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Examiners' Report
June 2018

GCSE Physics 1PH0 1H

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Introduction

Paper Introduction

This was the first examination of paper 1, at Higher Level, for the new specification. Questions were set to test candidates' knowledge, application and understanding from these seven topics in the specification:

- Topic 1 – Key concepts of physics
- Topic 2 – Motion and forces
- Topic 3 – Conservation of energy
- Topic 4 – Waves
- Topic 5 – Light and the electromagnetic spectrum
- Topic 6 – Radioactivity
- Topic 7 – Astronomy

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three or four marks each. There was a new emphasis, too, in the inclusion of questions designed at targeting candidates' knowledge and understanding of practical work. This included assessing their fundamental knowledge of practicals specified in the specification, together with further application, especially where they were asked to propose improvements to a procedure. The assessment of candidates' mathematical skills involved recall of some equations and became more demanding as the paper progressed. There were also two extended open response questions, worth six marks each.

Successful candidates:

- were well-acquainted with the content of the specification
- had been engaged with practical work during their course
- were competent in quantitative work, especially in being able to recall and rearrange equations and use numbers in standard form
- recognised key command words such as "describe" and "explain" and constructed their responses accordingly
- were willing to apply physics principles to the novel situations presented to them

Less successful candidates:

- had gaps in their knowledge of the topics of this paper
- had gaps in their procedural knowledge, relating to their practical work

- failed to set out calculations in a logical way that could be easily followed
- did not focus sufficiently on what the question was asking
- found difficulty in applying their knowledge to new situations

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come from responses which highlight successes and misconceptions, with the aim of aiding future teaching of these topics.

Question 1 (c)

Candidates were required to recall and rearrange the equation for speed and use it and data from a graph to find the time taken for a sonar pulse to travel. The most common errors were to use the wrong distance from the graph or not use double the distance.

(c) Figure 1 shows the depth of the sea, measured using sonar, at different distances from the shore.

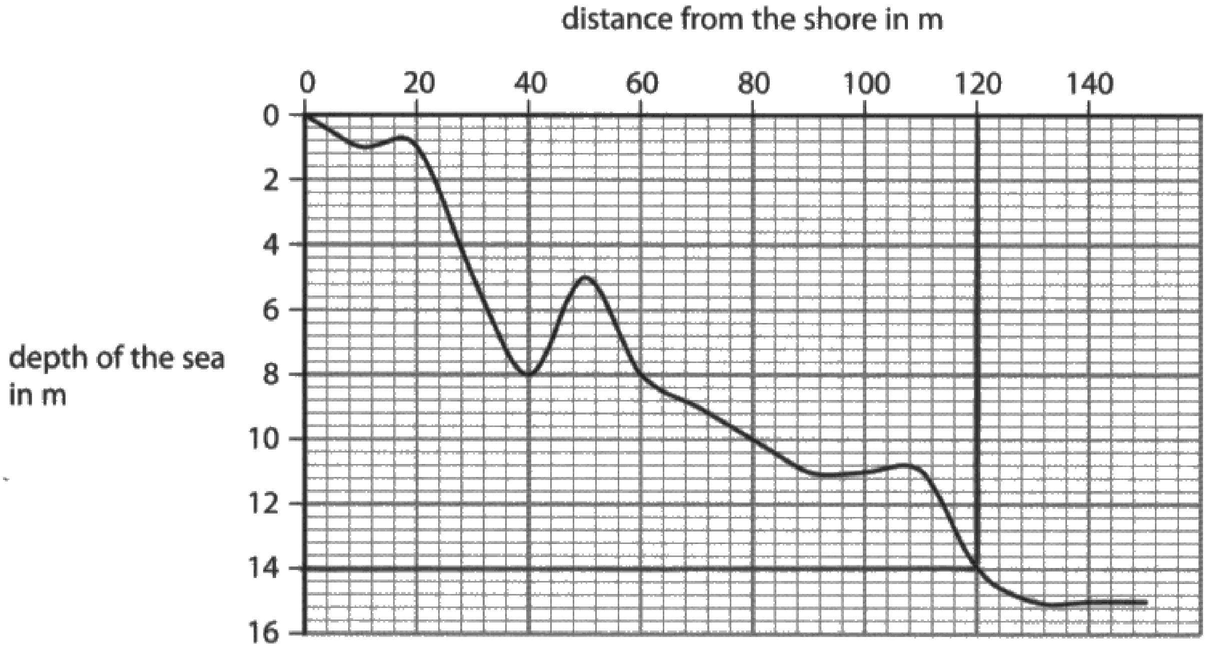

Figure 1

A technician on a boat uses sonar pulses to measure the depth of the sea when the boat is 120 m from the shore.

Calculate the **total** time of travel for the sonar pulse used to make this measurement.

The speed of the sonar pulse in seawater is 1600 m/s.

(4)

$$\text{Speed} = \frac{\text{distance}}{\text{time}} \qquad \text{time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\frac{28}{1600} = 0.0175 \text{ 3sf}$$

time of travel = 0.0175 s

ResultsPlus
Examiner Comments

The correct equation is recalled and rearranged and the correct value from the graph is used.

Question 2 (a) (iii)

To answer this question fully, candidates had to appreciate that there was a range of angles for which there was no data and to suggest a procedure for this particular context.

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

Repeat the experiment for higher values of angle X ~~and~~ as this will show if there is a limit to ~~proportionalit~~ proportionality or if the graph continues ~~steady~~ with a linear relationship.

ResultsPlus
Examiner Comments

This candidate has realised that the range of angles examined needs to be extended and gains full marks.

ResultsPlus
Examiner Tip

If you are asked to suggest improvements or, as in this case, developments to an investigation, make sure your answer refers to the particular circumstances in the question. Here, 'further readings' would gain some credit but for full marks the limited range had to be recognised.

Question 2 (b)

Calculations involving electromagnetic radiation will usually contain numbers in standard form. This was tested here; the rearranged equation having been given in the question. The unit for frequency was also required.

(b) The speed of light is 3.0×10^8 m/s.

The wavelength of yellow light is 5.8×10^{-7} m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

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

(3)

$$f = \frac{3.0 \times 10^8}{5.8 \times 10^{-7}}$$

$$= 5.172413793 \times 10^{14}$$

$$= 5.2 \times 10^{14}$$

frequency = 5.2×10^{14} unit Hz

ResultsPlus
Examiner Comments

The working is clearly shown, standard form is understood and the correct unit is used. Full marks.

(b) The speed of light is 3.0×10^8 m/s.

The wavelength of yellow light is 5.8×10^{-7} m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

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

(3)

$\frac{300000000}{0.00000058} = 5.172413793 \times 10^{14}$

$= 517241379300000$

frequency = 517241379300000 unit ....

ResultsPlus
Examiner Comments

A long-winded but successful way of dealing with standard form but unfortunately the unit is missing. Scores 2 of the 3 marks available.

Question 3 (a)

Candidates here are required to apply their knowledge and understanding of measuring radioactivity to devise a method for comparing the count-rates from two different rocks. Credit is given for knowing how a GM tube is used and what steps should be taken to make a fair comparison.

3 Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.

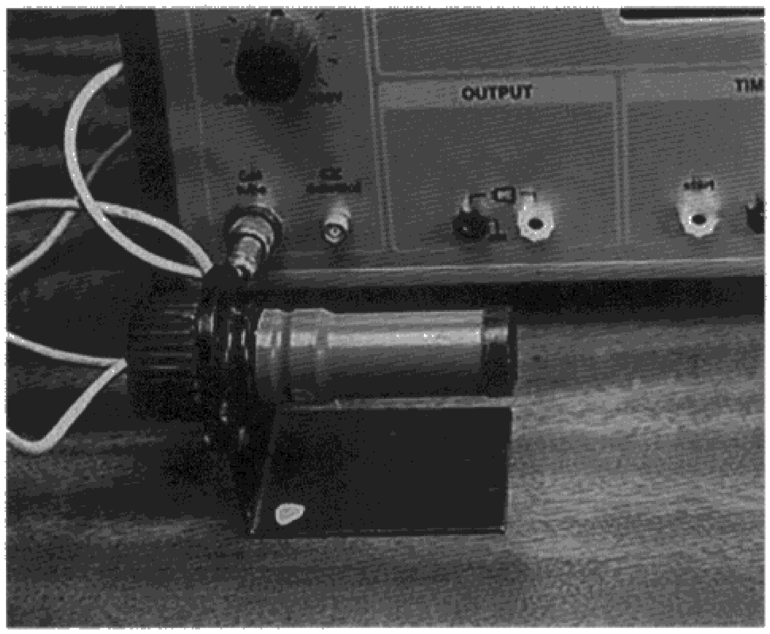

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Figure 4

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

A teacher would set up a Geiger-Müller (GM) and place a radioactive rock a certain measurable distance from it e.g. 5cm. The teacher would then listen to how many clicks it makes per minute they would then repeat this with different radioactive rocks and compare the amount of clicks it does per minute (count-rates) the ~~one~~ rock with the highest count-rate will be the most radioactive

ResultsPlus
Examiner Comments

This response has all four marks:

placing each rock in front of the tube

at the same distance

for the same time

allowing a fair comparison of count-rates.

ResultsPlus
Examiner Tip

In descriptions of experimental method, include what is being measured and what it is being measured with.

If a comparision is required, make sure you mention the factors that must stay the same.

3 Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.

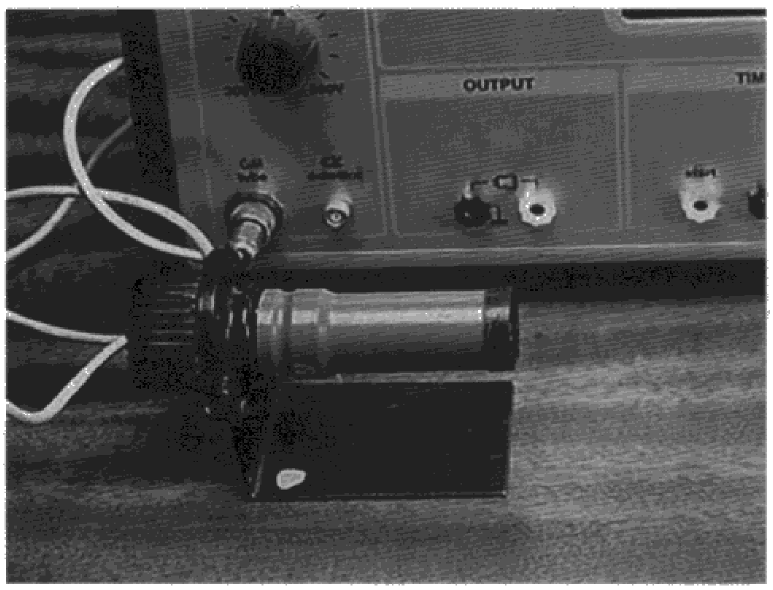

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Figure 4

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

→ when radioactivity is discovered, the ~~ge~~ geiger muller clicks and every click ~~is recorded~~ means it has found something radioactive. teacher could put one rock at a time ~~next~~ a certain distance from it to find out which is more reactive. The more reactive, the more clicks.

ResultsPlus
Examiner Comments

This does not mention a fixed time or rate but scores the other three marks.

Question 3 (b)

Candidates were asked to analyse some information about the half-life of an isotope to complete a graph. Full credit could be gained by either plotting three points from the information or two points and an appropriate curve.

(b) A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

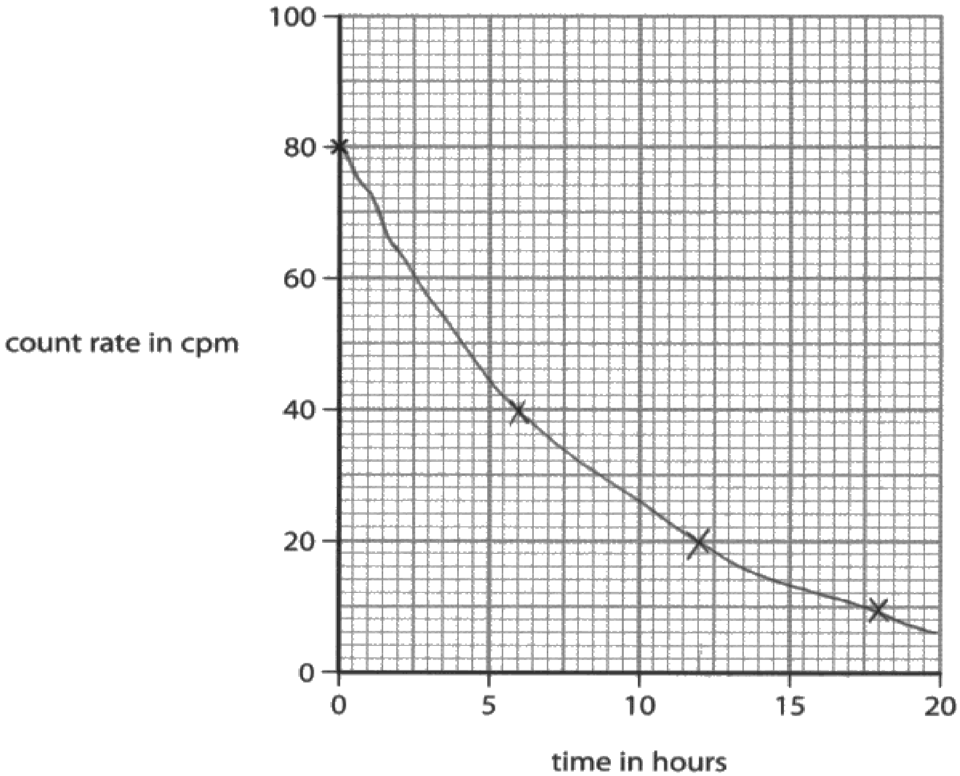

Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 5.

(3)

ResultsPlus
Examiner Comments

This candidate has used the data to find three half-lifes and plotted them accurately on the graph. This would be enough to score all 3 marks but the curve is acceptable also.

Question 4 (c) (i)

Part (c) tested knowledge and understanding about how red-shift and CMBR provide evidence in support of the Big Bang theory of the origin of the universe.

(c) Satellites are used to gather data about the origin of the Universe.

The Big Bang theory is a theory about the origin of the Universe.

Evidence for the Big Bang theory is provided by red-shift and CMB radiation.

(i) Describe what is meant by red-shift.

(2)

when galaxies move away, they are red-shifted, so the wavelengths of visible light become longer, making the light seem more red.

ResultsPlus
Examiner Comments

This is a good description of what is meant by red-shift.

Question 4 (c) (ii)

Part (c) tested knowledge and understanding about how red-shift and CMBR provide evidence in support of the Big Bang theory of the origin of the universe.

(ii) Explain how red-shift provides evidence for the Big Bang theory.

(2)

~~It~~ this means galaxies are ~~no~~ moving away therefore originally, they must've been closer and at one point may have come from a hot dense core * therefore, the Big Bang theory.

ResultsPlus
Examiner Comments

This is an acceptable explanation of how red-shift provides evidence for the Big Bang theory. Scores both marks.

Question 4 (c) (v)

Part (c) tested knowledge and understanding about how red-shift and CMBR provide evidence in support of the Big Bang theory of the origin of the universe.

(v) Explain how the presence of CMB radiation provides evidence for the Big Bang theory.

(2)

The CMB is radiation that is evenly dispersed accross the universe, as a result of this it comes the Big bang theory states that it all came from the same place. This occured 14 billion years ago and the Big bang theory suggests that the universe began 14 billion years ago.

ResultsPlus
Examiner Comments

This was an acceptable explanation at this level.

Question 5 (a)

Here, examiners were looking for reference to oscillations in the air and the direction of the oscillations in relation to the direction of travel of the sound wave.

5 (a) Figure 7 shows a tuning fork.

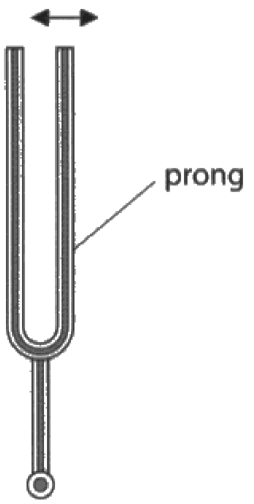

Figure 7

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 7.

Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

The particles in the prong vibrate a lot when struck and collide with each other. These vibrations then cause air particles in the surroundings to vibrate and these vibrations are passed through the air as a series compressions and rarefactions in a longtitudinal wave.

ResultsPlus
Examiner Comments

Here there are vibrating air particles and the reference to a longitudinal wave was accepted for the second mark. 2 marks.

Question 5 (c)

Candidates were required to apply their knowledge and understanding of the relationship between refraction, speed and wavelength to explain the dispersion of light at an air-glass boundary.

(c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain in terms of speed, why the light behaves like this.

(3)

White light consists of seven different wavelengths of light, which are the seven colours of the spectrum. When each of the different wavelengths reaches the boundary between air and glass, they slow down and this causes them to refract towards the normal. Each of the different wavelengths refracts by a different amount because they all slow down at the boundary by different amounts. This causes white light to split up into the colours of the spectrum.

(Total for Question 5 = 9 marks)

ResultsPlus
Examiner Comments

This is a very good response linking colour, wavelength and change in speed to the different amounts of refraction. 3 marks.

Question 6 (c)

All three readings in (b)(ii) and the calculated reading in (b)(i) were significantly below the accepted value for *g*. This, and the method described in (b)(i), meant that examiners were looking for improvements to the procedure in part (b) that would eliminate or reduce the effect of human reaction time.

(c) Explain **one** way the students could improve their procedure to obtain a more accurate value for *g*.

(2)

They could use a light gate instead of a stop-watch to get a more accurate reading, since using a stopwatch means that time is added on due to human thinking time

ResultsPlus
Examiner Comments

A well-reasoned, relevant answer.

ResultsPlus
Examiner Tip

Suggested improvements must be in the context of the question.

Question 6 (d)

Candidates were asked to use an equation selected from the list of equations at the end of the paper. They then had to rearrange the equation to find deceleration.

(d) A car travelling at 15 m/s comes to rest in a distance of 14 m when the brakes are applied.

Calculate the deceleration of the car.
Use an equation selected from the list of equations at the end of this paper.

(3)

$$\frac{v^2 - u^2}{2x} = a$$

$$\frac{(0)^2 - (15)^2}{2 \times 14} = -8 \cdot 035$$

deceleration = $-8 \cdot 035$ m/s²

ResultsPlus
Examiner Comments

The correct equation is selected from the list and rearranged for acceleration.

'*a*' is correctly evaluated, including the minus sign - meaning negative acceleration.

The minus sign was not insisted upon.

Question 7 (c) (i)

The question stated that the water gained kinetic energy by falling from the top of a dam. Candidates, therefore, had to recall and use the equation for change in gravitational potential energy, involving a rearrangement, to calculate the minimum height the water must fall.

(c) Electricity can be generated using a water turbine.

(i) Water gains kinetic energy by falling from the top of a dam.

Calculate the minimum height that 7.0 kg of water must fall to gain 1300 J of kinetic energy.

(3)

~~KEE~~ $E_k = \frac{1}{2} \times M \times V^2$

$1300 = \frac{1}{2} \times 7 \times V^2$

GPE = Mass × Gravity × Height

$1300 = 7 \times 10 \times H$

$\frac{1300}{70} = 18.571428 57$

minimum height = 18.5714 m

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Examiner Comments

Here the candidate initially went to the equation for kinetic energy but then, on reading the question thoroughly, realised it was about a change in gravitational potential energy and went on to find the minimum height successfully. 3 marks.

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Examiner Tip

Read the complete question for the physics involved to inform your choice of equation.

Question 7 (c) (ii)

This required recall and use of the equation for kinetic energy, involving rearrangement and taking a square root.

(ii) As water enters the turbine at the bottom of the dam, the kinetic energy of 8.0 kg of moving water is 1100 J.

Calculate the speed of the moving water as it enters the turbine.

(3)

$KE = \frac{1}{2}mv^2$

$1100 = \frac{1}{2} \times 8 \times v^2$

$v^2 = \frac{1100}{\frac{1}{2} \times 8}$

$v = \sqrt{\frac{1100}{\frac{1}{2} \times 8}} = 16.5831...$

$= 16.6$ m/s to 1.d.p.

speed = 16.6 m/s

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Examiner Comments

Clearly and logically set out response.

A model answer. 3 marks

Question 7 (d)

This was quite a complex calculation that required recall and understanding of the efficiency equation, involving interpretation of an unfamiliar graph.

(d) Moving air can be used to generate electricity using a wind turbine.

Figure 8 is a graph of kinetic energy against wind speed for a mass of moving air.

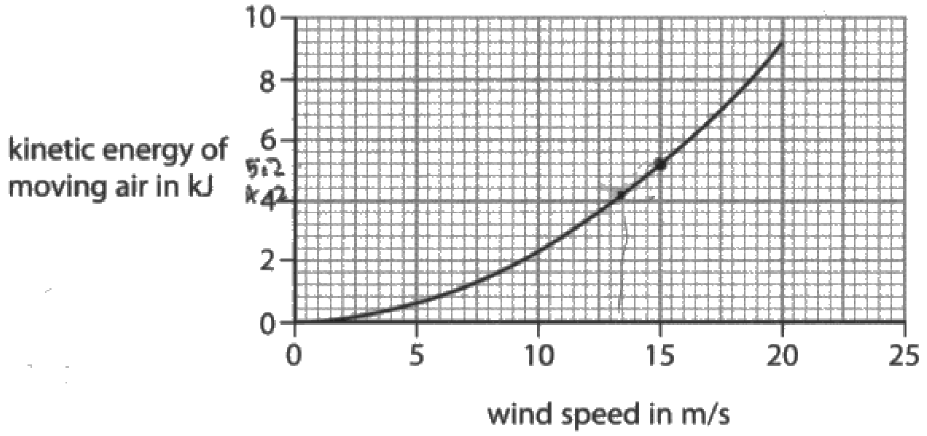

Figure 8

Just before the air reaches a wind turbine it has a wind speed of 15 m/s.

When the air has gone through the turbine it has a wind speed of 13 m/s.

As the air moves through the turbine some of its kinetic energy is transferred to the turbine.

Use the graph to determine the percentage of the kinetic energy transferred to the turbine from the air.

(3)

5.2 - 4.2

$\frac{1}{5.2}$ = 0.19230

0.19230 x 100 = 19.230

percentage of kinetic energy transferred from the air = 19.2 %

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Examiner Comments

This is a clear, logical way of getting to the correct answer. 3 marks.

Use the graph to find the difference between the kinetic energy of the air at speeds of 15 m/s and 13 m/s then calculate this difference as a percentage of the kinetic energy of the air at a speed of 15 m/s.

Question 8 (a)

This was about a procedure related to a core practical. Examiners were looking for the use of a thermometer to measure temperature at regular intervals of time.

Question 8 (b)

Here candidates had to interpret a graph by describing how intensity changed with wavelength. Examiners were looking for the fact that the graph peaked and one other observation, e.g. most of the radiation was outside the visible spectrum.

Question 8 (c) (i)

The calculation of the gradient of this graph involved drawing a tangent to the curve at a time of 30 ms, calculating the gradient of the tangent and deducing the unit from the labels on the axes.

(c) Figure 11 is a graph of temperature against time for a halogen lamp for the first 120 ms after it has been switched on.

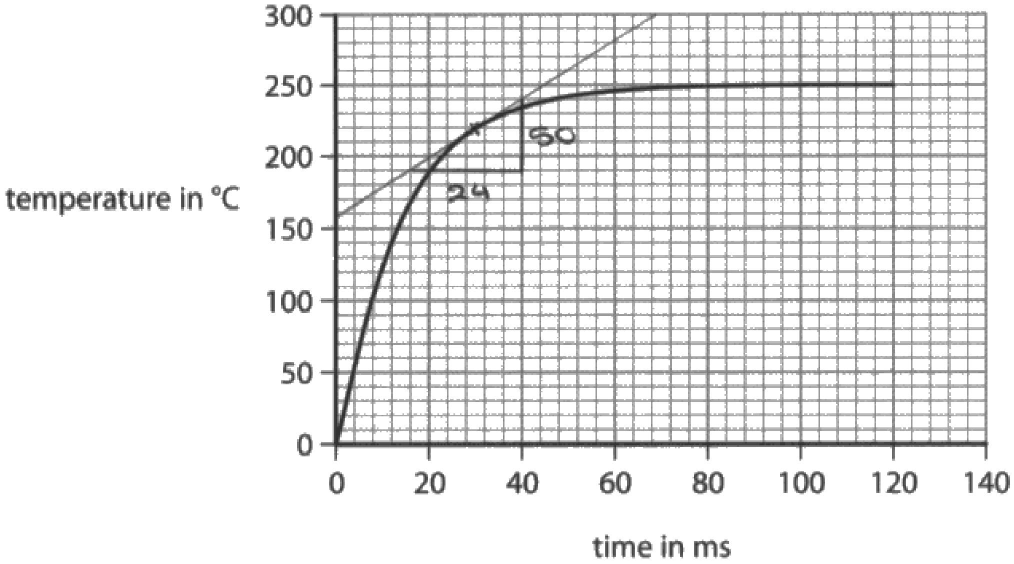

Figure 11

(i) Calculate the gradient of the graph at a time of 30 ms.

State the unit.

(4)

240 - 190 = 50

$\frac{50}{24} = 2.08\dot{3}$

gradient = 2.08 unit °C/ms

ResultsPlus
Examiner Comments

The tangent has been drawn at the correct point. Even though the triangle is quite small, correct values have been used to calculate the gradient and the unit is also correct.

Question 8 (c) (ii)

This is a difficult concept involving the variation in power radiated with temperature. It is based on specification points 5.16 and 5.17.

Full credit, 3 marks, was awarded for explaining that in the first part of the graph (while the temperature was rising) the power radiated by the lamp was less than the power supplied to the lamp. At constant temperature, the power radiated was equal to the power supplied.

2 marks could be scored if 'energy' was used instead of power.

(ii) Explain why the temperature of the lamp rises and then remains at a constant value.

(3)

The temperature of the lamp rises because it is absorbing more radiation that it is emitting. At a certain ~~point~~ temperature (250°C), the lamp emits the same amount of radiation as it absorbs, so its power ~~lamp~~ output equals its power input, so it ~~stay~~ remains at a constant temperature.

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Examiner Comments

This was one of the few responses that scored 3 marks. The fact that it refers to energy absorbed rather than supplied is allowed in the context of the demand of the question.

Question 9 (a) (i)

Part (a) of question 9 was about the procedures and techniques involved in a core practical. Part (ii) appeared to present the greatest challenge. Having direct experience of the practical would be an advantage here.

Question 9 (b)

This extended open response question was based on specification point 2.23. This requires candidates to recall and apply Newton's third law to a collision and relate it to the conservation of momentum in the collision. Level 3 could be achieved by a detailed statement of how Newton's third law applies to this collision, developed to show how this leads to the idea of conservation of momentum.

*(b) Figure 13 shows two objects, Q and R, before and after they collide.

Figure 13

The arrows show the direction of movement of the objects.
The arrows are not to scale.

Explain how momentum is conserved in the collision.

Use Newton's third law and Newton's second law in your answer.

Newton's second law can be written as

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

(6)

Newton's third law states that every action has an equal & opposite reaction. Therefore, when Q collides with R, R has an equal & opposite reaction to R. Momentum is a moving mass, and in collisions, momentum is conserved. Q exerts a force on R in the collision, and R exerts the same force back on Q, yet moves in the opposite direction to this force; to the right. $p = m \times v$. The masses of both R & Q remain the same, and Q & R split Q's original velocity, and so no velocity is lost, & therefore momentum also remains the same. The above equation ($f = \frac{fp - ip}{t}$) shows that as forces exerted are the same, the time of the collision is the same for R + Q, ~~and~~ so, change in momentum is the same for both Q & R; momentum is conserved.

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Examiner Comments

The first 7 lines of this response provides a good explanation of Newton's third law applied to this collision. The next part uses the equation given in the question (also in the list at the end of the paper) to explain that, as the force and the time of collision are the same for both Q and R, the momentum before the collision is equal to the momentum after the collision.

A good level 3 answer. Scores 6 marks.

Question 10 (a) (i)

Examiners were looking for explanations linking the idea that high temperature means high energy which is needed to overcome the electrostatic force of repulsion between the positively charged nuclei.

10 Fusion and fission are nuclear reactions in which large amounts of energy are released.

(a) (i) In a fusion reaction, two hydrogen nuclei are forced together to form a helium nucleus.

Explain why a very high temperature is needed for this reaction to happen.

(3)

Because very high amounts of energy is needed to overcome the ~~electrostatic force of attraction~~ electrostatic repulsion due to the 2 protons which will try to push each other away as they are both positive.

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Examiner Comments

A concise response, scoring all three marks.

Question 10 (a) (ii)

This is based on specification point 6.43P. The equation is given in the question.

(ii) In a fusion reaction, the combined mass of the two small nuclei is greater than the mass of the resulting nucleus.

This decrease in mass, *m*, appears as energy, *E*, according to the equation.

$$E = mc^2$$

c is the speed of light $= 3.0 \times 10^8$ m/s.

The energy released in one fusion reaction is 4.5×10^{-12} J.

Calculate the decrease in mass.

(3)

$E = mc^2$

$m = \frac{E}{c^2}$

$m = \frac{4.5 \times 10^{-12}}{(3.0 \times 10^8)^2}$

$m = 5 \times 10^{-29}$ kg

decrease in mass = 5×10^{-29} kg

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Examiner Comments

This is a good example of a well set out response to an unfamiliar calculation.

Question 10 (b)

In this extended open response question, candidates had to use their knowledge and understanding of control rods and moderators to explain how certain parts of a nuclear reactor, shown in a diagram, were used to maintain and control the chain reactor.

Level 3 could be achieved by explaining the function of the control rods and a moderator, linked to the diagram in the question.

Explain how the graphite core and the movable rods are used to maintain and control the chain reaction.

(6)

The graphite core contains the fuel rods. When the fission reaction occurs, neutrons are released ~~##~~ which have a high kinetic energy. The core helps to slow down neutrons so that they can be absorbed by more uranium nuclei in the fuel rods, and so allows the chain reaction to continue as quickly moving neutrons wouldn't be absorbed by the ~~fuel rods~~ uranium nuclei, so the chain reaction wouldn't occur.
The movable rods contain elements which absorb neutrons, in order to control the rate of the chain reaction. When the movable rods are lowered into the core, they absorb more neutrons and so the chain reaction happens more slowly. To make the chain reaction happen faster, the movable rods are lifted out slightly from the core.

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Examiner Comments

A well-structured response, covering all the points.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- make sure that they have a sound knowledge of the fundamental ideas in all the topics
- get used to the idea of applying their knowledge to new situations by attempting questions in support materials or previous examination papers
- when describing a practical procedure, make sure they are clear about what is to be measured and how the measurements will be taken. (Q3a)
- when suggesting improvements or extensions to a practical procedure, make sure they are relevant to the context of the question and not just 'repeat readings'. (Q2aiii)
- where a question involves a calculation, make sure they understand the physics of the situation before recalling or selecting an equation to use calculation. (Q7ci)
- make sure that they recognise SI prefixes such as m and k and n and how to handle these in calculations.
- use the marks at the side of a question as a guide to the form and content of their answer.

Grade Boundaries

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