
Question 6 (a) (iv)

This question was an opportunity for the more able candidates to demonstrate their understanding of red-shift as well as the continuous nature of the electromagnetic spectrum. A reasonable number of candidates were able to do so.

(iv) The electromagnetic radiation from most galaxies has a red-shift.

Suggest why, when a galaxy has a very large red-shift, some of its visible light is not detected through the Earth's atmosphere.

(2)



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A clearly expressed response which scores both marks.

Question 6 (b)

Full marks could be obtained by a clear description of the observation of red-shift of light from galaxies together with either an appreciation of its significance in terms of an expanding universe or some detail about the process. This should lead to a brief description about how this supported the Big Bang theory. This should then be coupled with an understanding of the significance of another observation; cosmic microwave background radiation.

Candidates were not asked to describe the Big Bang or Steady State theories in detail and many candidates devoted a large part of their answer in doing so. Some candidates used much of the available response area by effectively writing out the question again.

Some common inaccuracies were to write about planets expanding or moving away and galaxies being "red-shifted" (rather than the light from those galaxies). Nevertheless, candidates have clearly found this topic interesting and many displayed a very detailed understanding.

*(b) Scientists believe that the Universe is expanding.

Describe how careful observation of electromagnetic radiation from distant galaxies as well as from the whole of space gave evidence supporting the Big Bang Theory.

(6)

One theory that supports the big bang is red shift. ~~It is believed that~~ The ~~futer~~ further away a galaxy is, the more the spectrum is shifted to the red. This proves that the universe is expanding like the big bang theory suggests. Also, cosmic microwave background states that the universe is cooling. CMB is thought to have been left behind by the big bang. The big bang says that the universe started off very hot and has been cooling which is supported by CMB.

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This is a level two answer. There are some correct details about red-shift and CMBR; even though the candidate has described red-shift as a theory rather than an observation.

In order to be in level three the candidate would have needed to explain that the red-shift is caused by the galaxies moving away from us and have written more detail about CMBR (for example that it is observed in all directions).

Paper Summary

Candidates should:

- make sure that they have a sound knowledge of the fundamental ideas in all six topics
- get used to the idea of applying their knowledge to new situations
- show their working at each stage of a calculation
- use the available time effectively by writing answers appropriate to the command words such as *state.., describe.., explain.*.
- read the question carefully and underline the key words, for example in question 6 (b) "Describe how careful observation... gave evidence...".

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