OCR
Oxford Cambridge and RSA

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Friday 10 June 2016 – Morning

GCSE GATEWAY SCIENCE
CHEMISTRY B

B741/02 Chemistry modules C1, C2, C3 (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)

Duration: 1 hour 15 minutes

* B 7 4 1 0 2 *

* 1 2 5 1 3 8 4 3 8 6 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- 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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

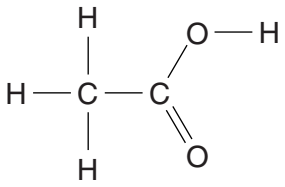
- The quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **28** pages. Any blank pages are indicated.

Answer **all** the questions.

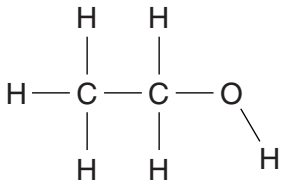
SECTION A – Module C1

1 This question is about carbon compounds.

Look at the displayed formulas of some compounds.



A



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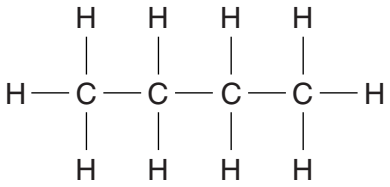
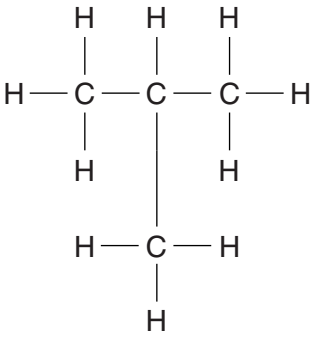
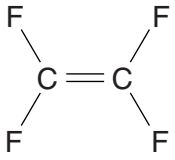
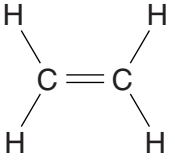


C





D



E

F

(a) Which compound is an **alkene**?

Choose from **A**, **B**, **C**, **D**, **E** or **F**.

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

(b) Which **two** compounds have the same **molecular formula**?

Choose from **A**, **B**, **C**, **D**, **E** and **F**.

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

(c) A molecule of dodecane, $C_{10}H_{22}$, can be cracked to give compound **E** and one other hydrocarbon, **X**.

Deduce the **molecular** formula for **X**.

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

(d) Compound **D** is a monomer and makes an addition polymer.

Draw the **displayed** formula for this polymer.

[1]

[Total: 4]

2 Esters can be used in nail varnish remover.

Look at the table of information about some esters.

Ester	Molecular formula of ester	Melting point in °C	Boiling point in °C	How well it dissolves in water (1 = poor 10 = good)
methyl ethanoate	$C_3H_6O_2$	–98	57	1
ethyl ethanoate	$C_4H_8O_2$	–84	77	8
propyl ethanoate	$C_5H_{10}O_2$	–95	102	2
butyl ethanoate	$C_6H_{12}O_2$	–77	127	1
pentyl ethanoate	$C_7H_{14}O_2$	–71		

(a) Esters are **not** hydrocarbons.

Explain why using information from the molecular formulas.

.....

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

(b) The solvent in a nail varnish remover needs to have these properties

- liquid at room temperature, 25 °C
- evaporates easily
- fairly soluble in water.

(i) Predict the boiling point for pentyl ethanoate.

..... °C **[1]**

(ii) Use the information in the table to predict if pentyl ethanoate is suitable as a solvent in nail varnish remover.

Explain your answer.

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

[Total: 4]

3 Air contains a mixture of gases.

The table shows the percentage by volume of different gases in air.

Gas	Percentage (%)
carbon dioxide	0.04
nitrogen	78
oxygen	21

The percentage by volume of these gases in air hardly changes because of the carbon cycle.

Explain why the percentage by volume of the gases in the table hardly changes.

Predict the effect that an increase in the world's population may have on these percentages.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

4 The Olympic flame for the London Olympics burned natural gas.

Natural gas is mostly methane, CH_4.

The Olympic flame was yellow because there was some incomplete combustion.

Construct a **balanced symbol** equation to show the incomplete combustion of methane to make carbon.

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

[Total: 2]

5 This question is about different paints.

Look at the table. It shows the percentage by mass of each ingredient in four paints.

Ingredient	Percentage by mass in each paint			
	Paint A	**Paint B**	**Paint C**	**Paint D**
solvent	32	25	55	20
oil	0	25	0	25
pigment	24	10	5	30
bonding medium	30	30	28	23
other additives	14	10	12	2

(a) Look at the column for paint **D**.

Parminder wants to present the data about the ingredients in paint **D**.

Which will be the **best** way for her to present this data?

Choose from

bar chart

line graph

pie chart

scatter graph

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

(b) Parminder wants to show the percentage of solvent in each of the four paints.

Which will be the **best** way for her to present this data?

Choose from

bar chart

line graph

pie chart

scatter graph

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

(c) Paint **D** is an oil paint.

Explain how an oil paint dries.

.....

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

(d) Paint is a mixture called a **colloid**.

Explain why the ingredients of a paint will not separate.

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

[Total: 6]

Question 6 begins on page 8

6 This Gore-Tex® jacket is both waterproof and breathable.

Gore-Tex® is made from a layer of nylon that is laminated with a PTFE polymer membrane.

(a) Use ideas about the structure of Gore-Tex® to explain why it is both waterproof and breathable.

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

(b) Suggest **one** advantage of a Gore-Tex® jacket over one made from only nylon.

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

[Total: 3]

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Question 7 begins on page 10

PLEASE DO NOT WRITE ON THIS PAGE

SECTION B – Module C2

7 This question is about metals and alloys.

(a) Look at the table. It shows some alloys and the metals they contain.

Complete the table.

Alloy	Metal(s) in the alloy
amalgam	.....
.....	copper and zinc
solder	..... and .....

[2]

(b) The alloy duralumin contains aluminium.

Aluminium reacts with oxygen, O_2.

Aluminium oxide, Al_2O_3, is made.

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

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

(c) Look at the table. It shows the properties of some alloys.

Alloy	Density in g/cm^3	Relative strength	Relative cost
A	2.8	high	high
B	8.4	high	medium
C	7.8	high	low
D	2.6	low	low

(i) Evaluate the advantages and disadvantages of these alloys for making aeroplane wings.

Put your answers in the table below.

Alloy	Advantages	Disadvantages
A	....	....
B	....	....
C	....	....
D	....	....

[3]

(ii) Which alloy would you choose?

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

[Total: 8]

8 The structure of the Earth is explained using the theory of plate tectonics.

The continental drift theory was put forward by a scientist called Wegener in 1914.

It has developed into the theory of plate tectonics.

Explain why the theory of plate tectonics is widely accepted by scientists.

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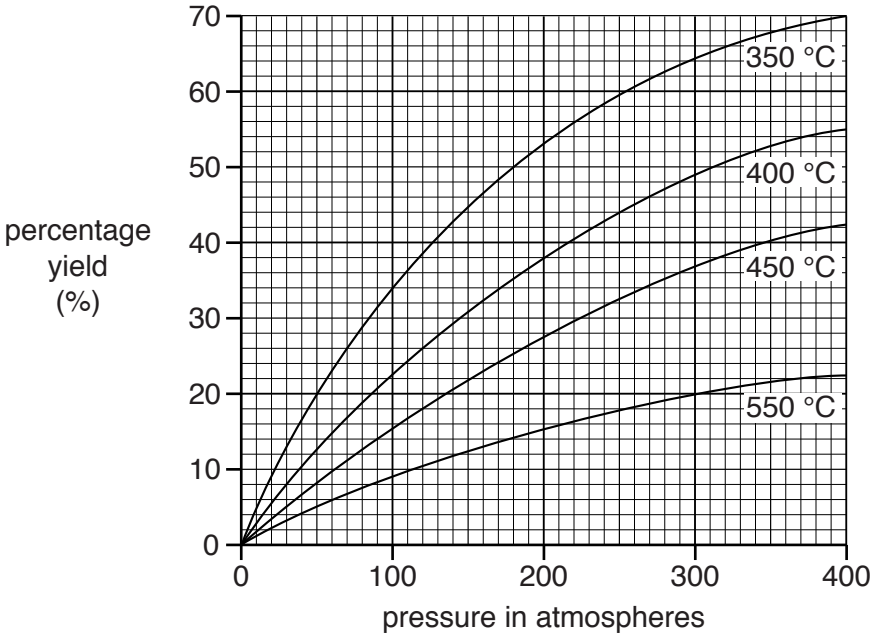
..... **[2]**

[Total: 2]

9 This question is about the conditions used in the Haber process to make ammonia.

Look at the graph.

It shows the yield of ammonia under different conditions of temperature and pressure.



In the manufacture of ammonia, the conditions used are:

- a pressure of 200 atmospheres
- a temperature of 450 °C.

Use the graph to decide the conditions of temperature and pressure that give the **highest** yield of ammonia.

Explain why the conditions that give the highest yield are **not** used in the Haber process.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

10 In 2012 bad weather destroyed farmers' crops in Burma.

The charity called Oxfam helped farmers after the disaster.

Oxfam gave the farmers

- seeds to plant new crops
- fertilisers.

(a) The fertilisers must be dissolved in water.

Explain why.

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

(b) If too much fertiliser is used, it can run off into streams and lakes.

This can cause **eutrophication**.

Explain what happens during eutrophication.

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..... **[3]**

(c) Fertilisers are made by reacting an acid with an alkali.

This is a neutralisation reaction.

Potassium hydroxide reacts with nitric acid.

Write a **word** equation for this reaction.

....	+	....	→	....	+	....

[2]

[Total: 6]

Question 11 begins on page 16

11 This question is about the corrosion of metals.

Look at the table. It shows how four metals corrode in different conditions.

Metal	Does the metal corrode in		
	damp air?	**damp acidic air?**	**dry air?**
A	no	quickly	no
B	slowly	quickly	no
C	very slowly	very slowly	no
D	very quickly	very quickly	quickly

(a) Metal **A** is aluminium.

Explain how you can tell from the information in the table.

.....

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

(b) **(i)** Iron rusts in damp air.

Rust is hydrated iron(III) oxide.

Write the **word** equation for the rusting of iron.

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

(ii) The rusting of iron is an **oxidation** reaction.

Explain why.

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

[Total: 3]

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Question 12 begins on page 18

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SECTION C – Module C3

12 Sodium hydrogencarbonate decomposes when it is heated.

sodium hydrogencarbonate	→	sodium carbonate	+	carbon dioxide	+	water
$2NaHCO_3$	→	Na_2CO_3	+	CO_2	+	H_2O

The table shows the relative formula masses, M_r, of the substances in the equation.

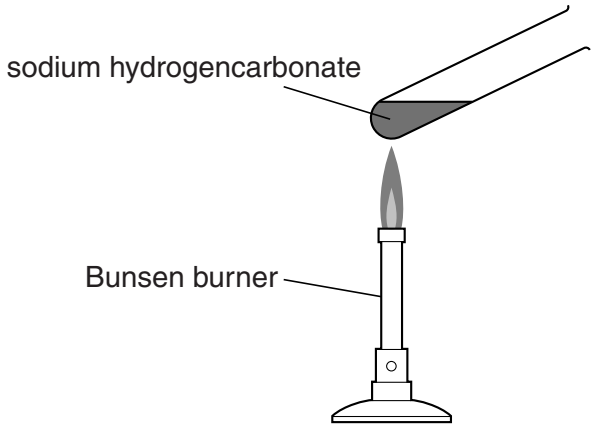
Substance	Relative formula mass
$NaHCO_3$	84
Na_2CO_3	106
CO_2	44
H_2O	18

(a) Use the relative formula masses in the table to show that mass is conserved during this reaction.

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

(b) Zakia heats some sodium hydrogencarbonate.

Look at the apparatus she uses.



Zakia heats 1.000 g of solid sodium hydrogencarbonate.

After heating for ten minutes the test tube contains 0.631 g of solid sodium carbonate.

Zakia does the experiment again.

This time she uses 2.500 g of solid sodium hydrogencarbonate.

(i) Show that the predicted mass of solid sodium carbonate that she should make is 1.578 g.

.....

.....

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

(ii) Zakia actually makes 1.124 g of solid sodium carbonate.

Calculate the percentage yield.

Give your answer to **three significant figures**.

percentage yield = ... % **[2]**

[Total: 5]

13 Phil is a research chemist.

He investigates a new pharmaceutical drug.

Phil extracts the drug from the leaves of a plant.

He purifies the drug and then checks to see if he has made a pure sample.

Phil uses two tests to check the purity of the drug

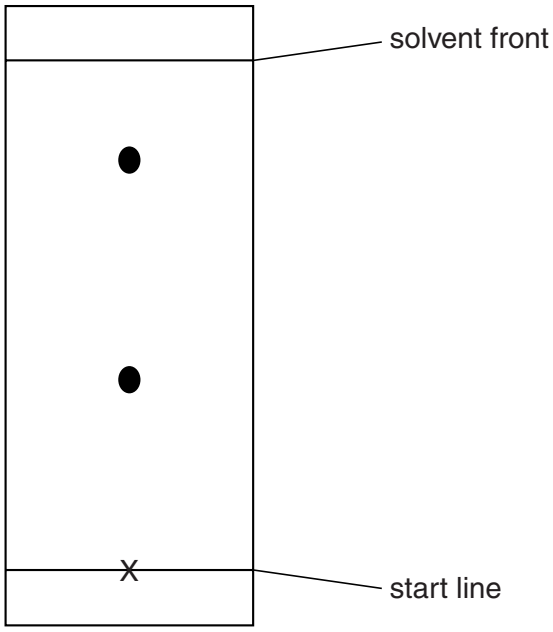
- melting point
- thin layer chromatography.

Look at the results of his tests.

Melting point

Substance	Melting point in °C
pure drug	175
sample of the drug obtained from plant	171 – 173

Thin layer chromatogram of sample of the drug obtained from the plant.



(a) Write about **how** a sample of the drug is obtained from the leaves of a plant.

What do the results of his tests show about the purity of the sample?

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

(b) It is difficult to test and develop new pharmaceutical drugs that are safe to use.

Explain why.

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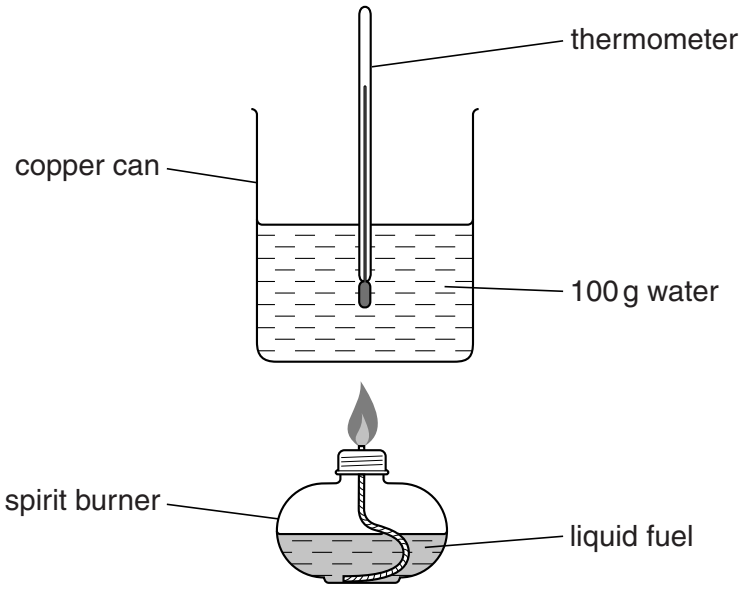
..... **[2]**

[Total: 8]

14 Zak heats 100 g of water using a liquid fuel.

Look at the apparatus he uses.



Zak burns 2.0 g of the liquid fuel.

The energy output of the fuel is 16 000 J/g.

(a) Calculate the energy released when 2.0 g of the liquid fuel is burned.

energy released = ... J **[1]**

(b) The energy released by the liquid fuel is related to the rise in temperature of the water, ΔT.

This relationship is shown by the equation

$$\text{energy released} = \text{mass} \times 4.2 \times \Delta T$$

Calculate the rise in temperature of the water in Zak's experiment.

rise in temperature = ... °C **[3]**

(c) The burning of a liquid fuel is an example of an **exothermic** reaction.

Explain, using ideas about bond breaking and bond making, why this reaction is exothermic.

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..... **[3]**

[Total: 7]

Question 15 begins on page 24

15 Zinc, Zn, reacts with hydrochloric acid, HCl.

Hydrogen gas, H_2, and zinc chloride, ZnCl_2, are made.

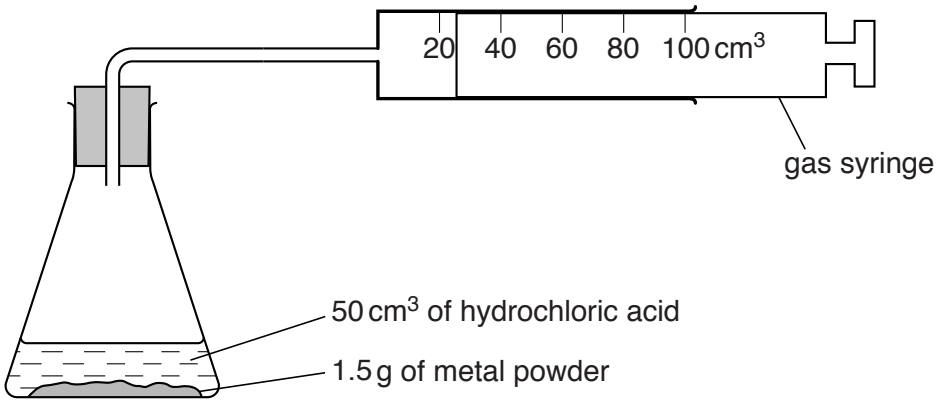
(a) Construct the **balanced symbol** equation for this reaction.

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

(b) Fatimah and Sam investigate the reaction between acid and metals.

They react dilute hydrochloric acid with zinc powder and with iron powder.

Look at the apparatus they use.

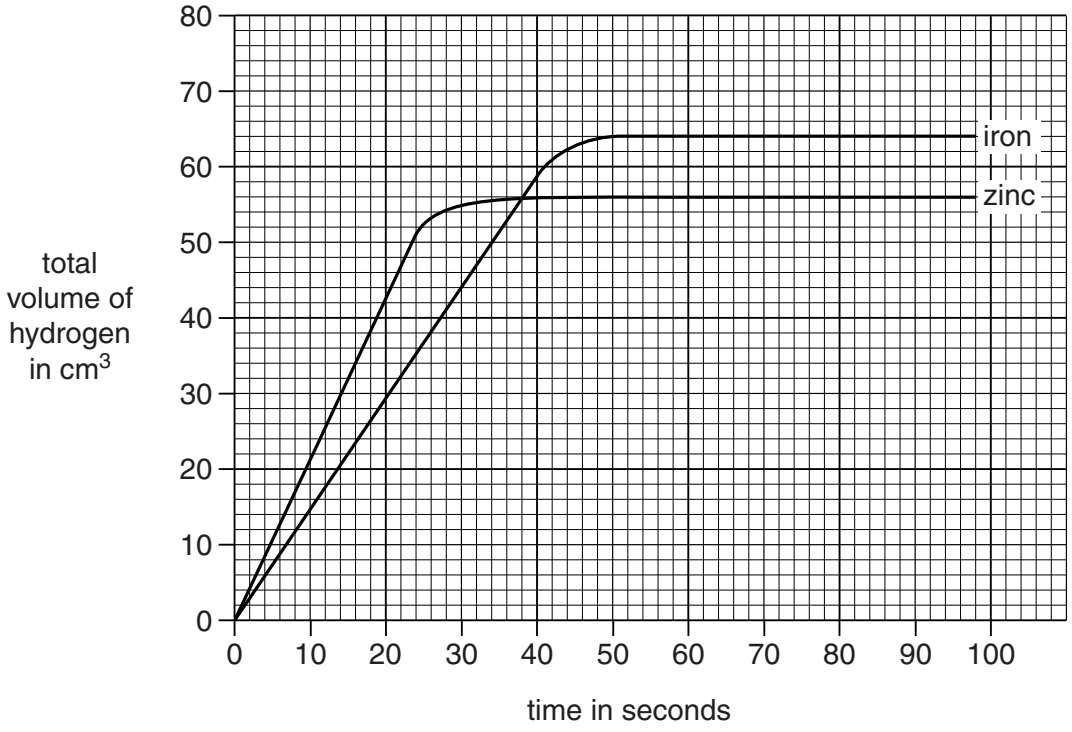


Every 10 seconds they measure the volume of gas in the gas syringe.

Fatimah and Sam do three different experiments.

- 50 cm^3 hydrochloric acid and 0.15 g of zinc
- 50 cm^3 hydrochloric acid and 0.15 g of iron
- 50 cm^3 hydrochloric acid and 0.075 g of iron mixed with 0.075 g of zinc.

Look at the graph of the results for the first two experiments.



(i) Calculate the rate of reaction of **iron** during the **first 30 seconds**.

.....

.....

rate of reaction = ... cm^3/s **[1]**

(ii) Predict the total volume of hydrogen formed when the **mixture** of zinc and iron powder is used.

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

(c) Increasing the concentration of a reactant in solution will increase the rate of reaction.

Use the reacting particle model to explain why.

.....

.....

.....

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

[Total: 5]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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.