Oxford Cambridge and RSA

Thursday 22 May 2025 – Morning

GCSE (9–1) Physics A (Gateway Science)

J249/03 (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Equation Sheet for GCSE (9–1) Physics A (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

H

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

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Section A

You should spend a **maximum** of **30 minutes** on this section.

Write your answer to each question in the box provided.

1 Which force is a **contact** force?

A Electrostatic

B Friction

C Gravity

D Magnetic

Your answer ☐

[1]

2 A crane lifts a steel beam of mass 500 kg to the top of a building 50 m high.

What is the **increase** in gravitational potential energy of the beam?

Use the equation: gravitational potential energy = mass × gravitational field strength × height

Gravitational field strength = 10 N / kg

A 2500 J

B 5000 J

C 25 000 J

D 250 000 J

Your answer ☐

[1]

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3 An astronaut has a mass of 80 kg.

Calculate the weight of the astronaut on the Moon.

Use the Equation Sheet.

The gravitational field strength on the Moon is 1.6 N / kg.

A 8.0 N

B 50 N

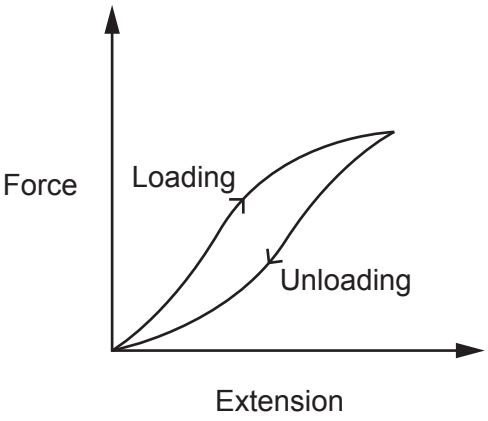
C 128 N

D 800 N

Your answer ☐

[1]

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]

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5 A current–carrying wire is in a magnetic field.

Under which conditions will the wire experience the **smallest** force?

Use the Equation Sheet.

	Magnetic flux density of field (mT)	Current in wire (A)	Length of wire (m)
A	6	4	0.8
B	8	4	0.5
C	8	5	0.4
D	12	6	0.2

Your answer ☐

[1]

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]

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

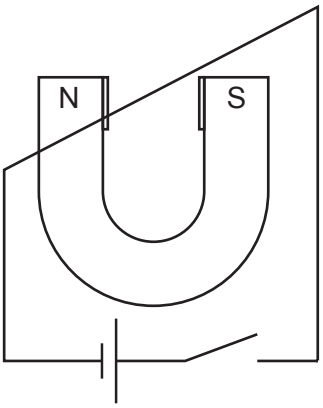
Which row describes the displacement of the train from its starting point and the velocity of the train?

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

Your answer ☐

[1]

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]

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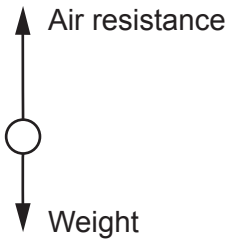
9 A skydiver jumps out of a plane.

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]

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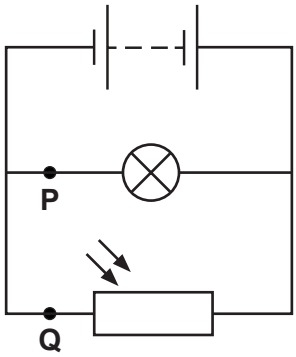
10 A teacher makes a parallel circuit with a battery, a lamp and an LDR.



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]

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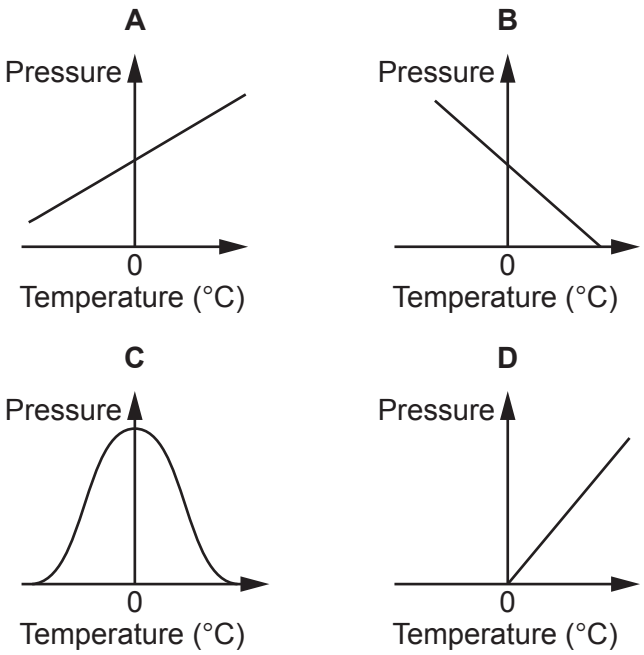
11 A scientist investigates how pressure changes with temperature for a fixed volume of gas.

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



Your answer ☐

[1]

12 Two forces act on an object.

One force has a magnitude of 5.0 N and the other force has a magnitude of 8.0 N.

Which row shows the minimum resultant force and the maximum resultant force which could act on the object?

	Minimum resultant force (N)	**Maximum resultant force (N)**
A	3.0	8.0
B	3.0	13.0
C	5.0	8.0
D	5.0	13.0

Your answer ☐

[1]

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13 Which sentence explains what is meant by the **inertia** of an object?

A It is a measure of how difficult it is to change the density of an object.

B It is a measure of how difficult it is to change the mass of an object.

C It is a measure of how difficult it is to change the velocity of an object.

D It is a measure of how difficult it is to change the weight of an object.

Your answer ☐

[1]

14 Calculate the change in pressure when a diver moves from a depth of 3.0 m to a depth of 7.0 m.

Use the Equation Sheet.

Gravitational field strength = 10 N / kg

Density of water = 1000 kg / m^3

A 4000 Pa

B 30 000 Pa

C 40 000 Pa

D 70 000 Pa

Your answer ☐

[1]

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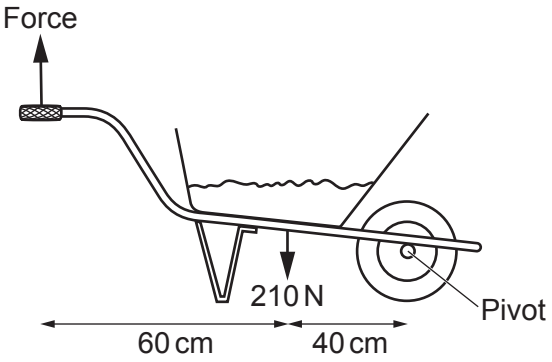
15 A gardener lifts a load of 210 N using a wheelbarrow.



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]

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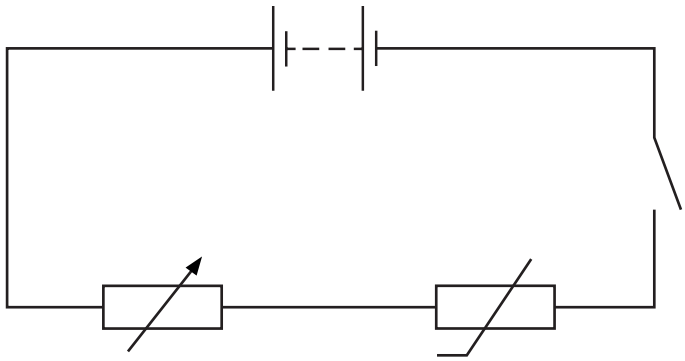
Section B

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]

(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]

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

.....

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

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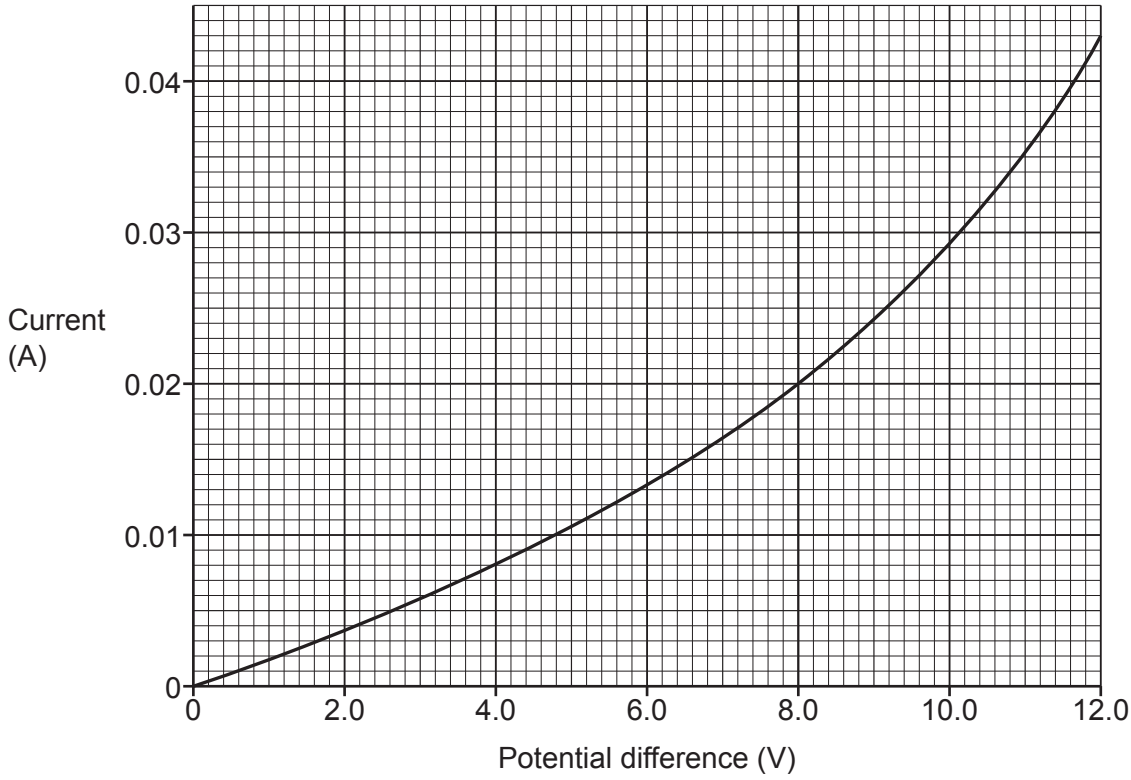
(b) The student takes readings of current and potential difference and plots them on a graph.



(i) Describe the trend shown by the graph.

.....

.....

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

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

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

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

Use the graph.

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

(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]**

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17 An engineer is investigating the density of polystyrene.

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

.....

.....

.....

.....

.....

.....

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

(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]**

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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]**

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

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

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

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

(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]

(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]**

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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]**

(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]

(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]**

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

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

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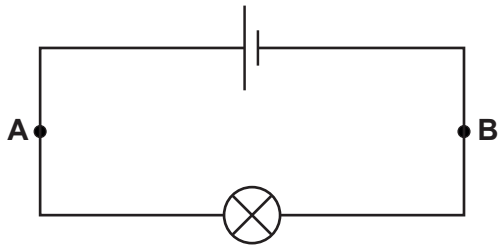
20 A teacher draws a simple electric circuit.



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

(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]

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

Include the unit.

Use the Equation Sheet.

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

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

Use the Equation Sheet.

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

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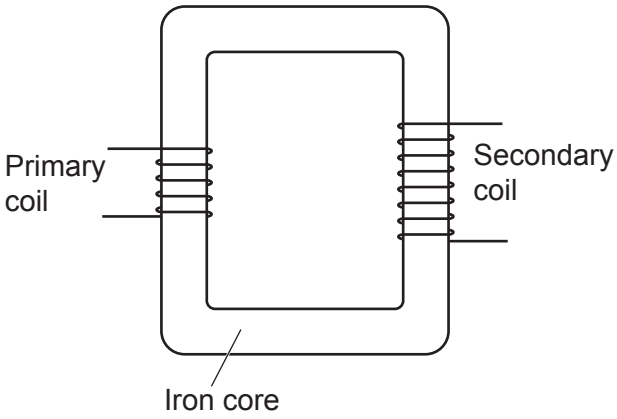
21 A transformer can be used to change the potential difference (p.d.) of an electrical supply.

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]

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

.....

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

(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]**

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

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

(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]

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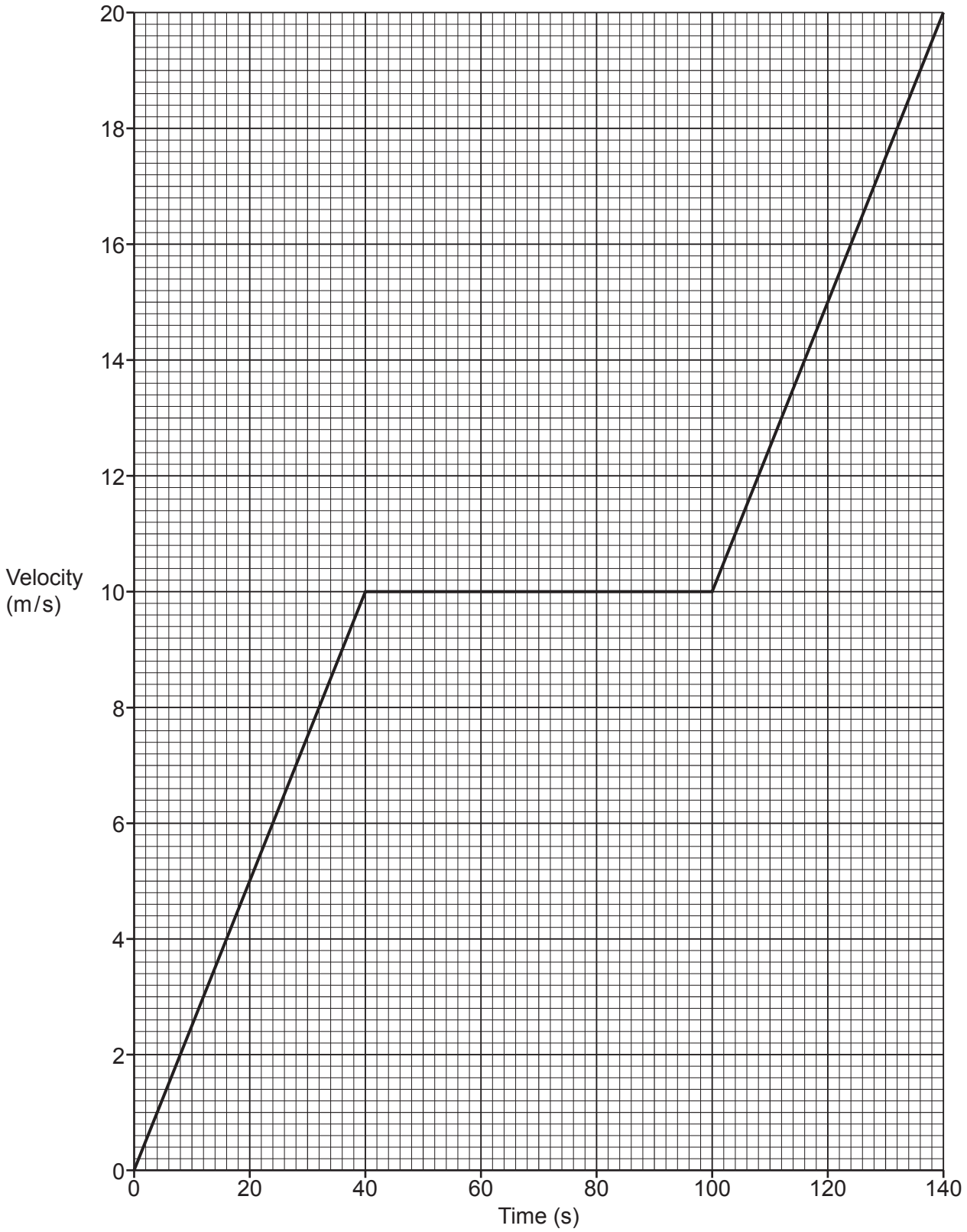
22* The velocity–time graph shows part of a train's journey on a level straight track.



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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.

.....

.....

.....

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.....

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

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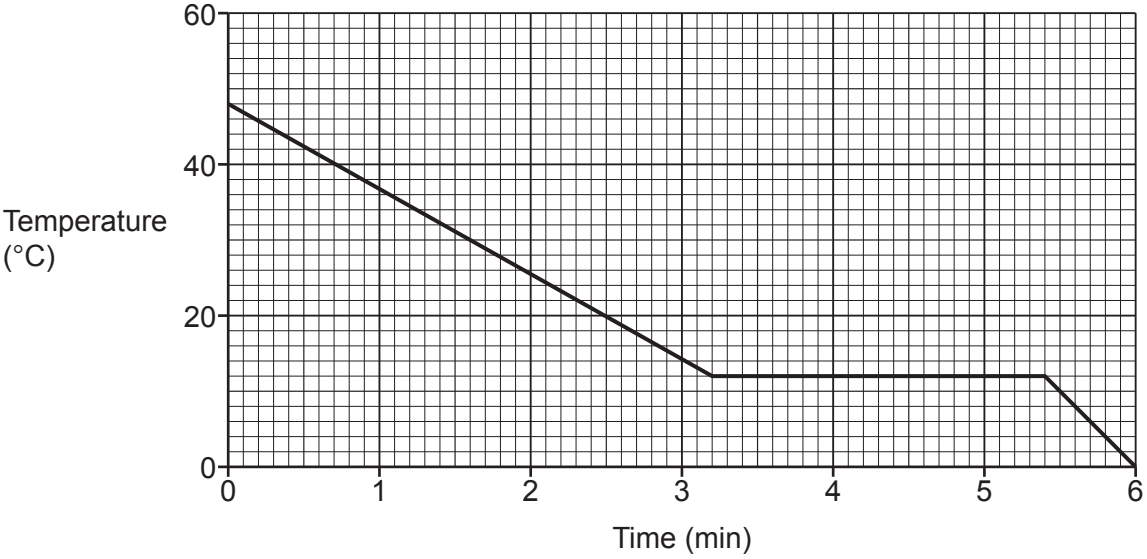
23 A scientist investigates how liquids cool when they are placed in a freezer.

(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]**

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

Freezing point = ... °C **[1]**

(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]**

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(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]**

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

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

(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]**

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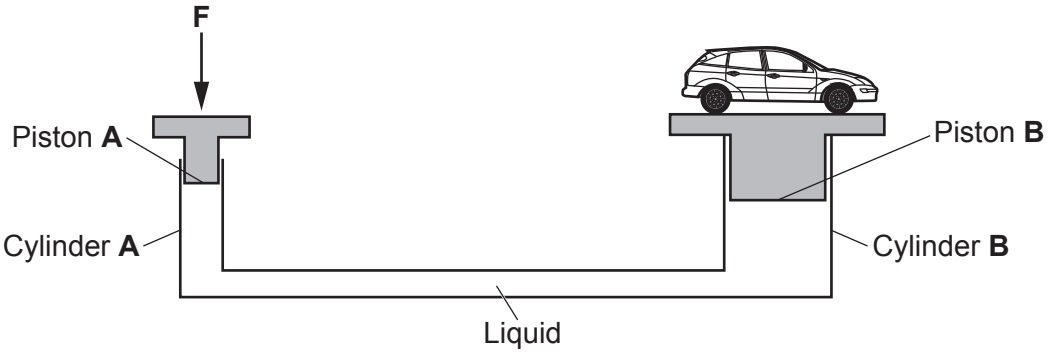
24 A car mechanic uses a hydraulic lift to raise cars.

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]

(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]**

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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