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Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

H

COMBINED SCIENCE: SYNERGY

Higher Tier Paper 4 Physical Sciences

8465/4H

Wednesday 10 June 2020 Morning

Time allowed: 1 hour 45 minutes

[Turn over]

JUN208465 4H01

At the top of page 1, write your surname and other names, your centre number, your candidate number and add your signature.

For this paper you must have:
- **a ruler, a protractor, a scientific calculator, the periodic table (enclosed), 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.**
- **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.**

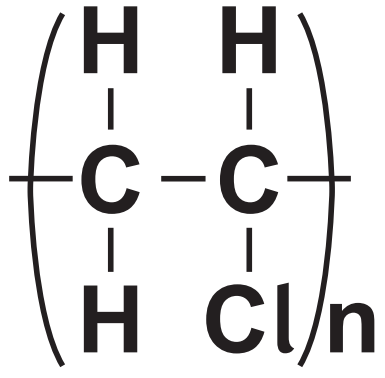
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **This question is about polymers and plastics.**

FIGURE 1 shows the displayed formula for poly(chloroethene).

FIGURE 1



0 1 . 1 **What does 'n' represent in the displayed formula for poly(chloroethene)? [1 mark]**

0 1 . 2 The representation of poly(chloroethene) in FIGURE 1 does NOT show the actual structure of the molecule.

Give ONE reason why.
[1 mark]

Poly(chloroethene) is commonly known as PVC.

PVC does not decompose in the ground.

Many polymer plastics like PVC become pollutant waste in the oceans.

In the oceans, PVC can break into smaller pieces.

The smaller pieces are called PVC nanoplastic.

0 1 . 3 **A piece of PVC nanoplastic has a thickness of 50 nm**

Calculate the thickness of the PVC nanoplastic in metres.

Give your answer in standard form. [2 marks]

1 nm = 0.000 000 001 m

Thickness (in standard form) =

_____ m

[Turn over]

0 1 . 4 **Suggest TWO reasons why PVC nanoplastic can be harmful to marine life. [2 marks]**

1 _____

_____

2 _____

_____

_____

0 1 . 5 **Suggest TWO ways to reduce plastic waste.**
[2 marks]

1 _____

_____

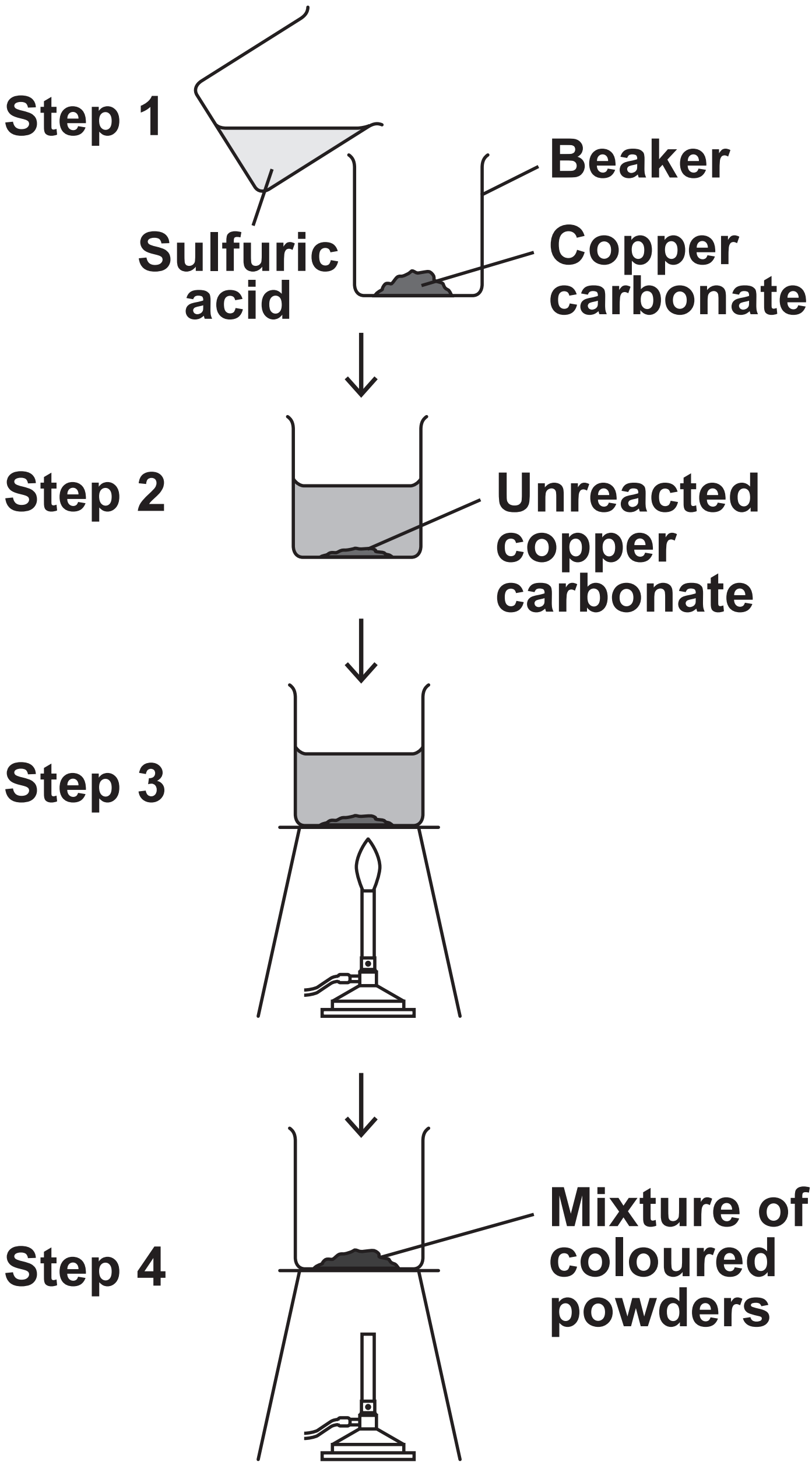
2 _____

_____

_____

8

FIGURE 2


Step 1
Sulfuric acid
Beaker
Copper carbonate
Step 2
Unreacted copper carbonate
Step 3
Step 4
Mixture of coloured powders

0 2 **A student wanted to make blue copper sulfate crystals from green copper carbonate powder and sulfuric acid.**

FIGURE 2, on page 10, shows the method the student used.

The student obtained a mixture of coloured powders NOT blue crystals.

[Turn over]

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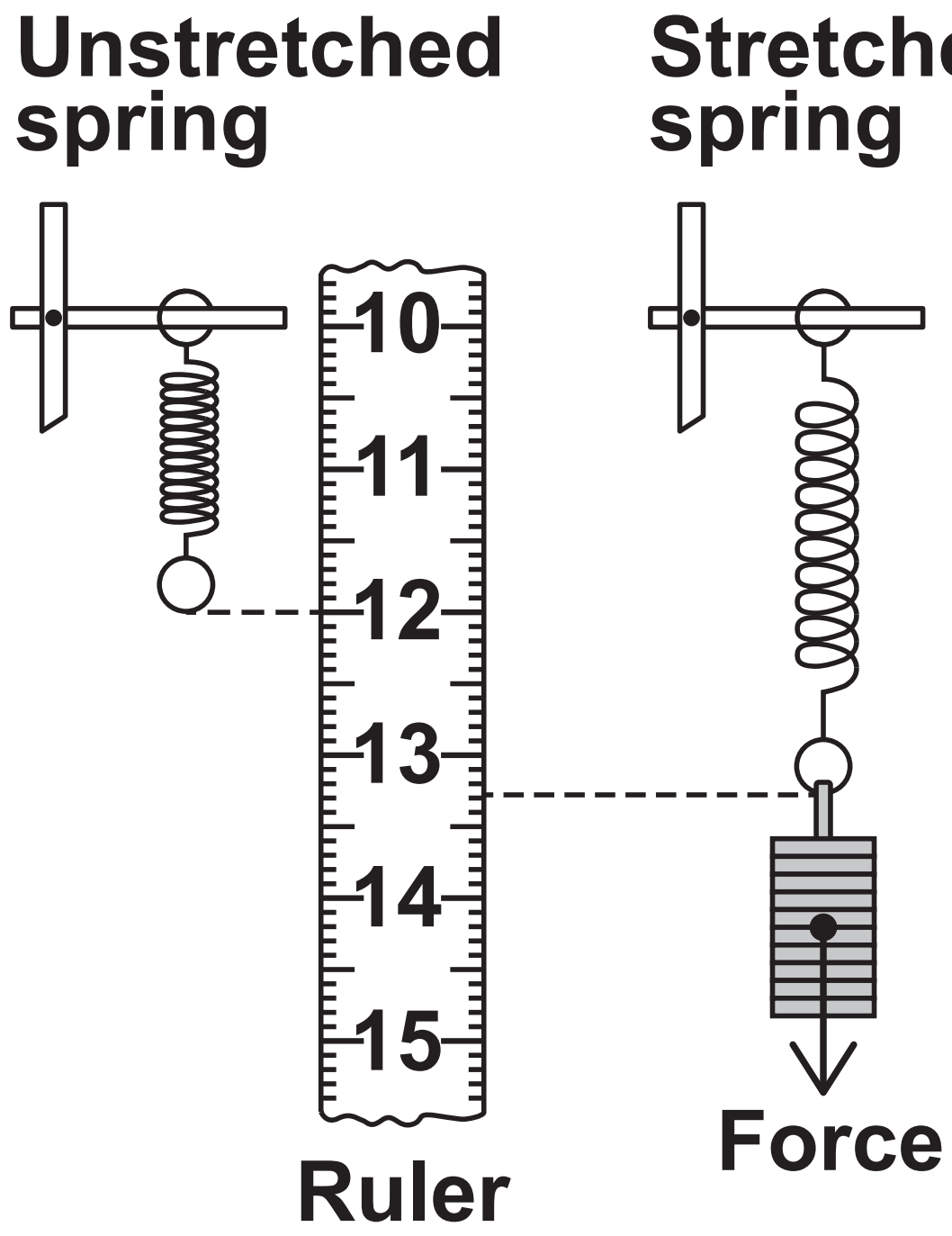
Describe how the method could be improved so that blue copper sulfate crystals are produced.
[6 marks]

6

0 3 **A student investigated how the extension of a spring varied with the force acting on the spring.**

FIGURE 3 shows the equipment the student used and a ruler scale between 10 cm and 15 cm

FIGURE 3



0 3 . 1 **Describe how the student should determine the extension of the spring. [2 marks]**

0 3 . 2 **Write down the equation which links extension (*e*), force (*F*) and spring constant (*k*). [1 mark]**

0 3 . 3 **The extension of the spring was 0.12 m when the force was 3.0 N**

Calculate the spring constant of the spring.
[3 marks]

Spring constant = _____ N/m

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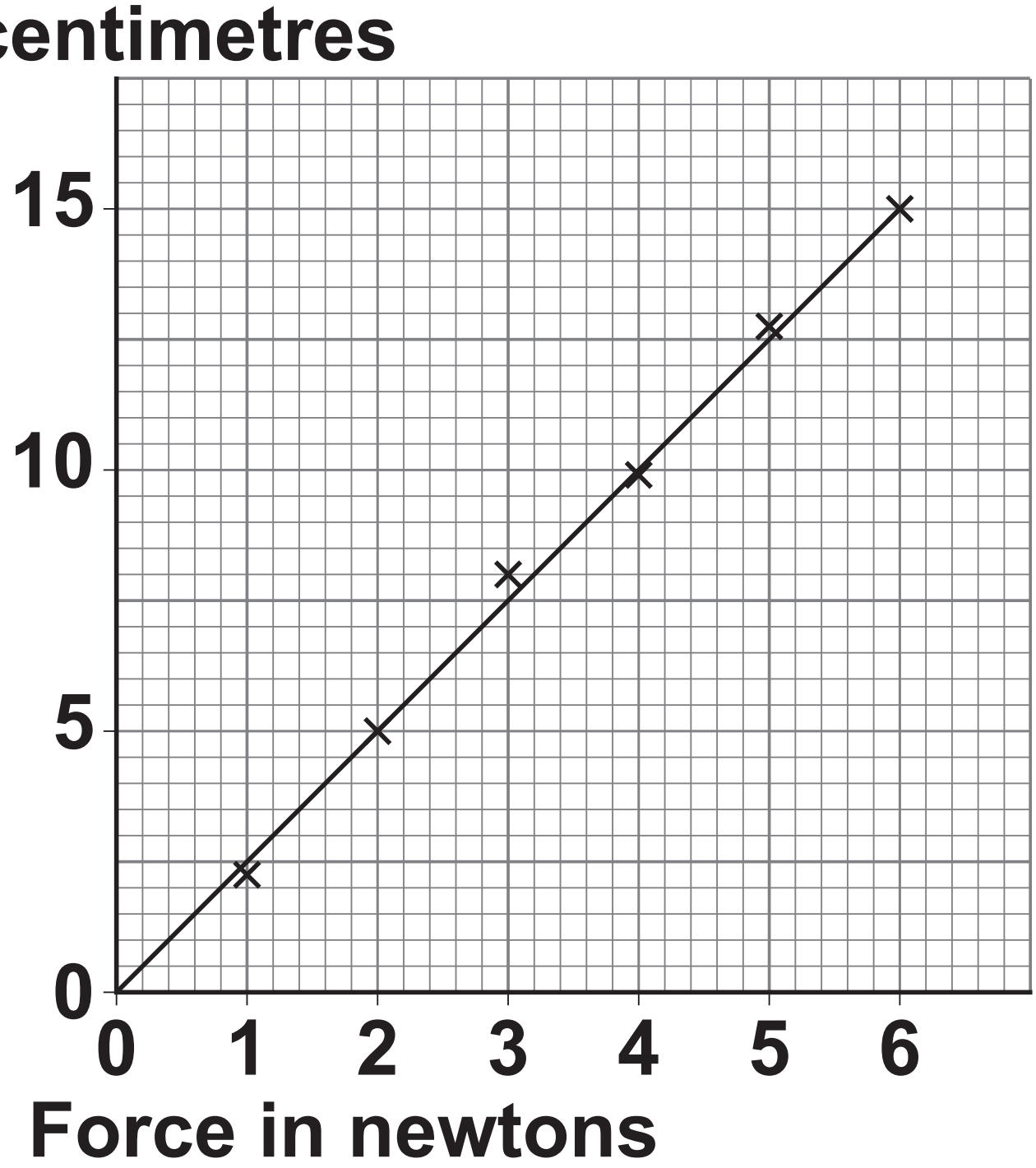
[Turn over]

0 3 . 4 **FIGURE 4 shows the results of the same investigation using a different spring.**

FIGURE 4



The spring constant of the spring was 40 N/m

Determine the energy stored by the spring when the force was 3.6 N [4 marks]

Use the Physics Equations Sheet.

Energy stored = _____ J

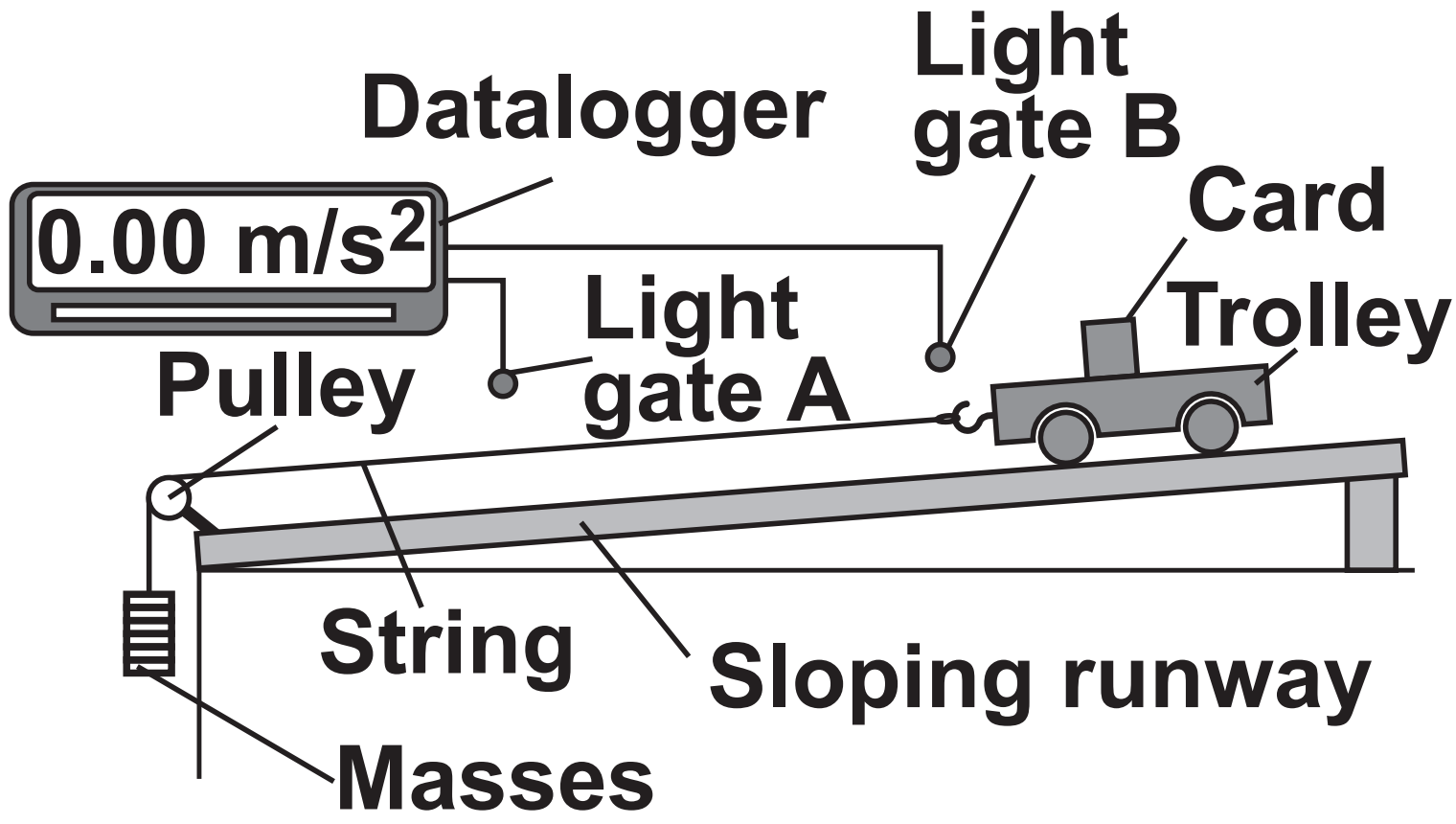
10

0 4 **A student investigated how the acceleration of a trolley varied with the resultant force on the trolley.**

The force on the trolley was provided by the masses on the string.

FIGURE 5 shows how the student set up the equipment.

FIGURE 5



This is the method used.

1. Release the trolley from the top of the runway.

2. As the card passes each light gate a timer turns on and off.

3. The datalogger calculates the velocity of the trolley at light gate A and at light gate B.

4. The datalogger calculates the acceleration using the two velocities.

5. Repeat steps 1 to 4 using different masses.

0 4 . 1 **Which TWO measurements are needed to determine the velocity of the trolley at each light gate? [2 marks]**

Tick (✓) TWO boxes.

- ☐ **Angle of sloping runway**
- ☐ **Distance between light gates**
- ☐ **Length of card**
- ☐ **Resultant force causing the acceleration**
- ☐ **Time that light gates are blocked by the card**

0 4 . 2 **Why was a sloping runway used instead of a flat runway? [1 mark]**

Tick (✓) ONE box.

- ☐ **To compensate for the effect of friction**
- ☐ **To increase the effect of air resistance on the trolley**
- ☐ **To make the trolley accelerate**

0 4 . 3 **What are TWO advantages of using a datalogger and light gates instead of a stopclock in this investigation? [2 marks]**

Tick (✓) TWO boxes.

- ☐ Ensures readings are repeatable
- ☐ Ensures readings are reproducible
- ☐ No reaction time error
- ☐ No systematic errors
- ☐ Performs calculations automatically

0 4 . 4 **Write down the equation which links acceleration (*a*), mass (*m*) and resultant force (*F*). [1 mark]**

---

0 4 . 5 **The acceleration of the trolley was 2.4 m/s^2**

The resultant force on the trolley was 1.2 N

Calculate the mass of the trolley. [3 marks]

Mass = _____ kg

9

0 5 This question is about the reactions of metals.

0 5 . 1 A student investigated the temperature change when a metal was added to 25 cm^3 of dilute sulfuric acid.

The student repeated the investigation with different metals.

The student kept all other variables constant.

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[Turn over]

TABLE 1 shows the results.

TABLE 1

Metal	Initial temperature in °C	Maximum temperature in °C
Magnesium	18.0	37.5
Nickel	18.0	22.0
Zinc	18.0	27.5

FIGURE 6 on page 31 shows an incomplete bar chart for the data in TABLE 1.

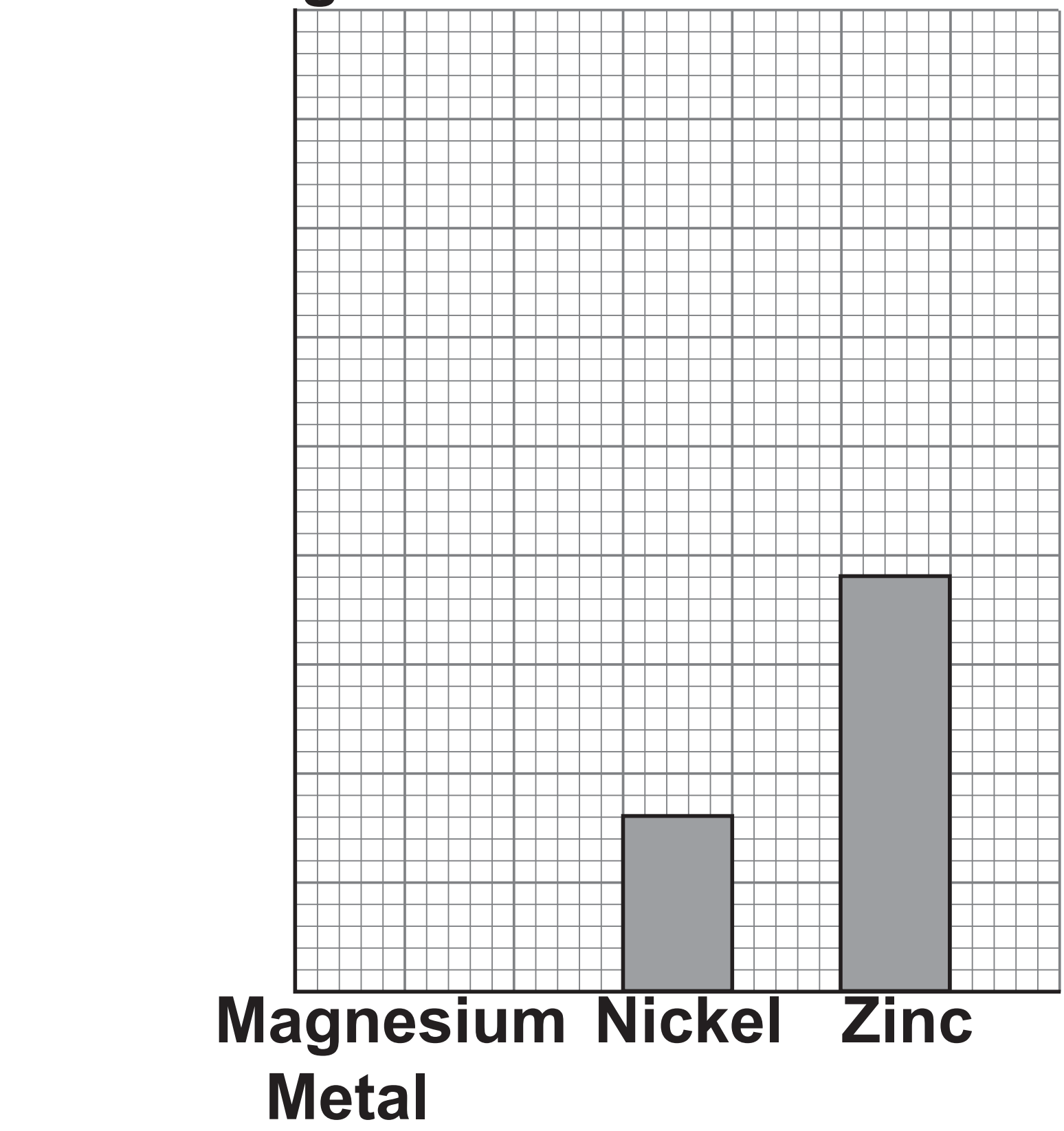
Complete FIGURE 6.

You should:

- write the correct scale on the y-axis
- plot the bar for magnesium.

[2 marks]

FIGURE 6



[Turn over]

Another student investigated displacement reactions of metals.

The student added magnesium, nickel and zinc to different metal sulfate solutions and recorded when a reaction occurred.

0 5 . 2 Predict which metals will react with each metal sulfate solution.

Complete TABLE 2 on page 33.

You should:

- use a tick (✓) to show where a reaction will occur
- use a cross (×) to show where NO reaction will occur.

TABLE 1 is repeated here to help you. [3 marks]

TABLE 1

Metal	Initial temperature in °C	Maximum temperature in °C
Magnesium	18.0	37.5
Nickel	18.0	22.0
Zinc	18.0	27.5

TABLE 2

	Metal sulfate solution		
Metal	Magnesium sulfate	Nickel sulfate	Zinc sulfate
Magnesium			
Nickel			
Zinc			

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0 5 . 3 **The student dissolved 0.0025 moles of nickel sulfate in water to make 5 cm^3 of nickel sulfate solution.**

Calculate the concentration of the nickel sulfate solution in g/dm^3 [3 marks]

Relative formula mass (M_r) of nickel sulfate = 155

Concentration =

_____ g/dm^3

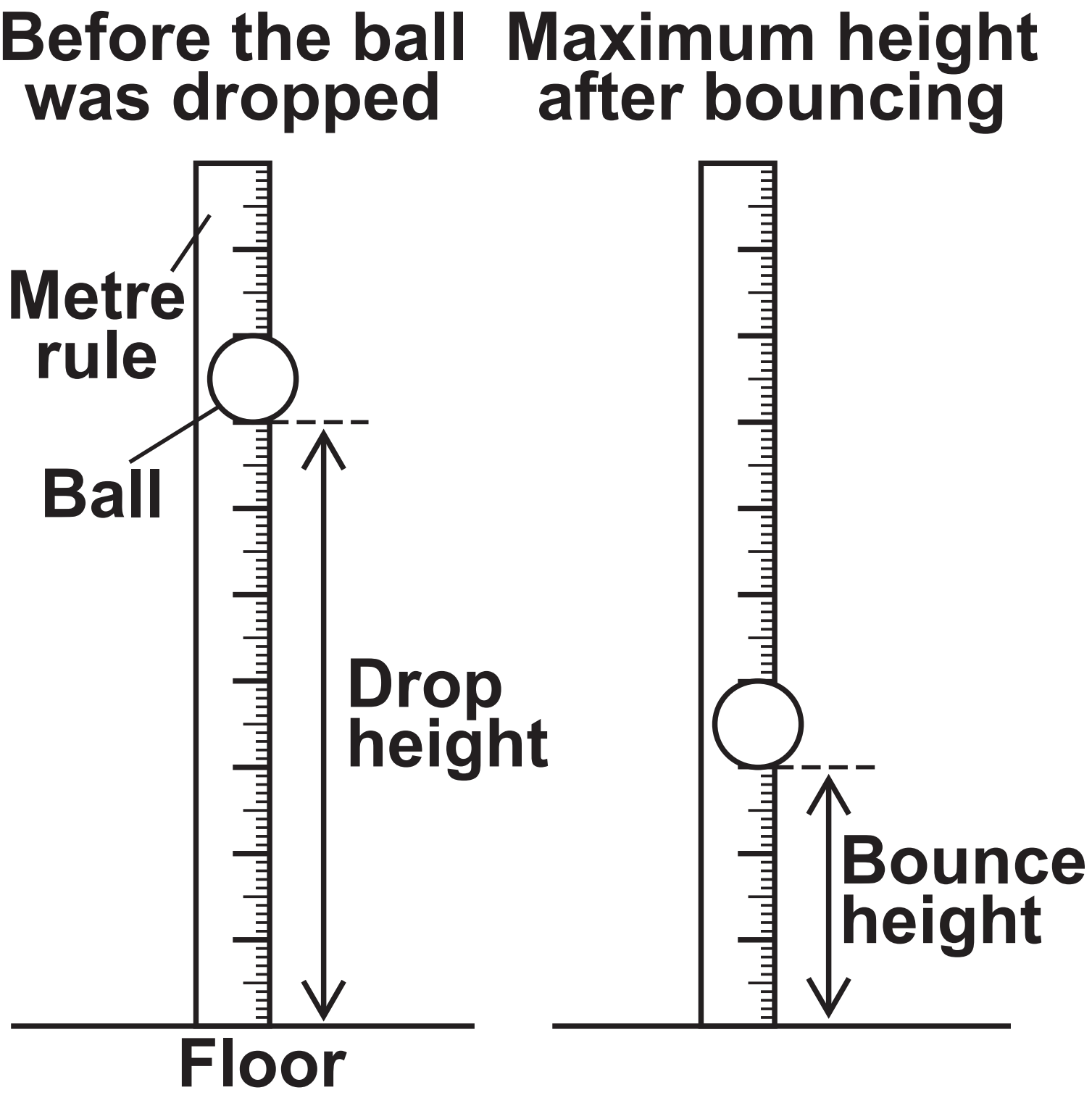
[Turn over]

8

0 6 **A student investigated how the bounce height of a ball varied with drop height.**

FIGURE 7 shows the ball before and after bouncing.

FIGURE 7



This is the method used.

1. Hold the ball at eye level and record the drop height using the metre rule.

2. Drop the ball and measure the bounce height using the metre rule.

3. Take repeat readings and calculate a mean.

4. Repeat steps 1 to 3 for different drop heights.

TABLE 3 shows the results.

TABLE 3

Drop height in centimetres	Bounce height in centimetres			
	Test 1	Test 2	Test 3	Mean
20.0	9.5	10.0	10.5	10.0
40.0	22.5	23.5	21.0	22.3
60.0	40.5	29.5	31.5	X
80.0	43.0	45.5	42.5	43.7
100.0	56.5	55.5	55.5	55.833

0 6 . 1 **Calculate value X in TABLE 3. [2 marks]**

X = _____ cm

[Turn over]

0 6 . 2

The mean value of 55.833 has NOT been recorded correctly in TABLE 3.

Give the value that should have been recorded.
[1 mark]

Value = _____ cm

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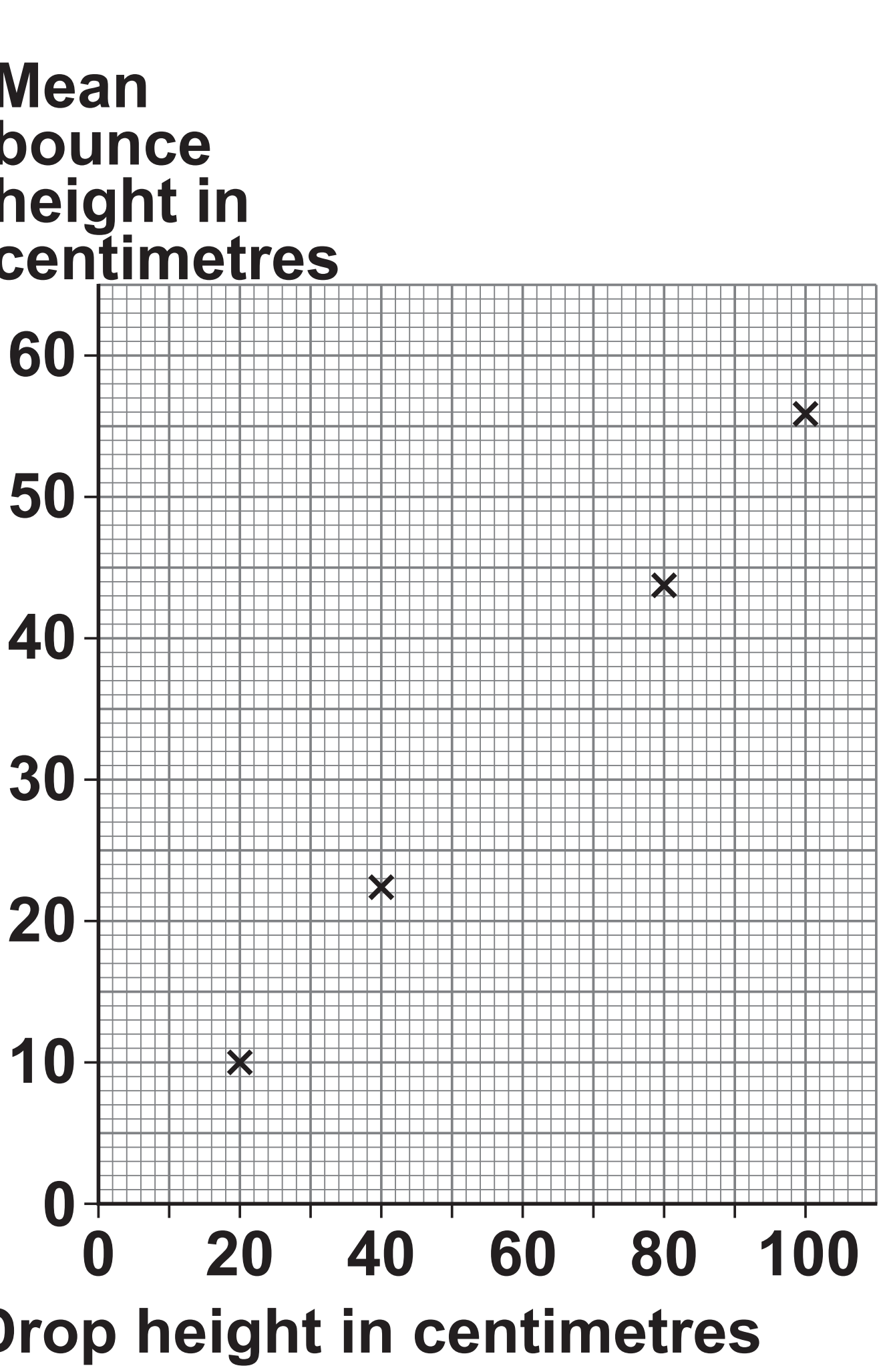
[Turn over]

0 6 . 3 **FIGURE 8 shows some of the results.**

FIGURE 8



What is the relationship between mean bounce height and drop height? [1 mark]

0 6 . 4 TABLE 4 shows some of the results.

TABLE 4

Drop height in centimetres	Bounce height in centimetres			
	Test 1	Test 2	Test 3	Mean
20.0	9.5	10.0	10.5	10.0

Calculate the uncertainty in the student's results when the drop height was 20.0 cm [2 marks]

Uncertainty = ± _____ cm

0 6 . 5 The investigation was repeated using a video camera to record the motion of the ball.

Explain why using a video camera could reduce the uncertainty in the results for bounce height.
[2 marks]

8

[Turn over]

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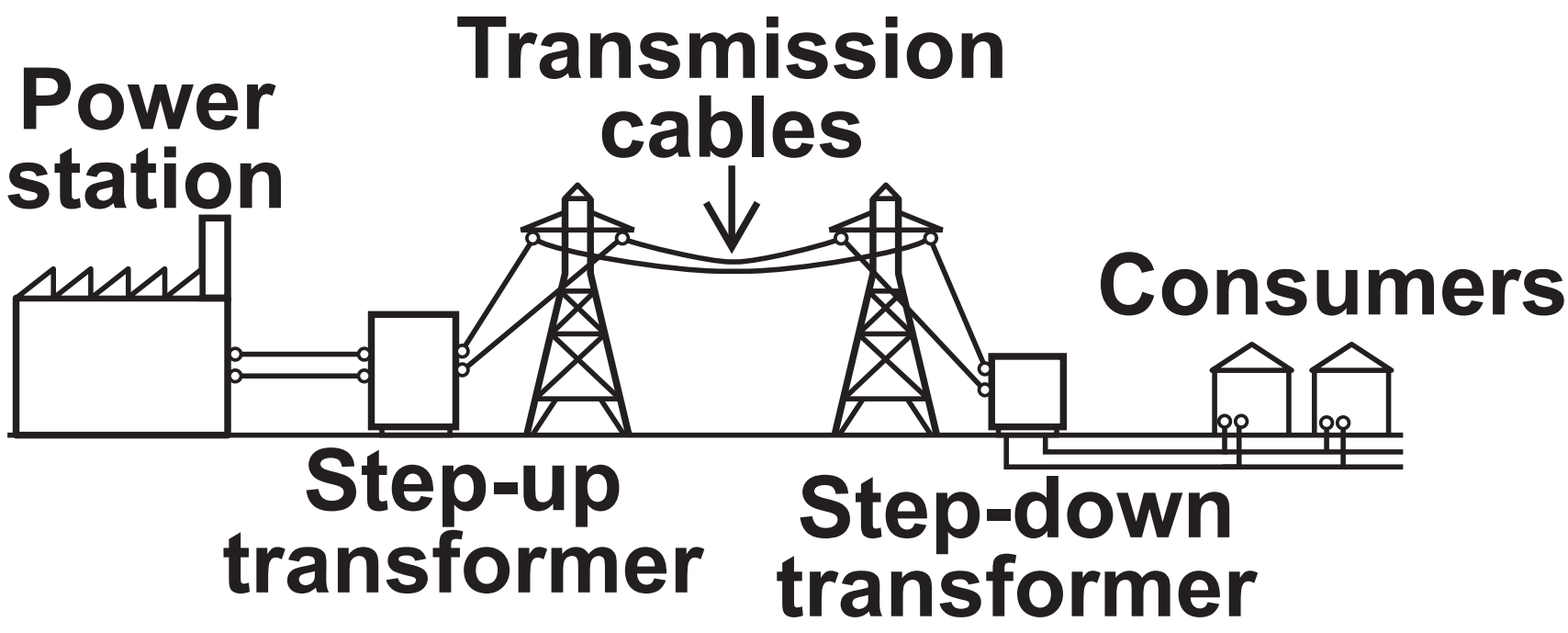
0	7

FIGURE 9 shows how the National Grid connects power stations to consumers.

FIGURE 9



[Turn over]

0 7 . 1 **Explain how transformers are used in the National Grid. [5 marks]**

[Turn over]

0 7 . 2 **A gas-fired power station has a power output of 50 MW**

Calculate the energy transferred during 24 hours. [4 marks]

Energy transferred =

_____ J

[Turn over]

0 7 . 3 **TABLE 5 shows some of the waste products produced by three different types of power station.**

TABLE 5

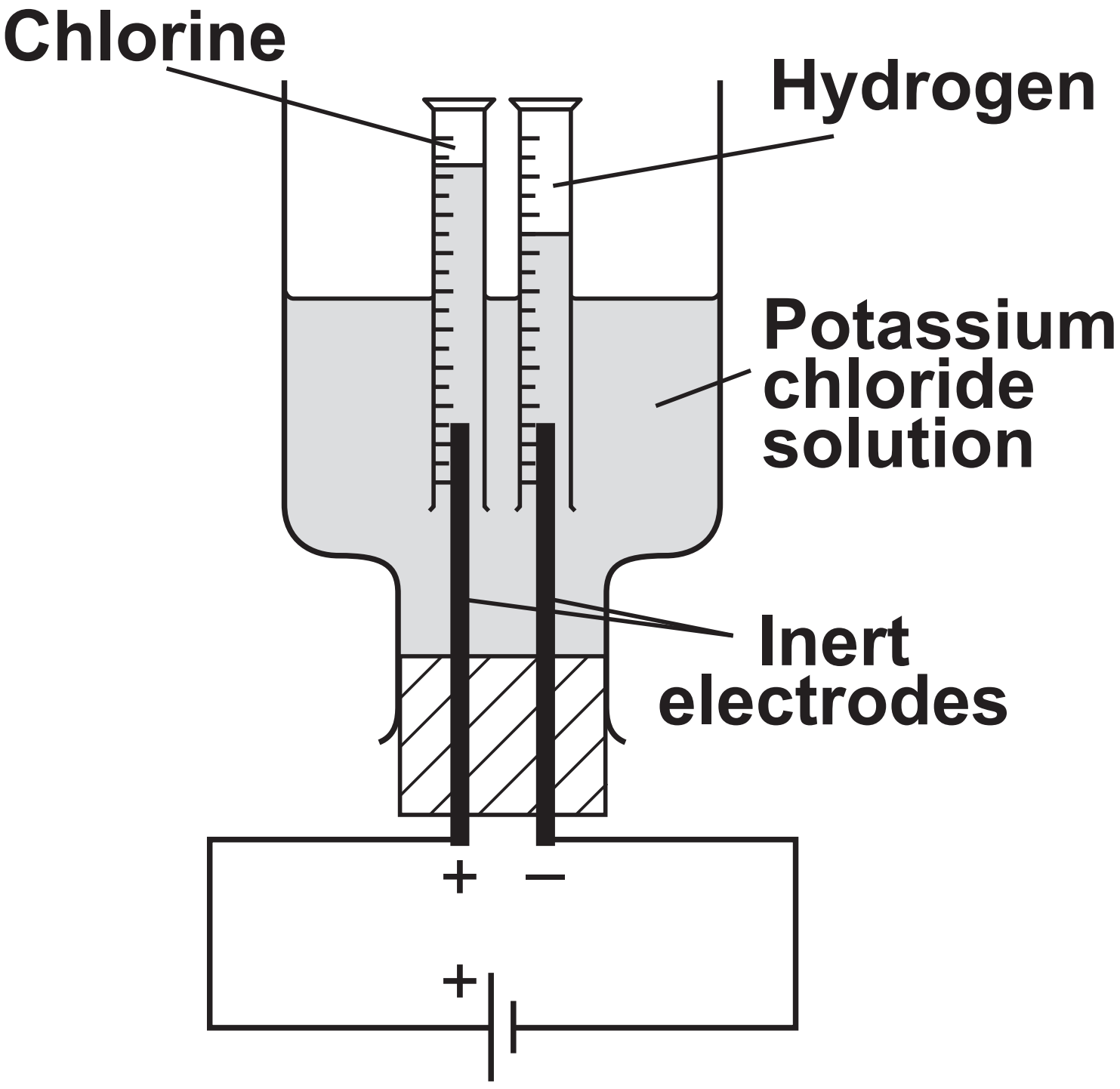
Type of power station	Carbon dioxide produced in kg/MJ	Other waste products
Coal	0.08	sulfur dioxide
Geothermal	0.03	none
Nuclear	0.00	radioactive waste

Evaluate the environmental impact of the power stations in TABLE 5. [4 marks]

0 8 **A student investigated the electrolysis of potassium chloride solution.**

FIGURE 10 shows the apparatus used.

FIGURE 10



0 8 . 1 **Why are inert electrodes used? [1 mark]**

_____

_____

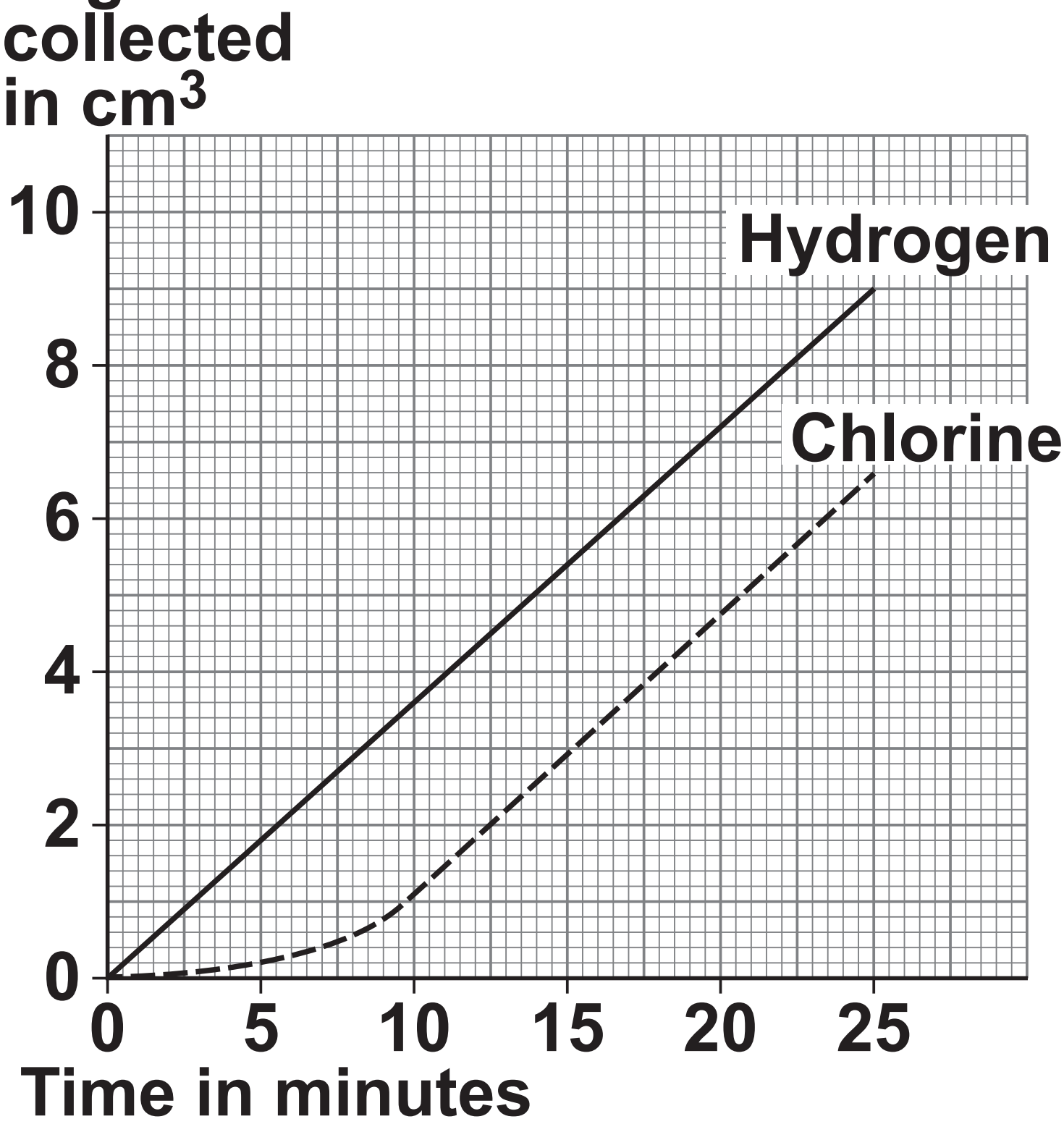
_____

[Turn over]

The student measured the volume of gas collected at each electrode for 25 minutes.

FIGURE 11 shows the results.

FIGURE 11



0 8 . 2 **Compare the RATE of collection of hydrogen and of chlorine.**

Give ONE similarity and ONE difference in the RATE of collection of the gases. [2 marks]

Similarity _____

_____

_____

Difference _____

_____

0 8 . 3 **The rate of production of hydrogen and of chlorine at the electrodes is the same.**

Explain how the graph on FIGURE 11 shows that chlorine is more soluble than hydrogen. [2 marks]

0 8 . 4 **Explain why hydrogen gas is produced at the negative electrode in the electrolysis of potassium chloride solution. [4 marks]**

0 8 . 5 **Write the half equation for the production of chlorine gas at the positive electrode. [2 marks]**

_____ → _____ + _____

11

0 9 **Hydrogen peroxide (H_2O_2) decomposes to produce oxygen gas and water.**

0 9 . 1 **Balance the equation for the reaction. [1 mark]**

_____ $H_2O_2 \longrightarrow$ _____ $H_2O + O_2$

[Turn over]

Two catalysts that can be used in the reaction are raw potato and manganese dioxide.

0 9 . 2 A student compared the rate of decomposition of hydrogen peroxide using:

- a cube of raw potato as the catalyst
- crushed raw potato as the catalyst.

The student kept all other variables constant.

The hydrogen peroxide decomposed at a different rate when using a cube of raw potato compared with using crushed raw potato.

Explain why. [3 marks]

0 9 . 3 The student repeated the investigation using boiled potato instead of raw potato.

When boiled potato is added to hydrogen peroxide no bubbles of oxygen are observed.

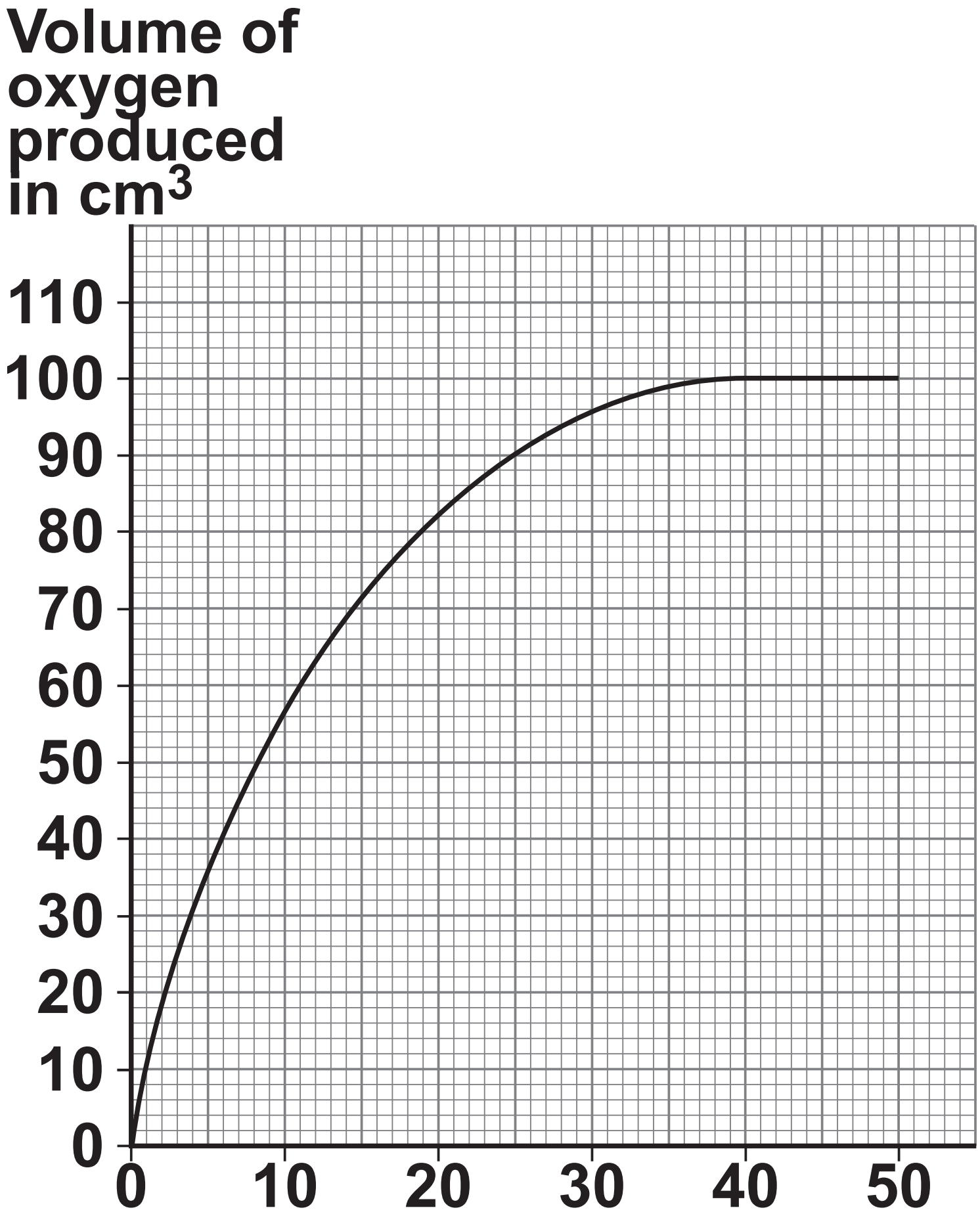
Explain why. [2 marks]

0 9 . 4 The student then investigated the rate of decomposition of hydrogen peroxide using manganese dioxide as the catalyst.

The student measured the volume of oxygen produced every 5 seconds for 50 seconds.

FIGURE 12, on page 66, shows the results.

FIGURE 12


Volume of oxygen produced in cm3
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
Time in seconds

Determine the rate of reaction at 15 s [4 marks]

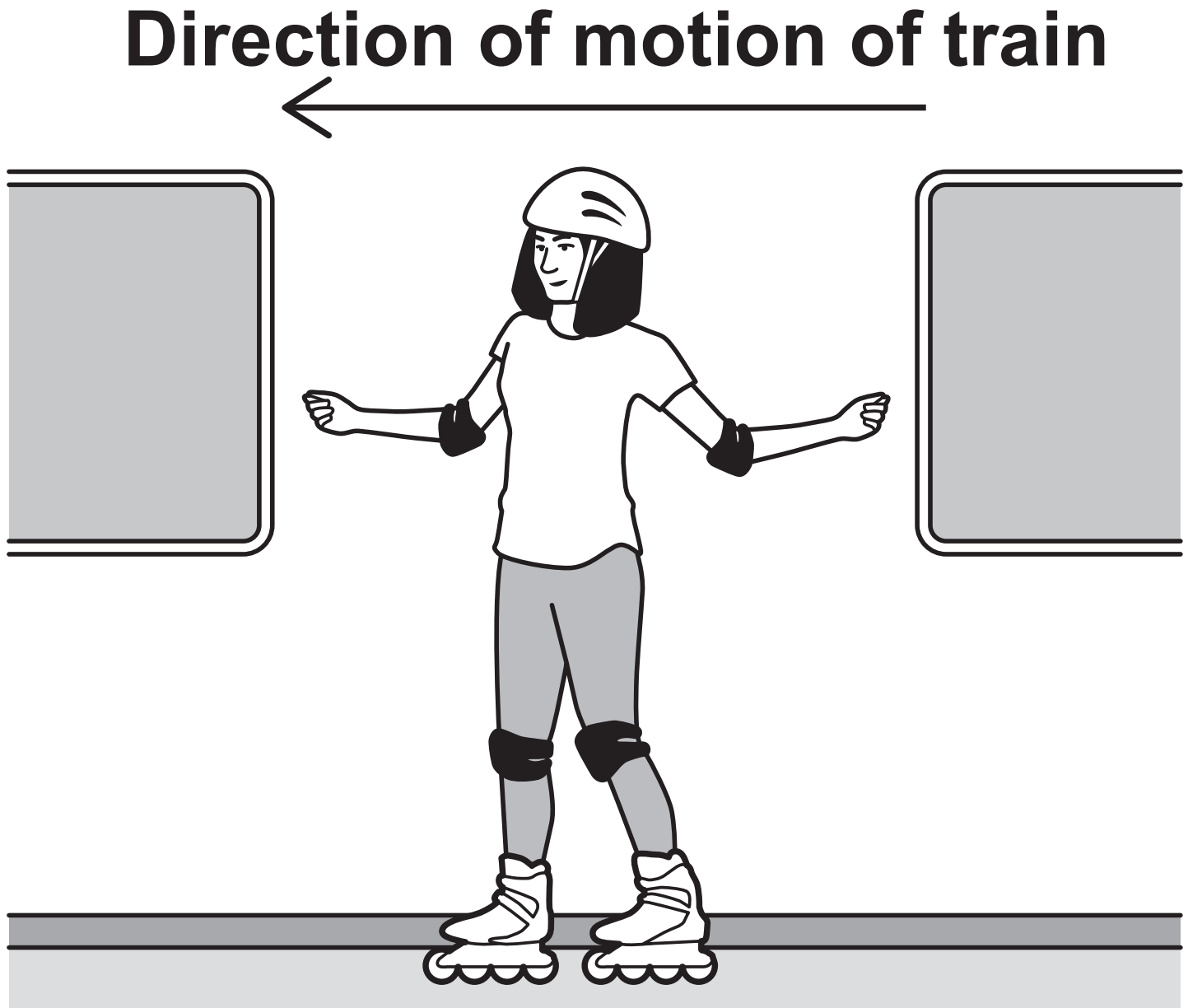
Rate = _____ cm^3/s

10

1 0 **FIGURE 13 shows a girl inside a train. The girl is wearing inline skates.**

The train is moving at a constant velocity. The girl is stationary relative to the train.

FIGURE 13



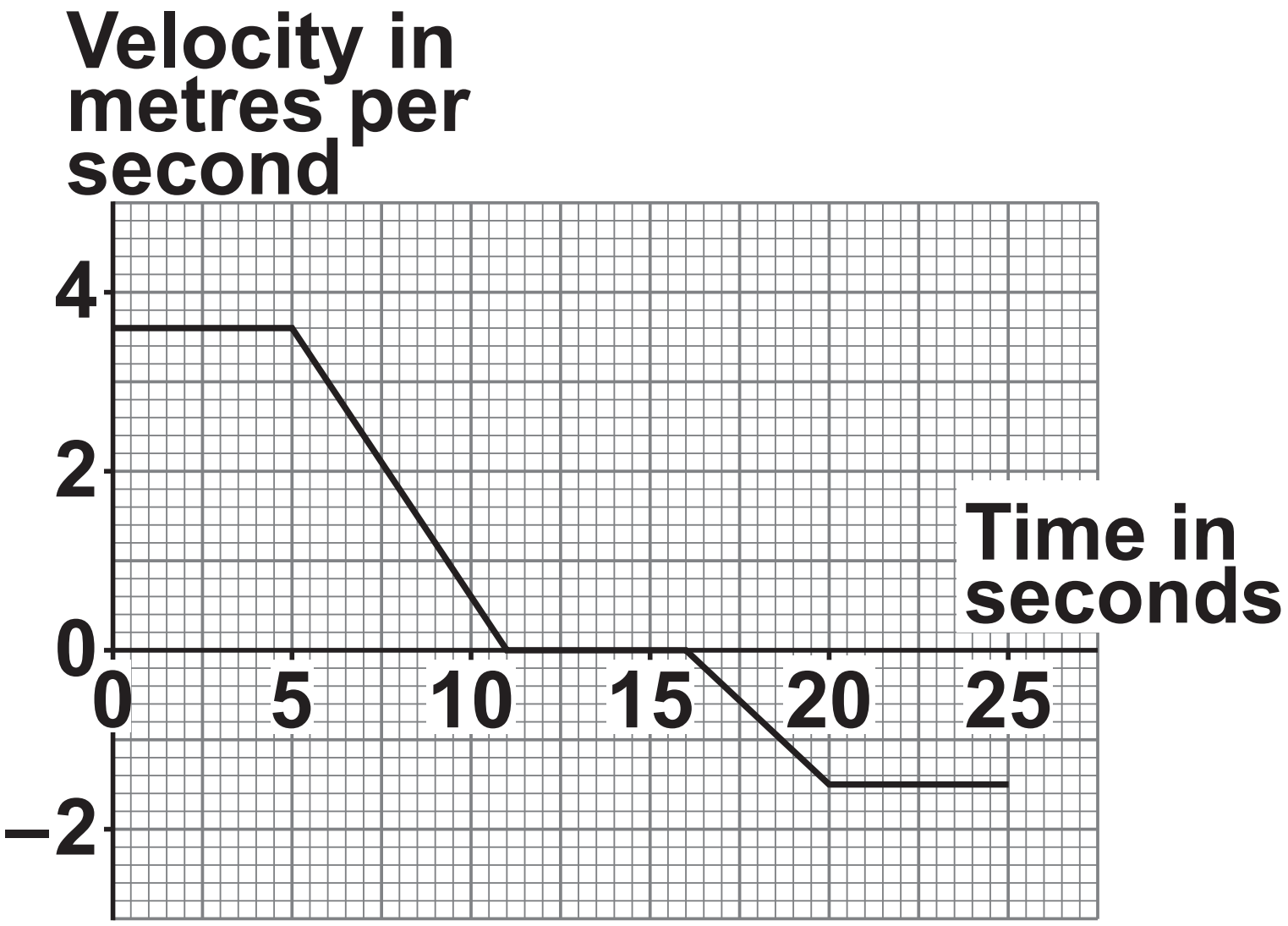
1 0 . 1 **The girl is not touching the train walls.**

The train suddenly decelerates.

Explain what will happen to the movement of the girl as the train suddenly decelerates. [3 marks]

FIGURE 14 shows a velocity-time graph for the train for part of its journey.

FIGURE 14



1 0 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t). [1 mark]

1 0 . 3 **Determine the acceleration of the train between 5 seconds and 11 seconds. [2 marks]**

Acceleration = _____ m/s^2

1 0 . 4 **Determine the total displacement of the train between 0 seconds and 25 seconds. [5 marks]**

Displacement = _____ m

[Turn over]

1 0 . 5 **At a different point in the journey the train decelerates from a velocity of 40 m/s to a velocity of 15 m/s**

The deceleration is 2.0 m/s^2

Calculate the distance the train travels while decelerating. [3 marks]

_____

_____

_____

Distance = _____ m

[Turn over]

1 0 . 6 **FIGURE 15 shows part of the track for the train's journey.**

The train moves at a constant speed along this part of the track.

The train is accelerating.

FIGURE 15

Explain how the train can be accelerating while travelling at a constant speed. [3 marks]

17

END OF QUESTIONS

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For Examiner's Use	
Question	Mark
1	
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9	
10	
TOTAL	