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Monday 23 November 2020 – Morning

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

J250/06 Paper 6 (Foundation Tier)

Time allowed: 1 hour 10 minutes

8171107433

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

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

J250006

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 **24** pages.

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

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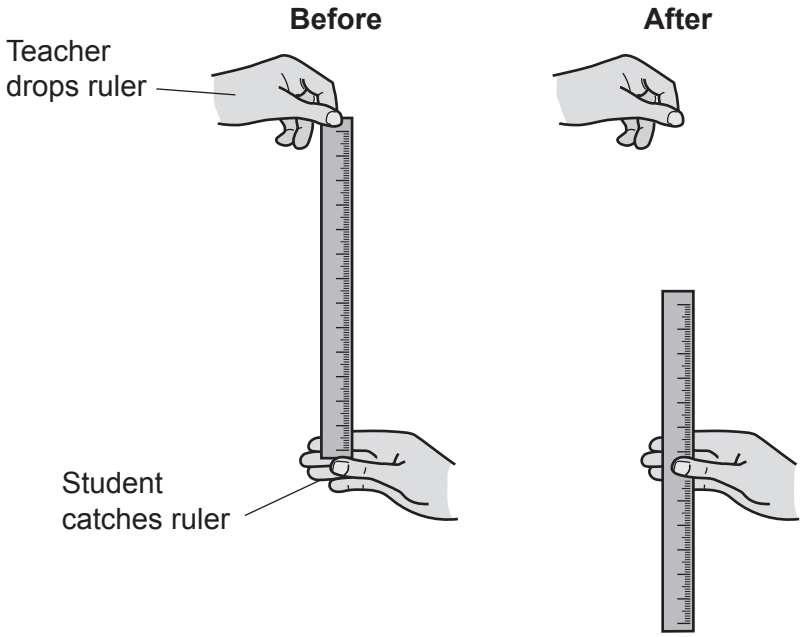
SECTION A

Answer **all** the questions.

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

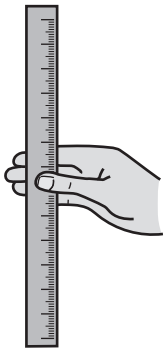
Write your answer to each question in the box provided.

1 A ruler can be used to estimate a student's reaction time:

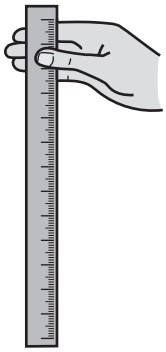


Which diagram shows the student with the **shortest** reaction time?

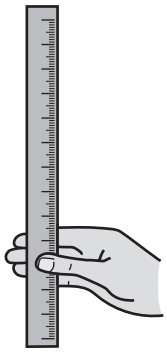
A



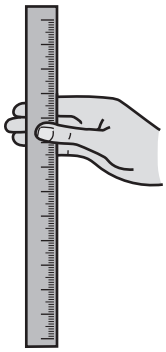
B



C



D



Your answer ☐ **[1]**

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2 A man weighs 700 N and climbs a staircase 5 m high.

How much work does he do?

Use the equation: work done = force × distance

A 140 J

B 350 J

C 695 J

D 3500 J

Your answer ☐ **[1]**

3 Atoms contain protons, neutrons and electrons.

Which row in the table describes the **nucleus**?

	Nucleus contains	**Charge on the nucleus**
A	Electrons and neutrons	Negative
B	Protons and electrons	Neutral
C	Protons and neutrons	Neutral
D	Protons and neutrons	Positive

Your answer ☐ **[1]**

4 Stopping distance depends on thinking distance and braking distance.

Which row in the table is correct?

	Thinking distance (m)	**Braking distance (m)**	**Stopping distance (m)**
A	18	55	73
B	18	73	55
C	55	18	37
D	73	55	18

Your answer ☐ **[1]**

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5 A heater transfers 150 000 J of energy in 120 s.

Calculate the power of the heater.

Use the equation: energy transferred = power × time

A 0.80 W

B 1.25 W

C 1250 W

D 18 000 W

Your answer ☐ **[1]**

6 Which row in the table is correct?

Use the equation: efficiency = useful output energy transfer / input energy transfer

	Useful output energy transfer (J)	**Input energy transfer (J)**	**Efficiency**
A	900	1500	0.6
B	900	1500	1.7
C	1500	900	0.6
D	1500	900	600.0

Your answer ☐ **[1]**

7 Hydroelectric power stations use water to transfer energy.

Which answer shows the energy transfer in a hydroelectric power station?

A kinetic store → gravitational store

B gravitational store → kinetic store

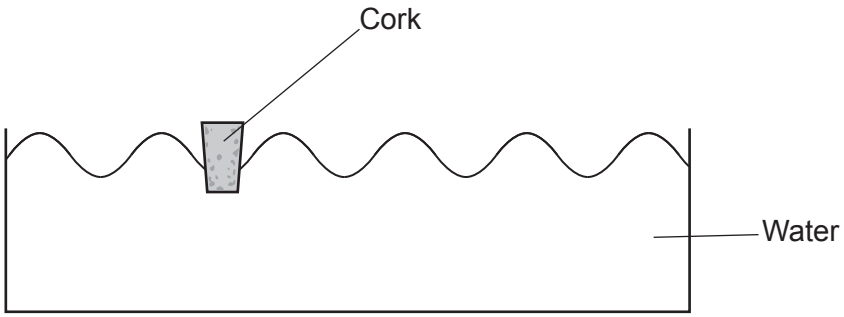
C kinetic store → chemical store

D gravitational store → chemical store

Your answer ☐ **[1]**

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8 A student makes transverse waves in a tray of water. He places a cork on the surface of the water.



Which row in the table describes the experiment correctly?

	How does the cork vibrate during the experiment?	Where is the water after the experiment?
A	↕	The water stays in its original position.
B	↔	The water moves to one side of the tray.
C	↕	The water moves to one side of the tray.
D	↔	The water stays in its original position.

Your answer ☐ **[1]**

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9 Brakes are used to decelerate a car safely in order to reduce the risk of injuries to the passengers.

Which row in the table is correct when the brakes are used safely?

	Deceleration	**Size of force on passengers**
A	Large	Large
B	Large	Small
C	Small	Large
D	Small	Small

Your answer ☐ **[1]**

10 Electromagnetic waves have many uses.

Which row in the table is correct?

	Electromagnetic wave	**Use**
A	Gamma rays	Tanning beds
B	Microwaves	Mobile phones
C	Radio waves	Killing bacteria
D	X-rays	Optical fibres

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

11 A student wants to check the electrical power of a mains filament lamp.

He sets up the circuit in **Fig. 11.1**.

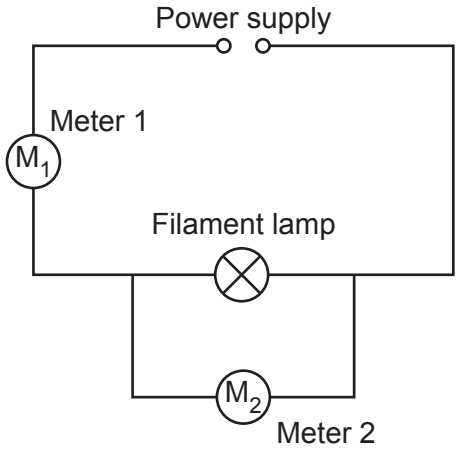


Fig. 11.1

(a) Complete the table to describe how he sets up the equipment in **Fig. 11.1**.

What is being measured?	Name of meter	Connected in
Potential difference	Meter 2 = …….	Parallel
…….	Meter 1 = Ammeter	…….

[2]

(b) (i) The student reads the meters in the circuit in **Fig. 11.1**.

- The value of the potential difference is 230 V.
- The value on the ammeter is 0.5 A.

Calculate the actual power of the mains filament lamp.

Use the equation: power = potential difference × current

Power = ... W **[2]**

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(ii) Another lamp has a power of 100 W.
1 kW = 1000 W

What is the power of the lamp in kilowatts (kW)?

Put a (ring) around the correct answer.

0.1 kW **1 kW** **100 kW** **100 000 kW** **[1]**

(c) Suggest how the student can make his readings more precise.

.....

.....

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

(d) **Fig. 11.2** shows a night-light. It contains a 1.0 W lamp and a 3.0 V battery.

The student compares the mains filament lamp with the night-light. They are both used for the **same amount of** time.

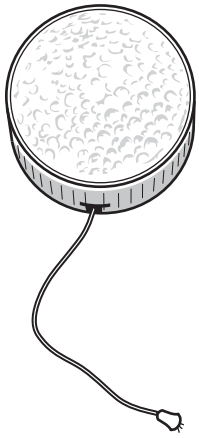


Fig. 11.2

Use these words to complete the sentences.

You can use each word once, more than once, or not at all.

more than **less than** **equal to**

The energy transferred by the night-light is …… the energy transferred by the mains filament lamp.

The power of the night-light is …… the power of the mains filament lamp. **[2]**

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12 **(a)** A scientist measures the activity of a radioactive isotope. She uses a Geiger-Muller tube connected to a counter.

Table 12.1 shows her results.

Measurement	Activity (Bq)
1	701
2	708
3	704
4	707

Table 12.1

(i) What is the **mean** activity of the isotope?

Mean activity = ... Bq **[1]**

(ii) Is there a pattern in the results in **Table 12.1**?

Explain your answer using ideas about radioactivity.

.....

.....

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

(b) **(i)** Carbon-12 is a stable isotope. Carbon-14 is an unstable radioactive isotope.

Table 12.2 shows the contents of each nucleus.

	Carbon-12	Carbon-14
Number of protons	6	6
Number of neutrons	6	8

Table 12.2

Explain why carbon-12 and carbon-14 are isotopes.

.....

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

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(ii) This is the equation for the radioactive decay of carbon-14:

$$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

What happens to the **nuclear mass** (mass number) when carbon-14 decays?

.....

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

(c) Americium-241 is a radioactive isotope used in smoke alarms.

Table 12.3 shows how the activity of americium-241 changes.

Time (years)	Activity (Bq)
458	36 000
916	18 000
1374	9 000

Table 12.3

(i) What is meant by the half-life of an isotope?

.....

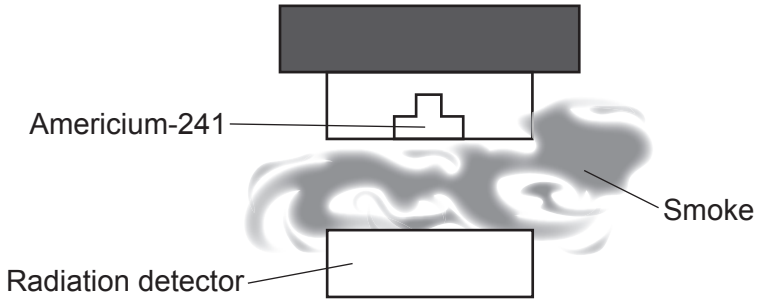
..... **[1]**

(ii) Use the data in **Table 12.3** to calculate the half-life of americium-241.

Half-life = ... years **[1]**

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(iii) This is a diagram of a smoke alarm.



Smoke enters the smoke alarm, which blocks the radiation emitted by the americium-241.

A smoke alarm company decides to use a different isotope.

Table 12.4 shows the three choices of isotope.

Isotope	Radiation emitted	Half-life (years)
A	Alpha	2
B	Beta	400
C	Alpha	350

Table 12.4

Which isotope, **A**, **B** or **C**, is the best to use in a smoke alarm?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

Explain your answer using the information in **Table 12.4**.

.....

.....

.....

.....

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

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13 (a) Electromagnetic waves have similar properties.

Use these words to complete the sentences:

You can use each word once, more than once, or not at all.

Acceleration **Frequency** **Longitudinal**

Sound **Speed** **Transverse** **Wavelength**

Electromagnetic waves are …….. waves.

Electromagnetic waves travel with the same …….. in space.

[2]

(b) A student wants to work out the speed of water waves in a ripple tank. **Fig. 13.1** shows the apparatus the student uses.

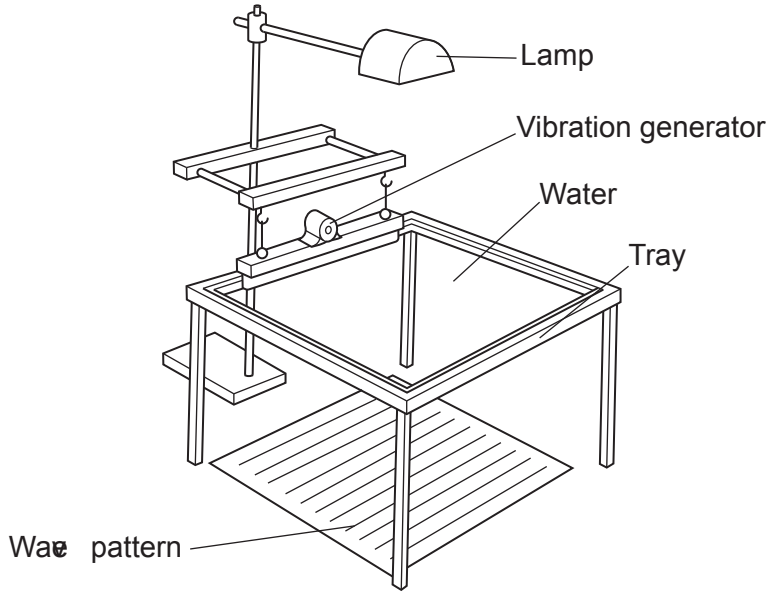


Fig. 13.1

Name the **two** extra pieces of apparatus she will need to work out the speed of the waves.

1 .....

2 .....

[2]

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14 This question is about domestic electricity.

(a) Draw lines to connect each **term** with the correct **description**.

Term	Description
National grid	Increases voltage.
Step-up transformer	Decreases voltage.
Alternating voltage	Network of wires connecting power stations to users.
Step-down transformer	Changes direction 50 times a second.

[3]

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(b) **Fig. 14.1** is a diagram of the wiring in a metal kettle.

The diagram in **Fig. 14.1** is incomplete.

Use these words to **label** the 3 wires on the diagram.

You may use each word once, more than once, or not at all.

Earth **Live** **Neutral** **[2]**

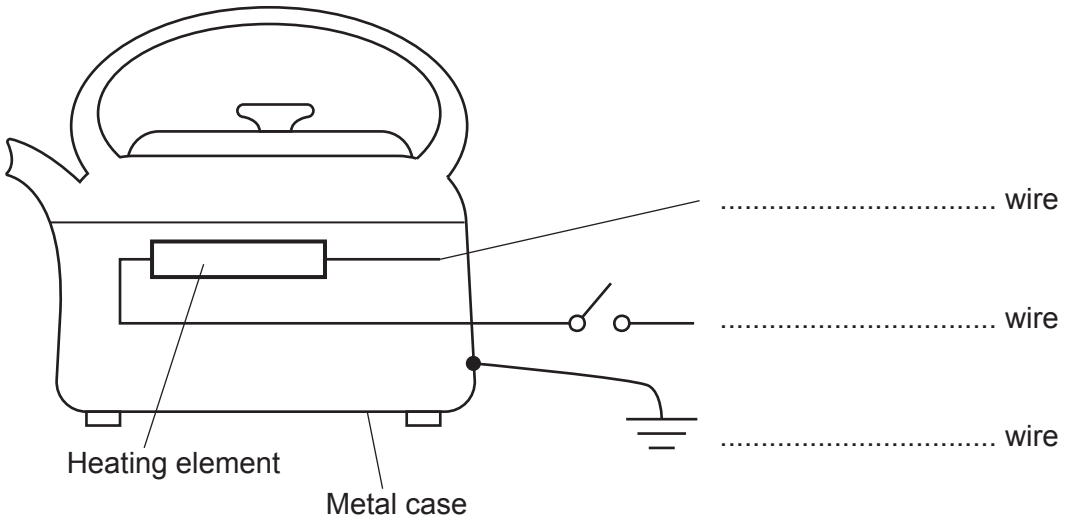


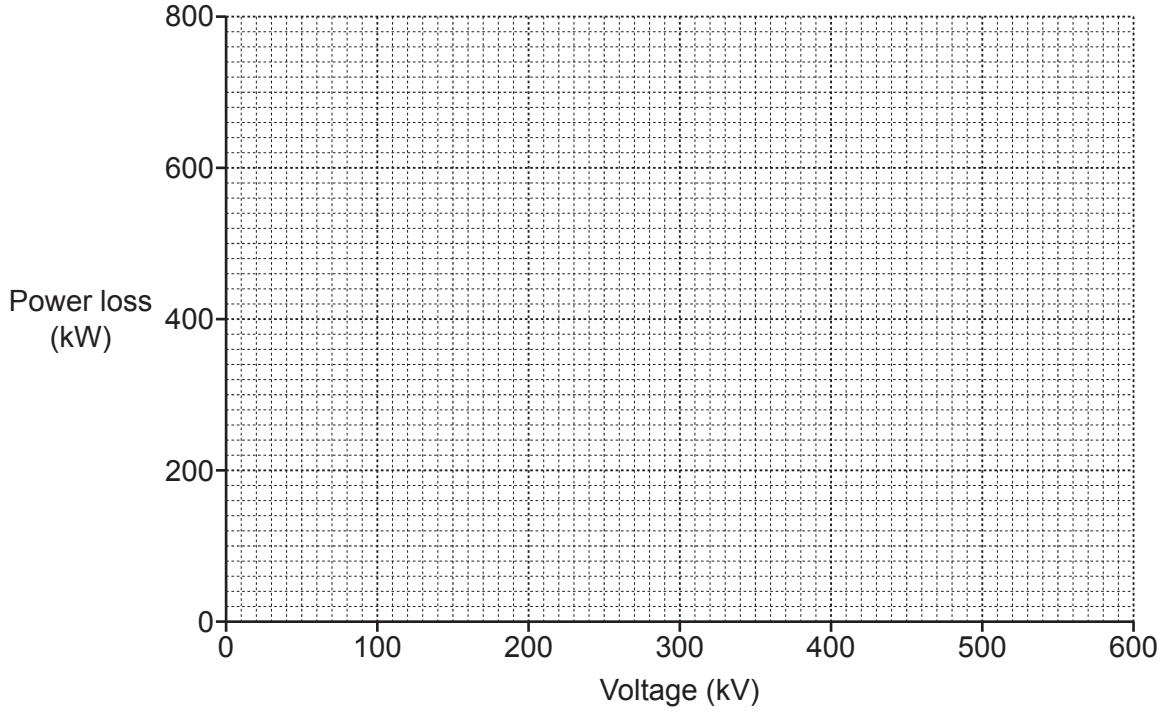
Fig. 14.1

(c) The table shows power losses for different voltages in a power line.

Voltage (kV)	Power loss (kW)
200	720
300	320
400	180
500	115
600	80

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(i) Using the data in the table, plot a graph of power loss against voltage and draw a line of best fit.



[2]

(ii) Describe the relationship between power loss and voltage.

You **may** use values from the graph or table in your answer.

.....

.....

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

(iii) Explain why the national grid is an efficient way to transfer energy.

.....

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

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15* **Fig. 15.1** shows how the height of a water wave changes with distance.

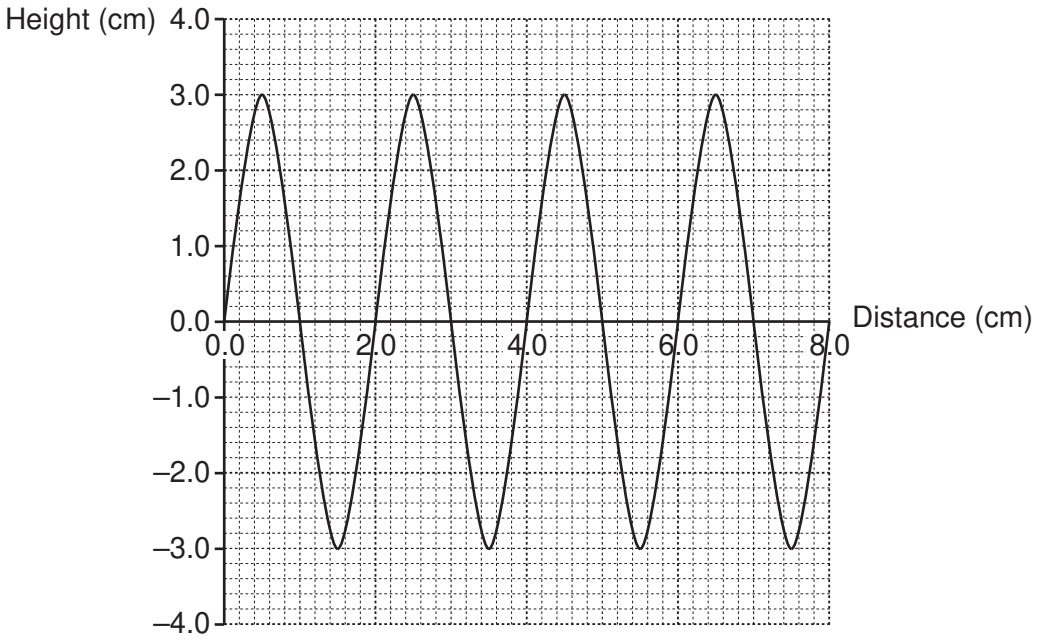


Fig. 15.1

Fig. 15.2 shows how the height of the **same** wave changes with time.

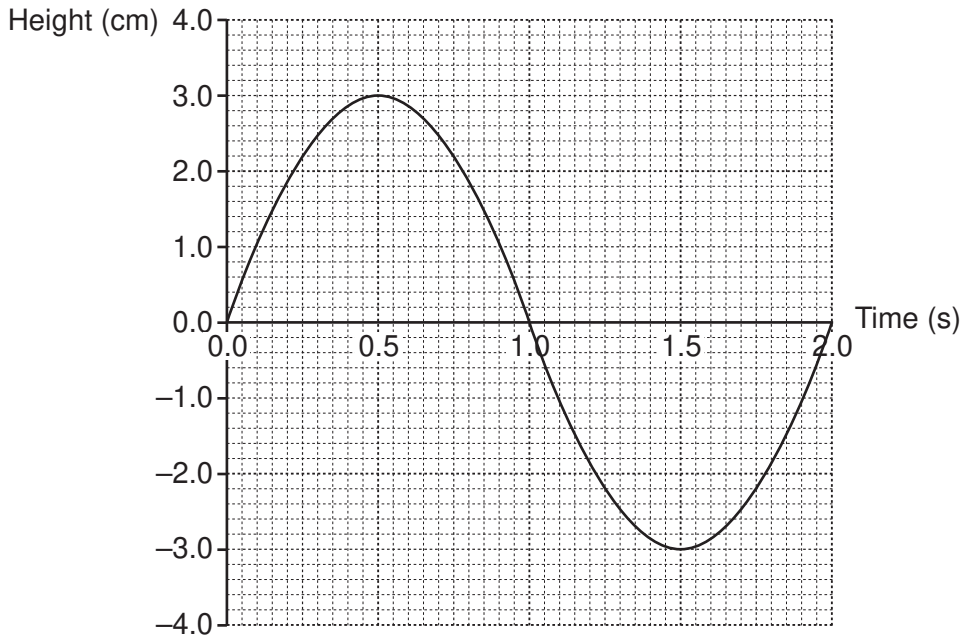


Fig. 15.2

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Waves can be described using these words:

- amplitude
- wavelength
- frequency
- wave speed.

Describe the wave represented by both **Fig. 15.1** and **Fig. 15.2** in detail.

Use calculations and definitions in your answer.

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

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16 A student measures the temperature of a beaker of water as it cools down.

The graph in **Fig. 16.1** shows how the temperature changes with time.

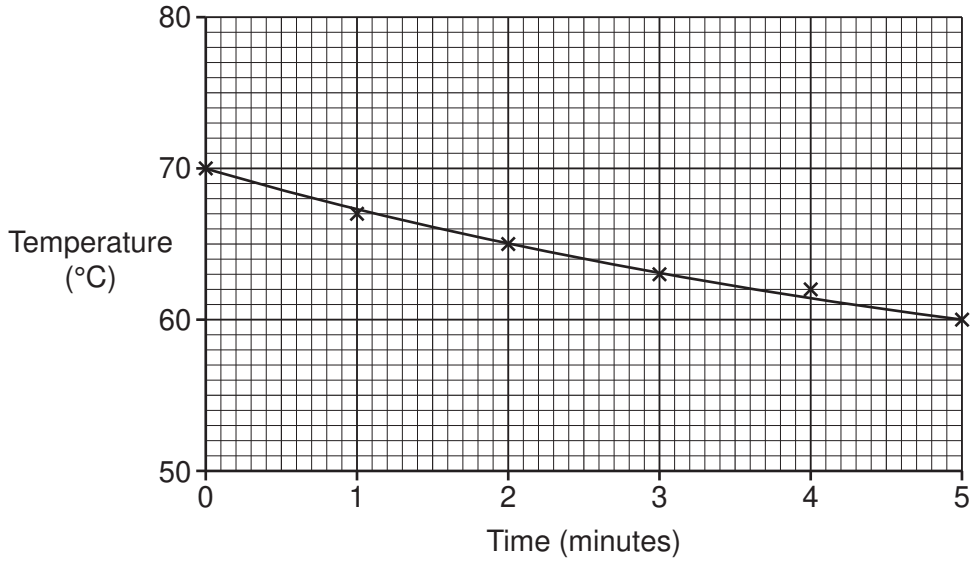


Fig. 16.1

(a) Calculate the rate of temperature change over the 5 minutes.

Rate of temperature change = ... °C / minute **[3]**

(b) (i) Describe, in detail, how the temperature changes over the 5 minutes.

.....

.....

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

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(ii) The beaker contains 0.2 kg of water.

The specific heat capacity of water is 4200 J / kg °C.

Calculate the change in thermal energy in the water after 5 minutes.

Give your answer to **1** significant figure.

Use an equation from the Data Sheet to help you.

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

(c) Describe the change in energy stores as the water cools down.

.....

.....

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

(d) The student is given some insulation. She wraps the insulation around the sides of the beaker and repeats the experiment.

(i) Add **another line** to the graph in **Fig. 16.1** to show how the temperature may change when the beaker is wrapped with insulation. **[1]**

(ii) State **one** thing the student can do to reduce the rate of cooling further.

.....

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

END OF QUESTION PAPER

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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).

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