AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

F

Foundation 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	
10	
TOTAL	

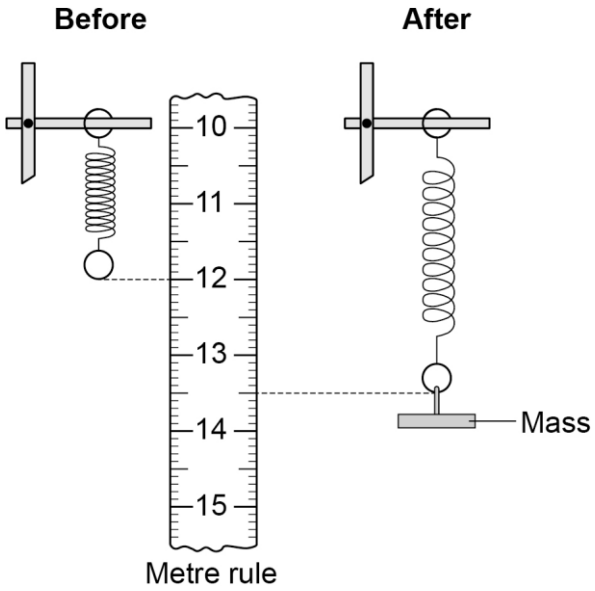
Answer **all** questions in the spaces provided.

Do not write outside the box

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]

- wear safety goggles / glasses
- stand up / away from apparatus

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]

W = 0.050 × 9.8

W = 0.49 (N)

Weight = 0.49 N

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

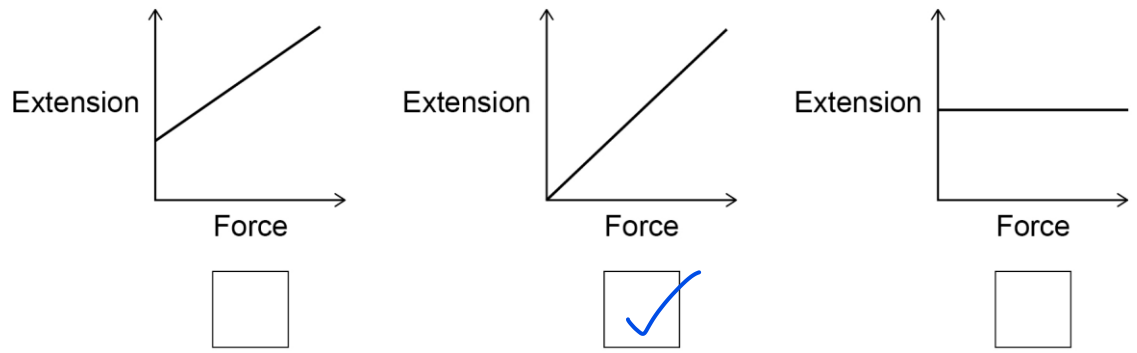
The student added more masses and recorded the extension of the spring.

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]

k = 2.0/0.080

k = 25 (N/m)

Spring constant = 25 N/m

7

Do not write outside the box

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 Kinetic energy of the car.

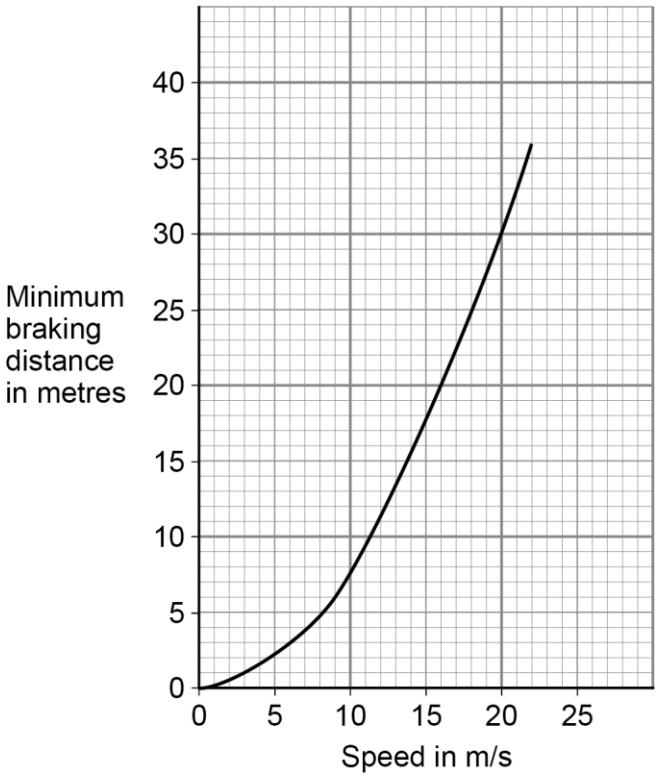
The work done by friction causes an increase in the Thermal energy store of the brakes.

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]

distance increases with increasing speed

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 increases .

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]

12.5 – 5.0 = 7.5 (m/s)

t = 7.5/0.25

t = 30 (s)

Time taken = 30 s

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

Use the equation:

resultant force = mass × deceleration

[2 marks]

F = 1600 × 0.25

F = 400 (N)

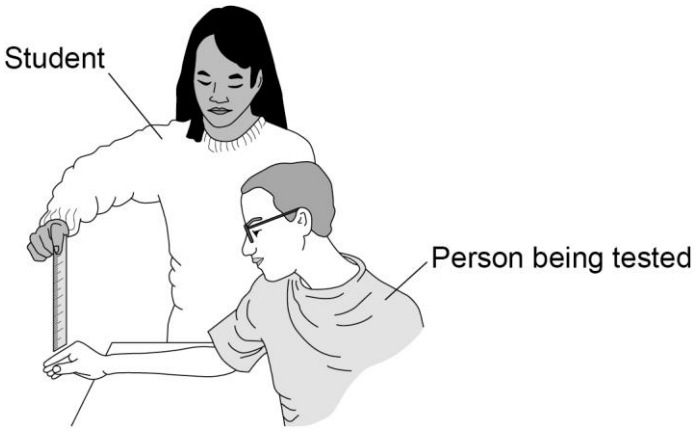
Resultant force = 400 N

Do not write outside the box

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]

There will be more variation in distances

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

[2 marks]

carry out the experiment listening to music, then not listening to music (and compare the variation in the results)

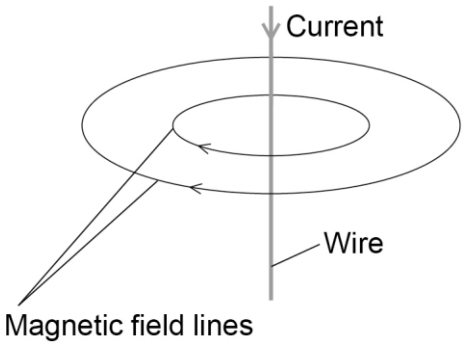
13

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]

Direction of the magnetic field

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 ☐

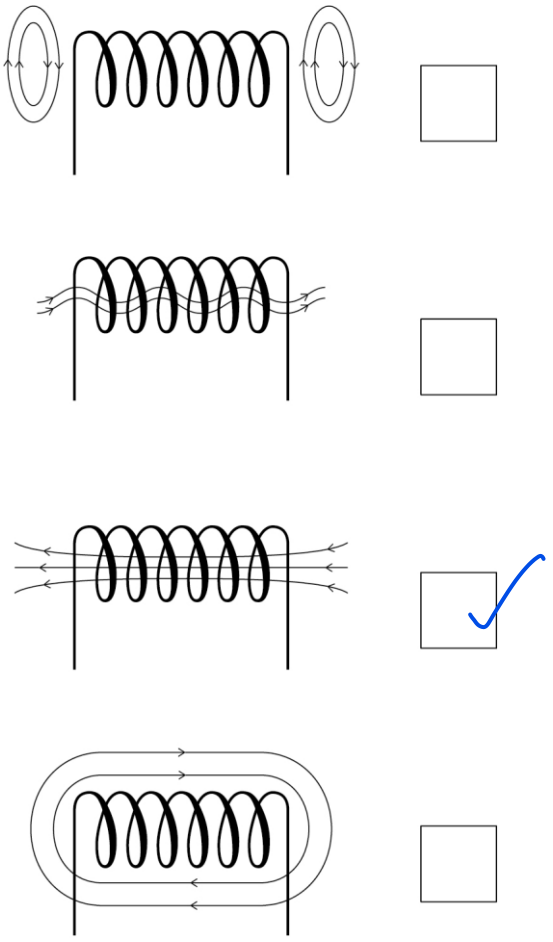
Do not write outside the box

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

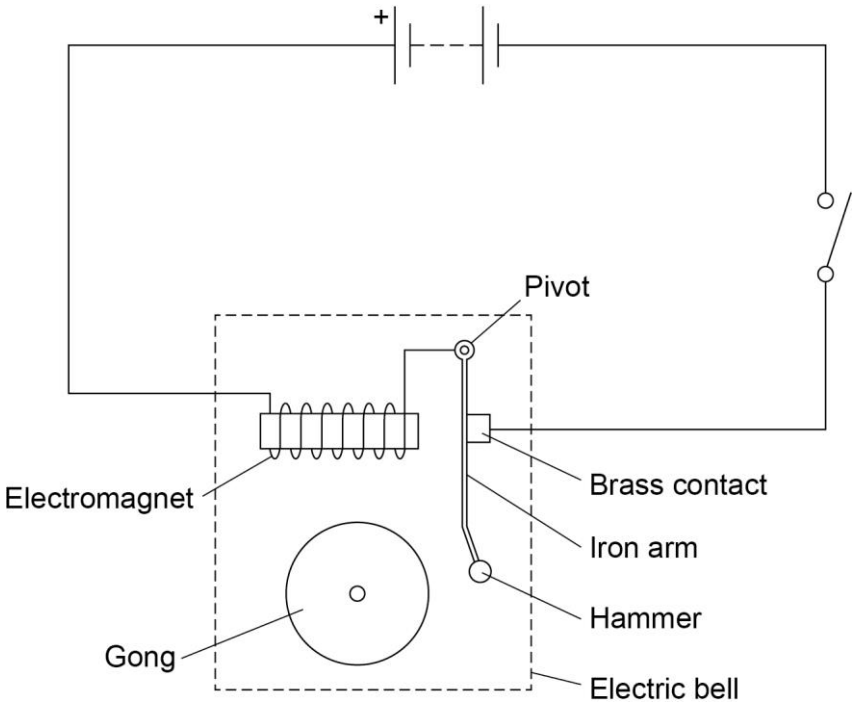


Question 3 continues on the next page

Do not write outside the box

Figure 7 shows the parts of an electric bell.

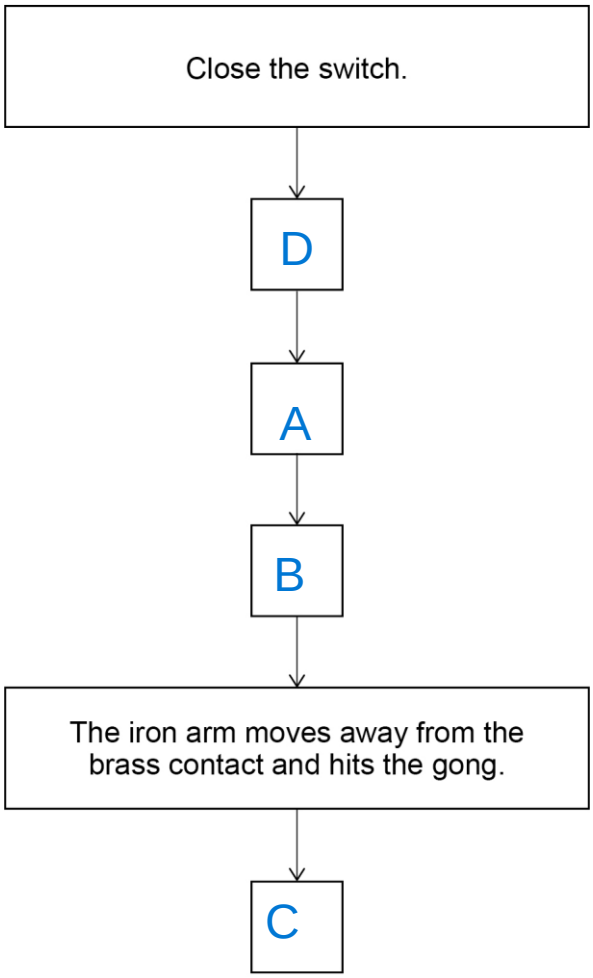
Figure 7



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.

Do not write outside the box

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 = 1/6.25

period = 0.16 (s)

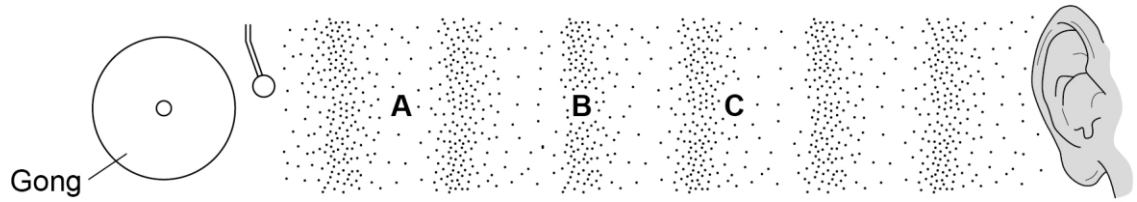
Period = 0.16 s

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

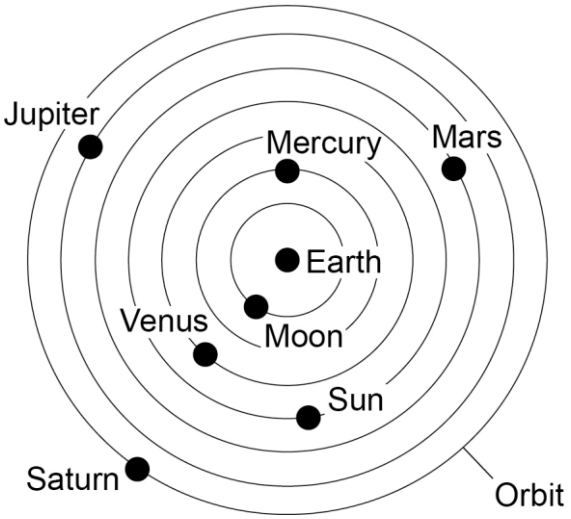
Turn over for the next question

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]

Similarities

- the planets are circular or elliptical
- the Moon orbits the Earth
- there is one star and Sun

Differences

- the planets orbit the Sun, whereas in the old model the planets orbit the Earth
- there are also dwarf planets, whereas no dwarf planets are shown in the old model
- other planets have moons, whereas other planets have no moons shown in the old model

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?

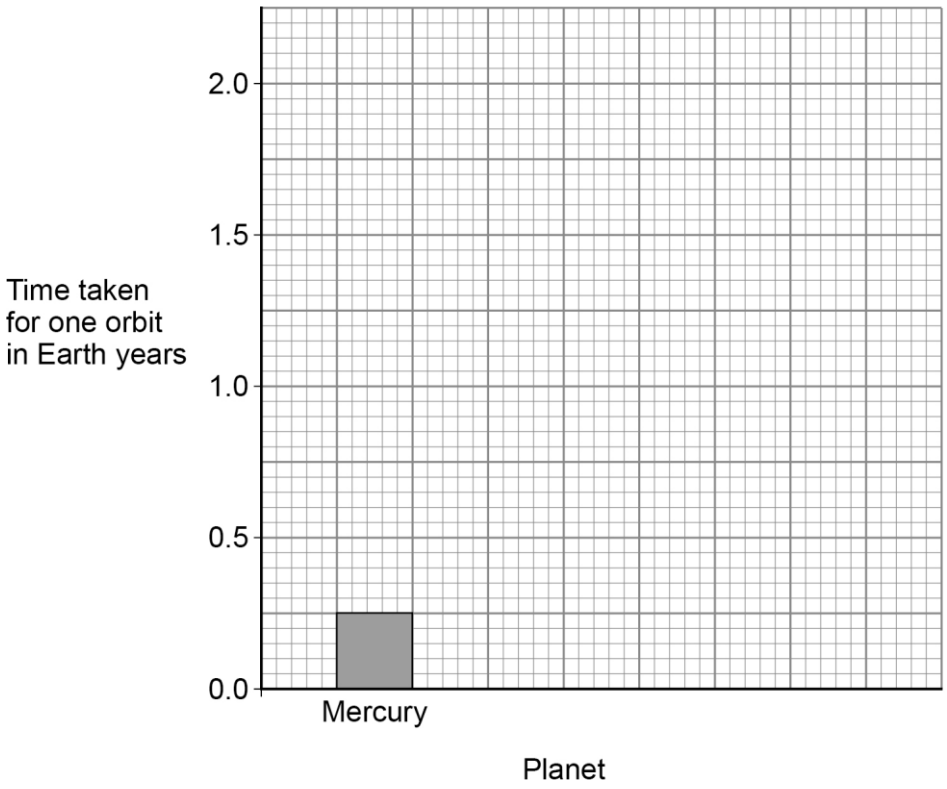
[1 mark]

it increases

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.

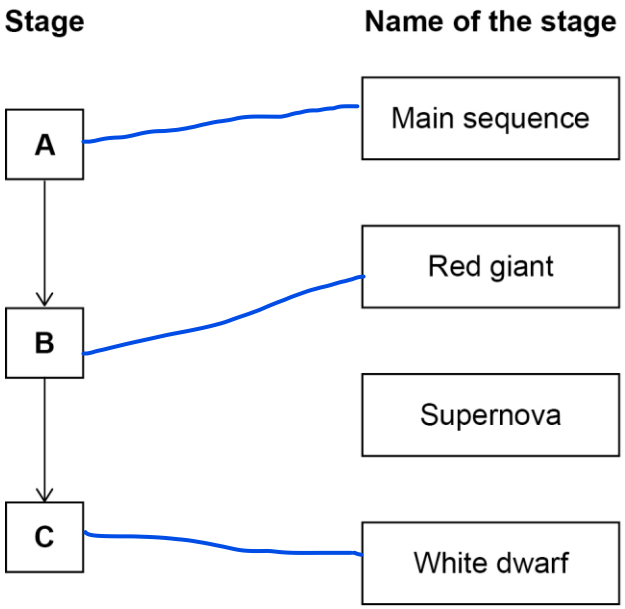
A, **B** and **C** in **Figure 12** represent three stages in the life cycle of the Sun.

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. ☐

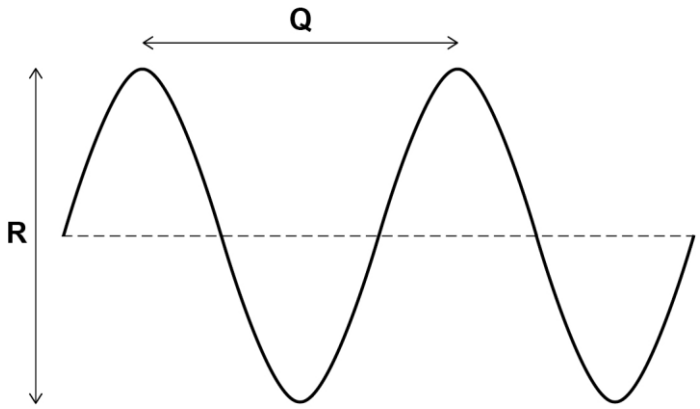
11

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 ☐

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]

$s = 300\,000\,000 \times 0.000009$

$s = 2700$ (m)

Distance = 2700 m

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

Give **one** other use of microwaves.

[1 mark]

satellite communications

6

Do not write outside the box

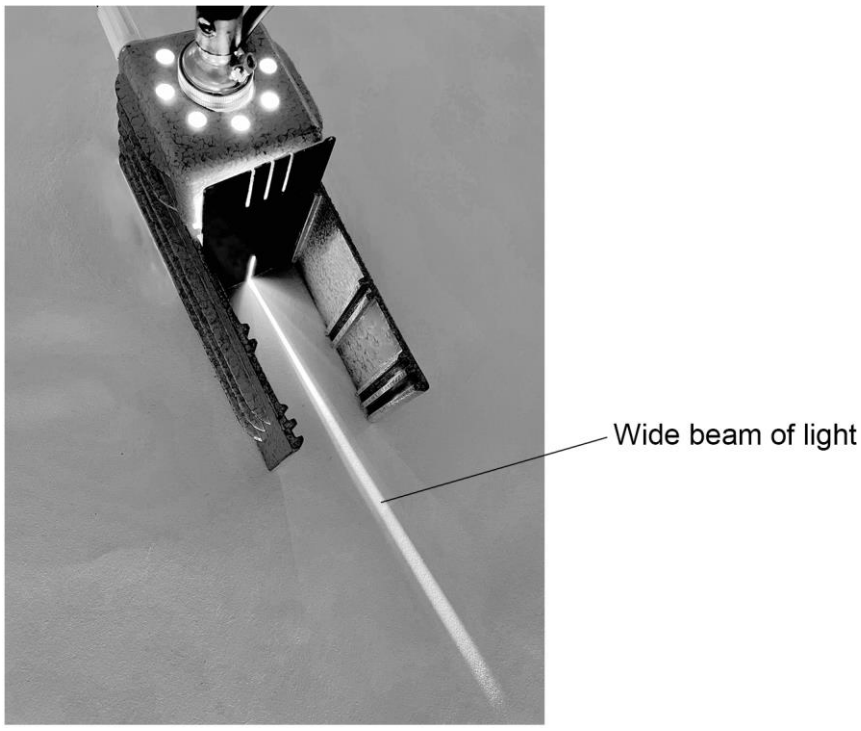
0 6 A student investigated the refraction of light through a glass block.

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. ☐

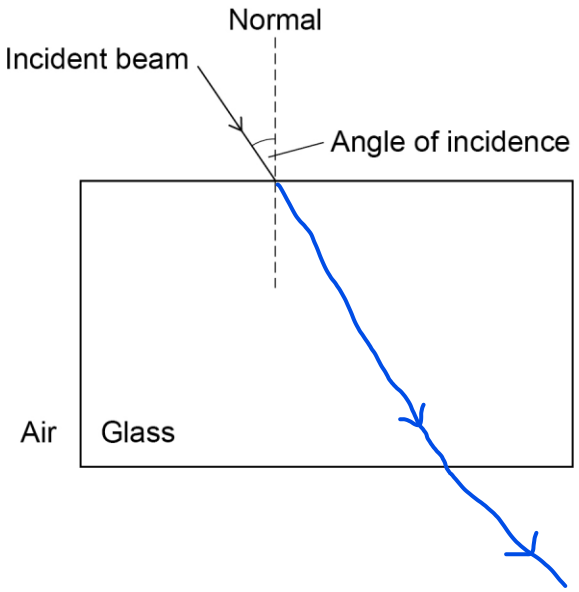
The angle of refraction will be larger than it should be. ☐

Turn over ►

Do not write outside the box

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

Figure 15



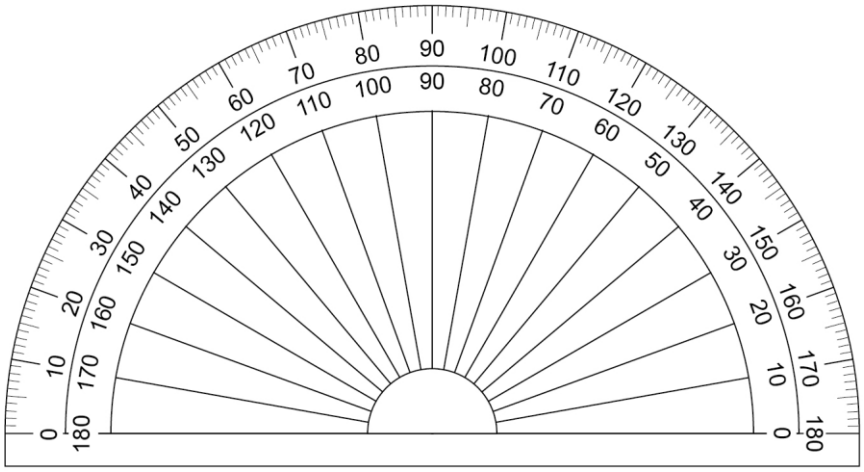
Complete **Figure 15** to show the path taken by the beam of light through the glass block and back into the air.

[3 marks]

Do not write outside the box

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 = 33 °

Turn over ►

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

absorbed 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]

wave speed = frequency × wavelength

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]

$3.0 \times 10^8 = 4.0 \times 10^{14} \times n$

$\frac{3.0 \times 10^8}{4.0 \times 10^{14}} = n$

Wavelength = 7.5×10^{-7} m

11

Do not write outside the box

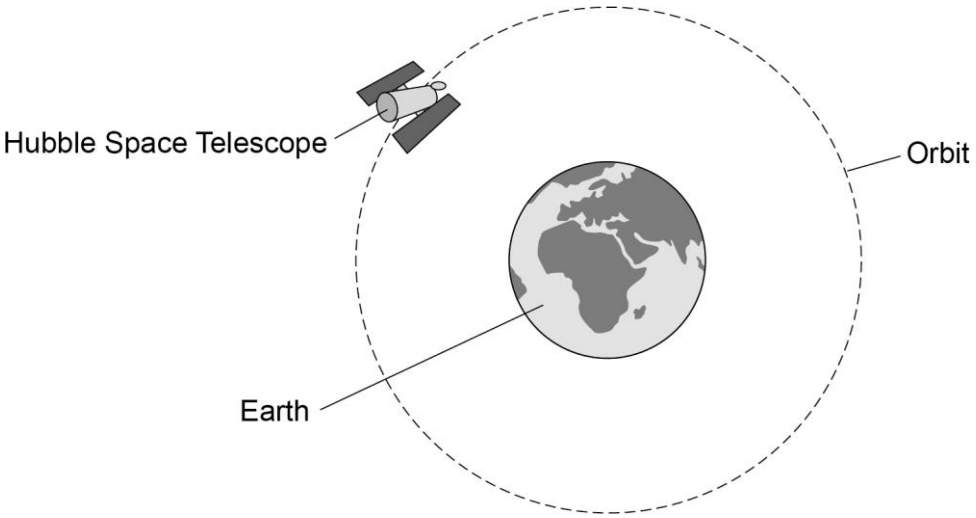
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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.

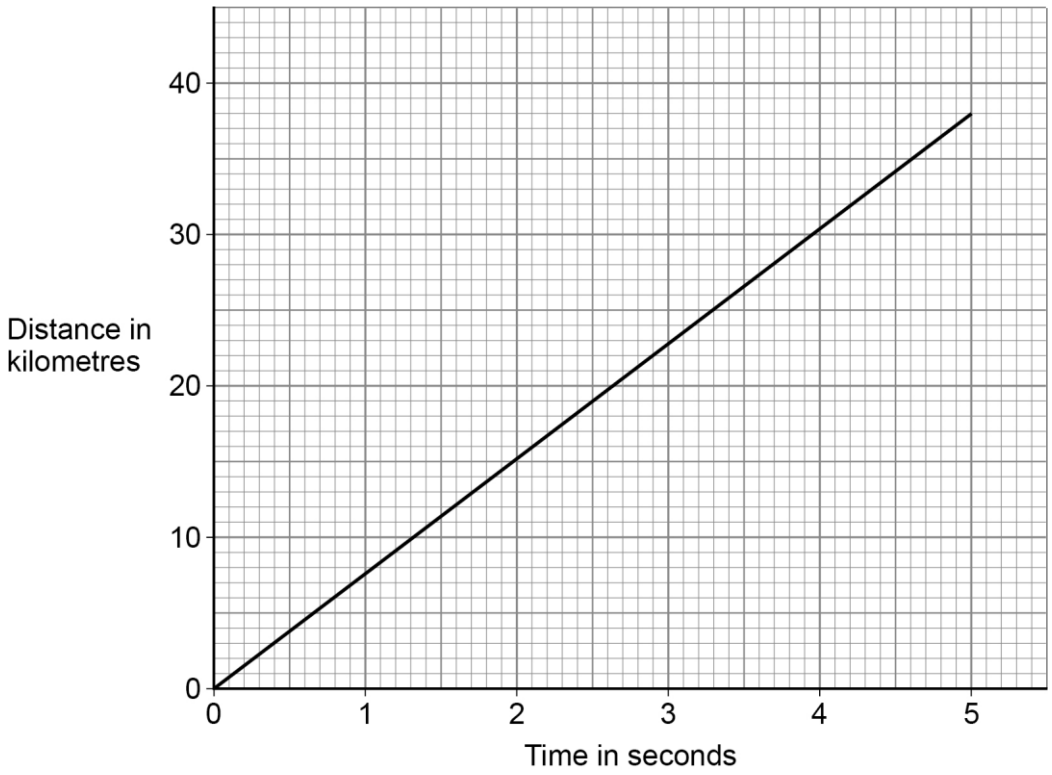
[1 mark]

Arrow drawn towards the centre of the Earth from the Hubble Space Telescope

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]

$V = \frac{38}{5} = 7.6 \text{ km/s}$

Speed = 7.6 km/s

Turn over ►

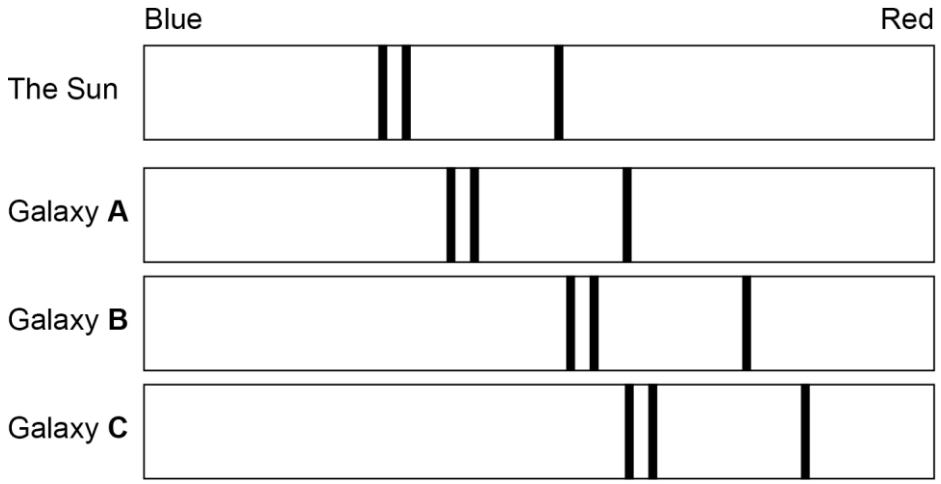
Do not write outside the box

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

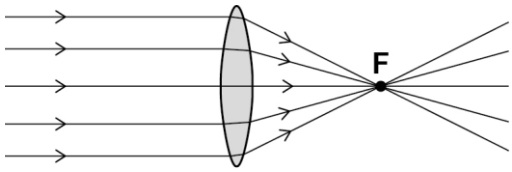
Turn over for the next question

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 ☑

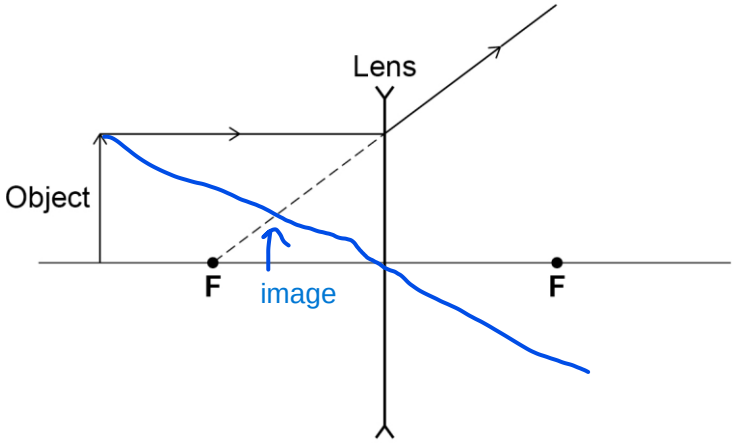
Do not write outside the box

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.

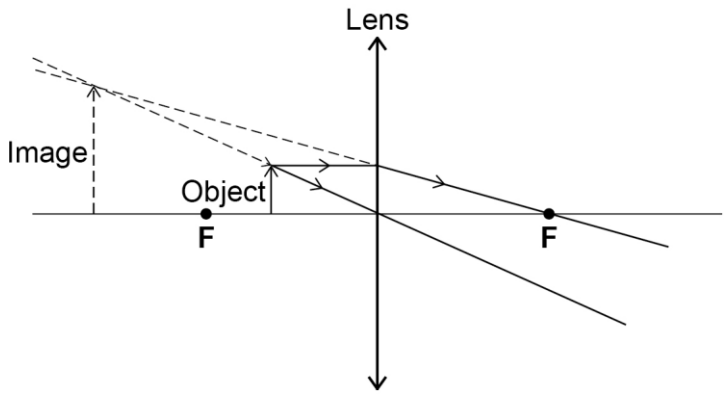
[2 marks]

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 upright

2 virtual

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]

3.5 = image height / 1.6
image height = 3.5 × 1.6
image height = 5.6 (mm)

Image height = 5.6 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.

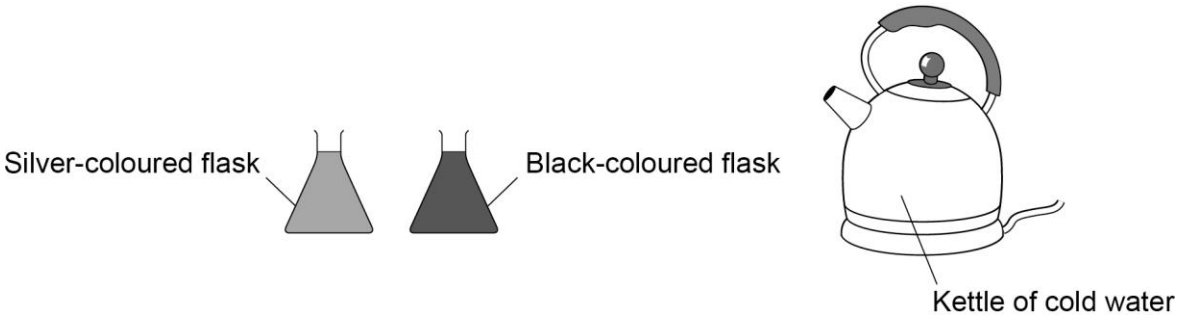
[1 mark]

In a transverse wave, the direction of oscillation is perpendicular 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]

heat the water / kettle

Add an equal volume of (hot) water to each flask

insert a thermometer into each flask

record the initial temperature from both flasks

Question 9 continues on the next page

Do not write outside the box

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 there is the greatest temperature difference (between the hot water and the surroundings)

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

[1 mark]

the temperature (increase / change after 10 minutes)

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 black surfaces absorb more (infrared than white surfaces)

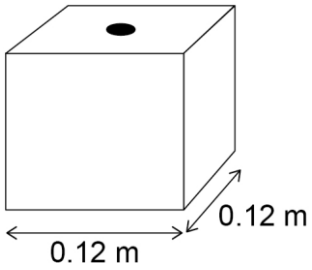
2 matt surfaces absorb more (infrared) than shiny surfaces of the same colour

Do not write outside the box

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]

1500 = F / 0.0144
F = 1500 × 0.0144
F = 21.6 (N)

Force = 21.6 N

17

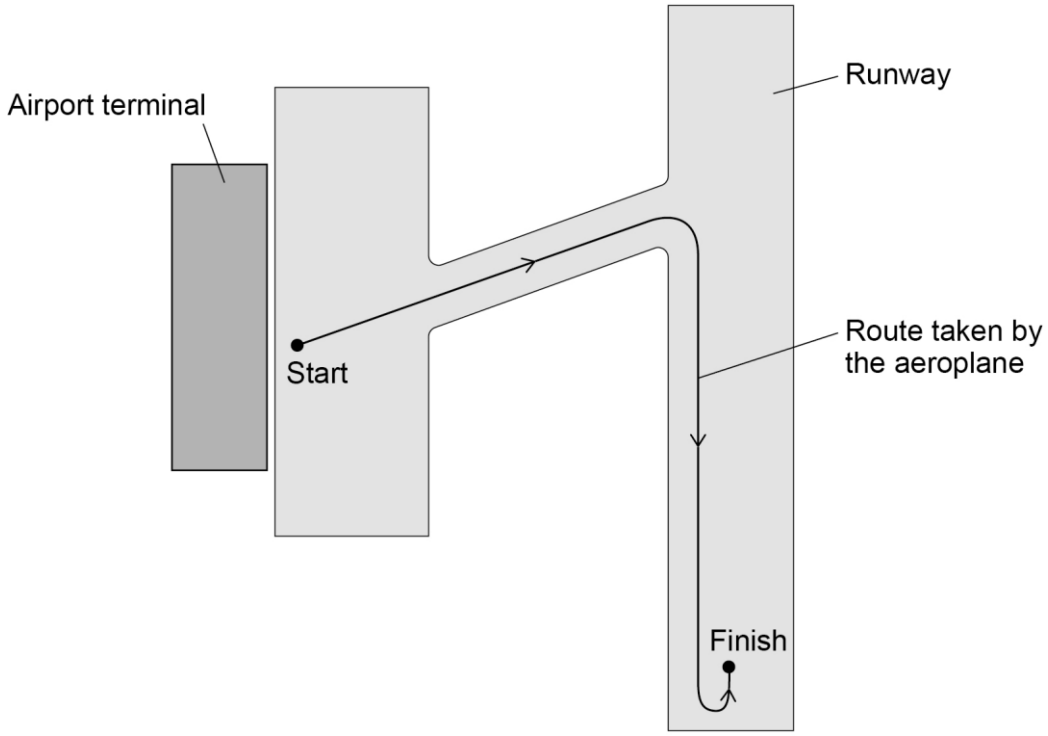
Turn over for the next question

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**.

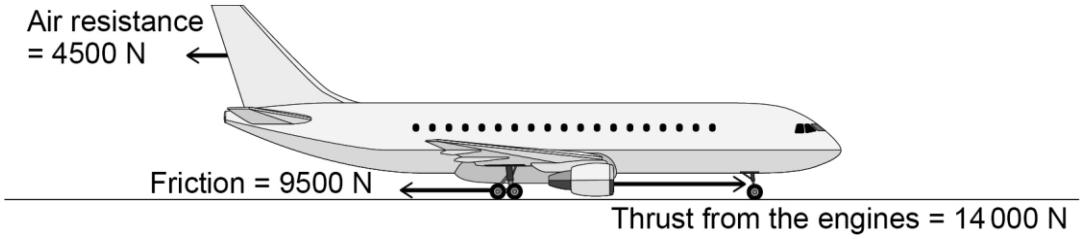
[2 marks]

Displacement = 7.1 (cm) 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



1 0 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = 0 N

1 0 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

constant velocity

1 0 . 4 Air resistance and friction are contact forces.

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

[1 mark]

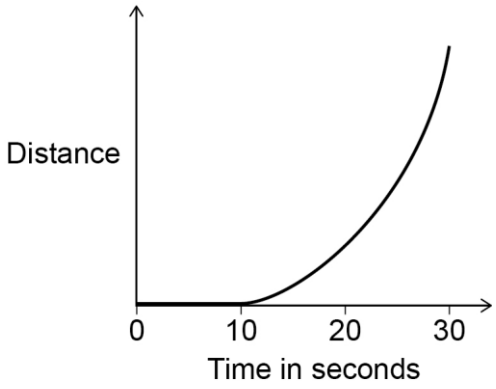
any one from:
- tension
- normal contact (force)
- upthrust

Turn over ►

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.

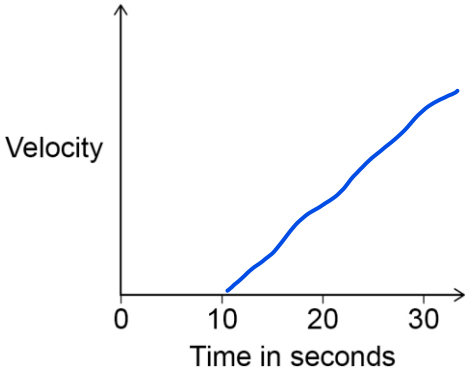
Figure 27



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

[2 marks]

Figure 28



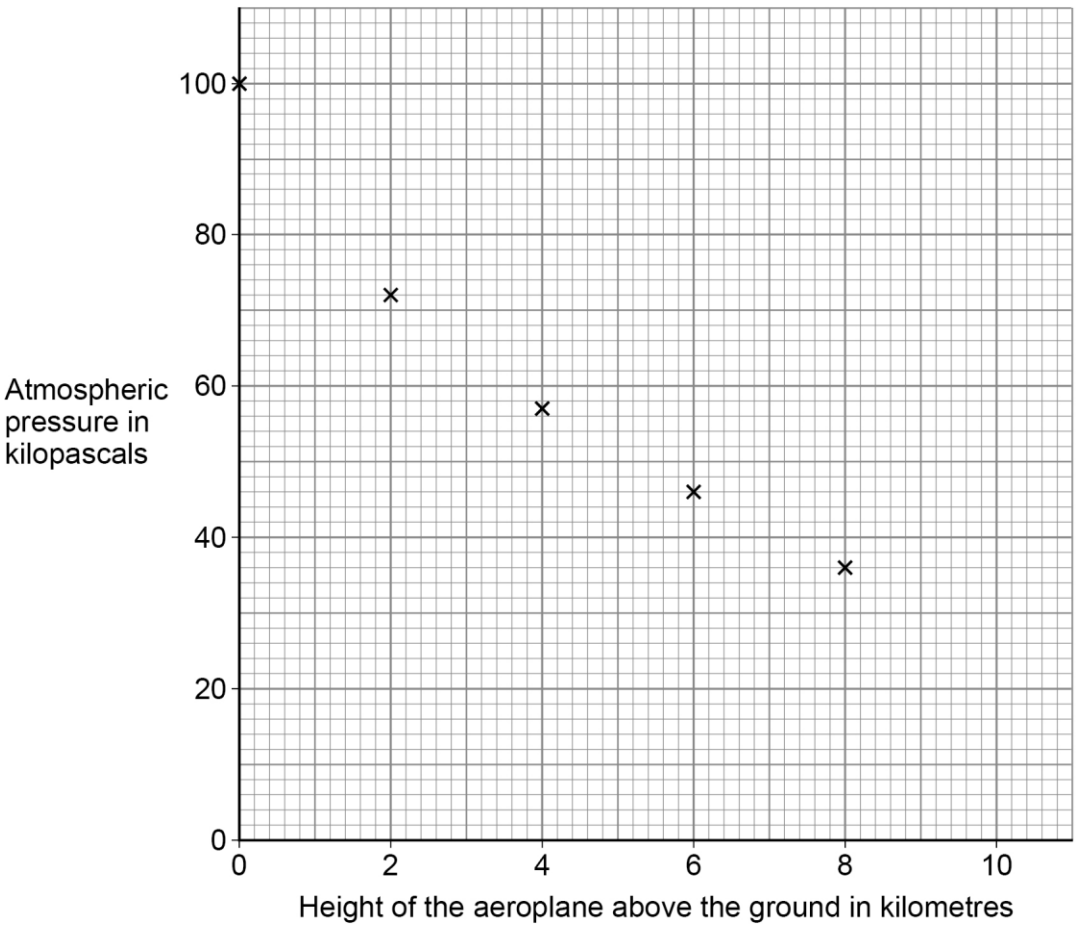
5 horizontal line drawn to 10s along the x-axis line with a positive gradient starting from 10 s

Do not write outside the box

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 = 28 kPa

Question 10 continues on the next page

Turn over ►

Do not write outside the box

10.7 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

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED