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Examiners' report

GCSE

GATEWAY SCIENCE PHYSICS A

OCR Level 1/Level 2 GCSE (9-1) in Physics A (Gateway Science)

J249

For first teaching in 2016

J249/03 Summer 2025 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from Teach Cambridge.

Paper 3 series overview

The paper was accessible to almost all the students, with higher marks across the candidates. The calculations were a source of confidence for students with most achieving full marks in those style questions.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• explained longer answer questions fully • used concise scientific language • knew the difference between latent heat and specific heat capacity.	• did not write working out for calculations • skipped some questions • were unfamiliar with the equations and so chose the wrong one.

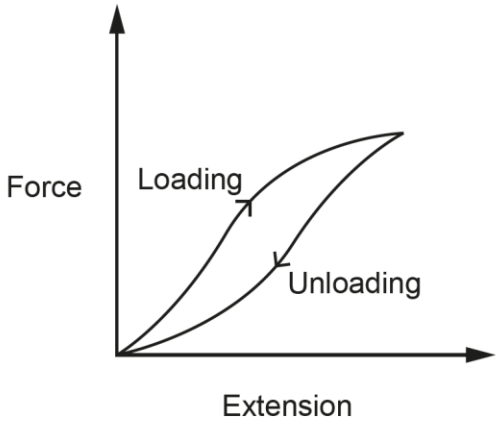
Section A overview

Questions 1, 2, 3, 5, 12, 13 and 14 were answered correctly by almost all candidates.

Question 15 was the hardest.

Question 4

4 The force–extension graph for a rubber band, during loading and unloading, is shown.



Which row describes the behaviour of the rubber band?

	Deformation	Obeys Hooke's Law?
A	elastic	no
B	elastic	yes
C	plastic	no
D	plastic	yes

Your answer ☐

[1]

This is a more challenging question requiring a deeper knowledge of elastic behaviour to answer correctly.

Question 6

6 An object is 1.0 m below the surface of a swimming pool.

Which statement describes the vertical forces acting on the object if it is **not** moving?

A Upthrust = water resistance

B Upthrust > water resistance

C Upthrust = weight

D Upthrust > weight

Your answer ☐

[1]

Neutral buoyancy is a more challenging concept required to answer this question.

Question 7

7 A toy train moves around a circular track at a constant speed.

Which row describes the displacement of the train from its starting point and the velocity of the train?

	Displacement	Velocity
A	changing	changing
B	changing	constant
C	constant	changing
D	constant	constant

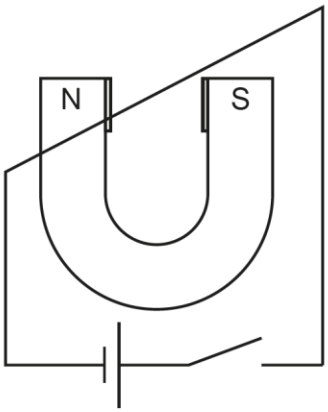
Your answer ☐

[1]

Vectors can be a more challenging concept but most candidates managed to answer this question.

Question 8

8 A current-carrying wire is placed between the two poles of a horseshoe magnet.



The circuit is switched on.

In which direction does the wire move?

A Down

B Left

C Right

D Up

Your answer ☐

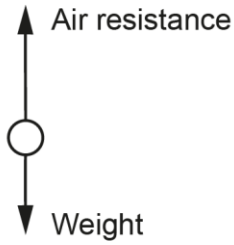
[1]

This question required the correct application of Fleming's left hand rule.

Question 9

9 A skydiver jumps out of a plane.

The vector diagram shows the forces acting on the skydiver at a time after they have jumped.



Which of the following describes the motion of the skydiver at this time?

A Decreasing speed and moving downwards

B Decreasing speed and moving upwards

C Increasing speed and moving downwards

D Increasing speed and moving upwards

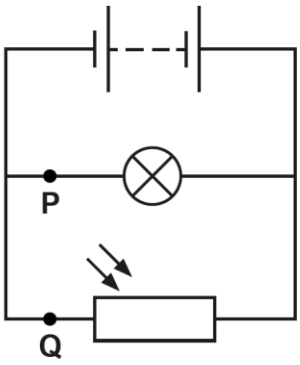
Your answer ☐

[1]

Most candidates answered this question correctly but some struggled to resolve the ideas.

Question 10

10 A teacher makes a parallel circuit with a battery, a lamp and an LDR.



The battery has a fixed potential difference.

The light intensity is increased.

Which row describes what happens to the current at point **P** and the current at point **Q**?

	Current at point P	Current at point Q
A	increases	increases
B	stays the same	decreases
C	stays the same	increases
D	stays the same	stays the same

Your answer ☐

[1]

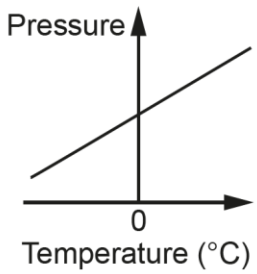
Candidates found this question more challenging as it requires the application of parallel circuits and a knowledge of LDRs.

Question 11

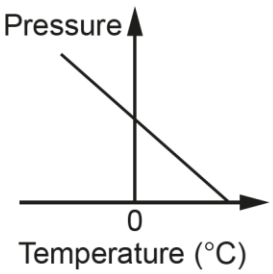
11 A scientist investigates how pressure changes with temperature for a fixed volume of gas.

Which graph shows the relationship between pressure and temperature for the gas?

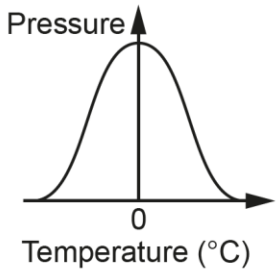
A



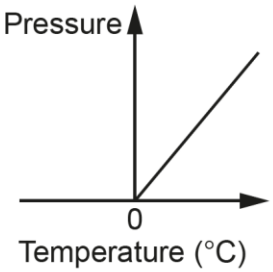
B



C



D



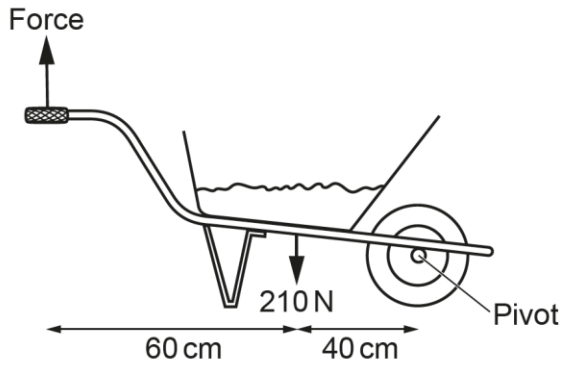
Your answer ☐

[1]

Many candidates opted for D, which suggests a knowledge of Charle's Law and absolute zero, but that they missed the detail of the unit.

Question 15

15 A gardener lifts a load of 210 N using a wheelbarrow.



What is the minimum force the gardener exerts to lift the load in the wheelbarrow?

A 84 N

B 126 N

C 140 N

D 210 N

Your answer ☐

[1]

This question requires working out using a balance of moments, which candidates found more challenging to achieve.

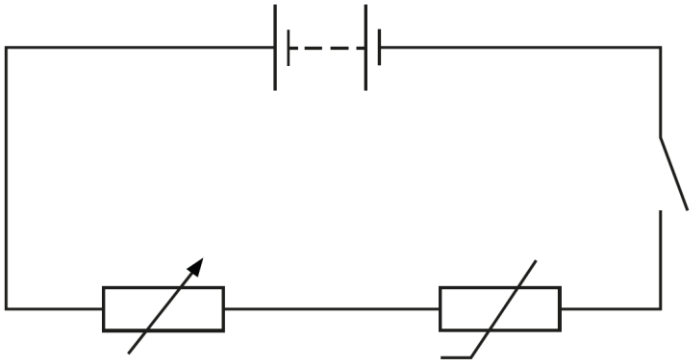
Section B overview

Candidates typically found the calculations easier and attempted every question. The Level of Response question (Question 22) was well attempted and candidates found it accessible.

Question 16 (a) (i)

16 A student investigates the current–potential difference (I–V) characteristic graph for a thermistor.

The diagram shows the circuit that the student builds.



(a)

(i) The student connects an ammeter and a voltmeter into the circuit to take the measurements needed for their investigation.

Draw **one** ammeter and **one** voltmeter in the correct positions in this circuit.

[3]

Most candidates placed the voltmeter correctly in parallel with the thermistor. Those that did not, mostly incorrectly placed the voltmeter in parallel across the variable resistor or in series.

Most candidates placed the ammeter correctly in series. Symbols were often correct.

Question 16 (a) (ii)

(ii) Why does the student use a variable resistor in the circuit?

Tick (✓) **one** box.

To change the current in the circuit ☐

To change the potential difference of the battery ☐

To change the temperature of the circuit ☐

[1]

This question was generally well answered.

Question 16 (a) (iii)

(iii) Explain why the student switches the circuit off between taking the readings of current and potential difference.

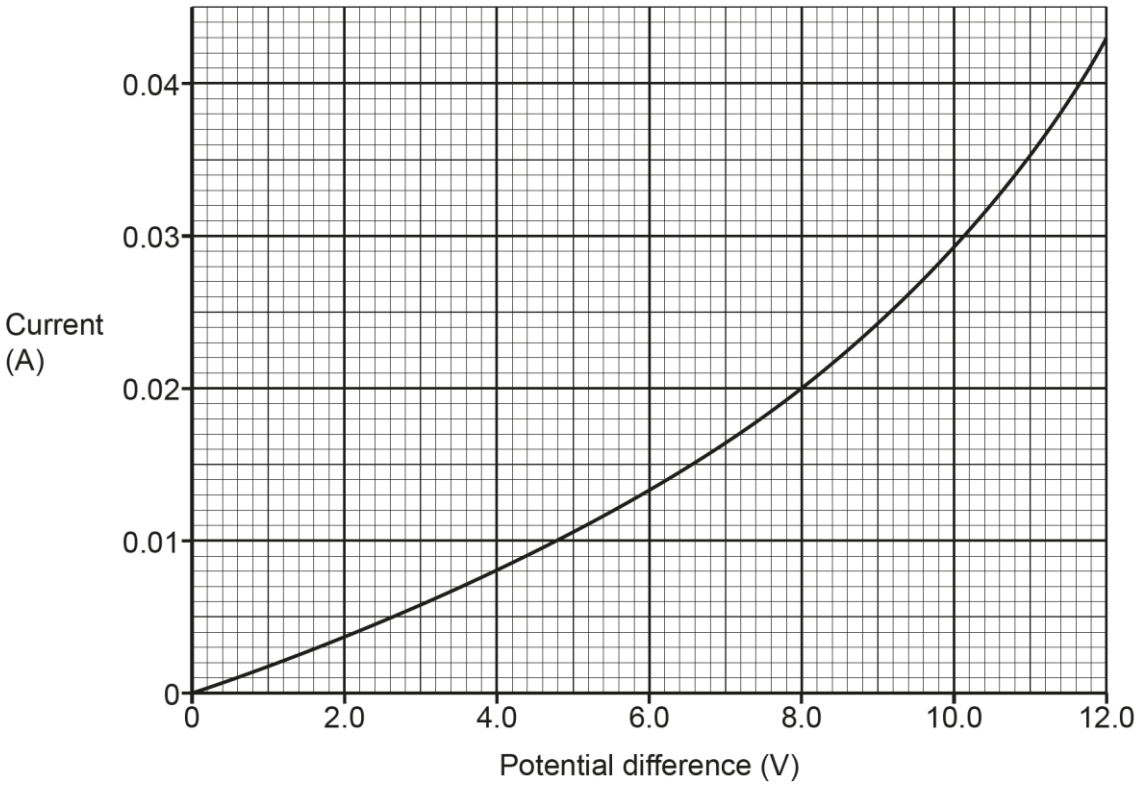
.....

..... **[1]**

Most candidates correctly referred to heating as a reason. Only a few mentioned accuracy as a reason. Incorrect responses were often vague.

Question 16 (b) (i)

(b) The student takes readings of current and potential difference and plots them on a graph.



(i) Describe the trend shown by the graph.

.....

.....

..... **[2]**

Most candidates realised that potential difference and current were related, but describing the rate caused some confusion. Most candidates were able to describe enough to warrant the first marking point.

Assessment for learning

Incorrect descriptions of proportionality were common errors and often not well communicated. The most common error was to say the graph is directly proportional.

A large number of candidates also referred to the graph as exponential.

Use of 'positive correlation' should also be avoided.

Question 16 (b) (ii)

(ii) How does the resistance of the thermistor change as the potential difference increases?

..... **[1]**

Most candidates answered this correctly.

Question 16 (b) (iii)

(iii) State the current in the thermistor when the potential difference across the thermistor is 8.0 V.

Use the graph.

Current = ... A **[1]**

Almost all candidates read off the graph accurately. Some made a power of ten error, reading 0.2 A.

Question 16 (b) (iv)

(iv) Calculate the resistance of the thermistor when the potential difference across the thermistor is 8.0 V.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

Most candidates successfully determined the resistance. Some students assumed the values were **resistance** and current or had trouble rearranging the equation.

Question 17 (a)

17 An engineer is investigating the density of polystyrene.

(a) Describe how to determine the mass and volume of a rectangular polystyrene block.

.....

.....

.....

.....

.....

..... **[3]**

Most candidates identified a valid method to measure mass. Note that 'weighing' is insufficient for marks, but at this standard of question, a loose description of 'scales' is accepted. A significant number tried to explain a displacement method which is likely unsuccessful due to the floating polystyrene block in the question stem. A good number continued to explain how to calculate density, which was irrelevant. Most candidates described measuring and calculating volume correctly, although many were vague and said to 'find' lengths.

Question 17 (b)

(b) One polystyrene block has a density of 50 kg / m^3.

The mass of the block is 0.60 kg.

Calculate the volume of the block.

Use the Equation Sheet.

Volume = ... m^3 **[3]**

Most candidates correctly identified the equation, rearranged and substituted the values.

Incorrect answers largely received no credit..

Question 18 (a) (i)

18 The atomic model has changed over time.

Three scientists who contributed to the atomic model are Thomson, Rutherford and Bohr.

(a)
(i) Which of these scientists discovered a particle called an electron?

..... **[1]**

This was the most common question to be answered incorrectly of this set. Most students opted for Rutherford here, although some added Dalton or Chadwick and may not have read the question carefully.

Question 18 (a) (ii)

(ii) Which of these scientists developed the Plum Pudding model of the atom?

..... **[1]**

This was answered correctly by almost all candidates.

Question 18 (a) (iii)

(iii) Which of these scientists suggested that electrons can only move in fixed orbits called electron shells?

..... **[1]**

Most candidates correctly identified Bohr as the correct answer.

Question 18 (b)

(b) One of these three scientists did an experiment where alpha particles were fired at a thin piece of gold foil.

Two important observations were recorded.

What did the scientist conclude about the atom from these observations?

Observation 1: Most alpha particles passed through the gold foil.

Conclusion: .....

.....

Observation 2: Some of the alpha particles were deflected.

Conclusion: .....

.....

[3]

Most candidates scored well here. Many low scoring candidates confused the atom with particles or the alpha particles. A few did not name the nucleus correctly (and put 'core') and some had correct conclusions with the incorrect observation.

Question 18 (c)

(c) A typical atom has a **radius** of 1.0×10^{-10} m.

A molecule consists of 20 of these atoms in a long line.

Calculate the length of this molecule.

Write your answer in **standard form**.

Length = ... m **[2]**

Most candidates successfully scored full marks with standard form. The most common error was not to double the radius.

Question 19 (a) (i)

19

(a) A student investigates the magnetic field between two magnets.

(i) The student uses iron filings to show the magnetic field pattern.

Write down a different piece of equipment that the student could use to investigate the magnetic field.

..... **[1]**

Most candidates answered correctly. A few candidates described equipment used in the teaching of magnetic fields (such as magnets, pencils and paper clips).

Question 19 (a) (ii)

(ii) The diagram shows the north pole of a magnet and the south pole of another magnet.

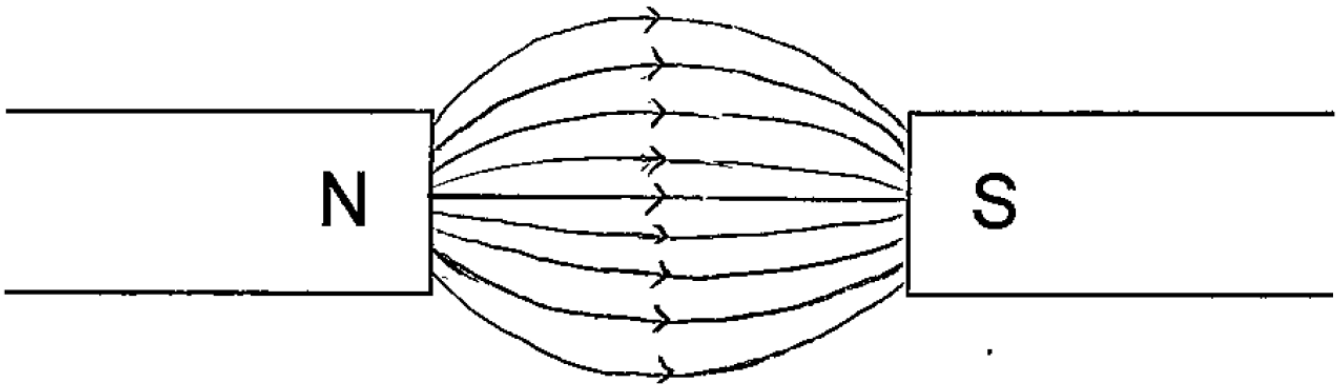
Sketch the magnetic field between the poles of the magnets.

[3]

Candidates invariably had correctly identified the direction of the magnetic field lines.

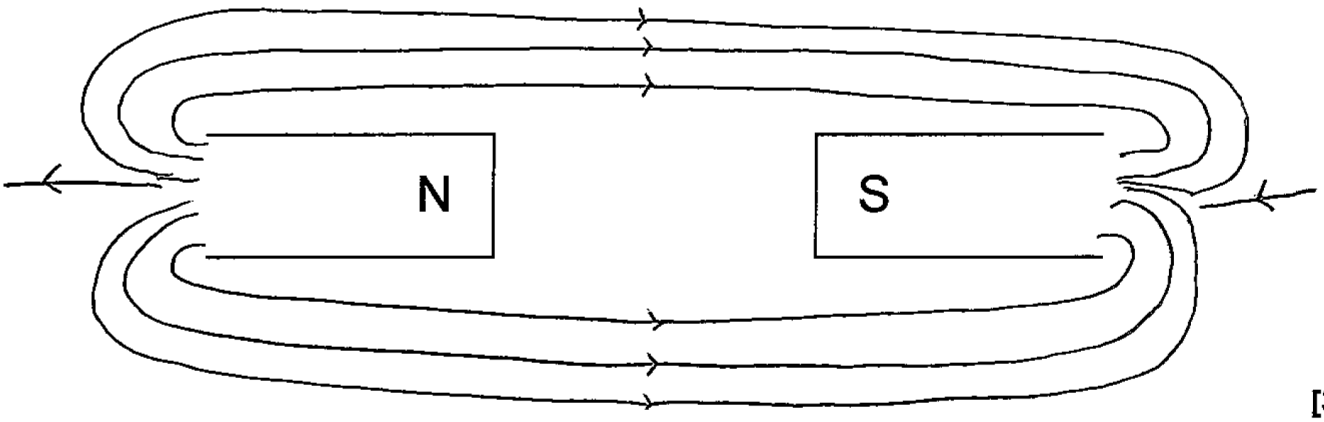
Some did not draw lines connected to the bar magnets.

Exemplar 1



Commonly omitted were the straight lines between the poles or the drew only one straight line.

Exemplar 2



[3]

Also commonly seen were extra poles drawn off the diagram which were ignored.

Question 19 (b) (i)

(b) A student makes a simple solenoid by wrapping insulated copper wire around an iron nail.

(i) Why did the student use **insulated** copper wire?

.....

..... **[1]**

Most candidates incorrectly referred to thermal insulation or energy transfers. A number also referenced electric shocks which was not credited as it is unfeasible in a classroom environment. Some candidates referred to charge or current 'escaping' in general terms. A proportion of candidates vaguely referred to 'safety' concerns.

This was a challenging question for most of the candidates.

Question 19 (b) (ii)

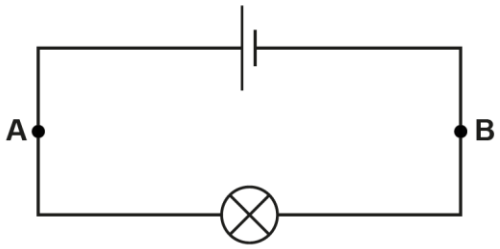
(ii) Write down **one** factor that can affect the strength of the magnetic field of a solenoid.

..... **[1]**

Common answers were current and coils. A list of answers given by the candidate here should was ignored, with only the first answer being considered.

Question 20 (a)

20 A teacher draws a simple electric circuit.



(a) Draw an arrow on the circuit to show the direction of electron flow. **[1]**

Most candidates incorrectly referred to conventional current direction (positive to negative terminals). As electrons have a negative charge, they would travel in a clockwise fashion in this circuit.

A number of candidates did not respond to the question at all.

Question 20 (b)

(b) How does the current at point **A** in the circuit compare to the current at point **B** in the circuit?

Tick (✓) **one** box.

Current at point **A** > current at point **B** ☐

Current at point **A** < current at point **B** ☐

Current at point **A** = current at point **B** ☐

[1]

A common incorrect answer was the top one.

Question 20 (c)

(c) Calculate the charge flow in the lamp when there is a current of 0.45A for 30s.

Include the unit.

Use the Equation Sheet.

Charge flow = ... Unit ..... **[4]**

Most incorrect answers lost the unit mark and included A/s or Q. Almost every candidate correctly identified the equation and calculated correctly.

Question 20 (d)

(d) Apart from current and time, which other quantity is needed to calculate the energy transferred by the lamp?

Use the Equation Sheet.

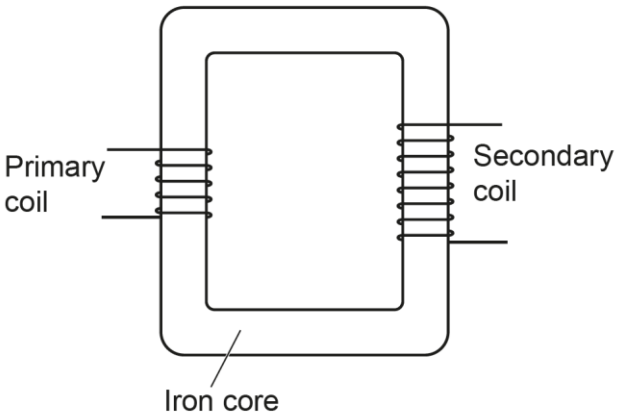
..... **[1]**

Most candidates answered correctly. Some students attempted to answer by writing the equation from the Equation Sheet and so scored no marks here.

Question 21 (a)

21 A transformer can be used to change the potential difference (p.d.) of an electrical supply.

The diagram shows a simple transformer.



(a) A student writes four statements about how a transformer works.

A This induces an alternating p.d. in the secondary coil.

B This produces a changing magnetic field in the iron core.

C There is an alternating p.d. across the primary coil.

D This produces an alternating current in the primary coil.

Put the steps in the correct order. The first one has been done for you.

C			

[2]

While generally well answered, some students only achieved one mark in this question.

Question 21 (b)

(b) Explain why a transformer does **not** work if the current in the primary coil is direct current (d.c.).

.....

..... **[2]**

Most candidates struggled to score full marks here. The most common mark to score was a description of changing magnetic fields. Some mentioned changing current or cutting of flux but not fully enough to score marks.

Most candidates re-stated the need for a.c. without explaining why. The link and description of d.c. was rare to see. Most candidates jumped straight to the secondary coil in their explanation.

Misconception

A steady current **does** induce a magnetic field but one that does not change.

Question 21 (c)

(c) A step-up transformer increases the potential difference from 230 V a.c. to 4600 V a.c.

There are 25 turns on the primary coil.

Calculate the number of turns on the secondary coil.

Use the Equation Sheet.

Number of turns = ... **[3]**

Most candidates scored full marks. Candidates that struggled to score rearranged incorrectly or substituted in error.

Question 21 (d)

(d) A high potential difference can be dangerous. Suggest how.

..... **[1]**

Most candidates answered correctly. Some referred to vague 'harms' and a few described, in length, the process of harm to the human body.

Misconception

High currents cause heat / burns / fire.

High voltages cause electric shocks / sparking.

Question 21 (e)

(e) Generators, motors, microphones and headphones all use magnetism to work.

Draw lines to connect each **device** with the correct description of **how it works**.

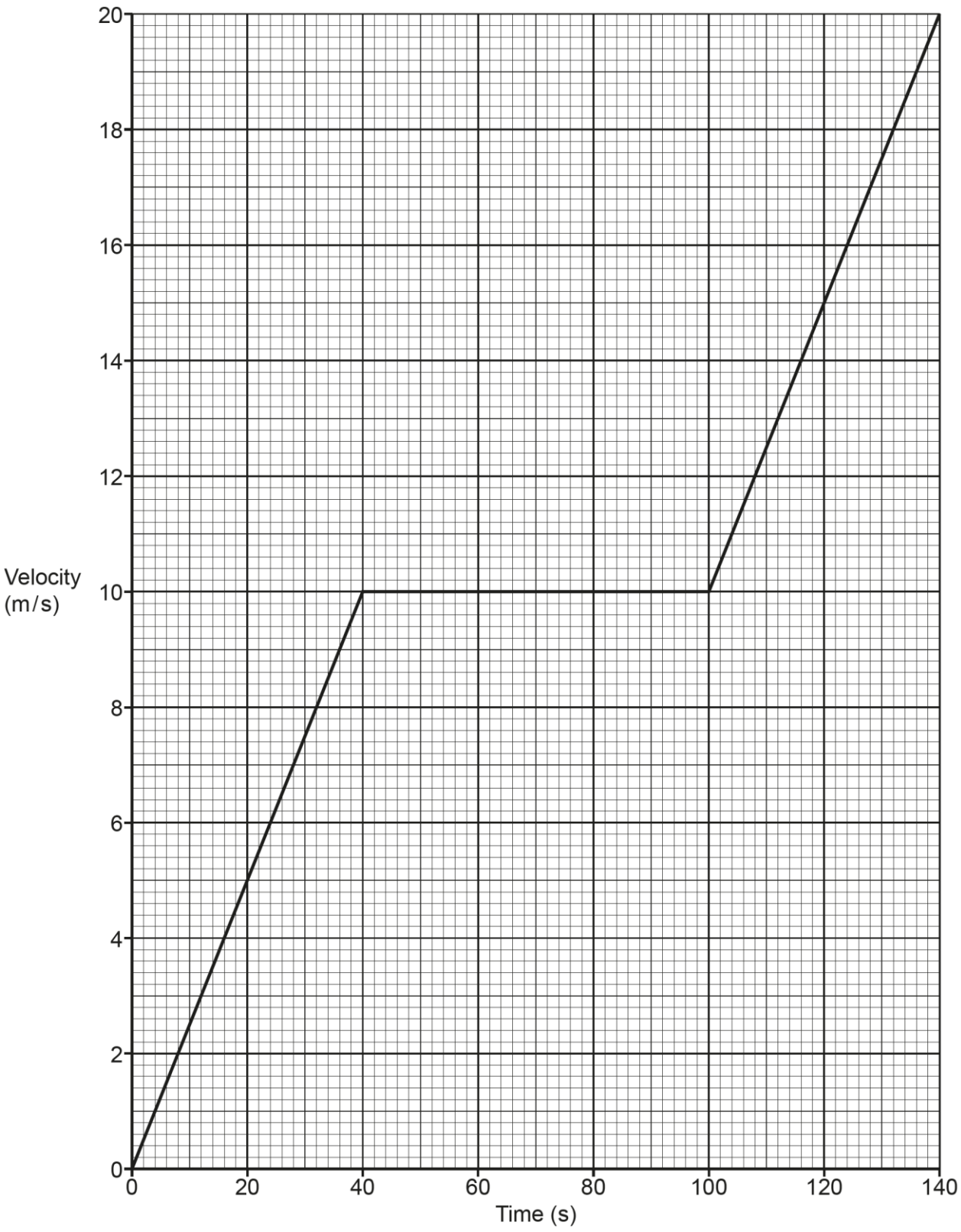
Device	How it works
generator	The movement of a wire in a magnetic field induces a potential difference across the wire.
headphones	A current in a wire in a magnetic field causes rotation.
microphone	Pressure variations in sound waves are converted into current variations in electrical circuits.
motor	Current variations in electrical circuits are converted into pressure variations in sound waves.

[2]

Most candidates achieved full marks. Very few did not score any marks.

Question 22*

22* The velocity–time graph shows part of a train's journey on a level straight track.



Use the graph to describe and explain the motion of the train between 0 and 140 seconds.

Include calculations of acceleration and distance in your answer.

Use the Equation Sheet.

.....

.....

.....

.....

.....

..... **[6]**

This was an accessible Level of Response question and most candidates were able to demonstrate their skills and knowledge.

Most candidates described the motion correctly throughout the journey and split the graph into correct sections.

A recurring mistake was to confuse this question with a distance-time graph, particularly with the horizontal portion.

Most candidates skillfully managed to calculate acceleration and distance. The most common error was to omit the rectangular section after 100s. Some candidates used incorrect units for acceleration or omitted them entirely.

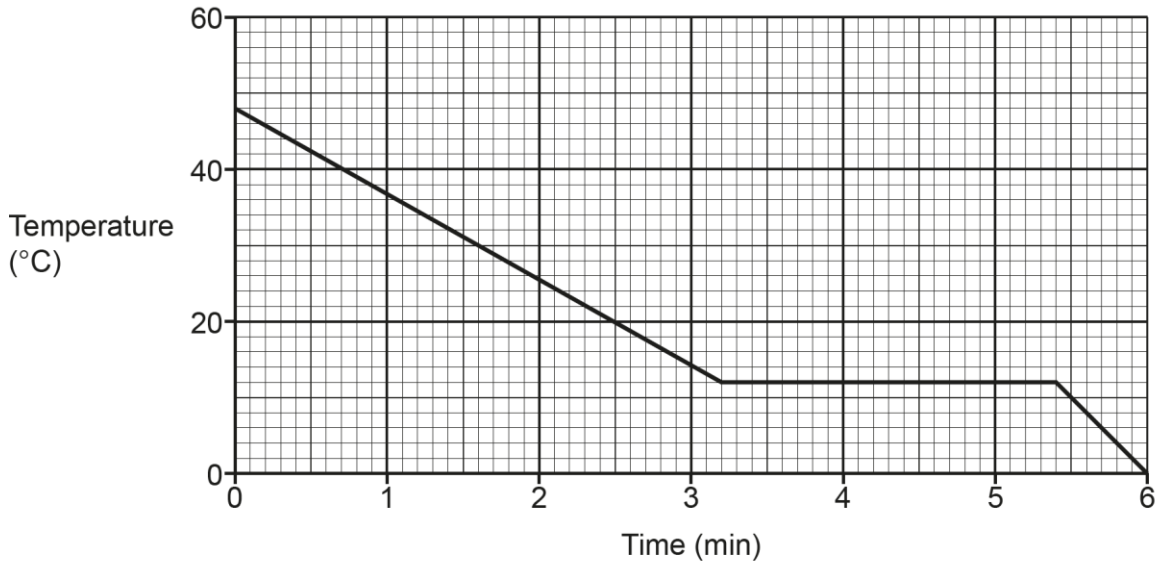
The higher achieving candidates were able to link and analyse the shape of the graph to the motion, as well as identify that the acceleration was the same numerical value. Most candidates were limited to Level 2 by only giving basic descriptions of the journey.

Question 23 (a) (i)

23 A scientist investigates how liquids cool when they are placed in a freezer.

(a) The scientist places 200 g of liquid **A** in a freezer.

The graph shows how the temperature changes with time as the liquid cools.



(i) What is the initial temperature of liquid **A**?

Initial temperature = ... °C **[1]**

This question was invariably answered correctly.

Question 23 (a) (ii)

(ii) What is the freezing point of liquid **A**?

Freezing point = ... °C **[1]**

Most candidates answered correctly. A few answered with 0 degrees C.

Question 23 (a) (iii)

(iii) Liquid **A** has a specific heat capacity of 3750 J/kg °C.

Calculate the energy needed to cool the liquid from its initial temperature until it starts to freeze.

Use the Equation Sheet.

Energy = ... J **[4]**

Most candidates scored full marks.

Some candidates did not convert from g to kg. An error in Question 23 (a) (i) and (ii) would still allow full marks with a correct calculation but was rarely seen.

A common error was to attempt to use the equation for latent heat.

Question 23 (b) (i)

(b)

(i) Liquid **B** is placed in the freezer.

The freezer needs 54 kJ of energy to cool liquid **B** from its initial temperature to its freezing point. This takes 360 s.

Calculate the minimum power of the freezer needed to cool liquid **B**.

Use the equation: energy transferred = power × time

Minimum power = ... W **[4]**

This question was generally answered well. A power of ten error on kJ was common but still scored the majority of the marks.

Question 23 (b) (ii)

(ii) Why is the actual power needed to cool liquid **B** larger than your answer to **(b)(i)**?

..... **[1]**

Most candidates incorrectly stated the energy flow was **out** of the freezer rather than **into** it.

Another significant proportion of candidates described the need to break or make bonds.

This was one of the most challenging questions on the paper. The most common successful answer was to describe the additional energy required to cool the contents of the freezer or a reference not being '100% efficient'.

Question 23 (c)

(c) The power of a different portable freezer is 240 W.

The components in the freezer have a total resistance of 0.80 Ω.

Calculate the current in the freezer.

Use the Equation Sheet.

Give your answer to **2** significant figures.

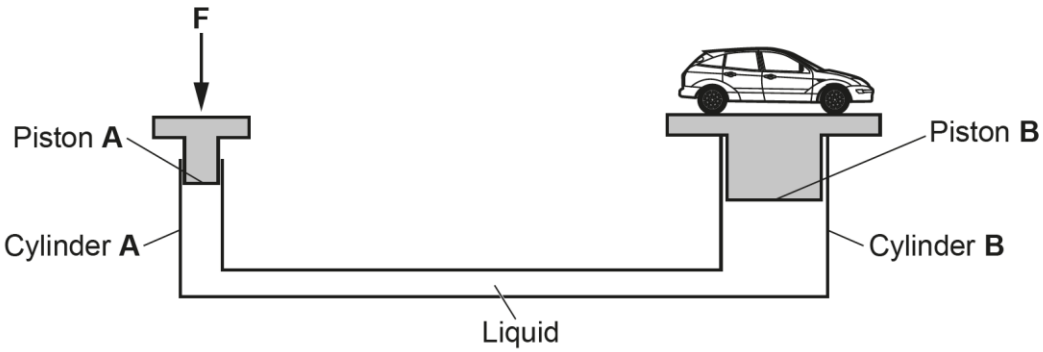
Current = ... A **[4]**

Most candidates answered this correctly. A minority selected the wrong equation. The most common error was to lose a mark on the significant figure marking point.

Question 24 (a)

24 A car mechanic uses a hydraulic lift to raise cars.

The diagram represents a simple model of a hydraulic lift.



(a) Which statement correctly compares the pressure in the cylinders?

Tick (✓) **one** box.

Pressure in cylinder **A** > pressure in cylinder **B** ☐

Pressure in cylinder **A** < pressure in cylinder **B** ☐

Pressure in cylinder **A** = pressure in cylinder **B** ☐

[1]

There were mixed responses for this questionbut most were correct.

Question 24 (b)

(b) Piston **A** has an area of $2.0 \times 10^{-4}\,m^2$.

Piston **B** has an area of $10 \times 10^{-4}\,m^2$.

A force F of 1000 N is applied to the liquid by piston **A**.

Calculate the minimum force exerted by the liquid on piston **B**.

Use the Equation Sheet.

Force = ... N **[4]**

Most candidates achieved full marks here.

It was interesting to note, a large number of candidates incorrectly answered Question 24 (a) and then correctly applied the concept of equal pressures in this question. Very few candidates used the ratios method ($\frac{F}{A} = \frac{F}{A}$). Most candidates opted to calculate the pressure.

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Once you have an Interchange username, use the form on this page to sign up for ExamBuilder, or ask an existing user at your centre to create an ExamBuilder account for you.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

Tell us what you think

Your feedback plays an important role in how we develop, market, support and resource qualifications now and into the future. We want you and your students to enjoy and get the best out of our qualifications and resources, but to do that we need your honest opinions to tell us whether we're on the right track or not.

You can email your thoughts to resources.feedback@ocr.org.uk or visit our feedback page to learn more about how you can help us improve our resources.

Designing and testing in collaboration with you and your students

Helping young people develop an ethical view of the world

Equality, diversity, inclusion and belonging (EDIB) are part of everything we do

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