



# **A-Level Chemistry**

**Group 7**

**Question Paper**

**Time available: 57 minutes**

**Marks available: 50 marks**

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1.

This question is about chlorine.

- (a) Chlorine has a low boiling point because the forces between the molecules are weak.

Explain how these forces arise between molecules of chlorine.

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(3)

- (b) Give an equation for the reaction of chlorine with water.

Give a reason why chlorine is added to drinking water.

Equation

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Reason

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(2)

- (c) Chlorine reacts with cold, aqueous sodium hydroxide in the manufacture of bleach.

Give an equation for this reaction.

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(1)

(Total 6 marks)

**2.**

This question is about Group 7 elements and their compounds.

- (a) Chlorine is used to treat water even though it is toxic to humans.

Give **one** reason why water is treated with chlorine.

Explain why chlorine is added to water even though it is toxic.

Give an equation for the reaction of chlorine with cold water.

Reason \_\_\_\_\_

\_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Equation

\_\_\_\_\_

**(3)**

- (b) Solid sodium iodide reacts with concentrated sulfuric acid to form iodine and sulfur in a redox reaction.

Give a half-equation to show the conversion of iodide ions to iodine.

Give a half-equation to show the conversion of sulfuric acid to sulfur.

Give an overall equation for this redox reaction.

Identify one other sulfur-containing reduction product formed when solid sodium iodide reacts with concentrated sulfuric acid.

Half-equation for the conversion of iodide ions to iodine

\_\_\_\_\_

Half-equation for the conversion of sulfuric acid to sulfur

\_\_\_\_\_

Overall equation

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Other sulfur-containing reduction product

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(4)

A student completes an experiment to determine the percentage by mass of sodium chloride in a mixture of sodium chloride and sodium iodide.

The student uses this method.

- 600 mg of the mixture are dissolved in water to form a solution.
- An excess of aqueous silver nitrate is added to the solution. This forms a precipitate containing silver chloride and silver iodide.
- Excess dilute ammonia solution is then added to the precipitate. The silver chloride dissolves.
- The silver iodide is filtered off from the solution, and is then washed and dried.

The mass of the silver iodide obtained is 315 mg

(c) Silver nitrate is added to the solution.

Suggest why an excess is used.

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(1)

- (d) Calculate the amount, in moles, of silver iodide obtained.

$$M_r(\text{AgI}) = 234.8$$

Amount of silver iodide \_\_\_\_\_ mol

**(1)**

- (e) Calculate, using your answer to part (d), the mass, in grams, of sodium iodide in the mixture.

$$M_r(\text{NaI}) = 149.9$$

Mass of sodium iodide \_\_\_\_\_ g

**(1)**

- (f) Calculate, using your answer to part (e), the percentage by mass of sodium chloride in the mixture.

Percentage of sodium chloride \_\_\_\_\_

(2)

(Total 12 marks)

3.

This question is about sodium halides.

- (a) State what is observed when silver nitrate solution is added to sodium fluoride solution.

\_\_\_\_\_

(1)

- (b) State **one** observation when solid sodium chloride reacts with concentrated sulfuric acid.

Give an equation for the reaction.

State the role of the chloride ions in the reaction.

Observation \_\_\_\_\_

Equation

\_\_\_\_\_

Role \_\_\_\_\_

(3)

- (c) Give an equation for the redox reaction between solid sodium bromide and concentrated sulfuric acid.

Explain, using oxidation states, why this is a redox reaction.

Equation

\_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

- (d) State what is observed when aqueous chlorine is added to sodium bromide solution.

Give an ionic equation for the reaction.

Observation \_\_\_\_\_

Ionic equation

\_\_\_\_\_

(2)

(Total 9 marks)

4.

This question is about some Group 7 compounds.

- (a) Solid sodium chloride reacts with concentrated sulfuric acid.

Give an equation for this reaction.

State the role of the sulfuric acid in this reaction.

Equation

\_\_\_\_\_

Role \_\_\_\_\_

(2)

- (b) Fumes of sulfur dioxide are formed when sodium bromide reacts with concentrated sulfuric acid.

For **this** reaction

- give an equation
- give **one** other observation
- state the role of the sulfuric acid.

Equation

\_\_\_\_\_

Observation \_\_\_\_\_

\_\_\_\_\_

Role \_\_\_\_\_

**(3)**

- (c) Chlorine reacts with hot aqueous sodium hydroxide as shown in the equation.



Give the oxidation state of chlorine in  $\text{NaClO}_3$  and in  $\text{NaCl}$

$\text{NaClO}_3$  \_\_\_\_\_

$\text{NaCl}$  \_\_\_\_\_

**(1)**

- (d) State, in terms of redox, what happens to chlorine in the reaction in part **(c)**.

\_\_\_\_\_

\_\_\_\_\_

**(1)**



- (e) Solution **Y** contains **two** different negative ions.

To a sample of solution **Y** in a test tube a student adds

- silver nitrate solution
- then an excess of dilute nitric acid
- finally an excess of concentrated ammonia solution.

The observations after each addition are recorded in the table.

Reagent added to solution <b>Y</b>	Observation
silver nitrate solution	cream precipitate containing compound <b>D</b> and compound <b>E</b>
excess dilute nitric acid	cream precipitate <b>D</b> and bubbles of gas <b>F</b>
excess concentrated ammonia solution	colourless solution containing complex ion <b>G</b>

Give the formulas of **D**, **E** and **F**.

Give an **ionic** equation to show the formation of **E**.

Give an equation to show the conversion of **D** into **G**.

Formula of **D** \_\_\_\_\_

Formula of **E** \_\_\_\_\_

Formula of **F** \_\_\_\_\_

Ionic equation to form **E**  
\_\_\_\_\_

Equation to show the conversion of **D** into **G**  
\_\_\_\_\_

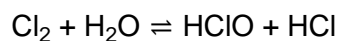
(6)

(Total 13 marks)

5.

Chlorine is used to decrease the numbers of microorganisms in water.

When chlorine is added to water, there is a redox reaction, as shown by the equation



- (a) Deduce the oxidation state of chlorine in **HClO** and the oxidation state of chlorine in **HCl**

Oxidation state of chlorine in **HClO** \_\_\_\_\_

Oxidation state of chlorine in **HCl** \_\_\_\_\_

(1)

- (b) Give two half-equations to show the oxidation and reduction processes that occur in this redox reaction.

Oxidation half-equation \_\_\_\_\_

Reduction half-equation \_\_\_\_\_

(2)

- (c) Chlorine is reacted with cold, aqueous sodium hydroxide in the manufacture of bleach.

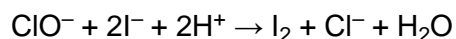
Give an equation for this reaction between chlorine and sodium hydroxide.

\_\_\_\_\_

(1)

- (d) The concentration of  $\text{ClO}^-$  ions in bleach solution can be found by reaction with iodide ions.

The overall equation for this reaction is shown.



A sample of bleach solution was found to contain  $\text{ClO}^-$  ions with a concentration of  $0.0109 \text{ mol dm}^{-3}$

Potassium iodide is added to a  $20.0 \text{ cm}^3$  portion of this bleach solution.

Calculate the mass, in mg, of potassium iodide needed to react with all of the  $\text{ClO}^-$  ions in the sample of bleach.

Give your answer to the appropriate number of significant figures.

Give **one** observation during this reaction.

Mass of potassium iodide \_\_\_\_\_ mg

Observation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(4)

- (e) Potassium chlorate(VII),  $\text{KClO}_4$ , is used in fireworks. When potassium chlorate(VII) decomposes, it produces potassium chloride and oxygen.

Give an equation for the decomposition of potassium chlorate(VII).

Use the data in the table to calculate the enthalpy change for this reaction.

Substance	$\Delta_f H / \text{kJ mol}^{-1}$
$\text{KClO}_4(\text{s})$	– 434
$\text{KCl}(\text{s})$	– 436

Equation \_\_\_\_\_

Enthalpy change \_\_\_\_\_  $\text{kJ mol}^{-1}$

(2)

(Total 10 marks)