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

J250/12 Paper 12, P4–P6 and CS7 (PAGs P1–P6)

(Higher Tier)

Friday 15 June 2018 – Morning

Time allowed: 1 hour 10 minutes

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

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

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, 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 **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

SECTION A

Answer **all** the questions.

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

1 A car travels at 10 m / s. The mass of the car is 800 kg.

Use the equation: Kinetic energy = 0.5 × Mass × Speed^2

Calculate the kinetic energy of the car.

A 4000 J

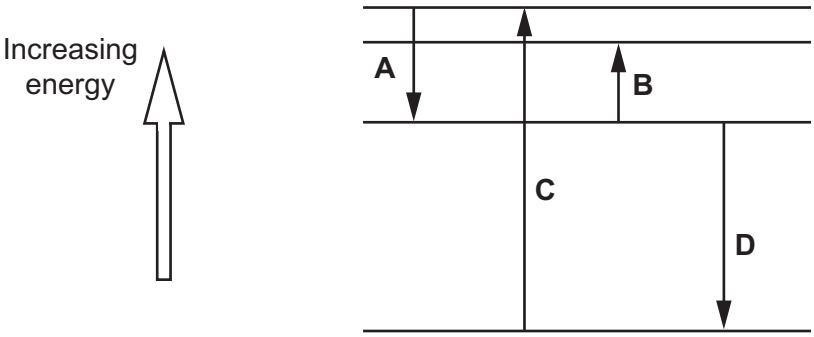
B 8000 J

C 40 000 J

D 80 000 J

Your answer ☐ **[1]**

2 This is a model of energy levels inside an atom.



The arrows shown as ↓ and ↑ are electrons moving between energy levels.

Which electron movement **emits** radiation with the **highest** energy?

Your answer ☐ **[1]**

3 Which sentence describes a **renewable** energy source?

A An energy source that can be replaced in your lifetime.

B An energy source that cannot be used again and again.

C An energy source that is not made from fossil fuels.

D An energy source that will run out.

Your answer ☐ **[1]**

4 In the UK, three wires are used in the domestic electricity supply.

They are the earth wire, the live wire and the neutral wire.

Which sentence is correct?

A The alternating p.d. between the neutral wire and the earth wire is 230 V.

B The alternating p.d. between the neutral wire and the live wire is 230 V.

C The earth wire contains a fuse for safety.

D The live wire is connected to the case of an appliance for safety.

Your answer ☐ **[1]**

5 A student makes some estimates about distance and time.

- 1 mile is about 1500 metres.
- 1 hour is about 3500 seconds.

The student uses this information to convert 30 mph to m/s.

Which answer is correct?

A 0.013 m/s

B 13 m/s

C 70 m/s

D 70 000 m/s

Your answer ☐ **[1]**

6 The table shows some information about transformers.

Use the equation:

p.d. across primary coil × Current in primary coil = p.d. across secondary coil × Current in secondary coil

	Type of transformer	p.d. across primary coil (V)	Current in primary coil (A)	p.d. across secondary coil (V)	Current in secondary coil (A)
A	Step down	200	4	100	8
B	Step down	500	6	1000	3
C	Step up	20	1	40	2
D	Step up	100	4	200	1

Which row of the table is correct?

Your answer ☐ **[1]**

7 A driver stops a moving car by pressing the brakes. The engine is turned off and the driver gets out of the car. The driver returns to the car after 30 minutes.

Which sentence is correct?

A The energy in the thermal store of the brakes increases.

B The energy in the thermal store of the driver increases.

C The energy in the thermal store of the surroundings increases.

D The energy in the thermal store of the tyres increases.

Your answer ☐ **[1]**

8 How are radio waves produced?

A By alternating currents

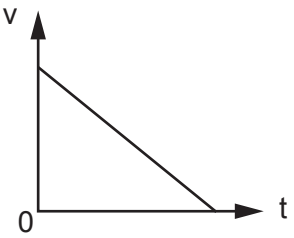
B By a radio

C By a speaker

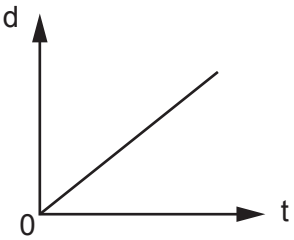
D By steady currents

Your answer ☐ **[1]**

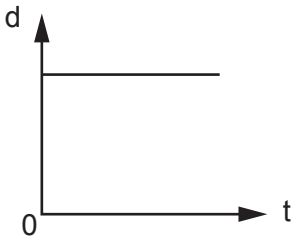
9 Look at the velocity-time graph for a car.



Which graph shows the correct distance-time graph for this car?



A



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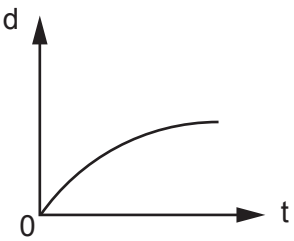

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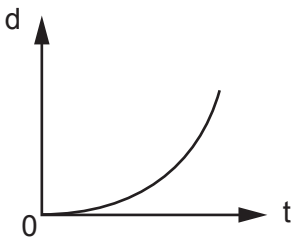

D

Your answer ☐ **[1]**

10 A teacher adds 200 cm^3 of warm water to a beaker.

He wraps the beaker in insulation. He measures the temperature drop after 10 minutes.

The table shows the results of four different experiments **A**, **B**, **C** and **D**.

Which experiment gives the **lowest** rate of cooling?

	Relative thermal conductivity	**Thickness of insulation (mm)**
A	1	10
B	1	20
C	2	20
D	2	10

Your answer ☐ **[1]**

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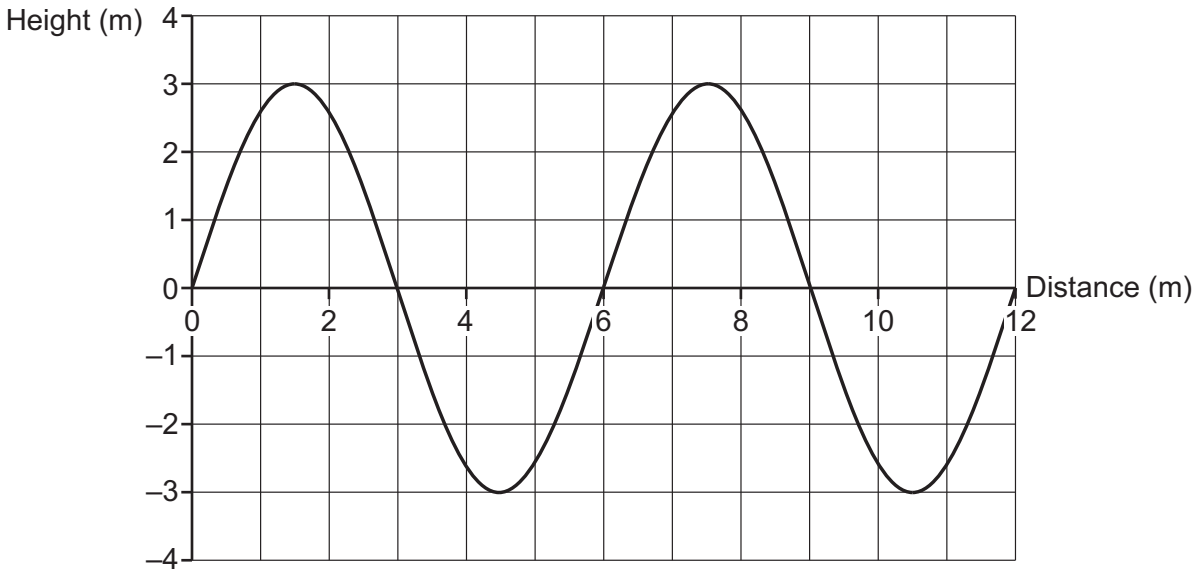
SECTION B

Answer **all** the questions.

11 The graph shows how the height of a water wave changes with distance.



(a) The water wave has a wavelength of 6 m.

Describe how the graph shows this.

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

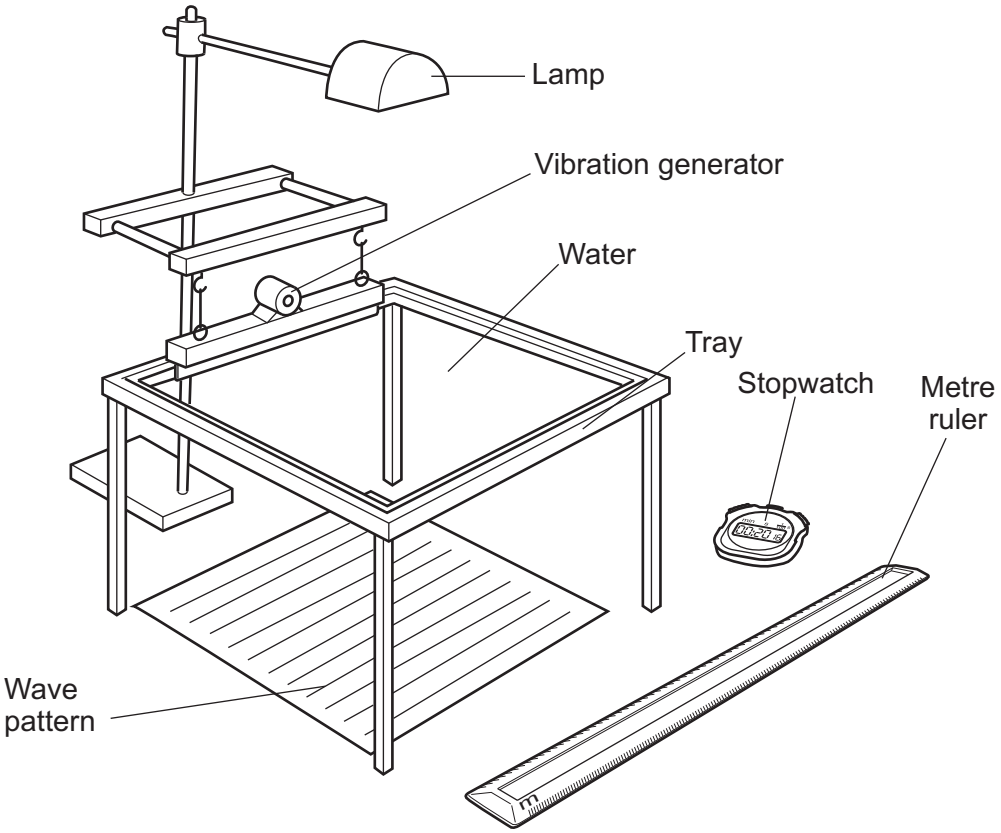
(b) The frequency of the water wave is 0.5 Hz.

Calculate the speed of this water wave.

Answer = ... m / s **[3]**

(c) A group of students use a ripple tank, a metre ruler and a stopwatch.

They draw a diagram of this equipment.



Explain how this equipment is used to measure the frequency of water waves.

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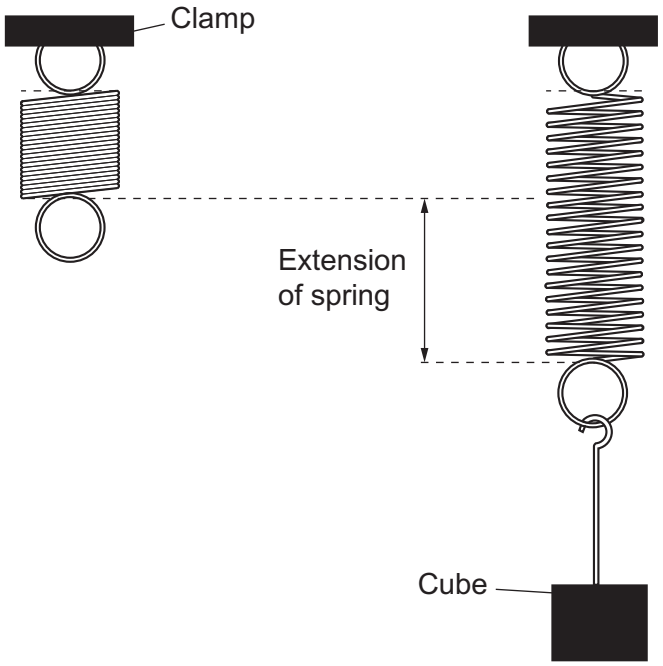
..... **[2]**

12 A student measures the extension of a spring when it is stretched.

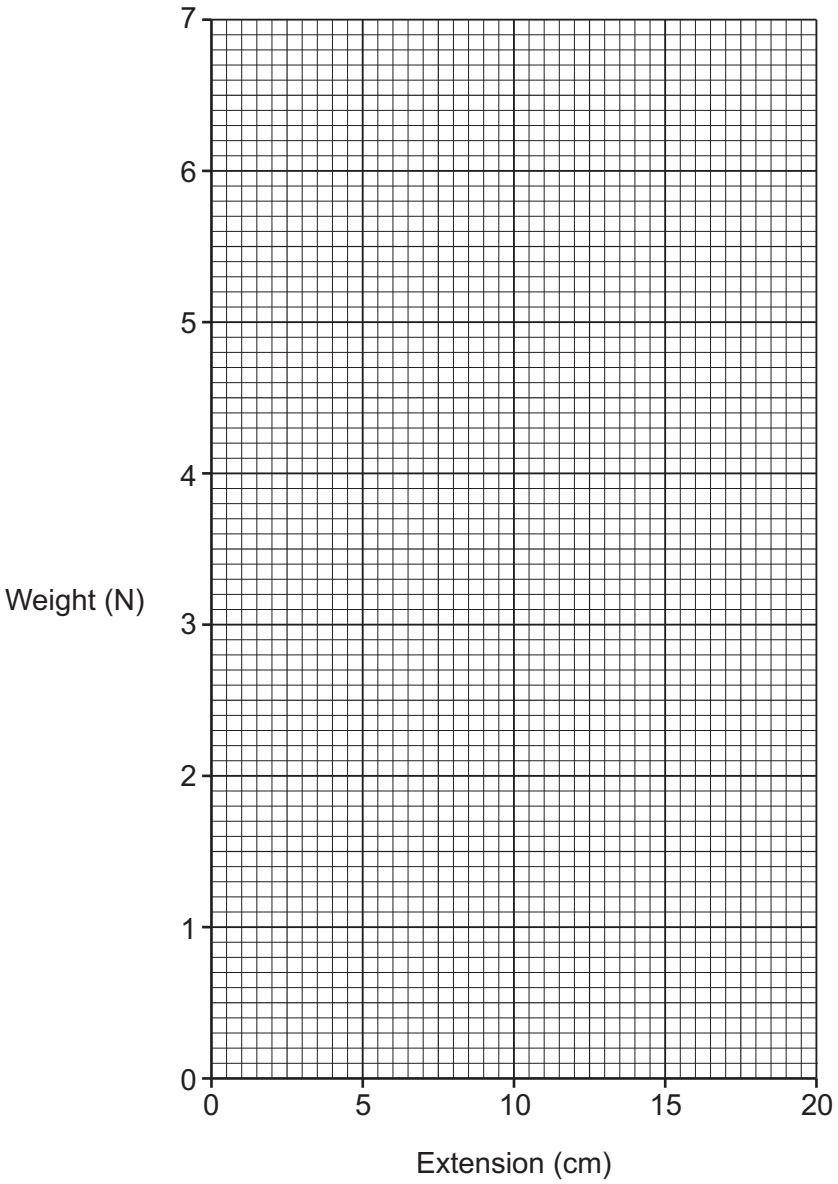


He hangs different cubes from the spring. He measures the extension of the spring for each cube.

Look at his results.

Weight of cube (N)	Extension of spring (cm)
1.0	2.9
3.0	8.4
4.0	11.4
5.0	14.4
7.0	20.0

(a) Plot a graph of the results on the grid.



[1]

(b) Use the results and the graph to show the spring constant is 35 N / m.

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

(c) The spring constant is 35 N / m.

Calculate the energy transferred to this spring when the extension is 0.2 m.

Answer = ... J **[2]**

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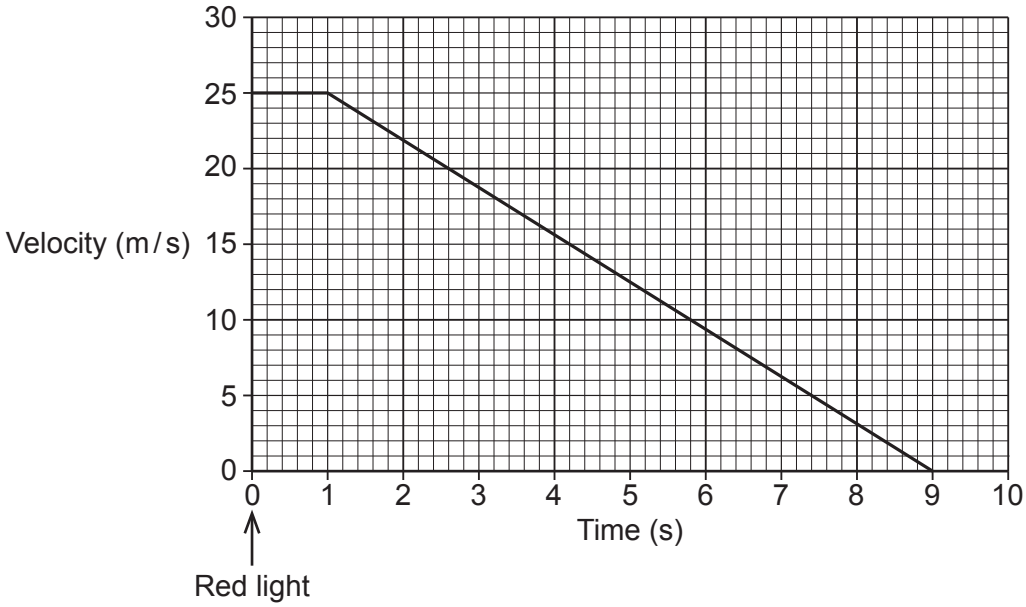
13* Person **A** and person **B** drive their cars along the same road on different days.

Both cars travel at 25 m / s. The traffic lights along the road change to red.

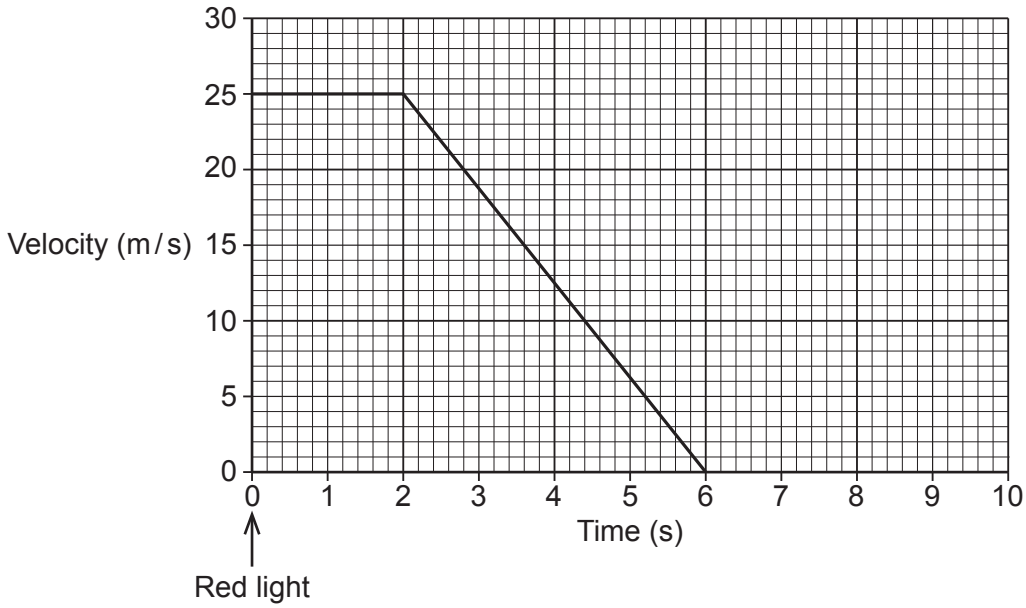
Person **A** and person **B** see the red light and press the brakes in their car.

The graphs show the velocity of each car **after** person **A** and person **B** see the red light.

Person **A**



Person **B**



The graphs are drawn using the same scale.

Explain what the graphs show you about how the cars stop.

Use values from the graphs and calculations in your answer.

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

14 This question is about nuclear radiation.

(a) **Q** and **R** are different radioactive isotopes. **Q** has a different half-life to **R**.

(i) Explain what is meant by the term **half-life**.

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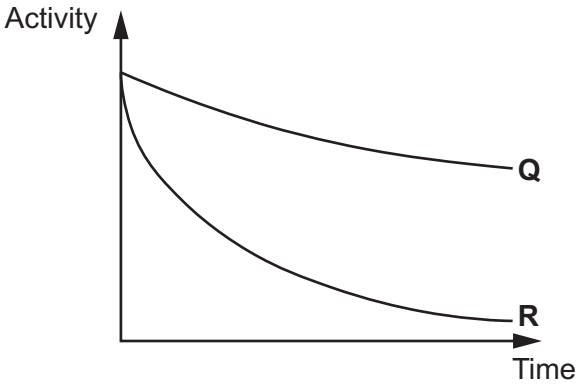
..... **[2]**

(ii) The graph shows how activity of isotope **Q** and isotope **R** change with time.



Which isotope, **Q** or **R**, has the **longest** half-life? Explain your answer.

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

(b) The table shows information about different elements.

Element	Symbol	Atomic number
Antimony	Sb	51
Caesium	Cs	55
Iodine	I	53
Tellurium	Te	52
Xenon	Xe	54

Iodine-131 is a radioactive isotope. Iodine-131 decays, emitting a beta (β) particle.

Write a balanced nuclear equation for iodine-131 decay. The first part is done for you.

$^{131}_{53}\mathrm{I} \rightarrow$ ..... **[3]**

(c) The table shows how the activity of iodine-131 decreases with time.

Time (days)	Activity (10^{12} Bq)
0	4.6
4	3.2
10	1.9
16	1.2
20	0.8

(i) Use the table to calculate the ratio: $\frac{\text{activity after 4 days}}{\text{activity after 20 days}}$

Answer = ... **[1]**

(ii) Use your answer to **(c)(i)** to calculate the half-life of iodine-131.

Answer = ... days **[2]**

15 The table shows some information about electrical appliances in the home.

Appliance	Power (W)	Current (A)	Resistance (Ω)
Electric drill	800	3.48	66.1
Iron	2000	8.69	26.5
Kettle	2500	10.86	21.1
Security light	500	2.17	105.8
Toaster	1650	7.17	32.1

(a) (i) Use the table to describe the relationship between power and resistance.

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

(ii) Explain this relationship. Use ideas about resistance in your answer.

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

(b) The security light is switched on for 45 minutes every day for 7 days.

Use the equation: Energy transferred = Power × Time

Calculate the energy transferred in kWh.

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

Answer = ... kWh **[4]**

(c) Explain the difference between direct voltage and alternating voltage.

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

(d) The electric drill does **not** need an earth wire.

Explain why.

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

(e) Mains electricity can be produced in a power station that burns coal.

An electric iron is plugged into the mains and switched on. The temperature of the iron increases.

Describe this process.

Use ideas about energy stores in your answer.

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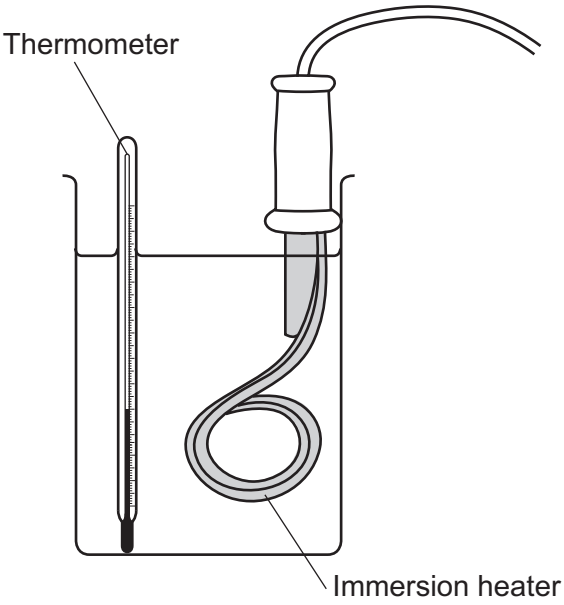
..... **[3]**

16 A scientist completes an experiment to determine the specific heat capacity of water.

She uses an immersion heater to increase the temperature of water in a beaker.



(a) Suggest **two** ways to ensure the scientist obtains accurate results.

1. .....

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2. .....

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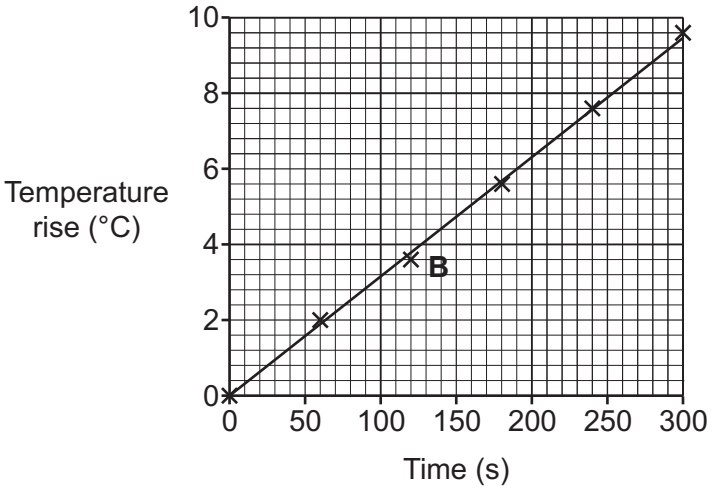
[2]

(b) The scientist measures the temperature of the water every 60 seconds.

She plots her results.



(i) Is there a random error in this experiment?

Explain your answer.

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

(ii) The scientist thinks the point labelled **B** on the graph is an anomaly.

Is she correct? Explain your answer.

.....

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

(c) (i) Calculate the gradient (slope) of the graph.

Answer = ...°C / s **[2]**

(ii) The scientist writes down more results.

- 0.1 kg of water used
- Power of immersion heater = 12.8 W

Use the equations:

Energy transferred = Power × Time

Change in thermal energy = Mass × Specific heat capacity × Change in temperature

Calculate the specific heat capacity of water.

Use the results **and** the gradient you calculated in part **(c)(i)**.

Answer = ... J / kg °C **[4]**

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).