

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

Unit 3: Modules B6 C6 P6 (Foundation Tier)

A217/01



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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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.
- 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

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

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

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

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

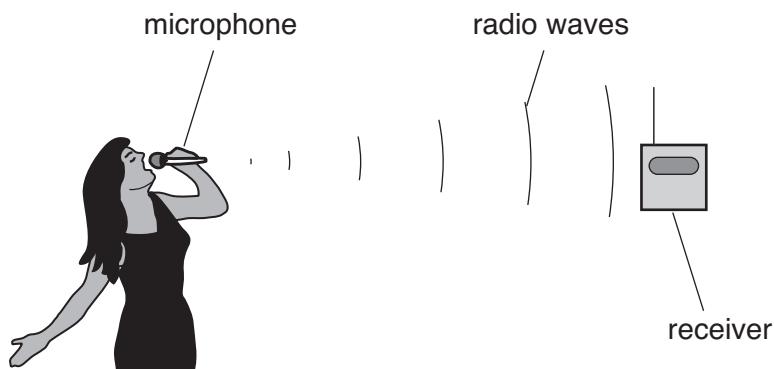
$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

The Wave Model of Radiation

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

Answer **all** the questions.

1 Sam uses a digital radio microphone when she sings karaoke.



(a) Radio waves are part of the electromagnetic spectrum.

Write **radio** in the correct place in the spectrum.

	microwaves		visible		X-ray	
--	------------	--	---------	--	-------	--

low frequency → high frequency

[1]

(b) Put a **ring** around the **best** choice to complete each sentence.

Sam sings into her radio microphone.

Sam's microphone acts as a **decoder / receiver / transmitter** of radio waves.

The sound of Sam's singing is used to **modulate / oscillate / reflect** the radio waves.

The radio waves travel away from the microphone.

Their intensity **decreases / doesn't change / increases** as they travel.

[3]

(c) Sam's radio microphone transmits her sound digitally.

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

Digital signals need to use expensive circuits.

Analogue transmission stops other microphones working.

It is easier to remove noise from the signal at the receiver.

Radio waves travel faster when they are pulsed on and off.

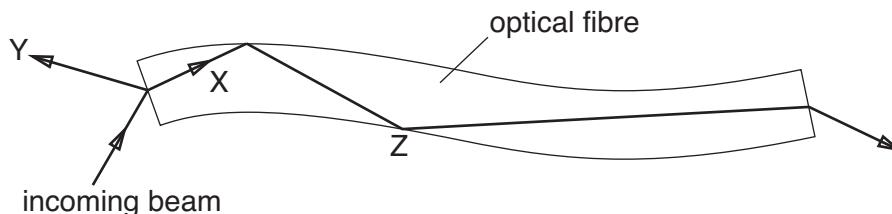
[1]

[Total: 5]

Turn over

2 TV cable networks use optical fibres made of glass to carry digital signals.

(a) The diagram shows a beam of infrared light entering and leaving an optical fibre.



Complete the sentences. Choose words from this list.

absorbed

diffracted

reflected

refracted

At the start of the optical fibre the incoming beam splits.

One part of the beam goes to **X**, the other part goes to **Y**.

The part which goes to **X** is

The part which goes to **Y** is

[2]

(b) At point **Z**, the beam is **totally internally reflected**. Why does this happen?

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

Infrared light travels faster through glass than through air.

None of the energy of the infrared light is absorbed by the glass.

The angle of refraction of the emerging beam would be more than 90°.

The glass has been coated with black plastic to absorb the infrared light.

[1]

(c) Four friends discuss why infrared is used to carry TV signals through optical fibres.



Who has the correct reason why infrared light is used to carry TV information through optical fibres?

answer [1]

[Total: 4]

3 Microwave ovens are used to heat food.



(a) When the oven is switched on it produces microwave photons.

These photons all have the same frequency.

Suppose that the frequency of the photons is increased.

What effect does this **increase** have on the energy and speed of the photons?

effect on energy

.....

effect on speed

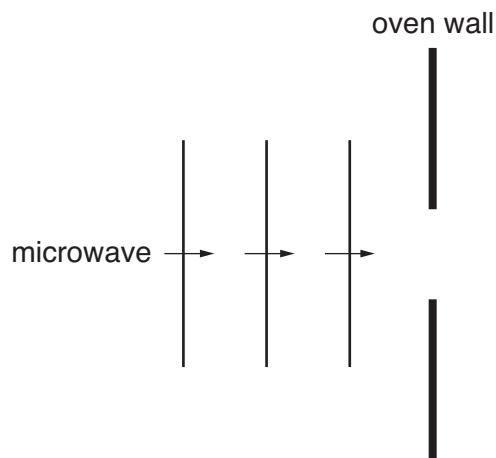
..... [2]

(b) The microwaves enter the oven through a small hole.

The diagram shows waves approaching the hole.

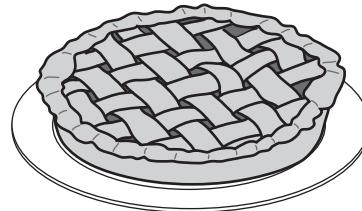
They **diffract** as they pass through the hole.

On the diagram, draw the waves after they have passed through the hole.



[1]

(c) Jo puts some food on a plastic plate in her microwave oven for two minutes.



Why does the food get hot but the plate stay cold?

[2]

[Total: 5]

4 Hannah is walking on a woodland path when she stumbles into some stinging nettles. She jumps away from them when they sting her.



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

learned motor muscles nerves reflex sensory

This type of response is a response.

The pain signal is carried by neurons.

The effectors are

The signal to the effectors is carried by neurons.

[3]

(b) Hannah's first response is to jump back.

She then realises that she has dropped her phone in the nettles.

Hannah reaches into the nettles to pick up the phone.

She knows the nettles will sting her.

Her brain makes it possible for her to **adapt her behaviour** in this way.

What is it about her brain that makes it possible to do this?

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

Her brain has many neurons.

Her brain has many possible pathways between the neurons.

Her brain is connected to her muscles.

Her brain has a fixed number of neuron pathways.

Her brain is in her central nervous system.

[1]

[Total: 4]

10

5 Brian walks out of the cinema into bright sunshine.
He is dazzled by the bright light until his eyes adjust.
His pupils get smaller. This is called the pupil reflex.

(a) Draw lines to join each **component** to the correct **part of the reflex arc**.

component	part of the reflex arc
muscle cells in the iris	processor
light sensitive cells in the retina	effector
central nervous system	receptor

[2]

(b) (i) Newborn babies have some reflexes which disappear after a time. These are called newborn reflexes.

When a baby is born, the nurse checks these newborn reflexes.

Give two newborn reflexes.

1

.....

2

.....

[2]

(ii) Newborn babies have other reflexes which do **not** disappear after a time.

One example is the pupil reflex.

Give another reflex which does not disappear as the body gets older.

.....

.....

[1]

[Total: 5]

6 Scientists study the brain to see how it works.

One part of the brain is mainly concerned with memory and language.

(a) Which part of the brain is mainly concerned with memory and language?

Put a (ring) around the correct answer.

cortex motor neuron optic nerve spinal cord

[1]

(b) Put ticks (✓) in the **two** boxes next to methods that scientists use to investigate activity in this part of the brain.

X-rays

IQ tests

ultrasound

MRI scans

electrical stimulation

[2]

[Total: 3]

12

7 This question is about how signals are transmitted around the nervous system.

Put a ring around the correct choice for each sentence.

Nerve signals travel along a neuron as **electrical / magnetic / mechanical** impulses.

Gaps between neurons are called **arcs / holes / synapses**.

Some neurons have a fatty sheath.

This **speeds up / slows down / stops** the impulses.

[2]

[Total: 2]

13

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Question 8 starts on page 14.

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8 Geoff reacts carbonates with acids.

(a) What would Geoff expect to notice?

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

Bubbles appear in the liquid.

The liquid becomes sticky.

The liquid dries up.

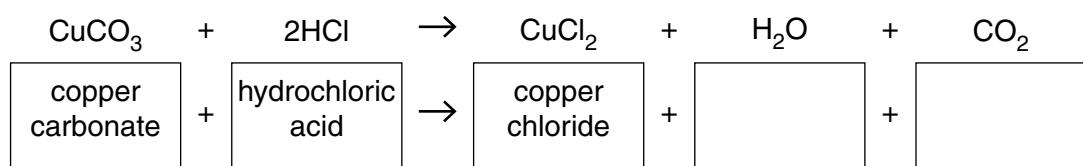
[1]

(b) One reaction that he tries is copper carbonate with hydrochloric acid.

(i) Here is the equation for the reaction.

Write the name of each chemical in its box.

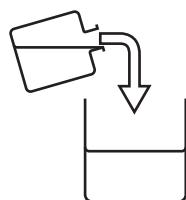
The first three have been done for you.



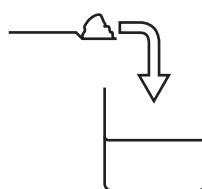
[1]

(ii) Here are the instructions that Geoff uses to carry out the reaction.

1. Pour the acid into a beaker.
2. Add one spatula of carbonate and allow it to react.
3. Add more carbonate and stir until all the acid has reacted.



stage 1



stages 2 and 3

How can he tell when **all** the acid has reacted?

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

The liquid warms up.

Solid is left in the beaker.

The solution changes colour.

All the carbonate has disappeared.

[1]

15

(iii) Geoff wants to make crystals of the salt from his solution.

What method should he use?

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

distil the solution

dilute the solution

evaporate some of the water

put the solution into a freezer

[1]

[Total: 4]

16

9 Geoff investigates how quickly copper carbonate reacts with hydrochloric acid.

(a) Suggest **two** ways in which Geoff could make the reaction go faster.

1

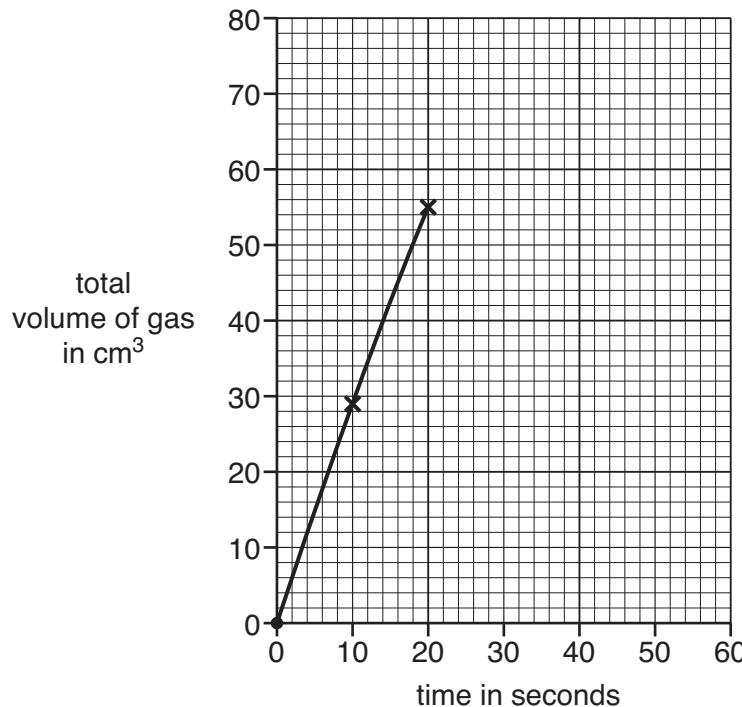
.....
2

[1]

(b) Geoff measures the volume of carbon dioxide given off every ten seconds.

time in seconds	total volume of gas in cm^3
0	0
10	29
20	55
30	66
40	72
50	74

(i) Finish the graph of these results. The first three points have been done for you.



[2]

(ii) Why does the reaction gradually slow down?

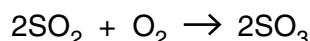
.....

[1]

[Total: 4]

10 The chemical industry makes millions of tonnes of sulfuric acid every year.

The equation for one of the stages in the reaction is



(a) (i) How many atoms of sulfur are shown on the left side of the equation?

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

1

2

3

4

5

[1]

(ii) Chemical engineers need to know the total number of reactant molecules in the equation.

Give the number of reactant molecules shown in the equation.

answer [1]

(b) The chemical engineers need to control the rate of the reaction.

(i) What does '**rate of reaction**' tell you?

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

how fast the reaction goes

how much reacts

how much energy the reaction needs

how much product forms

[1]

(ii) The reaction uses a catalyst.

Which of these statements about catalysts are true?

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

Catalysts decrease the yield.

Catalysts are biodegradable.

Catalysts speed up a reaction.

Catalysts are not used up in a reaction.

[1]

18

(iii) There are problems at the factory when the chemical engineers get the wrong speed for the reaction.

Draw a straight line from each **problem** to its **cause**.

problem	cause
not enough sulfuric acid is made	reaction too fast
safety valves release chemicals into the air	reaction too slow
tanks not big enough to hold all the products	

[2]

[Total: 6]

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	23 Na sodium 11	24 Mg magnesium 12	39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	209 Po polonium 84	[209] At astatine 85	[210] Rn radon 86				
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[264] Sg seaborgium 106	[268] Mt meitnerium 107	[277] Hs hassium 108	[271] Ds darmstadtium 109	[271] Rg roentgenium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated										
Key <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">relative atomic mass atomic symbol name</td> <td style="text-align: center;">atomic (proton) number</td> </tr> </table>								relative atomic mass atomic symbol name	atomic (proton) number												
relative atomic mass atomic symbol name	atomic (proton) number																				

* 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.