Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE
PHYSICS

F

Foundation Tier Paper 2

8463/2F

Friday 14 June 2019 Morning

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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.**
- **Answer ALL questions in the spaces provided.**
- **Do not write on blank pages.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

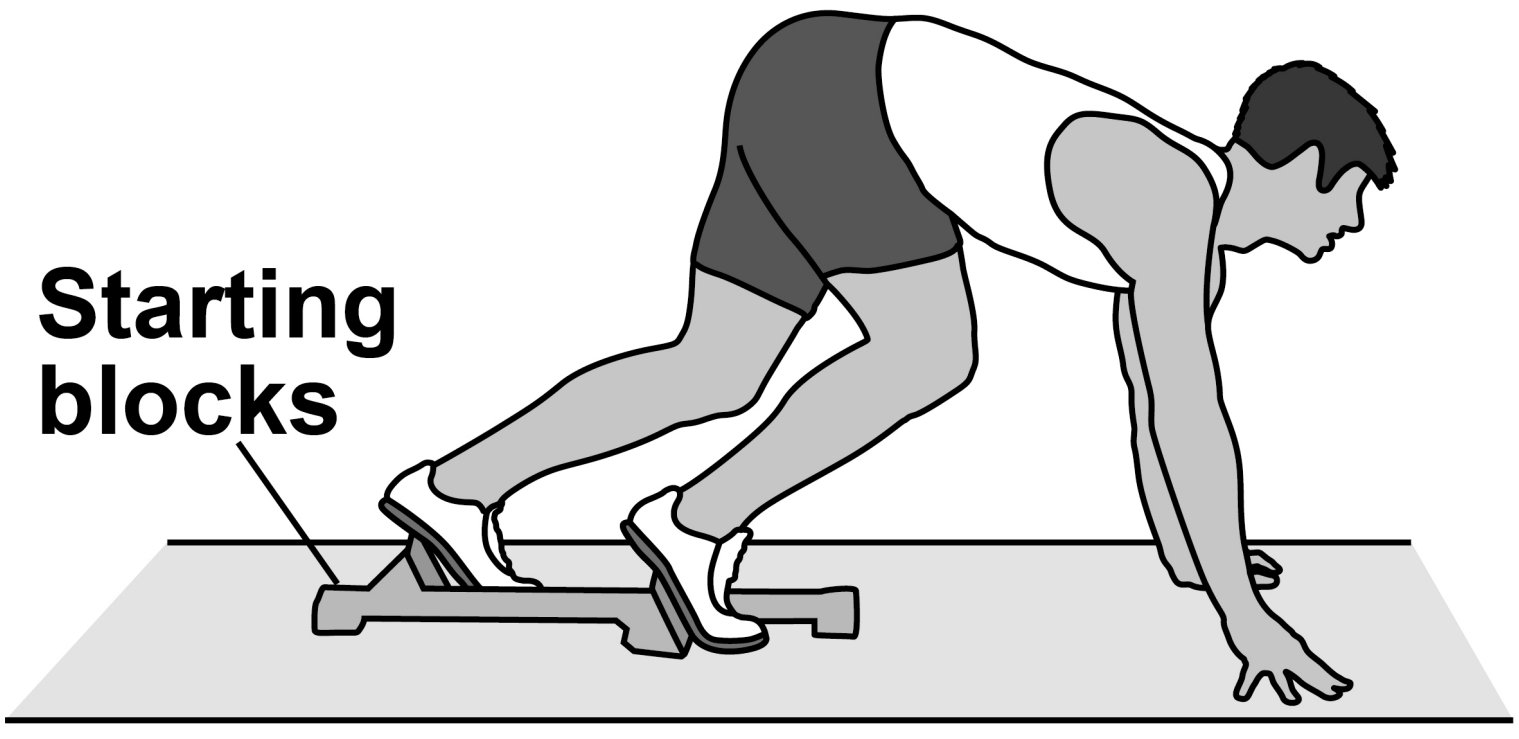
DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

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 list below.
[1 mark]

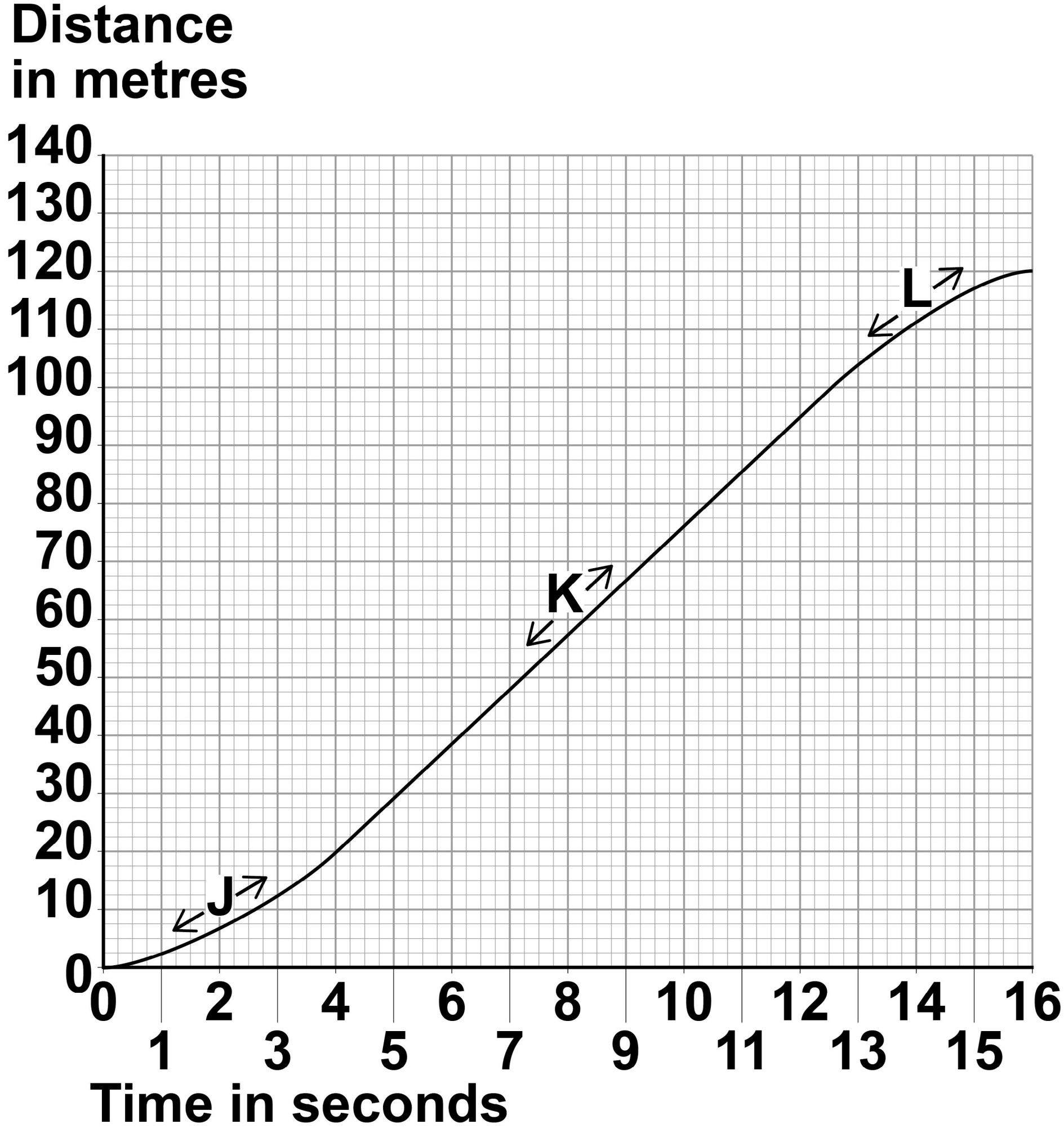
- **equal to**
- **greater than**
- **less than**

The force from the athlete pushing backwards on the starting blocks is _____ the force from the starting blocks pushing forwards on the athlete.

[Turn over]

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

FIGURE 2



0 1 . 2

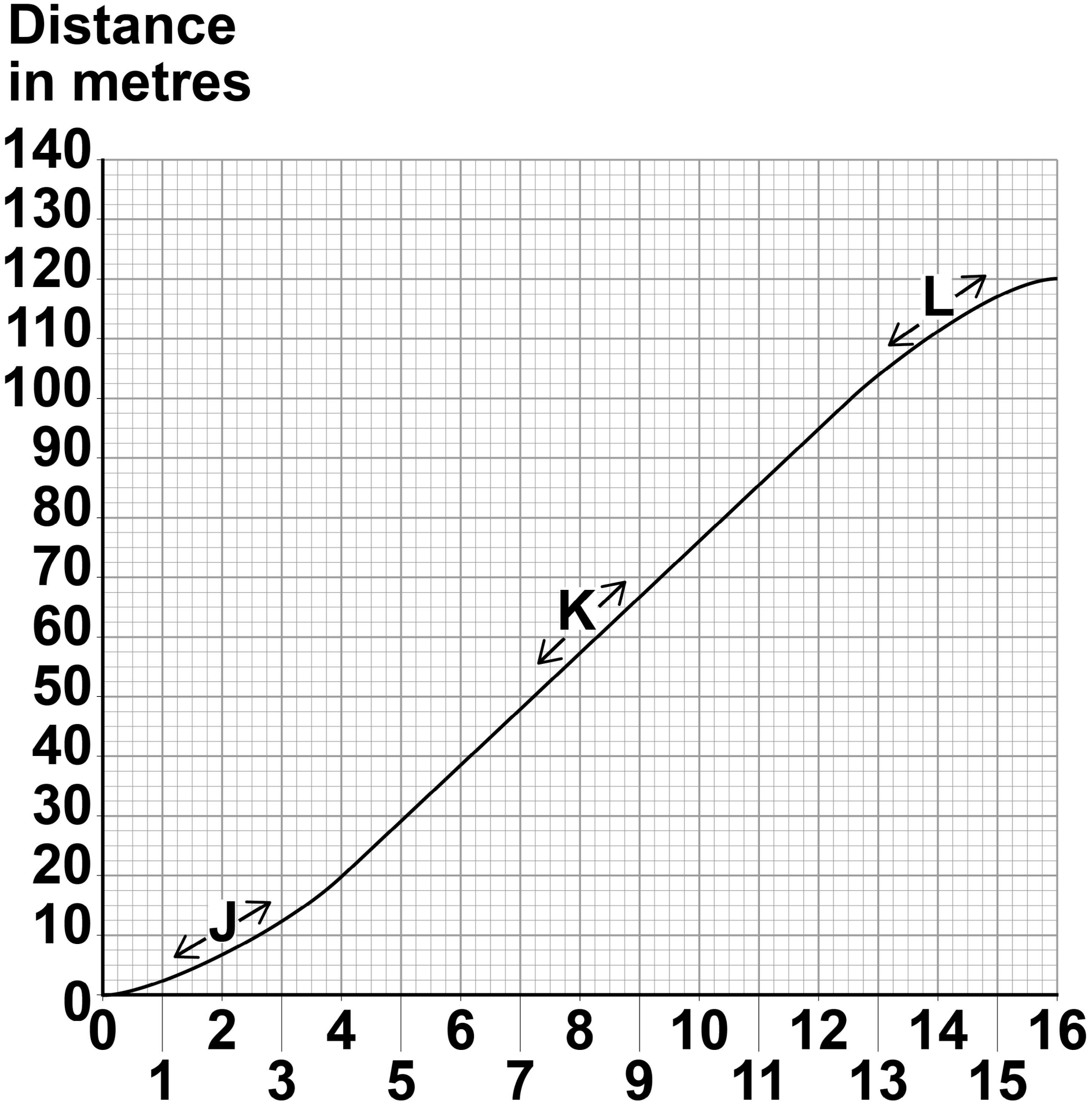
Three parts of the distance-time graph are labelled J, K and L.

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]

LABELS	DESCRIPTION OF MOTION
	not moving
J	
	constant speed
K	
	decreasing speed
L	
	increasing speed

Repeat of FIGURE 2



0 1 . 3

What distance does the athlete travel after the end of the race before stopping? [1 mark]

Distance = _____ m

[Turn over]

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]

Average speed = _____ m/s

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

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 list below.
[1 mark]

- **frequency**
- **speed**
- **wavelength**

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

BLANK PAGE

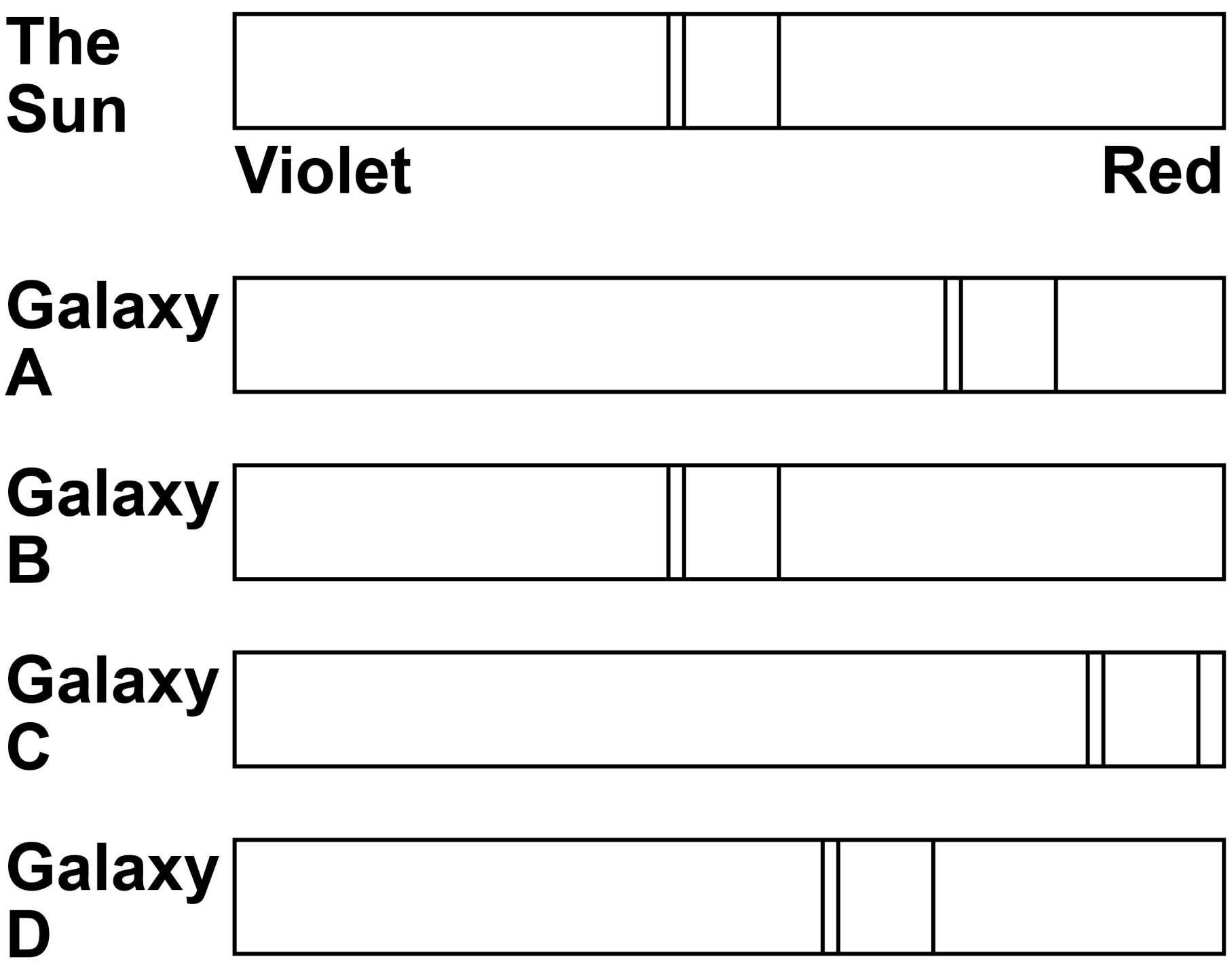
[Turn over]

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**

[Turn over]

0 2 . 3

Which galaxy is the furthest away from the Earth? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

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**

[Turn over]

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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[Turn over]

0 2 . 6

FIGURE 4, on the opposite page, shows three ways that the size of the universe may have changed with time.

Which graph would the Big Bang theory suggest is correct? [2 marks]

Tick (✓) ONE box.

☐ **X**

☐ **Y**

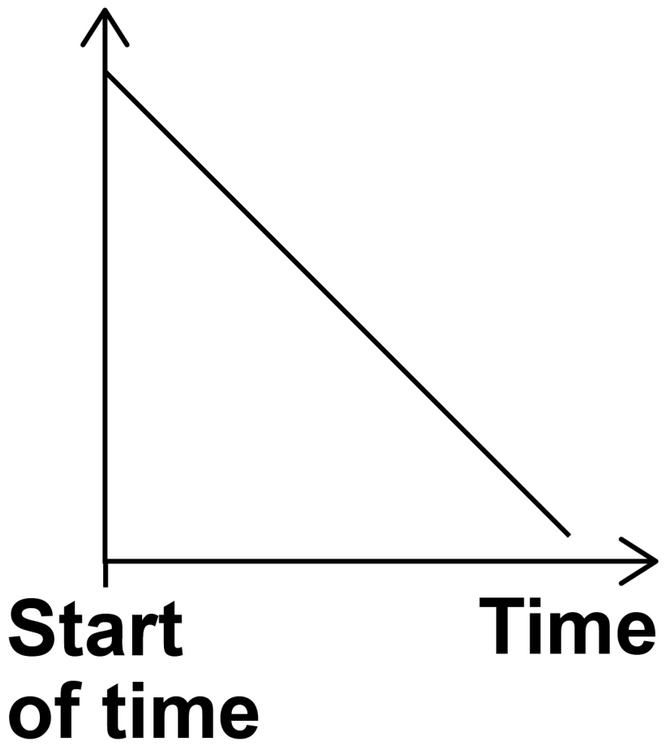
☐ **Z**

Give a reason for your answer.

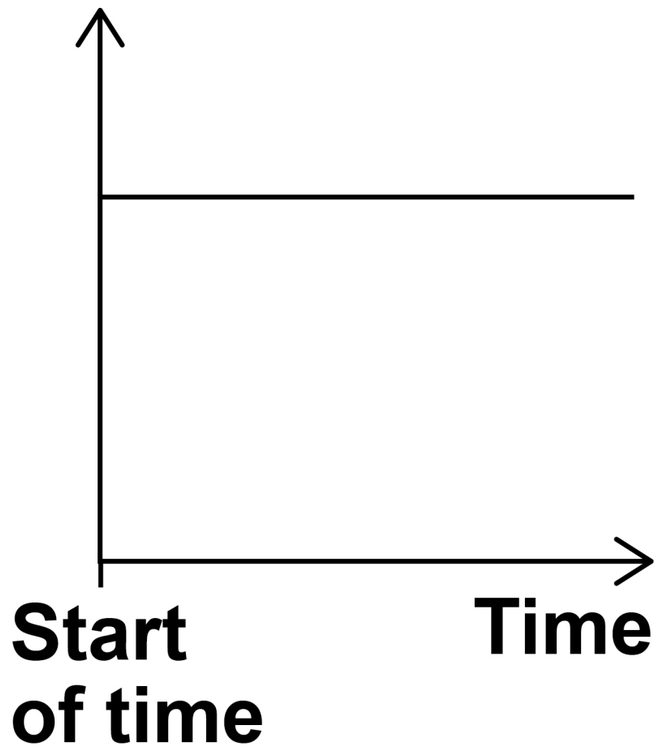
7

FIGURE 4

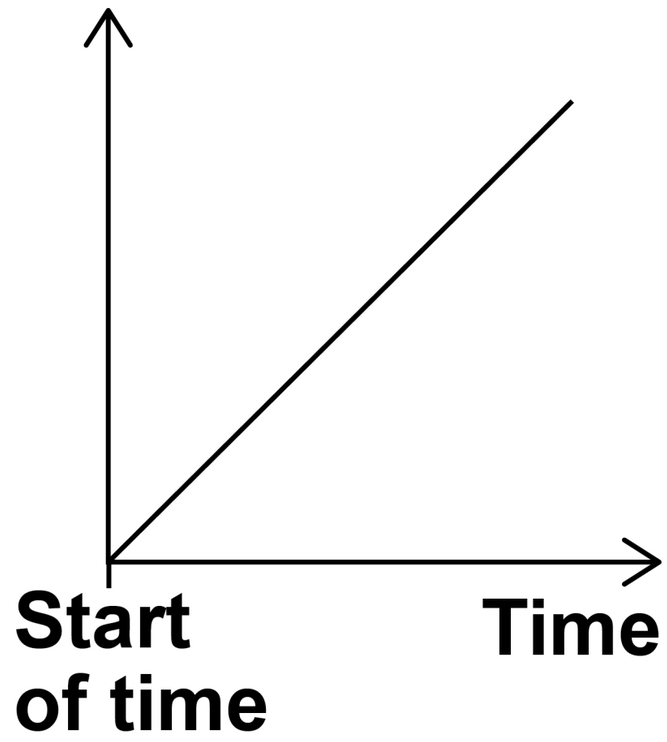
X



Y



Z



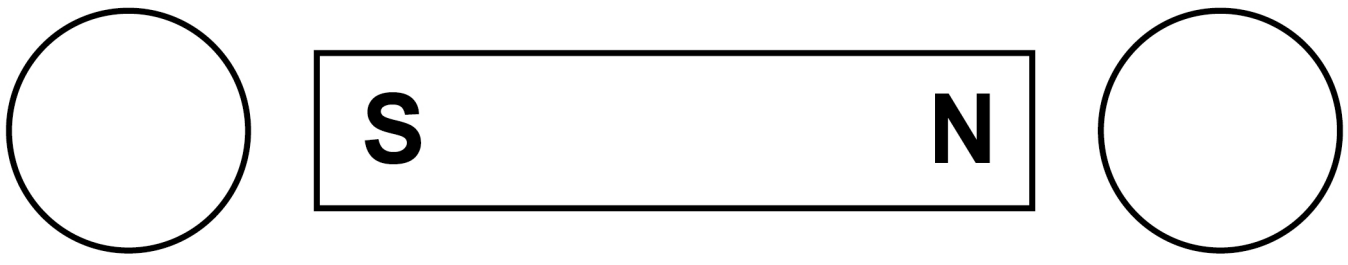
[Turn over]

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]

BLANK PAGE

[Turn over]

0 3 . 2

FIGURE 6, below, shows part of a coat.

The coat has two magnets hidden inside the material.

FIGURE 7, on the opposite page, shows how the magnets are used to fasten the coat.

FIGURE 6

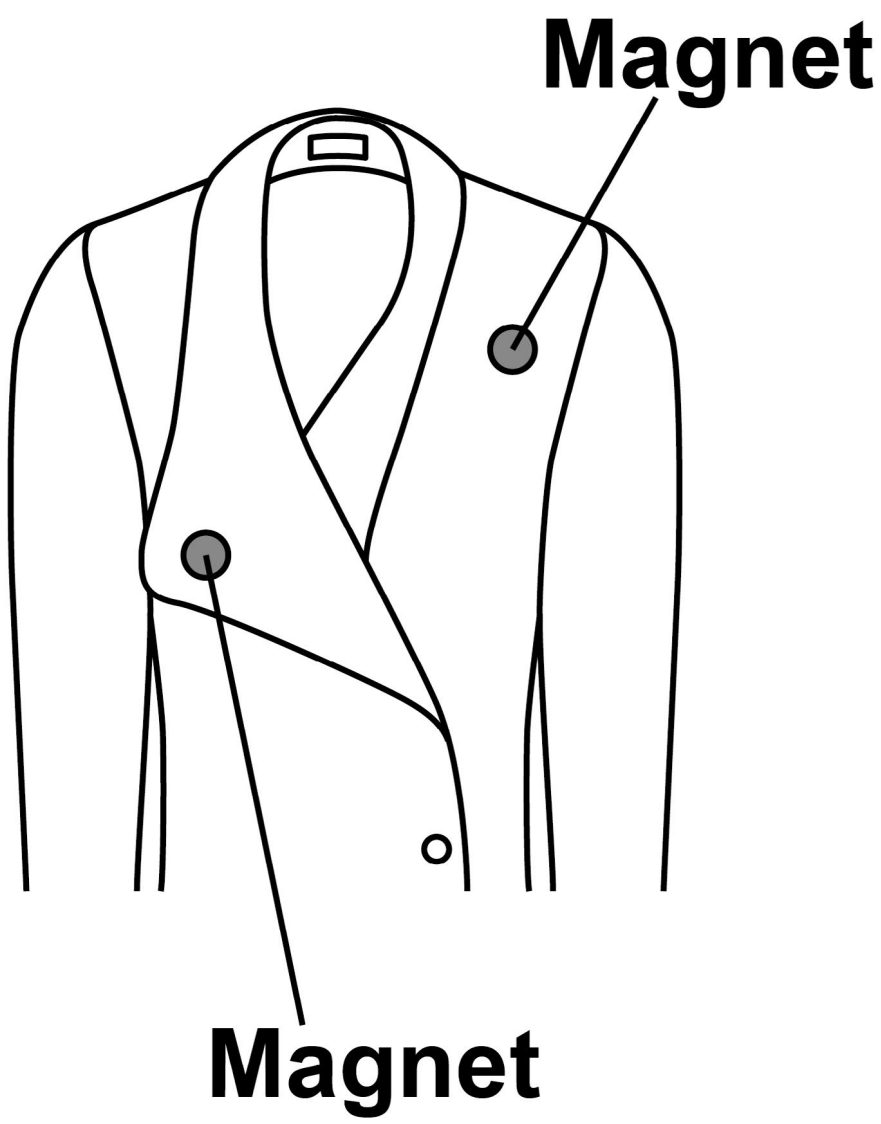
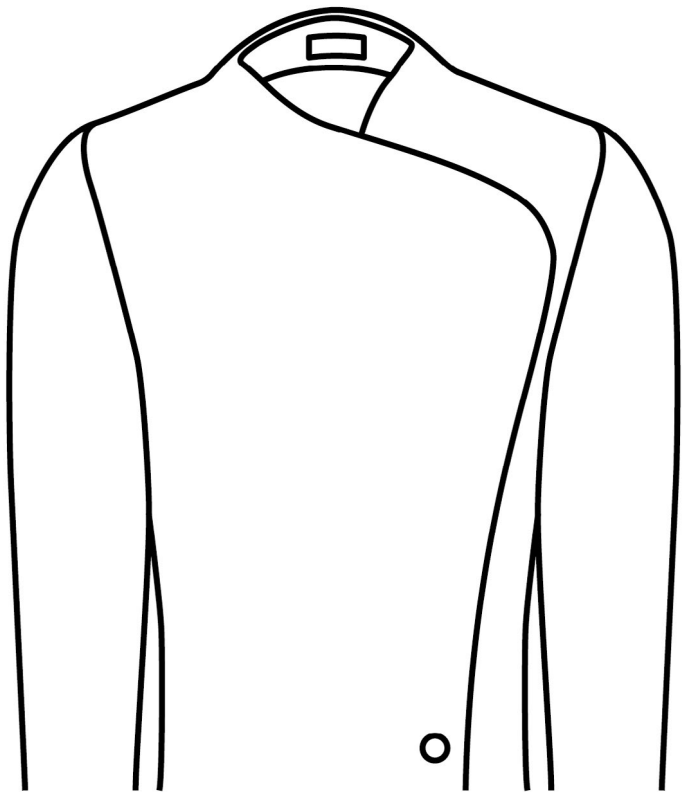


FIGURE 7



Explain why the magnets inside the coat must NOT have two south poles facing each other. [2 marks]

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, below and on the opposite page, shows the magnetic field produced by the current in the coil? [1 mark]

FIGURE 8

Tick (✓) ONE box.

☐ **A**

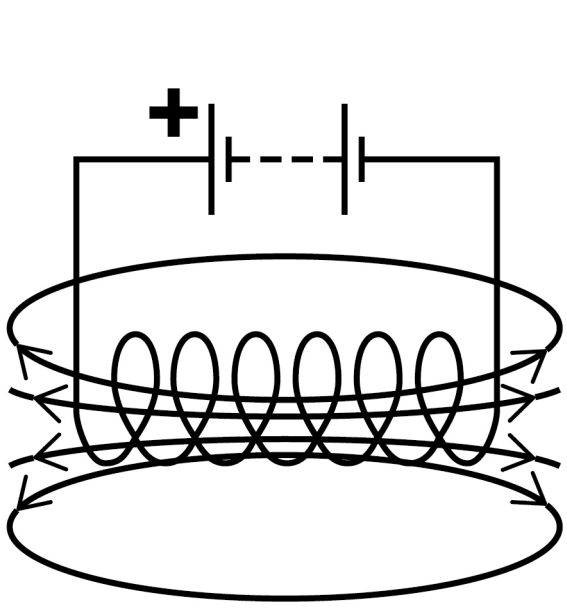
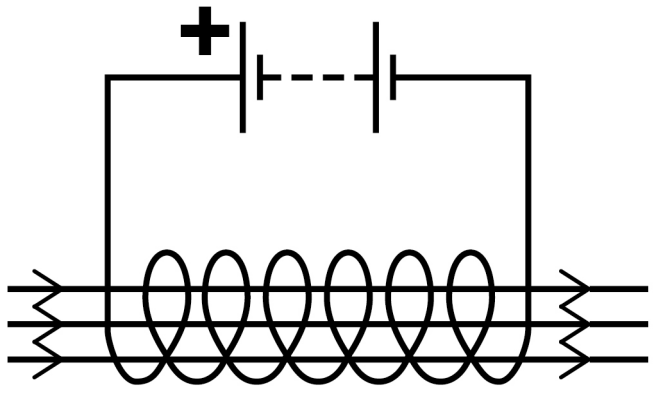
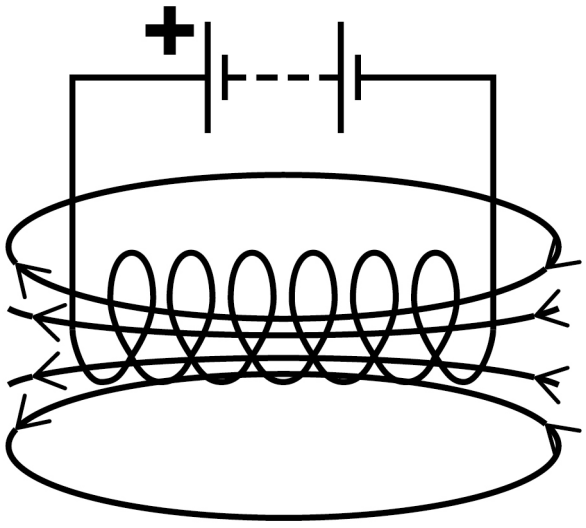


FIGURE 8 continued

☐ B



☐ C



[Turn over]

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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**

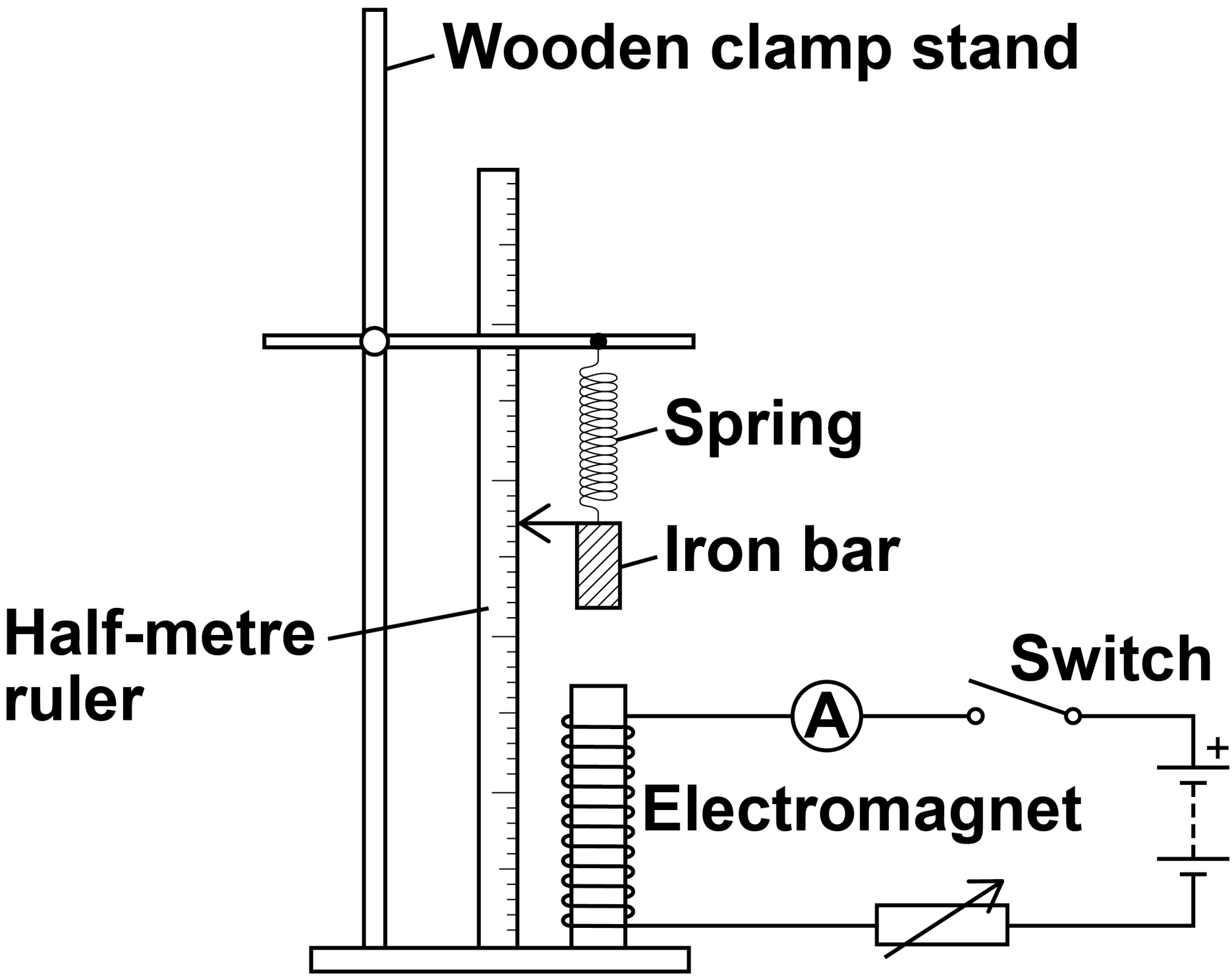
☐ **Wooden rod**

[Turn over]

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.

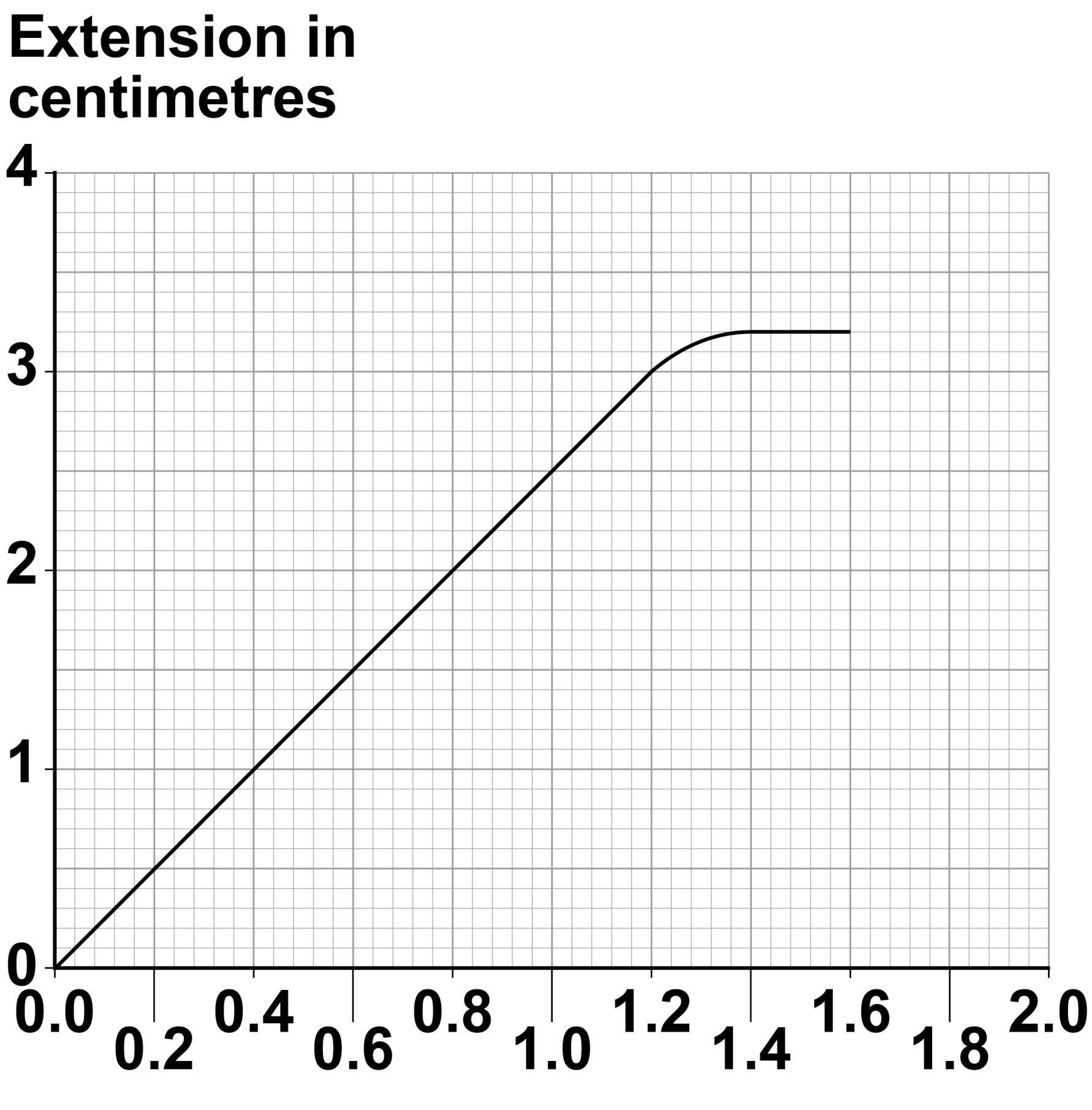
FIGURE 9



0 3 . 5

Why does the spring get longer when the electromagnet is switched on? [1 mark]

FIGURE 10


Extension in centimetres
4
3
2
1
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Current in amps

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

FIGURE 10, on the opposite page, shows the results.

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]

Increase in the extension = _____ cm

[Turn over]

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]

Increase in the force = _____ N

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]

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**

[Turn over]

BLANK PAGE

0 4 . 2

What is infrared used for? [1 mark]

Tick (✓) ONE box.

☐ **Electrical heating**

☐ **Energy efficient lamps**

☐ **Satellite communications**

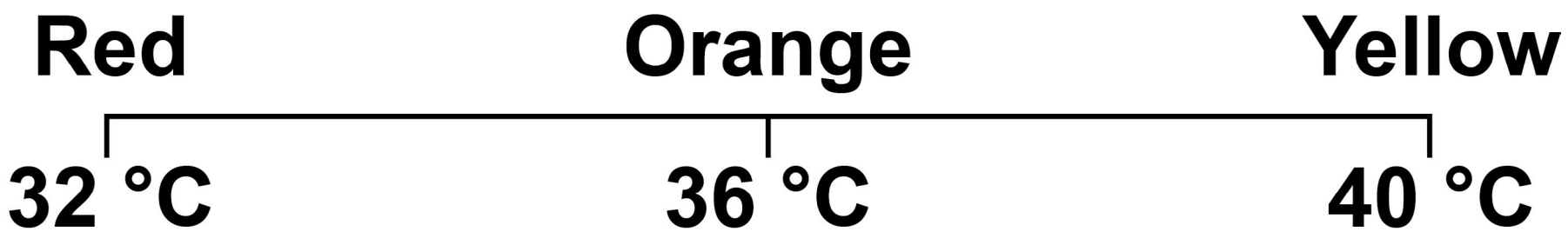
☐ **Sun tanning**

[Turn over]

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 on the opposite page.

Choose the answer from the list on the opposite page. [1 mark]

- orange
- red
- yellow

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

[Turn over]

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]

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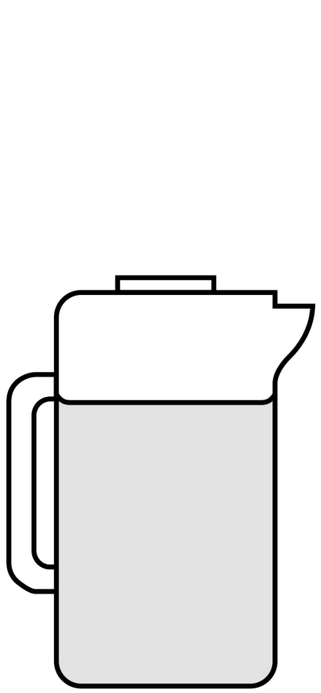
[Turn over]

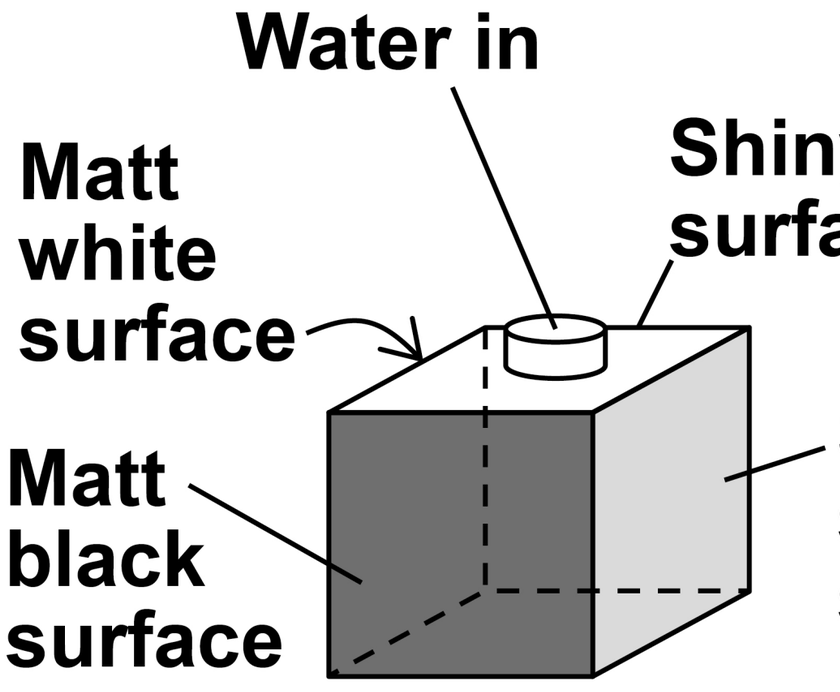
A student investigated how the type of surface affects the amount of infrared the surface radiates.

FIGURE 13, on the opposite page, shows the equipment used.

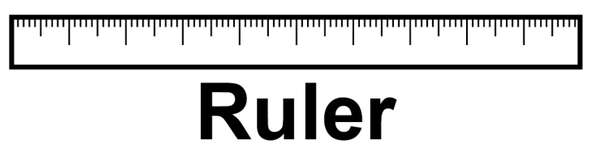
FIGURE 13

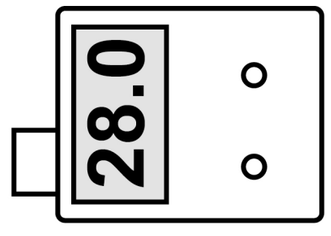


Kettle filled with hot water



Hollow metal cube





Infrared detector – uses infrared to give a temperature

[Turn over]

BLANK PAGE

0 4 . 5

Complete the sentence.

Choose the answer from the list below. [1 mark]

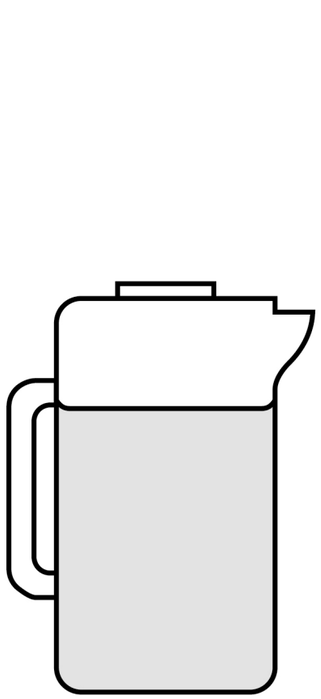
- **a control**
- **the dependent**
- **the independent**

In this investigation the type of surface is

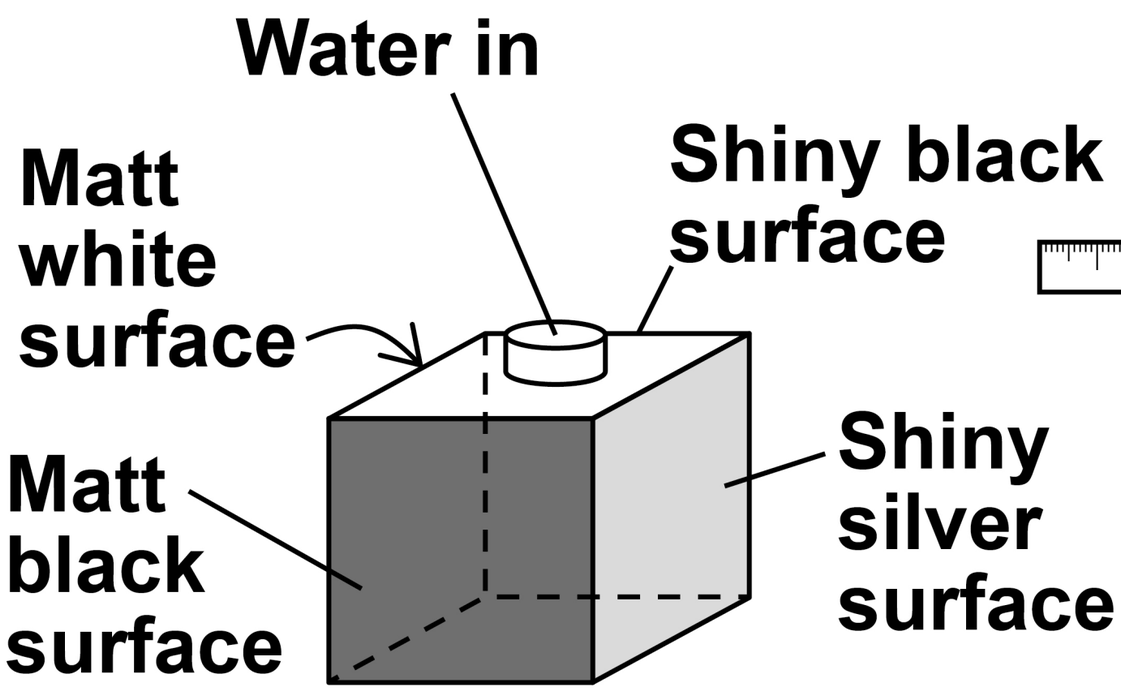
_____ variable .

[Turn over]

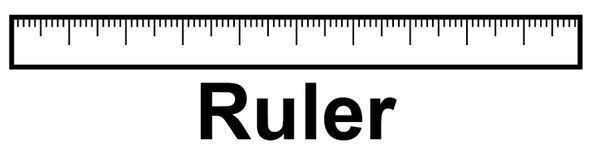
Repeat of FIGURE 13

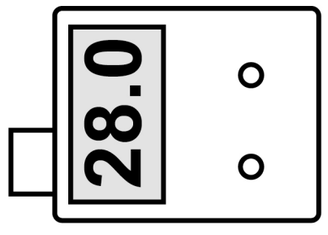


Kettle filled with hot water



Hollow metal cube





Infrared detector – uses infrared to give a temperature

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]

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]

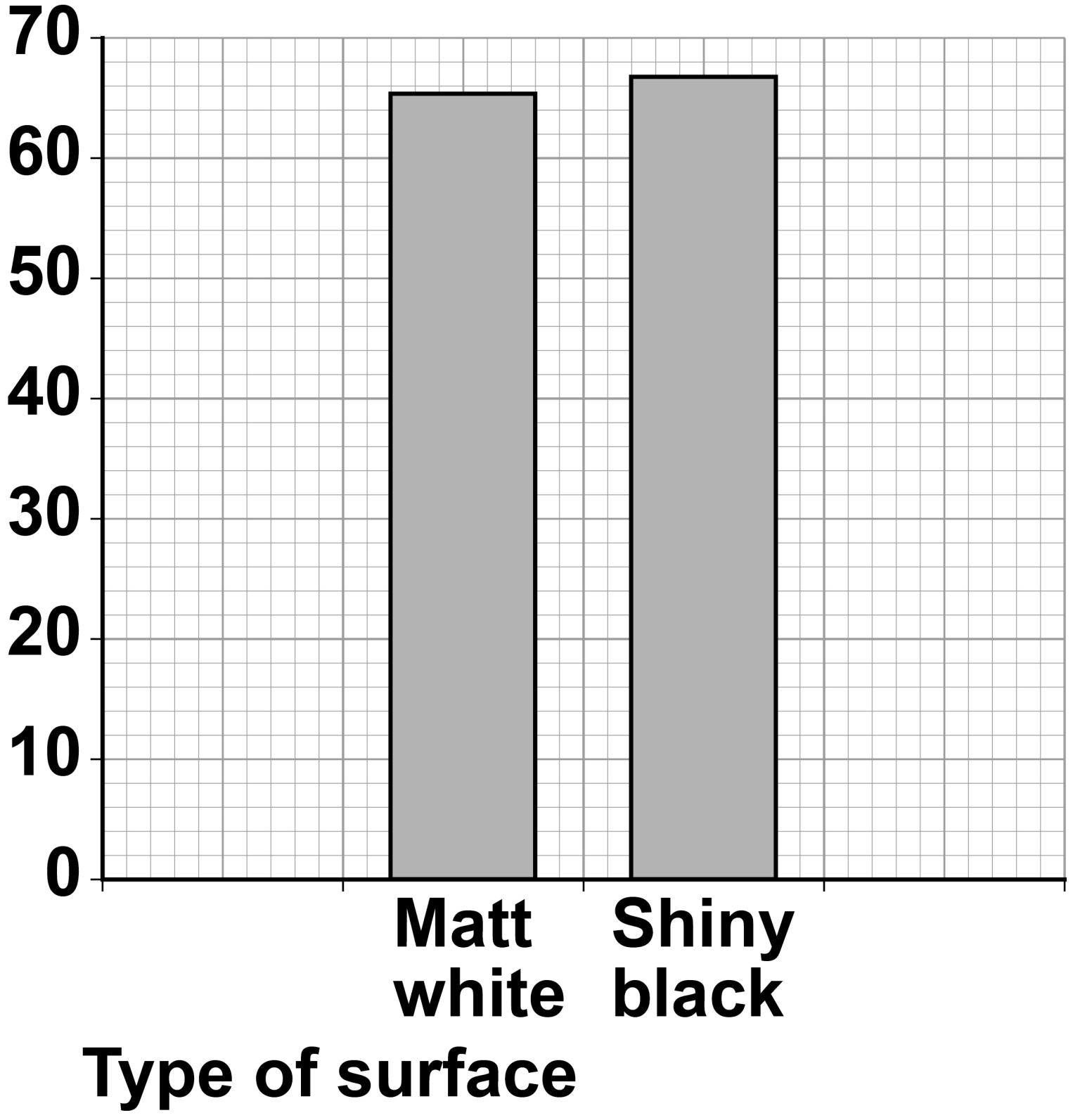
Tick (✓) ONE box.

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

[Turn over]

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

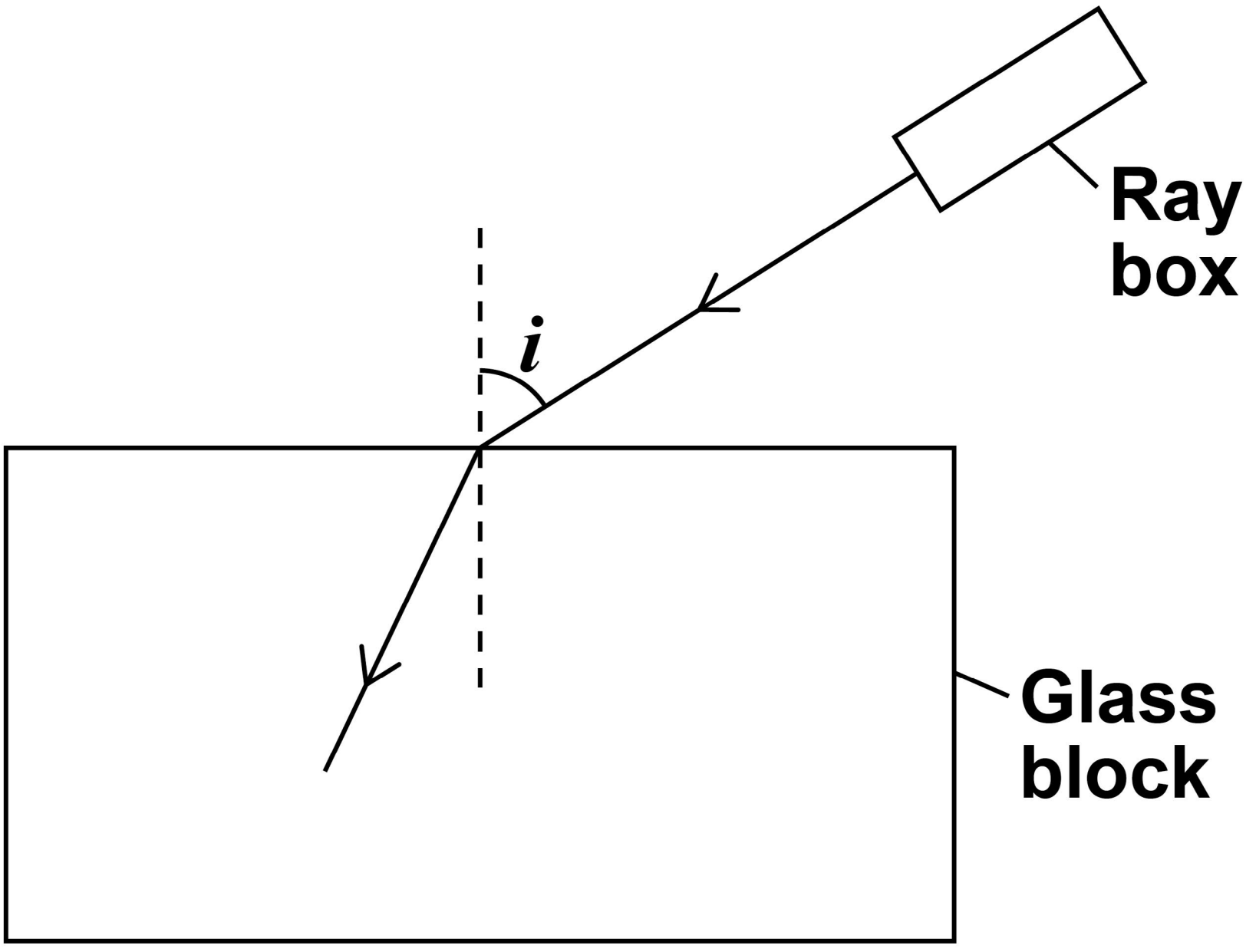
Give ONE conclusion that can be made from the results. [1 mark]

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 = _____ °

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]

[Turn over]

BLANK PAGE

0 5 . 4

Complete the sentence.

Choose an answer from the list below.
[1 mark]

- **random**
- **systematic**
- **zero**

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

[Turn over]

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]

_____

_____

_____

X = _____ **°**

0 5 . 6

Complete the sentence.

Choose the answer from the list below.
[1 mark]

- **equal to**
- **greater than**
- **less than**

The student used the data in TABLE 2, on page 58, and correctly concluded that the angle of refraction is

_____ 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]

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]

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.

- ☐ **The angles of incidence tested**
- ☐ **The angles of refraction tested**
- ☐ **The number of results recorded**
- ☐ **The size of the two blocks**

11

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**

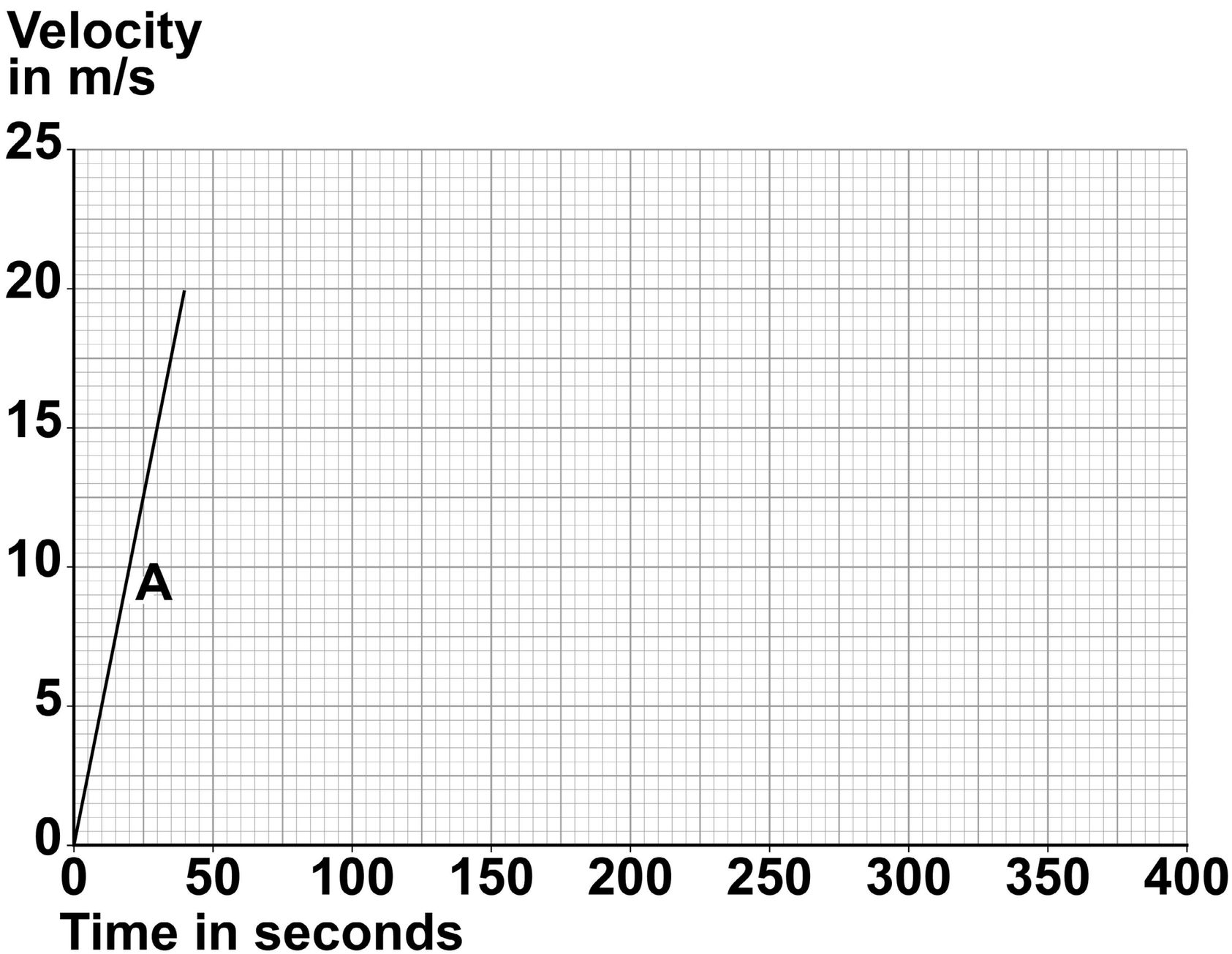
☐ **C**

0 6 . 2

FIGURE 16 shows part of the velocity–time graph for the train journey.

Complete FIGURE 16, on the opposite page, showing part B and part C of the train journey. [3 marks]

FIGURE 16



[Turn over]

0 6 . 3

Write down the equation which links acceleration, change in velocity and time taken. [1 mark]

0 6 . 4

Another train accelerated at 1.15 m/s^2 for 22.0 s

Calculate the increase in velocity of the train. [3 marks]

Increase in velocity =

_____ m/s

8

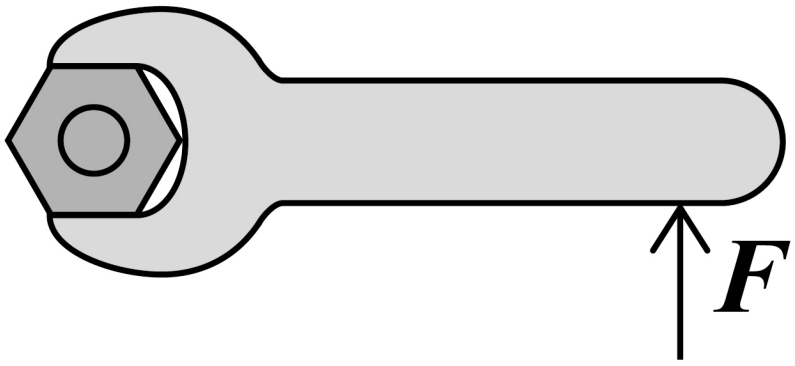
[Turn over]

0 7 . 1

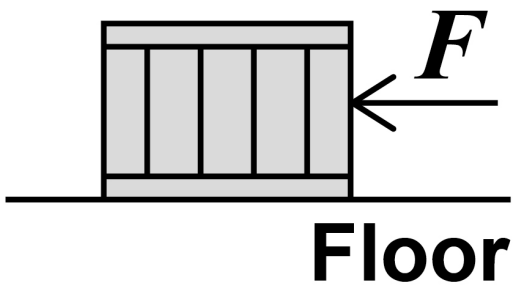
FIGURE 17 shows four examples of a force causing an object to move.

FIGURE 17

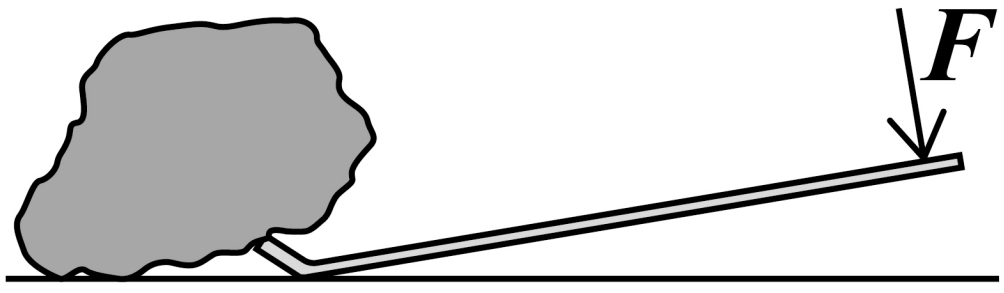
Spanner



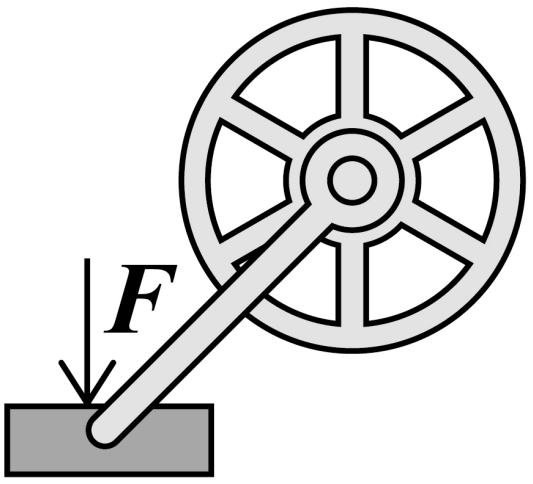
Crate



Crowbar



Bicycle pedal system



Which object is NOT likely to rotate?
[1 mark]

Tick (✓) ONE box.

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

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

FIGURE 19, on the opposite page, 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

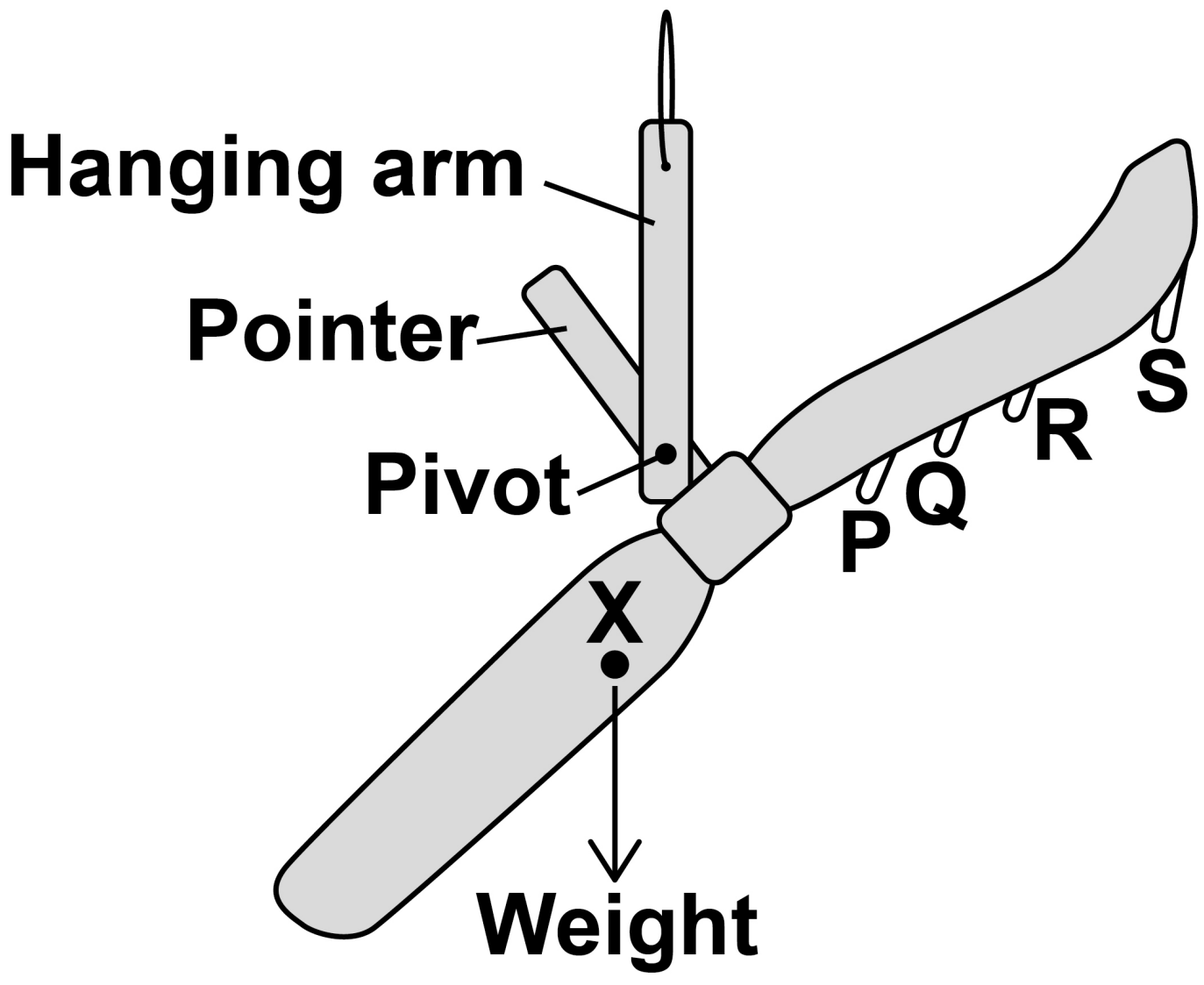
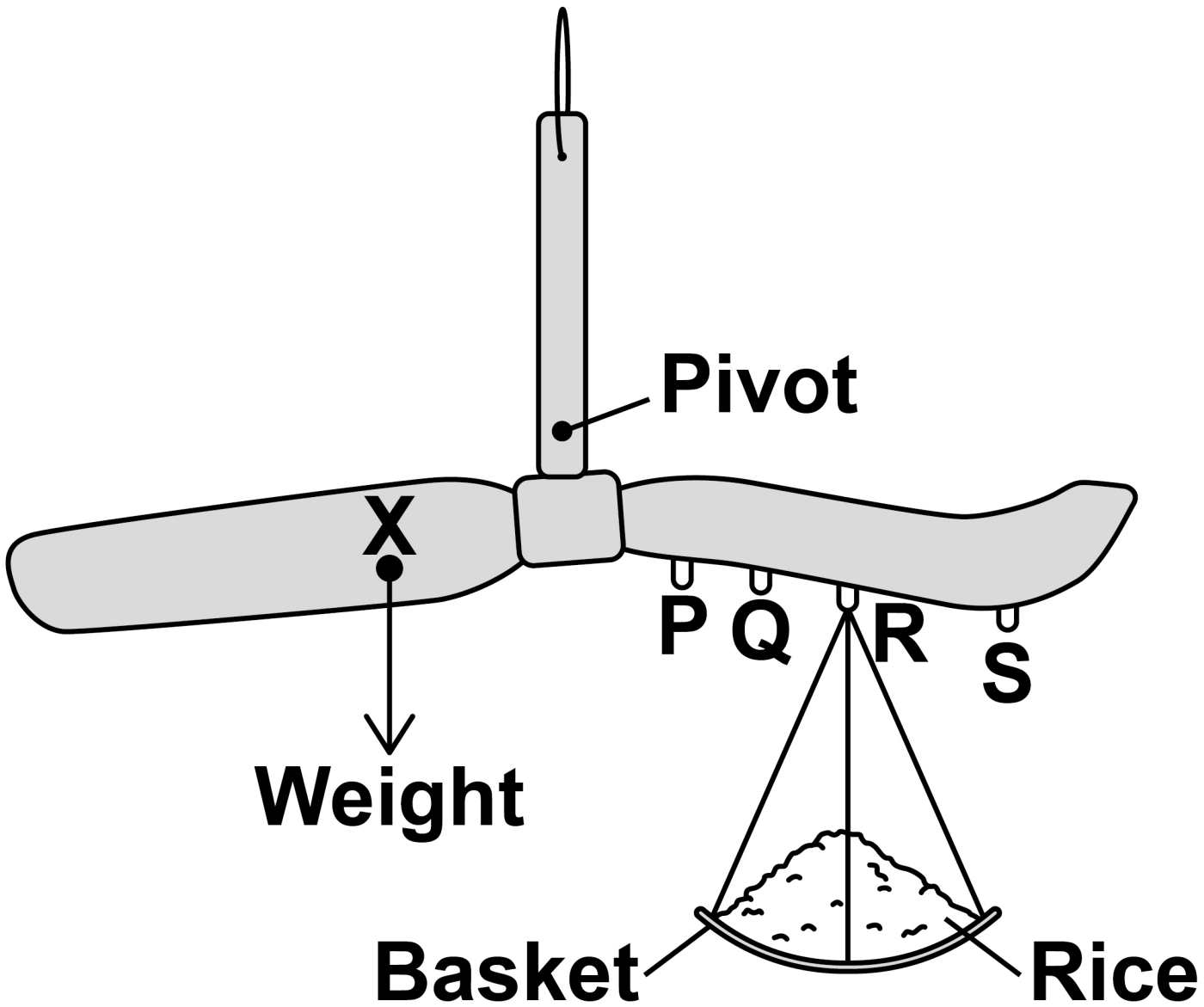


FIGURE 19



[Turn over]

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0 7 . 2

The weight of the device acts through the point labelled X.

What is point X called? [1 mark]

Tick (✓) ONE box.

- ☐ **Centre of balance**
- ☐ **Centre of mass**
- ☐ **Centre of weight**

0 7 . 3

How does FIGURE 19, on page 73, show that the weight of the device is balanced by the weight of the rice and basket?
[1 mark]

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**

[Turn over]

0 7 . 5

Write down the equation which links distance, force and moment of a force.
[1 mark]

0 7 . 6

In FIGURE 19, on page 73, 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]

Weight of rice and basket = _____ N

[Turn over]

0 7 . 7

Write down the equation which links gravitational field strength, mass and weight. [1 mark]

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]

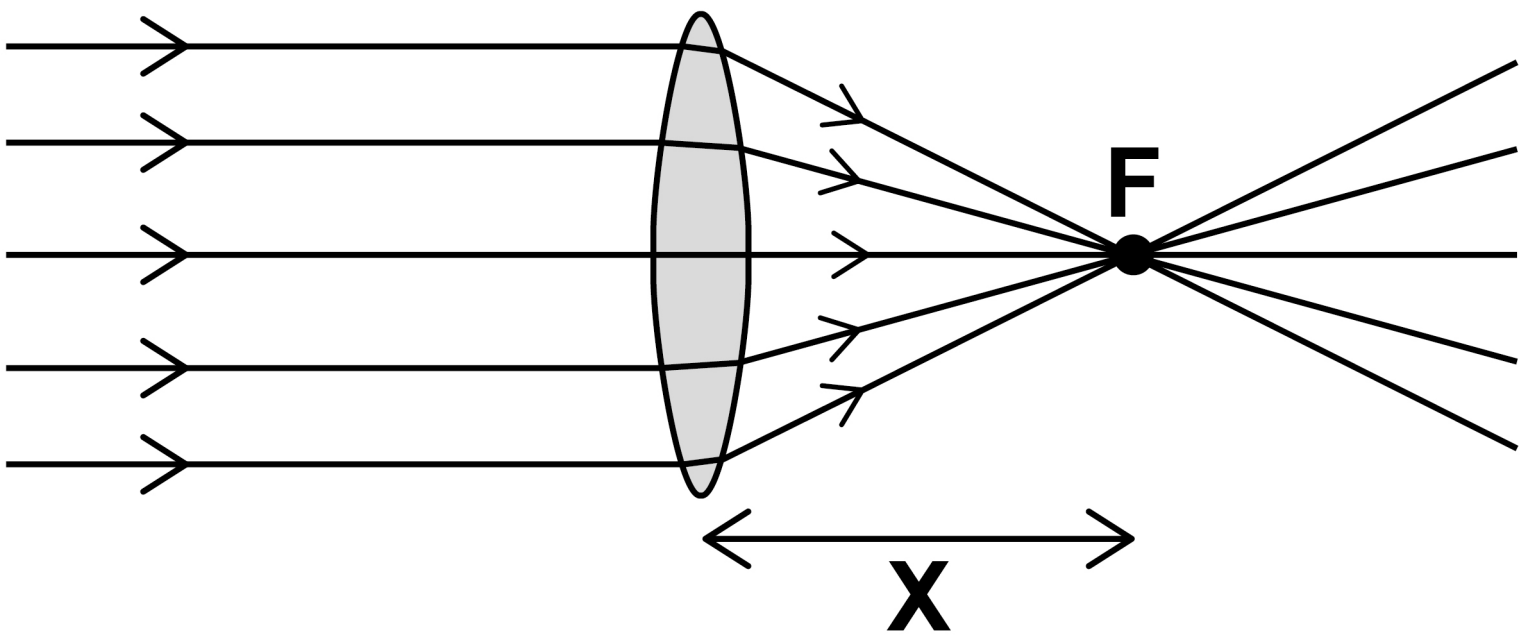
Mass = _____ kg

12

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]

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[Turn over]

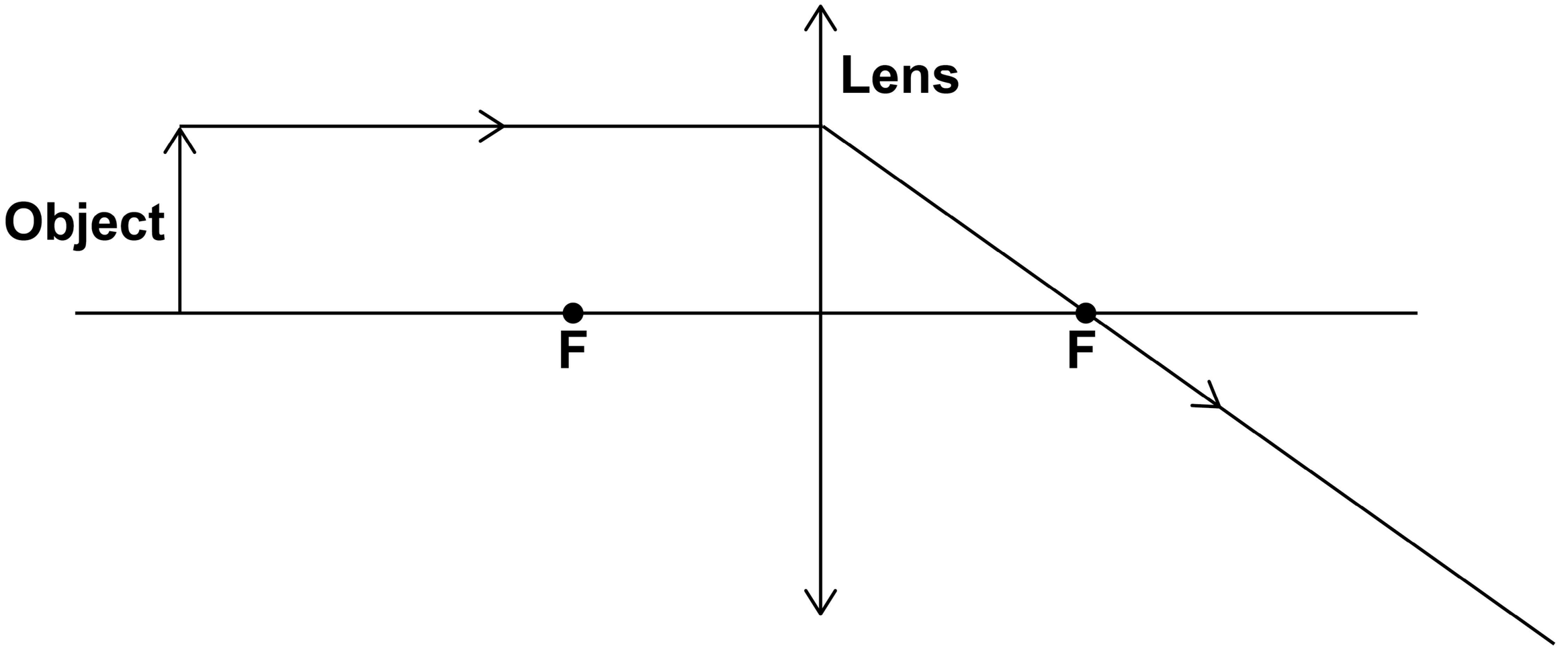
0 8 . 2

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

Complete the ray diagram in FIGURE 21, on the opposite page, to show how a CONVEX lens forms the image of the object.

Use an arrow to represent the image.
[2 marks]

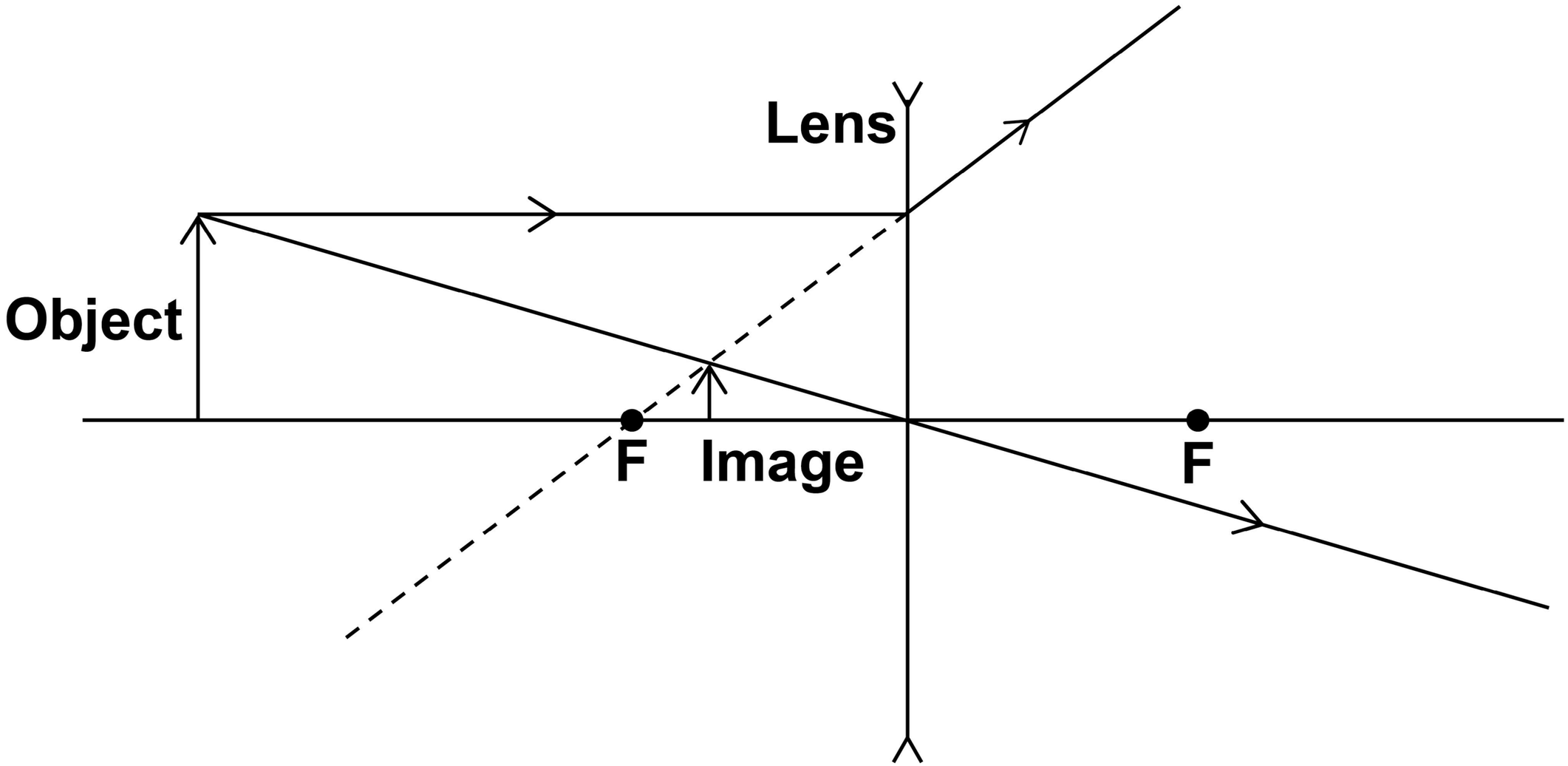
FIGURE 21



[Turn over]

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 _____

_____

Difference _____

_____

_____

[Turn over]

0 8 . 3

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]

Height = _____ mm

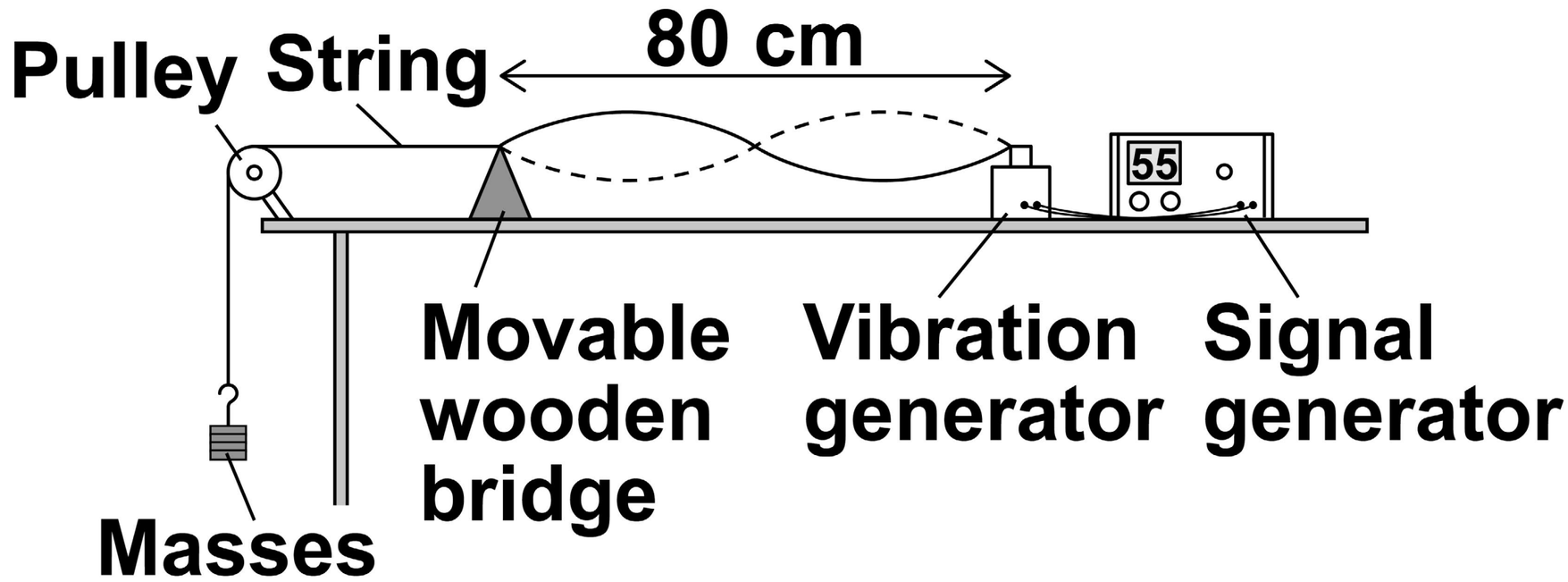
8

[Turn over]

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]

0 9 . 2

Write down the equation which links frequency, wavelength and wave speed. [1 mark]

0 9 . 3

The string in FIGURE 23 vibrates at 55 Hz

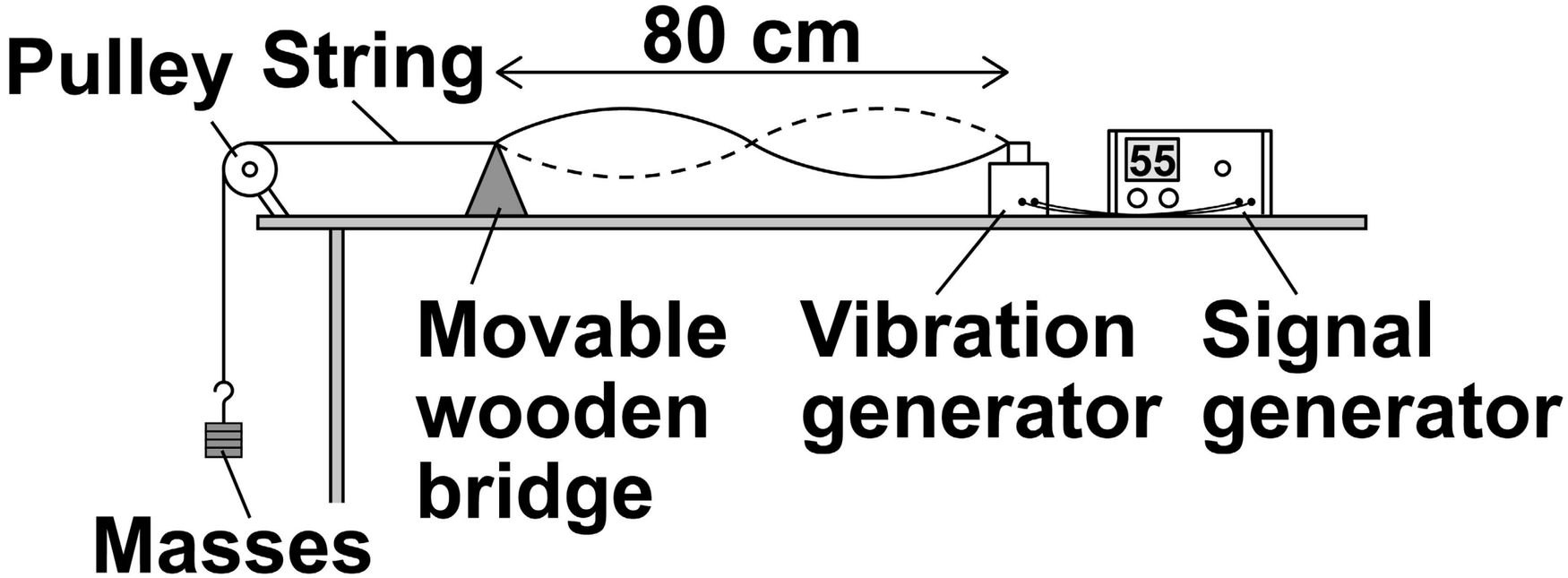
Calculate the wave speed of the wave shown in FIGURE 23.

Use data given in FIGURE 23, on page 90. [3 marks]

Wave speed = _____ m/s

[Turn over]

Repeat of FIGURE 23



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]

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 on page 94.

Describe a method the student could use for this investigation. [4 marks]

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]

[Turn over]

100

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[Turn over]

1 0 . 2

Write down the equation which links distance, force and work done. [1 mark]

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]

_____

_____

_____

Braking distance = _____ m

[Turn over]

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]

12

END OF QUESTIONS

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Question	Mark
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10	
TOTAL	