OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

CHEMISTRY B

Unit 2 Modules C4 C5 C6 (Higher Tier)

B642/02

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)

Wednesday 15 June 2011
Morning

Duration: 1 hour

B642/02

11LMP06091

Candidate forename		Candidate surname	

Centre number						Candidate number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- 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).
- Answer **all** the questions.
- Do **not** write in the bar codes.

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 **60**.
- The Periodic Table is printed on the back page.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

Section A – Module C4

1 Washing powder is used to clean clothes.

Look at the label on a box of biological washing powder.

Ingredients
water softener
bleach
optical brightener
detergent
enzyme

(a) The washing powder can be used to remove food stains using a low temperature wash.

Write down one **advantage** of using a low temperature wash.

.....

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

(b) The washing powder can also be used to remove oil stains.

(i) Draw a labelled diagram of a detergent molecule.

[1]

(ii) Describe how the detergent in the washing powder can remove oil stains.

Use ideas about the chemical structure of detergent molecules.

A labelled diagram will help you answer this question.

.....

.....

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

(c) Some people use a solvent to remove oil stains from clothes.

The solvent dissolves the oil stain.

Why is this method of removing oil stains called dry cleaning?

.....

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

[Total: 5]

2 Sea water contains many useful chemicals.

Ed uses the internet to find out the ions found in sea water.

Look at the table of information that Ed finds.

name of ion	formula of ion
bromide	Br^-
calcium	Ca^{2+}
chloride	Cl^-
magnesium	Mg^{2+}
potassium	K^+
sodium	Na^+
sulfate	SO_4^{2-}

(a) Sodium chloride, NaCl, and sodium sulfate can be extracted from sea water.

What is the formula for sodium sulfate?

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

(b) Ed tests sea water with silver nitrate solution.

A white precipitate is made.

Explain why.

.....

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

(c) Barium chloride solution reacts with potassium sulfate solution.

This is a precipitation reaction.

Look at the word equation for this precipitation reaction.

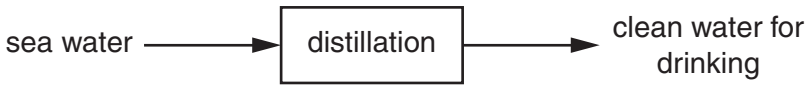
Finish the word equation.

barium chloride + potassium sulfate → ..... + ...

[1]

(d) In some parts of the world sea water is used to make clean water for drinking.

(i) Look at the flow chart. It shows how sea water can be made into fresh water.



It is expensive to make large quantities of fresh water using distillation.

Explain why.

.....

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

(ii) It is important that people in all parts of the world have a supply of clean water.

Explain why.

.....

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

[Total: 5]

3 Stowmarket Synthetics own a chemical factory.

They want to make hydrogen peroxide.

Hydrogen peroxide can be made by two methods.

Look at the table.

It gives some information about the two methods used to make hydrogen peroxide.

	method 1	**method 2**
starting materials	barium peroxide and sulfuric acid	hydrogen and oxygen
type of process	batch	continuous
temperature	5 °C	45 °C
catalyst	none needed	catalyst needed
percentage yield	70 %	95 %
pollution problems	poisonous waste product made	no waste products made

(a) Stowmarket Synthetics decide to make hydrogen peroxide by method **2**.

This is because method **2** is cheaper.

(i) The use of a catalyst helps to make method **2** cheaper.

Explain why.

.....

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

(ii) The use of a continuous process helps to make method **2** cheaper.

Suggest why.

.....

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

(iii) Using the table, explain **one other** reason why method **2** is cheaper.

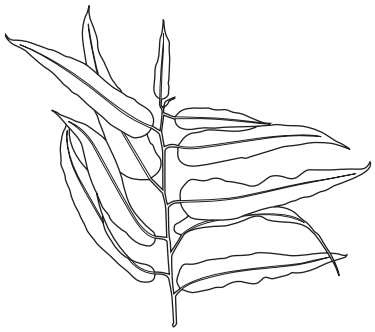
.....

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

(b) Stowmarket Synthetics also make medicines.

They extract chemicals from the leaves of a plant.

They use these chemicals as the starting material.



Write about how chemicals can be extracted from plants.

.....

.....

.....

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

[Total: 5]

4 Dylan is a farmer.

He uses fertilisers to make his plants grow faster and bigger.

Look at the diagram. It shows the bags of fertiliser that Dylan has bought.

(a) Ammonium nitrate, NH_4NO_3, has a relative formula mass, M_r, of 80.

Calculate the percentage by mass of nitrogen in ammonium nitrate.

The relative atomic mass, A_r, of nitrogen is 14.

.....

.....

.....

percentage by mass of nitrogen = ... **[1]**

(b) Fertilisers contain one or more of the three **essential elements**.

These elements are nitrogen, phosphorus and potassium.

Dylan puts the ammonium nitrate fertiliser on his fields to increase the crop yield.

Explain how the use of this fertiliser increases crop yield.

.....

.....

.....

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

(c) Dylan also uses ammonium phosphate fertiliser.

Ammonium phosphate can be made by the reaction between an acid and an alkali.

What are the names of the acid and the alkali?

acid .....

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

(d) Urea is another fertiliser that can be made from ammonia.

Urea has the formula $(NH_2)_2CO$.

What is the relative formula mass, M_r, for urea?

The relative atomic mass, A_r, of N is 14, of H is 1, of C is 12 and of O is 16.

.....

.....

.....

relative formula mass = ... **[1]**

[Total: 5]

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Section B – Module C5

5 Kim investigates the neutralisation reaction between ethanoic acid and potassium hydroxide.

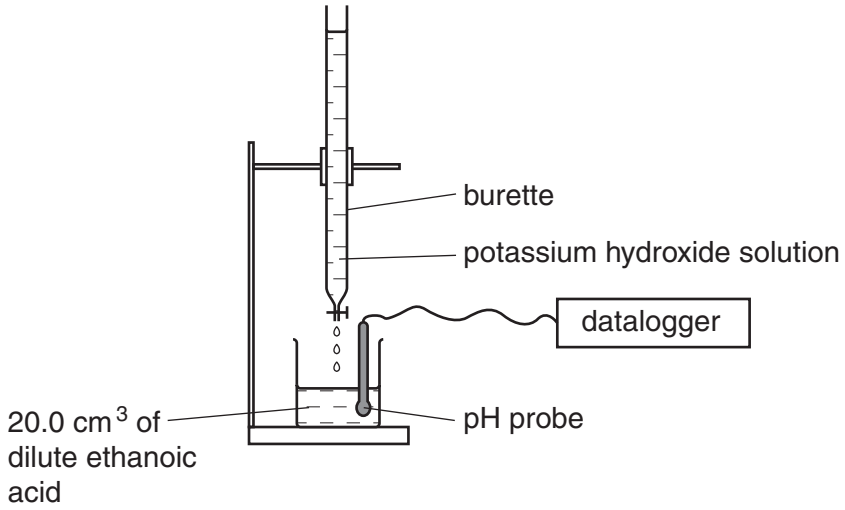
(a) Look at the symbol equation for this reaction.

$$CH_3COOH + KOH \rightarrow CH_3COOK + H_2O$$

Write down the formula of the **salt** in this reaction.

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

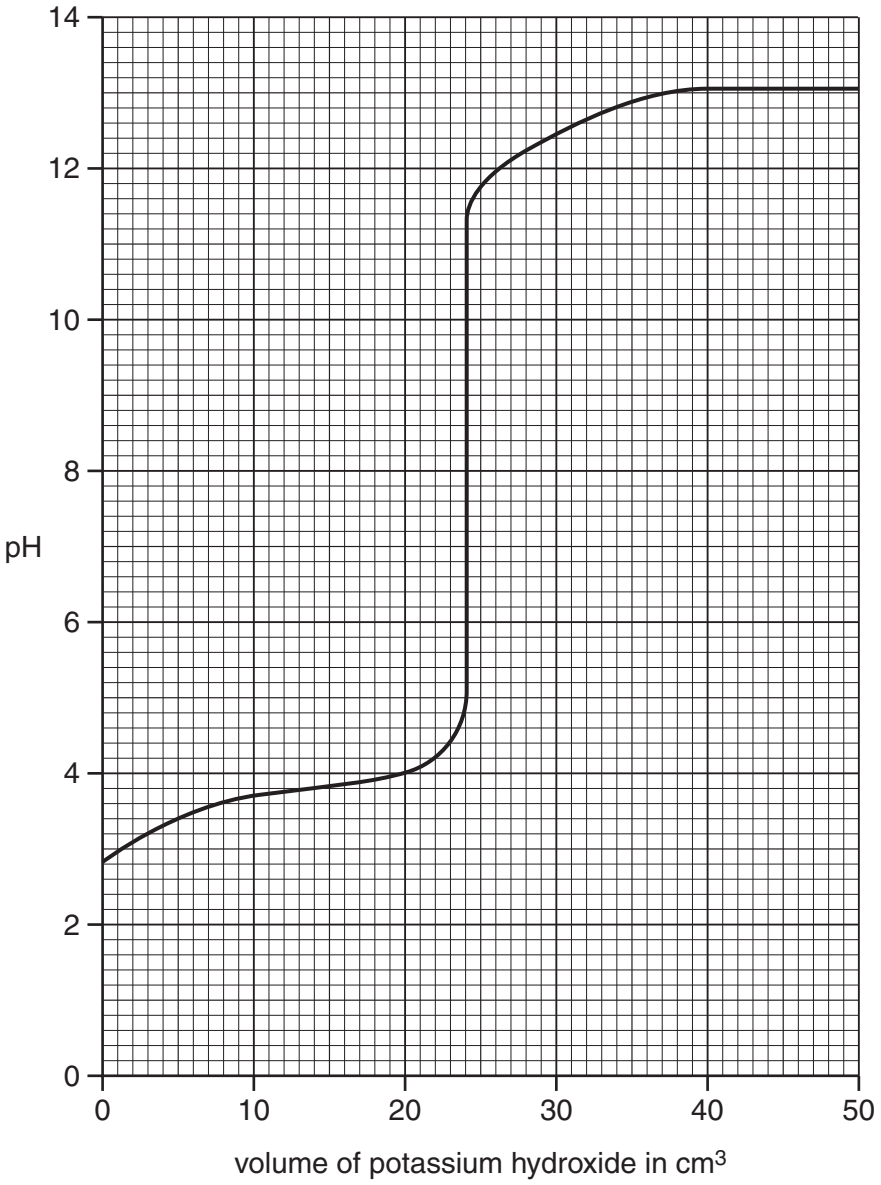
(b) Look at the diagram. It shows the apparatus Kim uses.



Kim slowly adds potassium hydroxide solution to the dilute ethanoic acid.

Kim uses a pH probe (pH meter) to find the pH of the solution in the beaker.

Look at the graph on the next page. It shows how the pH of the solution in the beaker changes as more potassium hydroxide solution is added.



(i) Kim adds 10.0 cm^3 of potassium hydroxide solution.

What is the pH of the solution in the beaker?

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

(ii) What volume of potassium hydroxide must be added to just neutralise the ethanoic acid?

..... cm^3 **[1]**

(c) Kim repeats the investigation.

This time she uses an indicator to tell when the ethanoic acid has been neutralised.

Look at the table. It shows the colours of two indicators at different pH values.

indicator	**pH 1**	**pH 4**	**pH 7**	**pH 10**	**pH 13**
methyl orange	red	yellow	yellow	yellow	yellow
phenolphthalein	colourless	colourless	colourless	pink	pink

Kim must use phenolphthalein as the indicator and not methyl orange.

Use information from the table and the graph to explain why.

.....

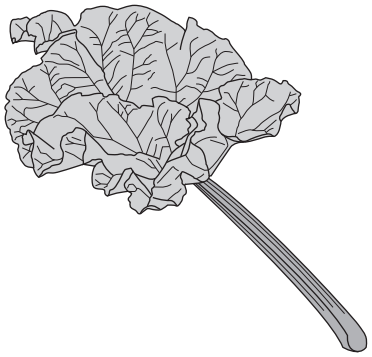
.....

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

[Total: 5]

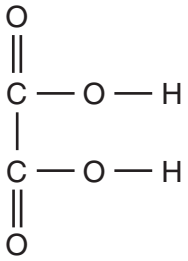
6 Chen is a research chemist.

He extracts a poisonous acid from rhubarb leaves.



The name of the acid is oxalic acid.

Look at the displayed formula for oxalic acid.



(a) What is the molecular formula for oxalic acid?

.....

[1]

(b) Oxalic acid is a weak acid.

Oxalic acid ionises in water.

Which one of these ions is made?

Choose from the list.

Cl^- **H^+** **OH^-** **SO_4^{2-}**

answer .....

[1]

(c) Ethanoic acid is another weak acid.

Dilute ethanoic acid can be used to remove limescale from kettles.

This is because ethanoic acid reacts with the calcium carbonate (limescale).

Hydrochloric acid is not used to remove limescale from kettles.

Explain why.

.....

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

[Total: 3]

7 Sulfuric acid, H_2SO_4, is made by the Contact Process.

Look at the symbol equation for one of the reactions in the Contact Process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

This reaction changes sulfur dioxide into sulfur trioxide. It is an exothermic reaction.

The conditions for this reaction are

- a temperature of 450 °C
- a pressure just above atmospheric pressure.

Under these conditions the position of equilibrium for the reaction is on the right.

(a) What is meant by **'the position of equilibrium is on the right'**?

.....

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

(b) A temperature of 450 °C is used rather than temperatures of 100 °C or 800 °C.

Explain why.

Use ideas about

- rate of reaction
- position of equilibrium.

.....

.....

.....

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

(c) The reaction to make sulfur trioxide uses a catalyst.

What is the name of this catalyst?

Choose from the list.

iron **manganese(IV) oxide** **nickel** **vanadium(V) oxide**

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

(d) Sulfur dioxide is made for use in the Contact Process.

Write down a **word** equation to show how sulfur dioxide is made.

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

[Total: 5]

8 People in a submarine need a constant supply of oxygen.

(a) Large submarines use electrolysis to make oxygen.

During the electrolysis hydroxide ions, OH^-, react.

Hydroxide ions lose electrons.

Oxygen, O_2, and water, H_2O, are made.

Write a **symbol** equation for this reaction of hydroxide ions.

Use e^- to represent an electron.

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

(b) The amount of oxygen made during the electrolysis depends on two factors

- time
- electric current.

Write about how each of these factors affect the amount of oxygen made during electrolysis.

(i) time

.....

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

(ii) electric current

.....

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

(c) A submarine makes 72 000 dm^3 of oxygen, measured at room temperature and pressure.

How many moles of oxygen are made?

One mole of oxygen at room temperature and pressure has a volume of 24 dm^3.

.....

.....

number of moles = ... **[1]**

(d) Potassium superoxide is used to provide emergency supplies of oxygen in submarines.

Look at the symbol equation.

It shows the reaction of potassium superoxide that makes oxygen.

$$4KO_2 + 2CO_2 \rightarrow 2K_2CO_3 + 3O_2$$

Anthony reacts 71g of potassium superoxide, KO_2, with excess carbon dioxide, CO_2.

What mass of oxygen is made?

Use the relative formula masses, M_r, in the table.

substance	relative formula mass, M_r
KO_2	71
CO_2	44
K_2CO_3	138
O_2	32

.....

.....

.....

.....

mass of oxygen = ... g **[2]**

[Total: 7]

Section C – Module C6

9 This question is about rusting.

(a) Zinc is used to prevent iron rusting.

The iron is coated in zinc.

This method of protection is called galvanising.

The layer of zinc stops oxygen and water reaching the iron.

Galvanising is an example of **sacrificial protection**.

Explain how this sacrificial protection works.

.....

.....

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

(b) When iron rusts, the atoms of iron, Fe, are changed into iron(II) ions, Fe^{2+}.

Write a **balanced** symbol equation for this reaction.

Use e^- to represent an electron.

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

(c) Zinc reacts with copper sulfate solution to make copper.

A solution of zinc sulfate is also made.

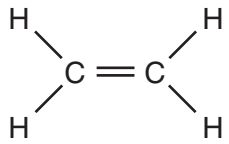
Write down the **word** equation for this reaction.

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

[Total: 5]

10 This question is about alcohols.

(a) Look at the **displayed** formula of ethene, C_2H_4.



Draw the **displayed** formula of ethanol, C_2H_5OH.

[1]

(b) The general formula of an alcohol is

$$\mathbf{C_nH_{2n+1}OH}$$

Write down the **molecular formula** of an alcohol with **4** carbon atoms.

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

(c) In Brazil, ethanol is made by fermentation of sugar cane.

In the United Kingdom, ethanol is made from ethene by hydration.

ethene + water → ethanol

The ethene is made from crude oil.

Suggest why the United Kingdom uses hydration of ethene for making ethanol.

.....

.....

.....

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

(d) Ethene, C_2H_4, reacts with water, H_2O, during hydration. Ethanol, C_2H_5OH, is made.

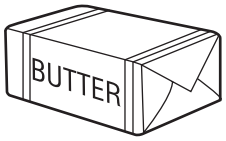
Write a **balanced symbol** equation for this reaction.

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

[Total: 5]

11 This question is about oils and fats.

Look at the pictures.



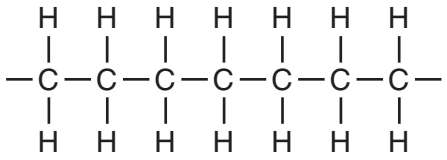
butter, a fat

olive oil, an oil

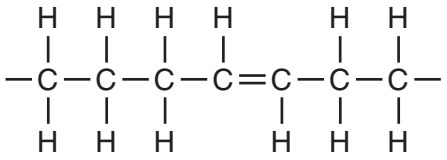
(a) (i) Butter contains saturated and unsaturated fats.

Fats **A** and **B** are both found in butter.

Look at parts of the structures of fats **A** and **B**.



fat **A**



fat **B**

Fat **B** is unsaturated.

How can you tell from its structure?

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

(ii) Jill wants to find out if olive oil is unsaturated.

Write about the experiment she does.

Your answer should include

- the chemical she uses
- any colour change.

.....

.....

.....

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

(b) Soap is made from fats and oils.

The fats and oils are hydrolysed using hot sodium hydroxide solution.

fat + sodium hydroxide → soap + glycerol

Write down the name of this type of reaction.

Choose from the list.

dehydration

electrolysis

fermentation

saponification

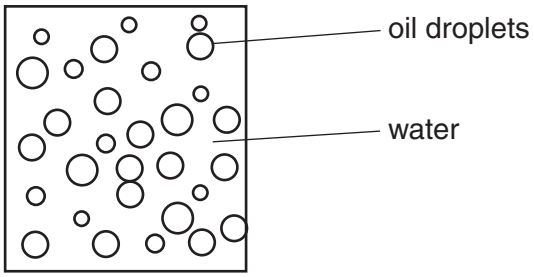
answer ..... **[1]**

(c) Jill looks at some milk under a microscope.

Milk contains tiny droplets of oil spread through water.

Milk is an oil-in-water emulsion.

Jill draws what she sees.



Jill now looks at a very thin sample of butter under a microscope.

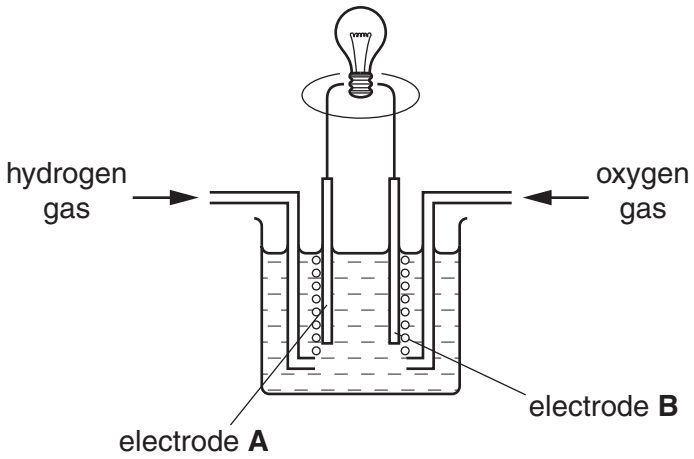
Draw and **label** a diagram of what she sees in the box below.

[1]

[Total: 5]

12 This question is about fuel cells.

The diagram shows how a fuel cell works.



(a) Look at the word equation for the reaction in this fuel cell.

hydrogen + oxygen → water

This reaction gives out energy.

What is the name given to all reactions that give out energy?

Choose from the list.

dehydration

endothermic

exothermic

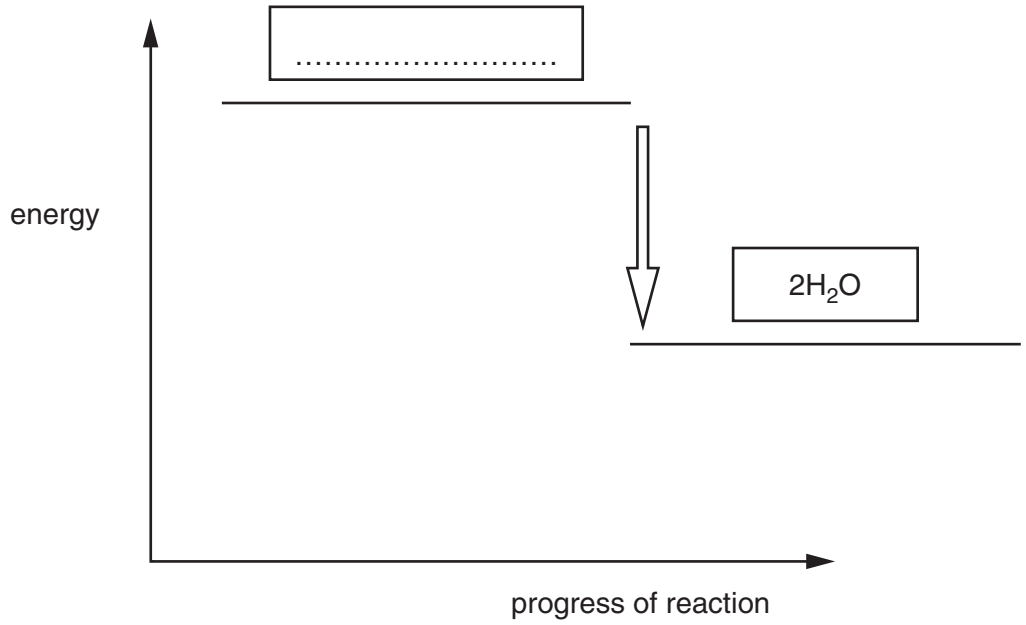
saponification

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

(b) Look at the energy level diagram for the reaction taking place in the fuel cell.

The diagram shows that energy is given out.

Complete the labelling of the diagram. Write your answer in the box.



[1]

(c) Look at the equations.

This is the equation for the reaction at electrode **A**.

$$H_2 - 2e^- \rightarrow 2H^+$$

This is the equation for the reaction at electrode **B**.

$$4H^+ + O_2 + 4e^- \rightarrow 2H_2O$$

The reactions in the fuel cell involve both oxidation and reduction.
Explain why. Use the equations to help you.

.....

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

(d) Fuel cells are used in spacecraft instead of batteries.

Write down **two** advantages of using fuel cells instead of batteries.

1 .....

.....

2 .....

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

[Total: 5]

END OF QUESTION PAPER

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.