

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
PHYSICS A**

**A332/02**

Unit 2: Modules P4 P5 P6 (Higher Tier)

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)

**Monday 1 February 2010  
Afternoon**

**Duration: 40 minutes**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**MODIFIED LANGUAGE**

**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- 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.
- Do **not** write in the bar codes.
- 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 page 2.
- The total number of marks for this paper is **42**.
- This document consists of **24** pages. Any blank pages are indicated.

## 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

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

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**Question 1 starts on page 4.**

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Answer **all** the questions.

- 1 This question is about different journeys that a lorry makes.



- (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**

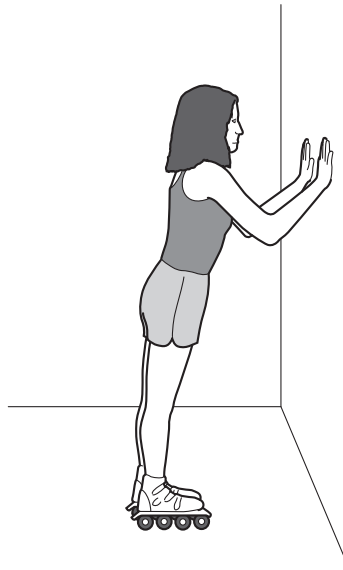
**10 m/s north**

**10 m/s south**

[1]



- 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 below 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.

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

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

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

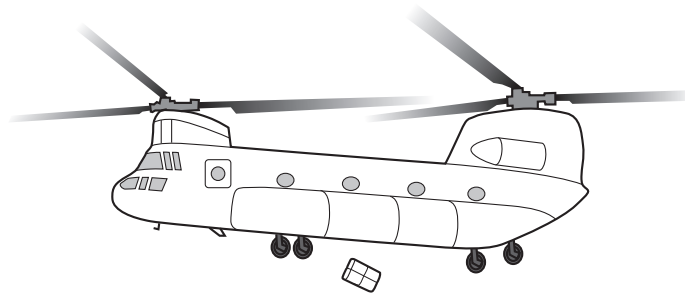
**Fred**  
They act as a cushion in the collision.

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]

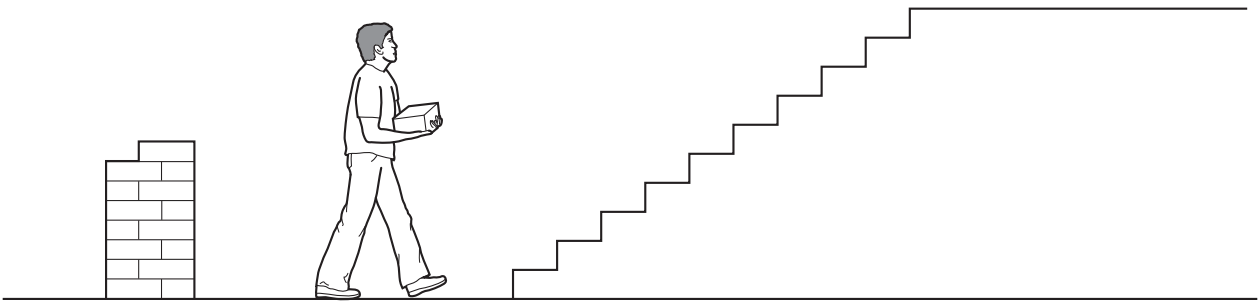


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**Question 5 starts on page 10.**

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- 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]

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**

**end**

Electric currents have ...

... few charges free to move.

Metallic conductors  
have ...

... positive or negative  
charges flowing.

Insulators have ...

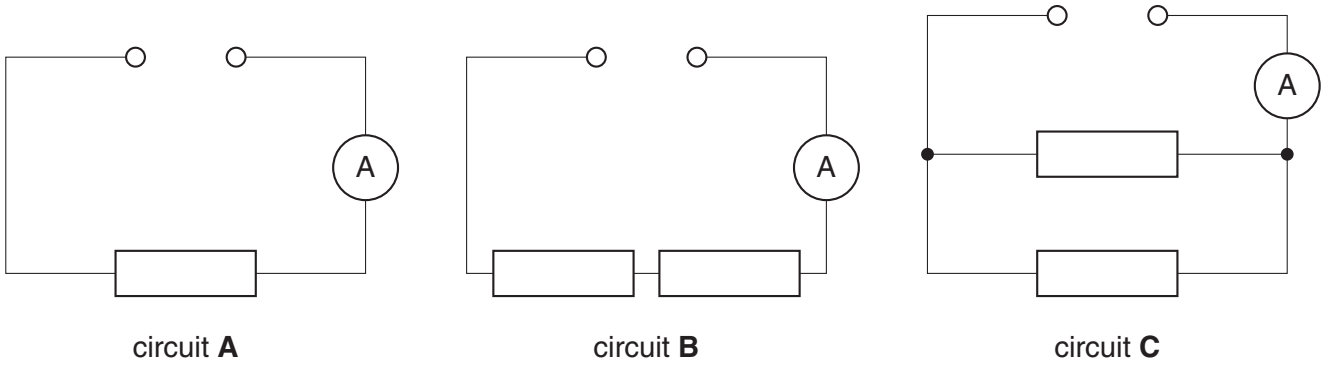
... many charges that are  
free to move.

[2]

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

Three of these circuits are drawn below.

All of the resistors in these circuits have exactly the same resistance and use the same size voltage supply.



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**.

.....

.....

.....

..... [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?

..... [1]

(ii) Temperature can be detected with a thermistor.

How does the resistance of a thermistor change with temperature?

.....

..... [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.

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

[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.

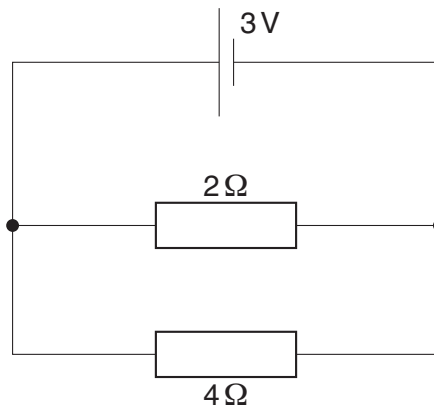
[1]

(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.

.....

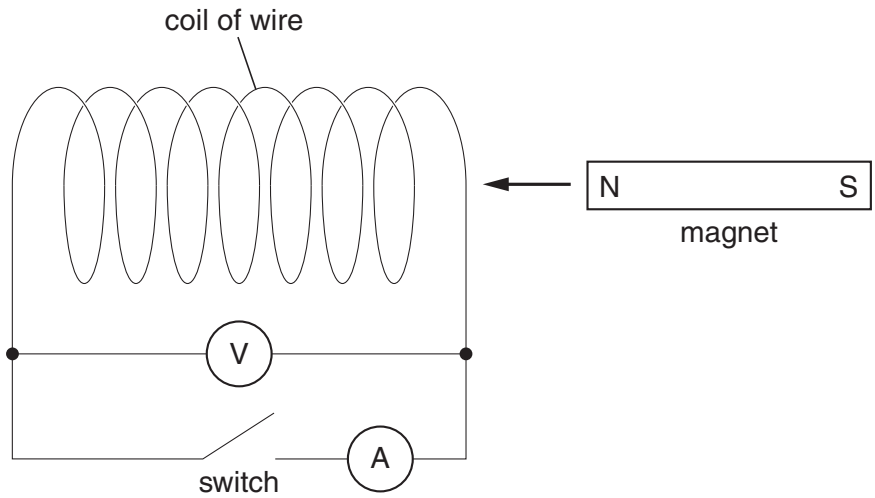
.....

.....

..... [2]

[Total: 12]

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.

	<b>switch open</b>	<b>switch closed</b>
A voltage is induced only when the magnet is moved.	<input type="checkbox"/>	<input type="checkbox"/>
A voltage is induced whenever the magnet is near the coil.	<input type="checkbox"/>	<input type="checkbox"/>
A current flows through the ammeter only when the magnet is moved.	<input type="checkbox"/>	<input type="checkbox"/>
A current flows through the ammeter whenever the magnet is near the coil.	<input type="checkbox"/>	<input type="checkbox"/>

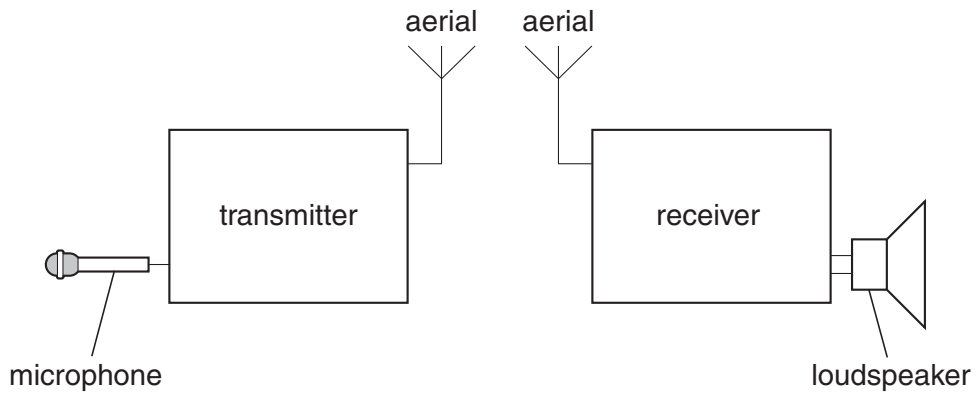
[4]

[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. They 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.

.....

.....

..... [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) Photons carry the energy in an electromagnetic beam of radiation.

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.

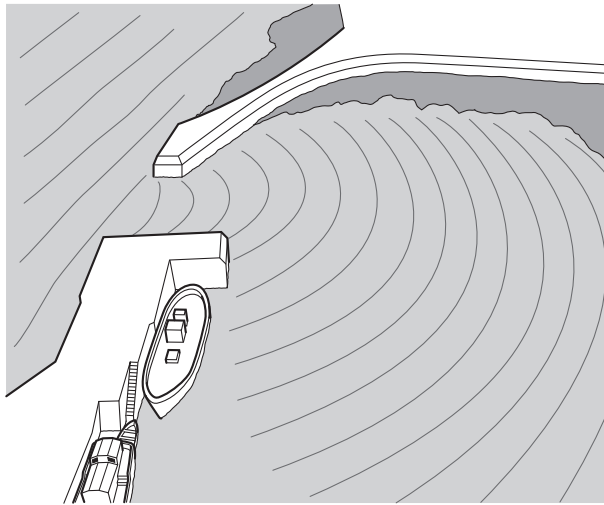
Photons travel at the speed of light.

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.

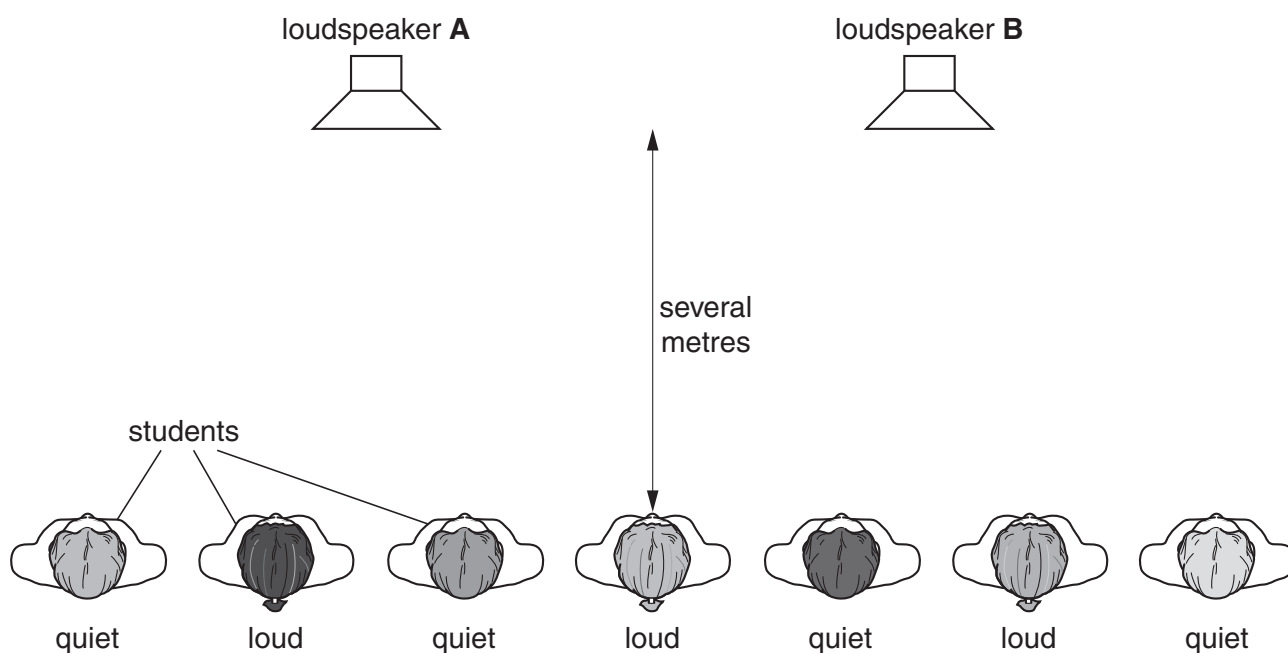
Visible light travels too fast.

Visible light has a very small wavelength.

Two beams of visible light can interfere.

[1]

(b) A line of students stand 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**.

sound	type of interference	explanation
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 600Hz 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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