



3055 BA SANGAM COLLEGE

PH: 6674003/9264117 E-mail: basangam@connect.com.fi



WORKSHEET 9

School: **Ba Sangam College**

Subject: **Chemistry**

Year: **12**

Name:

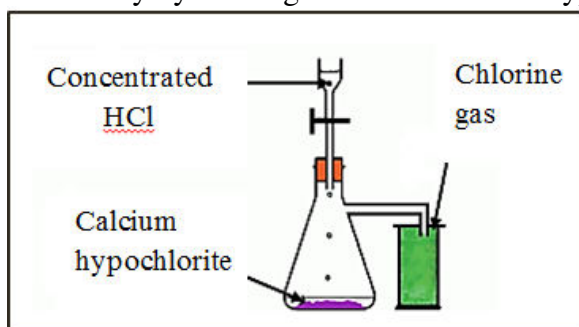
Strand	4 Materials
Sub strand	12.4.1 Inorganic Chemistry
Content Learning Outcome	12.4.1.2 Investigate the preparation, properties and uses of chlorine. Investigate the properties and reactions of chlorides of elements.

Chlorine Gas

- Chlorine is a chemical element with symbol Cl and atomic number 17.
- It is in the halogen group (Group VII) and is the second lightest halogen following fluorine.
- Exists as diatomic molecules (Cl₂).
- A yellow-green gas at 20 °C.
- Bleaches moist blue litmus paper.
- It is poisonous and has a suffocating or choking or irritating smell.

Laboratory Preparation of Chlorine gas

Chlorine can be prepared in the laboratory by reacting acids and calcium hypochlorite(bleaching powder).



Method of Collection:

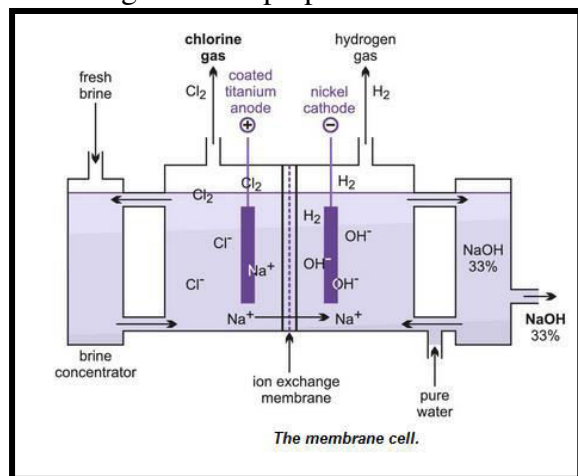
Chlorine gas is collected by upward displacement of air because it is denser than air.

Note: HNO₃ can also be used in place of concentrated HCl.

Reaction equation: $\text{Ca}(\text{OCl})_2(\text{s}) + 4\text{HCl}(\text{l}) \rightarrow \text{CaCl}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{Cl}_2(\text{g})$

Industrial Preparation of Chlorine gas

Chlorine gas can be prepared in the industries by the electrolysis of sodium chloride solution (brine).



The reactions occurring during electrolysis are:

Anode (Oxidation)	Cathode (Reduction)
Chlorine is oxidised to chlorine gas. $2\text{Cl}^-_{(\text{aq})} \rightarrow \text{Cl}_{2(\text{g})} + 2\text{e}^-$	Water is reduced to hydrogen gas. $2\text{H}_2\text{O}_{(\text{l})} + 2\text{e}^- \rightarrow 2\text{OH}^-_{(\text{aq})} + \text{H}_{2(\text{g})}$
The OH ⁻ from water reacts with Na ⁺ in the electrolyte to form NaOH $\text{Na}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})} \rightarrow \text{NaOH}_{(\text{aq})}$ Thus the overall equation for the reaction is: $2\text{NaCl}_{(\text{aq})} + 2\text{H}_2\text{O}_{(\text{l})} \rightarrow 2\text{NaOH}_{(\text{aq})} + \text{Cl}_{2(\text{g})} + \text{H}_{2(\text{g})}$	

1.Reactions of chlorine gas (Cl₂) 1. Reaction with iron (Fe) When chlorine gas is passed over hot iron in a combustion tank the iron burns to form iron(III) chloride.Iron(III) chloride forms black crystals. $2\text{Fe(s)} + 3\text{Cl}_2\text{(g)} \rightarrow 2\text{FeCl}_3\text{(s)}$	2. Reaction with calcium hydroxide solution Calcium hydroxide reacts with chlorine gas to produce the bleaching agent, calcium hypochlorite. $\text{Ca(OH)}_2\text{(s)} + \text{Cl}_2\text{(g)} \rightarrow \text{Ca(OC)}_2\text{(aq)} + \text{H}_2\text{O(l)}$
3. Reaction with sodium hydroxide solution Chlorine reacts with warm concentrated NaOH solution to give sodium chloride and sodium hypochlorate (NaClO ₃). The reaction between chlorine and warm concentrated sodium hydroxide solution is: $6\text{NaOH(aq)} + 3\text{Cl}_2\text{(g)} \rightarrow 5\text{NaCl(aq)} + \text{NaClO}_3\text{(aq)} + 3\text{H}_2\text{O(l)}$ The reaction between chlorine and cold dilute sodium hydroxide solution produces sodium hypochlorite (NaClO). $2\text{NaOH(aq)} + \text{Cl}_2\text{(g)} \rightarrow \text{NaCl(aq)} + \text{NaClO(aq)} + \text{H}_2\text{O(l)}$	4. Reaction with water Chlorine is only slightly soluble in water. It usually forms a mixture of two acids; hypochlorous acid (HOCl) and hydrochloric acid (HCl). $\text{Cl}_2\text{(g)} + \text{H}_2\text{O(l)} \rightarrow \text{HOCl(aq)} + \text{HCl(l)}$
5. Reaction with moist litmus paper (Test for chlorine) Chlorine gas (Cl ₂) turns moist blue litmus paper red and then bleaches it white. The litmus paper turns red because of formation of HCl and it turns white because of HClO. $\text{Cl}_2\text{(g)} + \text{H}_2\text{O(l)} \rightarrow \text{HOCl(aq)} + \text{HCl(l)}$	6. Reaction with damp starch iodide paper (Test for chlorine) Chlorine makes damp starch-iodide paper turn bluish-black.This is because the chlorine releases iodine from the potassium iodide and then iodine reacts with starch to produce a bluish-black color. $2\text{KI(aq)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{KCl(aq)} + \text{I}_2\text{(g)}$ $2\text{I}^- \text{(aq)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{Cl}^- \text{(aq)} + \text{I}_2\text{(g)}$

Activity

1. Chlorine can be prepared in the laboratory using concentrated HCl and calcium hypochlorite using upward displacement of air. . Write the balanced chemical equation for the preparation of chlorine gas as described above. (2 marks)	ii.Why is it possible to collect the gas by upward displacement of air? (1 mark)
iii. After preparing chlorine gas in the laboratory, a student wished to test for the gas prepared. He placed damp blue litmus paper at the mouth of the test-tube containing chlorine gas. Briefly explain what the student would observe and why. (2 marks)	iv. State and describe another method the student can use to test for the chlorine gas prepared. (1 mark) v. Write a balanced equation for the reaction of chlorine and sodium hydroxide to produce sodium hypochlorite. (1 mark)
2. Chlorine can also be prepared in the industries by the electrolysis of sodium chloride solution. i.Write the balanced chemical equation which occurs at the anode and cathode during electrolysis of NaCl solution Anode:_____ (1 mark) Cathode:_____ (1 mark)	3.Describe the test for chlorine using damp starch iodide paper. (1 mark)