Please write clearly in block capitals.

Centre number | | | | | Candidate number | | | |

Surname ______________________________

Forename(s) ______________________________

Candidate signature ______________________________
I declare this is my own work.

GCSE
PHYSICS

H

Higher Tier Paper 2

Friday 16 June 2023 Morning Time allowed: 1 hour 45 minutes

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or 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.

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

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 Infrared waves are transverse waves.

0 1 . 1 Complete the sentence.

[1 mark]

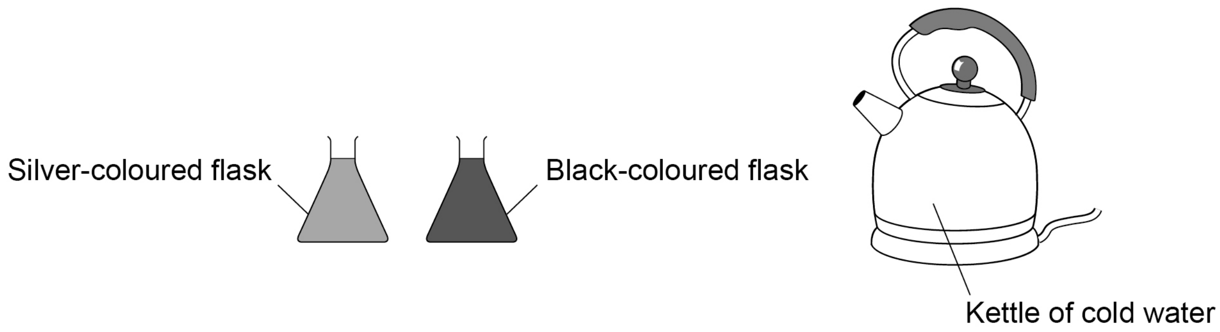
In a transverse wave, the direction of oscillation is ______________________________

to the direction of energy transfer by the wave.

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



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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]

Question 1 continues on the next page

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0 1 . 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 ____

____

Do not write outside the box

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

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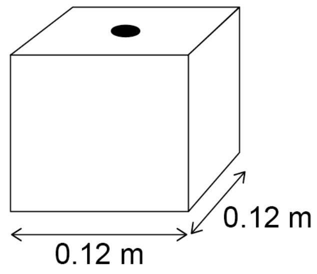
Figure 2 shows one of the cubes. The cube is filled with water.

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

Figure 2



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 = $\frac{\text{force}}{\text{area}}$ ☐

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

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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]

Force = ____________________ N

17

Turn over for the next question

Turn over ►

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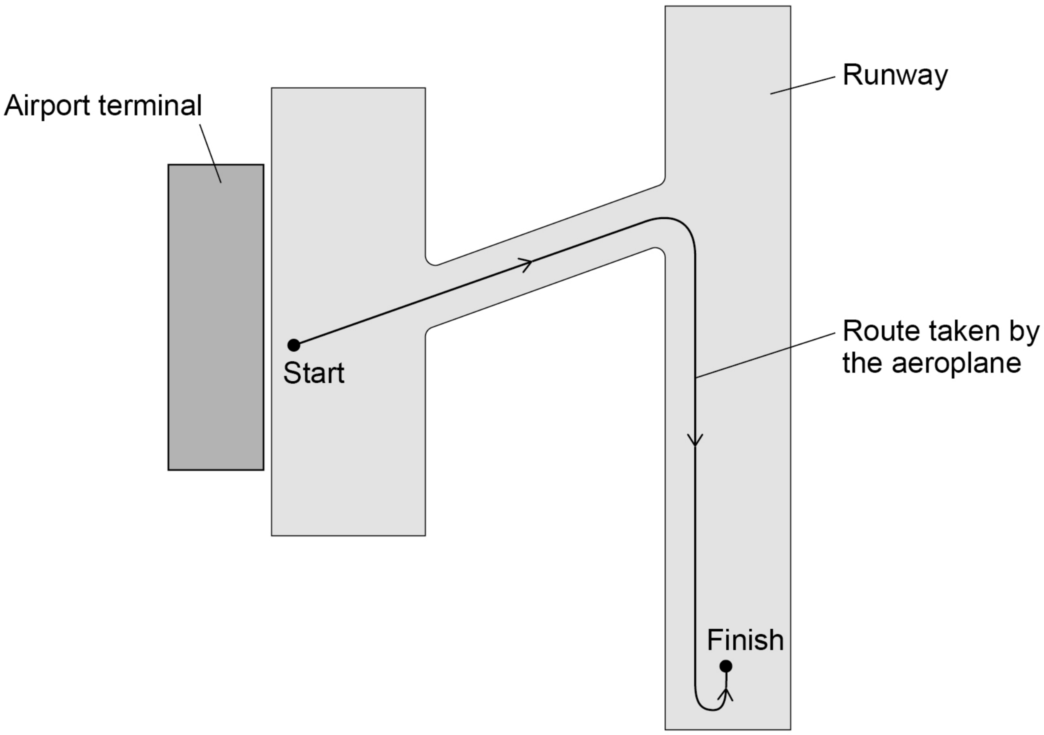
0 2 **Figure 3** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

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]

____

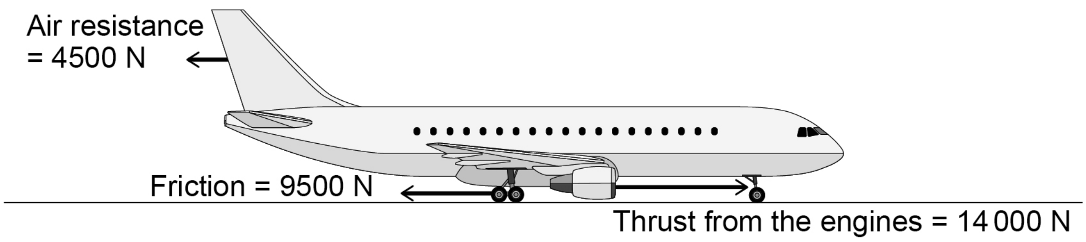
____

____

Displacement = ____________________ m

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



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.

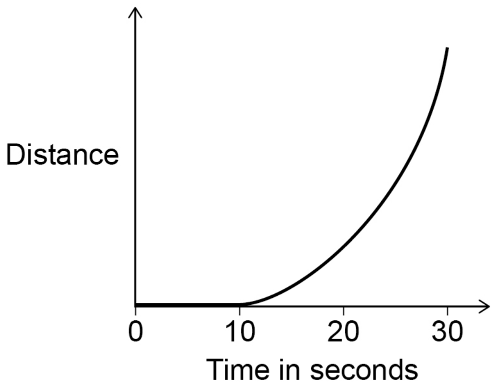
[1 mark]

____

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.

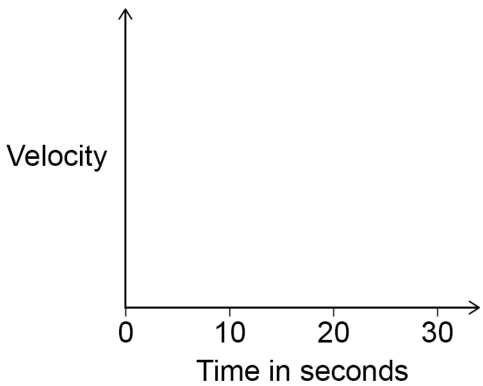
Figure 5



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 6**.

[2 marks]

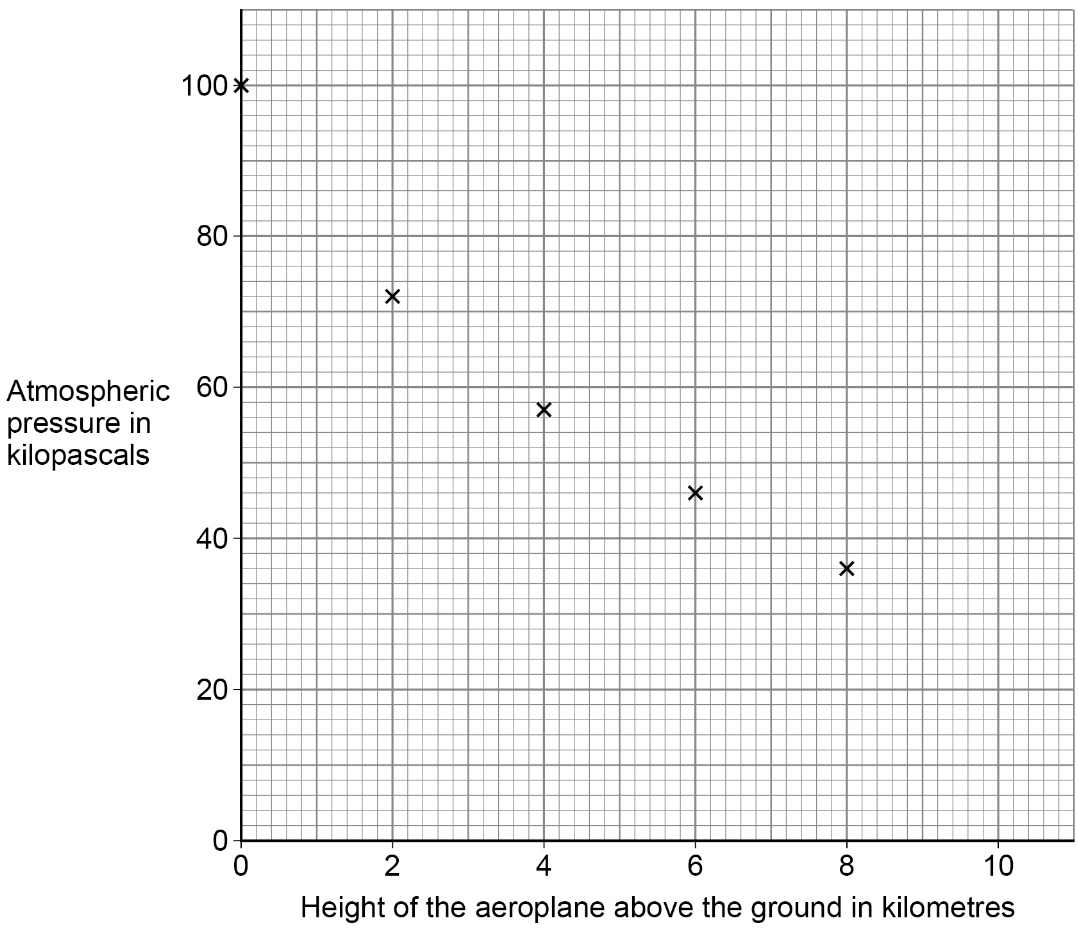
Figure 6



0 2 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 7 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 7



Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km.

[2 marks]

Atmospheric pressure = ____________________ kPa

Question 2 continues on the next page

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0 2 . 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. ☐

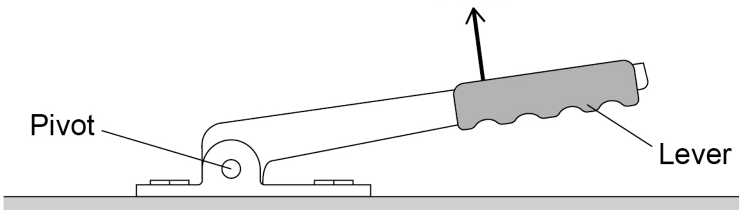
The volume of air below the aeroplane decreases. ☐

10

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]

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Question 3 continues on the next page

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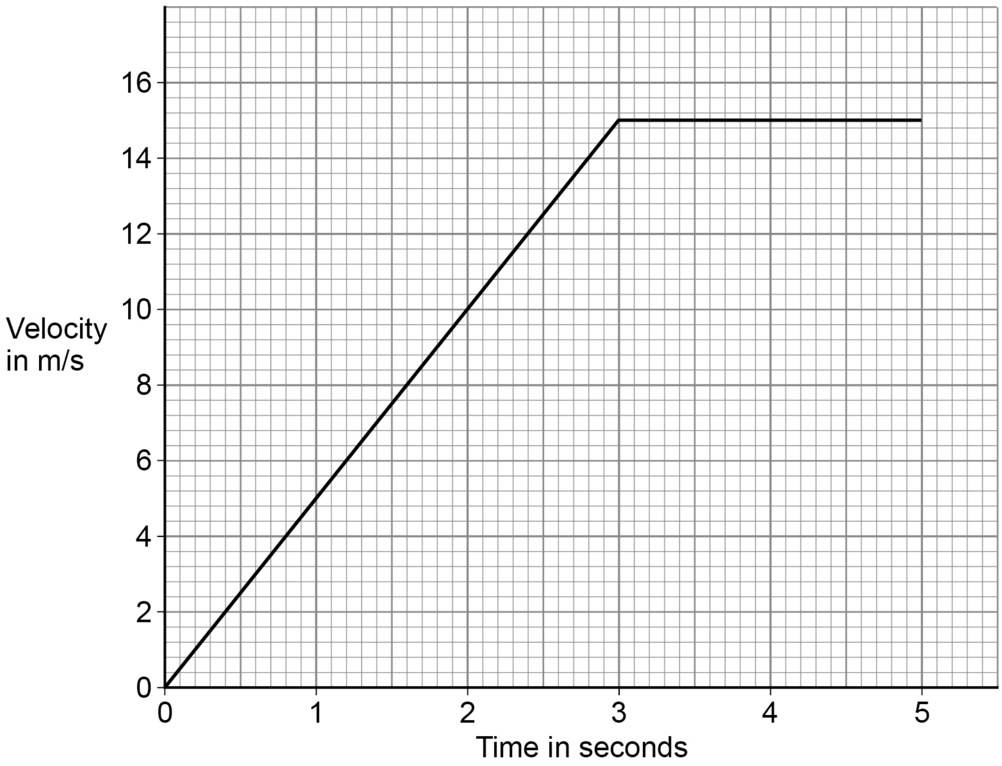
The driver releases the handbrake.

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

Figure 9



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]

Mass = ____________________ kg

Do not write outside the box

0 3 . 3 Determine the distance travelled by the car during the first 5 seconds of the journey.

Use **Figure 9**.

[3 marks]

Distance travelled by the car = ______________________ m

Question 3 continues on the next page

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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]

0 3 . 5 Explain why the temperature of the brakes increases as they are used.

[2 marks]

13

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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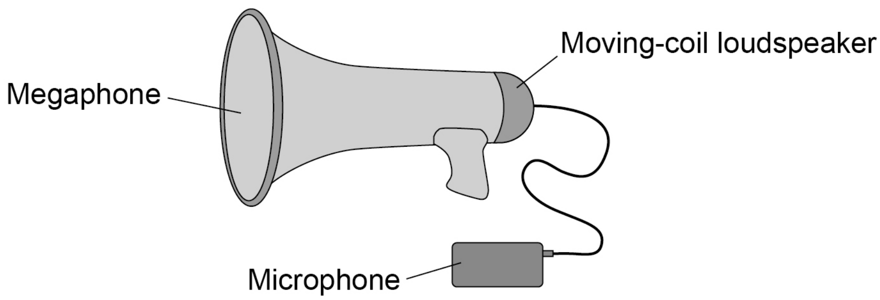
0 4 A megaphone uses a loudspeaker to amplify sounds that are detected by a microphone.

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 ________________________________ .

Do not write outside the box

0 4 . 2 The loudspeaker contains a permanent magnet.

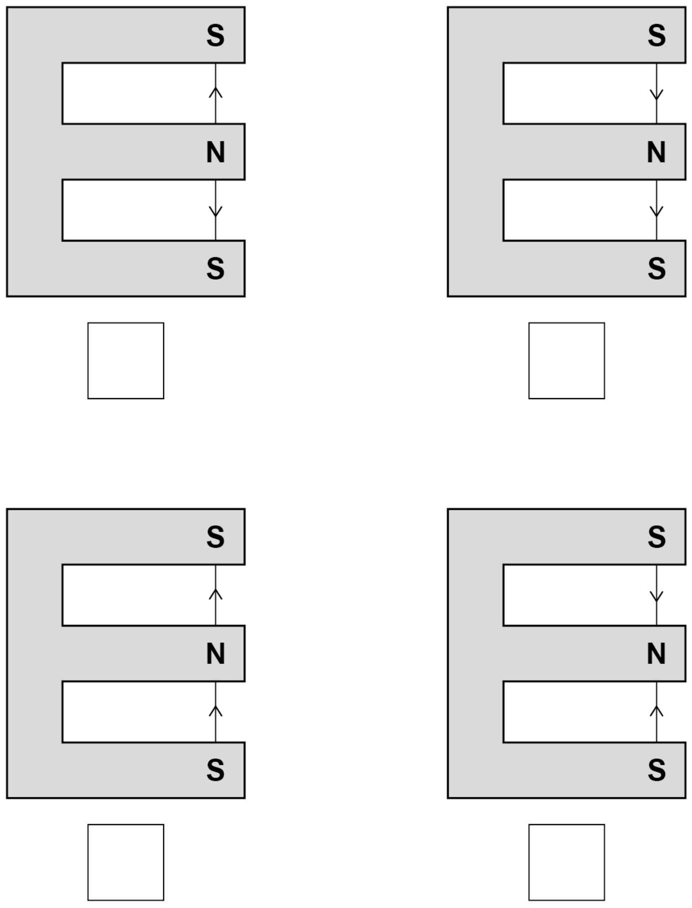
Which diagram in **Figure 11** shows the direction of the magnetic field between the north pole and the south pole of the magnet?

The magnets are shown in cross-section.

[1 mark]

Tick (✓) **one** box.

Figure 11



0 4 . 3 Some magnets are permanent magnets and some are induced magnets.

What is an induced magnet?

[1 mark]

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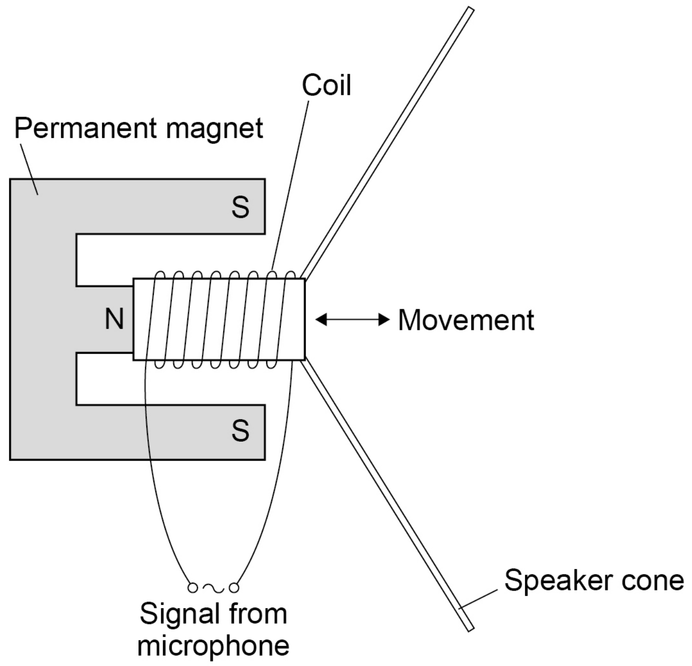
Do not write outside the box

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

Figure 12



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 ☐

Do not write outside the box

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]

Magnetic flux density = ______________________ T

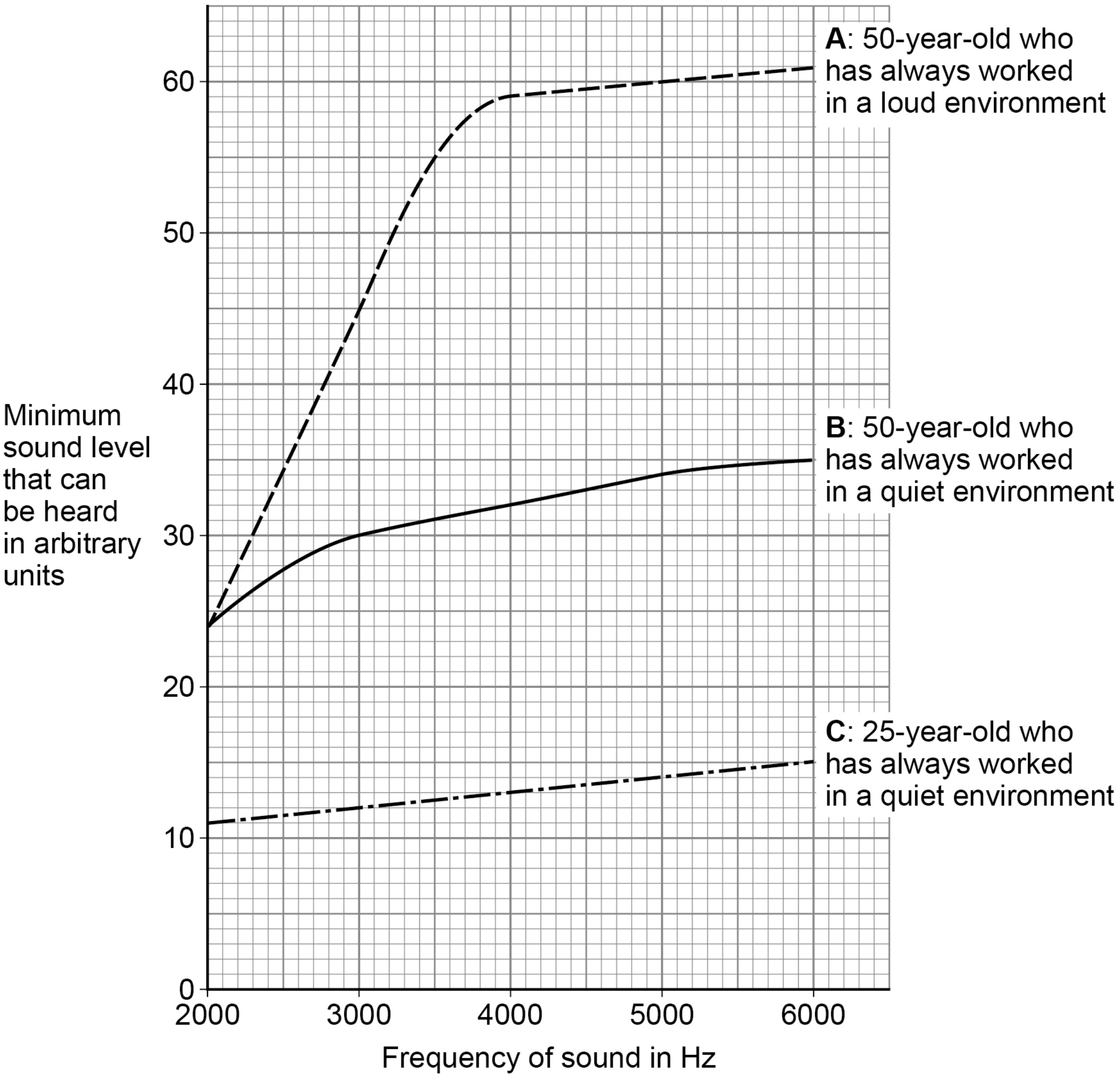
Question 4 continues on the next page

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 shows how frequency affects the minimum sound level that can be heard by three different people, **A**, **B** and **C**.

Figure 13



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Compare how different factors affect the minimum sound level that these people can hear.

[4 marks]

12

Turn over for the next question

0 5 **Figure 14** shows some bumper cars.

Bumper cars are designed to withstand collisions at low speeds.

Figure 14

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]

Do not write outside the box

0 5 . 2 How does Newton's Third Law of motion apply to the collision between the bumper car and the barrier?

[1 mark]

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

Question 5 continues on the next page

Do not write outside the box

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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0 5 . 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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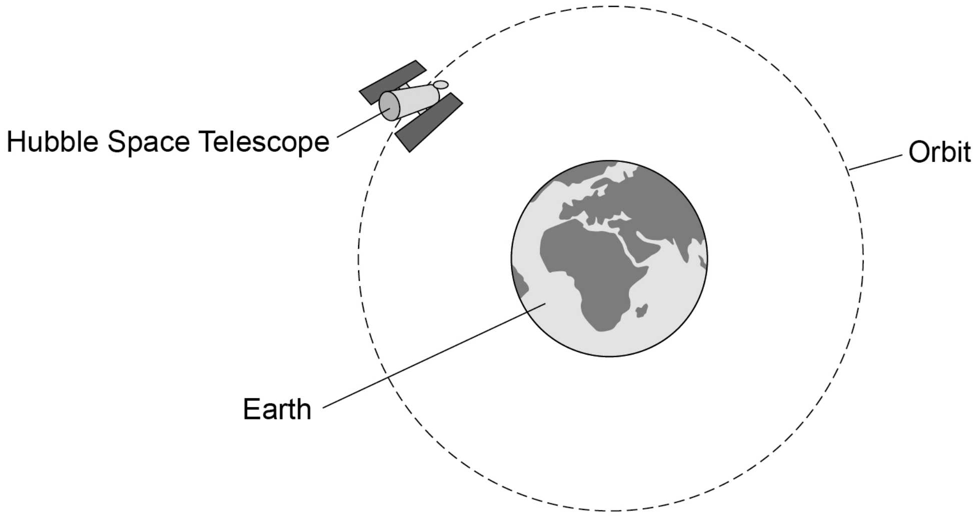
Initial constant velocity = ____________________ m/s

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]

Question 6 continues on the next page

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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]

Frequency (in standard form) = ______________________ Hz

0 6 . 3 Explain the effect of the Earth's gravitational force on the motion of the Hubble Space Telescope.

[3 marks]

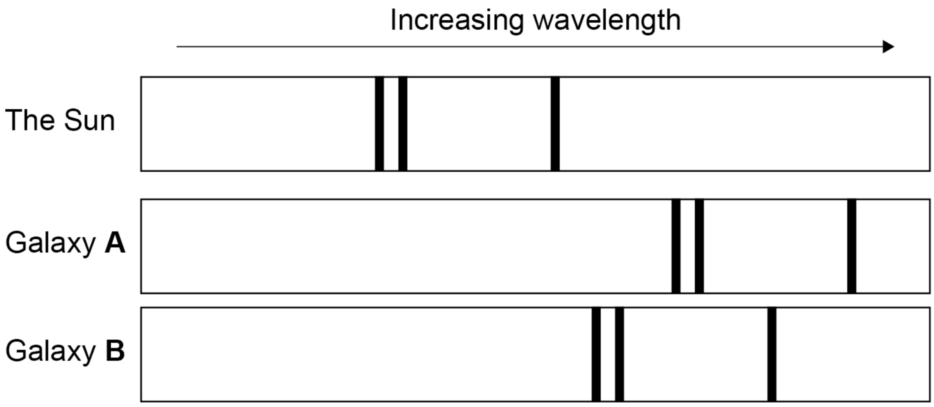
Do not write outside the box

0 6 . 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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12

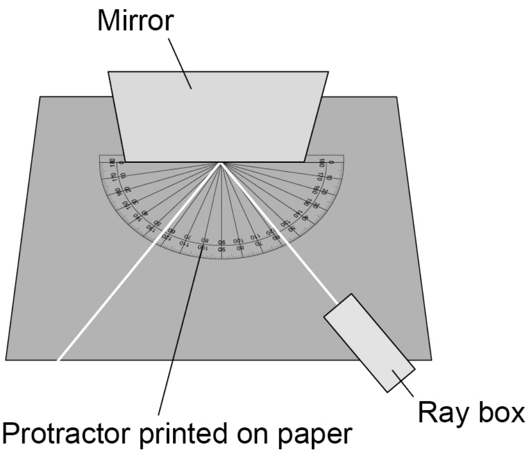
Turn over for the next question

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



0 7 . 1 What name is given to reflection from a smooth surface?

[1 mark]

____

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]

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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 ______________________

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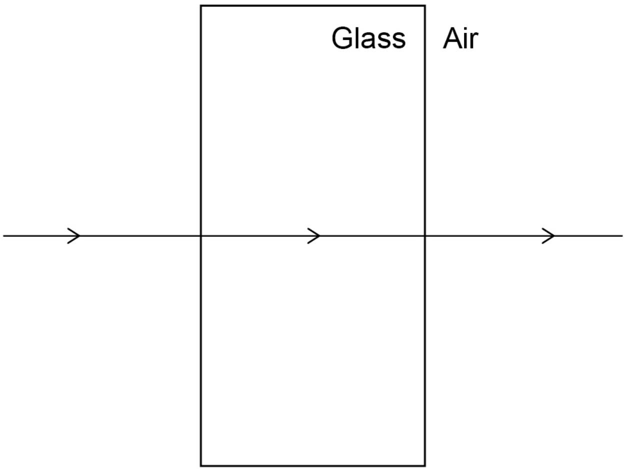
The student also investigated the refraction of light.

0 7 . 4 **Figure 18** shows the path of a ray of light through a glass block.

Figure 18



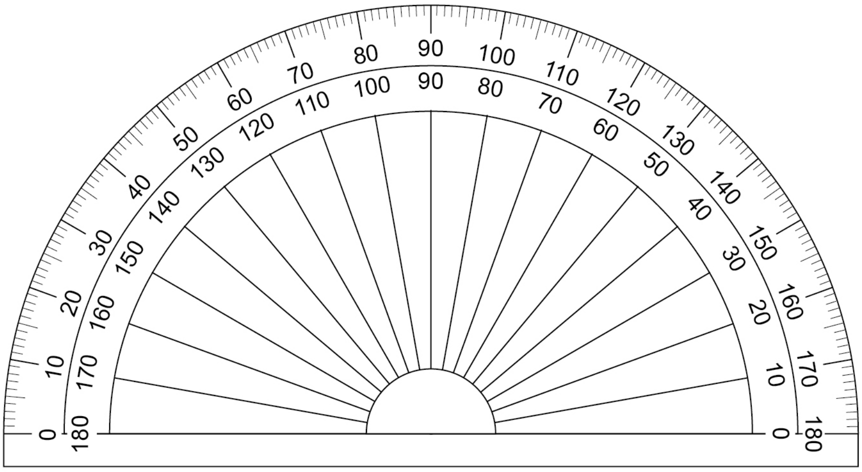
Why has refraction **not** occurred?

[1 mark]

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°

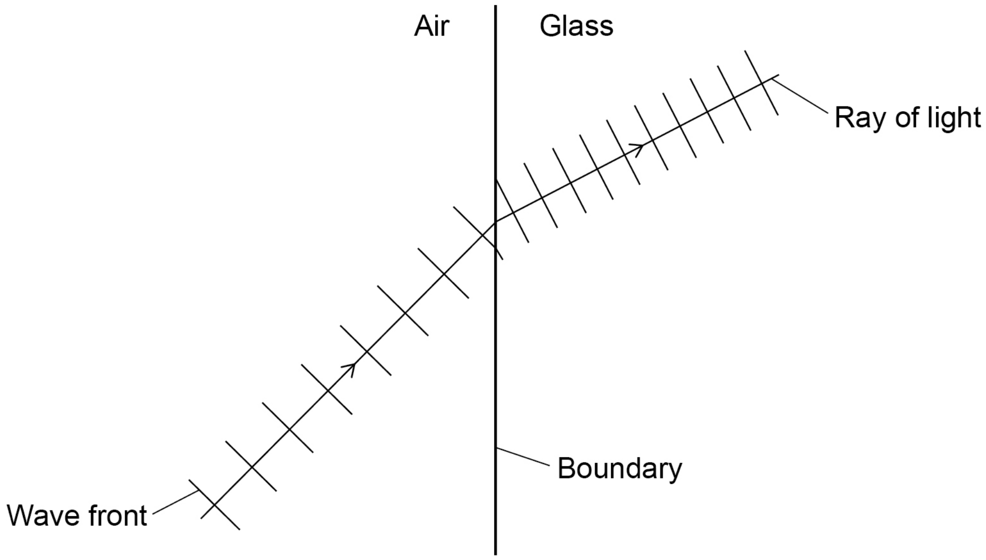
Explain why the student should **not** have recorded these results when using the protractor in **Figure 19** to make the measurements.

[2 marks]

Question 7 continues on the next page

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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10

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Turn over for the next question

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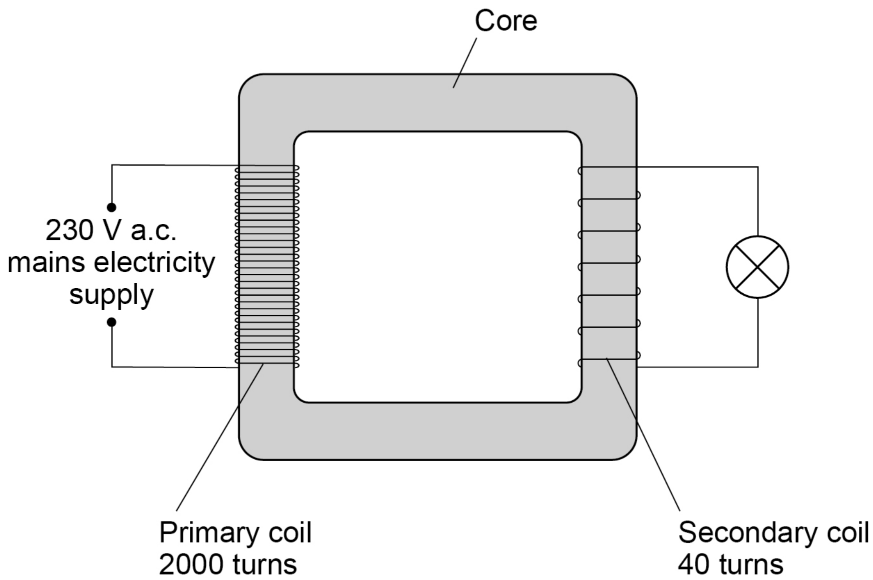
0 8 **Figure 21** shows a transformer used to power a lamp using the mains electricity supply.

Figure 21



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 ____

____

Do not write outside the box

0 8 . 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]

Current in the secondary coil = ____________________ A

7

Turn over for the next question

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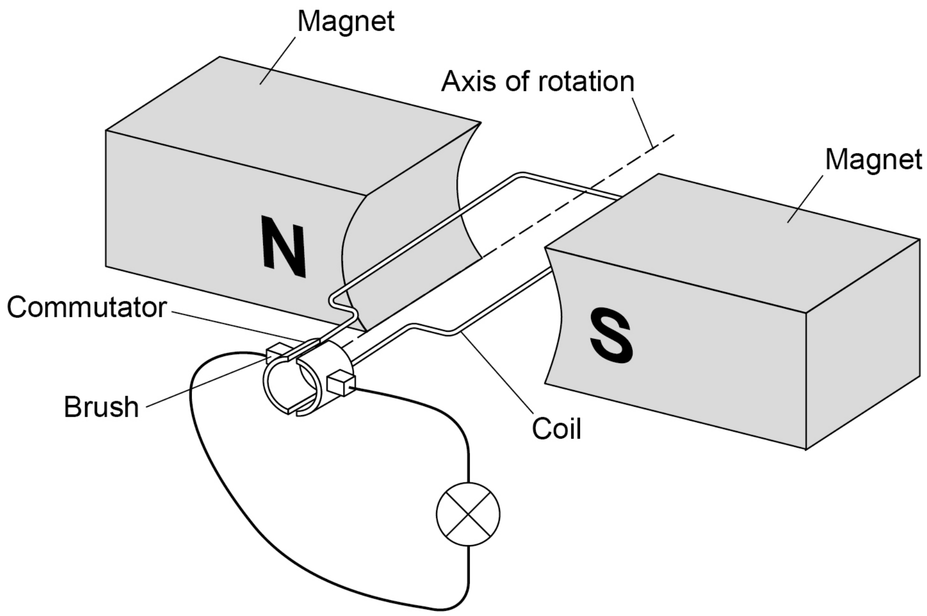
0 9 A dynamo is used to generate an electric current.

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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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

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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9

END OF QUESTIONS

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