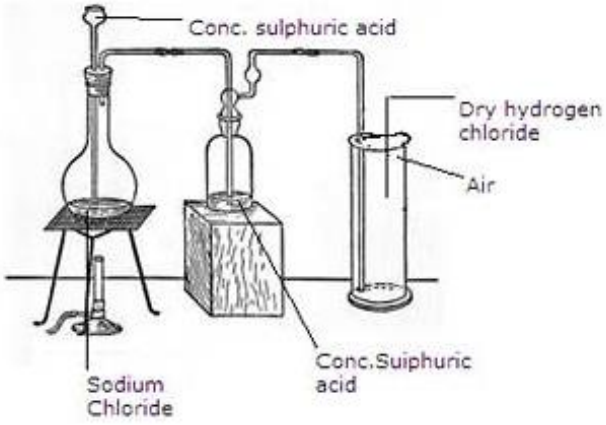
EXERCISE

Question 1:

Draw a labelled diagram for the laboratory preparation of hydrogen chloride gas. Give the balanced equation for the reaction.

Solution 1:

Labelled Diagram for laboratory preparation of Hydrogen chloride is:



Balanced equation: $NaCl + H_2SO_4 \xrightarrow{<200°C} NaHSO_4 + HCl \uparrow$

Question 2:

Name the drying agents:

(a) used in drying hydrogen chloride gas.

(b) phosphorus pentoxide and calcium oxide are good drying agent but they cannot be used to dry hydrogen chloride gas. Why?

Solution 2:

(a) Hydrogen chloride is dried by passing through conc. Sulphuric acid.

(b) Phosphorous pentoxide and CaO cannot be used to dry HCl because they react with HCl.

$2P_2O_5 + 3HCl \rightarrow POCl_3 + 3HPO_3$

$CaO + 2HCl \rightarrow CaCl_2 + H_2O$

Question 3:

Explain why:

(a) Anhydrous HCl is poor conductor while aqueous HCl is excellent conductor.

(b) When the stopper of a bottle full of hydrogen chloride gas is opened there are fumes in the air.

(c) A solution of hydrogen chloride in water turns blue litmus red, and conducts electricity, while a solution of the same gas in toluene:

(i) has no effect on litmus, and

(ii) does not conduct electricity.

(d) thick white fumes are formed when a glass rod dipped in NH_2OH is brought near the mouth of a bottle full of HCl gas.

(e) dry hydrogen chloride gas does not affect a dry strip of blue litmus paper but it turns red in the presence of a drop of water.

(f) hydrogen chloride gas is not collected over water.

Solution 3:

(a) Anhydrous HCl is poor conductor due to the absence of ions in it whereas aqueous HCl is excellent conductor since it contains ions.

(b) When the stopper is opened HCl gas comes in contact with water vapors of air and gives white fumes due to the formation of hydrochloric acid.

(c) A solution of HCl in water gives hydronium ions and conducts electricity, but HCl is also soluble in dry toluene, but in that case it neither (i) turns blue litmus red (ii) nor does conducts electricity. This indicates the absence of H^+ ions in toluene showing thereby that hydrogen chloride is a covalent compound.

(d) When ammonium hydroxide is brought near the mouth of HCl, dense white fumes are formed due to the formation of ammonium chloride.

$HCl + NH_4OH \rightarrow NH_4Cl + H_2O$

(e) Dry hydrogen chloride is not acidic whereas moist Hydrogen chloride is acidic. In presence of a drop of water HCl gas dissolves in water and forms hydrochloric acid which turns blue litmus paper red.

(f) Hydrogen chloride is not collected over water as it is highly soluble in water.

Question 4:

Write the main difference in hydrogen chloride gas and hydrochloric acid.

Solution 4:

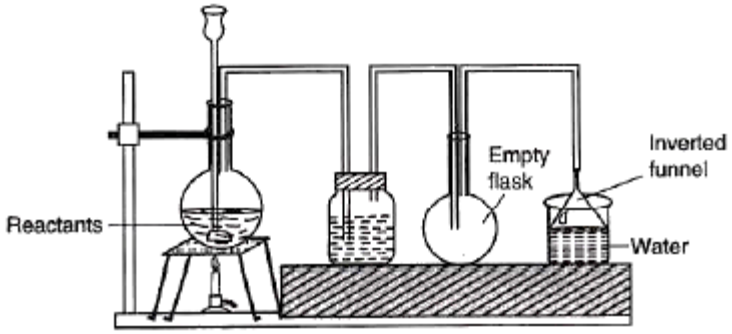
Difference between Hydrogen chloride gas and Hydrochloric acid is:

Hydrogen chloride gas	Hydrochloric acid
1. Dry hydrogen chloride gas does not turn blue litmus red due to non-acidic character. 2. Hydrogen chloride gas does not conduct electricity.	1. Being acidic it turns blue litmus red. 2. Hydrochloric acid is a good conductor of electricity.

Question 5:

The given set up in the figure is for the preparation of an acid.

(a) Name the acid prepared by this method.



(b) name the reactants used.

(c) why empty flask is used

(d) what is the drying agent used? Why is this drying agent chosen?

(e) what is the role of inverted funnel in the arrangement

Solution 5:

Hydrochloric acid is prepared by this method.

(a) The reactants are sodium chloride and Sulphuric acid.

(b) The empty flask acts as Anti-Suction device. In case the back suction occurs the water will collect in it and will not reach the generating flask.

(c) The drying agent is Conc. Sulphuric acid. Sulphuric acid is chosen as drying agent because it does not react with HCl.

(d) The Inverted funnel :

Prevents or minimizes back suction of water.

Provides a large surface area for absorption of HCl gas.

Question 6:

Write an equation for the reactions of aqueous hydrochloric acid on:

(a) silver nitrate solution (b) magnesium foil

(c) caustic soda solution (d) zinc carbonate

(e) lead nitrate solution (f) copper oxide

Solution 6:

Equations are:

(a) $AgNO_3 + HCl \rightarrow AgCl + HNO_3$

(b) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

(c) $NaOH + HCl \rightarrow NaCl + H_2O$

(d) $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + H_2O + CO_2$

(e) $Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2 + 2HNO_3$

(f) $CuO + 2HCl \rightarrow CuCl_2 + H_2O$

Question 7:

(a) Name an element which reacts with hydrogen to form a compound which is strongly acidic in water.

(b) Explain why dilute hydrochloric acid cannot be concentrated by boiling beyond 22.2%.

Solution 7:

(c) Chlorine.

The compound formed which is strongly acidic in water, is HCl.

$H_2 + Cl_2 \rightarrow 2HCl$

(d) A dilute aqueous solution of hydrochloric acid gets gradually concentrated on distillation, till the concentration of the acid reaches 22.2% HCl by weight which boils at 110^0C. When this concentration is reached, no further increase in concentration of the acid becomes possible by boiling. This is because vapours evolved before 110^0C are vapours of water but at temperature above 110^0C vapours consist mostly of molecules of HCl.

Question 8:

Hydrochloric acid contains (i) hydrogen (ii) chlorine. Prove it. Write equations for the reactions.

Solution 8:

We can prove that hydrochloric acid contains both hydrogen and chlorine by the following experiment.

Take a voltameter used for electrolysis of water, fitted with platinum cathode and graphite anode. Into the voltameter pour 4 molar HCl and pass direct current.

It is seen that a colourless gas is evolved at cathode and a greenish gas is evolved at anode.
When a burning splinter is brought near a colourless gas, it bursts into flame thereby proving that it is hydrogen gas.
When moist starch iodide paper is held in the greenish yellow gas, it turns blue black, thereby proving that the gas is chlorine.
$2HCl \rightarrow H_2 + Cl_2$
This experiment proves that hydrochloric acid contains both hydrogen and chlorine.

Question 9:

Name:
(a) black metallic oxide which reacts with hydrochloric acid to give a coloured solution.
(b) two colourless gases, which when mixed produce a white solid.
(c) two gases which chemically combine to form a liquid
(d) a chloride which is solube in excess of ammonium hydroxide
(e) the chemical in which gold can be dissolved
(f) the experiment which demonstrates that hydrogen chloride is soluble in water.
(g) the gas produced when chlorine water is exposed to sunlight

Solution 9:

(a) Manganese dioxide
(b) Hydrogen chloride and ammonia
(c) Hydrogen and oxygen
(d) AgCl(Silver chloride)
(e) Aqua regia
(f) Fountain experiment
(g) Hydrogen chloride gas

Question 10:

Give reasons for the following:
(a) An aqueous solution of chlorine in acidic in nature
Hint : $Cl_2 + H_2O \longrightarrow HCl + HClO$
(b) silver nitrate solution can be used to distinguish HCl from HNO_3

Solution 10:

(a) An aqueous solution of chlorine is acidic as it dissolves in water to form hydrochloric and hypochlorous acids.

(b) Silver nitrate reacts with hydrochloric acid to form thick curdy white ppt. of silver chloride whereas silver nitrate does not react with nitric acid.

$AgNO_3 + HCl \rightarrow AgCl + HNO_3$

(White ppt.)

Question 11:

Solution A reacts with an acid B (which gives greenish yellow gas on reacting with oxidizing agents like Pb_3O_4 to give white precipitate C insoluble in nitric acid but soluble in ammonium hydroxide. Name A, B and C.

Solution 11:

A is Silver nitrate

B is Hydrochloric acid

C is Silver chloride

Question 12:

Complete the following reactions and balance them.

(a) $NH_4OH + HCl \longrightarrow$

(b) $NaHSO_3 + HCl \longrightarrow$

(c) $Pb(NO_3)_2 + HCl \longrightarrow$

(d) $Pb_3O_4 + HCl \longrightarrow$

(e) $Zn + 2HCl \longrightarrow$

(f) $Ca(HCO_3)_2 + 2HCl \rightarrow$

Solution 12:

(f) $NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$

(g) $NaHSO_3 + HCl \longrightarrow NaCl + H_2O + SO_2$

(h) $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

(i) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + 4H_2O + Cl_2$

(j) $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

(k) $Ca(HCO_3)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O + 2CO_2$

Question 13:

How will the action of dilute hydrochloric acid enable you to distinguish between the following:

(a) Sodium carbonate and sodium sulphite

(b) sodium thiosulphate and sodium sulphite

Solution 13:

a. Sodium carbonate on treating with dil. HCl results in the formation of sodium chloride with the liberation of carbon dioxide gas.

$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2 \uparrow$

Sodium sulphite on treating with dil. HCl results in the formation of sodium chloride with the liberation of sulphur dioxide gas.

$Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2 \uparrow$

b. Sodium thiosulphate reacts with dil. HCl to produce sulphur dioxide gas and precipitates yellow sulphur.

$Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2 + S \downarrow$

Sulphur is not precipitated when sulphites are treated with dil. HCl.

Question 14:

Give three distinct test [apart from using an indicator] you would carry out with solution of HCl to illustrate the typical properties of an acid.

Solution 14:

Three tests are:

HCl gas gives thick white fumes of ammonium chloride when glass rod dipped in ammonia solution is held near the vapours of the acid.

$NH_3 + HCl \longrightarrow NH_4Cl$

With silver nitrate HCl gives white precipitate of silver chloride. The precipitate is insoluble in nitric acid but soluble in ammonium hydroxide.

$AgNO_3 + HCl \longrightarrow AgCl + HNO_3$

A greenish yellow gas is liberated when concentrated hydrochloric acid is heated with oxidizing agent like manganese dioxide.

$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

Question 15:

MnO_2, PbO_2 and red lead react with conc. HCl acid liberates Cl_2.

What is the common property being shown by these metal oxides?

Solution 15:

MnO_2, PbO_2 and red lead react with conc. HCl acid to liberate Cl_2. This shows that hydrochloric acid is oxidized to chlorine by oxidizing agents.

Question 16:

Giving reasons state which of the two- a solution of HCl in water or in toluene is an electrolyte.

Solution 16:

HCl dissolves both in water and toluene, when HCl dissolves in water it ionizes and forms hydronium and chloride ions. Whereas this ionization is not observed in toluene hence a solution of HCl in water can be used as an electrolyte.

Question 17:

Convert two soluble metallic nitrates to insoluble metallic chlorides using dil. HCl.

Solution 17:

Conversion of metallic nitrates to insoluble metallic chlorides using dil. HCl:

(i) $Pb(NO_3)_2 + 2HCI \longrightarrow PbCI_2 \downarrow + PbCI_2 \downarrow + 2HNO_3$

(ii) $Hg_2(NO_3)_2 + 2HCI \longrightarrow Hg_2CI_2 \downarrow 2HNO_3$

Question 18:

State the composition of aqua regia. State which component is the oxidizing agent in aqua regia.

Solution 18:

A mixture having three parts of conc. Hydrochloric acid and one part of conc. Nitric acid is called aqua-regia.

Nitric acid acts as oxidizing agent.

Question 19:

Convert hydrochloric acid to nascent chlorine.

Solution 19:

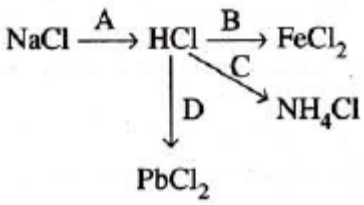
Hydrochloric acid can be converted to nascent chlorine by:

$3HCI + HNO_3 \longrightarrow NOCI + 2H_2O + 2[CI]$

Conc Conc Nascent chlorine

Question 20:

Study the flow chart and give balanced equations with conditions for the conversions A, B, C and D.



Solution 20:

$NaCl + H_2SO_4 \xrightarrow{<200°C} NaHSO_4 + HCl$

$Fe + 2HCl \longrightarrow FeCl_2 + H_2$

$HCl + NH_3 \longrightarrow NH_4Cl$

$PbO_2 + 4HCl \longrightarrow PbCl_2 + 2H_2O + Cl_2$

Question (2004) 21:

A solution of hydrogen chloride in water is prepared. The following substances are added to separate portions of the solution:

Sl. No.	Substances added	Gas evolved	Odour
1	Calcium carbonate		
2	Magnesium ribbon		
3	Manganese(IV) oxide with heating		
4	Sodium sulphide		

Complete the table by writing the gas evolved in each case and its odour.

Solution (2004) 21:

Sl. No.	Substances added	Gas evolved	Odour
1	Calcium carbonate	Carbon dioxide	Odourless
2	Magnesium ribbon	Hydrogen	Odourless
3	Manganese(IV) oxide with heating	Cl_2	Strong Pungent odour
4	Sodium sulphide	Hydrogen sulphide	Rotten egg

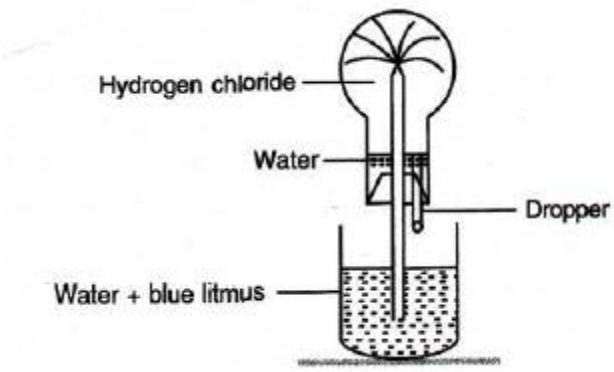
Question (2005) 22:

(a) Write balanced equations.

(i) copper oxide and dilute hydrochloric acid.

(ii) Manganese (iv) oxide and concentrated hydrochloric acid.

(b) (i) Name the experiment illustrated below.



(ii) Which property of hydrogen chloride is demonstrated by this experiment?

(iii) State the colour of the water that has entered the round bottomed flask.

Solution (2005) 22:

(a)

(i) $CuO + 2HCl \longrightarrow CuCl_2 + H_2O$

(ii) $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

(b)

(i) The experiment is called Fountain Experiment.

(ii) This experiment shows that hydrogen chloride is highly soluble in water.

(iii) Red

Question (2007) 23:

Write balanced equations for the reaction of dilute hydrochloric acid with each of the following:

(a) iron

(b) sodium hydrogencarbonate,

(c) iron (II) sulphide

(d) sodium sulphite

(e) sodium thiosulphate solution

Solution (2007) 23:

(i) $Fe + 2HCl \longrightarrow FeCl_2 + H_2$

(ii) $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$

(iii) $FeS + 2HCl \longrightarrow FeCl_2 + H_2S$

(iv) $Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2$
(v) $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2 + S$

Question (2008) 24:

What property of hydrogen chloride is demonstrated when it is collected by downward delivery (upward displacement)?

Solution (2008) 24:

When hydrogen chloride is collected by downward delivery or upward displacement, it shows that it is heavier than air.

Question (2008) 25:

Why is hydrogen chloride not collected over water?

Solution (2008) 25:

Hydrogen chloride is not collected over water as it is soluble in water.

Question (2008) 26:

Write the equations for the following reactions:
(a) Dilute hydrochloric acid and sodium thiosulphate,
(b) Dilute hydrochloric acid and lead nitrate solution.

Solution (2008) 26:

(i) $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2 + S$
(ii) $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$