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CLASS12

Solutions and Electrochemistry

Question :1

The density of a 0.438 M solution of potassium chromate at 298 K is 1.063 g cm^{-3}. Calculate the vapour pressure of water above this solution. Given : P^0 (water) = 23.79 mm Hg.

(23.22 mm Hg)

Question 2

Determine the ΔH in kJ for the process of converting 36.0 grams of ice from -10.0°C to liquid water at 0.00°C. The ΔH_{fusion} of water is 6.02 kJ/mole, the molecular weight of water = 18.0, and the specific heat of ice is 2.01 $Jg^{-1}°C^{-1}$, and the specific heat of liquid water is 4.18 $Jg^{-1}°C^{-1}$.

Question :3

10.0 grams of a nonvolatile, non electrolyte solute are dissolved in 180 grams of water. The freezing point of the solution is -2.07°C. The mole fraction of the solute is 0.01961 at 100°C. K_f of water is 1.86°C/molal. Calculate the vapor pressure of the solution, in atmospheres, at 100°C

Question :4

2.0 moles of sugar are dissolved in 40.0 moles of water what is the mole fraction of sugar in the solution

Question: 5

5.60 g of urea (MW = 60.0), a non-electrolyte, is dissolved in 350 g water (MW = 18.0) to give a solution with a volume of 357 mL. The temperature of the solution is 25.0°C. The vapor pressure of water at 25.0°C is 23.80 mm Hg.what will be the vapor pressure of the urea solution at 25.0°C in mm Hg

Question: 6

Calculate the boiling point of an aqueous solution of sodium sulfate, Na_2SO_4 (M.W.= 142) that contains 50.0 grams of Na_2SO_4 dissolved in 200 grams of water. Assume ideal behavior. (K_b of water = 0.512°C)

Question :7

Assuming ideal behavior, arrange the following aqueous solutions in order of *decreasing freezing point*. 0.1m urea ,0.1m NaCl ,0.05m $CaCl_2$, 0.05m HF will be ?

Question: 8.

Consider the following:

25.0 milliliters of an aqueous solution of hydrochloric acid, HCl contains 11.0 grams of HCl and 18.7 grams of H_2O. Calculate the molality of the HCl solution.

Question :9

Calculate the weight in grams of magnesium chloride, $MgCl_2$ (molecular wt.= 95.3) that should be added to 2500 grams of water to give a solution that boils at 101.00°C. Assume ideal behavior. (K_b of water = 0.512°C/molal)

Question:10

Beaker A contains 50 mL of 0.10 M sugar solution and Beaker B contains 50 mL of a 0.10M NaCl solution. The two beakers are placed in a closed container at 298K. When equilibrium is established, liquid is present in both beakers. Which of the following is true?

a) the volume of both solutions has increased.
b) the volume of both solutions has decreased.
c) the volume of the NaCl solution has decreased.
d) the volume of the NaCl solution has increased.
e) no observable change

Question:11

The vapour pressures of ethanol and methanol are 44.5 mm and 88.7 mm Hg respectively. An ideal solution is formed at the same temperature by mixing 60 g of ethanol with 40 g of methanol. Calculate the total vapour pressure for solution and the mole fraction of methanol in the vapour. (Ans= 0.6563)

Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.3 S m^{-1}. If resistance of the 0.4 M solution of the same electrolyte is 260 Ω, what will be its molar conductivity ?

Question:12

E_1, E_2 and E_3 are the emf values of the three galvanic cells respectively.

(a) $Zn \,|\, Zn^{+2}_{1M} \,||\, Cu^{+2}_{0.1M} \,|\, Cu$ **(b)** $Zn \,|\, Zn^{+2}_{1M} \,||\, Cu^{+2}_{1M} \,|\, Cu$ **(c)** $Zn \,|\, Zn^{+2}_{0.1M} \,||\, Cu^{+2}_{1M} \,|\, Cu$

Arrange E_1, E_2 and E_3 in increasing order

Question:13

The standard emf of galvanic cell involving 3 moles of electrons in its redox reaction is 0.59 V. what will be the equilibrium constant for the reaction of the cell

Question:14

9.65 C of electric current is passed through fused anhydrous magnesium chloride. The magnesium metal thus, obtained is completely converted into a Grignard reagent. What will be the number of moles of the Grignard reagent obtained

Question:15

What will be the potential of a hydrogen electrode at pH = 11

Question:16

For the reduction of silver ions with copper metal the standard cell potential was found to be +0.46V at 25°C. what will be the value of standard Gibbs energy, $\Delta G°$ ($F = 96500$ C mol^{-1})

Question:17

The Gibbs energy for the decomposition of Al_2O_3 at 500°C is as follows:

$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3} Al + O_2, \quad \Delta_rG = +966$ kJ mol^{-1}

What is the minimum potential difference needed for electrolytic reduction of Al_2O_3 at 500°C

Question:18

Resistance of a conductivity cell filled with a solution of an electrolyte of concentration 0.1 M is 100 Ω. The conductivity of this solution is 1.29 S m^{-1}. Resistance of the same cell when filled with 0.2 M of the same solution is 520 Ω. The molar conductivity of 0.02 M solution of the electrolyte will be **--------**

Question:19

Wich of the following has the highest electrical conductivity

0.1 M acetic acid, 0.1 M chloroacetic acid , 0.1 M fluoroacetic acid , 0.1 M difluoroacetic acid

Question:20

Saturated solution of KNO_3 is used to make 'salt bridge' because

a) velocity of K^+ is greater than that of NO_3^{-1}
b) velocity of $NO_3^{□}$ is greater than that of K^+
c) velocity of both K^+ and NO_3^{-1} are nearly the same
d) KNO_3 is highly soluble in water

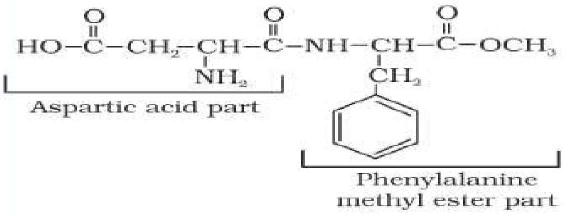
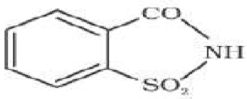
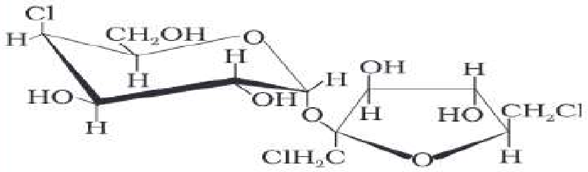
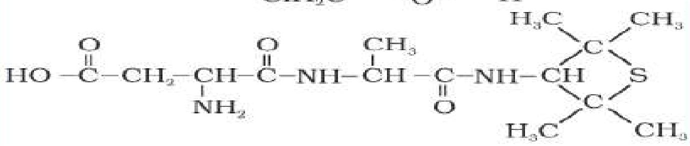
CHEMISTRY IN EVERYDAY LIFE

Revision Notes on Chemistry in Everyday Life:

Drugs:

Drugs	Description	Examples
Analgesics	Relieve or decreases the pain without causing unconsciousness. These are also known as “Pain Killers”.	Asprin, Analgin, seridon etc.
Tranquizers/ Antidepressants	These are used for treatment of mental diseases.	Equanil, Calmpose, Tofranil, Barbituric Acid, Cocaine and Iproniazids etc..
Antiseptics	They are applied on living tissues to kill or prevent the growth of micro-organisms.	Dettol, Savlon and Acriflavin etc.
Disinfectants	These are applied on floor, instruments or wall etc. to kill microorganisms but are not safe for application on living tissues.	Phenol
Antimicrobial	These are use to either kill (bactericidal) or stop the growth of diseases causing microorganisms. (bacteriostatic).	Salvarsan, Prontosil, Sulphanilamide, Bacteriostatic Drugs: Erythromycin, Tetracycline, Chloramphenicol Bactericidal Drugs: Ofloxacin, Aminoglycosides.
Antipyretics	These drugs bring down the body temperature during fever.	Paracetamol, Analgin and Novalgin.
Antifertility Drugs	Prevent pregnancy in women by controlling menstrual cycle and ovulation.	Norethindrone & Mestranol
Antacids	Used for the treatment of acidity. Metal hydroxides are generally used as antacids.	Eno, & Milk of magnesia [$Mg(OH)_2$]
Antibiotics	These are the chemical substances which are produced by micro –organisms like bacteria and fungi and are able to kill or stop the growth of pathogenic microorganisms.	Penicillin, Amoxicillin and Ampicillin.
Antihistamins	These drugs compete with histamine for finding sites of receptors and thus interfere with the natural action of histamine.	Brompheniramine & Terfenadine

Artificial Sweetening Agents

Artificial sweetener	Structural formula	Sweetness value in comparison to cane sugar
Aspartame		100
Saccharin		550
Sucralose		600
Alitame		2000

Food preservatives:

These are the chemical substances which prevent undesirable changes in flavor, colour, texture of the food during processing and storage of food.

Examples, Table salt, sugar, vegetable oils, sodium benzoate (C_6H_5COONa) etc

Cleansing Agents

Soaps:

Sodium or potassium salts of fatty acids.

$$\begin{array}{l} CH_2-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{35} \\ | \\ CH-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{35} \\ | \\ CH_2-O-\overset{O}{\overset{\|}{C}}-C_{17}H_{35} \end{array} + 3NaOH \longrightarrow 3C_{17}H_{35}COONa + \begin{array}{l} CH_2-OH \\ | \\ CH-OH \\ | \\ CH_2-OH \end{array}$$

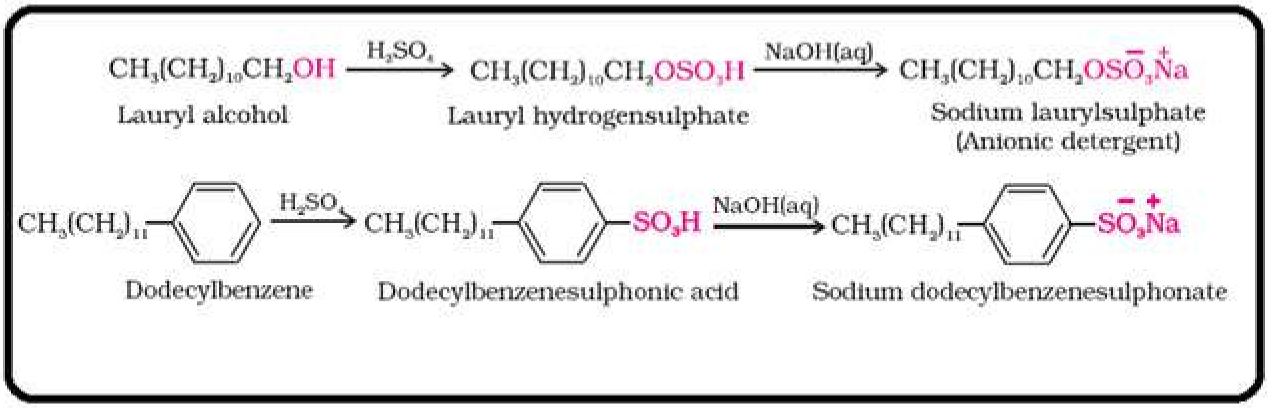
Glyceryl ester of stearic acid (Fat) | Sodium hydroxide | Sodium stearate | Glycerol (or Glycerine)

Soaps do not work with hard water as it forms insoluble salts with calcium and magnesium ions present in hard water.

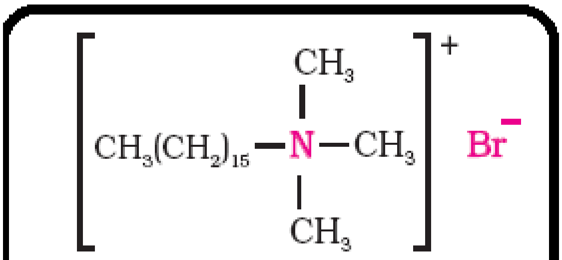
Detergents:

Sodium or potassium salts of sulphonic acids. These can work with hard water also.

Anionic Detergents: Sodium Slats of sulphonated long chain alcohols or hydrocarbons



Cationic Detergents: Quaternary ammonium salts of ammines with acetates, chlorates or bromates.



Cetyltrimethyl ammonium bromide

Non-Ionic Detergents: Do not contain any ion.

$$CH_3(CH_2)_{16}COOH + HO(CH_2CH_2O)_nCH_2CH_2OH \xrightarrow{-H_2O} CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$$

Stearic acid   Polyethyleneglycol

General Principles & Processes of Isolation of Metals

Types of Ores:

Ores may be divided into four groups

- **Native Ores:** These ores contain the metal in free state eg. Silver gold etc. These are usually formed in the company of rock or alluvial impurities like clay, sand etc.
- **Oxidised Ores**:These ores consist of oxides or oxysalts (eg. carbonates, phosphate) and silicate of metal. Important oxide ore includes, Fe_2O_3, $Al_2O_3.2H_2O$ etc. and important cabonate ores are limestone ($CaCO_3$), Calamine ($ZnCO_3$) etc.
- **Sulphurised Ores**: These ores consist of sulfides of metals like iron, lead, mercury etc. Examples are iron pyrites (FeS2). galena (PbS), Cinnabar (HgS)
- **Halide ores**: Metallic halides are very few in nature. Chlorides are most common examples include horn silver (AgCl) carnallite KCl. $MgCl_2.6H_2O$ and fluorspar (CaF_2) etc.

Metallurgy:

It is the process of extracting a metal from its ores. The following operations are carried out for obtaining the metal in the pure form.

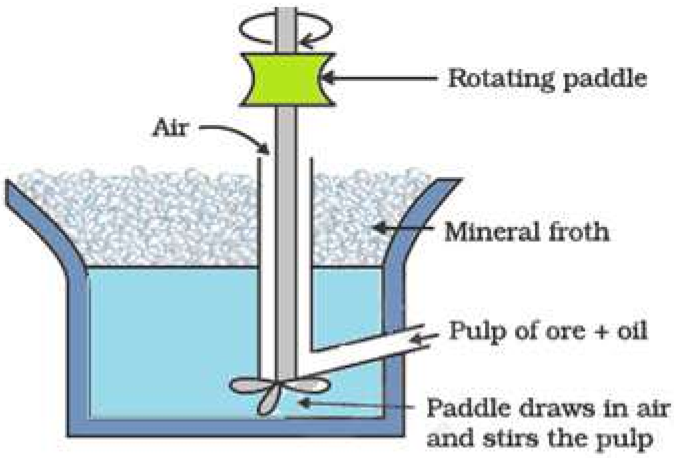
- Crushing of the ore
- Dressing or concentration of the ore.
- Reduction of metal.
- Purification or refining of the metal

Concentration

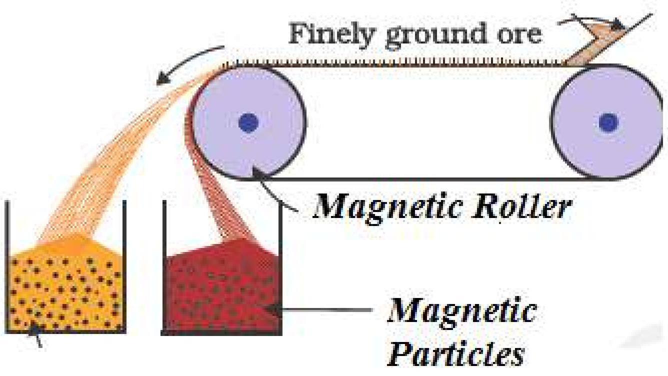
Physical Method

Gravity separation: The powdered ores is agitated with water or washed with a running stream of water. The heavy ore particles of sand, clay etc. are washed away.

Froth Floatation Process*:* The finely divided ore is introduced into water containing small quantity of oil (e.g. Pine Oil). The mixture is agitated violently with air a froth is formed which carries away along with it the metallic particles on account of the surface tension forces. The froth is transferred to another bath where gangue-free ore settles down**.**



Electro Magnetic Separator:. A magnetic separator consists of a belt moving over two rollers, one of which is magnetic. The powdered ore is dropped on the belt at the other end. Magnetic portion of the ore is attracted by the magnetic roller and falls near to the roller while the non-magnetic impurity falls farther off



Chemical Methods

Calcination: Carbonate or hydrated oxide ores are subjected to the action of heat in order of expel water from hydrated oxide and carbon dioxide from a carbonate.

Examples:

$ZnCO_3$ --> $ZnO + CO_2$

$CaCO_3$ --> $CaO + CO_2$

$Al_2O_3 \times 2H_2O$ --> $Al_2O_3 + 2H_2O$

$2Fe_2O_3 \times 3H_2O$ --> $2Fe_2O_3 + 3H_2O$

Roasting: Sulphide ores either are subjected to the action of heat and air at temperatures below their melting points in order to bring about chemical changes in them.

Examples:

$2PbS + 3O_2$ --> $2PbO + 2SO_2$

$PbS + 2O_2$ --> $PbSO_4$

$2ZnS + 3O_2$ --> $2ZnO + 2SO_2$

$ZnS + 2O_2$ --> $ZnSO_4$

$CuS + 2O_2$ --> $CuSO_4$

$2Cu_2S + 3O_2$ --> $2Cu_2O + 2SO_2$

Leaching: It involves the treatment of the ore with a suitable reagent as to make it soluble while impurities remain insoluble. The ore is recovered from the solution by suitable chemical method.

$Al_2O_3 + 2NaOH$ -->2 $NaAlO_2 + H_2O$

Reduction of Free Metal:

Smelting:

Reduction of a metal from its ore by a process involving melting

Several reducing agents such as sodium, magnesium and aluminium are used for reduction.

The calcinated or roasted ore is mixed with carbon (coal or coke) and heated in a reverberatory or a blast furnace.
Carbon and carbon monoxide produced by incomplete combustion of carbon reduce the oxide to the metal.

$$\left.\begin{array}{l} PbO + C \rightarrow Pb + CO \\ PbO + CO \rightarrow Pb + CO_2 \\ SnO_2 + 2C \rightarrow Sn + 2CO \end{array}\right\} \text{Carbon reductionprocess}$$

$$\left.\begin{array}{l} Cr_2O_3 + 2Al \rightarrow 2Cr + Al_2O_3 \\ 3Mn_3O_4 + 8Al \rightarrow 9Mn + 4Al_2O_3 \end{array}\right\} \text{Aluminiumreduction process (Gold - Schimidt alumino thermic process)}$$

Flux:

The ores even after concentration contain some earthy matter called gangue which is heated combine with this earthy matter to form an easily fusible material. Such a substance is known as flux and the fusible material formed during reduction process is called slag.

- **Acidic fluxes** like silica, borax etc are used when the gangue is basic such as lime or other metallic oxides like MnO, FeO, etc
- **Basic fluxes** like CaO, lime stone ($CaCO_3$), magnesite ($MgCO_3$), hematite (Fe_2O_3) etc are used when the gangue is acidic like silica, P_4O_{10} etc.

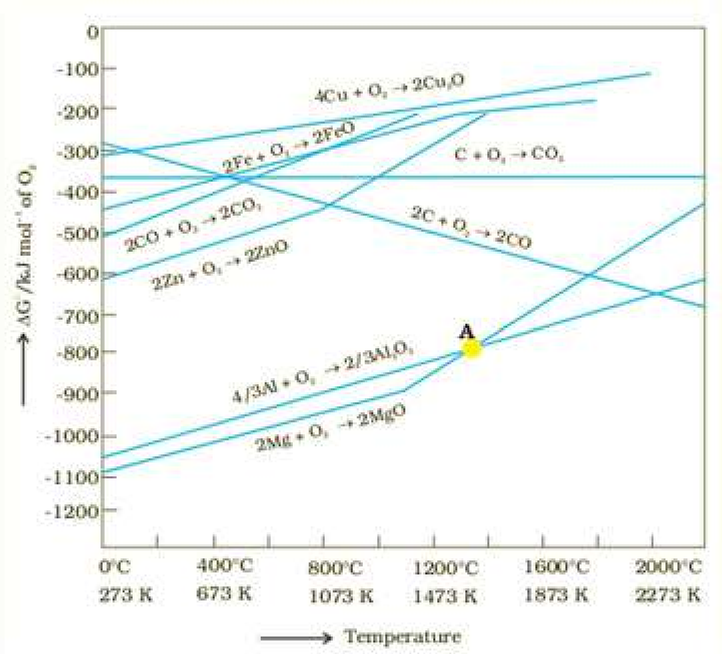
Refining

The metals obtained by the application of above reduction methods from the concentration ores are usually impure. The impure metal is thus subjected to some purifying process known as refining in order to remove undesired impurities. Various process for this are

a) Liquation process b) Distillation process
c) Cupellation d) Poling
e) Electrolytic refining f) Bessemerisation

Thermodynamic Principles of Metallurgy:

$\Delta G = \Delta H - TS$
or $\Delta G^0 = -RT \ln K$



An element A can reduce element B if ΔG value for oxidation of A to AO is lower than the ΔG value for oxidation of B to BO.

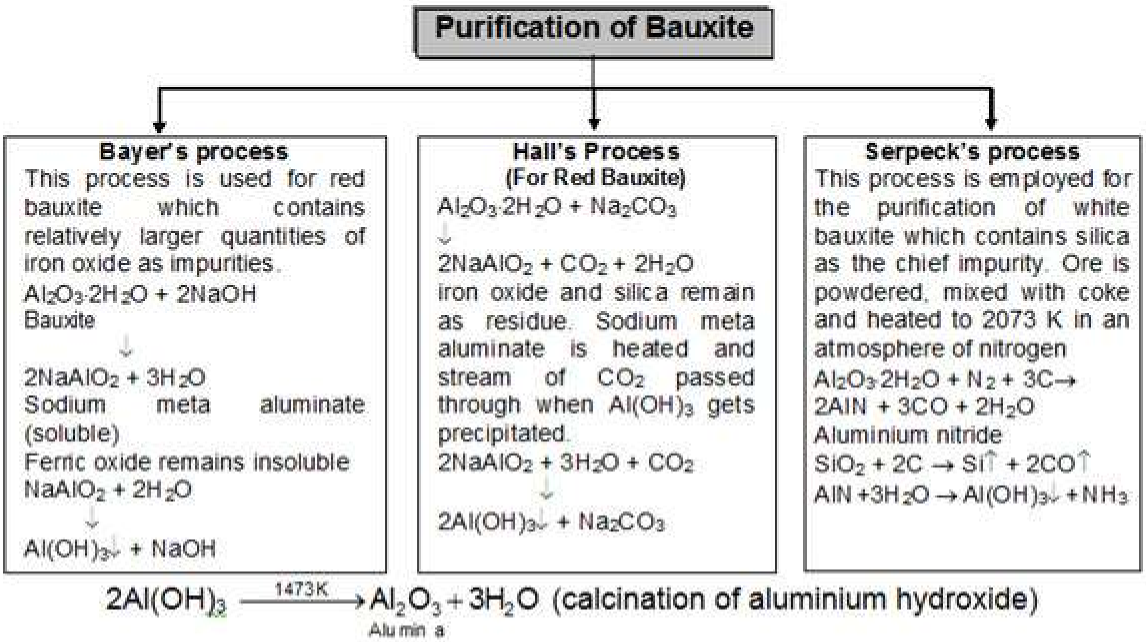
i.e. $\Delta G_{(A \to AO)} < \Delta G_{(B \to BO)}$

Extraction of Aluminium:

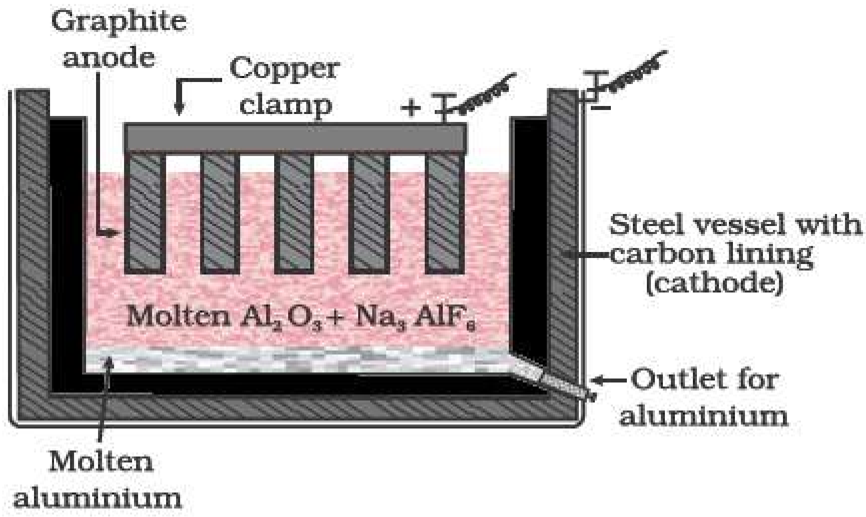
Important Ores of Aluminium:

- Bauxite : $Al_2O_3 \times 2H_2O$Cryolite: Na_3AlF_6
- Feldspar: $K_2OAl_2O_3 \times 6SiO_2$ or $KAlSi_3O8$
- Mica: $K2O \times 3Al_2O_3 \times 6SiO_2 \times 2H_2O$
- Corundum: Al_2O_3
- Alumstone or Alunite: $K_2SO_4 \times Al_2(SO_4)_3 \times 4Al(OH)_3$

Purification of Bauxite



Electrolysis of fused pure alumina (Hall & Herwlt Method)



The addition of cryolite (Na_3AlF_6) and fluorspar (CaF_2) makes alumina a good conductor of electricity and lowers its Fusion temperature from 2323 to 1140 K. the reaction taking place

$$Na_3AlF_6 \rightleftharpoons 3NaF + AlF_3$$

$$AlF_3 \rightleftharpoons Al^{3+} + 3F^-$$

At cathode

$$Al^{3+} + 3e^- \longrightarrow Al$$

At anode

$$F^- \longrightarrow F + e^-$$

$$2Al_2O_3 + 12\,F \longrightarrow 4AlF_3 + 3O_2$$

$$2C + O_2 \longrightarrow 2CO$$

$$2CO + O_2 \longrightarrow 2CO_2$$

during electrolysis.

Refining of Aluminium:

The graphite rods dipped in pure aluminium and Cu–Al alloy rod at the bottom in the impure aluminium work as conductors. On electrolysis, aluminium is deposited at cathode from the middle layer and equivalent amount of aluminium is taken up by the middle layer from the bottom layer (impure aluminium). Therefore, aluminium is transferred from bottom to the top layer through middle layer while the impurities are left behind. Aluminium thus obtained is 99.98% pure.

Hydrometallurgy (solvent extraction)

Solvent extraction is the latest separation technique and has become popular because of its elegance, simplicity and speed. The method is based on preferential solubility principles.

Solvent or liquid-liquid extraction is based on the principle that a solute can distribute itself in a certain ratio between two immiscible solvents, one of which is usually water and the other an organic solvent such as benzene, carbon tetrachloride or chloroform. In certain cases, the solute can be more or less completely transferred into the organic phase.

Extraction of Iron:

a) Important Ores of Iron:

Hematite Fe_2O_3 (red oxide of iron)

Limonite $Fe_2O_3 \times 3H_2O$ (hydrated oxide of iron)

Magnetite Fe_3O_4 (magnetic oxide of iron)

Varieties of Iron

Pig or Cast Iron

⇒ most impure form
⇒ 2.5 – 5% carbon and other impurities like Mn, Si, S and P
⇒ It is hard and Brittle and hence cannot be moulded by hammering

Wrought Iron

⇒ Purest form of iron
⇒ 0.1 – 0.25% carbon
⇒ Its is ductile, soft and malleable.

Steel

It is in between pig iron and wrought iron.
⇒ 0.25 to 2% carbon

Extraction of Cast Iron:

Reactions taking place in the blast furnace

Zone of combustion

$$\underset{\text{(Coke)}}{C} + O_2 \longrightarrow CO_2$$

Zone of reduction

$$Fe_2O_3 + 3CO \longrightarrow Fe + CO_2$$

Zone of reduction

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

$$FeO + CO \longrightarrow Fe + CO_2$$

Zone of slag formation

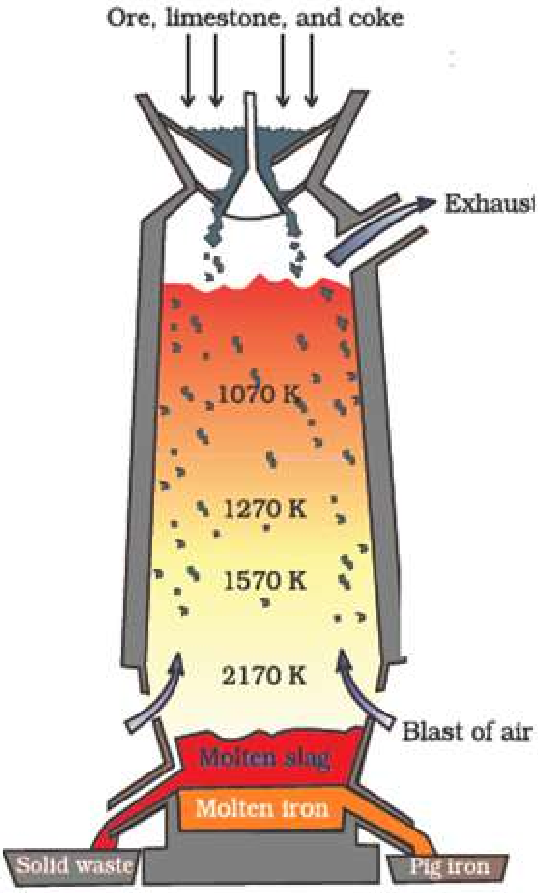
$$\underset{\text{(lim e stone)}}{CaCO_3} \longrightarrow CaO + CO_2$$

$$CaO + SiO_2 \longrightarrow \underset{\text{Fusible slag}}{CaSiO_3};$$

Zone of fusion

lower part of furnace

Molten iron is heavier than from molten slag. The two liquids are periodically tapped off. The molten iron tapped off from the furnace is solidifed into blocks called 'pigs'.



Extraction of Copper:

Ores of Copper:

- Copper glance (chalcocite) : Cu_2S
- Copper pyrites (Chalopyrites): $CuFeS_2$
- Malachite : $Cu(OH)_2 \times CuCO_3$
- Cuprite or Ruby copper: Cu_2O
- Azurite : $Cu(OH)_2 \times 2CuCO_3$

Refining of Metals:

Zone refining (Fractional crystallization): This method is employed for preparing extremely pure metals. This method is based upon the principle that when a molten solution of the impure metal is allowed to cool, the pure metal crystalises out while the impurities remain in the melt.

Electro-refining: In this method, the impure metal is converted into a block which forms the anode while cathode is a rod or plate of pure metal. These electrodes are suspended in an electrolyte which is the solution of a soluble salt of the metal usually a double salt of the metal. When electric current is passed, metal ions from the electrolyte are deposited at the cathode in the form of pure metal while an equivalent amount of metal dissolves from the anode and goes into the electrolyte solution as metal ion. The soluble impurities present in the crude metal anode go into the solution while the insoluble impurities settle down below the anode as anode mud.

Van-Arkel Method: In this method, the metal is converted into it volatile unstable compound such as iodide leaving behind the impurities. The unstable compound thus formed is decomposed to get the pure metal.

Cupellation and Poling are used for refining of metals, cupellation is contain impurities of other metals with traces of lead are removed from silver by heating impure silver with a blast of air in a cupel (an oval shaped pan made up of bone ash) in which lead is oxidised to lead oxide (PbO) which being volatile escapes leaving behind pure silver.Poling is used for refining of such metals which contain impurities of its own oxide. In this process, the molten impure metal is stored with green wooden poles. At the high temperature of the molten metal, wood liberates methane which reduces the oxide of the metal to free metal.

POLYMER

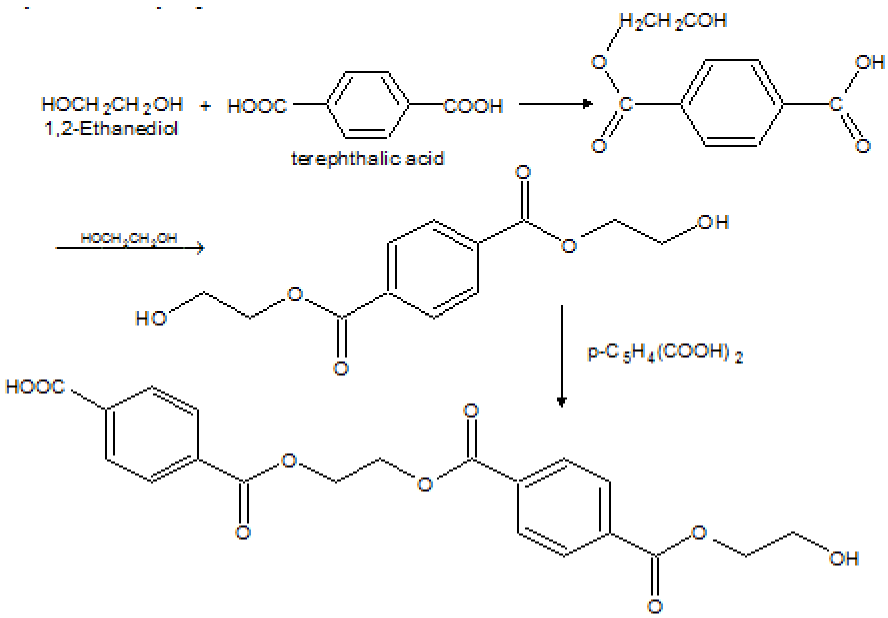
Polymer	Large molecules having high molecular mass formed by combination of number of small units called monomers.
Polymerisation	The process of formation of polymers from respective monomers.
Natural polymers	Found in plants and animals. Examples: proteins, cellulose, starch.
Synthetic polymers:	Synthesised in laboratory from natural material. Example, nylon 6, 6 , Buna-S
Addition Polymers	Formed by repeated addition of monomers having multiple bonds.
Homopolymers.	Addition polymers polymers formed from single monomeric species
Copolymers	Addition polymers formed from two different monomeric species
Condensation polymers	Formed by repeated condensation of different bi or tri-functional monomer units.
Fibres	Long thin, threadlike bits of material that are characterized by great tensile (pulling) strength in the direction of the fiber. The natural fibres – cotton, wool, silk – are typical. The lining-up is brought about by drawing – stretching — the return to random looping and coiling is overcome by strong intermolecular attractions.
Elastomers	Possesses the high degree of elasticity that is characteristic of rubber: it can be greatly deformed — stretched to eight times its original length e.g., buna N and buna S, When the stretching force is removed, the molecular chains of an elastomer do not remain extended and aligned but return to their original random conformations
Thermoplastic polymers	Soften on heating and stiffen on Cooling. e.g polythene, polystyrene, PVC
Thermosetting polymers	Do not soften on heating and cannot be remoulded. Example, bakelite

Polymers are formed in two general ways.

a) In chain-reaction polymerization

$Rad. + CH_2 = CH_2 \rightarrow RadCH_{2C}H_2 \rightarrow RadCH_{2C}H_{2C}H_{2C}H_{2x} \rightarrow$ etc.

b) In step reaction polymerization,



c) Free-radical vinyl polymerization:

$$nCH_2=\underset{\displaystyle G}{\underset{|}{CH}} \xrightarrow{\text{initiator}} -CH_2\underset{\displaystyle G}{\underset{|}{CH}}CH_2\underset{\displaystyle G}{\underset{|}{CH}}CH_2\underset{\displaystyle G}{\underset{|}{CH}}CH_2\underset{\displaystyle G}{\underset{|}{CH}}-$$

Vinyl monomer

$$\text{or } (-CH_2\underset{\displaystyle G}{\underset{|}{CH}}-)_n$$

Polymer

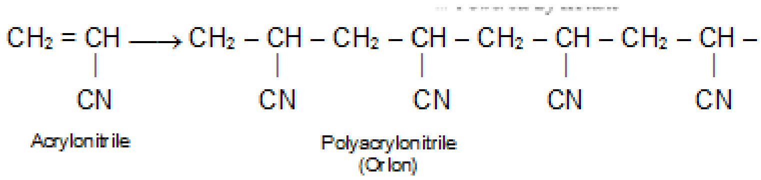
At the doubly bonded carbons — the vinyl groups — and is called *vinyl polymerization*. A wide variety of unsaturated monomers may be used, to yield polymers with different *pendant groups* (G) attached to the polymer backbone. For example.

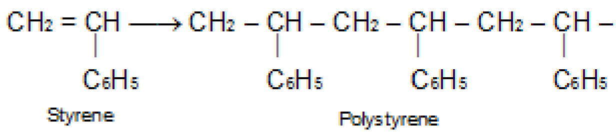
$$CH_2=\underset{\displaystyle Cl}{\underset{|}{CH}} \longrightarrow -CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-$$

Vinyl chloride

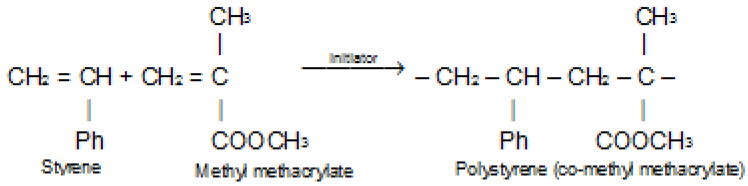
Poly (vinyl chloride)
(PVC)

POLYMER





d) Copolymerization:



Some Important Polymers:

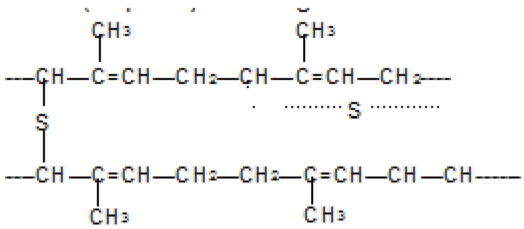
a) Natural Rubber:

Addition polymer of isoprene (2-methyl-1,3-butadiene)

An average chain length of 5000 monomer units of isoprene.

The rubber in which the arrangement of carbon chain is trans with respect to the double bond is known as ***Gutta Percha*** and this is the natural rubber obtained from bark of various trees.

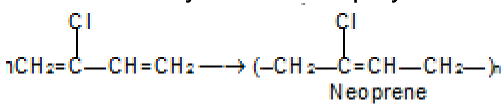
'Vulcanisation of rubber involves addition of sulphur to rubber and heating the mixture to increase the strength of natural rubber. sulphur forms short chains of sulphur atoms that link two hydrocarbon (isoprene) units together.



Vulcanised rubber is thus stronger and less sticky than the natural rubber.

b) Synthetic rubber:(Polychloroprene) or Neoprene)

It is obtained by free radical polymerisation of chloroprene in



A thermoplastic and need not to be vulcanised.

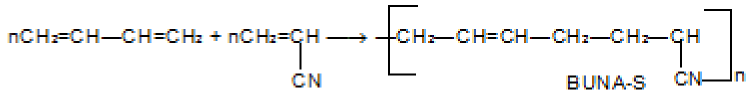
It is a good general purpose rubber and superior to natural rubber as it is resistant to the reaction of aire, heat, light chemicals, alkalis and acids below 50% strength.

It is used for making transmission belts, printing rolls and flexible tubing employed for conveyence of oil and petrol.

c) Buna rubbers:

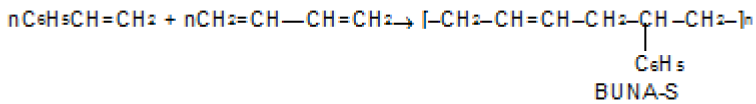
POLYMER

i) Buna - N or GRA: it is synthetic rubber obtained by copolymerisation of one part of acryl nitrile and two parts of butadiene.



It is more rigid responds less to heat and very resistant to swelling action of petorol, oils and other organic solvents.

ii) Buna -S or GRS (General purpose Styrene rubber): It is a copolymer of three moles of butadiene and one mole of styrene and is an elastomer. It is obtained as a result of free radical copolymerisation of its monomers.



It is generally compounded with carbon black and vulcanised with sulphur. It is extremely resistant to wear and tear and finds use in manufacture of tyres and other mechanical rubber goods.

d) Teflon: It is polymer of tetrafluorethylene ($F_2C=CF_2$) which on polymerisation gives Telfon.

$$nCF_2=CF_2 \xrightarrow{(NH_4)_2S_2O_8 \quad 870-1020K} (—CF_2—CF_2—)_n$$

It is thermoplastic polymer with a high softening point (600K).

It is very tough and difficult to work. It is inert to most chemicals except fluorine and molten alkali metals.

It withstands high temperatures. Its electrical properties make it an ideal insulating material for high frequency installation.

e) Nylon -66:

A condensation polymer formed by reaction between adipic acid and hexamethylene diamine. It is a thermoplastic polymer