A

AQA

GCSE
PHYSICS

H

Higher Tier Paper 2

8463/2H

Friday 16 June 2023   Morning

Time allowed: 1 hour 45 minutes

[Turn over]

JUN2384632H01

MATERIALS

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

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Answer ALL questions in the spaces provided.

0	1

Infrared waves are transverse waves.

0	1	.	1

Complete the sentence. [1 mark]

In a transverse wave, the direction of oscillation is

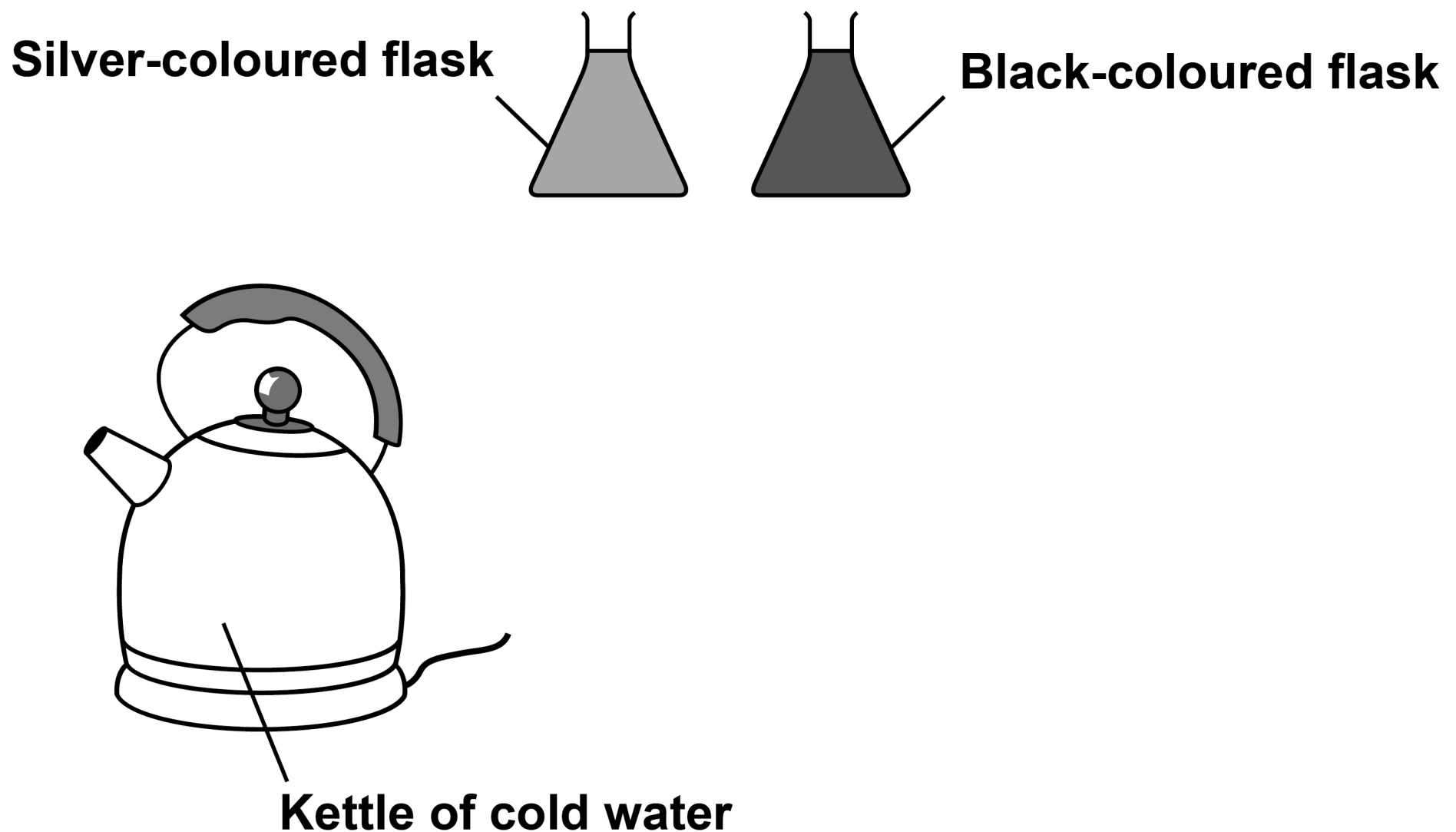**_____ to the direction of energy**

transfer by the wave.

[Turn over]

A student investigated how the colour of a surface affects the rate at which the surface emits infrared radiation.

FIGURE 1 shows some of the equipment used.

FIGURE 1

Silver-coloured flask   Black-coloured flask

Kettle of cold water

| 0 | 1 | . | 2 |

The student wrote the following hypothesis:

'The black-coloured flask will emit more infrared radiation than the silver-coloured flask during 10 minutes of cooling.'

Describe a method to test this hypothesis. [6 marks]

01 . 3

When will the flasks emit infrared radiation at the greatest rate?

Give a reason for your answer. [2 marks]

Tick (✓) ONE box.

☐ **During the 1st minute**

☐ **During the 5th minute**

☐ **During the 9th minute**

Reason _____

_____

_____

[Turn over]

Another student investigated the absorption of infrared radiation by different surface colours.

The student filled four hollow metal cubes with cold water.

Each cube was the same size but had a different surface colour.

The cubes were then placed the same distance from an infrared heater.

After 10 minutes, the student measured the temperature increase of the water inside each cube.

| 0 | 1 | . | 4 |

What was the dependent variable in this investigation?
[1 mark]

_____

_____

_____

0 1 . 5

TABLE 1 shows the results.

TABLE 1

SURFACE COLOUR OF THE CUBE	TEMPERATURE INCREASE AFTER 10 MINUTES IN °C
Matt white	3.0
Shiny white	2.0
Matt black	6.5
Shiny black	4.0

Give TWO conclusions that can be made from the results in TABLE 1. [2 marks]
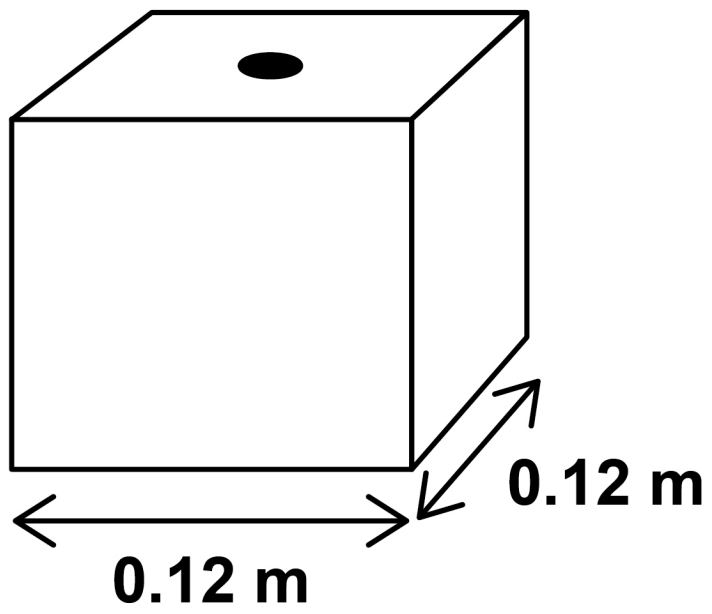
1 _____

_____

_____

2 _____

_____

_____

[Turn over]

FIGURE 2 shows one of the cubes. The cube is filled with water.

The weight of the water exerts a pressure on the bottom of the cube.

FIGURE 2

0.12 m

0.12 m

Use the Physics Equations Sheet to answer questions 01.6 and 01.7.

| 0 | 1 | . | 6 |

Which equation correctly links area, force and pressure?
[1 mark]

Tick (✓) ONE box.

☐ pressure = force × area^2

☐ pressure = force × area

☐ pressure = $\dfrac{\text{force}}{\text{area}}$

☐ pressure = $\dfrac{\text{area}}{\text{force}}$

[Turn over]

| 0 | 1 | . | 7 |

The water pressure at the bottom of the cube is 1500 Pa.

Calculate the force of the water on the bottom of the cube.
[4 marks]

_____

_____

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_____
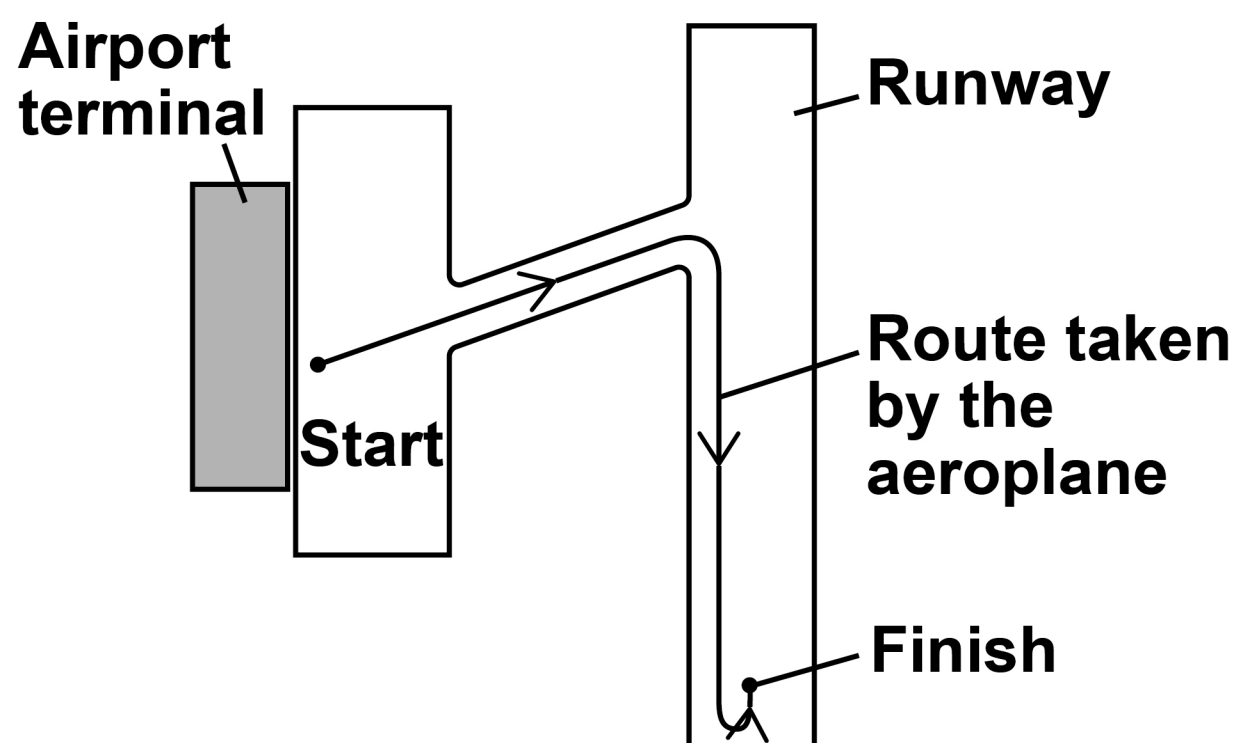
Force = _____ N

17

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[Turn over]

02

FIGURE 3 shows the route an aeroplane takes as it travels from an airport terminal to the runway.

FIGURE 3 has been drawn to scale.

FIGURE 3

Scale: 1 cm represents 70 m

0 2 . **1**

Determine the magnitude of the aeroplane's displacement from the start point to the finish point on FIGURE 3.
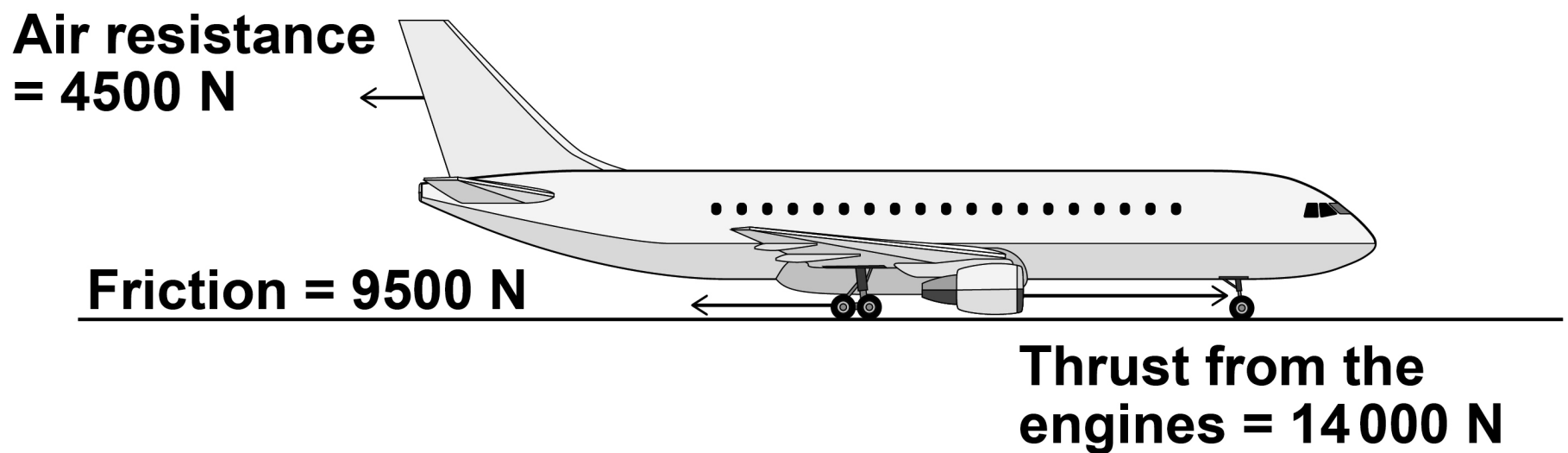**[2 marks]**

_____

_____

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_____

Displacement = _____ m

[Turn over]

FIGURE 4 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

FIGURE 4

Air resistance = 4500 N

Friction = 9500 N

Thrust from the engines = 14 000 N

| 0 | 2 | . | 2 |

Determine the magnitude of the resultant horizontal force on the aeroplane. [1 mark]

_____

_____

_____

Resultant horizontal force = _____ N

0 2 . 3

Describe the motion of the aeroplane as it moves towards the runway. [1 mark]

_____

_____

_____

0 2 . 4

Air resistance and friction are contact forces.

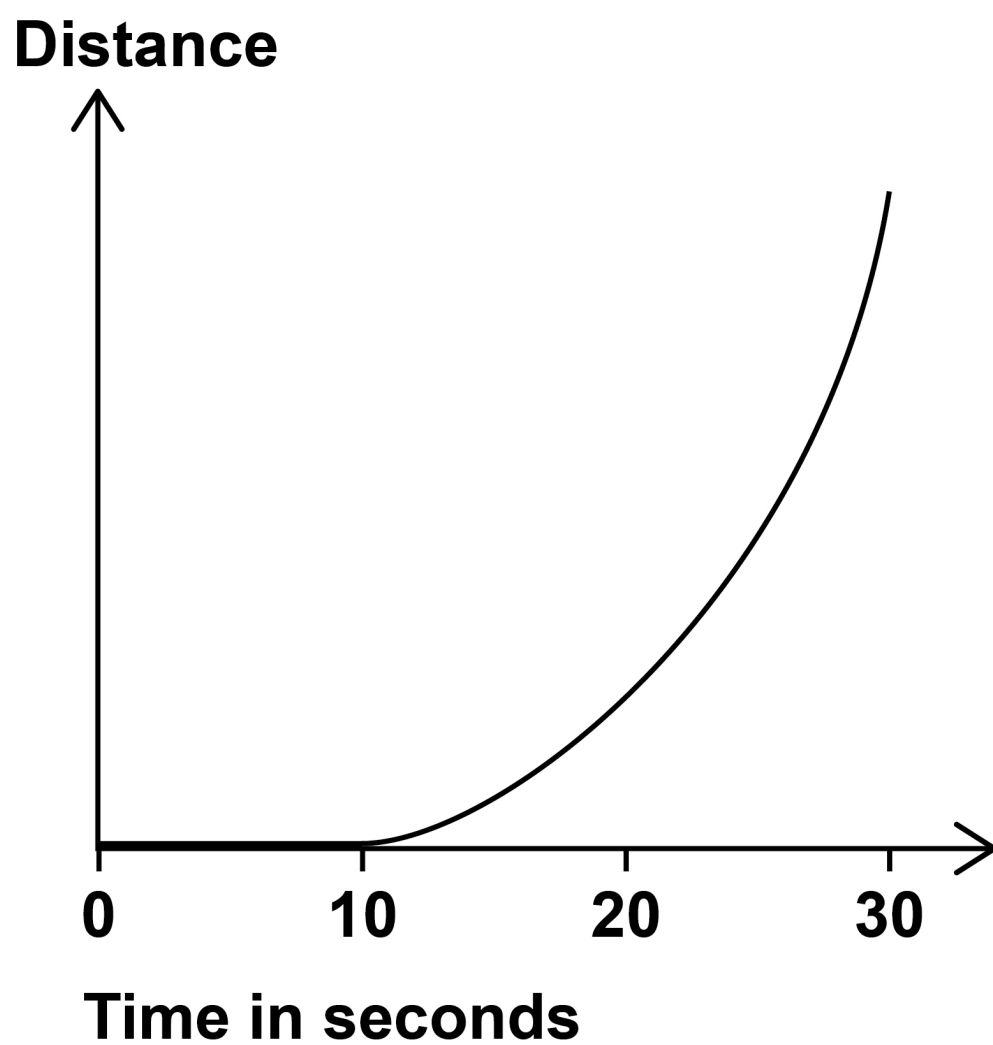Give ONE other example of a contact force. [1 mark]

_____

_____

[Turn over]

0 2 . 5

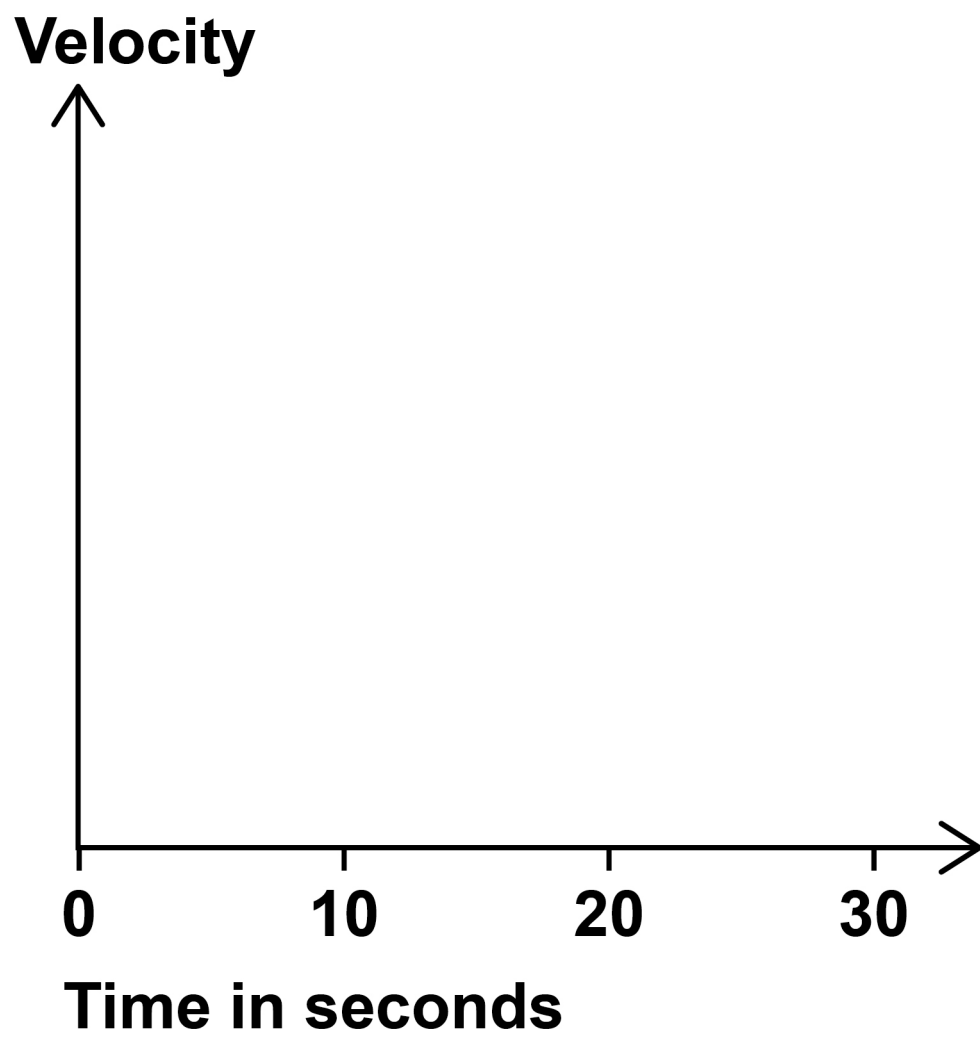The aeroplane stops for a short time and then accelerates along the runway.

FIGURE 5 shows a distance–time sketch-graph for this stage of the journey.

FIGURE 5

Distance

Time in seconds

Draw the velocity–time sketch-graph for this stage of the journey on FIGURE 6. [2 marks]

FIGURE 6

Velocity

0	**10**	**20**	**30**

Time in seconds

[Turn over]

0 2 . 6

The aeroplane takes off from the runway, so its height above the ground increases.

FIGURE 7, on the opposite page, shows how atmospheric pressure varies with the height of the aeroplane above the ground.
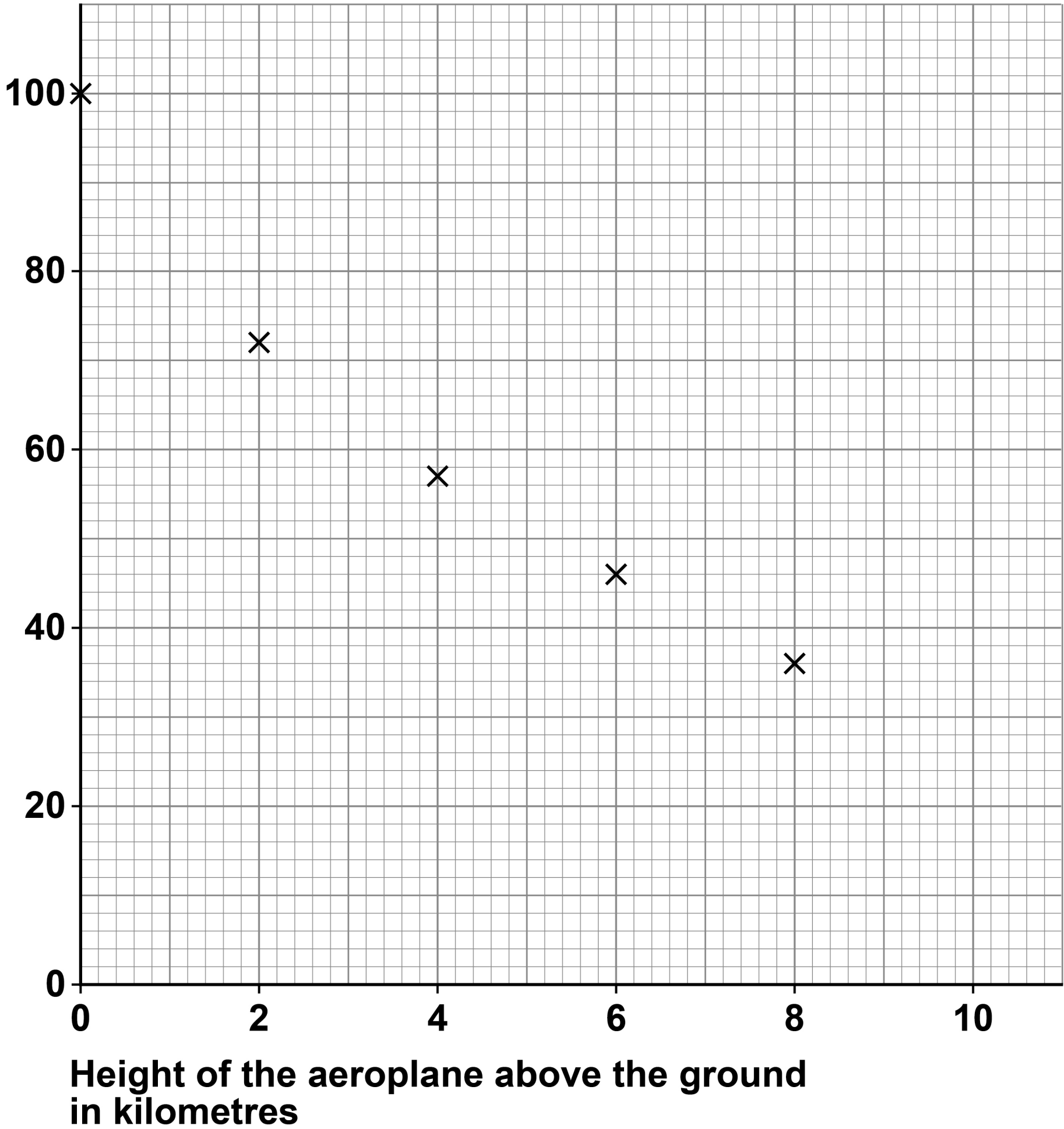
Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km. [2 marks]

Atmospheric pressure = _____ kPa

FIGURE 7

Atmospheric pressure
in kilopascals

Height of the aeroplane above the ground
in kilometres

$\boxed{0}\boxed{2}.\boxed{7}$

What happens to the air surrounding the aeroplane as the height of the aeroplane above the ground increases?
[1 mark]

Tick (✓) ONE box.

☐   **The average density of the air above the aeroplane decreases.**

☐   **The mass of air above the aeroplane increases.**

☐   **The temperature of the air increases.**

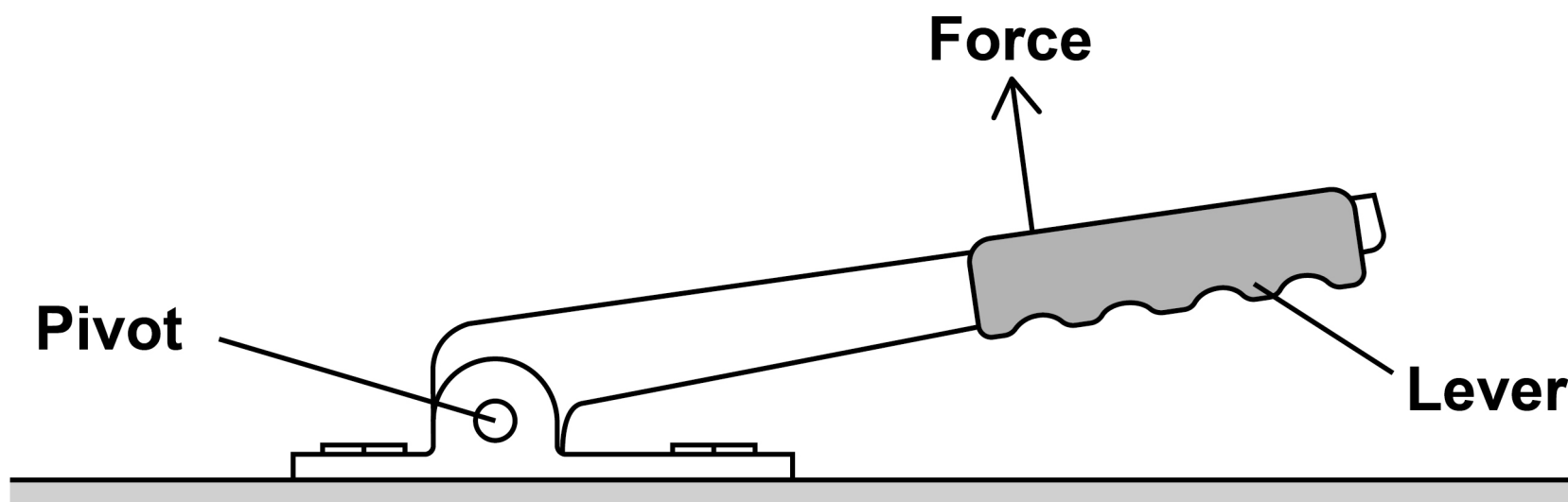☐   **The volume of air below the aeroplane decreases.**

$\boxed{\begin{array}{c} \\ \hline 10 \end{array}}$

0	3

Some cars have a lever that is used to apply the handbrake.

FIGURE 8 shows the handbrake lever in a car.

FIGURE 8

0	3	.	1

The driver applies the force shown in **FIGURE 8**. The force produces a moment about the pivot.

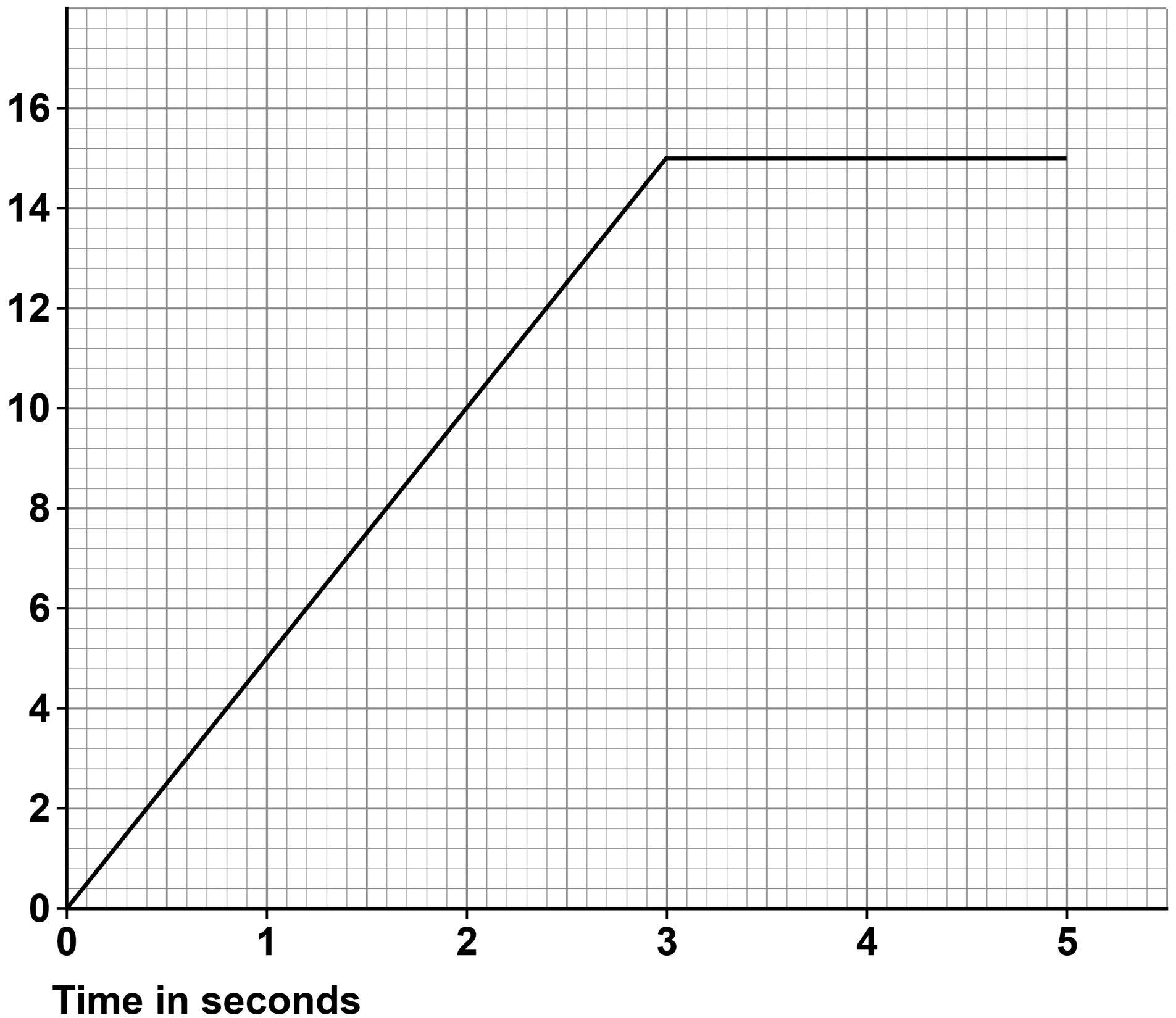How could the driver increase the moment about the pivot without increasing the size of the force? [1 mark]

_____

_____

_____

[Turn over]

The driver releases the handbrake.

FIGURE 9 shows how the velocity of the car changes during the first 5 seconds of a journey.

FIGURE 9

Velocity in m/s

Time in seconds

0 3 . 2

After 3 seconds, the momentum of the car is 24 000 kg m/s.

Calculate the mass of the car.

Use the Physics Equations Sheet. [4 marks]

_____

_____

_____

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_____

_____

_____

_____

Mass = _____ kg

[Turn over]

0	3	.	3

Determine the distance travelled by the car during the first 5 seconds of the journey.

Use FIGURE 9, on page 26. [3 marks]

_____

_____

_____

_____

_____

_____

Distance travelled by the car = _____ m

0 3 . 4

In an emergency the driver needs to apply the brakes suddenly to stop the car quickly.

The driver of the car is distracted.

Explain why the distraction will increase the stopping distance. [3 marks]

_____

_____

_____

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[Turn over]

0 3 . 5

Explain why the temperature of the brakes increases as they are used. **[2 marks]**

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_____

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13

0 4

A megaphone uses a loudspeaker to amplify sounds that are detected by a microphone.

FIGURE 10 shows a megaphone and microphone.

FIGURE 10
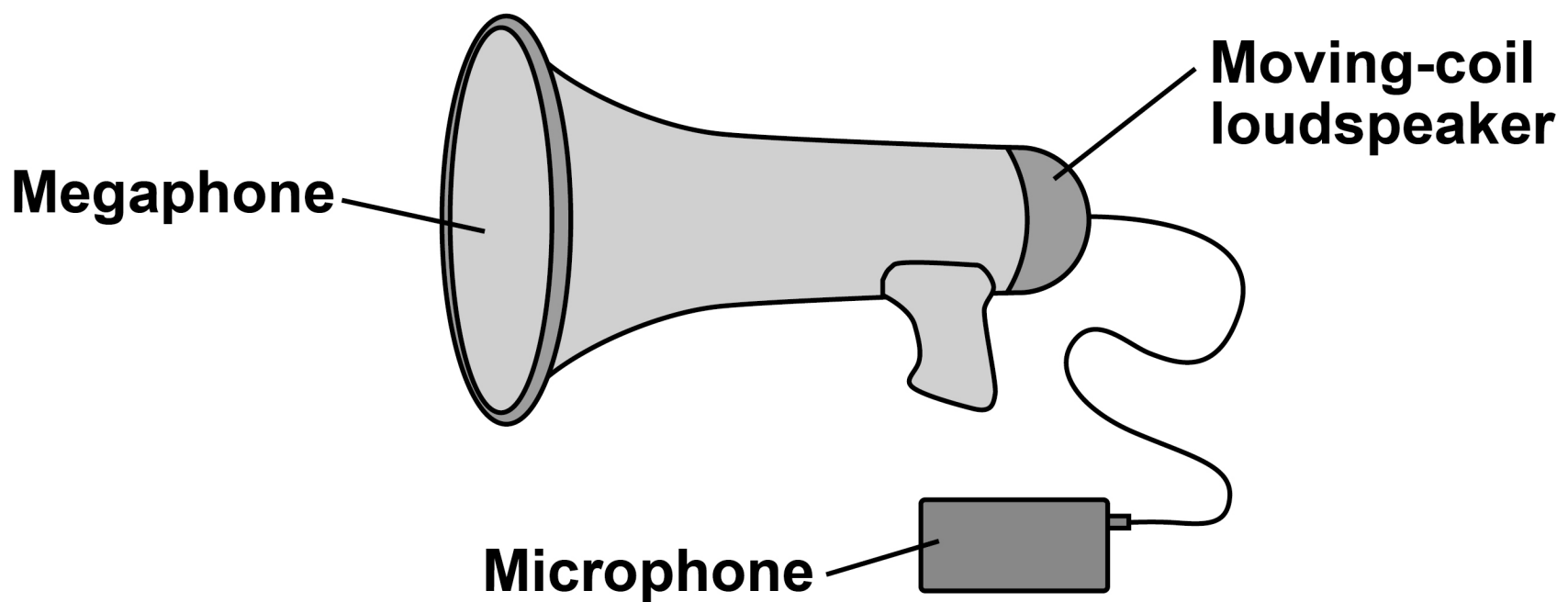
0 4 . 1

Complete the sentence. [1 mark]

The microphone is used to convert the pressure

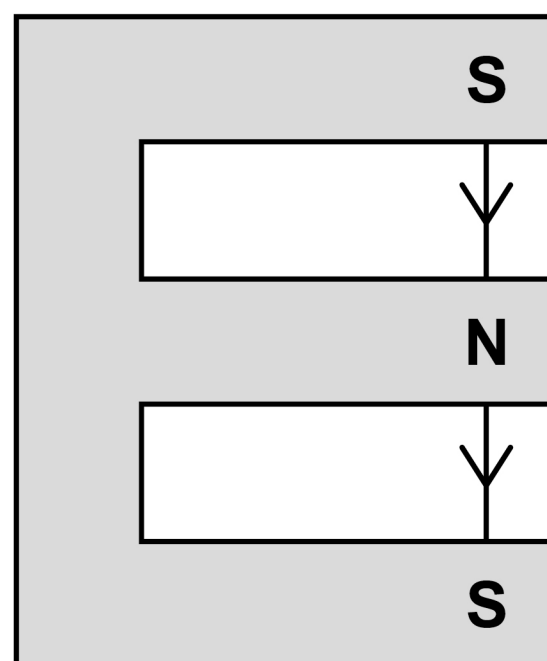variations in sound waves into variations in

_____ .

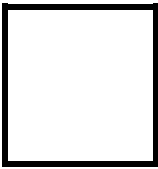[Turn over]

0 4 . 2

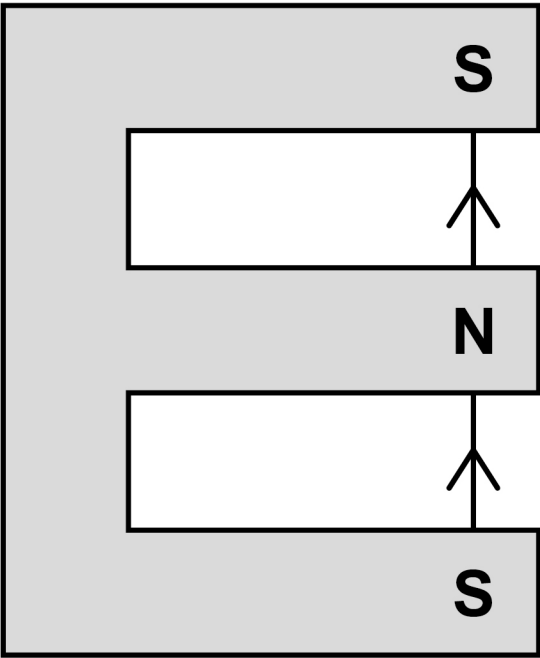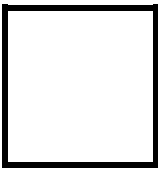The loudspeaker contains a permanent magnet.

Which diagram in FIGURE 11, below and on page 33, shows the direction of the magnetic field between the north pole and the south pole of the magnet?

The magnets are shown in cross-section. [1 mark]

Tick (✓) ONE box.

FIGURE 11
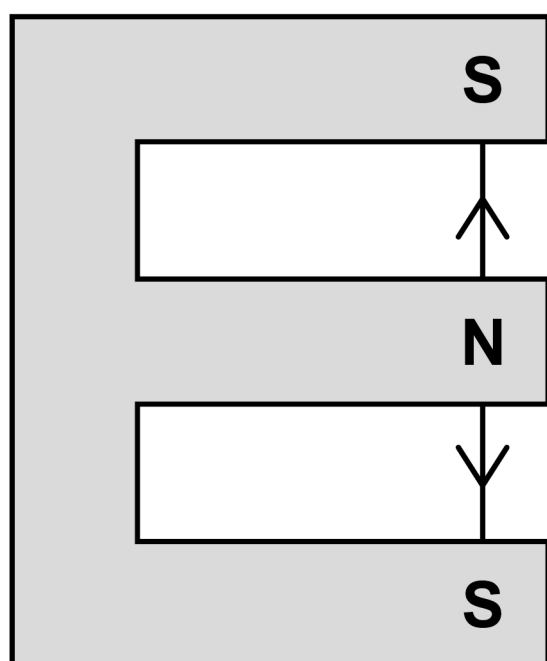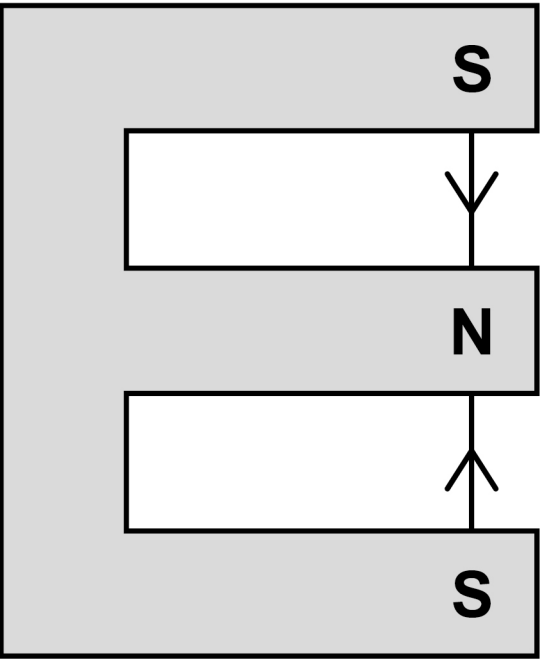
[Turn over]

0	4	.	3

Some magnets are permanent magnets and some are induced magnets.

What is an induced magnet? [1 mark]

_____

_____

_____

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[Turn over]

FIGURE 12 shows the parts of the loudspeaker in the megaphone.

FIGURE 12

Permanent magnet

Coil

S

N

S

Movement

Signal from microphone
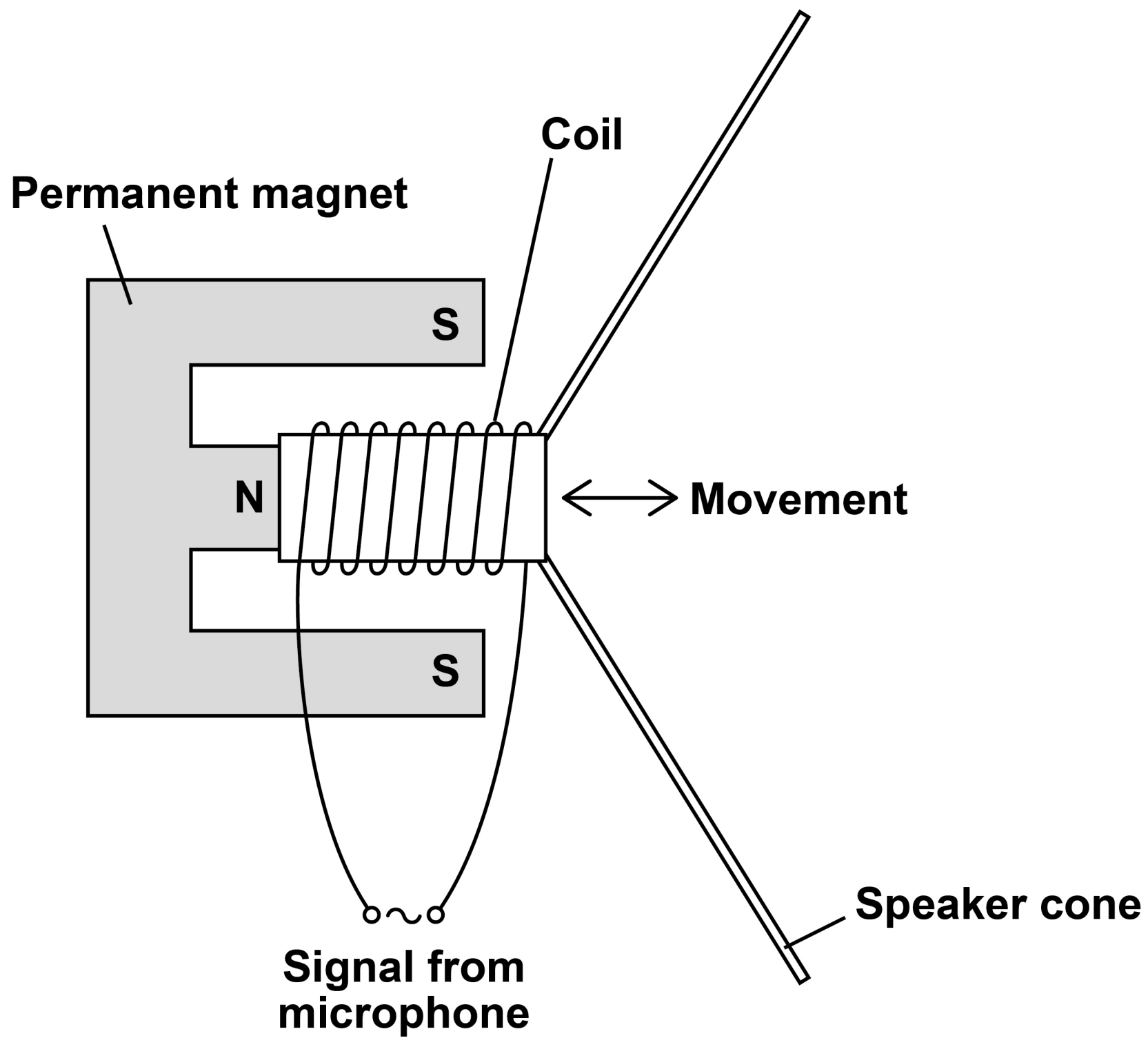
Speaker cone

A current in the coil of the loudspeaker causes the coil to move.

| 0 | 4 | . | 4 |

What is the name of the effect that causes the coil to move?
[1 mark]

Tick (✓) ONE box.

☐   **Electromagnet effect**

☐   **Induction effect**

☐   **Motor effect**

☐   **Speaker effect**

[Turn over]

0 4 . 5

When the current in the coil is 16 mA, the force on the coil is 0.013 N.

The length of the wire that makes up the coil is 6.5 m.

Calculate the magnetic flux density around the coil in the electromagnet.

Use the Physics Equations Sheet. [4 marks]

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Magnetic flux density = _____ T

0 4 . 6

Megaphones can produce very loud sounds.

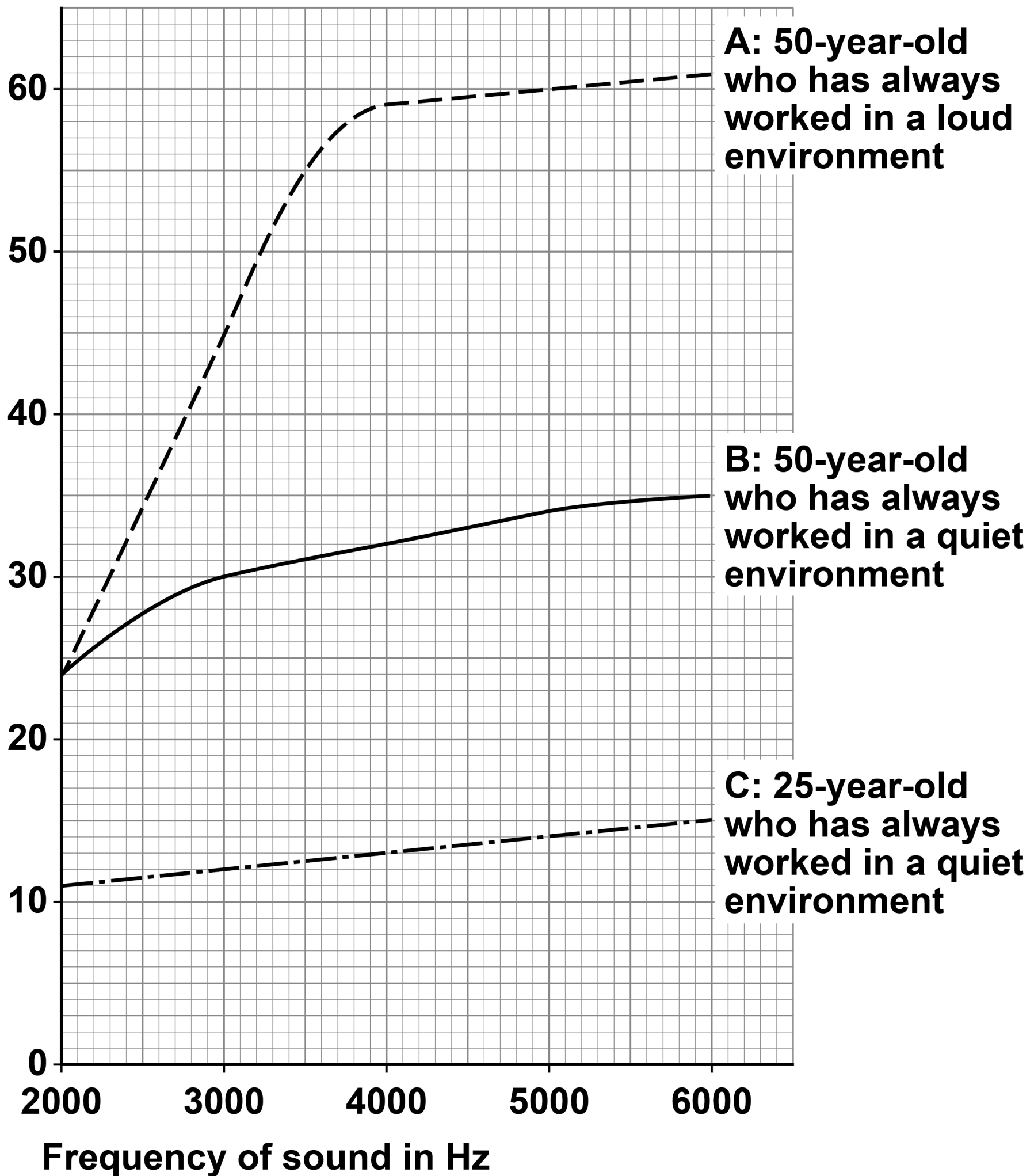A person's hearing can be affected by age and by working in a loud environment.

FIGURE 13, on page 40, shows how frequency affects the minimum sound level that can be heard by three different people, A, B and C.

[Turn over]

FIGURE 13

Minimum sound level that can
be heard in arbitrary units

A: 50-year-old
who has always
worked in a loud
environment

B: 50-year-old
who has always
worked in a quiet
environment

C: 25-year-old
who has always
worked in a quiet
environment

Frequency of sound in Hz

Compare how different factors affect the minimum sound level that these people can hear. [4 marks]

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_____

[Turn over]

$$\overline{}$$
$$\boxed{12}$$

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[Turn over]

0 5

FIGURE 14 shows some bumper cars.

Bumper cars are designed to withstand collisions at low speeds.

FIGURE 14

Bumper car

Flexible bumper

Barrier

0 5 . 1

During a collision between a bumper car and the barrier, the bumper car and barrier act as a closed system.

What is meant by a 'closed system'? [1 mark]

_____

_____

_____

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0 5 . 2

How does Newton's Third Law of motion apply to the collision between the bumper car and the barrier? [1 mark]

_____

_____

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_____

[Turn over]

| 0 | 5 | . | 3 |

During the collision, the change in momentum of the bumper car is 700 kg m/s.

The time taken for the collision is 0.28 s.

Calculate the force on the bumper car during the collision.

Use the Physics Equations Sheet. [2 marks]

_____

_____

_____

_____

_____

_____

Force = _____ N

0 5 . 4

The bumper car has a flexible bumper.

Explain how the flexible bumper reduces the risk of injury to the people in the bumper car during the collision. [3 marks]

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[Turn over]

$\boxed{0}\boxed{5}.\boxed{5}$

A bumper car moved with an initial constant velocity and then accelerated at 2.0 m/s^2.

While accelerating, the bumper car travelled a distance of 1.5 m.

The final velocity of the bumper car was 2.5 m/s.

Calculate the initial constant velocity of the bumper car.

Use the Physics Equations Sheet. [3 marks]

_____

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_____

Initial constant velocity = _____ m/s

$\boxed{\dfrac{}{10}}$

0 6

FIGURE 15 shows the Hubble Space Telescope orbiting the Earth.

FIGURE 15
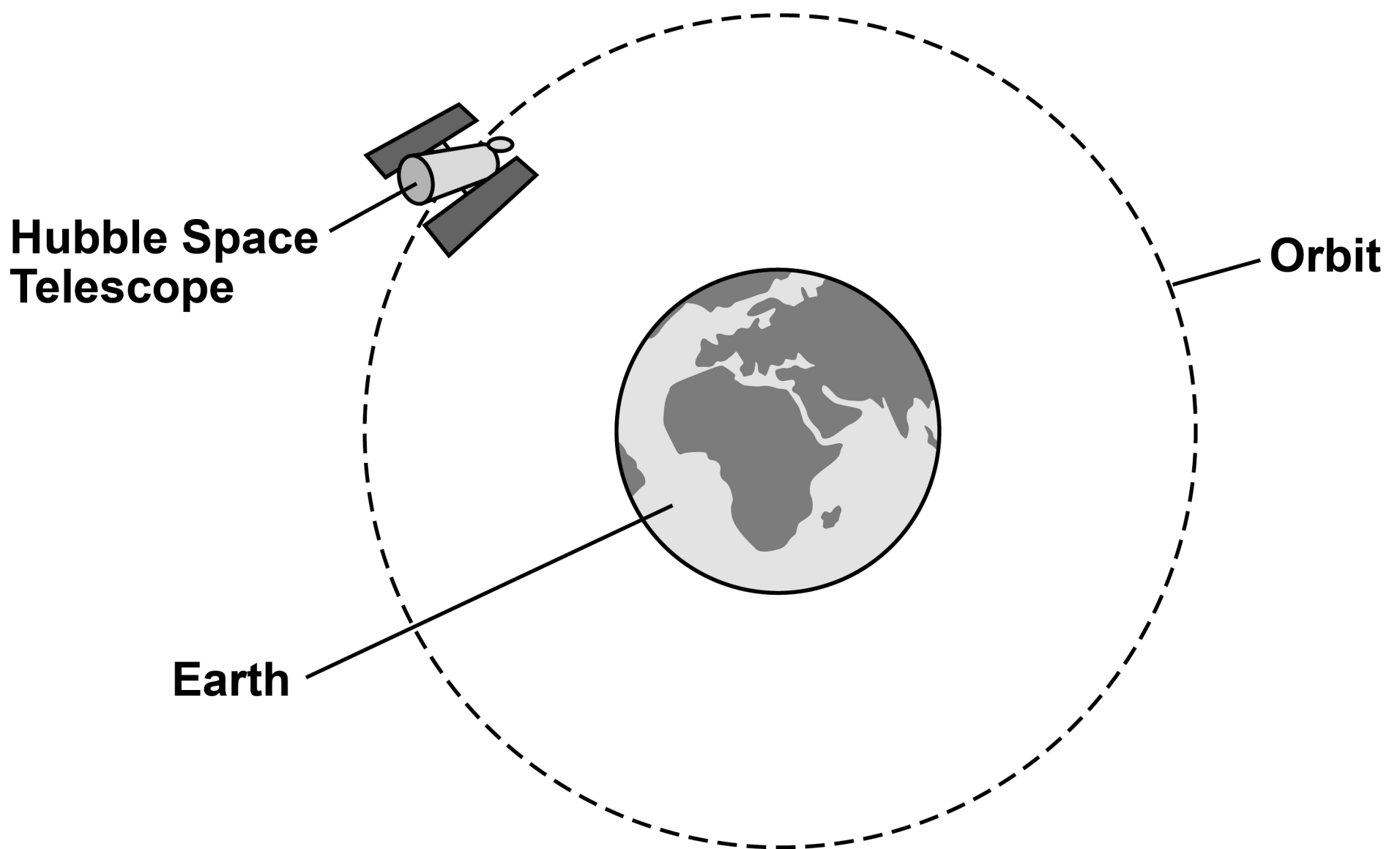
0 6 . 1

What name is given to objects that orbit a planet? [1 mark]

_____

_____

[Turn over]

0 6 . **2**

A space telescope uses microwaves to communicate with the Earth.

A microwave has a wavelength of 12.5 cm.

The speed of microwaves through space is 3.0 × 10^8 m/s.

Calculate the frequency of the microwave.

Use the Physics Equations Sheet.

Give your answer in standard form. [5 marks]

_____

_____

_____

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Frequency (in standard form) = _____ Hz

[Turn over]

0 6 . 3

Explain the effect of the Earth's gravitational force on the motion of the Hubble Space Telescope. [3 marks]

_____

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[Turn over]

06.4

The Hubble Space Telescope can detect visible light from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

FIGURE 16 shows the visible light spectra from the Sun and two galaxies.

FIGURE 16
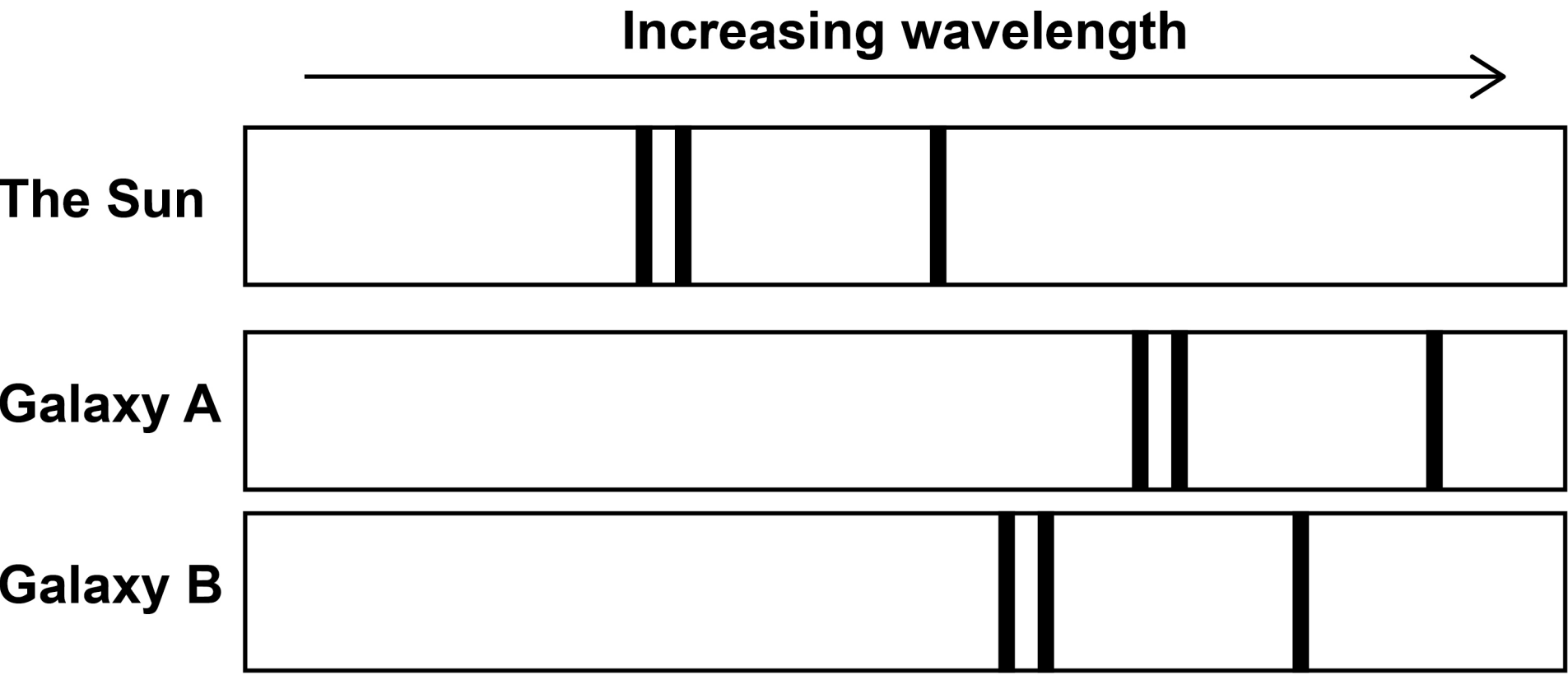
Explain what conclusions can be made about galaxies A and B. [3 marks]

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[Turn over]

$\overline{12}$

0 7

A student investigated the behaviour of light.

The student used a mirror with a smooth surface to investigate reflection.

FIGURE 17 shows the equipment used.

FIGURE 17

Mirror

Protractor printed on paper

Ray box
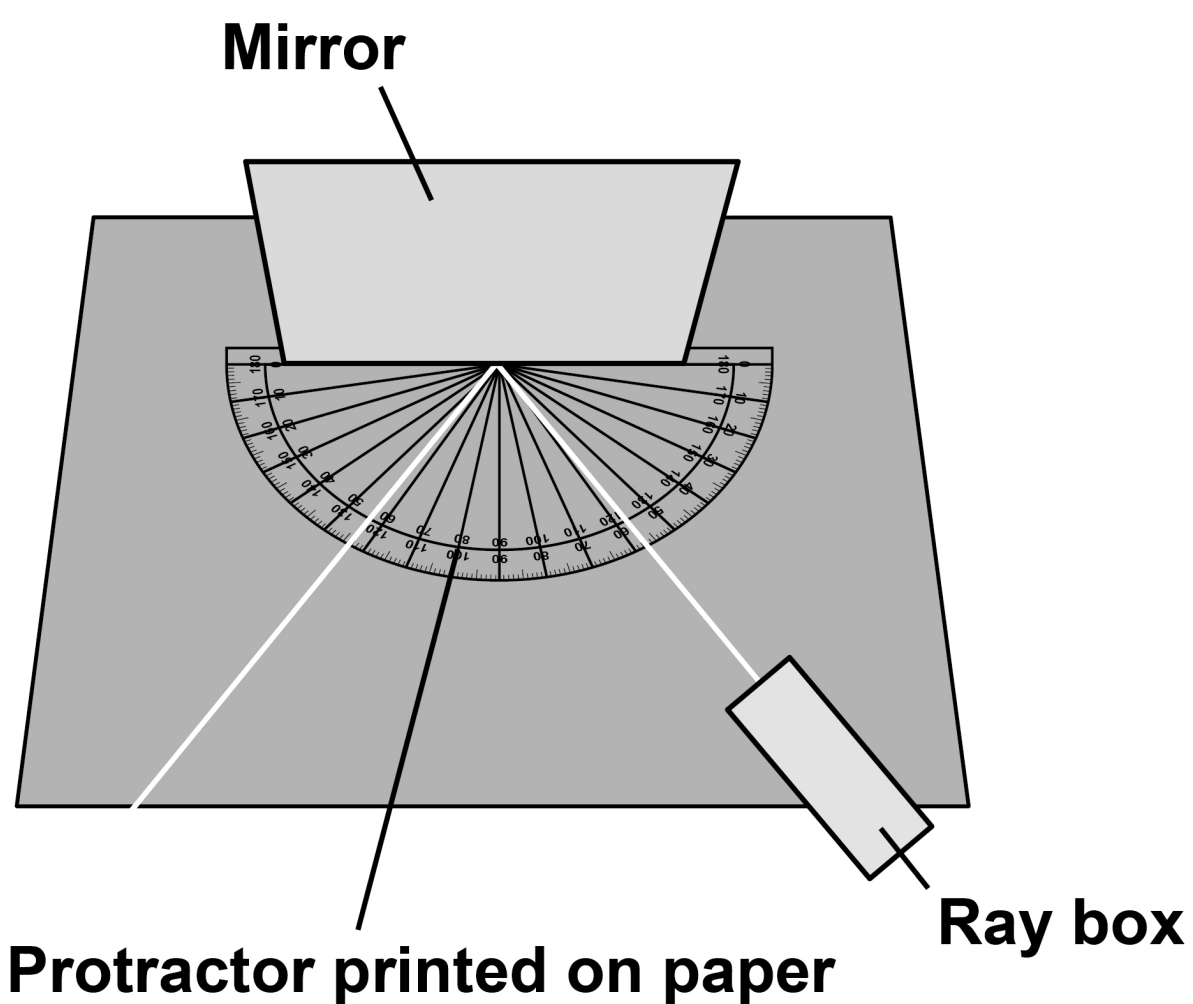
0 7 . 1

What name is given to reflection from a smooth surface?
[1 mark]

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[Turn over]

The student measured the angle of reflection for different angles of incidence.

TABLE 2 shows the results.

TABLE 2

ANGLE OF INCIDENCE IN DEGREES	ANGLE OF REFLECTION IN DEGREES			
	Test 1	Test 2	Test 3	Mean
10	8	10	11	10
20	20	21	20	20
30	28	29	32	30
40	39	41	41	40
50	49	50	52	50

| 0 | 7 | . | 2 |

What conclusion can be made from the results in TABLE 2?
[1 mark]

_____

_____

_____

0	7	.	3

What type of error caused the variation in the results for the angle of reflection?

Suggest ONE cause of this error. [2 marks]

Type of error _____

Cause of error _____

_____

_____

_____

[Turn over]

The student also investigated the refraction of light.

0 7 . 4

FIGURE 18 shows the path of a ray of light through a glass block.

FIGURE 18

Glass | Air
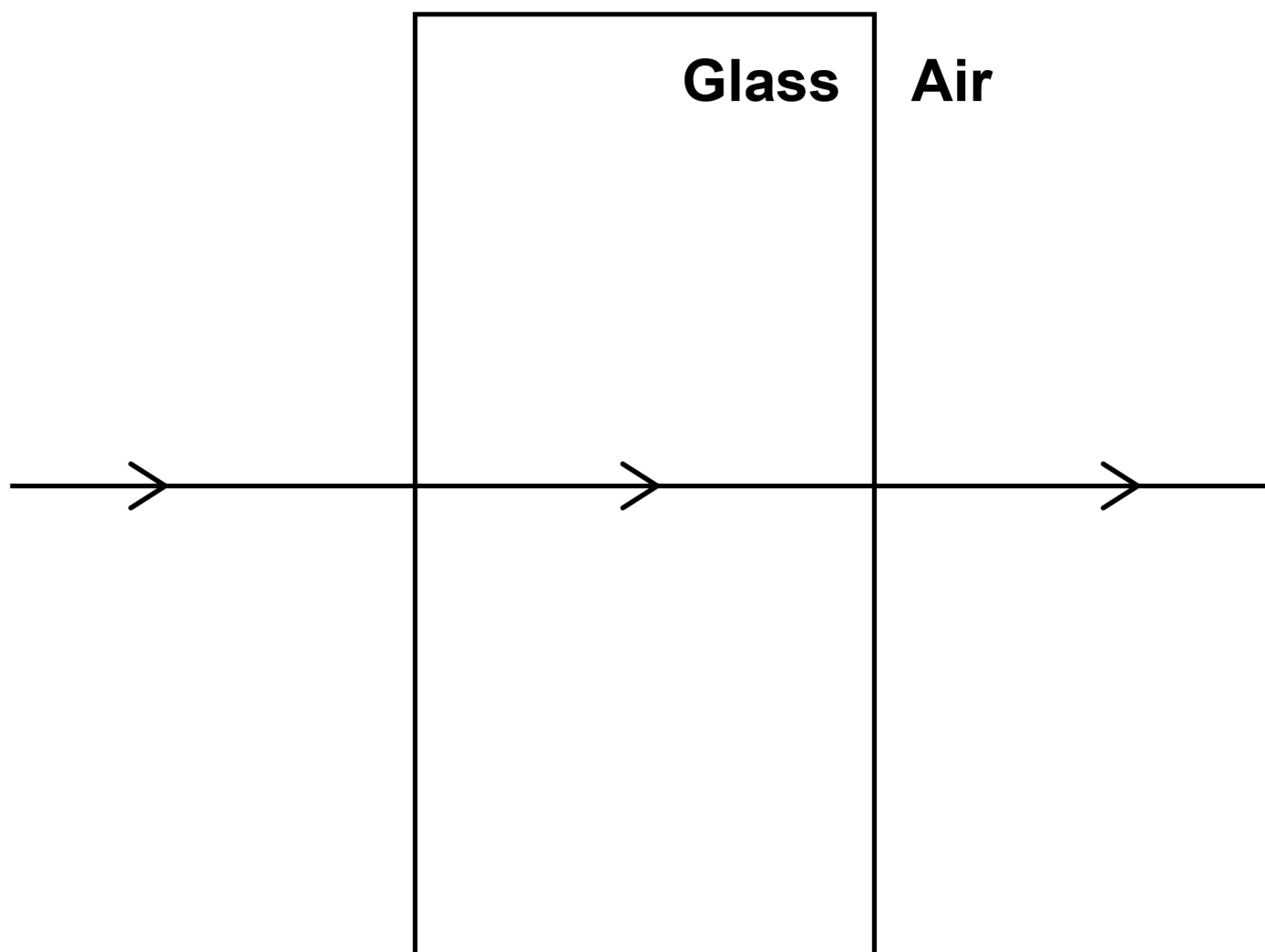
Why has refraction NOT occurred? [1 mark]

_____

_____

_____

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[Turn over]

| 0 | 7 | . | 5 |

The student measured the angle of refraction for different angles of incidence.

FIGURE 19 shows the protractor used.

FIGURE 19
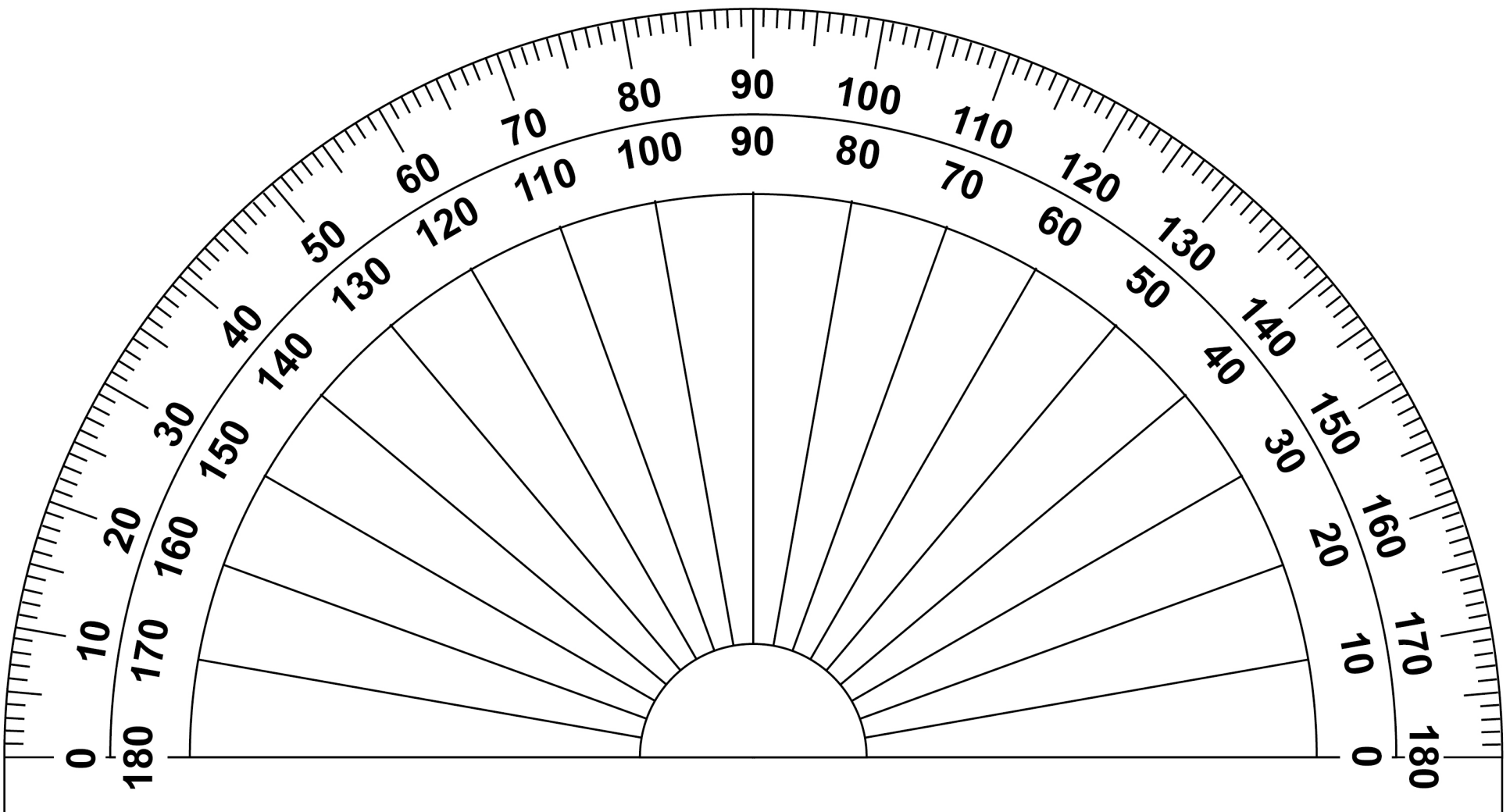
When the angle of incidence was 10° the student measured the angle of refraction four times.

The student recorded the measurements as:

6.0°   **6.3°**   **6.4°**   **5.8°**

Explain why the student should NOT have recorded these results when using the protractor in FIGURE 19 to make the measurements. [2 marks]

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_____

_____

_____

_____

[Turn over]

0 7 . 6

FIGURE 20 shows what happens to wave fronts as they pass across the boundary between air and glass.

FIGURE 20
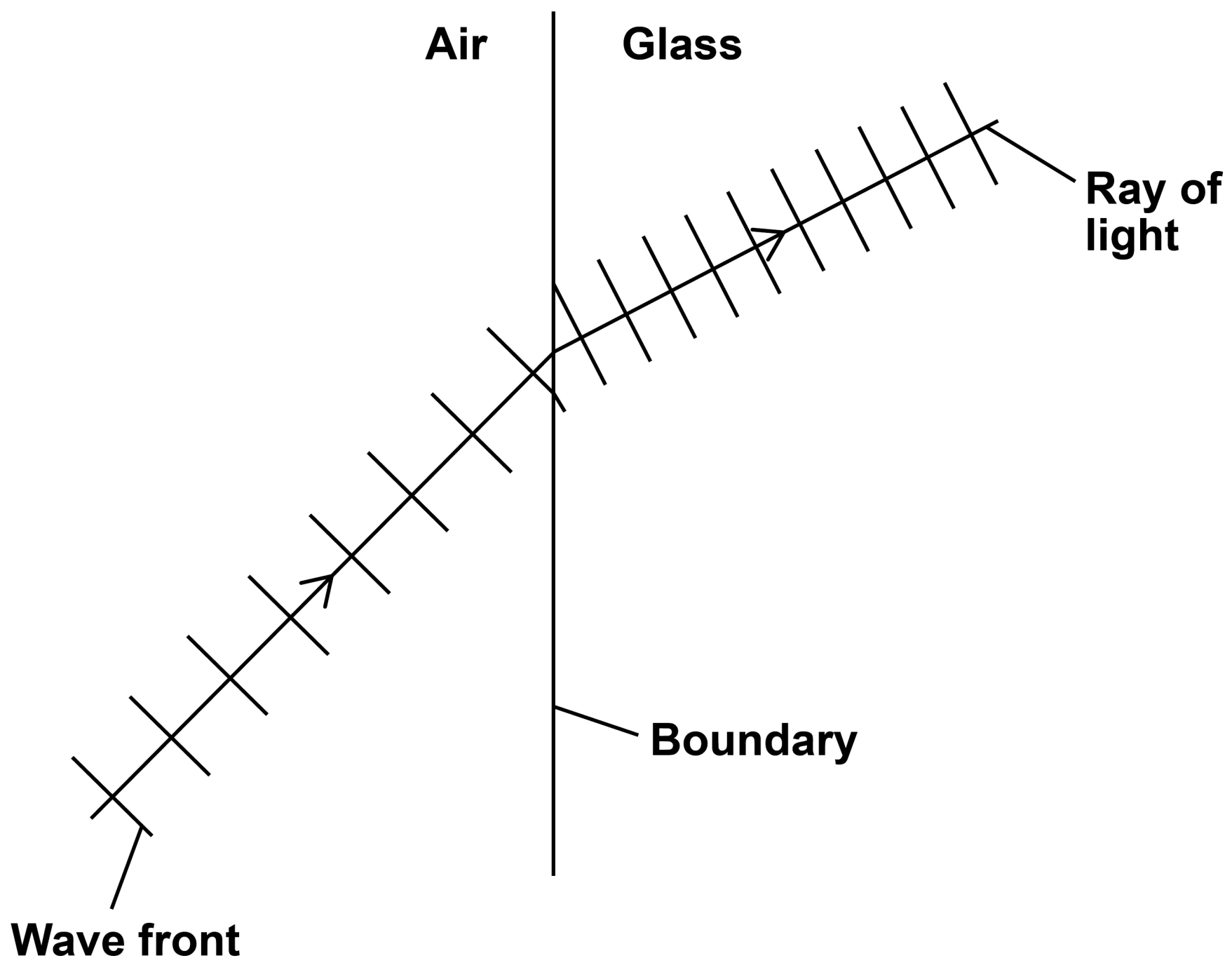
Explain in terms of the wave fronts, why refraction happens at the boundary between air and glass. [3 marks]

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[Turn over]

$$\frac{}{\boxed{10}}$$

0 8

FIGURE 21 shows a transformer used to power a lamp using the mains electricity supply.

FIGURE 21

Core

230 V a.c.
mains electricity
supply

Primary coil
2000 turns

Secondary coil
40 turns
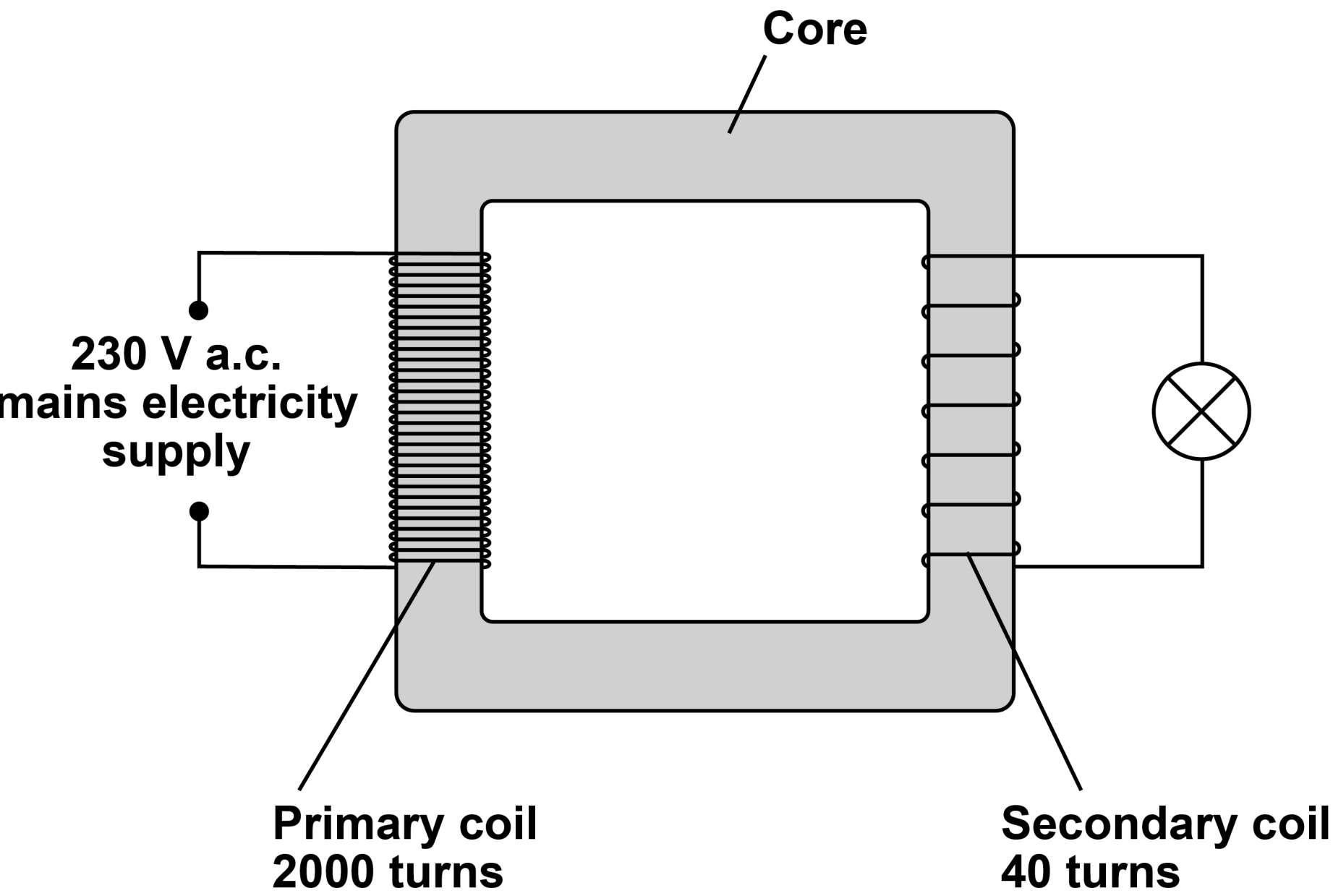
0	8	.	1

What material is used to make the core of the transformer?

Give the reason for using this material. [2 marks]

Material _____

Reason _____

_____

_____

[Turn over]

08 . **2**

Determine the current in the secondary coil when the power output of the transformer is 6.9 W.

The transformer is 100% efficient.

Use the Physics Equations Sheet. [5 marks]

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_____

_____

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_____

Current in the secondary coil = _____ A

[Turn over]

7
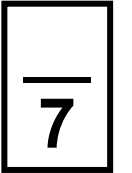
0	9

A dynamo is used to generate an electric current.

FIGURE 22 shows the inside parts of the dynamo connected to a lamp.

FIGURE 22
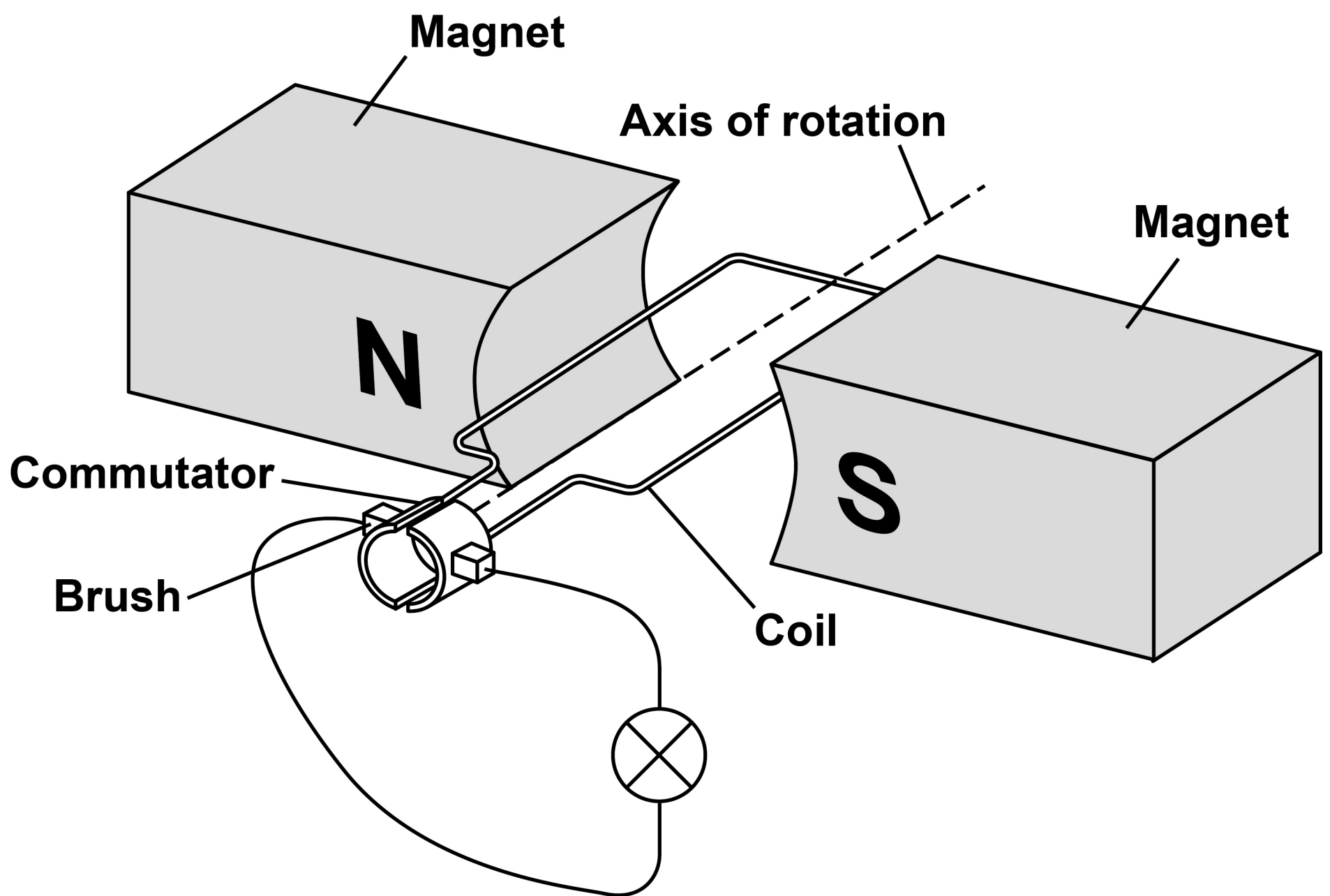
0	9	.	1

The coil is rotated.

Explain why a direct current is induced in the coil. [5 marks]

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_____

_____

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_____

_____

_____

_____

_____

_____

7 1

| 0 | 9 | . | 2 |

Sketch a graph on FIGURE 23 to show how the potential difference generated across the lamp varies for TWO complete revolutions of the dynamo coil. [1 mark]

FIGURE 23

**Potential
difference**

Time
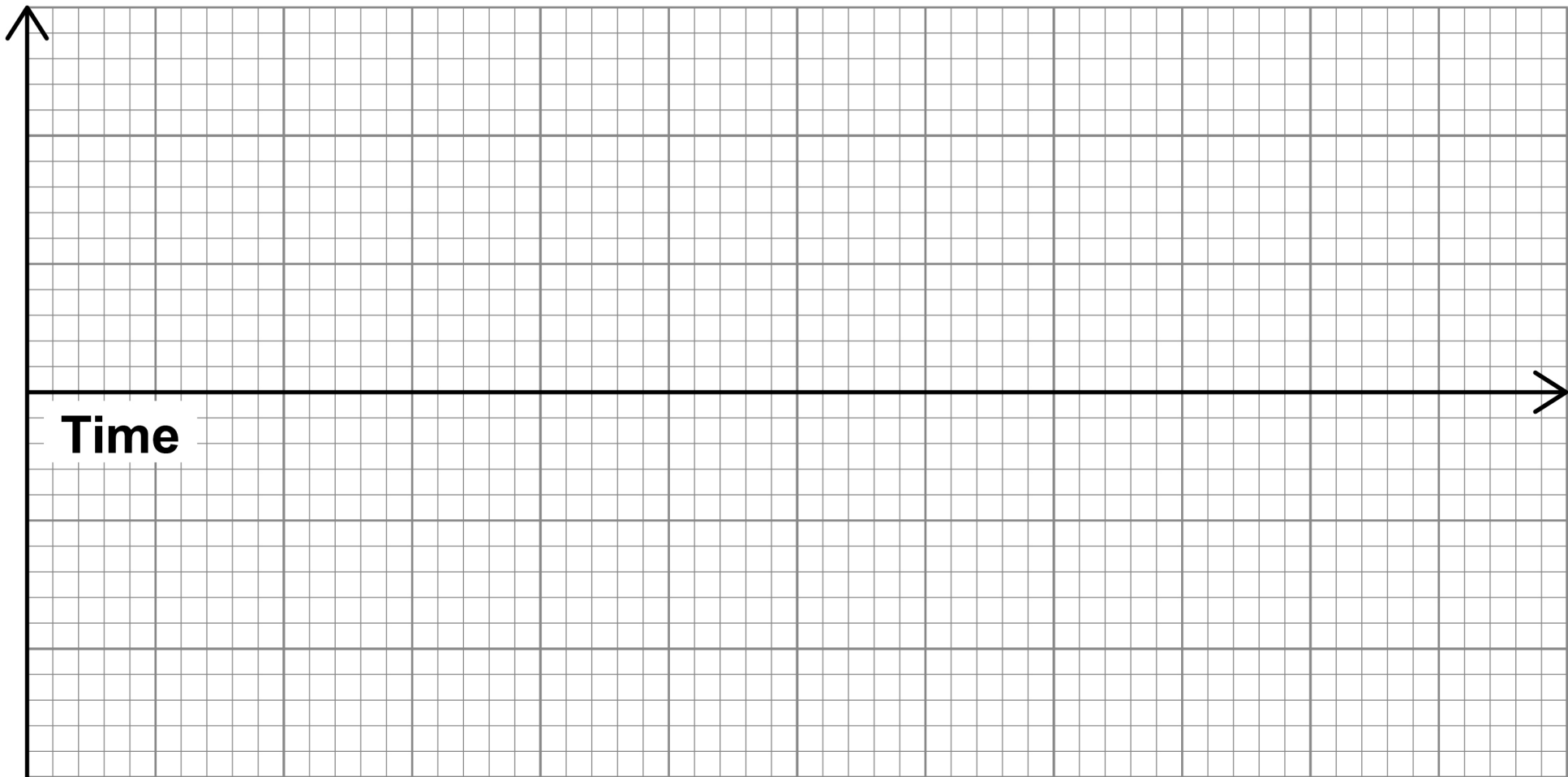
0 9 . 3

The lamp is disconnected from the dynamo.

Explain why the dynamo becomes much easier to turn.
[3 marks]

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_____

END OF QUESTIONS

9

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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