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Examiners' Report
November 2011

GCSE Physics/Science 5PH1H/01

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Introduction

This is the first 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.

The topics are

- Visible light and the Solar System
- The electromagnetic spectrum
- Waves and the Universe
- Waves and the Earth
- Generation and transmission of electricity
- Energy and the future

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 will be used to test quality of written communication.

It was recognised that some candidates did not have a great deal of time to prepare for this paper and that the paper itself was much longer than equivalent papers in the recent past. It was all the more encouraging, therefore, to note the positive way in which the vast majority of candidates approached the paper.

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 or using standard form and did not show the stages in their working
- did not think through their answers before writing.

The quality of written communication was generally appropriate to the level of response. When it was not, the mark within that level was reduced, if possible.

Question 1 (b) (i)

Most candidates understood what a wavelength was and used it to calculate the distance between the floats. Those who miscounted, but showed their working, where able to gain one of the two marks.

Question 1 (b) (iii)

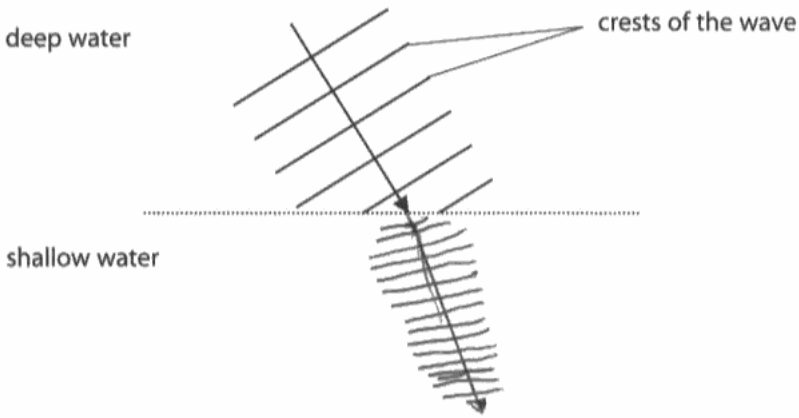
The majority of candidates were able to offer a reasonable suggestion here, to do with either the size or speed of the boat.

Question 1 (c)

It was good to see that most candidates knew that the wave would change direction and half of these knew the correct change in direction, given that the wave was moving more slowly. The best answers also showed a decrease in the wavelength.

(c) The wave reaches shallow water before it reaches the shore.
Water waves travel more slowly in shallow water.

The diagram shows the wave as it reaches the shallow water.



Complete the diagram to show how the wave travels in the shallow water.

(3)

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Examiner Comments

This scores all three marks - change in direction - towards the normal - decrease in wavelength.

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Examiner Tip

Using a ruler to draw straight lines would have made this clearer.

Question 2 (b) (i)

Nearly all candidates recognised that the black/dull colour of the box increases the constant temperature reached but fewer could suggest a second change such as "cover box with transparent material" "line the inside of the box with foil"

Question 2 (b) (ii)

Full marks could be gained for a response such as "at constant temperature, the pipe is radiating heat and absorbing heat at the same rate. One mark could be gained for knowing that the pipe/water absorbs heat and another for knowing that the pipe/water radiates heat.

(ii) Explain why the water reaches a constant temperature.

(3)

The amount of thermal energy being absorbed equalled to the amount of energy being emitted by the object itself. (horsepipe)/(metal box)

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Examiner Comments

Scores two marks - no mention of rate.

Question 2 (c)

Nearly all candidates calculated the energy absorbed by the heater but fewer went on to calculate the power absorbed.

Question 3 (b)

There was a mark available here for substituting the values into the equation, another for transposing the equation and a third for the evaluation, involving powers of ten. Although full marks were awarded for the correct answer without working, many candidates who did not get the correct answer lost one or even two marks by not showing their working. A calculator is essential in questions like these.

(b) Some microwaves have a frequency of 1.5×10^{10} Hz.
They travel at a speed of 3.0×10^{8} m/s.

Calculate their wavelength.

(3)

$\frac{\text{wavespeed}}{\text{frequency}} = \text{wavelength}$

$= \frac{3.0 \times 10^{8} \text{ m/s}}{1.5 \times 10^{10} \text{ Hz}}$

$= \frac{300000000}{15000000000}$

$= 0.02$

wavelength = 0.02 m

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Examiner Comments

This is a well presented answer, scoring all three marks.

Question 3 (c)

Full marks could be gained here for knowing that the frequency of the infrared used by a remote control is different from the frequency of the infrared used by the toaster. The specification does not require them to know which is higher. Full marks could also be gained for an explanation involving power or intensity. Over half of the candidates failed to score here.

Question 3 (d)

Here examiners were looking for the notion that gamma rays can damage cells and cause uncontrolled growth but, if they are focused on an area, they can destroy cells. Credit was also given for the idea that this can be achieved with minimal damage to surrounding cells.

Students who answered this question well tended to divide their answers into two sections – about how cancer could be caused and how it could be treated.

(d) Gamma rays can cause cancer.
Gamma rays can also be used to treat cancer.

Explain how gamma rays can do both.

(3)

Because gamma is ionising radiation it can harm cells by either killing them or the opposite allowing them to continuisly split that causes tumors / cancer but doctors can fire gamma rays at cancerous tumors killing the cells that need to be killed

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Examiner Comments

This scores all three marks.

Question 4 (c)

(c) Describe how infrasound differs from ultrasound.

(2)

Infrasound is below 20HZ but Ultrasound is above 20HZ.

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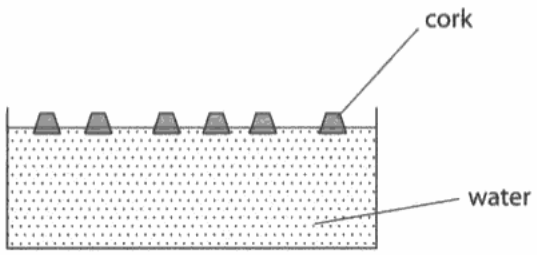
Examiner Comments

There is only one mark here. Above and below 20 Hz implies a difference in frequency but ultrasound is above 20 kHz.

Question 4 (d)

Most candidates were able to identify that that the corks were like the plates and the water was like the mantle. Most realised that the water needed to be moved in some way for the corks to move. Fewer related this to convection currents in the mantle and only the best answers included reference to a heat source. It was possible to gain full marks by adding to and labelling the diagram.

(d) Earthquakes are sometimes caused when plates in the Earth's crust move.
The diagram shows some corks floating on water.



Explain how this model of corks on water could be used to demonstrate what causes the Earth's plates to move.
You may add to the diagram to help with your answer.

(3)

The water is the magma and the cork are the earths plates. The waters flow moves the cork this is the same with plates and magma

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Examiner Comments

This scores only one mark here for comparing corks to plates. There is no mention of convection currents or heat source.

Question 4 (e)

This was a very challenging evaluation question. Examiners were looking for a statement about the arrival times or distances travelled for any two P-waves for one mark and a statement comparing any pair of S-P times for a second mark. The third mark was for a correct, quantitative comparison of these two statements, leading to a conclusion. Most candidates found this question very difficult. Many just re-wrote the stem. Those who understood the question found it very difficult to articulate the answer and didn't refer to the chart in doing so. Many realised that station L was the closest and N the furthest away but couldn't explain this in terms of distance travelled or arrival times of two P-waves.

Question 5 (a) (i)

Most candidates mention the part played by gravity. They were less likely to mention kinetic energy but many mentioned thermal energy and nuclear energy. Full credit could be gained for an accurate description of the process.

Question 5 (a) (ii)

This question carried only three marks and candidates were trying to include more detail than was required for the answer. A comment about what small stars would eventually become and what large stars would eventually become would have scored all three marks. This was a very accessible question answered well by the majority of candidates.

(ii) Describe how the mass of a main sequence star will affect what the star finally becomes.

(3)

• The more mass the main star has will determine what it becomes.
• For example: if a star has a ~~small~~ light mass it will become a planetary nebula then a white dwarf.
• However if the star has a ~~big~~ heavy mass it will become a Supernova then a Neutron Star or a black hole.

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Examiner Comments

This scores all three marks but would have done so even if "planetary nebula" and "supernova" had not been included.

Question 5 (b)

To gain full marks here, candidates would have to state what both pieces of evidence were and give an explanation of each of them, link this evidence to the appropriate theories and explain which theory was most likely on the basis of the evidence.

This was answered confidently by many candidates and there were some excellent examples of candidates gaining full marks for well-presented discussions. It was encouraging to see that the topic is well understood.

Marks were lost by some candidates because they described the two theories themselves rather than describe the evidence and its relevance.

*(b) While the origin of stars is well understood, there is still much debate about the origin of the Universe.
Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories.
Other evidence supports only one theory.

By considering the evidence, discuss why one of these theories is preferred by most scientists.

(6)

The big bang theory is more preferred as there is more evidence. Red shift supports this as it states that light from the edge of the universe is shifted towards the red part of the visible spectrum. This proves that the universe is expanding as galaxies (etc) move away from Earth. CMB radiation further backs the theory up as this evidence is it shows that the universe was once hot and is cooling. Cosmic background microwaves were at the time of the universe was created.

(Total for Question 5 = 12 marks)

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Examiner Comments

There was good discussion of evidence but not linked to the theories. This acheived level 2, QWC appropriate, four marks.

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(6)

In my opinion, the most prefered theory is the Big Bang theory because it has moure evidance. The Big Bang theory is a collision of atoms colided and caused the Big Bang so all the matter is still expanding, although the Big Crunch is the obviouse ending. On the other hand the steady state theory is new matter will continusly be created. So some stars are expanidig but there is equal number toward as-well. Both theorys have alot of evidance and both seem reasonably. However I think the Big Bang theory has the edge because although gravity is in play the universe is expanding.

(Total for Question 5 = 12 marks)

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Examiner Comments

No marks were awarded here. Theories discussed but no evidence considered.

Question 6 (b) (i)

The best way to approach this question was to solve the transformer equation for the output voltage, getting a value of 825 V. The same issues concerning working arose as they did in Q3b but on the whole, candidates scored well in this question.

Question 6 (b) (ii)

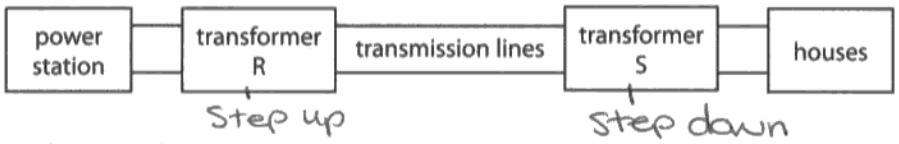
This was a complex question. It required candidates to realise that, for 100% efficiency, power input is equal to power output and by using P=VI, the current in the secondary could be calculated. Many did not attempt it and of those who did attempt it, most tried comparing the ratio (primary current / secondary current) to the ratio (primary turns / secondary turns) instead of (secondary turns / primary turns).

Question 6 (c)

To gain full marks here, candidates would have to state that thermal energy was lost in the transmission lines, relate this to current and explain that the current can be reduced by stepping up the voltage in transformer R.

There were some good answers describing that stepping up the voltage would result in less thermal energy loss in the transmission lines but failing to mention that for constant power, high voltage implies a low current which results in low thermal energy loss in the lines.

distant houses.



Transformers R and S are not 100% efficient.
By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

(6)

This reduction is achieved because the step up transforme makes the voltage in the secondary coil 40,000 V so then when it goes through the transmission lines it would not waste as much electricity as when the voltage is lower. It then goes to the step down transformer which makes the voltage low in the secondary coil to bring it to a safe amount of electricity for us in our houses.

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Examiner Comments

This is level 1. The candidate knows that a step-up transformer steps up the voltage and a step-down transformer steps down the voltage.

There is no reference to thermal energy loss or that this was related to current.

Paper Summary

In order to improve their performance 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 by attempting questions in support materials or previous exam papers
- show their working at each stage of a calculation
- use the marks at the side of a question as a guide to the form and content of their answer
- read the question carefully and underline the key words, for example in Q5b "By considering the evidence....."

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