Periodic Table, Group 2 & The Halogens AS & A Level

Question Paper 2

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Periodic Table & Energy
Topic	Periodic Table, Group 2 & The Halogens
Paper	AS & A Level
Booklet	Question Paper 2

Time allowed: **47 minutes**

Score: **/35**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

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Chlorine and its compounds have wide uses in chemistry.

(a) In drinking water, HC*l*O kills bacteria.

(i) Write an equation to show how HC*l*O can form in drinking water. [1]

(ii) Some scientists believe that chlorine compounds should **not** be present in drinking water.

Suggest **one** reason why scientists may be worried by the presence of these compounds. [1]

(b) Chlorine reacts directly with Group 2 elements to form chlorides that are very soluble in water.

Aqueous chloride ions can be detected by adding aqueous silver nitrate.
The appearance of solid silver chloride, AgC*l*, confirms the presence of chloride ions.

(i) State the type of reaction that has taken place. [1]

(ii) Write the ionic equation for this reaction.
Include state symbols. [1]

(c) A student is given a sample of an unknown Group 2 chloride.

- The student dissolves 2.86 g of the chloride in water.
- The student adds excess aqueous silver nitrate.
- 8.604 g of solid silver chloride, AgC*l*, forms.

(i) Calculate the amount, in moles, of AgC*l* that forms.

The molar mass of AgC*l* = 143.4 g mol^{-1}. [1]

(ii) Deduce the amount, in moles, of the Group 2 chloride that the student dissolves.

Hence deduce the relative atomic mass and the identity of the Group 2 metal.
Give the relative atomic mass to **one** decimal place.

You **must** show your working. [3]

(d) Ammonium chloride, NH_4Cl, is a salt which has covalent bonding, dative covalent (coordinate) bonding and ionic bonding.

(i) What is a *dative covalent* (*coordinate*) bond? [1]

(ii) Give the formulae of the ions present in NH_4Cl. [1]

(iii) Draw a '*dot-and-cross*' diagram to show the bonding in NH_4Cl. [2]
Show the outer electrons only.

(e) A teacher heats potassium chlorate(V), $KClO_3$. The equation is given below.

$$2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$$

(i) This is an example of a redox reaction.

What other type of reaction takes place? [1]

(ii) The teacher heats 0.824 g of $KClO_3$.

Calculate the volume of oxygen produced, in cm^3, measured at room temperature and pressure.

Give your answer to the **nearest whole number**. [3]

[Total 16 Marks]

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Many metallic elements react with dilute hydrochloric acid to form a solution containing a salt.

(a) Zinc reacts with dilute hydrochloric acid to form a solution of the salt, zinc chloride, $ZnCl_2$.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

(i) Explain why $ZnCl_2$ is a salt. [1]

(ii) Predict the formula of the zinc salt that could be formed by adding an excess of zinc to phosphoric(V) acid, H_3PO_4. [1]

(b) Group 2 elements also react with dilute hydrochloric acid.

Describe **and** explain the trend in reactivity of the Group 2 elements with dilute hydrochloric acid as the group is descended.

In your answer you should use appropriate technical terms, spelled correctly. [5]

[Total: 7 Marks]

In the Periodic Table, the chemistry of elements in a group can often be predicted from the chemistry of just one element in the group.

(a) Ions of Group 7 elements take part in displacement reactions. These reactions can be used to compare the reactivities of the elements within Group 7.

A student adds aqueous solutions of halogens to test-tubes containing solutions of halide ions. The resulting mixtures are then shaken with cyclohexane, an organic solvent.

One of the student's results is shown in the table.

experiment number	experiment details	colour seen within the organic solvent
1	addition of Cl_2(aq) to I^-(aq) ions	
2	addition of Cl_2(aq) to Br^-(aq) ions	orange
3	addition of Br_2(aq) to Cl^-(aq) ions	

(i) Complete the table to show the expected colours. [2]

(ii) Write the ionic equation for the reaction taking place in experiment 2. [1]

(iii) These three experiments alone are unable to confirm the order of reactivity for Cl_2, Br_2 and I_2.

Suggest **one** further displacement reaction which could be carried out to confirm the order of reactivity of Cl_2, Br_2 and I_2. [1]

(b) Chlorine gas reacts with water as shown below.

$$Cl_2(g) + H_2O(l) \rightarrow HClO(aq) + HCl(aq)$$

(i) Using oxidation numbers, explain why this reaction is an example of disproportionation. [3]

(ii) State **one** benefit for public health, of the reaction between chlorine gas and water. [1]

(c) Group 2 elements and compounds show periodic trends. One trend is shown by the effect of heat upon Group 2 carbonates.

A student carried out an experiment to find out the volume of carbon dioxide obtained by heating a weighed sample of magnesium carbonate.

The student placed a 1.47 g sample of $MgCO_3$ into a test-tube and heated it until there was no further change in mass.

The following reaction took place.

$$MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$$

(i) What type of reaction is this? [1]

(ii) What volume of CO_2, in dm^3, would have been given off when measured at room temperature and pressure?

The molar mass of $MgCO_3$ = 84.3 g mol^{-1} [2]

(iii) The student repeated the experiment a further three times, using the same number of moles of $CaCO_3$, $SrCO_3$ and $BaCO_3$.

What trend in the behaviour of the Group 2 carbonates would be observed by the student? [1]

[Total: 12 Marks]