OCR
Oxford Cambridge and RSA

Wednesday 22 May 2024 – Morning

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

J250/11 Physics (Higher Tier)

Time allowed: 1 hour 10 minutes

H

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

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

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 **60**.
- 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 **20** pages.

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

Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 Which row describes the difference between a vector quantity and a scalar quantity?

	Has magnitude	Has direction
A	scalar only	vector only
B	vector and scalar	vector only
C	vector and scalar	scalar only
D	vector only	vector and scalar

Your answer ☐ **[1]**

2 Different scientists have contributed to the model of the atom.

What is the order of each scientist's contribution from the oldest to the newest?

Oldest ⟶ Newest

A Bohr, Rutherford, Thomson

B Rutherford, Bohr, Thomson

C Thomson, Bohr, Rutherford

D Thomson, Rutherford, Bohr

Your answer ☐ **[1]**

3 An object is rubbed with a cloth and becomes **positively** charged.

Which sentence explains how the object becomes positively charged?

A Electrons move from the cloth to the object.

B Electrons move from the object to the cloth.

C Protons move from the cloth to the object.

D Protons move from the object to the cloth.

Your answer ☐ **[1]**

4 An astronaut has a mass of 70 kg on Earth.

The mass of the Moon is smaller than the mass of the Earth.

Which row describes the astronaut's mass and weight on the Moon compared to their mass and weight on Earth?

	Mass of astronaut	**Weight of astronaut**
A	smaller	larger
B	larger	stays the same
C	stays the same	smaller
D	stays the same	stays the same

Your answer ☐ **[1]**

5 Which two units measure the same quantity?

A W and J

B N m and J

C kg and N

D V and A

Your answer ☐ **[1]**

6 A skydiver jumps from an airplane and reaches terminal velocity before the parachute opens.

Which statement describes what is happening when they reach terminal velocity?

A Air resistance equals the weight of skydiver.

B Air resistance has no effect on the skydiver.

C Air resistance is greater than the weight of skydiver.

D Air resistance is less than the weight of skydiver.

Your answer ☐ **[1]**

7 A sealed rigid container of air is in a room at 20 °C. The container is then placed in a refrigerator at 4 °C.

Which row explains what happens to the speed of the air molecules and the pressure inside the container?

	Air molecules inside the container	**Pressure on the inside of the container**
A	move faster	decreases
B	move faster	increases
C	move slower	decreases
D	move slower	increases

Your answer ☐ **[1]**

8 Four cars are travelling along a road.

Which car has the **highest** momentum?

Use the equation: momentum = mass × velocity

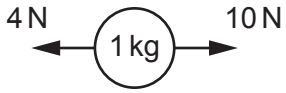
	Mass of car (kg)	**Velocity of car (m / s)**
A	1000	5
B	1000	10
C	2000	5
D	2000	10

Your answer ☐ **[1]**

9 Four different objects are acted on by different forces.

Which object has the **highest** acceleration?

A



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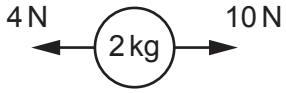

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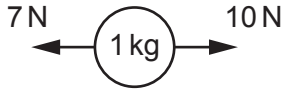

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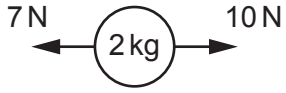


Your answer ☐ **[1]**

10 A spring has a spring constant of 20 N / m.

What is the extension of the spring when it is stretched by a force of 6 N?

The spring is **not** stretched beyond its limit of proportionality.

Use the equation: force exerted by a spring = spring constant × extension

A 0.3 m

B 0.3 mm

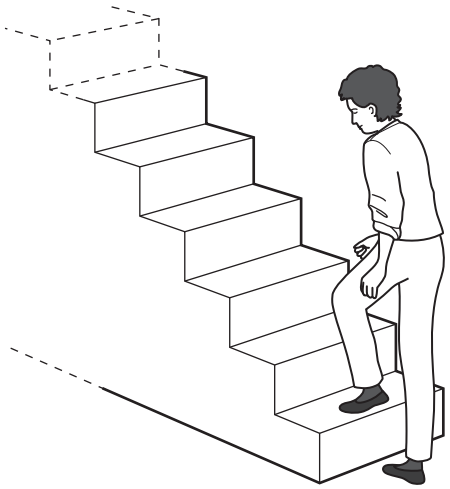
C 3.3 m

D 3.3 mm

Your answer ☐ **[1]**

Section B

11 Two students do an experiment to measure their power by walking up steps.



(a) This is the data from student **P**:

- Weight = 600 N
- Number of steps = 250
- Height of each step = 0.20 m

Calculate the work done by student **P**.

Work done = ... J **[3]**

(b) This is the data from student **Q**:

- Work done = 36 000 J
- Time taken = 240 s

Calculate the power of student **Q**.

Use the equation: power = $\frac{\text{work done}}{\text{time}}$

Give your answer in kW.

Power = ... kW **[3]**

(c) Describe how the students carry out this experiment. Include any equipment they need to use.

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

(d) Student **P** carries out the experiment five more times and calculates their power.

Here are student **P**'s results.

	Try 1	**Try 2**	**Try 3**	**Try 4**	**Try 5**
Power (W)	120	121	122	121	123

(i) How can student **P**'s results be described?

Tick **one** (✓) box in each row.

	Yes	**No**
Precise		
Repeatable		

[1]

(ii) Explain your answer to **(d)(i)**.

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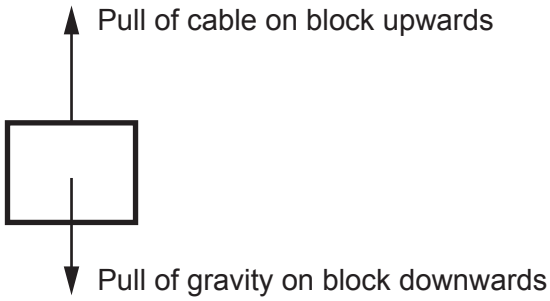
..... **[2]**

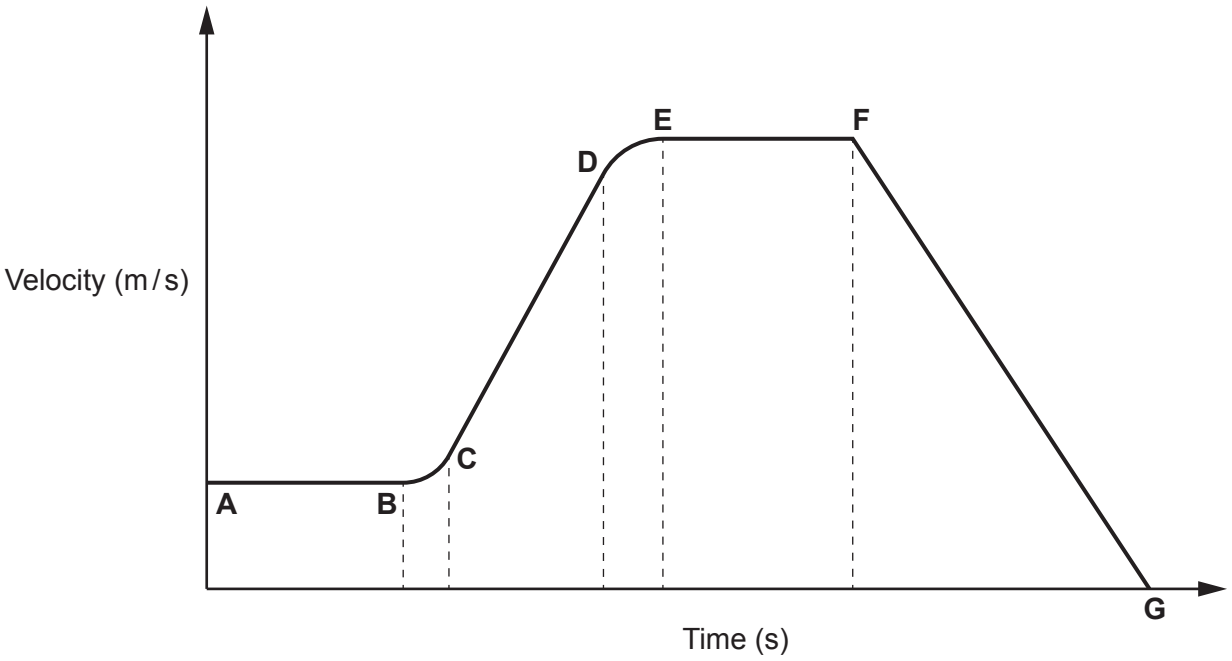
12* A cable is used to lift a block vertically upwards. **Fig. 12.1** shows the forces acting on the block.

Fig. 12.1



The size of the resultant force on the block changes as the block is lifted.
Fig. 12.2 shows the velocity-time graph for the block during the time it is being lifted.

Fig. 12.2



Describe how the motion of the block **and** resultant force on the block change as the block moves from point **A** to point **G**.

Use **Fig. 12.1** and **Fig. 12.2**

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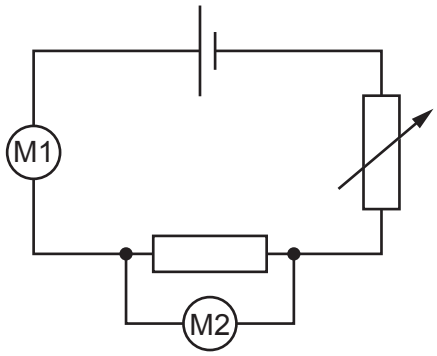
..... **[6]**

13 A student uses the circuit shown in the diagram to measure the resistance of a resistor.
M1 and M2 are meters.



(a) Explain the purpose of the variable resistor in the diagram.

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

(b) Explain why meter M1 in the diagram must be an ammeter.

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

(c) When meter M1 in the diagram is replaced by a voltmeter, no current flows.

Suggest why.

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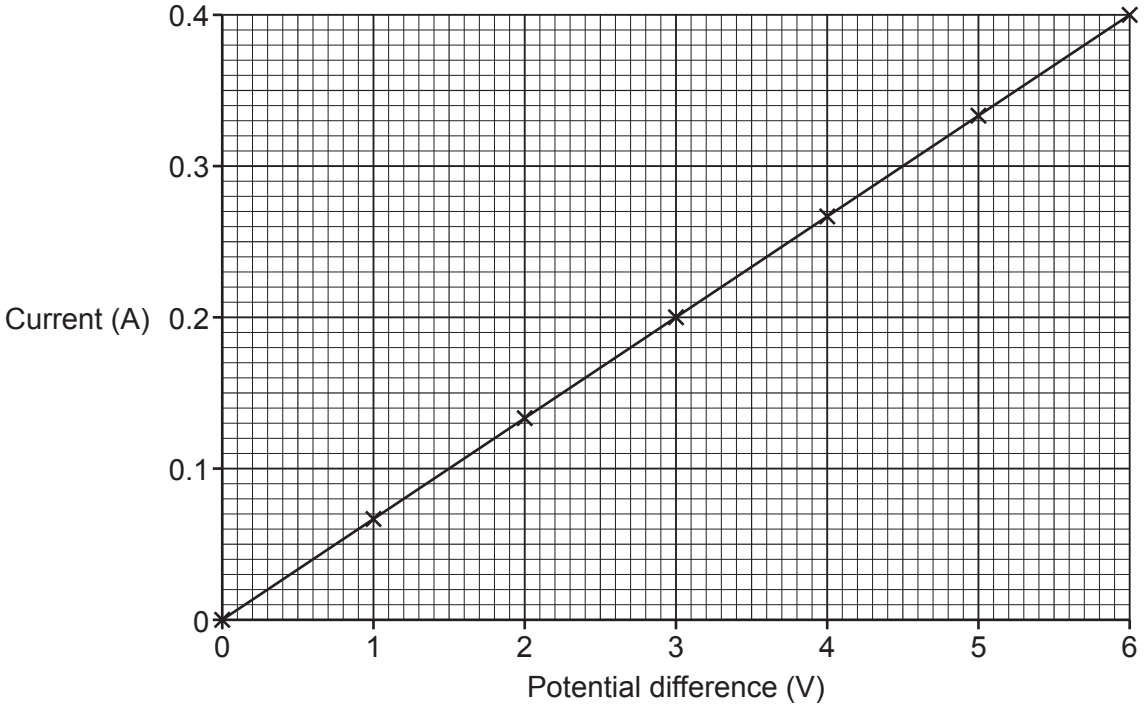
..... **[1]**

(d) The graph shows the student's results from using the circuit.



(i) Calculate the resistance of the resistor. Use the graph.

Resistance = ... Ω **[4]**

(ii) Complete the sentence about the graph to explain the relationship between potential difference and resistance.

Use words from the list.

decreases	**increases**	**stays the same**

As the potential difference increases, the resistance ..... . **[1]**

14

(a) A teacher measures the specific latent heat of ice using this method:

- Pour water at 30 °C into a beaker.
- Add the ice cube to the beaker of water.
- Measure the final temperature of the water after the ice cube melts.

(i) Here are the first set of results from the experiment.

Starting temperature of ice cube = 0 °C Mass of water = 0.2 kg Starting temperature of water = 30 °C Final temperature of water = 14 °C The specific heat capacity of water = 4200 J / kg °C

Calculate the change in thermal energy of the water.

Use the Equation Sheet.

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

Change in thermal energy = ... J **[3]**

(ii) Here are the second set of results from the experiment.

Change in thermal energy of the water = 15 000 J Energy needed to raise temperature of melted ice = 12 600 J Mass of ice cube = 0.0075 kg

Use these results to calculate the specific latent heat of ice.

Use the Equation Sheet and this equation:

$$\text{change in thermal energy of water} = \begin{matrix}\text{thermal energy needed} \\ \text{to change ice to water}\end{matrix} + \begin{matrix}\text{energy needed to raise the} \\ \text{temperature of melted ice}\end{matrix}$$

Specific latent heat = ... J / kg **[3]**

(iii) The ice must be dried with a paper towel before starting the experiment.

Suggest why.

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

(b) Describe how the terms **specific latent heat** and **specific heat capacity** are different.

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

(c) The teacher then measures the density of an ice cube.

This is the method they use:

- Measure the mass of the ice cube.
- Place the ice cube in a measuring cylinder containing water.
- Measure the increase in volume of the water after the water has settled.
- Divide the mass by the increase in volume to measure density.

(i) The teacher's method does **not** give an accurate value for the density of ice.

Suggest why.

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

(ii) Suggest a change to the method which would give a more accurate value for the density of ice.

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

(iii) An ice cube weighs 0.046 N.

The volume of the ice cube is $5.0 \times 10^{-6}\,m^3$.

Calculate the density of the ice cube.

Gravitational field strength = 10 N / kg

Use the equations: density = $\frac{\text{mass}}{\text{volume}}$

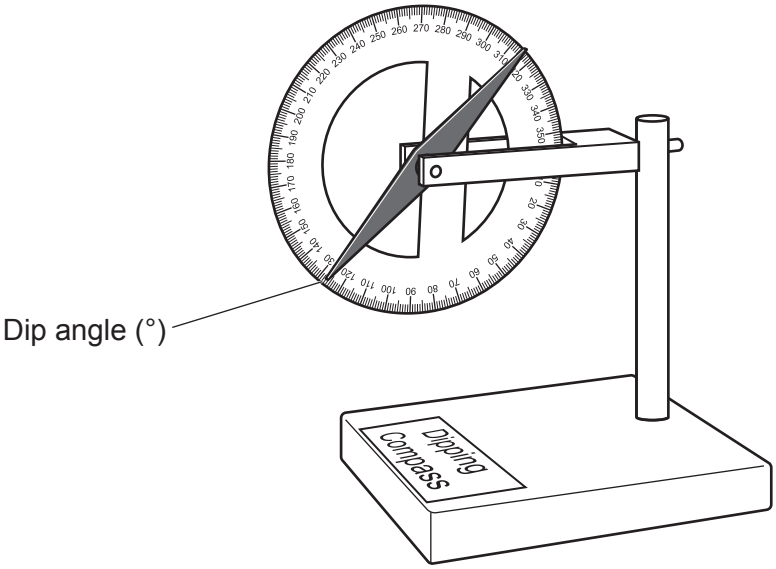
gravitational force = mass × gravitational field strength

Density = ... kg / m^3 **[3]**

15 This question is about magnetism.

(a) **Fig. 15.1** shows a dipping compass.

Fig. 15.1



In some places, a dipping compass shows a dip angle of 90°.

Where could the dipping compass be on Earth?

Tick (✓) **two** boxes.

At the equator ☐

At the North geographic pole ☐

At the North magnetic pole ☐

At the South magnetic pole ☐

In the United Kingdom ☐

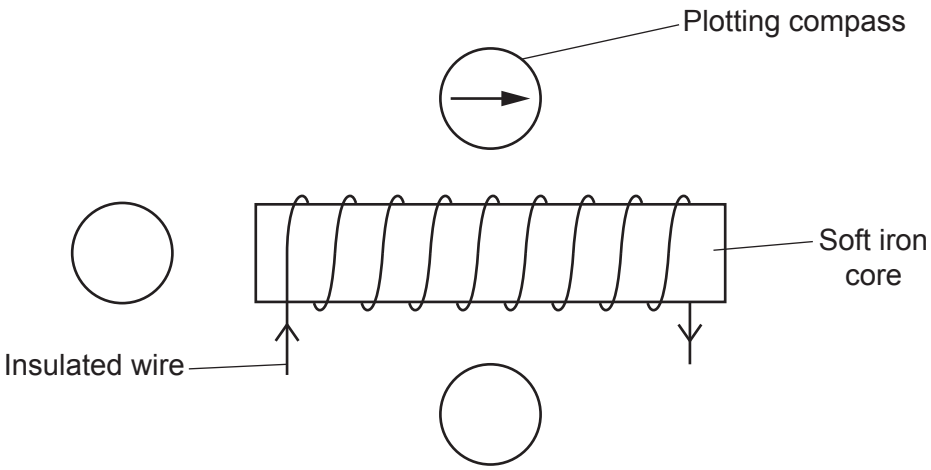
[1]

(b) A student uses a coil of insulated wire to construct an electromagnet.

(i) The student uses plotting compasses to show the magnetic field around the electromagnet.

Fig. 15.2 shows a diagram of the electromagnet. The circles show the position of three plotting compasses when the electromagnet is switched on.

Fig. 15.2



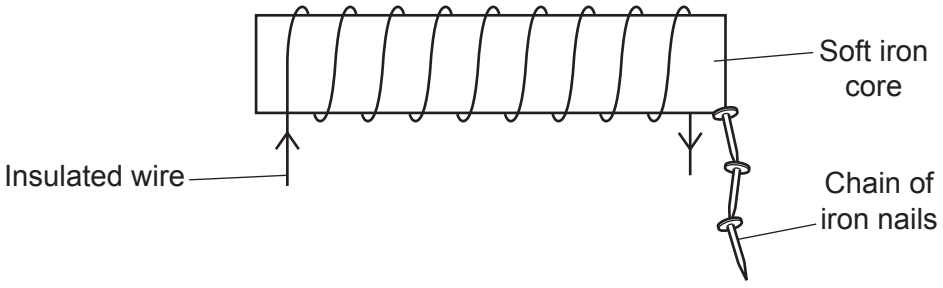
Complete **Fig. 15.2** by drawing arrows on the plotting compasses to show the direction they point.

One is already drawn for you. **[2]**

(ii) The student uses the electromagnet to pick up some iron nails.

Fig. 15.3 shows what happens when the electromagnet is switched on.

Fig. 15.3



Explain why a chain of iron nails is attracted to the electromagnet.

You can label **Fig. 15.3** to help explain your answer.

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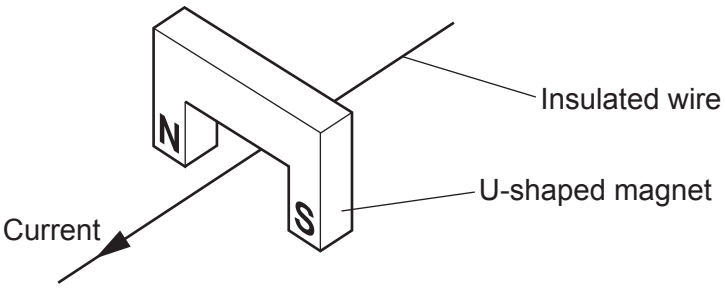
..... **[2]**

(c) The student then places some insulated wire in a straight line between the poles of a U-shaped magnet as shown in **Fig. 15.4**.

Fig. 15.4



(i) Explain what happens when a current passes through the insulated wire.

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

(ii) The magnetic flux density between the poles of the U-shaped magnet is 0.12 T.
The length of wire that lies between the poles is 0.04 m.

Calculate the force on this length of wire when a current of 0.25 A flows through it.

Use the Equation Sheet.

Give your answer in mN.

Force = ... mN **[3]**

END OF QUESTION PAPER

EXTRA ANSWER SPACE

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