

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 27 January 2010
Afternoon

Duration: 1 hour



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number			
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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.

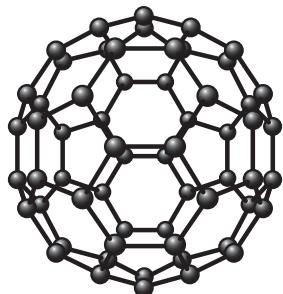
INFORMATION FOR CANDIDATES

- 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:

C₂

C₈

C₃₀

C₆₀

C₆₈

answer

[1]

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

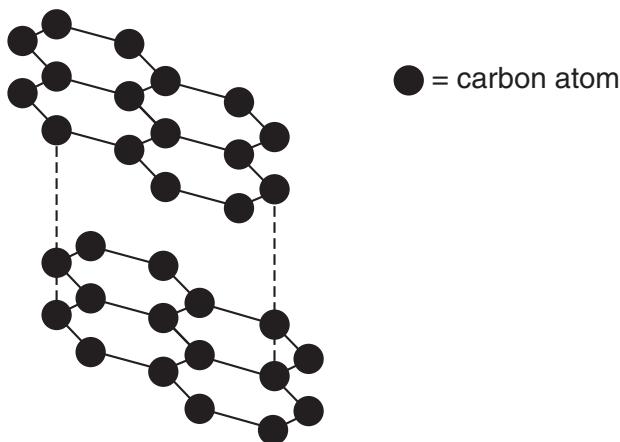
Nanotubes are used to reinforce graphite in tennis rackets.

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	$(\text{NH}_4)_3\text{PO}_4$	149	28	21	0
potassium nitrate	KNO_3	101	14	0	39
potassium phosphate	K_3PO_4	212	0	15	55
urea	$(\text{NH}_2)_2\text{CO}$		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, $(\text{NH}_2)_2\text{CO}$.

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.

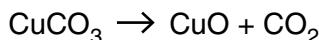
Which **acid** should she use?

.....

[Total: 6]

3 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.



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.

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

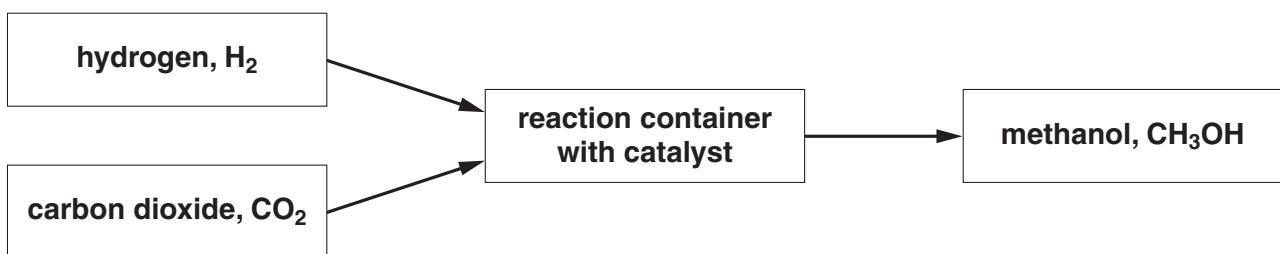
mass of copper oxide = g

[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]

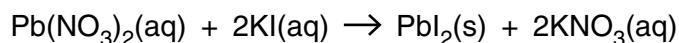
[Total: 4]

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.



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.



..... [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]

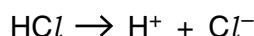
[Total: 5]

10

6 Hydrochloric acid, HCl , is a strong acid.

Ethanoic acid, CH_3COOH , is a weak acid.

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



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

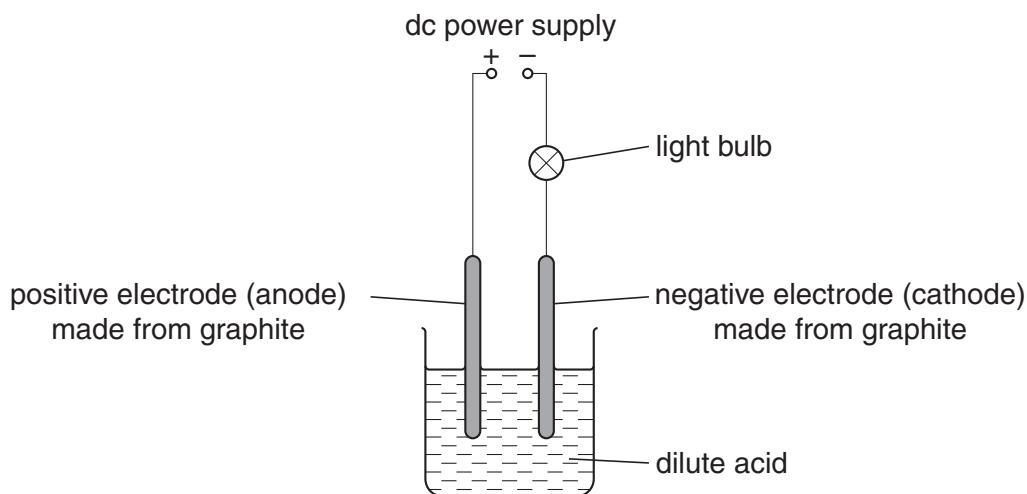
Dilute hydrochloric acid reacts much faster than dilute ethanoic acid.

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.

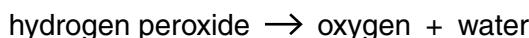
Use ideas about ions.

..... [1]

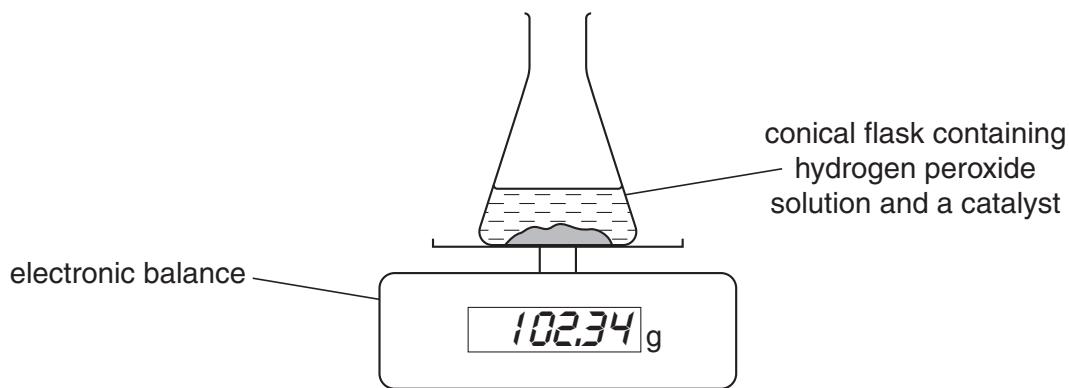
[Total: 5]

12

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



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]

13

(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 dm³.

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

.....
.....

volume = dm³

[1]

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

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

[2]

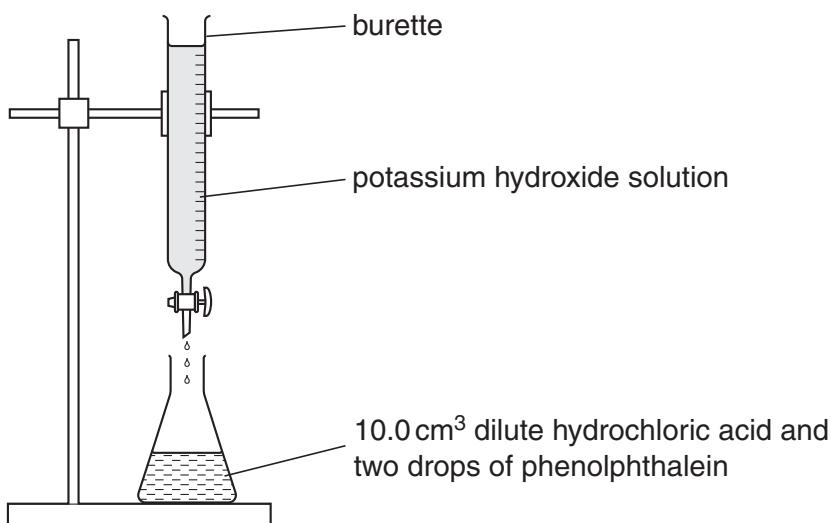
[Total: 4]

14

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.

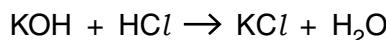
Explain why.

.....
.....

[1]

15

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



Calculate the **concentration** of potassium hydroxide in mol/dm³.

These steps may help.

Work out the

- number of moles in 10.0 cm³ of 0.200 mol/dm³ hydrochloric acid
- number of moles of potassium hydroxide neutralised
- average titre, in cm³, using titration numbers **2** and **4**.

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

concentration of potassium hydroxide = mol/dm³

[4]

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

Explain why.

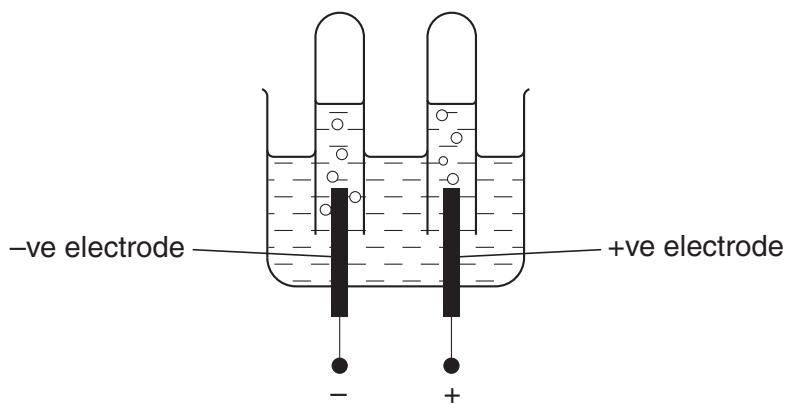
.....
.....

[1]

[Total: 6]

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

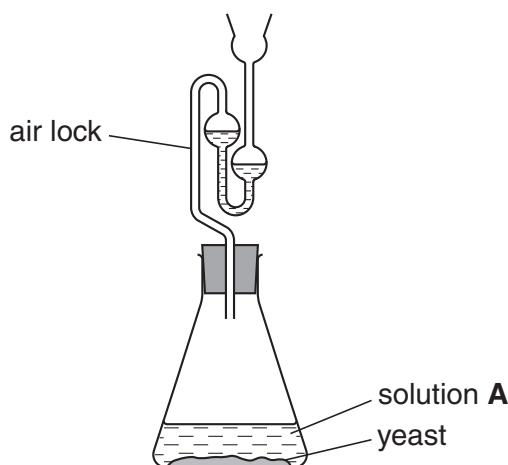
[2]

[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

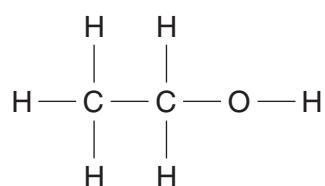
.....

absence of oxygen

..... [2]

18

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

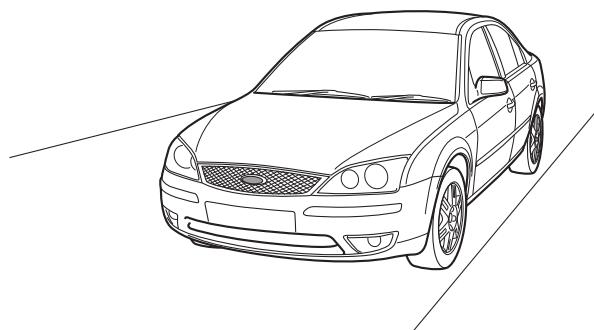


Write down the **molecular formula** of ethanol.

..... [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

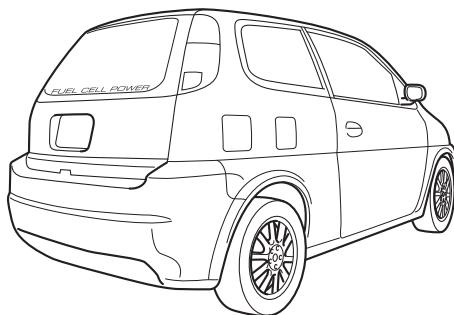
answer [1]

[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.



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

.....

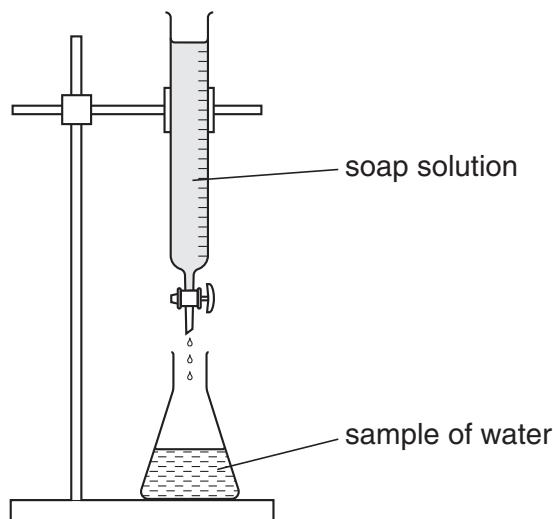
2

..... [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]

22

(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

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0
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 sulphur 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
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Nb niobium 41	93 Zr zirconium 40	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44
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
[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	[268] Mt meitnerium 109
					[277] Hs hassium 108	[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.