Please write clearly in block capitals.

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

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________
I declare this is my own work.

GCSE PHYSICS

Foundation Tier   Paper 2

F

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	
10	
TOTAL	

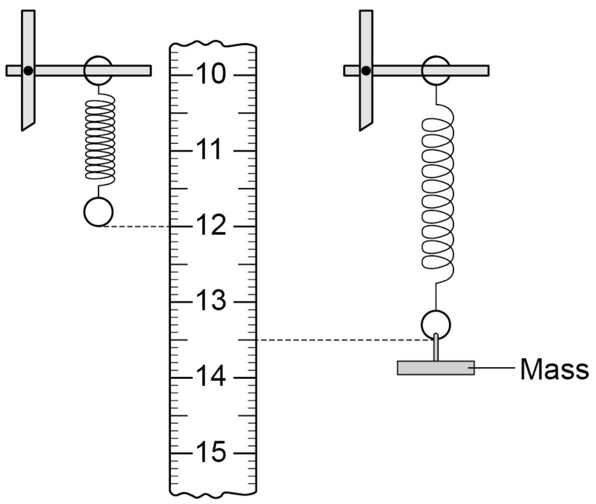
Do not write outside the box

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

0 1 A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.

Figure 1



0 1 . 1 What is the extension of the spring in **Figure 1**?

[1 mark]

Tick (✓) **one** box.

1.5 cm ☐

3.5 cm ☐

13.5 cm ☐

Do not write outside the box

0 1 . 2 Give **one** safety precaution the student should have taken during this investigation.

[1 mark]

____

____

0 1 . 3 The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

____

____

Weight = ____________ N

0 1 . 4 The weight of the mass applies a force to the spring.

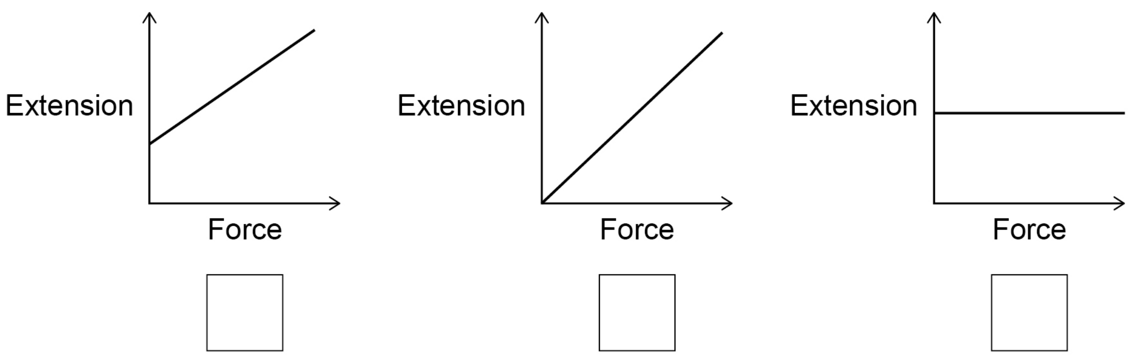
The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

[1 mark]

Tick (✓) **one** box.

Figure 2



Do not write outside the box

0 1 . 5 A force of 2.0 N was applied to a different spring.

The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

[2 marks]

____

____

____

Spring constant = ________________________ N/m

7

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

As the car slows down, there is a decrease in the ____________________

energy of the car.

The work done by friction causes an increase in the ____________________

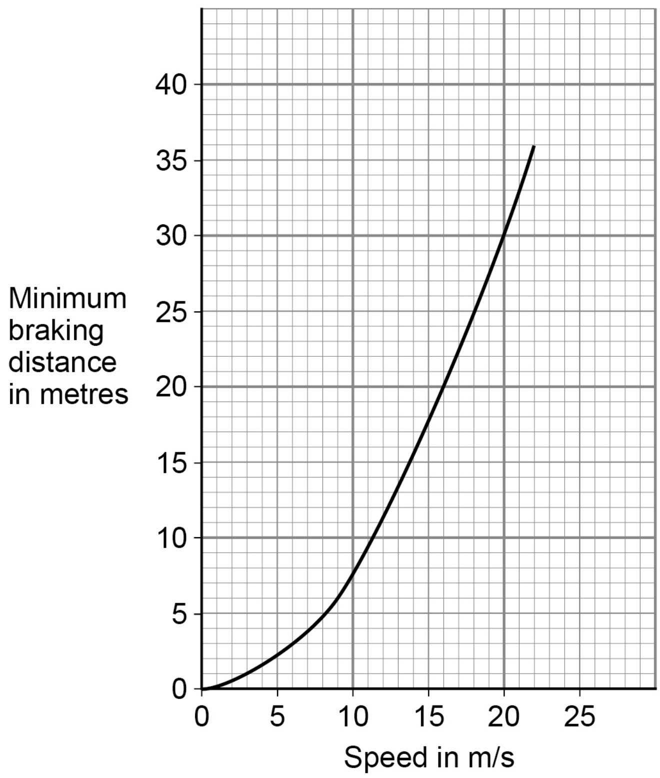
energy store of the brakes.

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

____

____

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the road becomes icy, the braking distance ____________________ .

Do not write outside the box

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

$$\text{time taken} = \frac{\text{change in velocity}}{\text{deceleration}}$$

[3 marks]

Time taken = ____________________ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

resultant force = mass × deceleration

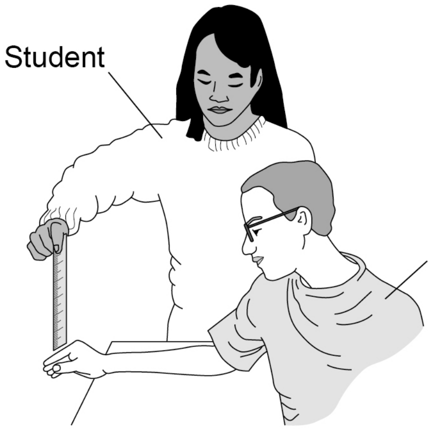
[2 marks]

Resultant force = ____________________ N

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Distance fallen by the ruler before being caught ☐

Initial height of the ruler above the person's hand ☐

Reaction time of the person being tested ☐

Do not write outside the box

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

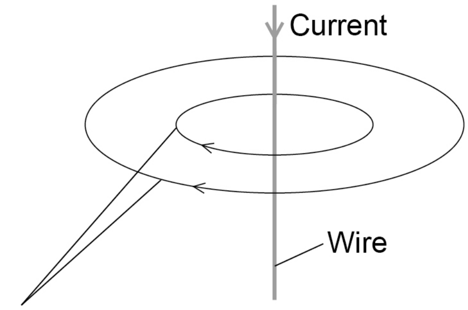
13

Turn over for the next question

Do not write outside the box

0 3 **Figure 5** shows the magnetic field pattern produced when there is a current in a wire.

Figure 5



0 3 . 1 What do the arrows on the magnetic field lines represent?

[1 mark]

____

____

0 3 . 2 How could the strength of the magnetic field be increased?

[1 mark]

Tick (✓) **one** box.

Change the direction of the current in the wire ☐

Increase the current in the wire ☐

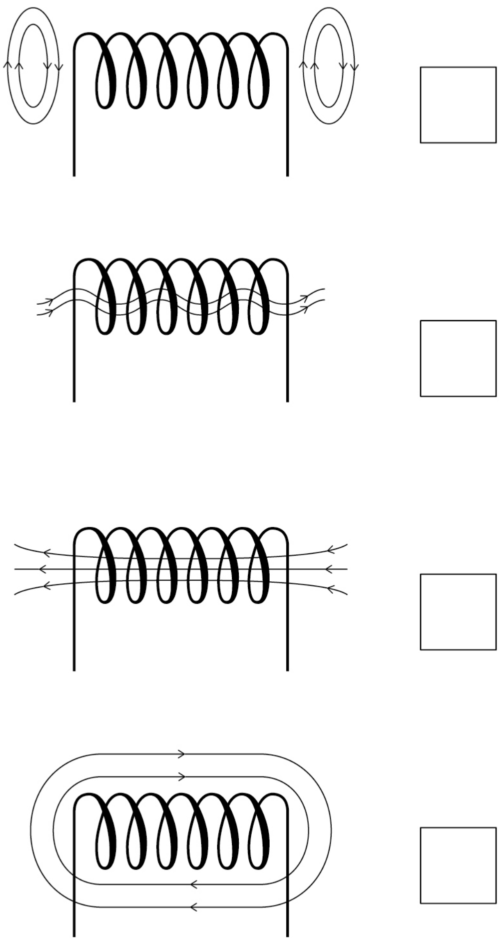
Increase the temperature of the wire ☐

0 3 . 3 The wire is coiled to make a solenoid.

Which diagram in **Figure 6** shows the magnetic field pattern produced when there is a current in the solenoid?

[1 mark]

Figure 6

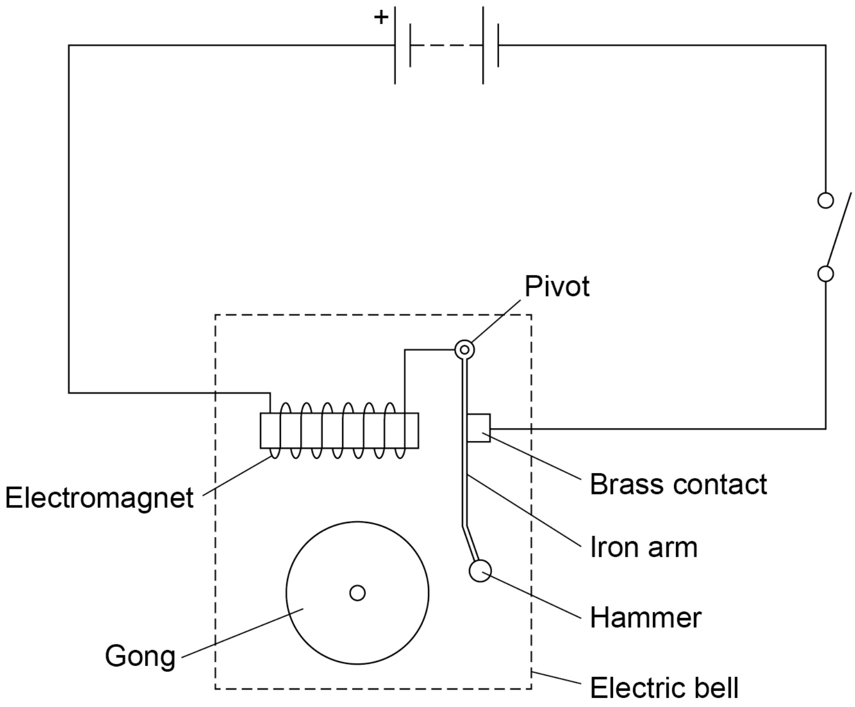


Question 3 continues on the next page

Do not write outside the box

Figure 7 shows the parts of an electric bell.

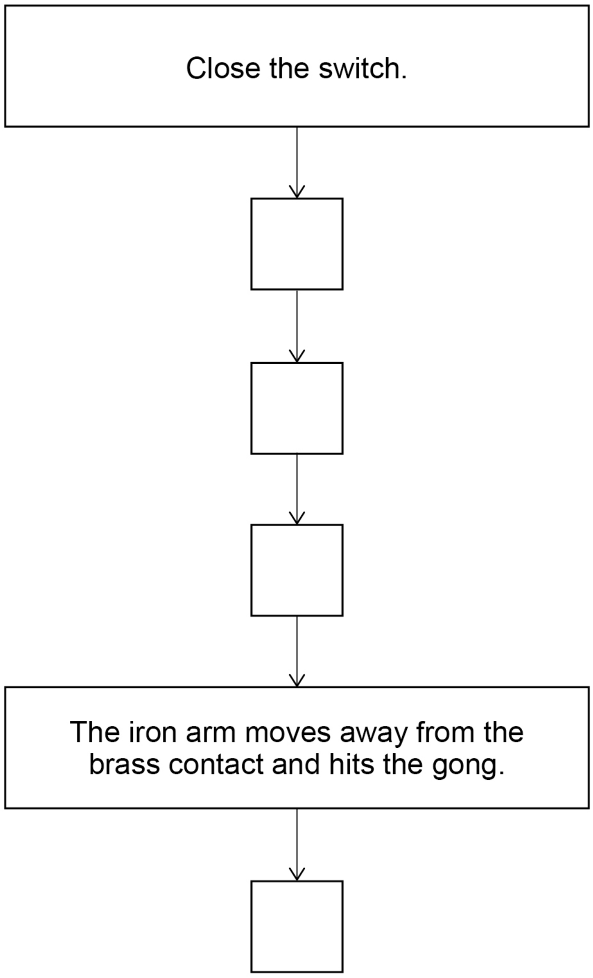
Figure 7



Do not write outside the box

0 3 . 4 **Figure 8** shows an incomplete sequence of how the bell works.

Figure 8



Write **one** letter in each box to show the correct sequence.

Use each letter once.

[2 marks]

A A magnetic field is created around the electromagnet.

B A resultant force acts on the iron arm causing it to move towards the electromagnet.

C The iron arm returns to its original position.

D There is a current in the circuit.

0 3 . 5 Which of the following would increase the resultant force on the iron arm?

[1 mark]

Tick (✓) **one** box.

Decrease the distance between the electromagnet and the iron arm ☐

Decrease the number of cells in the circuit ☐

Decrease the number of turns on the electromagnet ☐

0 3 . 6 The iron arm of the bell vibrates with a frequency of 6.25 Hz.

Calculate the period of the iron arm.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

____

____

____

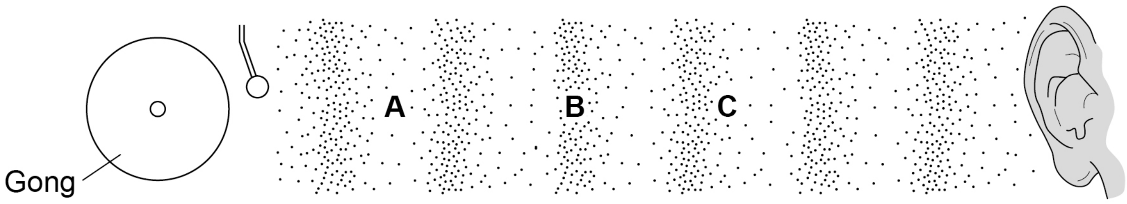
Period = ____________________ s

Do not write outside the box

0 3 . 7 The sound waves produced by the bell are longitudinal waves.

Figure 9 shows the position of the air particles at one point in time as the sound waves travel through the air.

Figure 9



Which letter represents an area of compression?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

9

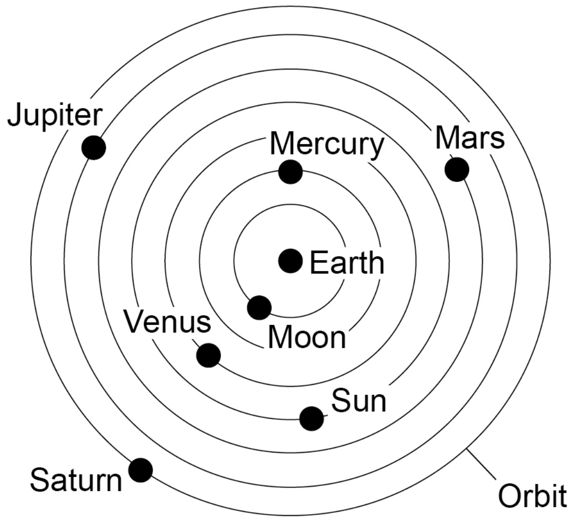
Turn over for the next question

Do not write outside the box

0 4 **Figure 10** shows an old scientific model of the solar system that has now been replaced.

Figure 10

Old scientific model



0 4 . 1 Which statement is a reason for replacing an old scientific model with a newer scientific model?

[1 mark]

Tick (✓) **one** box.

The old model cannot explain new observations. ☐

The old model has been used by scientists for a long time. ☐

The old model is too simple. ☐

Do not write outside the box

0 4 . 2 Compare the model of the solar system used now with the old model of the solar system shown in **Figure 10**.

[4 marks]

Question 4 continues on the next page

Do not write outside the box

Table 1 shows data about four planets.

Table 1

Planet	**Mean distance from the Sun in millions of kilometres**	**Time taken for one orbit in Earth years**
Mercury	58	0.25
Venus	108	0.60
Earth	150	1.00
Mars	228	1.90

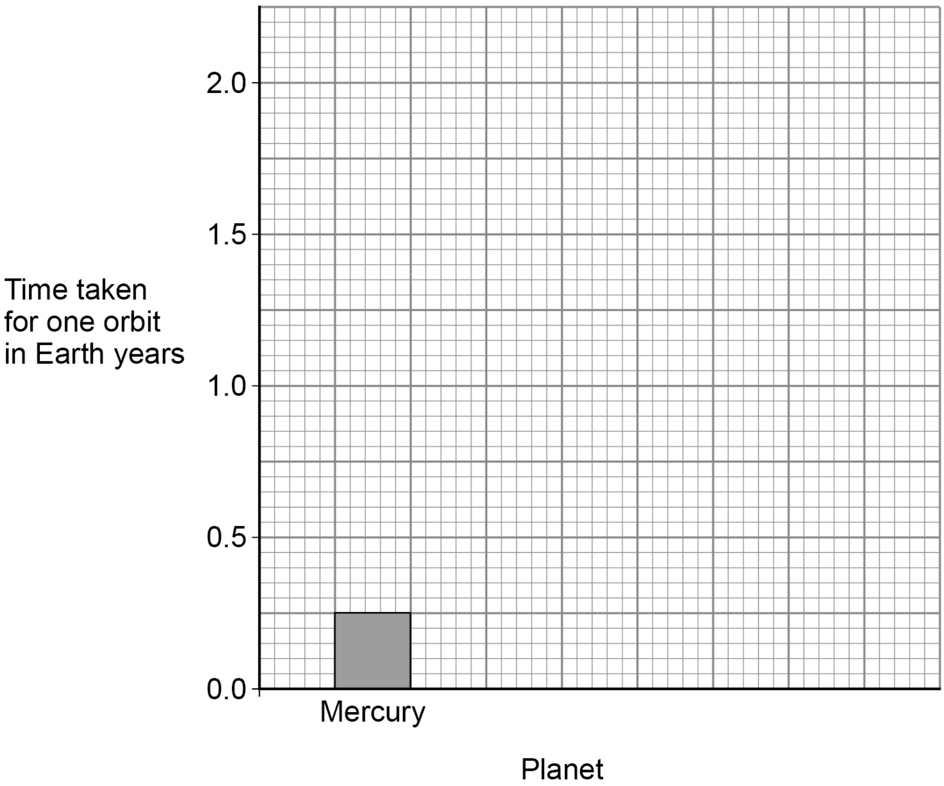
0 4 . 3 How does the time taken for one orbit change as the mean distance from the Sun increases?

[1 mark]

Do not write outside the box

0 4 . 4 The bar chart in **Figure 11** shows some of the data from **Table 1**.

Figure 11



Complete the bar chart.

Use data from **Table 1**.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 All stars have a life cycle.

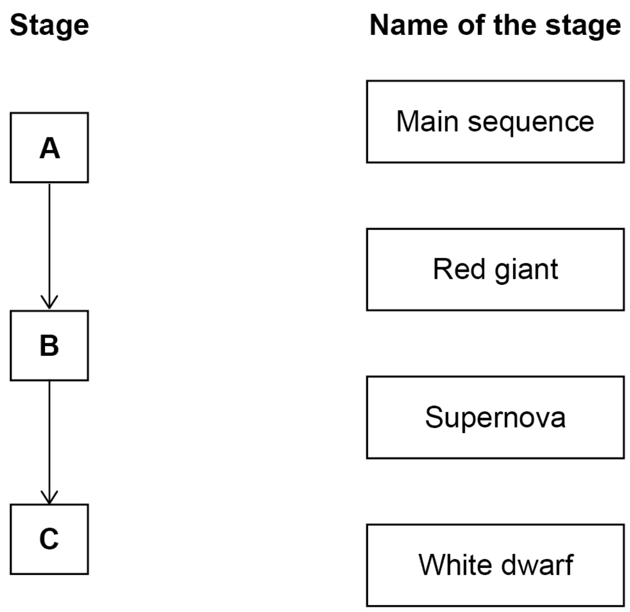
A, **B** and **C** in **Figure 12** represent three stages in the life cycle of the Sun.

The stages are in the correct order.

Draw **one** line from each stage to the name of the stage.

[2 marks]

Figure 12



0 4 . 6 Stars act like black bodies.

Which statement is true for perfect black bodies?

[1 mark]

Tick (✓) **one** box.

They are good reflectors of radiation. ☐

They are the best emitters of radiation. ☐

They easily transmit radiation. ☐

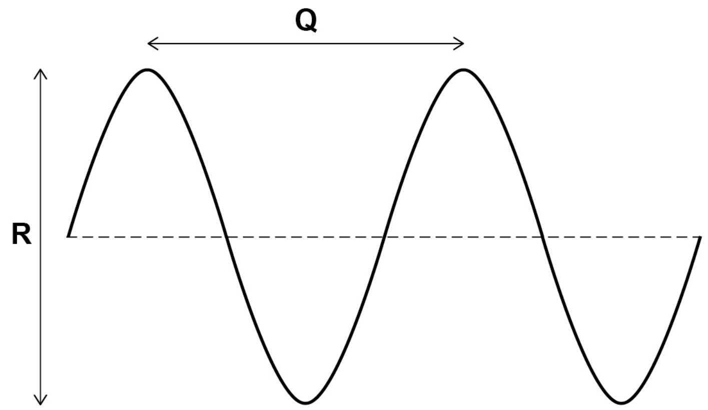
11

Do not write outside the box

0 5 Electromagnetic waves are transverse.

Figure 13 represents a transverse wave.

Figure 13



0 5 . 1 Which of the following gives the wavelength of the transverse wave?

[1 mark]

Tick (✓) **one** box.

wavelength = $\frac{Q}{2}$ ☐

wavelength = Q ☐

wavelength = 2 Q ☐

0 5 . 2 Which of the following gives the amplitude of the transverse wave?

[1 mark]

Tick (✓) **one** box.

amplitude = $\frac{R}{2}$ ☐

amplitude = R ☐

amplitude = 2 R ☐

Turn over ►

Do not write outside the box

0 5 . 3 Microwaves are electromagnetic waves used for mobile phone communications.

Which other type of electromagnetic wave is also used for communications?

[1 mark]

Tick (✓) **one** box.

Radio waves ☐

Ultraviolet ☐

X-rays ☐

0 5 . 4 Microwaves from a mobile phone take 0.000 009 s to reach a mobile phone mast.

speed of microwaves = 300 000 000 m/s

Calculate the distance between the mobile phone and the mobile phone mast.

Use the equation:

distance = speed × time

[2 marks]

____

____

____

Distance = __________________ m

0 5 . 5 Mobile phone communications is only one of the uses for microwaves.

Give **one** other use of microwaves.

[1 mark]

____

____

6

Do not write outside the box

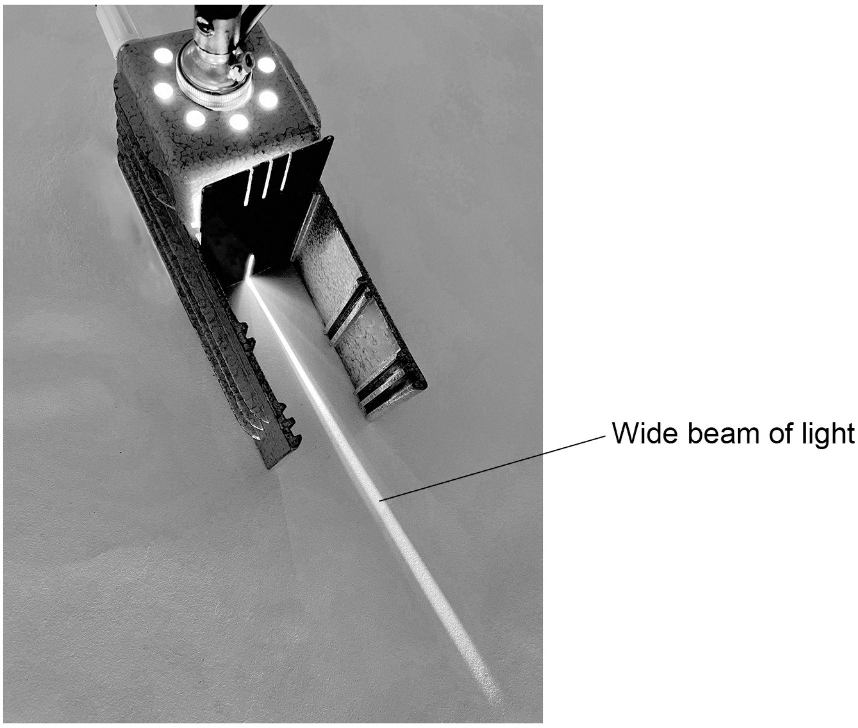
0 6 A student investigated the refraction of light through a glass block.

Figure 14 shows the ray box used.

The student aimed the beam of light from the ray box towards a glass block.

The student measured the angle of incidence at the point where the light entered the glass block.

Figure 14



0 6 . 1 Why is using a wide beam of light less likely to give accurate results than using a narrow beam?

[1 mark]

Tick (✓) **one** box.

It will be harder to judge where the centre of the beam is. ☐

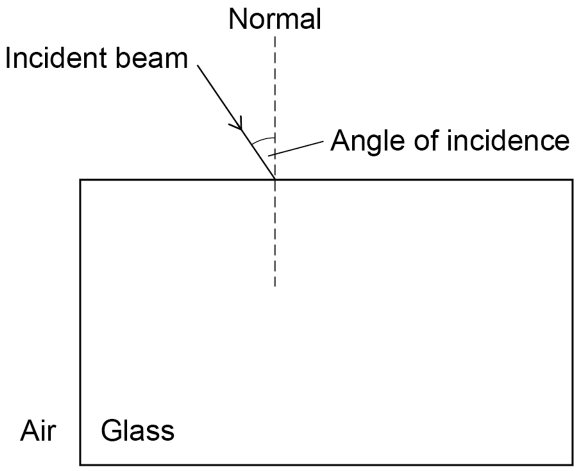
It will cause a smaller uncertainty in the measurements. ☐

The angle of refraction will be larger than it should be. ☐

Do not write outside the box

0 6 . 2 **Figure 15** shows the beam of light incident on the glass block.

Figure 15

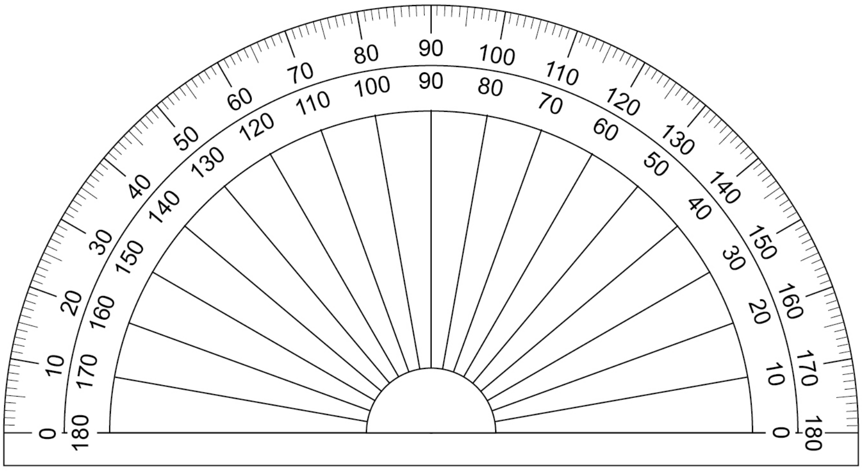


Complete **Figure 15** to show the path taken by the beam of light through the glass block and back into the air.

[3 marks]

Figure 16 shows the protractor used by the student.

Figure 16



0 6 . 3 What is the resolution of the protractor?

[1 mark]

Tick (✓) **one** box.

1 degree ☐

10 degrees ☐

180 degrees ☐

0 6 . 4 For one angle of incidence the student measured the angle of refraction three times.

The three measurements were:

35° 31° 33°

Calculate the mean angle of refraction.

[1 mark]

____

____

Mean angle of refraction = ____________________ °

Do not write outside the box

The student placed a red filter in front of the white beam of light.

Only red light passes through the filter.

0 6 . 5 Complete the sentence.

[1 mark]

When white light is incident on the red filter, all colours except for red are

____________________ by the filter.

Use the Physics Equations Sheet to answer questions **06.6** and **06.7**.

0 6 . 6 Write down the equation which links frequency (f), wave speed (v) and wavelength (λ).

[1 mark]

____

0 6 . 7 Light has a wave speed of 3.0×10^{8} m/s in air.

The frequency of the red light is 4.0×10^{14} Hz.

Calculate the wavelength of the red light in air.

[3 marks]

____

____

____

____

____

Wavelength = ____________________ m

11

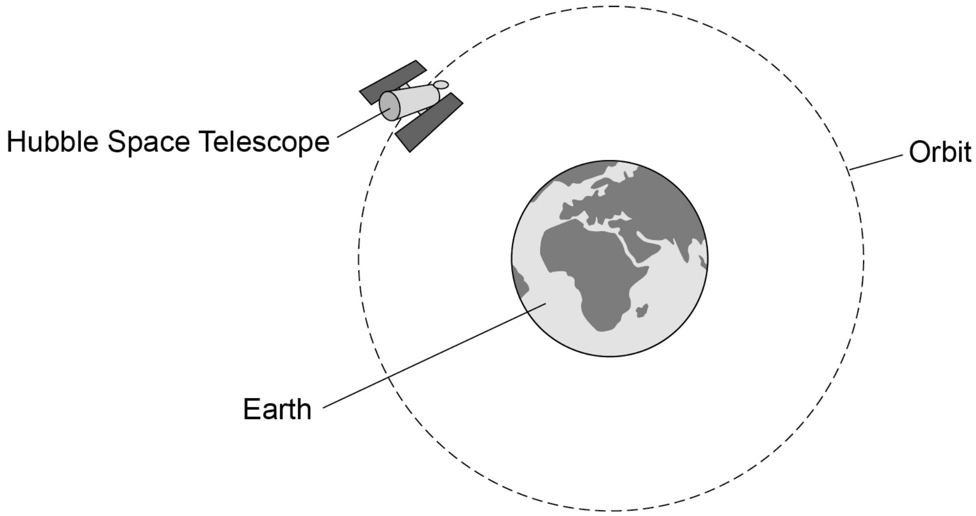
Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 7 **Figure 17** shows the Hubble Space Telescope orbiting the Earth.

Figure 17



0 7 . 1 What name is given to an object that orbits a planet?

[1 mark]

Tick (✓) **one** box.

A comet ☐

A satellite ☐

A star ☐

0 7 . 2 The Earth exerts a gravitational force on the Hubble Space Telescope.

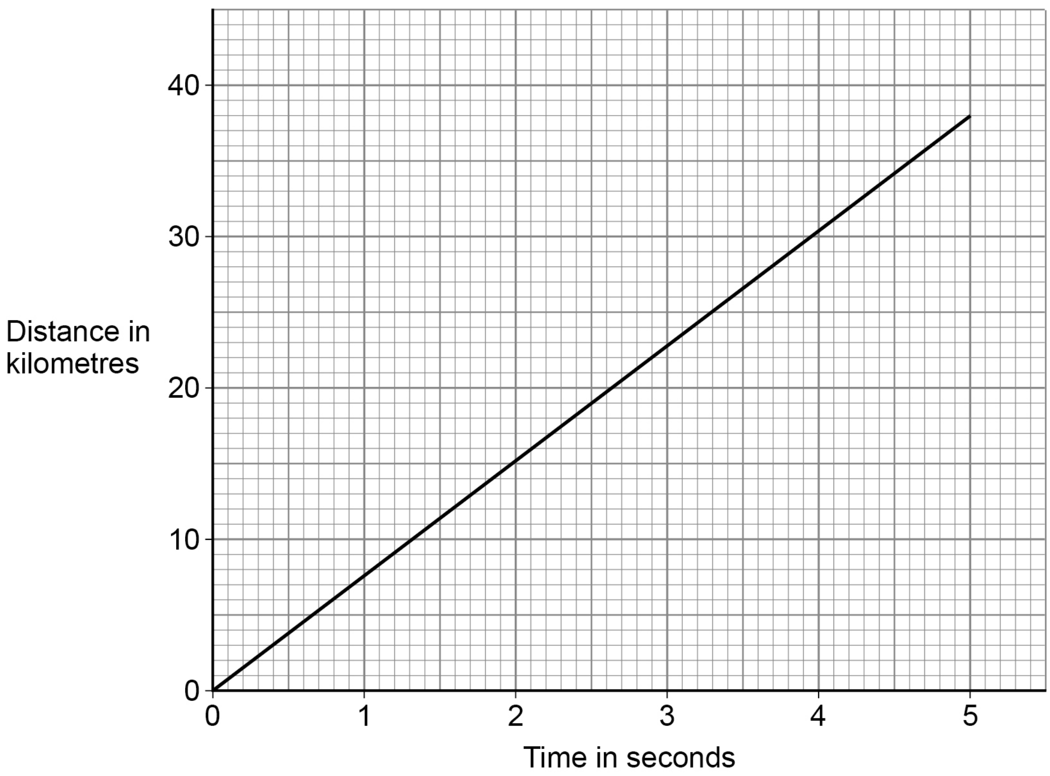
Draw an arrow on **Figure 17** to show the gravitational force.

[1 mark]

Do not write outside the box

0 7 . 3 **Figure 18** shows how the distance travelled by the Hubble Space Telescope during its orbit changes with time.

Figure 18



The gradient of the line in **Figure 18** gives the speed of the Hubble Space Telescope.

Determine the speed of the Hubble Space Telescope.

Give your answer in km/s.

[3 marks]

____

____

____

____

____

Speed = ____________________ km/s

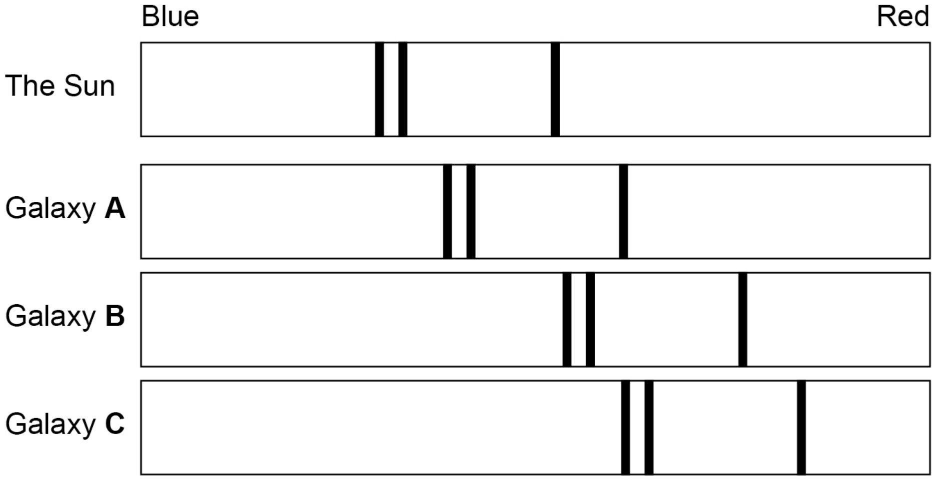
Turn over ►

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

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

Figure 19 shows the visible light spectra from the Sun and three galaxies.

Figure 19



0 7 . 4 Which galaxy is moving away from the Earth the fastest?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

Do not write outside the box

0 7 . 5 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

0 7 . 6 New scientific observations indicate that many galaxies rotate too quickly for the known mass of the stars they contain.

Why is it important that new scientific observations are peer reviewed?

[1 mark]

Tick (✓) **one** box.

To check the observations are correct ☐

To identify control variables ☐

To provide more proof ☐

8

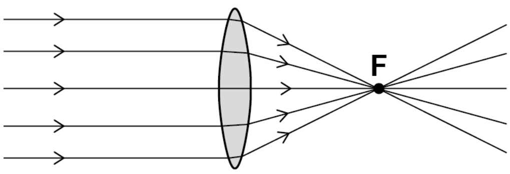
Turn over for the next question

Do not write outside the box

0 8 Lenses can be used to form an image of an object.

0 8 . 1 **Figure 20** shows parallel rays of light being refracted by a **convex** lens.

Figure 20



What is the position marked '**F**' called?

[1 mark]

Tick (✓) **one** box.

Focal length ☐

Focus point ☐

Principal focus ☐

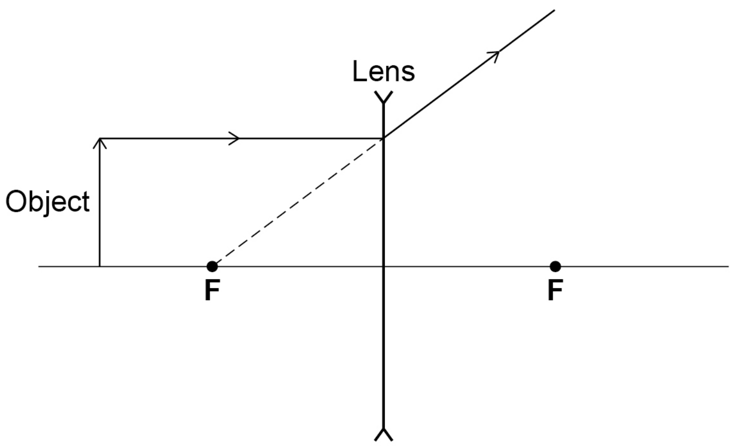
Do not write outside the box

0 8 . 2 Complete the ray diagram in **Figure 21** to show how a **concave** lens forms the image of the object.

Use an arrow to represent the image.

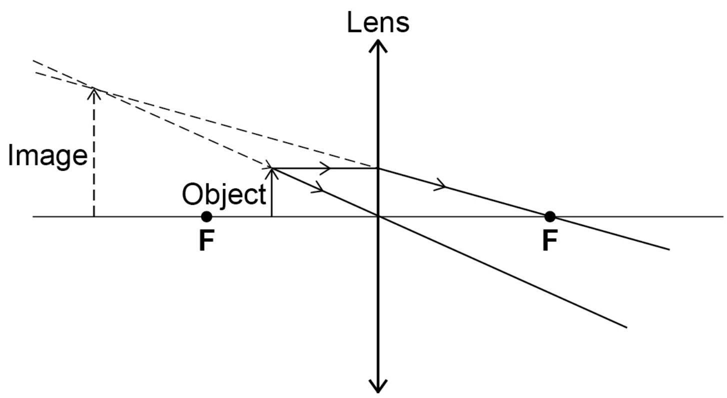
[2 marks]

Figure 21



0 8 . 3 **Figure 22** shows how a **convex** lens can be used to form a magnified image of an object.

Figure 22



Give **two** ways that the image formed by the convex lens in **Figure 22** is similar to the image formed by the concave lens.

[2 marks]

1 ____

2 ____

Do not write outside the box

0 8 . 4 A convex lens is used as a magnifying glass to identify a symbol on the back of a silver spoon.

The symbol has an actual height of 1.6 mm.

The magnification produced by the lens is 3.5

Calculate the image height of the symbol when viewed through the magnifying glass.

Use the Physics Equations Sheet.

[3 marks]

____

____

____

____

____

Image height = ____________________ mm

8

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 Infrared waves are transverse waves.

0 9 . 1 Complete the sentence.

[1 mark]

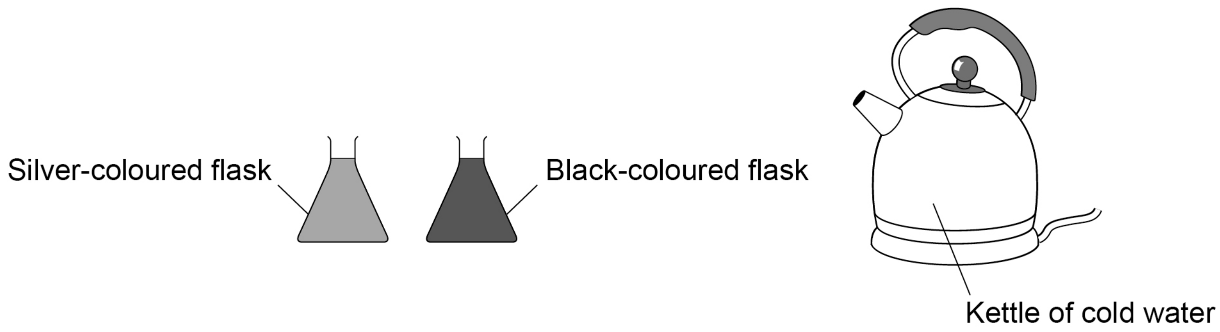
In a transverse wave, the direction of oscillation is ______________________________

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 23 shows some of the equipment used.

Figure 23



Do not write outside the box

0 9 . 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 9 continues on the next page

0 9 . 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 ____

____

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 9 . 4 What was the dependent variable in this investigation?

[1 mark]

0 9 . 5 **Table 2** shows the results.

Table 2

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 2**.

[2 marks]

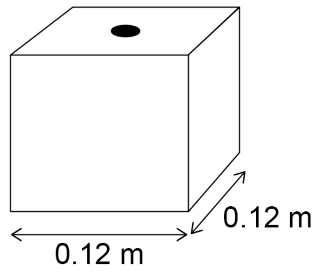
1

2

Figure 24 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 24



Use the Physics Equations Sheet to answer questions **09.6** and **09.7**.

0 9 . 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 = $\frac{\text{area}}{\text{force}}$ ☐

Do not write outside the box

0 9 . 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

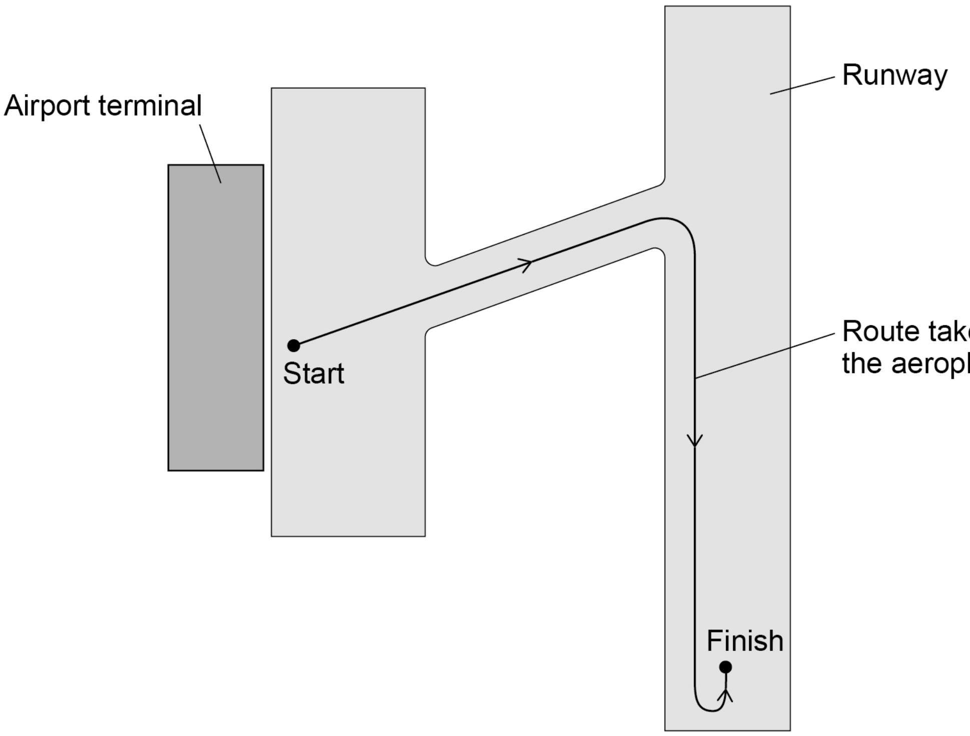
Turn over for the next question

Do not write outside the box

1 0 **Figure 25** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 25 has been drawn to scale.

Figure 25



Scale: 1 cm represents 70 m

1 0 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 25**.

[2 marks]

____

____

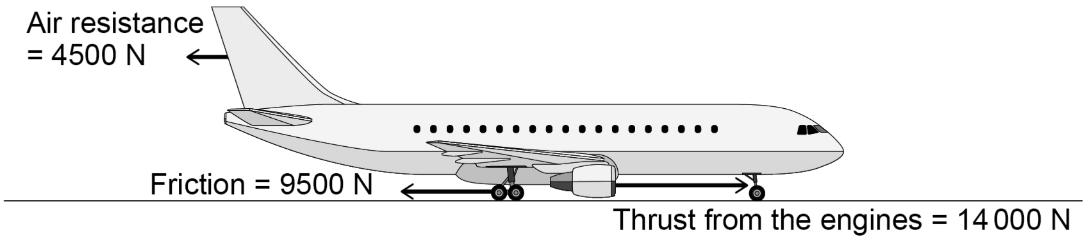
____

Displacement = ____________________ m

Do not write outside the box

Figure 26 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 26



10.2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

____

____

Resultant horizontal force = ____________________ N

10.3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

____

____

10.4 Air resistance and friction are contact forces.

Give **one** other example of a contact force.

[1 mark]

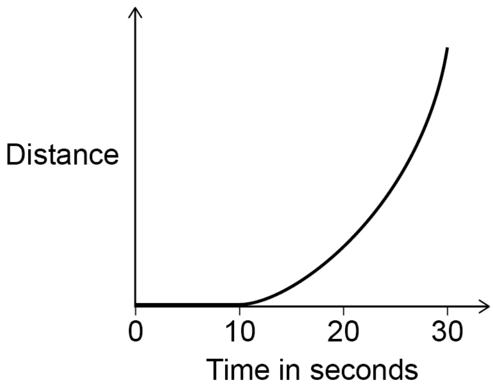
____

Do not write outside the box

1 0 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 27 shows a distance–time sketch-graph for this stage of the journey.

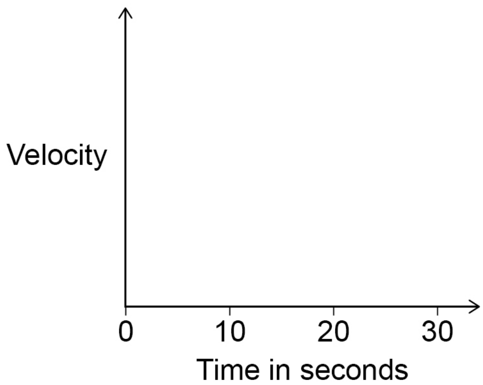
Figure 27



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 28**.

[2 marks]

Figure 28



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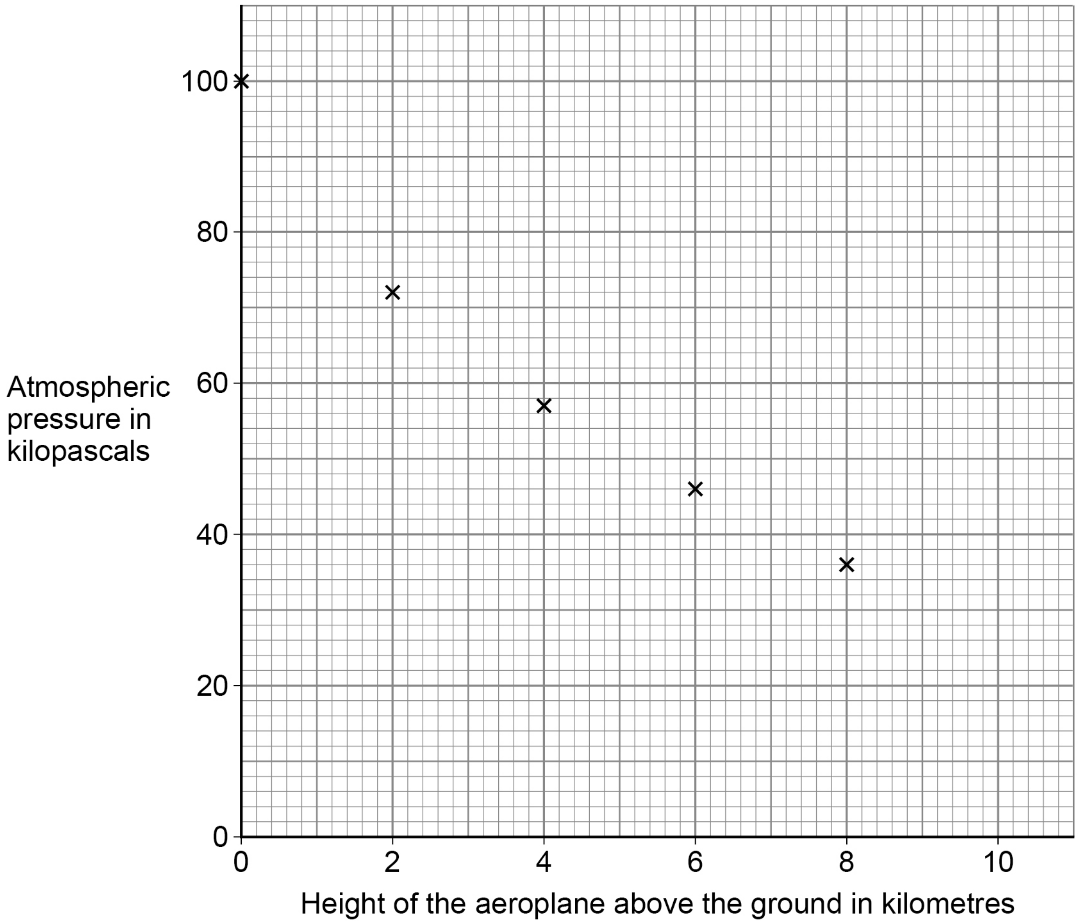
1 0 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 29 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 29



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

[2 marks]

Atmospheric pressure = ________________________ kPa

Question 10 continues on the next page

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1 0 . 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

END OF QUESTIONS

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