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Examiners' Report
June 2022

International GCSE Physics 4PH1 2PR

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June 2022

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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 candidates' demonstrations of experimental skills and understanding. Candidates were provided with advance information about which sub-topics from the specification would form the main focus of the examination. In addition, candidates were provided with a full list of the formulae to be used.

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.

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Question 1 (a)

Q01(a) differentiated well between candidates who had revised the Hertzsprung-Russell diagram and those who had not. It was well answered by most with a significant majority able to score full marks. Others scored two or one mark probably due to a combination of guesses or they had revised the evolution of stars and therefore were able to make an informed match for the red giant and white dwarf.

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Question 1 (b)

Most candidates knew the answer to Q01(b) and many knew the correct distance despite knowledge of parsecs being beyond the specification. Some weaker candidates discussed size or distance with no mention of brightness.

(b) Describe what is meant by the term **absolute magnitude**.

(2)

The brightness of the star, taking account of its distance.

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Examiner Comments

This response was awarded 1 mark. The candidate knows that absolute magnitude is a measure of brightness, but the idea of a standard distance is not clear so the second mark is withheld.

(b) Describe what is meant by the term **absolute magnitude**.

(2)

The brightness of star at a standard distance (i.e. 10 parsecs)

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Examiner Comments

This response was awarded 2 marks and represents a model definition of absolute magnitude.

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Question 2 (a)

Most candidates were comfortable with the experiment in Q02(a) and produced well-prepared responses, most likely due to the experiment's named inclusion in the advance information. The majority of candidates opted to describe a method with two people standing a large distance apart, although others chose an echo method. A few candidates described a method using microphones and oscilloscopes, but these candidates sometimes confused the purpose of the oscilloscope as a device to measure a time interval, rather than observing when the microphones are exactly one wavelength apart. Generally, candidates can improve their methods by ensuring a suitable distance is included ie people standing at least 100m apart.

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2 (a) Describe an investigation to determine the speed of sound.

You may draw a diagram to help your answer.

(5)

~~dia~~ Put a device that produce sound at one place. Put another device that can detect ~~the~~ and record the ~~tine~~ time it takes for the sound to arivee. Then use the speed ~~forer~~ formula of speed = $\frac{\text{distance}}{\text{time}}$ to determine the speed of sound.

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Examiner Comments

This candidate has described an unusual method and one that most likely will not be effective in measuring the speed of sound. However, they have been awarded 2 marks for the idea of measuring the time for sound to travel a distance (MP1) and a suitable formula (MP6). The candidate's diagram does not receive any marks as it is not labelled.

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Examiner Tip

Diagrams should be labelled if they are likely to be awarded any marks when supporting written responses.

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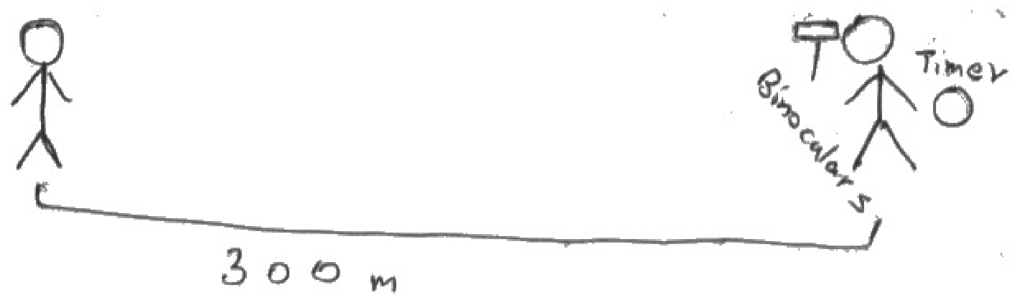
2 (a) Describe an investigation to determine the speed of sound.

You may draw a diagram to help your answer.

(5)



~~Use~~ Stand 300 meters away from a friend. The Friend is given a stop watch and a binocular. You will clap once, when the friend sees it using the binocular he starts the stopwatch. He ends it when he hears the sound. Repeat this three times and get the average time. Use that in the equation :-

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Make sure the area has no reflective surfaces that may affect the sound. Repeat the entire test around 3 times and ga the average speed found. Make sure that there are no other sources of sounds that could sabotage the experiment.

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Examiner Comments

This is an excellent response, which was awarded full marks. All six marking points from the mark scheme are covered.

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Question 2 (b)

More able candidates coped well with the demands of Q02(b) and usually scored full marks. Weaker candidates struggled to count the correct number of squares for one wavelength and then could not apply the correct scale due to the timebase being given in milliseconds. Some candidates tried to use f=1/T in Q02(b)(i), rather than in Q02(b)(ii). However, most candidates received full marks in Q02(b)(ii) due to the application of error carried forward (ECF).

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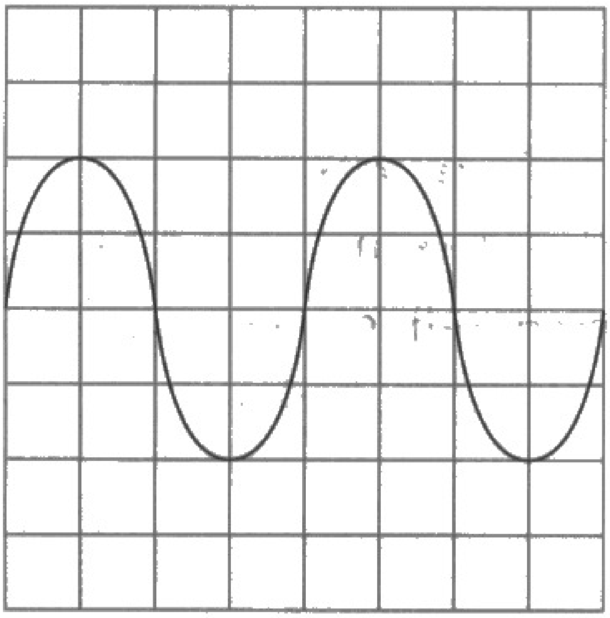
(b) A microphone is connected to an oscilloscope.

A sound is detected by the microphone.

The diagram shows the oscilloscope trace.



Oscilloscope settings

y direction: 1 square = 0.1 V

x direction: 1 square = 5.0 ms

(i) Determine the period of the sound wave.

(3)

8 x 5 = 40 ms

40 ÷ 1000 = 0.04 s

period = 0.04 s s

(ii) Calculate the frequency of the sound wave.

(2)

4 x 5 = 20 ms

20 ÷ 1000 = 0.02 s

$\frac{1}{0.02\,s}$ = 50 Hz

frequency = 50 Hz

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Examiner Comments

This candidate has read the trace period incorrectly from the screen as 8 squares. However, they have then gone on to use the timebase setting and deal with the conversion from milliseconds to seconds correctly to earn 2 marks in Q02(b)(i). Error carried forward has been applied in Q02(b)(ii) to award a further 2 marks.

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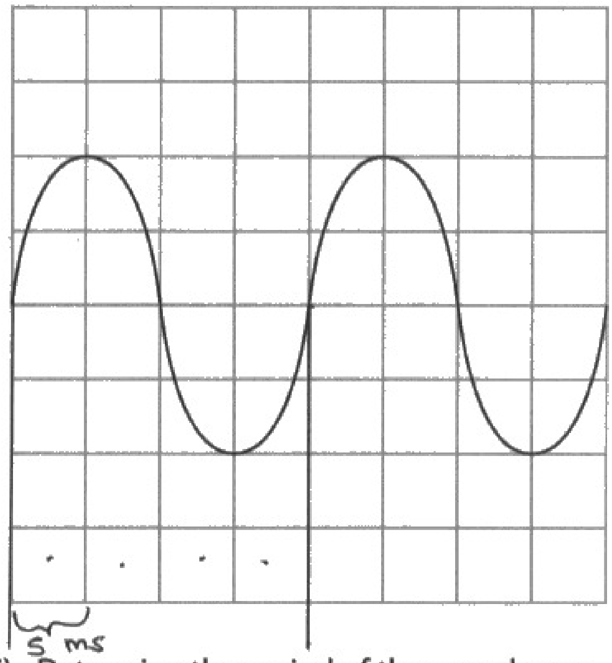
(b) A microphone is connected to an oscilloscope.

A sound is detected by the microphone.

The diagram shows the oscilloscope trace.



Oscilloscope settings
y direction: 1 square = 0.1 V
x direction: 1 square = 5.0 ms

(i) Determine the period of the sound wave.

(3)

5 ms × 4 = 20 ms   1 ms = 1×10^{-3} s

20×10^{-3} s

period = 20×10^{-3} s

(ii) Calculate the frequency of the sound wave.

(2)

~~f~~ ~~v = f λ~~

$f = \frac{1}{T} = \frac{1}{20 \times 10^{-3}}$

= 50

frequency = 50 Hz

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Examiner Comments

This response is wholly correct and was awarded full marks. The candidate's working is neatly laid out and is easy to follow.

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Question 3 (a)

Q03(a) required candidates to give differences between the sulfur particle and sulfur ion. Those candidates who answered incorrectly mainly focused their answers with comments about their electrostatic forces (attraction and repulsion), speeds and masses. There were also incorrect use of ions inside an atom and some candidates effectively rewrote the question as a statement ie 'neutral has no charge and positive has positive charge'.

3 The SPS is a particle accelerator in Geneva.

The SPS can accelerate sulfur particles to speeds almost as fast as the speed of light.

(a) Neutral sulfur particles can become positively charged sulfur particles.

Describe the difference between a neutral sulfur particle and a positively charged sulfur particle.

(2)

neutral sulfur particles has equal number of electrons and protons whereas positively charged sulfur particles has protons only.

ResultsPlus
Examiner Comments

This response was awarded 1 mark. The description of the neutral particle is correct, but the description of the positive ion is misleading and inaccurate so the second mark was withheld.

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Question 3 (b)

The first marking point was seen in most candidates' responses in Q03(b) as candidates identified either repulsion or attraction. However, many candidates did not link this to acceleration through the inclusion of a (resultant) force in their response. Some candidates confused terminology from the magnetism topic and referred to opposite poles attracting. This question was a good discriminator at the higher grade boundaries.

(b) Diagram 1 shows a section of the SPS.

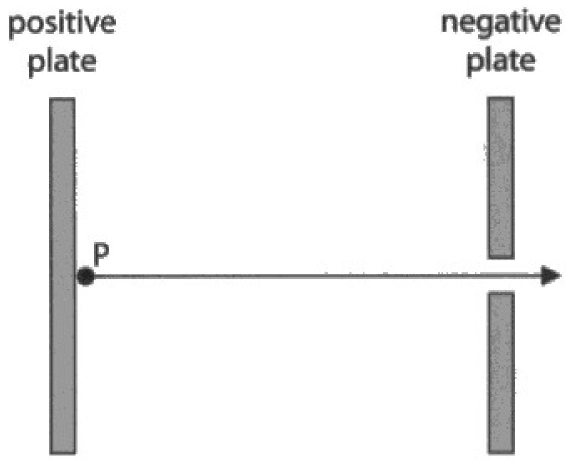

Diagram 1

Positively charged sulfur particles are introduced at point P and accelerate to the right.

Explain why the positively charged sulfur particles accelerate.

(2)

Because positive particles and positive plate repel each other thus it pushes the particle which accelerates. (like charges repel)

ResultsPlus Examiner Comments

This response scored 1 mark. The candidate has correctly identified the repulsion between like charges, but has not linked this sufficiently to the existence of a force.

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(b) Diagram 1 shows a section of the SPS.

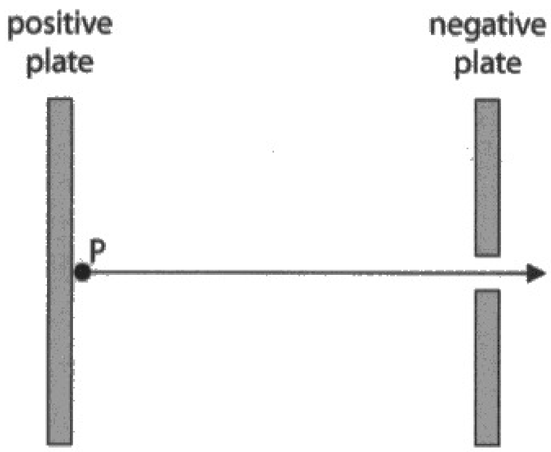

Diagram 1

Positively charged sulfur particles are introduced at point P and accelerate to the right.

Explain why the positively charged sulfur particles accelerate.

(2)

Negative plate attracts positively charged sulfur particle as opposite charge attracts. The electrostatic force therefore becomes the resultant force and makes the positively charged sulfur particles to accelerate towards negatively charged plate.

ResultsPlus
Examiner Comments

This is a higher level response, which was awarded both marks. The attraction between opposite charges is clearly expressed and this is linked to there being a resultant force.

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Question 3 (c)(ii)

Most candidates were awarded at least 2 marks in Q03(c)(ii). However, power of ten (POT) errors were the most common reason for full marks not being awarded. The unit conversion and the use of data in standard form in the same formula compounded the issue for many candidates. Weaker candidates experienced difficulty in rearranging the formula. A few candidates used speed = distance/time instead of the orbital period formula.

(ii) The tube has a radius of 1.1 km and the sulfur particle has an orbital speed of 2.9×10^8 m/s.

Calculate the orbital period of the sulfur particle.

(3)

$$\text{orbital speed} = \frac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$$

$$v = \frac{2 \times \pi \times 1.1 \text{ km}}{2.9 \times 10^8 \text{ m/s}}$$

orbital period = 0.0238 s

ResultsPlus Examiner Comments

This response was awarded 2 marks. The rearrangement of the formula and substitution of data is correct, but there is a power of ten error in the final evaluation. It is unclear from the working whether this originated from the conversion from km to m or the presentation of data in standard form.

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Question 4 (a)

Q04(a) was very well answered. Only a minority of candidates answered incorrectly with mistakes such as an incorrect temperature difference, unnecessarily trying to convert the units of mass or specific heat capacity and substituting the values of specific heat capacity and energy into the formula incorrectly.

4 A student heats a sample of water.

The student measures the temperature of the sample of water during heating.

(a) The sample of water has a mass of 0.45 kg.

Calculate the energy required to increase the temperature of the water from 16 °C to 100 °C.

[specific heat capacity of water = 4200 J/kg °C]

(3)

$\Delta Q = m \times C \times \Delta T$

$\Delta Q = 0{\cdot}45 \times 4200 \times 100 - 16$

$= 18884$

energy = 18884 J

ResultsPlus
Examiner Comments

This response was awarded 2 marks. The candidate has evaluated the temperature difference and substituted correctly into the specific heat capacity formula. However, the candidate has not used their calculator correctly to evaluate their expression.

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Examiner Tip

Candidates should be familiar with how to use their calculators. In this case, the candidate should either have used brackets or completed the calculation in several steps.

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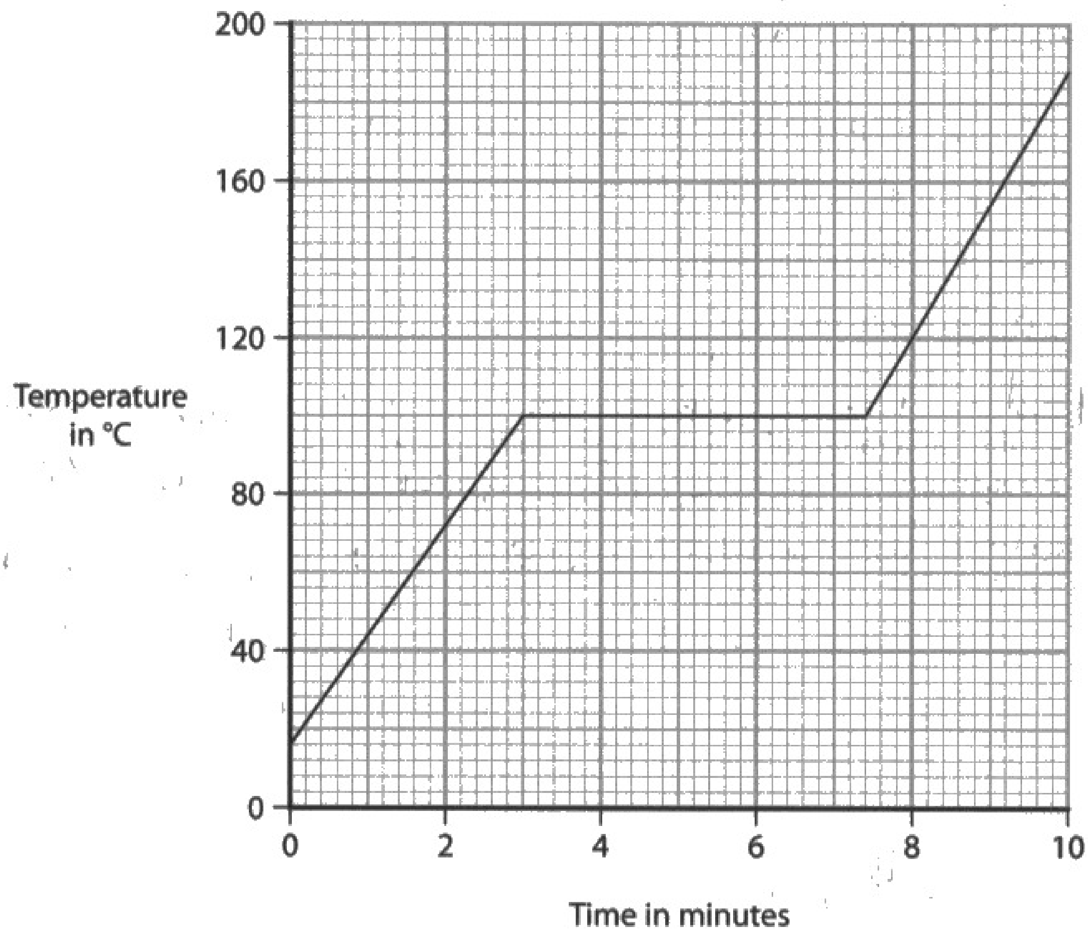
Question 4 (b)

Values for the time interval in Q04(b)(i) varied significantly, which suggested many candidates did not understand how to relate the graph to the idea of a phase change and/or could not interpret data accurately from a graph. Rearrangement of the formula was the most common source of difficulty in Q04(b)(ii). However, many candidates were awarded full marks through the application of ECF. Some candidates did not convert to seconds from minutes.

(b) The diagram shows the temperature-time graph for the sample of water.



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(i) Use the graph to determine the time taken from when the water started to boil to when the water stopped boiling.

(1)

time taken = 2.2 minutes

(ii) The heater used to heat the water has a power rating of 2200 W.

Calculate the energy required to boil all of the water.

(3)

E = I x V x t   P = I x V

E = 2200 x 2.2

E = 4840

energy = 4840 J

ResultsPlus
Examiner Comments

This candidate has misread the graph in Q04(b)(i), but has used their value correctly in Q04(b)(ii). However, they have not converted minutes into seconds and so only score 2 marks.

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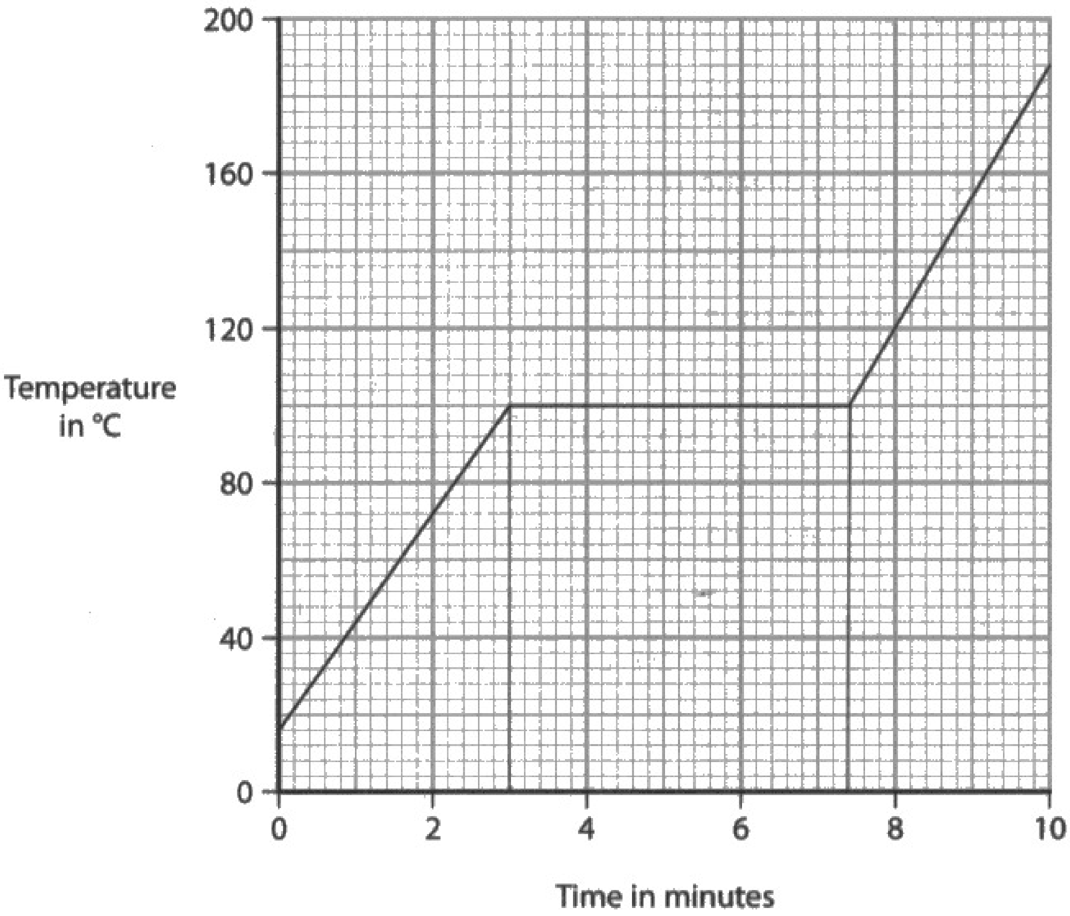
(b) The diagram shows the temperature-time graph for the sample of water.



(i) Use the graph to determine the time taken from when the water started to boil to when the water stopped boiling.

(1)

7.4 − 3 = 4.4

time taken = 4.4 minutes

(ii) The heater used to heat the water has a power rating of 2200 W.

Calculate the energy required to boil all of the water.

(3)

2200 × (4.4 × 60) = 580800 ≈ 580000

energy = 580000 J

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Examiner Comments

This candidate has answered both parts of the question correctly to earn full marks.

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Question 4 (c)

Most candidates gave valid responses in Q04(c) and were able to express their ideas with the correct terms of even thermal/heat energy distribution, which was the most popular response. A few answered with keeping temperature constant. Some candidates wrote about temperature spreading, which suggest a misconception of temperature and energy being the same thing.

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Question 4 (d)

Candidates found Q04(d) surprisingly challenging. There was a lot of discussion off topic about bonding, kinetic energy and collision theory. The best answers kept to a simple format of either two sentences such as 'in a liquid...in a gas...' or 'the motion in the two is...the arrangement in the two is...'.

The motion of water particles was often poorly described, with candidates using ‘random motion’ or ‘slow moving’ or ‘vibrating’ to describe them. Other answers described fluidity and flow in terms of macro properties (‘liquids fill their container’) and did not describe the particles themselves. Some candidates described water particles as having small gaps between them and diagrams of such resembled a gas more than a liquid. Most answers did not emphasise the large spaces between gas particles or that water particles are mostly touching each other.

(d) When water boils, the liquid water becomes a gas called steam.

Describe the changes in arrangement and motion of the molecules in liquid water and the molecules in steam.

(4)

In liquid particles ~~solide~~ slide over each other and are loosley packed. When become ~~gas~~ steam, particle freely move and collide with each other and wall of container due to kinetic energy. When become steam has no ~~sha~~ shape and has faster motion. No fixed arrangment in steam. In liquid loose arangment is there.

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This response was awarded 2 marks. The candidate has described the motion of water molecules correctly, but then described them as being loosely packed. The motion of gas molecules is also described correctly, but the idea of gas molecules being far apart from each other is missing from the response.

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(d) When water boils, the liquid water becomes a gas called steam.

Describe the changes in arrangement and motion of the molecules in liquid water and the molecules in steam.

(4)

The particles change from ~~movin~~ ~~mov~~ sliding past each other to randomly moving in all directions. The particles are arranged randomly. The particles change from packing quite closely together to ~~separating~~ seperating from ~~each o~~ each other further apart.

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Examiner Comments

This response was awarded 4 marks. The candidate has presented their ideas concisely to produce a comprehensive answer to the question.

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Question 5 (a)

Most candidates identified that transformers increase/decrease voltage in Q05(a). Although many candidates also knew that increasing the voltage caused the current to decrease, fewer explained the reason for the decrease in current. Even fewer got all 4 marks, usually missing the reason for reduced current into homes. Some candidates clearly misinterpreted the question, as answers didn't relate to the question asked.

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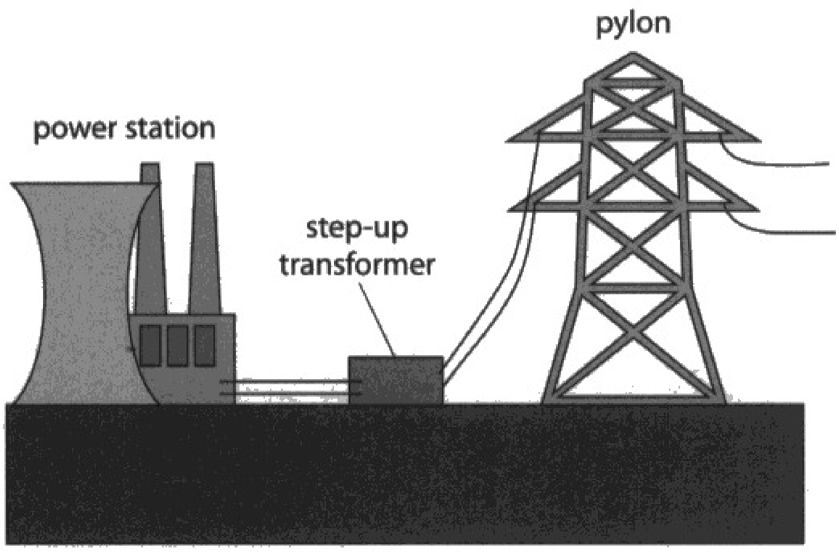
5 The diagram shows part of the National Grid.



(a) There is a step-up transformer at the power station end of a transmission line and a step-down transformer at a distant town.

Explain why step-up transformers and step-down transformers are used in this way.

(4)

A step up transformer increases the voltage so the voltage can be transffered without going down signifficantly A step down transformer decreases the voltage so it can be used ~~without destroying~~ safely in people's homes

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Examiner Comments

This response was awarded 2 marks. The candidate has identified that step-up transformers increase voltage (MP1) and also identified that step-down transformers decrease voltage for safety purposes (MP4). However, the reason for increasing the voltage is missing from the response.

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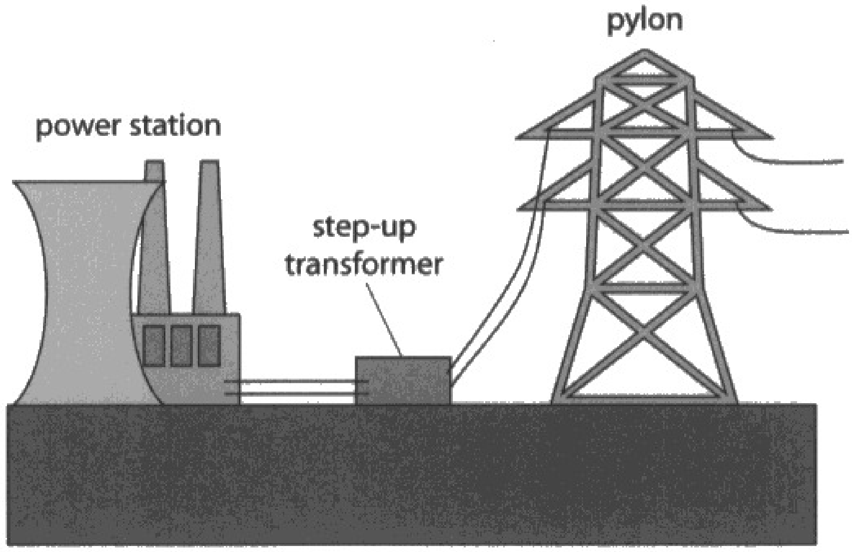
5 The diagram shows part of the National Grid.



(a) There is a step-up transformer at the power station end of a transmission line and a step-down transformer at a distant town.

Explain why step-up transformers and step-down transformers are used in this way.

(4)

A step up transformer increases the voltage and decreases the current. The decrease in current during transmission reduces the heat lost to the ~~sur~~ surroundings through ~~a~~ the wire. But as this high voltage is not safe for use in houses hence is steped down to reduce voltage to a safe level.

ResultsPlus
Examiner Comments

This response was awarded full marks. The candidate has produced a concise explanation of the inclusion of transformers in the long range transmission of electricity.

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Question 5 (b)

Most candidates answered Q05(b)(i) correctly due to the formula's inclusion in the supplied formulae sheet. The following calculation in Q05(b)(ii) was completed successfully by most candidates. Those candidates who were not able to reach the correct answer usually experienced difficulty in the rearrangement of the formula.

(b) (i) State the formula linking the input voltage, the output voltage and the turns ratio for a transformer.

(1)

$$\frac{\text{Input voltage}}{\text{output voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}.$$

(ii) The primary coil on a step-up transformer has 3300 turns.

Calculate the number of turns required on the transformer's secondary coil to step up the voltage from 15 kV to 340 kV.

(3)

3300

$$\frac{15}{340} = \frac{3300}{?} = 145.58$$

number of turns = 145.588

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Examiner Comments

This response received 1 mark in Q05(b)(ii) for a correct substitution. Although not shown in the working, issues in the rearrangement of the formula is the most likely cause for arriving at the incorrect final answer.

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Examiner Tip

Candidates should show all steps in their working clearly. The rearrangement step is missing in this response, but may have been undertaken successfully, which would have resulted in another mark being awarded.

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Question 5 (c)(i)

The majority of candidates produced correct answers in Q05(c)(i). Some candidates did not read the question and named various parts of the national grid.

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Question 5 (c)(ii)

Q05(c)(ii) was intended to be challenging and the marks distribution of candidates reflected this. Many candidates did not seem to understand what the question was asking. This was evidenced by the number of candidates who referred to elements of motors and generators in their responses. Many of the answers were attempts to describe electromagnetic induction in detailed terms to varying levels of understanding. Similarly, there was much discussion about interacting magnetic fields. Very few focussed on the key physics ideas. Other candidates had revised explanations of how a transformer works and repeated these here – as evidenced by the number of candidates referring to a secondary coil. Where a mark was scored it was usually for the idea that a potential difference was induced (somewhere).

(ii) The iron core of a transformer is an electrical conductor.

When the transformer is in use, the primary coil causes a changing magnetic field in the iron core. This causes a small current to be induced in the core.

Explain how a current is induced in the core of the transformer.

(3)

As the alternating current is supplied to the primary coil, it produced a magnetic field which change direction, so it induced the iron core. The a.c magnetic field and current in the iron core than transfer to the other side and create a current in the secondary coil. as it changing directions. The iron core got current because the magnetic field lines cut through the core.

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Examiner Comments

This response was awarded 1 mark. The candidate has written an explanation of how a transformer works, which shows they have not properly understood the question. The single mark is awarded for the last sentence, which states that the core cuts the magnetic field lines.

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(ii) The iron core of a transformer is an electrical conductor.

When the transformer is in use, the primary coil causes a changing magnetic field in the iron core. This causes a small current to be induced in the core.

Explain how a current is induced in the core of the transformer.

(3)

~~Primary~~ Iron core cuts through the changing magnetic field in primary coil. This induces a changing emf and hence changing voltage in iron core. Delocalised ~~charged~~ electrons are free to move in iron core (an electrical conductor), so voltage causes movement of electrons, inducing current in iron core of transformer.

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This candidate has clearly read and understood the question. Their excellent response was awarded full marks.

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Question 6 (a)(i)

The majority of candidates were able to extract the correct independent variable from the text in Q06(a)(i). Some candidates listed several variables, which prevented the mark from being awarded.

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Question 6 (a)(ii)

Most candidates gained at least 1 mark in Q06(a)(ii), which showed a good understanding of calculating a mean value. Approximately half of those took the anomalous result into account to gain full marks. Some candidates did not arrive at a valid answer due to errors in using their calculator eg entering the calculation in one line without the use of brackets.

(ii) The table shows the student's results for an angle of incidence of 40°.

Angle of refraction 1 (°)	Angle of refraction 2 (°)	Angle of refraction 3 (°)
22	23	67

Calculate the mean value for the angle of refraction.

(2)

$(22 + 23 + 67) \div 3$

$= 37.3$

mean angle = ~~22.5~~ 37.3 degrees

~~20th~~ $\frac{(22 + 23)}{2}$

$= 22.5$

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Examiner Comments

This response was awarded 1 mark. The candidate has calculated the mean value with and without the anomalous result, but ultimately chosen the wrong value to write on the answer line.

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Examiner Tip

Examiners cannot choose between two different methods in calculations. It is the candidate's responsibility to show the correct working.

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(ii) The table shows the student's results for an angle of incidence of 40°.

Angle of refraction 1 (°)	Angle of refraction 2 (°)	Angle of refraction 3 (°)
22	23	67

Calculate the mean value for the angle of refraction.

(2)

67° is an anomalous

$\therefore$ mean °ϕ = $\frac{22+23}{2}$ = 22.5

mean angle = 22.5 degrees

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Examiner Comments

This is the correct method. The candidate has clearly identified the anomalous result and not included it in the mean calculation.

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Question 6 (a)(iii)

Q06(a)(iii) was misunderstood by the majority of candidates. They concentrated on general ways to improve equipment, rather than a specific method to increase the accuracy of the refractive index. Repeat and average was seen often, but was rarely precise enough to gain the mark. Only the most able plotted the correct graph and said what to do with it.

(iii) Describe how the student could improve their method to get a more accurate value for the refractive index.

(2)

Repeat the investigation with different angles of incidence and refraction. Then, calculate the refractive index with those values and take the average.

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This candidate has clearly stated repeating the method for different angles of incidence and then finding a mean value for the refractive index.

(iii) Describe how the student could improve their method to get a more accurate value for the refractive index.

(2)

~~use many~~

~~at~~ Plot a graph of sin(i) against sin(r) and use the gradient as the refractive index

ResultsPlus Examiner Comments

This candidate has opted for a graphical method of increasing the accuracy.

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Question 6 (b)(i)

Q06(b)(i) was answered to a high standard and most candidates gained at least one or two marks. The few who lost marks substituted values of i and r as sin i and sin r. Some candidates could not identify the correct angles for i and r from the diagram. The question proved to be a very good differentiation question, which assessed maths skills in addition to knowledge of ray diagrams.

(b) Diagram 1 shows a ray of light refracted by a transparent block of material.

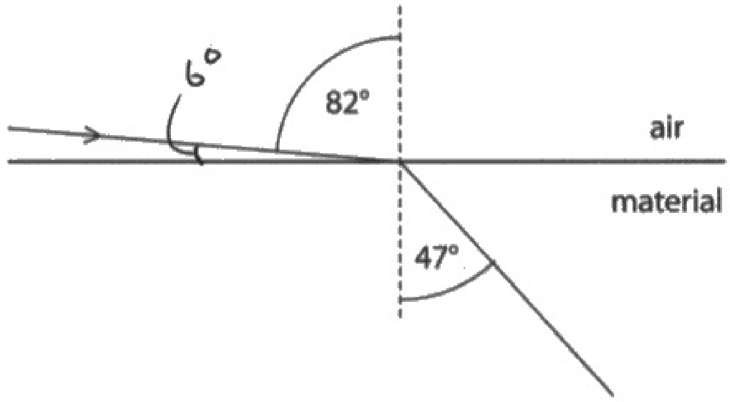

Diagram 1

(i) Calculate the refractive index of this material.

(2)

$n = \frac{\sin(i)}{\sin(r)}$ $\quad \frac{82}{47} = 1.744\ldots$

$90 - 84 = 6 = \frac{6}{47} = 0.127\ldots$

refractive index = 1.7

ResultsPlus
Examiner Comments

This response was awarded zero marks. Despite writing the correct formula, the candidate has not used the sine functions when marking the data substitution, which has led to the incorrect final answer.

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Question 6 (b)(ii-iii)

Almost all candidates gained the mark in Q06(b)(ii) due to the formula's inclusion in the supplied formulae sheet. The calculation in Q06(b)(iiii) was answered to a high standard. However, some candidates failed to involve the sin or $\sin^{-1}$ aspect of the formula. Otherwise, the majority gained full marks.

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Question 6 (c)

The concept of total internal reflection (TIR) was generally well known in Q06(c). However some candidates described the path of light rather than explaining it. Most identified TIR and knew the angle of incidence was greater than the critical angle. Incorrect answers included incorrect ideas about refractive index, density and angles of refraction.

(c) Diagram 2 shows a ray of light travelling through an optical fibre.

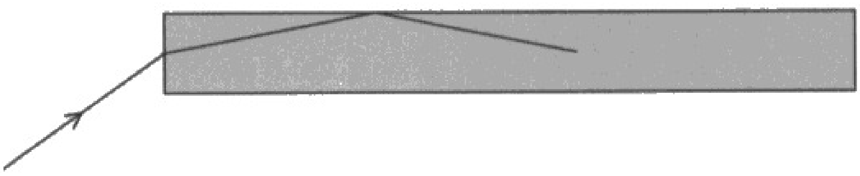

Diagram 2

The optical fibre is made of a material with a refractive index of 1.7

Explain the path of the ray in the optical fibre.

(2)

The ray of light enters the optical fibre and gets refracted. Then, the ray of light hits the inner wall of the optical fibre and gets reflected

ResultsPlus
Examiner Comments

This response was awarded zero marks. The candidate has identified that reflection is happening inside the fibre, but not identified it as total internal reflection. No marks were given for what happens on entry to the fibre.

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(c) Diagram 2 shows a ray of light travelling through an optical fibre.

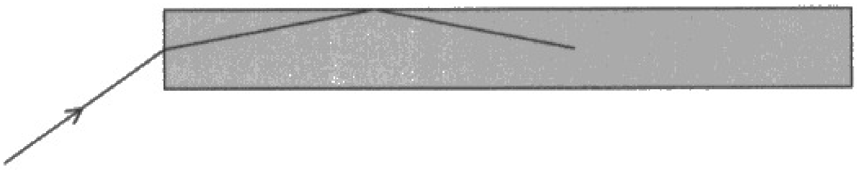

Diagram 2

The optical fibre is made of a material with a refractive index of 1.7

Explain the path of the ray in the optical fibre.

(2)

The ray of ~~x~~ light is totally internally refracted because the angle of incidence ~~is t~~ is bigger than the critical angle of the materal

ResultsPlus
Examiner Comments

This response was awarded 1 mark. The candidate understands what is happening in the fibre and has explained it using ideas about the angle of incidence and the critical angle. However, they have incorrectly described the phenomenon as total internal refraction instead of total internal reflection.

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Question 7 (a)

Most candidates were awarded full marks in Q07(a) for recognising the proportional relationship between force and extension. Weaker candidates only scored 1 mark for giving a simple pattern statement between the variables ie 'as force increases, extension increases'. Very few candidates did not score in this question.

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7 Diagram 1 shows a gate fitted with a spring mechanism.

The spring mechanism shuts the gate automatically.

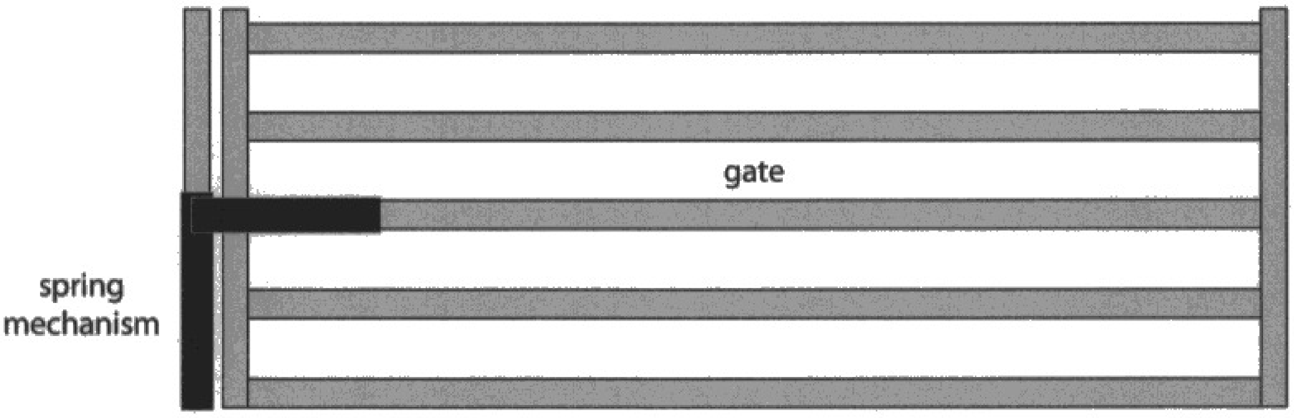
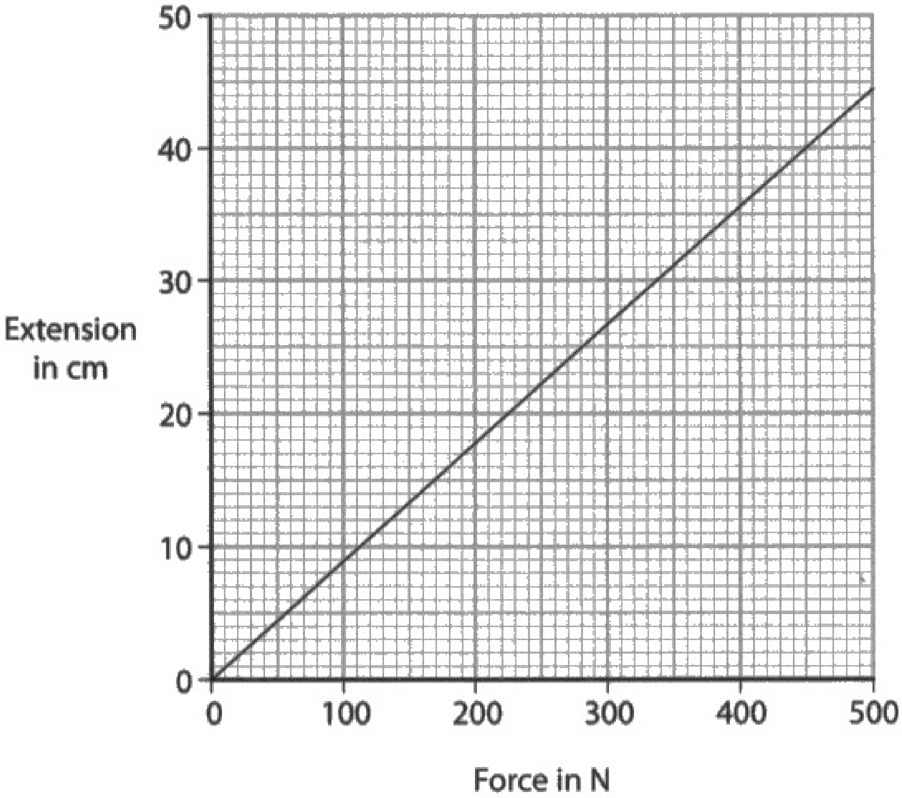


Diagram 1

(a) The graph shows some data from an investigation into how the extension of the spring changes with an increasing force.



Describe the relationship shown by the graph.

(2)

As the force ~~fu er~~ increase, the extension increase

https://xtremepape.rs/

ResultsPlus
Examiner Comments

This simple pattern statement only scored 1 mark.

https://xtremepape.rs/

7 Diagram 1 shows a gate fitted with a spring mechanism.

The spring mechanism shuts the gate automatically.

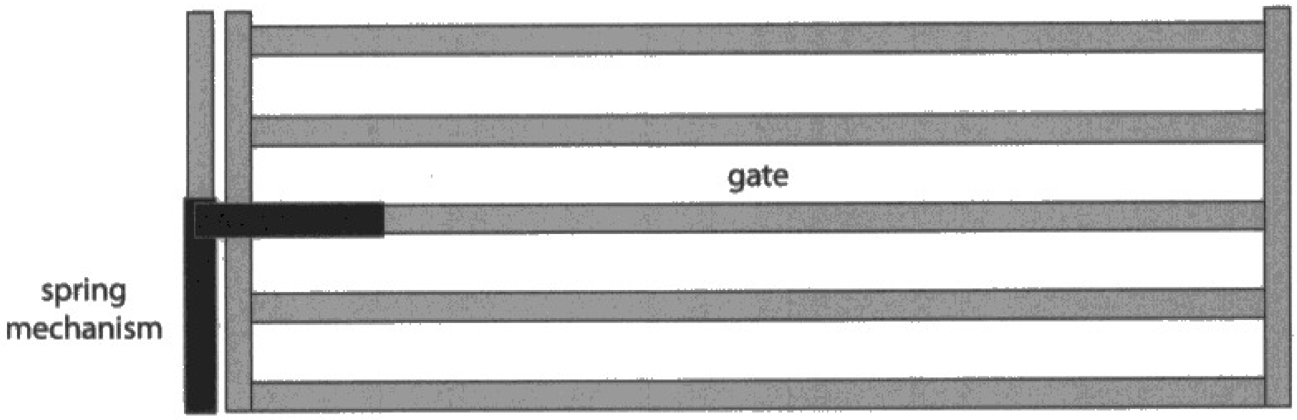
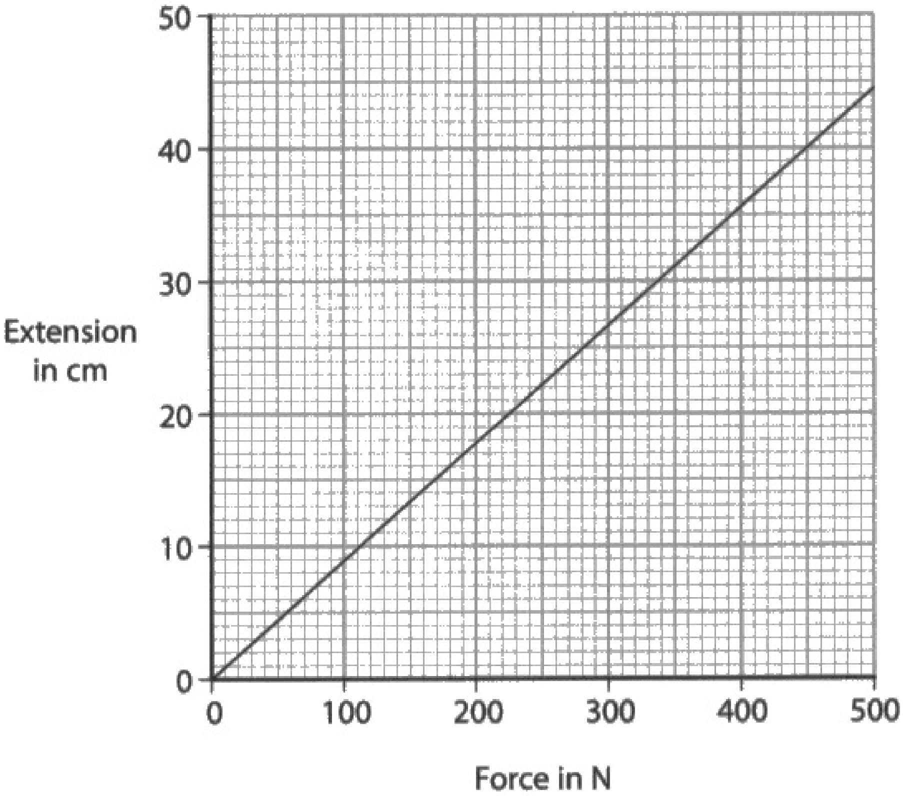


Diagram 1

(a) The graph shows some data from an investigation into how the extension of the spring changes with an increasing force.



Describe the relationship shown by the graph.

(2)

It shows that Extension is directly proportional to the force because of the straight line.
E ∝ F (Linear relationship)

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ResultsPlus
Examiner Comments

This response was awarded 2 marks. The addition of the proportionality in the relationship lifts this to a higher level of understanding.

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Question 7 (b)

Most candidates were able to select the correct formula to use in Q07(b) and use it to calculate the moment by identifying the correct distance to pivot. There were some candidates who did not know what to do and tried to use any of the numbers in the diagram that will add/subtract to about 400. Some did not realise that the perpendicular distance was in cm and decided to divide their final answer by 100 to get about 400.

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Question 7 (c)

The majority of candidates gained full marks in Q07(c). Most correct answers were 126/125. Errors were mainly POT, subtracting the two distances from the pivot from each other or using the wrong formula eg force=change in momentum/time. However, some candidates were able to score 2 marks by clearly attempting to use the principle of moments and creating a correct expression for the moment of force F. It was surprising to also see some candidates add 1N on to their calculated value so that it was enough to open the gate – these candidates only scored 3 marks.

(c) The force, F, is the minimum force needed to start opening the gate.

Calculate the magnitude of force F.

(4)

$84 \times 480 = 320 \times F$

$320 \times F = 40320$

$F = \frac{40320}{340} = 118.6$

force F = 118.6 N

ResultsPlus
Examiner Comments

This response was awarded 2 marks. The candidate has set up a principle of moments equation and created a correct expression for the moment of force F, even though the distance is in cm. However, when rearranging the equation the candidate has replaced the correct value of 320 with 340 and no mark could be awarded beyond this point.

ResultsPlus
Examiner Tip

Candidates should double check their calculations at the end of the examination if there is time to do so.

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(c) The force, F, is the minimum force needed to start opening the gate.

Calculate the magnitude of force F.

(4)

anticlockwise moment = clockwise moment

480 × 0.84 = F × 3.2

$$F = \frac{480 \times 0.84}{3.2}$$

= 126 N

force F = 126 N

ResultsPlus Examiner Comments

This response was awarded full marks. The candidate has presented all their working clearly and it is easy to follow, which would have been useful if their final answer had been incorrect.

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Question 7 (d)

Candidates answering Q07(d) correctly wrote either very detailed explanations (with more than enough information) or concise single/double sentenced answers. Many wrote about the spring no longer behaving like elastic but instead a plastic. Some candidates were concerned that the spring would break, which was not credited.

(d) The spring is removed for testing.

Explain what will happen to the spring if the force applied to extend the spring is too large.

(2)

~~The gate will move anti-clockwise.~~ will reach limit of propotionality. Spring will break

ResultsPlus
Examiner Comments

This response was awarded 1 mark for the idea that spring will reach its limit of proportionality. The idea of the spring breaking was not credited.

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(d) The spring is removed for testing.

Explain what will happen to the spring if the force applied to extend the spring is too large.

(2)

If the force added keeps on increasing, it will meet its limit of proportionality where it does not ~~d~~ obey Hooke's law and extend more than expected. At its elastic limit, the spring denatures and become permanently stretched.

ResultsPlus
Examiner Comments

This response was awarded 2 marks. The candidate clearly understands the situation and has written an excellent explanation of what will happen to the spring.

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Paper Summary

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

- 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.

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