A

AQA

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I declare this is my own work.

GCSE
PHYSICS

H

Higher Tier Paper 1

8463/1H

Thursday 25 May 2023 Morning

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

JUN2384631H01

MATERIALS

For this paper you must have:

- **a ruler**
- **a scientific calculator**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided.**
- **Do not write on blank pages.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

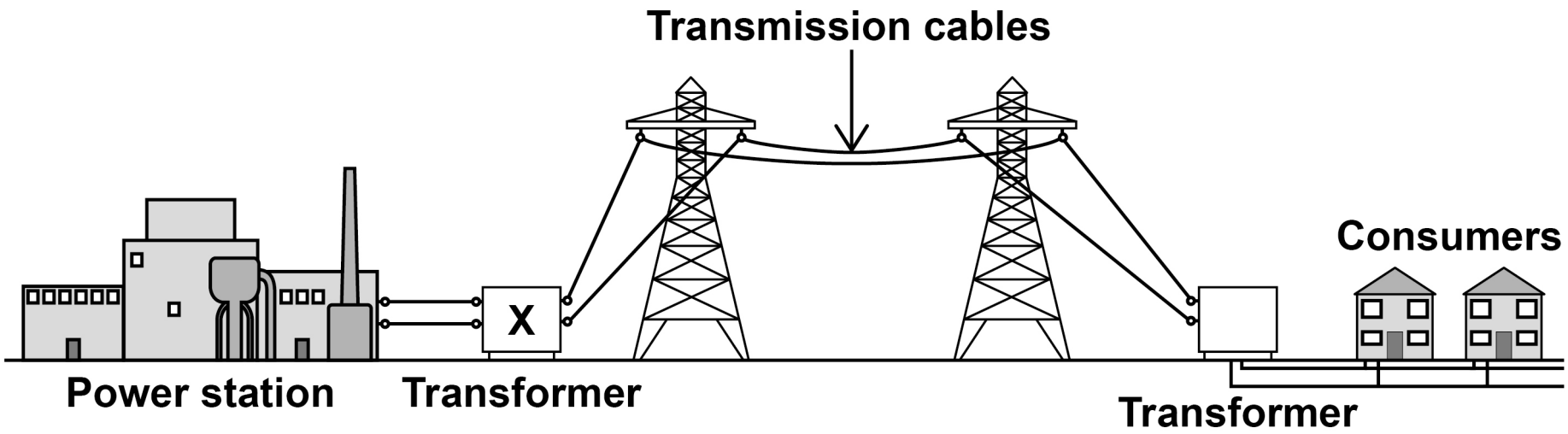
DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

0 1

FIGURE 1 shows how the National Grid connects a power station to consumers.

FIGURE 1



0 1 . 1

Complete the sentences. [2 marks]

Transformer X causes the potential difference to _____ .

Transformer X causes the current to _____ .

[Turn over]

Use the Physics Equations Sheet to answer questions 01.2 and 01.3.

0 1 . 2

Which equation links current (*I*), power (*P*) and resistance (*R*)? [1 mark]

Tick (✓) ONE box.

☐ $P = \frac{I}{R}$

☐ $P = \frac{I}{R^2}$

☐ $P = I^2 R$

☐ $P = IR$

0 1 . 3

A transmission cable has a power loss of 1.60×10^9 W.

The current in the cable is 2000 A.

Calculate the resistance of the cable. [3 marks]

_____

_____

_____

_____

_____

_____

_____

Resistance = _____ Ω

[Turn over]

Use the Physics Equations Sheet to answer questions 01.4 and 01.5.

0 1 . 4

Write down the equation which links efficiency, total energy input and useful energy output. [1 mark]

0 1 . 5

The total energy input to the National Grid from one power station is 34.2 GJ.

The National Grid has an efficiency of 0.992

Calculate the useful energy output from this power station to consumers in GJ. [3 marks]

_____

_____

_____

_____

_____

_____

_____

Useful energy output = _____ GJ

[Turn over]

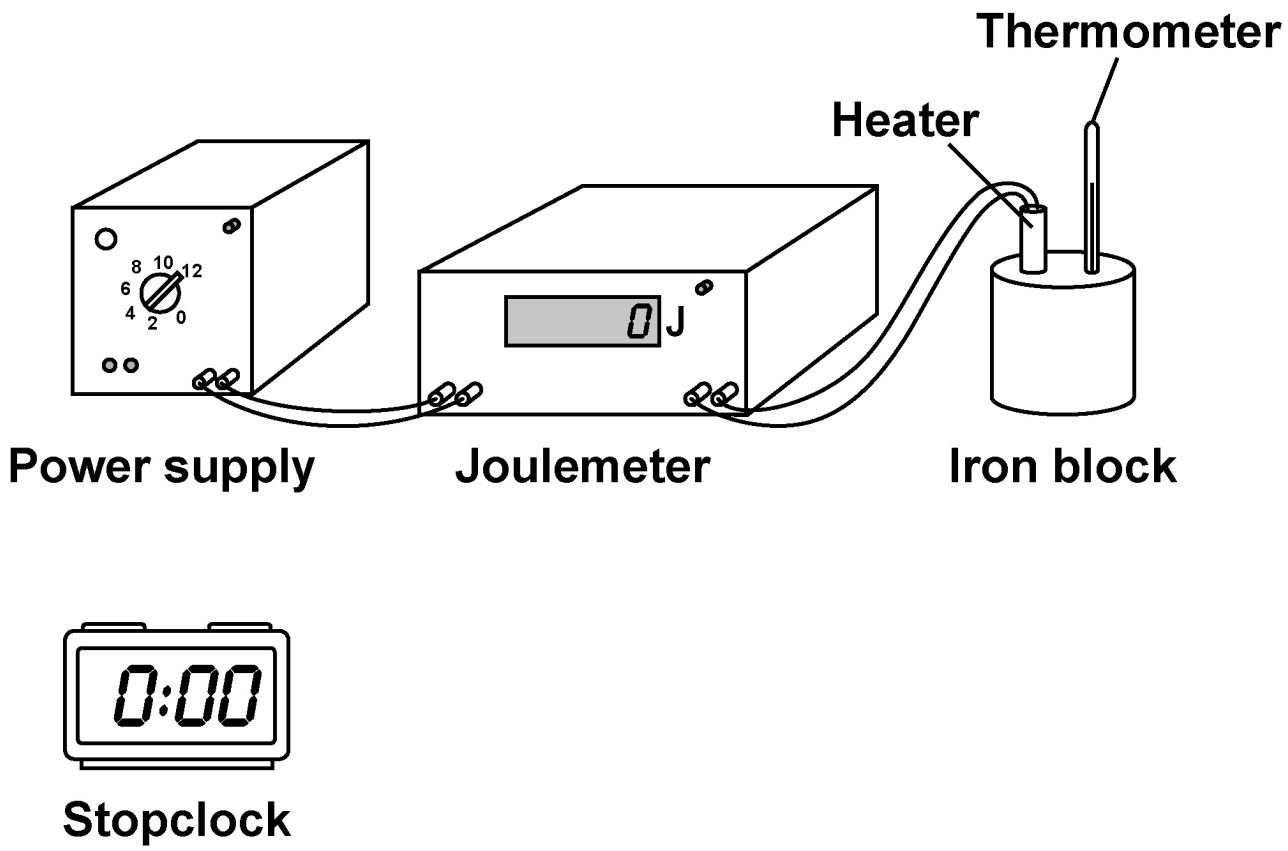
10

0 2

FIGURE 2 shows the equipment a student used to determine the specific heat capacity of iron.

The iron block the student used has two holes, one for the heater and one for the thermometer.

FIGURE 2



0 2 . 1

Before the power supply was switched on, the thermometer was used to measure the temperature of the iron block.

The student left the thermometer in the iron block for a few minutes before recording the initial temperature.

Suggest why. [1 mark]

_____

_____

_____

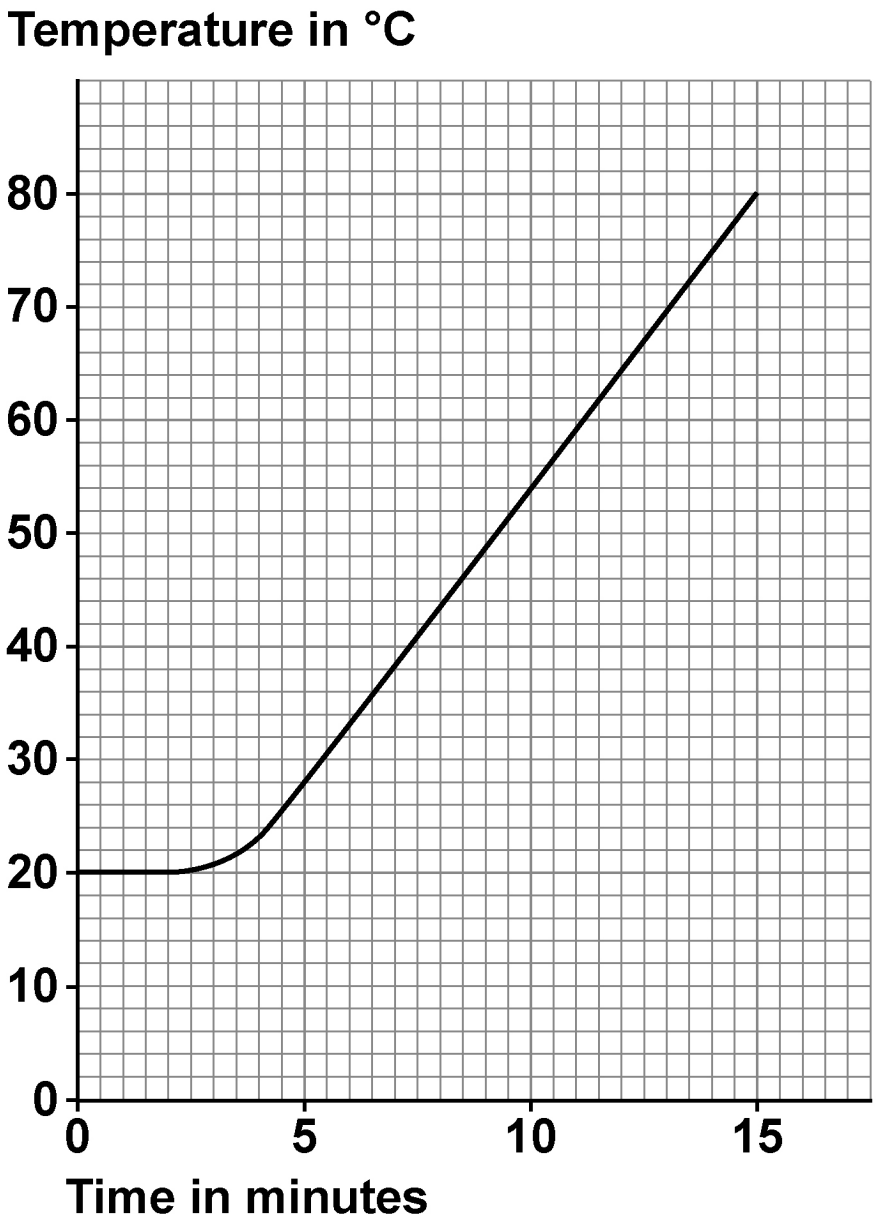
_____

[Turn over]

0 2 . 2

FIGURE 3 shows how the temperature changed after the power supply was switched on.

FIGURE 3



The energy transferred to the iron block between 5 and 10 minutes was 26 000 J.

The mass of the iron block was 2.0 kg.

Calculate the specific heat capacity of iron.

Use information from FIGURE 3 and the Physics Equations Sheet. [4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Specific heat capacity =_____ J/kg °C

[Turn over]

0 2 . 3

The student repeated the investigation but wrapped insulation around the iron block.

What effect will adding insulation have had on the investigation? [2 marks]

Tick (✓) TWO boxes.

- [ ] **The calculated specific heat capacity will be more accurate.**
- [ ] **The iron block will transfer thermal energy to the surroundings at a lower rate.**
- [ ] **The power output of the heater will be lower than expected.**
- [ ] **The temperature of the iron block will increase more slowly than expected.**
- [ ] **The uncertainty in the temperature measurement will be greater.**

7

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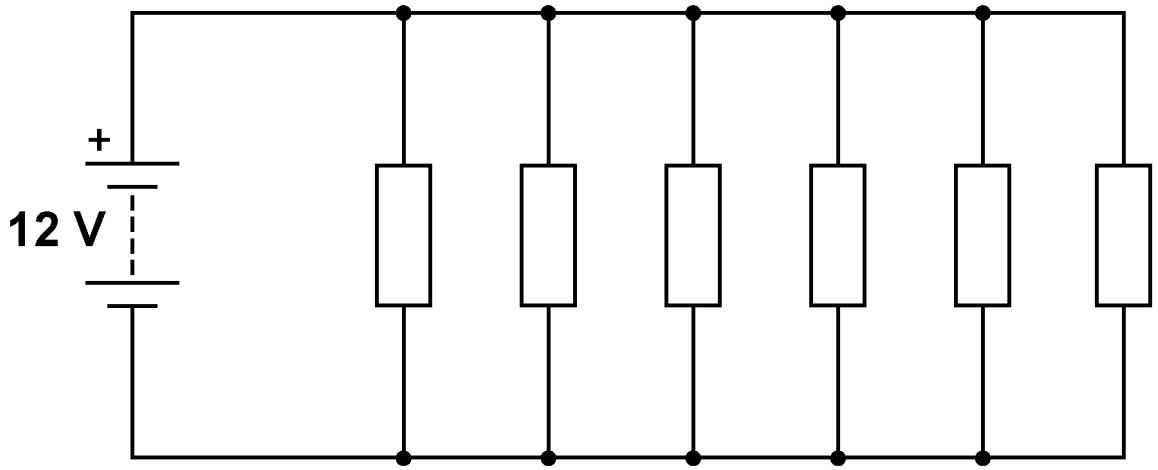
[Turn over]

0 3

FIGURE 4 shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

FIGURE 4



0 3 . 1

The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'? [1 mark]

_____

_____

_____

_____

[Turn over]

Use the Physics Equations Sheet to answer questions 03.2 and 03.3.

0 3 . 2

Which equation links charge flow (*Q*), energy (*E*) and potential difference (*V*)? [1 mark]

Tick (✓) ONE box.

☐ $E = \frac{V}{Q}$

☐ $E = QV$

☐ $E = \frac{Q}{V}$

☐ $E = \frac{V^2}{Q}$

0 3 . 3

Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy. [3 marks]

Charge flow =_____ C

[Turn over]

0 3 . 4

Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet. [3 marks]

_____

_____

_____

_____

_____

_____

_____

Specific latent heat of fusion of water =

_____ **J/kg**

0 3 . 5

The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

Explain the changes in the arrangement AND movement of the particles as the ice melted and the temperature increased to 5 °C. [6 marks]

[Turn over]

14

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[Turn over]

0 4

A remote village in the UK uses a hydroelectric generator to provide electricity.

0 4 . 1

In one day, 2 500 000 kg of water passes through the hydroelectric generator.

The change in gravitational potential energy of the water is 367.5 MJ.

gravitational field strength = 9.8 N/kg

Calculate the mean change in vertical height of the water as it moves through the hydroelectric generator.

Use the Physics Equations Sheet. [4 marks]

Mean change in vertical height =

_____ **m**

[Turn over]

0 4 . 2

The generator transfers 3.0 kW of electrical power.

Calculate the time taken for the generator to transfer 2.16×10^7 J of energy.

Use the Physics Equations Sheet.

Give your answer in standard form. [5 marks]

Time taken (in standard form) =

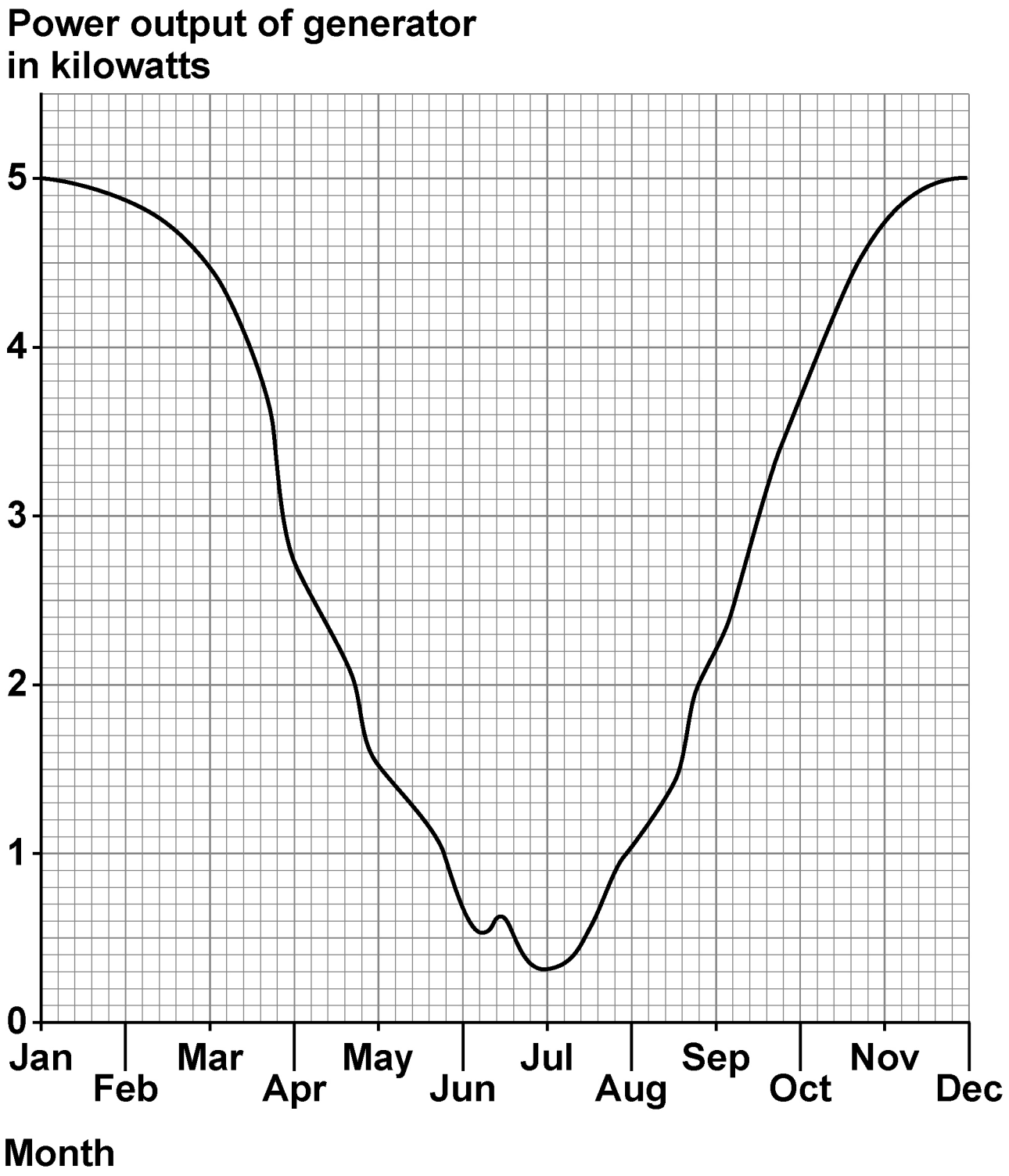
_____ **s**

[Turn over]

0 4 . 3

FIGURE 5 shows how the power output of the generator varied during one year.

FIGURE 5



A solar power system is installed in the remote village in addition to the hydroelectric generator.

Explain why this improves the reliability of the electricity supply to the village.

Use information from FIGURE 5. [2 marks]

_____

_____

_____

_____

_____

_____

_____

[Turn over]

11

0 5

Some isotopes emit nuclear radiation.

0 5 . 1

Carbon-14 and carbon-12 are isotopes of carbon.

Compare the structure of an atom of carbon-14 with the structure of an atom of carbon-12. [3 marks]

0 5 . 2

Carbon-14 is a radioactive isotope.

Carbon-14 has a half-life of 5700 years.

What does 'a half-life of 5700 years' mean? [1 mark]

_____

_____

_____

_____

[Turn over]

TABLE 1 gives the half-life of some other radioactive isotopes.

TABLE 1

ISOTOPE	HALF-LIFE IN SECONDS
Nitrogen-18	0.62
Nitrogen-17	4.17
Fluorine-17	64.37
Fluorine-18	6584.34

0 5 . 3

A sample of fluorine-17 has an activity that is one quarter of its original activity.

Calculate the age of the sample of fluorine-17.
[2 marks]

_____

_____

_____

_____

Age = _____ s

0 5 . 4

All of the isotopes in TABLE 1 emit beta radiation.

Explain which isotope would cause the biggest risk to a person's health based only on the half-life of each isotope. [3 marks]

[Turn over]

0 5 . 5

People who work in the nuclear power industry need to be aware of irradiation and contamination.

Describe the difference between irradiation and contamination. [2 marks]

0 5 . 6

Give ONE health risk to a person working close to a source of nuclear radiation. [1 mark]

0 5 . 7

Workers in nuclear power stations are monitored to check the radiation they emit.

A worker stands 1 cm away from a radiation detector.

The amount of radiation the worker emits is recorded.

Explain why the worker needs to stand close to the radiation detector. [2 marks]

[Turn over]

0 5 . 8

Workers in the nuclear power industry are exposed to nuclear radiation.

Pilots on aircraft are exposed to cosmic radiation from space.

DAILY dose caused by working in a nuclear power station = 0.00050 mSv

HOURLY dose from cosmic rays to a pilot while flying = 0.0030 mSv

Calculate the number of days it takes for a nuclear power station worker to receive the same dose as a pilot flying for 24 hours. [3 marks]

Number of days = _____

[Turn over]

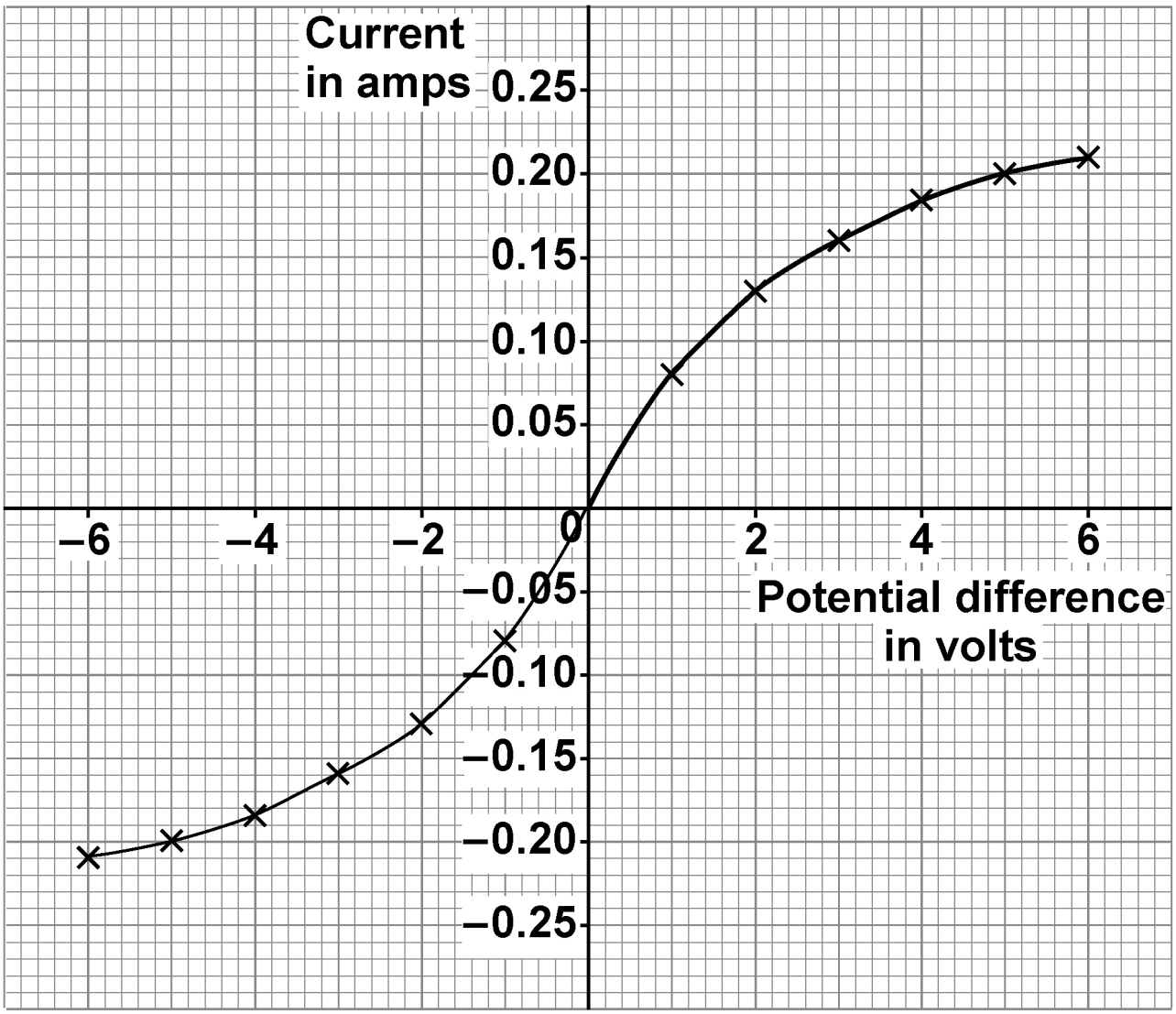
17

0 6

A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

FIGURE 6 shows the results.

FIGURE 6



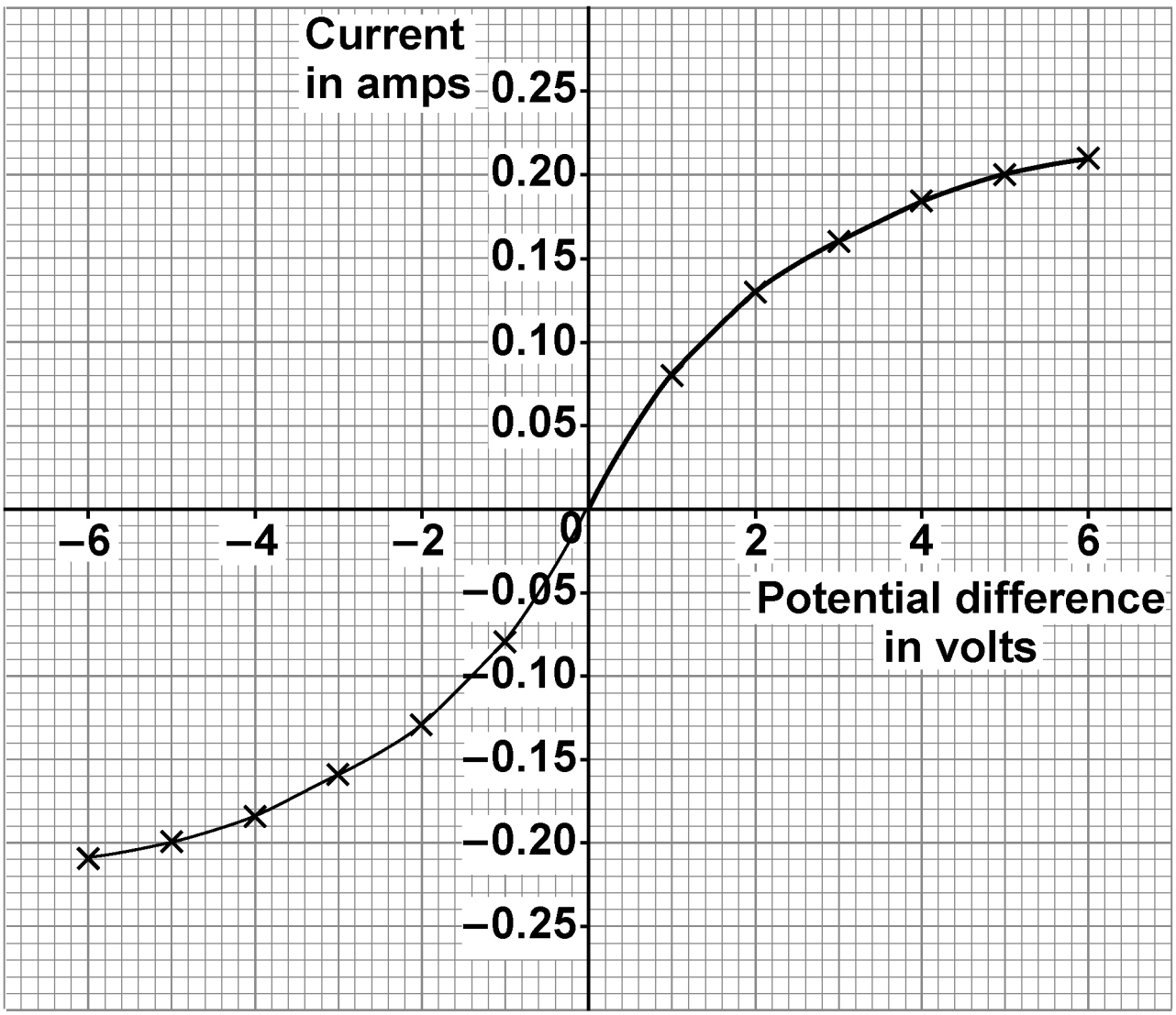
0 6 . 1

Describe a method the student could use to obtain these results.

You should include a circuit diagram. [6 marks]

[Turn over]

REPEAT OF FIGURE 6



0 6 . 2

Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use FIGURE 6 on the opposite page. [3 marks]

_____

_____

_____

_____

_____

_____

_____

Resistance = _____ Ω

[Turn over]

0 6 . 3

The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet. [5 marks]

Energy transferred = _____ J

[Turn over]

0 6 . 4

The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is NOT correct. [2 marks]

16

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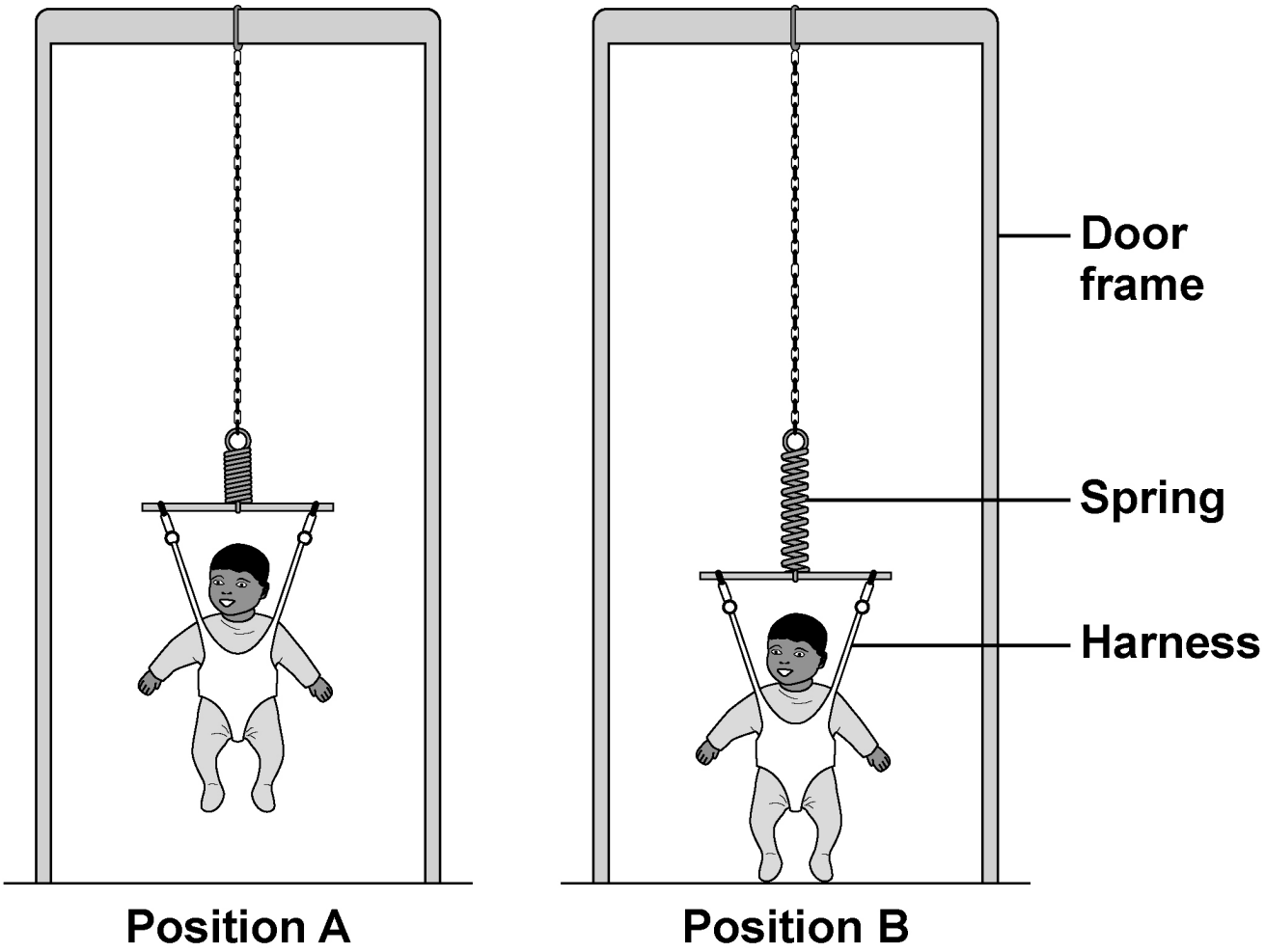
[Turn over]

0 7

A baby bouncer is a harness attached to a spring that hangs from a door frame.

FIGURE 7 shows a baby in a baby bouncer in two positions.

FIGURE 7



0 7 . 1

The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest ONE reason why. [1 mark]

_____

_____

_____

_____

[Turn over]

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0 7 . 2

In positions A and B the baby is stationary.

Describe the energy transfers as the baby moves from position A to position B. [3 marks]

[Turn over]

0 7 . 3

In one position the extension of the spring is 8.0 cm.

The elastic potential energy stored by the spring is 4.0 J.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet. [4 marks]

Spring constant = _____ N/m

8

0 8

Scientists developed new models of the atom as new particles were discovered.

0 8 . 1

Draw ONE line from each particle to the year it was discovered. [2 marks]

PARTICLE	YEAR OF DISCOVERY
Electron	1897
Neutron	1911
Nucleus	1920
Proton	1932

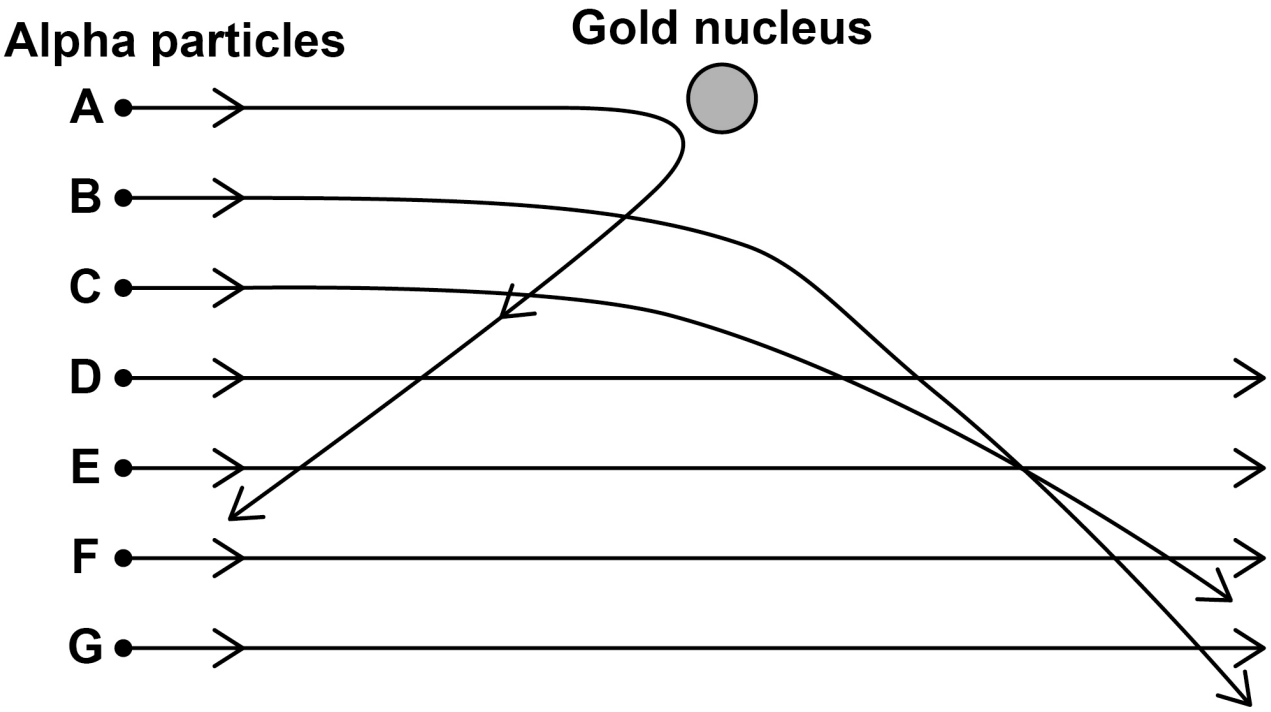
[Turn over]

The nucleus was discovered using an alpha particle scattering experiment.

Alpha particles were directed at a sheet of gold foil.

FIGURE 8 shows the paths taken by seven alpha particles, A, B, C, D, E, F and G.

FIGURE 8



0 8 . 2

Explain why alpha particle A takes the path shown in FIGURE 8. [2 marks]

0 8 . 3

Explain why the path of alpha particle B is more tightly curved than the path of alpha particle C. [2 marks]

[Turn over]

0 8 . 4

What can be deduced about the atom from the paths taken by alpha particles D, E, F and G in FIGURE 8, on page 54? [1 mark]

Tick (✓) ONE box.

- [ ] **The atom contains a nucleus.**
- [ ] **The atom contains protons, neutrons and electrons.**
- [ ] **The atom is mostly empty space.**

0 8 . 5

How is the Bohr model of the atom different from the nuclear model of the atom? [1 mark]

_____

_____

_____

_____

0 8 . 6

Explain how an electron can move up and down between energy levels in an atom. [2 marks]

_____

_____

_____

_____

_____

_____

[Turn over]

10

0 9

FIGURE 9 shows air being pumped into a car tyre.

FIGURE 9

0 9 . 1

Complete the sentence. [1 mark]

Air particles in the tyre move quickly in

_____ directions.

0 9 . 2

When the tyre is at the correct pressure, pumping more air into the tyre causes the pressure to increase further.

The volume and temperature of the air in the tyre do NOT change.

Explain why the pressure increases as more air is pumped into the tyre. [2 marks]

[Turn over]

0 9 . 3

The air pressure in a car tyre changes if the temperature of the air in the tyre increases.

Explain why. [4 marks]

END OF QUESTIONS

7

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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Question	Mark
1	
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TOTAL	

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