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Examiners' Report
June 2024

Int GCSE Physics 4PH1 2PR

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Introduction

The examination was written to assess across the full range of grades from 1 to 9. Consequently, some questions were written to be challenging whilst others were designed to be more straightforward and accessible. A range of different question types were included in the examination such as objective and multiple choice, calculations and both short and long written responses. Approximately 20% of the marks available in the examination were for the candidates demonstration of experimental skills and understanding. Candidates were provided with a full list of the formulae to be used in this examination.

Successful candidates were well-acquainted with the content of the specification and could recall facts whilst applying their understanding to new and complex situations. They were competent in performing quantitative work and could rearrange and substitute data into given formulae to obtain the correct answer. Successful candidates also showed evidence of undertaking all the required practicals themselves and could produce detailed, coherent methods whilst recalling the relevant results of these experiments.

Less successful candidates showed gaps in their knowledge of topics and either had limited experience or could not recall information from the required practical tasks. These candidates often did not address the demands of the question and overlooked the importance of the command words being used.

Question 1 (a)

Most candidates scored at least 1 mark in this question, with nearly half of all candidates labelling both axes correctly. Candidates experienced more difficulty labelling the y-axis than the x-axis. Some candidates got the labels the wrong way round.

Question 1 (b)

Most candidates successfully labelled the shaded area as the main sequence.

Question 2 (a)

Some candidates confused fission with fusion, but most were able to score at least 2 marks. Some candidates thought that nuclear fission requires high temperature and pressure and lost the mark for this row of the table. Other candidates wrongly thought that radioactive daughter nuclei are produced in nuclear fusion, which also lost a mark.

Question 2 (b)

Most candidates could state that the control rods absorb neutrons. Fewer could recall the function of the moderator. Many candidates lost both marks for not mentioning neutrons, but referred to particles, electrons, molecules, atoms or ions instead.

(b) Nuclear fission reactors use control rods and a moderator.

Describe the function of the control rods and the function of the moderator in a nuclear fission reactor.

(2)

control rods

Control rods will absorb any excess stray neutrons that were produced by fission

moderator

Moderators slow the nuclei down to control the rate of ~~the number~~ of reactions happening

ResultsPlus
Examiner Comments

This response scored 1 mark. The description of the function of the control rods is correct, but the description for the moderator refers to nuclei, rather than neutrons.

ResultsPlus
Examiner Tip

Candidates should be careful with their use of key terms in this topic.

(b) Nuclear fission reactors use control rods and a moderator.

Describe the function of the control rods and the function of the moderator in a nuclear fission reactor.

(2)

control rods

control the rate of fission

moderator

slow the neutrons

ResultsPlus
Examiner Comments

This response also scored 1 mark. The description of the function of the moderator is correct, but the description for the control rods is insufficient. The control rods absorb neutrons – it is the quantity of them and their position in the reactor that determines the rate of fission.

(b) Nuclear fission reactors use control rods and a moderator.

Describe the function of the control rods and the function of the moderator in a nuclear fission reactor.

(2)

control rods

absorbs neutrons

moderator

slows down neutrons

ResultsPlus
Examiner Comments

This succinct response was sufficient for both marks.

Question 3 (a)

Most candidates gained at least 3 marks in this question. Candidates regularly achieved 2 marks for drawing solid particles in the correct arrangement and 1 mark regularly for a random arrangement in liquid. The most common error was for not attempting to draw most particles in contact with each other for the liquid arrangement.

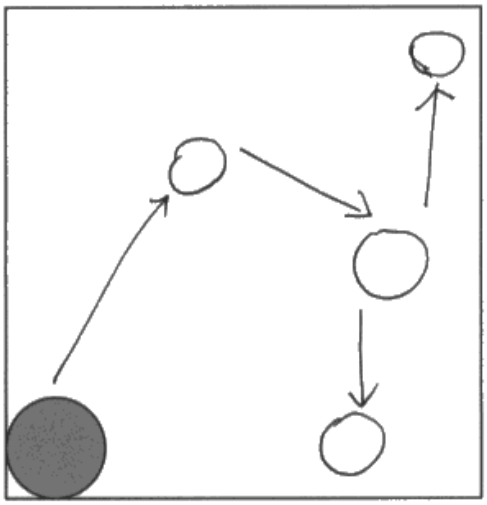
3 A sample of liquid gallium is allowed to cool in a laboratory.

The liquid gallium freezes to become a solid.

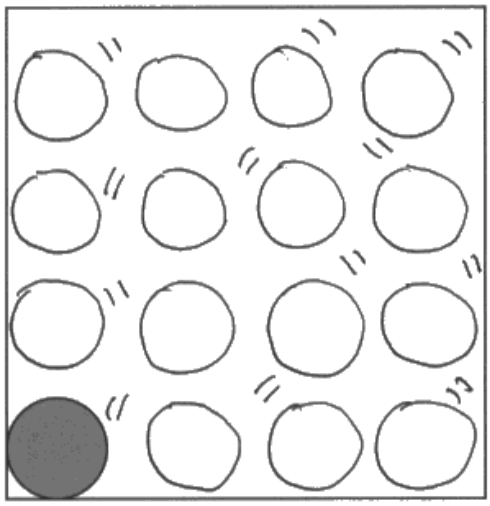
(a) Complete the diagram by drawing the arrangement of particles in a liquid and the arrangement of particles in a solid.

The first particle in each box has been drawn for you.

(4)



Liquid



Solid

ResultsPlus
Examiner Comments

This response scored 2 marks. The particles were judged to be regularly arranged in the solid and irregularly arranged in the liquid. However, in both states, there was clearly no attempt to draw the particles touching each other to show they are closely packed.

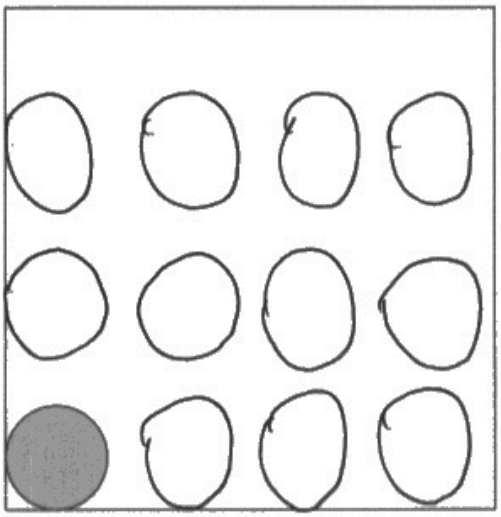
3 A sample of liquid gallium is allowed to cool in a laboratory.

The liquid gallium freezes to become a solid.

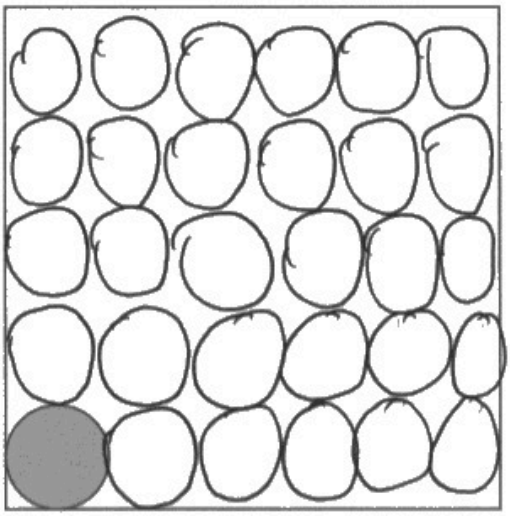
(a) Complete the diagram by drawing the arrangement of particles in a liquid and the arrangement of particles in a solid.

The first particle in each box has been drawn for you.

(4)



Liquid



Solid

ResultsPlus
Examiner Comments

This response also scored 2 marks. The particles were judged to be regularly arranged in the solid and drawn in contact with each other. However, the particles in the liquid are clearly not touching each other and are also not irregularly arranged.

ResultsPlus
Examiner Tip

Many candidates develop a misconception that particles in a liquid are further spaced than particles in a solid.

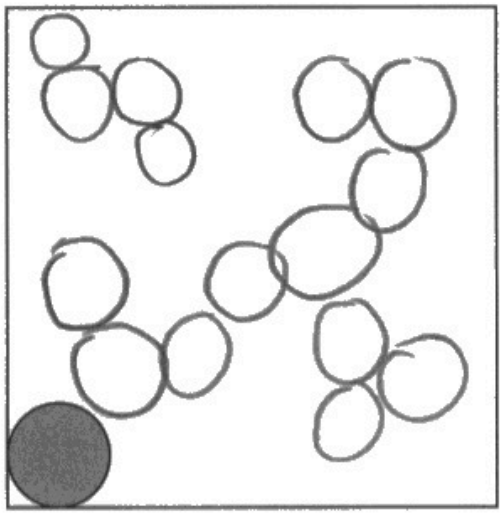
3 A sample of liquid gallium is allowed to cool in a laboratory.

The liquid gallium freezes to become a solid.

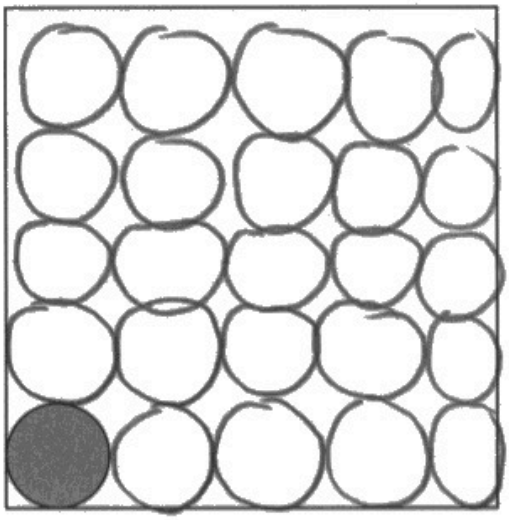
(a) Complete the diagram by drawing the arrangement of particles in a liquid and the arrangement of particles in a solid.

The first particle in each box has been drawn for you.

(4)



Liquid



Solid

ResultsPlus
Examiner Comments

This response scored 3 marks. The particles were judged to be regularly arranged in the solid and irregularly arranged in the liquid. The particles are also closely packed in the solid. However, in the liquid state, the gaps between the particles are too large in places to be deemed correct. If particles in a liquid really did look like this then a liquid would be very easy to compress, which is not the case.

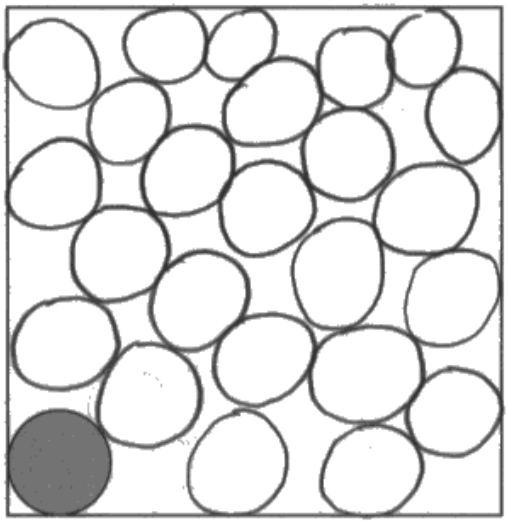
3 A sample of liquid gallium is allowed to cool in a laboratory.

The liquid gallium freezes to become a solid.

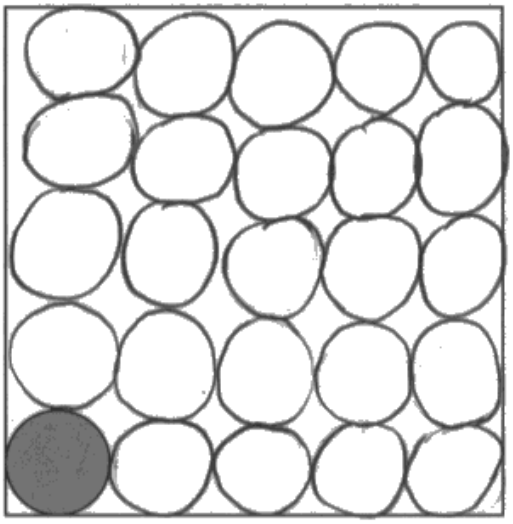
(a) Complete the diagram by drawing the arrangement of particles in a liquid and the arrangement of particles in a solid.

The first particle in each box has been drawn for you.

(4)



Liquid



Solid

ResultsPlus
Examiner Comments

This response has been drawn carefully and was awarded full marks.

Question 3 (b)

It was encouraging to see the majority of candidates gaining full marks in this question. Marks were sometimes lost for starting the line with a horizontal section (which incorrectly indicated another change of state), not including any horizontal section or failing to include a scale on the temperature axis.

(b) The initial temperature of the sample of liquid gallium is 80 °C.

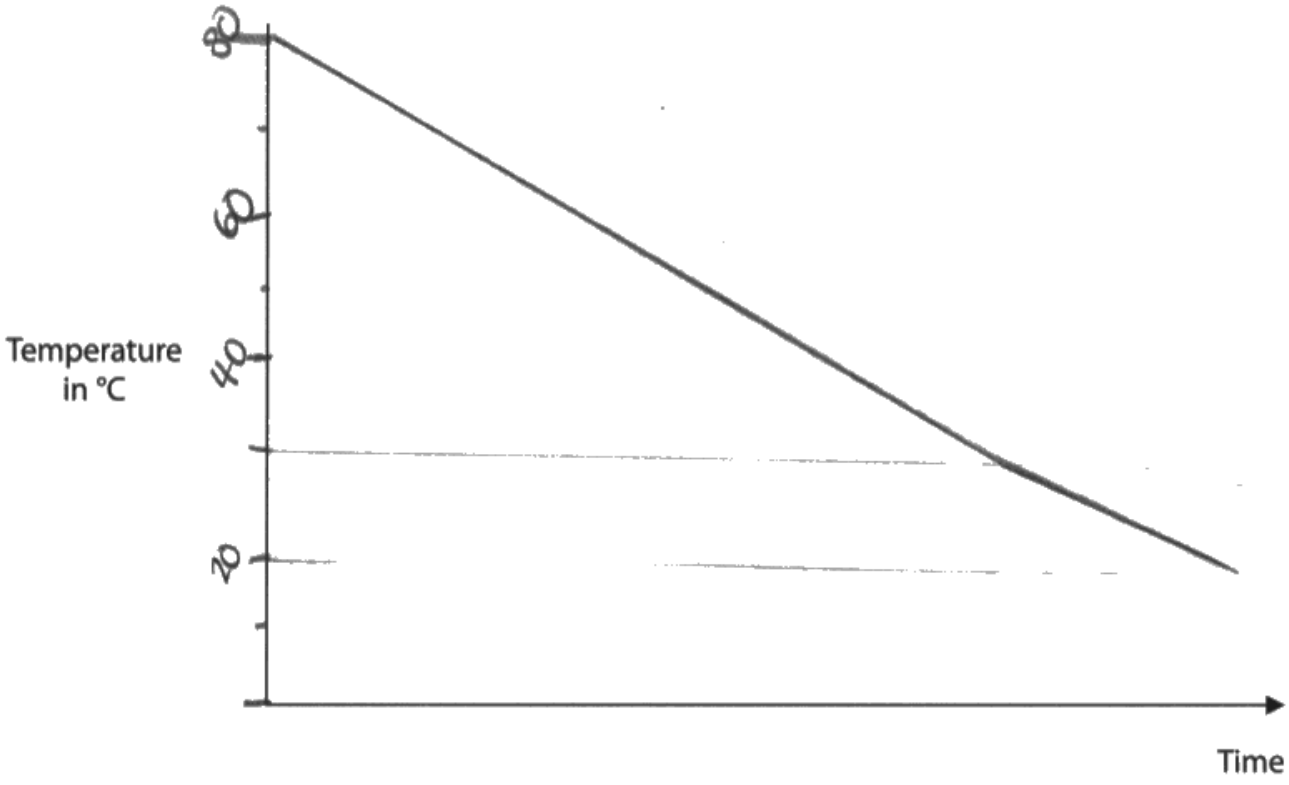
The freezing temperature of gallium is 30 °C.

The final temperature of the solid gallium is 20 °C.

Complete the graph to show how the temperature of the gallium changes during the time that it cools to 20 °C.

Add appropriate values to the temperature axis.

(3)



ResultsPlus
Examiner Comments

This response scored 1 mark. The lack of a horizontal section meant the response could not be awarded either the second or third marking points.

(b) The initial temperature of the sample of liquid gallium is 80 °C.

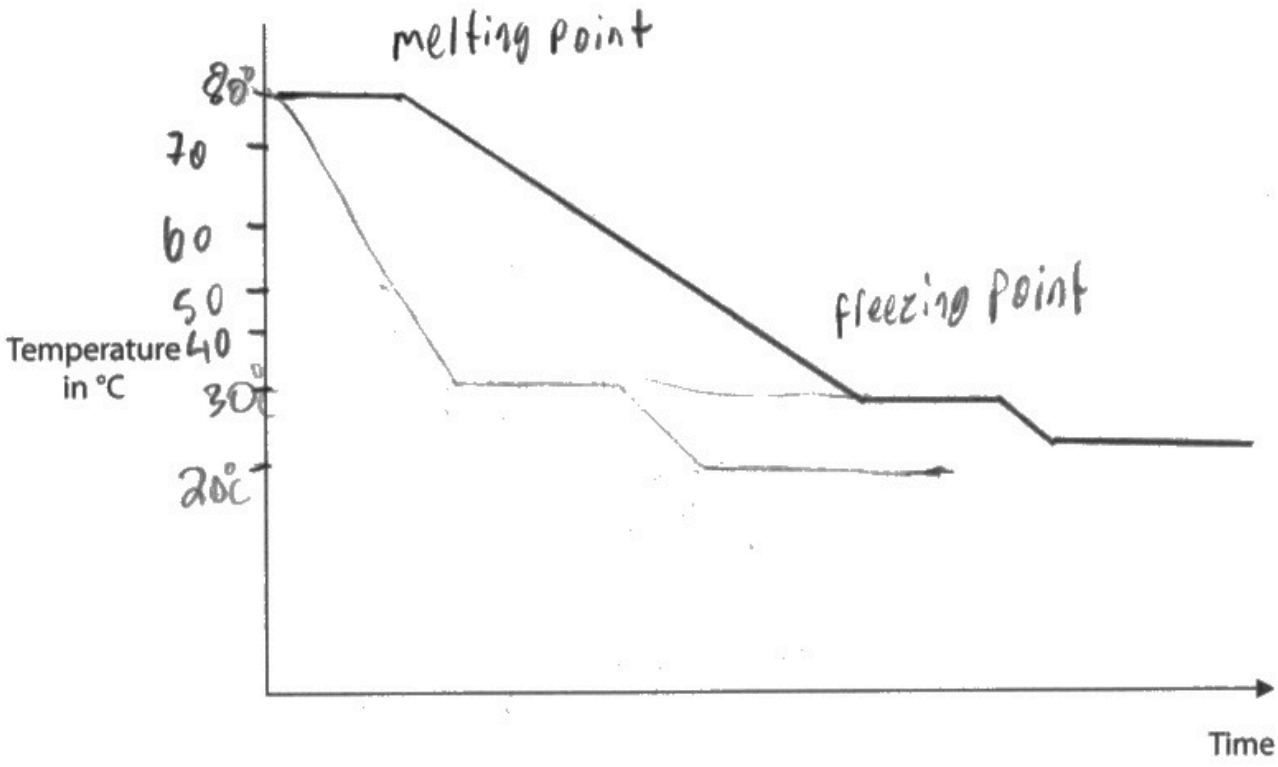
The freezing temperature of gallium is 30 °C.

The final temperature of the solid gallium is 20 °C.

Complete the graph to show how the temperature of the gallium changes during the time that it cools to 20 °C.

Add appropriate values to the temperature axis.

(3)



ResultsPlus
Examiner Comments

This response scored 2 marks. The inclusion of an additional horizontal section at the beginning of the process indicates an additional change of state (supported by this candidate labelling it as "melting point"). The horizontal section at the end of the process was allowed as the gallium would be unlikely to cool further below room temperature.

(b) The initial temperature of the sample of liquid gallium is 80 °C.

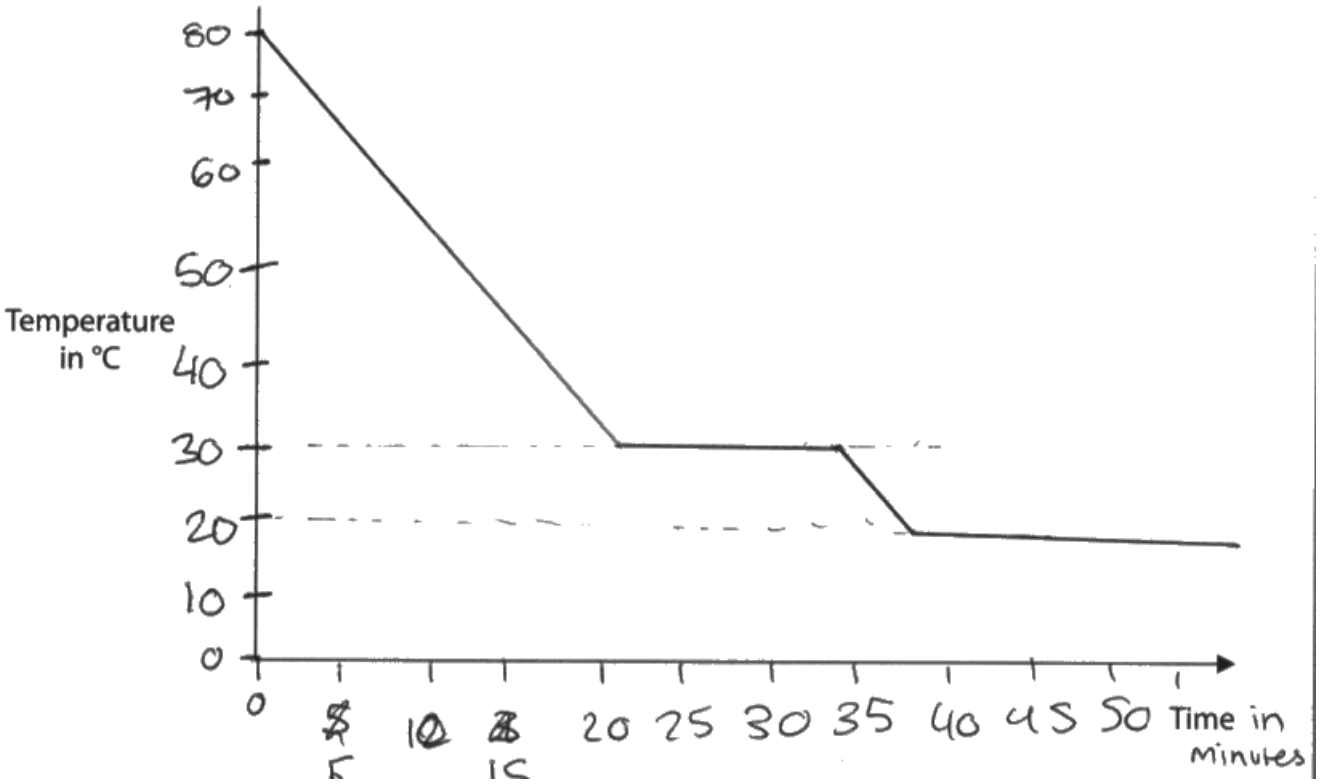
The freezing temperature of gallium is 30 °C.

The final temperature of the solid gallium is 20 °C.

Complete the graph to show how the temperature of the gallium changes during the time that it cools to 20 °C.

Add appropriate values to the temperature axis.

(3)



ResultsPlus
Examiner Comments

This response was fully correct and was awarded 3 marks.

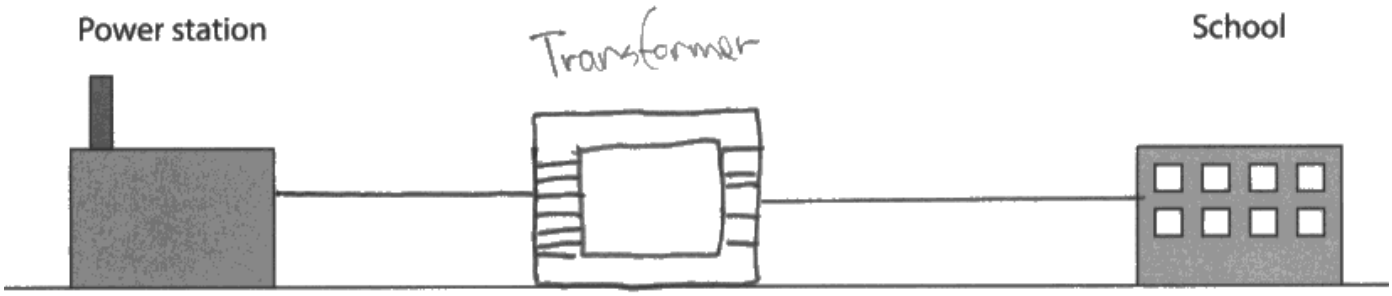
Question 4 (a)

Most candidates scored at least 1 mark in this question, but many completely misinterpreted what was being asked and simply drew pictures of pylons and transmission lines. Some candidates lost marks for only drawing one transformer or for confusing which one was "step-up" and which one was "step-down". Other candidates did not label their drawings, but many were drawn well enough to still gain full marks.

(a) The diagram shows a power station and a school.

Add to the diagram by drawing the structures needed to efficiently transfer energy from the power station to the school using electricity.

(3)



ResultsPlus
Examiner Comments

This response scored 1 mark for drawing a single transformer.

(a) The diagram shows a power station and a school.

Add to the diagram by drawing the structures needed to efficiently transfer energy from the power station to the school using electricity.

(3)

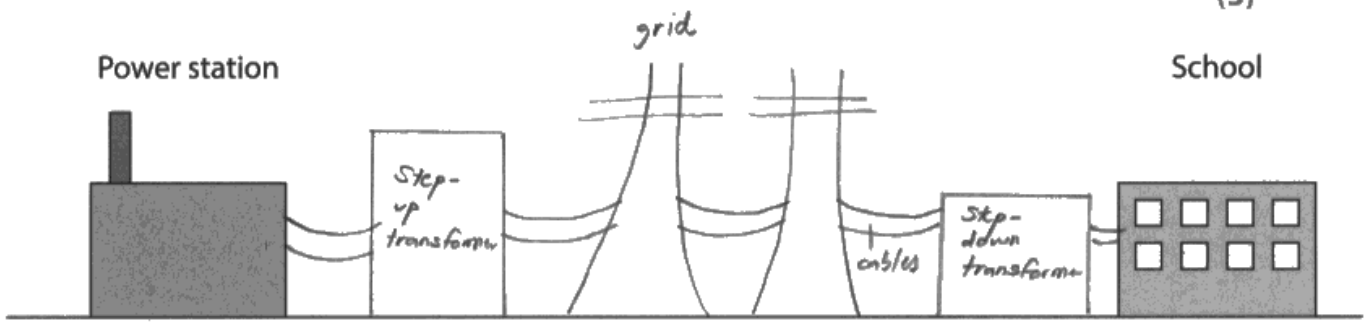
ResultsPlus
Examiner Comments

This response scored 2 marks. Although the candidate has correctly drawn two transformers, they have labelled them the wrong way round.

(a) The diagram shows a power station and a school.

Add to the diagram by drawing the structures needed to efficiently transfer energy from the power station to the school using electricity.

(3)



ResultsPlus
Examiner Comments

This response scored 3 marks. Both transformers have been drawn and labelled correctly.

(a) The diagram shows a power station and a school.

Add to the diagram by drawing the structures needed to efficiently transfer energy from the power station to the school using electricity.

(3)

ResultsPlus
Examiner Comments

This response also scored 3 marks. Although the objects have not been labelled, they are clearly identifiable as transformers and the turns show whether they are step-up or step-down.

Question 4 (b)

Most candidates knew what a transformer was used for (changing voltage and current), although this was not always correctly applied in this question. In some cases, candidates would just describe every stage of the step-up/step-down process, which usually resulted in the second marking point being awarded. The connection between current and heating in the wires (MP1) was seen less often. However, the loss of thermal energy was generally well known.

Question 5 (a)

Candidates found this question surprisingly challenging and more than half did not score any marks. Although many candidates knew that this scenario was an example of Newton's third law, they did little more than recite this law "every action has an equal and opposite reaction". This was not deemed to be a suitable description of the forces and so only scored 1 mark. More candidates opted to compare the magnitude of the forces, rather than their directions. Some candidates simply stated that the forces were the same, which was not credited due to it not clearly being linked to the magnitude of the forces.

(a) When the balls collide, ball B applies a force on ball A, which causes the velocity of ball A to change.

Ball A also applies a force on ball B during the collision.

Describe how the force applied on ball A compares with the force applied on ball B during the collision.

(2)

The force on ball A and the force on ball ~~the~~ B are equal, as Newton's third law of motion states that every force has an equal but opposite reaction force.

ResultsPlus
Examiner Comments

This response scored 1 mark. The forces are clearly referred to as being equal, but the recital of Newton's third law was insufficient to be awarded the mark for the forces being in opposite directions.

(a) When the balls collide, ball B applies a force on ball A, which causes the velocity of ball A to change.

Ball A also applies a force on ball B during the collision.

Describe how the force applied on ball A compares with the force applied on ball B during the collision.

(2)

The force applied on ball A and ball B are equal in magnitude but opposite in direction.

ResultsPlus
Examiner Comments

This response clearly compares both aspects of the forces and was awarded 2 marks.

Question 5 (b)-(c)

Candidates performed well in these calculations. Few experienced difficulties when attempting Q05(b). Most candidates knew to apply the law of conservation of momentum in Q05(c), but many experienced difficulties in setting up a mathematical equation to solve. However, candidates were provided with the answer to the calculation and this prompted many to go back and check their working to identify their mistake(s); the most common error was not including the velocity/momentum of ball A after the collision as a negative value since it was travelling in the opposite direction.

(b) Calculate the momentum of ball A before the collision.

(2)

$p = m \times v$

$p = 0.018 \times 4.9 = 0.0882$

momentum of ball A before collision = 0.0882 kg m/s

(c) Show that the velocity, v, of ball B after the collision is about 0.6 m/s.

(4)

momentum after the collision = momentum before

momentum after = $3.5 \times$ ~~0.018~~ $0.018 = 0.063$

ResultsPlus
Examiner Comments

This response scored 2 marks in Q05(b) and 1 mark in Q05(c). The candidate knew to apply the law of conservation of momentum, but was unable to develop their calculation beyond this.

(b) Calculate the momentum of ball A before the collision.

(2)

$p = m \times v$

$= 0.018 \times 4.9$

$= 0.0882$ kg m/s

momentum of ball A before collision = 0.0882 kg m/s

(c) Show that the velocity, v, of ball B after the collision is about 0.6 m/s.

(4)

$0.0882 = (3.5 \times 0.018) + (v \times 0.265)$

$0.0882 = 0.063 + 0.265v$

~~$0.265v = \frac{0.0882}{0.063}$~~

~~$v = \frac{1.4}{0.265}$~~

$0.265v = 0.0882 - 0.063$

$v = \frac{0.0252}{0.265}$

$v = 0.0951$

~~$v =$~~

ResultsPlus
Examiner Comments

This response scored 2 marks in Q05(b) and 3 marks in Q05(c). The candidate has applied the law of conservation of momentum, but has not accounted mathematically for ball A travelling in the opposite direction after the collision. This has led to an incorrect value of 0.095 m/s as the velocity of ball B after the collision.

ResultsPlus
Examiner Tip

In "show that" style calculations candidates should check their working if their calculated answer does not round to the value given in the question. This should indicate that they have made a mistake.

(b) Calculate the momentum of ball A before the collision.

(2)

momentum = mass x velocity

momentum (A) : 0.018 x 4.9

= 0.0882 kg m/s

momentum of ball A before collision = 0.0882 kg m/s

(c) Show that the velocity, v, of ball B after the collision is about 0.6 m/s.

(4)

$(0.265 \times v) - (3.5 \times 0.018) = 0.0882$

$0.265v - 0.063 = 0.0882$

$0.265v = 0.1512$

$v = 0.5706$ m/s

$v \approx 0.6$ m/s

ResultsPlus
Examiner Comments

This response scored 2 marks in Q05(b) and 4 marks in Q05(c). The candidate has applied the law of conservation of momentum correctly to calculate the correct value of velocity of ball B after the collision.

Question 5 (d)

Candidates applied their knowledge and understanding well in this unfamiliar context of elastic collisions. Most candidates selected the correct formula and most made an attempt at calculating the kinetic energy before and after the collision, the former being more successful due to it including only one moving object. There were a significant number of miscalculated values caused by adding together masses to give a total mass of 0.283kg. Some candidates tried to use the momentum equation to show the difference in kinetic energy, perhaps knowing they had to reference kinetic energy, but didn't choose the correct formula. Some candidates did not attempt a clear conclusion regardless of their calculations.

Question 6 (a)

Solar panels were well understood, and were sometimes the only energy source that was discussed. Either because candidates didn't realise they were supposed to refer to both, or they didn't know what geothermal was. While many candidates did refer to geothermal, with correct references to the limited number of places that they could be built, some thought it was a traditional fossil fuel power station. Other candidates made it difficult to identify which source they were attributing the advantage and disadvantage to, sometimes incorporating them together, although there were many good examples of them clearly separating them out using sub-headings and bullet points.

There were a large number of responses that cited '**renewable**' as being an advantage, despite this being clearly given in the stem of the question. Other responses included subjective points such as 'causes visual pollution / costs lots (or more) to build or maintain' and these were not credited.

There were several common misunderstandings expressed:

- geothermal plants not releasing greenhouse gases.
- geothermal relying on fossil fuels.
- geothermal being a finite resource.

Some candidates confused geothermal with a biofuel plant. There were lots of discussions about plant start up times (mostly wrong) and ability to meet demand changes as well as putting solar panels on houses (presumably a direct advantage for householder bills – but this was not expressed).

The most common creditworthy responses were:
Advantages of solar: doesn't produce CO_2 / greenhouse gases.
Disadvantages of solar: takes up too much land / sun doesn't always shine.
Advantages of geothermal: (often not seen) / took up little space / works 24 hours a day.
Disadvantages of geothermal: produces greenhouse or toxic gases / not available in all locations.

Discuss the advantages and disadvantages of generating electricity using solar power and geothermal resources.

(4)

One advantage of using solar and geothermal is that the energy is sustainable. Another advantage of using solar is that it is cheaper to set up and maintain. A disadvantage of solar is that it is not very effective and also it takes up a lot of space. A disadvantage of geothermal is that it releases harmful gases.

ResultsPlus
Examiner Comments

This response scored 2 marks. The advantages and disadvantages for each method are easy to identify. However, only the disadvantages are worthy of credit. The advantages are either a repetition of the information given in the question or focus on subjective issues such as cost.

Discuss the advantages and disadvantages of generating electricity using solar power and geothermal resources.

(4)

advantage of Solar Power :- renewable resource
- no air Pollution and green house gas.

disadvantage of Solar Power :- occupy large amount of land.
- not always have sun.

advantage of geothermal resources: ~~stable~~ - it is steady
- don't depend on weather.

disadvantage of geothermal resources: - Produce green house gas
- high building cost.

ResultsPlus
Examiner Comments

This is an excellent response and it scored 4 marks. A suitable advantage and disadvantage is given for both methods.

Question 6 (b)(i)

Nearly half of all candidates produced a results table that scored full marks. Headings were usually clear in tables with two columns. Units caused the most significant difficulty with some candidates losing a mark for adding units to the data in the body of the table. Surprisingly, some candidates drew a graph instead of a table.

Draw a table showing the student's results. (3)

Distance in cm	output voltage in V
5	0.45
8	0.18
11	0.1
14	0.06
17	0.04
20	0.03

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate lost a mark for not writing all the values of output voltage correctly to decimal places.

Draw a table showing the student's results. **(3)**

Distance in cm	output voltage
5 cm	0.45V
8 cm	0.18V
11 cm	0.10V
14 cm	0.06V
17 cm	0.04V
20 cm	0.03V

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate lost a mark for including units with the data in the body of the table, rather than only in the column headings.

Draw a table showing the student's results.

(3)

cm	volts
5.	0.45
8	0.18
11	0.10
14	0.06
17	0.04
20	0.03

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate lost a mark for not writing the names of the variables in the column headings.

Draw a table showing the student's results.

(3)

Distance (cm)	Voltage (V)
5	0.45
8	0.18
11	0.10
14	0.06
17	0.04
20	0.03

ResultsPlus
Examiner Comments

This response scored 3 marks.

Question 6 (b)(ii)

It was surprising to see less than half of all candidates give an appropriate control variable in this question. Most incorrect answers referred to the distance between the lamp and the solar cell, which highlighted misunderstandings between the different variables used in an investigation.

Question 6 (b)(iii)

This question caused many candidates to make incorrect statements. The main issue was candidates were under the impression that the bulb hadn't lit up yet and made detailed reference to the fact that if there was no energy in the system to begin with, then that was the reason it could not work.

Question 7 (a)

Candidates recognised that sound travels very fast, but less than half of all candidates could extend this idea to why standing closer to the wall presented a problem. Some candidates stated that an echo wouldn't be heard, which was too vague to earn credit.

Question 7 (b)(i)-(iv)

These linked questions differentiated well between candidates. Most candidates circled the correct anomaly in Q07(b)(i). However, the reason for the anomaly proved to be a more challenging question. Some responses were too vague and cited human error or reaction time issues as the cause of the anomaly. Most successful candidates in Q07(b)(ii) referred to the stopwatch being started late or stopped early.

The mean value in Q07(b)(iii) was often calculated correctly, but errors were seen in not excluding the anomaly or presenting the final value to an incorrect number of decimal places. Candidates usually scored at least 1 mark in Q07(b)(iv), but many failed to double the distance and/or divide the time by 20.

(b) The students repeat their method five times.

The table shows the students' results.

Time between starting and stopping timer in seconds					
test 1	test 2	test 3	test 4	test 5	mean
11.80	11.18	11.76	11.75	11.72	

(i) The students decide that one of their tests shows an anomalous result.

Circle the anomalous result in the table.

(1)

(ii) Suggest a reason for the anomalous result.

(1)

The student started the stop watch early

(iii) Calculate the mean time between starting and stopping the timer.

Give your answer to a suitable number of decimal places.

(3)

$$\frac{11.80 + 11.76 + 11.75 + 11.72}{4} = 11.8$$

mean time = 11.8 s

(iv) The speed of sound in air can be calculated using the formula

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

Use the students' results to calculate a value for the speed of sound in air.

(3)

$$\text{Speed} = \frac{100}{11.8}$$
$$= 8.47$$

speed of sound = 8.47 m/s

ResultsPlus
Examiner Comments

This candidate did not score the mark in Q07(b)(ii) since starting the stopwatch early would result in a longer time, not shorter. Although the anomaly has been correctly excluded in the mean calculation, the candidate has rounded to an incorrect number of decimal places, so loses a further mark. Finally, the candidate does not double the distance or divide the time by 20 in Q07(b)(iv) so loses a further 2 marks.

(b) The students repeat their method five times.

The table shows the students' results.

Time between starting and stopping timer in seconds					
test 1	test 2	test 3	test 4	test 5	mean
11.80	11.18	11.76	11.75	11.72	

(i) The students decide that one of their tests shows an anomalous result.

Circle the anomalous result in the table.

(1)

(ii) Suggest a reason for the anomalous result.

(1)

The student's reaction was early.

The student stood closer to the wall, therefore reacting earlier and stopping the timer early.

(iii) Calculate the mean time between starting and stopping the timer.

Give your answer to a suitable number of decimal places.

(3)

$$\frac{11.80 + 11.76 + 11.75 + 11.72}{4}$$

$$= 11.76$$

mean time = 11.76 s

(iv) The speed of sound in air can be calculated using the formula

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

Use the students' results to calculate a value for the speed of sound in air.

(3)

$$V = \frac{200}{11.76}$$

$$v = 17.0$$

speed of sound = 17.0 m/s

ResultsPlus
Examiner Comments

This candidate lost a single mark in Q07(b)(iv) since they have not divided the time by 20. All their other work is correct.

(b) The students repeat their method five times.

The table shows the students' results.

Time between starting and stopping timer in seconds					
test 1	test 2	test 3	test 4	test 5	mean
11.80	11.18	11.76	11.75	11.72	

(i) The students decide that one of their tests shows an anomalous result.

Circle the anomalous result in the table.

(1)

(ii) Suggest a reason for the anomalous result.

(1)

student stopped the timer ~~late~~ early

(or)

student ~~began~~ started the timer late

(iii) Calculate the mean time between starting and stopping the timer.

Give your answer to a suitable number of decimal places.

(3)

$$\frac{11.80 + 11.18 + 11.76 + 11.75 + 11.72}{5}$$

$= 11.642$

≈ 11.64

mean time = 11.64 s

(iv) The speed of sound in air can be calculated using the formula

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

Use the students' results to calculate a value for the speed of sound in air.

(3)

$$\text{speed} = \frac{100 \times 2 \times 2}{11.64}$$

$= 343.6$

speed of sound = ... m/s

ResultsPlus
Examiner Comments

This candidate lost a single mark in Q07(b)(iiii) since they have included the anomaly in their mean calculation. All their other work is correct.

Question 8 (a)(i)

Most responses scored 1 mark, usually for simply identifying that the proton has a positive charge.

Question 8 (a)(ii)

Candidates completed the calculation in Q08(a)(ii) to a high standard to score full marks. Occasionally mistakes were seen when rearranging the formula or failing to give the final evaluation to more significant figures than the value given in the question.

Question 8 (b)(i)

Only the most able candidates were able to deduce the correct direction of the magnetic field in this question.

Question 8 (b)(ii)

Most candidates were able to identify the increased force on the proton, with most achieving 1 mark. Most candidates also referred an increase in speed of the proton, which was not creditworthy. More able candidates gave the idea of a shorter path, but few suggested that the acceleration would increase.

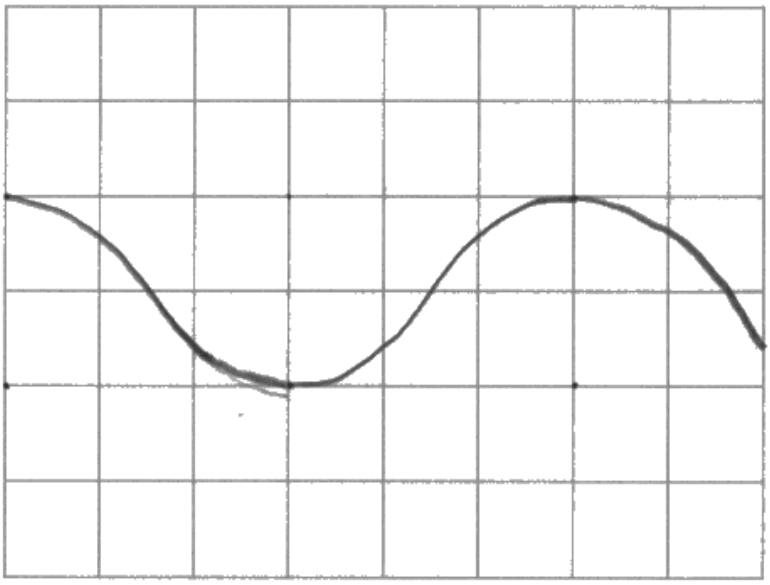
Question 9 (a)

Surprisingly, a third of all candidates did not know which instrument should be connected to the oscilloscope in this question.

Question 9 (b)

It was very encouraging to see candidates perform very well in this question; half of all candidates were able to score full marks. Some candidates calculated the time period correctly, but did not draw this correctly on the oscilloscope grid, which resulted in losing a single mark.

(b) The diagram shows the screen of the oscilloscope and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 2V
x direction: 1 square = 0.001 s

A sound wave of frequency 250 Hz is detected.

The sound wave produces a trace on the oscilloscope of amplitude 4 V.

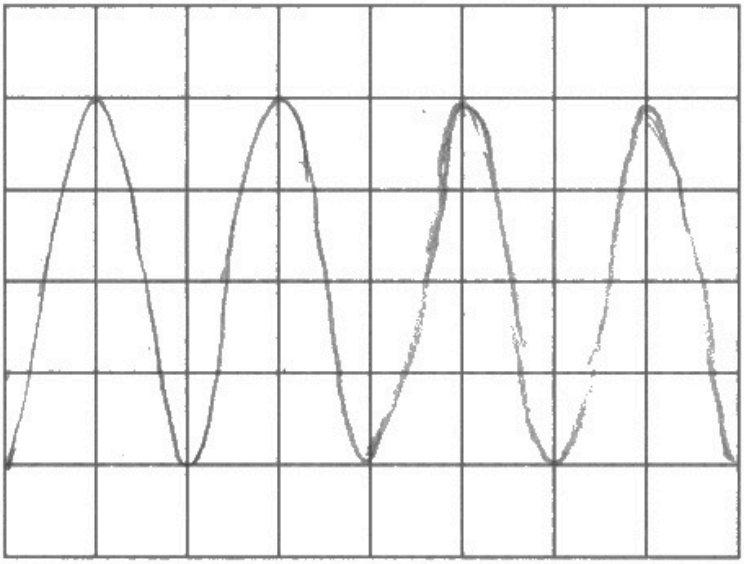
Complete the diagram by drawing the trace of this sound wave on the oscilloscope screen.

(5)

ResultsPlus
Examiner Comments

This response scored 1 mark. The trace resembles a sine wave, but none of its properties are correctly drawn.

(b) The diagram shows the screen of the oscilloscope and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 2V
x direction: 1 square = 0.001 s

A sound wave of frequency 250 Hz is detected.

The sound wave produces a trace on the oscilloscope of amplitude 4 V.

Complete the diagram by drawing the trace of this sound wave on the oscilloscope screen.

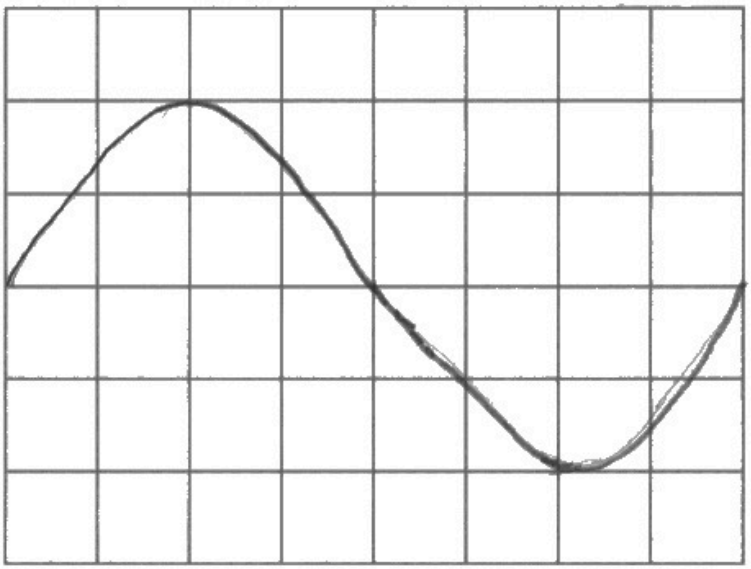
(5)

speed = frequency x wavelength.
= 250 x 4
= 1000 s

ResultsPlus
Examiner Comments

This response scored 2 marks. The trace resembles a sine wave and has the correct amplitude, but its period is incorrect. The working shown in the answer space is irrelevant/incorrect.

(b) The diagram shows the screen of the oscilloscope and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 2V
x direction: 1 square = 0.001 s

A sound wave of frequency 250 Hz is detected.

The sound wave produces a trace on the oscilloscope of amplitude 4V.

Complete the diagram by drawing the trace of this sound wave on the oscilloscope screen.

(5)

$\text{Freq} = \frac{1}{\text{time period}}$

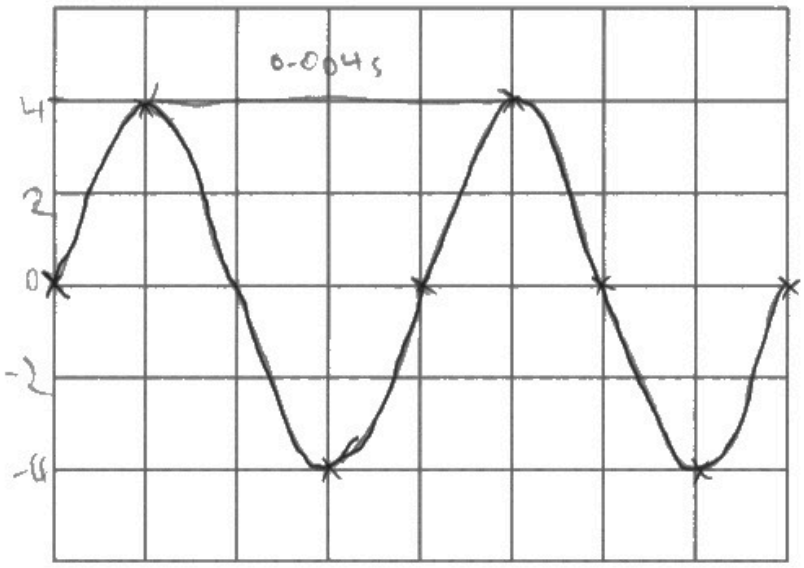
$250 = \frac{1}{t}$

$t = 0.004\text{ s}$

ResultsPlus
Examiner Comments

This response scored 4 marks. The trace resembles a sine wave and has the correct amplitude, but its period is incorrect. However, the working clearly shows that it should have a period of 0.004s despite this not being shown on the trace.

(b) The diagram shows the screen of the oscilloscope and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 2V
x direction: 1 square = 0.001 s

A sound wave of frequency 250 Hz is detected.

The sound wave produces a trace on the oscilloscope of amplitude 4 V.

Complete the diagram by drawing the trace of this sound wave on the oscilloscope screen.

(5)

$f = \frac{1}{T}$

$T = \frac{1}{f}$

$T = \frac{1}{250}$

$T = 0.004$ s for one wave

$\frac{4}{2} = 2$ squares vertically

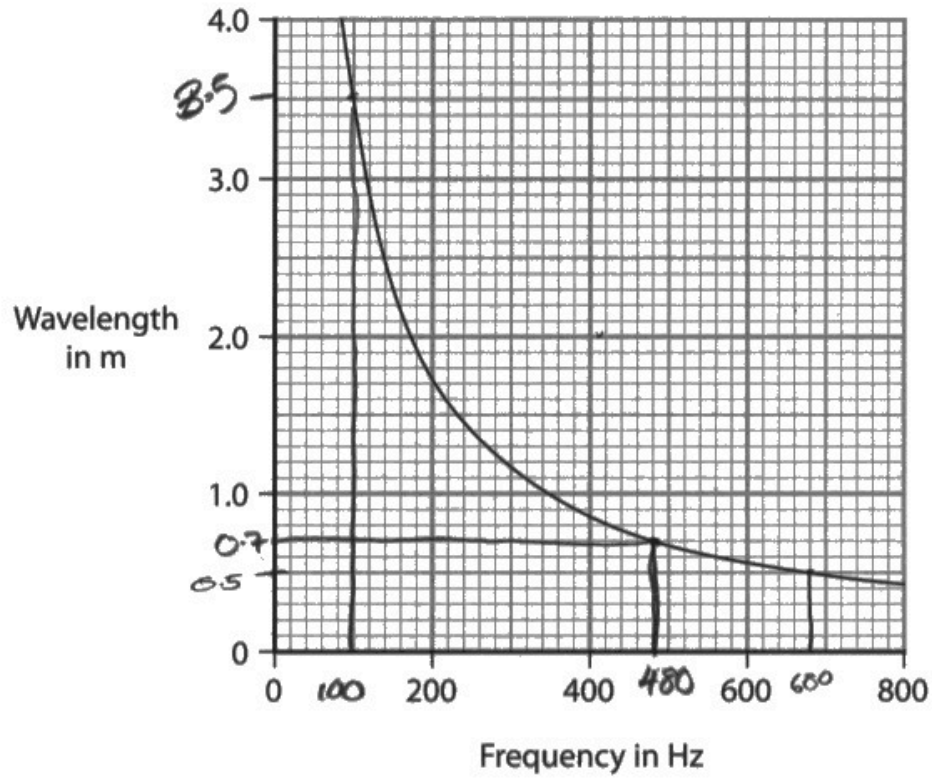
ResultsPlus
Examiner Comments

This response is correct and scored 5 marks.

Question 9 (c)

Candidates were usually able to score at least 1 or 2 marks for correctly calculating 1 or more constants from data read from the graph. However, many candidates did not appreciate that with real experimental data we expect to see some variation due to errors (uncontrolled variables) or, more likely, slight errors in reading data from the graph and so did not reach the correct conclusion, that the variables are inversely proportional. Others did not provide a comparative statement about their calculated data (such as they are roughly the same etc.) so could not score the final marking point. There were also many weaker responses to this question that adopted a purely qualitative response, which did not score any marks.

(c) The graph shows how the wavelength of sound waves in air varies with their frequency.



If wavelength and frequency are inversely proportional, then

wavelength × frequency = constant

Using the graph, evaluate whether the wavelength of sound waves in air is inversely proportional to their frequency.

(3)

$100 \times 3.5 = 350$ ~~⇒ when $\lambda = 3.5$,~~

$480 \times 0.7 = 336$

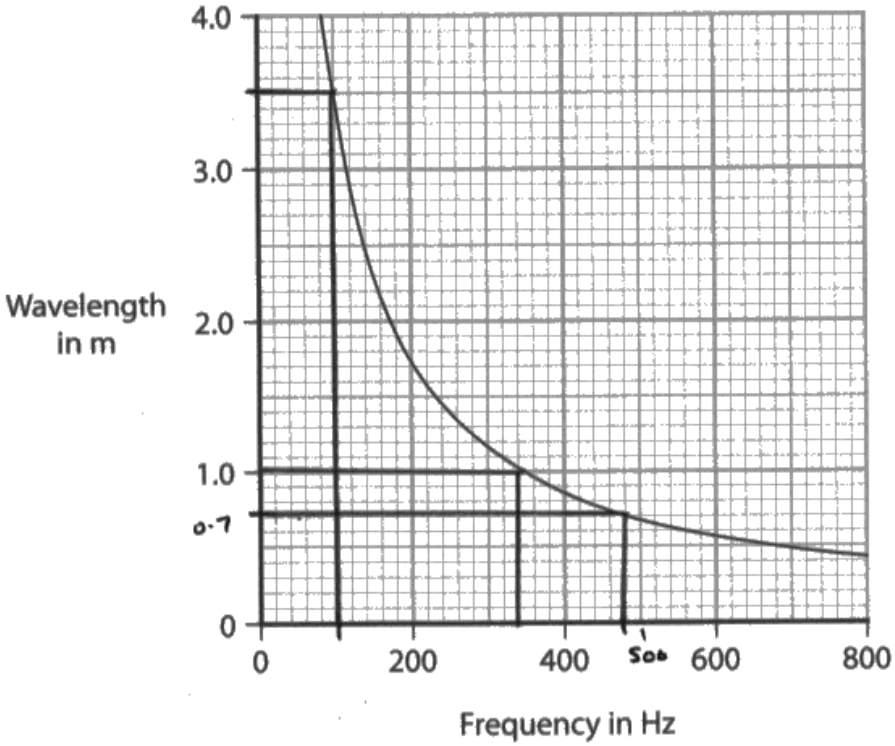
$680 \times 0.5 = 340$

∴ they are not inversely proportional because when taking multiple values, the constant for each are similar, but not exact

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate has correctly calculated some constants using data from the graph, but expects them to be exactly the same for the relationship to be valid. No appreciation of any errors has been given and so the final marking point is not awarded.

(c) The graph shows how the wavelength of sound waves in air varies with their frequency.



If wavelength and frequency are inversely proportional, then

wavelength × frequency = constant

Using the graph, evaluate whether the wavelength of sound waves in air is inversely proportional to their frequency.

(3)

0·7m × 480Hz = 336

3·5m × 100Hz = 350

1·0m × 340Hz = 340

The values of the constant are similar, therefore wavelength is inversely proportional to frequency.

ResultsPlus
Examiner Comments

This response scored 3 marks. The candidate has correctly calculated some constants and appreciates that they do not need to be exactly equal for the relationship to be valid.

Paper Summary

Based on their performance on this paper, candidates should:

- Take note of the number of marks available for each question and use this as a guide for the amount of detail expected in the answer.
- Take note of the command word used in each question to determine how the examiner expects the question to be answered, for example, whether to give a description or an explanation.
- Be able to use the formulae listed in the specification confidently in terms of substitution, rearrangement and evaluation.
- Know the SI units for physical quantities and be able to convert from non-SI units to SI units when required.
- Show all working so that some credit can still be given for answers that are only partly correct.
- Take advantage of opportunities to draw labelled diagrams as well as, or instead of, written answers.

Grade boundaries

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