

This question is about sodium and chlorine.

Figure 2 shows the positions of sodium and chlorine in the periodic table.

Figure 2

Na															Cl		

1.1

State **one** difference and **one** similarity in the electronic structure of sodium and of chlorine.

[2 marks]

Difference

Similarity

1.2

Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer.

[4 marks]

This question is about the halogens.

2.1

Write the state symbol for chlorine at room temperature.

[1 mark]

Cl₂ ()

$$\text{Cl}_2 + 2 \text{KBr} \rightarrow \text{Br}_2 + 2 \text{KCl}$$

[3 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Source: AQA 2018 Combined Science Paper 1, original question 04.5

This question is about metals and metal compounds.

1
c

3.1

Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.

[2 marks]

1

2

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

4.1

Name the products formed when chlorine solution reacts with potassium iodide solution.

[1 mark]

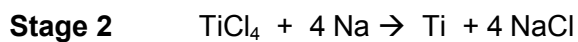
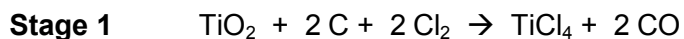
4.2

Explain why chlorine is more reactive than iodine.

[3 marks]

Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two stage industrial process.



5.1

Water must be kept away from the reaction in **Stage 2**.

Give **one** reason why it would be hazardous if water came into contact with sodium.

[1 mark]

5.2

Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon and **not** in air.

[2 marks]

6.1

The catalyst in catalytic converters is a mixture of three elements.

Where in the periodic table are these elements most likely to be found?

[1 mark]

Tick **one** box.

Alkali metals

☐

Halogens

☐

Noble gases

☐

Transition metals

☐

A student wants to make a fair comparison of the reactivity of the metals with hydrochloric acid.

7.1

Predict the reactivity of beryllium compared with magnesium.

Give a reason for your answer.

Use the periodic table.

[2 marks]

Reason _____

This question is about elements in the periodic table.

8.1

What order did scientists use to arrange elements in early periodic tables?

[1 mark]

8.2

In the early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame this in his periodic table.

Give **one** way Mendeleev did this.

[1 mark]

Question 4 continues on the next page

8.3

Explain why neon is unreactive.

Give the electronic structure of neon in your answer.

[2 marks]

This question is about sodium.

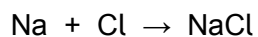
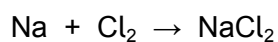
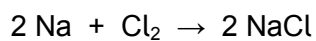
9.1

Sodium reacts with chlorine.

What is the balanced equation for the reaction?

[1 mark]

Tick (✓) **one** box.

☐☐☐☐

9.2

Hot sodium is put in a gas jar of chlorine.

Describe the observations made before, during and after the reaction.

[3 marks]

Before reaction _____

During reaction _____

After reaction _____

9.3

Explain why sodium is less reactive than potassium.

[4 marks]

Question 6 continues on the next page

This question is about the periodic table.

In the 19th century, some scientists tried to classify the elements by arranging them in order of their atomic weights.

Figure 1 shows the periodic table Mendeleev produced in 1869.

His periodic table was more widely accepted than previous versions.

Figure 1

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Period 1	H						
Period 2	Li	Be	B	C	N	O	F
Period 3	Na	Mg	Al	Si	P	S	Cl
Period 4	K Cu	Ca Zn	* *	Ti *	V As	Cr Se	Mn Br
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	* I

10.1

The atomic weight of tellurium (Te) is 128 and that of iodine (I) is 127

Why did Mendeleev reverse the order of these two elements?

[1 mark]

10.2

Mendeleev left spaces marked with an asterisk *

He left these spaces because he thought missing elements belonged there.

Why did Mendeleev's periodic table become more widely accepted than previous versions?

[3 marks]

10.3

Mendeleev arranged the elements in order of their atomic weight.

What is the modern name for atomic weight?

[1 mark]

Tick (✓) **one** box.

Atomic number

☐

Mass number

☐

Relative atomic mass

☐

Relative formula mass

☐

10.4

Complete the sentence.

[1 mark]

In the modern periodic table, the elements are arranged in order of

10.5

Chlorine, iodine and astatine are in Group 7 of the modern periodic table.

Astatine (At) is below iodine in Group 7.

Predict:

- the formula of an astatine molecule
- the state of astatine at room temperature.

[2 marks]

Formula of astatine molecule _____

State at room temperature _____

10.6

Sodium is in Group 1 of the modern periodic table.

Describe what you would see when sodium reacts with chlorine.

[2 marks]

11.1

Ammonia reacts with oxygen in the presence of a metal oxide catalyst to produce nitrogen and water.

Which metal oxide is most likely to be a catalyst for this reaction?

[1 mark]

Tick (✓) **one** box.

CaO

☐

Cr₂O₃

☐

MgO

☐

Na₂O

☐

This question is about elements.

Caesium is in Group 1 of the periodic table.

12.1

Explain what happens to caesium atoms and to oxygen atoms when caesium reacts with oxygen to produce caesium oxide.

You should answer in terms of electrons.

[4 marks]

12.2

Explain why caesium is more reactive than sodium.

You should answer in terms of electrons.

[4 marks]

12.3

Figure 6 shows part of Mendeleev's periodic table.**Figure 6**

16 O	19 F
32 S	35.5 Cl
79 Se	80 Br
128 Te	127 I

Explain why the early periodic tables placed iodine (I) before tellurium (Te), but then Mendeleev placed tellurium before iodine.

[3 marks]

END OF QUESTIONS

This question is about metals and the reactivity series.

13.1

Which **two** statements are properties of most transition metals?

[2 marks]

Tick (✓) **two** boxes.

They are soft metals.

☐

They form colourless compounds.

☐

They form ions with different charges.

☐

They have high melting points.

☐

They have low densities.

☐

14.1

Mendeleev published his periodic table in 1869.

Mendeleev arranged the elements in order of atomic weight.

Mendeleev then reversed the order of some pairs of elements.

A student suggested Mendeleev's reason for reversing the order was to arrange the elements in order of atomic number.

Explain why the student's suggestion **cannot** be correct.

Use **Figure 2**.

[2 marks]

14.2

Give the correct reason why Mendeleev reversed the order of some pairs of elements.

[1 mark]

This question is about the halogens.

Table 5 shows the melting points and boiling points of some halogens.

Table 5

Element	Melting point in °C	Boiling point in °C
Fluorine	−220	−188
Chlorine	−101	−35
Bromine	−7	59

15.1

What is the state of bromine at 0 °C **and** at 100 °C?

[1 mark]

Tick (✓) **one** box.

State at 0 °C

State at 100 °C

Gas

Gas

☐

Gas

Liquid

☐

Liquid

Gas

☐

Liquid

Liquid

☐

Solid

Gas

☐

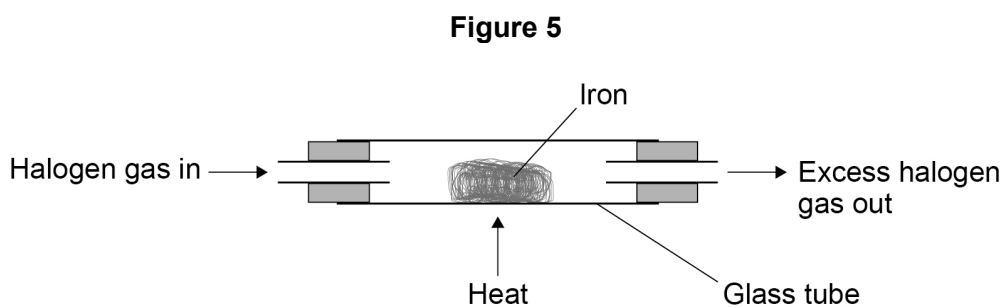
Solid

Liquid

☐

Iron reacts with each of the halogens in their gaseous form.

Figure 5 shows the apparatus used.



15.2

Explain why the reactivity of the halogens decreases going down the group.

[3 marks]

16.1

Other metal ions form coloured equilibrium mixtures with thiocyanate ions.

Which metal ion could form a coloured equilibrium mixture with thiocyanate ions?

[1 mark]

Tick (✓) **one** box.

Al^{3+}

☐

Co^{2+}

☐

Mg^{2+}

☐

Na^{+}

☐

END OF QUESTIONS

This question is about the periodic table.

17.1

0 1 . 1 **Figure 1** shows part of Mendeleev's version of the periodic table.

Figure 1

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K	Ca		Ti	V	Cr	Mn	Fe Co Ni
Cu	Zn			As	Se	Br	
Rb	Sr	Y	Zr	Nb	Mo		Ru Rh Pd
Ag	Cd	In	Sn	Sb	Te	I	

Which group of elements had **not** been discovered when Mendeleev's version of the periodic table was published?

[1 mark]

Gallium (Ga) is in Group 3 of the modern periodic table.

18.1

What is the most likely formula of a gallium ion?

[1 mark]

Tick (✓) **one** box.

 Ga^+ ☐ Ga^- ☐ Ga^{3+} ☐ Ga^{3-} ☐

18.2

Gallium was discovered six years after Mendeleev published his periodic table.

Give **two** reasons why the discovery of gallium helped Mendeleev's periodic table to become accepted.

[2 marks]

1

2

This question is about Group 1 elements.

19.1

Give **two** observations you could make when a small piece of potassium is added to water.

[2 marks]

1 _____

2 _____

19.2

Complete the equation for the reaction of potassium with water.

You should balance the equation.

[2 marks]



19.3

Explain why the reactivity of elements changes going down Group 1.

[4 marks]

Sodium reacts with oxygen to produce the ionic compound sodium oxide.

Oxygen is a Group 6 element.

19.4

Draw a dot and cross diagram to show what happens when atoms of sodium and oxygen react to produce sodium oxide.

[4 marks]

Diagram

This question is about Group 7 elements.

20.1

What are the Group 7 elements known as?

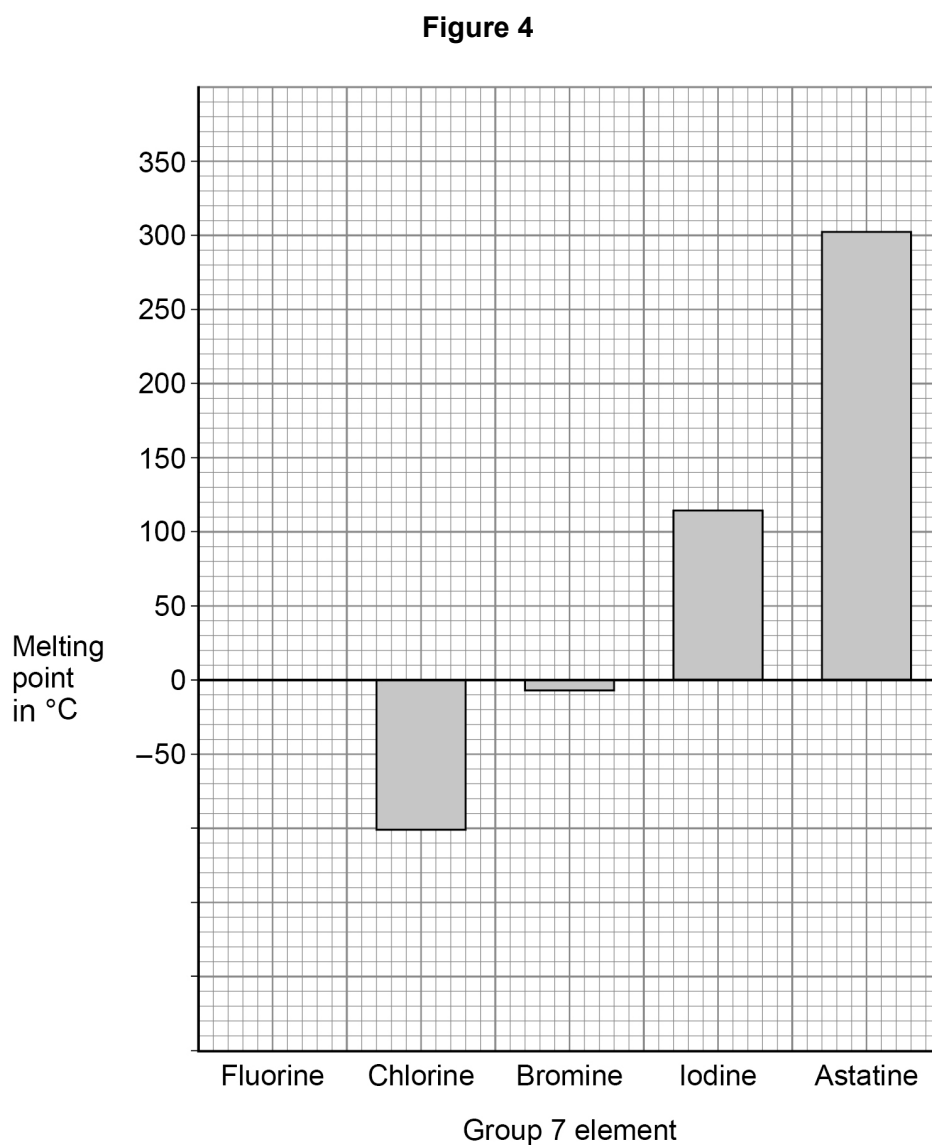
[1 mark]

20.2

Why do Group 7 elements react in similar ways?

[1 mark]

Figure 4 shows the melting points of some Group 7 elements.



20.3

The melting point of fluorine is -220°C

Complete **Figure 4**.

You should:

- complete the scale on the y-axis
- draw the bar for the melting point of fluorine.

[2 marks]

20.4

Explain the trend in the melting points of the Group 7 elements.

Use **Figure 4**.

[3 marks]

20.5

What is the state symbol for bromine at $-50\text{ }^{\circ}\text{C}$?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

(aq)

☐

(g)

☐

(l)

☐

(s)

☐

This question is about metals and non-metals.

Figure 1 shows an outline of part of the periodic table.

Figure 1



21.1

Element **Q** is a dull solid with a melting point of 44 °C.

Element **Q** does not conduct electricity.

Which section of the periodic table in **Figure 1** is most likely to contain element **Q**?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

21.2

Element **R** forms ions of formula **R²⁺** and **R³⁺**

Which section of the periodic table in **Figure 1** is most likely to contain element **R**?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

21.3

Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

1 _____

2 _____

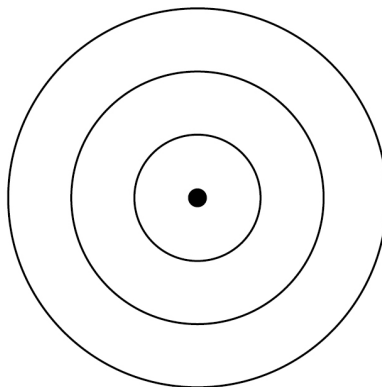
21.4

Complete **Figure 2** to show the electronic structure of an aluminium atom.

Use the periodic table.

[1 mark]

Figure 2



This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

22.1

Rubidium and potassium are added to water.

Predict **one** observation you would see that shows that rubidium is more reactive than potassium.

[1 mark]

22.2

Explain why rubidium is more reactive than potassium.

[3 marks]

22.3

Complete the equation for the reaction of rubidium with water.

You should balance the equation.

[3 marks]

22.4

The noble gases are in Group 0.

Which is a correct statement about the noble gases?

[1 mark]

Tick (✓) **one** box.

The noble gases all have atoms with eight electrons in the outer shell.

☐

The noble gases have boiling points that increase going down the group.

☐

The noble gases have molecules with two atoms.

☐

The noble gases react with metals to form ionic compounds.

☐

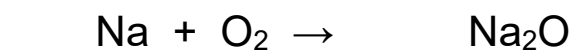
Sodium is in Group 1 of the periodic table.

Sodium reacts with oxygen to produce sodium oxide.

23.1

Balance the equation for the reaction.

[1 mark]



23.2

Explain what happens to sodium atoms and to oxygen atoms when sodium reacts with oxygen to produce sodium oxide (Na_2O).

Answer in terms of electrons.

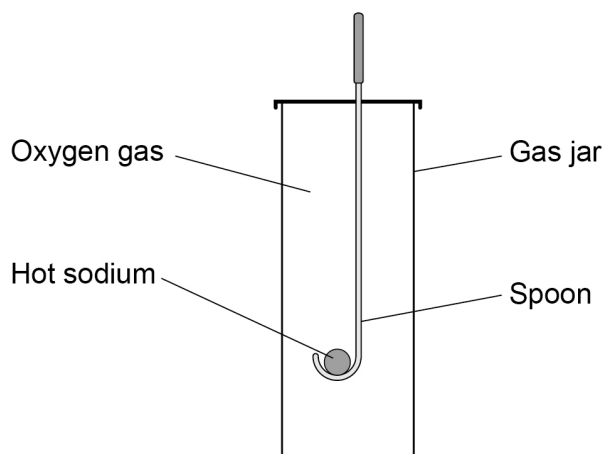
[4 marks]

23.3

Sodium burns in a gas jar of oxygen.

Figure 3 shows the apparatus.

Figure 3



Give **two** observations seen during the reaction.

[2 marks]

1 _____

2 _____

23.4

Describe **two** differences in the observations if potassium is used instead of sodium.

[2 marks]

1 _____

2 _____

A bromine atom can be represented as $^{81}_{35}\text{Br}$.

24.1

What is the number of electrons in a bromide **ion**?

[1 mark]

Very few atoms of the element tennessine (Ts) have ever been identified.

The atomic number of tennessine is 117

25.1

Predict the number of outer shell electrons in an atom of tennessine.

Give **one** reason for your answer.

Use the periodic table.

[2 marks]

Number of outer shell electrons _____

Reason _____

25.2

Tennessine was first identified by a small group of scientists in 2010.

Suggest **one** reason why tennessine was **not** accepted as a new element by other scientists until 2015.

[1 mark]

Question 1 continues on the next page

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

26.1

Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

[1 mark]

This question is about elements in the periodic table.

27.1

Argon has the atomic number 18

Explain why argon does **not** form compounds.

Answer in terms of electrons.

[2 marks]

27.2

Phosphorus (P) is the element below nitrogen in the periodic table.

Predict the formula of the compound formed between phosphorus and hydrogen.

[1 mark]

Formula = _____

27.3

Tellurium is the element with atomic number 52

Predict whether tellurium reacts with metals.

Explain your answer.

Answer in terms of the position of tellurium in the periodic table.

[2 marks]
