OCR
Oxford Cambridge and RSA

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GCSE (9–1) Physics B (Twenty First Century Science)

J259/01 Breadth in physics (Foundation Tier)

Wednesday 23 May 2018 – Afternoon

Time allowed: 1 hour 45 minutes

7030363065

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Physics B (inserted))

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

J259901

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **24** pages.

Answer **all** the questions.

1 Jamal is listening to the radio.

(a) He can hear a musical instrument playing a steady note.

What type of wave is the **sound** that Jamal hears?

Put a (ring) around the correct answer.

electromagnetic **longitudinal** **radio** **transverse**

[1]

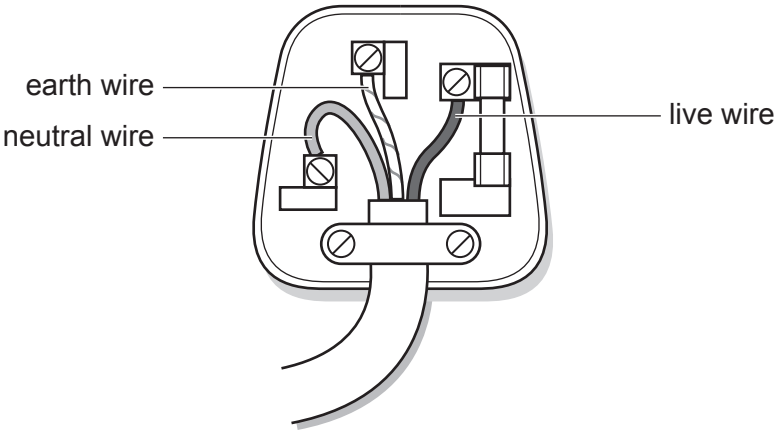
(b) The sound waves that Jamal hears have a frequency of 400 Hz and a wavelength of 0.84 m.

Calculate the speed of the sound waves.

Use the equation: wave speed = frequency × wavelength

Wave speed = ... m/s **[2]**

2 The diagram shows the inside of a three-pin plug.



(a) **(i)** Put a **tick** (✓) in the correct box in each row to show the correct descriptions of the live, neutral and earth wires.

Wire	Connected to the National Grid	Is at the same voltage as the ground
Live		
Neutral		
Earth		

[2]

(ii) Put a (ring) around the voltage between the live and neutral wires.

0 V **12 V** **230 V** **25 000 V**

[1]

(b) Batteries supply direct current (d.c).

Another type of current is alternating current (a.c).

Each statement in the table below may be **true** about d.c, or **true** about a.c, or **true** for both d.c and a.c.

Put a **tick** (✓) in the correct box in each row.

	True only for d.c	True only for a.c	True for both
The current always flows in the same direction.			
The domestic supply in the UK uses this.			

[2]

3 Alex is planning his journey to school.

(a) Alex usually walks to school.

Which is the most likely speed at which Alex walks?

Put a (ring) around the correct answer.

0.12 m/s **1.2 m/s** **12 m/s** **120 m/s**

[1]

(b) He could travel by car.

A car travels at 36 km/h (kilometres per hour).

Which is the correct calculation to work out this speed in m/s (metres per second)?

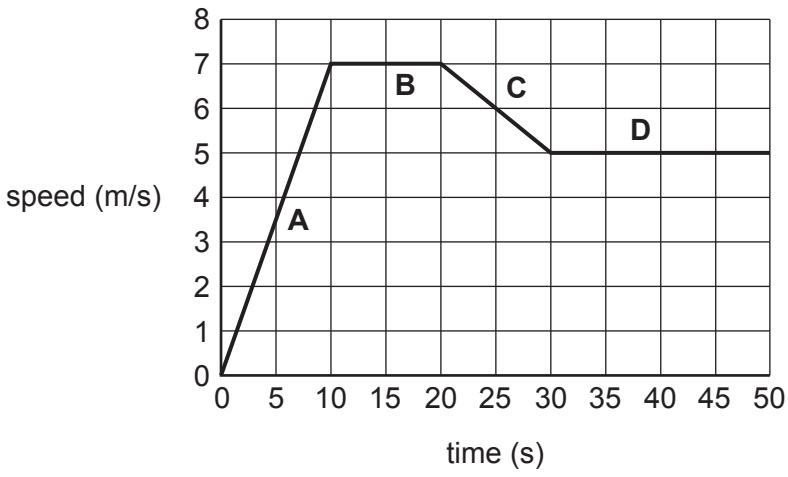
Put a (ring) around the correct answer.

$\frac{36 \times 60}{1000}$ $\frac{36 \times 1000}{60}$ $\frac{36 \times 3600}{1000}$ $\frac{36 \times 1000}{3600}$

[1]

(c) In the end Alex decides to cycle to school.

The graph shows the first part of this journey.



(i) Put a tick (✓) in the **one** correct box in each row.

	A	B	C	D
In which section does Alex have an average speed of 3.5 m/s?				
In which section does Alex slow down?				

[2]

(ii) Calculate the acceleration in section **A** of the journey.

Use the equation: acceleration = change in speed ÷ time

Acceleration = ... m/s^2 **[3]**

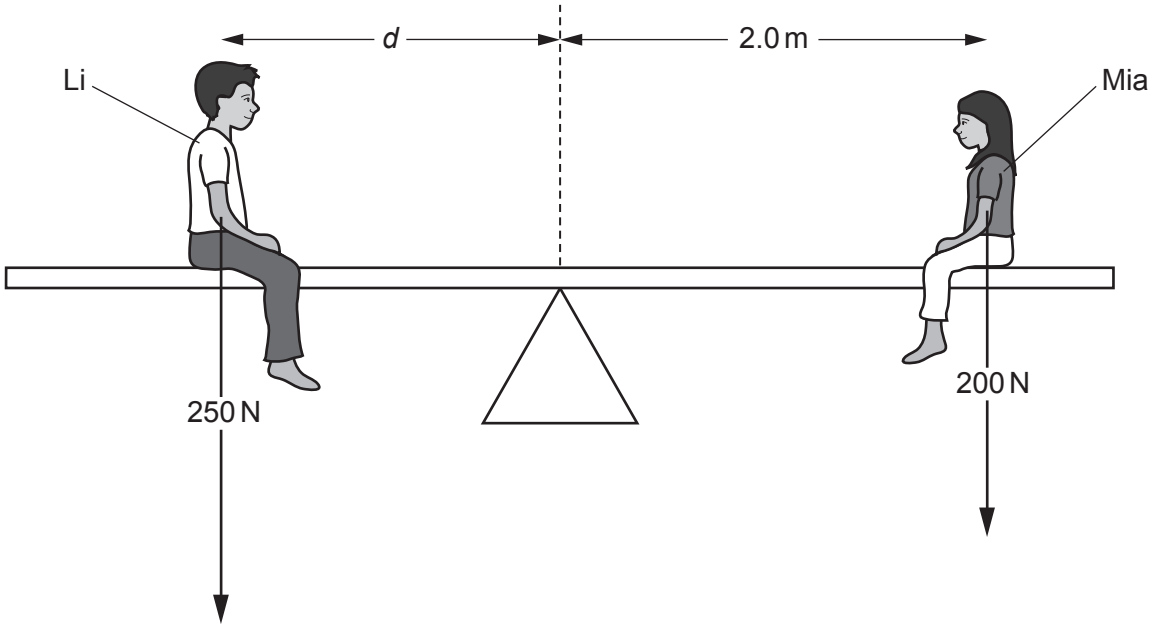
4 Eve has a mass of 23 kg.

Calculate Eve's weight.

Gravitational field strength = 10 N/kg

Weight = ... N **[3]**

5 The figure shows Li and Mia balanced on a see-saw.



(a) Mia weighs 200 N.

Calculate the moment of Mia's weight about the centre of the see-saw.

Moment = ... N m **[3]**

(b) Li weighs 250 N.

To balance Mia as shown in the diagram, he needs to sit at a distance *d* from the centre of the see-saw.

Calculate the distance *d*.

Distance *d* = ... m **[3]**

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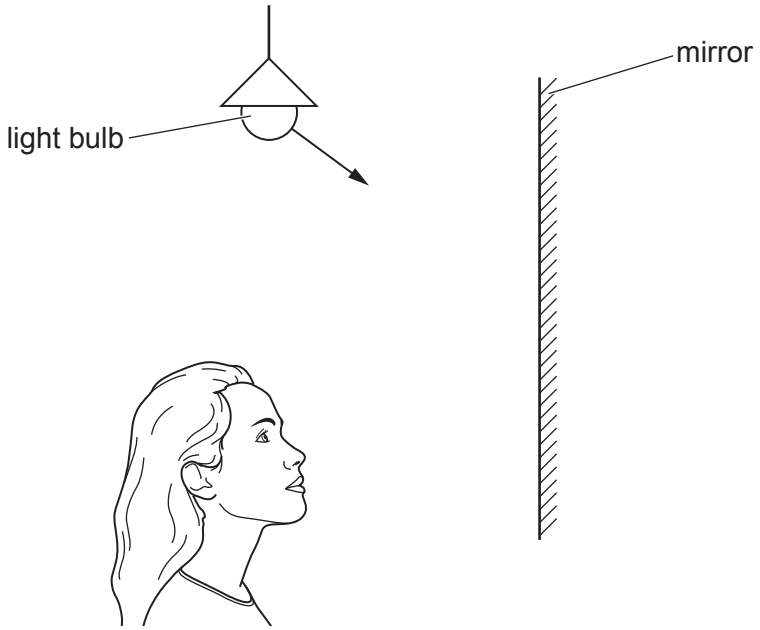
6 Jane sees the reflection of the light bulb in her bathroom mirror.

(a) Complete the diagram to show the path taken by the reflected light.



[2]

(b) Jane fills the bath with hot water. The mirror 'steams-up' and is now covered in tiny drops of water. This makes the surface of the mirror look white.

(i) Jane says, 'The water on the mirror came from the bath'.

Explain how this happened.

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

(ii) Explain why the water droplets covering the mirror make it look white.

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.....

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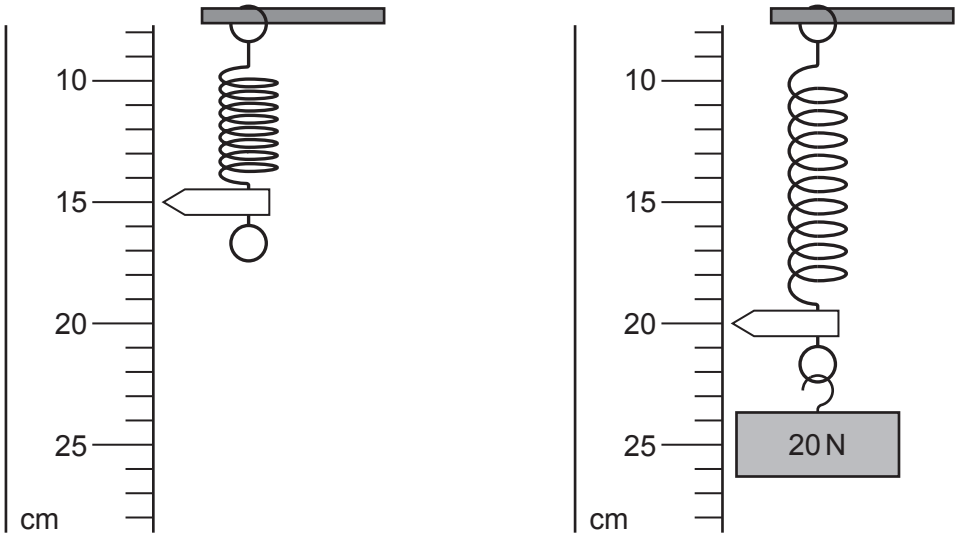
..... **[2]**

7 Ali hangs a spring next to a ruler with a centimetre scale, as shown in the diagram **A**.

He attaches a 20 newton (N) weight to the bottom of the spring.

The spring stretches as shown in **B**.



A **B**

(a) (i) What is the correct extension (in **metres**) of the spring in diagram **B**?

Put a (ring) around the correct answer.

0.05 m **0.15 m** **0.25 m** **0.35 m** **[1]**

(ii) Show that the spring constant is 400 N/m.

[3]

(b) Calculate the **energy stored** in the spring when it is stretched as in **(a)**.

Energy stored = ... J **[3]**

(c) When Ali adds another 20 N weight, the extension doubles.

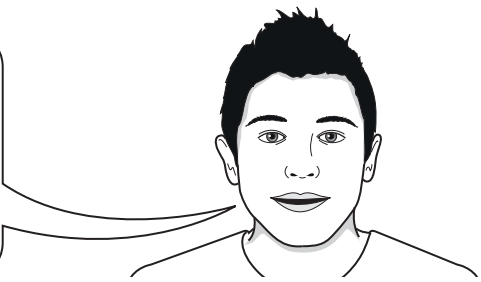
Describe the relationship between force and extension.

.....

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

(d) Ali pulls the spring in diagram **B** downwards a further 2 cm and then lets go.

Ali
I did work on the spring when I pulled it downwards. This increases the energy stored in the spring. When I let go of the spring, the mass moves up and down several times, with smaller and smaller movements. Eventually the mass stops moving.



Describe what happens to the energy stored in the spring when Ali lets go.

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

8 Some smoke alarms contain the radioactive isotope americium-241.

(a) Americium-241 can be represented as

$$^{241}_{95}\text{Am}$$

(i) Which is the number of protons in americium-241?

Put a ring around the correct answer. **[1]**

95 **241** **241 + 95** **241 – 95**

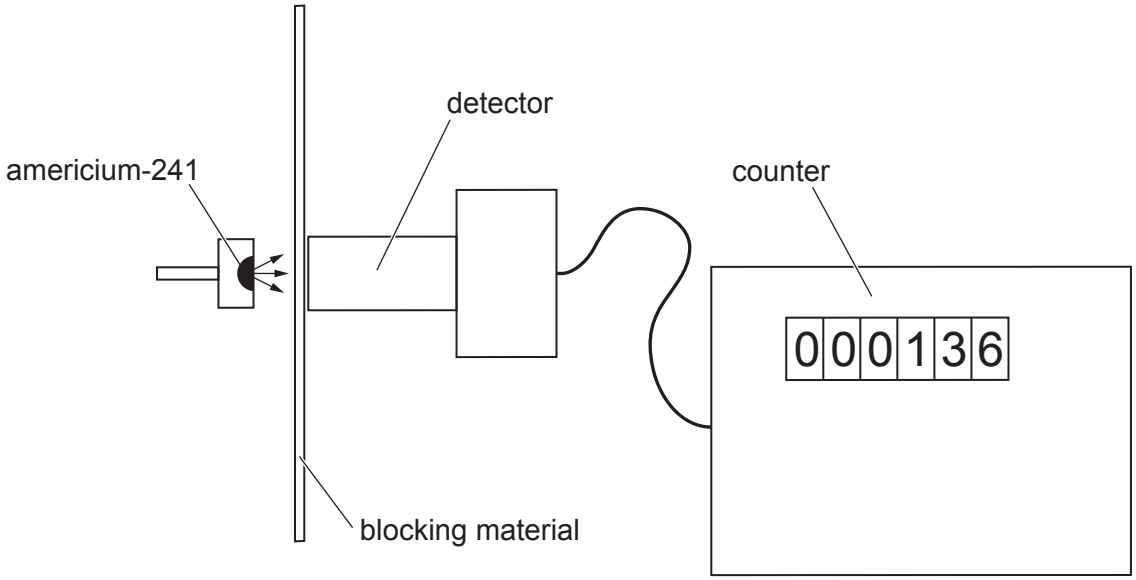
(ii) Which is the number of neutrons in americium-241?

Put a ring around the correct answer. **[1]**

95 **241** **241 + 95** **241 – 95**

(b) Two students investigate the radiation emitted by americium-241.

The diagram shows their equipment.



They recorded the number of counts detected in one minute with different blocking materials.

The table shows their results.

Blocking material	Counts per minute
nothing (just air)	620
paper	23
thin aluminium	23

(i) The students agree that americium-241 emits alpha radiation but not beta radiation.

Explain how the evidence supports this conclusion.

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

(ii) They cannot tell from their results whether americium-241 emits gamma radiation.

What should they do to decide whether the source emits gamma radiation?

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

(c) In fact, americium-241 emits both alpha radiation **and** gamma radiation.

Evaluate how dangerous it is to have a small amount of americium-241 in a smoke alarm.

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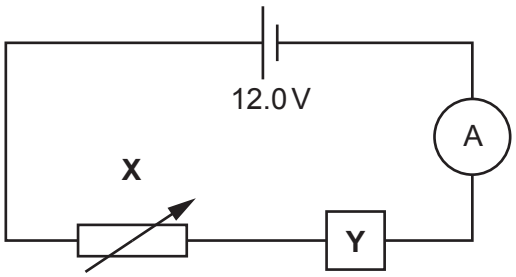
..... **[2]**

9 Sundip builds a circuit to investigate a mystery component.

(a) She builds this circuit. The mystery component is the box labelled **Y**.



(i) Add a voltmeter to the circuit to measure the potential difference across component **Y**. **[1]**

(ii) Describe how to use component **X** to vary the current in the circuit.

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.....

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

(b) The table shows Sundip's results.

Potential difference (V)	Current (A)	Resistance (Ω)
1.0	0.68	1.47
2.0	0.93	2.15
3.0	1.13	2.65
4.0	1.30	3.08
5.0	1.45	3.45
6.0	1.59	

(i) Calculate the resistance when the potential difference is 6.0 V.

Give your answer to **3** significant figures.

Resistance = ... Ω **[4]**

(ii) Describe the relationship between current and resistance.

.....

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

(iii) Suggest what component **Y** is.

Explain your answer.

Component **Y** is .....

Explanation .....

.....

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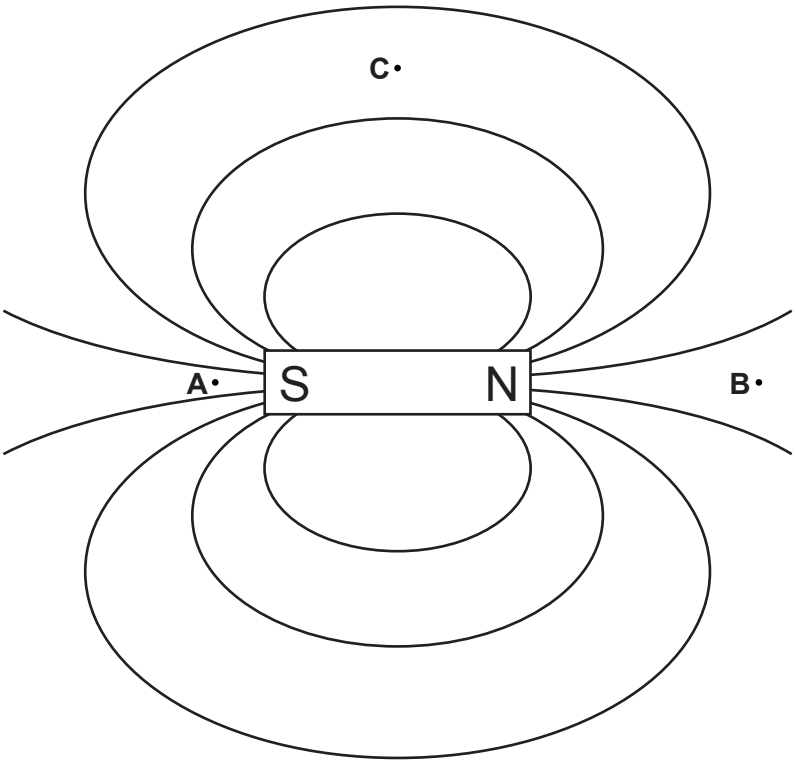
..... **[2]**

10 The diagram shows the field around a bar magnet.
Three points are labelled **A**, **B** and **C**.



(a) (i) Where is the field strongest?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

[1]

(ii) Where would a magnetic compass point to the right?

Tick (✓) **two** boxes.

A ☐

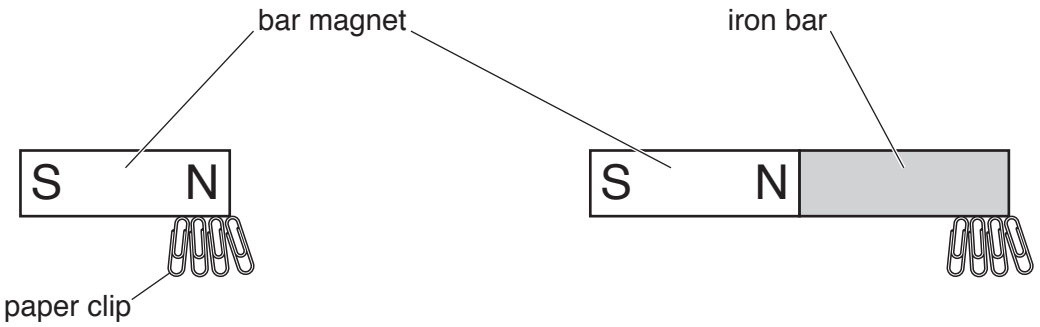
B ☐

C ☐

[1]

(b) The bar magnet can pick up paper clips.

An iron bar can also pick up paper clips if it is held next to a bar magnet.



Describe the difference in magnetism between the bar magnet and the iron bar.

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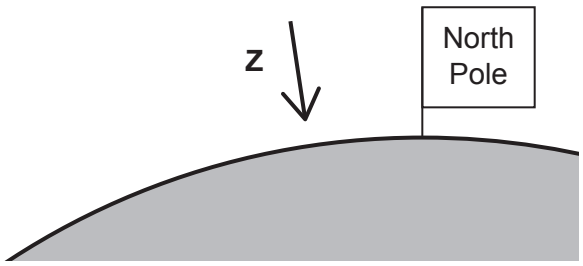
..... **[1]**

(c) The diagram shows a section through the Earth.

The flag marks the position of the geographic north pole of the Earth.

The arrow **Z** shows the point at which a compass needle would point vertically down at the surface.



Here are some statements about the Earth's magnetism, some are **true**, and some are **false**.

Put a **tick** (✓) in the correct box after each statement.

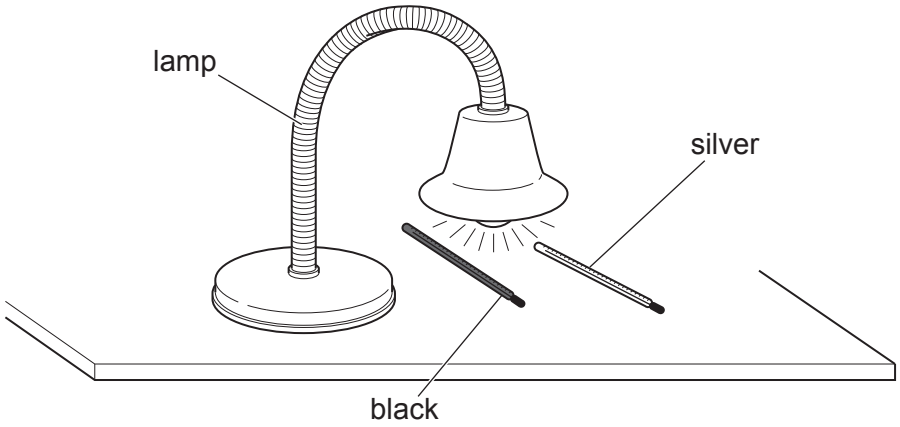
	True	False
A compass will always point towards the centre of the Earth.	☐	☐
The Earth's magnetic north pole is in the same place as the Earth's geographic north pole.	☐	☐
The core of the Earth is magnetic and produces a magnetic field.	☐	☐
The compass points down because the surface at the north pole is covered with iron.	☐	☐

[2]

11 Ben investigates how much radiation is absorbed by different coloured surfaces.

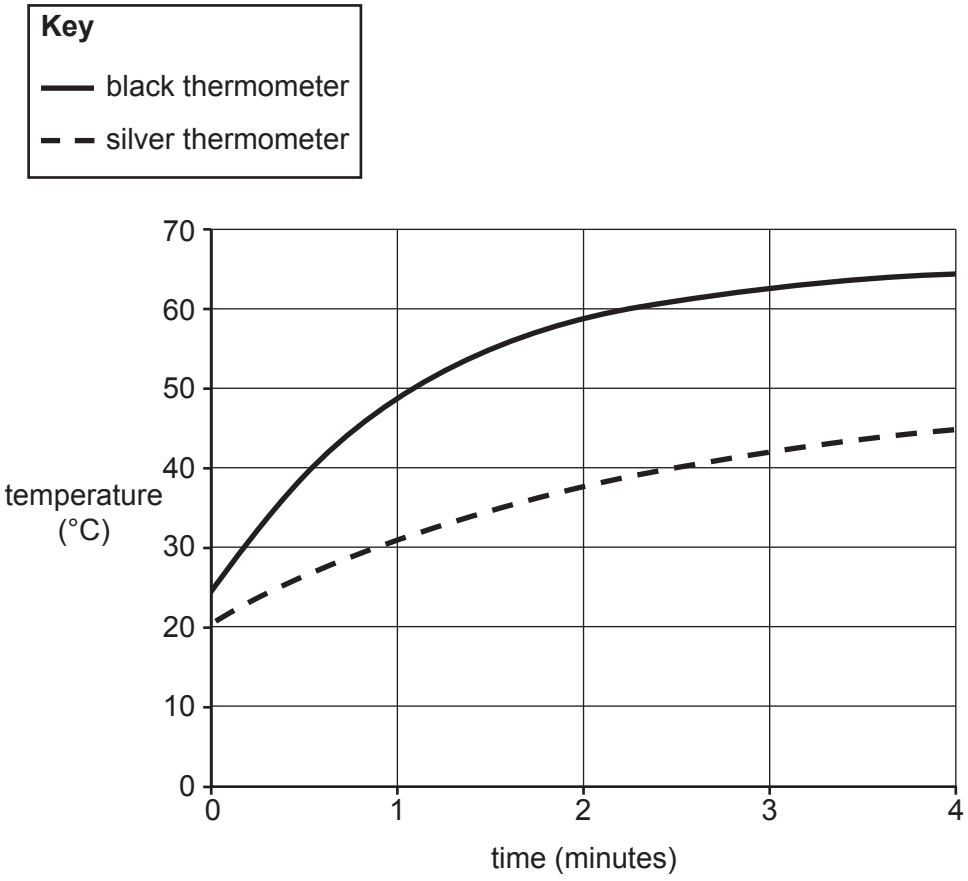
He uses two thermometers and a lamp.

He paints one thermometer black and the other thermometer silver and places them under the lamp.



He records how the temperature of each thermometer changes over four minutes.

The graph shows his results.



(a) Describe **similarities** and **differences** between the results for the black thermometer and the silver thermometer.

Similarities .....

.....

Differences .....

.....

.....

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

(b) Explain the results of the experiment.

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

(c) Identify a weakness with Ben's method and suggest how it could be improved using information from the diagram or from the graph.

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

12 Nina is writing a report about the Solar System.

She has written an introduction.

> The planets in our Solar System all move around the Sun.
> They orbit in perfect circles and in the same direction.
> Each planet has at least one moon orbiting it.
> The planets and their moons are all made of rock.

(a) Identify **two** mistakes in Nina's introduction.

1 .....

.....

2 .....

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[2]

(b) Nina wants to include a section about how the Solar System was formed.

Describe how the Solar System was formed.

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

(c) Nina researches how the Sun releases energy. She finds this information in a textbook.

> The Sun releases energy by nuclear fusion. The Sun emits about 4×10^{26} J of energy every second. As a result, its mass falls by about 4 billion kilograms every second.

Explain why nuclear fusion causes the mass of the Sun to decrease.

.....

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

13 A toothbrush uses a rechargeable battery.

(a) The energy that is stored in the battery comes from a power station.

State how the energy is transferred from the power station to the chemical store in the battery.

.....

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

(b) The potential difference across the battery is 1.2 V.

During a typical use, 360 C of charge moves though the toothbrush motor over a time of 2 minutes.

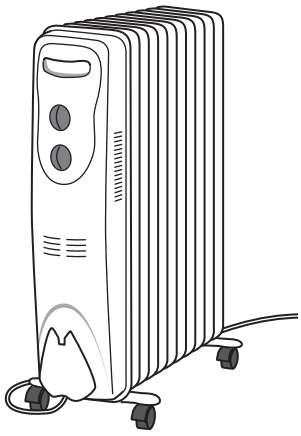
(i) Calculate the total energy transferred by the toothbrush in one day if it is used **two** times a day.

Energy transferred = ... J **[3]**

(ii) Calculate the current in the toothbrush when used for 2 minutes each time.

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

14 The diagram shows a common type of electric heater. It contains oil which is heated by an electrical element.



The table shows some information about the heater.

Electrical power	1500 W
Voltage rating	230 V
Specific heat capacity of oil	1600 J / kg °C
Mass of oil	4.5 kg

(a) Show that more than 700 000 J of energy is needed to heat the oil from 20 °C to 120 °C.

Use the equation:
change in internal energy = mass × specific heat capacity × change in temperature

[2]

(b) (i) Use your answer to **(a)** to calculate the minimum time for the oil to reach a temperature of 120 °C, starting at 20 °C.

Minimum time = ... s **[3]**

(ii) In practice, it will take longer than this for the heater to reach 120 °C.

State the reason for this.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).