OCR
RECOGNISING ACHIEVEMENT

F

A322/01

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

Unit 2 Modules C4 C5 C6 (Foundation Tier)

FRIDAY 25 JANUARY 2008

Morning
Time: 40 minutes

Candidates answer on the question paper.
Additional materials (enclosed):
None

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

CUP/T43544

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	6	
2	9	
3	5	
4	5	
5	5	
6	5	
7	7	
TOTAL	42	

This document consists of **16** printed pages.

[Turn over

Answer **all** the questions.

1 Elements in Group 7 are called the halogens. The table gives some information about the physical properties of three of the halogens.

halogen	proton number	melting point in °C	boiling point in °C	state at 25 °C	colour
chlorine	17	–101	–35		pale green
bromine	35	–7	59	liquid	deep red
iodine	53	114	184	solid	dark grey

(a) The halogens show trends in physical properties with increasing proton number.

Use information from the table to help you answer these questions.

(i) Finish the sentence about the trend in melting point.

As the proton number …… the melting point …… . [1]

(ii) What is the state of chlorine at 25 °C?

Put a (ring) around the correct answer.

gas **liquid** **solid**

[1]

(iii) **Astatine** is a halogen. The proton number of astatine is 85.

The halogens get darker in colour as the proton number increases.

Predict the colour of **astatine**.

Put a (ring) around the correct answer.

yellow **orange** **black**

[1]

(b) The halogens also show a trend in reactivity.

This can be shown by the displacement reactions when halogens are added to solutions of halides.

A student made the following observations.

- When chlorine is added to potassium bromide solution, red bromine appears.
- When bromine is added to potassium iodide solution, brown iodine appears.
- When bromine is added to potassium chloride solution, there is no displacement.

(i) What is the correct order of reactivity for these halogens?

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

decreasing reactivity →

bromine	chlorine	iodine	☐
chlorine	bromine	iodine	☐
iodine	bromine	chlorine	☐

[1]

(ii) Fluorine is a halogen with proton number 9.

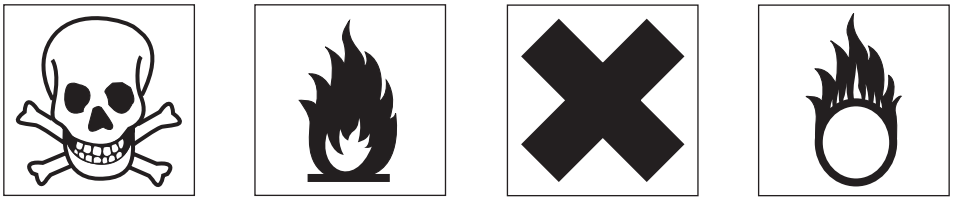
Which statement describes the displacement reactions of fluorine?

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

Fluorine displaces chlorine, bromine and iodine.	☐
Fluorine displaces iodine but not chlorine or bromine.	☐
Fluorine displaces chlorine and bromine but not iodine.	☐
Fluorine displaces bromine and iodine but not chlorine.	☐

[1]

(c) Hazard symbols are used to show the dangers involved in handling some chemicals.



A **B** **C** **D**

Iodine is **harmful**. Which hazard symbol, **A**, **B**, **C** or **D**, should be placed on a container of iodine?

answer ..... [1]

[Total: 6]

2 This diagram shows part of the Periodic Table.

						He
Li	Be		C			Ne
Na	Mg				Cl	Ar
K	Ca				Br	

(a) (i) Which three elements shown in the diagram are in the same **group**?

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

Be	C	He	☐
Na	Mg	Ar	☐
He	Be	Ar	☐
Li	Na	K	☐

[1]

(ii) Which three elements shown in the diagram are in the same **period**?

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

Na	Mg	Ar	☐
Li	Na	Ca	☐
He	Ne	Ar	☐
Na	Ca	Br	☐

[1]

(b) One element in the diagram has the symbol Be. This element is in Group 2.

Write down the following information about the element with the symbol **Be**.

Use the Periodic Table on the back page to help you.

name .....

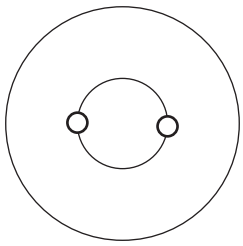
proton number .....

relative atomic mass ..... [3]

(c) Finish the diagram to show the arrangement of electrons in an atom of the element **carbon**.

Use a circle ○ to show the position of each electron.

The positions of two electrons have already been drawn to help you.



[1]

(d) The elements sodium and chlorine react to form the compound sodium chloride.

(i) Sodium chloride is made of sodium ions, Na^+, and chloride ions, Cl^-.

Which statement describes evidence that sodium chloride is made of ions?

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

Sodium chloride is a solid. ☐

Sodium chloride is made of crystals. ☐

Sodium chloride has a high melting point. ☐

Molten sodium chloride conducts electricity. ☐

[1]

(ii) The table shows the arrangement of electrons in sodium atoms and chlorine atoms.

Complete the table to show the arrangement of electrons in sodium ions and chloride ions.

sodium atom Na	**sodium ion Na^+**	**chlorine atom Cl**	**chloride ion Cl^-**
2.8.1		2.8.7	

[2]

[Total: 9]

3 The table gives information about ions dissolved in sea water.

ion	symbol	percentage by mass of the total dissolved solids (%)
chloride	Cl^-	55
sodium	Na^+	30
sulfate	SO_4^{2-}	8
magnesium	Mg^{2+}	4
calcium	Ca^{2+}	1
potassium	K^+	1
carbonate	CO_3^{2-}	0.5
bromide	Br^-	0.2

These ions enter the sea water when crystals of ionic compounds in rocks dissolve.

Each of these ionic compounds is made up of one type of positive ion and one type of negative ion shown in the table.

(a) One compound that dissolved from the rocks into the water is magnesium sulfate.

Suggest the name of one **other** ionic compound that dissolved from the rocks into the water.

Use information from the table to help you.

..... [1]

(b) What holds together the ions in the crystals of ionic compounds?

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

sharing of pairs of electrons ☐

attraction between ions of opposite charge ☐

attraction between ions of the same charge ☐

[1]

(c) Sea water conducts electricity.

Which **two** statements give the best explanation for this?

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

Ions are able to move around in the sea water.	☐
Electrons can pass from ion to ion in the sea water.	☐
The sea water contains more ions with positive charges than ions with negative charges.	☐
The sea water contains ions that have positive charges and ions that have negative charges.	☐

[2]

(d) When a sample of sea water is evaporated to dryness, a white solid is left. This is a mixture of several ionic compounds.

Look at the **percentage by mass of the total dissolved solids** column in the table.

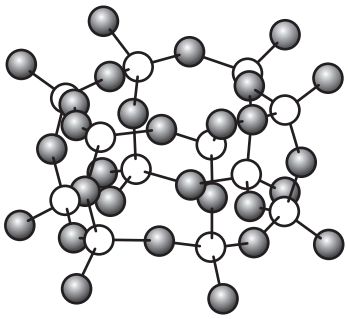
Use the information to name the ionic compound that makes up **most** of the white solid.

..... [1]

[Total: 5]

4 All of the materials in the world are made up of elements.

(a) Much of the elements oxygen and silicon are in the compound silicon dioxide.



key

○ Si atom

● O atom

Here are some sentences about **silicon dioxide**.

Finish these sentences by putting a tick (✓) in the box next to the correct word in each pair.

Silicon dioxide is a giant

ionic	
covalent	

structure.

It is very

soft	
hard	

and has

low	
high	

melting and boiling points.

Silicon dioxide is

soluble	
insoluble	

in water and

does	
does not	

conduct electricity.

[4]

(b) The compounds in living organisms are made **mainly** of four elements. Two of these elements are **carbon** and **hydrogen**.

Which are the other **two** elements?

Put a (ring) around each of the **two** correct answers.

calcium **nitrogen** **oxygen** **sodium**

[1]

[Total: 5]

5 The ore haematite contains iron oxide. Iron is extracted from this ore by reaction with carbon.

iron oxide + carbon $\longrightarrow$ iron + carbon dioxide

(a) Oxidation **and** reduction take place in this reaction.

What is the name of the substance that has been **oxidised**?

..... [1]

(b) Which **two** of the metals below are also extracted by reaction with carbon?

Put a (ring) around each of the **two** correct answers.

copper **potassium** **sodium** **zinc**

[2]

(c) The ore bauxite contains aluminium oxide.

Carbon is **not** used to extract aluminium from this ore.

(i) Why is carbon **not** used to extract aluminium from bauxite?

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

The reaction is too fast.	☐
Aluminium is more reactive than carbon.	☐
Carbon is more reactive than aluminium.	☐
The reaction would use too much carbon.	☐

[1]

(ii) Suggest **one** method that can be used to extract large quantities of aluminium from bauxite.

..... [1]

[Total: 5]

6 An acid and an alkali react to form a salt and water.

$$\text{acid} + \text{alkali} \longrightarrow \text{salt} + \text{water}$$

(a) What type of reaction is this?

Put a (ring) around the correct answer.

decomposition **neutralisation** **oxidation** **polymerisation**

[1]

(b) Draw straight lines to join up the boxes to show which **acid** reacts with which **alkali** to make each **salt**.

acid	**alkali**	**salt**
sulfuric acid	potassium hydroxide	sodium sulfate
hydrochloric acid	ammonium hydroxide	potassium chloride
nitric acid	sodium hydroxide	magnesium nitrate
phosphoric acid	magnesium hydroxide	

[3]

(c) Acids also react with metals.

$$\text{acid} + \text{metal} \longrightarrow \text{salt} + \text{hydrogen}$$

A piece of zinc is added to 20 cm^3 of dilute hydrochloric acid.

Bubbles of hydrogen gas appear.

What is the formula of **hydrogen gas**?

Put a (ring) around the correct answer.

H **2H** **H_2**

[1]

[Total: 5]

7 Magnesium sulfate is one of the chemicals in detergent powder.

Mary makes some magnesium sulfate using this reaction.

magnesium carbonate + sulfuric acid → magnesium sulfate + water + carbon dioxide

$$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$$

She measures out 100 cm^3 of dilute sulfuric acid and adds solid magnesium carbonate until no more bubbles appear.

(a) Some solid magnesium carbonate is left in the solution.

What technique can Mary use to remove the solid from the solution?

..... [1]

(b) Mary works out the theoretical yield to be 12.0 g.

(i) To make this calculation Mary uses the relative formula mass of magnesium carbonate and magnesium sulfate.

She uses these relative atomic masses: C = 12; Mg = 24; O = 16; S = 32.

Use this information to work out these relative formula masses.

relative formula mass of magnesium carbonate, $MgCO_3$ = ...

relative formula mass of magnesium sulfate, $MgSO_4$ = ...
[2]

(ii) The theoretical yield for Mary's experiment is 12.0 g.

Mary dries and weighs the magnesium sulfate she makes. This is her actual yield.

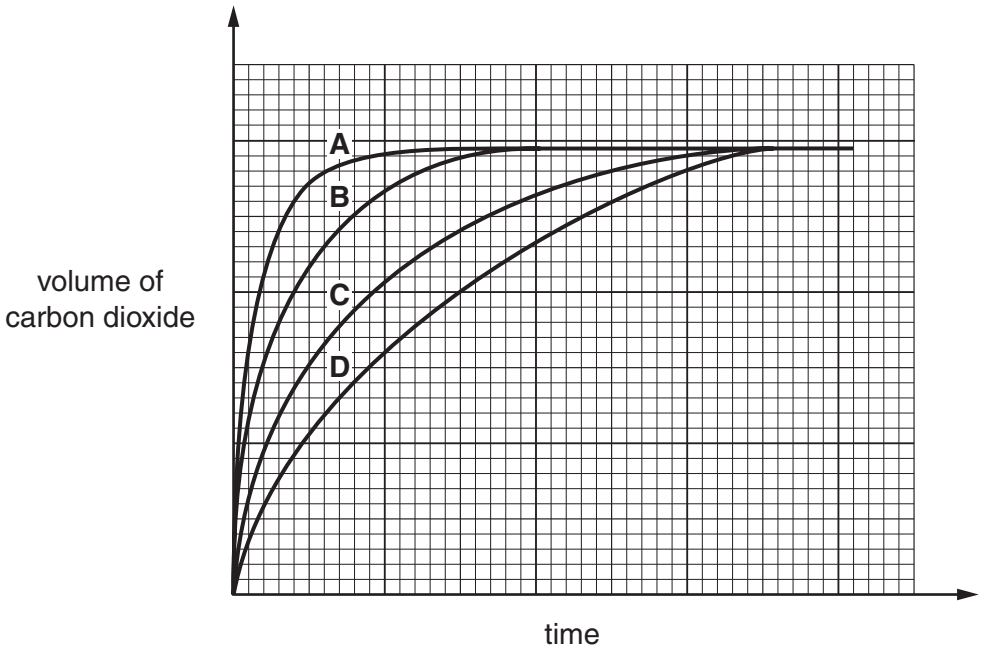
Actual yield = 10.8 g.

Work out the percentage yield for Mary's experiment.

percentage yield = ... [1]

(c) Mary investigates the rate of this reaction using the same sulfuric acid solution with different sized lumps of magnesium carbonate.

She measures the volume of carbon dioxide given off at time intervals and plots her results on a grid.



(i) How do these graphs show that Mary used the same mass of magnesium carbonate for each experiment?

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

Each line is a curve. ☐

Each line begins at the origin. ☐

Each line finishes at the same time. ☐

Each line finishes at the same volume. ☐

[1]

(ii) Which line, **A**, **B**, **C** or **D**, shows results from:

the fastest rate of reaction?

answer .....

the largest lumps of magnesium carbonate?

answer .....[1]

(iii) What **other** change to Mary's experiment would make the reaction faster?

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

decreasing the concentration of the acid ☐

increasing the temperature of the acid ☐

decreasing the mass of magnesium carbonate ☐

[1]

[Total: 7]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE

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