OCR
RECOGNISING ACHIEVEMENT

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B642/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

CHEMISTRY B

Unit 2 Modules C4 C5 C6 (Higher Tier)

FRIDAY 25 JANUARY 2008

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	

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 **21** printed pages and **3** blank pages.

[Turn over

2
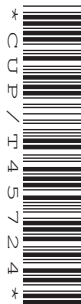
Answer **all** the questions.

Section A – Module C4

1 Ammonium sulfate and ammonium nitrate are both fertilisers.

Ammonium sulfate has the formula $(NH_4)_2SO_4$.

Ammonium nitrate has the formula NH_4NO_3.

(a) What is the total number of **atoms** shown in the formula $(NH_4)_2SO_4$?

.... [1]

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

What is the relative formula mass of ammonium sulfate?

The relative atomic mass of H is 1, of N is 14, of O is 16, and of S is 32.

....

....

....

relative formula mass = ...   [1]

Ammonium nitrate contains 35% by mass of nitrogen.

What is the percentage by mass of nitrogen in ammonium sulfate?

....

....

percentage by mass = ...   [1]

(c) Ammonium sulfate dissolves in water.

Why is it important that a fertiliser dissolves in water?

....

.... [1]

3

(d) Clare makes ammonium nitrate.

Look at the apparatus she uses.

acid
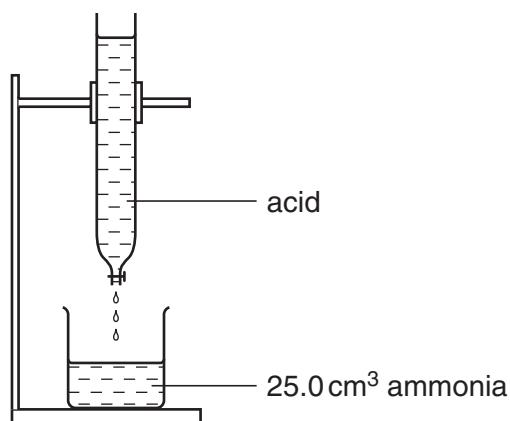
25.0 cm^3 ammonia

She uses 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]

(ii) The pH value in the beaker changes as the acid is added.

Describe how the pH value changes.

....

Explain why.

....

....

.... [2]

[Turn over for remainder of question 1

4

(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) Many millions of tonnes of ammonia are 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.

Explain why these conditions are chosen.

Use ideas about rate of reaction and percentage yield in your answer.

....

....

....

....

.... [3]

(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.

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

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

....

....

.... [2]

(c) The anti-cancer drug is made in a batch process rather than a continuous one.

Suggest one reason why.

....

.... [1]

[Total: 6]

[Turn over

3 Washing up liquids contain a detergent.

Washing up liquid will clean plates covered in fat.

(a) Look at the diagram of a detergent molecule.

Label the diagram to show

- the hydrophilic part of the molecule

- the hydrophobic part of the molecule.

[1]

(b) Detergent molecules help to remove fat from a dirty plate.

Explain how.

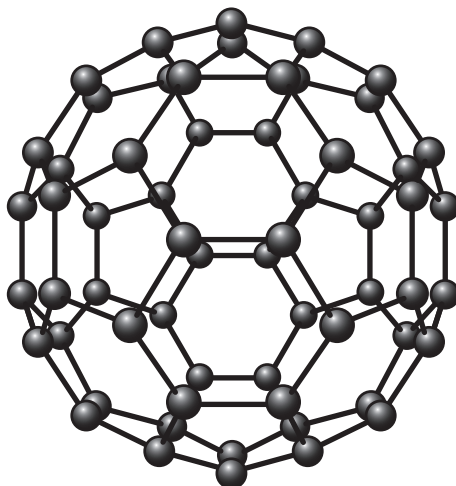A labelled diagram will help you to answer this question.

....

....

....

.... [2]

[Total: 3]

4 This question is about fullerenes and nanotubes.

(a) Look at the diagram of a fullerene.

It is called buckminster fullerene.

What is the chemical formula of buckminster fullerene?

.... [1]

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

Nanotubes are used to make very effective industrial catalysts.

Give **one** reason why.

.... [1]

[Total: 2]

[Turn over

8

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9

Section B – Module C5

5 Hannah investigates the electrolysis of aqueous potassium sulfate.

Look at the apparatus she uses.

cathode ⎯ anode

−ve   +ve
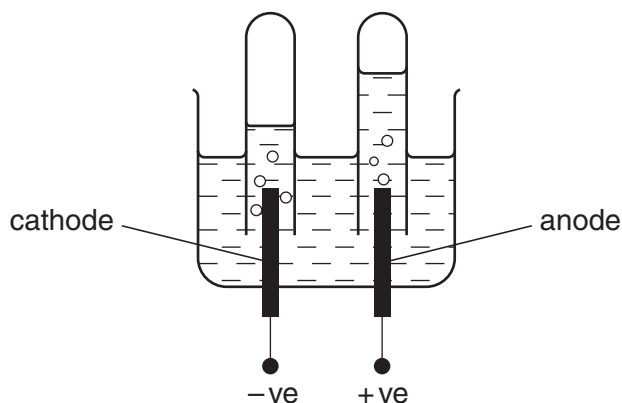
(a) There are bubbles of gas made at both electrodes.

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]

(b) Write down **two** factors that affect the amount of gas made when aqueous potassium sulfate is electrolysed.

1 ....

2 .... [2]

[Total: 4]

[Turn over

6 Monty investigates the properties of two acids

- dilute ethanoic acid, CH_3COOH

- dilute hydrochloric acid, HCl.

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

Monty sees bubbles of a gas. At the end of the reaction a colourless solution is left.

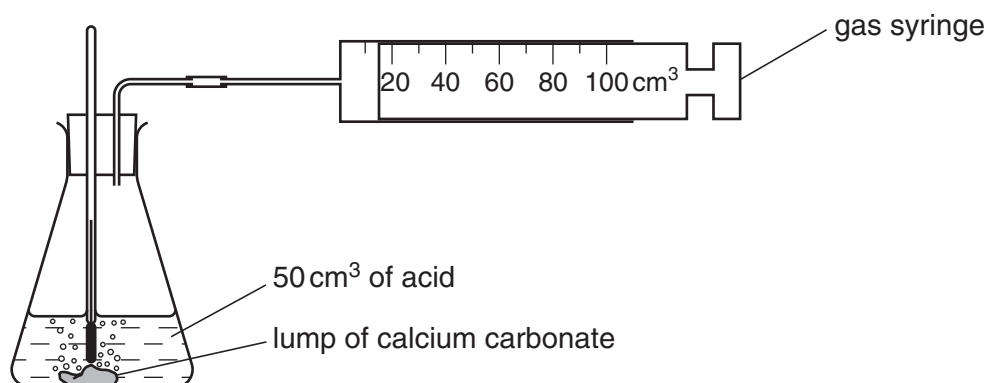The colourless solution contains magnesium ethanoate, $Mg(CH_3COO)_2$.

Write down the balanced **symbol** equation for the reaction between magnesium and ethanoic acid.

.... [2]

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

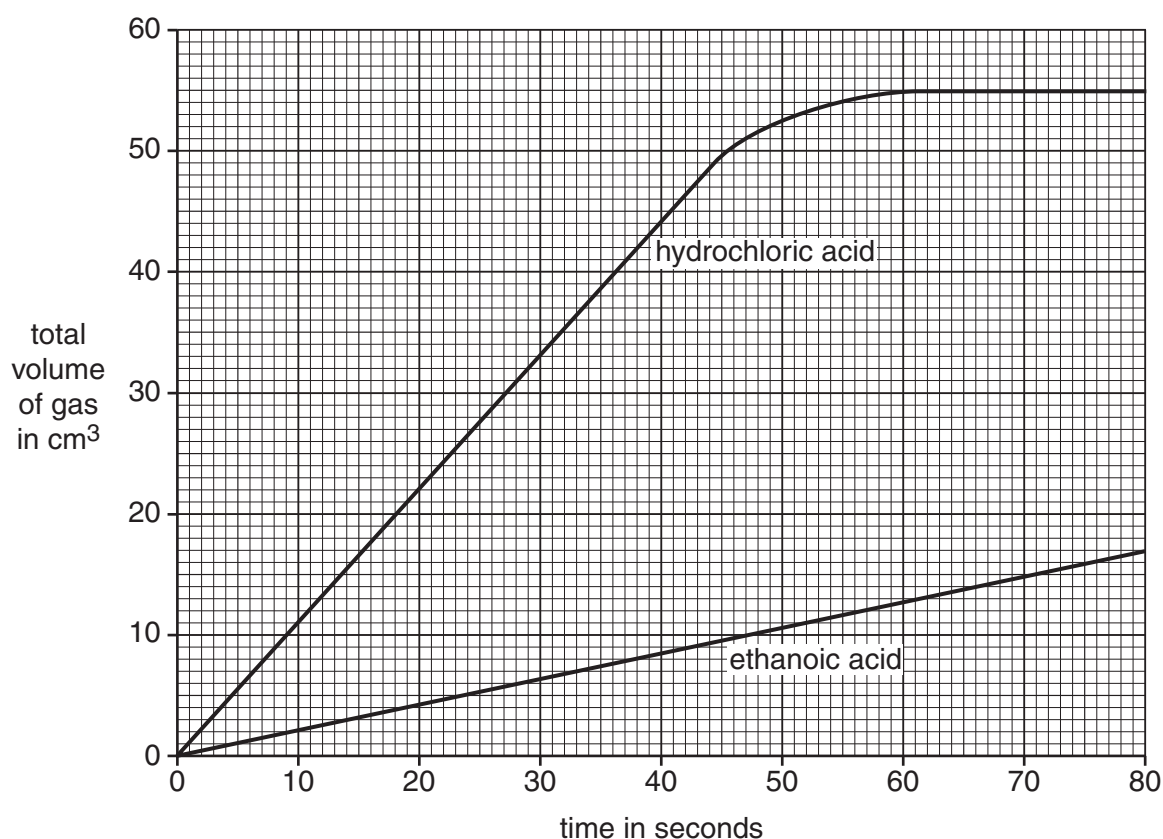He wants to find out the volume of gas made every 10 seconds.

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) 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?

.... cm^3　　　　　　　　[1]

(ii) Dilute hydrochloric acid reacts much faster than dilute ethanoic acid.

Explain why.

Use ideas about

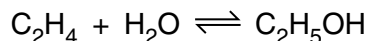- hydrogen ions

- collisions between particles.

....

....

....

.... [3]

[Total: 6]

7 This question is about equilibrium and reversible reactions.

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

$$C_2H_4 + H_2O \rightleftharpoons C_2H_5OH$$

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%

What happens to the percentage of ethene as the pressure increases but the temperature stays the same?

.... [1]

13

(d) Calculate the maximum mass of ethanol that can be made from 5.6 tonnes of ethene.

The relative atomic mass for H is 1, for C is 12 and for O is 16.

....

....

....

....

maximum mass of ethanol = ... [3]

[Total: 6]

[Turn over

8 Zoe tests copper(II) sulfate solution.

(a) Zoe adds barium chloride solution to copper(II) sulfate solution.

A white precipitate appears.

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

.... [1]

(b) Zoe adds sodium hydroxide solution to copper(II) sulfate solution.

This time she gets a blue precipitate of copper(II) hydroxide, $Cu(OH)_2$.

Write down the **ionic** equation for the reaction between aqueous Cu^{2+} and aqueous OH^-.

Include **state** symbols.

.... [3]

[Total: 4]

15

Section C – Module C6

9 This question is about the hardness of water.

(a) Look at the list.

calcium hydrogencarbonate

calcium sulfate

ethanoic acid

sodium chloride

sodium hydroxide

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

Choose from the list.

answer .... [1]

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

Choose from the list.

answer .... [1]

(b) Calcium carbonate, $CaCO_3$, reacts with water and carbon dioxide to make calcium hydrogencarbonate, $Ca(HCO_3)_2$.

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

.... [1]

(c) Ion exchange resins can be used to soften water.

Explain how ion exchange resins soften water.

....

....

....

.... [2]
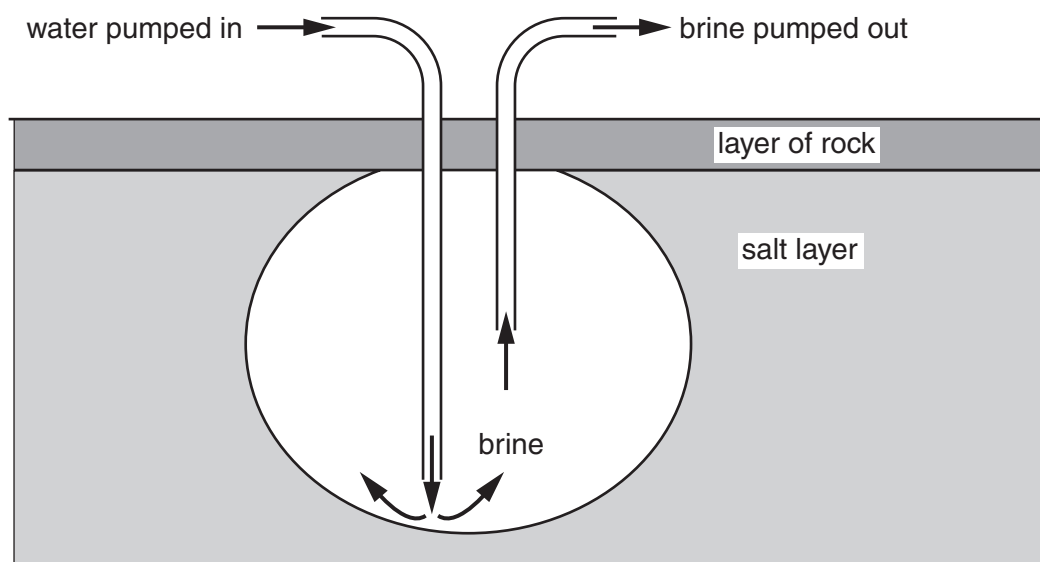
[Total: 5]

[Turn over

10 This question is about sodium chloride.

Brine is a solution of sodium chloride.

Solution mining is used to get brine out of the ground.
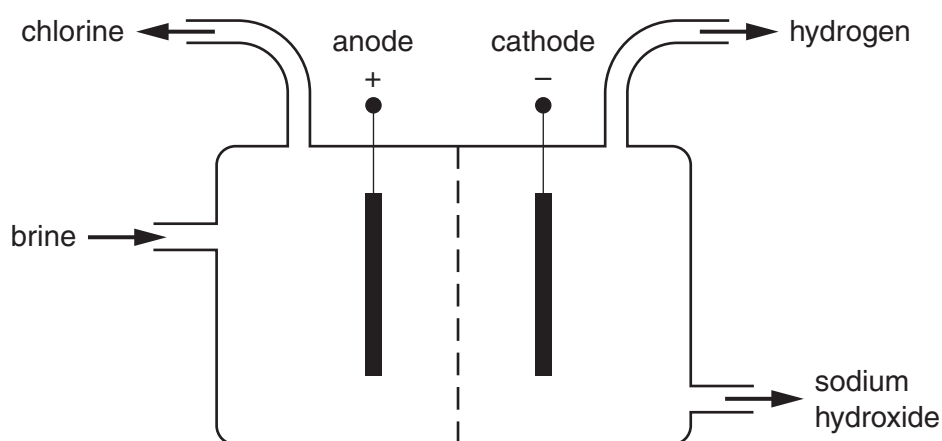
Look at the diagram of solution mining.

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

.... [1]

(b) Look at the diagram.

It shows the apparatus used for the electrolysis of sodium chloride solution (brine).

Chlorine, hydrogen and sodium hydroxide are made.

(i) Hydrogen ions, H^+, react to make hydrogen gas, H_2.

Write an equation for this reaction.

Use e^- to show an electron.

.... [1]

(ii) Chloride ions, Cl^-, react to form chlorine gas.

Write an equation for this reaction.

Use e^- to show an electron.

.... [1]

(iii) Sodium hydroxide is also made in this electrolysis.

Explain why.

.... [1]

[Total: 4]

11 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) 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]

(c) A fermentation reaction takes place at 40 °C.

When the temperature is raised to 80 °C, fermentation stops.

Explain why.

....

.... [1]

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

$$H-\overset{\displaystyle \overset{H}{|}}{\underset{\displaystyle \underset{H}{|}}{C}}-O-H$$
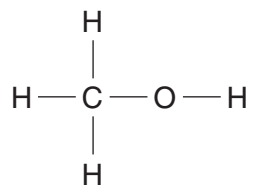
Draw the displayed formula of ethanol, C_2H_5OH.

[1]

(e) Look at this table.

It shows the formulae of some alcohols.

alcohol	formula
methanol	CH_3OH
ethanol	C_2H_5OH
propanol	
butanol	C_4H_9OH

(i) Complete the table by writing the formula for propanol. [1]

(ii) The general formula for an **alkene** is C_nH_{2n}.

Write down the general formula for an **alcohol**.

.... [1]

[Total: 6]

[Turn over

12 This question is about fats and oils.

(a) In a saturated fat all the bonds between carbon atoms are single bonds.

How is an unsaturated fat different?

.... [1]

(b) Describe a chemical test for unsaturation in a fat.

test... [1]

result .... [1]

(c) Fats and oils can be heated with sodium hydroxide to make soap.

Look at the list.

displacement

neutralisation

oxidation

reduction

saponification

Put a (ring) around the word that best describes the process. [1]

(d) How is margarine manufactured from vegetable oils?

.... [1]

[Total: 5]

END OF QUESTION PAPER

21
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22

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The Periodic Table of the Elements

Key

| relative atomic mass |
| **atomic symbol** |
| name |
| atomic (proton) number |

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

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.