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 14 June 2024 Afternoon

Time allowed: 1 hour 15 minutes

[Turn over]

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On 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

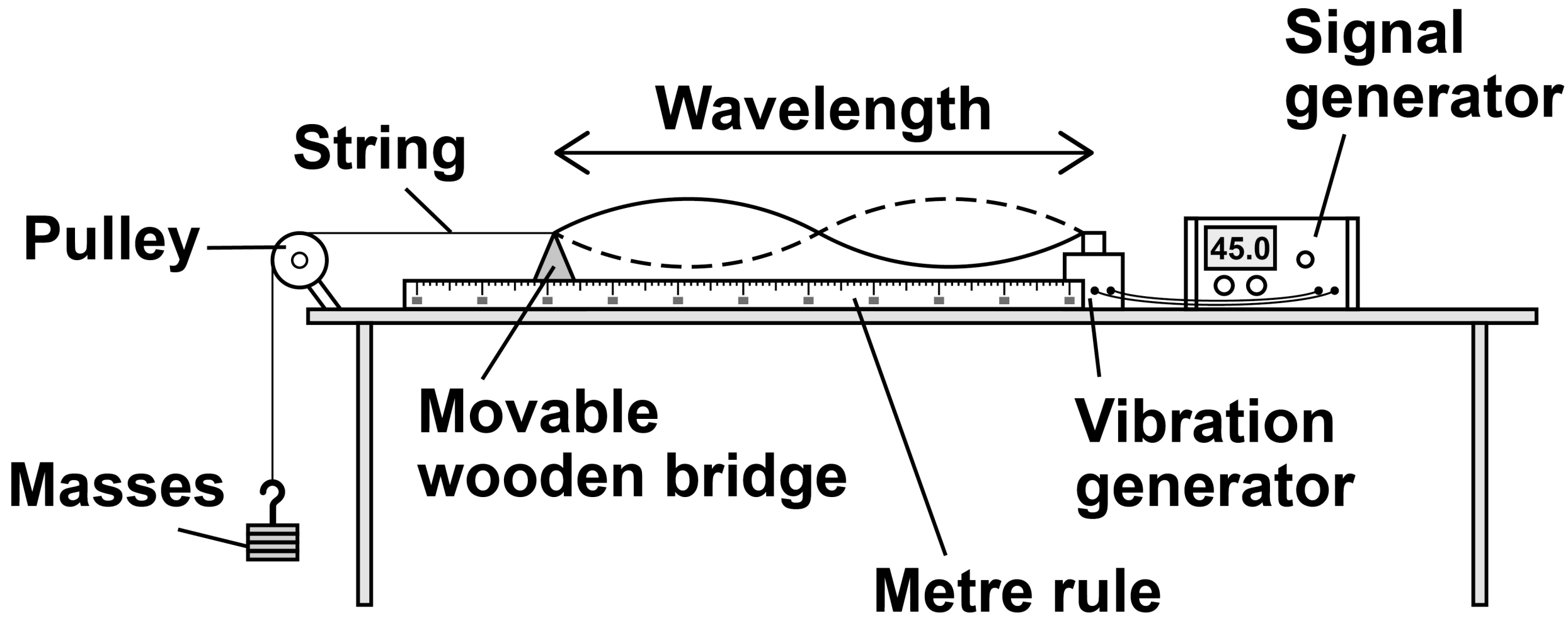
0 6

0 1

A teacher demonstrated how the frequency of a wave on a string affects the wavelength of the wave.

FIGURE 1, on the opposite page, shows the equipment used.

FIGURE 1



The frequency of the signal generator is adjusted so that the wave shown in FIGURE 1 is seen.

At this frequency the string vibrates between the two positions shown in FIGURE 1.

[Turn over]

8

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0 1 . 1

Describe a method the teacher could use to investigate how the frequency of the wave affects the wavelength. [4 marks]

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

0 1 . 2

Which equation links frequency (*f*), wavelength (*λ*) and wave speed (*v*)? [1 mark]

Tick (✓) ONE box.

☐ $f = \lambda \times v$

☐ $\lambda = f \times v$

☐ $v = f \times \lambda$

0 1 . 3

The wave on the string has a frequency of 45.0 Hz.

The wave speed is 35.1 m/s.

Calculate the wavelength of the wave.
[3 marks]

Wavelength = _____ m

8

0 2

FIGURE 2 shows an Olympic gymnast performing a floor routine.

FIGURE 2

The floor contains springs.

When the gymnast lands on the floor, a force compresses the springs in the floor.

0 2 . 1

When a spring is compressed, the elastic potential energy of the spring increases.

Explain why compressing the springs in the floor helps the gymnast to jump higher.

Use ideas about energy in your answer.
[2 marks]

0 2 . 2

When the gymnast lands on the floor, one of the springs compresses by 1.2 cm.

spring constant = 8500 N/m

Calculate the elastic potential energy stored in the spring.

Use the Physics Equations Sheet.

Give the unit. [4 marks]

_____

_____

_____

Elastic potential energy =

_____

Unit _____

[Turn over]

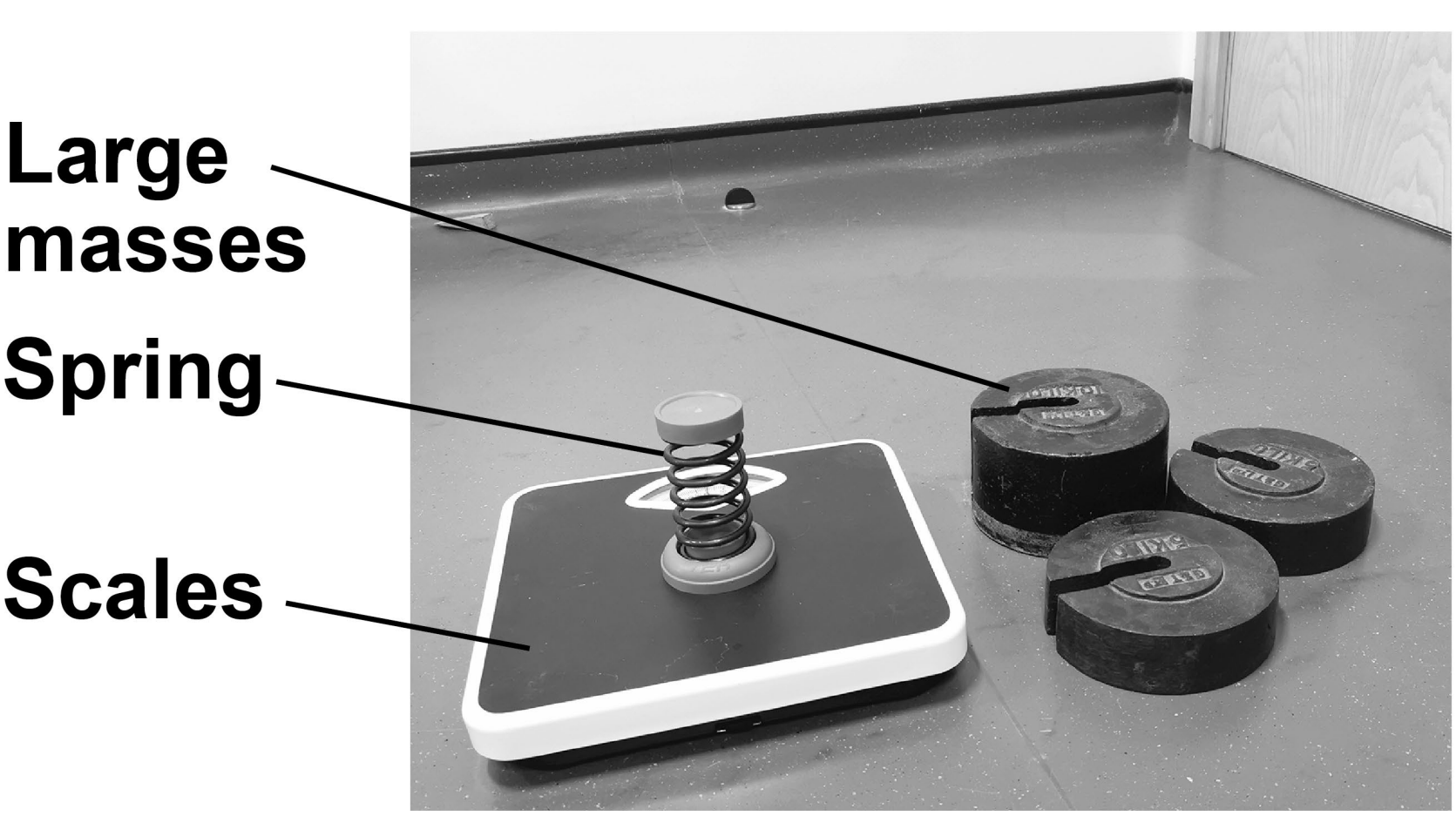
A student investigated a spring with a different spring constant.

When masses are placed on the spring it compresses.

The student measured the compression of the spring for different masses.

FIGURE 3 shows some of the equipment used.

FIGURE 3



0 2 . 3

Describe how the compression of the spring could be determined. [2 marks]

0 2 . 4

Explain why the investigation should be done on the laboratory floor rather than on a table. [2 marks]

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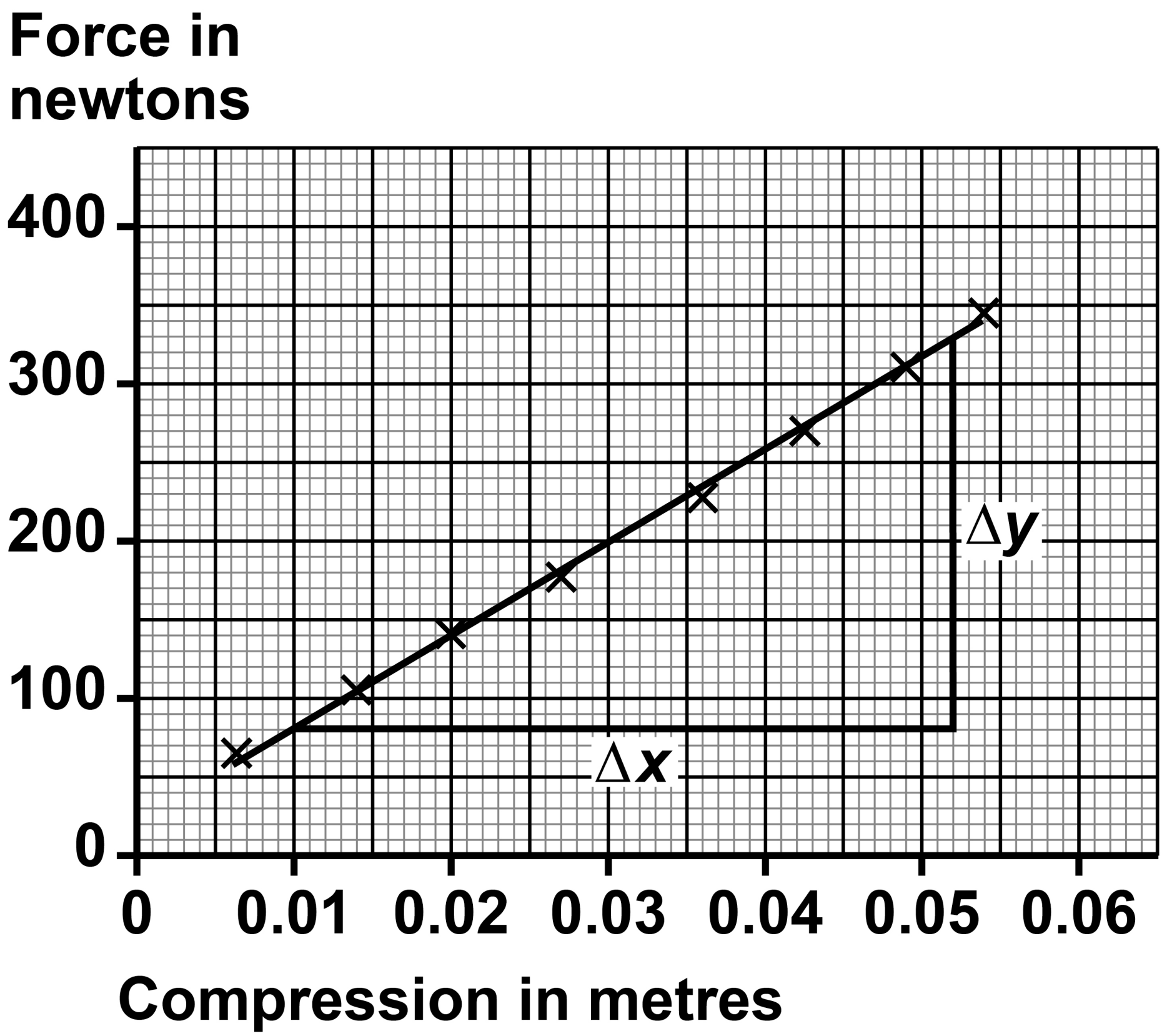
[Turn over]

FIGURE 4 shows the results.

FIGURE 4



The spring constant is the gradient of the line of best fit shown on FIGURE 4.

0 2 . 5

Determine the value Δy on FIGURE 4.
[1 mark]

Δy = _____ N

0 2 . 6

Determine the value Δx on FIGURE 4.
[1 mark]

Δx = _____ m

[Turn over]

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0 2 . 7

Determine the spring constant of the spring.

Use your answers to Question 02.5 and Question 02.6, on page 21.

Give your answer to 3 significant figures.
[2 marks]

Spring constant (3 significant figures) =

_____ N/m

[Turn over]

14

0 3

Electromagnetic waves are grouped according to their wavelength and frequency.

Electromagnetic waves are transverse waves and can travel through a vacuum.

0 3 . 1

Give one OTHER property that is the same for all types of electromagnetic wave. [1 mark]

0 3 . 2

What is meant by ‘transverse wave’?
[1 mark]

0 3 . 3

Which group of electromagnetic waves is used for satellite communications?
[1 mark]

[Turn over]

0 3 . 4

Visible light is the only group of electromagnetic waves that the human eye can detect.

Which colour of visible light has the shortest wavelength? [1 mark]

0 3 . 5

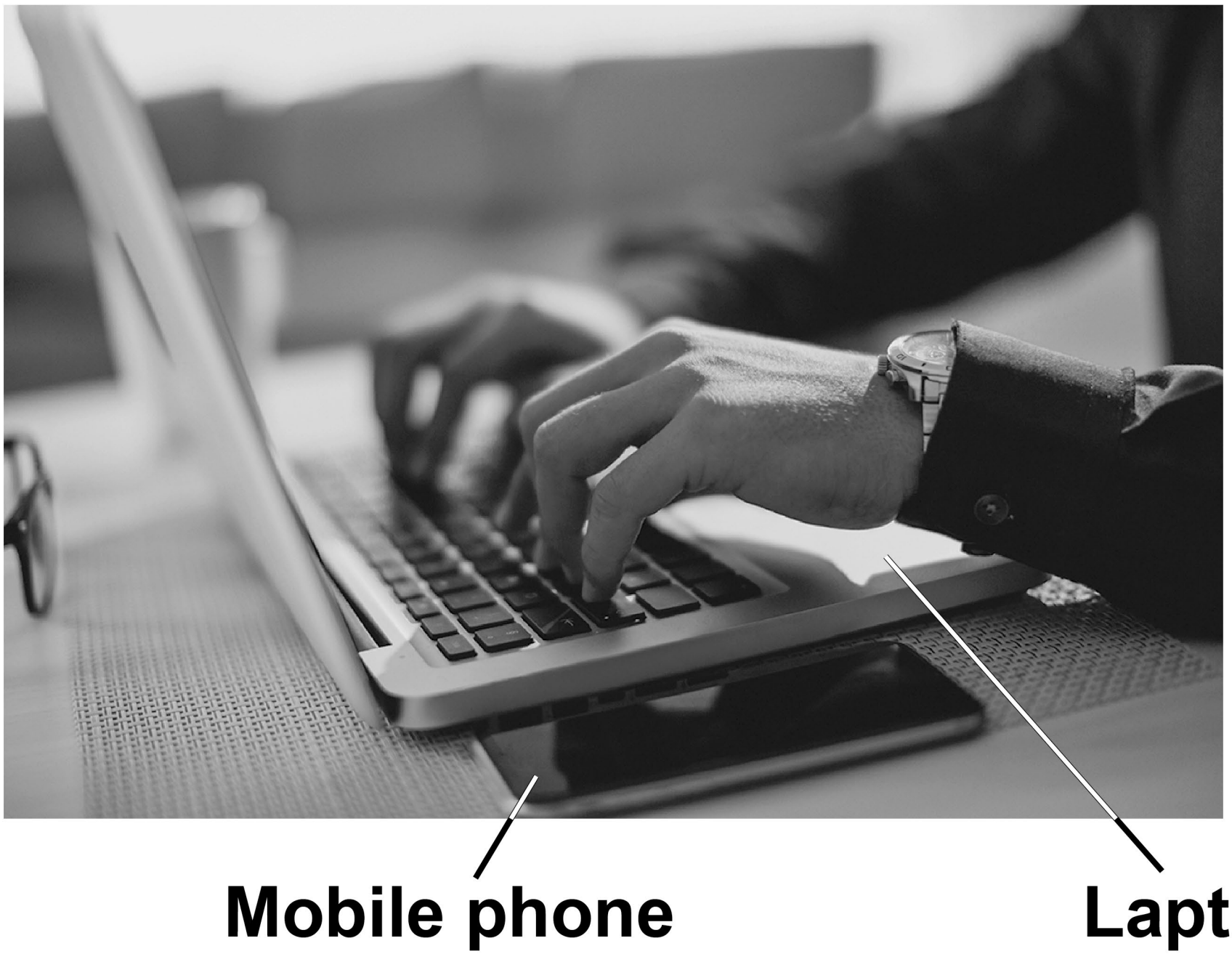
The three highest frequency groups of electromagnetic waves are hazardous.

Describe a risk linked to each group of high frequency electromagnetic wave.

[2 marks]

FIGURE 5 shows a person using a mobile phone to allow a laptop to access the Internet.

FIGURE 5



The electromagnetic waves emitted by the mobile phone send information to the laptop.

0 3 . 6

The electromagnetic waves emitted by the mobile phone have a period of 4.0×10^{-10} s.

Calculate the frequency of the waves.

Use the Physics Equations Sheet.

Give your answer in standard form.
[3 marks]

Frequency (in standard form) =

_____ Hz

[Turn over]

0 3 . 7

The electromagnetic waves are produced by oscillations in the transmitter of the mobile phone.

Explain how oscillations in the transmitter enable information to be transferred to the detector in the laptop. [4 marks]

31

[Turn over]

13

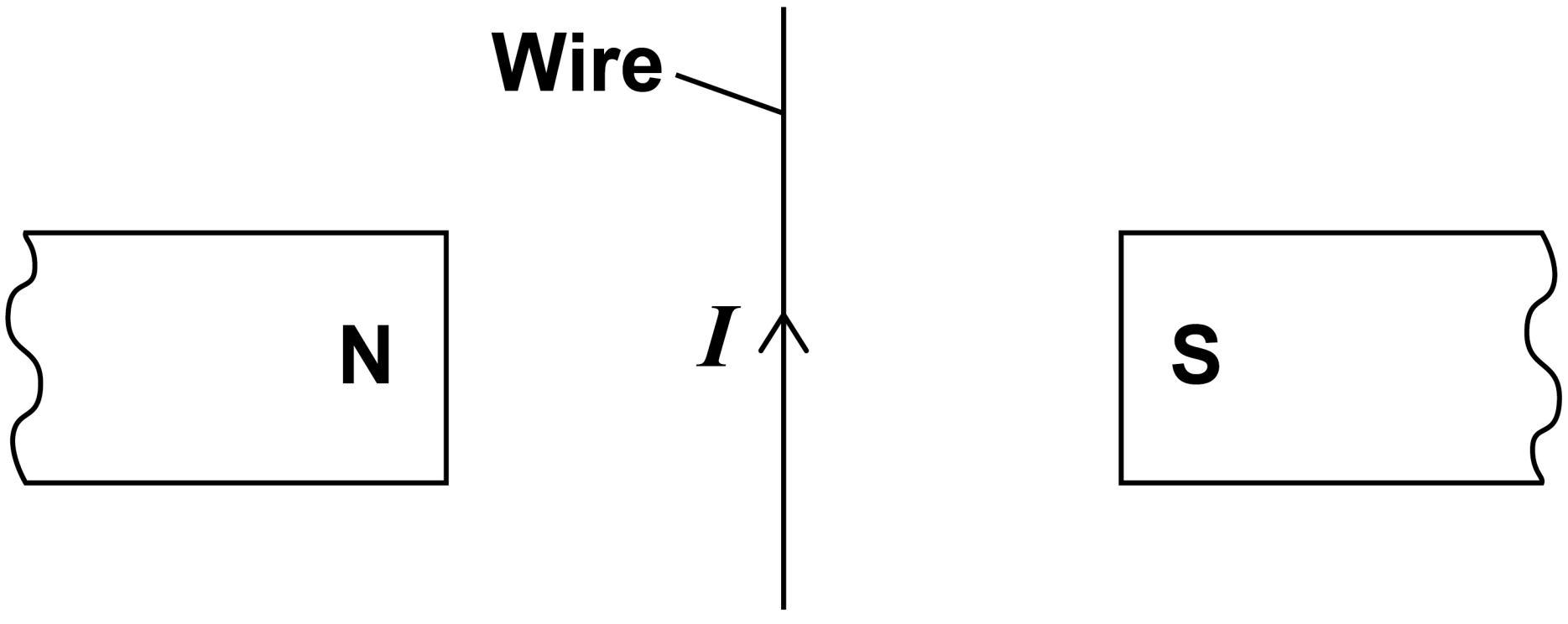
3 1

0	4

FIGURE 6 shows two magnets and a wire.

There is a current in the wire.

FIGURE 6



0 4 . 1

A force acts on the wire in FIGURE 6.

What is the direction of the force on the wire? [1 mark]

Tick (✓) ONE box.

- ☐ Into the page
- ☐ Out of the page
- ☐ To the left
- ☐ To the right

[Turn over]

0 4 . 2

The length of the wire in the magnetic field between the magnets is 80 mm.

The current in the wire is 4.6 A.

The force on the wire is 0.092 N.

Calculate the magnetic flux density between the magnets.

Use the Physics Equations Sheet.

Give the unit. [4 marks]

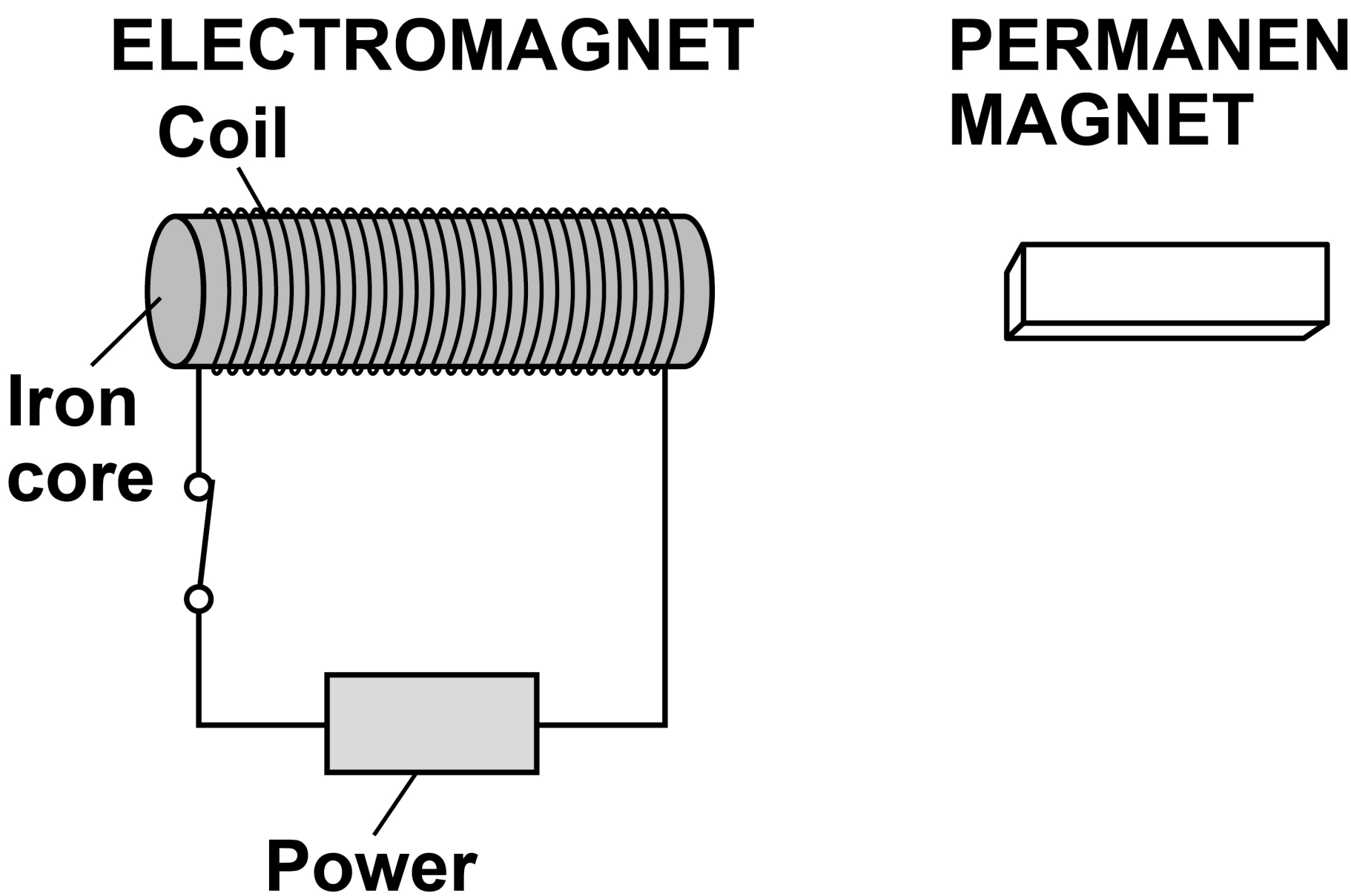
Magnetic flux density = _____

Unit _____

[Turn over]

FIGURE 7 shows an electromagnet close to a permanent magnet.

FIGURE 7



0 4 . 3

The electromagnet exerts a force on the permanent magnet.

The permanent magnet exerts an equal and opposite force on the electromagnet.

Which law is this an example of?
[1 mark]

Tick (✓) ONE box.

☐ **Newton's first law**

☐ **Newton's second law**

☐ **Newton's third law**

[Turn over]

0 4 . 4

Give TWO changes to the electromagnet that would increase the force exerted on the permanent magnet. [2 marks]

1

2

0 4 . 5

Give TWO changes to the electromagnet that would reverse the direction of the force exerted on the permanent magnet.
[2 marks]

1

2

10

0 5

A safety test was carried out to determine how the speed of a car affects the stopping distance of the car.

0 5 . 1

At the start of the test the car was moving slowly.

Then the car accelerated at 5.8 m/s^2 for 2.5 s.

The final velocity of the car was 20 m/s.

Calculate the initial velocity of the car.

Use the Physics Equations Sheet.
[4 marks]

Initial velocity = _____ m/s

[Turn over]

0 5 . 2

The reaction time of the driver was measured.

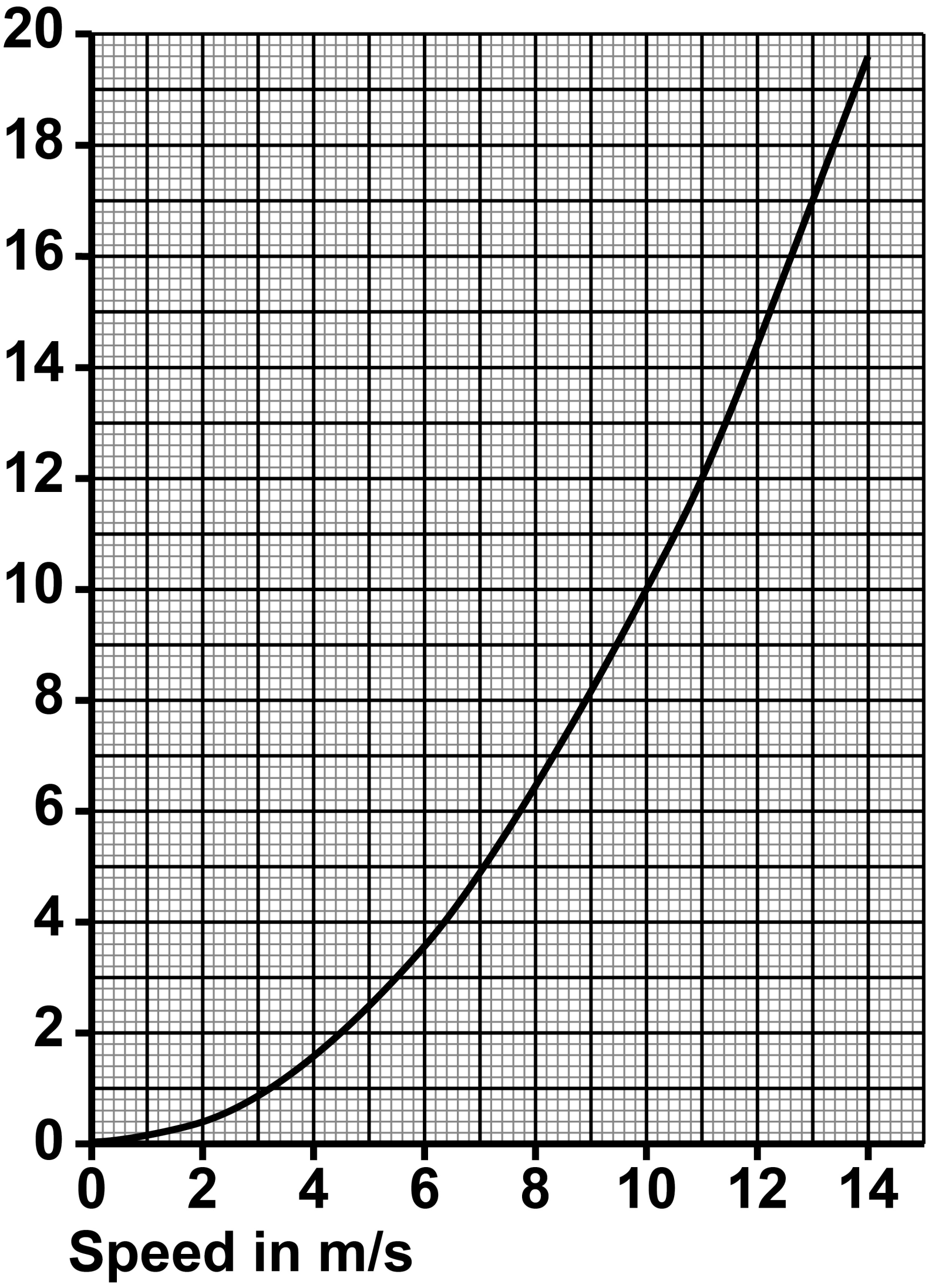
How can the reaction time of the driver be used to calculate the thinking distance? [1 mark]

The car was driven at a constant speed. The driver applied the maximum braking force, and the braking distance was measured.

The test was repeated at different speeds.

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

FIGURE 8



[Turn over]

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0 5 . 3

Which of the following gives the relationship between the speed and the braking distance? [1 mark]

Tick (✓) ONE box.

☐ **braking distance ∝ $\frac{1}{\text{speed}}$**

☐ **braking distance ∝ speed**

☐ **braking distance ∝ speed^2**

[Turn over]

0 5 . 4

During one test the brakes were applied with a force of 6250 N.

The deceleration of the car was 5.0 m/s^2.

The braking distance of the car was 14.4 m.

Determine the momentum of the car before the brakes were applied.

Use the Physics Equations Sheet.

Use FIGURE 8, on page 43. [6 marks]

Momentum = _____ kg m/s

[Turn over]

12

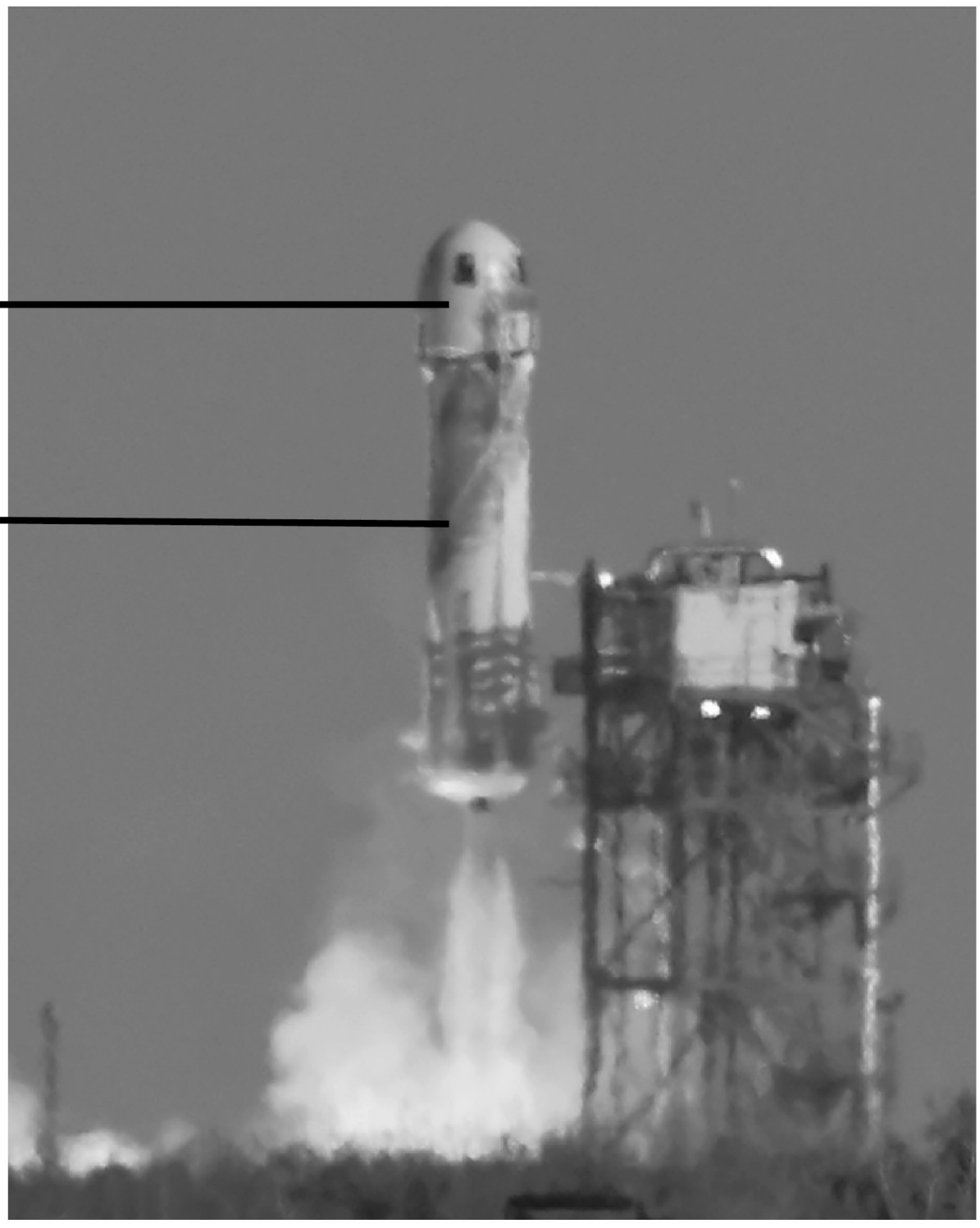
0	6

Rockets have been developed so that people who are not trained astronauts can pay to travel to space.

FIGURE 9, on the opposite page, shows the passenger module and the propulsion module of a rocket.

The propulsion module burns a large volume of fuel.

FIGURE 9



[Turn over]

0 6 . 1

The rocket was initially stationary on the ground.

Then the rocket accelerated upwards until it reached a height of 40 km.

The constant acceleration of the rocket was 6.48 m/s^2.

Calculate the velocity of the rocket at a height of 40 km.

Use the Physics Equations Sheet.

[4 marks]

Velocity = _____ m/s

[Turn over]

0 6 . 2

Explain how the weight of the rocket changed as it accelerated upwards.
[3 marks]

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[Turn over]

0 6 . 3

At a height of 40 km, the rocket stopped burning fuel.

The rocket continued upwards to its maximum height of 60 km.

Explain why the velocity of the rocket decreased between a height of 40 km and a height of 60 km. [3 marks]

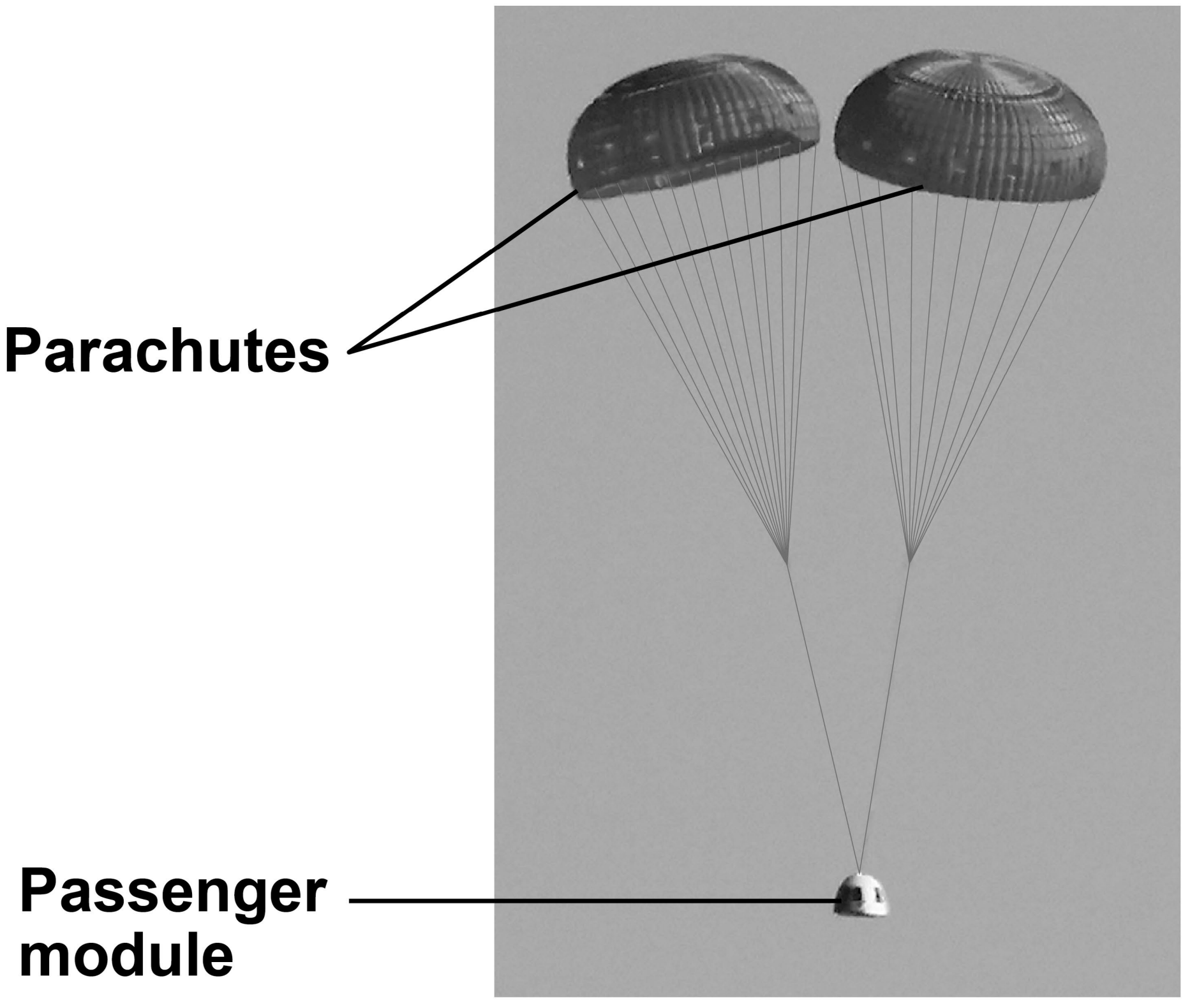
[Turn over]

0 6 . 4

At a height of 60 km the two modules of the rocket separated and the passenger module fell back to Earth.

FIGURE 10 shows the passenger module falling towards the Earth's surface.

FIGURE 10



Using parachutes causes the passenger module to fall with a lower terminal velocity than if parachutes were not used.

Explain why the parachutes allow the passenger module to fall with a lower terminal velocity. [3 marks]

END OF QUESTIONS

13

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	
2	
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4	
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6	
TOTAL	