A

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

F

COMBINED SCIENCE: SYNERGY

Foundation Tier Paper 4 Physical Sciences

8465/4F

Wednesday 10 June 2020 Morning

Time allowed: 1 hour 45 minutes

[Turn over]

JUN208465 4F01

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

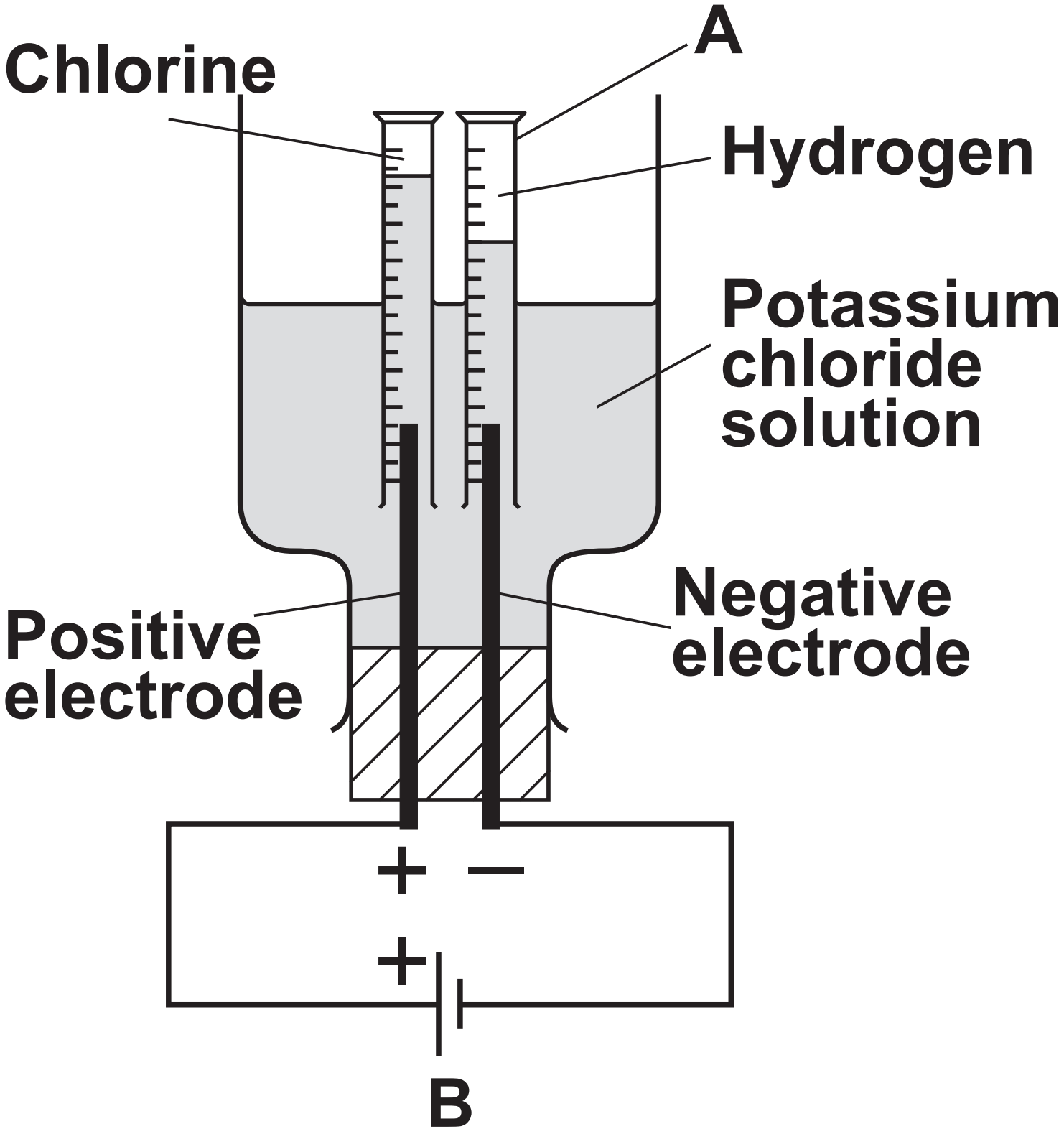
- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **A student investigated the electrolysis of potassium chloride solution.**

FIGURE 1 shows the apparatus used.

FIGURE 1



0 1 . 1 The student used the piece of equipment labelled A to measure the volume of gas collected.

What is the piece of equipment labelled A?
[1 mark]

Tick (✓) ONE box.

☐ Balance

☐ Conical flask

☐ Measuring cylinder

☐ Thermometer

0 1 . 2 What does the circuit symbol B represent? [1 mark]

---

0 1 . 3 Complete the sentence.

Choose the answer from the list. [1 mark]

anode

cathode

electrolyte

product

In this process potassium chloride solution is the _____.

0 1 . 4 **Direct current (dc) is supplied to the circuit.**

What is direct current?
[1 mark]

Tick (✓) ONE box.

☐ **Current that always passes in the same direction.**

☐ **Current that changes direction 100 times each second.**

☐ **Current that does not have a direction.**

0 1 . 5 **Potassium chloride solution contains potassium (K^+) ions and chloride (Cl^-) ions.**

Why are chloride ions attracted to the positive electrode? [1 mark]

0 1 . 6 **Hydrogen gas is produced at the negative electrode.**

Which test should the student use to identify hydrogen gas? [1 mark]

Tick (✓) ONE box.

- ☐ **A burning splint**
- ☐ **A glowing splint**
- ☐ **Bubble through limewater**
- ☐ **Damp litmus paper**

[Turn over]

0 1 . 7 Hydrogen ions and potassium ions move to the negative electrode.

Hydrogen gas is produced at the negative electrode.

Why is hydrogen gas produced at the negative electrode? [1 mark]

Tick (✓) ONE box.

☐ Hydrogen is a non-metal.

☐ Hydrogen is less reactive than potassium.

☐ Too few potassium ions move to the electrode.

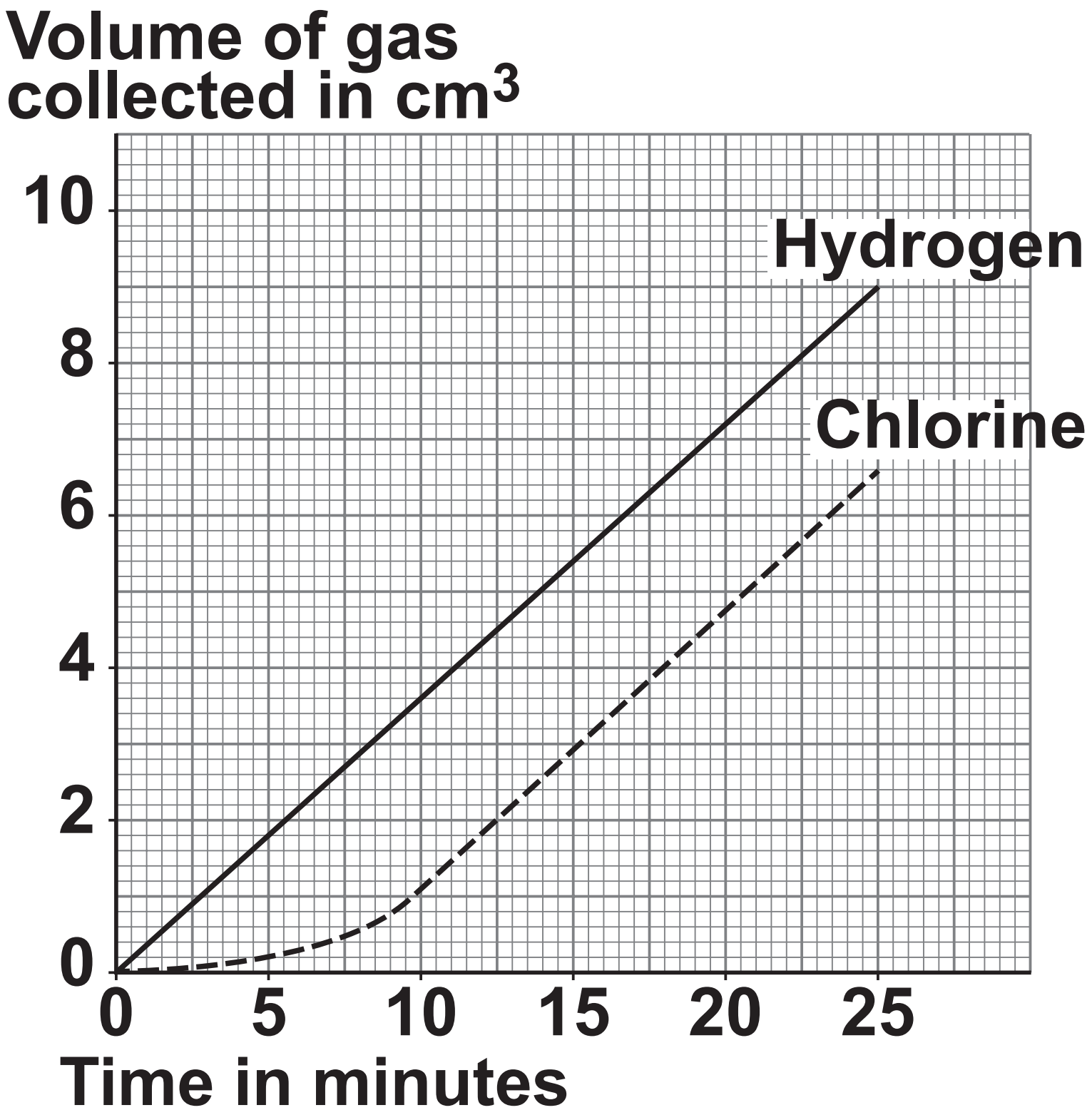
BLANK PAGE

[Turn over]

0 1 . 8 The student measured the volume of gas collected at each electrode every minute for 25 minutes.

FIGURE 2 shows the results.

FIGURE 2



Describe ONE similarity and ONE difference in the volume of hydrogen and the volume of chlorine collected during the 25 minutes.

Use FIGURE 2. [2 marks]

Similarity _____

_____

_____

Difference _____

_____

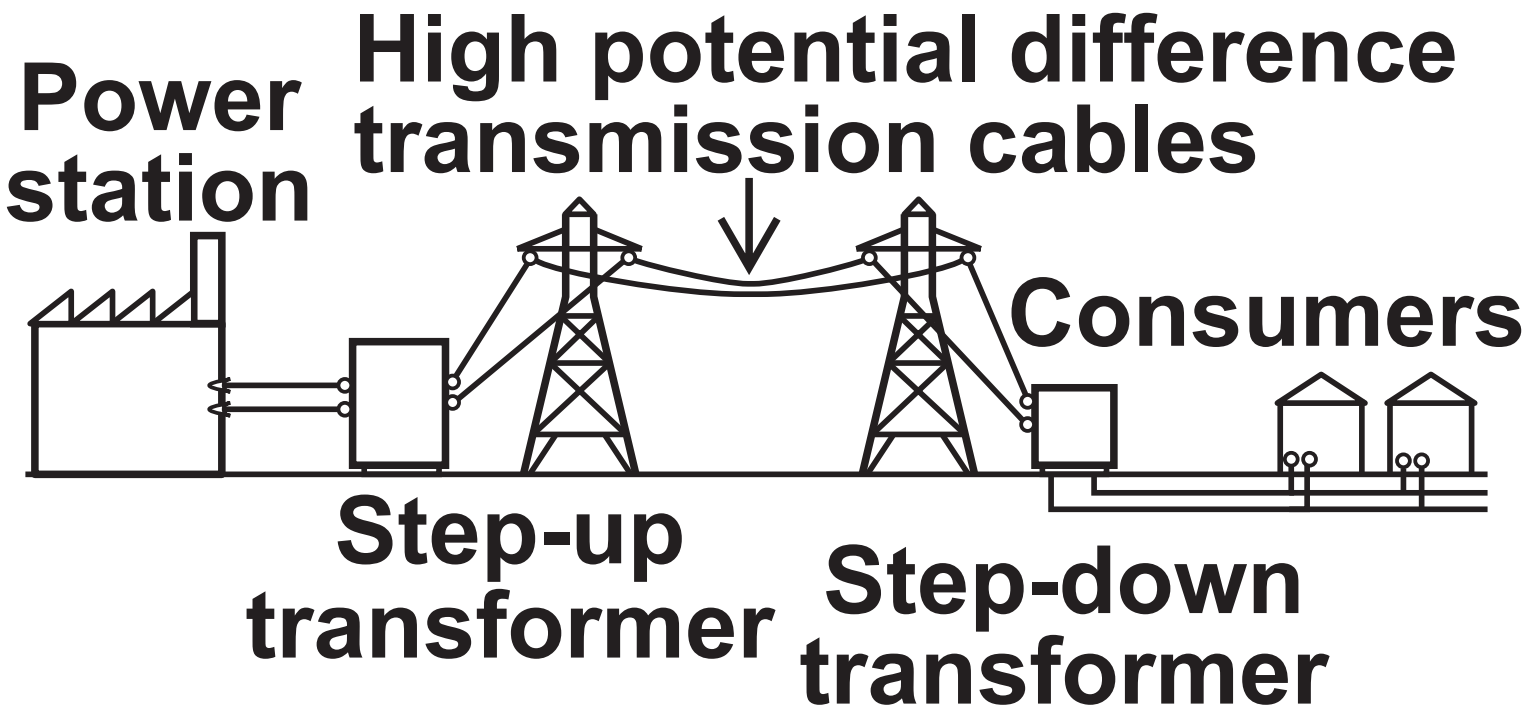
_____

9

BLANK PAGE

0 2 **FIGURE 3 shows how a power station supplies electricity to consumers.**

FIGURE 3



0 2 . 1 **The National Grid is a system of cables and transformers linking power stations to consumers.**

Complete the sentences.

Choose answers from the list.

Each answer may be used once, more than once or not at all. [3 marks]

decrease

increase

remain the same

The step-up transformer causes the potential difference to increase and the current to

_____.

The use of the step-up transformer causes the energy transferred by heating of the cables to

_____.

The step-down transformer causes the potential difference to decrease and the current to

_____.

[Turn over]

BLANK PAGE

0 2 . 2 **A nuclear power station has a power output of 350 000 000 W**

Calculate the energy transferred by the power station in 60 seconds.

[2 marks]

Use the equation:

energy transferred = power × time

Energy transferred = _____ J

[Turn over]

TABLE 1 shows some of the waste products produced by three different types of power station.

TABLE 1

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

0 2 . 3 Which type of power station contributes least to global warming?

Give a reason for your answer. [2 marks]

Power station _____

Reason _____

_____

_____

0 2 . 4 Which type of power station produces waste products that cause acid rain?

Give a reason for your answer. [2 marks]

Power station _____

Reason _____

_____

_____

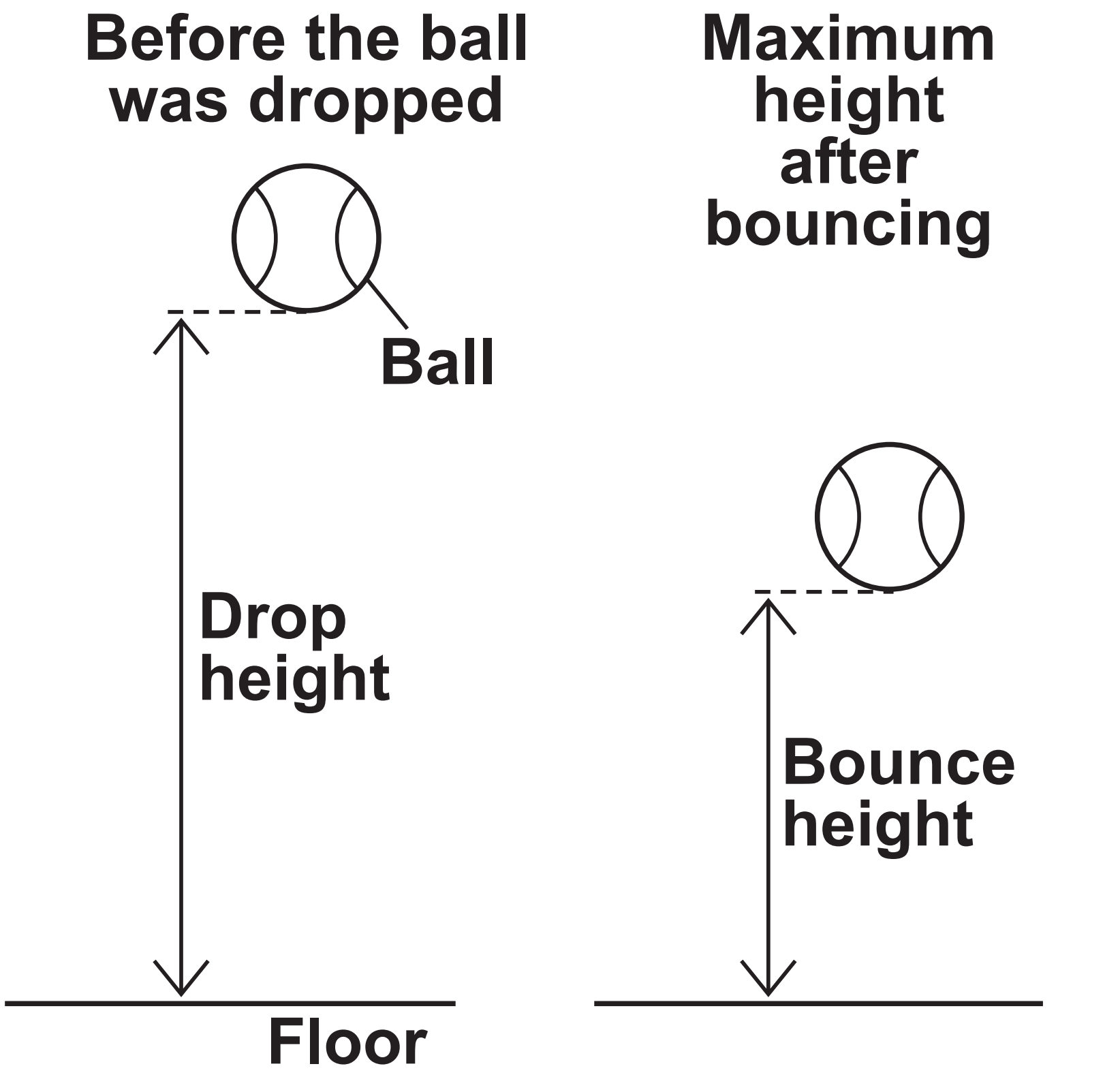
9

[Turn over]

0 3 **A student investigated how the bounce height of a ball varied with drop height.**

FIGURE 4 shows the ball before and after bouncing.

FIGURE 4

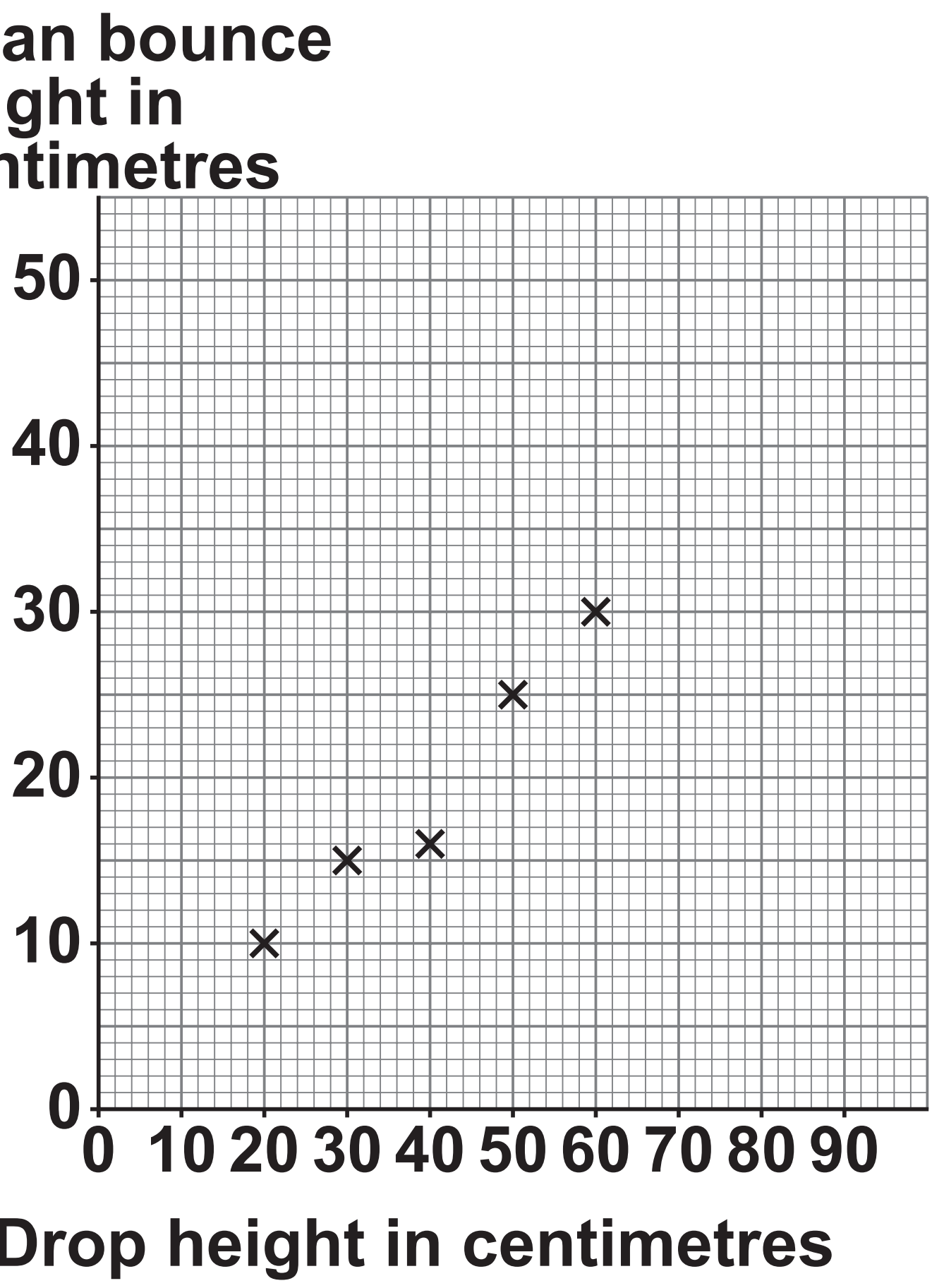


BLANK PAGE

[Turn over]

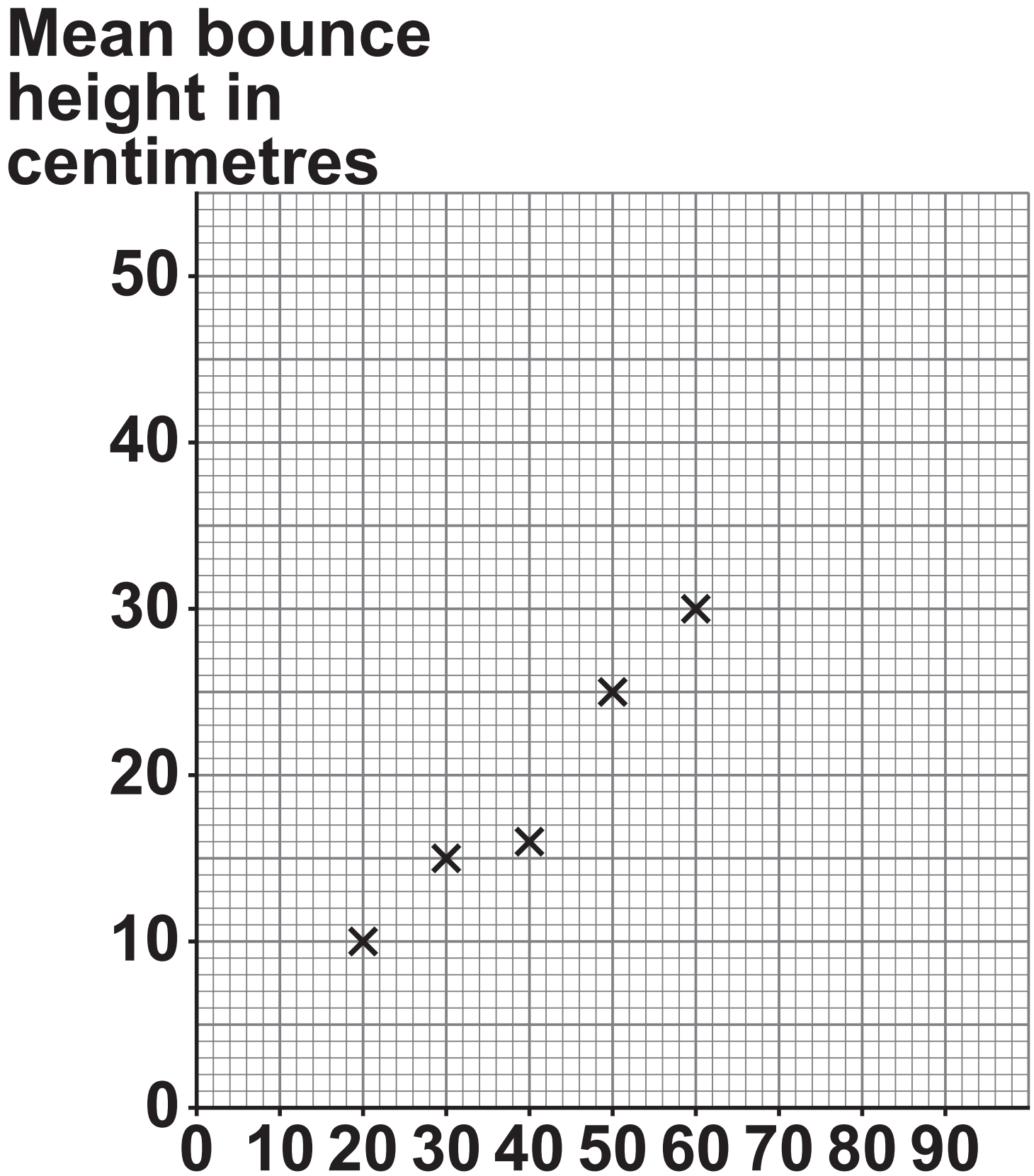
FIGURE 5 shows some of the student's results.

FIGURE 5



0 3 . 1 **Describe a method the student could use to obtain the data shown in FIGURE 5. [4 marks]**

REPEAT OF FIGURE 5



0 3 . 2 Draw a ring around the anomalous result on FIGURE 5.

Give ONE reason why you chose this result. [2 marks]

---

0 3 . 3 TABLE 2 shows some of the student's results.

TABLE 2

Drop height in centimetres	Mean bounce height in centimetres
70	35
80	40

Plot the data in TABLE 2 on FIGURE 5.

Draw a line of best fit.
[2 marks]

0 3 . 4 **What conclusion can be made from FIGURE 5? [1 mark]**

Tick (✓) ONE box.

☐ **As drop height increases, the mean bounce height decreases.**

☐ **Mean bounce height is always higher than drop height.**

☐ **Drop height and mean bounce height show a linear relationship.**

BLANK PAGE

[Turn over]

0 3 . 5 **TABLE 3 shows some of the student's results.**

TABLE 3

Drop height in centimetres	Bounce height in centimetres			
	Test 1	Test 2	Test 3	Mean
60	31	30	29	30

What was the uncertainty in the student's results when the drop height was 60 cm? [1 mark]

Tick (✓) ONE box.

☐ **Uncertainty = ±1 cm**

☐ **Uncertainty = ±2 cm**

☐ **Uncertainty = ±4 cm**

0 3 . 6 **What is the reason for the uncertainty in the values of bounce height? [1 mark]**

Tick (✓) ONE box.

☐ **It is difficult to judge when the ball is at maximum height.**

☐ **The bounce height is too small to measure.**

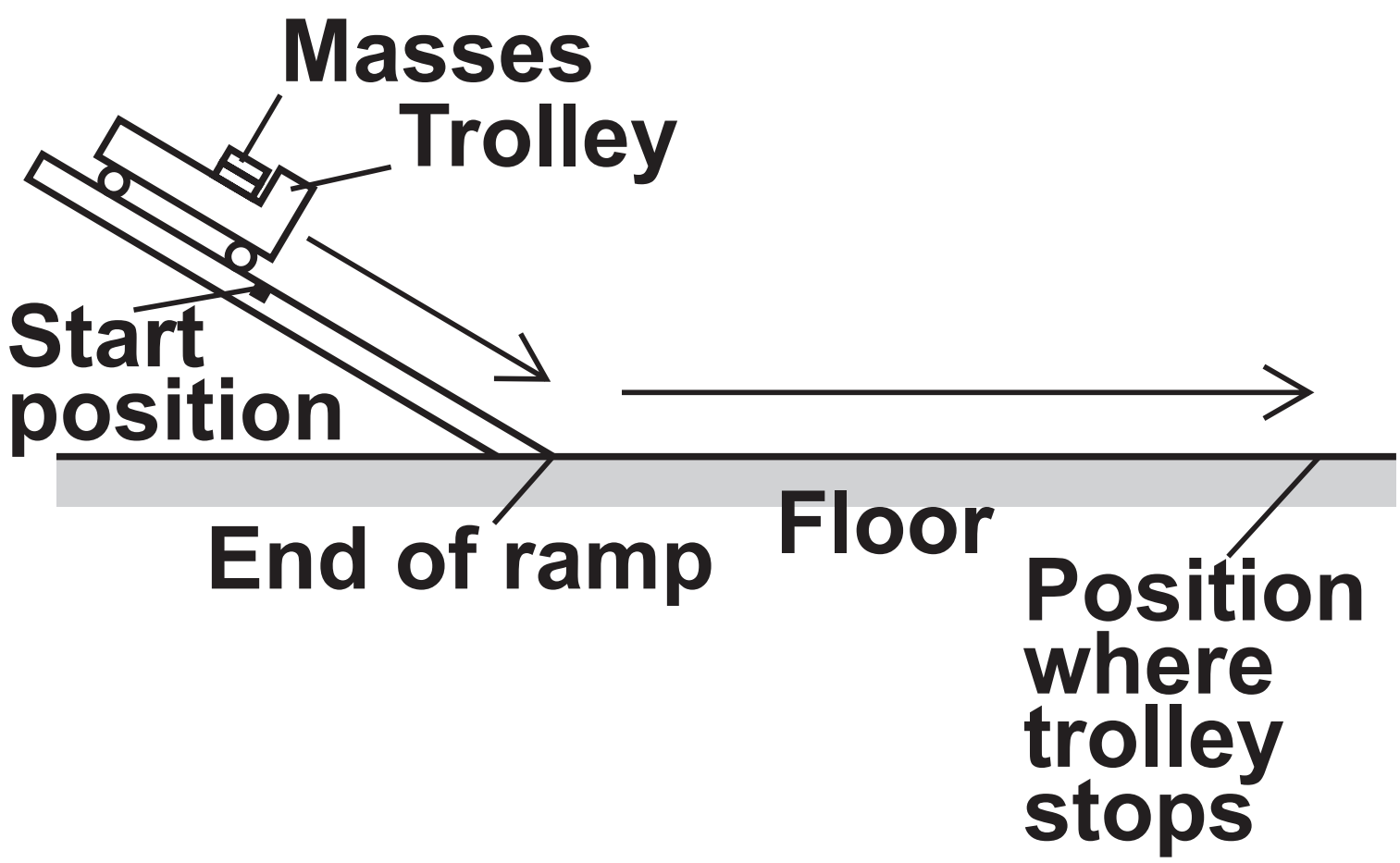
☐ **When the ball bounces, energy is transferred to the surroundings.**

[Turn over]

0 4 **A student investigated how the distance travelled by a trolley from the end of a ramp varied with the total mass of the trolley.**

FIGURE 6 shows the equipment the student used.

FIGURE 6



This is the method used.

1. Put the trolley on the ramp at the start position.

2. Let the trolley roll down the ramp.

3. Measure the distance from the end of the ramp to the position where the trolley stops.

4. Repeat steps 1 to 3 with different masses on the trolley.

0 4 . 1 Give ONE variable the student should have kept the same in the investigation.
[1 mark]

TABLE 4 shows the results.

TABLE 4

Total mass of trolley and masses in kilograms	Distance travelled by trolley until it stopped in metres
0.50	1.60
1.00	3.50
1.50	X
2.00	6.40

0 4 . 2 Predict a value for X in TABLE 4. [1 mark]

X = _____ m

0 4 . 3 **What conclusion can be made from these results? [1 mark]**

0 4 . 4 When the trolley was in the start position, the vertical height between the centre of mass of the trolley and the floor was 0.600 m

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the trolley when the total mass of the trolley and masses was 2.50 kg [2 marks]

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

Gravitational potential energy = _____ J

[Turn over]

0 4 . 5 When the trolley is released from the start position, energy is transferred in different ways.

Complete the sentences.

Choose answers from the list. [3 marks]

chemical

elastic potential

gravitational potential

kinetic

thermal

As the trolley moves down the ramp the trolley accelerates.

There is a DECREASE in the trolley's

_____

energy.

There is an INCREASE in the trolley's

_____

energy.

After leaving the ramp the trolley slows down.

There is an INCREASE in the

_____

energy of the surroundings.

8

[Turn over]

0 5 This question is about hydrogen peroxide.

The formula of hydrogen peroxide is H_2O_2

0 5 . 1 Name the elements in a molecule of hydrogen peroxide. [1 mark]

_____ and

_____

0 5 . 2 How many atoms are in a molecule of hydrogen peroxide? [1 mark]

_____

0 5 . 3 **Hydrogen peroxide decomposes to produce oxygen and water.**

Write the word equation for the reaction. [1 mark]

_____ → _____ + _____

A student investigated the decomposition of hydrogen peroxide.

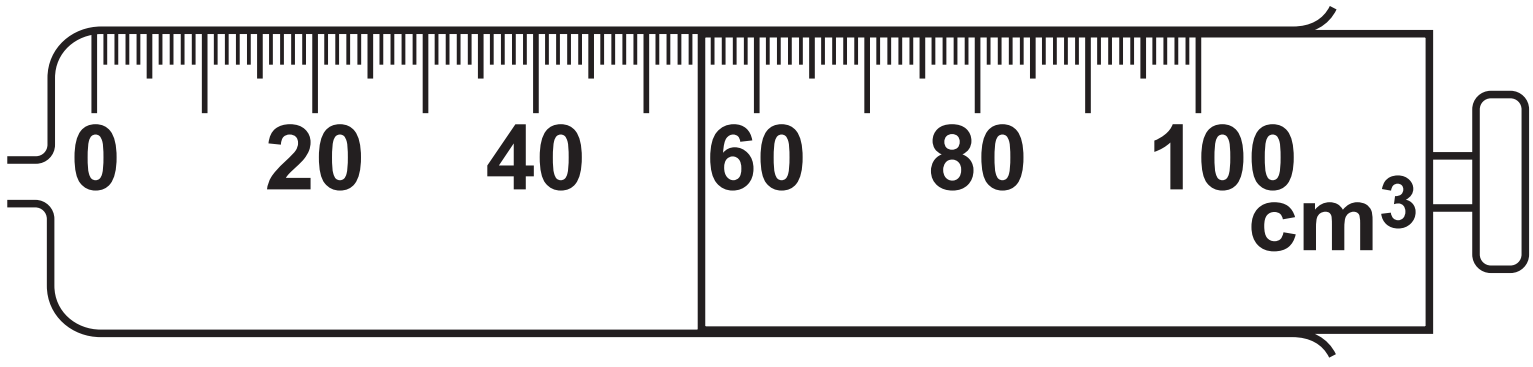
The student used manganese dioxide as a catalyst.

The student measured the volume of oxygen produced.

0 5 . 4 **The student collected the oxygen in a gas syringe.**

FIGURE 7 shows a gas syringe.

FIGURE 7



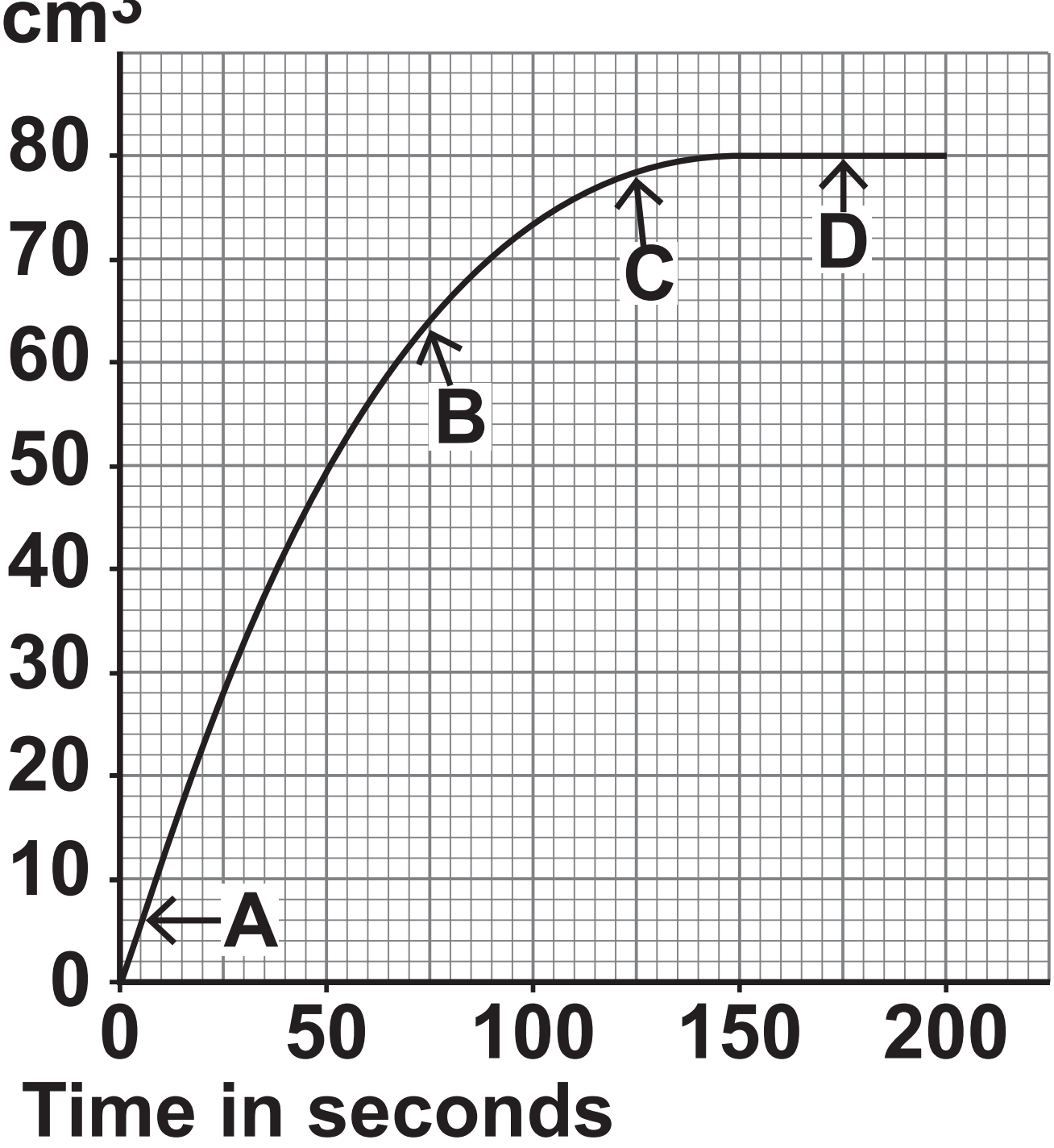
What is the volume of oxygen in the syringe?
[1 mark]

Volume of oxygen = _____ cm^3

[Turn over]

FIGURE 8 shows how the volume of oxygen collected varied with time.

FIGURE 8



0 5 . 5 **Which point on FIGURE 8 shows when the reaction is fastest? [1 mark]**

Tick (✓) ONE box.

A	B	C	D
☐	☐	☐	☐

0 5 . 6 **Which point on FIGURE 8 shows when the reaction has stopped? [1 mark]**

Tick (✓) ONE box.

A	B	C	D
☐	☐	☐	☐

0 5 . 7 **The student repeated the investigation using raw potato instead of manganese dioxide.**

An enzyme in the potato acts as the catalyst.

Draw ONE line from each catalyst to the type of substance the catalyst is. [2 marks]

Catalyst	Type of substance
Enzyme	Buckminster-fullerene
Manganese dioxide	Gaseous element
	Metal compound
	Protein molecule

[Turn over]

0 5 . 8 **The student repeated the investigation using boiled potato instead of raw potato.**

The enzyme in the boiled potato did NOT catalyse the reaction.

How will the rate of decomposition of hydrogen peroxide using boiled potato compare with the rate using raw potato? [1 mark]

Tick (✓) ONE box.

- ☐ **The hydrogen peroxide will decompose at a faster rate.**
- ☐ **The hydrogen peroxide will decompose at a slower rate.**
- ☐ **The hydrogen peroxide will decompose at the same rate.**

9

0 6 **This question is about the reaction of metals with sulfuric acid.**

0 6 . 1 **The word equation for the reaction of zinc with sulfuric acid is:**

zinc + sulfuric acid ⟶ zinc sulfate + hydrogen

What type of substance is zinc sulfate? [1 mark]

Tick (✓) ONE box.

- ☐ **Acid**
- ☐ **Alkali**
- ☐ **Base**
- ☐ **Salt**

0 6 . 2 **Calculate the relative formula mass (M_r) of zinc sulfate ($ZnSO_4$). [2 marks]**

Relative atomic masses (A_r): Zn = 65 S = 32 O = 16

Relative formula mass (M_r) = _____

[Turn over]

A student investigated the temperature increase when the same mass of different metals were added to 0.1 M sulphuric acid.

The student used four different metals.

The student did the experiment three times for each metal and calculated the mean temperature increase for each metal.

0 6 . 3 TABLE 5 shows the results for nickel.

TABLE 5

Temperature increase in °C			
Test 1	Test 2	Test 3	Mean
3.5	X	3.5	4.0

Calculate value X. [2 marks]

X = _____ °C

[Turn over]

TABLE 6 shows the mean values for the four metals.

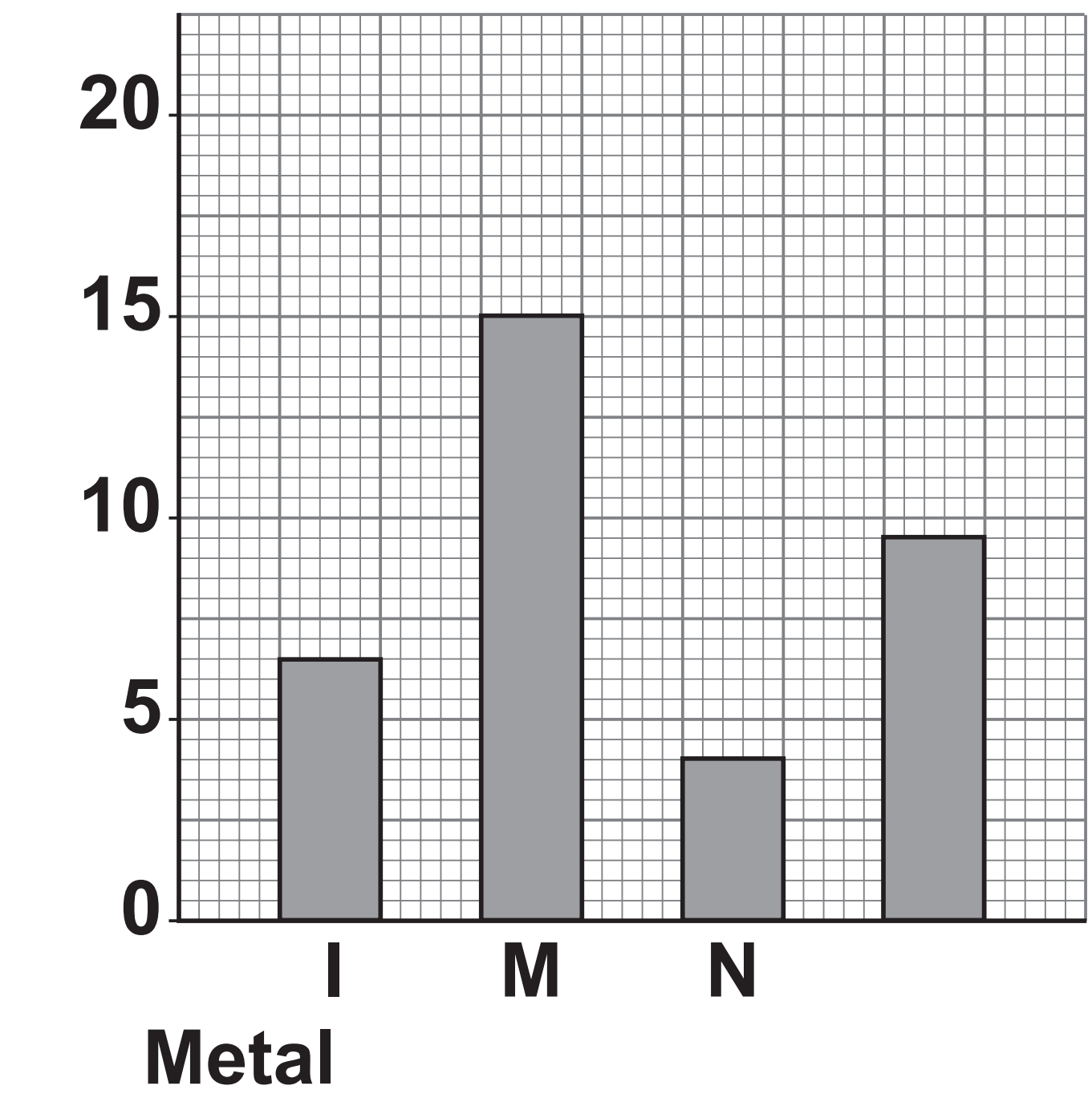
TABLE 6

Metal	Mean temperature increase in ºC
Iron	6.5
Magnesium	18.0
Nickel	4.0
Zinc	9.5

The student plotted the results on a bar chart.

FIGURE 9 shows the bar chart.

FIGURE 9



Key:

I = Iron

M = Magnesium

N = Nickel

[Turn over]

0 6 . 4 **The student made some errors when plotting the bar chart.**

Give THREE errors the student made. [3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

REPEAT OF TABLE 6

Metal	Mean temperature increase in ºC
Iron	6.5
Magnesium	18.0
Nickel	4.0
Zinc	9.5

0 6 . 5 **Use TABLE 6 to place the metals in order of reactivity. [1 mark]**

Most reactive _____

_____

_____

Least reactive _____

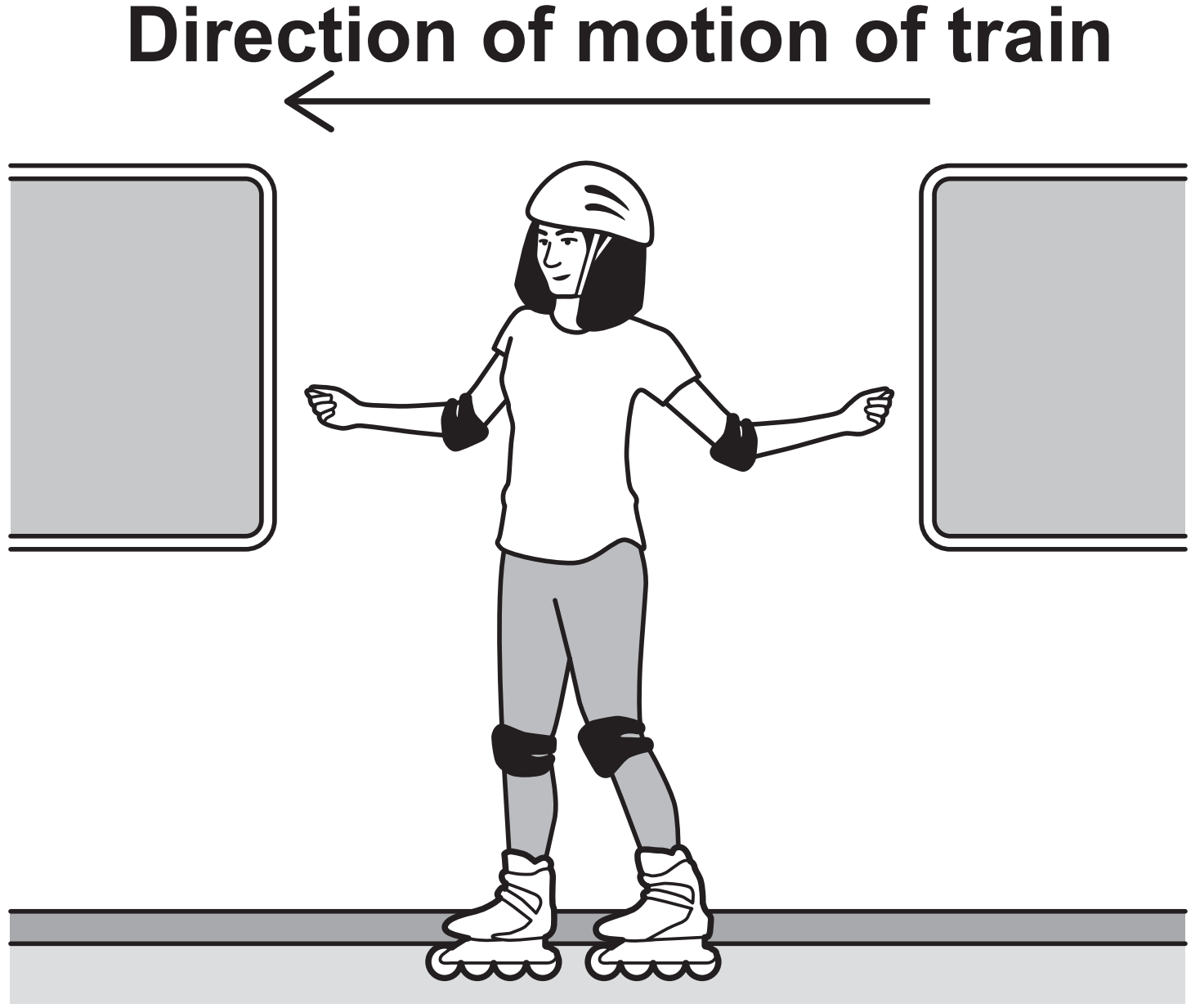
9

[Turn over]

0 7 **FIGURE 10 shows a girl inside a train which is moving to the left at a speed of 20 m/s**

The girl is wearing inline skates.

FIGURE 10



0 7 . 1 The train is moving at a constant speed of 20 m/s

The train suddenly decelerates.

The girl continues to move with a speed of 20 m/s

Which of Newton's laws is a correct explanation of this situation? [1 mark]

Tick (✓) ONE box.

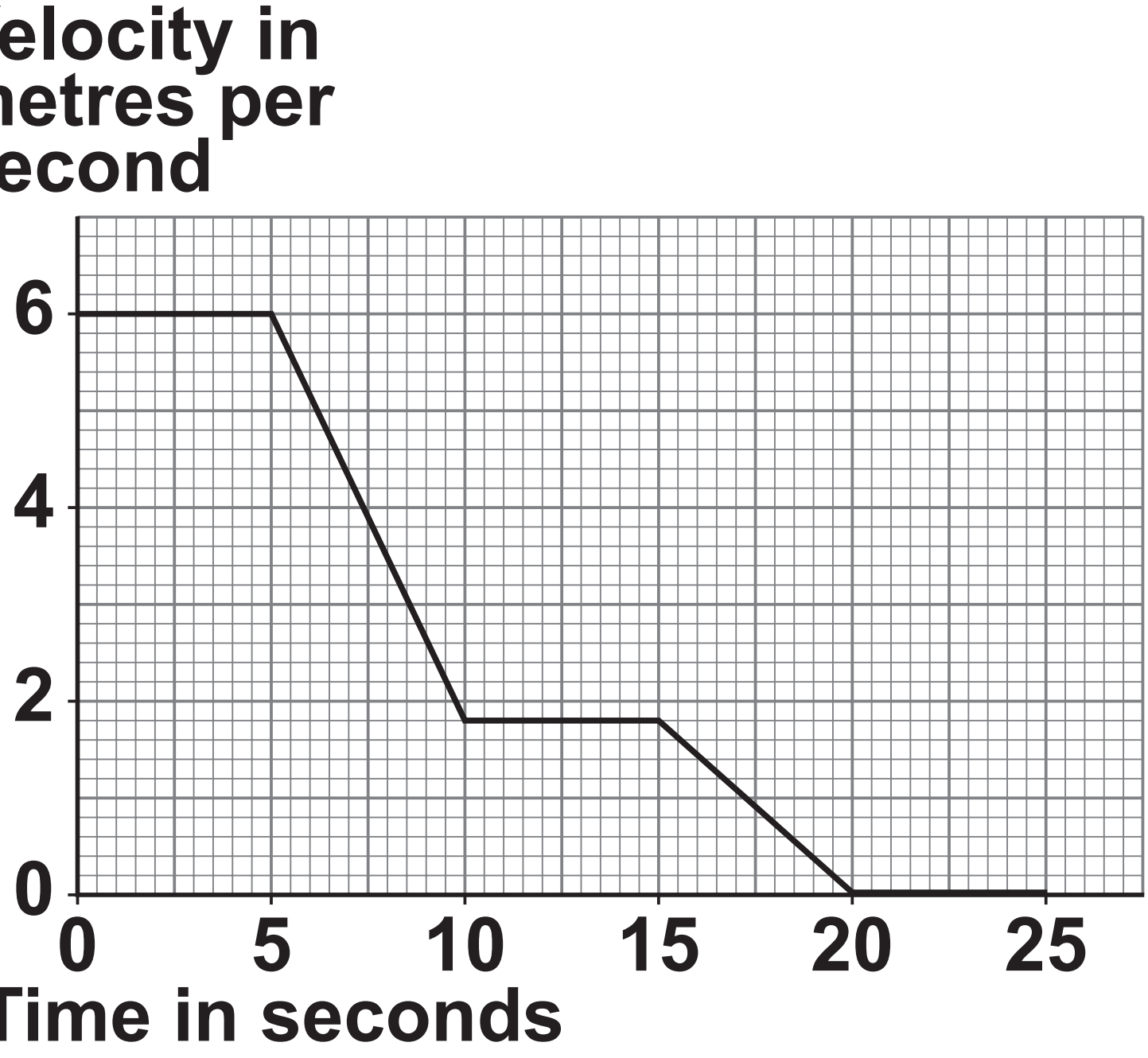
☐ Newton's First Law

☐ Newton's Gravitational Law

☐ Newton's Third Law

FIGURE 11 shows a velocity-time graph for the train as it arrives at a station and stops.

FIGURE 11



0 7 . 2 **Between which two times on FIGURE 11 is the train stationary? [1 mark]**

Tick (✓) ONE box.

- ☐ **Between 0 and 5 seconds**
- ☐ **Between 10 and 15 seconds**
- ☐ **Between 20 and 25 seconds**

0 7 . 3 The train travels at a constant speed between 0 seconds and 5 seconds.

Determine the distance the train travels between 0 seconds and 5 seconds.
[2 marks]

Use the equation:

distance travelled = speed × time

Distance = _____ m

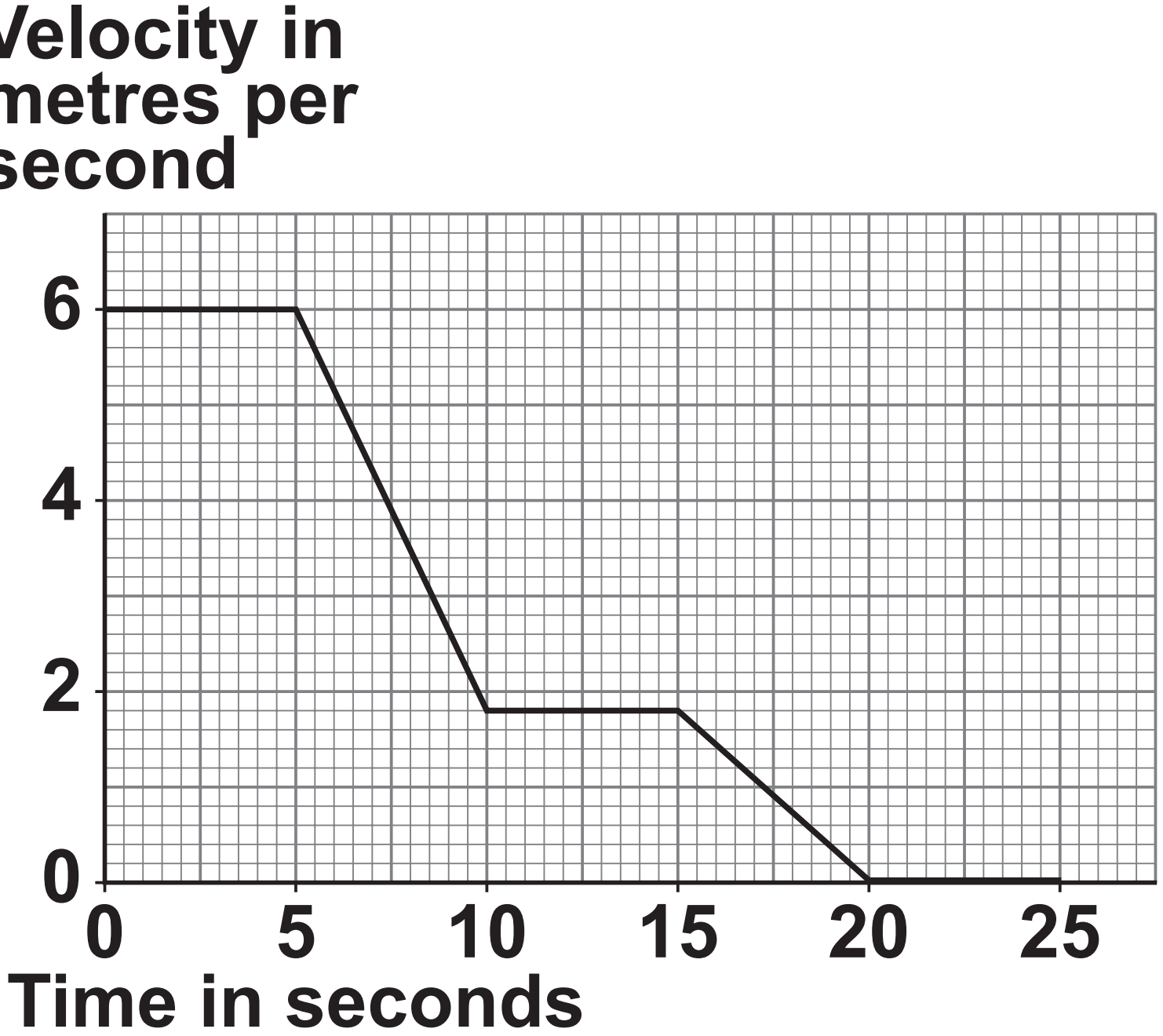
0 7 . 4 **Between which two times on FIGURE 11 is the deceleration of the train the greatest? [1 mark]**

Between _____ seconds

and _____ seconds.

[Turn over]

REPEAT OF FIGURE 11



0 7 . 5 **Write down the equation which links acceleration (*a*), change in velocity (Δv) and time taken (*t*). [1 mark]**

0 7 . 6 **Determine the acceleration of the train between 15 seconds and 20 seconds. [2 marks]**

Acceleration = _____ m/s^2

0 7 . 7 **Write down the equation which links kinetic energy (E_k), mass (m) and speed (v). [1 mark]**

[Turn over]

0 7 . 8 At one point in the train's journey the train's speed was 6.0 m/s

At this point the kinetic energy of the train was 1 080 000 J

Calculate the mass of the train. [3 marks]

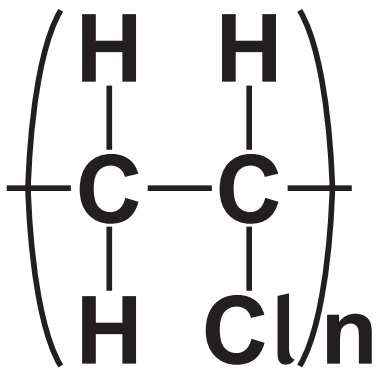
Mass = _____ kg

12

0 8 **This question is about polymers and plastics.**

FIGURE 12 shows the displayed formula for poly(chloroethene).

FIGURE 12



0 8 . 1 **What does 'n' represent in the displayed formula for poly(chloroethene)? [1 mark]**

0 8 . 2 **The representation of poly(chloroethene) in FIGURE 12 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 8 . 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 8 . 4 **Suggest TWO reasons why PVC nanoplastic can be harmful to marine life. [2 marks]**

1 _____

_____

2 _____

_____

_____

0 8 . 5 **Suggest TWO ways to reduce plastic waste.**
[2 marks]

1 _____

_____

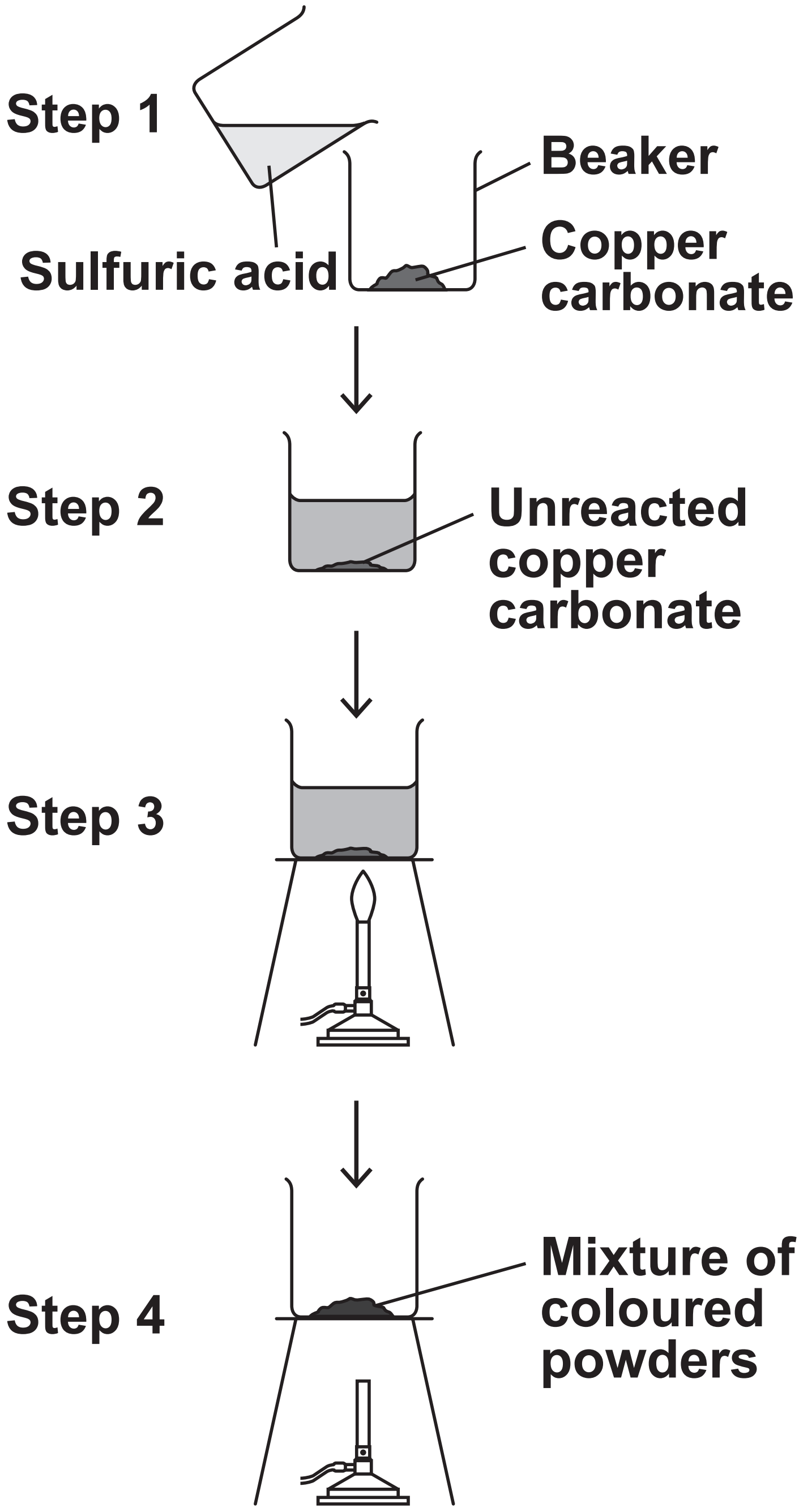
2 _____

_____

_____

8

FIGURE 13


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

0 9 **A student wanted to make blue copper sulfate crystals from green copper carbonate powder and sulfuric acid.**

FIGURE 13, on page 74, shows the method the student used.

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

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

76

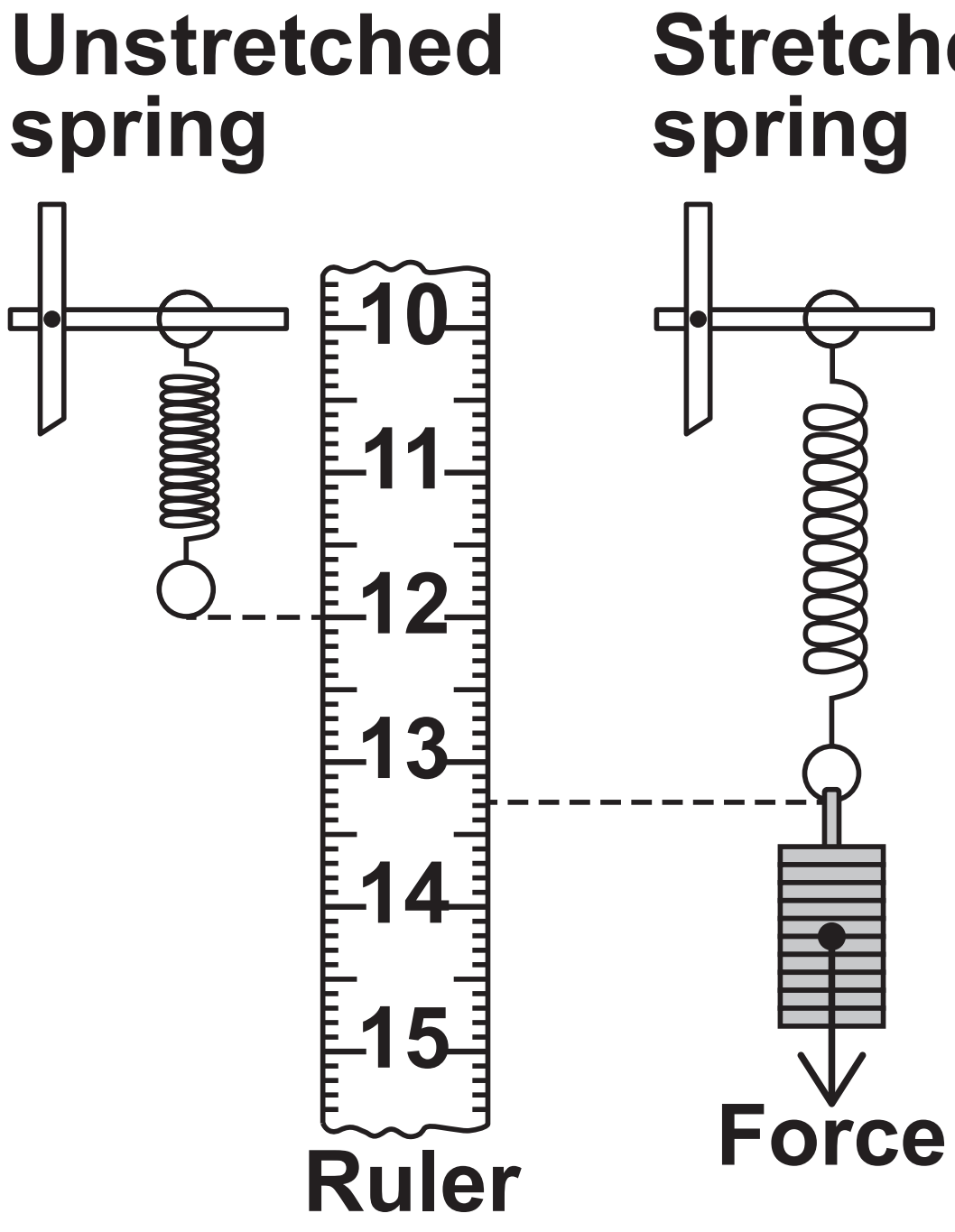
BLANK PAGE

[Turn over]

1 0 **A student investigated how the extension of a spring varied with the force acting on the spring.**

FIGURE 14 shows the equipment the student used and a ruler scale between 10 cm and 15 cm

FIGURE 14



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

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

BLANK PAGE

1 0 . 3 The extension of the spring was 0.12 m when the force was 3.0 N

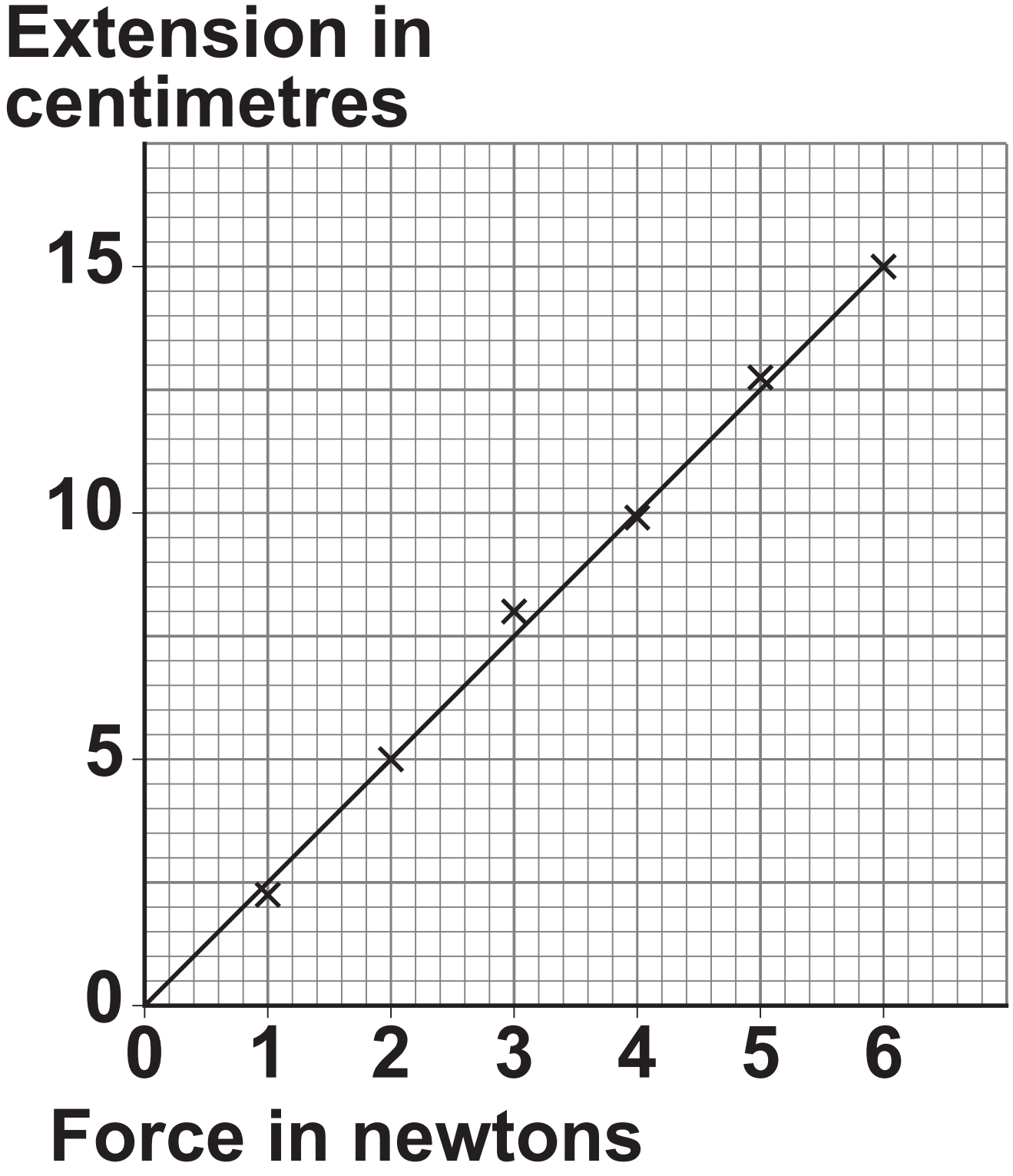
Calculate the spring constant of the spring. [3 marks]

Spring constant = _____ N/m

[Turn over]

1 0 . 4 **FIGURE 15 shows the results of the same investigation using a different spring.**

FIGURE 15



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

BLANK PAGE

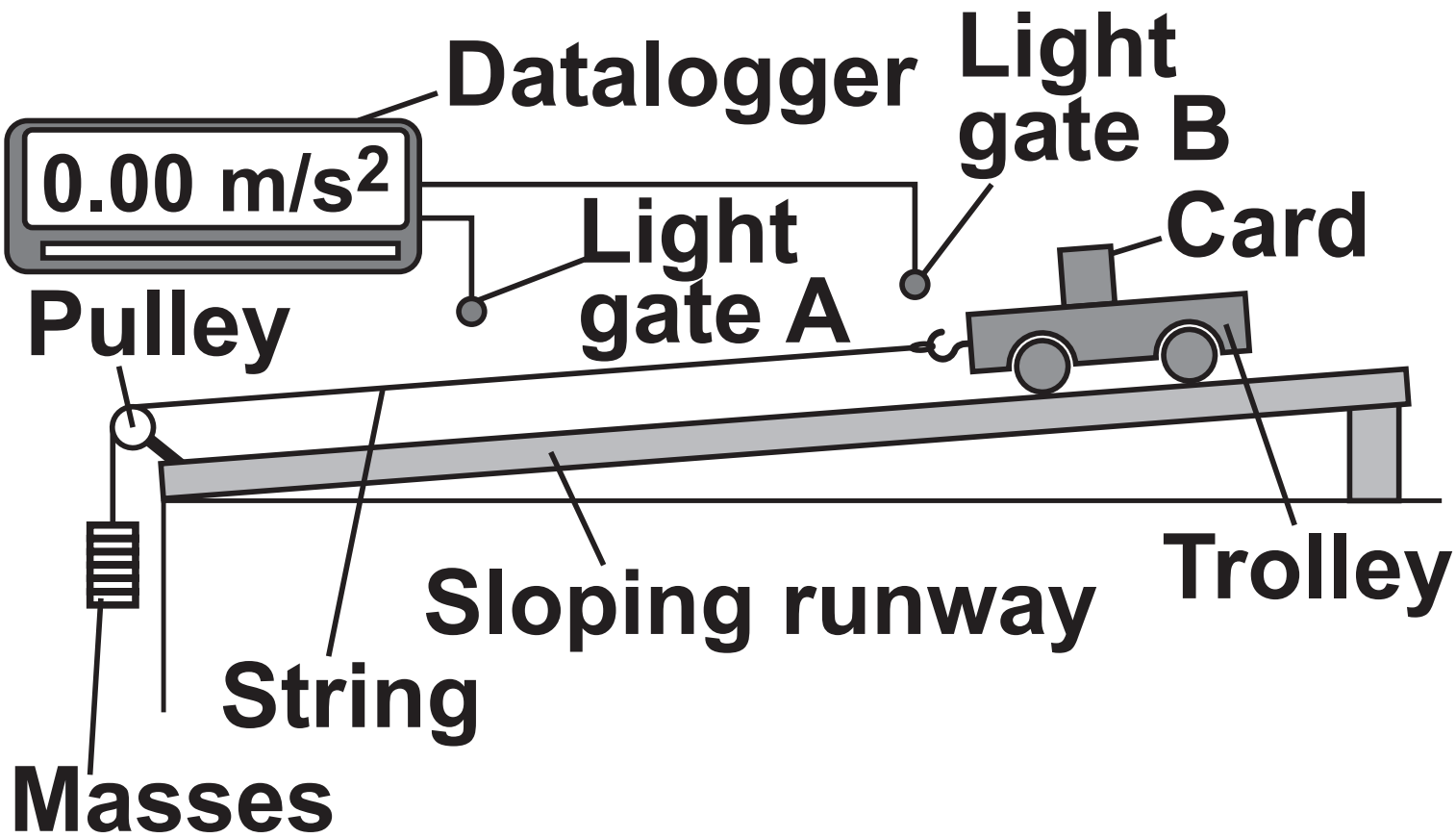
[Turn over]

1 1 **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 16 shows how the student set up the equipment.

FIGURE 16



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.

[Turn over]

11.1 **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**

1 1 . 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**

[Turn over]

1 1 . 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**

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

[Turn over]

1 1 . 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

END OF QUESTIONS

BLANK PAGE

BLANK PAGE

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	