OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A217/02

Unit 3: Modules B6 C6 P6
(Higher Tier)

OCE/V03083

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)

Friday 19 June 2009
Morning

Duration: 40 minutes

A217702

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

kinetic energy = $\frac{1}{2}$ × mass × [velocity]^2

Electric Circuits

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

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

energy transferred = power × time

power = potential difference × current

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

The Wave Model of Radiation

wave speed = frequency × wavelength

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Question 1 starts on page 4.

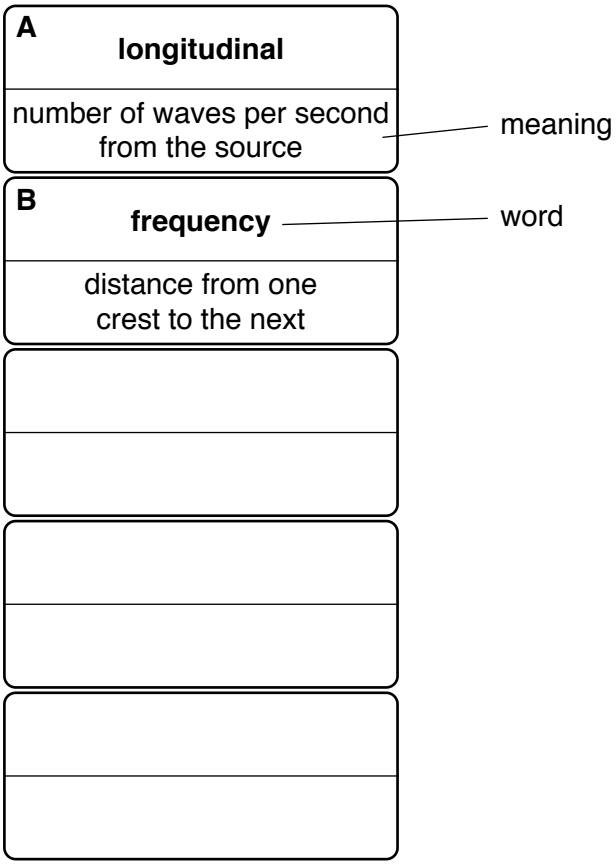
PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 **(a)** Micky plays dominoes in a lesson about waves.

Each domino has a **word** at the top and a **meaning** at the bottom.

Each word must be placed below its correct meaning, as shown below.



Here are the other three dominoes.

C	D	E
amplitude	**wavelength**	**speed**
how far a wave goes in a second	height of a crest	energy flow parallel to wave disturbance

Write **C**, **D** or **E** in each blank domino so that each word is below its correct meaning.
You may fill in the blank dominoes if it helps you work out the answers. **[2]**

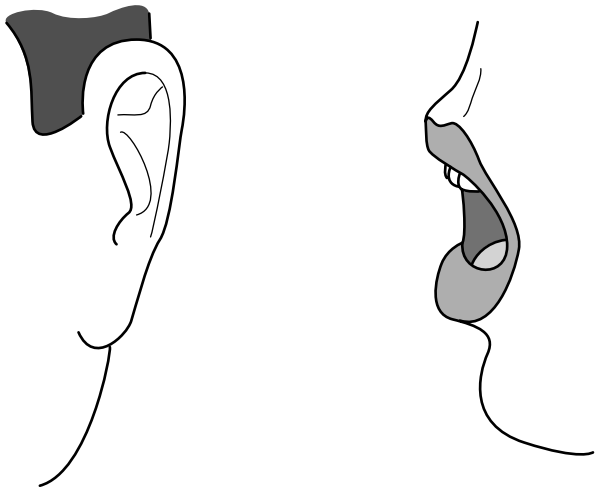
(b) Which one of these actions could change the speed of a wave?

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

change the intensity of the wave	☐
change the amplitude of the wave	☐
change the frequency of the wave source	☐
change the medium that the wave passes through	☐

[1]

(c) Alice talks to Micky about their work.



What do the sound waves transfer from Alice to Micky?

Put a (ring) around the correct answer.

atoms **energy** **rays** **wavelengths**

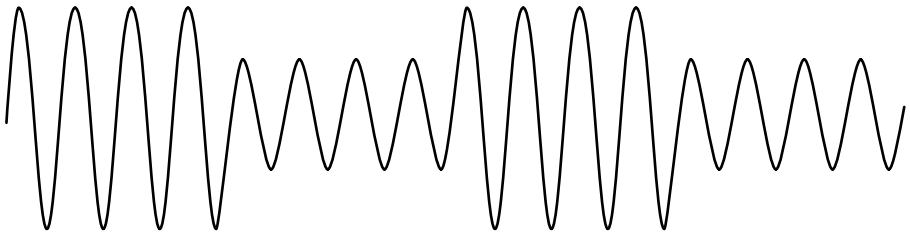
[1]

[Total: 4]

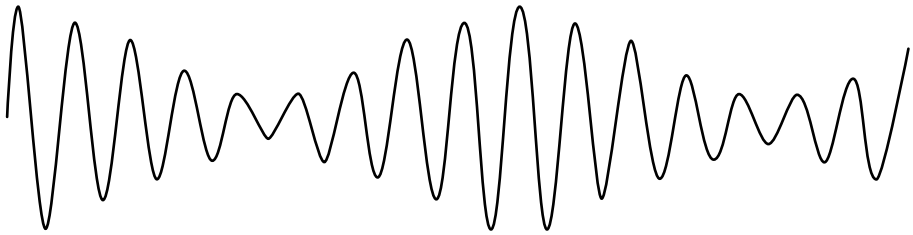
2 Jake is a security guard. He uses radio waves to communicate with his boss.

(a) Here are three wave patterns for the radio waves leaving Jake's radio.

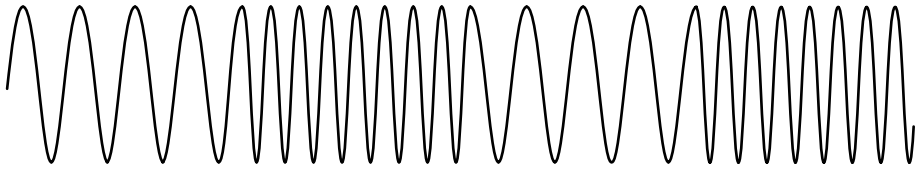
A



B



C



Draw straight lines to match each **wave pattern** with its best **description**.

wave pattern	description
A	amplitude modulation by a digital signal
B	frequency modulation by a digital signal
C	amplitude modulation by an analogue signal
	frequency modulation by an analogue signal

[2]

(b) Jake's radio transmits his voice signal in a digital format.

The sentences explain how the voice signal is sent from Jake to his boss.

They are in the wrong order.

A The radio wave leaves the transmitter.

B The radio wave is absorbed by the receiver.

C The pattern of digital information is recovered.

D The information and noise signals are amplified.

E The voice signal is modulated onto the radio wave.

F The voice signal is recreated from the digital pattern.

G The intensity of the wave decreases and it picks up noise as it travels.

Fill in the boxes to show the correct order.

The first and last have been done for you.

E						F

[2]

(c) What is the **advantage** of sending Jake's voice signal in a digital format?

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

It is easier to switch a wave on and off than to alter its amplitude. ☐

The information is sent as a pattern of two values called 1 and 0. ☐

Digital circuits are much more complicated than analogue ones. ☐

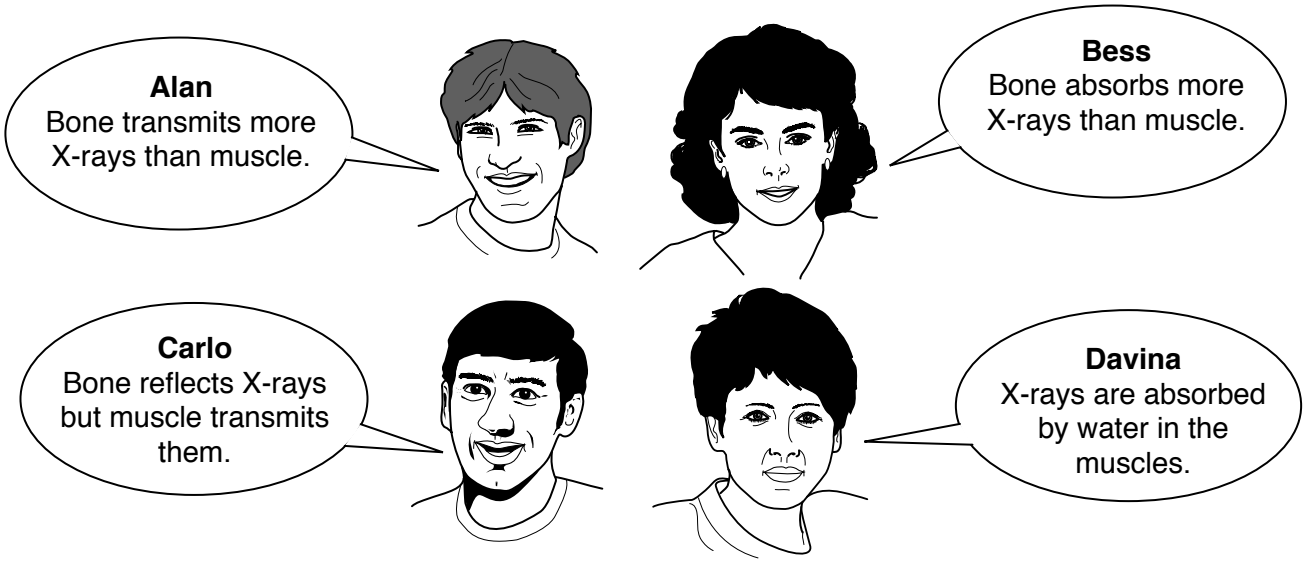
The digital pattern is recognisable even when noise has been added to the wave. ☐

[1]

[Total: 5]

3 Ben hurts his foot playing football. The hospital takes an X-ray image of his foot to see if any bones are broken.

(a) Ben asks his friends why X-rays can be used to make an image of his bones.



Who has the correct idea?

answer ..... **[1]**

(b) Ben knows that exposure to X-rays can be dangerous.
This is because X-ray photons carry a lot of energy and can damage cells.

Why do X-ray photons carry a lot of energy?

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

X-rays have a very high speed. ☐

X-rays have a very big amplitude. ☐

X-rays have a very high frequency. ☐

X-rays have a very big wavelength. ☐

[1]

(c) The hospital is concerned for Ben's safety.

The hospital measures the intensity of the X-rays before making an image of his bones.

Complete this equation for intensity. Choose words from this list.

energy per photon

energy per second

frequency per wavelength

photons per metre

photons per second

intensity of X-ray beam	=		=		×	

[2]

(d) X-rays are part of the electromagnetic spectrum.

So are ultraviolet waves.

Draw straight lines to link the **start** of each sentence with its correct **end**.

start	**end**
	... speed.
X-rays and ultraviolet waves in empty space always have the same ...	
	... amplitude.
X-rays and ultraviolet waves always have different values for their ...	
	... wavelength.

[1]

[Total: 5]

4 Sam is ironing and accidentally touches the hot plate of the iron.

He pulls his hand away very quickly.

(a) Which sentences describe his reaction?

Put a tick (✔) in the box next to each of the correct phrases.

His response is …

… learned.	☐
… deliberate.	☐
… involuntary.	☐
… a simple reflex.	☐
… a conditioned reflex.	☐

[1]

(b) Which parts of the nervous system are involved in Sam's reaction?

Put a (ring) around **each** correct part.

brain

consciousness

intelligence

memory

motor neuron

sensory neuron

spinal cord

synapse

[2]

(c) Later, Sam prepares a meal. He picks up a hot dish but does **not** drop it.

Why is his response different?

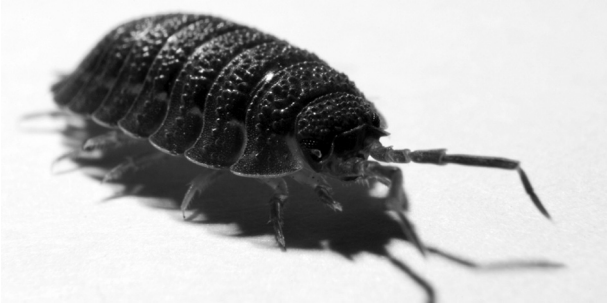
Put a tick (✔) in the box next to the **best** answer.

The receptors in his hand have become less sensitive.	☐
His brain has modified his reflex response.	☐
The smell of the food is a secondary stimulus.	☐
His brain does not have conscious control of his response.	☐

[1]

[Total: 4]

5 Animals such as woodlice respond to changes in their environment.



This process follows a series of steps.

(a) Complete the sentences to explain these steps.

Choose words from the list.

an action **an effector** **a hormone**

a motor neuron **a receptor**

a sensory neuron **a stimulus** **a synapse**

The change in the environment is ..... .

The change is detected by ..... .

Information is carried to the central nervous system by ..... .

Information is carried from the central nervous system by ..... .

The response is carried out by ..... .

[4]

(b) Receptors and effectors can be found in complex organs.

Draw lines to join each **type of cell** to the **organ** where it is found.

Draw lines to show whether each **type of cell** is an **effector or receptor**.

organ	type of cell	effector or receptor
gland	light sensitive cell	receptor
muscle	hormone secreting cell	effector
eye	muscle cell	

[2]

[Total: 6]

6 Scientists have studied the brain and its functions by a variety of methods.

(a) Which of these methods, **A**, **B**, **C** or **D**, requires physical contact with the brain?

A MRI scans of the brain

B X-ray photographs of the brain

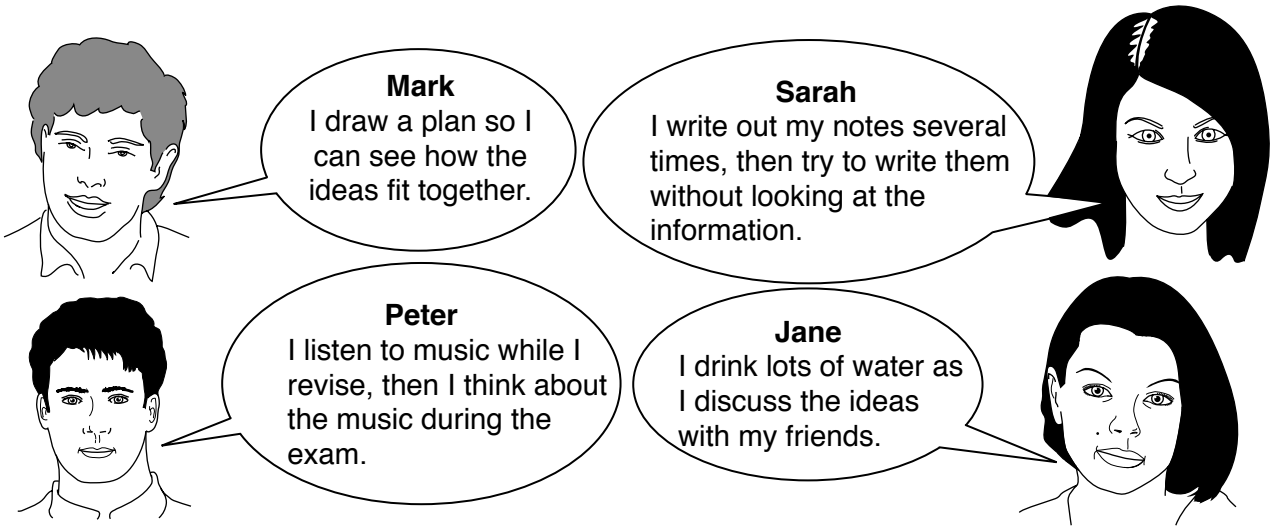
C electrical stimulation of the brain

D interviews of patients with brain damage

method ..... **[1]**

(b) Four friends are revising for their exams.

They talk about the methods they use.



(i) Who is remembering by repetition?

answer .....
[1]

(ii) Who is using a stimulus to help them remember?

answer .....
[1]

(c) What is memory?

Put a tick (✔) in the box next to each of the **two** phrases that **best** describe memory.

giving information	☐
storing information	☐
inputting information	☐
retrieving information	☐
processing information	☐

[1]

[Total: 4]

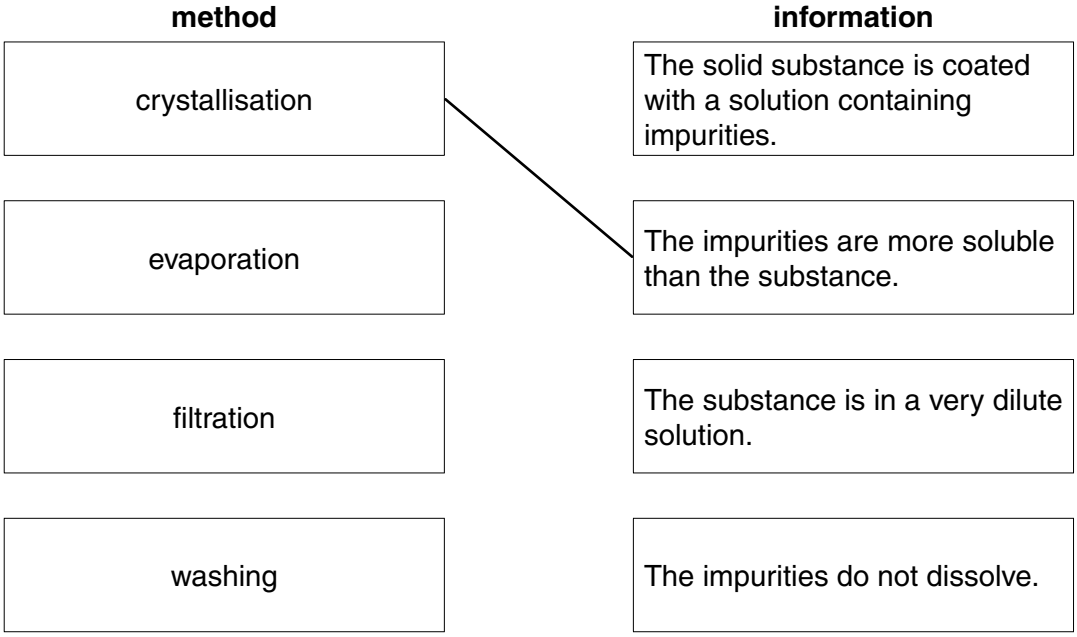
7 Benzoic acid is added to foods as a preservative.

Benzoic acid forms solid crystals which must be purified before the acid is used.

(a) The table shows different methods of purifying chemicals, and information about when you would use each method.

Draw lines to link each **method** to the correct piece of **information**.

One has been done for you.



[2]

(b) Terry does a titration to check the purity of some benzoic acid.

He wants to use an indicator which changes colour when the solution becomes slightly alkaline.

	indicator	**pH range for colour change**
A	gentian violet	0 to 2
B	methyl red	4 to 6
C	litmus	5 to 8
D	phenolphthalein	8 to 10
E	nitramine	11 to 13

(i) Which indicator, **A**, **B**, **C**, **D**, or **E**, should he use?

answer ..... **[1]**

(ii) Terry does the titration five times.

He writes down his titration results.

titration number	1	2	3	4	5
volume of alkali in cm^3	25.9	25.1	25.0	25.0	25.0

Put a tick (✔) in the box next to the result that he should use for his calculations.

25.0 ☐

25.1 ☐

25.2 ☐

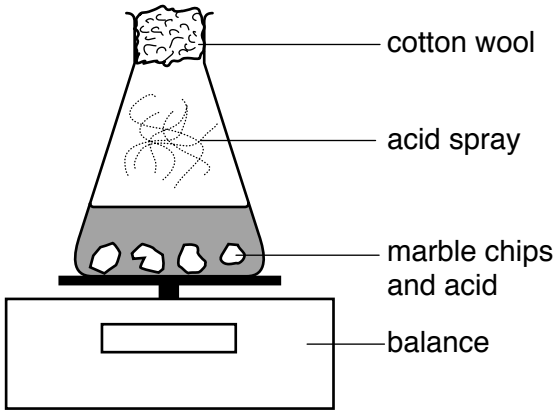
25.9 ☐

[1]

[Total: 4]

8 Bobby reacts marble chips (calcium carbonate) with acid. He uses an excess of marble chips.

He measures the change in mass as the acid reacts.



(a) Bobby uses sulfuric acid, but he finds the reaction stops almost immediately.

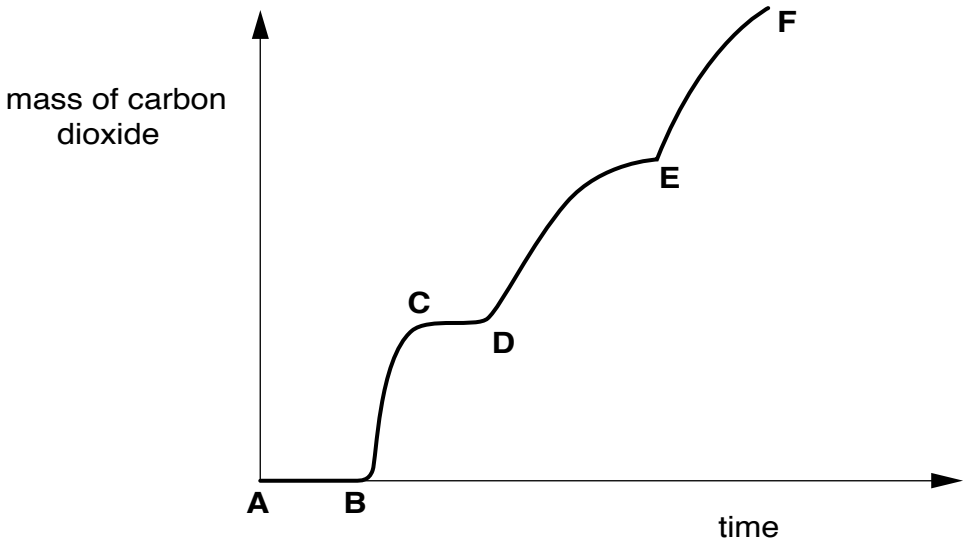
This is because the calcium carbonate becomes covered with a layer of an insoluble salt.

What is the name of the salt?

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

(b) Bobby repeats the experiment using hydrochloric acid instead of sulfuric acid.

He starts the reaction by adding some acid. Bobby twice adds more acid part way through. One of these times he lets the reaction stop before he adds the extra acid.



(i) On the list below, put a (ring) around the letters which show places where acid was added.

One has been ringed for you.

A **(B)** **C** **D** **E** **F** **[1]**

(ii) Put a tick (✔) in the box next to the region of the graph where the reaction stops.

B to C ☐

C to D ☐

D to E ☐

E to F ☐ **[1]**

(c) Susan tells Bobby that he can calculate the mass of carbon dioxide produced using relative formula masses and the equation for the reaction.

Relative atomic masses H=1, C=12, O=16, C*l*=35.5, Ca=40

(i) Put a ring around the relative formula mass of CO_2.

12 **16** **32** **40** **44** **56** **[1]**

(ii) Calculate the relative formula mass of $CaCO_3$.

answer ..... **[1]**

(iii) Calcium carbonate reacts with hydrochloric acid to form calcium chloride, carbon dioxide and water.

Complete and balance the equation for the reaction.

$CaCO_3$ + HCl $\rightarrow$

[2]

(d) Bobby does two more experiments.

First, he reacts marble chips with dilute hydrochloric acid. The reaction takes 15 minutes to complete.

Then he repeats this experiment exactly as before, but with concentrated hydrochloric acid. The reaction takes 10 minutes to complete.

Here are some statements about the reaction with concentrated hydrochloric acid.

A	The acid particles move faster.	☐
B	Particles collide more frequently.	☐
C	More gas is produced at each collision.	☐
D	Particles collide with the same average energy.	☐
E	The calcium carbonate has more surface area.	☐
F	Acid particles are closer together in the solution.	☐
G	Particles are closer together in the acid and in the calcium carbonate.	☐

(i) Put a tick (✔) in the box next to each correct statement. **[2]**

(ii) Which **two** statements make an explanation of why the reaction goes quicker?

statements ..... and ..... **[1]**

[Total: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
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						

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.