Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A332/02

TWENTY FIRST CENTURY SCIENCE
PHYSICS A

Unit 2: Modules P4 P5 P6 (Higher Tier)

MONDAY 31 JANUARY 2011: Afternoon
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (LEO/SW) 11MEP01217 40958/1

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. 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.**

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 pages 4 and 5.**
- **The total number of marks for this paper is 42.**

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QUESTION 1 STARTS ON PAGE 6

TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

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

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

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

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

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

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

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

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

Answer ALL the questions.

1 This question is about a theme park ride.

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.

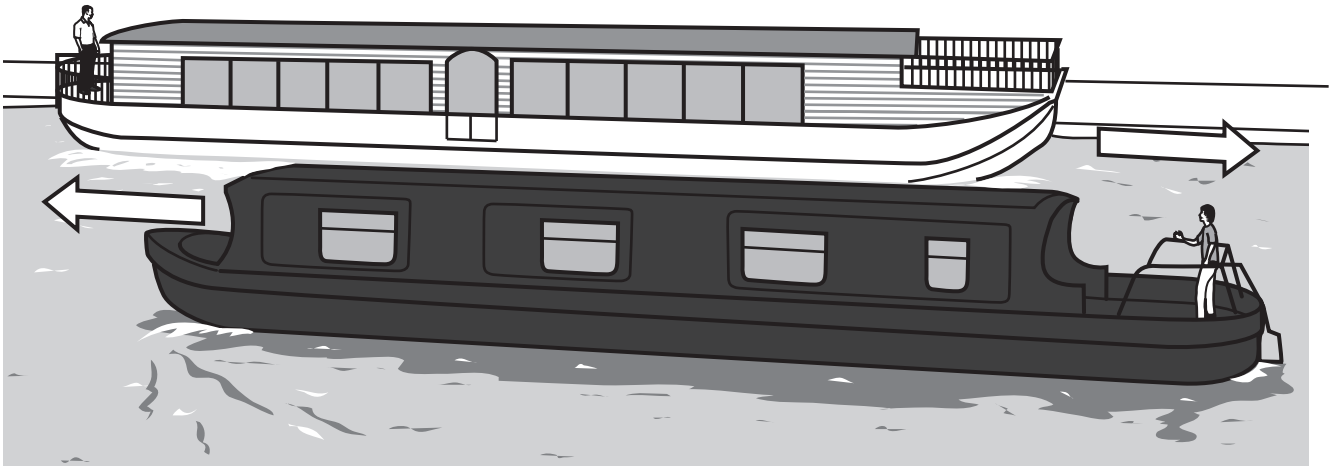
_____

_____ **[2]**

[Total: 7]

2 Two boats pass each other on a canal.

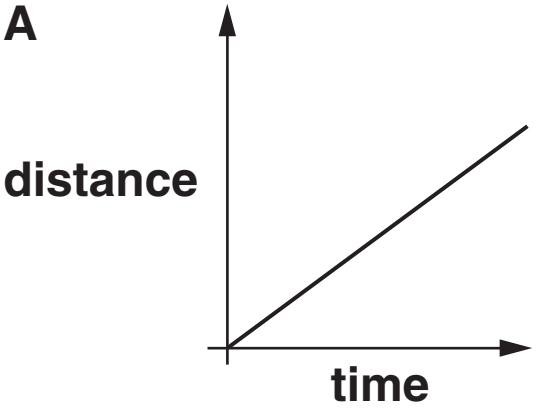
One boat is painted white and the other is painted black.



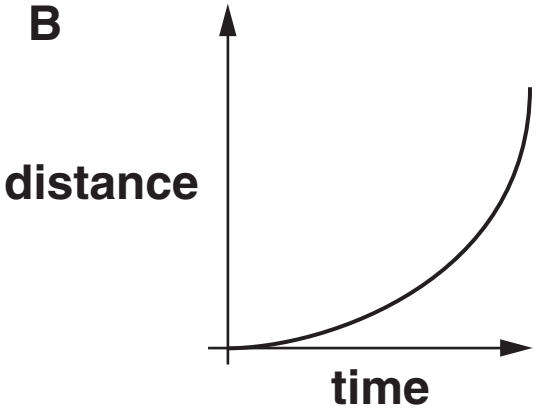
(a) The black boat is moving at a constant speed.

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

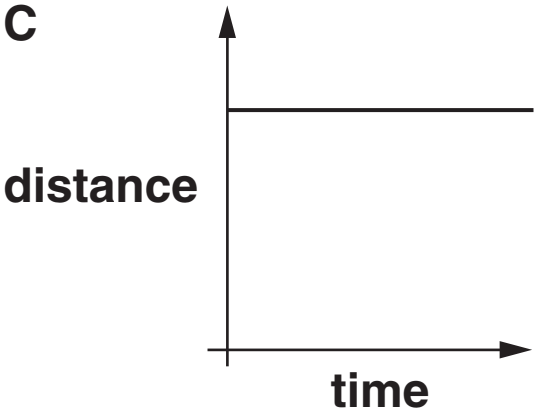
A



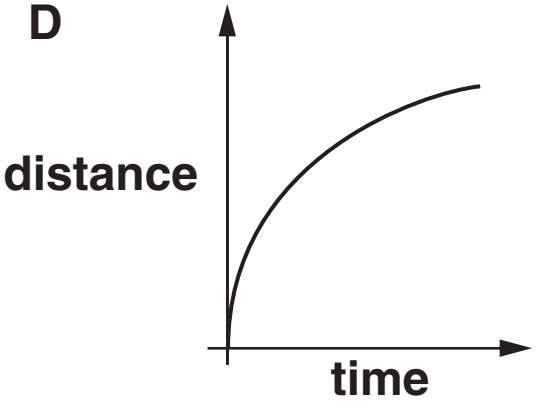
B



C

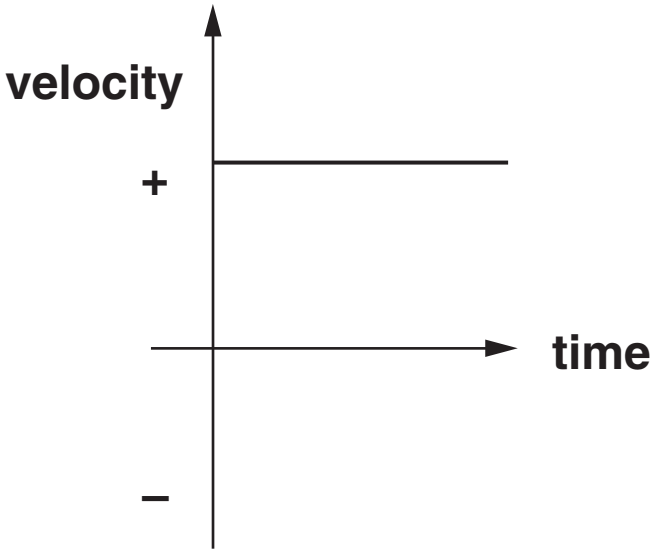


D



graph _____ [1]

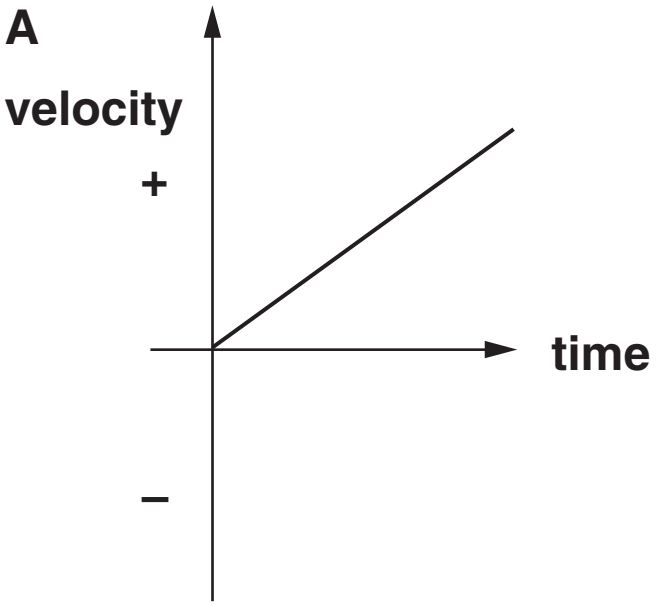
(b) This is the velocity-time graph for the black boat.



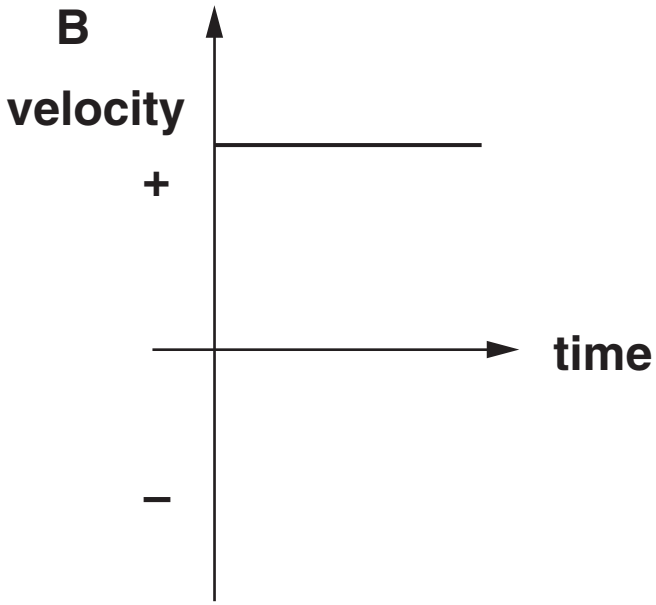
The white boat is moving at the same speed in the opposite direction.

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

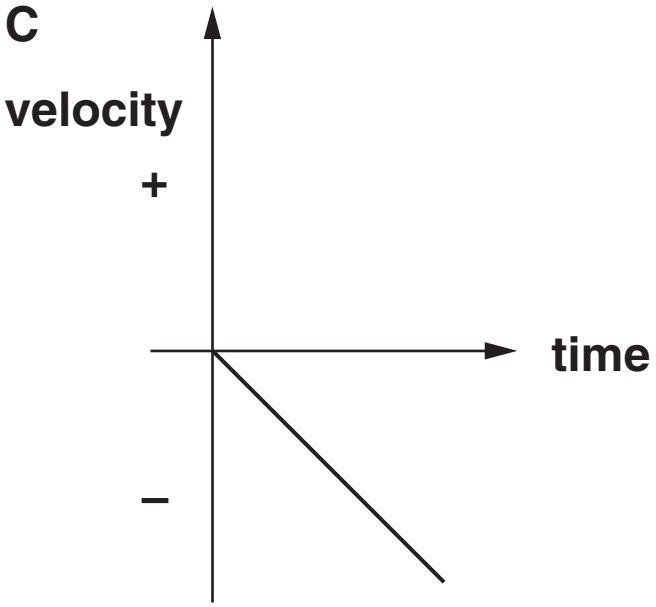
A



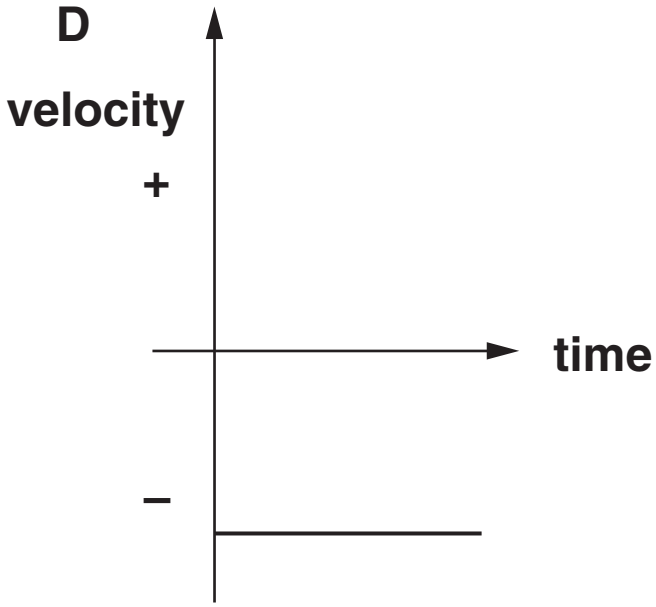
B



C

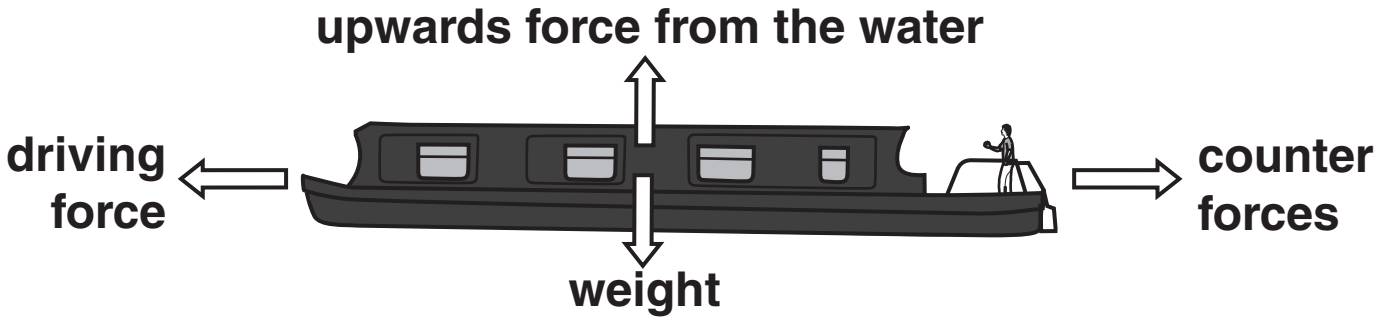


D



graph _____ **[1]**

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



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. ☐

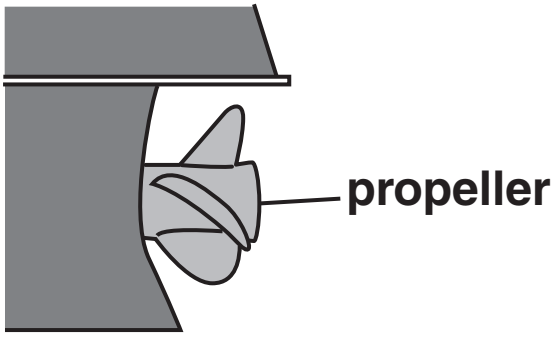
[2]

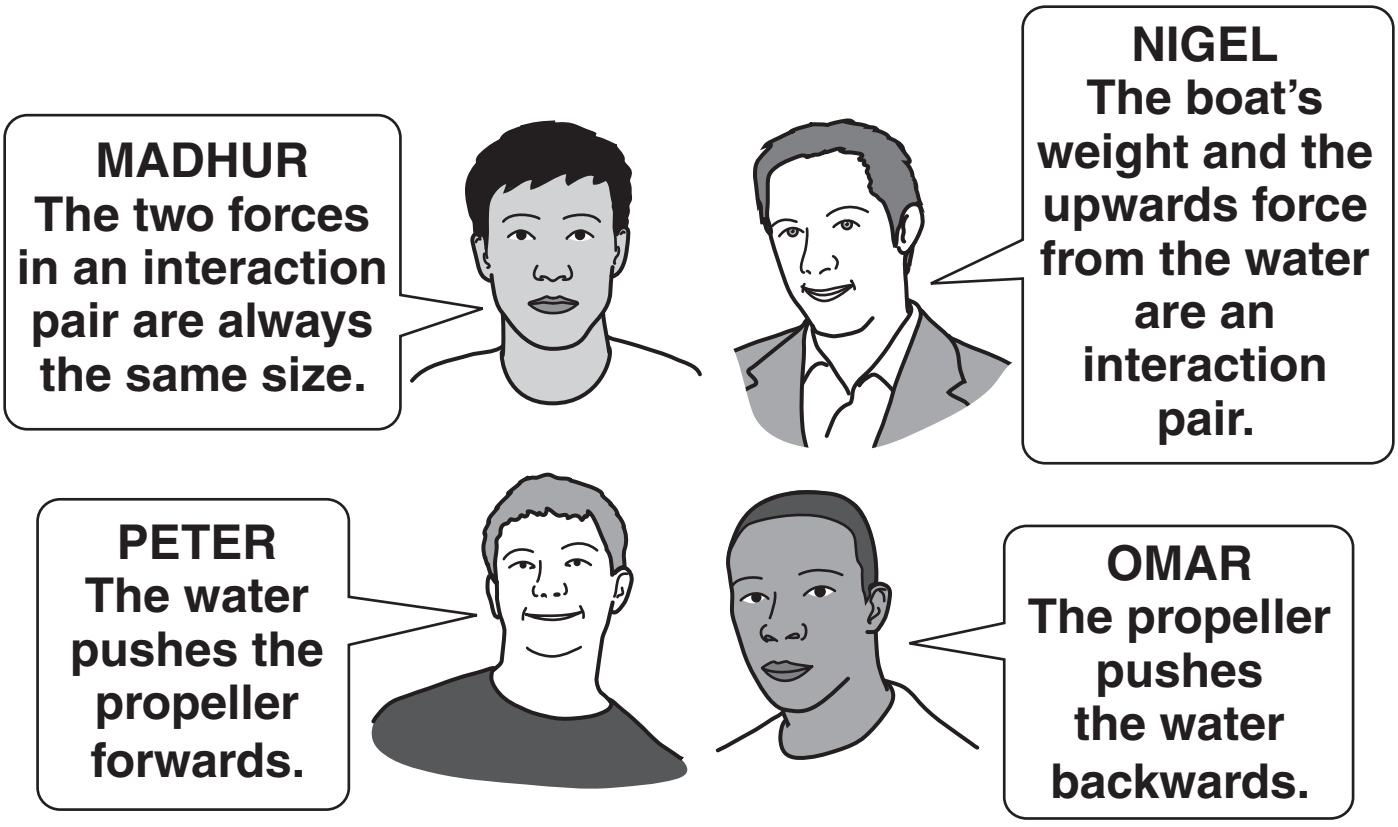
(d) **When objects interact with each other there are two forces.**

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.





Which person is making an incorrect statement?

answer _____ **[1]**

[Total: 5]

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]

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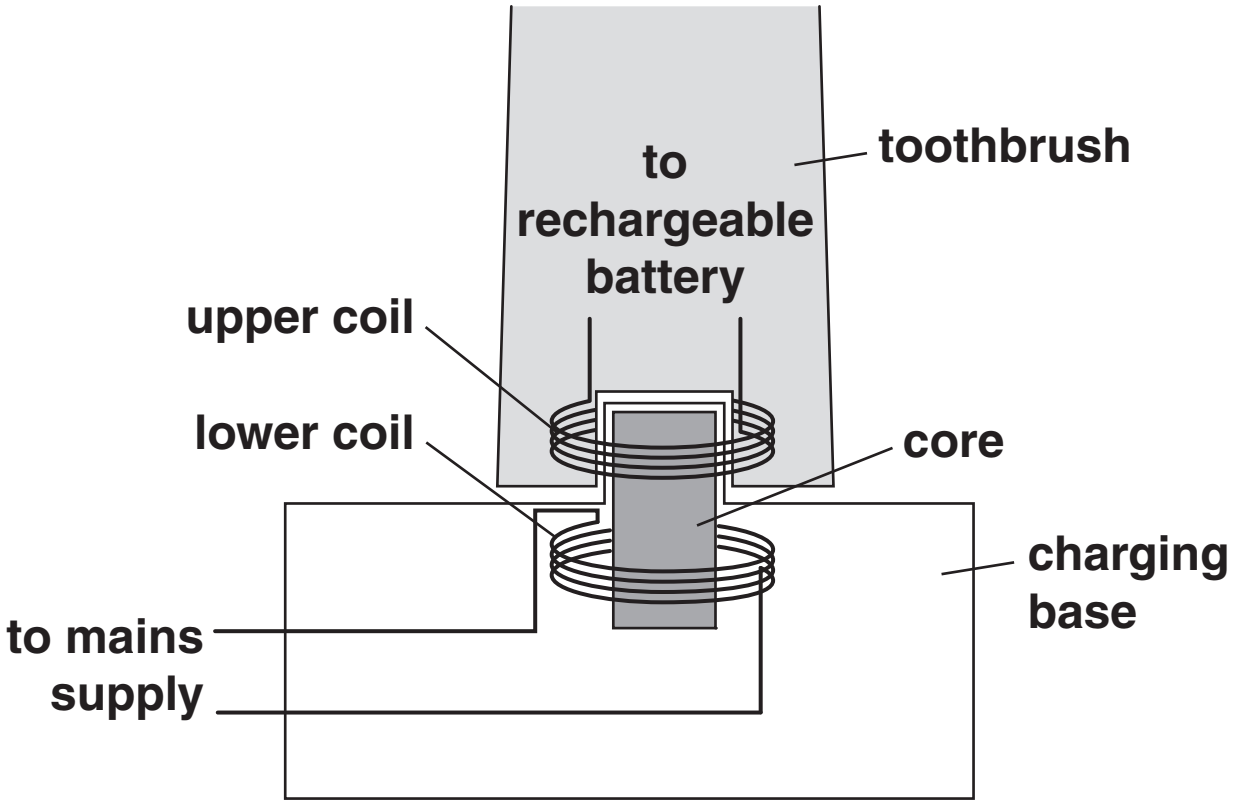
QUESTION 4 STARTS ON PAGE 16

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.



(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]

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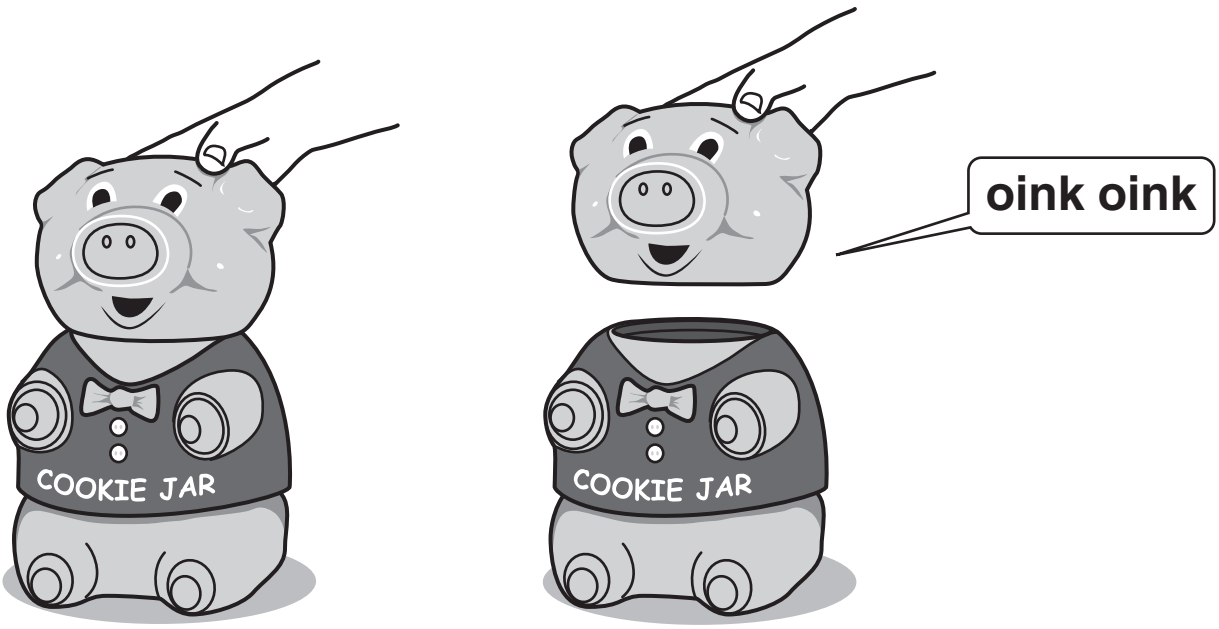
QUESTION 5 STARTS ON PAGE 20

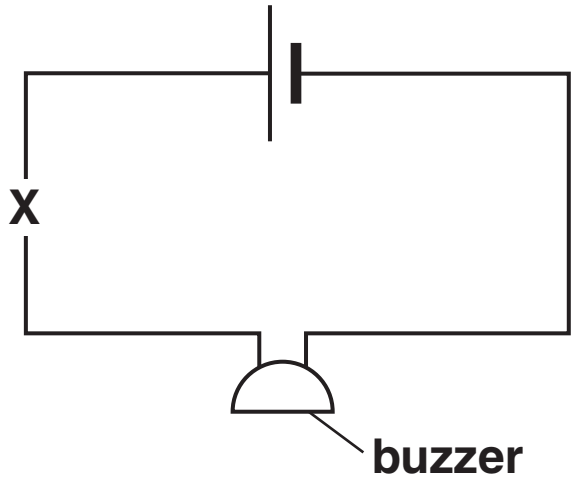
5 (a) Mark is given a biscuit jar.

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



He wonders how this works.

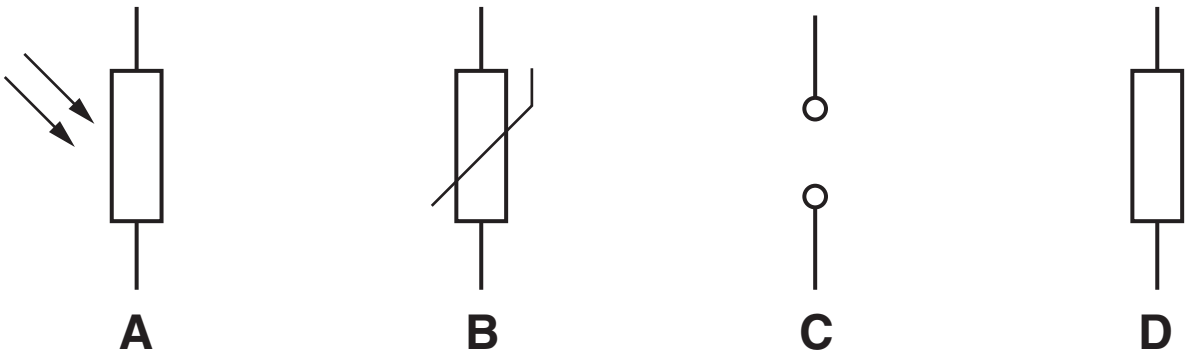
He makes this circuit to test his ideas.



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?



component _____

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

_____ **[1]**

(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 3V, the buzzer makes a sound.

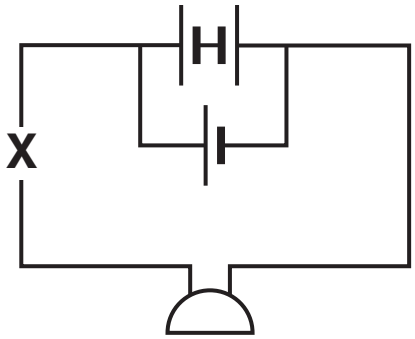
Calculate the current in the circuit when the buzzer sounds.

current = _____ amps [1]

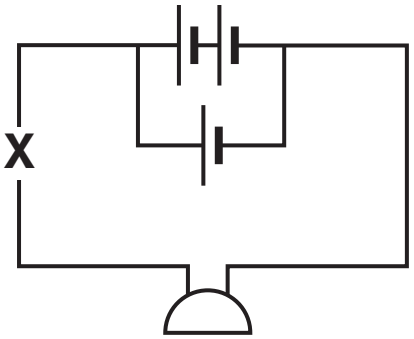
(ii) **Mark finds that he needs a larger current in his circuit.**

He adds two more cells to the circuit.

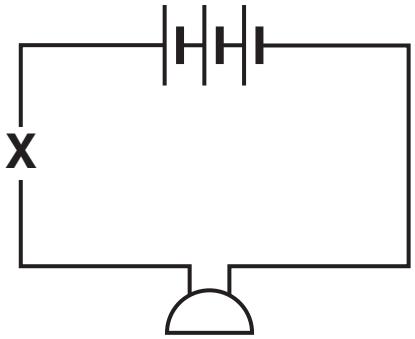
Which TWO of the following arrangements of cells gives a larger current?



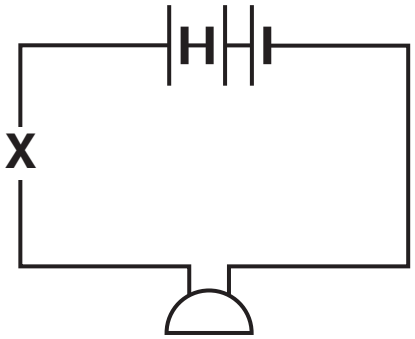
circuit A



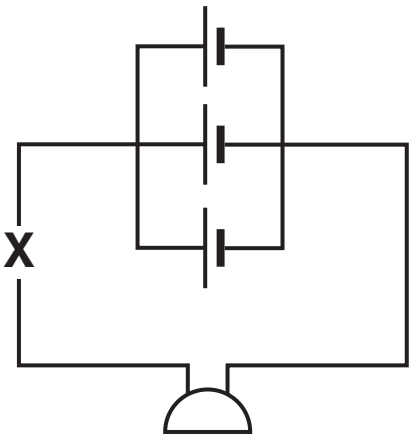
circuit B



circuit C



circuit D

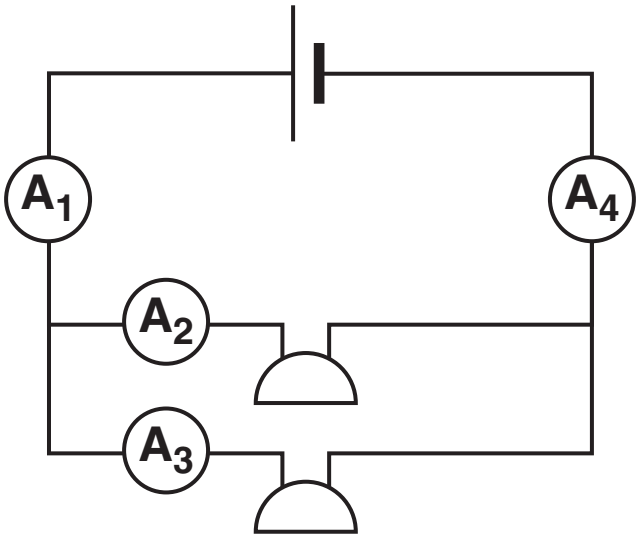


circuit E

circuits _____ and _____ [2]

(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]

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QUESTION 6 STARTS ON PAGE 26

6 Jeff makes a poster about light.

Unfortunately, ink is splashed on the poster.

The ink covers up some of the words in some of the information boxes on the poster.

Look at the information boxes labelled A, B and C and then answer the questions below.

A

Light is an example of a [redacted] wave.

B

Light is made up of different colours, which always have a different [redacted] and from each other.

C

All the colours have the same [redacted] in a vacuum.

(a) Which word should be on the poster underneath the ink splash in box 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 underneath the ink splashes in boxes B and C?

box B _____ and

_____

box 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**

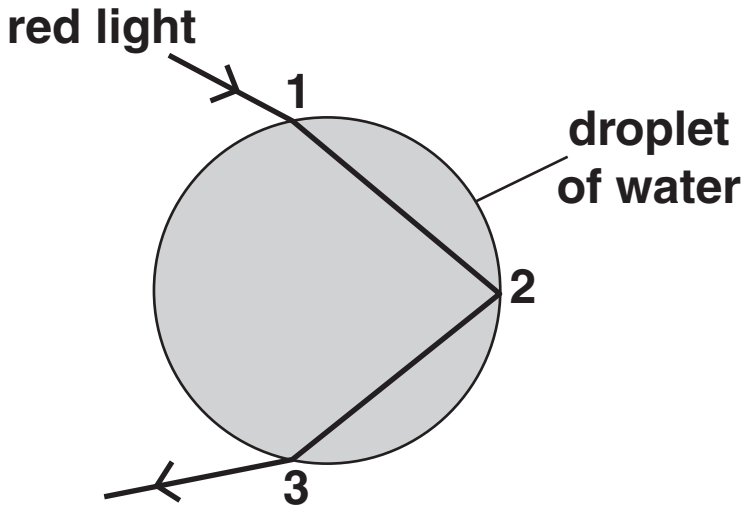
[1]

(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.



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]

7 Sunni is doing an experiment with a ripple tank.

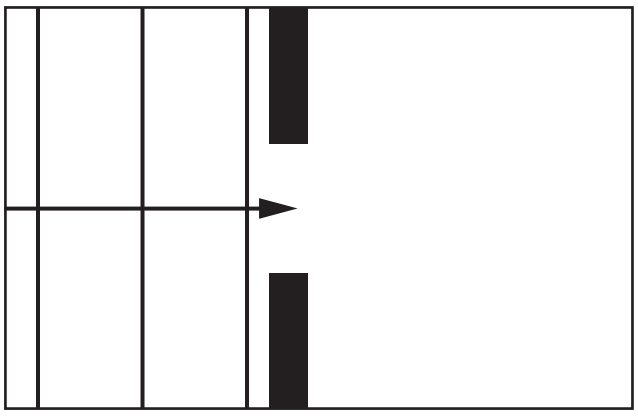
She places a barrier in the tank with a small gap in the middle.

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

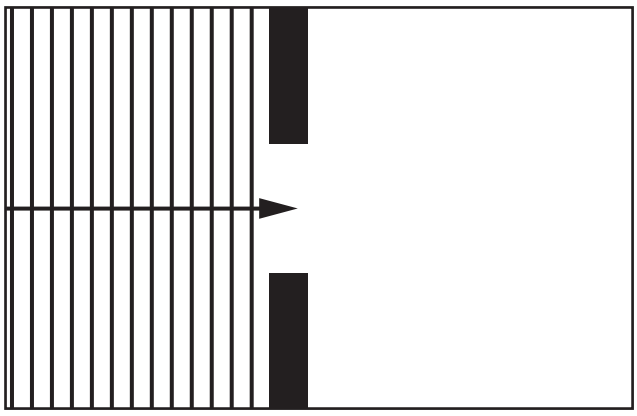
Complete the diagrams A and B and use them to explain Sunni's observations.

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