

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

A217/02

Unit 3: Modules B6 C6 P6 (Higher Tier)

**Tuesday 22 June 2010
Morning**

Duration: 40 minutes

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)



Candidate Forename		Candidate Surname	
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Centre Number							Candidate Number				
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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. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page 2.
- The Periodic Table is printed on the back page.
- This document consists of **20** 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

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

Answer **all** the questions.

- 1 Ted shouts, making a sound wave of frequency 1500 Hz with a wavelength of 0.2 m.



- (a) What is the speed of the wave?

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

30 m/s

300 m/s

3000 m/s

30 000 m/s

[1]

- (b) Draw straight lines to link each **wave property** to its **meaning**.

wave property

meaning

intensity

waves per second

amplitude

energy per second

frequency

size of disturbance

wavelength

distance between crests

[2]

- (c) Complete the sentences below using words from this list.

increases

decreases

stays the same

The sound wave travels away from Ted.

Its amplitude as it travels away.

Its speed as it travels away.

[1]

[Total: 4]

Turn over

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PLEASE DO NOT WRITE ON THIS PAGE

2 Jane uses her mobile phone to talk to Mike.



(a) Complete the sentences. Choose words from the list.

amplify analogue digital morse
modulate noise pulses sound transmit

Jane speaks into the microphone of her phone.

The microphone output is converted into a series of pulses, called a code.

These pulses the amplitude of the waves which leave the phone.

Waves that her phone receives pick up on the way from the transmitter.

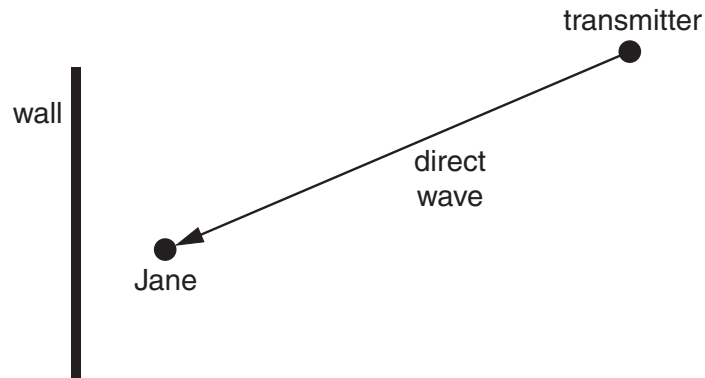
This can be removed to restore the correct pattern of wave

[2]

(b) Jane finds that mobile phone reception is very bad when she stands close to a wall.

She thinks that this is because waves from the transmitter reflect off the wall.

(i) The diagram shows the direction of a wave travelling directly from the transmitter to Jane.



Another wave reaches Jane from the transmitter.

It reflects off the wall before it reaches her.

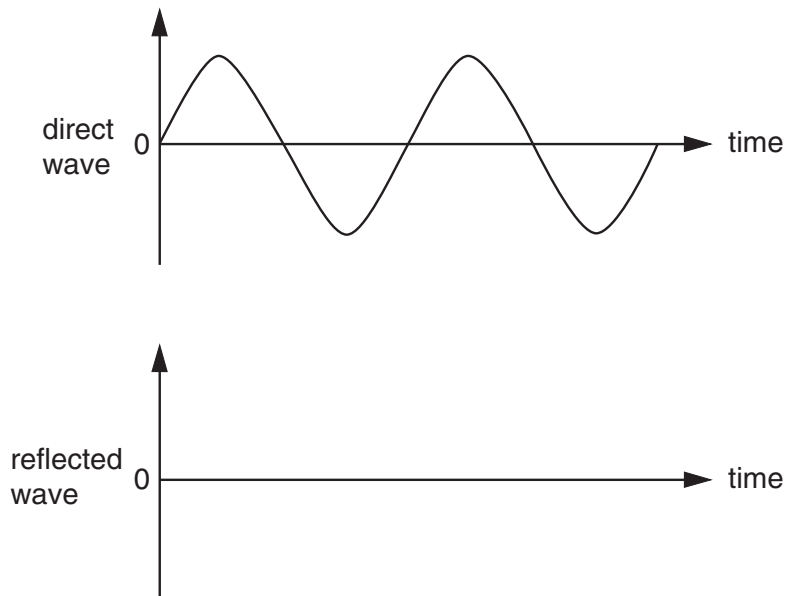
Draw this wave on the diagram.

[1]

(ii) Jane's phone reception is bad because of the reflected wave.

The diagram shows the direct wave.

Complete the diagram to show the reflected wave



[1]

- (iii) Jane finds that she can improve the phone reception by choosing carefully where she stands near the wall.

Put ticks (✓) in the boxes next to the **two** statements that explain this.

The wall attracts waves from the transmitter.

Waves which arrive in step add and reinforce each other.

The direct wave absorbs the reflected wave when they overlap.

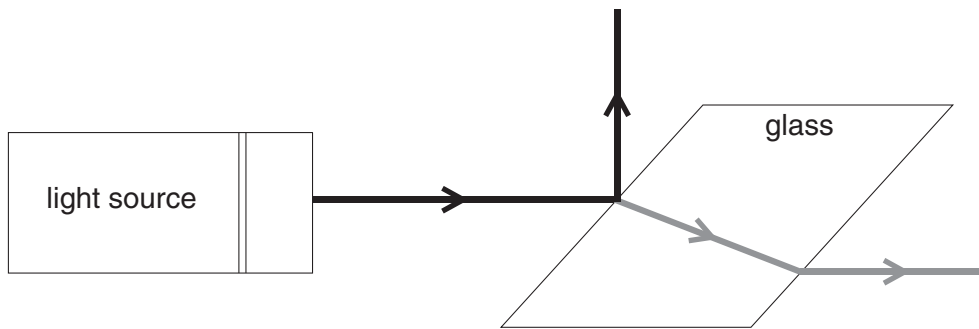
The amplitude of the reflected wave increases as it reflects off the wall.

There is an interference pattern where the direct and reflected waves overlap.

[1]

[Total: 5]

3 Fiona shines a beam of light onto a block of glass.



(a) Draw straight lines to link the **start** of each sentence to its best **ending**.

start

The light does not change speed ...

The light slows down ...

The light speeds up ...

The light refracts ...

ending

... as it enters and leaves the glass.

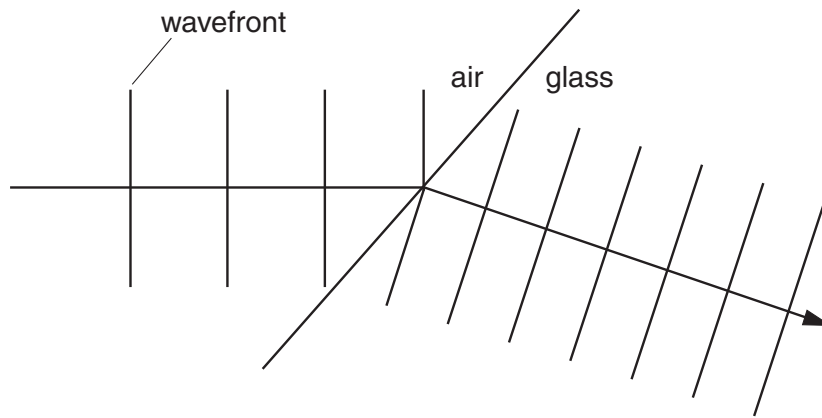
... as it reflects off the glass.

... as it enters the glass.

... as it leaves the glass.

[2]

(b) The diagram shows what happens to wavefronts of the light as it enters the glass.



Explain the change in spacing of the wavefronts as the light enters the glass.

Your answer should refer to the wavelength, frequency and speed of the wave.

.....

.....

.....

..... [2]

(c) The light is an electromagnetic wave.

Here are some electromagnetic waves in the spectrum, in order of frequency.

	microwaves	infrared		ultraviolet	X-rays	
--	------------	----------	--	-------------	--------	--

Complete the table by writing in the missing parts of the spectrum.

[1]

[Total: 5]

4 Daisy chooses an acid to clean metals.

Acids can be bought with different levels of purity.

Some are very pure. Others still contain impurities.

(a) Suggest and explain why she chooses an impure acid to clean metals.

.....
.....
..... [2]

(b) Daisy wants to find the pH of the acid before she uses it.

Give **two** ways that she could do this.

For each method

- state what she will use
- describe what she will see.

method one

.....
.....

method two

.....
.....

[2]

[Total: 4]

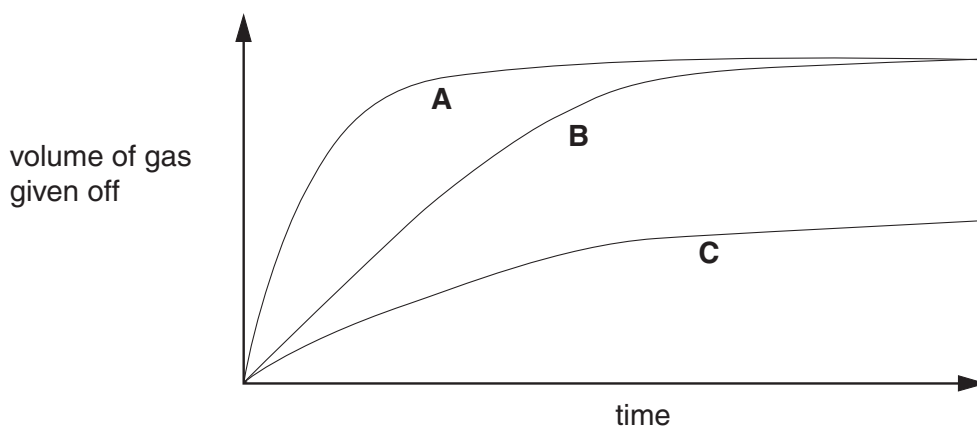
- 5 Arthur, Beth and Chet measure how fast a gas is given off when they react acid with an excess of marble chips.

They each carry out two different experiments but they all use the same size of marble chips.

Here are the experiments that they carry out.

student	experiment	volume of acid in cm ³	relative concentration of acid	temperature in °C
Arthur	1	50	1.0	20
Arthur	2	50	1.0	30
Beth	1	50	1.0	20
Beth	2	25	1.0	20
Chet	1	50	1.0	20
Chet	2	25	2.0	20

They plot their results.



Complete the table with **A**, **B** or **C** to show the shape of the graph that would be expected for each experiment.

student	experiment 1	experiment 2
Arthur		
Beth		
Chet		

[4]

[Total: 4]

12
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6 Acids react with alkalis.

(a) Put **rings** around the **two** alkalis in this list.



[1]

(b) Nitric acid reacts with sodium carbonate.

What substances are formed?

..... [2]

(c) Acids also react with metal oxides.

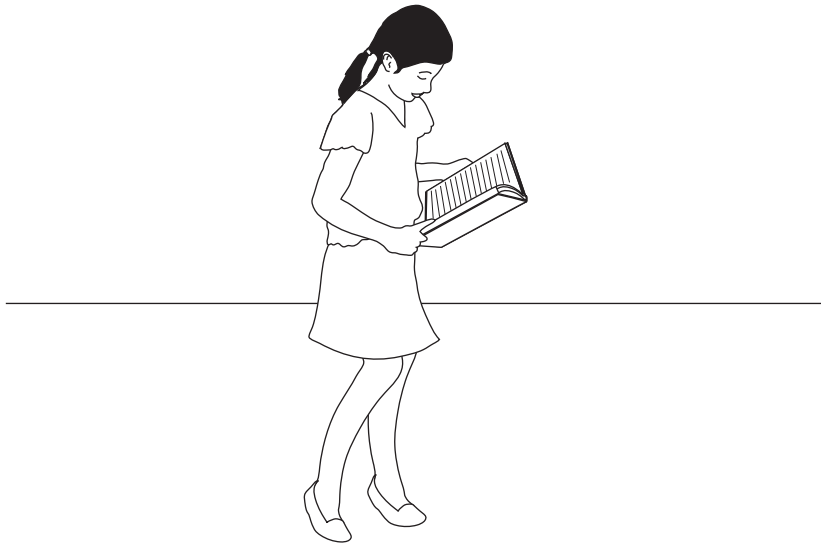
When hydrochloric acid reacts with copper oxide, CuO, it makes copper chloride, CuCl₂, and another substance.

Write a balanced symbol equation for this reaction.

..... + → + [3]

[Total: 6]

7 Amelia is learning the words for her part in the school play.



(a) What is happening to the information in Amelia’s memory as she rehearses the play?
Put a **ring** around each of the **two** words which best describe what is happening.

- duplication loss retrieval storage transmission**

[1]

(b) The sentences describe what happens in her brain.

Complete the sentences below using the **best** words from this list.

- axon billions experience**
hundreds response thousands transmit

Amelia’s brain has of neurons.

They can connect together to make pathways.

When she first reads her words, they are a new

This causes new pathways to form.

When she repeats the words, these new pathways are more likely to impulses.

[2]

(c) After a week of rehearsals, some of Amelia's words in the play are changed.

She has to learn new words.

How is this possible?

Put a tick (✓) in the box next to the **best** explanation.

Some neurons will stop transmitting impulses.

New pathways are created by moving neurons around.

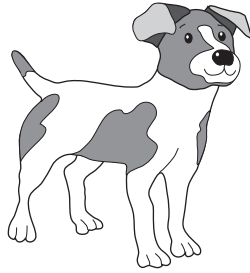
New experiences remove existing pathways in the brain.

The variety of potential pathways makes it possible to adapt to new situations.

[1]

[Total: 4]

8 Keith is looking after a puppy.



(a) Keith buys frozen food for his puppy.

He heats the food in a microwave oven.

The puppy produces saliva when it smells the food heating up.

The microwave oven rings a bell when the heating is complete.

After some time the puppy produces saliva every time a bell rings.

(i) Draw a straight line from each **part of the reflex** to the correct **event**.

part of the reflex	event
response	puppy eats food
primary stimulus	puppy barks
secondary stimulus	puppy produces saliva
	smell of food
	sound of bell

[2]

(ii) A **conditioned reflex** has been created in the puppy.

Here are some statements about conditioned reflexes.

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

The final response of a conditioned reflex ...

... has no connection at all to the secondary stimulus.

... has a direct connection to the primary stimulus.

... has no direct connection to the primary stimulus.

... has a voluntary connection to the secondary stimulus.

[1]

(b) The puppy tries to catch a fly but the fly moves.

The fly moving is an example of a **simple reflex** action.

Describe the advantages and disadvantages to the fly of using simple reflexes.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

- 9 Diane puts her hand into a sewing box and stabs her finger on a needle.
She pulls her hand away quickly.
The reaction involves a reflex arc.

Some of the statements below can be arranged in sequence to describe what happens in part of a reflex arc.

In each pair of statements, only one is true for a reflex arc.

- A this reaches the myelin sheath
- B this reaches the synapse

- C causing release of a chemical transmitter
- D causing release of an electrical spark

- E an electrical impulse travels up the sensory neuron
- F a chemical impulse travels up the sensory neuron

- G and binds to receptor molecules on the membrane of the motor neuron
- H and enters the motor neuron through the membrane

- I this jumps to the next neuron
- J this diffuses to the next neuron

Put a **ring** around the letter of the correct statement in each pair.

Arrange the correct statements in the right order for the sequence of events in a reflex arc.

--	--	--	--	--

[4]

[Total: 4]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109
133 Cs caesium 133	137 Ba barium 137	139 La* lanthanum 139	178 Hf hafnium 178	181 Ta tantalum 181	184 W tungsten 184	186 Re rhenium 186	190 Os osmium 190	192 Ir iridium 192
223 Fr francium 223	226 Ra radium 226	227 Ac* actinium 227	261 Rf rutherfordium 261	262 Db dubnium 262	266 Sg seaborgium 266	268 Bh bohrium 268	277 Hs hassium 277	288 Mt meitnerium 288
51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	80 Br bromine 80	81 Kr krypton 81	82 Xe xenon 82	83 Rn radon 83	84 At astatine 84	85 Po polonium 85
119 Sb antimony 119	120 Te tellurium 120	121 I iodine 121	127 Br bromine 127	131 Kr krypton 131	132 Xe xenon 132	133 Rn radon 133	134 At astatine 134	135 Po polonium 135
209 Bi bismuth 209	210 Po polonium 210	211 At astatine 211	209 Pb lead 209	210 Tl thallium 210	211 Pb lead 211	212 Bi bismuth 212	213 Po polonium 213	214 At astatine 214
201 Hg mercury 201	202 Tl thallium 202	203 Pb lead 203	204 Bi bismuth 204	205 Po polonium 205	206 At astatine 206	207 Rn radon 207	208 Fr francium 208	209 Ac actinium 209
63.5 Cu copper 63.5	65 Zn zinc 65	70 Ga gallium 70	73 Ge germanium 73	75 As arsenic 75	79 Se selenium 79	80 Br bromine 80	84 Kr krypton 84	86 Xe xenon 86
108 Ag silver 108	112 Cd cadmium 112	115 In indium 115	119 Sn tin 119	122 Sb antimony 122	128 Te tellurium 128	127 I iodine 127	131 Xe xenon 131	136 Rn radon 136
197 Au gold 197	201 Hg mercury 201	204 Tl thallium 204	207 Pb lead 207	209 Bi bismuth 209	210 Po polonium 210	211 At astatine 211	216 Rn radon 216	222 Fr francium 222
[272] Rg roentgenium [272]	[271] Ds darmstadtium [271]	[268] Mt meitnerium [268]	[266] Sg seaborgium [266]	[262] Db dubnium [262]	[261] Rf rutherfordium [261]	[258] Bh bohrium [258]	[257] Hs hassium [257]	[254] Mt meitnerium [254]
Elements with atomic numbers 112-116 have been reported but not fully authenticated								

1 H hydrogen 1

relative atomic mass
atomic symbol
name
atomic (proton) number

Key

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.