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Centre Number						Candidate Number				
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**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 1 FEBRUARY 2010: 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**

## **INSTRUCTIONS TO CANDIDATES**

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully and make sure that you know what you have to do before starting your answer.**
- **Answer ALL the questions.**
- **Write your answer to each question in the space provided, however additional paper may be used if necessary.**

## **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 4–5.**
- **The total number of marks for this paper is 42.**

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# TWENTY FIRST CENTURY SCIENCE EQUATIONS USEFUL RELATIONSHIPS

## EXPLAINING MOTION

- **speed =  $\frac{\text{distance travelled}}{\text{time taken}}$**
- **momentum = mass  $\times$  velocity**
- **change of momentum = resultant force  $\times$  time for which it acts**
- **work done by a force = force  $\times$  distance moved by the force**
- **change in energy = work done**
- **change in GPE = weight  $\times$  vertical height difference**
- **kinetic energy =  $\frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$**

## ELECTRIC CIRCUITS

- **resistance =  $\frac{\text{voltage}}{\text{current}}$**
- **$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}}$**   
**=  $\frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$**
- **energy transferred = power × time**
- **power = potential difference × current**
- **efficiency =  $\frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$**

## THE WAVE MODEL OF RADIATION

- **wave speed = frequency × wavelength**

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Answer ALL the questions.

1 This question is about different journeys made by a lorry.

(a) The lorry is travelling north on a long straight road.

The road runs directly north-south.

The lorry travels 6 km north and then turns around and travels 3.6 km south.

The lorry's average speed in the second part of the journey is 10 m/s.

What is the lorry's average VELOCITY during the second part of the journey?

Put a ring around each of the TWO correct answers.

10 m/s

-10 m/s NORTH

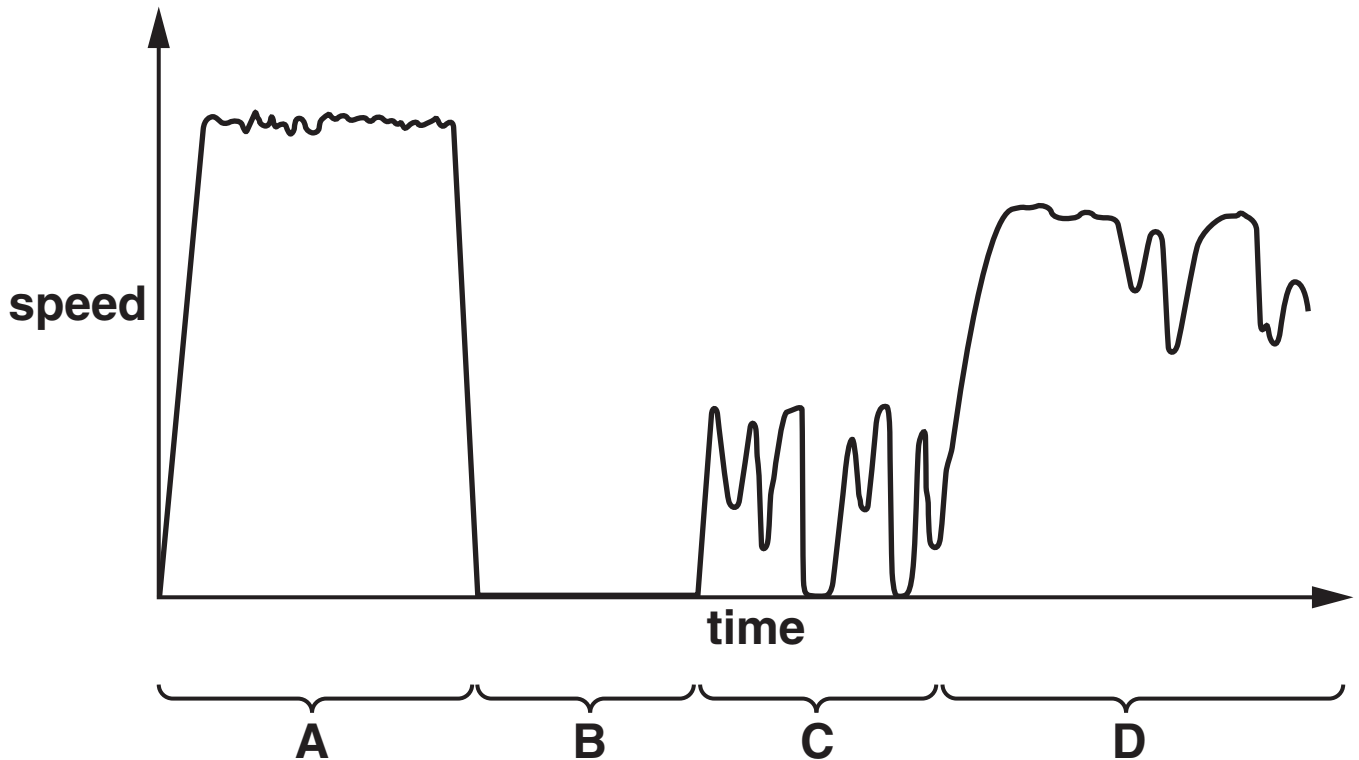
10 m/s NORTH

10 m/s SOUTH

[1]

**(b) A tachograph is a graph that shows how a vehicle's speed changes during a journey.**

**On a different journey part of the lorry's tachograph looks like this. The letters A, B, C and D label different parts of the journey.**



**From the tachograph we can tell what is happening in each part of the journey.**

**A shows the lorry driving along a motorway.**

**B shows a rest period.**

**C shows the lorry driving through a town.**

**D shows the lorry driving along a busy main road.**



**Part B was a rest period because the tachograph shows that the lorry was not moving.**

**Explain how the tachograph shows what is happening during A, C and D.**

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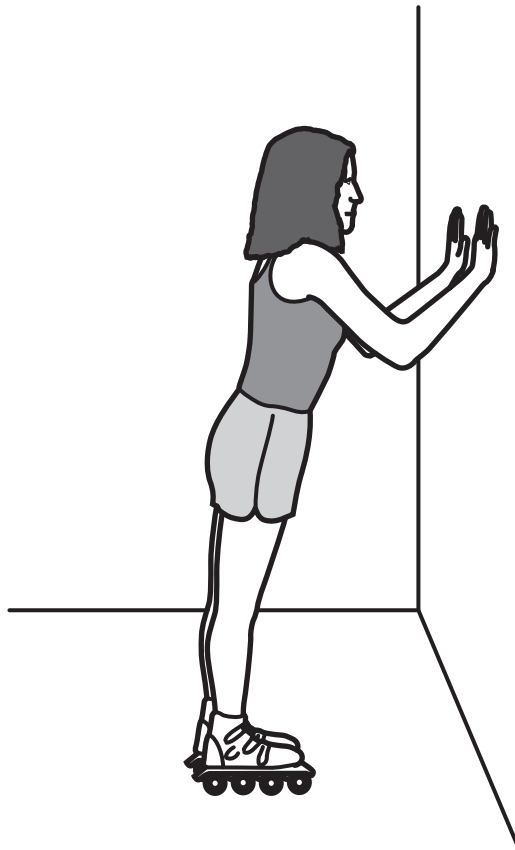
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**[3]**

**[Total: 4]**

**2 Alex is wearing roller skates and is standing facing a wall.**



**She pushes against the wall and she goes backwards.**

**Some of the statements opposite help to explain why Alex moves backwards.**

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

The resultant force on Alex gives her momentum in a backwards direction.

There is no interaction force between Alex and the wall.

If Alex exerts a force on the wall, then the wall will exert an equal force on Alex.

Because Alex moves backwards, then the wall must exert a bigger force than Alex.

The force Alex exerts divided by the time she pushes on the wall will be equal to her change in momentum.

[2]

[Total: 2]

**3 Four students discuss air bags as a safety feature in cars.**

**They stop the driver from hitting the steering wheel.**

**MATTHEW**

**They decrease the change in momentum occurring in the collision.**

**SANDRA**

**VICKY**

**They increase the time taken for the driver's momentum to be lost.**

**FRED**

**They act as a cushion in the collision.**

**Which student gave the BEST scientific explanation of why air bags are important during a collision?**

**answer \_\_\_\_\_ [1]**

**[Total: 1]**

**4 A helicopter is used to deliver food parcels.**

**The helicopter hovers at a height of 20 m.**

**It drops a food parcel of mass 40 kg and weight 400 N.**

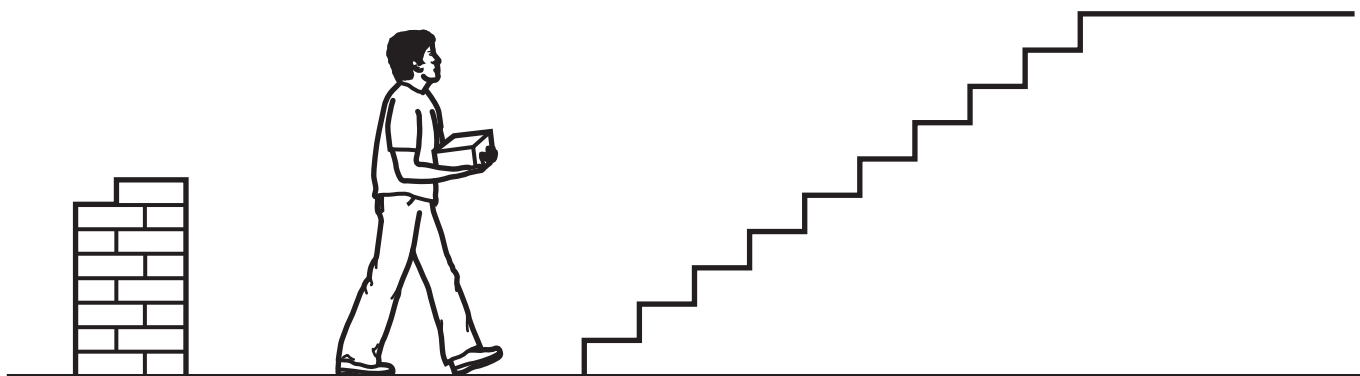
**Calculate the maximum speed at which the parcel hits the ground.**

**Use the idea of transfer between gravitational potential energy and kinetic energy to help you.**

**speed = \_\_\_\_\_ m/s [3]**

**[Total: 3]**

- 5 Chris is moving a pile of bricks from the bottom of a flight of stairs to the top.



For parts (a), (b) and (c), complete the sentence by drawing a line from the start of the sentence to the correct end of the sentence.

(a)

START

END

The weight of the bricks is equal to ...

... the gravitational force on the bricks.

... the gravitational force on the bricks  $\times$  the time taken to move them.

... the height of the stairs  $\times$  gravitational potential energy of the bricks.

... the gain in gravitational potential energy of the bricks.

[1]

(b)  
START

The amount of work done to move the bricks is equal to ...

END

... the gravitational force on the bricks.

... the gravitational force on the bricks  $\times$  the time taken to move them.

... the height of the stairs  $\times$  the gravitational potential energy of the bricks.

... the gain in gravitational potential energy of the bricks.

[1]

(c)  
START

The amount of work done does NOT depend on ...

END

... the gravitational force on the bricks.

... the time taken to move the bricks.

... the height of the stairs.

... the weight of the bricks.

[1]

[Total: 3]

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**6 This question is about electric currents flowing through a circuit.**

**(a) Harry has been asked to write a few sentences about electric currents in a television set.**

**Complete the sentences by drawing a line from the START of each sentence to the correct END of each sentence.**

**START**

**Electric currents have ...**

**Metallic conductors have ...**

**Insulators have ...**

**END**

**... few charges free to move.**

**... positive or negative charges flowing.**

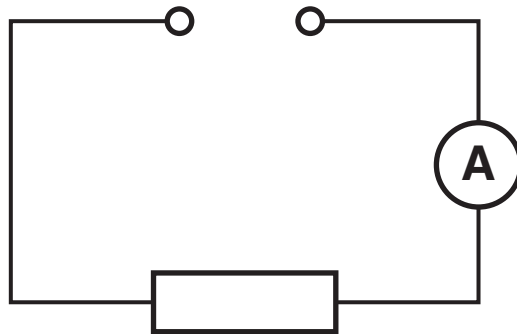
**... many charges that are free to move.**

**[2]**

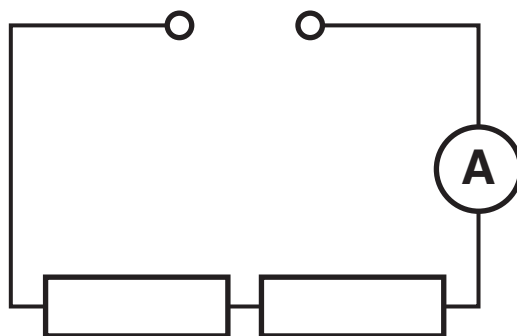
**(b) Inside the television set there are lots of different circuits.**

**Three of these circuits are drawn below.**

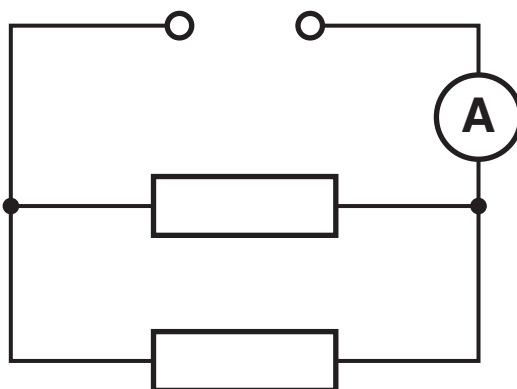
**In these circuits all of the resistors have exactly the same resistance and use the same size voltage supply.**



**circuit A**



**circuit B**



**circuit C**

Write down the letter, A, B or C, of the circuit with the smallest current and the circuit with the largest current.

(i) The smallest current is in circuit

The largest current is in circuit

[1]

(ii) Explain your answer to part (i). Use the terms RESISTANCE, CURRENT and VOLTAGE.

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[2]

(c) (i) All these resistors will heat up when the television is turned on.

Why does turning on the television cause the resistors to heat up?

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[1]

(ii) Temperature can be detected with a thermistor.

How does the resistance of a thermistor change with temperature?

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[1]

(d) John's television has a power rating of 500 watts.

He uses it for 4 hours every day.

The cost of electricity is 8 pence per kWh.

How much does his television cost to run in pence per day?

Put a **ring** around the correct calculation.

$$500 \times 4 \times 8\text{p}$$

$$\frac{500}{1000} \times 4 \times 8\text{p}$$

$$500 \times 4\text{p}$$

$$\frac{500}{1000} \times 4 \times 60 \times 60 \times 8\text{p}$$

[1]

(e) Domestic electricity meters measure the electrical energy used in a house in kilowatt hours and not in joules.

Complete the following sentence using one of the words in this list.

SMALL

LARGE

USEFUL

WASTEFUL

This is because a joule is a very

\_\_\_\_\_ amount of energy  
compared to a kilowatt hour.

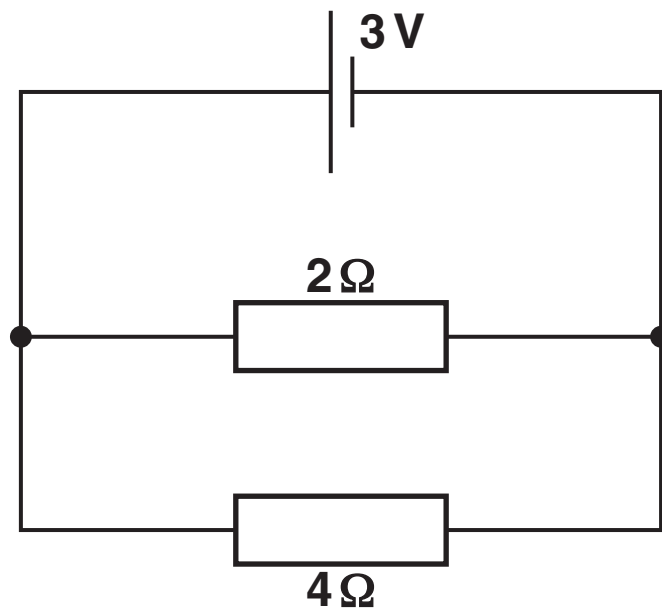
[1]

(f) Electric charge is measured in coulombs.

If a battery has a voltage of 1 V then it supplies every coulomb of charge with 1 joule of energy to flow round the circuit.

A voltage of 2V means it supplies 2 joules of energy to every coulomb of charge and so on.

Look at the circuit below.



(i) How much energy is transferred by 1 coulomb of charge to the 2 ohm resistor?

answer \_\_\_\_\_ J [1]

**(ii) The energy transfer causes the resistors to get hot.**

**Explain why the resistors get hot.**

**Use ideas about electrons and atoms.**

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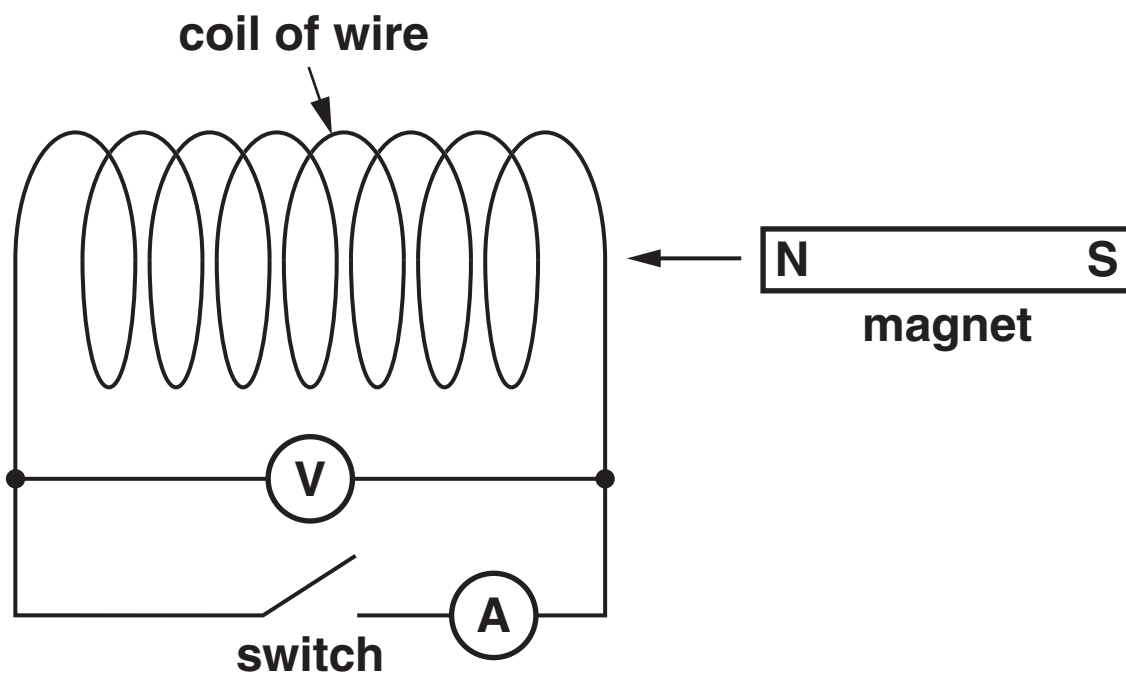
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**[2]**

**[Total: 12]**

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- 7 Michael moves a magnet into a large coil of copper wire.



The switch can be either OPEN or CLOSED.

Here are four statements about the voltage and the current.

In each box put a tick (✓) if the statement is correct or a cross (X) if the statement is incorrect, when the switch is open and when the switch is closed.



**SWITCH**  
**OPEN**

**SWITCH**  
**CLOSED**

**A voltage is induced only when the magnet is moved.**

**A voltage is induced whenever the magnet is near the coil.**

**A current flows through the ammeter only when the magnet is moved.**

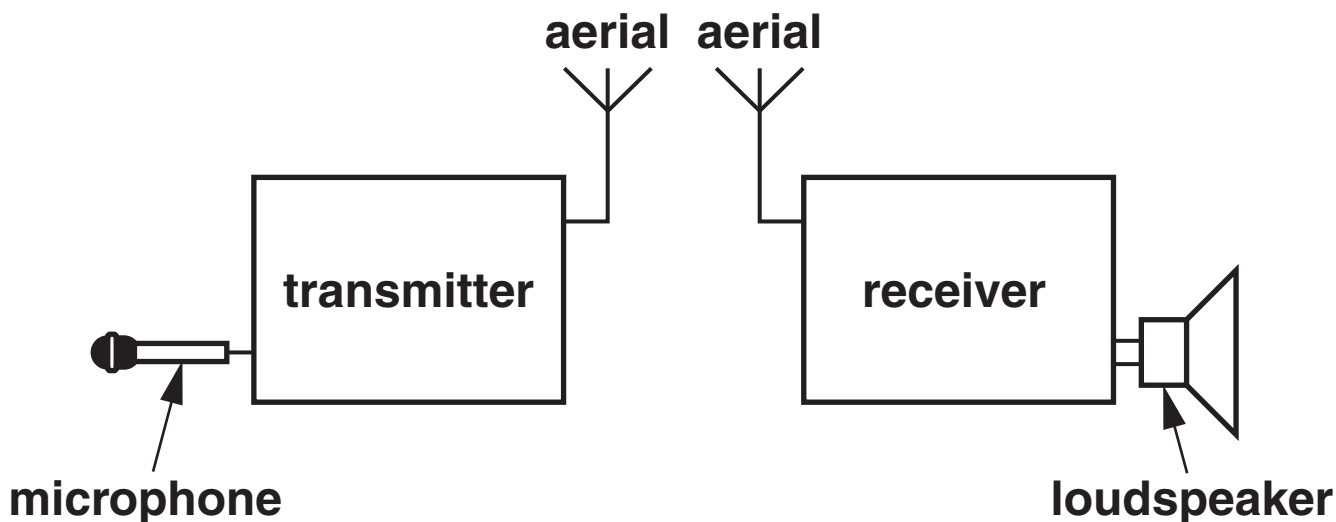
**A current flows through the ammeter whenever the magnet is near the coil.**

**[4]**

**[Total: 4]**

**8 This question is about radiation from different parts of the electromagnetic spectrum.**

**(a) The diagram below shows a very simplified model of a radio system.**



**The microphone collects the analogue sound signals, which are then converted into digital radio signals. The digital radio signals are sent to a receiver.**

- (i) What is the difference between an ANALOGUE signal and a DIGITAL signal?

Draw diagrams to help you explain the answer.

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[2]

- (ii) Complete the following sentences about the radio transmission system.

Use the BEST words from this list.

ANALOGUE

DIGITAL

FREQUENCY

INTENSITY

QUALITY

SPEED

WAVELENGTH

Radio signals have to be amplified because the further they travel the more

they decrease in \_\_\_\_\_ .

As they travel they pick up unwanted noise, which reduces the

signal's \_\_\_\_\_ .

When the signal is amplified the noise is also amplified. It is easier to remove amplified

noise if the signal is \_\_\_\_\_

rather than \_\_\_\_\_ .

[3]

**(iii) What does the receiver do?**

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

**modulates the signal**

**reproduces the original sound**

**diffracts the signal**

**transmits the signal**

**[1]**

**(b) Which of the following statements is true for all electromagnetic waves travelling through a vacuum?**

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

**They all have the same wavelength.**

**They all have the same frequency.**

**They all have the same speed.**

**They all have the same amplitude.**

**[1]**

**(c) In an electromagnetic beam of radiation, the energy is carried by photons.**

**Here are four statements about photons. Some statements are correct, the others are false.**

**Put a tick (✓) in the box next to each of the TWO correct statements.**

**The greater the frequency of the radiation the lower the energy of its photons.**

**The intensity of a beam of light depends on the number of photons arriving per second.**

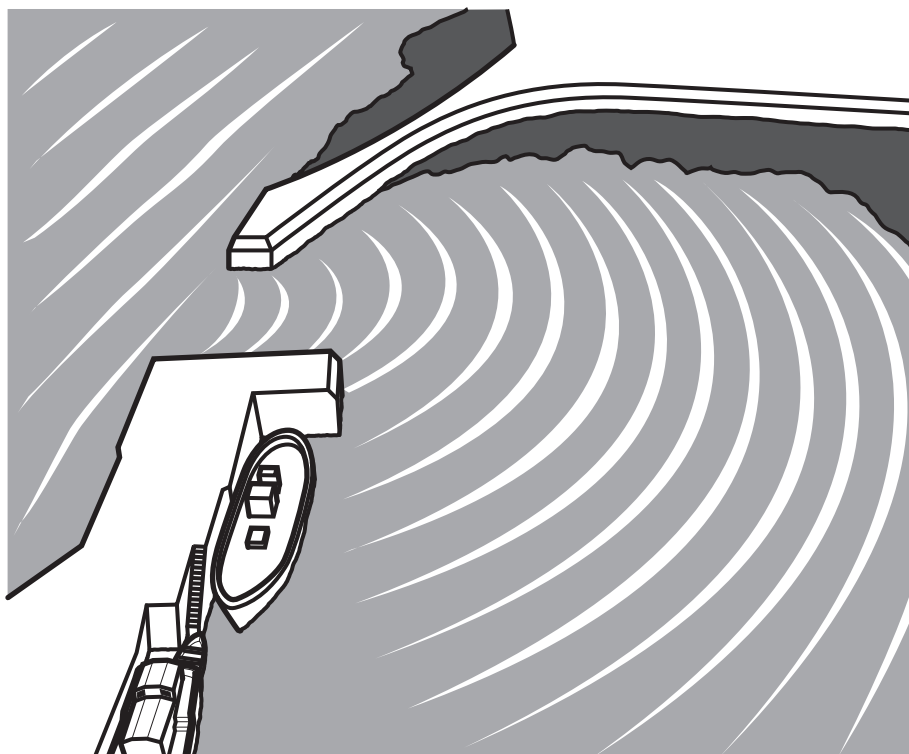
**Photons travel at the speed of light.**

**The greater the energy of the photon the faster it moves.**

**[2]**

**[Total: 9]**

- 9 The diagram shows water waves being diffracted as they pass through a gap into a harbour.



- (a) It is more difficult to demonstrate diffraction of visible light.

Put a tick (✓) in the box next to the correct reason for this.

Visible light consists of a beam of photons.

Visible light travels too fast.

Visible light has a very small wavelength.

Two beams of visible light can interfere.

[1]

(b) The diagram opposite shows a line of students standing several metres in front of two loudspeakers.

The loudspeakers both play sound of exactly the same frequency and amplitude.

Some of the students hear a loud sound and some of the students hear a very quiet sound.

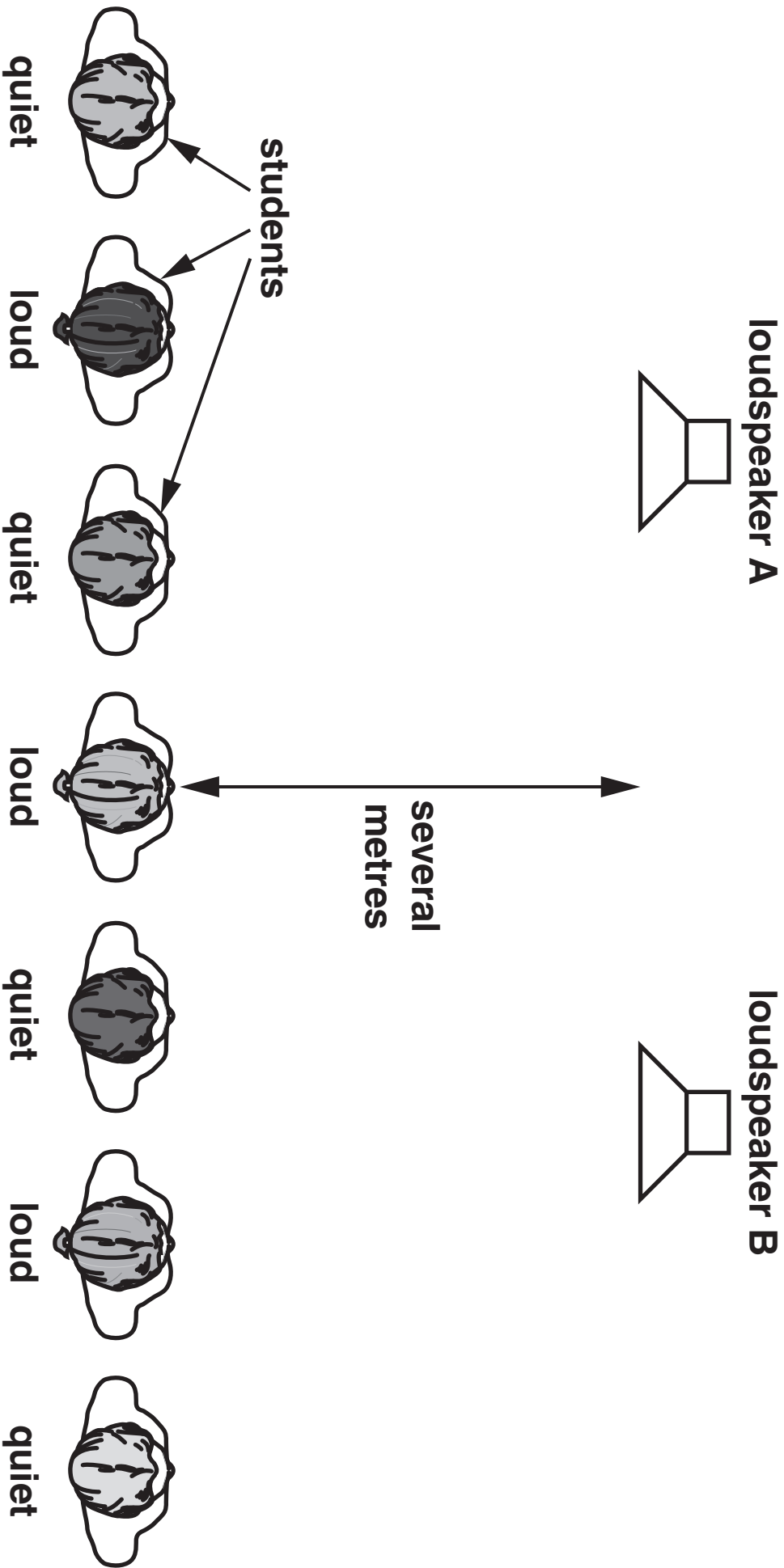
Join the boxes to explain these observations.

Draw a straight line from each SOUND to the TYPE OF INTERFERENCE and another straight line from the TYPE OF INTERFERENCE to its best EXPLANATION.

<u>SOUND</u>	<u>TYPE OF INTERFERENCE</u>	<u>EXPLANATION</u>
loud	destructive interference	no waves arrive
quiet	constructive interference	waves arrive in step
	no interference	waves arrive out of step
		two waves arrive

[2]





(c) Chris has been trying to find the wavelength of a certain sound.

He knows that the frequency of the sound being produced is 600 Hz and it has a speed of 300 m/s.

Put a **ring** around the answer that shows the correct way of calculating the wavelength.

$$600 + 300$$

$$300 \times 600$$

$$\frac{300}{600}$$

$$\frac{600}{300}$$

$$600 - 300$$

[1]

[Total: 4]

**END OF QUESTION PAPER**

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