Name :- Krishnandan Mukhiya

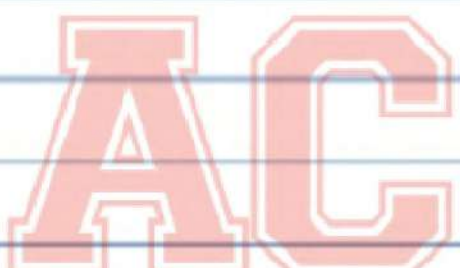
Address:- Kaudena -01 (laxmipur)

Subject:- Chemistry-II

Year/Part:- First Year / Second Part (Second Semester)

College:-Shree Sarasawti Secondary School

Gmail:- krishnandanmukhiya82@gmail.com



UNIT-1
07/03/23
Ver.1

Unit → Non-metals and their compound
Sub-unit → 1.3 (Nitric acid)

(1)

(*) manufacture of Nitric acid by ostwald's process [by catalytic oxidation of ammonia]

principle:-

(1) A mixture of ammonia and dry air in the ratio 1:2 by volume is heated at 800°C in ~~pressure~~ presence of platinum gauze then ammonia is oxidised to nitric acid.

$$4NH_3 + 5O_2 \xrightarrow[800^\circ C]{Pt\ gauze} 4NO + 6H_2O$$

(2) Nitric oxide so formed is cooled and allowed to come in contact with air and then it gets oxidised to nitrogen dioxide

$$2NO + O_2 \longrightarrow 2NO_2$$

(3) Nitrogen dioxide formed is dissolved in water in presence of air then nitric acid is formed.

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

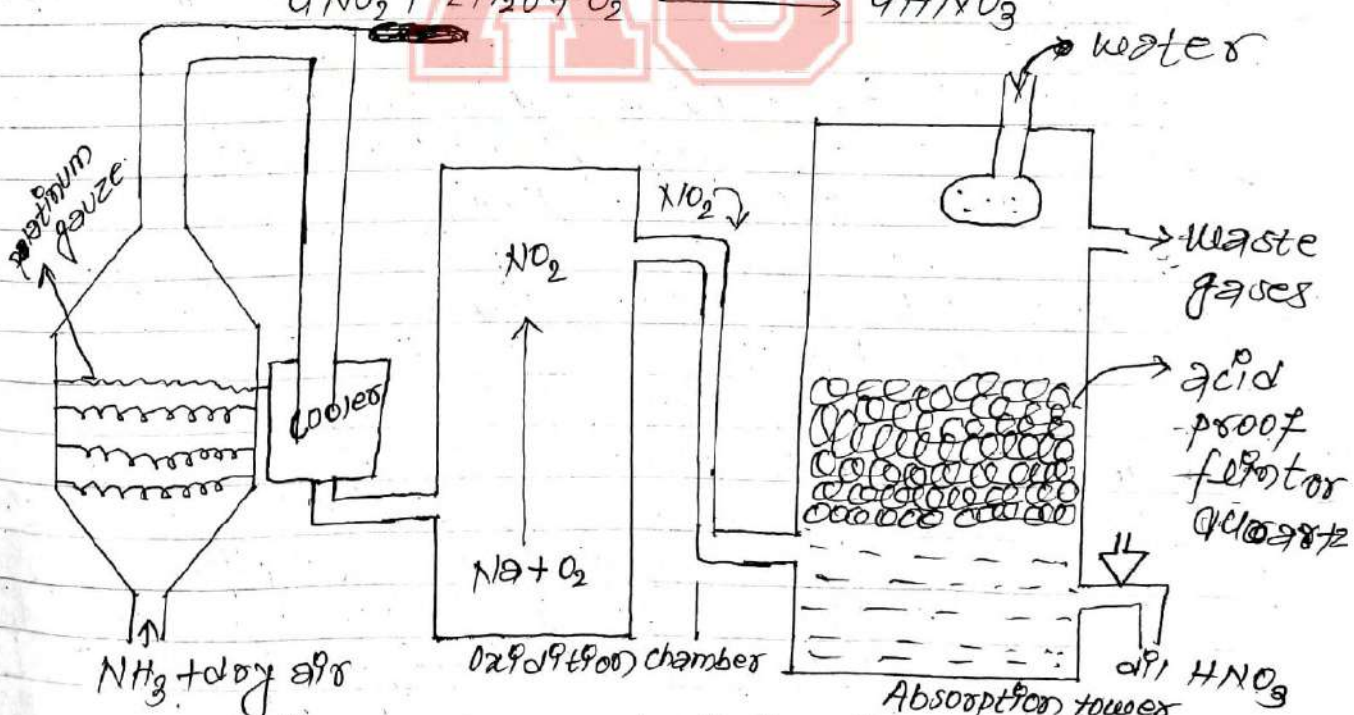


fig. manufacture of Nitric acid by ostwald's process

Procedure :-

The mixture of ammonia and dry air is passed into converter packed with platinum gauze. This mixture of gas is heated at 800°C Ammonia react with oxygen to form nitric oxide. The nitric oxide thus formed is passed through cooler and then oxidation chamber where Nitric oxide is oxidised into nitrogen dioxide. Nitrogen dioxide is then passed through absorption tower which is packed with acid proof flint and water is sprayed from the top. Downing coming water absorbs up going nitrogen dioxide in presence of oxygen to form dilute nitric acid which is taken out from this tower through tapping hole.

(*) Chemical properties of nitric acid :-

(1) Acid nature :- Nitric acid is a strong acid due to following reason -

(a) It turns moist blue litmus paper to red.

(b) It gives H^+ ions when dissolved in water

$$HNO_3 \xrightarrow{H_2O} H^+ + NO_3^-$$

(c) It reacts with base to give salt and water.

$$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$$

(2) Reaction with carbon :-

Nitric acid oxidises carbon to CO_2

$$2HNO_3 \longrightarrow H_2O + 2NO_2 + [O] \quad]\times 2$$

$$C + 2[O] \longrightarrow CO_2$$

$$C + 4HNO_3 \longrightarrow CO_2 + 4NO_2 + 2H_2O$$

(3) Reaction with sulphar :-

Nitric acid oxidises sulphar to sulpharic acid.

$2HNO_3 \longrightarrow H_2O + 2NO_2 + [O]$] X3

$S + 2[O] \longrightarrow SO_2$

$SO_2 + H_2O + [O] \longrightarrow H_2SO_4$

$S + 6HNO_3 \longrightarrow H_2SO_4 + 2H_2O + 6NO_2$

(4) Reaction with H_2S [Hydrogen sulphide] :-

Nitric acid oxidises H_2S to S.

$2HNO_3 \longrightarrow H_2O + 2NO_2 + [O]$

$H_2S + [O] \longrightarrow H_2O + S$

$2HNO_3 + H_2S \longrightarrow 2H_2O + 2NO_2 + S$

(5) Reaction with SO_2 [sulphes dioxide] :-

Nitric acid oxidises SO_2 to sulphuric acid.

$2HNO_3 \longrightarrow H_2O + 2NO_2 + [O]$

$SO_2 + [O] \longrightarrow SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$

$2HNO_3 + SO_2 \longrightarrow H_2SO_4 + 2NO_2$

079/08/24
unit-1

sub-unit [Ammonia (NH_3)]

(4)

manufacture of ammonia by Haber's process :-

principle :-

When nitrogen and hydrogen gases are heated together in presence of iron as a catalyst and molybdenum as a promotor at about 450°C and under 200 – 900 atm pressure ammonia is obtained

$$N_2 + 3H_2 \underset{Fe/Mo}{\overset{450°C,\ 200-900\ atm}{\rightleftharpoons}} 2NH_3 + 22.4\ KCal.$$

Diagram

The mixture of nitrogen and hydrogen is in the 1:3 ratio by volume is led to compression pump. the mixture of gas is subjected to pressure of 200-900 atm. The compressed mixture of gas is passed into catalytic chamber containing iron and molybdenum. The mixture of gas is heated electrically up to 450°C. Since the reaction is exothermic therefore, once the reaction is started further heating is not required Here, nitrogen react with hydrogen to form ammonia.

The efficiency of this reaction is only 15% Ammonia and unreacted nitrogen and hydrogen are passed through condenser in a receiver. Uncondensed nitrogen and hydrogen are recirculated ~~thro~~ toward the compressor by means of recirculation pump.

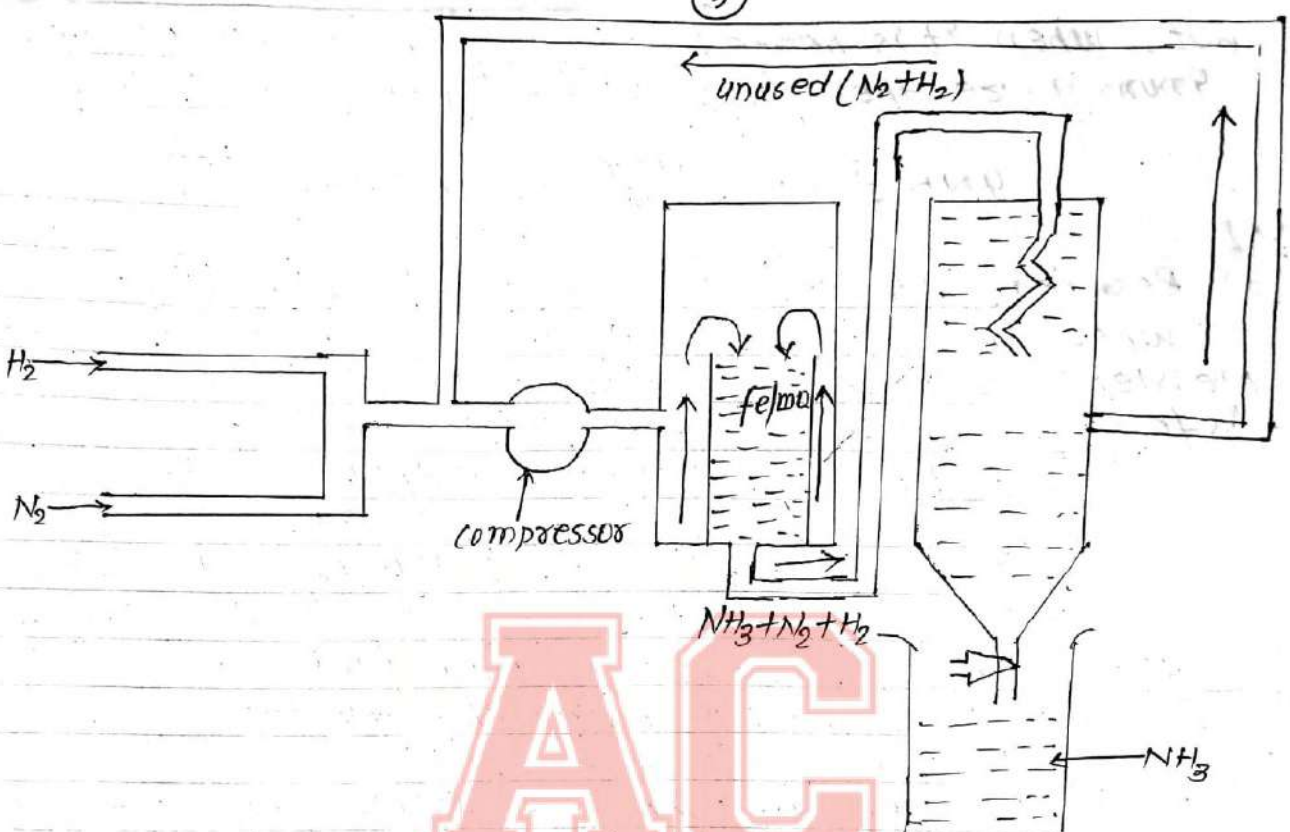


fig. manufacture of ammonia by Haber's process.

(*) Chemical properties of ammonia :-

(1) Reaction with water :- Ammonia react with water to give ammonia hydroxide

$$NH_3 + H_2O \longrightarrow NH_4OH$$

V.V.I

(2) Reaction with oxygen :- Ammonia gas burns in air with yellow flame to give nitrogen gas.

$$4NH_3 + 3O_2 \longrightarrow 6H_2O + 2N_2 \uparrow$$

But, when it is heated up to 800°C in presence of platinum gauze then nitric ~~acid~~ oxide is formed.

$$4NH_3 + 5O_2 \xrightarrow[Pt]{800^\circ C} 6H_2O + 4NO$$

V.V.I

(3) Reaction with Nessler's reagent [K_2HgI_4] :-
when ammonia gas is treated with alkaline Nessler's reagent then a brown ppt of iodide's base is formed.

$$2K_2HgI_4 + KOH + NH_3 \longrightarrow [Hg_2ONH_2I]\downarrow + 7KI + 2H_2O$$

(Brown ppt iodide base)

(4) Reaction with AgCl :- when ammonia solution ~~is treated~~ (NH_4OH) is treated with AgCl then colorless diammine silver chloride complex is formed.

$$2NH_4OH + AgCl \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

(diammine silver chloride)

V.V.I

(5) Reaction with copper sulphate ($CuSO_4$) :-
when ammonia solution is treated with copper sulphate solution then deep blue coloured tetrammine copper sulphate complex formed.

$$CuSO_4 + 4NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$$

(Tetrammine copper sulphate)
(deep blue color)

(6) Reaction with sodium metal [Na] :- when ammonia is ~~treated~~ with sodium metal then sodamide is formed.

$$2Na + NH_3 \xrightarrow{\Delta} 2NaNH_2 + H_2$$

(sodamide)

2079/03/24
unit-1

sub-unit → [sulphuric acid (H_2SO_4)]

(7)

(*) Manufacture of sulphuric acid by contact process :-

Principle :-

(I) sulpher dioxide gas is obtained by burning sulpher or by roasting iron pyrites:

$$S + O_2 \longrightarrow SO_2$$

$$4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$$

(II) sulpher dioxide gas is oxidised to sulpher trioxide by heating it in presence of oxygen at (450–500)°C and catalyst vanadium pentaoxide (V_2O_5)

$$2SO_2 + O_2 \underset{V_2O_5}{\overset{(450-500)^\circ C}{\rightleftharpoons}} 2SO_3 + 45\ KCal$$

(III) sulpher trioxide is absorbed by conc. H_2SO_4 to form pyro-sulphuric acid [oleum]

$$SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7$$

(oleum)

(IV) finally oleum is dissolved in water to get sulphuric acid of desired concentration.

$$H_2S_2O_7 + H_2O \longrightarrow H_2SO_4$$

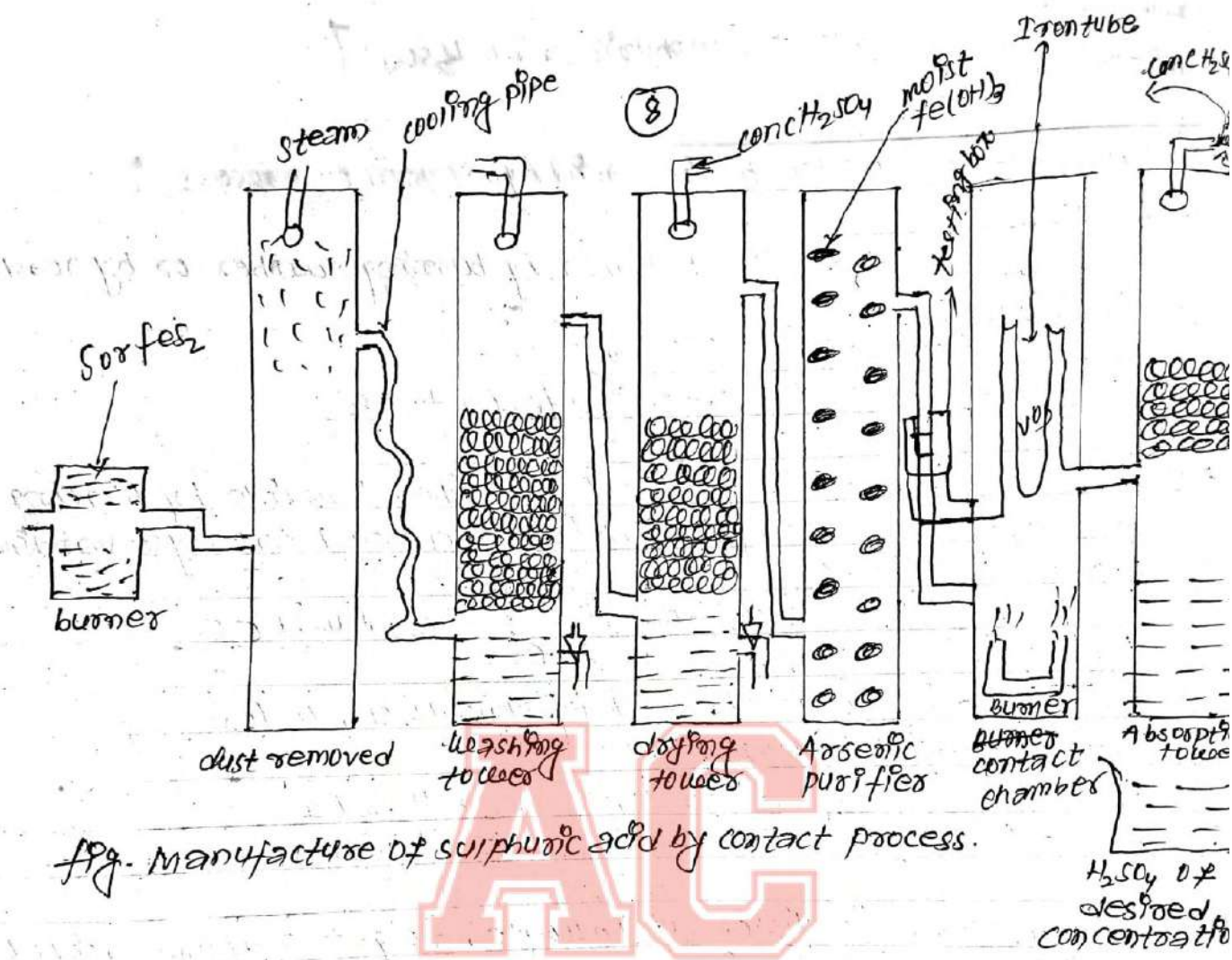


fig. Manufacture of sulphuric acid by contact process.

procedure :-

(1) Burner :- In this chamber, sulpher dioxide gas is obtained either by burning sulpher or by roasting iron pyrites

(2) Dust remover :- The SO_2 thus obtained from above is contaminated with dust, sulpher, Arsenous oxide etc are spreyed by steam from top which condenses these and makes them heavier to settle down.

The gas is then cooled down at 100°C by passing through cooling pipe. The pipe is cooled by air.

(3) Washing tower :- The gases coming out from the cooling pipe is now passed into a washing tower where it meets a descending spray of water which removes the soluble impurities.

(4) Drying tower :- It is packed with acid proof quartz and conc. H_2SO_4 is sprinkled from the top which absorbs moisture present in ~~H_2SO_4~~ SO_2 gas.

(5) Arsenic purifier :- It contain a number of shelves containing ferric hydroxide which absorbs Arsenous oxide present in the gas.

(6) Testing box :- Whether the gas is free from dust particle or not is tested in this box by tyndall effect. If gas is found free from solid particles then it is passed into contact tower and if found to be impure then these are recycled through purifying unit.

(7) Contact chamber :- The purified SO_2 gas is mixed with air [SO_2] and heated upto (450-500)°C. It contain platinum or vanadium pentaoxide (V_2O_5) catalyst and and in this chamber SO_2 reacts with oxygen to form SO_3

(8) Absorption tower :- It is packed with acid proof quartz and conc. H_2SO_4 is sprinkled from top which absorb up going SO_3 gas to form oleum which is collected in receiver. finally it is dissolved in calculated amount of water to get sulphuric acid of desired concentration.

(*) Chemical properties of H_2SO_4 :-

(1) Acidic nature [As an acid] :- H_2SO_4 acts as an acid due to following reasons

(a) It turns blue litmus paper to red.

(b) It gives H^+ ion on dissolving in water.

$$H_2SO_4 \xrightarrow{\text{water}} 2H^+ + SO_4^{--}$$

(c) It form salt and water with base.

$$\underset{\text{(base)}}{2NaOH} + \underset{\text{(acid)}}{H_2SO_4} \longrightarrow \underset{\text{salt}}{Na_2SO_4} + \underset{\text{water}}{2H_2O}$$

(2) As a dehydrating agent :- Conc. H_2SO_4 acts as a dehydrating agent because of following reasons.

(a) It absorbs water molecules from hydrous salt

$$\underset{\text{(blue vitriol)}}{CuSO_4 \cdot 5H_2O} \xrightarrow{\text{conc. } H_2SO_4} CuSO_4 + H_2SO_4 \cdot 5H_2O$$

(b) It causes the charring of sugar.

$$\underset{\text{(sugar)}}{C_{12}H_{22}O_{11}} + \text{conc. } H_2SO_4 \rightarrow \underset{\text{(black)}}{12C} + H_2SO_4 \cdot 11H_2O$$

Charring $\Rightarrow$ burnt and black

(c) It dehydrates oxalic acid and formic acid

$$COOH.2H_2O \xrightarrow{conc.H_2SO_4} CO + CO_2 + H_2SO_4 \cdot 3H_2O$$
$$COOH$$

(oxalic acid)

$$HCOOH \xrightarrow{conc.H_2SO_4} CO + H_2SO_4 \cdot H_2O$$

(formic acid)

(3) As an oxidising agent :- It acts as an oxidising agent due to following reasons -

(a) It oxidises carbon to carbon dioxide.

$$H_2SO_4 \longrightarrow H_2O + SO_2 + [O] \times 2$$
$$C + 2[O] \longrightarrow CO_2$$
$$C + 2H_2SO_4 \longrightarrow CO_2 + 2H_2O + 2SO_2$$

(b) It oxidises phosphorous to phosphoric acid

$$H_2SO_4 \longrightarrow H_2O + SO_2 + [O] \times 10$$
$$P_4 + 10[O] \longrightarrow 2P_2O_5$$
$$P_2O_5 + 3H_2O \longrightarrow 2H_3PO_4] \times 2$$
$$P_4 + 10H_2SO_4 \longrightarrow 4H_3PO_4 + 4H_2O + 10SO_2$$

(c) It oxidises sulphur to sulphur dioxide

$$H_2SO_4 \longrightarrow H_2O + SO_2 + [O] \times 2$$
$$S + 2[O] \longrightarrow SO_2$$
$$S + 2H_2SO_4 \longrightarrow 2H_2O + 3SO_2$$

(d) Hydrogen sulphide [H_2S] is oxidised to sulphur

$$H_2SO_4 \longrightarrow H_2O + SO_2 + [O]$$
$$H_2S + [O] \longrightarrow H_2O + S$$

$$H_2S + H_2SO_4 \longrightarrow 2H_2O + SO_2 + S$$

(4) Action with copper and zinc :-

(a) dilute H_2SO_4 react with active metal zinc to given hydrogen gas.

$$Zn + H_2SO_4 \text{ (dil)} \longrightarrow ZnSO_4 + H_2\uparrow$$

(b) Hot and conc. H_2SO_4 reacts with copper to given sulphurdioxide gas.

$$Cu + 2H_2SO_4 \text{ (Hot and conc.)} \longrightarrow CuSO_4 + 2H_2O + SO_2\uparrow$$

- Use of H_2SO_4 :-

(i) It is used as a strong acid in laboratory.
(ii) It is used as dehydrating agent.
(iii) It is used as oxidising agent.
(iv) It is used in battery and chemical industry.

2075 Necessary condition for better yield of sulphuric acid :- We have the reaction —

$$2SO_2 + O_2 \underset{V_2O_5}{\overset{(450-600)^\circ C}{\rightleftharpoons}} 2SO_3 + 45\,kcal$$

2 volume 1 volume 2 volume

The above reaction in reversible, exothermic and proceeds with decrease in volume. A/c to le — chateliers principle, following condition are.

necessary for better yield of sulphuric acid —

(1) Tempreture and catalyst :- since the reaction is exothermic, therefore, low tempreture increase the yield of SO_3 but at low tempreture, the rate of reaction decrease. so, to increase the rate of reaction at low tempreture, catalyst like V_2O_5 is used.

(2) pressure :- since the reaction proceeds with decrease in volume, a high pressure is required. A pressure of 2-3 atm is sufficient to make steady flow of gases.

(3) High concentration of ~~reaction~~ reactants :- If the concentration of oxygen or SO_2 is increased, the reaction proceeds in forward direction. so, better yield of SO_3, requires high concentration of SO_2 and oxygen i.e. high concentration of sulphur and air.

(*) water :- A compound which is formed by combination of hydrogen and oxygen in 2:1 ratio is called water.

Depending upon the nature of salt present in natural water and its behaviour towards soap, water ~~eg~~ water is classified into two types :-

(1) soft water :- The water that readily produce lather with soap and doesnot contain dissolved salt of bicarbonate. sulphate and chloride of calcium and magnesium is called soft water eg :- Rain water distilled water etc.

(2) Hard water :- The water that doesnot produce lather with soap easily and contains bicarbonate, sulphate and chloride of calcium and magnesium is called hard water. Tap water, well water, sea water, underground water

(*) types of hardness :-

(1) Temporary hardness :- The hardness of water due to presence of calcium bicarbonate and magnesium bicarbonate is called Temporary hardness of water.
⇒ $Ca(HCO_3)_2$, $Mg(HCO_3)_2$

(2) permanent hardness of water :- The hardness of water due to presence of calcium ~~bicarbonate and magnesium bicarbonate~~ sulphate, calcium chloride, magnesium sulphate and magnesium chloride is called permanent hardness of water.

$CaSO_4$	$MgSO_4$
$CaCl_2$	$MgCl_2$

→ permanent hardness

*) Removal of temporary hardness of water :-

(1) By boiling :-

When temporary hard water is boiled then soluble salt of bicarbonate of calcium and magnesium is changed to insoluble carbonate of calcium and magnesium which is removed by filtration. The filtrate become a soft water.

$$Ca(HCO_3)_2 \xrightarrow{\text{Boiling}} CaCO_3\downarrow + H_2O + CO_2 \xrightarrow{\text{filtration}} \text{soft water}$$

$$Mg(HCO_3)_2 \xrightarrow{\text{Boiling}} MgCO_3\downarrow + H_2O + CO_2 \xrightarrow{\text{filtration}} \text{soft water}$$

(2.) By clark's method :-

When temporary hard water is treated with slacked lime ($Ca(OH)_2$) then soluble salt of bicarbonate reacts with slacked lime to give insoluble carbonate of calcium and magnesium which is removed by sedimentation process.

$$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$$

$$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow MgCO_3\downarrow + CaCO_3 + 2H_2O$$

(*) Removal of permanent hardness of water :-

(1) By addition of washing soda ($Na_2CO_3 \cdot 10H_2O$] :-

When permanent hard water is treated with washing soda then sulphate and chloride of Ca and Mg is changed into insoluble carbonate of Ca and Mg which is filtered to get water.

$$CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3\downarrow + Na_2SO_4$$

$$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$$

$$MgSO_4 + Na_2CO_3 \longrightarrow MgCO_3 + Na_2SO_4$$

$$MgCl_2 + Na_2CO_3 \longrightarrow MgCO_3 + 2NaCl.$$

(2) By permutit process :- The hard water is passed through a bed of a special material called zeolite which remove Ca and mg from hard water and substituting sodium for their palace. The common artificial zeolite is permutit which is a complex compound occurs in nature but it may be also be synthesized.

$$CaCl_2 + Na_2Z \longrightarrow 2NaHCO_3 + CaZ\downarrow$$
$$CaSO_4 + Na_2Z \longrightarrow CaZ + Na_2SO_4$$
$$MgSO_4 + Na_2Z \longrightarrow MgZ + Na_2SO_4$$

(c) Soda – lime process :-

This method is applicable for softening both temporary and permanent hardness of water. Calculated amount of slacked lime and washing soda are used in which slacked lime removes temporary hardness where as washing soda remove permanent hardness of water.

$$MgCl_2 + Na_2CO_3 \longrightarrow MgCO_3\downarrow + 2NaCl$$
$$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow MgCO_3\downarrow + CaCO_3\downarrow + H_2O$$

(*) The advantage and disadvantage of hard water :-

(*) Advantage of hard water :-

(1) some people prefer the taste.
(2) Calcium ion in hard water are good for children's teeth and bones.
(3) It helps to reduce heart ~~dese~~ disease.
(4) some breweers prefer using hard water for making
(5) A coating of limescale inside copper pipe stops poisonous salts dissolving into water.

(*) Disadvantage of hard water :-

(1) It is more difficult to form a lather with soap.
(2) Scum may form by reaction with soap, wasting the soap.
(3) Lime scale forms inside the kettle which wastels energy whenever you boil a kettle.
(4) Limescale starts to coat the inside of pipe which can eventually get blocked up.//

*) Meaning of drinking water :- water used for drinking purpose showed fulfil the following condition.

(1) It should be colourless and free from any foul smell.
(2) It shouldnot contain any suspended impurities like dirt, sand etc.
(3) It should be free from dissolved salt like nitrate, nitrite ammonia, ammonium salt etc.
(4) It should contain small amount of calcium for which is essential for growth and water tasty.
(5) It should be free from any germs, bacteria, algae and fungi which causes disease like typhoid and jaundice.

(*) Purification of water :- There are following methods of purification of drinking water —

(1) Boiling :- It is suitable method of purification of water for household purpose. Boiling of water upto 5 to 10 minutes kill bacteria, spores, cysts etc. It also remove temporary hardness of water.

(II) Filtration :- Water can be purified on a small scale by filtration process carried out by means of candle which is made up of porcelain. It removes temporary hardness of water.

(III) Chemical disinfection :- Bleaching powder, chlorine solution, Iodine, potassium permagnate, Ozonation etc are used as chemical disinfection which are used for purification of drinking water.

(*) fer

(*) fertilizer :- The artificial substance which are added to soil to remove the deficiency of essential element for plants or such as nitrogen, potassium and phosphorus from outside is called fertilizer.

(*) Types of fertilizer :-

(I) Organic fertilizer :- The fertilizer which is obtained by dead, decayed and decomposed part of animals and plants or their waste product is called organic fertilizer.

(II) Inorganic or chemical fertilizer :- The fertilizer which is obtained by mixing different kind of chemical is called inorganic fertilizer. It is also called chemical fertilizer.

(*) Role of fertilizer in plant or vegetable :-
→ fertilizer contains mainly three nutrients.

(1) Nitrogen :- Nitrogen is essential for growth of plants it imparts green colour to leaves. It is the constituants of protein and amino acid which are made for the formation of new cells.

(2) phosphorous :- It is essential for root growth and to give maturity in the plants. It causes to give resistance of disease. It help in formation of seeds.

(3) potassium :- it helps in flowering of plant. It also help in the resistance towards various disease.

(*) NPK - fertilizer :- The fertilizer which provide all three essential nutrients nitrogen, phosphorous and potassium to the soil is called NPK-fertilizer. It is called complete fertilizer.

(*) Characteristic good fertilizer :-
(1) The essential elements such as N, P and K should be present in large percentage.
(2) It is in the form which should be easily untilized by plants.
(3) It should be easily soluble in water.
(4) It should be cheap.
(5) It should be nontoxic and safe to handle.
(6) It should be stable in the soil for quite sometime.

(*) Advantage of organic fertilizer :-

(i) It increase productivity of soil.
(ii) It control environmental pollution.
(iii) It doesnot harmful to the composition of soil.

(*) Disadvantage of organic fertilizer :-

(1) Difficult in collection and transportion.
(2) less soluble in water.
(3) They have insufficient nutrients.

(*) Advantage of chemical fertilizer :-

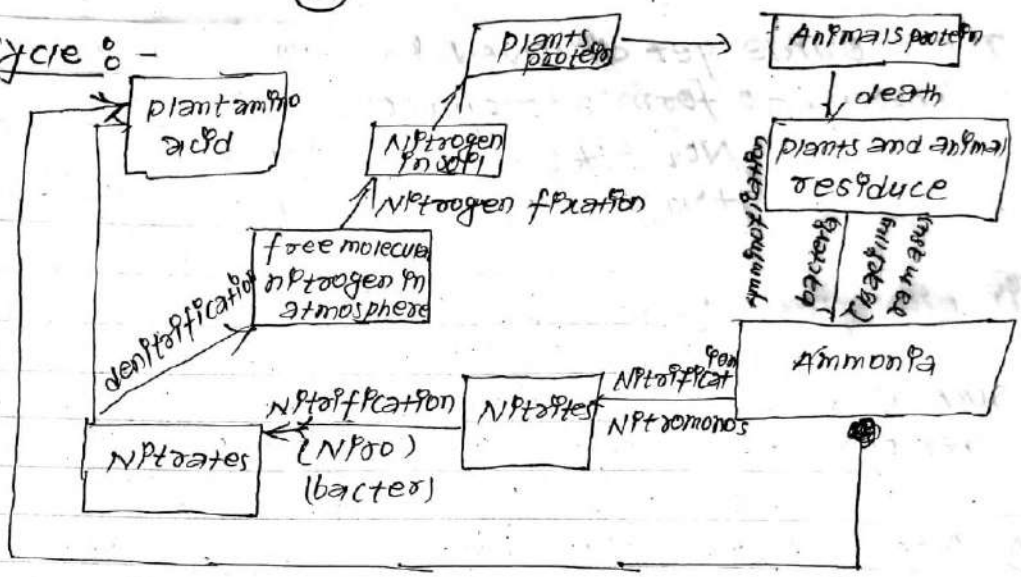
(i) It is of predictability and reliability.
(ii) They are in the three essential nutrients needed for plants growth.

(iii)
(1) They are easy to transport from one place to another.
(ii) They have rich amount of nutrients.
(iii) They are easily soluble in water.

(*) Disadvantage of chemical fertilizer :-

(i) They causes environmental pollution.
(ii) They causes air, water and soil pollution.
(iii) They make fruits and vegetable unhealthy.
(iv) It is non - renewable.
(v) Long term uses of chemical fertilizer changes the pH of soil.

Nitrogen Cycle :-



Nitrogen is an essential elemunation for plants growth and development. The main sources of nitrogen is atmospheric nitrogen which is not directly available to plants. The plants absorb nitrogen from soil in the form of nitrogenous compound. The nitrogen cycle consists of following steps —

(a) **Nitrogen fixation :-** The conversion of free molecules nitroge of atmosphere into biologically acceptable form or nitrogeneous compound is known as nitrogen fixation it is of two types——

(i) **physio - chemical fixation :-** It is the process in which the atmospheric nitrogen combine with oxygen during lightening and produces different nitrogen oxides.

$$N_2 + 2[O] \longrightarrow 2NO$$
$$2NO + 2[O] \longrightarrow 2NO_2$$
$$2NO_2 + 2[O] \longrightarrow N_2O_5$$

These oxide get dissolved in rainwater and react with minerals to form nitrogeneous compound.

$$NO_2 + H_2O \longrightarrow 2HNO_3$$
$$HNO_3 + CaCO_3 \longrightarrow Ca(NO_3)_2 + CO_2 + H_2O$$

(a) Biological fixation :-
It is carried out by certain bacteria such as Rhizobium, Clostridium, Azotobacter etc. These fix atmospheric nitrogen in the soil into nitrogeneous compound

(b) Nitrogen Assimilation :-
The nitrogen in the form of nitrate nitrite ammonia is absorbed by green plant and convert it into nitrogeneous compound is called nitrogen assimilation The plant protein moves to animals.

(c) Ammonification :- The dead remains of both plants and animals are decomposed by microorganism such as Bacillus ratmasus and release ammonia is called ammonification.

(d) Nitrification :- The conversion of ammonia into nitrite by nitrosomonas and nitrite into nitrate by nitrobacter is called Nitrification.

(e) Denitrification :- The conversion of nitrate into free molecules of Nitrogen in atmospere by bacteria such as micrococcus bacillus is called denitrification.

(f) Sedimentation :- Nitrate of soil are washed away sea or reached deep into the earth. These nitrate locked up in the rock. This process is called sedimentation. Nitrogen of rock is released only when rocks are exposed or weathered.

* HYDROGEN * SULPHIDE * (24)

(*) Lab preparation of hydrogen sulphide [H_2S] :-

Principle :-

When ferrous sulphide is treated with dilute H_2SO_4 then hydrogen sulphide [H_2S] gas is produced.

$$FeS + H_2SO_4 \longrightarrow FeSO_4 + H_2S\uparrow$$

Diagram

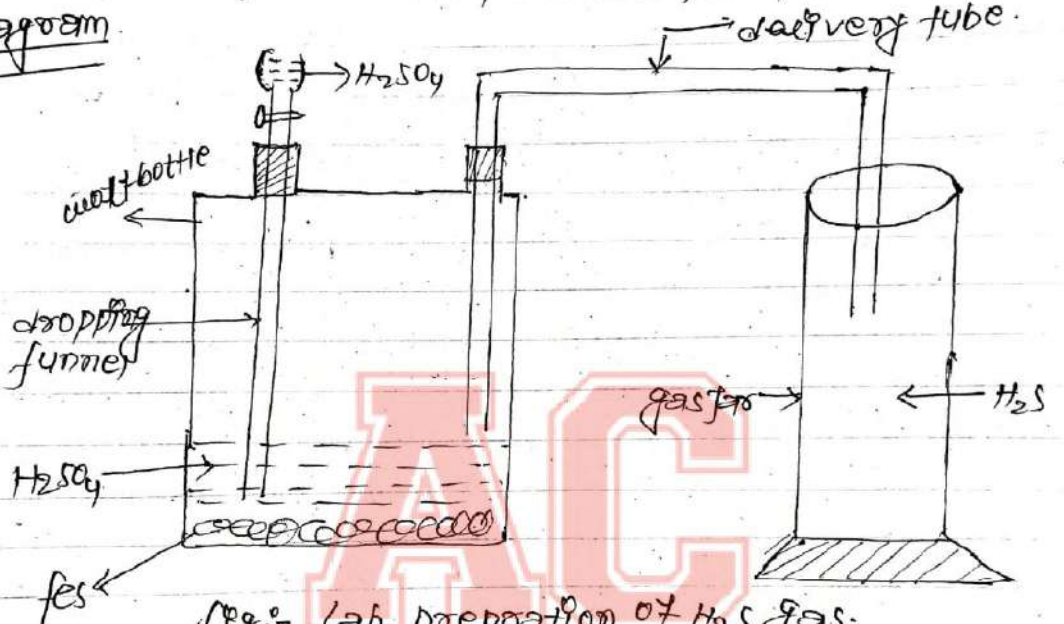


fig:- Lab preparation of H_2S gas.

Apparatus is fitted as shown in figure. pieces of ferrous sulphide are taken in woulf's bottle and dilute H_2SO_4 is is poured into it through dropping funnel. As a result of reaction, Hydrogen sulphide [H_2S] gas is evolved out which is collected in the gas jar by up ward displacement of air.

(*) Chemical properties of H_2S :-

Acidic Nature :- following example show the that H_2S is acidic in nature.

(a) It turns moist blue litmus paper to red
(b) It gives H^+ ion on dissolving in water.

$H_2S \xrightarrow{H_2O} 2H^+ + S^{--}$

(c) It react with a base to give salt and water

$2NaOH + H_2S \longrightarrow Na_2S + 2H_2O$

(2) Reducing agent :-

following reducing agent :-

(a) It reduce nitric acid (HNO_3) to NO_2

$2HNO_3 \longrightarrow H_2 + 2NO_2 + [O]$

$H_2S + [O] \longrightarrow H_2O + S$

$H_2S + 2HNO_3 \longrightarrow 2H_2O + 2NO_2 + S$

(b) It reduce sulphurdioxide to sulphur.

$SO_2 + H_2S \longrightarrow 2H_2O + S$

(c) It reduce acidified potassium permanghate solution The pink colour of solution is changed to colourless.

$KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

$H_2S + [O] \longrightarrow H_2O + S \quad]\times 5$

$2KMnO_4 + 3H_2SO_4 + 5H_2S \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$

(d) It reduce acidified potassium dichromate solution. The orange colour of solution is changed to green.

$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$

$H_2S + [O] \longrightarrow H_2O + S \quad]\times 3$

$K_2Cr_2O_7 + 4H_2SO_4 + 3H_2S \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3S$

(*) what happens when H_2S gas is passed through acidified potassium permagnate solution?

(*) what happen when H_2S gas is passed through acidified potassium dichromate solution?

(3) Reaction with lead acetate paper :-
when H_2S gas is passed over lead acetate paper then paper turns into black due to formation of lead sulphide.

$$H_2S + (CH_3COO)_2Pb \longrightarrow 2CH_3COOH + PbS\downarrow$$
(black)

(4) Reaction with silver powder :-
when H_2S gas is passed over silver powder then silver get tarnished due to formation of silver sulphide.

$$H_2S + 2Ag \longrightarrow Ag_2S\downarrow + H_2\uparrow$$
(black)

(Q) write the reaction of H_2S with
(a) lead acetate paper
(b) silver powder.

(Q) write any two reaction to illustrate (show) the reducing nature of H_2S gas?

use of H_2S :-
(i) It is used as a laboratory reagent.
(ii) It is used as a reducing agent.
(iii) It is used in the formation of metallic sulphide.

09/4/12

CHLORINE [Cl_2]

V.V.I

lab preparation of chlorine without application of heat

principle :- chlorine can be prepared without application of heat by dropping conc. HCl on powdered potassium permanganate [$KMnO_4$]

$$2KMnO_4 + 6HCl \longrightarrow 2KCl + 2MnCl_2 + 3H_2O + 5[O]$$
$$2HCl + [O] \longrightarrow H_2O + Cl_2] \times 5$$

$$2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2\uparrow$$

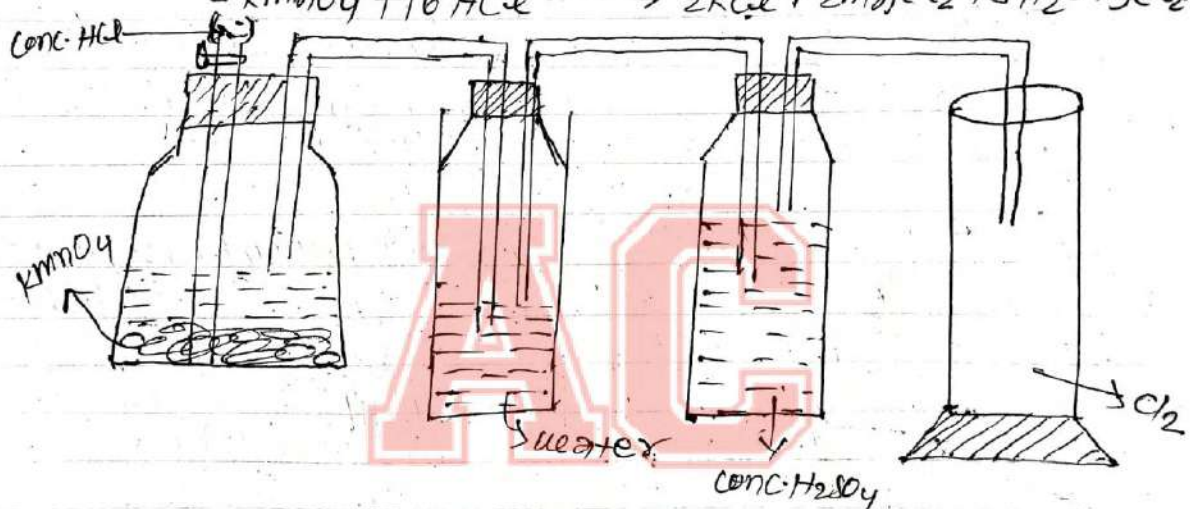


fig :- lab preparation of chlorine without application of heat. powdered $KMnO_4$ is ~~taken in to this flask through dropping funnel. Apparatus is fitted as shown in figure when everything is ready.~~ is taken in conical flask and conc. HCl is dropped in to this flask through dropping funnel. Apparatus is fitted as shown in figure. when every thing is ready, conc. HCl is dropped on $KMnO_4$ then Cl_2 gas is produced which is bubbled through water to dissolve HCl and then dried by conc. H_2SO_4 water absorbs chlorine gas but it soon becomes.

saturated with chlorine and then it passes on which is collected in gas jar by upward displacement of air.

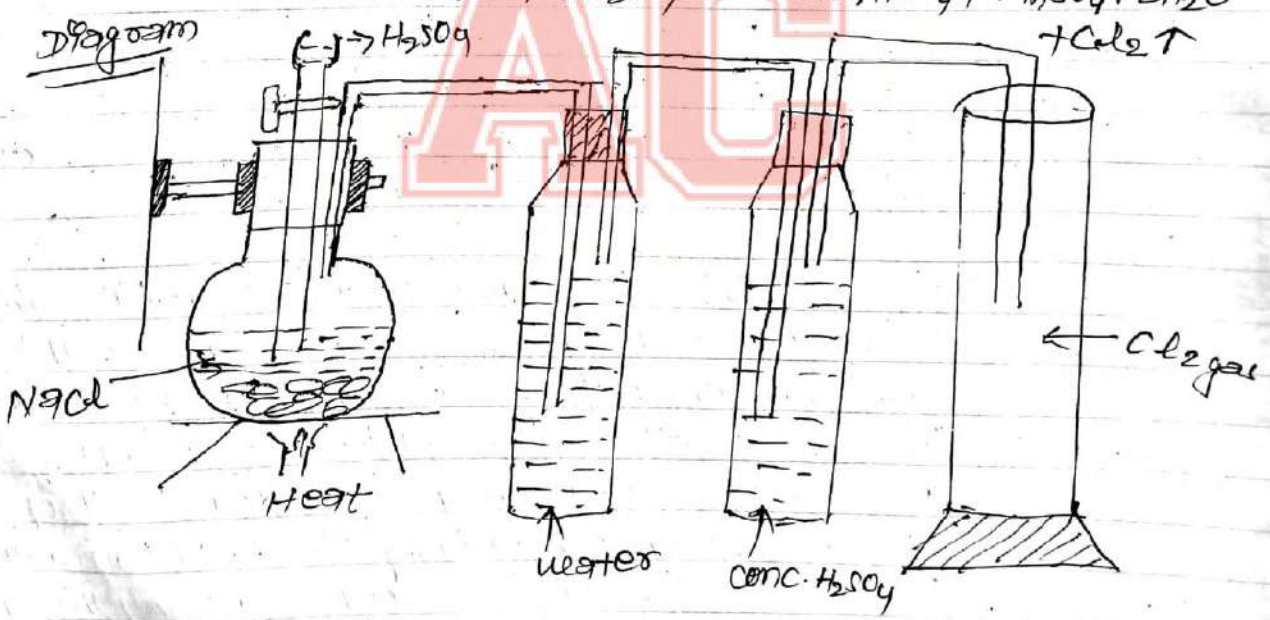
(*) Lab preparation of chlorine gas with application of heat :-

Principle :- In laboratory, chlorine gas be prepared by heating a mixture of sodium chloride, conc. H_2SO_4 and manganese dioxide (MnO_2).

$$NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl \quad \} \times 2$$
$$MnO_2 + H_2SO_4 \longrightarrow MnSO_4 + H_2O + [O]$$
$$2HCl + [O] \longrightarrow H_2O + Cl_2$$

$$2NaCl + MnO_2 + 3H_2SO_4 \longrightarrow 2NaHSO_4 + MnSO_4 + 2H_2O + Cl_2\uparrow$$

Diagram



Sodium chloride with a little amount of MnO_2 is taken in R.b flask and apparatus is fitted as shown in figure conc. H_2SO_4 is poured into it through a dropping funnel so that lower end dipped into acid.

When everything is ready the flask is heated. As a result chlorine gas is formed.

The chlorine gas is bubbled first through a bottle containing water and then through a bottle containing conc. H_2SO_4 to remove impurities and vapours. Finally pure gas is collected by upward displacement of air in gas jar.

(*) Properties of chlorine gas :-

(1) It is a greenish yellow coloured gas which is soluble in water.

(2) Reaction with water :- It reacts with water slowly to form hydrochloric acid (HCl) and hypochlorous acid [HClO]

$$Cl_2 + H_2O \longrightarrow HCl + HClO$$

(3) Reaction with ammonia :-

It reacts with ammonia to form nitrogen trichloride and hydrochloric acid.

~~$3Cl_2 + NH_3 \longrightarrow NCl_3 + 3HCl$~~

~~$H_2 + Cl_2 \xrightarrow{\text{sunlight}} 2HCl$~~

$$3Cl_2 + NH_3 \longrightarrow NCl_3 + 3HCl$$

(4) Reaction with hydrogen :- It reacts with hydrogen in presence of sunlight to form hydrochloric acid.

$$H_2 + Cl_2 \xrightarrow{\text{sunlight}} 2HCl$$

V.V.I

(5) Reaction with sodium hydroxide [NaOH] :-

(a) It reacts with cold and dilute NaOH to give sodium chloride, sodium chlorite and water

$$2NaOH + 3Cl_2 \longrightarrow NaCl + NaClO + H_2O$$

(b) It reacts with hot and conc. NaOH to give sodium chloride, sodium chlorate and water.

$$6NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$$

(6) Bleaching property of chlorine gas :-

When a moist coloured flower is placed in a jar containing Cl_2 gas then the colour of flower is discharged to colour less flower due to oxidation caused by nascent oxygen produced by Cl_2 gas in moisture.

$$Cl_2 + H_2O \longrightarrow HCl + HClO$$
$$HClO \longrightarrow HCl + [O]$$
$$\text{Coloured flower} + [O] \longrightarrow \text{colourless}$$

(7) Oxidising property of chlorine gas :-

(a) It oxidises H_2S to S.

$$Cl_2 + H_2O \longrightarrow 2HCl + [O]$$
$$H_2S + [O] \longrightarrow H_2O + S$$

$$Cl_2 + H_2S \longrightarrow 2HCl + S$$

(b) It oxidises SO_2 to H_2SO_4.

$$Cl_2 + H_2O \longrightarrow 2HCl + [O]$$
$$SO_2 + 2H_2O + [O] \longrightarrow 2H_2SO_4$$

$$Cl_2 + SO_2 + 3H_2O \longrightarrow 2HCl + 2H_2SO_4$$

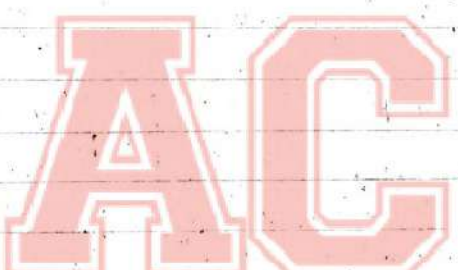
(c) It oxidises acidified ferrous sulphate to ferric sulphate.

$$Cl_2 + H_2O \longrightarrow 2HCl + [O]$$
$$2FeSO_4 + H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 2HCl$$

$$2FeSO_4 + H_2SO_4 + Cl_2 \longrightarrow Fe_2(SO_4)_3 + 2HCl$$
(green) (yellow)

Use of Cl_2:- It is used as

(i) oxidising agent
(ii) bleaching agent
(iii) It is used in the preparation of phosgene gas, mustard gas tear gas.



HYDROCHLORIC ACID (HCl)

(*) Lab preparation of hydrochloric acid [HCl]:-

principle In lab, hydrochloric acid gas can be prepared by heating sodium chloride with concentrated sulphuric acid. The reaction occurs in two stages. sodium hydrogen sulphate is formed at low temperature and sodium sulphate is formed at high temperature.

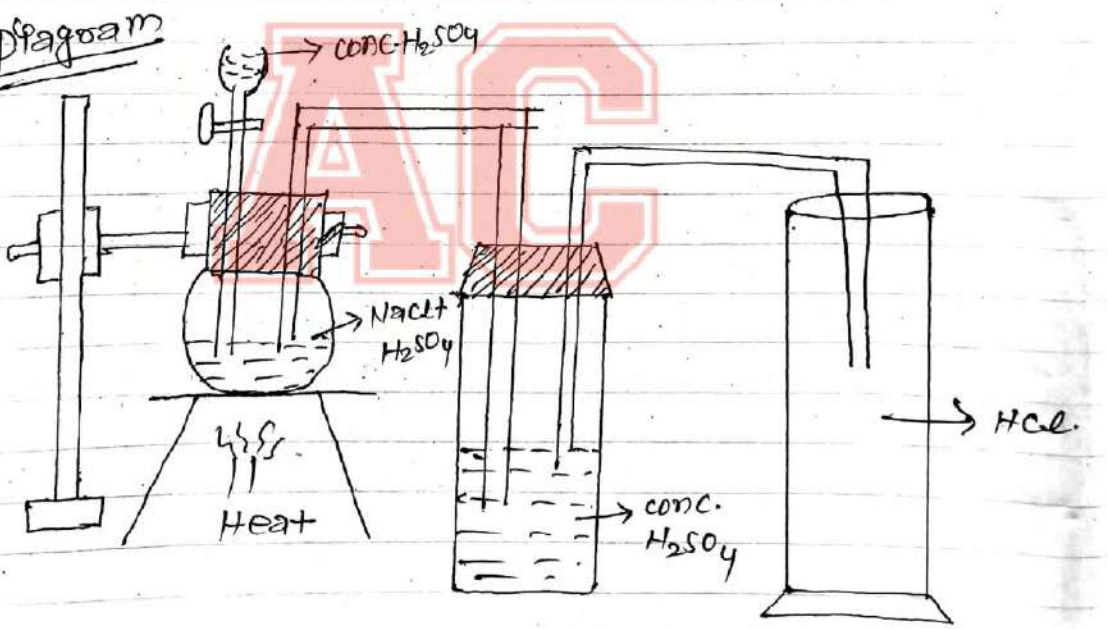
$$NaCl + H_2SO_4 \xrightarrow[\text{low temp.}]{\Delta} NaHSO_4 + HCl\uparrow$$

(sodium hydrogen sulphate)

$$NaCl + H_2SO_4 \xrightarrow[\text{high temp.}]{\Delta} Na_2SO_4 + 2HCl\uparrow$$

(sodium sulphate)

Diagram



The powdered sodium chloride is taken in R.B flask which is fitted with dropping funnel through which concentrated H_2SO_4 is poured in to this flask. Apparatus is fitted as shown in figure. When everything is ready the flask is heated and as a result, HCl gas is evolved which is

dried by passing through a bottle containing conc. H_2SO_4 and gas is collected in gas jar by upward displacement of air.

Q// why HCl gas can't be dried with CaO or P_2O_5?

Ans→ HCl gas cannot be dried over quick lime [CaO] or phosphorus pentaoxide [P_2O_5] because HCl react with these compound to give different products

eg. $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

$P_2O_5 + 10HCl \longrightarrow PCl_5 + 5H_2O$

(*) properties of hydrochloric acid [HCl] :-

(1) It is a colourless gas having pungent smell which is highly soluble in water.

(2) acidic nature :- following example illustrate [shows] the acidic nature of HCl.

(a) It turns moist blue litmus paper to red.

(b) It gives H^+ ions on dissolving in water.

$HCl \xrightarrow{H_2O} H^+ + Cl^-$

(c) It reacts with base to give salt and water.

$HCl + NaOH \longrightarrow NaCl + H_2O$

(acid) (Base) (salt) (water)

(3) Reaction with ammonia :- It react with ammonia to give dense white fumes of ammonium chloride.

V.V.I

(4) Reaction with silver nitrate solution [$AgNO_3$] :- It reacts with silver nitrate solution to give white ppt of AgCl which is highly soluble in NH_4OH solution. $HCl + AgNO_3 \longrightarrow AgCl\downarrow + HNO_3$

$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$

(diammine silver chloride)

(5) Reducing Agent :- It acts as a reducing agent due to following reasons ——

(a) It reduce of KMNO4 solution. The pink colour of potassium permanganate is changed to colourless.

$$2KMnO_4 + 16HCl \longrightarrow 2KCl + MnCl_2 + 8H_2O + 6Cl_2$$

(b) It reduce MnO_2 to $MnCl_2$

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

Uses :- (i) It is used in the preparation of aqua-regia.
(ii) It is used in the manufacture of dye, textile, chemicals etc.
(iii) It is used in laboratory and industry.

Q-1 What happen when HCl gass is passed through silver nitrate solution?

Q-2 What happen when HCl gas is passed through potassium permanganate solution.

2079
4-14

CARBON

(*) Allotropy :- different physical form of an element having nearly same chemical properties but different physic properties are called allotropes and phenomenon of their existence is called allotropy

(*) Allotropes of carbon

- Crystalline allotropes
  - Diamond
  - Graphite
  - Fullerene
- Amorphous allotropes
  - Wood charcoal
  - Animals charcoal
  - Lamp black
  - Coke
  - Coal

(*) Properties of Diamond :-

(I) It is 100% pure form of carbon.
(II) It is the crystalline allotrope of carbon.
(III) It is the hardest substance known.
(IV) It is transparent to x-ray.
(V) Its mop is 3550°C [3750°C]
(VI) Its Refractive index is 2.45
(VII) Its specific gravity is 3.51 at 15°C
(VIII) Chemically it is inactive but it burns at 800°C to give CO_2. $C + O_2 \xrightarrow{800\text{-}900°C} CO_2$
(IX) It reacts with fluorine to form carbon tetra fluoride at 750°C $C + 2F_2 \xrightarrow{750°C} CF_4$
(X) It changes to graphite above 1800°C

(*) Use of diamond :

(i) It is used for cutting glass, marble, stone and other material

(ii) It is used for drilling rocks and for making bones.

(iii) It is used in jaweller ies and polishing hard material.

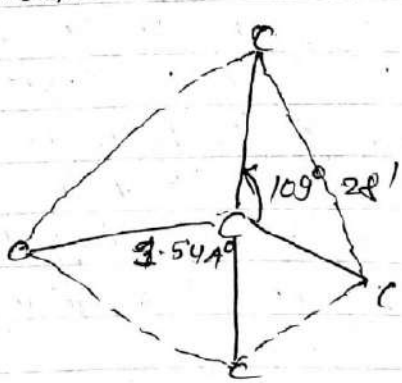
(*) Structure of diamond :-

(i) In the crystal of diamond, each carbon is bonded covalently with four other carbon atoms and are arranged in tetrahedral fashion.

(ii) four covalent bonds are directed towards four corner of a regular tetrahedron.

(iii) The C-C bond length is 1.54 A° which is very short strong and rigid. due to this, the compactness between carbon atoms becomes very high. that's why diamond is hardest substance.

(iv) All the four valence electrons of carbon are involved in bond formation. Due to absence of free electron it cannot conduct heat and electricity.



Q.1 why diamond hardest substance

Q.2 why diamond is not good conductor of heat and electricity ?

(*) properties of graphite :-

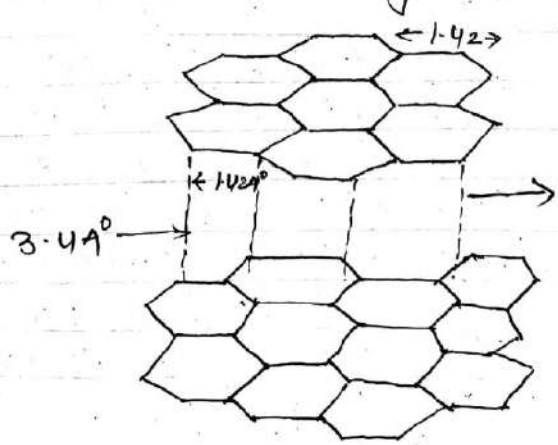
(I) Natural graphite is (95-97)% pure form of carbon.
(II) It is also crystalline allotrope of carbon.
(III) It is dark grey coloured substance.
(IV) It is soft to touch.
(V) Its specific gravity is 2.2
(VI) It is lighter than diamond.
(VII) It marks paper black. therefore, it is called black lead. the lead for pencil is the mixture of graphite and clay.
(VIII) It is chemically ~~inert~~ reactive but burns in air on strong heating to give CO_2

$$C + O_2 \xrightarrow{\Delta} CO_2$$

(IX) when it is heated with conc. HNO_3 then a yellow mass graphite acid [$C_{11}H_4O_5$] is obtained.
(X) when it is heated with alkaline $KMnO_4$ then it is oxidised to oxalic acid and mellitic acid [$C_6(COOH)_6$]

(*) structure :-

(I) It exists in layered structure in which each carbon atom is covalently with three other carbon atoms and are arranged in hexagonal fashion.



(ii) The distance between two layer is 3.4 Å and C-C bond length is 1.42 Å

(iii) since successive planar layer of graphite are held together only by weak vandarwall's force so, layer can slip one over other that's why graphite is soft and slippery.

(iv) each of carbon atom in graphite has one free electron Due to presence of free electron it can conduct electricity very well.

(*) use of graphite :-

(i) it is used for making pencils, electrode plates etc.

(ii) it is used as a lubricant in the form of aquadag or oildag [graphite + distilled water]

(iii) it is used as a pigment in paints and in stone polish.

Q.1 why graphite is soft and slippery?

Q.2 why graphite conduct electricity very well?

unit-2
079/04/18

(*) Difference between metal and non-metal

Metal	Non-metal
(1) They exist in solid state. exception :- Hg exists in liquid state.	(1) They exist in all three possible state. chlorine → gas Bromine → liquid, Iodine → solid
(2) They are generally hard except alkali metal are soft can be cut easily with a knife.	(2) They are generally soft but diamond is a hardest substance
(3) They have high mop and bop	(3) They have low mop and bop
(4) They are good conductor of heat and electricity.	(4) They are bad conductor of heat and electricity except graphite.
(5) They are movleable and ductile.	(5) They are not ~~lustrous~~
(6) They are lustrous	(6) malleable and ductile.
(7) They form alloy	(6) They are not lustrous.
(8) Their density is high.	(7) They donot form alloy.
(9) They form unstable hydride with difficulty.	(8) Their density is low.
(10) They behaves as a reducing agent	(9) They form stable hydride easily.
	(10) They behaves as an oxidising agent.

(*) metalloid :- The element showing the characteristic of both metal as well as Non-metal are called metalloid.
eg. Beryllium [Be], Germenium [Ge], Arsenic [As] Antimony [Sb], Bismuth (Bi) etc.

(*) metal exist in following two state —

(1) free state (Native state) :- there are some metal like gold, silver, platinum etc which are not affected by atmospheric oxygen, CO_2, moisture etc. these associated with other element and hence are said to be free state.

(2) combined state :- most of the metal are affected by atmospheric oxygen, CO_2, moisture etc. these metal are found in nature being associated with other element and hence are said to exist in combined state.

Eg. Na, K, Ca } occur as halide

Mg, Al } occur as oxide.

Zn, Fe, Ni } occur as sulphide.

(*) Alloy :- it is homogeneous mixture of two or more metal. it is three types —

(i) ferrous alloy :- it is a types of alloy in which Iron is one of the major constituent. Eg. ~~Brass [Cu+Zn], Bronze [Cu+Sn]~~ steel [Fe+C], stainless steel [Fe+C+Cr+Ni]

(ii) Non-ferrous alloys :- it doesnot contain Iron. Eg. Brass [Cu+Zn], Bronze [Cu+Sn]

(iii) Amalgam :- it contains mercury [Hg] as one of the constituent.

Eg. (a) Sodium ~~amalgam~~ amalgam [Na/Hg]
(b) zinc amalgam [Zn/Hg]

IX

(*) Object of alloy making :-
(i) To increase the chemical reactivity of metal.
(ii) To increase the hardness of metal.
(iii) To modify the colour.
(iv) To lower melting point.
(v) To increase the strength.

(*) Chemistry of metallic carbonate ——

(*) Preparation :-
(I) By heating metallic bicarbonate :- metallic bicarbonate on heating gives metallic carbonate.

eg $2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2\uparrow$
$Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3 + H_2O + CO_2\uparrow$

(2) By passing CO_2 into alkali :- when CO_2 gas is passed through soluble hydroxide [alkali] then metallic carbonate is formed.
$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$
$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(*) Properties :-
(1) Solubility :- Alkali metal carbonate and ammonium carbonate are soluble in water while rest metal carbonate are insoluble in water.

(2) Action of heat :- Alkali metal carbonate fuses on heating but donot give CO_2
$Na_2CO_3 \xrightarrow{\Delta} Na_2CO_3$ [melt]
But all other metal carbonate give CO_2 on heating
$CaCO_3 \xrightarrow{\Delta} CaO + CO_2\uparrow$
$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2\uparrow$

(3) Action of heat :- All metallic carbonates react with acid to give CO_2 gas. $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$
$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$ //

Q.1 Write any two metallic carbonate which on heating donot give CO_2 gas? Na_2CO_3, K_2CO_3

Q.2 How metallic carbonate are prepared? Write down

Q.3 Write the chemistry of metallic carbonate?

Q.4 Write any two method of preparation of metallic carbonate

2079/04/19

ALKALI METAL

→ metal belonging to group I(A) or I of periodic table are called alkali metal. They are Li, Na, K, Rb, Cs and Fr. Among them francium (Fr) is a radioactive element

They are called alkali metal because they form alkalies in water.

$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$
$2K + 2H_2O \longrightarrow 2KOH + H_2$ (alkali)

(*) General Characteristics of alkali metal :-

(1) State :- they all exist in solid state. They are soft metal which can cut easily with a knife.

(2) Colour :- freshly cut alkali metal are silvery white in colour but on exposure to air they get tarnished.

(3) Oxidation state :- they always show +1 oxidation state only.

(4) flame colouration :-

Li	Na	K	Rb	Cs
Crimson red	golden yellow	violet	Reddish violet	Blue violet

← violet →

(5) Reaction with oxygen :- Alkali metals react with oxygen to form oxides.

(a) Lithium react with oxygen to form lithium oxide.

$$4Li + O_2 \longrightarrow 2Li_2O$$

(b) Sodium gives normal oxide at ordinary temperature and sodium peroxide at high temp.

$$4Na + O_2 \xrightarrow[\text{temp.}]{\text{ordinary}} 2Na_2O$$ (sodium oxide)

(c) K, Rb and Cs form superoxide.

$$K + O_2 \longrightarrow KO_2$$ [potassium superoxide]

$$Rb + O_2 \longrightarrow RbO_2$$ [Rubbidium oxide]

$$Cs + O_2 \longrightarrow CsO_2$$ [cesium oxide]

(6) Reaction with water :- Alkali metals dissolve in water to form alkali along with evolution of hydrogen gas and excess of heat energy.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2 + heat$$

$$2K + 2H_2O \longrightarrow 2KOH + H_2 + heat.$$

3500°

V.V.I

(7) Reaction with air [Exposed to air] :-

When alkali metal is exposed to air then it reacts with oxygen, CO_2 and moisture to form various products specially a layer of carbonate is formed on the surface of metal. that's why alkali metal gets tarnished.

$$4Na + O_2 \longrightarrow 2Na_2O$$
$$Na_2O + H_2O \longrightarrow 2NaOH$$
$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

(8) Reaction with hydrogen :- when alkali metal is heated with hydrogen at 800°C then metal hydride is formed.

$$2Na + H_2 \xrightarrow[800^\circ C]{\Delta} 2NaH$$
[Sodium hydride]

$$2K + H_2 \xrightarrow[800^\circ C]{\Delta} 2KH$$
[Potassium hydride]

V.V.I

(9) Reaction with ammonia :- when alkali metal is heated with ammonia then metalmide is obtained.

$$2Na + 2NH_3 \xrightarrow{\Delta} 2NaNH_2 + H_2$$
(Sodamide)

$$2K + 2NH_3 \xrightarrow{\Delta} 2KNH_2 + H_2$$
(Potassamide)

(10) Reaction with hydrogen [X = Cl, Br, I] :-

Alkali metal reacts directly with halogen to form metal halide.

$$2Na + Cl_2 \longrightarrow 2NaCl$$ [Sodium chloride]
$$2K + I_2 \longrightarrow 2KI$$ [Potassium iodide]

Q.1 What happens when sodium metal is exposed to air?

Q.2 What happen when sodium metal is placed in water?

Q.3 What happen when sodium metal is heated with (a) ammonia (b) hydrogen.

Use of sodium :-

(i) It is used in the manufacture of sodium peroxide sodamide etc.

(ii) It is used for detection of foreign element in organic compound.

(iii) It is used as a catalyst in the preparation of Rubber.

(*) properties of ~~compou~~ sodium :-

(i) Sodium metal exists in solid state.

(ii) freshly cut sodium metal is silvery white in colour but when it is exposed to air it gets tarnished.

(iii) Sodium metal is soft which can cut easily with knife.

(iv) Sodium metal ~~is soft which can cut~~ react with oxygen to give sodium oxide at ordinary tempreture and sodium peroxide at high tempreture.

$$4Na + O_2 \xrightarrow{\text{low temp}} 2Na_2O$$

$$2Na + O_2 \xrightarrow{\text{high temp}} Na_2O_2$$

(v) Sodium metal shows +1 oxidation state and its flame colouration is golden yellow.

(vi) When sodium metal is placed in water then sodium hydroxide is formed along with evolution of hydrogen gas and excess of heat energy.

(VII) When sodium metal is exposed to air then it reacts with atmospheric oxygen, CO_2 and moisture to form a carbonate layer on the surface of metal. that's why, sodium metal gets tarnished.

$$4Na + O_2 \longrightarrow 2Na_2O$$
$$Na_2 + H_2O \longrightarrow 2NaOH$$
$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

(VIII) When sodium metal is heated with hydrogen at 300°C then sodium hydride is formed.

$$2Na + H_2 \xrightarrow[300°C]{\Delta} 2NaH$$

(IX) When sodium metal is heated with ammonia then sodamide is obtained. $2Na + 2NH_3 \longrightarrow 2NaNH_2 + H_2$

(X) When sodium metal is allowed to react with chloride then sodium chloride is obtained.

$$2Na + Cl_2 \longrightarrow 2NaCl.$$

(XI) sodium reacts with mercury to form sodium amalgam.

$$Na + Hg \longrightarrow NaHg$$

Chemistry of metallic Nitrate :-

preparation :-

(i) Metallic nitrate can be prepared by treating metal with conc. nitric acid.

$$Zn + HNO_3 \longrightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$$
$$Cu + HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

(ii) metallic nitrate can be prepared by treating metallic oxide, metallic hydroxide, metallic carbonate etc with dilute nitric acid.

$$ZnO + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2O$$
$$NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$$
$$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$$

properties :- (i) All metallic nitrates are soluble in water.

(ii) **Action of heat :-**

(a) Alkali metal nitrate decomposes to give nitric and oxygen

$$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$$
$$2KNO_3 \xrightarrow{\Delta} 2KNO + O_2$$

(b) most of metal nitrate decomposed to give metal oxide, Nitrogendioxide gas and oxygen.

$$2Zn(NO_3)_2 \xrightarrow{\Delta} 2ZnO + 4NO_2\uparrow + O_2\uparrow$$
$$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2\uparrow$$

(c) Silver nitrate and mercuric nitrate on heating gives silver and mercury metal respectively.

$$2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2\uparrow + O_2\uparrow$$
$$Hg_2(NO_3)_2 \longrightarrow 2Hg + 2NO_2 + O_2\uparrow$$

Q.1 What happens when mercuric nitrate is strongly heated.
Q.2 What happens when sodium nitrate is heated strongly?
Q.3 Give the chemistry of metallic nitrate?
Q.4 Write preparation and properties of metallic nitrate?

Chemistry of metallic chloride*

(x) preparation :-

(1) Metallic chloride can be prepared by treating metal with hydrochloric acid.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2\uparrow$$
$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$$

(11) Metallic chloride can be prepared by the action of hydrochloric acid on metallic oxide hydroxide or carbonate.

$$MgO + 2HCl \longrightarrow MgCl + H_2O$$
$$NaOH + HCl \longrightarrow NaCl + H_2O$$
$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2 \quad CaCl_2 + H_2O + CO_2\uparrow$$

(2) properties :-

(a) Action of heat :- Alkali metal chlorides simply fuse on heating but some of metallic chloride lose chlorine on heating.

$$2CuCl_2 \xrightarrow{\Delta} Cu_2Cl_2 + Cl_2\uparrow$$

(11) Hydrated metallic chloride loso their water of crystallization on heating.

$$CaCl_2 \cdot 6H_2O \xrightarrow{\Delta} CaCl_2 + 6H_2O$$

Q.1 What happens when cupric chloride is heated?
Q.2 Give the chemistry of metallic chloride?
Q.3 Write preparation and properties of metallic chloride?

Chemistry of metallic sulphate (49)

(*) **preparation :-**

(i) metallic sulphate can be prepared by action of dilute sulphuric acid on metal.

$$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2\uparrow$$
$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$$

(ii) Metallic sulphate can be prepared by action of sulphuric acid on metallic oxide, hydroxide or carbonate.

$$MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$$
$$Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$$
$$Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$$

properties :-

(i) All metallic sulphate except sulphate of Ba, Sr and Pb are soluble in water.

(ii) Metallic sulphate do not react with acids.

(iii) **Action of heat :-** certain metallic sulphate on heating decompose to give SO_2 and oxygen with metallic oxide. $2CuSO_4 \xrightarrow{\Delta} 2CuO + 2SO_2 + O_2$

But some metallic sulphate like silver and mercuric sulphate decompose to give metal along with SO_2 and O_2

$$Ag_2SO_4 \xrightarrow{\Delta} 2Ag + SO_2\uparrow + O_2\uparrow$$
$$HgSO_4 \longrightarrow Hg + SO_2\uparrow + O_2\uparrow$$

Q.1 What happens when silver and mercuric sulphate is heated?

Q.2 What happens when copper sulphate is heated?

Q.3 Give the chemistry of metallic sulphate?

Q.4 Write preparation and properties of metallic sulphate?

2079/04/19

Alkaline earth metal (50)

metals belonging to group II A [2] of periodic table are called alkaline earth metals. They are Beryllium [Be] Magnesium [mg] Calcium [ca], Strontium [Sr] Barium (Ba) and Radium (Ra). Ra is a radioactive element. they are called alkaline earth metal because aqueous solution of these of these metal oxide is alkaline in nature.

(*) General characteristics of alkaline earth metal :-

(1) State :- they all exist in solid state. they are soft metal but harder than alkali metals.

(2) Colour : freshly cut alkaline earth metal are greyish white in colour but on exposure to air they get tarnished

(3) oxidation state :- They always show +2 oxidation state.

(4) flame colouration :- they imparts characteristic colour when exposed to bunsen burner.

Be mg — do not give flame test
Ca → brick red
Sr → crimson
Ba → apple green
Ra → red

↳ Due to small size and high ionisation potential which require a large amount of heat that cannot be give by bunsen burner]

(5) Reaction with oxygen [O_2] :- Be, mg and ca form normal oxide Ba and Sr form peroxide.

$2mg + O_2 \longrightarrow 2MgO$ [magnesium oxide]
$2ca + O_2 \longrightarrow 2CaO$ [calcium oxide]

(6) Reaction with water :- Be doesnot react with water
- Mg react with water only on heating

$$Mg + 2H_2O \longrightarrow Ca(OH)_2 + H_2\uparrow$$

(7) Reaction with hydrogen :- All alkaline earth metal [except Be] are heated with hydrogen in an inert atmosphere to give metal hydride.

$$Mg + H_2 \longrightarrow MgH_2 \text{ (mag. hydride)}$$
$$Ca + H_2 \longrightarrow CaH_2 \text{ (cal. hydride)}$$

(8) Reaction with halogen [Cl, Br, I] :-
Alkaline earth metals react with halogen on heating to form metal halide.

$$Mg + Cl_2 \xrightarrow{\Delta} MgCl_2 \text{ (mg. chloride)}$$
$$Ca + Cl_2 \xrightarrow{\Delta} CaCl_2 \text{ (cal. chloride)}$$

(9) Reaction with nitrogen :- they react with nitrogen on heating to give metal nitride.

$$3Mg + N_2 \xrightarrow{\Delta} Mg_3N_2 \text{ (mag. Nitride)}$$
$$Ca + N_2 \xrightarrow{\Delta} Ca_3N_2 \text{ (cal. Nitride)}$$

(10) Reaction with acid [HCl, H_2SO_4] :- Alkaline earth metals react with dil. HCl or dil. H_2SO_4 to give corresponding salt along evolution of hydrogen gas.

$$Mg + \underset{(dil)}{HCl} \longrightarrow MgCl_2 + H_2\uparrow$$

$$Ca + \underset{(dil.)}{H_2SO_4} \longrightarrow CaSO_4 + H_2\uparrow$$

Calcium

(*) properties of calcium :-

(i) calcium is silvery white metal.
(ii) it is very soft having low density.
(iii) it is good conductor of heat and electricity.
(iv) it shows +2 oxidation state and gives brick red flame colouration.
(v) it react with oxygen or air on heating to give calcium oxide. $2Ca + O_2 \xrightarrow{\Delta} 2CaO$
(vi) when calcium is heated with nitrogen then calcium nitride is obtained.
$3Ca + N_2 \xrightarrow{\Delta} Ca_3N_2$
(vii) calcium react with cold water to give calcium hydroxide along with evolution of hydrogen gas.
$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2\uparrow$
(viii) It react with HCl and H_2SO_4 give hydrogen gas
$Ca + 2HCl \longrightarrow CaCl_2 + H_2\uparrow$
$Ca + H_2SO_4 \longrightarrow CaSO_4 + H_2\uparrow$
(ix) It reacts with halogen to give calcium halide.
$Ca + Cl_2 \longrightarrow CaCl_2$
(x) It reacts with hydrogen to give metal hydride.
$Ca + H_2 \longrightarrow CaH_2$

Uses :-
(i) it is used for removing sulphur from petroleum.
(ii) it is used for removing water from alcohol.
(iii) it is used to remove air from vaccum tubes.

Aluminium

(*) Physical properties of aluminium :-

(1) It is bluish white metal. Its density is 2.7 g/ml
(2) It is malleable and ductile.
(3) It is a good conductor of heat and electricity
(4) It melts at 933 K and boils at 2723 K in absence of air.

(*) Chemical properties of Aluminium :-

(1) Reaction with air [oxygen] :- when Aluminium is heated to redness, it burns with a white bright flame to give Aluminium oxide.

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

(2) Reaction with water :- Aluminium decomposes on boiling with water to liberate hydrogen gas along with Aluminium hydroxide.

$$2Al + 6H_2O \xrightarrow{\text{boiling}} 2Al(OH)_3 + 3H_2\uparrow$$

(3) Reaction with nitrogen :- on heating with nitrogen, it form Aluminium nitride.

$$2Al + N_2 \xrightarrow{\Delta} 2AlN$$

(Aluminium nitride)

(4) Reaction with halogen [Cl, Br, I] :-
when halogen is passed over heated Aluminium then Aluminium halide is formed.

$$2Al + 3Cl_2 \longrightarrow 2AlCl_3$$
$$2Al + 3Br_2 \longrightarrow 2AlBr_3$$

(5) Reaction with acid [HCl, H_2SO_4] :-

(a) Aluminium reacts with dil. HCl to give hydrogen gas.

$$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2 \uparrow$$

(b) Aluminium doesnot react with dil. H_2SO_4 but it react with hot and conc. H_2SO_4 to give sulphur dioxide and Aluminium sulphate.

$$2Al + 6H_2SO_4 \text{ (Conc.)} \longrightarrow Al_2(SO_4)_3 + 6H_2O + 3SO_2 \uparrow$$

(6) Reaction with alkali [Caustic soda, NaOH] :-

It react with hot caustic soda to give sodium meta aluminate along with evolution of hydrogen.

$$2Al + 2NaOH + 2H_2O \longrightarrow 2NaHO_2 + 3H_2 \uparrow$$

(Sodium meta aluminate)

(7) Reaction with carbon and sulphur :-

When Aluminium is heated with carbon and sulphur separately then Aluminium carbide and Aluminium sulphide are formed respectively.

$$4Al + 3C \xrightarrow{\Delta} Al_4C_3 \quad \text{[Aluminium carbide}$$

$$2Al + 3S \longrightarrow Al_2S_3 \quad \text{[Aluminium sulphide}$$

(8) Reducing nature of Aluminium :- Aluminium reduces ferric oxide and Chromium oxide to corresponding metal. This process is called Aluminio thermite process.

$$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3$$

(ferric oxide)

$$Cr_2O_3 + 2Al \longrightarrow 2Cr + Al_2O_3$$

[Chromium oxide]

Uses of Aluminium :-

(I) It is used for making coins and alloys.
(II) It is used for making aeroplane parts and kitchen utensils.
(III) It is used for making electric wire, window frame, beer kegs etc.

2079 04-24

IRON

(*) Physical properties of Iron :-

(I) pure Iron is a grey white lustrous metal.
(II) It is malleable and ductile.
(III) It is good conductor of heat and electricity.
(IV) Its specific gravity is 7.86
(V) Its mop is 1536°C and bop is 2750°C

(*) Chemical properties of Iron :-

(1) Reaction with air/oxygen :- At ordinary temperature dry air is not attacked to Iron but when Iron is heated with air then ferroso ferric oxide is formed

$$3Fe + 2O_2 \xrightarrow{\Delta} Fe_3O_4$$

But when moist air containing CO_2 is passed over Iron then a brown layer is formed on the surface of Iron which is called rust.

$$4Fe + 3O_2 + xH_2O \longrightarrow 2Fe_2O_3 \cdot xH_2O$$
(Rust)

(2) Reaction with water :- when steam is passed over red hot Iron then ferroso ferric oxide is formed along with evolution of hydrogen gas.

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2\uparrow$$
(Steam)

Reaction with acid :-

(i) Dilute and concentrated hydrochloric acid react with Iron to give ferrous chloride along with evolution of hydrogen gas.

$$Fe + 2HCl \longrightarrow FeCl_2 + H_2\uparrow$$

(ii) (a) When iron is treated with dilute H_2SO_4 then ferrous sulphate is formed along with evolution of ~~sulphur dioxide gas~~. Hydrogen gas.

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$$

(b) When iron is treated with conc. H_2SO_4 then ferric suphate is formed along with evolution of sulphurdioxide gas.

$$2Fe + 6H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 6H_2O + 3SO_2$$

(iii) (a) Dilute nitric acid reacts with iron to give ferrous nitrate and ammonium nitrate

$$4Fe + 10HNO_3 \longrightarrow 4Fe(NO_3)_2 + NH_4NO_2 + 3H_2O$$

~~$Fe + 6HNO_3 \longrightarrow Fe(NO_3)_3 + 3NO_2 + 3H_2O$~~

(b) moderately nitric acid react with iron to give ferric nitrate and amnture of nitric oxide and and Nitrogen dioxide

$$Fe + 4HNO_3 \longrightarrow Fe(NO_3)_3 + NO + 2H_2O$$
$$Fe + 6HNO_3 \longrightarrow Fe(NO_3)_3 + 3NO_2 + 3H_2O$$

(c) Pure and highly concentrated HNO_3 makes Iron passive due to formation of Fe_3O_4 on the surface of iron. such Iron place is called passive iron and ~~passivity of iron~~. This phenomenos is called passivity of iron.

$$3Fe + 8HNO_3 \longrightarrow Fe_3O_4 + 8NO_2 + 4H_2O$$

(4) Reaction with chlorine :- when iron is heated with chlorine then ferric chloride is formed.

$$2Fe + 3Cl_2 \xrightarrow{\Delta} 2FeCl_3$$

(5) Reaction with sulphur :- when iron is heated with sulphur then ferrous sulphide is formed.

$$Fe + S \xrightarrow{\Delta} FeS$$

V.V.I

(6) Reaction with carbon monoxide :- when carbon monoxide is passed over heated powder of iron at 120°C then iron carbonyl is formed which at (150°C - 180°C), it gives back iron and carbon monoxide.

$$Fe + 5CO \xrightarrow[\Delta]{120^\circ C} Fe(CO)_5 \xrightarrow{(150-180)^\circ C} Fe + 5CO$$

(Iron carbonyl)

(7) Displacement reaction :- since iron is more electro-positive than Cu, Ag, Au etc then copper Ag is displaced from their salt solution.

$$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$$

$$Fe + 2AgNO_3 \longrightarrow Fe(NO_3)_2 + 2Ag$$

Uses of Iron :-

(i) it is used to make vehicle and machinery
(ii) military hardwares are based on iron.
(iii) Heavy steel and industries are based on iron.
(iv) most of tools and equipment are based on iron eg. saw, hammer, knife etc.

2079
04-24

ZINC [Zn]

(*) Physical properties of zinc :-

(i) It is bluish white metal brittle at ordinary temp but malleable and ductile between 100°C and 150°C

(ii) Its melting point is 420°C and boiling point is 908°C

(iii) It is a good conductor of heat and electricity

(iv) Its specific gravity is 7.10

(*) Chemical properties of zinc :-

(1) Reaction with air :-

(a) Zinc react with moist air to give basic zinc carbonate so, zinc becomes dull in moist air.

$$2Zn + H_2O + CO_2 + O_2 \longrightarrow ZnCO_3 \cdot Zn(OH)_2$$

Basic zinc carbonate

(b) When Zn is heated upto 600°C in presence of air then zinc oxide is formed which is called Philosphers wool. $2Zn + O_2 \longrightarrow 2ZnO$

(Philosphers wool)

(2) Reaction with water :- When water steam is passed over heated zinc then hydrogen gas is evolved.

$$Zn + H_2O \longrightarrow ZnO + H_2\uparrow$$

(3) Reaction with acid :-

(a) Dilute and concentrated HCl react with zinc to give zinc chloride along with evolution of hydrogen gas.

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$$

(b) Dilute H_2SO_4 gives H_2 gas and conc. H_2SO_4 give SO_2 after the reaction with zinc.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$
(dil.)

$Zn + 2H_2SO_4 \longrightarrow ZnSO_4 + 2H_2O + SO_2\uparrow$
(conc.)

(c) Zinc react with different concentration of nitric acid to give different product.

(i) With conc. HNO_3 :- In this case, NO_2 is formed.

(ii) ~~With moderately~~ $Zn + 4HNO_3 \rightarrow Zn(NO_3)_2 + 2H_2O + 2NO_2\uparrow$

(iii) With moderate [1:1] In this case, NO is formed.

$$3Zn + 8HNO_3 \longrightarrow Zn(NO_3)_2 + 4H_2O + 2NO$$

(iii) With dilute HNO_3 :- In this case, NO_2 is formed.

$$4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + NO_2 + 5H_2O$$

(iv) With very dilute HNO_3 :- In this case, zinc nitrate ammonia nitrate is formed.

$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$$

V.V.I (d) Reaction with conc. and hot NaOH :- When zinc is dissolved in hot and conc. NaOH solution then sodium zincate is formed.

$$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2\uparrow$$
(hot and conc.) (sodium zincate)

(5) Reaction with chlorine and sulphur :-
When zinc is heated with chlorine then zinc chloride is formed.

$$Zn + Cl_2 \xrightarrow{\Delta} ZnCl_2$$

When zinc is heated with sulphur then zinc sulphide is formed.

$$Zn + S \xrightarrow{\Delta} ZnS$$

(6) Displacement reaction :- zinc displaces less electro positive metal likes Cu, Ag, Au etc from their salt solutions.

$$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$$
$$Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag.$$

(#) Use of zinc :-
(I) Granulated zinc is used in laboratorys.
(II) It is used as cathode in dry cell.
(III) It is used in making alloy like brass (Cu + Zn)
(IV) It is used in galvanisation (Zn) of Iron.

2079
5-23

[Lead Pb] (61)

(#) physical properties of lead :-

(I) pure lead is a soft bluish grey lustrous metals.
(II) It is highly malleable but not very ductile in nature
(III) It marks black on paper having specific gravity is 11.3
(IV) It is poor conductor of electricity and melts at 3260°C

(#) chemical properties of lead :-

(1) Reaction with air [oxygen] :- When lead is heated with oxygen at low temperature then litharge is formed which on further heating 450°C then lead is obtained.

$$2Pb + O_2 \longrightarrow 2PbO$$
[Litharge]

$$6PbO + O_2 \longrightarrow 2Pb_3O_4$$
[Red lead]

(2) Reaction with water [plumbo solvency] :-
Lead is attacked by water containing oxygen to give sparingly soluble plumboos hydroxide. Such solvent action of water on lead is called plumbo solvency.

$$2Pb + O_2 + 2H_2O \longrightarrow 2Pb[OH]_2$$

(3) Reaction with acid :-
(I) Dilute H_2SO_4 doesnot react with lead but conc. H_2SO_4 reacts with lead at 240°C to form along with evolution of SO_2 gas

$$Pb + 2H_2SO_4 \longrightarrow PbSO_4 + 2H_2O + SO_2\uparrow$$

(II) Dilute HCl doesn't react with lead but when lead is boiled with conc. HCl then chloro plumbic acid is formed

$$Pb + 2HCl \longrightarrow PbCl_2 + H_2\uparrow$$
$$PbCl_2 + 2HCl \longrightarrow H_2PbCl_2$$
[chloro plumbic acid]

(III a.) Dilute nitric acid attacks the metal forming nitric oxide.

$$3Pb + 8HNO_3 \longrightarrow 3Pb(NO_3)_2 + 4H_2O + 2NO$$

(b) Pb reacts with conc. HNO_3 to give NO_2 gas.

$$Pb + 4HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + 2NO_2$$

TOVol. (4) Reaction with NaOH :- Hot and conc. NaOH reacts with leads to give sodium plumbate along with evolution of hydrogen gas.

$$Pb + 2NaOH \longrightarrow Na_2PbO_2 + H_2$$
[sodium plumbate]

(5) Reaction with chlorine and sulphur :- When lead is heated with chlorine or sulphur then lead chloride or lead sulphide is formed.

$$Pb + Cl_2 \xrightarrow{\Delta} PbCl_2$$
$$Pb + S \xrightarrow{\Delta} PbS$$

(6) Reaction with Acetic acid :- Lead dissolved in acetic acid in presence of air to form lead acetate.

$$2Pb + 4CH_3COOH + O_2 \rightarrow 2[CH_3COO]_2Pb + 2H_2O$$
(Lead acetate)

(#) Used of lead #

(I) It is used for making water and gas pipes.
(II) It is used for making plate of batteries.
(III) It is used for making bullets and shots.
(IV) It is used for making cable coverings.

2079
5-23

UNIT-3

(4)

Organic Greek life ⟶ living beings

(#) Old definition :- The compound which are obtained from living beings are called organic compound and chemistry dealing with these compound ~~and chemistry~~ dealing is called organic chemistry.

(#) Vital force theory and its decline :- Earlier on it was believed that organic compound are synthesized on the cell of living organism by some natural called vital forces present in living organism. such theory is called vital force theory. A/c to this theory organic compound cannot be synthesized outside the living cell in laboratory.

(#) Decline :- A german chemist name friedrich wehler synthesized organic compound 'urea' from inorganic compound by heating a mixture of ammonium sulphate and potassium cyanates.

$$(NH_4)_2SO_4 + 2KCNO \xrightarrow{\Delta} K_2SO_4 + 2NH_4CNO$$

$$NH_4CNO \xrightarrow{\text{Rearrangement}} H_2N-\overset{\overset{O}{\|}}{C}-NH_2$$

(urea)

KOl be synthesized acetic acid from their constituent elements and Berthelot synthesized methane from carbon and hydrogen thus, it can be calculated that organic compound are synthesized on the cells of living organism as well as in laboratorys.

odern definitions :- The compound of carbon and hydrogen and their derivatives in which covalently bonded carbon is essential element [constitent] is called organic compound. The branch of chemistry which deals with the study of hydrocarbon and their derivative is called organic chemistry.

It may be noted that some organic compound may also contain element like N, P, S, O Cl, Br and I besides carbon and hydrogen.

*) Reasons for separate study of organic compound.

→ Difference between organic compound and Inorganic compound]

	Organic compound		Inorganic compound.
1.)	The compound which are obtined from living sources are called organic compound.	1)	The compound which are obtined from non-living sources are called inorganic compounds.
2.)	organic compound are formed by participation of only nine element viz, C, H, O, N, P, S, Cl, Br and I	2.	Inorganic compound are formed by participation of all most all element.
3)	organic compound having low mp millions.	3.	Inorganic compound are about 1-15 lakhs.
(4)	organic compound having low mp and bp.	4.	Inorganic compound have high bp and mop.
(5)	organic compound are insoluble in water but soluble in organic solvent.	5.	In organic compound are soluble in water.
(6)	They have covalent bond.	6.	They have ionic bond.
(7)	They are volitile.	7.	They are non-volatile.
(8)	They are combustile	8.	They are not combustile
(9)	They show isomerism.	9.	They do not show isomerism.
10.	alchol, ether etc.	10.	NaCl, $CuSO_4$, HCl, H_2SO_4 etc.

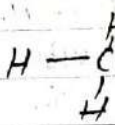
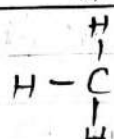
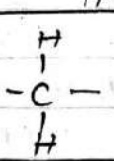
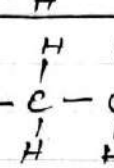
Hydrocarbon :- The compound of carbon and hydrogen is called hydrocarbon. It is classified into following two types:

(I) Saturated hydrocarbon :- The hydrocarbon ~~eg: methane~~ containing single bond between carbon atom is called saturated hydrocarbon. eg:- methane, ether, propane etc.

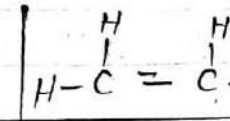
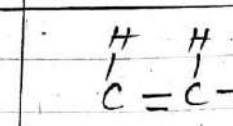
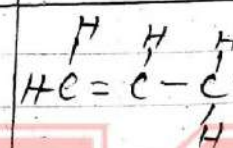
(II) Unsaturated hydrocarbon :- The hydrocarbon containing double or tripple bond between carbon carbon atom is is called unsaturated hydrocarbon. eg. ethene, ethyne propene, propyne etc.

Hydrocarbon is further classified into following 3 types

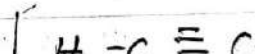
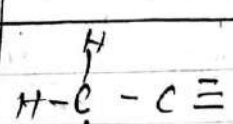
(I) Alkane :- The saturated hydrocarbon containing carbon - carbon single bond is called alkane.
the general formula for alkane is C_nH_{2n+2}, where n is the number of carbon atoms.

$n=2$	$C_1H_{2\times1+2} = CH_4$		CH_4 methane
$n=2$	$C_2H_{2\times2+2} = C_2H_6$		CH_3-CH_3 ethane
$n=3$	$C_2H_{2\times3+2} = C_3H_8$		$CH_3-CH_2-CH_3$ propane
$n=4$	$C_4H_{2\times4+2} = C_4H_{20}$		$CH_3-CH_2-CH_2-CH_3$ Butane.

(II) Alkene :- The unsaturated hydrocarbon containing carbon - carbon double bond is called alkene. The general formula for alkene is C_nH_{2n} where, n is the number of carbon atoms.

n=2	$C_2H_{2\times2} = C_2H_4$		$CH_2=CH_2$ ethene
n=3	$C_3H_{2\times3} = C_3H_6$		$CH_2=CH-CH_3$ propene
n=4	$C_3H_{2\times4} = C_3H_8$		$CH_4=CH-CH_2-CH_3$ propene

(III) Alkyne :- The unsaturated hydrocarbon containing carbon - carbon triple bond is called alkyne. The general formula for alkyne is C_nH_{2n-2}, where n is the number of carbon atoms.

n=2	$C_2H_{2\times2-2} = C_2H_2$		$CH\equiv CH$ ethyne
n=3	$C_3H_{2\times3-2} = C_3H_4$		$CH_3-C\equiv CH$ propyne.
n=4	$C_4H_{2\times4-2} = C_4H_6$		

(#) Functional group :- Atom or group of atoms which determines the characteristic properties of organic compound is called functional group example:- CH_3-CH_2-OH

Residual group — functional group.

In ethyl alchol, OH group is called functional group because it's determine the characteristic properties of ethyl alcohol.

List of functional group :-

functional group	Name of group	class of compound
$-X$ [Cl, Br, I]	Halo [chloro, bromo, Iodo	Holegen derivatives
$-OH$	Alcohol	Alcohol
$-OR$, $R \neq H$	Ether	Ethers
$-CHO$, $[-\overset{O}{\overset{\|}{C}}-H]$	Aldehyde	Aldehyde
$-COR$, $-\overset{O}{\overset{\|}{C}}-OH$	Carboxylic acid	Carboxylic Acids
$-COOR$, $-\overset{O}{\overset{\|}{C}}-OR$, $R \neq H$	ester	esters
$-COCl$, $-\overset{O}{\overset{\|}{C}}-NH_2$	Amide	Amides
$-NH_2$	Amino	Amines
$-NO_2$	Nitro	Nitro compound

(#) Characteristic of functional group :-

(I) A functional group gives identification of the compound.
(II) A functional group is specific for organic compounds.
(III) The reactivity of organic compound is determined by its functional groups.

(IV) The group of compound with same functional group is called class or family. the member of same class have similar chemical properties.

(#) Homologous series :- Homo = uniform
logous = to study

A series of organic compound having same functional group. In which adjacent two member differ from each other by $-CH_2$ unit is called homologous series.

Example :-

series of alcohal	series of carboxylic Acid
CH_3-OH	$HCOOH$
CH_3-CH_2-OH	CH_3COOH
$CH_3-CH_2-CH_2-OH$	CH_3-CH_2-COOH
$CH_3-CH_2-CH_2-CH_2-OH$	$CH_3-CH_2-CH_2-COOH$
$CH_3-CH_2-CH_2-CH_2-CH_2-OH$	$CH_3-CH_2-CH_2-COOH$
$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-OH$	$CH_3-CH_2-CH_2-CH_2-COOH$

(#) Characteristic of homologous series :-

(I) They all have same functional groups.
(II) The adjacent two member differ from each other by a $-CH_2$ unit.
(III) All the member of series can be represented by same general formula.
(IV) They all have same chemical properties.
(V) They all have same method of preparations.

(#) Alkyl group [Alkyl radical] :- When one of the H-atom Alkane is removed, the remaining part which, we get is called Alkyl group or Alkyl radical. It is denoted by R.

$$C_nH_{2n+2} \xrightarrow{-H} C_nH_{2n+1}$$

Alkane → Alkyl

Example:-

$$CH_4 \xrightarrow{-H} -CH_3$$

methane → methyl

$$CH_3-CH_3 \xrightarrow{-H} -CH_2-CH_3$$

ethane → ethyl

(#) International union of pure and applied chemistry [IUPAC] system of Nomenclature of organic compound :-

The name of organic compound has three parts.

(1) Word root — primary suffix
(2) suffix — secondary suffix.
(3) prefix

(1) Word root :- It is denoted the number of carbon atoms in chains of organic compound.

Chain length	Word root
C_1	meth
C_2	eth
C_3	prop
C_4	but
C_5	pent
C_6	Hex

C_7	Hept
C_8	Oct
C_9	Non
C_{10}	Dec

(2) Suffix (a) primary suffix :- Its indicates the nature linkage or bond between carbon-carbon atoms of the chain of organic compound.

Nature of linkage or bond	primary suffix
Carbon-carbon single bond [-C-C-]	-ane
carbon-carbon double bond [-C=C-]	-ene
carbon-carbon triple bond [C≡C]	-yne

(b) Secondary suffix :- Its indicate the presence of functional group in the organic compounds.

functional group	secondary group
Alcohol (-OH)	-ol
Aldehyd (-CHO)	-al
Ketone (-COR)	-one
Carboxylic Acid [-COOH]	-oic acid
Ester [-COOR]	-oate
Acid amide [-$CONH_2$]	-Amide
Acid chloride [-COCl]	-oyl chloride.

(3) prefix :- [side chain] :- these are many groups which are not regarded as functional group in IUPC name of organic compound. these are regarded as prefix which are ~~not~~ put before the word root while naming the compounds.

Side chain	prefix
$-Cl$	- chloro
$-Br$	- Bromo
$-I$	- Iodo
$-NO_2$	- Nitro
$-NH_2$	- amino
$-CH_3$	- methyl
$-O-CH_3$	- methoxy
$-O-CH_2-CH_3$	- ethoxy

∴ Name of organic compound :-

prefix + word root + primary suffix + secondary suffix

eg.

(a) $\overset{5}{CH_3}-\overset{4}{CH_2}-\overset{3}{CH_2}-\overset{2}{CH_2}-\overset{1}{CH_2}-OH$ (Cl at 1)

prefix = chloro

word root = pent

pos = ane

sos = ol

∴ 2 - chloro pentan - 1 - ol

(b) $\overset{5}{CH_3}-\overset{4}{CH}=\overset{3}{CH}-\overset{2}{CH_2}-\overset{1}{CHO}$

prefix = x

word root = pent

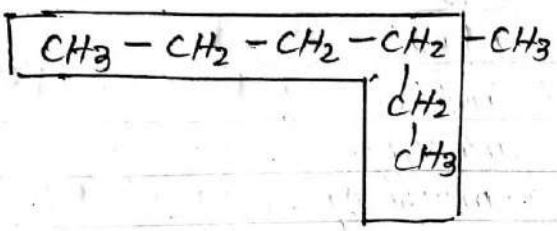
pos = ene

sos = al

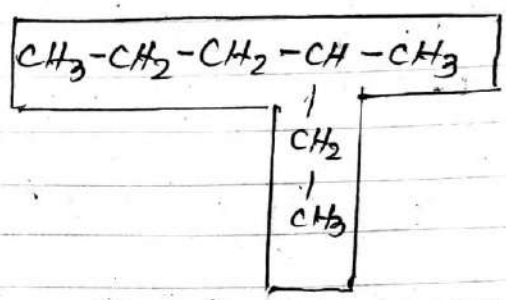
∴ pent - 3 - en - 1 - al

(#) IUPAC nomenclature of branched chain alkane :-

(1) Select the longest continuous chain of carbon atoms in a given molecules as the parent chain.

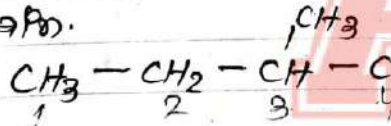


contain 6 carbon atom
[parent chain]

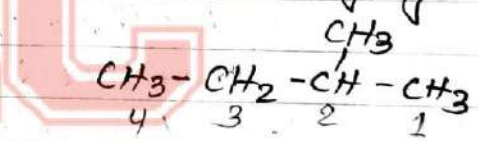


Contain 5 carbon atom
[Not parent chain]

(2) The numbering of carbon atom in the parent chain as 1, 2, 3 - - - etc is done starting from that end which gives lower number to carbon atom carrying side chain.

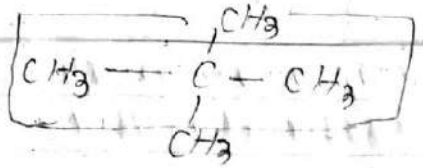


side chain is present at 3rd position (wrong)

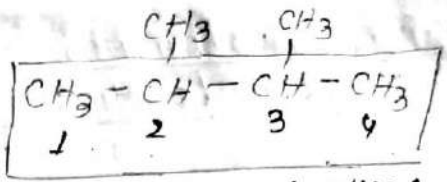


side chain is present at 2nd position [correct]
prefix = methyl
word root = But
pos = one
sos = x
∴ 2-methyl butane

(3) If the same side chains occours more than once then prefix di, tri, tetra - - - etc attached to the name of side chains



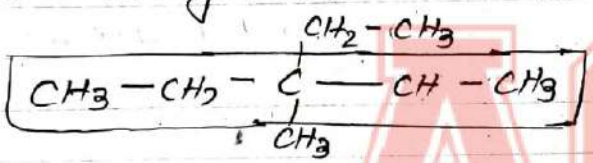
prefix = methyl
word root = prop
pos = ane
2, 2 – dimethyl



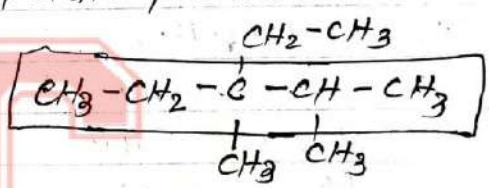
prefix = methyl
word root = but
pos = ane
sos = x
2, 3 – dimethyl.

~~(4) If~~

(4) If two or more different side chain are present in a molecule, they are named in the alphabetical order along with their Appropriate positions.



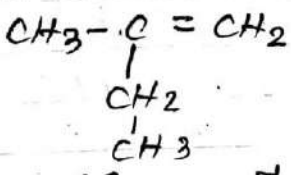
wrong.
[side chain at 3rd and 4th position.]



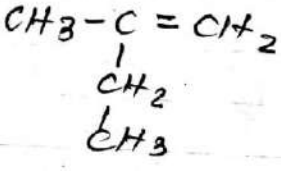
correct
[side chain at 2nd and 3rd position]
prefix = methyl, ethyl
word root = pent
pos = ane
sos = x
3 - ethyl 2, 3 - dimethyl pentane

(#) IUPAC nomenclature of alkenes and alkynes :–

(1) The longest continuous chain containing double or triple bond is selected as parent chain.



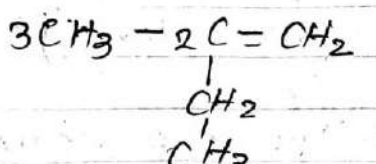
[Correct]



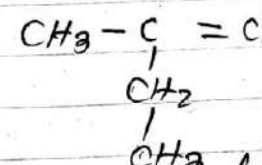
contains 3 carbon atoms having double bond

contain 4 carbon atoms but doesnot has double bond.

(2) The numbering is done from that end in which double bond or tripple bond comes in lower positions.

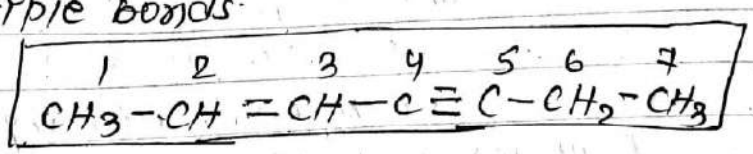


(correct)
Double bond is present at 1st position
prefix = ethyl
word root = prop
pos = ene
2 - ethyl prop-1-ene

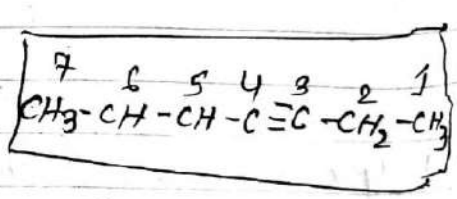


(wrong)
Double bond is present at 2nd position

(3) If both double and tripple bond are present in the same molecule then numbering is started from that end of carbon which lies nearer to double or tripple bonds.



Double bond = 2nd
tripple bond = 4th
[correct]



Double = 5th
tripple = 3rd

Hept - 2 - en - 4 - yne

(4) If more than one double or tripple bonds are present then di, tri, tetra, ... etc prefix is added to enecryne

(a) $\overset{1}{CH_2} = \overset{2}{CH} - \overset{3}{CH} = \overset{4}{CH_2}$

But-1, 3-diene [But-1, 3-diene]

(b) $\overset{1}{CH_3} - \overset{2}{\underset{\overset{|}{CH_3}}{C}} = \overset{3}{CH} - \overset{4}{CH_2} - \overset{5}{CH} = \overset{6}{CH} - \overset{7}{CH_3}$

2 - methyl Hept-2, 5-diene

(c) $\overset{1}{CH} \equiv \overset{2}{C} - \overset{3}{C} \equiv \overset{4}{CH}$

But-1, 3-diene

(#) IUPAC nomenclature of compound containing functional group:-

(1) Halo alkane :- $R-X$, $X = Cl, Br, I$

prefix + word root + primary suffix.

(a) CH_3-Cl chloro + meth + ane ⇒ Chloromethane

(b) CH_3-CH_2-Br, Bromo + eath + ane ⇒ Bromo ethane

(c) $\overset{3}{CH_3} - \overset{2}{CH_2} - \overset{1}{CH_2} - I$, 1 - Iodo + propane = 1-Iodo propane

(d) $\overset{1}{CH_3} - \overset{2}{\underset{,Br}{CH}} - \overset{3}{CH_3}$ 2-bromo propane

(e) $\overset{1}{\underset{,Cl}{CH_2}} - \overset{2}{\underset{,Br}{CH}} - \overset{3}{\underset{,I}{CH_2}}$ 2-bromo 1-chloro 3-Iodo propane.

② Alcohol :- R-OH

prefix + root word + position

(a) CH_3-OH (methyl alcohol) ⇒ methane - ol = methanol

(b) CH_3-CH_2-OH (ethyl alcohol) ⇒ ethane - ol = ethanol

(c) $CH_3-CH_2-CH_2-OH$ ⇒ propane - ol = propane-1-ol

(d) $CH_3-\underset{OH}{\underset{|}{CH}}-CH_3$ ⇒ propane - ol = propane-2-ol

(e) $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH$ 2-methyl propan-1-ol

(f) $\begin{matrix} CH_2-OH \\ | \\ OH-OH \end{matrix}$ ethane-1, 2-diol

③ ether :- R-O-R

small group = No. of carbon atom → alkoxy = alk

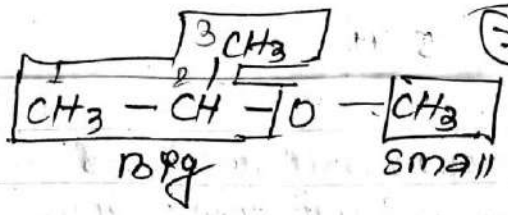
big group = No. of carbon atom = alkane = ane + ate

(a) CH_3-O-CH_3 methane + oxy + methane = methoxy methane

(b) $\underbrace{CH_3-CH_2}_{\text{big}}-O-\underbrace{CH_3}_{\text{small}}$ methoxy ethane

(c) $\underbrace{CH_3-CH_2}_{\text{big}}-O-\underbrace{CH_2-CH_3}_{\text{small}}$ ethoxy ethane.

(d) $\underbrace{\overset{3}{CH_3}-\overset{2}{CH_2}-\overset{1}{CH_2}}_{\text{big}}-O-\underbrace{CH_3}_{\text{small}}$ 1-methoxy propane

(e) 

2-methoxy propane

(4) Aldehyde :- R-CHO
prefix + word root + pos + sos

(a) $H-\overset{O}{\overset{\|}{C}}-H$ (formal dehyde) ⇒ meth + ane - etal
⇒ methanal

(b) $CH_3-\overset{O}{\overset{\|}{C}}-H$ [Acetaldehyde] ⇒ eth + ane - etal
⇒ ethanal

(c) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$ propane - etal ⇒ propanal

(d) $CH_3-\underset{CH_3}{CH}-\underset{CH_3}{CH}-\overset{O}{\overset{\|}{C}}-H$ 2,3 - dimethyl butanal

(5) Ketone :- $R-\overset{O}{\overset{\|}{C}}-R$
prefix + word root + pos + sos

(a) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ (Acetone) prop + ane - etone
⇒ propanone.

(b) $\overset{4}{CH_3}-\overset{3}{CH_2}-\overset{2}{\overset{O}{\overset{\|}{C}}}-\overset{1}{CH_3}$ but + ane - etone ⇒ Butane - 2 - one

(c) $\overset{5}{CH_3}-\overset{4}{CH_2}-\overset{3}{CH_2}-\overset{2}{\overset{O}{\overset{\|}{C}}}-\overset{1}{CH_3}$ pent + ane - etone ⇒ pentan - 2 - one

(d) ~~Carboxylic Acid~~
(d) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$ pent + ane - etone ⇒ pentan - 3 - one.

(6) Carboxylic acid :- R-COOH

prefix + word root + pos + s.f

(a) $H-\overset{O}{\overset{\|}{C}}-OH$ (formic acid) meth + ane - etoic acid ⇒ methanoic acid.

(b) $CH_3-\overset{O}{\overset{\|}{C}}-OH$ (Acetic acid) eth + ane - etoic acid ⇒ ethanoic acid.

(c) $CH_3-\overset{O}{\overset{|}{C}}H_2-\overset{O}{\overset{\|}{C}}-OH$ propane - etoic acid ⇒ propanoic acid

(d) $CH_3-\overset{Cl}{\overset{|}{C}}H-CH_2-\overset{O}{\overset{\|}{C}}-OH$ 3-chloro butanoic acid

(e) $CH_3-CH_2-\overset{CH_3}{\overset{|}{C}}H_2-\overset{O}{\overset{\|}{C}}-OH$ 2-methyl butanoic acid.

(7) Ester :- $\left[R-\overset{O}{\overset{\|}{C}}-OR,\ R\neq H\right]$

↳ alkyl + word root + ane-et oate

(a) $H-\overset{O}{\overset{\|}{C}}-O-CH_3$ methyl methanoate

(b) $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$ methyl ethanoate

(c) $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$ ethyl ethanoate

(d) $CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-O-CH_3$ methyl butonoate.

(e) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$ ethyl propanoate.

(8) Amide $\left[R-\overset{O}{\overset{\|}{C}}-NH_2\right]$:-

prefix + word root + pos + sos + amide

(a) $H-\overset{O}{\overset{\|}{C}}-NH_2$ methane - e + amide = methanamide

(b) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$ eth + ane - e + amide : ethanamide

(c) $CH_3-CH(CH_3)-C(=O)-NH_2$ propane - e + amide = propanamide.

(d) $CH_3-CH_2-CH_2-C(=O)-NH_2$ But + ane - e + amide = butanamide

(e) $CH_3-CH(NO_2)-CH_2-C(=O)-NH_2$ 3-Nitro 3-Nitro butanamide.

(f) $CH_3-CH(Br)-CH_2-CH_2-C(=O)-NH_2$ 4-bromo pen + anamide //

2079
5-31

methane

(#) properties of methane :-

(1) Halogenation [Chlorination] :- Chlorination of methane is carried out by treating methane with chlorine in presence of sunlight to give mixture of chloro methane

$CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3-Cl \xrightarrow[\text{sunlight}]{Cl_2} CH_2-Cl_2$

methane — Chloro methane — dichloro methane

dichloro methane $+ Cl_2 \xrightarrow{\text{sunlight}} CHCl_3$ + trichloro methane

$CHCl_3 \xrightarrow[\text{sunlight}]{+Cl_2} CCl_4$

Tetra chloro methane

(2.) Combustion of methane :- [oxidation of methane] :- methane burns in air or oxygen to give carbondioxide and water along with evolution of heat energy.

$CH_4 + 2O_2 \xrightarrow{\Delta} CO_2 + 2H_2O + \text{Heat}$

(3) Action of steam :- [water gas] :- When a mixture of methane gas and steam is passed over heated nickel at 800°C then a mixture of carbon monoxide and hydrogen is formed which is called water gas.

$CH_4 + H_2O \xrightarrow[Ni]{800°C} \underbrace{CO + H_2}_{\text{water}}$

$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$

$2NaOH + SO_2 \longrightarrow Na_2SO_3 + H_2O$

(#) Properties of ethene [ethylene] :-

(1) Addition Reaction :-

(I) Addition of hydrogen :- when ethene gas is mixed with hydrogen and mixture is passed over heated nickel at about (200-800)°C then ethane is obtained.

$$\underset{\text{ethene}}{CH_2 = CH_2} + H_2 \xrightarrow[Ni]{(200-300)^\circ C} \underset{\text{ethane}}{CH_3 - CH_3}$$

(II) Addition of bromine water :- when ethene is treated with bromine water in presence of CCl_4 then 1,2-dibromo ethene is obtained.

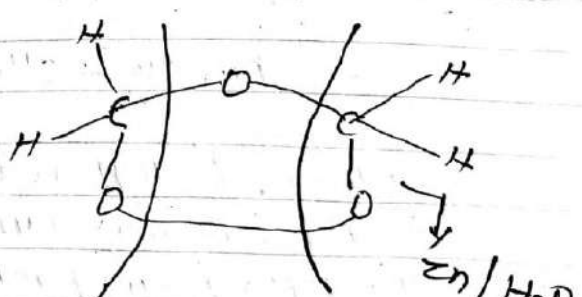
$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} \underset{CH_2}{Br} - \underset{CH_2}{Br}$$

1,2 dibromo ethane

(III) Addition of ozone [ozonolysis] :-

when ethene is treated with ozone then ozonide is obtained which on hydrolysis with Zn/H_2O gives methanal [formaldehyde]

$$CH_2 = CH_2 + O_3 \longrightarrow$$



ozonide

$$2H - \overset{O}{\overset{\|}{C}} - H + H_2O_2$$

methanol

(IV) Addition of Hx [HCl, HBr, HI] :-

Hx is add to ethene to give halo Alkane

$$CH_2 = CH_2 + H_2O + [O] \xrightarrow{HCl} CH_3 - CH_2 - Cl$$

Chloro ethane

TOTOI

(2) Oxidation of ethene [Baeyer's test] :- Alkaline potassium permanganate [$KMnO_4 / OH^-$] is called Baeyer's reagent. It is pink coloured solution.

When ethene is passed through alkaline $KMnO_4$, then pink colour of solution is discharged because ethene is oxidised to ethene, 1, 2 - diol

$$2KMnO_4 + 2KOH \longrightarrow 2K_2MnO_4 + H_2O + [O]$$

$$CH_2 = CH_2 + H_2O + [O] \longrightarrow \underset{\text{ethene - 1, 2 - diol}}{\overset{OH \quad OH}{CH_2 - CH_2}}$$

(3) Polymerisation :- When a large number of ethene gas is heated at high temperature and pressure then they polymerises to give polyethene.

$$n\ CH_2 = CH_2 \xrightarrow[\text{and pressure}]{\text{high temp}^r} -(CH_2 - CH_2 - CH_2 - CH_2)-$$

polyethene

(#) Use of ethene [ethylene] :-

(I) It is used for manufacture of alcohol

(II) It is used for manufacture of polymers eg :- polythene polyvinyl chloride

(III) Oxy - ethylene flame is used for welding the metal.

VoVoI

(#) MARKOVNIKOV'S RULES :- When an assymetrical regent like H_X [HCl, HBr, and HI] is added to assymetrical alkene then positive part of H_X [i.e H^+] goes to that doubly bonded C-atom which already contains highers number of hydrogen atom to give major products.

$$CH_3-CH=CH_2 + HCl \longrightarrow CH_3-\underset{Cl}{CH}-CH_3$$

propene — 2-chloro propane.

VoVoI

(#) ANTIMARKOVNIKOV'S RULES [PEROXIDE EFFECT] :- When assymetrical reagent specially H_{Br} is subjected for addition to assymetrical alkene in presence of organic peroxide [R-O-OR] then positive part of H_{Br} [i.e H^+] goes to that doubly bonded carbon atom which already contain less number of hydrogen atoms to gives major product. this effect is called peroxide effects.

(85) Aluminium

* physical properties of Aluminium:

(i) It is a bluish white metal its density is 2.7 g/cm³

(ii) It is malleable and ductile.

(iii) It is a good conductor of heat and electricity

(iv) It melts at 933 K and boil at 2723 K in absence of air.

* Chemical properties of Aluminium:

(i) Reaction with air (Oxygen):- When Aluminium is heated to redness it burns with a white light flame to give Aluminium oxide.

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

(ii) Reaction with water:- Aluminium decomposes on boiling with water to liberate hydrogen gas along with aluminium hydroxide.

$$2Al + 6H_2O \xrightarrow{\text{boiling}} 2Al(OH)_3 + 3H_2\uparrow$$

(iii) Reaction with nitrogen:- on heating with nitrogen it form Aluminium nitride

$$2Al + N_2 \xrightarrow{\Delta} 2AlN$$

(Aluminium nitride)

Reaction with halogen (Cl, Br, I):- When halogen is passed over heated Aluminium then Aluminium halide is formed.

$2Al + 3Cl_2 \longrightarrow 2AlCl_3$

$2Al + 3Br_2 \longrightarrow 2AlBr_3$

(c) Reaction with acid (HCl, H_2SO_4):-

→ Aluminium reacts with dil. HCl to give hydrogen gas.

$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2\uparrow$

(b) → Aluminium does not react with dil. H_2SO_4 but it reacts with hot and conc. H_2SO_4 to give sulphur dioxide and Aluminium sulphate.

$2Al + 6H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O + 3SO_2\uparrow$

(d) Reaction with alkali (caustic soda NaOH).

→ It react with hot caustic soda to give sodium meta aluminium along with evolution of hydrogen.

$2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2\uparrow$

(Sodium meta aluminate)

(e) Reaction with carbon and sulphur:-

→ When Aluminium is heated with carbon and sulphur separately then Aluminium carbide and Aluminium sulphide are formed respectively.

(i) $4Al + 3C \xrightarrow{\Delta} Al_4C_3$ (Al. carbide)

(ii) $2Al + 3S \longrightarrow Al_2S_3$ (Al. sulphide)

(8) Reducing nature of Aluminium.

→ Aluminium reduces ferric oxide and chromium ox to corresponding metal. This process is called Aluminium thermite process

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$
(Ferric oxide)

$Cr_2O_3 + 2Al \rightarrow 2Cr + Al_2O_3$
(Chromium oxide)

Uses of Aluminium.

(i) It is used for making coins and alloys

(ii) It is used for making aeroplane parts and kitchen utensils.

(iii) It is used for making electric wire window fram beer kegs. etc

coinage metal

coinage metal:- copper (Cu), silver (Ag) and gold (Au) are called coinage metal because of their use in making coins. These are the elements of group 13 (II) of periodic table.

General characteristics of coinage metals

1. coinage metals occur in free state as well as combined state.
2. They are hard and posses high melting and boiling point.
3. They are very good conductor of heat and electricity.
4. Since the electric configuration of these metal is (n-1)d^{10} ns^1. Hence they have only one electron in its outermost orbit therefore coinage metal resemble with alkali metal of group IA.
5. Coinage metal exhibit variable oxidation state because they lose one or more electron from peh ultimate d- orbital along with s- electron of valence shell since the energy difference between ns and (n-1)d orbital is not so much.
6. Coinage metals have different degree of reactivity Cu is readily acted by acid Ag less readily and Au is least reactive with acid.
7. All coinage metal form complex

$[Cu(NH_3)_4]SO_4$	$Ag(NH_3)_2]Cl$
Tetramine copper sulphate	diammine silver chloride

$K[Au(CN)_2]$ potassium dicyanoaurate

(8) Since the penultimate shell of coinage metals contain 18 electrons, so their properties are quite different from alkali metal eg:- alkali metals are highly reactive where as coinage metal are relatively inert Thus metals Ag and Au are also called Nobel metals.

copper

* physical properties of copper.
→ It is reddish brown coloured metals.
→ It is malleable and ductile.
→ It is good conductor of heat and electricity.
→ Its m.p is 1083°C and b.p is 2582°C
→ Its specific gravity is 8.95.

* Chemical properties of copper.
(1) Reaction with air (oxygen)
(a) when copper is heated with air below 1100°C then black oxide of copper i.e cupric oxide is formed.

$$2Cu + O_2 \xrightarrow[\Delta]{\text{below } 1100^\circ C} 2CuO$$

cupric oxide

(b) when copper is heated with air above 1100°C then red oxide of copper i.e cuprous oxide is formed.

$$4Cu + O_2 \xrightarrow[\Delta]{\text{above } 1100^\circ C} 2Cu_2O$$

Cuprous oxide.

(c) when copper is exposed to moist air then it reacts with atmospheric oxygen, moisture and CO_2 to form green basic carbonate.

$$2Cu + O_2 + H_2O + CO_2 \rightarrow [CuCO_3 \cdot Cu(OH)_2]$$

Basic copper carbonate (green).

(2) Reaction with water } — No reaction
(3) Reaction with alkali }

(4) Reaction with nitric acid :- copper reacts with 5.1 HNO_3 to give nitric oxide whereas with conc. HNO_3 to give nitrogen dioxide.

$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$
(dil.)

$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$
(conc.)

(5) Reaction with HCl and H_2SO_4:-

→ Copper doesn't react with cold and dilute HCl and H_2SO_4 but it reacts with warm and dilute HCl and H_2SO_4 in presence of oxygen to give copper chloride and copper sulphate respectively.

$2Cu + 4HCl + O_2 \longrightarrow 2CuCl_2 + 2H_2O$

$2Cu + 2H_2SO_4 + O_2 \longrightarrow 2CuSO_4 + 2H_2O$

But when copper is heated with hot and conc. H_2SO_4 then sulphur dioxide gas is formed.

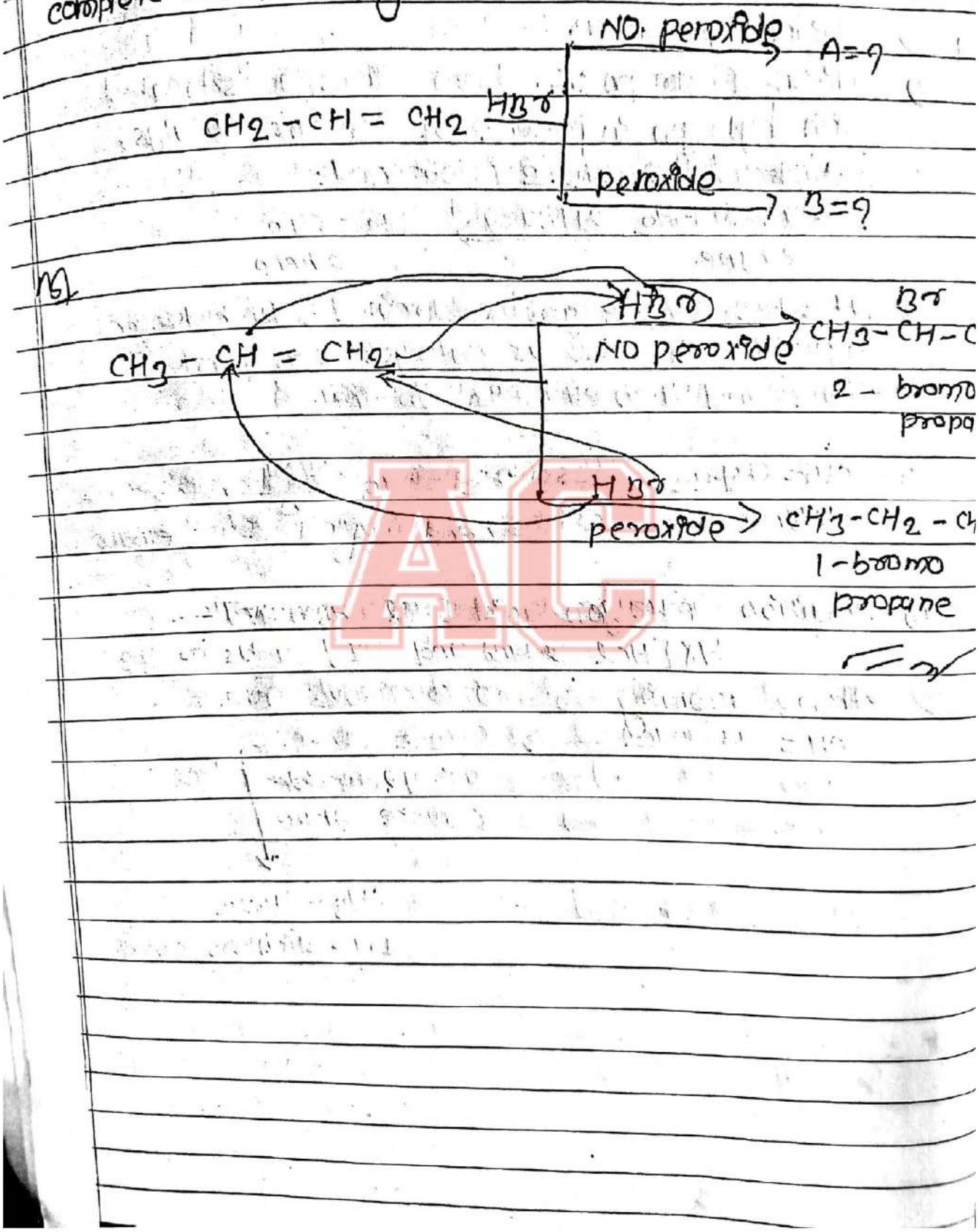
$Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2\uparrow$
(conc.)

(6) Reaction with water:- water at ordinary temperature has no action on copper but at highly temperature Cu reacts with water on boiling gives hydrogen gas.

$Cu + H_2O \xrightarrow[\text{(boiling)}]{\text{steam}} CuO + H_2\uparrow$

(92)

Complete the following reaction



* properties of ethyl [Acetylene] gas.

① Addition of reaction.

ⓐ Addition of hydrogen :- when ethyl gas is treated with hydrogen in presence of Lindlar's catalyst [Pd/BaSO4] the ethene is obtained.

$$CH \equiv CH + H_2 \xrightarrow{Pd/BaSO_4} CH_2 = CH_2$$

ethyne. ethene

But when ethyne gas is treated with hydrogen in presence of Nickel as catalysis then first ethene and then ethane is obtained.

$$CH \equiv CH + H_2 \xrightarrow[\Delta]{Ni} CH_2 = CH_2 \xrightarrow[\Delta]{H_2/Ni} CH_3 - CH_3$$

ethyne ethene ethane

ⓑ Addition of Haigen acid [HCl, HBr, HI] :-
HX [HCl or HBr and HI] adds to the ethyne according to markovnikov's rule.

$$CH \equiv CH + HCl \longrightarrow CH_2 = CH - Cl \xrightarrow{HCl} CH_3 - CHCl_2$$

vinyl chloride (chloro ethene) → 1,1-dichloro ethane

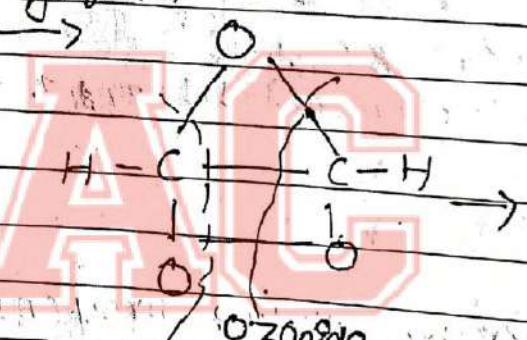
) Addition of water :- Addition of water to ethyne take place in presence of 42% H_2SO_4 and 1% $HgSO_4$ at 60° to form ethenol which tauto merises to form ethanol

$$CH \equiv CH + H_2O \xrightarrow[1\% HgSO_4]{42\% H_2SO_4} H-C=C-H \rightarrow CH_3-C-H$$

(ethenol → ethanal)

Addition of ozone :- Ethyne on ozonolysis gives ozonide which on hydrolysis gives glyoxal.

$$CH \equiv CH + O_3 \longrightarrow$$



ozonide → $H-C(=O)-C(=O)-H$ glyoxal (ethane-1,2-dial)

) Addition of Haugene [Cl_2, Br_2].

When chlorine and ethyne are brought into contact in presence of sunlight then a flame is produced which gives carbon and hydrochloric acid.

$$CH \equiv CH + Cl_2 \xrightarrow{\text{sunlight}} 2C + 2HCl$$

But in dark, chlorine or bromine adds to ethyne gives first 1,2-dihalo ethene and then 1,1,2,2-tetra halo ethane.

$CH \equiv CH + Br_2 \xrightarrow{\text{dark}} \underset{\text{1,2-dibromo ethene}}{CHBr=CHBr} \xrightarrow{Br_2} \underset{\text{1,1,2,2-tetra bromo ethane}}{CHBr_2-CHBr_2}$

$CH \equiv CH + Cl_2 \longrightarrow \underset{\text{1,2-dichloro ethene}}{CHCl=CHCl} \xrightarrow{Cl_2} \underset{\text{1,1,2,2-tetra chloro ethane.}}{CHCl_2-CHCl_2}$

(v) Oxidation by alkaline $KMnO_4$ (Baeyer's test):—
Ethyl on oxidation with alkaline $KMnO_4$ (Baeyer's reagent) to give oxalic acid

$2KMnO_4 + 2KOH \longrightarrow 2K_2MnO_4 + H_2O + [O]$

$H-C \equiv CH + 4[O] \longrightarrow \underset{COOH}{\overset{COOH}{|}}$ (oxalic acid)

(3) polymerisation:— when ethyne gas is passed through a red hot copper tube, three molecules of ethyne combine to form a molecule of benzene

$3CH \equiv CH \xrightarrow{\text{red hot}} C_6H_6$ (benzene)

Define pollution:- Any change which adversely influences the biological and non-biological equilibrium of environment is called pollution there are many types of pollution such as air pollution, water pollution soil pollution etc.

Why the water containing soluble salts of ca and mg [hard water] doesnot provide lather with soap?

⇒ Soap are sodium and potassium salts of higher fatty acids such as stearic acid, palmitic acid oleic acid etc calcium and magnesium ion present in hard water combine with anion of soap to form white curdy precipitate of calcium stearate.

$$2\,C_{17}H_{35}COONa + CaCl_2 \rightarrow (C_{17}H_{35}COO)_2Ca\downarrow + 2NaCl$$

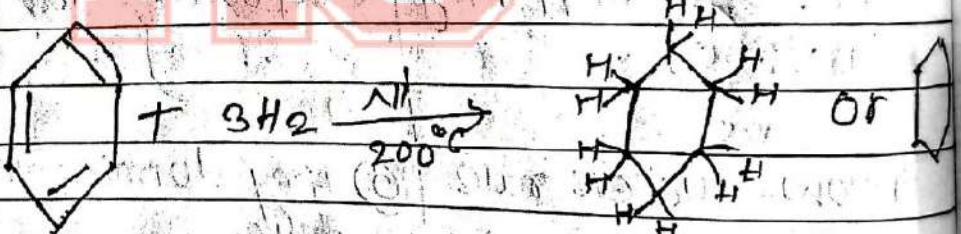
soap (sodium stearate) | present in hard water | (white curdy ppt)

* physical properties of benzene:-
1. It is a colourless liquid
2. B.P = 80.4°C
3. It is insoluble in water but soluble in organic solvent like alcohol, ether etc.
4. It is highly inflammable and also toxic.

* chemical properties of benzene.

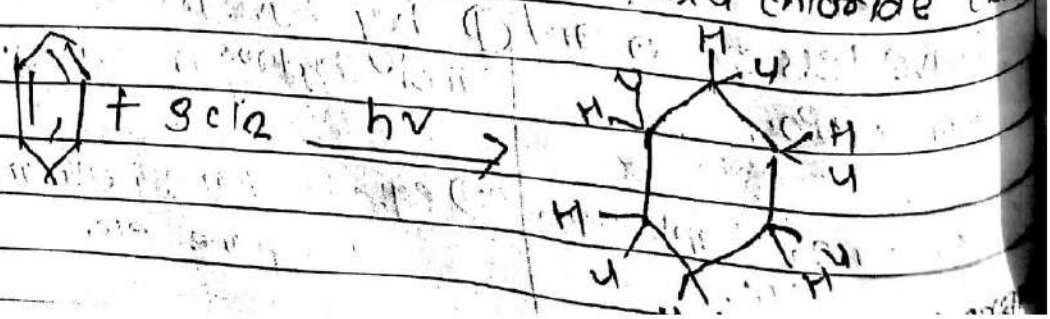
1. Addition reaction

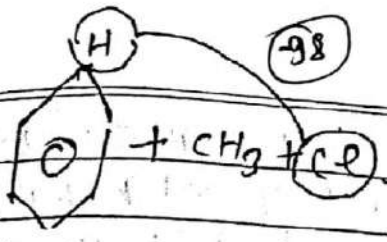
(i) Addition of hydrogen:- When hydrogen gas is passed to benzene ring in presence of Nickel catalyst at about 200°C then cyclohexane is obtained.

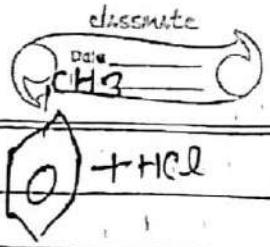


cyclohexene

(ii) Addition of halogen:
Benzene adds three molecule of chlorine in presence of UV light to give benzene Hexa chloride (BHC)

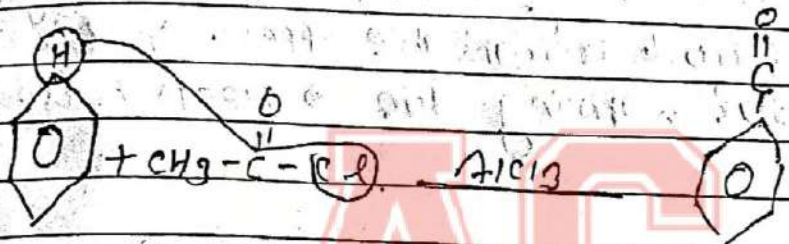


eg:- 



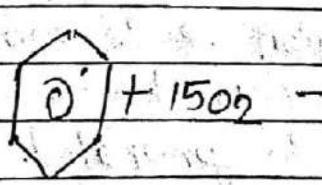
methyl benzene
Toulence.

(b) Friedel Craft's acylation :- when benzene is treated with Acetyl chloride in presence of $AlCl_3$ the acylated benzene is obtained.



Acetophenanie.

(3) combustion of benzene :- Benzene burns in air to give sooty flame.



use of benzene:

(1) It is used in preparation of BHC.
(2) It is used as solvents for fats and oils.
(3) It is used as fuel in the name of benzol
(4) It is used as starting material for the preparation of many other aromatic compounds.

Q How does CO and CO_2 are harmful for human body?

→ Carbonmonoxide attacks on circulatory media of human it combines with haemoglobin of blood to produce Carboxhaemoglobin which reduces oxygen carrying capacity of haemoglobin and due to which it causes Nervous disorders The direct effect of this gas is headache difficult in breathing, dizzine heart palpitation etc carbondioxide causes difficulty in breathing when present in large amount. The most remarkable effect of this gas is global warming due to green house effect.

Q. What is aqua-region? How does it dissolves nobel metal?

→ A mixture containing 1 parts by volume of conc. HNO_3 and 3 parts by volume of conc. HCl is known as aqua-region. It is able to dissolve nobel metal like Au, Pt etc because Nacent Chlorine is generated.

$$HNO_3 + 3HCl \rightarrow NaCl + 2H_2O + 2[Cl]$$

$$Au + 3[Cl] \rightarrow AuCl_3$$

$$Pt + 4[Cl] \rightarrow PtCl_4$$

Date
Page

* Difference between aliphatic and aromatic compounds.

Aromatic compound	Aliphatic compounds.
(1) They contain an aromatic ring or benzene ring.	(1) They do not contain an aromatic ring or benzene ring.
(2) They need special conditions to react.	(2) They react more freely and easily.
(3) They are always cyclic	(3) They are linear as well as cyclic.
(4) They are always unsaturated	(4) They are saturated as well as unsaturated.
(5) They are conjugated due to presence of alternating double bonds.	(5) The majority of aliphatic compounds are not conjugated
(6) They follow Hucker's rule	(6) They do not follow Hucker's rule.
(7) They have pleasent smell.	(7) They have no pleasent smell.
(8) They burns with sooty flame	(8) They burns with non-sooty flame.
(9) They have less carbon and hydrogen ratio.	(9) They have more carbon and hydrogen ratio.
(10) eg:- Benzene, Naphthalene etc.	(10) eg:- methane, ethane, propane etc.

dassmate Date Page

* characteristics of aromatic compound.

(1) Aromatic compounds are cylic compounds having five six, or seven membered rings.

(2) They are highly unsaturated Although these do not undergo addition reaction but they give substitution reaction

(3) The percentage of carbon in aromatic compound is high so, they burns with shooty flame.

(4) Aromatic amino compounds are less reactive than aliphatic amines.

(5) Aromatic compounds are stable and possess low value of hydrogenation than expected.

(6) Aromatic compounds follow Huckel rule of aromaticity.

* Huckel's rule of aromaticity

→ According to this rule, a planar cyclic system containing $(4n+2)\pi$-electrons is an aromatic system. For planar system all the carbon atoms of the ring should be sp^2 hybridised

In $(4n+2)\pi$-electrons, $n = 0, 1, 2, 3, 4 \ldots$

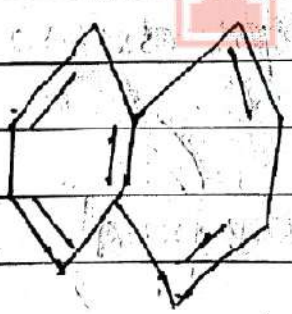
If $n=0$, then $(4n+2)\pi$-electron $= (4\times0+2)\pi$ electron
$= 2\pi$-electron

If $n=1$ then $(4\times1+2)$ π- electron = 6 π-electron
If $n=2$ then $(4\times2+2)$ π-electron = 10π- electron
If $n=3$ then $(4\times3+2)$ π- electron = 14π- electron
In this way, the cyclic planar system as containing 2π, 6π, 10π electron are known as aromatic system.

eg:- (i)

No. of π-electron = 6π-electron
Hence this compound is around.

(ii)



→ Naphthalene

No. of π-electron = 10π-electron. It follows Hu rule Hence it is aromatic.

(1) Hydrogen chloride is treated with lead acetate?

(2) Calcium carbonate is heated

→ When calcium carbonate ($CaCO_3$) or lime stone ($CaCO_3$) is heated breaks down to form calcium oxide and carbon dioxide

$$CaCO_3 \xrightarrow{\Delta} CaO + O_2$$

(3) Zinc react with dilute nitric acid.

→ When zinc react with dil. HNO_3 then zinc nitrate and N_2O is formed

$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + N_2O + 5H_2O$$

(4) Sodium is heated with ammonia.

→ When sodium is heated with ammonia then sodamide is formed.

$$2Na + NH_3 \xrightarrow{\Delta} 2NaNH_2 + H_2$$
(sodamide)

(5) Calcium is heated with nitrogen?

→ When calcium is heated with nitrogen then calcium nitratde is obtained.

$$3Ca + N_2 \xrightarrow{\Delta} Ca_3N_2$$

(6) Aluminium is treated with concentrated sulphuric acid.

→ When aluminium is treated with conc. H_2SO_4 to give sulphur dioxide.

$$2Al + 6\,H_2SO_4 \text{ (conc.)} \longrightarrow Al_2(SO_4)_3 + 6H_2O + 3SO_2\uparrow$$

hydrogen chloride is passed into potassium peramagnate?

⇒ when hydrogen is passed into potassium permaganate ($KMnO_4$) the colour of $KMnO_4$ is changed into colourless.

$$2KMnO_4 + 4HCl \longrightarrow 2KCl + MnCl_2 + H_2O + O$$
$$4HCl + O \longrightarrow H_2O + Cl_2 \uparrow \times 6$$

$$2KMnO_4 + 16HCl \longrightarrow 2KCl + MnCl_2 + 6Cl_2 + 8H_2O$$
(colourless)

8) zinc metal is treated with conc. nitric acid.

⇒ zinc react with conc. nitric acid then to give NO_2 is formed

$$Zn + 4HNO_3 \longrightarrow Zn(NO_3)_2 + 4H_2O + 2NO$$

(9) H_2S gas is passed over acidified $KMnO_4$ solution ?

⇒ H_2S gas is passed over acidified potassium peramagnate solution The pink colour of solution is changed to colourless

$$KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$
$$H_2S + [O] \longrightarrow H_2O + S \uparrow \times 5$$

$$2KMnO_4 + 8H_2SO_4 + 5H_2S \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$$

(10) sodium metal is exposed to air.

⇒ when sodium metal is exposed to air then it reacts with oxygen, CO_2 and moisture to form various products specially a layer of carbonate is formed on the surface of metal. that's why ~~alkali~~

$$Na_2O + H_2O \longrightarrow 2NaOH$$

(11) Hydrochloric acid react with silver nitrate solution

⇒ HCl react with silver nitrate solution to give white ppt of AgCl which is highly soluble in NH_4OH solution

$$HCl + AgNO_3 \longrightarrow AgCl \downarrow + HNO_3$$
$$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$$
(diammine silver chloride)

(12) ethyne gas is passed through heated red hot iron tube.

⇒ When ethyne gas is passed through heated red hot iron then benzene is formed

$$3HC \equiv CH \xrightarrow{\text{Iron tube}} C_6H_6$$

(Benzene)

(13) Ethylene react with acidic potassium permanganate solution.

⇒ When ethylene react with acidic potassium permanganate solution methonic acid is formed.

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$CH_2 = CH_2 + 4[O] \longrightarrow 2HCOOH$$

Methonic acid.

(14) Acetylene is passed over heated sodium.

⇒ When acetylene is passed over heated sodium, sodium acetylide is formed.

$$CH \equiv CH + 2Na \longrightarrow NaC \equiv CNa + H_2$$

(Sodium acetylide.)

(15) Iron is treated with conc. H_2SO_4 acid.

⇒ When Iron react with conc. H_2SO_4 acid it gives ferric salt and H_2SO_4

$$2Fe + 2H_2SO_4 \longrightarrow Fe(SO_4)_3 + SO_2 + H_2O$$

(conc.)

(16) Lead is treated with acetic acid.

⇒ Lead dissolved in acetic acid in presence of air to form lead acetate.

$$2Pb + 4CH_3COOH + O_2 \rightarrow 2(CH_3COO)Pb + 2H_2O$$

(Lead acceate)

(17) Aluminium is treated with dil. HCl.

⇒ $2Al + 6HCl \xrightarrow{\text{(dil.)}} 2AlCl_3 + 3H_2\uparrow$

When aluminium is treated with dil. HCl then it give hydrogen gas.

(18) conc. sulphuric acid is dropped over paper.

⇒ paper is formed from cellulose. When conc. sulphuric acid is dropped over cellulose, cellulose lose water molecules and get dehydrated.

(19) A gas obtained by dropping conc. HCl over the crystals of $KMnO_4$ is passed through hot and conc. caustic soda.

⇒ When conc. HCl acid is dropped over the crystals of $KMnO_4$ chlorine gas is evolved.

$$2KMnO_4 + 16\,HCl \xrightarrow{(conc.)} 2KCl + 2MnCl_2 + 8H_2O$$

chlorine gas when passed through hot and conc. ~~soda~~ caustic soda solution; sodium chlorate is obtained.

$$3Cl_2 + 6NaOH \longrightarrow NaClO_3 + 5NaCl_2 + 3H_2O$$

(20) Ammonia gas is passed over heated cupric oxide.

⇒ When ammonia gas is passed over heated cupric oxide copper and ammonia gas are formed.

$$3NH_3 + 3CuO \xrightarrow{\Delta} 3Cu + 3H_2O + N_2$$

(21) A gas obtained by dropping dil. H_2SO_4 over fes is passed through aqueous solution of sulphur dioxide.

⇒ Hydrogen sulphide gas is obtained by dropping dil. H_2SO_4 over fes

$$dil.\ H_2SO_4 + fes \longrightarrow feSO_4 + H_2S\uparrow$$

When H_2S gas is passed through SO_2, it gives sulphur and water. $2H_2S + SO_2 \longrightarrow 3S + H_2O$

(22) zinc is treated with very dilute nitric acid solution.

⇒ When zinc is treated with very dilute nitric acid solution ammonium nitrate is obtained.

$$4Zn + 10\,HNO_3 \longrightarrow 4Zn(NO_3)_2 + NH_4(NO_3)_2 + 3H_2O$$