Collins

AQA

GCSE

Chemistry

F

SET B – Paper 1 Foundation Tier

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Materials

Time allowed: 1 hour 45 minutes

For this paper you must have:

- a ruler
- a calculator
- the Periodic Table (found at the end of the paper).

Instructions

- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 07.6 and 10.4 you need to make sure that your answer:
  – is clear, logical, sensibly structured
  – fully meets the requirements of the question
  – shows that each separate point or step supports the overall answer.

Advice

- In all calculations, show clearly how you work out your answer.

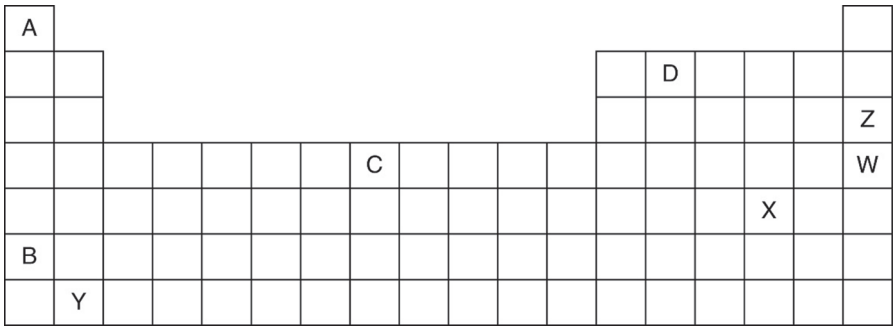
Name: .....

01 This question is about atomic structure and the Periodic Table.

01.1 **Figure 1.1** shows the location of some of the elements in the Periodic Table.

The letters are **not** the actual symbols for the elements in that location.

Figure 1.1



Write letters from **Figure 1.1** to identify the following.

Two elements in the same period	
An element with a full outer shell	
A transition metal	
An element with only six protons	

[4 marks]

01.2 Identify the correct electron configuration for nitrogen.

Tick **one** box.

- 2,8,6 ☐
- 2,7 ☐
- 2,5 ☐
- 2,2,3 ☐

[1 mark]

01.3 How many protons are there in a nitrogen atom?

Tick **one** box.

5 ☐

7 ☐

9 ☐

14 ☐

[1 mark]

01.4 Explain why a nitrogen atom has no overall charge.

.....

.....

.....

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

01.5 Draw **one** line from each word to its definition.

Word	Definition
element	where two or more substances are together but can be separated
compound	a substance that is made from only one type of atom
mixture	a substance that contains only neutrons and protons
	where two or more substances have chemically combined

[1 mark]

Turn over >

02 All metals in Group 1 react in a similar way.

For example, when potassium reacts with water, the reaction can be represented by:

$$K(s) + H_2O(l) \rightarrow KOH(aq) + H_2(g)$$

02.1 Name the **gas** produced.

.....

[1 mark]

02.2 Some students place 1 g of a Group 1 metal into a trough of water.

At the end of the reaction, one of the students adds a few drops of universal indicator to the trough.

The solution turns a light purple, meaning it has become alkaline.

Which **ion** makes the solution alkaline?

.....

[1 mark]

02.3 The reactions of **potassium with water** and **sodium with water** are similar, but not identical.

State **two** differences between the reaction of potassium and water compared to the reaction of sodium and water.

1. .....

.....

2. .....

.....

[2 marks]

02.4 Explain why the elements in Group 1 get more reactive further down the group when moving from lithium to francium.

[3 marks]

02.5 Silver and gold are transition metals.

Where are silver and gold found on the Periodic Table?

[1 mark]

02.6 Transition metals have different properties to Group 1 metals.

Which **two** statements about the properties of transition metals are correct?

Tick **two** boxes.

- They are less reactive than Group 1 metals. ☐
- They have lower densities than Group 1 metals. ☐
- They have higher melting points than Group 1 metals. ☐
- They do not tend to form coloured compounds, unlike Group 1 metals. ☐

[2 marks]

03 Some students were investigating the reactivity of four different metals.

They used 1 mol/dm^3 hydrochloric acid and 3 cm lengths of each metal.

When the metals react, they release hydrogen gas as gas bubbles in the test tube.

03.1 Draw **one** line from each description to the correct variable.

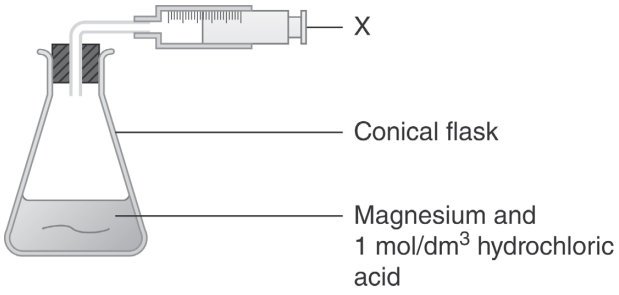
Description	Variable
independent variable	number of bubbles
dependent variable	type of metal
control variable	concentration of acid used

[2 marks]

03.2 The students then investigated the volume of hydrogen gas produced.

Figure 3.1 shows the apparatus used.

Figure 3.1



This is their method:

1. Place a 3 cm length of metal ribbon in the flask.
2. Add 15 cm^3 1 mol/dm^3 hydrochloric acid.
3. Connect the piece of apparatus labelled X immediately.
4. Measure the volume of gas produced every 10 s, for a total of 60 s

What is the name of the piece of apparatus, labelled X, used to collect the hydrogen?

.....

[1 mark]

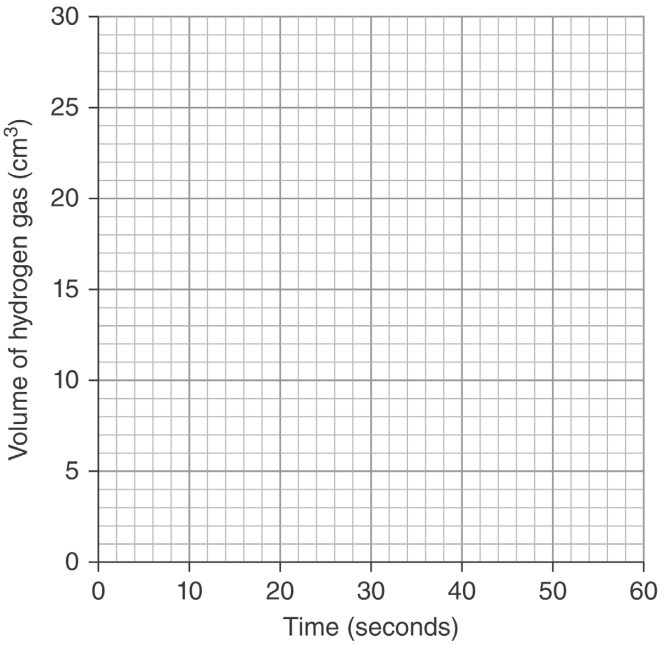
03.3 Their results are shown in **Table 3.1**

Table 3.1

Time (seconds)	Volume of hydrogen gas (cm^3)
0	0
10	8
20	16
30	15
40	21
50	23
60	23

Plot these results on the grid below.

Draw a line of best fit.



[2 marks]

Question 3 continues on the next page

03.4 The results for magnesium have produced an anomalous result.

Identify which result is anomalous.

Explain why this result can be treated as an anomalous result.

.....

.....

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

03.5 Describe the pattern in the results.

.....

.....

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

03.6 The results in **Table 3.1** above show that in 50 seconds the reaction produced 23 cm^3 of hydrogen gas.

Calculate the mean volume of hydrogen produced per second in the reaction.

Give your answer to 1 decimal place.

.....

.....

Mean volume of hydrogen produced throughout the reaction = ... cm^3/s

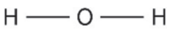
[2 marks]

04 Scientists use models as a way to show and describe what they mean.

04.1 Models can be used to show bonding in different structures.

Which type of structure is shown in the model of water in **Figure 4.1**?

Figure 4.1



Tick **one** box.

Covalent ☐

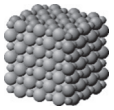
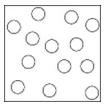
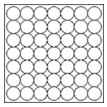
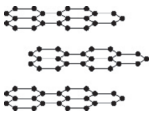
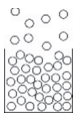
Metallic ☐

Ionic ☐

[1 mark]

04.2 Models can also be used to distinguish between different substances.

Draw **one** line from each statement to the model that shows it best.

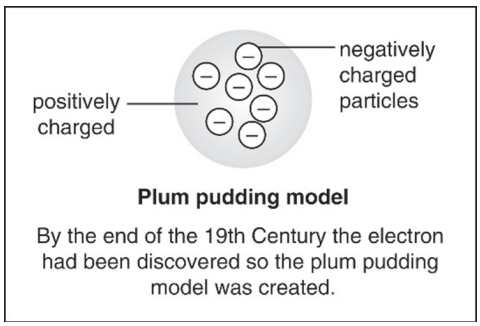
Statement	Model
This substance is a giant covalent structure.	A 
This substance is a compound.	B 
This substance is a solid.	C 
This substance is evaporating.	D 
This substance is a gas.	E 

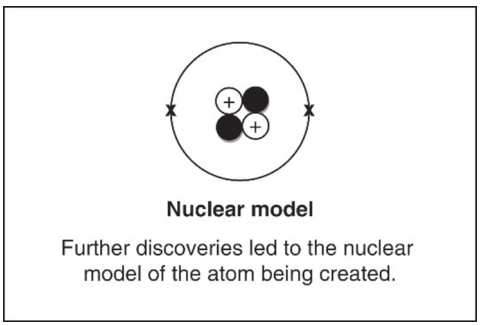
[4 marks]

Question 4 continues on the next page

04.3 **Figure 4.2** show models that different scientists have used at different times in history, to describe how the atom is structured.

Figure 4.2





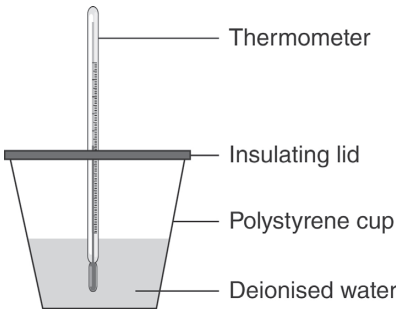
Compare the older plum pudding model with the modern nuclear model of the atom.

Use your own knowledge and the diagrams in **Figure 4.2**

[4 marks]

05 Students use the apparatus shown in **Figure 5.1** to investigate how the temperature changes as different solids dissolve.

Figure 5.1



This is their method:

1. Place 25 cm^3 deionised water in a polystyrene cup.

2. Measure the temperature of the water.

3. Add 1 g calcium chloride, and stir.

4. Record the highest or lowest temperature reached.

5. Repeat the experiment using potassium chloride instead of calcium chloride.

05.1 **Table 5.1** shows the results.

Table 5.1

Solute	Initial temperature in °C	Final temperature in °C
calcium chloride	20	29
potassium chloride	20	14

Calculate the temperature change for each solute.

calcium chloride: ..... °C

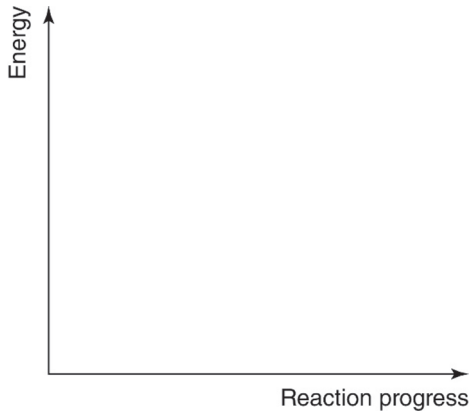
potassium chloride: ..... °C **[2 marks]**

Question 5 continues on the next page

05.2 On the sketch graph below, draw the reaction profile for dissolving calcium chloride.

Label the reactants **and** the products on the profile.

You do not have to show activation energy.



[2 marks]

05.3 Which of the two solutes could be used in first aid ice packs?

.....

[1 mark]

05.4 What is the word used for a reaction that transfers energy **from** the reactants **to** the surroundings?

.....

[1 mark]

05.5 Calcium chloride has the chemical formula $CaCl_2$

Calculate the **relative formula mass** (M_r) of calcium chloride.

Relative atomic masses A_r : Cl = 35.5; Ca = 40

.....

.....

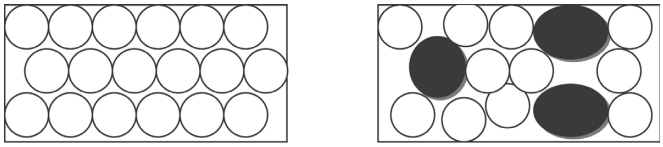
[1 mark]

06.1 Choose words from the box to complete the paragraph about **metals** and **alloys**.

Use **Figure 6.1** to help you.

hard	smooth	soft	ordered
harder	distorted	softer	better

Figure 6.1



Pure metal Alloy

Pure metals and alloys have different properties.

A pure metal is ..... , because the atoms are all arranged in layers which slide over each other.

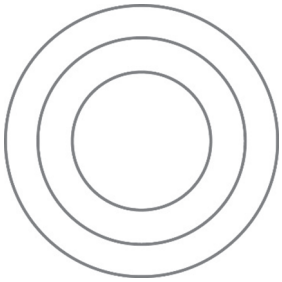
In an alloy, the layers are ..... .

This makes alloys ..... than pure metals. **[3 marks]**

06.2 Magnesium atoms have 12 electrons each.

Draw on **Figure 6.2** to show how the electrons are arranged in a magnesium atom.

Figure 6.2



[2 marks]

06.3 Magnesium is in Group 2 and Period 3 of the Periodic Table.

Explain why magnesium is in this location, in terms of electrons and electron shells.

.....

.....

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

Question 6 continues on the next page

06.4 Metals have unique properties due to their chemical structure.

Draw **one** line from each property of a metal to the feature of the structure of metals.

Property	Feature
	have layers which can slide over each other
good conductors of electricity	no delocalised electrons to carry a charge
often have a high melting point	strong covalent bonds
malleable	strong electrostatic forces of attraction
	delocalised electrons to carry a charge

[2 marks]

06.5 Silver particles are used in plasters.

The particles have a diameter of 20 nm.

Explain, in terms of their size, why they are classed as nanoparticles.

.....

[1 mark]

06.6 A picometre is 1×10^{-12} m

A silver atom has a radius of 165 picometres.

What is the radius of a silver atom in **nanometres**?

Give your answer in Standard Form.

.....

.....

.....

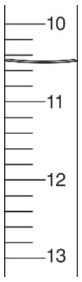
[2 marks]

07 A burette is filled to the zero line with sodium hydroxide solution.

Some of the solution is let out of the burette.

Figure 7.1 shows the level of the remaining solution.

Figure 7.1



07.1 What is the volume of sodium hydroxide solution that was let out of the burette?

Tick **one** box.

10.25 cm^3 ☐

10.50 cm^3 ☐

11.50 cm^3 ☐

11.25 cm^3 ☐

[1 mark]

07.2 The concentration of the sodium hydroxide solution is 45 g/dm^3

Calculate how many grams of sodium hydroxide there are in the sodium hydroxide solution let out of the burette.

Show your working.

.....

.....

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

Question 7 continues on the next page

07.3 The label on the burette states ±0.25 cm^3

A student uses the burette to measure 50 cm^3 liquid.

What is the largest **real** volume that they could have measured?

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

07.4 When sodium hydroxide reacts with an acid it produces sodium sulfate.

What is the name of the acid used in the reaction?

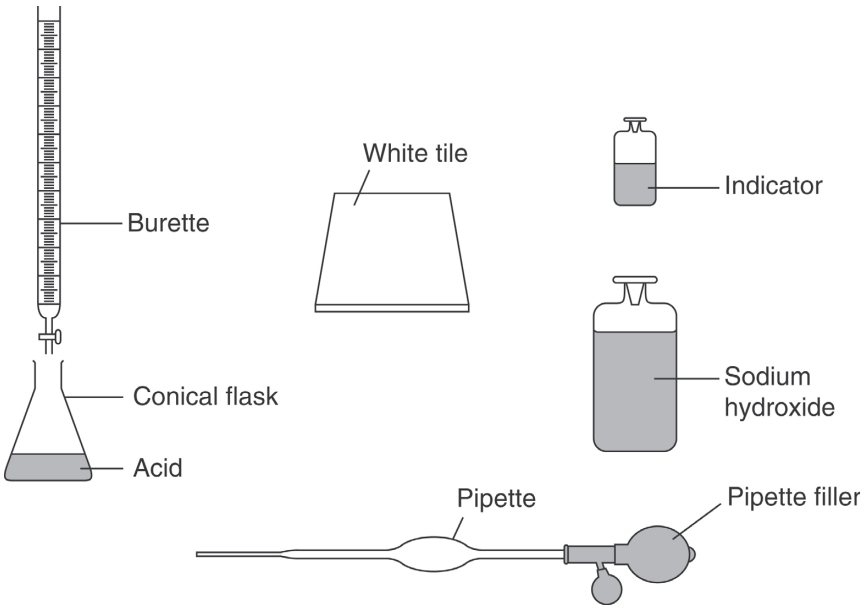
..... **[1 mark]**

07.5 What is the name of this **type** of reaction?

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

07.6 A student will use the equipment shown in **Figure 7.2** to carry out a titration.

Figure 7.2



The student plans to carry out a titration to find the volume of sodium hydroxide required to react with a known volume of acid.

Describe the method they should use.

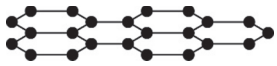
Your answer should include reference to each piece of equipment.

You do **not** need to include any calculations in your answer.

[6 marks]

08 **Figure 8.1** shows the structure of **graphene**.

Figure 8.1



Graphene is a single layer made of the same atoms that make up graphite.

It is said that graphene:

- is the strongest material ever measured
- is one of the best conducting materials known
- may have the highest melting point in nature.

08.1 Complete the sentences about **graphene**.

Use the correct words from the boxes.

calcium	chlorine	carbon
three	four	five

Graphene is made from ..... atoms.

In graphene, each atom bonds to ..... other atoms. **[2 marks]**

08.2 Graphite, like graphene, can conduct electricity.

Explain why graphite can conduct electricity.

.....

.....

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

08.3 Explain why **graphite** is used in lubricants.

.....

.....

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

09 Electrolysis can be used to separate some substances into their components.

09.1 Which **two** of the following substances could be separated into their components using electrolysis?

Tick **two** boxes.

Solid carbon dioxide ☐

Molten magnesium chloride ☐

A solution of potassium iodide ☐

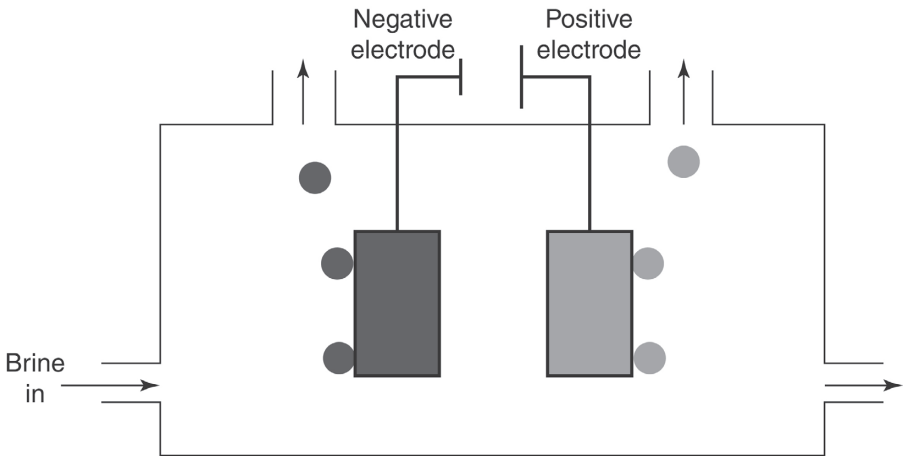
Molten sulfur dioxide ☐

Solid potassium iodide ☐

[1 mark]

09.2 The electrolysis of sodium chloride solution (brine) can be carried out in a school laboratory or on a larger scale in industry as shown in **Figure 9.1**

Figure 9.1



Complete **Table 9.1** to identify the name of the product left in the solution.

Table 9.1

Location	Product
positive electrode	chlorine
negative electrode	hydrogen
product left in solution	

[1 mark]

Question 9 continues on the next page

09.3 Explain why hydrogen ions move to the negative electrode.

.....

.....

[1 mark]

09.4 Explain why hydrogen forms at the negative electrode, but sodium does not.

.....

.....

[1 mark]

09.5 Describe how a chloride ion turns into a chlorine atom.

.....

.....

[1 mark]

09.6 Sodium chloride forms from the reaction between sodium and chlorine.

Balance the equation for this reaction, below.

..... $Na(s) + Cl_2(g) \rightarrow$ ..... $NaCl(s)$

[1 mark]

09.7 Chlorine is in Group 7.

What is the name given to the elements in Group 7?

Tick **one** box.

Halogens ☐

Alkali metals ☐

Noble gases ☐

[1 mark]

09.8 **Table 9.2** provides information about the Group 7 elements.

Table 9.2

Element	Colour in aqueous solution	Boiling point (°C)
fluorine	colourless	–185
chlorine	green / yellow	
bromine	orange	59
iodine		184

Predict the colour of **iodine** in aqueous solution.

.....

[1 mark]

09.9 Predict the boiling point of **chlorine**.

.....

[1 mark]

09.10 When aqueous fluorine is added to lithium bromide solution, a displacement reaction occurs.

The equation for this reaction is:

$$2LiBr(aq) + F_2(aq) \rightarrow Br_2(aq) + 2LiF(aq)$$

Explain why a displacement reaction occurs.

.....

[1 mark]

09.11 What is the colour of the solution at the end of the reaction?

.....

[1 mark]

Turn over >

10 **Figure 10.1** shows **the outer shells of** beryllium and fluorine.

Figure 10.1

10.1 Draw a diagram to show a **molecule** of fluorine, F_2

You only need to show the **outer** electron shells.

[1 mark]

10.2 Beryllium reacts with fluorine to form beryllium fluoride.

Write down the empirical formula of beryllium fluoride.

.....

[1 mark]

10.3 Describe what happens

- when atoms of fluorine react with atoms of beryllium
- to the charge on any ions that form.

Use **Figure 10.1** to help you.

[4 marks]

10.4 Fluorine is a gas at room temperature.

Beryllium fluoride is a solid at room temperature.

Explain why these two substances have these different properties.

You should include

- reference to the bonding involved
- a description of the structure of both fluorine and beryllium fluoride.

[6 marks]

END OF QUESTIONS

Key

Metals

Non-metals

Relative atomic mass — 1
Atomic symbol — H
Name — hydrogen
Atomic/proton number — 1

1	2											3	4	5	6	7	0 or 8
																	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	[285] **Cn** copernicium 112	[286] **Uut** ununtrium 113	[289] **Fl** flerovium 114	[289] **Uup** ununpentium 115	[293] **Lv** livermorium 116	[294] **Uus** ununseptium 117	[294] **Uuo** ununoctium 118

*The lanthanides (atomic numbers 58–71) and the actinides (atomic numbers 90–103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.