A

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Physics Paper 2H

H

8464/P/2H

Friday 16 June 2023 Morning

Time allowed: 1 hour 15 minutes

[Turn over]

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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 protractor**
- **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.**
- **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).**
- **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 70.**
- **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 6

0 1

The Sun emits a continuous spectrum of electromagnetic waves.

FIGURE 1 names some of the groups of waves in the electromagnetic spectrum.

FIGURE 1

A	**B**	**Infrared**	**Visible light**	**Ultraviolet**	**C**	**Gamma Rays**

0 1 . 1

Name groups A, B and C in FIGURE 1. [2 marks]

A _____

B _____

C _____

[Turn over]

8

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0 1 . 2

Give ONE similarity and ONE difference between the properties of ultraviolet waves and gamma rays. [2 marks]

Similarity _____

_____

_____

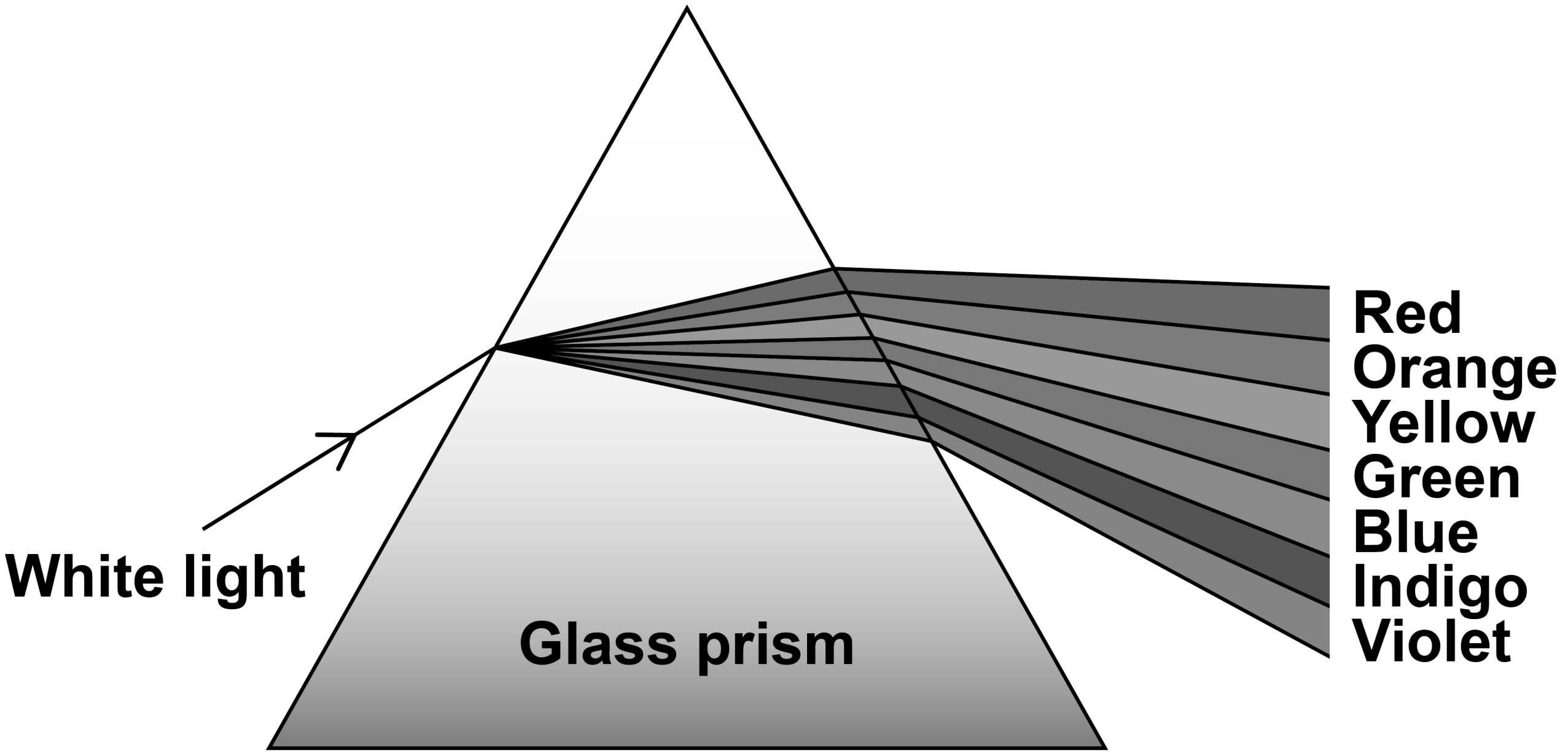
Difference _____

_____

_____

FIGURE 2 shows white light split into a spectrum of different colours by a glass prism.

FIGURE 2



0 1 . 3

Light changes direction when it enters the glass prism.

What name is given to this process? [1 mark]

_____

_____

[Turn over]

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

0 1 . 4

Write down the equation that links frequency (*f*), wavelength (*λ*) and wave speed (*v*). [1 mark]

0 1 . 5

The wave in the middle of the spectrum has a wavelength of 5.0×10^{-7} m.

wave speed of light = 3.0×10^{8} m/s

Calculate the frequency of the wave.
[3 marks]

Frequency = _____ Hz

[Turn over]

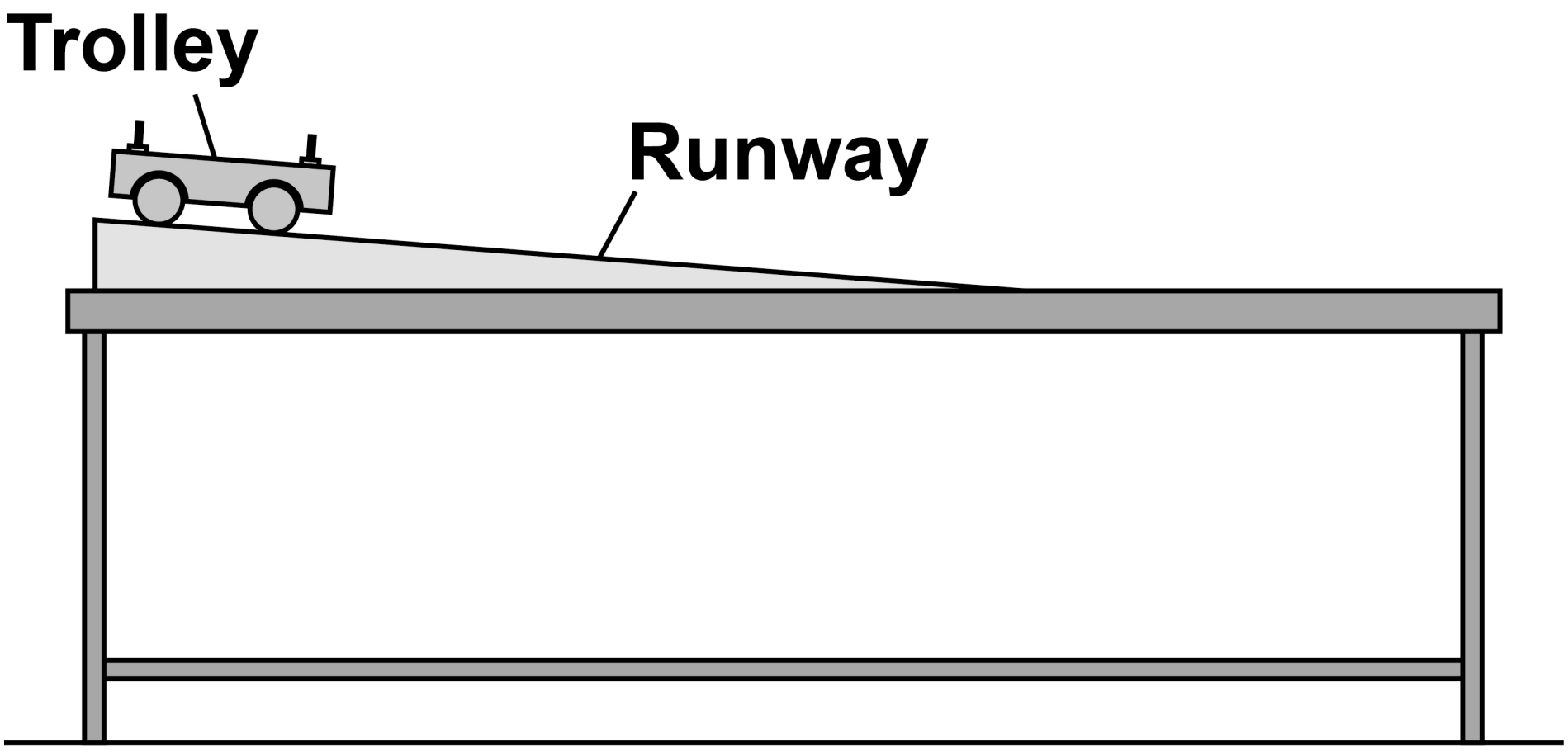
9

0 2

A student investigated how the acceleration of a trolley is affected by the force acting on the trolley.

FIGURE 3 shows some of the equipment used.

FIGURE 3



0 2 . 1

Describe a method the student could use.

Your answer should include any extra equipment needed. [6 marks]

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[Turn over]

TABLE 1 shows one set of results for a similar investigation.

TABLE 1

Resultant force in newtons	Acceleration in m/s^2
1.2	1.6

0 2 . 2

Which of Newton's laws predicts that the acceleration of the trolley is proportional to the resultant force on the trolley?
[1 mark]

Tick (✓) ONE box.

☐ **First law**

☐ **Second law**

☐ **Third law**

0 2 . 3

Determine the acceleration of the trolley when the resultant force is 3.6 N.

Use TABLE 1. [2 marks]

Acceleration = _____ m/s^2

[Turn over]

Use the Physics Equations Sheet to answer questions 02.4 and 02.5.

0 2 . 4

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

0 2 . 5

A resultant force of 0.42 N acts on a different trolley.

The acceleration of the trolley is 1.2 m/s^2.

Calculate the mass of the trolley.
[3 marks]

Mass of trolley = _____ kg

13

[Turn over]

0 3

A teacher used a ripple tank to demonstrate water waves.

The teacher used a lamp to project a shadow of the water waves onto a screen below the ripple tank.

0 3 . 1

FIGURE 4 represents the shadow of the water waves seen on the screen.

FIGURE 4

1.0 mm on FIGURE 4 represents 5.0 mm on the screen.

Determine an ACCURATE value for the wavelength of the waves on the screen.

Give your answer in mm.

Show how you work out your answer.

[3 marks]

Wavelength = _____ mm

[Turn over]

The teacher adjusted the frequency of the waves produced in the ripple tank.

The teacher measured the wavelength five times.

TABLE 2 shows the results.

TABLE 2

MEASUREMENT	1	2	3	4	5	MEAN
Wavelength in millimetres	96	99	97	X	97	97

0 3 . 2

Calculate value X in TABLE 2. [2 marks]

_____

_____

_____

X = _____ **mm**

0 3 . 3

The teacher states that the results are very precise.

Which of the following supports the statement made by the teacher? [1 mark]

Tick (✓) ONE box.

- ☐ **The mean value is very close to the true value.**
- ☐ **The spread of values about the mean is very small.**
- ☐ **The values are all given to the nearest millimetre.**
- ☐ **The wavelength measurement was taken five times.**

0 3 . 4

Describe the difference between longitudinal waves and transverse waves. [2 marks]

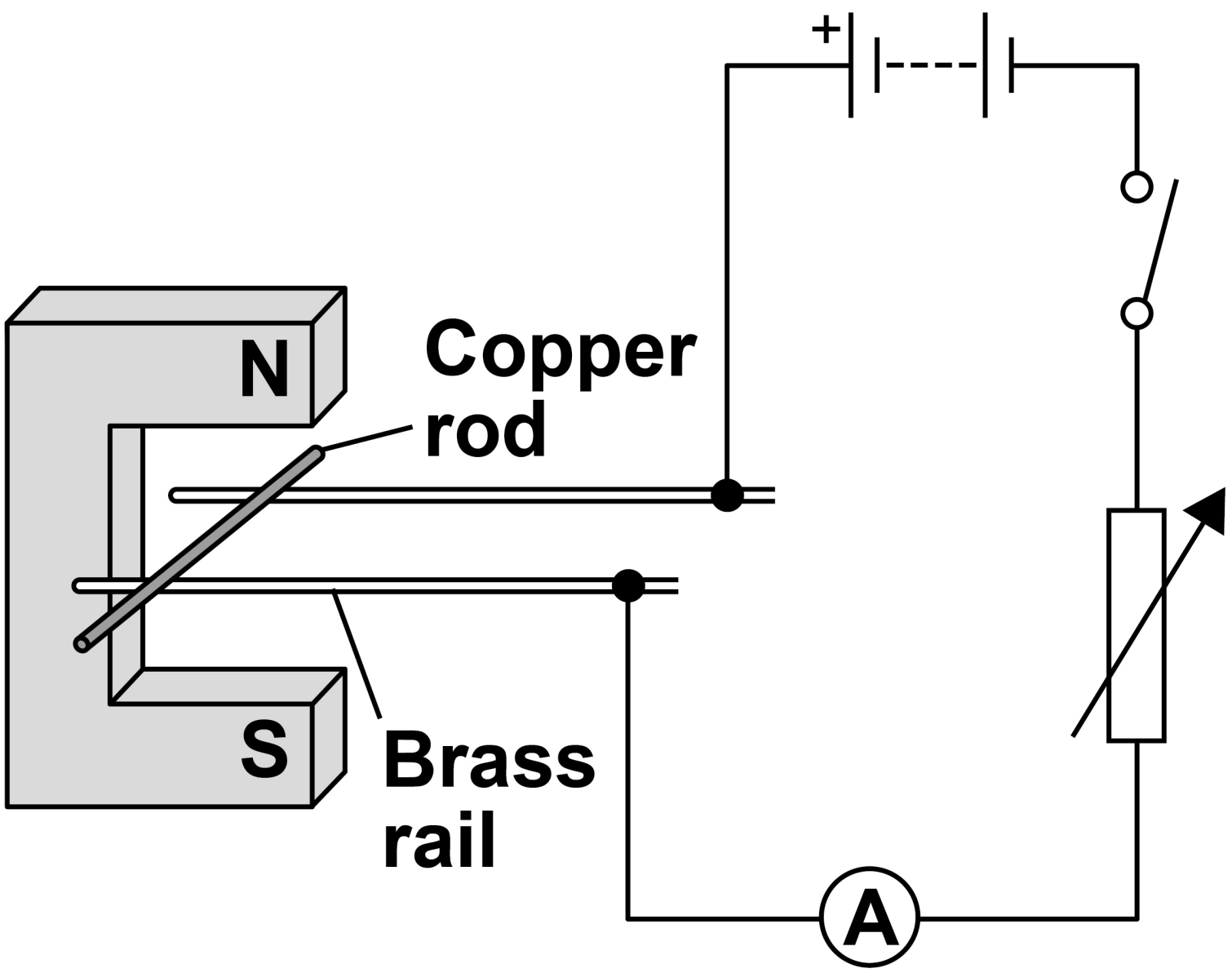
8

0 4

A teacher demonstrated the motor effect.

FIGURE 5 shows the equipment used. The equipment includes a permanent magnet.

FIGURE 5



0 4 . 1

The copper rod remains stationary while the switch is open.

Complete the sentence. [1 mark]

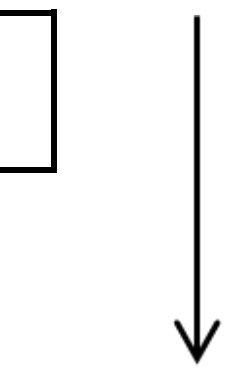
The tendency for an object to remain stationary is called _____ .

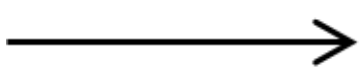
When the switch is closed the copper rod accelerates.

0 4 . 2

In which direction will the copper rod accelerate? [1 mark]

Tick (✓) ONE box.

☐ 

☐ 

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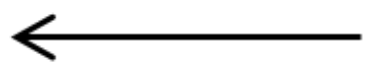
☐ 

0 4 . 3

Explain ONE way the teacher could increase the acceleration of the copper rod. [2 marks]

0 4 . 4

The magnet used in the demonstration was a permanent magnet.

FIGURE 6 shows an iron bar and a permanent magnet.

FIGURE 6

Iron bar

Permanent magnet

Describe how the permanent magnet could be used to test if the iron bar is also a permanent magnet. [2 marks]

0 4 . 5

FIGURE 7 shows a magnetic compass used by walkers.

FIGURE 7

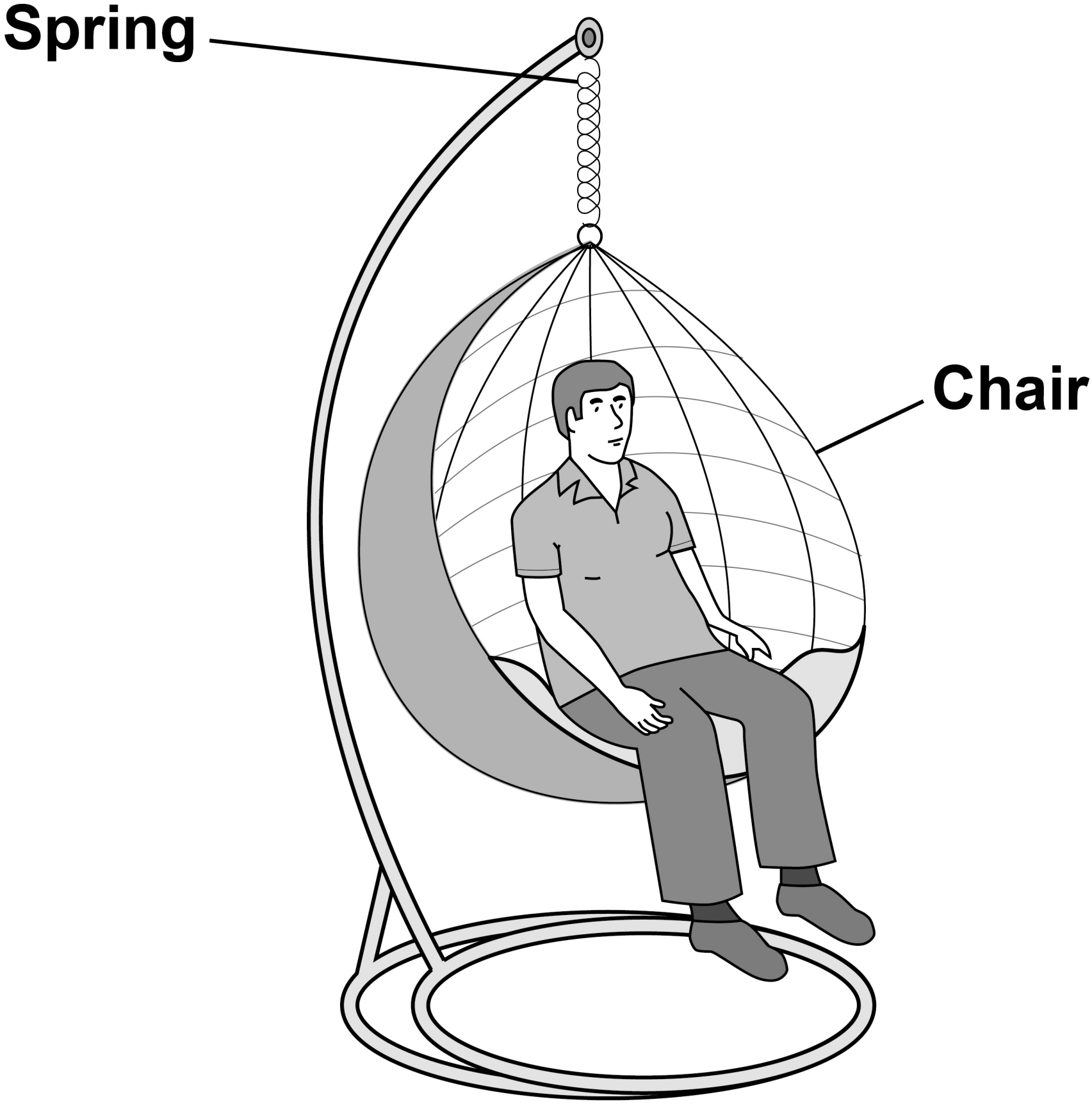
Explain how a magnetic compass provides evidence that the Earth has a magnetic field. [2 marks]

8

0 5

FIGURE 8 shows a garden chair hanging from a spring.

FIGURE 8



0 5 . 1

Which of the following describes the relationship between the weight (*W*) acting on the spring and the extension (*e*) of the spring? [1 mark]

Tick (✓) ONE box.

☐ $W = e$

☐ $W \propto e$

☐ $W \sim e$

☐ $W < e$

[Turn over]

0 5 . 2

The person in FIGURE 8, on page 36, has a weight of 750 N.

The person's weight causes the spring to extend by 60 mm.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.
[3 marks]

_____

_____

_____

Spring constant = _____ N/m

[Turn over]

The manufacturer of the chair tests a new spring to see if it is suitable to hang the chair.

The spring can store a maximum of 1800 J of elastic potential energy before it becomes inelastically deformed.

0 5 . 3

Describe what is meant by 'inelastically deformed'. [2 marks]

0 5 . 4

Calculate the maximum extension of the spring before the spring becomes inelastically deformed.

spring constant = 225 N/m

Use the Physics Equations Sheet.
[3 marks]

Maximum extension = _____ m

[Turn over]

0 5 . 5

Evaluate the suitability of the new spring to hang the chair.

maximum elastic potential energy = 1800 J

spring constant = 225 N/m

weight of person = 750 N

distance between the bottom of the chair and the ground = 30 cm

Include a calculation in your answer.

Use the Physics Equations Sheet.
[3 marks]

0 6

FIGURE 9 shows a child dropping a stone into water.

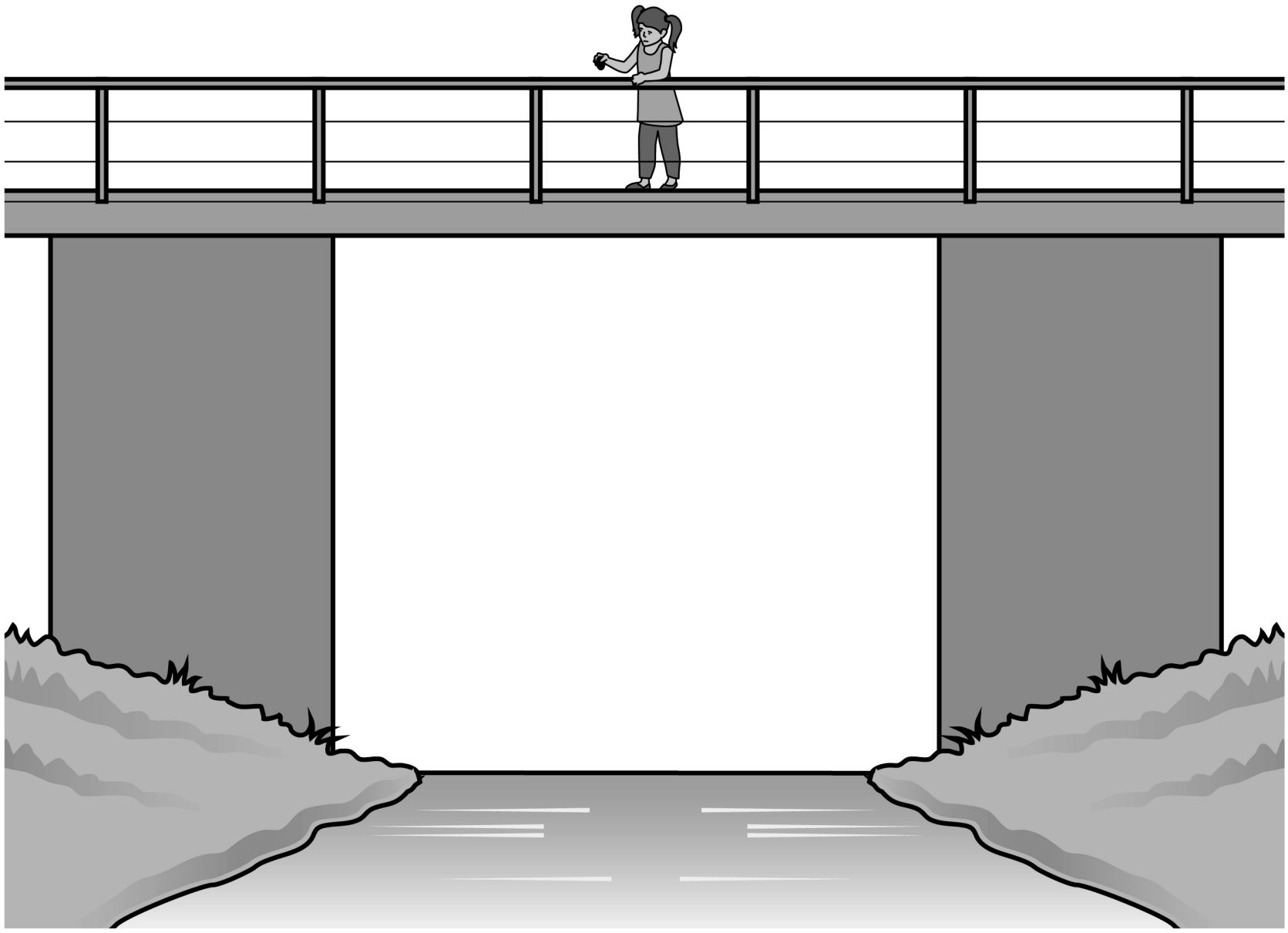


FIGURE 9

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[Turn over]

0 6 . 1

When the child drops the stone it passes the child's feet with a velocity of 3.1 m/s.

The child's feet are 6.3 m above the water.

acceleration due to gravity = 9.8 m/s^2

Calculate the velocity of the stone as it hits the water.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

[4 marks]

Velocity (2 significant figures) =

_____ m/s

[Turn over]

0 6 . 2

Velocity is a vector.

Describe the velocity of the stone as it falls through the air.

Assume there is no air resistance.
[2 marks]

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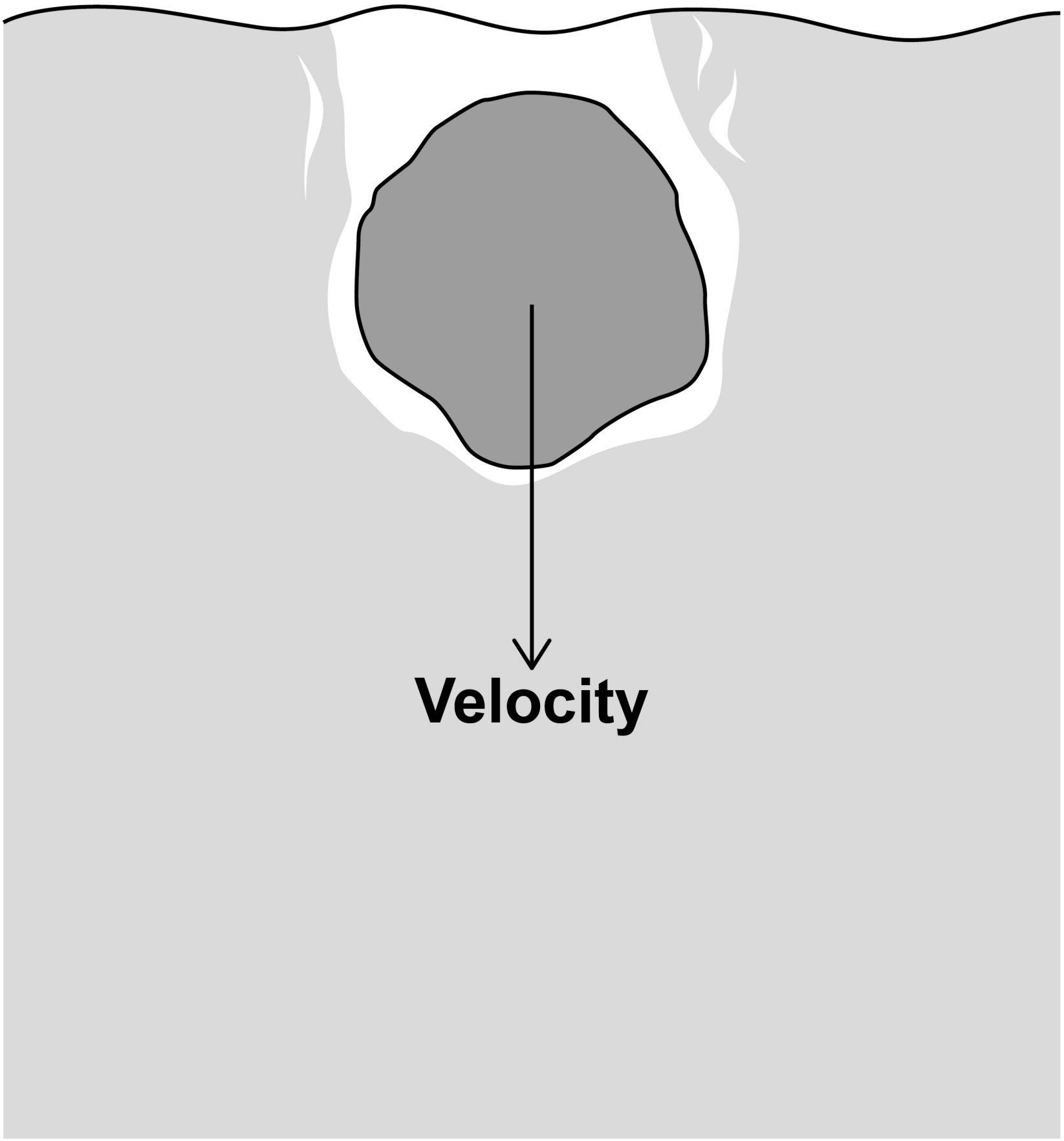
[Turn over]

0 6 . 3

FIGURE 10 shows the stone just after it has entered the water.

FIGURE 10



As the stone moves through the water, the stone slows to a constant velocity.

Explain why. [4 marks]

10

0 7

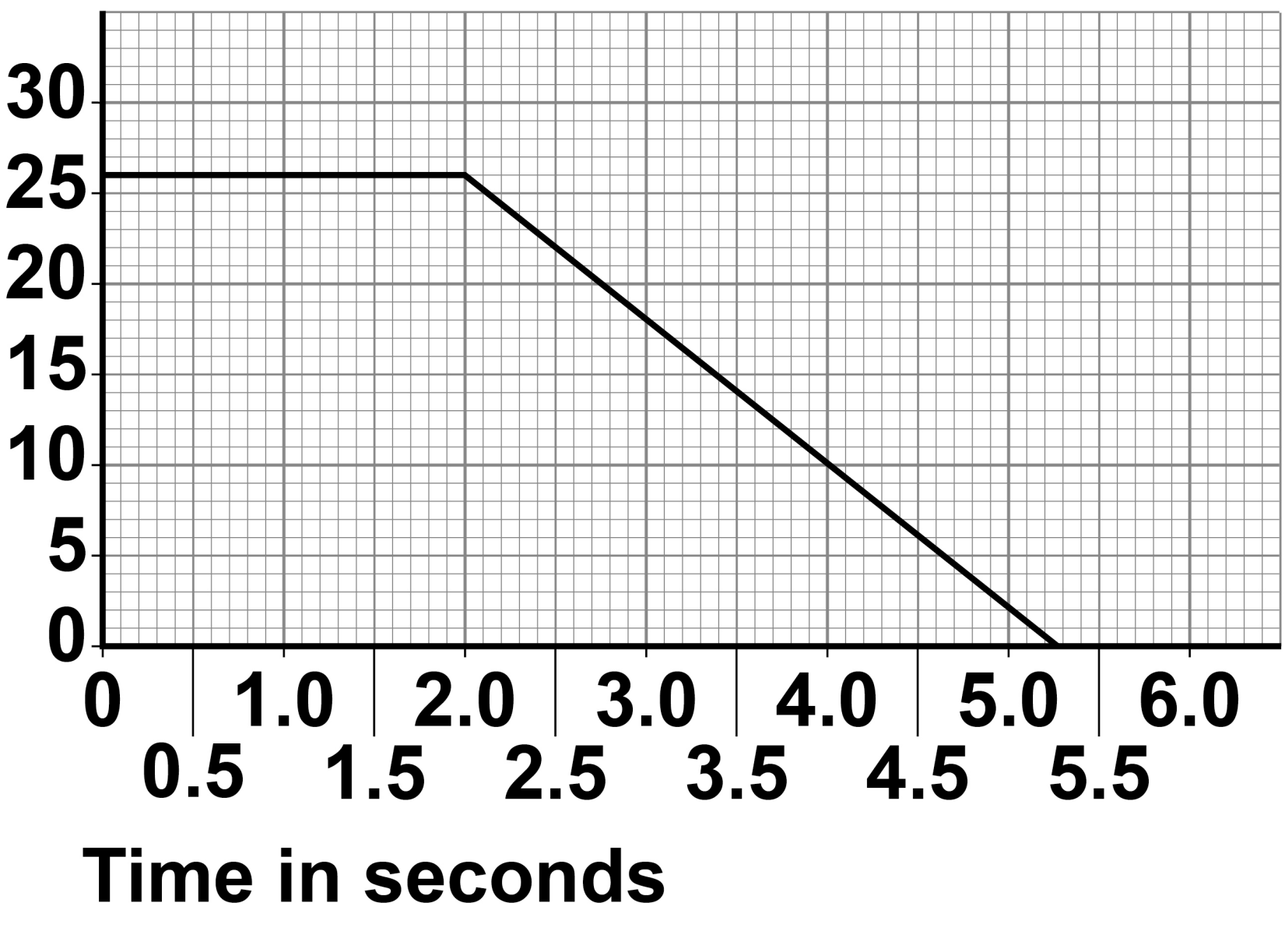
A car contains a device called a black box. The black box records the velocity and acceleration of the car.

The car was travelling at a constant velocity. The driver then reacted to a hazard.

FIGURE 11, on page 54, shows the velocity–time graph for the car.

[Turn over]

FIGURE 11


Velocity
in metres
per second
30
25
20
15
10
5
0
0
1.0
2.0
3.0
4.0
5.0
6.0
0.5
1.5
2.5
3.5
4.5
5.5
Time in seconds

0 7 . 1

Determine the deceleration of the car.

Give the unit. [3 marks]

Deceleration = _____ Unit _____

0 7 . 2

The driver of the car has a reaction time of 0.75 s.

Determine the stopping distance of the car.

Use the Physics Equations Sheet.

Use FIGURE 11, on page 54. [5 marks]

Stopping distance = _____ m

[Turn over]

0 7 . 3

If the black box records large decelerations, it identifies that the driving may be dangerous.

Explain why large decelerations may be dangerous. [2 marks]

END OF QUESTIONS

10

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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For Examiner's Use	
Question	Mark
1	
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TOTAL	