

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

A217/02

Unit 3: Modules B6 C6 P6 (Higher Tier)

Candidates answer on the Question Paper
A calculator may be used for this paper

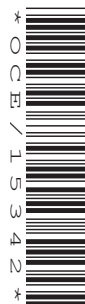
OCR Supplied Materials:
None

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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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 **16** 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

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

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

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

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

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

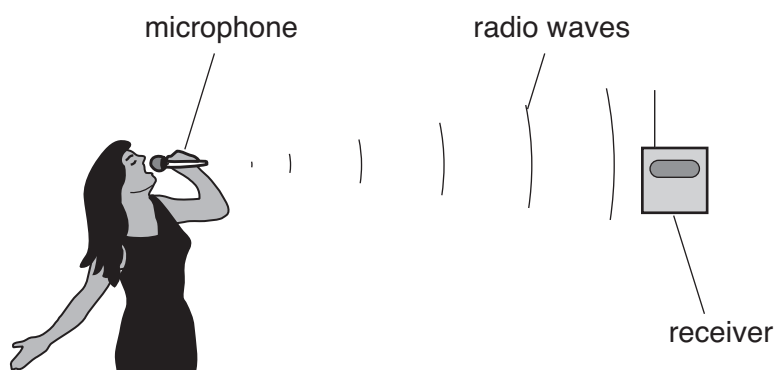
The Wave Model of Radiation

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

3

Answer **all** the questions.

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



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

decodes**modulates****oscillates****receives****transmits**

Sam sings into her radio microphone.

Her singing the radio waves.

The aerial on her microphone the radio waves.

After the receiver picks up the radio waves, it them to produce a copy of Sam's sound.

[2]

- (b) The radio microphone uses digital coding instead of analogue coding.

This transmits Sam's sound with a higher quality.

Explain why digital coding gives a higher quality result than analogue coding.

.....

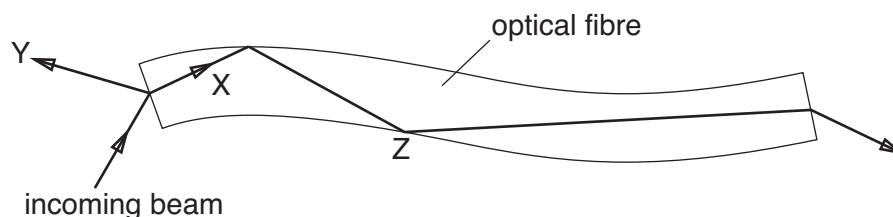
 [3]

[Total: 5]

4

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.

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

[1]

5

(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]

6

- 3 Microwave ovens are used to heat food.



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

Put ticks (✓) in the boxes next to the **two** correct ways of increasing the intensity of a beam.

The intensity of a beam can be increased by ...

... increasing the speed of the photons.

☐

... decreasing the speed of the photons.

☐

... decreasing the frequency of the photons.

☐

... decreasing the wavelength of the photons.

☐

... increasing the rate of production of the photons.

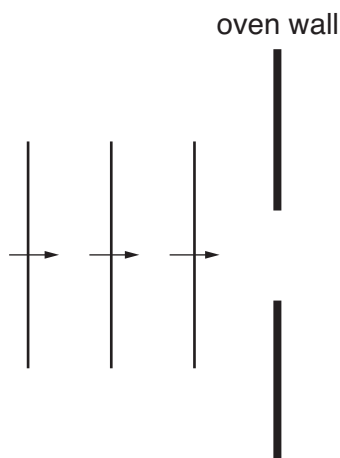
☐

[2]

7

(b) The microwaves **diffract** as they emerge from a small hole into the oven.

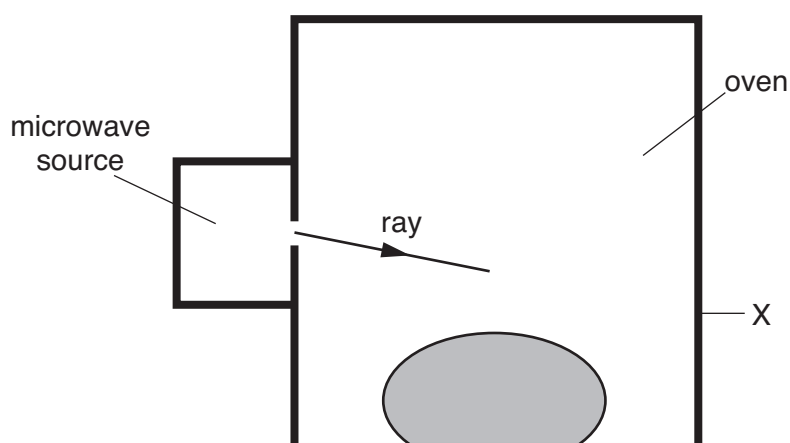
(i) On the diagram draw three waves **after** passing through the hole.



[1]

(ii) The microwave rays reflect off the metal oven walls.

Complete the diagram to show the microwave ray reflecting off the wall at **X**.



[1]

(c) Complete the sentences.

Choose words from this list.

absorb**diffract****emit****interfere****reflect****refract**

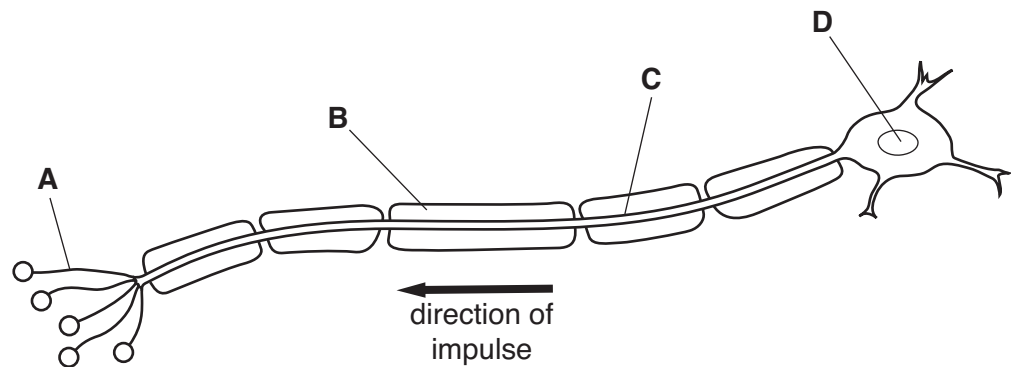
The food is heated because water molecules in it the microwaves.

The heating is uneven because reflected microwaves with microwaves which come directly from the source.

[1]

[Total: 5]

4 This question is about a motor neuron.



(a) (i) Which part of the diagram, **A**, **B**, **C** or **D**, shows the fatty sheath?

answer [1]

(ii) The speed of the impulse along this neuron is 18 m/s.

What is the speed of the impulse likely to be in a different neuron that does not have a fatty sheath?

Put a ring around the correct speed.

2 m/s 18 m/s 30 m/s 75 m/s [1]

(iii) Explain **another** reason why neurons in organisms have a fatty sheath.

.....

 [2]

(iv) The motor neuron might send the impulse to a muscle cell.

Name another **type** of cell which might receive the impulse from a motor neuron.

answer [1]

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

Motor neurons are found in the **external / peripheral / sensory** nervous system.

Neurons release chemicals into the **synapse / reflex arc / spinal cord**.

These chemicals move to the next cell by **active transport / diffusion / osmosis**.

A receptor on the membrane of a neuron binds to **specific / many / all** chemicals. [2]

[Total: 7]

- 5 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]

10

- (b) (i) 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]

- (ii) This is an example of a modified reflex response.

This requires a change to the reflex arc.

Describe how Hannah's brain makes this change.

.....

..... [1]

[Total: 5]

- 6 Some scientists study how people learn.

They test two groups of people.

Each group is given a short time to look at a set of numbers

Numbers shown to group **A**: 158 258 358 458 558 658

Numbers shown to group **B**: 558 185 358 685 258 458

Each person is then asked to repeat back what they can remember.

- (a) Which part of their brain are they using to remember the numbers?

Put a ring around the correct answer.

cerebral cortex

hypothalamus

pituitary

spinal cord

[1]

- (b) Suggest a reason why group **A** was better at remembering the whole list.

.....
.....
..... [1]

[Total: 2]

12

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

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

.....

.....

.....

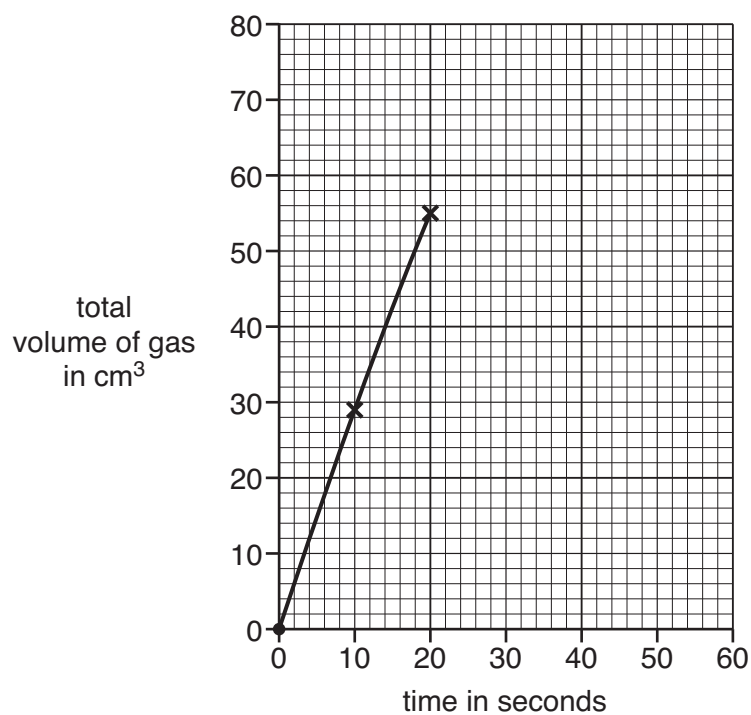
.....

..... [2]

(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]

13

(ii) Why does the reaction gradually slow down?

.....

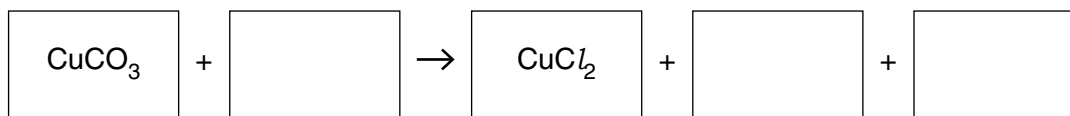
..... [1]

[Total: 5]

14

- 8 Geoff reacts copper carbonate with hydrochloric acid.
He knows that this will produce a salt and two other products.

(a) Write the formula of each chemical in its box, then balance the equation



[3]

(b) What causes the acidic reactions of hydrochloric acid?

Put a ring around the correct answer.

chloride ions hydrogen ions hydroxide ions hydrogen chloride molecules

[1]

(c) Geoff produces some crystals of his salt, but they are not pure.

Here are six techniques used in purification.

Choose **five** of these techniques and put them into a sequence to show how Geoff can produce pure, dry crystals from the impure crystals.

A crystallisation

B dissolving

C distillation

D drying

E evaporation

F filtration

--	--	--	--	--

[2]

(d) Geoff makes 10.3g of crystals.

He knows that the theoretical yield for the reaction is 17.4 g.

What is the percentage yield for the reaction?

Put a ring around the correct answer.

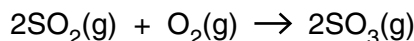
0.59 1.7 59 170

[1]

[Total: 7]

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

The equation for one stage in the manufacture of sulfuric acid is



- (a) This process uses a catalyst.

Draw one line from **column A** to **column B**, and one line from **column B** to **column C**, to show what a catalyst does.

column A	column B	column C
It speeds up the reaction and takes part in the reaction and is used up in the reaction.
or	or	or
It slows down the reaction but does not take part in the reaction and is not used up in the reaction.

[1]

- (b) A catalyst affects the rate of a reaction.

What does 'rate of reaction' tell you?

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

the cost of producing a substance	<input type="checkbox"/>
the amount of substance produced	<input type="checkbox"/>
the amount of substance produced per second	<input type="checkbox"/>
the amount of substance produced per gram of reactant	<input type="checkbox"/>

[1]

[Total: 2]

END OF QUESTION PAPER

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The Periodic Table of the Elements

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1	2	Key										3	4	5	6	7	0	
		relative atomic mass atomic symbol name atomic (proton) number																
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10	
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18	
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	
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54	
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	[210] At astatine 85	[222] Rn radon 86	
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated							

16

Key

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.