A

AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

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**

**[Turn over]**

JUN238463 1H01

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**At the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.**

**MATERIALS**

**For this paper you must have:**

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

**[Turn over]**

## 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.**

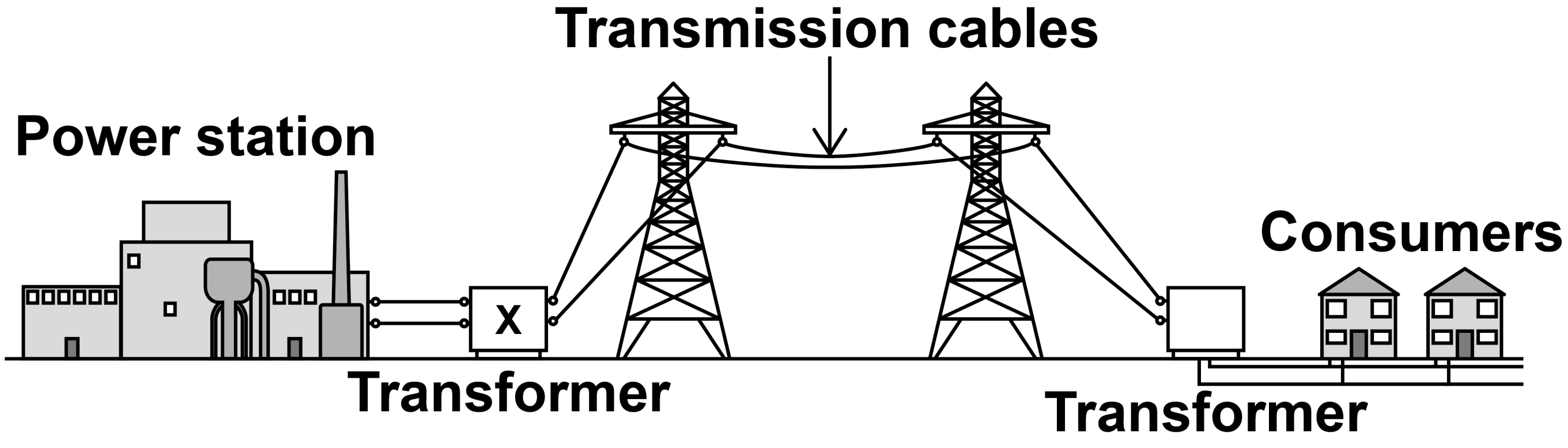
**DO NOT TURN OVER UNTIL TOLD TO DO SO**

**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 7

**0 1 . 1**

**Complete the sentences. [2 marks]**

**Transformer X causes the potential difference to**

**_____ .**

**Transformer X causes the current to _____ .**

**7**

**[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 $1.60 \times 10^9$ 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]**



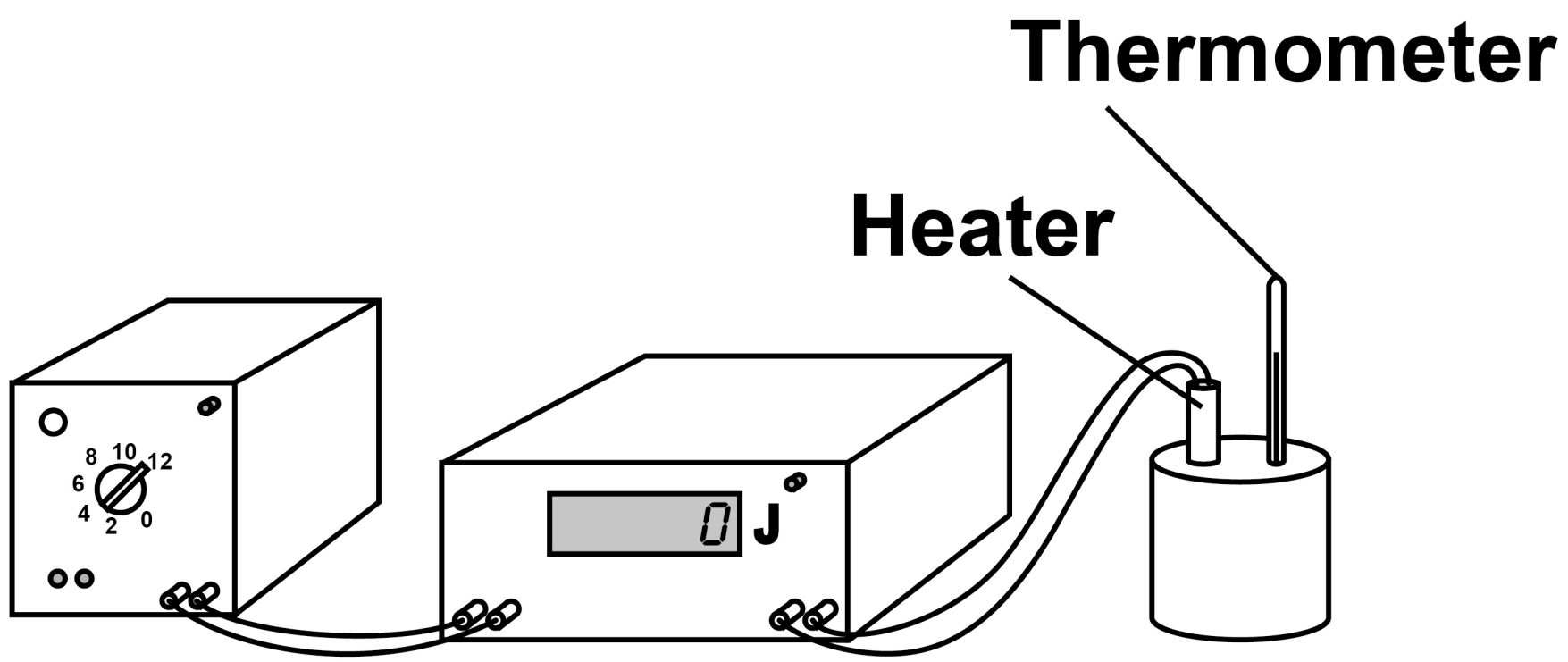
**10**

**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**




**Power supply** **Joulemeter** **Iron block**


**Stopclock**

**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]**

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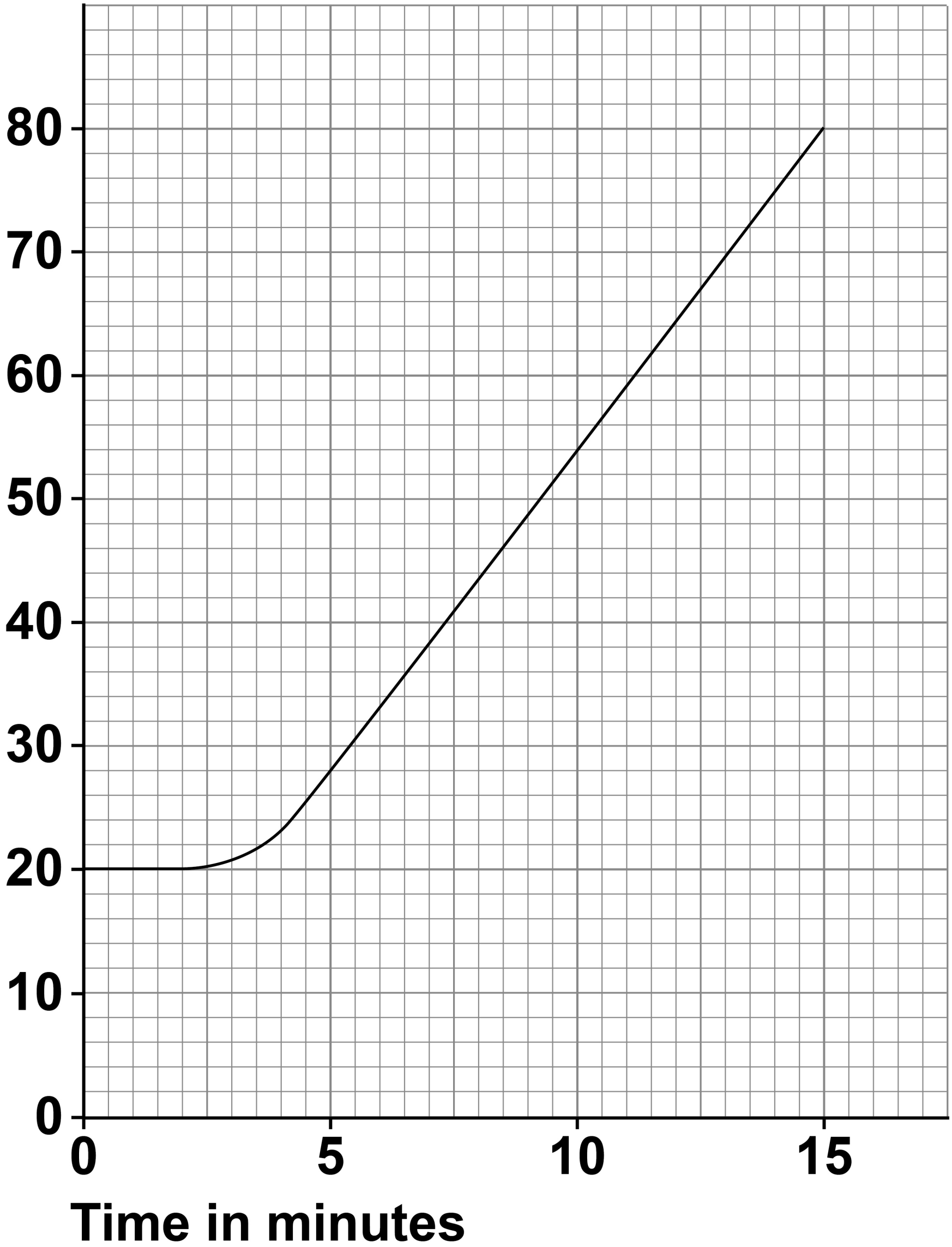
**0 2 . 2**

**FIGURE 3, on page 16, shows how the temperature changed after the power supply was switched on.**

**[Turn over]**

# FIGURE 3


Temperature in °C
80
70
60
50
40
30
20
10
0
0
5
10
15
Time in minutes

**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]**

**On the opposite page, 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.

[Turn over]

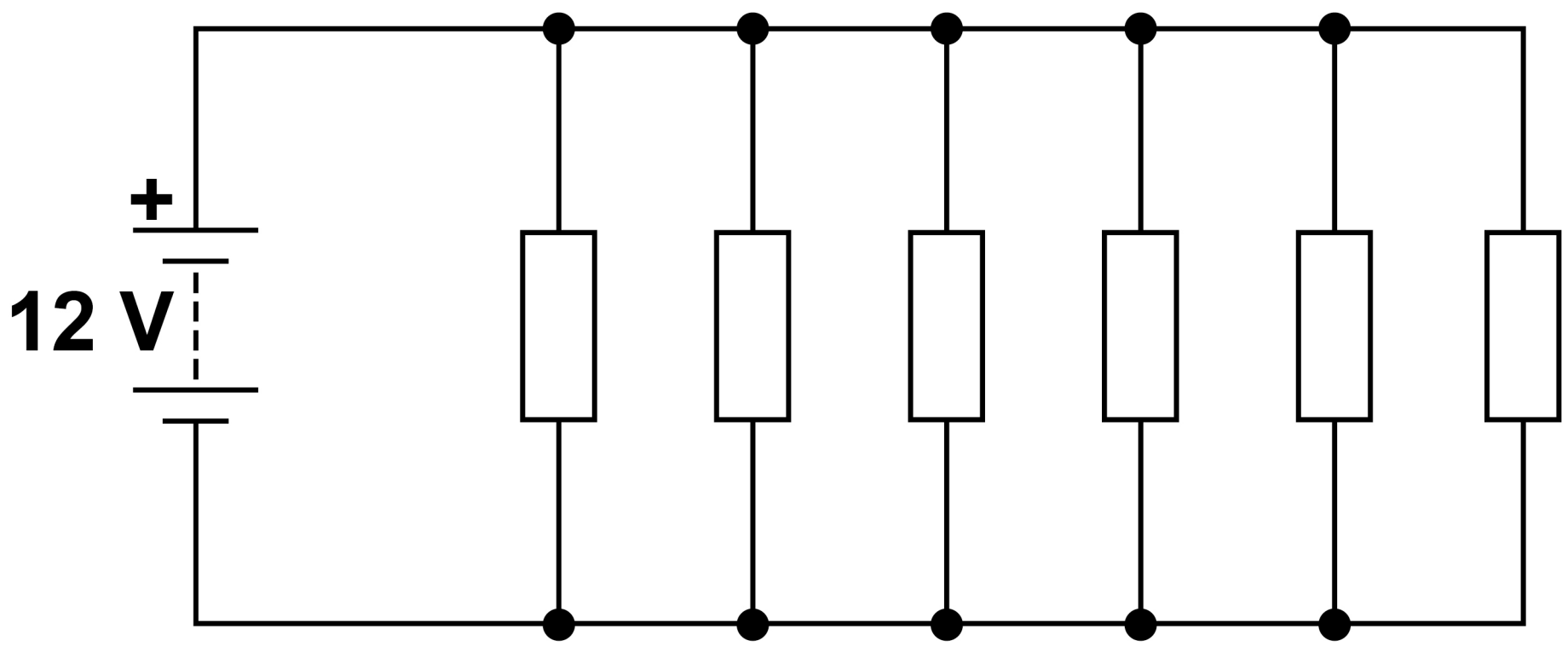
7

**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]**

**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**

**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

[Turn over]

**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]

**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 $2.16 \times 10^7$ J of energy.**

**Use the Physics Equations Sheet.**

**Give your answer in standard form.**
**[5 marks]**

**Time taken (in standard form) =**

**_____ s**

**[Turn over]**

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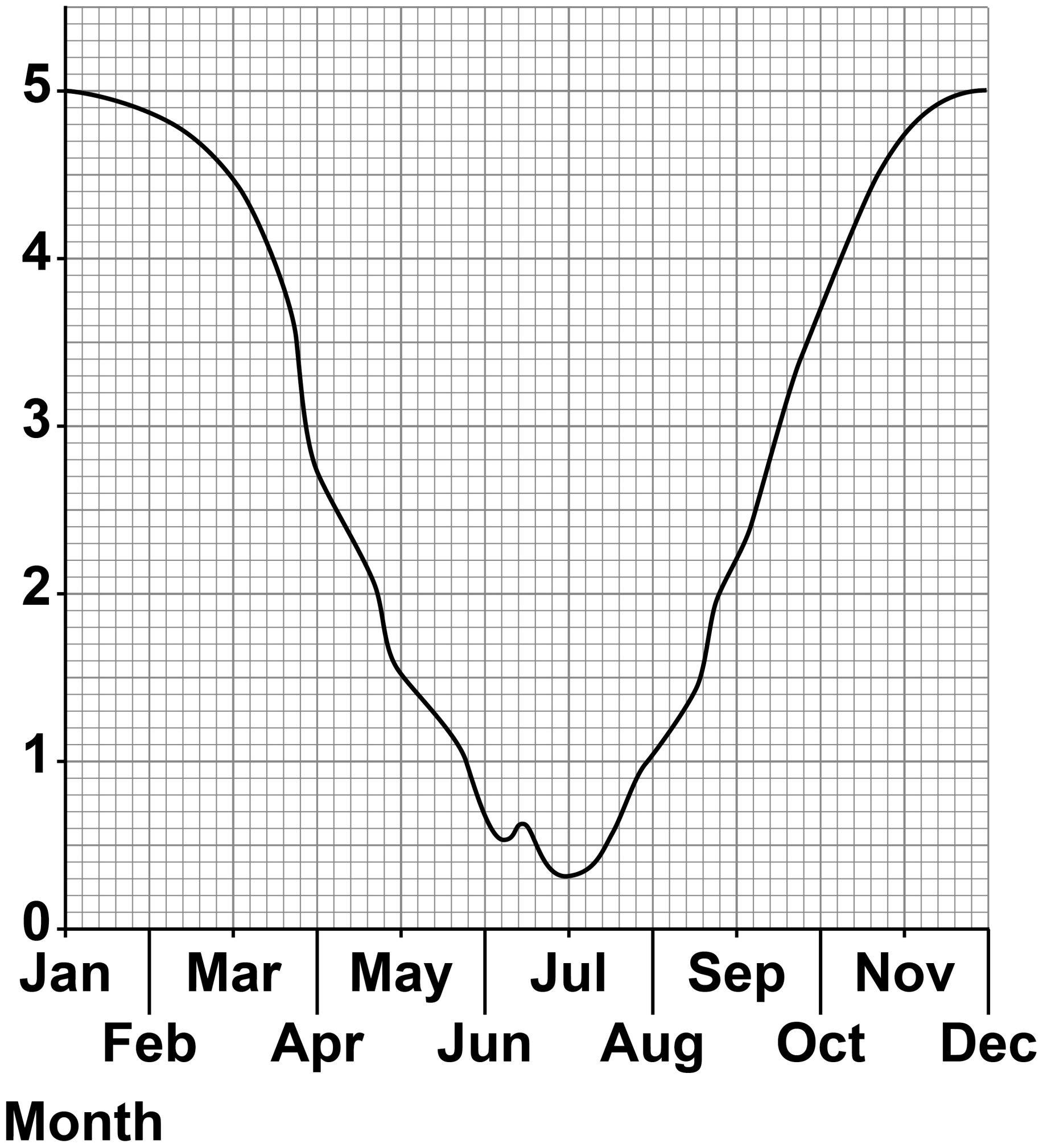
**0 4 . 3**

**FIGURE 5, on page 34, shows how the power output of the generator varied during one year.**

**[Turn over]**

# FIGURE 5


Power output of generator in kilowatts
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

**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, on the opposite page. [2 marks]**

**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]**

**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**

# REPEAT OF 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 . 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]**

**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]**

---

**[Turn over]**

**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]**

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**[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]**

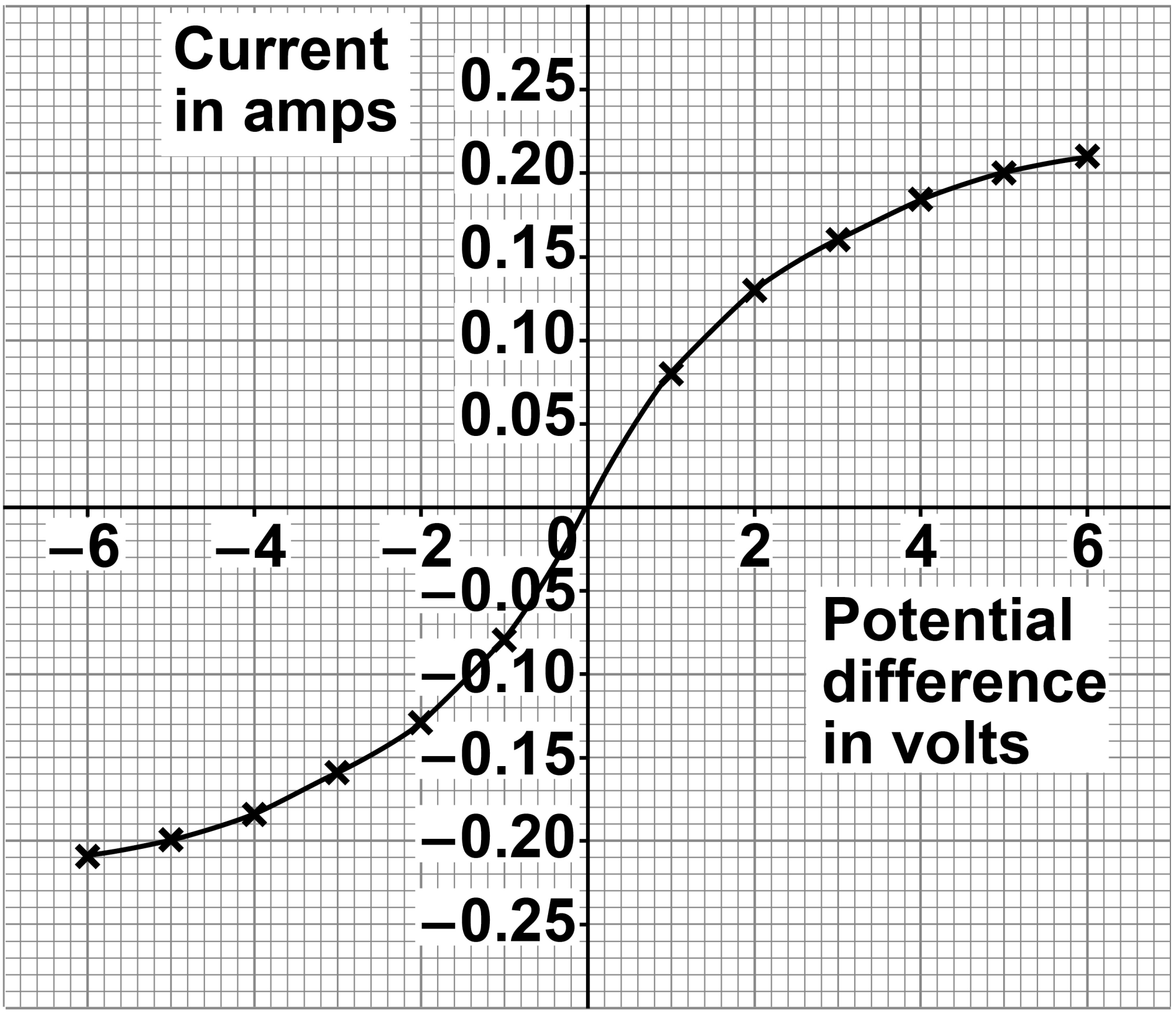
**Number of days = _____**

**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**

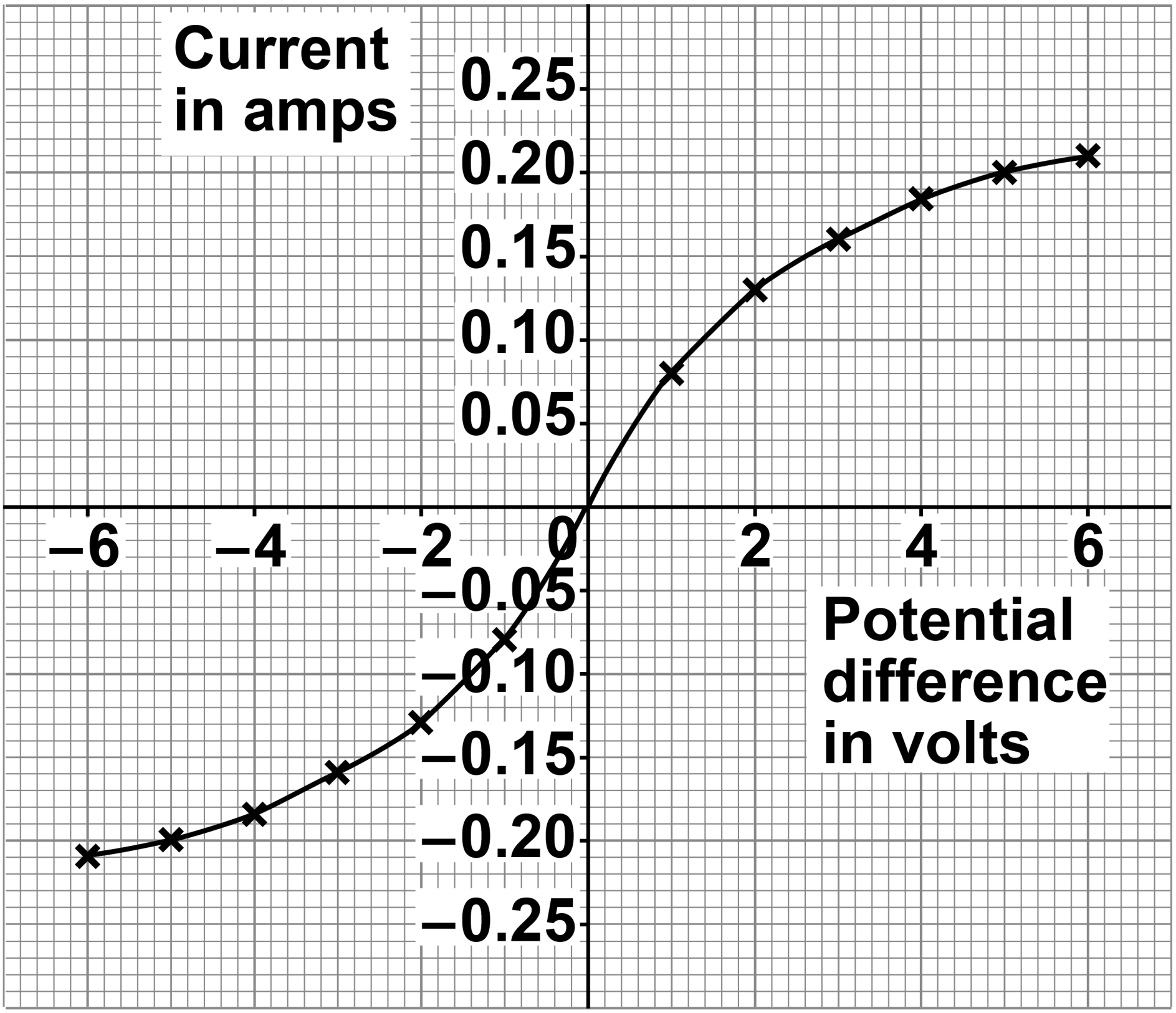
**Describe a method the student could use to obtain these results.**

**You should include a circuit diagram.**
**[6 marks]**

# 50

[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]**

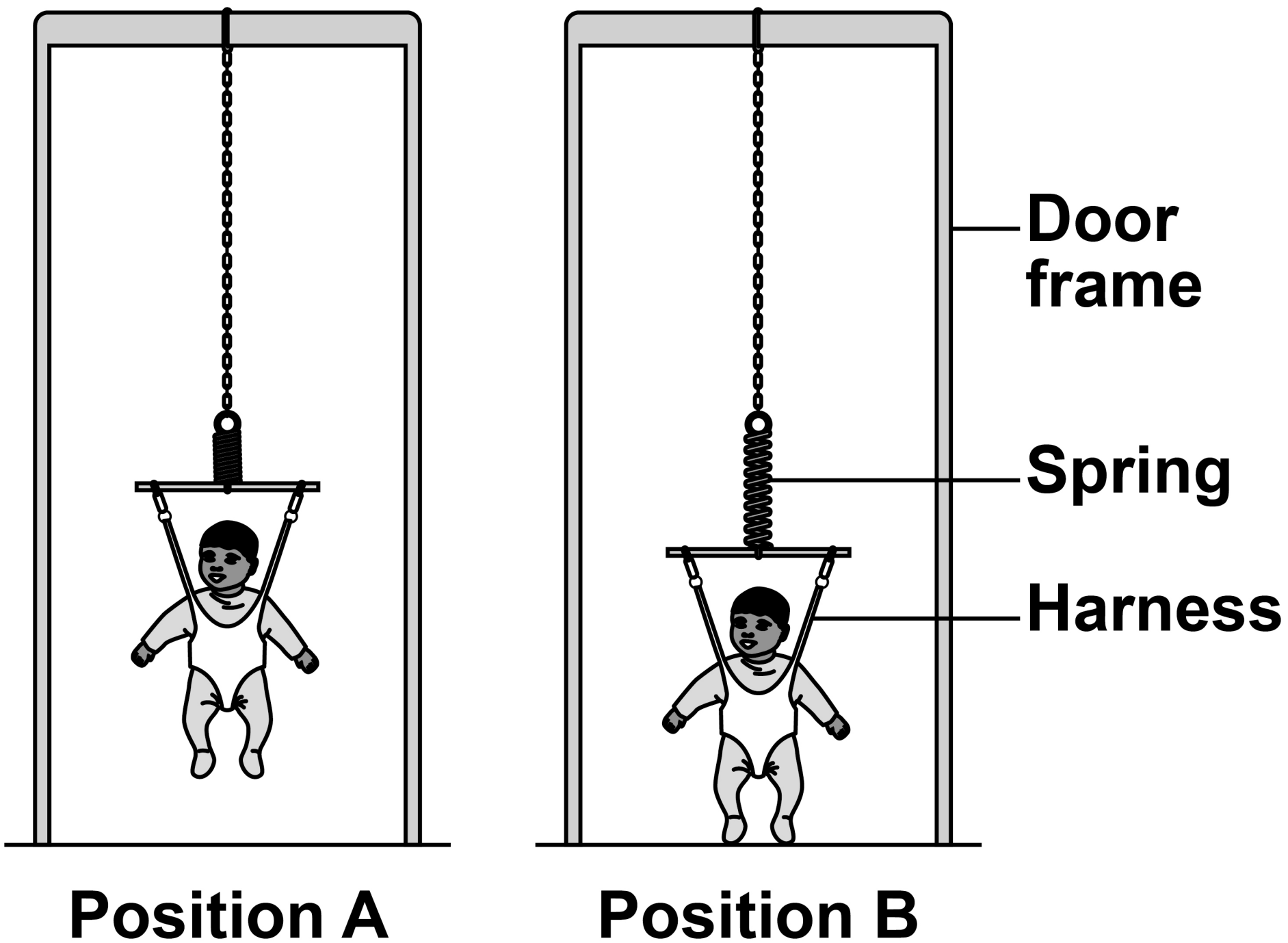
[Turn over]

**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]**

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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]**

**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

[Turn over]

8

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**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 |

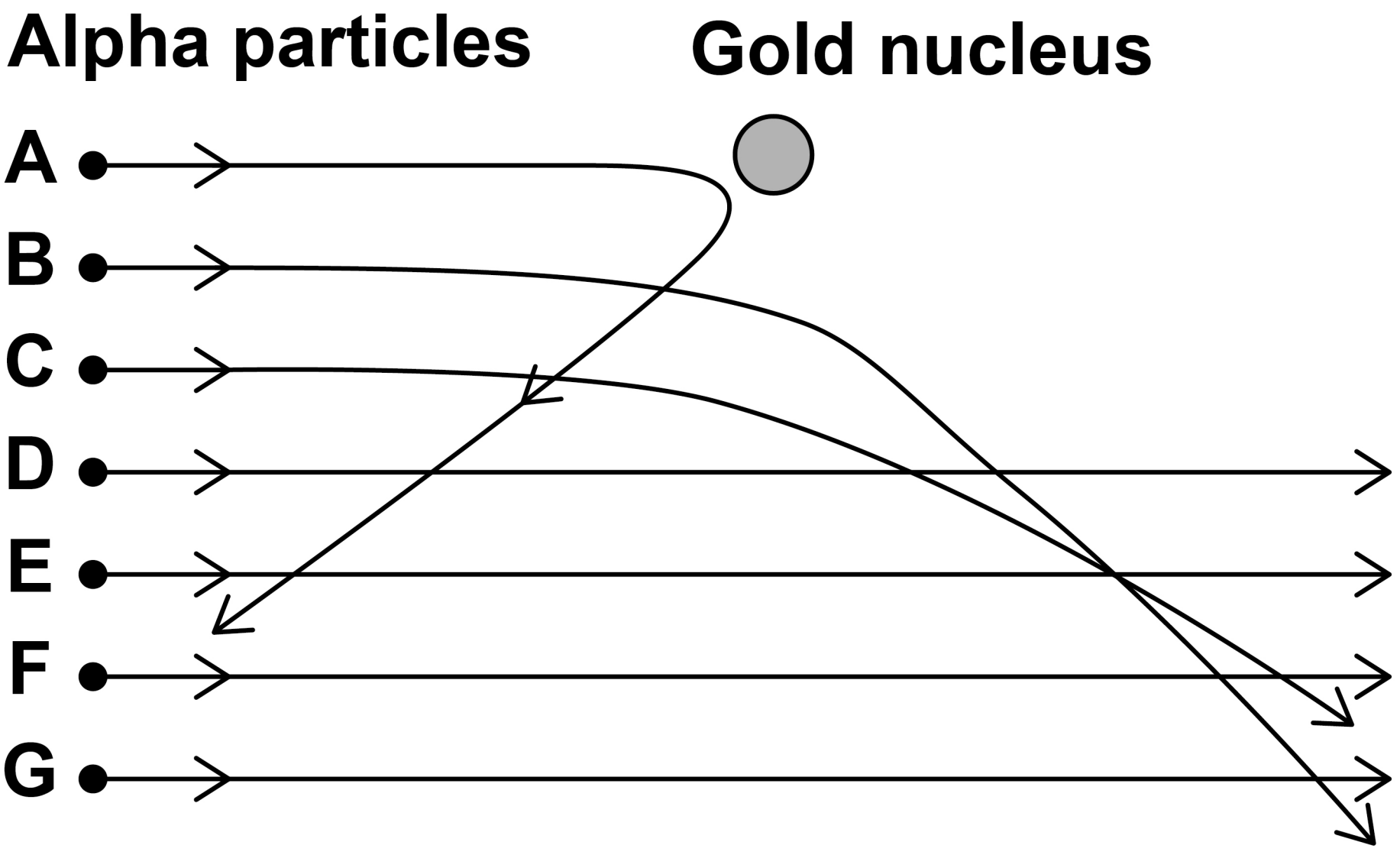
**[Turn over]**

**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]**

**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 66? [1 mark]**

**Tick (✓) ONE box.**

☐ **The atom contains a nucleus.**

☐ **The atom contains protons, neutrons and electrons.**

☐ **The atom is mostly empty space.**

**[Turn over]**

**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]**



**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]**

**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.**

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**Additional page, if required.**

**Write the question numbers in the left-hand margin.**

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| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| **TOTAL** | |