Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE
PHYSICS

H

Higher Tier Paper 2

8463/2H

Friday 15 June 2018 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]

JUN188463 2H 01

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For this paper you must have:
- **a ruler**
- **a scientific calculator**
- **the Physics Equation Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided.**
- **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

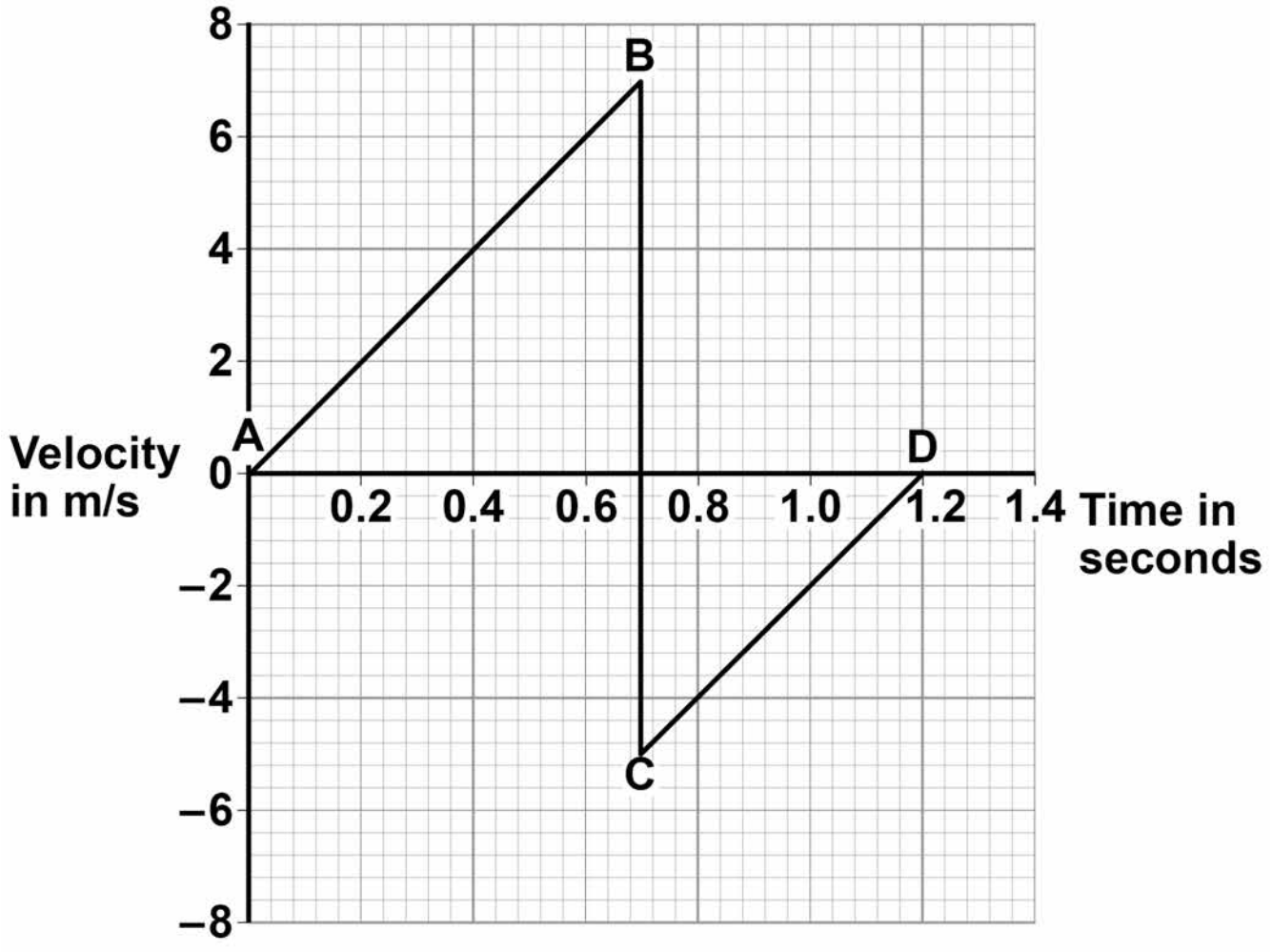
0 1 **A child drops a ball.**

The ball hits the ground and bounces.

FIGURE 1 shows the velocity-time graph for the ball from when the ball is dropped until when the ball reaches the top of its first bounce.

Air resistance has been ignored.

FIGURE 1



0 1 . 1 **Describe the motion of the ball between points A and B on FIGURE 1. [2 marks]**

0 1 . 2 **What direction is the ball moving between points C and D on FIGURE 1? [1 mark]**

[Turn over]

0 1 . 3 **The ball and the Earth form a system.**

What is meant by 'a system'? [1 mark]

Tick ONE box.

- ☐ **A group of objects that interact.**
- ☐ **Objects with big differences in mass.**
- ☐ **Objects with gravitational potential energy.**

0 1 . 4 **When the ball hits the ground, energy is transferred from the ball to the Earth.**

Explain how the data in FIGURE 1 shows this energy transfer. [4 marks]

8

[Turn over]

0 2 **A student carried out an investigation to determine the spring constant of a spring.**

TABLE 1 gives the data obtained by the student.

TABLE 1

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

0 2 . 1 **Describe a method the student could have used to obtain the data given in TABLE 1.**

Your answer should include any cause of inaccuracy in the data.

Your answer may include a labelled diagram.
[6 marks]

[Turn over]

0 2 . 2 **The student measured the extension for five different forces rather than just measuring the extension for one force.**

Suggest why. [1 mark]

_____

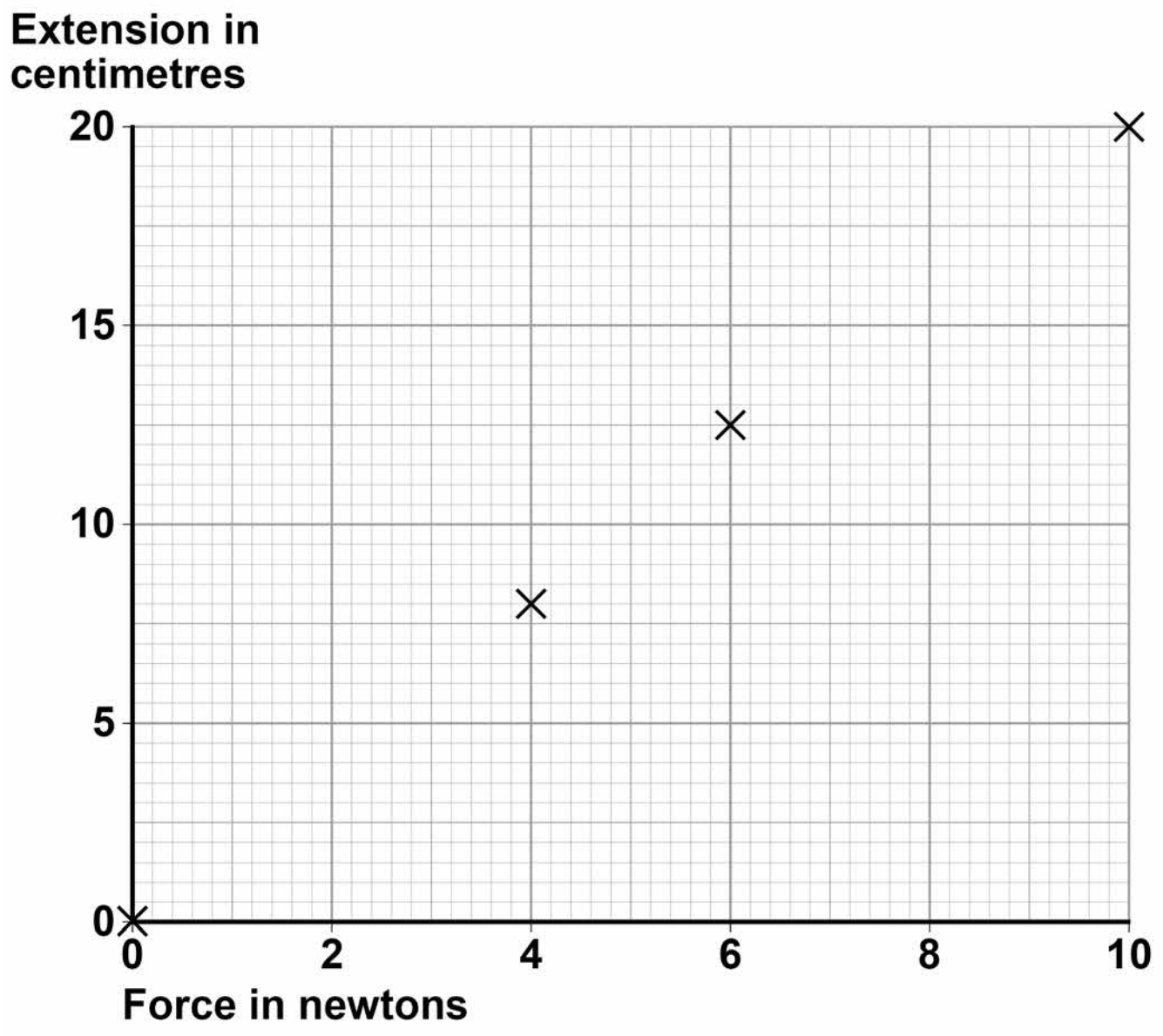
_____

_____

[Turn over]

FIGURE 2 shows some of the data obtained by the student.

FIGURE 2



0 2 . 3 **Complete FIGURE 2 by plotting the missing data from TABLE 1.**

Draw the line of best fit.

TABLE 1 is repeated here to help you answer this question. [2 marks]

TABLE 1

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

0 2 . 4 **Write down the equation that links extension, force and spring constant. [1 mark]**

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0 2 . 5 **Calculate the spring constant of the spring that the student used.**

Give your answer in newtons per metre.
[4 marks]

Spring constant = _____ N/m

[Turn over]

0 2 . 6 **Hooke's Law states that:**
'The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded.'

The student concluded that over the range of force used, the spring obeyed Hooke's Law.

Explain how the data supports the student's conclusion. [2 marks]

16

0 3 **P-waves and S-waves are two types of seismic wave caused by earthquakes.**

0 3 . 1 **Which ONE of the statements about P-waves and S-waves is correct?**

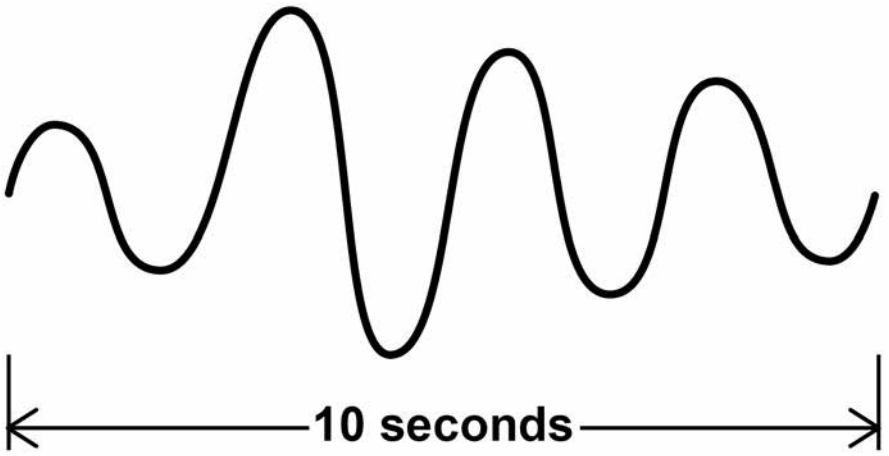
Tick ONE box. [1 mark]

- ☐ **P-waves and S-waves are transverse.**
- ☐ **P-waves and S-waves are longitudinal.**
- ☐ **P-waves are transverse and S-waves are longitudinal.**
- ☐ **P-waves are longitudinal and S-waves are transverse.**

Seismometers on the Earth's surface record the vibrations caused by seismic waves.

FIGURE 3 shows the vibration recorded by a seismometer for one P-wave.

FIGURE 3



0 3 . 2 Calculate the frequency of the P-wave shown in FIGURE 3. [1 mark]

_____

_____

_____

Frequency = _____ Hz

0 3 . 3 **Write down the equation which links frequency, wavelength and wave speed. [1 mark]**

0 3 . 4 **The P-wave shown in FIGURE 3 is travelling at 7200 m/s.**

Calculate the wavelength of the P-wave.
[3 marks]

Wavelength = _____ m

[Turn over]

0 3 . 5 **Explain why the study of seismic waves provides evidence for the structure of the Earth's core. [2 marks]**

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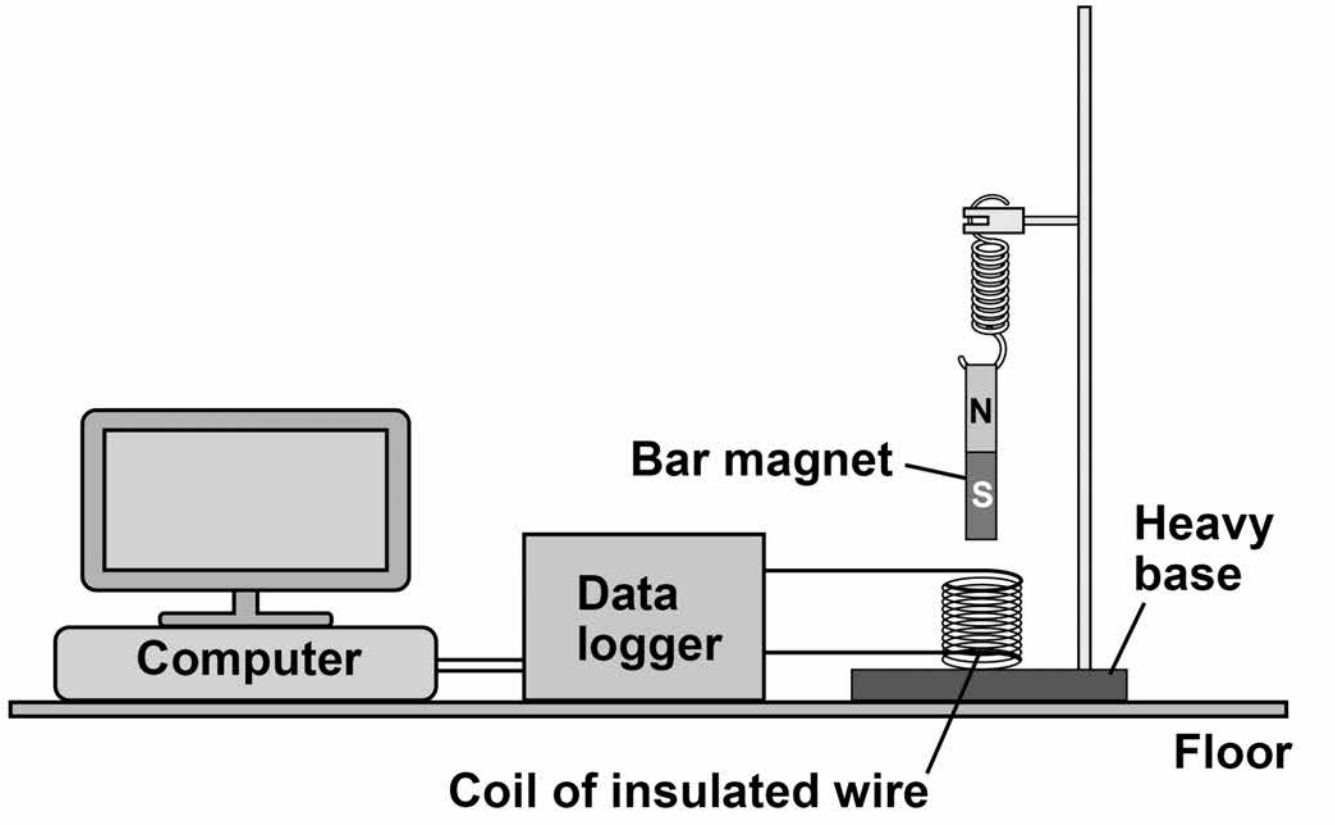
[Turn over]

FIGURE 4 shows a simple seismometer made by a student.

FIGURE 4



To test that the seismometer works, the student pushes the bar magnet into the coil and then releases the bar magnet.

0 3 . 6 **Why does the movement of the bar magnet induce a potential difference across the coil? [1 mark]**

0 3 . 7 **Why is the induced potential difference across the coil alternating? [1 mark]**

_____

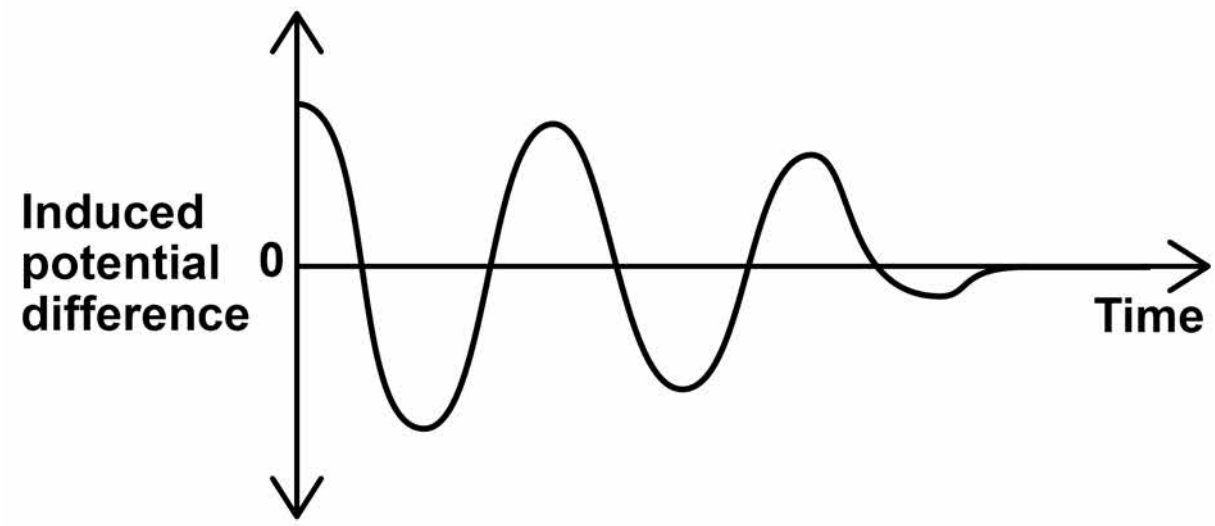
_____

_____

[Turn over]

0 3 . 8 **FIGURE 5 shows how the potential difference induced across the coil varies after the bar magnet has been released.**

FIGURE 5



Which statement describes the movement of the magnet when the induced potential difference is zero? [1 mark]

Tick ONE box.

☐ **Accelerating upwards.**

☐ **Constant speed upwards.**

☐ **Decelerating downwards.**

☐ **Stationary.**

0 3 . 9 **The seismometer cannot detect small vibrations.**

Suggest TWO changes to the design of the seismometer that would make it more sensitive to small vibrations. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

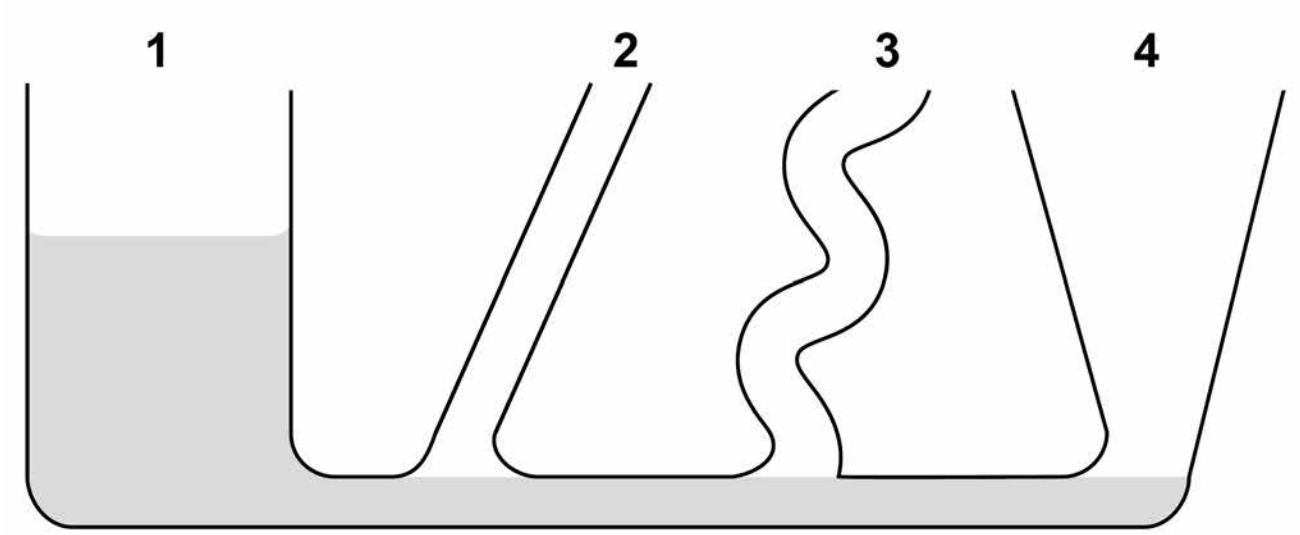
13

[Turn over]

0 4 **FIGURE 6 shows an unusually shaped container.**

The container has four vertical tubes of different shape and size.

FIGURE 6



Water is poured into the container up to the level shown in tube 1.

0 4 . 1 **Complete FIGURE 6 to show the height of the water in tubes 2, 3 and 4. [1 mark]**

0 4 . 2 **The further a swimmer dives below the surface of the sea, the greater the pressure on the swimmer.**

Explain why. [2 marks]

[Turn over]

0 4 . 3 **A person swims from a depth of 0.50 m to a depth of 1.70 m below the surface of the sea.**

density of the sea water = 1030 kg/m^3

gravitational field strength = 9.8 N/kg

Calculate the increase in pressure on the swimmer.

Give the unit.

Use an equation from the Physics Equation Sheet. [4 marks]

Increase in pressure = _____

Unit _____

7

0 5 **FIGURE 7 shows the apparatus a student used to investigate the reflection of light by a plane mirror.**

The student drew four ray diagrams for each angle of incidence.

The student measured the angle of reflection from each diagram.

TABLE 2, on page 30, gives the student's results.

FIGURE 7

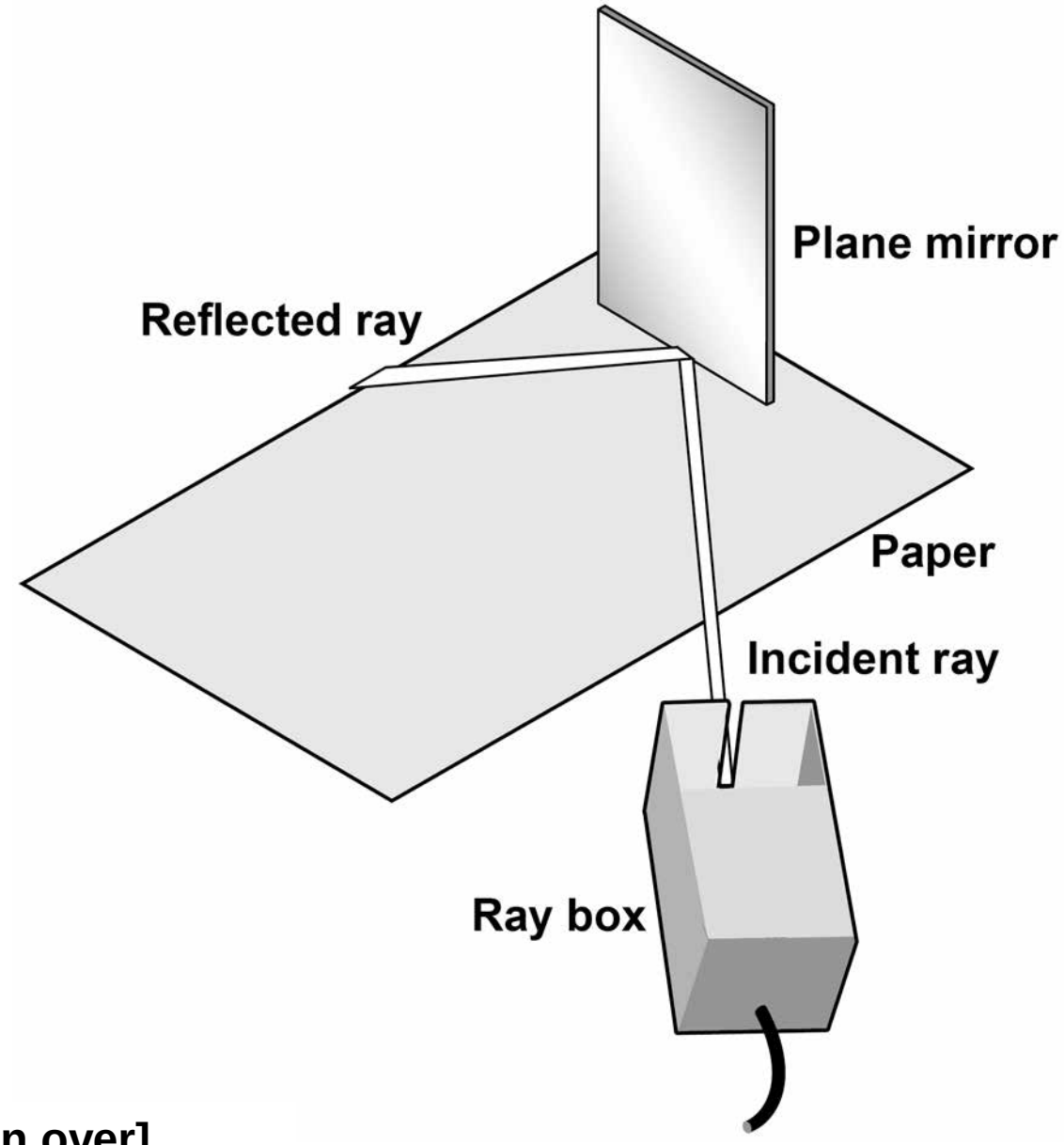


TABLE 2

	Angle of reflection			
Angle of incidence	**Test 1**	**Test 2**	**Test 3**	**Test 4**
20°	**19°**	**22°**	**20°**	**19°**
30°	**31°**	**28°**	**32°**	**30°**
40°	**42°**	**40°**	**43°**	**41°**
50°	**56°**	**49°**	**53°**	**46°**

0 5 . 1 **For each angle of incidence, the angle of reflection has a range of values.**

This is caused by an error.

What type of error will have caused each angle of reflection to have a range of values?
[1 mark]

0 5 . 2 **Suggest what the student may have done during the investigation to cause each angle of reflection to have a range of values. [1 mark]**

_____

_____

_____

0 5 . 3 **Estimate the uncertainty in the angle of reflection when the angle of incidence is 50°.**

Show how you determine your estimate. [2 marks]

_____

_____

_____

_____

_____

_____

Uncertainty = + – _____ °

[Turn over]

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0 5 . 4 **The student concluded that for a plane mirror, the angle of incidence is equal to the angle of reflection.**

Explain whether you agree with this conclusion.

Use examples from the results in TABLE 2 in your answer. [2 marks]

0 5 . 5 **What extra evidence could be collected to support the student's conclusion? [1 mark]**

[Turn over]

0 5 . 6 **State ONE change the student should make to the apparatus if he wants to use the same method to investigate diffuse reflection.**
[1 mark]

_____

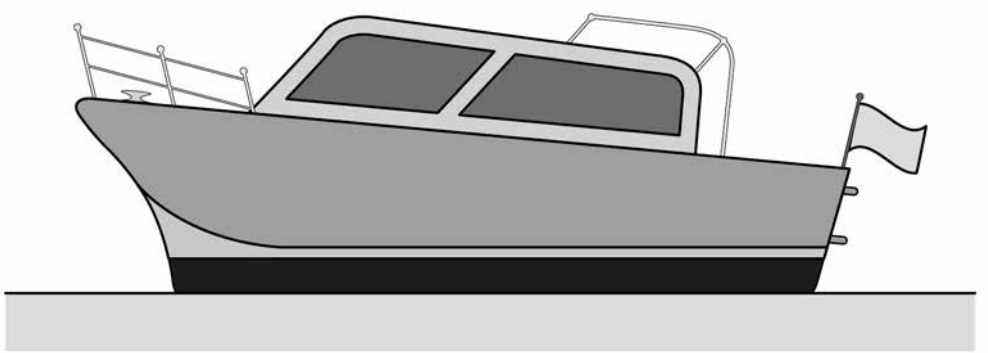
_____

_____

8

0 6 **FIGURE 8 shows a boat floating on the sea. The boat is stationary.**

FIGURE 8



0 6 . 1 **FIGURE 9 shows part of the free body diagram for the boat.**

Complete the free body diagram for the boat.
[2 marks]

FIGURE 9

Scale:

Take this distance to be 1 cm

1 cm = 5 kN

[Turn over]

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0 6 . 2 **Calculate the mass of the boat.**

Use the information given in FIGURE 9.

gravitational field strength = 9.8 N/kg

Give your answer to TWO significant figures.
[4 marks]

Mass = _____ kg

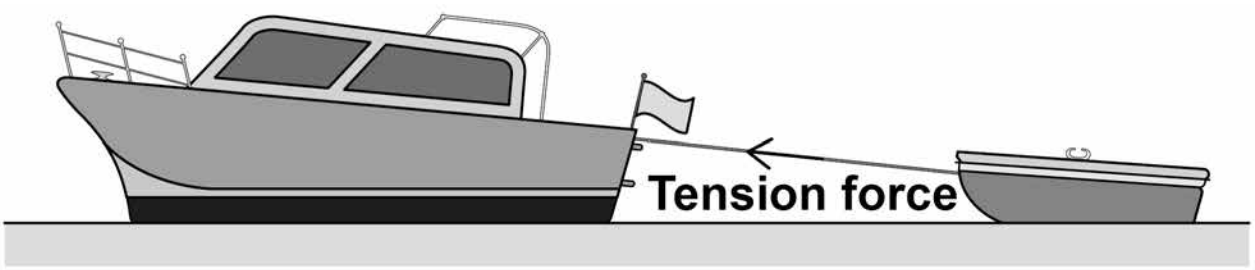
0 6 . 3 **When the boat propeller pushes water backwards, the boat moves forwards.**
The force on the water causes an equal and opposite force to act on the boat.

Which law is this an example of? [1 mark]

[Turn over]

0 6 . 4 **FIGURE 10 shows the boat towing a small dinghy.**

FIGURE 10



The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy.

horizontal force forwards = 150 N
vertical force upwards = 50 N

FIGURE 11 shows a grid.

Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy. [4 marks]

Magnitude of the tension force in the tow rope =

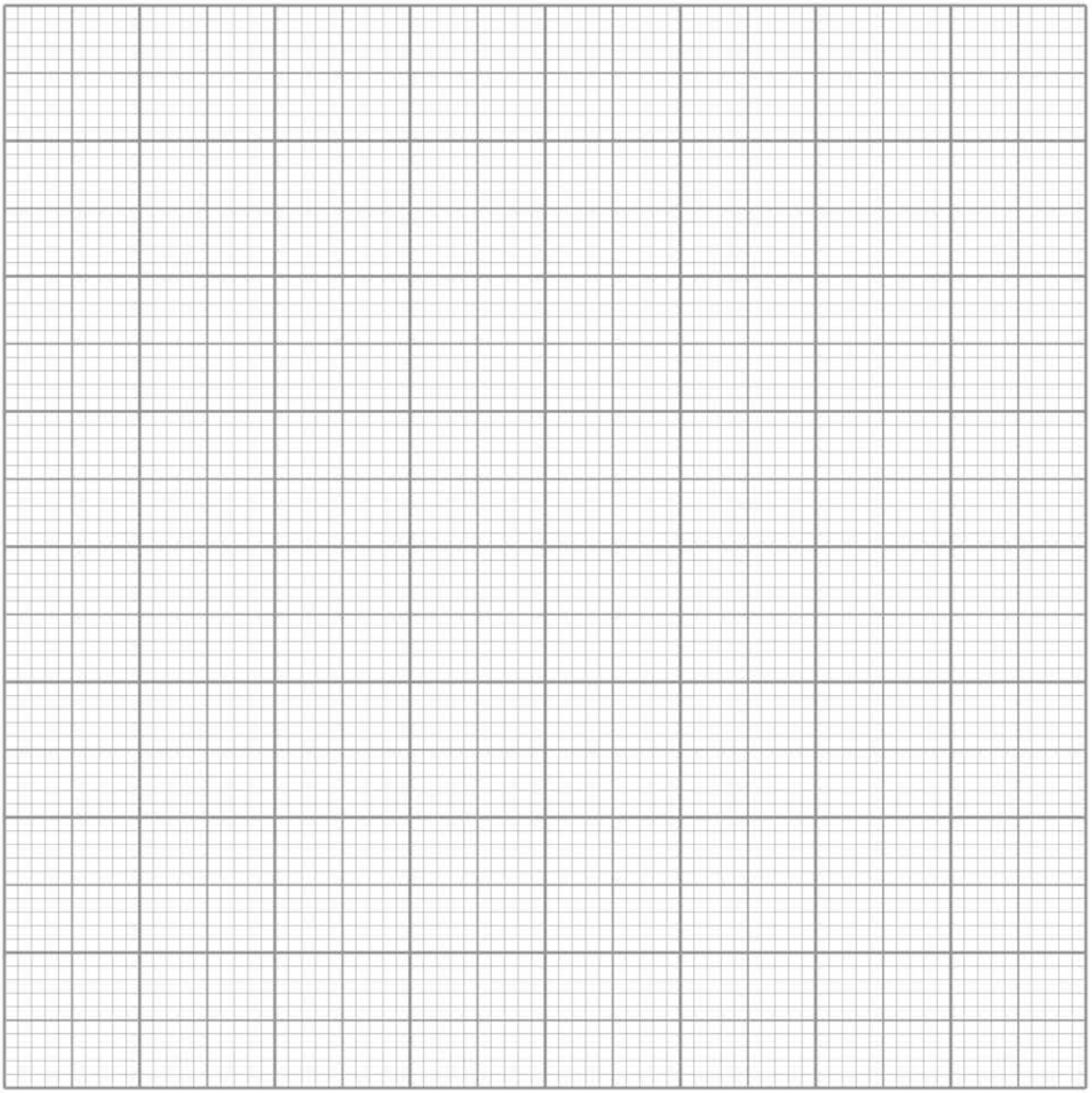
_____ **N**

Direction of the force on the dinghy caused by the tension force in the tow rope =

_____

11

FIGURE 11



[Turn over]

0 7 **A student used a simple transformer to investigate how the number of turns on the secondary coil affects the potential difference (p.d.) across the secondary coil.**

The student kept the p.d. across the primary coil fixed at 2V.

FIGURE 12, on page 41, shows the results collected by the student.

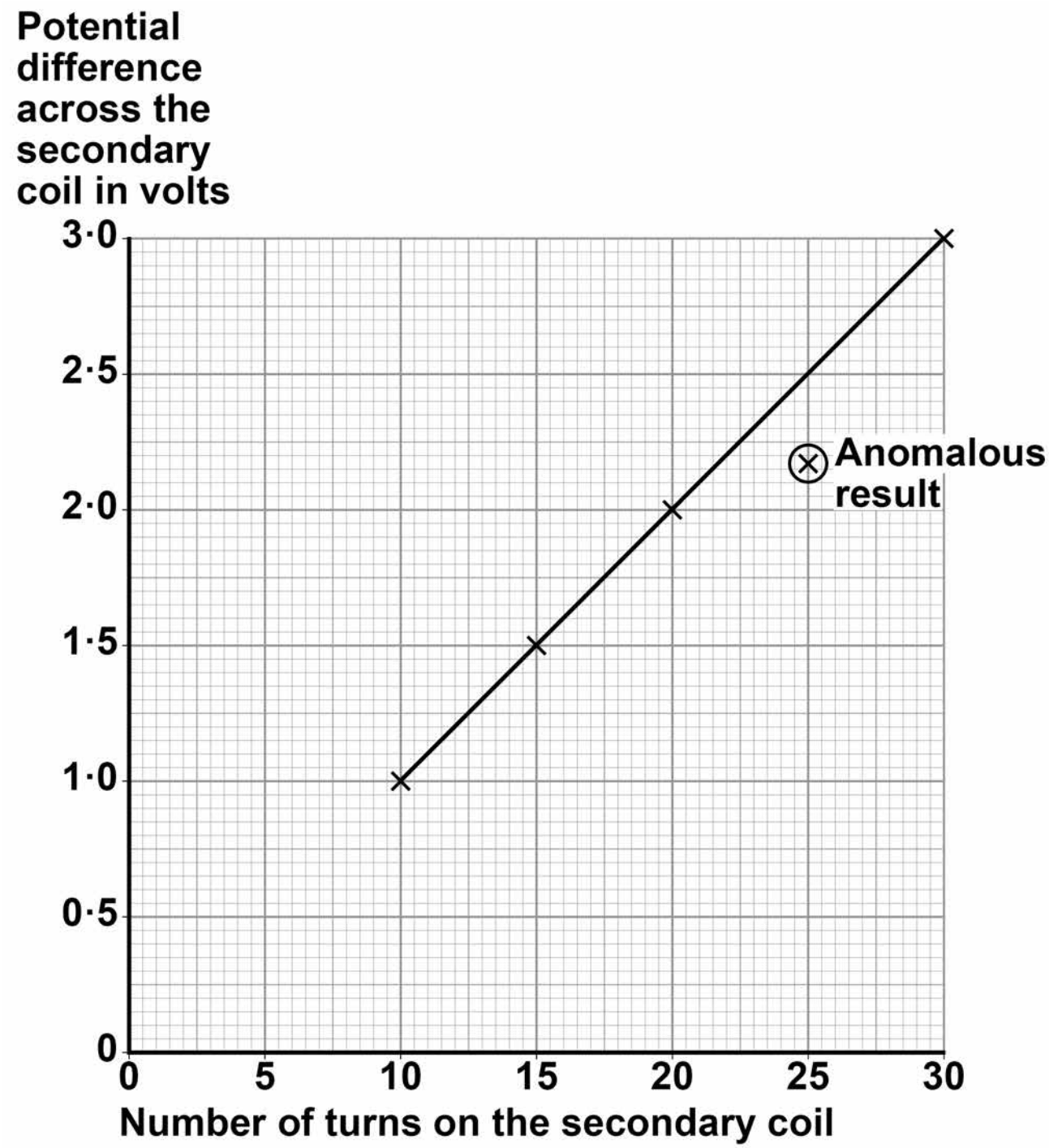
0 7 . 1 **FIGURE 12 contains one anomalous result.**

Suggest ONE possible reason why this anomalous result occurred. [1 mark]

0 7 . 2 **The transformer changes from being a step-down to a step-up transformer.**

How can you tell from FIGURE 12 that this happens? [1 mark]

FIGURE 12

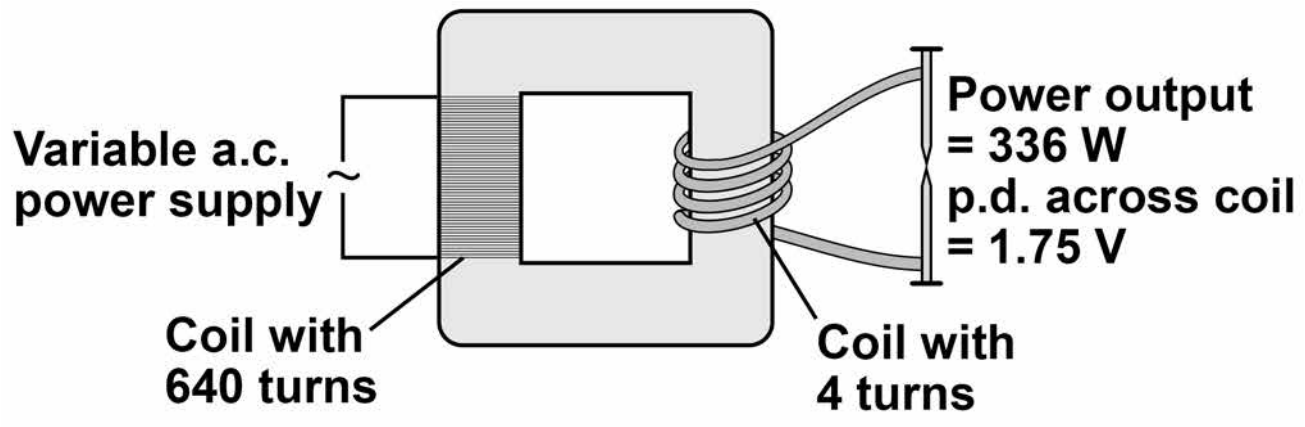


[Turn over]

A spot-welder is a device that uses a transformer to produce a large current to join sheets of metal together.

FIGURE 13 shows a transformer demonstrating how a large current can heat and join two nails together.

FIGURE 13



0 7 . 3 How does the amount of infrared radiation emitted by the nails change when the power supply is switched on? [1 mark]

0 7 . 4 **Calculate the current from the power supply needed to provide a power output of 336 W.**

Use the data in FIGURE 13.

The transformer is 100% efficient. [5 marks]

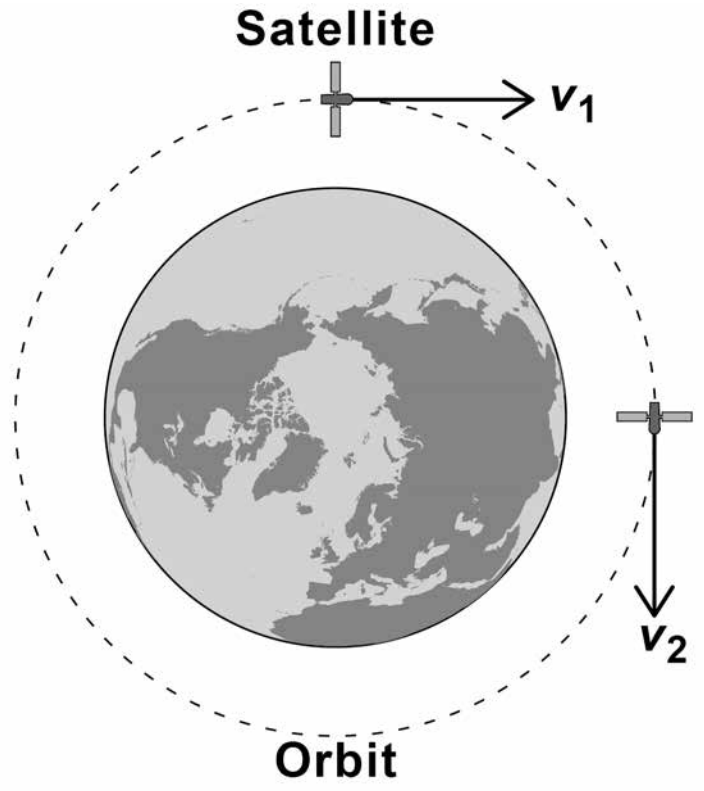
Current = _____ A

8

0 8 **A satellite is in a circular orbit around the Earth.**

FIGURE 14 shows the velocity of the satellite at two different positions in the orbit.

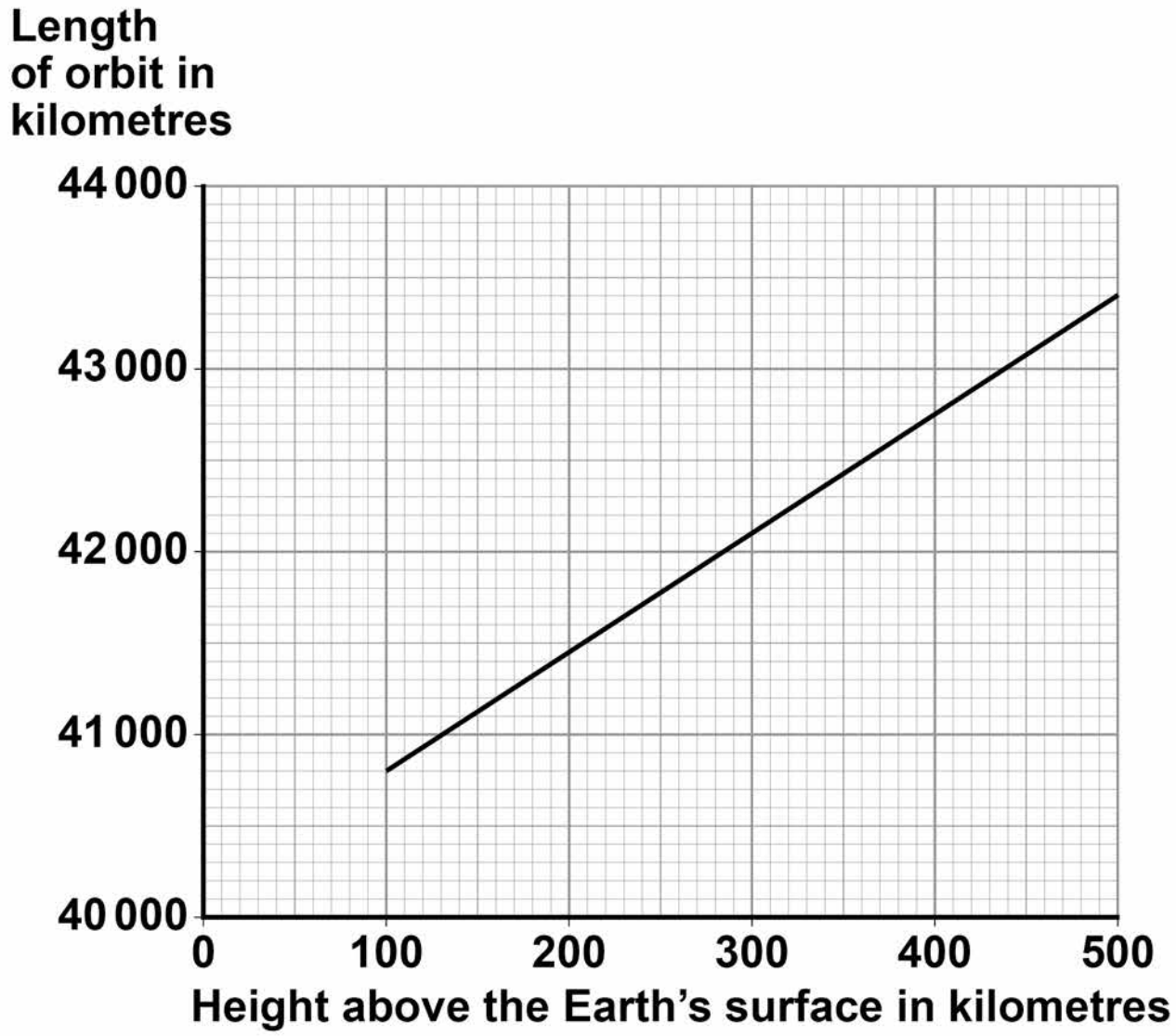
FIGURE 14



0 8 . 1 Explain why the velocity of the satellite changes as it orbits the Earth. [3 marks]

0 8 . 2 **FIGURE 15 shows how the length of a satellite orbit depends on the height of the satellite above the Earth's surface.**

FIGURE 15



A satellite orbits 300 km above the Earth's surface at a speed of 7.73 km/s.

Calculate how many complete orbits of the Earth the satellite will make in 24 hours. [5 marks]

Number of complete orbits = _____

[Turn over]

In 1772, an astronomer called J Bode developed an equation to predict the orbital radii of the planets around the Sun.

TABLE 3 shows Bode's predicted orbital radii and the actual orbital radii for the planets that were known in 1772.

TABLE 3

Planet	Predicted orbital radius in millions of kilometres	Actual orbital radius in millions of kilometres
Mercury	60	58
Venus	105	108
Earth	150	150
Mars	240	228
Jupiter	780	778
Saturn	1500	1430

0 8 . 3 **The predicted data can be considered to be accurate.**

Give the reason why. [1 mark]

0 8 . 4 **J Bode used his equation to predict the existence of a planet with an orbital radius of 2940 million kilometres.**

The planet Uranus was discovered in 1781.

Uranus has an orbital radius of 2875 million kilometres.

Explain why the discovery of Uranus was important. [2 marks]

0 9 **Light is usually described as a wave. Light can also be described as a stream of particles.**

These are two different scientific models of light.

0 9 . 1 **Which statement describes a scientific model? [1 mark]**

Tick ONE box.

- ☐ **A small scale version of a real object.**
- ☐ **A way of guessing what will happen.**
- ☐ **An idea used to explain observations and data.**

0 9 . 2 **Why do scientists sometimes have different models like the wave and particle models of light? [1 mark]**

0 9 . 3 **Sometimes an old scientific model is replaced by a new model.**

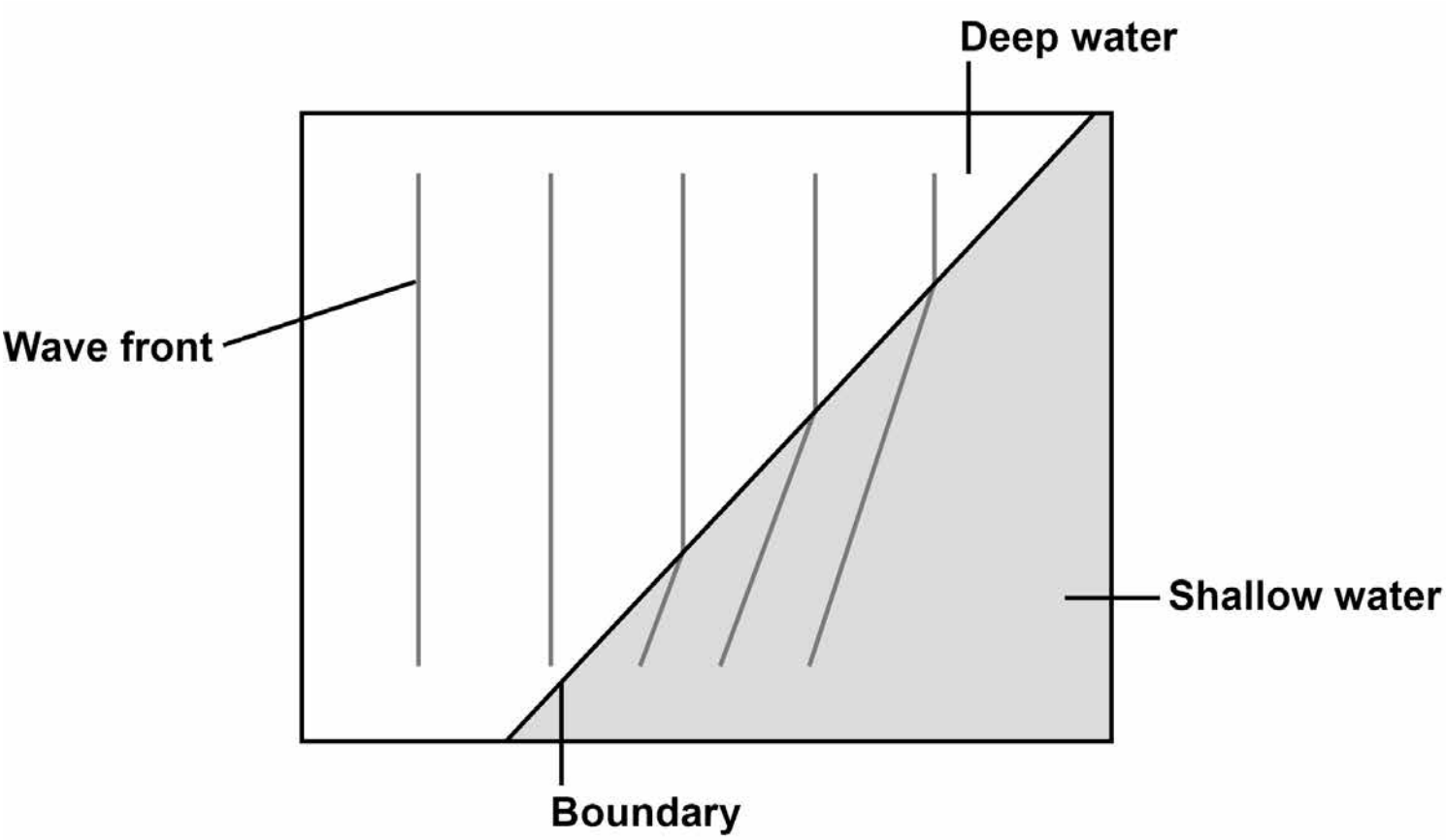
Explain why scientists replace an old scientific model with a new model.

Include an example from Physics in your answer. [4 marks]

Some students used water waves in a ripple tank to model the behaviour of light waves.

0 9 . 4 **FIGURE 16 shows what happens to the wave fronts as they pass the boundary between deep water and shallower water.**

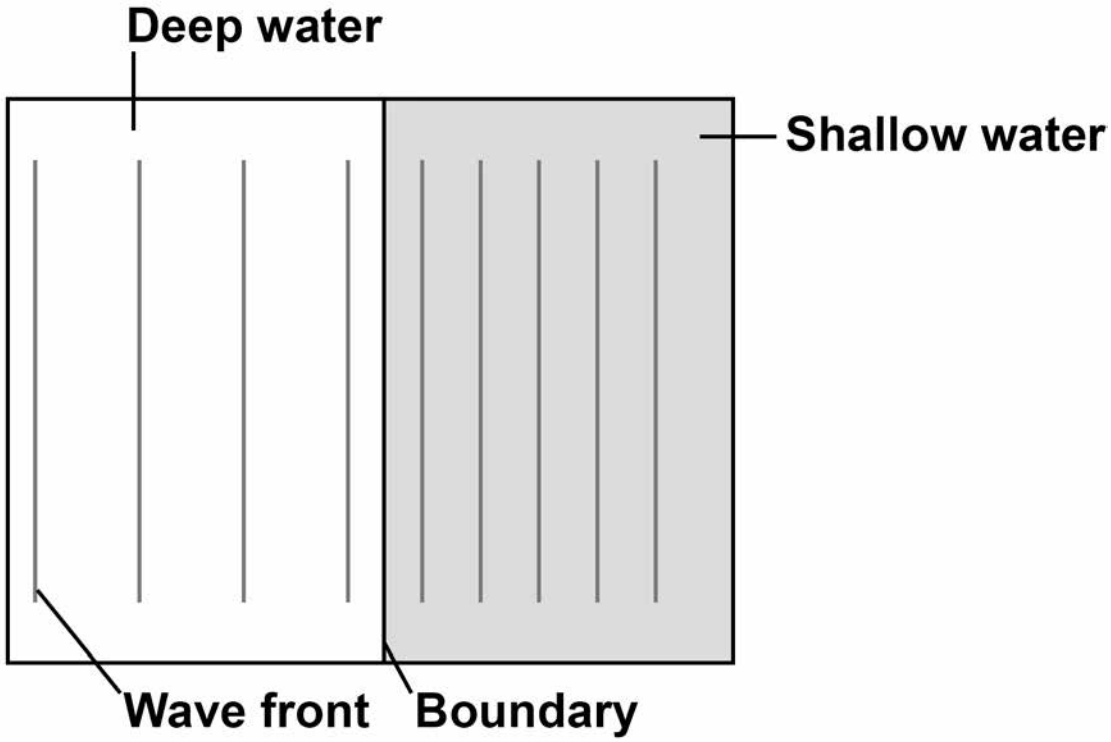
FIGURE 16



Explain why refraction happens at the boundary between the deep water and shallower water. [3 marks]

0 9 . 5 **FIGURE 17 shows the wave fronts travelling parallel to the boundary between deep water and shallower water.**

FIGURE 17



Explain why the wave fronts in FIGURE 17 do not refract at the boundary. [2 marks]

11

1 0 **The circle in FIGURE 18 represents a straight wire carrying a current. The cross shows that the current is into the plane of the paper.**

FIGURE 18

1 0 . 1 **Complete FIGURE 18 to show the magnetic field pattern around the wire. [2 marks]**

1 0 . 2 **The magnetic flux density 10 cm from the wire is 4 microtesla.**

Which of the following is the same as 4 microtesla? [1 mark]

Tick ONE box.

☐ 4×10^{-2} T

☐ 4×10^{-3} T

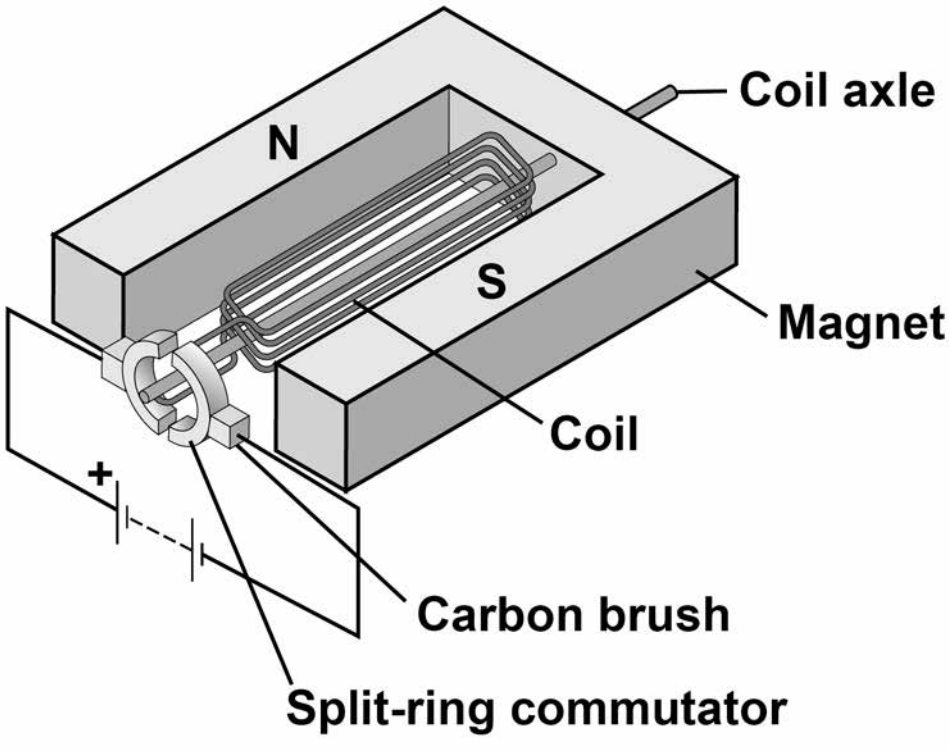
☐ 4×10^{-6} T

☐ 4×10^{-9} T

[Turn over]

1 0 . 3 FIGURE 19 shows a simple electric motor.

FIGURE 19



When there is a current in the coil, the coil rotates continuously.

Explain why. [4 marks]

END OF QUESTIONS

7

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For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	