R

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

PHYSICS

H

Higher Tier Paper 2

8463/2HR

Time allowed: 1 hour 45 minutes

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

[Turn over]

For this paper you must have:

- **a ruler**
- **a scientific calculator**
- **a protractor**
- **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 an electric super-car.

FIGURE 1

0 1 . 1

The battery in an electric car needs to be recharged.

Suggest TWO factors that affect the distance an electric car can travel before the battery needs to be recharged.
[2 marks]

1 _____

_____

2 _____

_____

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

0 1 . 2

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

0 1 . 3

The maximum acceleration of the car is 20 m/s^2.

On the opposite page, calculate the time taken for the speed of the car to change from 0 m/s to 28 m/s at its maximum acceleration. [3 marks]

Time taken = _____ s

[Turn over]

0 1 . 4

In a trial run, the car accelerates at 10 m/s^2 until it reaches its final velocity.

distance travelled by the car = 605 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.
[3 marks]

Final velocity = _____ m/s

[Turn over]

Use the Physics Equations Sheet to answer questions 01.5 and 01.6.

0 1 . 5

Write down the equation which links distance (*s*), force (*F*) and work done (*W*). [1 mark]

0 1 . 6

When travelling at its maximum speed the air resistance acting on the car is 4000 N.

Calculate the work done against air resistance when the car travels a distance of 7.5 km at its maximum speed. [3 marks]

Work done = _____ J

13

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0 2

A student used a ray box to shine a ray of light through air into a glass block.

The student investigated how the angle of refraction varied with the angle of incidence.

TABLE 1, on page 14, shows the results.

[Turn over]

TABLE 1

Angle of incidence in degrees	Angle of refraction in degrees
10	5
20	10
30	14
40	19
50	23
60	26
70	28
80	29

0 2 . 1

Describe a method the student could have used to obtain the results in TABLE 1, on the opposite page.

Your answer may include a labelled diagram. [6 marks]

BLANK PAGE

[Turn over]

0 2 . 2

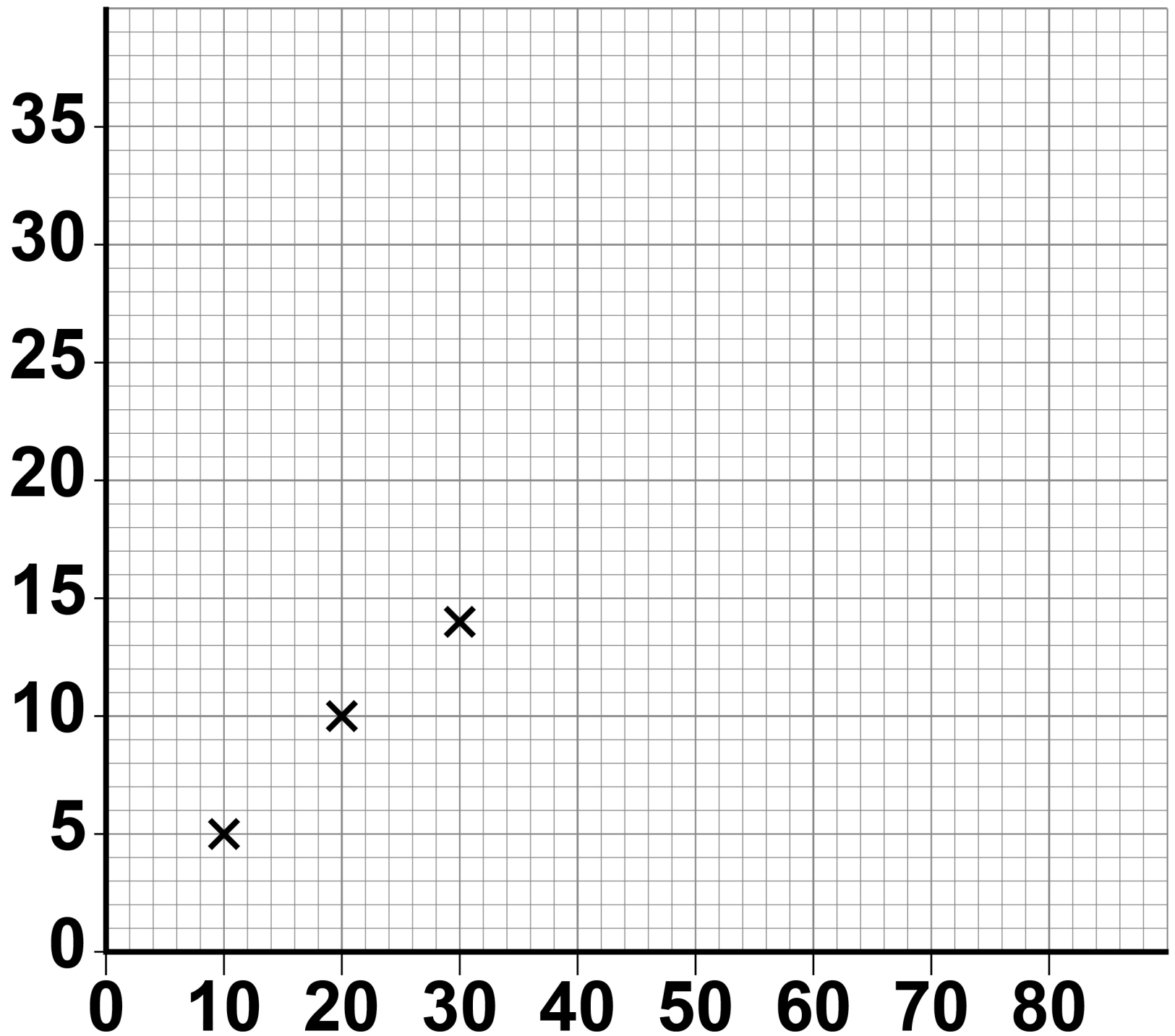
FIGURE 2, on the opposite page, is an incomplete graph of the results.

Complete FIGURE 2 using data from TABLE 1, on page 14.

- **Label the axes.**
- **Plot the remaining data.**
- **Draw a line of best fit.**

[4 marks]

FIGURE 2



[Turn over]

0 2 . 3

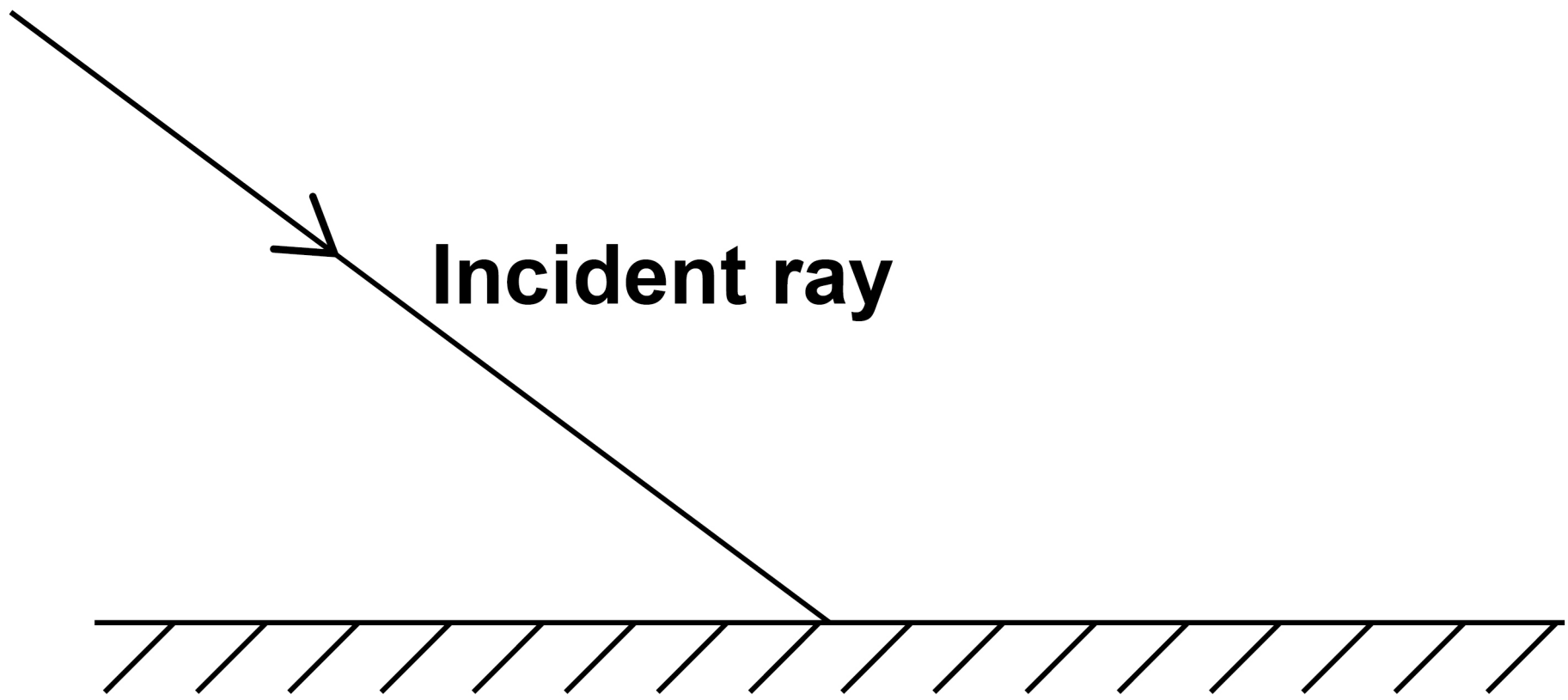
Complete the ray diagram in FIGURE 3 to show the reflection of light from the surface of a plane mirror.

You should:

- **draw the normal line**
- **draw the reflected ray.**

[2 marks]

FIGURE 3



0 2 . 4

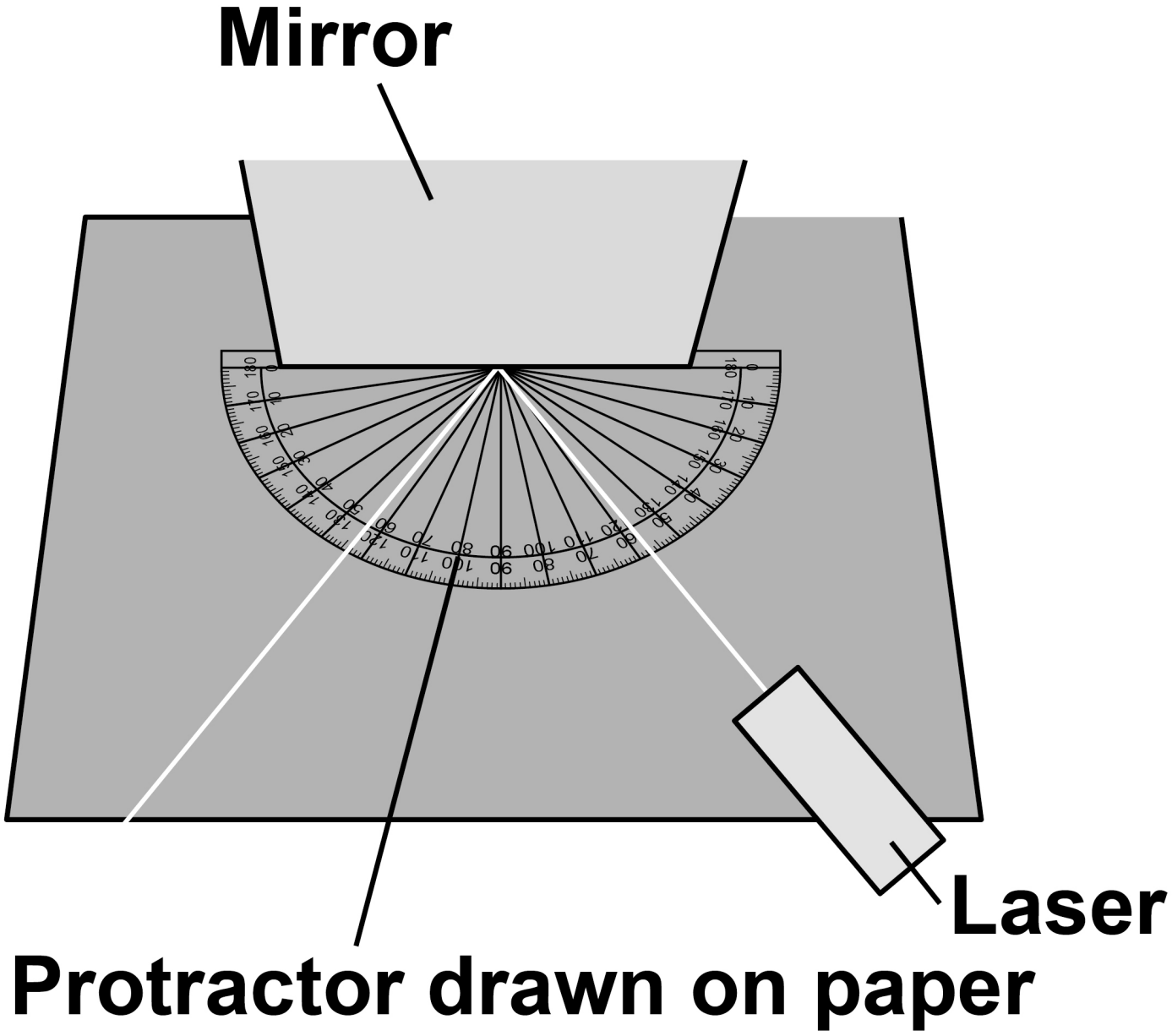
Two students investigated the reflection of light by a plane mirror.

FIGURE 4, on pages 22–23, shows the different equipment the students used.

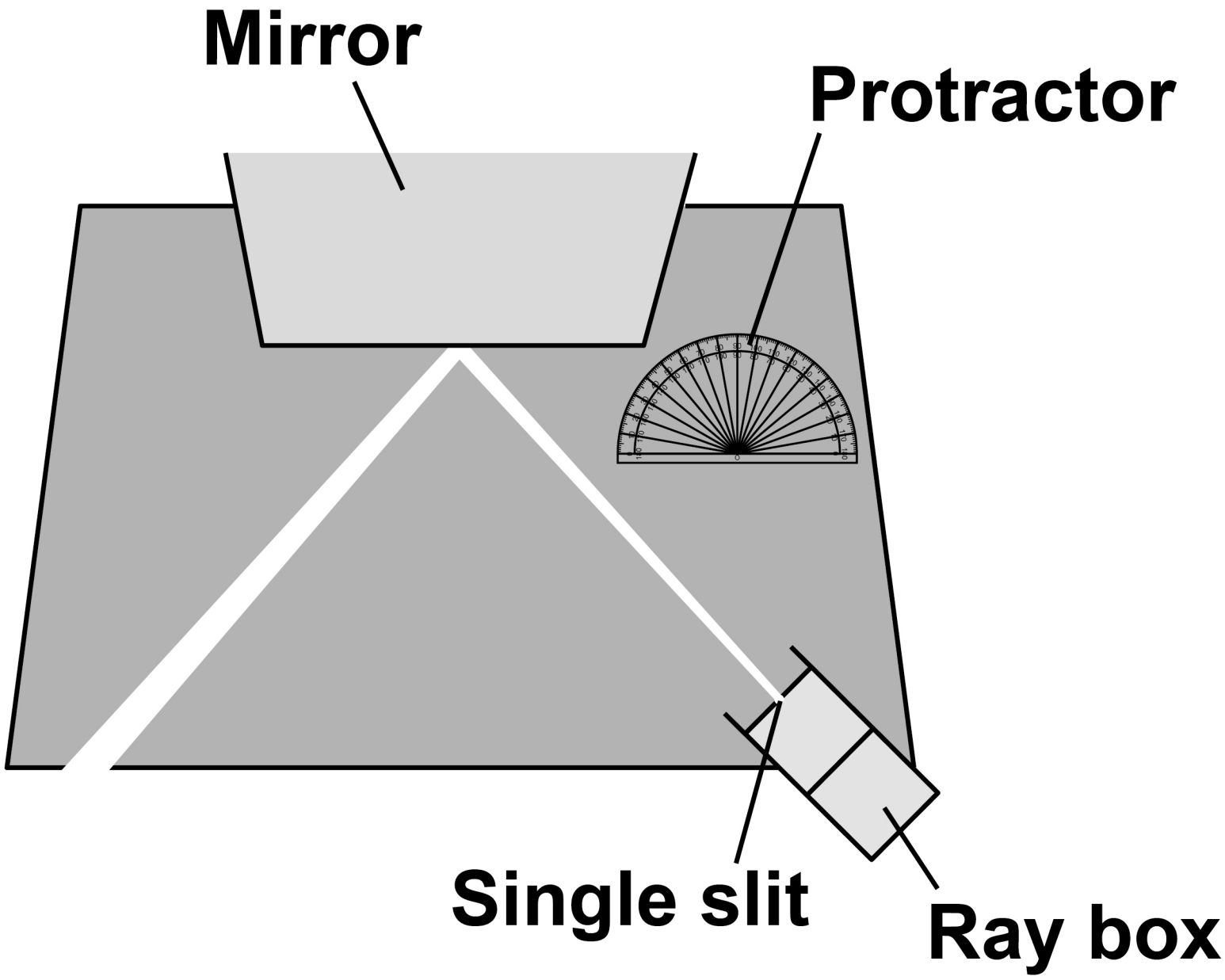
[Turn over]

FIGURE 4

METHOD A



METHOD B



[Turn over]

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Explain TWO ways that METHOD A is better than METHOD B. [4 marks]

1

2

[Turn over]

16

0 3

Speed limits on roads increase safety.

0 3 . 1

The braking distance of a car increases as the speed of the car increases.

Give two OTHER factors that INCREASE the braking distance of a car. [2 marks]

1 _____

_____

2 _____

0 3 . 2

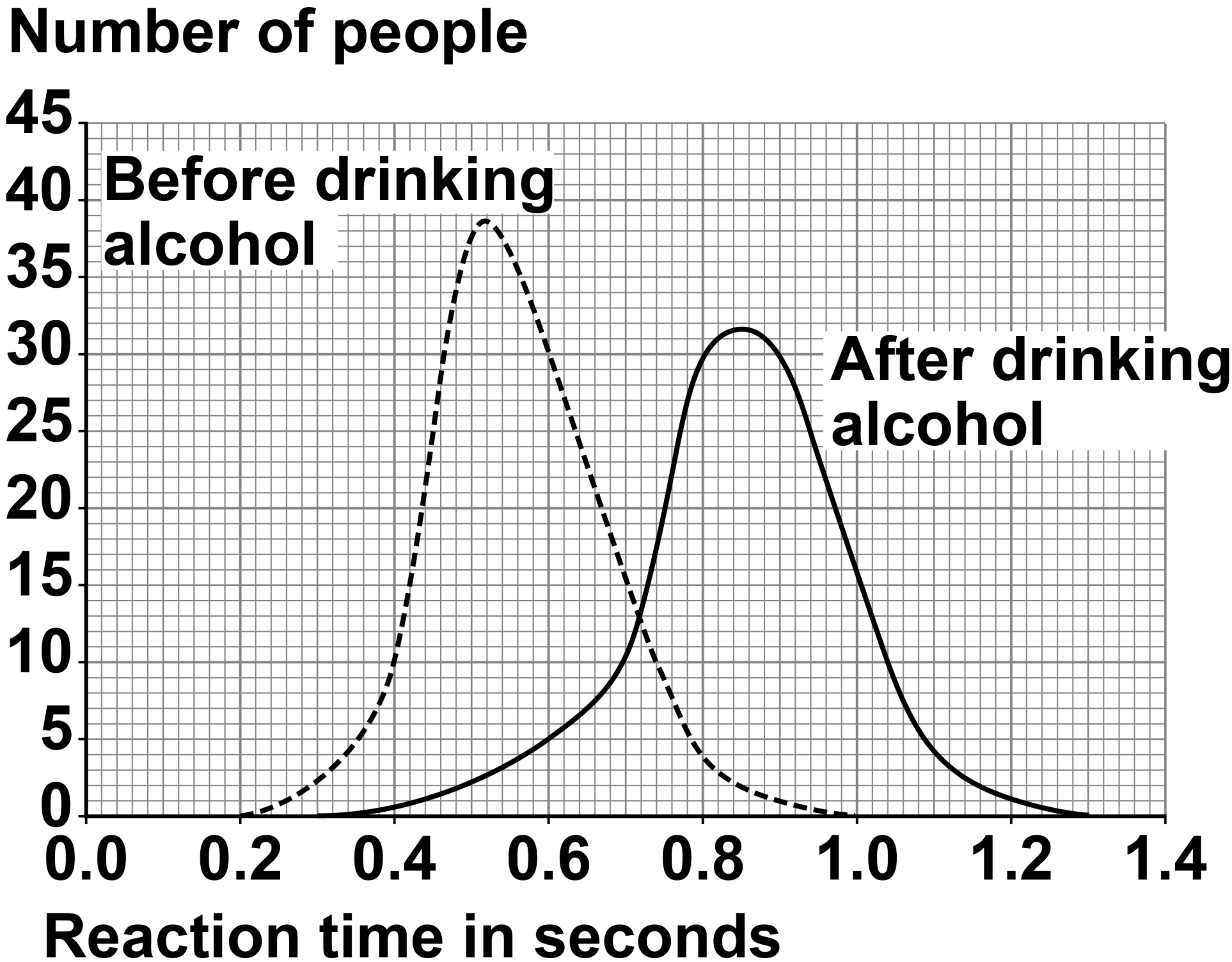
Explain why the driver's reaction time affects the thinking distance of a car.
[2 marks]

0 3 . 3

Scientists have investigated how drinking alcohol affects a person's reaction time.

FIGURE 5 shows the results of the investigation.

FIGURE 5



Which of the following conclusions can be made using FIGURE 5? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Every person's reaction time increases after drinking alcohol.**
- ☐ **Mean reaction time increases after drinking alcohol.**
- ☐ **Some people's reaction time is not affected by drinking alcohol.**
- ☐ **The change in reaction time is not the same for all people after drinking alcohol.**
- ☐ **There is a smaller range of reaction times after drinking alcohol.**

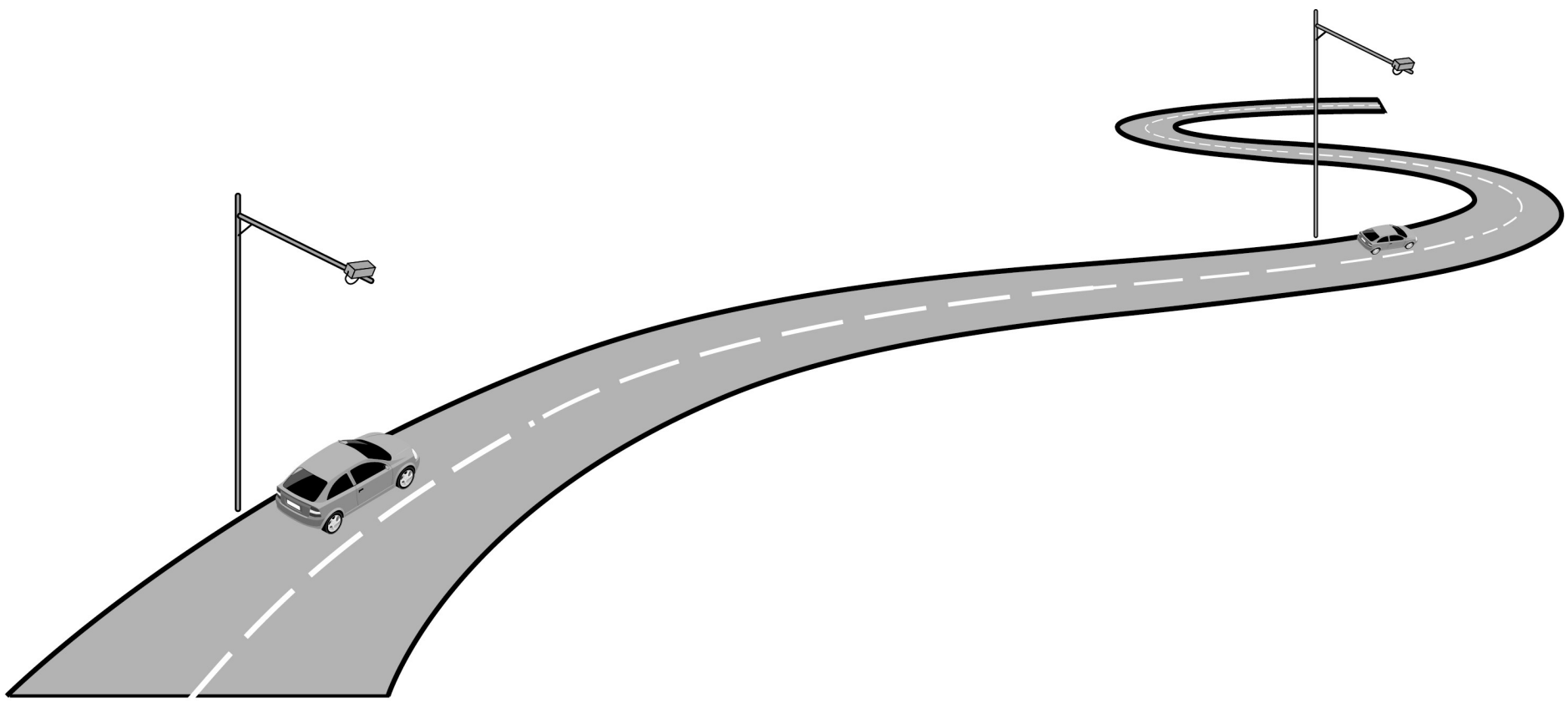
[Turn over]

FIGURE 6 shows some speed cameras on a road.

The speed cameras determine the average speed of cars on the road.

FIGURE 6

The diagram is not drawn accurately.



0 3 . 4

The speed limit on the road in FIGURE 6 is 20 m/s.

The cameras in FIGURE 6 are 1.5 km apart.

Calculate the minimum time it takes to travel 1.5 km without breaking the speed limit.

Use the Physics Equations Sheet.
[4 marks]

Minimum time = _____ s

[Turn over]

0 3 . 5

The average speed of a car between the cameras and the average velocity of the car between the cameras are different.

Explain why. [3 marks]

13

0 4

Hailstones are small balls of ice. Hailstones form in clouds and fall to the ground.

FIGURE 7 shows different-sized hailstones.

FIGURE 7

[Turn over]

A hailstone falls from a cloud and accelerates.

0 4 . 1

Why does the hailstone accelerate?

[1 mark]

0 4 . 2

The hailstone stops accelerating and reaches terminal velocity.

Explain why the hailstone reaches terminal velocity. [3 marks]

A scientist investigated how the mass of hailstones affects their terminal velocity.

FIGURE 8, on the opposite page, shows the results.

0 4 . 3

Why does terminal velocity increase with mass? [1 mark]

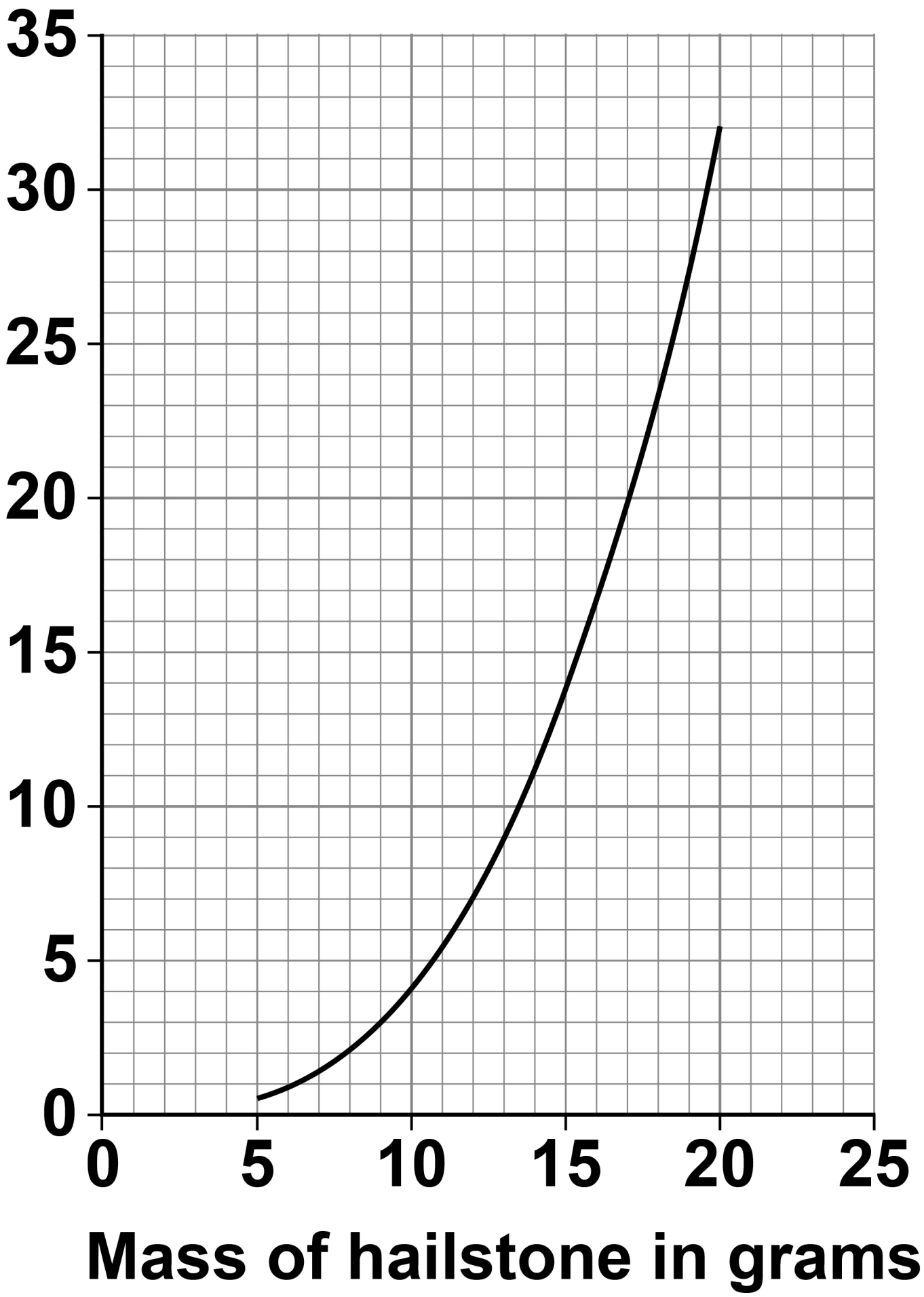
Tick (✓) ONE box.

☐ As mass increases the cross-sectional surface area of a hailstone increases.

☐ As mass increases the volume of a hailstone increases.

☐ As mass increases the weight of a hailstone increases.

FIGURE 8



[Turn over]

0 4 . 4

Explain the difference in the maximum kinetic energy of a hailstone with a mass of 10 g and a hailstone with a mass of 20 g. [3 marks]

0 4 . 5

The kinetic energy of a hailstone is measured in joules.

Which of the following is the same as 1 joule? [1 mark]

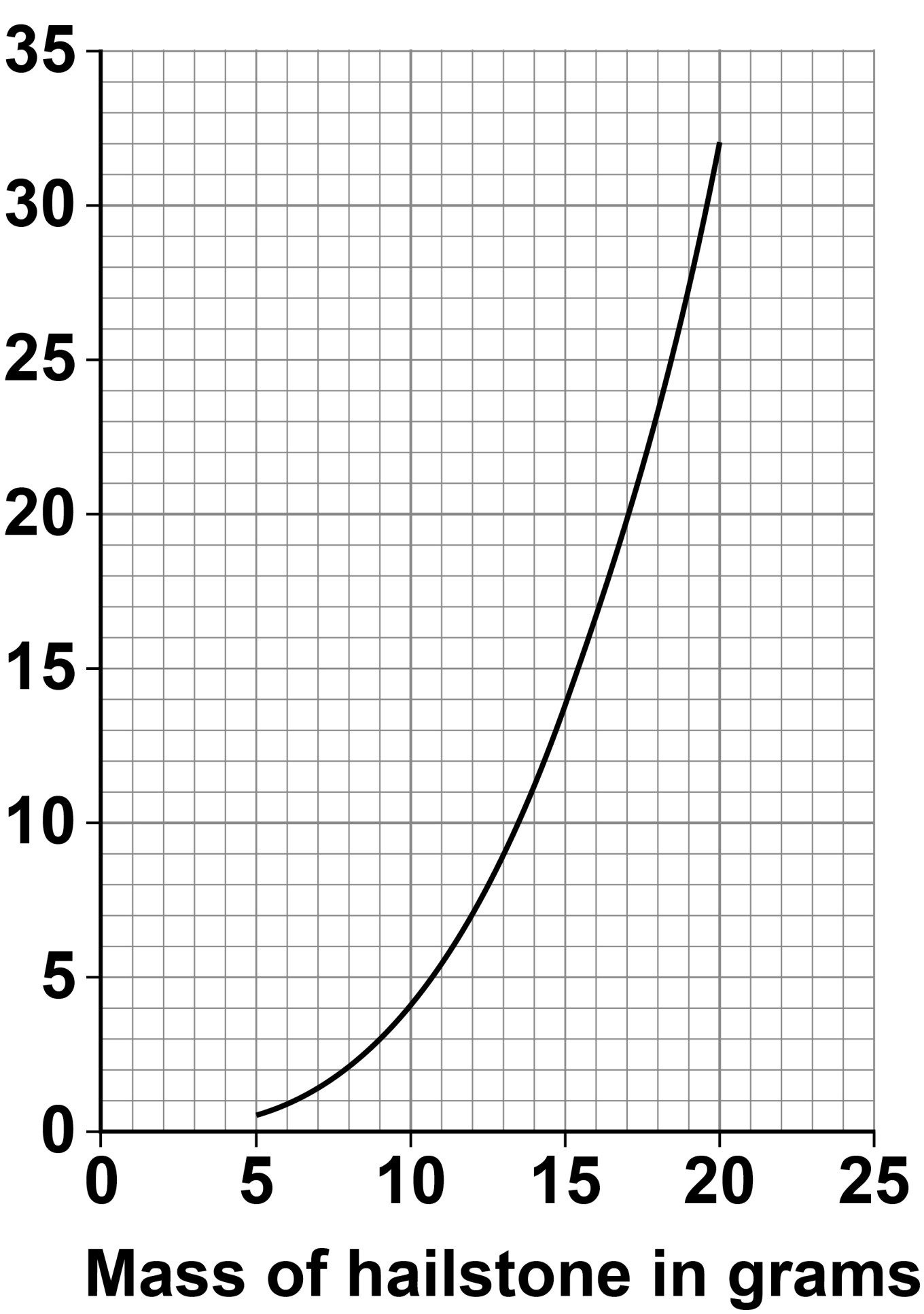
Tick (✓) ONE box.

- ☐ **1 N m**
- ☐ **1 N/m**
- ☐ **1 N/m^2**
- ☐ **1 N m^2**

[Turn over]

FIGURE 8 is repeated below.

FIGURE 8



0 4 . 6

A hailstone hit the ground at its terminal velocity of 25 m/s.

The hailstone took 0.060 s to stop moving.

Determine the average force on the hailstone as it hit the ground.

Use information from FIGURE 8.

Use the Physics Equations Sheet.
[3 marks]

Average force = _____ N

12

BLANK PAGE

[Turn over]

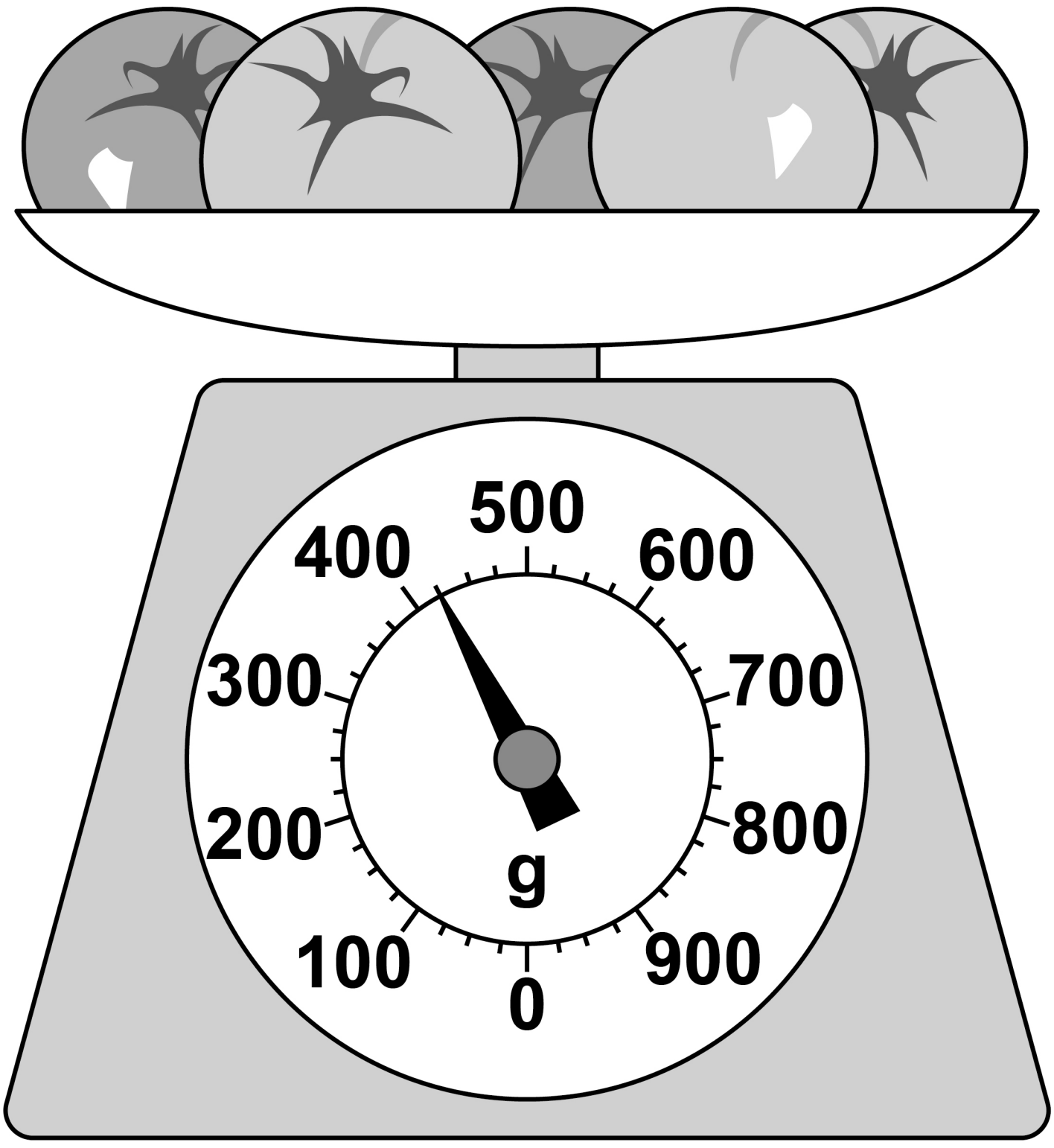
0 5

FIGURE 9, on the opposite page, shows a balance used to measure the mass of five tomatoes.

0 5 . 1

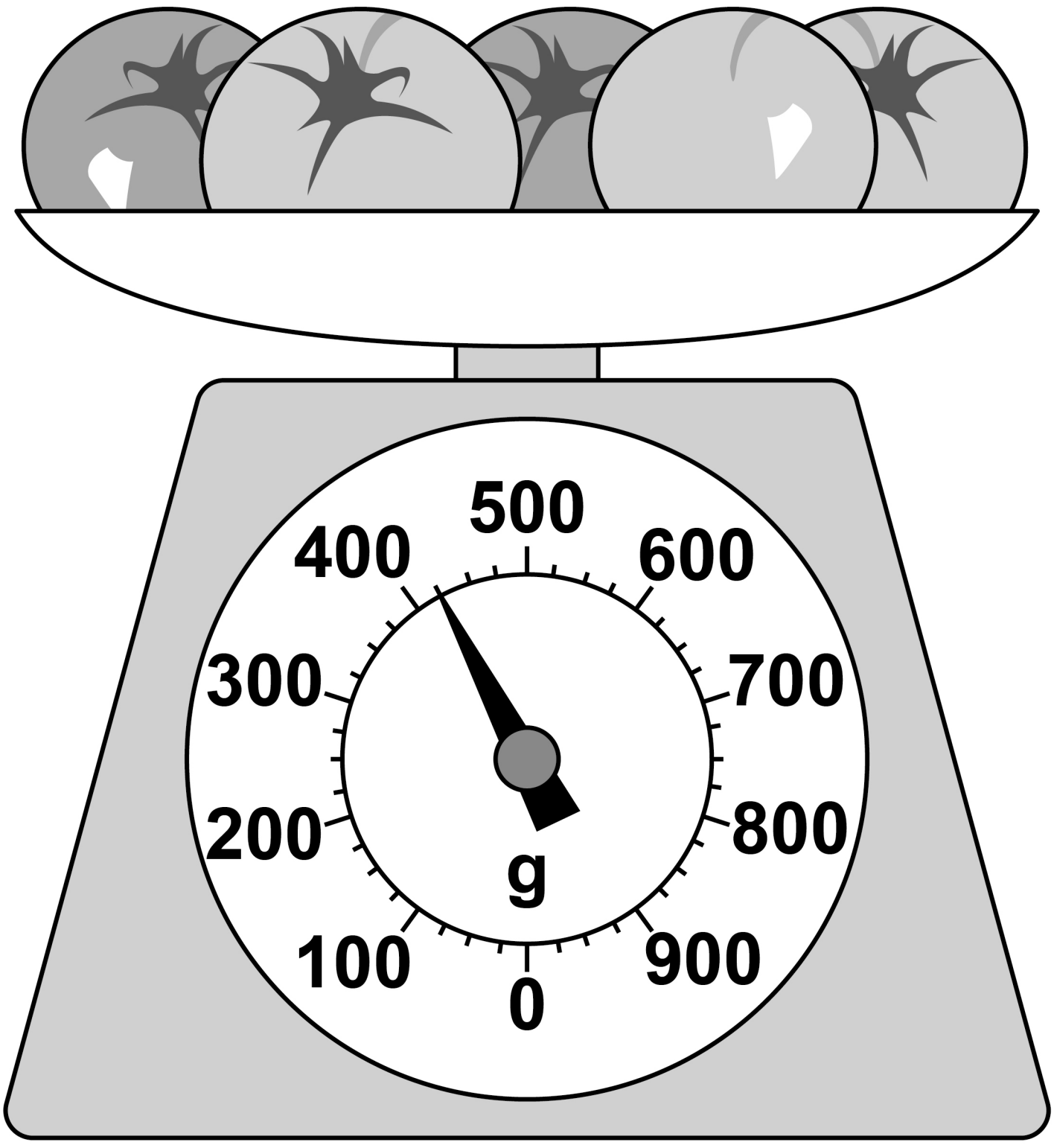
What is meant by ‘centre of mass’?
[1 mark]

FIGURE 9



[Turn over]

REPEAT OF FIGURE 9



0 5 . 2

Calculate the mean weight of a tomato in FIGURE 9.

Use the Physics Equations Sheet.

gravitational field strength = 9.8 N/kg

[3 marks]

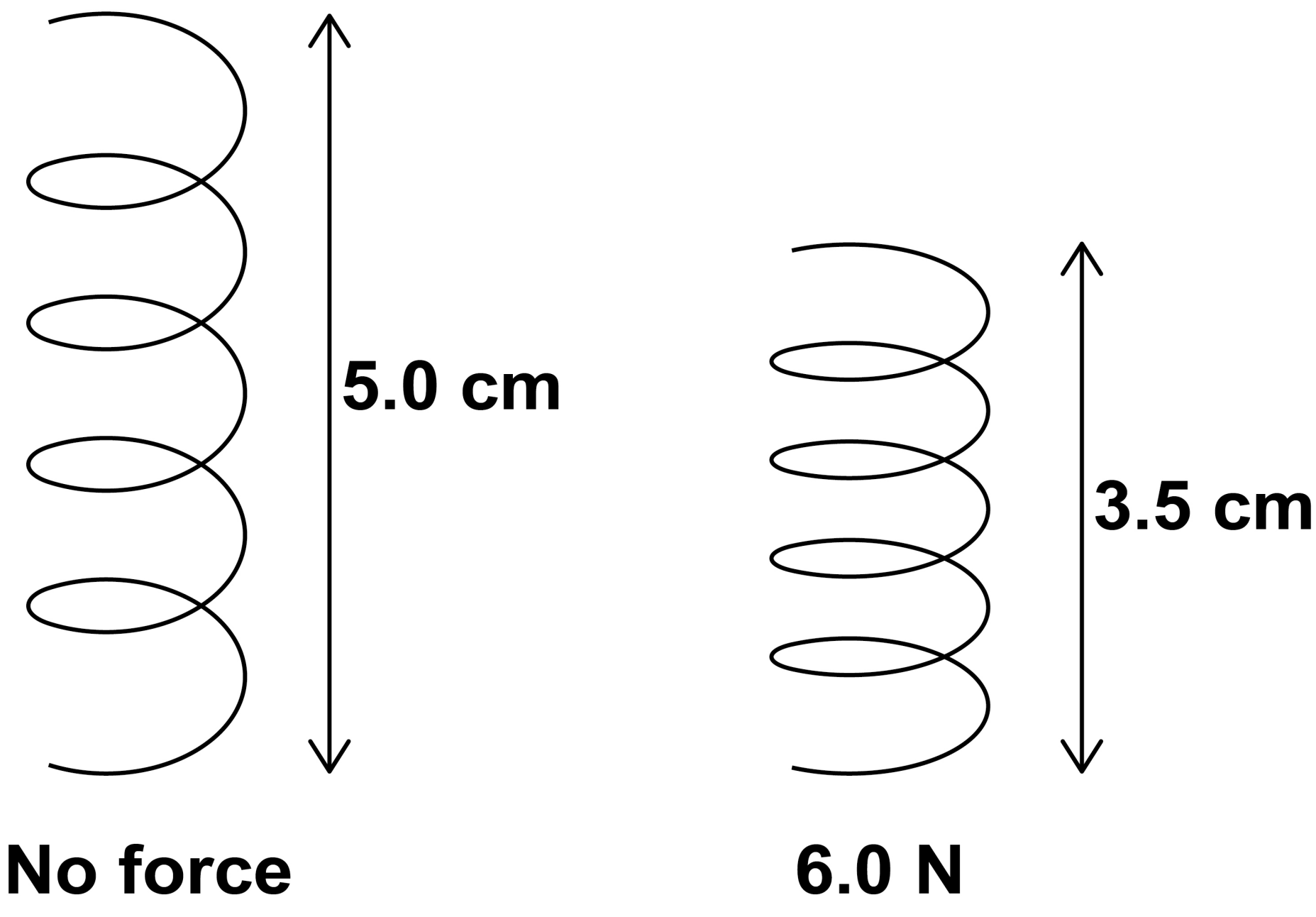
Weight = _____ N

0 5 . 3

The balance in FIGURE 9, on page 45, contains a spring that compresses when the tomatoes are placed on the balance.

FIGURE 10 shows the spring with no force acting and with a 6.0 N force acting.

FIGURE 10



Determine the spring constant of the spring.

Use the Physics Equations Sheet.
[3 marks]

Spring constant = _____ N/m

[Turn over]

0 5 . 4

Explain ONE property of the spring that makes it suitable for use in the balance.
[2 marks]

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[Turn over]

0 6

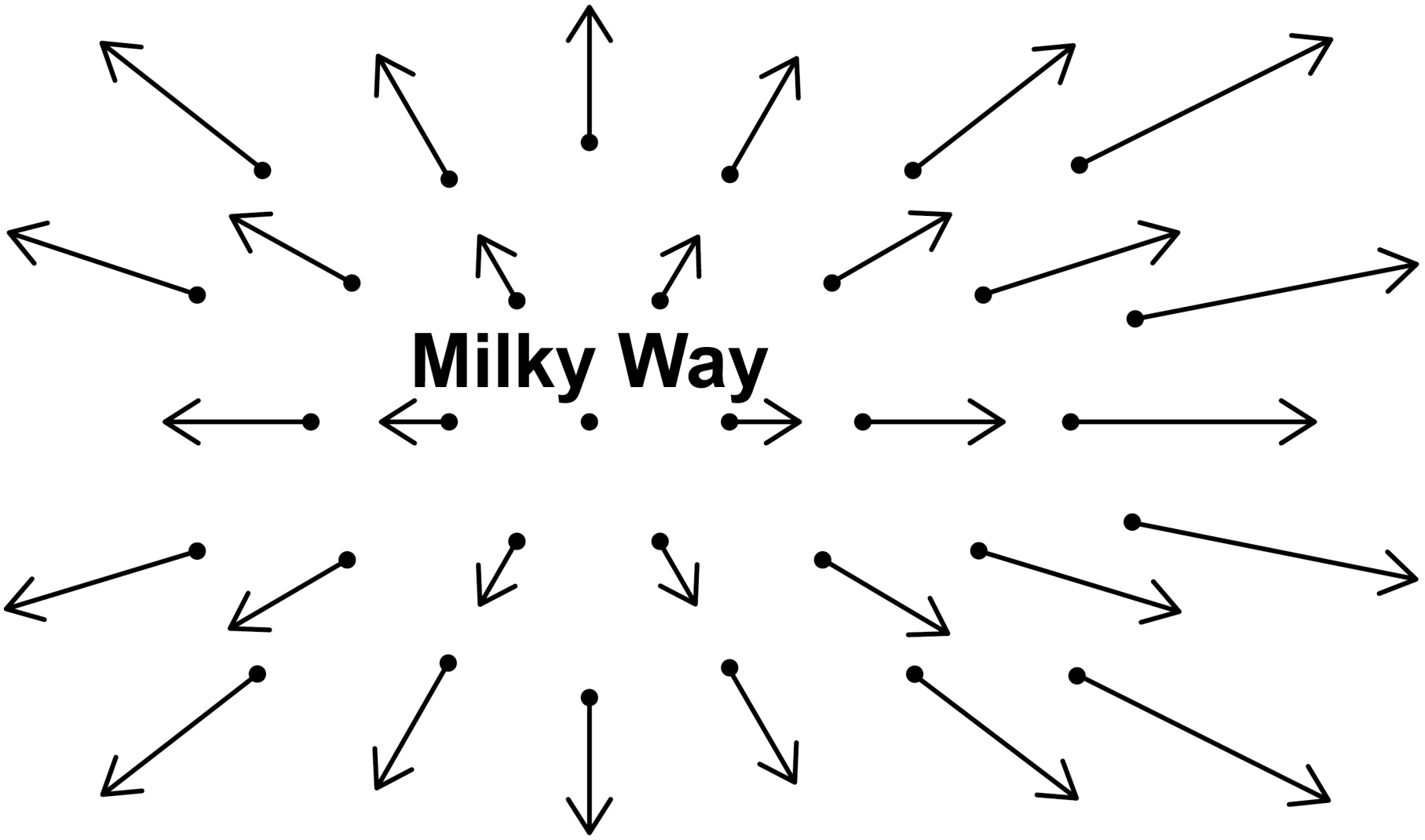
Galaxies contain billions of stars.

0 6 . 1

Compare the formation and life cycles of stars with a similar mass to the Sun to stars with a much greater mass than the Sun. [6 marks]

The points on FIGURE 11 represent galaxies that are moving away from the Milky Way.

FIGURE 11



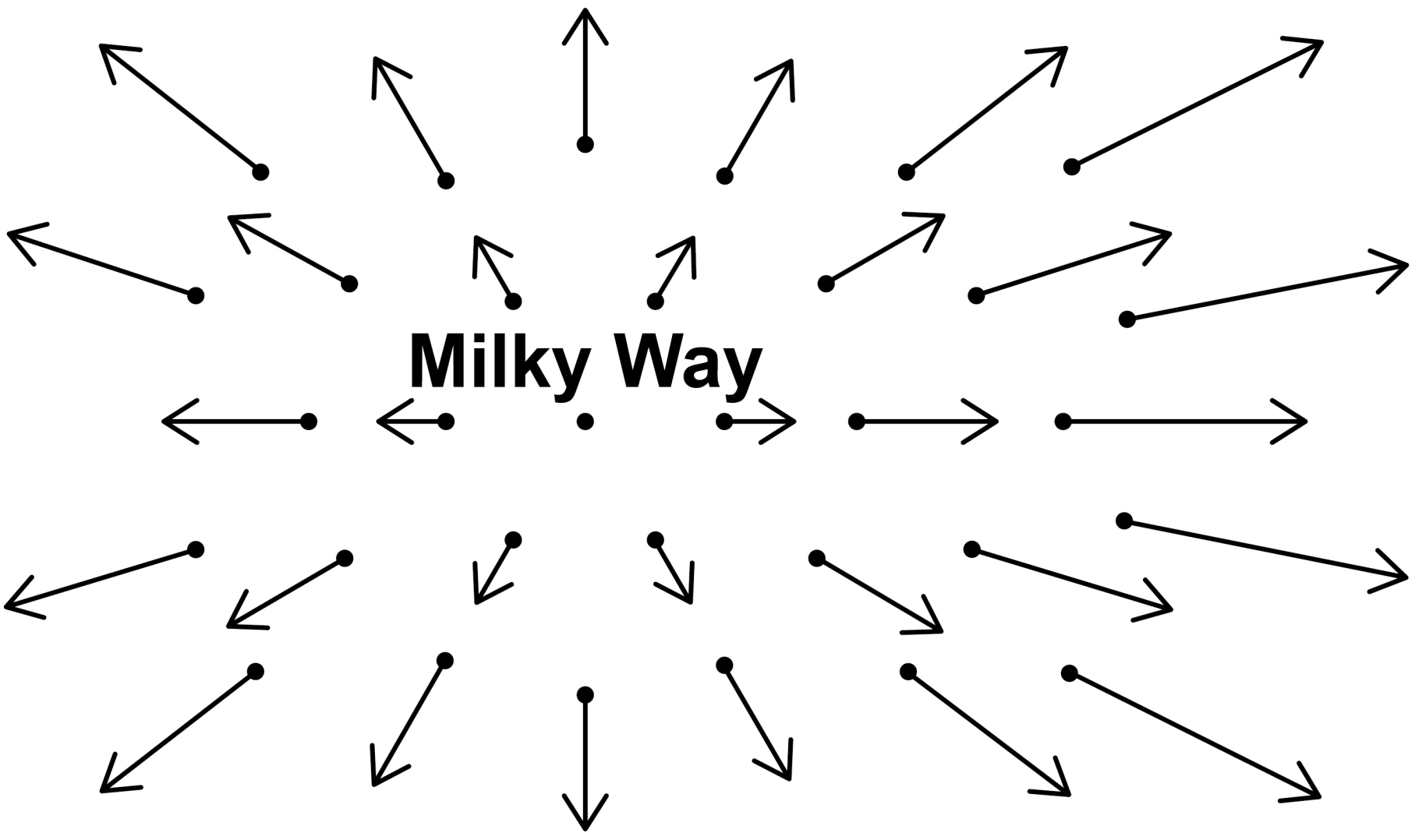
Each arrow represents the velocity of the galaxy relative to the Milky Way.

0 6 . 2

Light from all galaxies represented in FIGURE 11 is red-shifted.

Describe what is meant by red-shift.
[2 marks]

REPEAT OF FIGURE 11



0 6 . 3

Explain how FIGURE 11 provides evidence for the Big Bang theory.
[2 marks]

0 6 . 4

Sometimes scientists have to change theories about the universe.

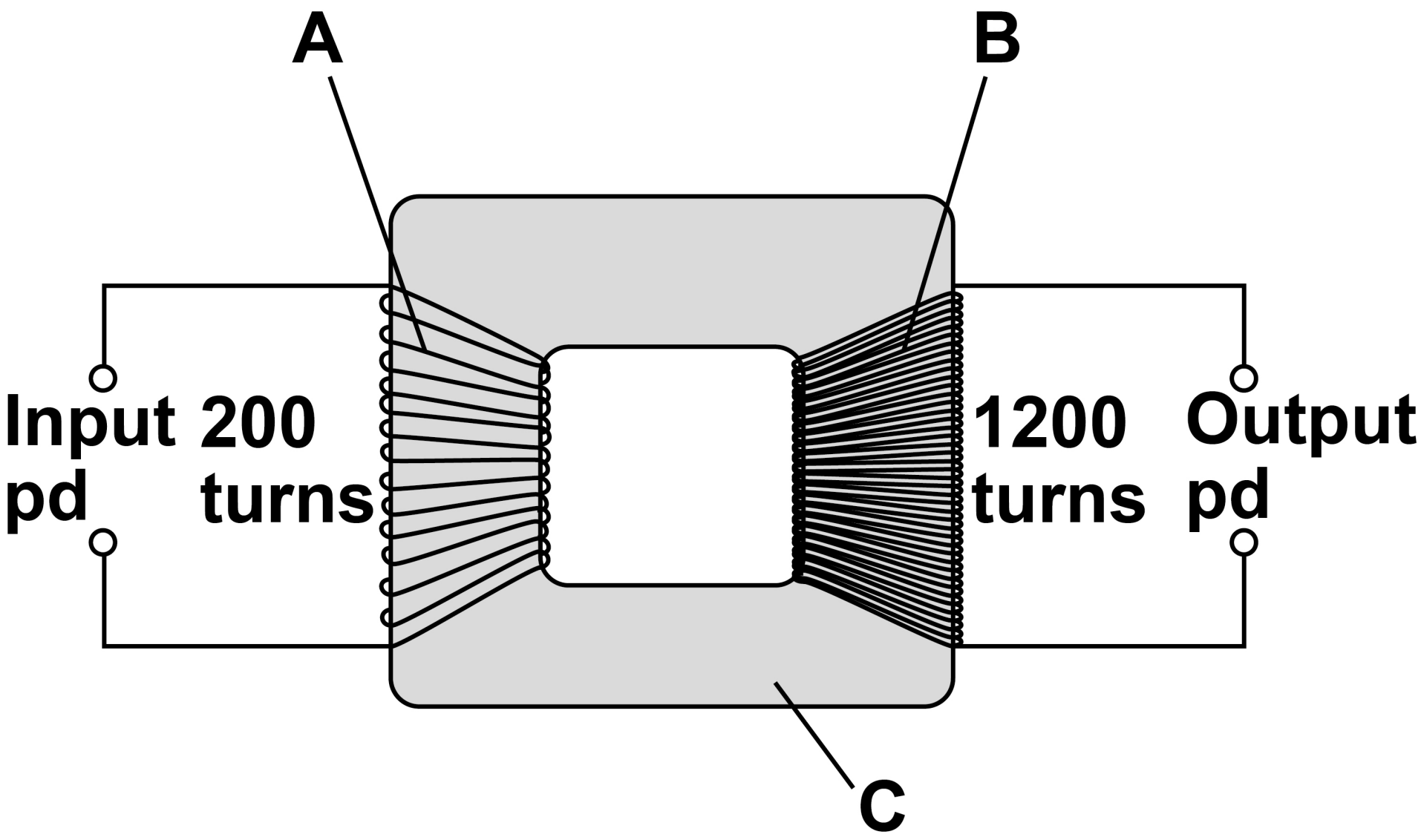
Give the reason why. [1 mark]

0 7

The National Grid uses transformers to change potential difference (pd).

FIGURE 12 shows a transformer.

FIGURE 12



0 7 . 1

Identify the parts of the transformer labelled in FIGURE 12. [2 marks]

A _____

B _____

C _____

[Turn over]

0 7 . 2

There is an alternating input pd of 230 V.

Determine the output pd.

Use the Physics Equations Sheet.

[3 marks]

Output pd = _____ V

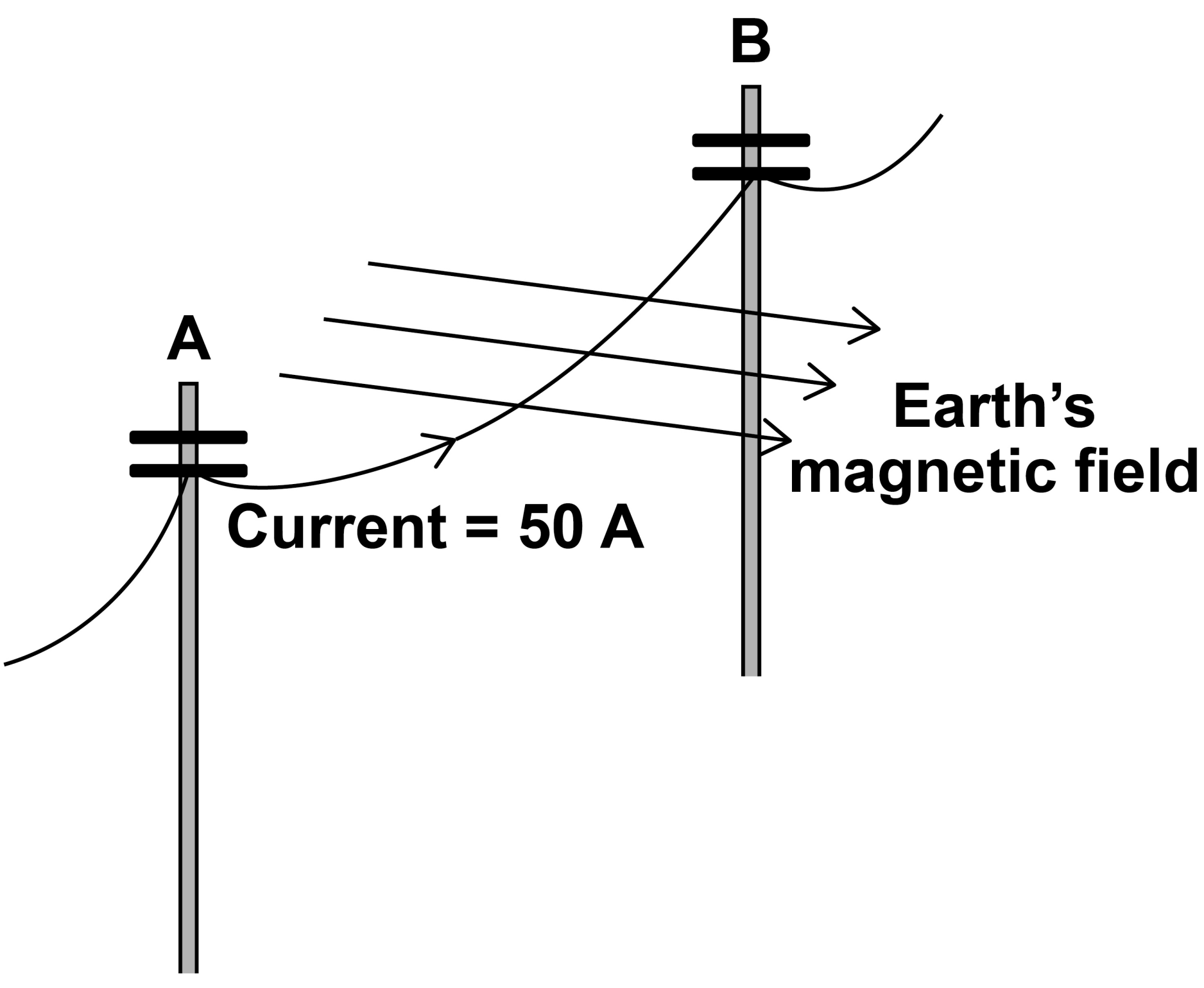
0 7 . 3

The input pd causes an alternating current.

Explain why there is an alternating current in the output when the transformer is connected to a circuit.
[3 marks]

FIGURE 13 shows a large cable supported by two wooden poles. The cable is connected to an electricity supply.

FIGURE 13



0 7 . 4

There is a force on the cable due to the Earth's magnetic field when the current is in the direction A to B.

What is the direction of this force?

[1 mark]

Tick (✓) ONE box.

- ☐ **Down**
- ☐ **Left**
- ☐ **Right**
- ☐ **Up**

[Turn over]

0 7 . 5

The cable experiences a force of 0.045 N due to the Earth's magnetic field.

magnetic flux density = 60 μT

current = 50 A

Calculate the length of the cable between A and B.

Use the Physics Equations Sheet.
[4 marks]

Length = _____ m

0 7 . 6

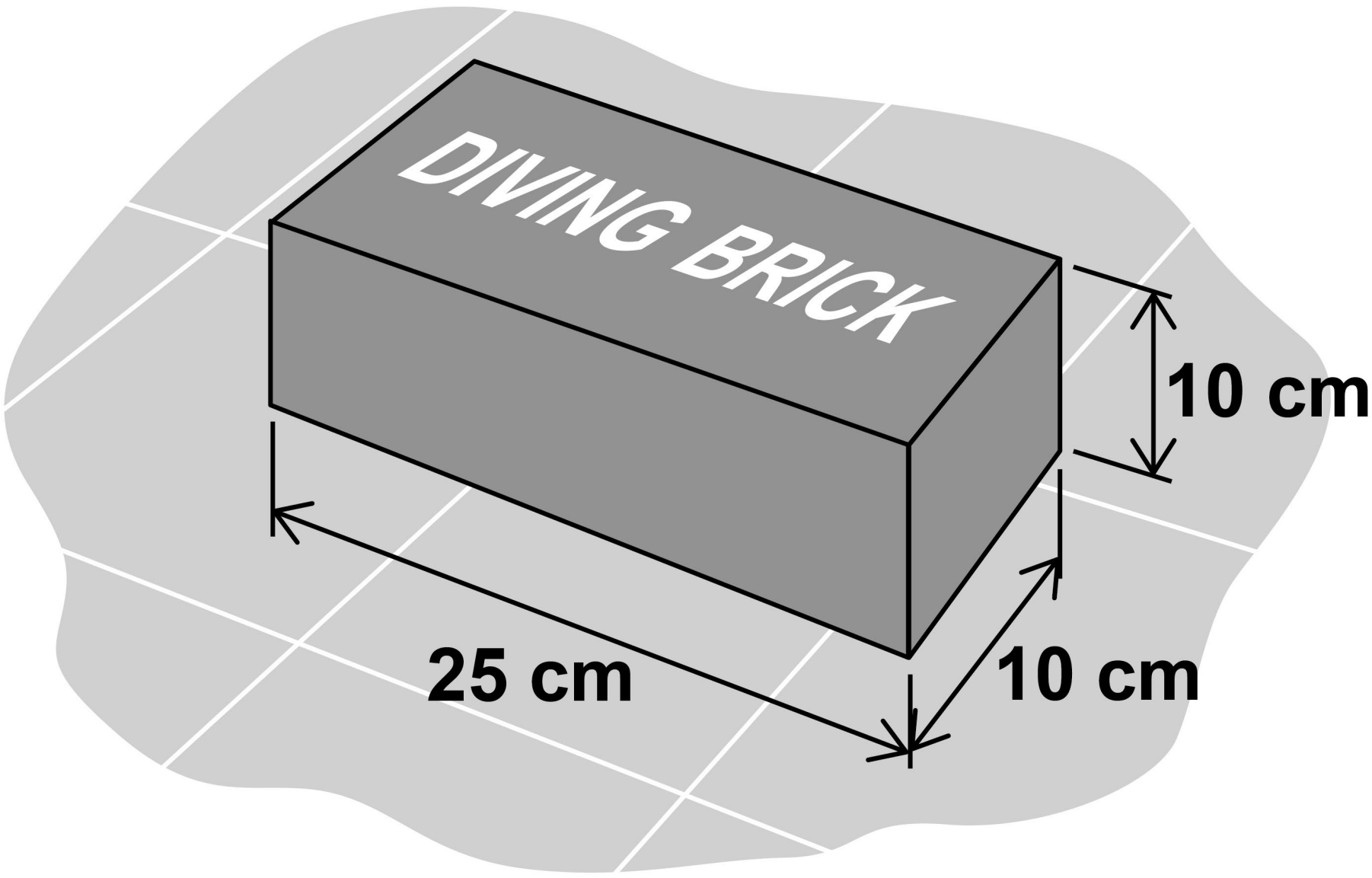
State ONE assumption you made in your calculation. [1 mark]

0 8

Diving bricks sink to the bottom of a swimming pool.

FIGURE 14 shows a diving brick.

FIGURE 14



Swimmers practise diving to the bottom of the swimming pool to pick up the diving brick.

0 8 . 1

Explain why the forces on the brick at the bottom of the pool cause the brick to be stationary. [3 marks]

0 8 . 2

When the brick from FIGURE 14, on page 66, is at the bottom of the pool, the top surface of the brick is 2.50 m below the surface of the water.

The force acting on the top surface of the brick due to the weight of the water is 637 N.

gravitational field strength = 9.8 N/kg

On the opposite page, calculate the density of the water in the swimming pool.

Use the Physics Equations Sheet.
[6 marks]

Density of water = _____ kg/m^3

[Turn over]

BLANK PAGE

0 8 . 3

Professional divers are trained in a very deep swimming pool.

The density of the water in this pool is NOT the same as the density of the water in Question 08.2

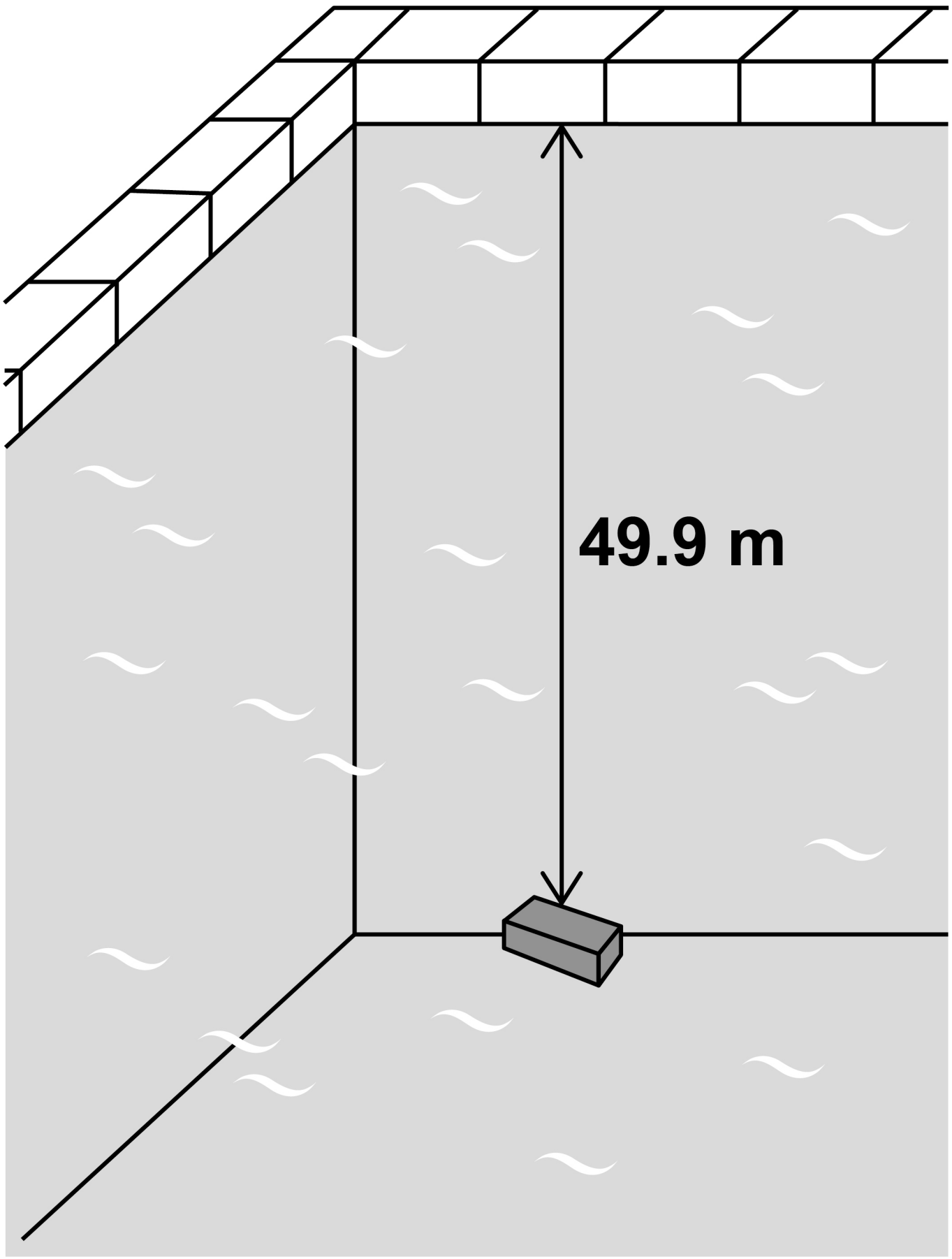
The diving brick was dropped into the very deep swimming pool.

When the brick was at a depth of 2.50 m, the force due to the weight of the water on the top surface of the brick was 618 N.

FIGURE 15, on page 72, shows the diving brick at the bottom of the very deep swimming pool.

[Turn over]

FIGURE 15



Determine the force due to the weight of the water on the top surface of the brick in FIGURE 15.

Use the Physics Equations Sheet.

Give your answer to 3 significant figures.

[3 marks]

Force (3 significant figures) =

_____ N

12

END OF QUESTIONS

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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For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	