OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B642/02

CHEMISTRY B

Unit 2 Modules C4 C5 C6 (Higher Tier)

OCE/11175

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 27 January 2010
Afternoon

Duration: 1 hour

B642 02

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.

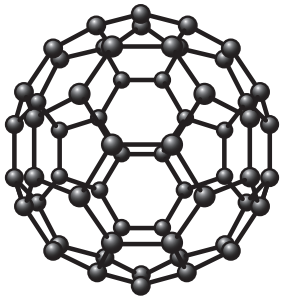
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

Section A – Module C4

1 Fullerenes are one form of carbon.



(a) Which of the following is the molecular formula of Buckminster Fullerene?

Choose from:

C_2 C_8 C_{30} C_{60} C_{68}

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

(b) Fullerenes can be joined together to make nanotubes.

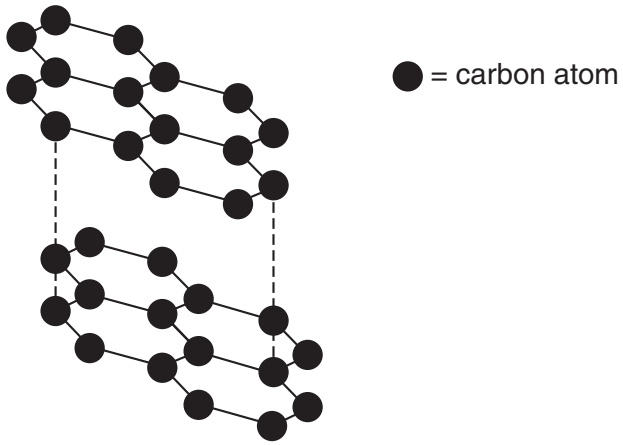
Nanotubes are used to reinforce graphite in tennis rackets.

Write down one **other** use of nanotubes.

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

(c) Graphite is another form of carbon.

Look at the structure of graphite.



Graphite is used as a lubricant because it is slippery.

Explain why graphite is slippery.

Use ideas about structure and bonding.

.....

.....

Graphite also has a high melting point.

Explain why.

Use ideas about structure and bonding.

.....

.....

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

[Total: 5]

2 Farmers use fertilisers to make their plants grow bigger and faster.

Look at the table. It gives information about some fertilisers.

fertiliser	formula	relative formula mass	percentage by mass of nitrogen	percentage by mass of phosphorus	percentage by mass of potassium
ammonium nitrate	NH_4NO_3	80		0	0
ammonium phosphate	$(NH_4)_3PO_4$	149	28	21	0
potassium nitrate	KNO_3	101	14	0	39
potassium phosphate	K_3PO_4	212	0	15	55
urea	$(NH_2)_2CO$		47	0	0

Fertilisers contain one or more of the essential chemical elements.

These elements are nitrogen, phosphorus and potassium.

(a) Explain how the use of fertilisers increases crop yield.

.....

.....

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

(b) Calculate the relative formula mass (M_r) of urea, $(NH_2)_2CO$.

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

.....

.....

.....

.....

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

(c) Calculate the percentage by mass of nitrogen in ammonium nitrate.

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

.....

.....

.....

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

(d) Why do fertilisers need to be soluble in water?

.....

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

(e) Maddy wants to make potassium nitrate by neutralising an acid with an alkali.

She decides to use potassium hydroxide as the alkali.

Which **acid** should she use?

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

[Total: 6]

3 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.

$$CuCO_3 \rightarrow CuO + CO_2$$

Look at the table. It shows the relative formula masses (M_r) of each compound in the equation.

compound	relative formula mass
$CuCO_3$	124
CuO	80
CO_2	44

(a) During any reaction the total mass of the reactants equals the total mass of the products.

This is called the principle of conservation of mass.

Show that mass is conserved in the decomposition of copper carbonate.

Use the equation and the relative formula masses to help.

.....

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

(b) Tim investigates the decomposition of copper carbonate.

He predicts he should make 3.69 g of copper oxide.

Tim actually makes 3.32 g of copper oxide.

Calculate his percentage yield.

.....

.....

.....

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

(c) Jack heats 6.20 g of copper carbonate.

Calculate the mass of copper oxide that he should make.

Use the relative formula masses in the table.

.....

.....

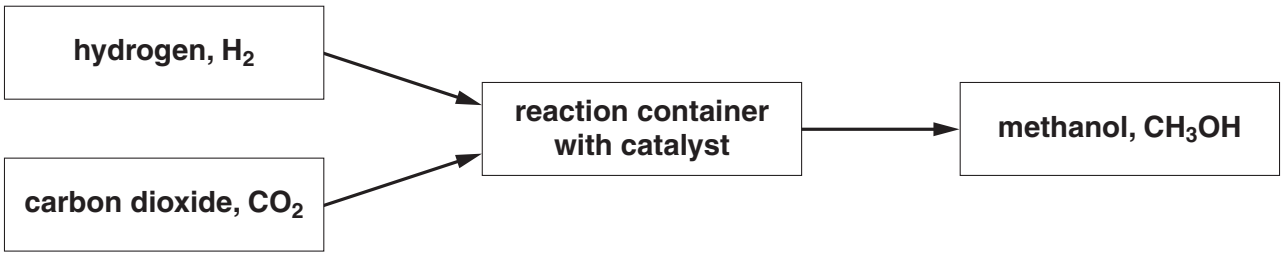
.....

mass of copper oxide = ... g **[2]**

[Total: 5]

4 Methanol is an important **solvent**.

Look at the flow chart. It shows how methanol can be made.



(a) Write the **word** equation for the making of methanol.

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

(b) The use of a catalyst reduces the cost of making methanol.

Describe how.

.....

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

(c) Look at the table. It gives some information about making methanol.

	catalyst used	**temperature used in °C**	**pressure used in atmospheres**
method 1	a mixture of zinc oxide and chromium(III) oxide	400	300
method 2	copper based substance	250	70

Both methods use the reaction between carbon dioxide and hydrogen to make methanol.

Making methanol using **method 2** is **cheaper** than using method 1.

Suggest **two** reasons why.

1 .....

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

[Total: 4]

Section B – Module C5

5 This question is about precipitation reactions.

(a) Lead nitrate solution reacts with potassium iodide solution.

A bright yellow precipitate is made.

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

Raj mixes lead nitrate solution with potassium iodide solution.

He wants to get a pure **dry** sample of lead iodide, PbI_2, from this mixture.

Write down **two** steps needed to get a pure dry sample.

1 .....

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

(b) Barium chloride solution reacts with sodium sulfate solution.

This is a precipitation reaction.

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

$\rightarrow$

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

(c) A solution of sodium chloride reacts with a solution of silver nitrate.

Solid sodium chloride does not react with **solid** silver nitrate.

Explain why the solutions react but the solids do not.

Use ideas about collisions between ions.

.....

.....

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

[Total: 5]

6 Hydrochloric acid, HCl, is a strong acid.

Ethanoic acid, CH_3COOH, is a weak acid.

(a) Hydrochloric acid **completely** ionises in water.

$$HCl \longrightarrow H^+ + Cl^-$$

Ethanoic acid, CH_3COOH, only **partially** ionises in water to make an **equilibrium** mixture.

Write a symbol equation to show this ionisation of ethanoic acid.

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

(b) Ellen investigates the properties of these two acids.

In each experiment Ellen uses the same concentration of acid.

Look at Ellen's results table.

test	**result with dilute hydrochloric acid**	**result with dilute ethanoic acid**
pH value	1	4
reaction with magnesium ribbon	bubbles rapidly to make hydrogen	bubbles slowly to make hydrogen

Dilute hydrochloric acid reacts much faster than dilute ethanoic acid.

Explain why. Use ideas about collisions between ions.

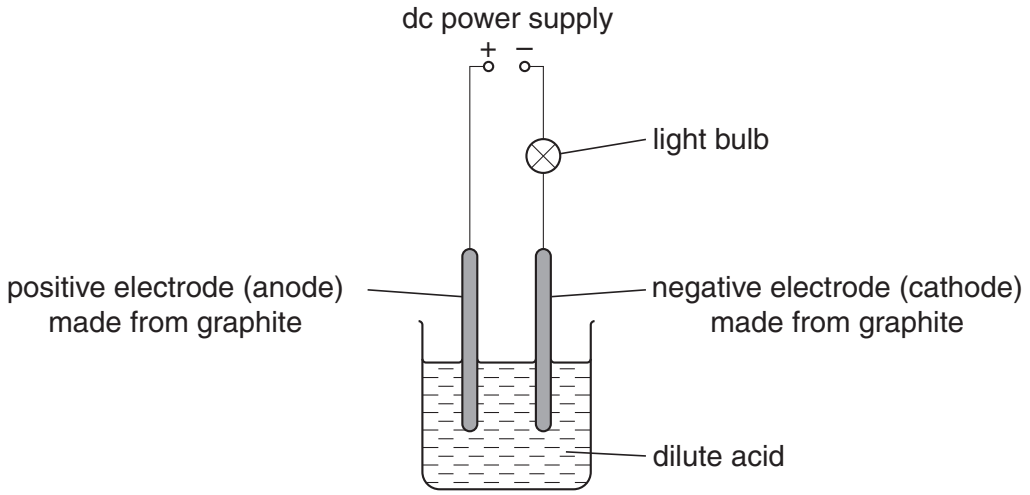
.....

.....

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

(c) Ellen also investigates the electrolysis of the two acids.

Look at the apparatus she uses.



Ellen electrolyses dilute **ethanoic** acid.

She then electrolyses dilute **hydrochloric** acid.

Ellen uses the same concentration of both acids.

She finds that the light bulb glows much more brightly with dilute hydrochloric acid.

Explain why.

Use ideas about ions.

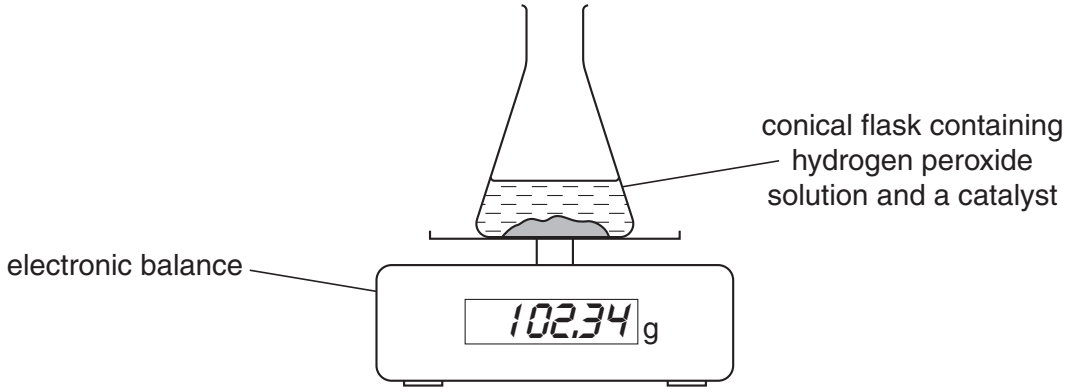
..... **[1]**

[Total: 5]

7 Hydrogen peroxide solution decomposes when a catalyst is added to it.

$$\text{hydrogen peroxide} \longrightarrow \text{oxygen} + \text{water}$$

Look at the diagram.



Elliott measures the mass of the contents of the conical flask at the start of the reaction.

Once the reaction has finished he measures the mass of the contents of the conical flask again.

Look at the results table.

	mass in grams
contents of conical flask at start of reaction	102.34
contents of conical flask at end of reaction	102.24

(a) The mass of one mole of oxygen molecules is 32 g.

(i) Calculate the amount, in moles, of oxygen made in this experiment.

.....

.....

amount = ... mol **[1]**

(ii) In another experiment 0.0025 moles of oxygen molecules are made.

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

Calculate the volume of 0.0025 moles of oxygen molecules at room temperature and pressure.

.....

.....

volume = ... dm^3 **[1]**

(b) Elliott wants to measure the **volume** of oxygen made.

Draw a labelled diagram of the apparatus that he could use.

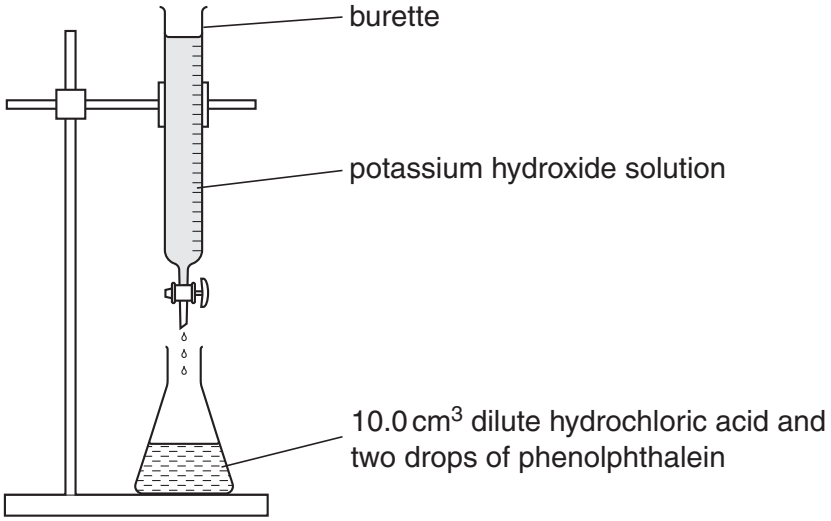
[2]

[Total: 4]

8 This question is about acid-base titrations.

Aliena wants to find out the concentration of potassium hydroxide solution needed to neutralise 10.0 cm^3 of 0.200 mol/dm^3 hydrochloric acid.

Look at the apparatus she uses.



She adds potassium hydroxide solution slowly until the phenolphthalein changes colour.

She repeats the experiment three more times.

Look at Aliena's results table.

titration number	**1**	**2**	**3**	**4**
final burette reading in cm^3	26.9	27.6	27.0	28.2
initial burette reading in cm^3	0.5	2.5	1.2	3.2
titre (volume of acid used) in cm^3	26.4	25.1	25.8	25.0

(a) Aliena decides to use only the results from titration numbers **2** and **4**.

Explain why.

.....

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

(b) Look at the equation for the reaction between potassium hydroxide and hydrochloric acid.

$$KOH + HCl \longrightarrow KCl + H_2O$$

Calculate the **concentration** of potassium hydroxide in mol/dm^3.

These steps may help.

Work out the

- number of moles in $10.0\,cm^3$ of $0.200\,mol/dm^3$ hydrochloric acid
- number of moles of potassium hydroxide neutralised
- average titre, in cm^3, using titration numbers **2** and **4**.

.....

.....

.....

.....

.....

.....

concentration of potassium hydroxide = ... mol/dm^3 **[4]**

(c) The pH value of the dilute hydrochloric acid increases as more potassium hydroxide is added.

Explain why.

.....

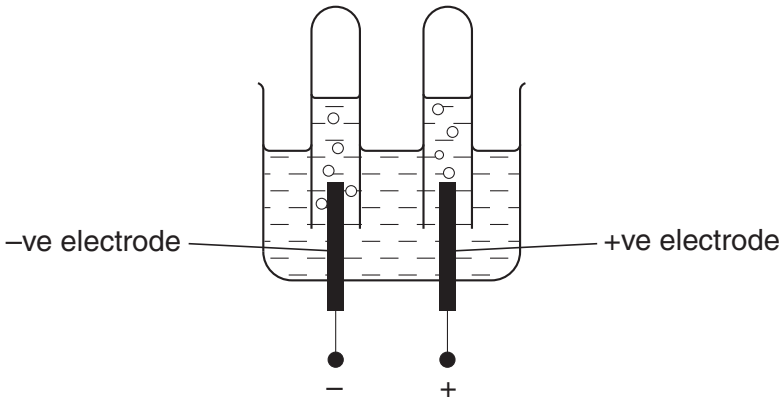
..... **[1]**

[Total: 6]

Section C – Module C6

9 Sarah investigates the electrolysis of concentrated sodium chloride solution.

Look at the apparatus she uses.



Bubbles of gas are made at both electrodes.

Write down the name of the **gas** made at each electrode.

Choose from the list.

Complete the table.

carbon dioxide

chlorine

hydrogen

nitrogen

oxygen

electrode	name of gas
anode	.....
cathode	.....

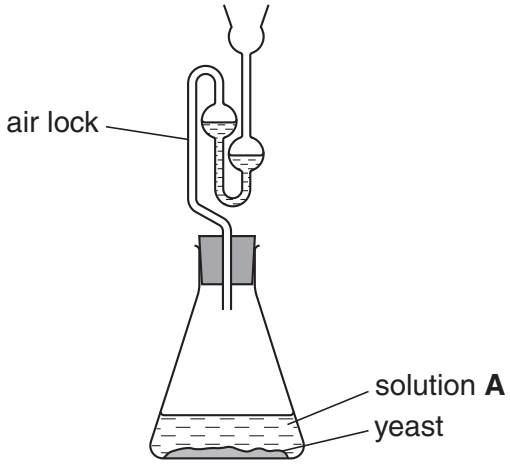
[2]

[Total: 2]

10 Sarah and Daniel investigate fermentation.

Look at the diagram.

It shows the apparatus they use.



(a) Ethanol is made by fermentation.

Yeast and solution **A** are used to make ethanol.

Write down the name of solution **A**.

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

(b) A gas is made during fermentation.

Write down the name of this gas.

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

(c) Fermentation works best under these specific conditions:

- a temperature between 25 – 50 °C
- in the absence of oxygen.

Explain why these conditions lead to successful fermentation.

temperature between 25 – 50 °C .....

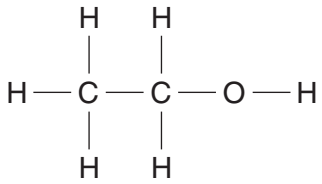
.....

absence of oxygen .....

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

Turn over for the remainder of question 10

(d) Look at the **displayed formula** of ethanol.

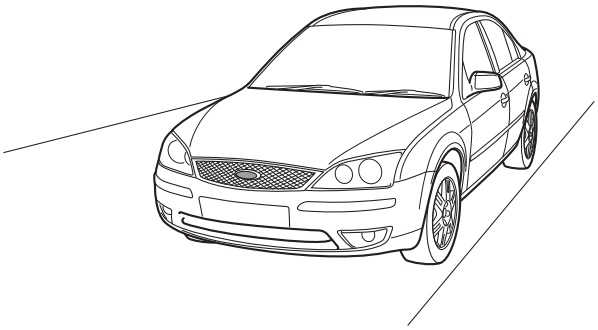


Write down the **molecular formula** of ethanol.

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

[Total: 5]

11 Look at the picture of a car.



(a) Some of the car body is made of iron.

One disadvantage of using iron is that it rusts.

Oxygen and water are needed for rusting to happen.

Hydrated iron(III) oxide is made.

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

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

(b) What **type** of reaction is rusting?

Choose from the list.

dehydration

displacement

electrolysis

redox

saponification

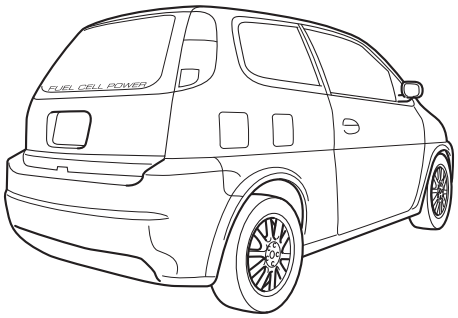
answer ..... **[1]**

[Total: 2]

12 Look at the picture of another car.

It is powered by a fuel cell.

Oxygen and hydrogen are used in the fuel cell to produce electric current.



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

hydrogen + oxygen → water

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

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

(b) A car using a fuel cell as a source of power has benefits.

One benefit is that it causes less pollution compared with conventional fuels.

Write down two **other** benefits of using a fuel cell.

1 .....

.....

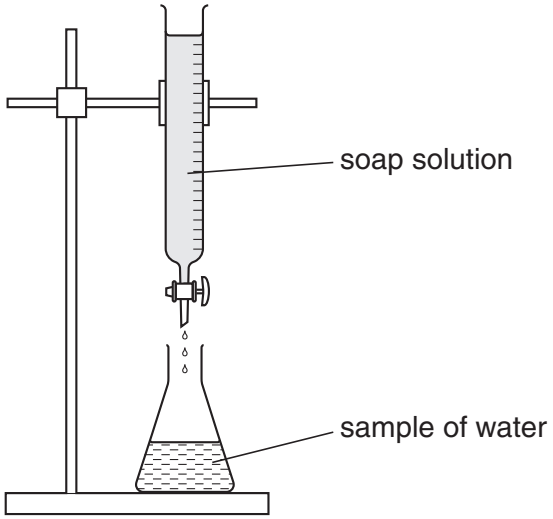
2 .....

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

[Total: 4]

13 This question is about hardness in water.

Luke and Henry investigate the hardness of three different samples of water.



They do this by adding drops of soap solution to each sample of water.

They add soap until lather remains on the surface after shaking.

Look at their table of results.

sample of water	volume of soap added in cm^3
tap water	30
river water	28
boiled tap water	15
distilled water	5

(a) Tap water contains **both** temporary hardness and permanent hardness.

Explain how you can tell from the results.

.....

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

(b) The water in some parts of the country is very hard.

Boiling this water in kettles produces limescale.

A weak acid removes the limescale.

Explain how the limescale is removed.

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

Turn over for the remainder of question 13

(c) Hardness in tap water is caused by calcium ions, Ca^{2+}, and magnesium ions, Mg^{2+}.

When tap water passes through an ion-exchange column the tap water becomes softer.

The column contains a resin with sodium ions, Na^{+}, on it.

Explain how this ion-exchange column softens hard water.

.....

.....

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

[Total: 4]

14 This question is about fats and oils.

(a) Animal fats and oils are often saturated.

Vegetable fats and oils are often unsaturated.

Unsaturated fats and oils are healthier to eat.

Explain why.

.....

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

(b) Unsaturated fats and oils contain at least one double bond between carbon atoms.

Bromine water can detect double bonds in unsaturated fats and oils.

Explain how.

.....

.....

.....

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

[Total: 3]

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.