



GENERAL CERTIFICATE OF SECONDARY EDUCATION
GATEWAY SCIENCE
CHEMISTRY B

Unit 2 Modules C4 C5 C6 (Foundation Tier)

FRIDAY 25 JANUARY 2008

F
B642/01

Morning
 Time: 1 hour

Candidates answer on the question paper.

Additional materials (enclosed):

None

Calculators may be used.

Additional materials: Pencil
 Ruler (cm/mm)



Candidate
 Forename

Candidate
 Surname

Centre
 Number

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Candidate
 Number

| | | | |
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| | | | |
|--|--|--|--|

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.

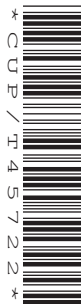
INFORMATION FOR CANDIDATES

- 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 **60**.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE

| Section | Max. | Mark |
|--------------|-----------|------|
| A | 20 | |
| B | 20 | |
| C | 20 | |
| TOTAL | 60 | |

This document consists of **20** printed pages.



Answer **all** the questions.

Section A – Module C4

- 1** Potassium sulfate and ammonium nitrate are both fertilisers.

Potassium sulfate has the formula K_2SO_4 .

Ammonium nitrate has the formula NH_4NO_3 .

Fertilisers contain one or more of the essential elements needed by plants.

- (a)** Ammonium nitrate contains the essential element nitrogen.

Potassium sulfate, K_2SO_4 , contains another one of these essential elements.

Which one?

..... [1]

- (b)** What is the total number of atoms shown in the formula K_2SO_4 ?

..... [1]

- (c)** Ammonium nitrate has a relative formula mass (M_r) of 80.

What is the relative formula mass of potassium sulfate, K_2SO_4 ?

The relative atomic mass of O is 16, of S is 32 and of K is 39.

.....
.....
.....

relative formula mass = [1]

3

(d) Potassium sulfate dissolves in water.

A **neutral** solution is made.

(i) What is the pH of potassium sulfate solution?

Choose from the list.

5

7

8

14

answer [1]

(ii) Why is it important that a fertiliser dissolves in water?

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

(e) Clare makes ammonium nitrate.

She neutralises 25.0 cm^3 of an alkali called ammonia.

She slowly adds an acid until the alkali is just neutralised.

(i) What is the name of the acid she must use?

Choose from the list.

hydrochloric acid

nitric acid

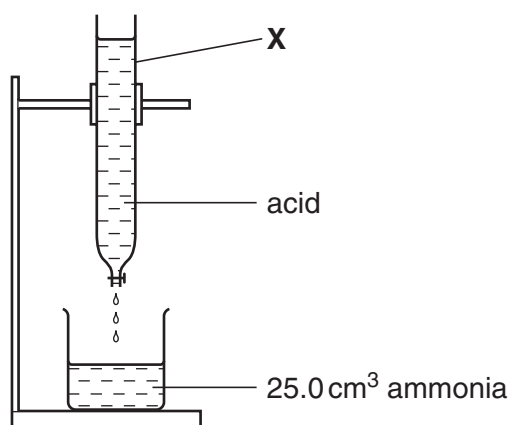
phosphoric acid

sulfuric acid

answer [1]

4

(ii) Look at the apparatus she uses.



What is the name of the apparatus labelled **X**?

..... [1]

(iii) Clare makes 0.45 g of ammonium nitrate.

She predicts she should make 0.50 g.

What is her percentage yield?

.....
.....
.....

percentage yield = % [2]

[Total: 9]

5

2 This question is about the manufacture of chemicals.

(a) Lots of ammonia is manufactured each year in the United Kingdom.

Ammonia is made by the reaction of nitrogen and hydrogen in a continuous process.

The conditions used for this reaction are

- 450 °C
- high pressure
- iron catalyst.

One of the costs of making ammonia is buying the raw materials.

Write about **two** other costs of making ammonia.

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

(b) A new anti-cancer drug is made from a rare plant only found in South America.

Less than 100 kg of the drug is made each year.

It is made in a batch process.

(i) What is the difference between a continuous process and a batch process?

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

(ii) The cost of manufacturing and developing the drug is very high.

Write about some of the reasons why this cost is very high.

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

[Total: 5]

- 3 In the year 2006 many areas of the United Kingdom suffered drought conditions.

Water companies take water from rivers and store it in reservoirs.

Unfortunately in the year 2006 many rivers were almost dry.

Reservoirs were often less than half full.

- (a) Look at the table.

It shows the annual rainfall in 1998 and 2001 for some regions of the United Kingdom.

| region | rainfall in 1998 in mm | rainfall in 2001 in mm |
|--------------|---------------------------|---------------------------|
| Anglia | 713 | 731 |
| Northumbria | 1039 | 807 |
| North West | 1435 | 1081 |
| Severn Trent | 885 | 767 |
| Southern | 875 | 865 |
| South West | 1428 | 1008 |
| Thames | 812 | 779 |
| Wales | 1642 | 1250 |
| Wessex | 1005 | 825 |
| Yorkshire | 964 | 787 |

- (i) Which region had the **most** rainfall in the year 2001?

..... [1]

- (ii) One region had **more** rainfall in the year 2001 than in 1998.

Which one?

..... [1]

7

- (b) Rivers and reservoirs are two sources of drinking water.

Write down the name of one **other** source of drinking water in the United Kingdom.

..... [1]

- (c) Water from rivers sometimes contains dangerous microbes.

These must be killed before the water is safe to drink.

How are these microbes killed when water is purified?

..... [1]

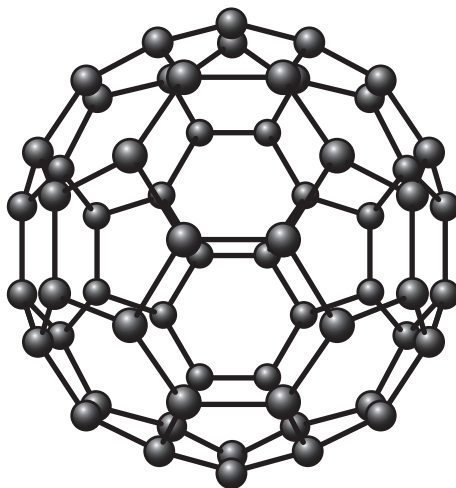
[Total: 4]

8

4 This question is about fullerenes and nanotubes.

(a) Look at the diagram of a fullerene.

It is called buckminster fullerene.



Buckminster fullerene is an element.

Which element?

..... [1]

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

Nanotubes are used to make semiconductors and to reinforce graphite in sports equipment.

Put a tick (✓) in the box next to a correct property of nanotubes.

electrical insulator

☐

soluble in water

☐

strong

☐

very low melting point

☐

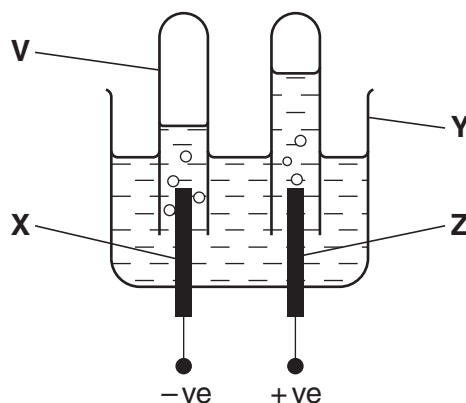
[1]

[Total: 2]

Section B – Module C5

- 5 Hannah investigates the electrolysis of aqueous potassium sulfate.

Look at the apparatus she uses.



- (a) Look at the table. It shows some of the names of the apparatus used.

Finish the table.

| name of apparatus | letter |
|-------------------|--------|
| anode | |
| cathode | |
| test tube | |

[3]

- (b) There are bubbles of gas made at both electrodes.

What are the names of the **two** gases made during this electrolysis?

Choose from the list.

carbon dioxide

hydrogen

nitrogen

oxygen

sulfur dioxide

answer and [2]

[Total: 5]

6 Monty investigates the properties of two acids

- dilute ethanoic acid, CH_3COOH
- dilute hydrochloric acid, HCl .

(a) How many different **elements** are chemically bonded in ethanoic acid?

..... [1]

(b) Describe how Monty can measure the pH value of dilute ethanoic acid.

.....

..... [2]

(c) Monty adds a small piece of magnesium ribbon to a sample of dilute ethanoic acid.

Look at the word equation for this reaction.



A gas is made when magnesium reacts with ethanoic acid.

What is the name of this gas?

..... [1]

(d) Ethanoic acid and hydrochloric acid both react with calcium carbonate.

A gas is made when these acids react with calcium carbonate.

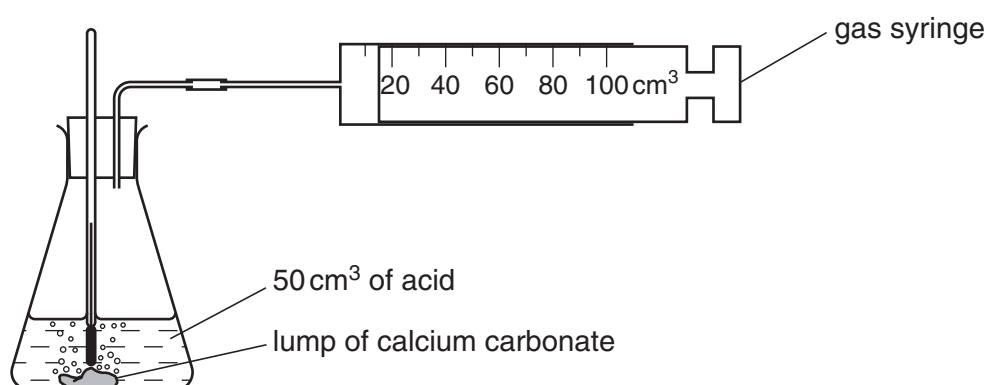
What is the name of this gas?

..... [1]

(e) Monty investigates the reaction of both acids with a lump of calcium carbonate.

He wants to find out the volume of gas made every 10 seconds.

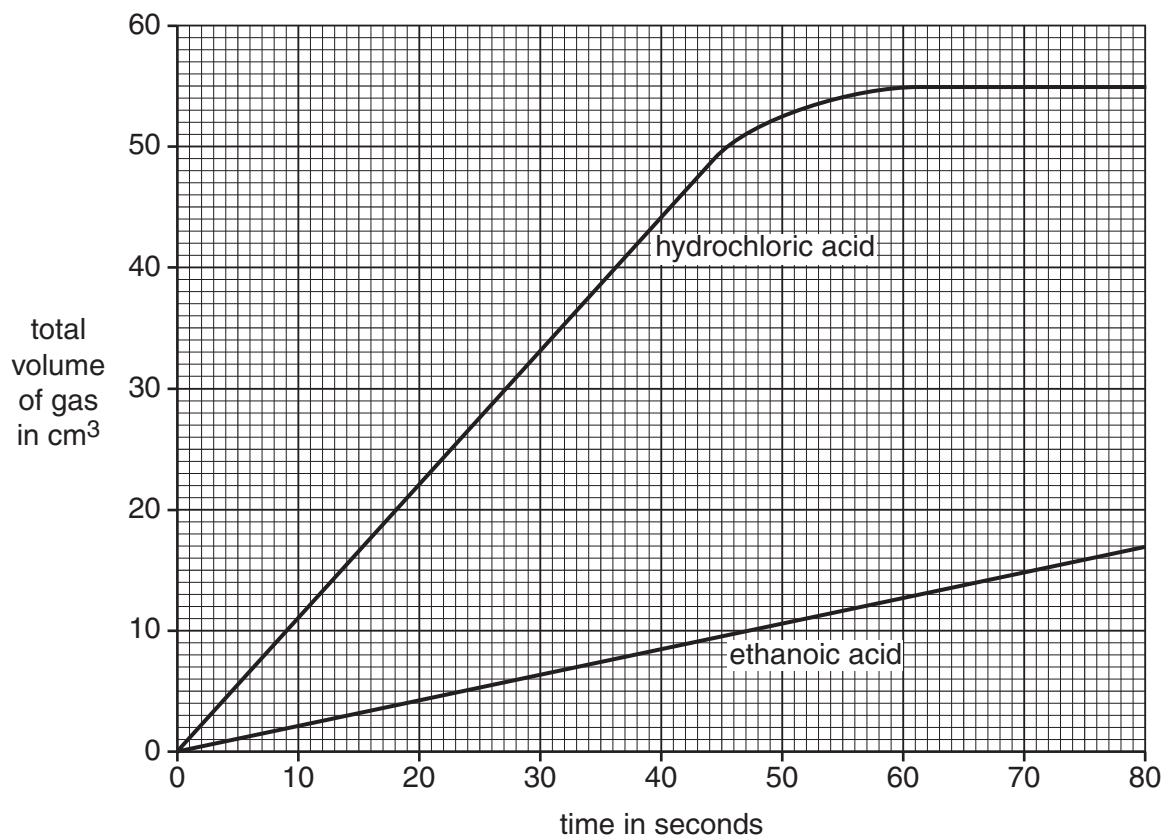
Look at the apparatus he uses.



He does two experiments, one with dilute ethanoic acid and one with dilute hydrochloric acid.

He makes sure he does a fair test.

Look at the graph of his results.



(i) Which acid reacts faster?

.....

Use the graph to explain your answer.

.....

..... [1]

(ii) How long does it take for the reaction with hydrochloric acid to stop?

..... seconds [1]

(iii) The reaction between calcium carbonate and ethanoic acid is still happening after 80 seconds.

What will be the total volume of gas collected at the **end** of this reaction?

..... cm³ [1]

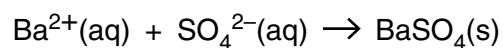
[Total: 8]

7 Zoe tests an unknown solution.

(a) She uses barium ions in solution to test for sulfate ions.

Look at the ionic equation.

It shows the reaction between barium ions and sulfate ions.



(i) What is the meaning of (s) in $\text{BaSO}_4(\text{s})$?

..... [1]

(ii) What is the meaning of (aq) in $\text{Ba}^{2+}(\text{aq})$?

..... [1]

(b) Zoe tests the unknown solution again.

This time she adds silver nitrate solution.

She sees a pale yellow precipitate.

Which ion is in the solution?

Choose from the list.

chloride, Cl^-

bromide, Br^-

iodide, I^-

answer [1]

[Total: 3]

- 8 This question is about equilibrium and reversible reactions.

Ethene reacts with steam in a reversible reaction to make ethanol.



This reversible reaction can reach equilibrium if it is in a sealed container.

- (a) At equilibrium there is a connection between the rate of the forward reaction and the rate of the backward reaction.

What is this connection?

..... [1]

- (b) What happens to the concentration of ethene and of water at equilibrium?

..... [1]

- (c) Look at the table.

It shows how the percentage of ethene at equilibrium changes as the **temperature** changes and as the **pressure** changes.

| | temperature | | |
|----------------|-------------|--------|--------|
| pressure | 200 °C | 260 °C | 320 °C |
| 30 atmospheres | 37% | 26% | 21% |
| 40 atmospheres | 40% | 30% | 25% |
| 50 atmospheres | 44% | 35% | 30% |
| 60 atmospheres | 48% | 40% | 34% |

- (i) Look at the row at 30 atmospheres.

What happens to the percentage of ethene as the temperature increases?

..... [1]

- (ii) What happens to the percentage of ethene as the pressure increases but the temperature stays the same?

..... [1]

[Total: 4]

Section C – Module C6

- 9 People living in hard water areas find they use more soap when washing.

The hardness of water can be measured by adding soap to the water until it makes permanent bubbles.

Look at the table.

It shows the results for some samples of water.

The volume of water in each sample was the same.

| | sample of water | | | |
|---|-----------------|---|----|----|
| | distilled water | A | B | C |
| volume of soap added to cold water in cm ³ | 3 | 3 | 15 | 14 |
| volume of soap added to boiled water in cm ³ | 3 | 3 | 15 | 3 |

- (a) (i) Which sample of water shows **permanent** hardness?

Choose from **A**, **B** or **C**.

answer

[1]

- (ii) Which sample of water shows **temporary** hardness?

Choose from **A**, **B** or **C**.

answer

[1]

(b) Look at the list.

calcium hydrogencarbonate

calcium sulfate

ethanoic acid

sodium chloride

sodium hydroxide

(i) Write down the name of a substance that causes **permanent** hardness.

Choose from the list.

answer [1]

(ii) Write down the name of a substance that causes **temporary** hardness.

Choose from the list.

answer [1]

(iii) Hard water causes limescale to form on the heating element of a kettle.

Write down the name of a substance that could be used as a limescale remover.

Choose from the list.

answer [1]

[Total: 5]

10 Chlorofluorocarbons, CFCs, are substances that damage the ozone layer.

$\text{CFC}l_3$ is the formula for a chlorofluorocarbon.

(a) Write down the **names** of the three elements found in $\text{CFC}l_3$.

element 1

element 2

element 3

[2]

(b) What is the main use of CFCs?

Choose from the list.

cooking oil

disinfectants

refrigerants

rocket fuel

answer [1]

(c) Damage to the ozone layer causes increased levels of ultraviolet light.

This can lead to medical problems.

Write about **two** of these medical problems.

.....

.....

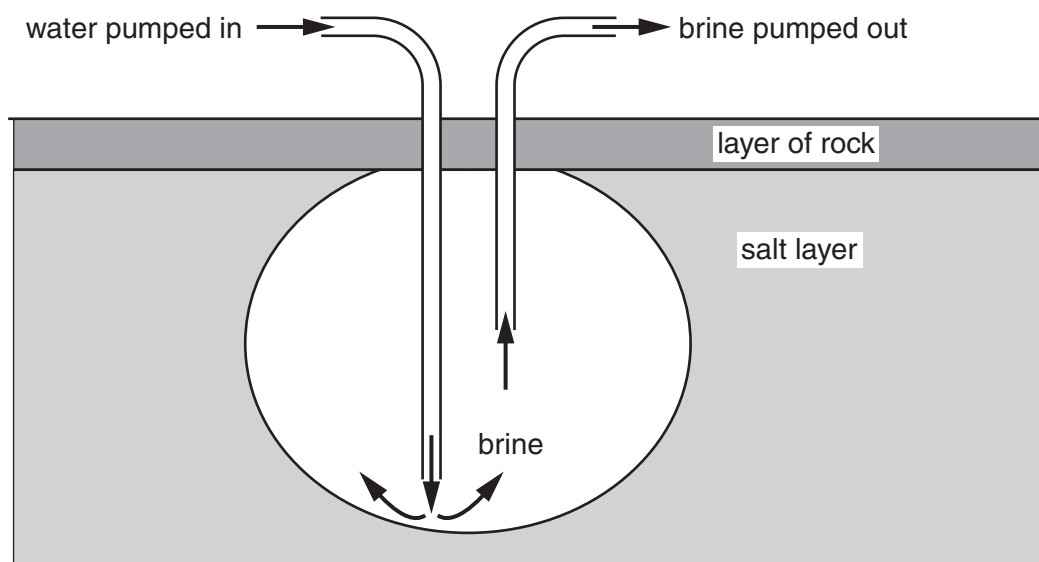
..... [2]

[Total: 5]

11 Brine is a solution of sodium chloride.

Solution mining is used to get brine out of the ground.

Look at the diagram of solution mining.



(a) Write about one major environmental problem caused by solution mining.

..... [1]

(b) Hydrogen and chlorine can be obtained by the electrolysis of brine.

(i) Describe a chemical test for hydrogen gas.

test

result

..... [2]

(ii) Describe a chemical test for chlorine gas.

test

result

..... [2]

[Total: 5]

18

12 Ethanol is made by the fermentation of glucose.

Carbon dioxide is also made in the process.

(a) Complete the **word** equation for fermentation.

glucose \rightarrow + [1]

(b) What is the best temperature for fermentation to happen?

Choose from the list.

0 °C

40 °C

100 °C

400 °C

answer [1]

(c) Fermentation makes a dilute solution of ethanol.

What method of separation could be used to get almost pure ethanol?

Choose from the list.

crystallisation

electrolysis

evaporation

filtration

fractional distillation

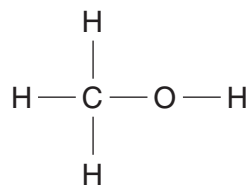
answer [1]

19

(d) Write down **one** of the uses of ethanol.

..... [1]

(e) Look at the displayed formula for methanol, CH_3OH .



Draw the displayed formula of ethanol, $\text{C}_2\text{H}_5\text{OH}$.

[1]

[Total: 5]

END OF QUESTION PAPER

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The Periodic Table of the Elements

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20

| | | | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|---|-------------------------------------|-------------------------------|----------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|---|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|----------------------------|------------------------|
| 1 | 2 | 3 | | | | | | | | | | 4 | 5 | 6 | 7 | 0 | | |
| | | Key | | | | | | | | | | 1 H hydrogen 1 | | | | | | 4 He helium 2 |
| | | relative atomic mass atomic symbol name atomic (proton) number | | | | | | | | | | | | | | | | |
| 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 | | | | | | | |

* 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.