OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A
Unit 2: Modules P4 P5 P6 (Higher Tier)

A332/02

**Monday 31 January 2011
Afternoon**

Duration: 40 minutes

Candidate forename		Candidate surname	

Centre number					Candidate number				

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. Pencil may be used for graphs and diagrams only.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Answer **all** the questions.
* Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* A list of physics equations is printed on page **2**.
* The total number of marks for this paper is **42**.
* This document consists of **24** pages. Any blank pages are indicated.

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Turn over

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

The Wave Model of Radiation

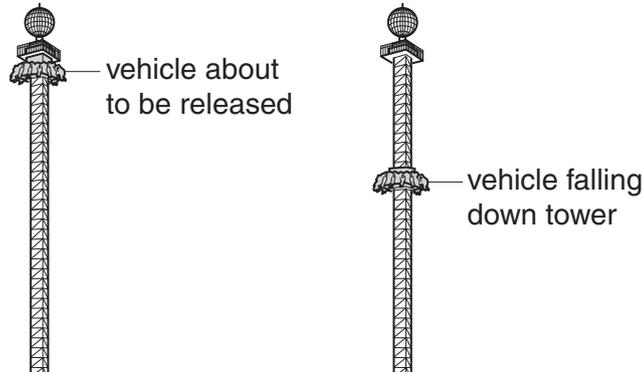$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

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Question 1 starts on page 4

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Answer **all** the questions.

1 This question is about a theme park ride.

vehicle about to be released

vehicle falling down tower

Riders sit in a vehicle.

It is pulled up to the top of the tower.

It is then dropped from the top of the tower.

It falls to the ground.

The vehicle is stopped by brakes as it nears the bottom.

(a) (i) How does the gravitational potential energy of the vehicle change during the ride?

....

....

.... **[2]**

(ii) Work is done against gravity when the vehicle is pulled upwards.

Work is also done against other forces when the vehicle is pulled upwards.

Write down **one** of these forces.

.... **[1]**

(b) The ride is 40 metres high. The vehicle has a weight of 20 000 N.

What is the change in gravitational potential energy of the vehicle when it goes from the bottom of the ride to the top of the ride?

Put a (ring) around the correct answer.

0.5 kJ   50 kJ   200 kJ   500 kJ   800 kJ   800 000 kJ

[1]

(c) Work is done by gravity as the vehicle falls.

   (i) Assume gravity is the only force on the vehicle.

   What is the **maximum** kinetic energy the vehicle could have at the bottom of the tower?

   answer .... kJ **[1]**

   (ii) The vehicle does not actually gain this much kinetic energy.

   Explain why.

   ....

   .... **[2]**
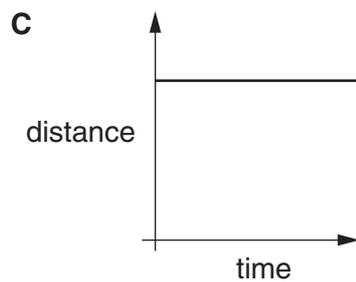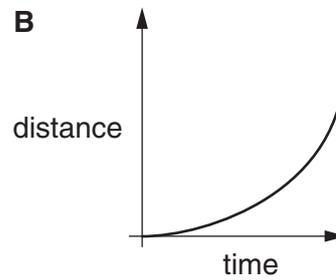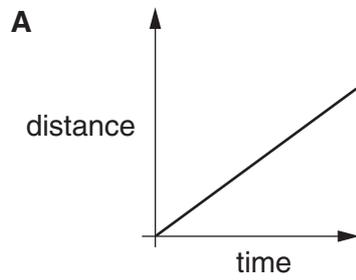
[Total: 7]

Turn over
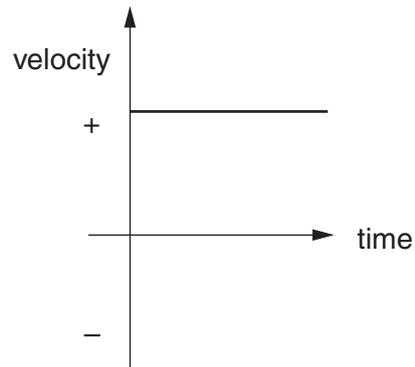
2 Two boats pass each other on a canal.
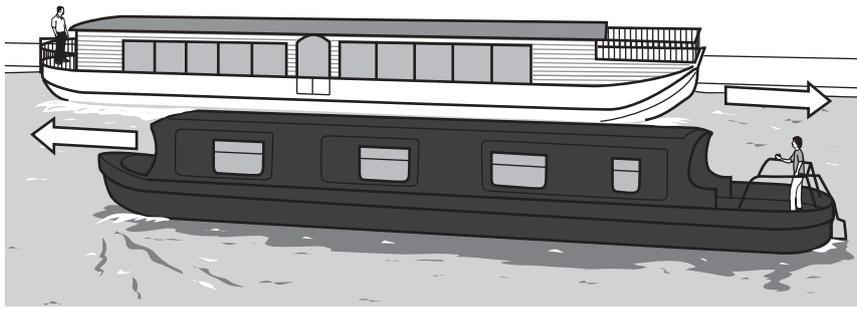
(a) The black boat is moving at a constant speed.

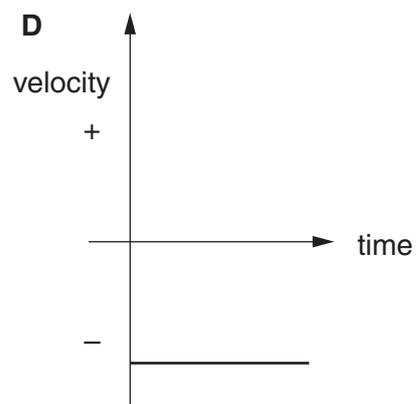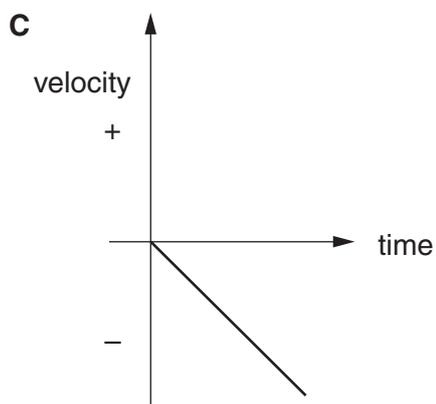Which distance-time graph, **A**, **B**, **C** or **D**, shows the motion of the black boat?
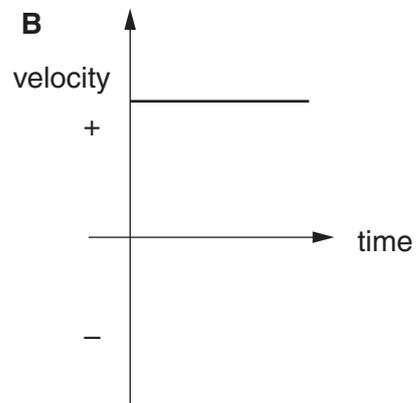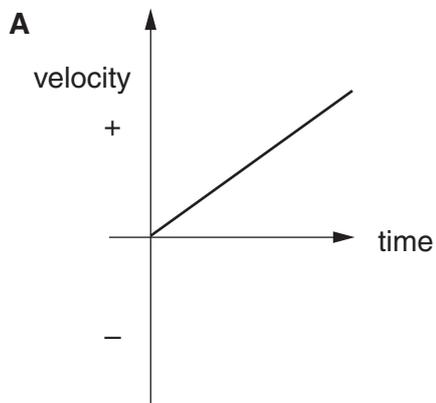
A

distance | time

B

distance | time

C

distance | time

D

distance | time
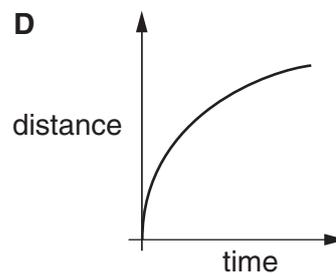
graph .... **[1]**

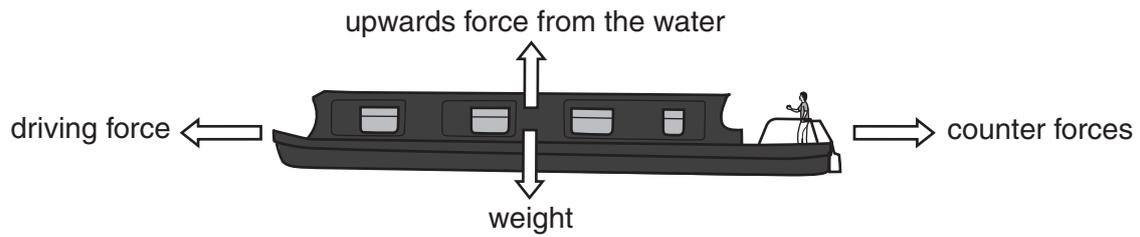**(b)** This is the velocity-time graph for the black boat.

The white boat is moving at the same speed in the opposite direction.

Which graph shows the correct velocity-time graph for the white boat?

graph .... **[1]**

(c) The forces acting on the black boat are shown below.

upwards force from the water

driving force ⟸   ⟹ counter forces

weight

Several passengers jump off the boat as it moves.

There is no change to the driving force.

The boat **floats higher** in the water and **travels faster** as a result.

Which of the following statements explain these effects?

Put ticks (✓) in the boxes next to the **two** correct answers.

The upwards force from the water stays the same. ☐

The upwards force from the water on the boat increases. ☐

The counter forces on the boat decrease when the passengers jump off. ☐

The counter force is always equal to the driving force. ☐

The weight decreases. ☐
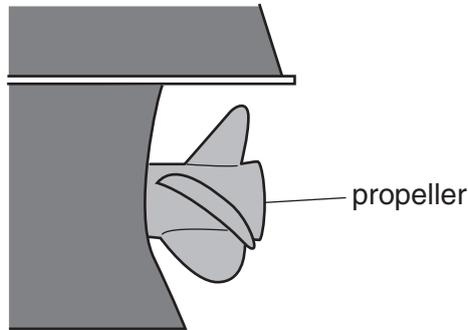
The driving force equals the upwards force. ☐

[2]

(d) When objects interact with each other there are two forces.

These forces are called an interaction pair.

Four people are watching the boat and talking about the forces.

They know that the driving force is provided by the boat's propeller in the water.
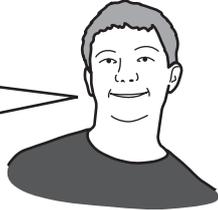

propeller

Madhur
The two forces in an interaction pair are always the same size.

Nigel
The boat's weight and the upwards force from the water are an interaction pair.

Peter
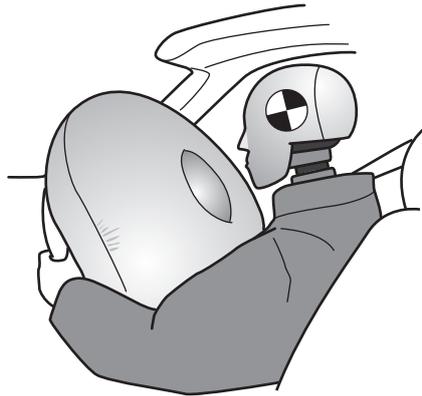The water pushes the propeller forwards.

Omar
The propeller pushes the water backwards.

Which person is making an incorrect statement?

answer .... **[1]**

[Total: 5]

Turn over

3 Cars can be fitted with air bags, which are tested using crash test dummies.

(a) Complete these sentences.

Put a (ring) around the correct choice in each sentence.

The momentum of the dummy before the collision with the air bag is **less than / the same as / greater than** the momentum of the dummy after the collision.

The force from the dummy on the air bag is **less than / the same as / greater than** the force from the air bag on the dummy.

[1]

(b) Explain how air bags reduce injury in a collision.

Include in your answer

- the duration of the impact
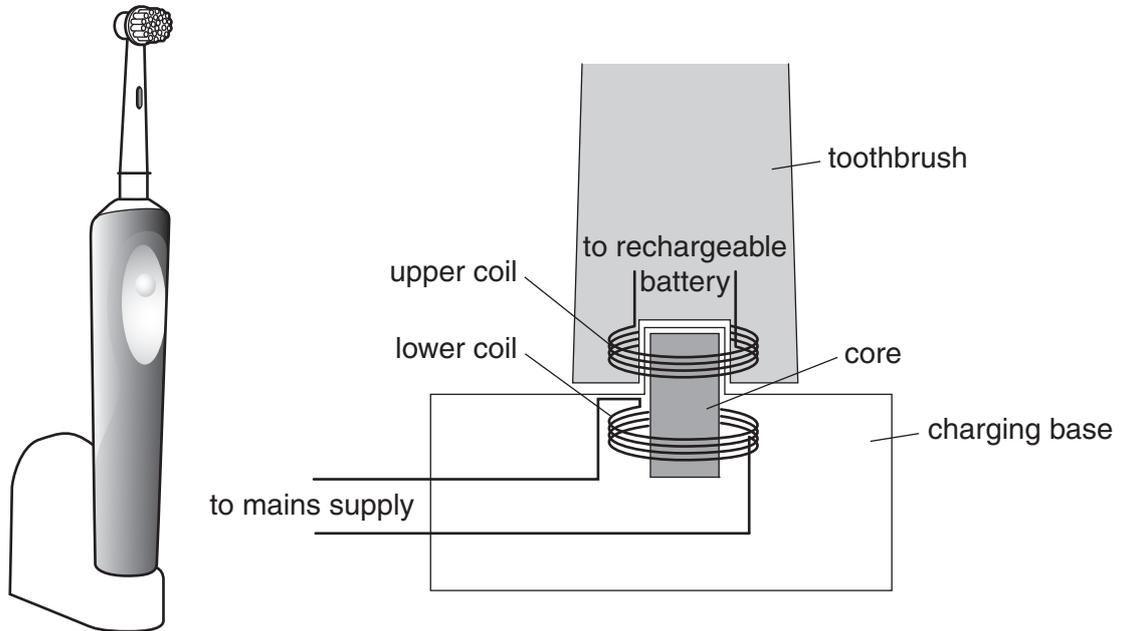- the change in momentum involved
- the force involved.

....

....

....

.... **[2]**

[Total: 3]

4 An electric toothbrush contains a rechargeable battery.

It is charged from a separate charging base.

The toothbrush and charging base contain coils of wire that act as a transformer.

toothbrush

to rechargeable battery

upper coil

lower coil

core

charging base

to mains supply

(a) Here are five statements about how the battery is charged.

They are in the **wrong order**.

 A This causes a current to flow in the upper coil.

 B The battery charges.

 C The magnetic field in the core changes.

 D A voltage is induced in the upper coil.

 E The mains supply produces a changing current in the lower coil.

Fill in the boxes to show the correct order.

[3]

(b) Which of the following describes the mains supply in the United Kingdom?

Put a (ring) around the correct answer.

110V d.c.   **110V a.c.**   **230V d.c.**   **230V a.c.**

[1]

(c) The upper coil has 100 turns and a voltage of 12V.

How many turns are there in the lower coil?

Show your working.

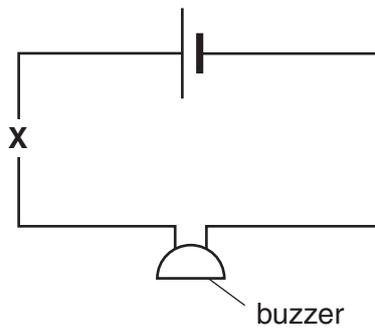answer = ... turns **[3]**

[Total: 7]

5 (a) Mark is given a biscuit jar.

When it is opened, light enters the jar and it makes a noise.

He wonders how this works.

He makes this circuit to test his ideas.

buzzer

The buzzer makes a noise when a current passes through it.

Mark puts a component at **X** that responds to **light**.

Which component, **A**, **B**, **C** or **D**, does he use?

A   B   C   D

component ....

What is the name of this component that responds to light?

.... **[1]**

Turn over

(b) What happens to the resistance of this component when there is more light?

Put a tick (✓) in the box next to the correct answer.

The resistance increases. ☐

The resistance decreases. ☐

The resistance stays the same. ☐

The resistance becomes zero. ☐

[1]

(c) (i) The buzzer has a resistance of 15 Ω.

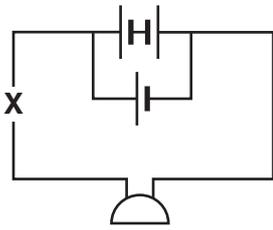When the voltage across it is 3 V, the buzzer makes a sound.

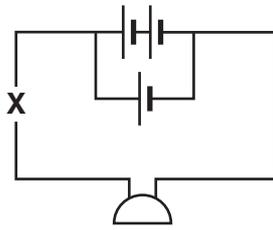Calculate the current in the circuit when the buzzer sounds.

current = ... amps **[1]**

(ii) Mark finds that he needs a larger current in his circuit.

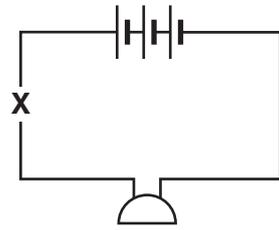He adds two more cells to the circuit.

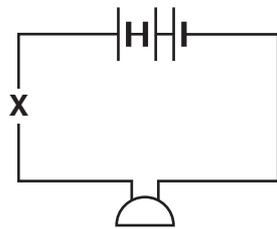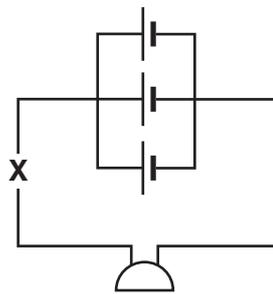Which **two** of the following arrangements of cells gives a larger current?

circuit **A**   circuit **B**   circuit **C**

circuit **D**   circuit **E**

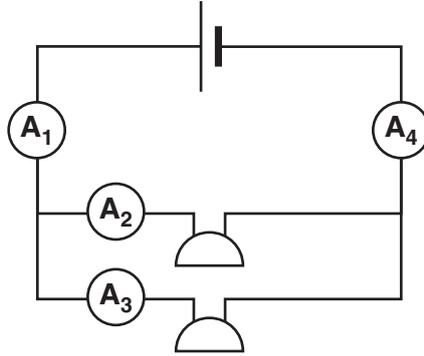circuits .... and .... **[2]**

Turn over

(d) A different circuit is set up with two identical buzzers in parallel.

The current is measured in four different places around the circuit.

Which of the following statements are true?

Put ticks (✓) in the boxes next to the **two** correct answers.

The reading on ammeter A_2 is greater than the reading on ammeter A_3. ☐

The total resistance of the circuit increases when the second buzzer is added. ☐

The current passing through A_1 is equal to the current through ammeters A_2 and A_3 combined. ☐

Less current will return to the battery as some is used to power the buzzer. ☐

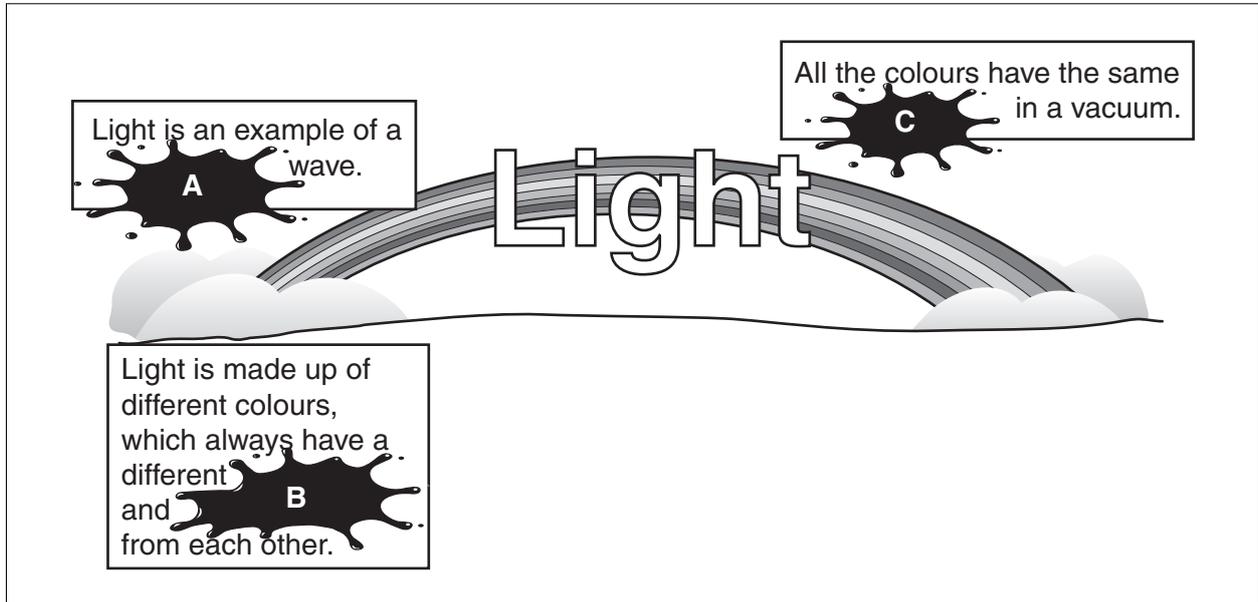When the second buzzer is added the total current leaving the battery increases. ☐

[2]

[Total: 7]

17

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Question 6 starts on page 18

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Turn over

6 Jeff makes a poster about light.

Unfortunately, ink is splashed on the poster.

The ink splashes have been labelled **A**, **B** and **C**.

(a) Which word should be on the poster underneath ink splash **A**?

Put a (ring) around the correct answer.

transverse   longitudinal

Complete the following sentences about light waves.

Use options from this list.

You can use each option once, twice or not at all.

perpendicular

not related

parallel

at 45°

In light waves, the direction of oscillation is .... to the direction the wave travels.

The direction of the energy transfer is .... to the direction the wave travels.

[2]

(b) Which three correct words should be at positions **B** and **C**?

position **B** .... and ....

position **C** ....

[2]

(c) At what speed does red light travel in space?

Put a (ring) around the correct answer.

300 m / s   **300 000 m / s**   **300 km / s**   **300 000 km / s**
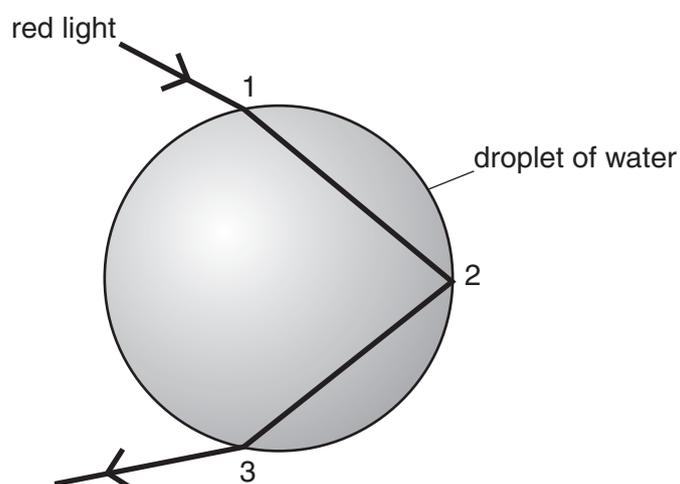
[1]

Turn over

(d) Jeff reads about how rainbows form.

    (i) He finds this diagram.

        It shows how red light travels on the way into a droplet of water, inside it, and out again.

        The three boundaries between air and water have been labelled **1**, **2** and **3**.

red light

droplet of water

1

2

3

        Put ticks (✓) in the table to show what happens to the speed of the red light at each of the boundaries **1**, **2** and **3**.

	speed of the red light		
	increases	**decreases**	**stays the same**
boundary **1**			
boundary **2**			
boundary **3**			

[2]

(ii) Jeff also finds out that different colours are refracted by different amounts when they enter the droplet of water.

Blue light is refracted more than red light.

Put ticks (✓) in the boxes next to the correct statements.

The wavelength of blue light is shorter in the droplet than in the air. ☐

The wavelength of red light is longer in the droplet than in the air. ☐

Light of both colours has the same wavelength in the droplet. ☐

Blue light travels slower than red light in the droplet. ☐

Blue light travels faster than red light in the droplet. ☐

Both blue and red light travel at the same speed in the droplet. ☐

[2]

[Total: 9]

Turn over

**7** Sunni is doing an experiment with a ripple tank.

She places a barrier in the tank with a small gap in the middle.

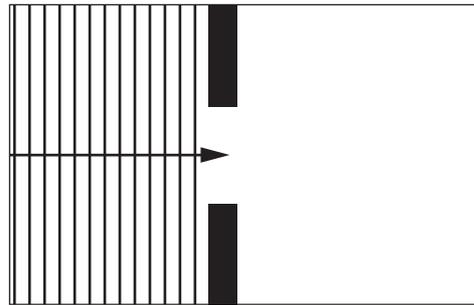She sends waves with different wavelengths towards the gap and observes what happens.

Complete the diagrams **A** and **B** and use them to explain Sunni's observations.

Include in your answer

- the wave process involved
- why the waves behave differently in each case.
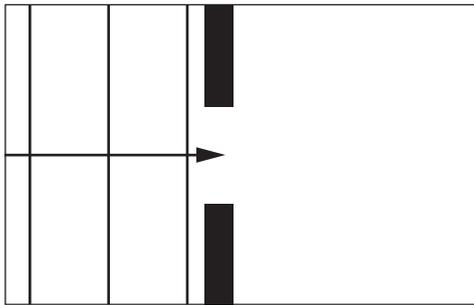
A   **B**

....

....

....

.... **[4]**

[Total: 4]

END OF QUESTION PAPER

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