

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

CHAPTER

5

Halogens

You will learn in this chapter about:

- ✦ Occurrence, sources of halogens and importance of halogens in daily life.
- ✦ chlorine and preparations of chlorine, laboratory and commercial preparations of chlorine.
- ✦ Physical, chemical properties and uses of chlorine, compounds of chlorine, hydrochloric acid, its preparation, Properties and its uses.
- ✦ Bleaching powder, its preparation and importance.
- ✦ Silver nitrate test for the presence of Cl^- , Br^- and I^- ions.

Section - A

Multiple Choice Questions (M.C.Qs.)

Choose the correct answer for each from the given options:

1. In the process of electrolysis :
(a) Oxidation takes place at cathode (b) Reduction takes place at anode
(c) Cations are discharged at cathode. (d) Anions are discharged at cathode.
2. Which one of the following will release chlorine from hydrochloric acid?
(a) Na (b) MnO_2 (c) KOH (d) CuSO_4
3. When chlorine atom combines with hydrogen atoms, which type of the bond is formed?
(a) Ionic bond (b) Coordinate covalent
(c) Polar covalent (d) Non-Polar covalent.
4. Chlorine gas prepared in the laboratory is collected in the gas jar by :
(a) Upward displacement of water (b) Upward displacement of air
(c) Downward displacement of air (d) Downward displacement of water
5. The most abundant and useful halogen is :
(a) Bromine (b) Fluorine (c) Iodine (d) Chlorine
6. Group number of halogens in the periodic table :
(a) VA (b) VIA (c) VIIA (d) VIIIA
7. Number of members of the halogen family :
(a) 4 (b) 5 (c) 6 (d) 7
8. Common oxidation state for all halogens :
(a) 1 (b) -1 (c) 7 (d) -7
9. The number of electrons in the valence shell of halogens are:
(a) 4 (b) 5 (c) 6 (d) 7

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10. Halogen are agents:

- (a) Oxidizing (b) reducing (c) neutralizing (d) Sulphonating

11. Radioactive member of the halogen family:

- (a) fluorine (b) chlorine (c) iodine (d) astatine

12. Atomic number of fluorine is:

- (a) 9 (b) 17 (c) 35 (d) 53

13. Atomic number of chlorine is:

- (a) 9 (b) 17 (c) 35 (d) 53

14. Atomic number of bromine is:

- (a) 9 (b) 17 (c) 35 (d) 53

15. Atomic number of iodine is:

- (a) 9 (b) 17 (c) 35 (d) 53

16. Atomic weight of fluorine is:

- (a) 19 (b) 35.5 (c) 80 (d) 127

17. Atomic weight of chlorine is:

- (a) 19 (b) 35.5 (c) 80 (d) 127

18. Atomic weight of bromine is:

- (a) 19 (b) 35.5 (c) 80 (d) 127

19. Atomic weight of iodine is:

- (a) 19 (b) 35.5 (c) 80 (d) 127

20. Fluorine is a _____ gas.

- (a) pale yellow (b) pale green (c) bright yellow (d) bright green

21. Chlorine is a _____ gas.

- (a) pale yellow (b) pale green (c) bright yellow (d) bright green

22. Bromine is:

- (a) reddish brown (b) shiny black (c) violet (d) indigo

23. Iodine is:

- (a) reddish brown (b) shiny black (c) violet (d) indigo

24. The electronegativity value of fluorine is:

- (a) 2.5 (b) 2.8 (c) 3 (d) 4

25. The electronegativity value of chlorine is:

- (a) 2.5 (b) 2.8 (c) 3 (d) 4

26. Each kilogram of sea water contains about _____ g of sodium chloride.

- (a) 10 (b) 20 (c) 30 (d) 40

27. Poly tetra fluoroethane is commonly called:

- (a) teflon (b) tungsten (c) cryolite (d) corundum

28. Iodine dissolved in _____ alcohol is commonly called tincture of iodine.

- (a) methyl (b) ethyl (c) propyl (d) butyl

29. Chlorine discovered by:

- (a) Priestley (b) Lavoisier (c) Scheele (d) Dalton

30. Iodine deficiency causes a disease called :

- (a) goiter (b) anaemia (c) anorexia (d) gluttony

31. The boiling point of chlorine is :

- (a) -14°C (b) -24°C (c) -34°C (d) -44°C

32. Chlorine is _____ times heavier than air.

- (a) 2.5 (b) 3.5 (c) 4.5 (d) 5.5

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33. Chloride ions give which precipitate of AgCl reaction with AgNO_3 .
 (a) white (b) light yellow (c) bright yellow (d) colourless
34. Bromide ions give which precipitate of AgBr on reaction with AgNO_3 .
 (a) white (b) light yellow (c) bright yellow (d) colourless
35. Iodide ions give which precipitate of AgI on reaction with AgNO_3 .
 (a) white (b) light yellow (c) bright yellow (d) colourless
36. Chemical name of bleaching powder is :
 (a) calcium oxychloride (b) calcium dioxychloride
 (c) Magnesium oxychloride (d) zinc oxide
37. Which one is not a use of chlorine.
 (a) making sodium chloride (b) making PVC plastic
 (c) sterilizing water (d) making domestic bleach
38. The formula for chloropicrin is :
 (a) COCl_2 (b) CCl_3NO_2 (c) $(\text{C}_2\text{H}_4\text{Cl}_2)_2\text{S}$ (d) S_2Cl_2
39. The formula for phosgene is :
 (a) COCl_2 (b) CCl_3NO_2 (c) $(\text{C}_2\text{H}_4\text{Cl}_2)_2\text{S}$ (d) S_2Cl_2
40. The formula for mustard gas is :
 (a) COCl_2 (b) CCl_3NO_2 (c) $(\text{C}_2\text{H}_4\text{Cl}_2)_2\text{S}$ (d) S_2Cl_2
41. Bleaching powder is commonly known as:
 (a) bleach (b) oxidant (c) reductant (d) dye
42. All halogen are:
 (a) monoatomic (b) diatomic (c) triatomic (d) pentaatomic
43. Which halogen sublimes?
 (a) fluorine (b) chlorine (c) iodine (d) astatine
44. The concentration of hydrochloric acid in the stomach is:
 (a) 0.5 % (b) 1 % (c) 1.5 % (d) 2 %
45. Chloroquin is a very effective medicine against:
 (a) dyspepsia (b) ulcer (c) malaria (d) measles

Answers of M.C.Qs.

- | | | | | | | |
|--------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 8. (b) | 15. (d) | 22. (a) | 29. (c) | 36. (a) | 43. (c) |
| 2. (b) | 9. (d) | 16. (a) | 23. (b) | 30. (a) | 37. (a) | 44. (a) |
| 3. (c) | 10. (a) | 17. (b) | 24. (d) | 31. (c) | 38. (b) | 45. (c) |
| 4. (b) | 11. (d) | 18. (c) | 25. (c) | 32. (a) | 39. (a) | |
| 5. (d) | 12. (a) | 19. (d) | 26. (c) | 33. (a) | 40. (c) | |
| 6. (c) | 13. (b) | 20. (a) | 27. (a) | 34. (b) | 41. (a) | |
| 7. (b) | 14. (c) | 21. (b) | 28. (b) | 35. (c) | 42. (b) | |

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Section - B/C Short / Descriptive Answer Questions

Q1. Give an introduction about Halogens.

Ans. An Introduction of Halogens : Halogens are group vii A elements They have seven electrons in their valence shells. They are called halogens because they form salts on reaction with metals. Halogens include five elements. The first two members, fluorine and chlorine are gases. Bromine is a liquid. Iodine is a solid. While the last member of the halogen family, astatine, is a rare radio active metals which is unstable.

All halogen are reactive and strong oxidizing agents because they are electrons removers i.e. they tend to gain electrons their reactivity and oxidizing power decrease down the group. Thus fluorine is the most reactive and most electronegative element while iodine is the least reactive and the least oxidizing agents among the halogen. All halogen are coloured. fluorine is pale yellow chlorine pale green, bromine reddish brown while iodine is black. Iodine sublimes directly to form vapours from the solid state. All halogen are diatomic molecules. All halogens have various oxidation states excepts fluorine which has only -1 oxidation states which is the most common oxidation state of all halogens.

Element	Fluorine(F ₂)	Chlorine(Cl ₂)	Bromine(Br ₂)	Iodine (I)
Atomic number	9	17	35	53
Electronic configuration	2,7	2,8,7	2,8,18,7	2,8,18,18,7
Outer Shell (E.C)	2s ² 2p ⁵	3s ² 3p ⁵	4s ² 4p ⁵	5s ² 5p ⁵
State at 20°C	Gas	Gas	Liquid	Solid
Colour	pale yellow	greenish yellow	reddish brown	Black
Atomic size (Å)	0.71	0.99	1.14	1.33
Ionic size (x) (Å)	1.33	1.81	1.96	2.20
First ionization energy (K.J/mol)	1681	1251	1140	1008
Electron affinity (K.J/mol)	-328	-349	-325	-295
Electro negativity	4.0	3.0	2.8	2.5
Melting point (°C)	-220	-101	-7	-113
Boiling point (°C)	-188	-35	59	183
X-X single bond energy (K.J/mol)	155	242	193	151
Reduction Potential (volt)	2.87	1.36	1.07	0.546
Solubility in water (g/100g water) $1/2 X_2 + e^- \longrightarrow X^-_{(aq)}$	Reacts readily with water	0.5g (Reacts partially with water)	3.6g	0.018g

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Q2. Write down the occurrence and sources of halogens.

Ans. Occurrence and Sources of Halogens : The halogens are too reactive to occur as free elements. They occur as salts both in the earth's crust and in sea water. These salts are very soluble in water particularly at higher temperatures.

Chlorine : Chlorine does not occur free in nature because it is too reactive. Instead, it is usually found in the combined state as chlorides. The most abundant of these is sodium chloride or common salt, which is found both in the sea and as salt deposits. Each kilogram of sea water contains about 30g of NaCl (3%). Pakistan has got the largest common salt deposits at Khewra near Jhelum. Other salts of chlorine include potassium chloride (KCl), calcium chloride (CaCl_2) and magnesium chloride (MgCl_2), which are all solutes in the sea.

Fluorine : Fluorine does not occur in the free state because of its high reactivity. Instead, it is found mainly in minerals like cryolite, Na_3AlF_6 , and fluor spar, CaF_2 , which is the most common fluorine compound and also as fluorapatite, $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$.

Bromine : It occurs naturally in the combined state. Bromides, e.g. those of magnesium, sodium and potassium occur in sea water and in salt deposits, but they are not as abundant as chlorides. Sea water contains the concentration of bromide as low as 70 parts per million.

Iodine : Iodine occurs in minute concentrations in sea water (0.05 parts per million). Iodides are also found as organic compounds in some sea weeds with a concentration of 800 parts per million. Iodine is also found as sodium iodide (NaI) in certain oil wells and also as sodium iodate (NaIO_3) found along with Chile salt petre (NaNO_3).

Astatine : It does not occur naturally. It is a radioactive element, which is unstable and rare.

Q3. Write down the importance / uses of halogens in daily life.

Ans. Importance / Uses of Halogens in Life :

Fluorine : It is used in rocket propulsion; fluoro compounds are used as refrigerants, aerosol propellants, anaesthetics, fire extinguisher fluids. Polytetrafluoroethane (PTFE) is an electrical insulator and is used for wire coverings. PTFE is commonly called teflon. It is used in preparing non-sticking utensils. Stannous fluoride (SnF_2) is used in tooth pastes. HF torches are used in welding producing a temperature of 4000°C .

Chlorine : See uses of chlorine. Q.8

Bromine : Bromine compounds are used in pharmaceuticals, dyes, fumigants, and pesticides, fire extinguishers and fire retardants. Silver bromide (AgBr) is used in photographic films as it is light sensitive.

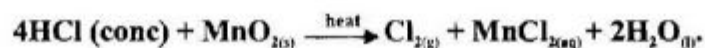
Iodine : Iodine and its compounds have uses in analytical chemistry. Iodine is used to synthesize thyroxine in the thyroid gland. Thyroxine helps to regulate metabolism. Iodine dissolved in ethyl alcohol is called tincture of iodine, which is used as a mild antiseptic for cuts and scratches. Iodine mixed with detergents is used in cleaning dairy equipment.

Q4. How is Chlorine prepared in the laboratory?

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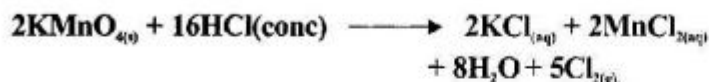
Ans. Preparation of Chlorine in the Laboratory from Hydrochloric Acid :

1. **Action of HCl on MnO_2 :** Lumps of manganese dioxide (MnO_2) are mixed with concentrated hydrochloric acid (HCl) in a round bottom flask, fitted with a cork along with a delivery tube. On heating the mixture gently greenish yellow chlorine is formed which is collected by the upward displacement of air.

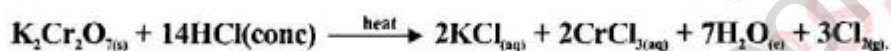


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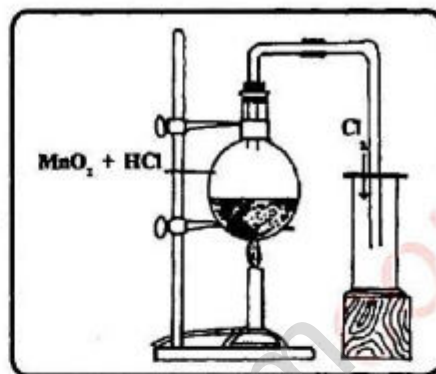
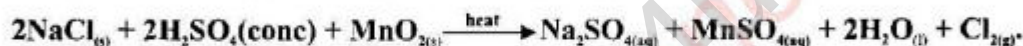
2. **Action of HCl on KMnO_4 :** When concentrated hydrochloric acid is mixed with potassium permanganate (KMnO_4), chlorine is produced along with potassium chloride (KCl), manganese chloride (MnCl_2) and water.



3. **Action of HCl on $\text{K}_2\text{Cr}_2\text{O}_7$:** Chlorine is also produced by heating potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) with concentrated hydrochloric acid.



4. **Action of H_2SO_4 on NaCl :** Chlorine is also prepared by heating sodium chloride (NaCl) with concentrated sulphuric acid along with manganese oxide (MnO_2).



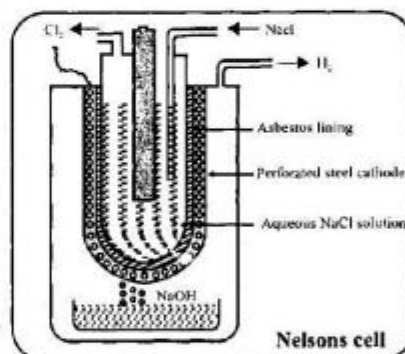
Preparation of chlorine

Q5. How is chlorine produced industrially / commercially?

Ans. Industrial / commercial preparation of chlorine :

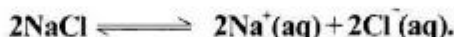
1. **From Nelson's cell :** The cell consists of a U-shaped perforated steel vessel which acts as cathode and a graphite rod which acts as anode. The cathode is separated from the anode by an asbestos layer deposited on the inner wall of the U-tube.

The U-tube is filled with an aqueous solution of sodium chloride. On passing the electric current, Chlorine is obtained at the anode. Sodium metal is deposited at the cathode which reacts with the water of the solution seeping through the asbestos releasing hydrogen gas along with (NaOH) which is collected at the bottom of the cathode compartment.



Nelson's cell

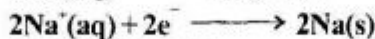
Ionization reaction.



Reaction at anode.



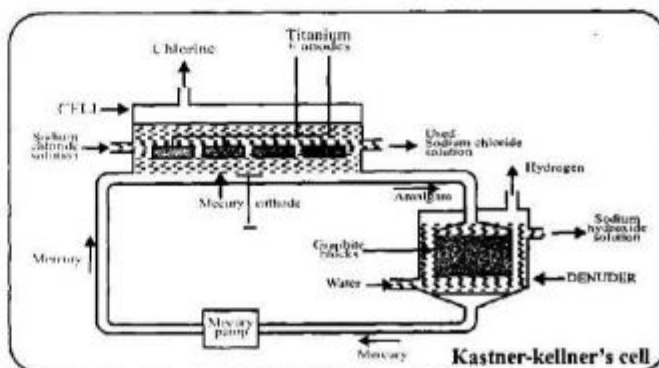
Reaction at cathode.



2. **From Castner Kellner's Cell:**

The cell used for electrolysis has titanium rods as anodes and a cathode of mercury. The electrolyte is concentrated brine (sodium chloride solution). The mercury flows continuously from one to the other end. During electrolysis, chlorine is liberated at the anode, sodium is discharged at the cathode and forms sodium amalgam with the mercury.

The sodium amalgam flows into a lower cell called soda cell which contains water. The sodium amalgam here reacts with water to form sodium hydroxide and hydrogen.



Castner-kellner's cell

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Ionization reaction : $2\text{NaCl(aq)} \rightleftharpoons 2\text{Na}^+(\text{aq}) + 2\text{Cl}^-(\text{aq}).$

Reaction at anode : $2\text{Cl}^-(\text{aq}) \longrightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$

Reaction at Cathode : $2\text{Na}^+(\text{aq}) + 2\text{e}^- \longrightarrow 2\text{Na(s)}.$

$2\text{Na(s)} + 2\text{Hg(l)} \longrightarrow 2\text{NaHg(l)}$

$2\text{NaHg(l)} + 2\text{H}_2\text{O(l)} \longrightarrow 2\text{NaOH(aq)} + \text{H}_2(\text{g}) + 2\text{Hg(l)}$

As mercury is toxic, chlorine is now produced using the diaphragm cell, which does not use mercury.

Q6. Write down the physical properties of chlorine.

Ans. Physical Properties of Chlorine :

1. Chlorine is a greenish yellow gas with a characteristic pungent smell :-
2. It is about 2.5 times denser than air.
3. It is moderately soluble in water and the solution is called chlorine water.
4. It boils at -34°C .
5. Its electronegativity is 3.
6. Its density is 3.214 g/dm^3 .
7. Its most common oxidation state is -1. Its other oxidation states are +1, +3, +5 and +7.

Q7. Write down the chemical properties of chlorine.

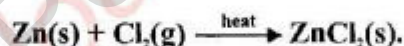
Ans. Chemical properties of chlorine :

1. **Reaction with Metals :** Most metals react with chlorine on heating.

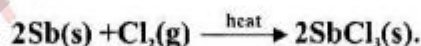
(i) Sodium react with chlorine to form sodium chloride.



(ii) Zinc reacts with chlorine to form zinc chloride.

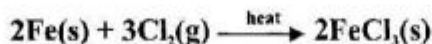


(iii) Antimony reacts with chlorine to form antimony chloride.

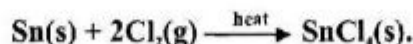


Metals having more than one oxidation number tend to form the 'higher' chlorides when reacting directly with chlorine.

(iv) Iron reacts with chlorine to give ferric chloric (FeCl_3) and not ferrous chloride.



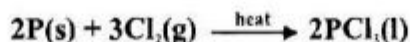
(v) Tin (Sn) forms stannic chloric (SnCl_4) and not stannous chlorides (SnCl_2),



Note : All the metal chlorides are ionic chlorides formed by the transference of electrons. Metals tend to lose electrons while chlorine (nonmetal) tends to gain electron.

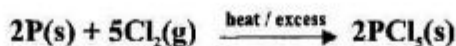
2. **Reaction with Nonmetals :** Most nonmetals react with chlorine to form covalent chlorides.

(i) Phosphorus reacts with chlorine to form phosphorous trichloride (PCl_3), a colourless liquid.

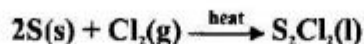


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- (ii) With excess chlorine, phosphorous forms phosphorous pentachloride (PCl_5), a pale yellow solid.

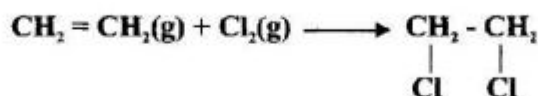


- (iii) Chlorine combines with hot sulphur to form disulphur dichloride (S_2Cl_2), a yellowish liquid.



3. Addition Reactions : Chlorine combines directly with many compounds to form addition products.

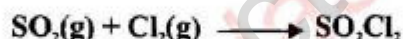
- (i) Chlorine combines with ethene ($\text{CH}_2=\text{CH}_2$) to form an addition product, 1,2 - dichloroethane.



- (ii) Chlorine combines with carbon monoxide (CO) to form an addition product Carbonyl chloride (COCl_2), which is a poisonous gas and is also called phosgene, which is used in chemical warfare.



- (iii) Chlorine combines with sulphur dioxide gas to form an addition product called sulphuryl chloride (SO_2Cl_2).



4. Substitution Reactions : Chlorine can displace one or more atoms from other compounds such reactions are called substitution or displacement reactions.

- (i) Chlorine has a strong attraction to hydrogen and it will remove hydrogen from many compound, especially hydrocarbons, to form hydrogen chloride gas forming a series of substituted product.



- (ii) Chlorine displaces hydrogen from hydrogen sulphide forming HCl gas.



- (iii) Any halogen above another in the family is more reactive and will therefore, displace any halogen below it from a solution of its salt.



5. Oxidation and Bleaching Action :

- (i) Chlorine dissolves in water to form chlorine water, a solution of hydrochloric (HCl) and hypochlorous acids (HOCl).

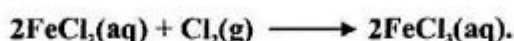
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Chlorine water is a powerful bleach because of the presence of hypochlorous acid. This decolourizes dyes by adding oxygen, to the dye, which removes its colour. Bleaching is a form of oxidation.



(ii) Chlorine oxidizes green coloured ferrous chloride (FeCl_2) to yellow colour ferric chloride (FeCl_3).



(iii) Chlorine oxidizes sulphurous acid (H_2SO_3) to sulphuric acid (H_2SO_4).

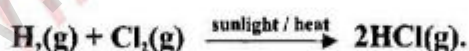


6. **Reaction with Ammonia :** Chlorine reacts with ammonia (NH_3) violently to form nitrogen (N_2) and hydrogen chloride (HCl), HCl combines with excess ammonia (NH_3) to form white fumes of ammonium chloride (NH_4Cl).



This reaction calls for excess ammonia, otherwise nitrogen trichloride (NCl_3) is produced instead of nitrogen (N_2). NCl_3 is a highly explosive compound.

7. **Reaction with Hydrogen :** Chlorine combines with hydrogen in the presence of sunlight or on heating quickly to produce hydrogen chloride (HCl).

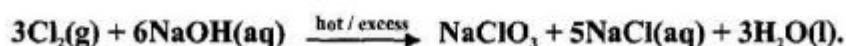


8. **Reaction with Alkalis :**

(i) **With Cold Dilute Alkalis:** When chlorine reacts with cold dilute solutions of sodium, or calcium hydroxides to form respectively hypochlorites and chlorides along with water.



(ii) **With Hot Concentrated Alkalis :** Excess chlorine reacts with hot and concentrated solutions of alkalis to give respective chlorates and chlorides along with water.



(iii) When chlorine gas is passed over dry slaked lime at 40°C bleaching powder, $\text{Ca}(\text{OCl})\text{Cl}$, is produced,



Bleaching powder

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Q8. Write down the uses of chlorine.

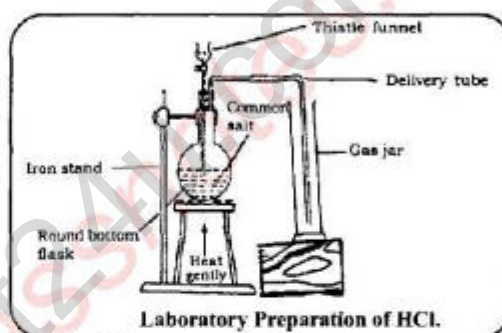
Ans. *Uses of chlorine :*

1. Chlorine is used for sterilizing drinking water.
2. It is used in the manufacture of synthetic rubber.
3. Chlorine is used industrially in making dyes, drugs, explosives, PVC plastic, poisonous gases (phosgene, mustard gases) carbon tetrachlorine, chloroform, etc.
4. It is used in the manufacture of bleaching powder.
5. It is used in making pesticides.

Q9. Write down the laboratory and industrial preparation of hydrochloric acid.

Ans. *Laboratory Preparation of Hydrochloric Acid :*

Common salt (NaCl) is placed in a round bottom flask fitted with a thistle funnel and a delivery tube. Concentrated sulphuric acid (H_2SO_4) is added to common salt from the thistle funnel and hydrogen chloride is collected in gas jar through the delivery tube by the upward displacement of air. The flask is heated gently to get HCl at a fast rate. HCl gas is highly soluble in water to give HCl acid.



Industrial Preparation of Hydrochloric Acid.

1. **From Hydrogen and Chlorine :** Hydrochloric acid is prepared commercially by the direct combination of hydrogen and chlorine gases.



The gas mixture of hydrogen and chlorine is burnt in a brick lined furnace. Hydrogen chloride gas is absorbed in water to get HCl acid.

2. **By the Reaction of PCl_3 with H_2O :** Hydrochloric acid is obtained from the chlorides of nonmetals such as phosphorous trichloride (PCl_3) on reaction with water (H_2O).



3. **Reaction between chlorine and Hydrogen compound:** Hydrochloric acid can also be obtained by the action of chlorine on hydrogen compounds such as hydrogen sulphide (H_2S) and water (H_2O).



Q10. Write down the physical properties of hydrochloric acid.

Ans. *Physical Properties of Hydrogen Chloride Gas :*

1. It is a colourless gas with a pungent smell and a sour taste.
2. Its boiling point is $-85^\circ C$.

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3. It is slightly (1.25 times) heavier than air. It is, therefore, collected by the upward displacement of air.
4. It is highly soluble in water forming hydrochloric acid.
5. It gives dense white fumes in moist air.
6. It turns damp blue litmus paper red showing that it is acidic in aqueous solution.

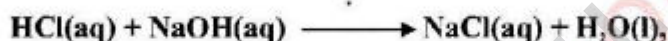
Q11. Write down the chemical properties of Hydrochloric acid.

Ans. Chemical Properties of Hydrochloric Acid :

1. **Reaction with Water :** Hydrochloric acid is a strong acid and ionizes in water to give hydronium ions (H_3O^+) and chloride ions (Cl^-).



2. **Reaction with Alkalis and Bases :** Hydrochloric acid reacts with alkalis and bases to produce salts and water.



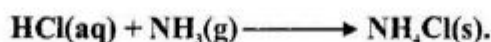
3. **Reaction with Metal Carbonates and Bicarbonates :** It reacts with metallic carbonates and hydrogen carbonates (bicarbonates) to liberate carbon dioxide (CO_2) along with respective salts and water.



4. **Reaction with Certain Metals :** Certain metals (less electropositive metals) like magnesium, aluminium, zinc, iron, tin react with dilute hydrochloric acid to give hydrogen gas along with respective salts (chlorides).



5. **Reaction with Ammonia :** Hydrochloric acid reacts with ammonia to produce white fumes of ammonium chloride.



6. **Reaction with silver Nitrate (AgNO_3) and Lead Nitrate $\text{Pb(NO}_3)_2$:** Silver nitrate and lead nitrate reacts with dilute hydrochloric acid to precipitate their chlorides.



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Q12. Write down the uses of Hydrochloric Acid.

Ans. *Uses of Hydrochloric Acid:*

1. It is used to remove scales and rust from metal surfaces, the process is called pickling.
2. It is used in the manufacture of dyes, rubber, medicine, gelatine, glue, etc.
3. It is used to remove calcium carbonate deposits from sanitary wares and floors.
4. It is used as a chemical reagent in the lab.

Q13. Write down the laboratory and industrial preparation of bleaching powder.

Ans. *Laboratory preparation of Bleaching powder:* Bleaching powder is prepared by shaking a small quantity of freshly prepared slaked lime with chlorine in a jar. The colour of chlorine disappears immediately.



Industrial / commercial preparation of Bleaching powder: Bleaching powder is prepared commercially by Hasenclever process. The chlorination of the slaked lime takes place in a chlorinating tower. The slaked lime Ca(OH)_2 is blown from the top of the tower by means of compressed air and allowed to fall. The chlorine gas is then passed up the tower in the opposite direction from the bottom of the tower. When the required amount of chlorine has been absorbed, hot air is blown through the product to remove all traces of chlorine gas. Bleaching powder (CaOCl_2) an off white amorphous powder, is removed, dried and packed in wooden vats and kept in the dark.

Reaction:



Q14. Write down the physical and chemical properties of bleaching powder.

Ans. *Physical properties of Bleaching powder:*

1. It is soft, dry, yellowish white.
2. It is amorphous.
3. It smells of chlorine.
4. It is an oxidizing agent.

Chemical Properties of Bleaching Powder:

1. *Reaction with Water:* In water, it liberates chlorine gas.



In excess water, it decomposes into calcium chloride (CaCl_2) and calcium hypochlorite.



2. *Reaction with Strong Acids:* Bleaching powder reacts with strong acids like HCl and H_2SO_4 to liberate chlorine gas.



3. *Reaction with CO_2 in the presence of moisture (H_2O) [with carbonic acid]:*

Bleaching powder reacts slowly with CO_2 of the air in the presence of moisture to hypochlorous acid (HClO).

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4. **Reaction with Ammonia :** Bleaching powder reacts with a concentrated solution of ammonia to give nitrogen gas.



Q15. Write important uses of Bleaching powder.

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Ans. Uses of Bleaching Powder :

1. It is used for bleaching cotton, linen and paper pulp.
2. It is used for the preparation of chlorine gas (Cl_2).
3. It is also used to prepare hypochlorous acid (HClO).
4. It is used for disinfecting drainages and sewers.
5. It is also used for the sterilization of drinking water.

Q16. Describe silver nitrate test for the presence of halide ion in a salt of chloride. Give the reactions.

Ans. Test for Halide ions with Silver Nitrate (AgNO_3) solution : The presence of halide ions [chloride (Cl^-), bromide (Br^-) and iodine (I^-)] is confirmed by the colour of the precipitate formed in AgNO_3 solution and the solubility of the precipitate in aqueous ammonia (NH_3).

Reaction :



Halide Ions	Colour of Precipitate	Solubility in Aqueous Ammonia
Cl^-	white precipitate	soluble
Br^-	faint yellow	partially soluble
I^-	yellow	insoluble

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Textbook Exercise

1. (a) **Fill in the blanks :**

- (i) Br_2 is the dark brown volatile liquid.
- (ii) I_2 is the black shining low melting solid.
- (iii) F_2 can replace all other halogens from the solutions of their salts.
- (iv) I_2 dissolved in alcohol is called tincture of iodine.
- (v) Cl_2 gas is liberated by the action of bleaching powder over water.

(b) **Write True or False in the following statements :**

- (i) In the electrolysis of sodium chloride solution, chloride ions are discharged at the anode. (true)
- (ii) Hydrochloric acid reacts with many metals to release H_2 gas. (true)
- (iii) Bleaching powder is a powerful reducing agent. (false)
- (iv) All halogens contains six electrons in the outer shell. (false)
- (v) Astatine the last member of halogens is unstable and radioactive. (true)
- (vi) Br_2 can displace chlorine from KCl . (false)

(c) **Pick up the correct answers :**

Ans: See MCQs 1 to 4.

2. **Complete the following reactions :**

(BALANCE) :

- (i) $\text{MnO}_2(\text{s}) + 4\text{HCl}(\text{conc}) \longrightarrow \text{Cl}_2(\text{g}) + \text{MnCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
- (ii) $2\text{NaHg}(\text{l}) + 2\text{H}_2\text{O}(\text{l}) \longrightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g}) + 2\text{Hg}(\text{l})$
- (iii) $2\text{KI}(\text{s}) + \text{Cl}_2(\text{g}) \longrightarrow 2\text{KCl}(\text{s}) + \text{I}_2(\text{g})$
- (iv) $6\text{NaOH}(\text{aq}) + 3\text{Cl}_2(\text{g})(\text{excess}) \xrightarrow{\text{heat}} 5\text{NaCl}(\text{aq}) + \text{NaClO}_3(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$
- (v) $\text{AgNO}_3(\text{aq}) + \text{HCl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{HNO}_3(\text{aq})$
- (vi) $\text{Ca}(\text{OCl})\text{Cl}(\text{s}) + 2\text{HCl}(\text{aq}) \longrightarrow \text{CaCl}_2(\text{aq}) + \text{Cl}_2(\text{g}) + \text{H}_2\text{O}$
- (vii) $\text{KBr}(\text{aq}) + \text{AgNO}_3(\text{aq}) \longrightarrow \text{KNO}_3 + \text{AgBr}(\text{s})(\text{ppt.})$
- (viii) $\text{K}_2\text{Cr}_2\text{O}_7(\text{s}) + 14\text{HCl}(\text{conc}) \xrightarrow{\text{heat}} 2\text{KCl}(\text{aq}) + 2\text{CrCl}_3(\text{aq}) + 7\text{H}_2\text{O}(\text{l}) + 3\text{Cl}_2(\text{g})$

3. (a) **What are halogens? Why are they placed in VII A group in the periodic table? Describe the state of each member of the family and also their colours.**

Ans: See Q.1.

(b) **What are the sources of halogens? Describe the importance of Cl_2 , Br_2 and I_2 in our daily life.**

Ans: See Q.2 and 3.

4. (a) **How is chlorine prepared in the laboratory?**

Ans: See Q.4.

(b) **Describe the commercial preparation of chlorine by the electrolysis of aqueous NaCl solution in Nelson's cell.**

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Ans: See Q.5.

(c) What happens when chlorine reacts with:

- (i) Sn (ii) H_2S (iii) CO (iv) P (v) $FeCl_2$
(vi) H_2O . Give reactions and equations.

Ans: See Q.7.

(d) Discuss the uses of chlorine.

Ans: See Q.8.

5. (a) Give the preparation of hydrogen chloride (HCl) in the laboratory by the action of conc. H_2SO_4 over common salt (NaCl).

Ans: See Q.9.

(b) How is hydrogen chloride is manufactured commercially by direct combination of H_2 and Cl_2 gases.

Ans: See Q.9(i).

(c) What is the action hydrochloric acid (HCl) on .

- (i) NaOH (ii) $NaHCO_3$ (iii) $Pb(NO_3)_2$ (iv) MnO_2
(v) $KMnO_4$

Ans: See Q.11.

6. (a) What is bleaching powder? How is it manufactured commercially by Hasenclever process? Give the uses of bleaching powder.

Ans: See Q.13 and 14.

(b) What is the action bleaching powder over:

- (i) water (ii) excess of water (iii) H_2CO (weak acid)
(iv) ammonia (NH_3). (v) HCl.

Ans: See Q.14.

7. (a) Describe silver nitrate test for the presence of Cl^- ion in a salt of chloride. Give the reaction.

Ans: See Q.16.

(b) Identify the following :

(i) A pale green gas that dissolves in aqueous NaOH solution give a solution used as a bleach.

Ans: Chlorine (Cl_2).

(ii) A gas with pungent smell, acidic taste, highly soluble in water to form a strong acid.

Ans: Hydrogen Chloride (HCl).

(iii) White amorphous solid which reacts with water to liberate chlorine gas.

Ans: Bleaching Powder.

(iv) The deficiency of this leads to the enlargement of thyroid gland.

Ans: Iodine.

(v) A pale yellow gas, very unstable in water.

Ans: Nitric Oxide.

(vi) A non-sticking material, having very low coefficient of heat.

Ans: Teflon.

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