Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
PHYSICS

F

Foundation Tier Paper 2

Friday 14 June 2019 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.
- Fill in the box 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.
- 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	

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ANSWER IN THE SPACES PROVIDED

Answer all questions in the spaces provided.

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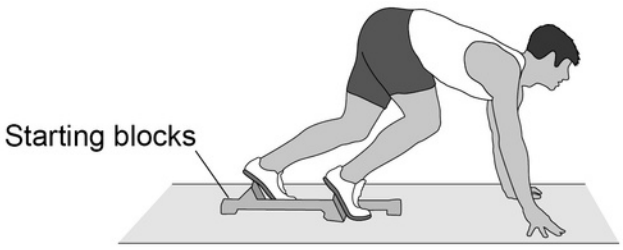
0 1 Figure 1 shows an athlete on starting blocks waiting to start a 100 metre race.

Figure 1



0 1 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

equal to	greater than	less than

The force from the athlete pushing backwards on the starting blocks

is equal to the force from the starting

blocks pushing forwards on the athlete.

Question 1 continues on the next page

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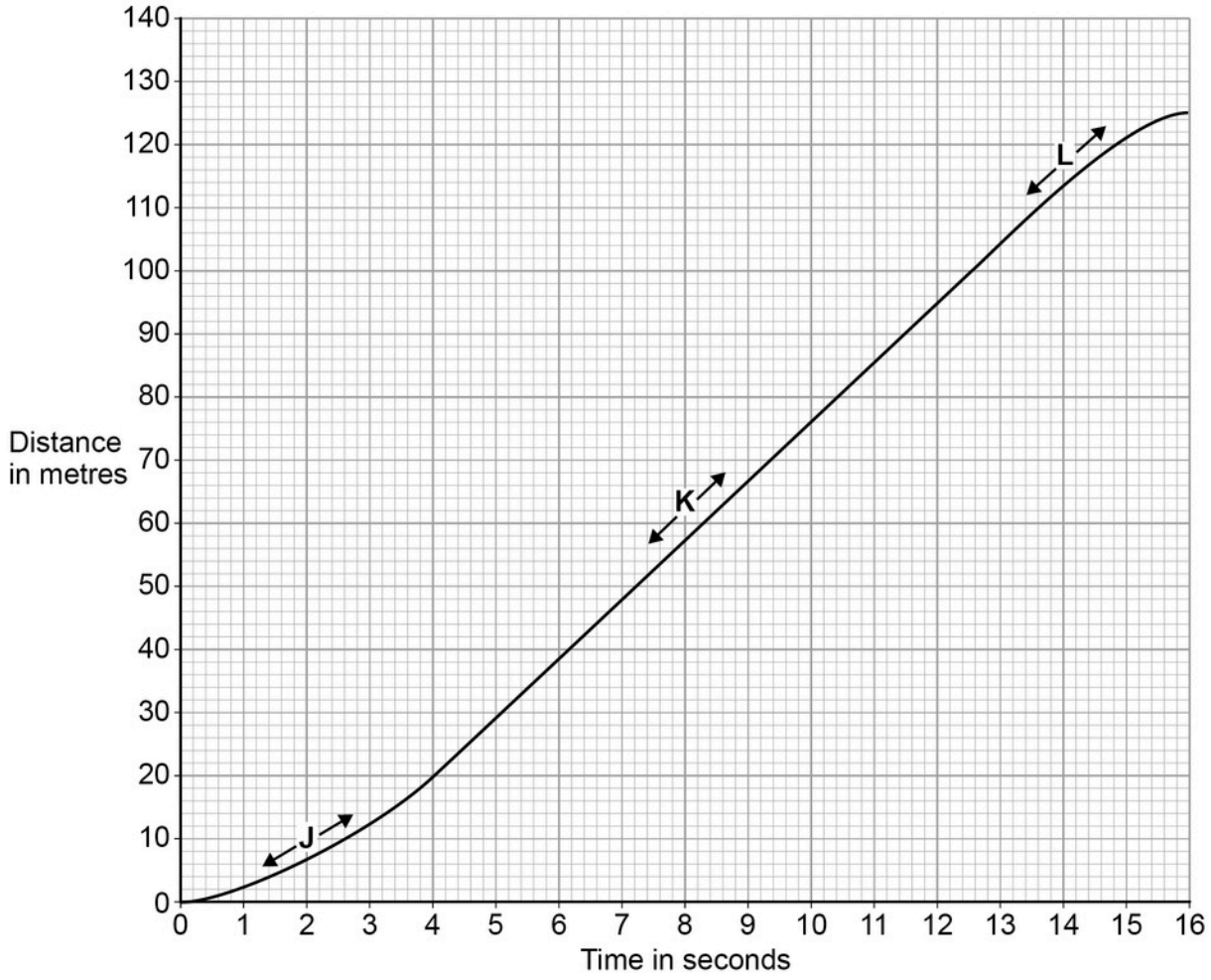
Figure 2 shows a distance-time graph for the athlete from the moment the race starts.

Figure 2



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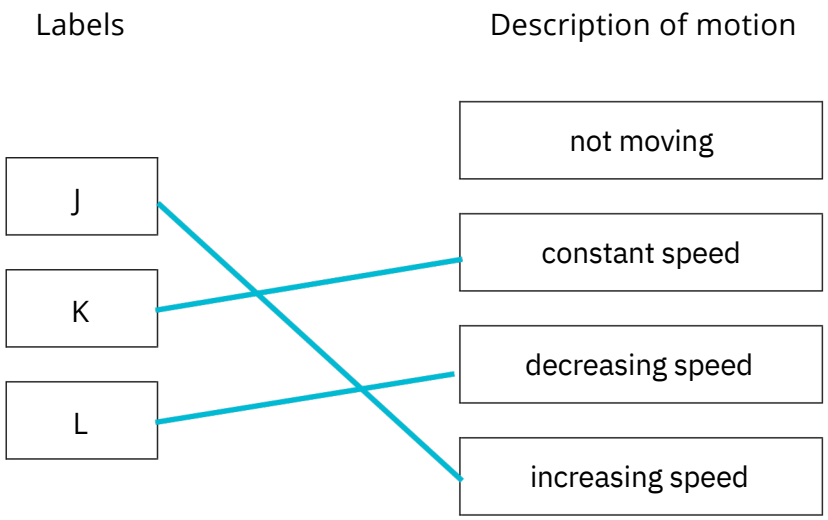
0 1 . 2 Three parts of the distance-time graph are labelled J, K and L.

Draw one line from each of the labels to the correct description of the athlete's motion for that part of the graph.

[2 marks]



0 1 . 3 What distance does the athlete travel after the end of the race before stopping?

[1 mark]

Distance = 25 m

0 1 . 4 Calculate the average speed of the athlete between the start and finish of the 100 metre race.

Use the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

[2 marks]

Av speed = $\frac{100}{12.5}$

Average speed = 8.0 m/s

Turn over ►

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0 1 . 5 The athlete runs faster than a typical person.

What is the average running speed of a typical person in metres per second?

[1 mark]

Tick (☒) one box.

1.5 ☐

3.0 ☒

4.5 ☐

6.0 ☐

7

Turn over for the next question

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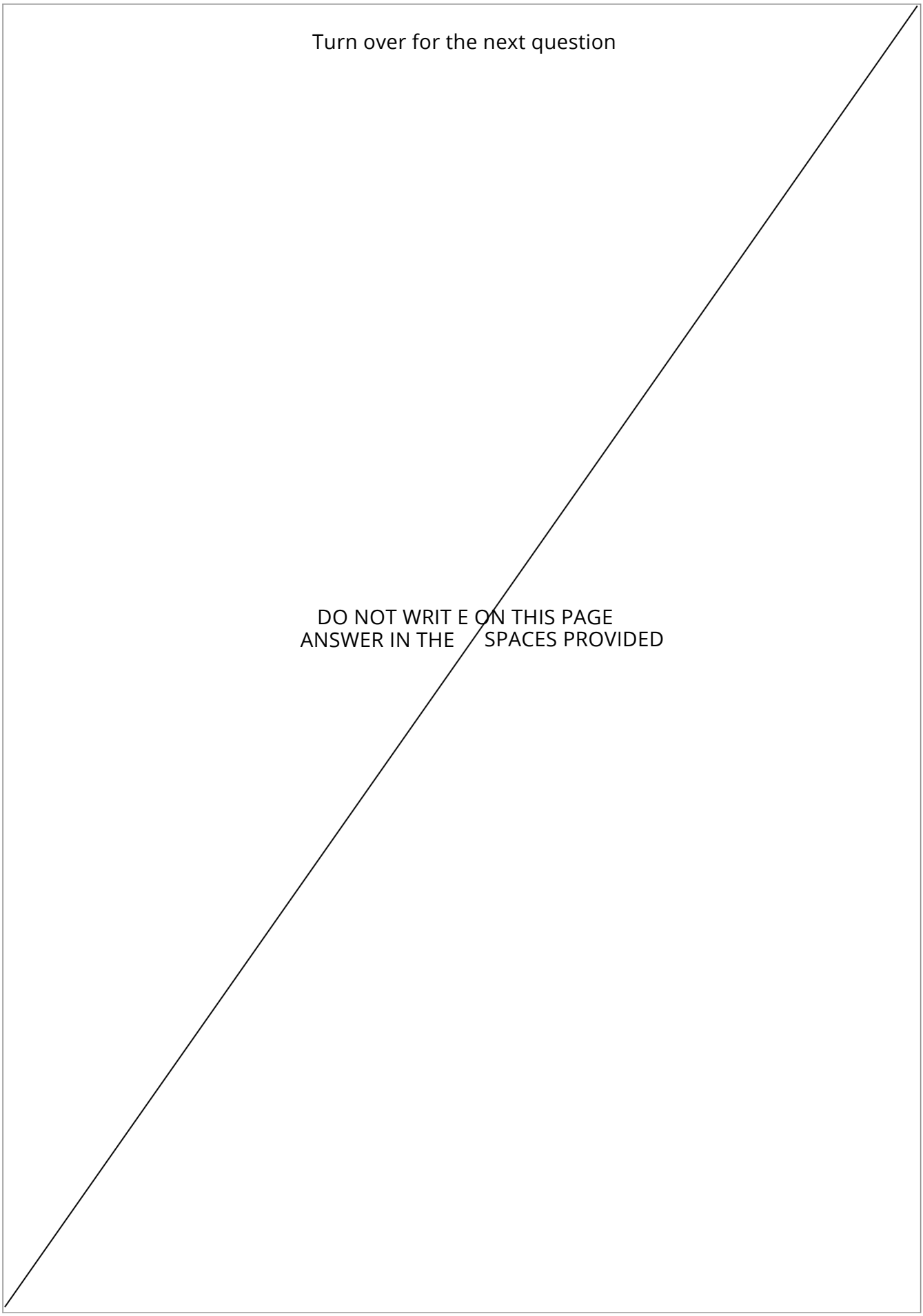

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0 2 Most galaxies are moving away from the Earth. Scientists can determine the speed of a galaxy by observing the light from the galaxy.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

frequency	speed	wavelength

When scientists observe the light from distant galaxies, they observe an increase in the wavelength of light from those galaxies.

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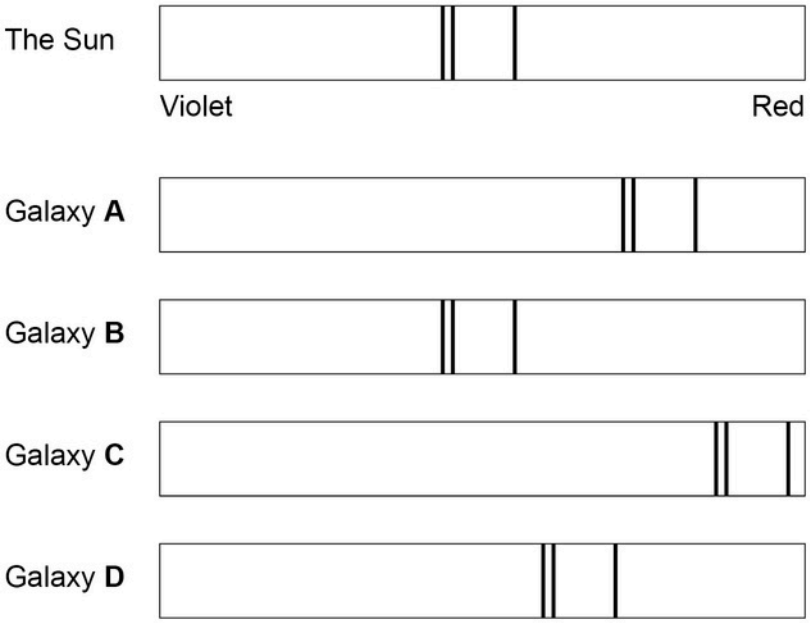
The light spectra from stars and galaxies include dark lines.

The lines have the same pattern.

Figure 3 shows the light spectrum from the Sun and from four galaxies.

Figure 3



0 2 . 2 Which galaxy is moving the fastest away from the Earth?

[1 mark]

Tick (✓) one box.

A ☐ B ☐ C ☑ D ☐

0 2 . 3 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) one box.

A ☐ B ☐ C ☑ D ☐

Do not write outside the box

0 2 . 4 The Big Bang theory is one way to explain the origin of the universe.

How does the Big Bang theory describe the universe when it began?

[1 mark]

Tick (✓) one box.

- Very big and very dense ☐
- Very big and extremely hot ☐
- Very dense and extremely hot ☑
- Very small and extremely cold ☐

0 2 . 5 Which statement about the Big Bang theory is correct?

[1 mark]

Tick (✓) one box.

- Scientists have proved that the theory is correct. ☐
- Scientific evidence supports the theory. ☑
- There is no other way to explain the origin of the universe. ☐

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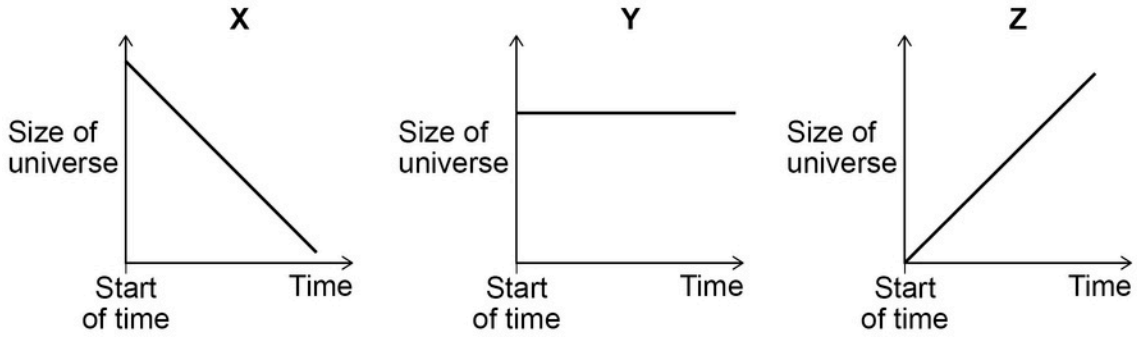
0 2 . 6 Figure 4 shows three ways that the size of the universe may have changed with time.

Figure 4



Which graph would the Big Bang theory suggest is correct?

[2 marks]

Tick (☒) one box.

X ☐ Y ☐ Z ☒

Give a reason for your answer.

Only one shows the universe is expanding

7

Turn over for the next question

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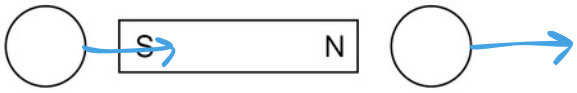
0 3 . 1 Figure 5 shows a bar magnet.

Each circle represents a compass.

Figure 5



Draw an arrow inside each circle to show the direction that each compass would point.

[1 mark]

0 3 . 2 Figure 6 shows part of a coat.

The coat has two magnets hidden inside the material.

Figure 7 shows how the magnets are used to fasten the coat.

Figure 6

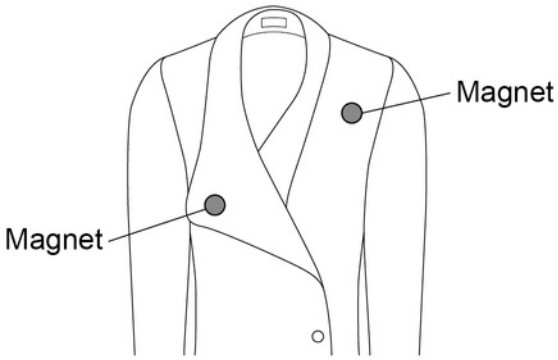
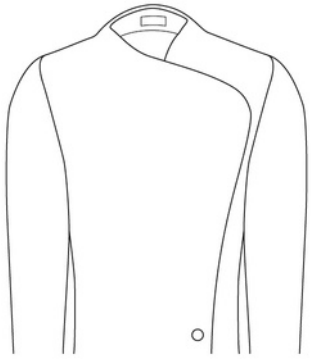


Figure 7



Explain why the magnets inside the coat must not have two south poles facing each other.

[2 marks]

Two south poles would repel so the coat would not be held together

Do not write outside the box

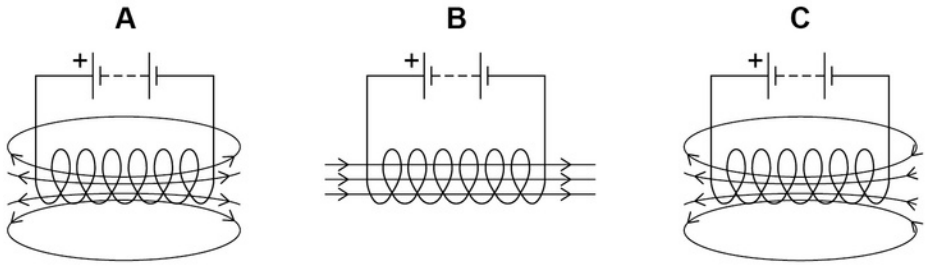
A coil of wire is connected to a battery.

The current in the coil produces a magnetic field.

0 3 . 3 Which diagram in Figure 8 shows the magnetic field produced by the current in the coil?

Tick (✓) one box. [1 mark]

Figure 8



A ☐ B ☐ C ☑

0 3 . 4 A solid rod is placed inside the coil.

Which type of rod would make the magnetic field of the coil stronger?

[1 mark]

Tick (✓) one box.

Glass rod ☐

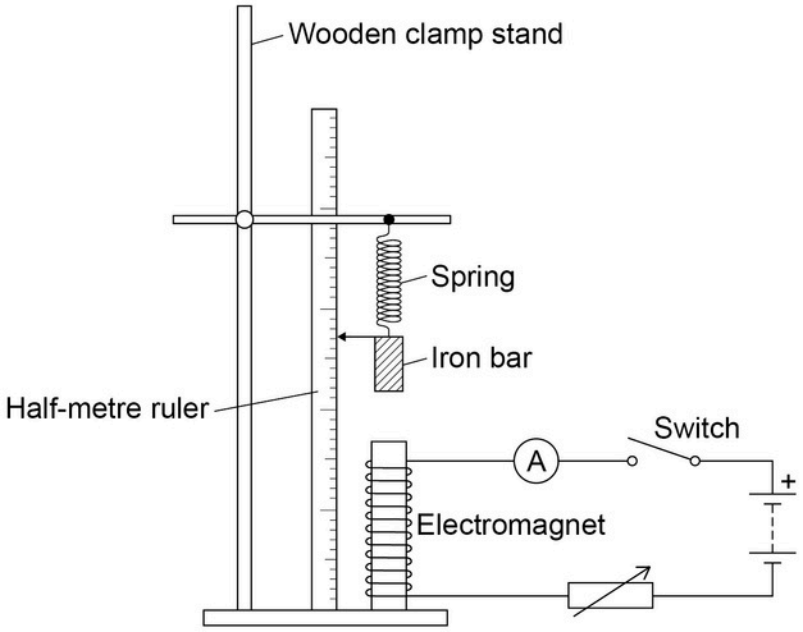
Plastic rod ☐

Steel rod ☑

Wooden rod ☐

A student investigated how the strength of an electromagnet varies with the current in the coil of the electromagnet.
Figure 9 shows the equipment the student used.

Figure 9



0 3 . 5 Why does the spring get longer when the electromagnet is switched on?

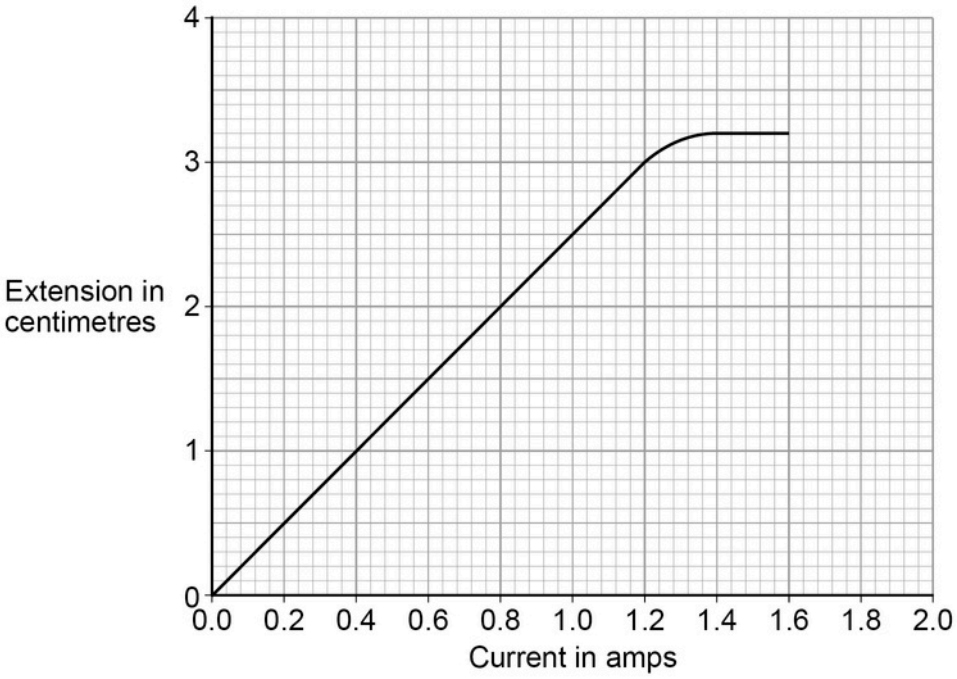
[1 mark]

Electromagnet exerts a downwards force on the iron bar.

Do not write outside the box

The student measured how much further the spring extended with different values of current in the coil.
Figure 10 shows the results.

Figure 10



0 3 . 6 The current in the coil is increased from 0.6 A to 1.2 A

Determine the increase in the extension of the spring.

[1 mark]

1.5 (cm)

Increase in the extension = 1.5 cm

0 3 . 7 Calculate the increase in the force on the spring when the current in the coil increased from 0.6 A to 1.2 A

Spring constant = 0.18 N/cm

Use the equation:

force = spring constant × extension

[2 marks]

$F = 0.18 \times 1.5$

Increase in the force = 0.27 N

Turn over ►

0 3 . 8 Describe what happened to the strength of the electromagnet as the current in the coil increased from 1.2 A to 1.6 A

[2 marks]

It increases and reaches a maximum.

11

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Do not write outside the box

0 4 . 1 Figure 11 shows the position of three types of wave in the electromagnetic spectrum.

Figure 11

A	Microwaves	**B**	Visible light	**C**	**D**	Gamma rays

Which letter represents infrared in the electromagnetic spectrum?

[1 mark]

Tick (✓) one box.

A ☐ B ☑ C ☐ D ☐

0 4 . 2 What is infrared used for?

[1 mark]

Tick (✓) one box.

Electrical heating ☑

Energy efficient lamps ☐

Satellite communications ☐

Sun tanning ☐

Question 4 continues on the next page

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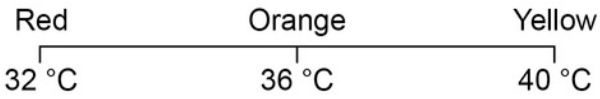
An infrared camera produces a colour image. Different colours show different temperatures.
People emit infrared radiation. Figure 12 shows how the colour of the image of a person on an infrared camera depends on the person's body temperature.

Figure 12



0 4 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

orange	red	yellow

The image produced by an infrared camera of a person with a body temperature of 37 °C is mainly orange .

0 4 . 4 Rescue workers use infrared cameras to search for people trapped under rubble after an earthquake.

How does the image of a trapped person change if the person's body temperature drops from 37 °C to 33 °C?

[1 mark]

It becomes more red

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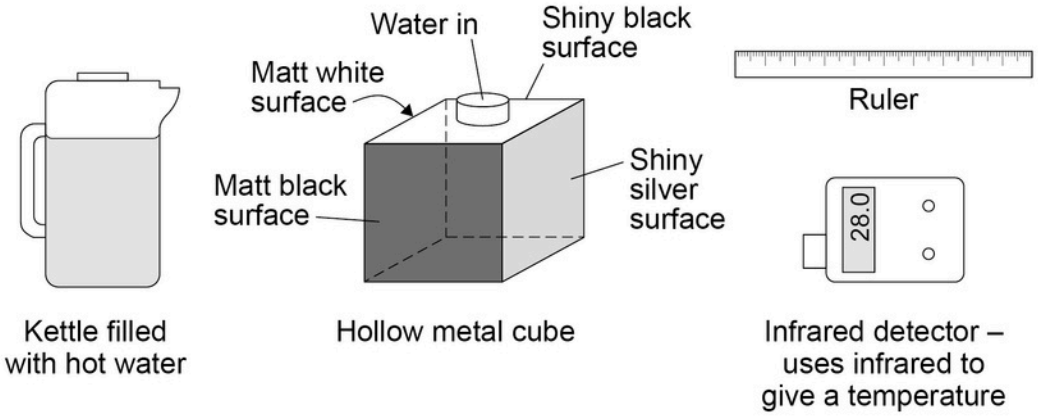
A student investigated how the type of surface affects the amount of infrared the surface radiates.

Figure 13 shows the equipment used.

Figure 13



0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

a control	the dependent	the independent

In this investigation the type of surface is the independent variable.

0 4 . 6 Describe how the equipment shown in Figure 13 would be used to compare the infrared radiation emitted from the vertical surfaces of the cube.

[3 marks]

Pour hot water into the hollow metal)cube
point the IR detector at each side and take a reading.

Do not write outside the box

Table 1 shows the results.

Table 1

Type of surface	Temperature in °C
Matt black	68.0
Matt white	65.5
Shiny black	66.3
Shiny silver	28.0

0 4 . 7 What is the resolution of the infrared detector?

[1 mark]

Tick (✓) one box.

- 0.1 °C ☑
- 1.0 °C ☐
- 1.7 °C ☐
- 68.0 °C ☐

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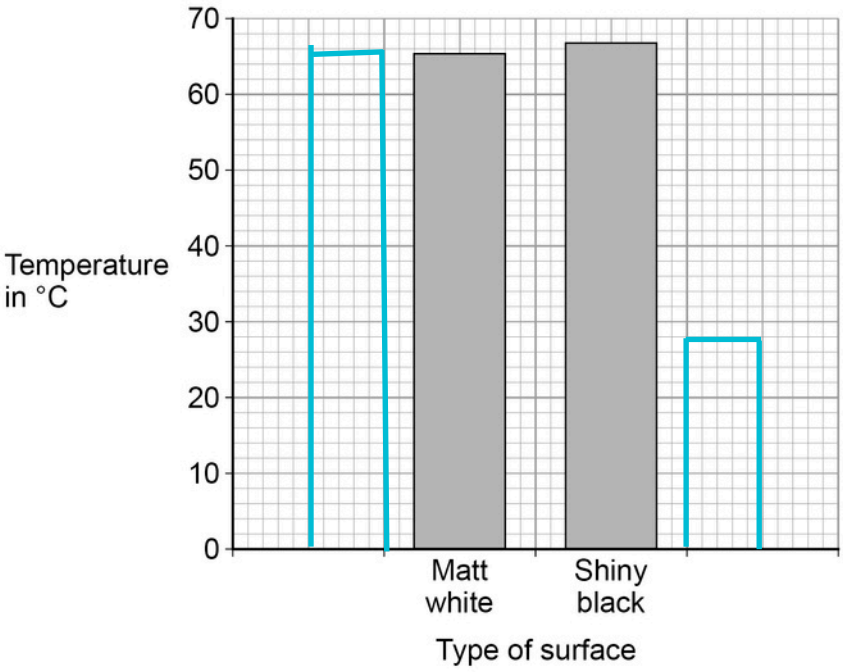
The bar chart in Figure 14 shows two of the results.

Figure 14



0 4 . 8 Complete the bar chart to show all of the results.

[3 marks]

0 4 . 9 Give one conclusion that can be made from the results.

[1 mark]

Matt black is the best emitter.

13

Turn over for the next question

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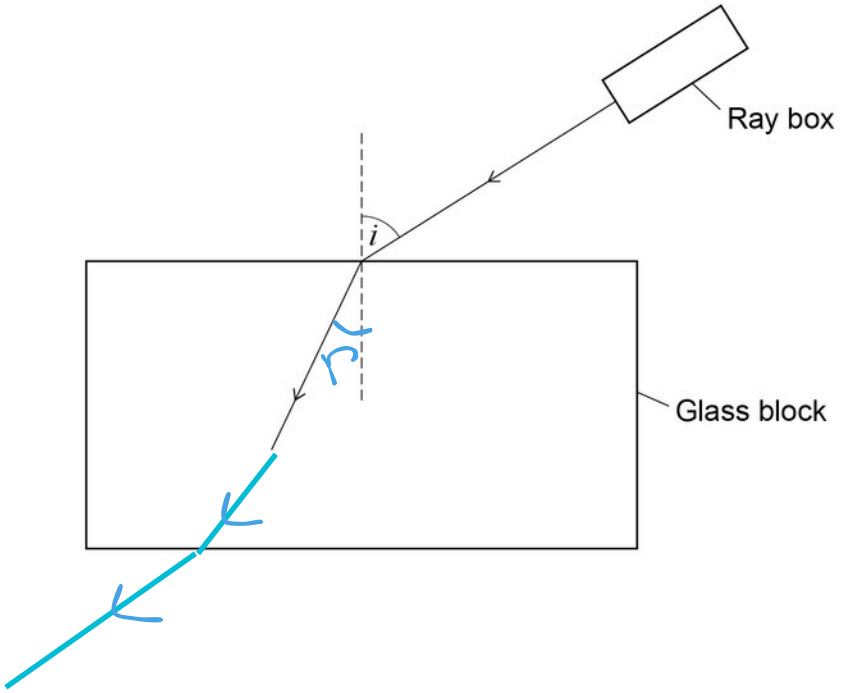
0 5 A student used a ray box and glass block to investigate refraction of light.

Figure 15 shows a ray of light entering the glass block.

Figure 15



0 5 . 1 In Figure 15, the angle of incidence is labelled with the letter *i*.

Label the angle of refraction in Figure 15 with the letter *r*.

[1 mark]

0 5 . 2 Measure the angle of incidence in Figure 15.

[1 mark]

Angle of incidence = 58 (degrees)°

0 5 . 3 Complete Figure 15 to show the path taken by the ray of light through the glass block and out into the air.

[3 marks]

Do not write outside the box

0 5 . 4 Complete the sentence.

Choose an answer from the box.

[1 mark]

random	systematic	zero

The student repeated the measurement three times and calculated the mean to reduce the effect of random errors.

Table 2 shows the student's values for the angles of incidence and the mean angles of refraction.

Table 2

Angle of incidence in degrees	Mean angle of refraction in degrees
20	13
30	19
40	X
50	31

0 5 . 5 For an angle of incidence of 40° the three measurements for the angle of refraction were:

23° 27° 25°

Calculate the value of X in Table 2.

[1 mark]

25

X = 25 °

Turn over ►

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0 5 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

equal to	greater than	less than

The student used the data in Table 2 and correctly concluded that the angle of refraction is less than the angle of incidence used.

0 5 . 7 Why is the student's conclusion only valid for angles of incidence between 20° and 50°?

[1 mark]

There is no results outside of that range

0 5 . 8 The student repeated the investigation using a transparent plastic block.

Why did the student use a transparent block and not an opaque block?

[1 mark]

Light would not pass through an opaque block

Do not write outside the box

0 5 . 9 The student wanted to compare the refraction caused by the plastic with the refraction caused by the glass.

What must the student keep the same for both the plastic block and the glass block?

[1 mark]

Tick (✓) one box.

- [x] The angles of incidence tested
- [ ] The angles of refraction tested
- [ ] The number of results recorded
- [ ] The size of the two blocks

11

Turn over for the next question

Do not write outside the box

0 6 The following statements describe parts of a short train journey between two railway stations.

Part A: The train accelerates at a constant rate from 0 m/s to 20 m/s in 40 s

Part B: The train travels at a constant velocity for 260 s

Part C: The train decelerates at a constant rate coming to a stop in 60 s

0 6 . 1 During which part of the journey is the resultant force on the train zero?

[1 mark]

Tick (☒) one box.

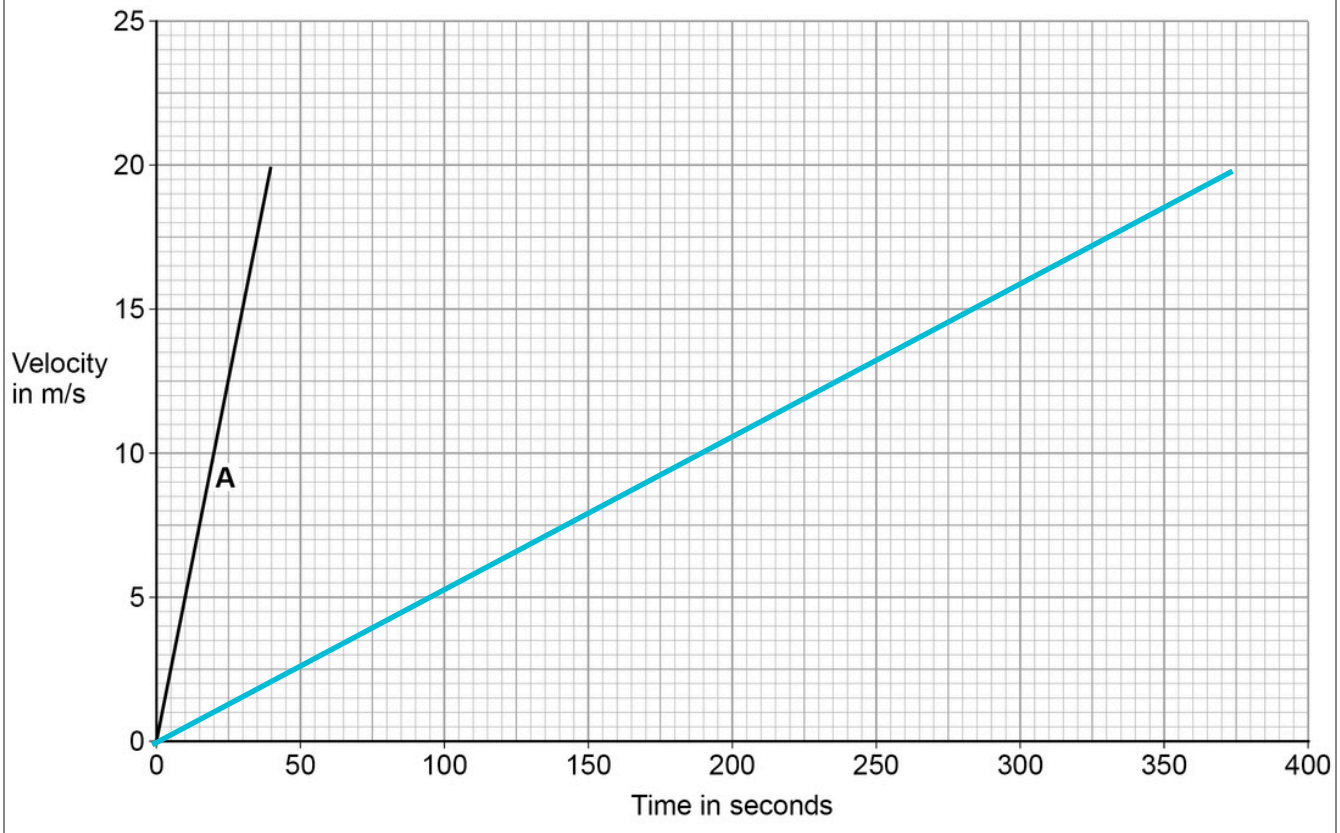
A ☐ B ☒ C ☐

0 6 . 2 Figure 16 shows part of the velocity-time graph for the train journey.

Complete Figure 16 showing part B and part C of the train journey.

[3 marks]

Figure 16



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0 6 . 3 Write down the equation which links acceleration, change in velocity and time taken.

[1 mark]

acceleration= change in velocity / time taken

0 6 . 4 Another train accelerated at 1.15 m/s2 for 22.0 s

Calculate the increase in velocity of the train.

[3 marks]

$1.15 = \frac{\Delta v}{22}$

$\Delta v = 1.15 \times 22$

Increase in velocity = 25.3 m/s

8

Turn over for the next question

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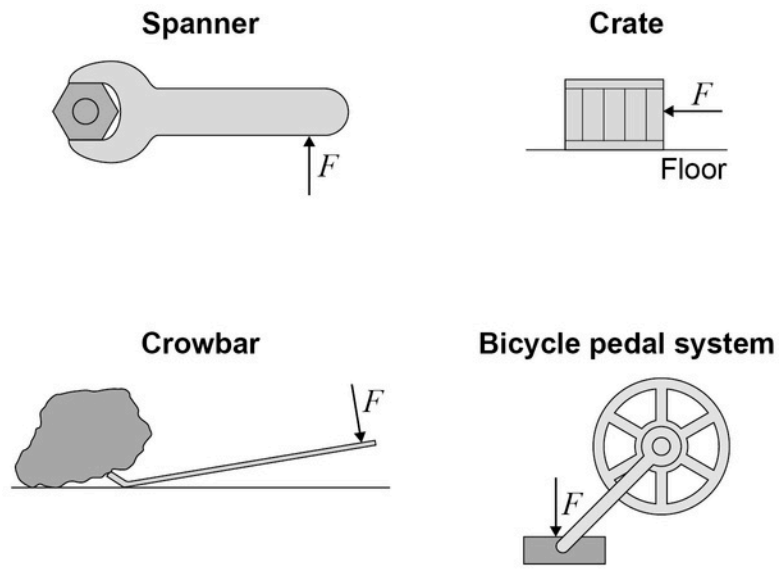
0 7 . 1 Figure 17 shows four examples of a force causing an object to move.

Figure 17



Which object is not likely to rotate?

[1 mark]

Tick (✓) one box.

- Bicycle pedal system ☐
- Crate ☑
- Crowbar ☐
- Spanner ☐

Question 7 continues on the next page

Do not write outside the box

Figure 18 shows a simple device that can be used as a weighing scale.

Figure 19 shows the device being used to measure a quantity of rice.

The weight of the device is balanced by the weight of the rice and basket.

Figure 18

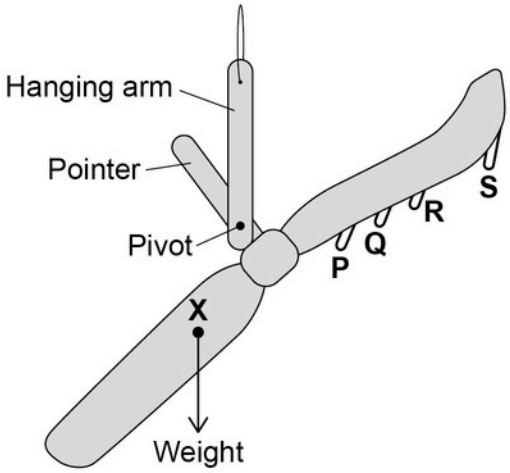
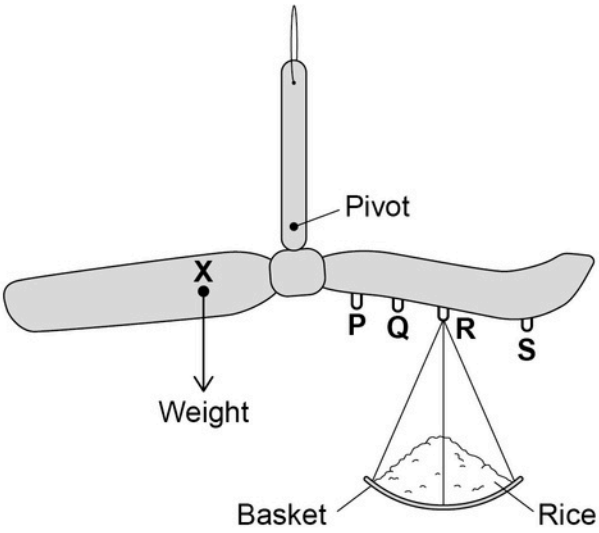


Figure 19



0 7 . 2 The weight of the device acts through the point labelled X.

What is point X called?

Tick (✓) one box. [1 mark]

- Centre of balance ☐
- Centre of mass ☑
- Centre of weight ☐

Do not write outside the box

0 7 . 3 How does Figure 19 show that the weight of the device is balanced by the weight of the rice and basket?

[1 mark]

The pointer is vertical.

0 7 . 4 The basket can hang from different points on the device.

Where should the basket hang to measure the largest quantity of rice?

[1 mark]

Tick (✓) one box.

P ☑ Q ☐ R ☐ S ☐

0 7 . 5 Write down the equation which links distance, force and moment of a force.

[1 mark]

moment (of a force) = force x distance

0 7 . 6 In Figure 19, the weight of the device causes an anticlockwise moment of 0.15 Nm about the pivot.
The weight of the rice and basket acts 0.06 m from the pivot.

Calculate the weight of the rice and basket.

[3 marks]

$0.15 = W \times 0.06$

$W = \frac{0.15}{0.06}$

Weight of rice and basket = 2.5 N

Turn over ►

Do not write outside the box

0 7 . 7 Write down the equation which links gravitational field strength, mass and weight.

[1 mark]

weight = mass × gravitational field strength

0 7 . 8 The basket has a mass of 0.04 kg

gravitational field strength = 9.8 N/kg

Calculate the mass of rice in the basket.

[3 marks]

$2.5 = m \times 9.8$

$m = \frac{2.5}{9.8}$

Mass = 0.255 kg

12

Turn over for the next question

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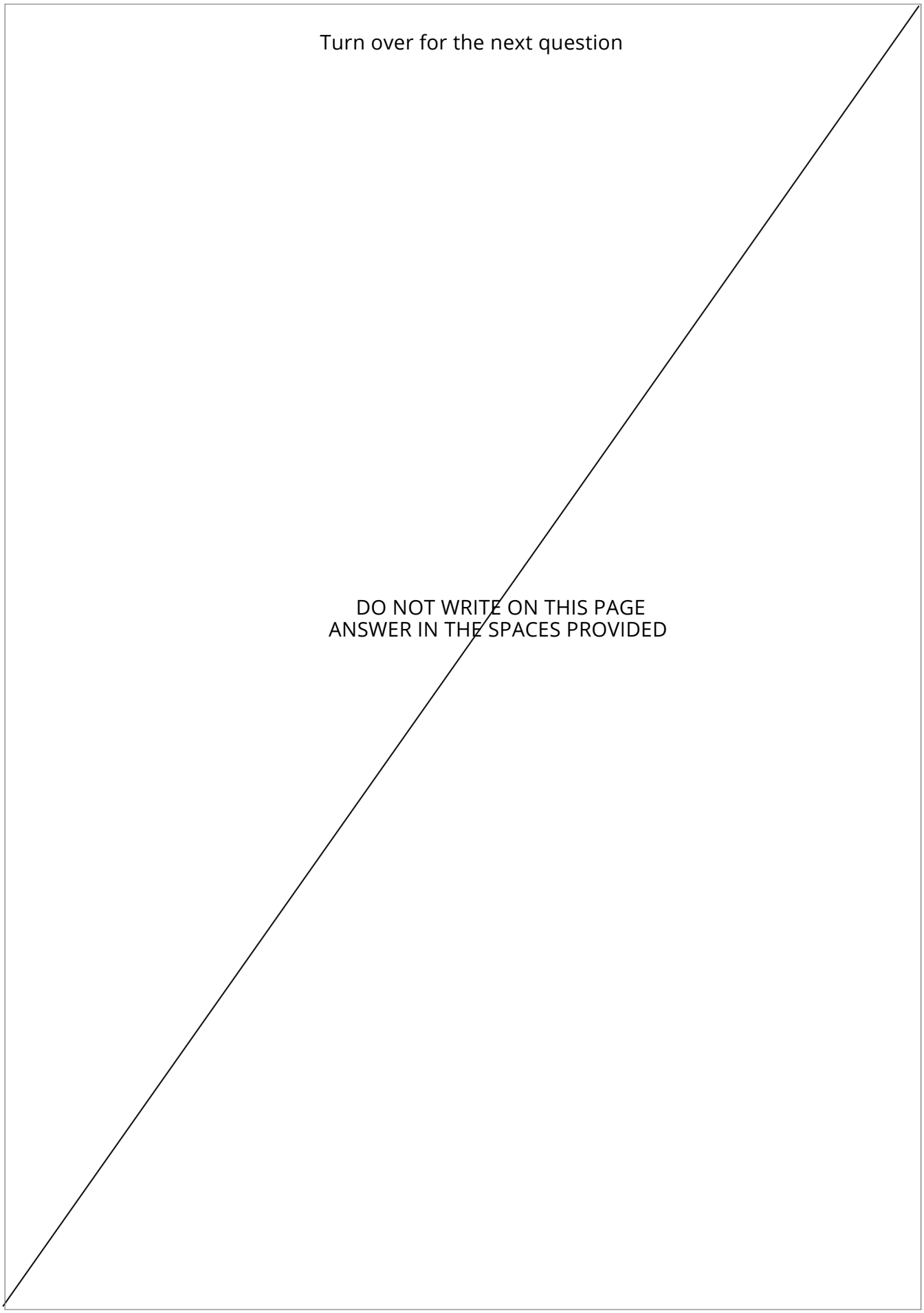

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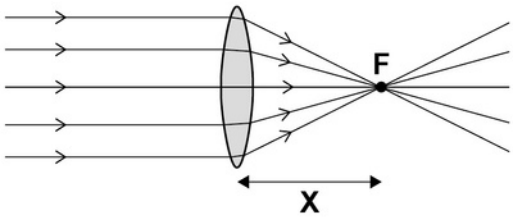
0 8 . 1 Figure 20 shows parallel rays of light being refracted by a convex lens.

Figure 20



What is distance 'X' called?

[1 mark]

Focal length

0 8 . 2 Lenses can be used to form the image of an object.

Complete the ray diagram in Figure 21 to show how a convex lens forms the image of the object.
Use an arrow to represent the image.

[2 marks]

Figure 21

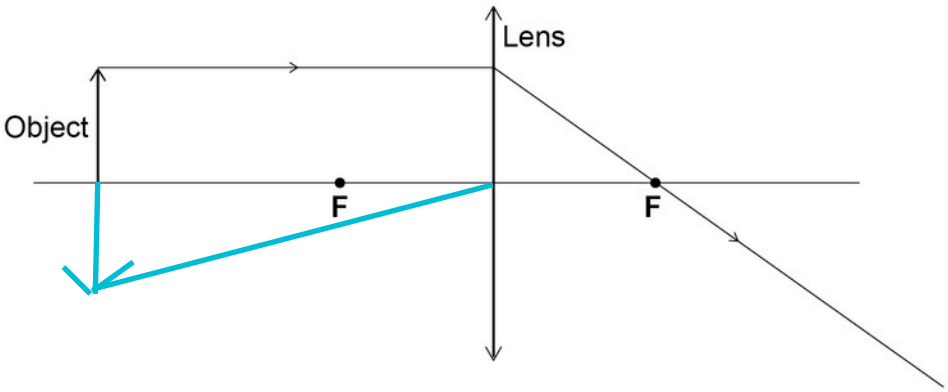


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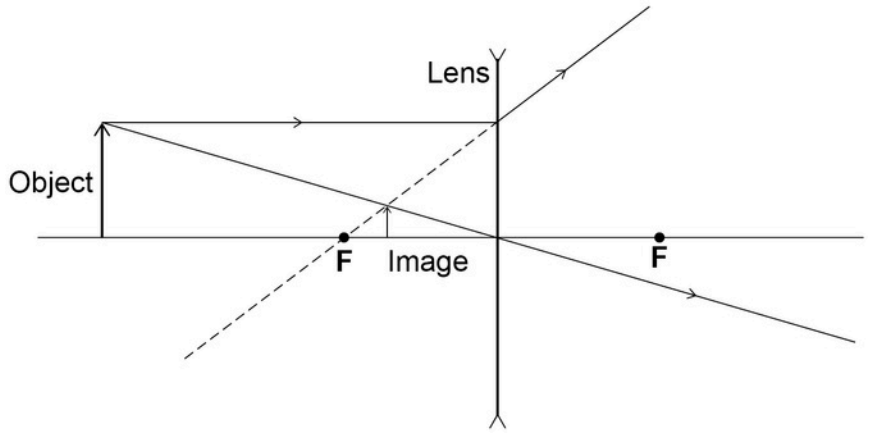
Figure 22 shows how a concave lens forms the image of an object.

Figure 22



0 8 . 3 Give one similarity and one difference between the image formed by the convex lens and the image formed by the concave lens.

[2 marks]

Similarity both are diminished

Difference concave is virtual and convex is real

0 8 . 4 A person uses a lens to read the letters on the back of a coin.

The image height of the letters on the coin is 9.0 mm

The magnification produced by the lens is 6.0

Calculate the height of the letters on the coin.

Use the Physics Equations sheet.

[3 marks]

$6.0 = \frac{9.0}{\text{height}}$

$= 9.0 / 6.0$

Height = 1.5 mm

8

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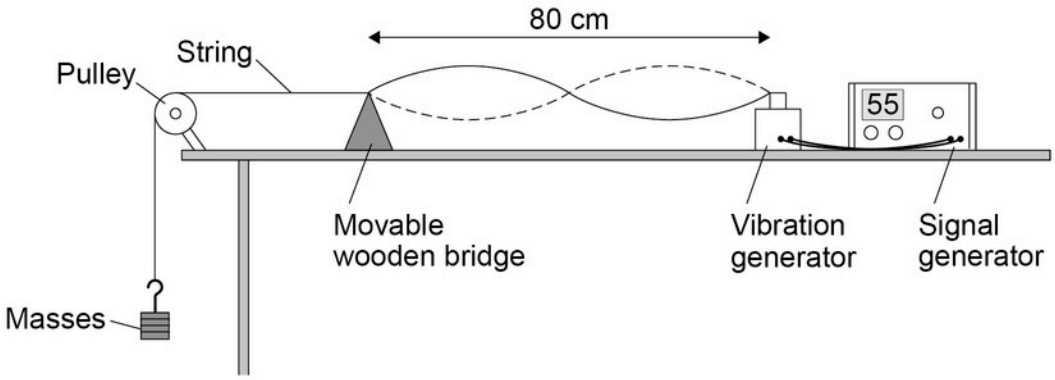
0 9 Figure 23 shows the apparatus used to investigate the waves in a stretched string.

Figure 23



The frequency of the signal generator is adjusted so that the wave shown in Figure 23 is seen.
At this frequency the string vibrates between the two positions shown in Figure 23.

0 9 . 1 The wavelength of the wave shown in Figure 23 was measured as 80 cm

What piece of apparatus would have been suitable for measuring this wavelength?

[1 mark]

metre rule

0 9 . 2 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

wave speed = frequency × wavelength

0 9 . 3 The string in Figure 23 vibrates at 55 Hz

Calculate the wave speed of the wave shown in Figure 23.

Use data given in Figure 23.

[3 marks]

80 cm = 0·8m

v = 55 × 0·8

Wave speed = 44 m/s

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0 9 . 4 The frequency of the signal generator is increased.

This makes the wavelength of the wave change.

The wave speed stays the same.

Describe how the apparatus could be adjusted to show one complete wave without reducing the frequency.

[2 marks]

move the wooden bridge to the right

0 9 . 5 A student wants to investigate how the speed of a wave on a stretched string depends on the tension in the string.

The student uses the apparatus in Figure 23.

Describe a method the student could use for this investigation.

[4 marks]

add or take away masses from the string.
adjust frequency using the signal generator.
and move the wooden bridge.
observe a stationary pattern.
measure the wavelength.
calculate wave speed from frequency and wavelength.
a Level 1 answer should include a way of changing tension.
a complete Level 2 answer would include either changing frequency and/or moving the bridge

11

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1 0 . 1 The driver of a vehicle sees a hazard on the road.

The driver uses the brakes to stop the vehicle.

Explain the factors that affect the distance needed to stop a vehicle in an emergency.

[6 marks]

- reaction time
  explained in terms of longer reaction times increase thinking distance (from a given speed)
- taking drugs
- drinking alcohol
- tiredness
- age
- distractions
  explained in terms of effect on driver's reaction time
- speed
  explained in terms of the faster the vehicle the greater the distance travelled in the driver's reaction time.•

condition of the tyres

- condition of road surface
- wet roads
  explained in terms of condition of tyres and road surface affecting friction between tyres and road
- condition of brakes
  explained in terms of effect on braking force applied to the wheels or reduced friction

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1 0 . 2 Write down the equation which links distance, force and work done.

[1 mark]

work (done) = force × distance

1 0 . 3 The work done by the braking force to stop a vehicle was 900 000 J

The braking force was 60 000 N

Calculate the braking distance of the vehicle.

[3 marks]

900000 = 60 000 × distance

= 900000 / 60000

Braking distance = 15 m

1 0 . 4 The greater the braking force, the greater the deceleration of a vehicle.

Explain the possible dangers caused by a vehicle having a large deceleration when it is braking.

[2 marks]

Brakes overheating and causing loss of control

12

END OF QUESTIONS

There are no questions printed on this page

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