ND's SSLC MEMORY MODULE - CHEMISTRY (EM)

Help Line: **9447107327**

1. GASEOUS STATE

SOLID	LIQUID	GAS
➢ Fixed shape & volume ➢ Molecules are closely packed ➢ Force of attraction between molecules is very strong ➢ Freedom of movement of molecules are very slow	➢ Fixed volume but no shape ➢ Molecules are loosely arranged than solid ➢ Force of attraction between molecules is weak ➢ Freedom of movement of molecules are slow	➢ No shape & volume ➢ Molecules are loosely arranged ➢ Force of attraction between molecules is very weak ➢ Freedom of movement of molecules are very fast.

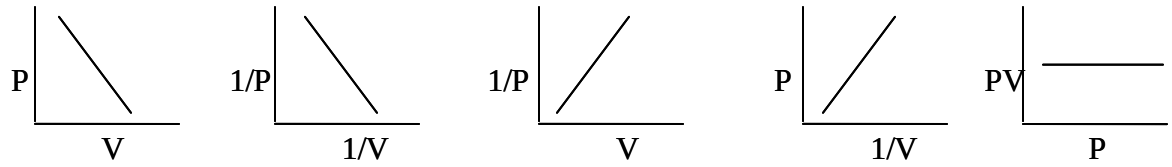
❖ Change of state: we can change the state of an object by giving and removing heat.

Melting	Evaporation	Condensation	Solidification
Solid to Liquid	Liquid to Gas	Gas to Liquid	Liquid to Solid

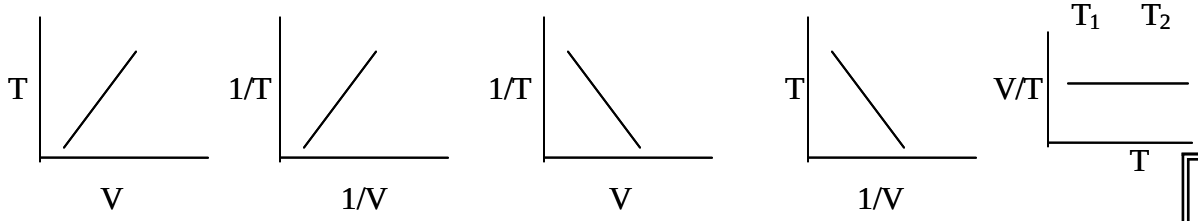
❖ Diffusion: The ability of the molecules which have freedom of movement and mixed together. Gases have high diffusion rate.

❖ Gas Laws:

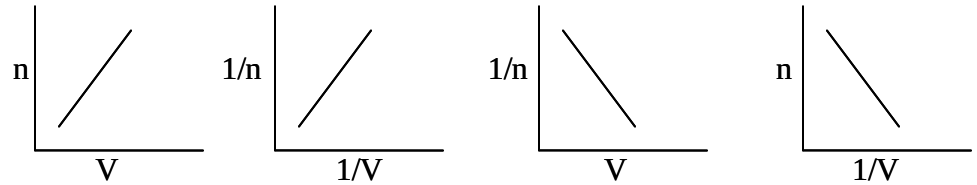
- **Boyles Law:** Volume inversely proportional to Pressure V∝ 1/P (T, n Constant) $P_1V_1 = P_2V_2$



- **Charles Law:** Volume directly proportional to Temperature V∝ T (P, n Constant) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$



- **Avogadros Law:** Volume directly proportional to number of molecules V∝ n (P,T Constant)



- **Common Gas Equation** = Boyles Law + Charles Law $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

AN
CT V
BP
After**N**oon
ലെ **C**lass
Test
Vട്ടപ്പായ്
Babu **P**oyi
(Easily memorize gas laws)

2. CHEMICAL REACTIONS AND THE MOLE CONCEPT

Chemical Reaction: Reactant ⟶ Product

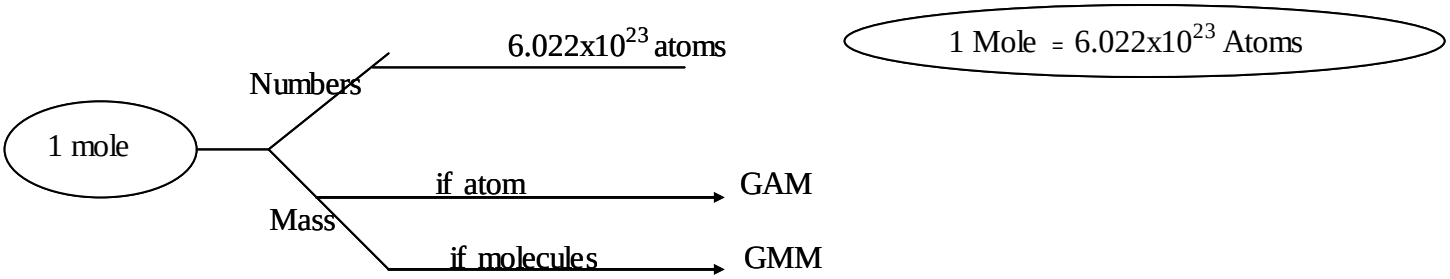
Factors influencing Chemical Reaction

Factors	Effect
1. Nature of reactants	1. Rate of reaction changes
2. Concentration of reactant	2. Rate of reaction increases
3. Temperature	3. Rate of reaction increases
4. Pressure	4. Rate of reaction increases
5. Catalyst	5. Rate of reaction changes

Catalyst: Substances which influences a chemical reaction by changing the speed of the reaction without undergoing any permanent chemical change. MnO_2 is +ve catalyst (to increase the reaction) and H_3PO_4 is -ve catalyst (to decrease the reaction) in the decomposition of H_2O_2

Avogadro number: The number of atoms of an element in one gram atomic mass is $6.022x10^{23}$. This number is Avogadro number. Denoted with N_A.

Mole: The amount of substances which includes $6.022x10^{23}$ numbers of molecules.



Molar Volume and STP : The volume of a gas in mole of substance. If one mole of a gas is at STP (Standard Temperature & Pressure = 273K Temperature and 1atm Pressure) its volume is 22.4L

One mole means

1 mole = $6.022x10^{23}$ molecules
= GAM/GMM of substance
= 22.4L volume (STP)

Number of moles = $\frac{\text{Mass in gm}}{\text{Gm molecular mass}}$

Number of moles = $\frac{\text{number of molecules}}{6.022x10^{23}}$

Number of moles = $\frac{\text{Volume at STP}}{22.4}$

Number of mole atoms = $\frac{\text{Mass in gm}}{\text{gm atomic mass}}$

Mole Concept and Chemical Reactions

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

Mole: 1 mole CH_4 + 2 mole O_2 → 1 mole CO_2 + 2 mole H_2O

GMM: 16gm CH_4 + 64gm O_2 → 44gm CO_2 + 36gm H_2O

Amount of oxygen to burn 16gm CH_4 = 64gm

Amount of oxygen to burn 1gm CH_4 = 64/16 = 4gm

Amount of CO_2 when burnt 16gm CH_4 = 44gm

Amount of CO_2 when burnt 1gm CH_4 = 44/16 = 2.75gm

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3. ATOMIC STRUCTURE AND ELECTRONIC CONFIGURATION

Shell

Shell number	:	1st shell	2nd shell	3rd shell	4th shell
Shell	:	K	L	M	N
Electron	:	2	8	18	32
Sub shell	:	s	s, p	s, p, d	s, p, d, f
Electron	:	2	2,6	2,6,10	2,6,10,14

*) **Aufbau Principle**: Sub shell electronic configuration written only in the increasing order of energy of different sub shells. 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p

eg: $_{11}Na = 1s^2 2s^2 2p^6 3s^1$ $_{17}Cl = 1s^2 2s^2 2p^6 3s^2 3p^5$ $_{24}Cr = 1s^2 2s^2 2p^6 3s^2 3p^6 \underline{3d^5 4s^1}$

$_{29}Cu = 1s^2 2s^2 2p^6 3s^2 3p^6 \underline{3d^{10} 4s^1}$

*) Block, Period, Group

a) Block : Last Sub shell in electronic configuration.

b) Period : The biggest shell number in electronic configuration.

c) Group : *) ends with s sub shell, the number above s sub shell

*) ends with p sub shell, the number above p sub shell + 12

*) ends with d sub shell, the number above d sub shell + the number above s sub shell

*) ends with f sub shell, they have no group

ഉദാ: $_{12}Mg = 1s^2 2s^2 2p^6 3s^2$ Block = s, Period = 3, Group = 2

$_{16}S = 1s^2 2s^2 2p^6 3s^2 3p^4$ Block = p, Period = 3, Group = 4+12 = 16

$_{24}Cr = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ Block = d, Period = 4, Group = 5+1 = 6

Transition elements: * 3 group to 12 groups:

Properties: * d Block * Metals * different oxidation state *different coloured compounds

Representative elements: Elements of s and p block (Reason: It includes Solid, Liquid, Gas, Metal, and Non Metal)

Electro negativity (EN): Ability to receive electrons.

E.N decreases down the group, it increases from left to right in a period.

F(4.0) has the highest and for Fr(0.7) has the lowest.

Electro negativity Scale (Pauling Scale): Scale on the basis of electro negativity.

*) The value of electro negativity of elements is in between 0 and 4.

*) The difference in electro negativity is above 1.7 in a compound it is ionic and if it is below 1.7 the compound is covalent.

Ionization Energy (I.E): The energy required to remove the electron in the outermost shell of an atom is its IE

*) I.E decreases down the group, it increases from left to right

*) I.E Most higher - Inert gas

*) I.E least amount - Highly reactive metal.

4. METALS

Physical Properties:

1. Solid 2. Very strong 3. Heat conductor 4. electrical conductor 5. Luster
5. Malleability 6. Ductility 7. High Density 8. High Melting Point 9. Sonority

Chemical Properties: Chemical Properties are explained on the basis of reactivity series.

1. Reaction with Oxygen: Highly reactive metals react strongly and forms oxides of that metal.
   $4Na + O_2 \longrightarrow 2Na_2O$
2. Reaction with water: Metal + Water ⟶ Hydroxide + Hydrogen
   $2Na + 2H_2O \longrightarrow 2NaOH + H_2$
3. Reaction with CO_2: Metal + CO_2 ⟶ Carbonate + Water
   $2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$
4. Reaction with acid: Metal + Acid ⟶ Metal Salt + Hydrogen
   $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$
6. Displacement Reaction: One metal can displace other metal from its solution which has low reactivity.
   eg: Zn can displace Cu from $CuSO_4$ solution. The colour of Zn changes to red and blue colour of $CuSO_4$ becomes colourless. In this reaction Zn (Highly reactive) occur oxidization (loss of electron $Zn \longrightarrow Zn^{2+}+2e^-$) While Cu (low reactive) occur reduction (gain of electrons…. $Cu^{2+}+2e^- \longrightarrow Cu$)

Reactivity Series
K Fe
Na Pb
Ca Cu
Mg Ag
Al Au
Zn

പൊട്ടിയ സോഡ കാല്സ് മഗ്ഗിലെടുത്തു. അല്പു സിംഗ് ഇരുമ്പിന്റെ ലെഡു ചെമ്പ് പാത്രത്തിലുമെടുത്തു. ഈ സമയം സിൽവ മോൾ സ്വർണകുമാരിയെ നോക്കിചിരിച്ചു.

Electrochemical cells: Produces electricity by a chemical reaction. Eg: Galvanic Cell

Parts of this Cell: It have two electrodes namely Cathode, Anode

*) Cathode – Low reactive (occurs reduction) $Cu^{2+} + 2e^- \longrightarrow Cu$

*) Anode – Highly reactive (occurs oxidation) $Zn \longrightarrow Zn^{2+} + 2e^-$

*) Salt Bridge: Ensures the continuous flow of electrons in a cell.

SHE (Standard Hydrogen Electrode): Basic electrode to identify the potential of electrodes.

Properties of SHE:

*) Temperature = 298K, Pressure = 1atm, Concentration of H_2 = 1mol, Electrode = Platinum, Electrolyte = HCl

- Minerals: Compounds of metals exists in nature
- Ore: Mineral from which the metal can be extracted Eg: Hematite – Fe, Bauxite - Al.

Concentration of Ore	Metal Extraction	Purification
*)Washing in a stream of water - Density of impurities is less than that of the ore	*)Electrolysis - K, Na, Ca, Mg	*)Distillation - Zn, Hg
*) Froth Floatation - Density of ore is less than that of impurities, used for sulphide ores - Pine oil. Eg: ZnS, PbS, HgS	*)Reduction with aluminium – Cr, Mn, V	*)Liquation - Sn, Pb
*)Magnetic Separation – If ore has magnetic property eg: Fe_2O_3	*) Reduction with Hydrogen Zn, Cu, Pb, W	
*) Leaching – Impurities are insoluble but ore is soluble in a solvent. Eg: Bauxite is mixed with NaOH	*) Reduction with Carbon (Smelting) - Zn, Sn, Fe, Ni, Pb	*)Electrolysis - Cu, Ag
*) Roasting – Ore heated in a strong blast of air. After Froth floatation sulphides ores are converted to their oxides using this method. Eg: $2PbS+3O_2 \longrightarrow 2PbO+2SO_3$	*) Cyanide process - Au, Ag, Pt	
*) Calcination – Heated either the absence of air or in controlled air stream. Eg: $CaCO_3 \longrightarrow CaO+CO_2$		

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❖ Aluminium Production: 2 Steps (Hall-Haroult Process)

a) Concentration of Ores: The process for concentration is Leaching. The ore mixed with NaOH, forms Sodium Aluminate ($NaAlO_2$). Sodium Aluminate is diluted with water and heated strongly, we get Alumina (Al_2O_3).

b) Metal Extraction: Electrolysis of pure Alumina dissolved in molten cryolite with carbon lining iron tank as cathode and graphite rods as anode (cryolite is added to reduce the melting point of Alumina). At anode oxidisation occurs and changes it regularly. Aluminium is formed at cathode by reduction ($Al^{3+}+3e^- \rightarrow Al$)

❖ Iron Extraction: Magnetic Separation is used for concentration.

The mixture of Hematite, coke and limestone are added from top into the blast furnace. A powerful current of hot air (2000K). During the flow of air coke combines with oxygen forms CO and it reduces hematite into pig iron. The impurity SiO_2 (gangue) is removed by reacting with $CaCO_3$ (flux) and forms $CaSiO_3$ (Slag)

Gangue + Flux ⟶ Slag

Reactions in blast furnace:

1. $C+O_2 \longrightarrow CO_2+Heat$ 2. $CO_2+C+Heat \longrightarrow 2CO$ 3. $CaCO_3 \longrightarrow CaO+CO_2$
4. $CaO+SiO_2 \longrightarrow CaSiO_3$ 5. $Fe_2O_3+3CO \longrightarrow 2Fe+3CO_2$

❖ Cast Iron: Pig iron is heated to melting and again solidified to get cast iron. It can't be bent so it is not used for concrete purpose.

❖ Steel: Iron with 0.05 to 1.5% Carbon

5.SOME NON METALLIC COMPOUNDS

✖ Ammonia: Produces with the reaction of ammonium chloride and calcium hydroxide

$$2NH_4Cl + Ca(OH)_2 \longrightarrow 2NH_3 + CaCl_2 + 2H_2O$$

For drying the gas calcium oxide (quick lime) is used as drying agent. Gas jar is placed mouth downwards because the ammonia has lower density than air. Hard glass test tube placed slightly inclined for safety.

Industrial Preparation: Haber process is used.

$$N_2+3H_2 \xrightarrow[500^0c]{\text{Sponge Fe}} 2NH_3$$

Test for ammonia: a) A glass rod dipped in hydrochloric acid is brought in contact with ammonia gas, a white smoke is produced. b) Ammonia salt is identified using Nessler's reagent. The reaction forms a chocolate brown precipitate (അനിക)

✖ Liquor Ammonia: The concentrated solution of ammonium hydroxide by dissolving ammonia in water.

✖ Liquid Ammonia: The liquefied form of ammonia gas by applying pressure.

Sulphuric acid(H_2SO_4): Contact Process: 4 steps

$$\text{❋ } S+O_2 \longrightarrow SO_2 \quad \text{❋ } 2SO_2+O_2 \xrightarrow[450^0C\text{ (suitable temp.)}]{V_2O_5\text{ (catalyst)}} 2SO_3 \quad \text{❋ } SO_3+H_2SO_4 \longrightarrow H_2S_2O_7 \text{ (Oleum)} \quad \text{❋ } H_2S_2O_7+H_2O \longrightarrow 2H_2SO_4$$

*) Physical properties: colorless, odorless acid, soluble in water, high density.

★Chemical properties: 1) Dibasic acid: It forms two salts known as sulphate and bisulphate while reacting with an alkali. 2) Dehydrating agent: absorption of chemically combined water from substances.

Eg: $C_{12}H_{22}O_{11}+11H_2SO_4 \longrightarrow 12C+11H_2SO_4.2H_2O$ $CuSO_4.5H_2O \longrightarrow CuSO_4+5H_2SO_4.H_2O$

3) Drying agent: absorption of moisture from gaseous substances like SO_2, HCl.

✖ Uses: Chemical Fertilizer, Storage Battery, Soap, Detergent, Paint

★Test for sulphate:

It reacts with Barium chloride ($BaCl_2$) forms white precipitate of Barium sulphate ($BaSO_4$). (രസതന്ത്രം V)

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★ Test for nitrates:

To the salt, add an equal amount of freshly prepared ferrous sulphate solution, Shake well and pour concentrated sulphuric acid slowly along the sides of the test tube. A brown ring is formed.(ന്മഷീസ. T.V)

★ Test for chlorides:

It reacts with Silver nitrate forms a white curdy precipitate of Silver Chloride (ക്ലോസി. VT)

✖ Reversible reaction: Reactants combine to form products and products recombine to form reactants. Such reactions are called reversible. It does not end. It occurs in equilibrium state.

✖ Factors effecting reversible reaction: Concentration, Temperature and Pressure are the factors. This is explained by Le-Chatlier with his principle. "If a system in equilibrium is subjected to a change of pressure, temperature and concentration, the equilibrium is shifted in such a way as to cancel the effect of hat change.

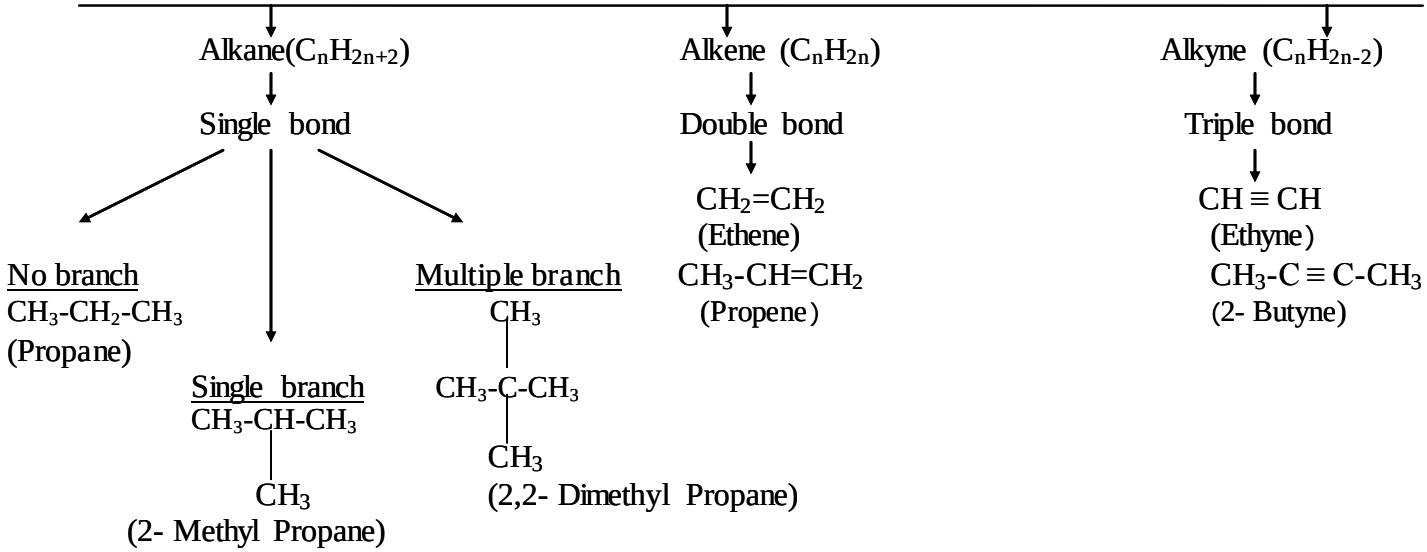
- Effect of concentration: Concentration of reactant increases forward reaction increases and concentration of products increases backward reaction increases.
- Effect of Temperature: Every Chemical reaction there must be an energy (heat) change.
  When temperature increases, forward reaction increases while it is endothermic and decreases while it is exothermic
  When temperature decreases, forward reaction increases while it is exothermic and decreases while it is endothermic.
- Effect of Pressure: When pressure increases forward reaction increases while the volume decreases with forward reaction.
- Catalyst: It helps the system to attain equilibrium by equaling the rate of forward and backward reaction.

6. ORGANIC CHEMISTRY – NAMING and ISOMERISM

Hydrocarbon (Only compounds include carbon and Hydrogen)

Naming Rules:

1. Find the maximum number of carbon atoms in an open chain and write the appropriate word root.
2. If the bonding between carbon atoms are single, double, triple use ane, ene, yne respectively as suffix.
3. If single branch is in the given compound: Position of the branch + hyphen + the adjective denoting the branch (methyl/ethyl/propyl) + word root + suffix
4. If more than one branch with same type: Positions of the branch by separating 'coma' + hyphen + di/tri/tetra + the adjective denoting the branch (methyl/ethyl/propyl) + word root + suffix
5. If more than one branch with different types, write the branch position, branch name separately and the branch names are arranged in the alphabetic order.



Functional Group: The atom or atom groups which comes by replacing a hydrogen atom from the hydrocarbon structure.

Functional Group	Name	Common Name	Naming Rule
-Cl, -F, -Br, -I	Halo(Chloro, Flouro, Bromo, Iodo)	Halogens	Halo+Alkane
-OH	Hydroxyl	Alcohol	Alkane-e+ol
-COOH	Carboxyl	Acid	Alkane-e+oic acid
-CO-	Carbonyl	Ketones	Alkane-e+one
-CHO	Aldehyde	Aldehyde	Alkane-e+al
-O-	Oxy	Ethers	Alk+Oxy+Alkane
$-NH_2$	Amino	Amines	Amino+Alkane
$-NO_2$	Nitro		Nitro+Alkane

Isomerism: Compounds having same molecular formula but different structural formula is called isomers and this phenomenon is called isomerism.

Isomerism

- Chain Isomerism (Difference in carbon chain)
- Functional Group Isomerism (Difference in functional group)
- Position Isomerism (Difference in position of the functional group)

7. ORGANIC CHEMISTRY - CHEMICAL REACTIONS

- Combustion: Reaction with Oxygen. Products are CO_2 & H_2O
  eg: $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
- Substitution Reaction: The atoms or atom groups which comes by replacing the hydrogen atom from hydrocarbon.
  eg: 1) $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ 2) $C_2H_6 + Br_2 \longrightarrow C_2H_5Br + HBr$
- Addition Reaction: Unsaturated Hydrocarbons reacts with $H2/Cl_2/HCl$ and forms the saturated compound.
  eg: 1) $CH_2 = CH_2 + H_2 \longrightarrow CH_3\text{-}CH_3$ 2) $CH_2 = CH_2 + Cl_2 \longrightarrow CH_2Cl\text{-}CH_2Cl$
- Thermal Cracking (Pyrolysis): Hydrocarbons heated in the absence of air and forms single compounds.
  eg: $CH_3\text{-}CH_2\text{-}CH_3 \longrightarrow CH_4 + CH_2 = CH_2$
- Polymerisation: number of monomers combined to form a polymer.
  eg: $_n[CH_2 = CH_2] \longrightarrow [CH_2 - CH_2]_n$
  Ethene Poly Ethene

Some Organic Compounds

Alcohol (-OH) or Hydroxyl Group

*) Ethanol $CH_3 - CH_2 - OH$ – Produced by the fermentation process of sugar solution.

Fermentation

*) Yeast is added to sugar solution. The enzyme Invertase changes the solution to Glucose and Fructose.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

*) The second enzyme Zymase changes Glucose to Ethanol.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5 - OH + 2CO_2$$

Uses of Ethanol: Paints, Fuels, Preservatives, Medicines, Varnish and beverages.

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Kinds of Ethanol:

Wash	8 – 10 % alcohol
Rectified Spirit	95.6 % alcohol
Absolute alcohol	100 % alcohol
Power alcohol	Petrol + alcohol(4:1)

*) Denatured (Methylated) Spirit: To resist the miss using of ethanol, industrially add the toxic methanol/pyridine/rubber distillate to ethanol. This process is called methylating and the spirit is called methylated spirit.

*) Organic acid: Carboxyl group (-COOH): It is manufactured by the oxidation process of Ethanol in the presence of an enzyme.

$$CH_3 - CH_2 - OH + O_2 \rightarrow CH_3 - COOH + H_2O$$

*) Glacial acetic acid: 100% acid *) Vinegar: 5-8% acid (Used as preservative)

*) Ester: Mixture of alcohol and organic acid is called ester. It has the smell of flowers and fruits, used in jam, squash and perfumes.

eg: a) Banana - $CH_3COOC_5H_{11}$ - Amyl acetate b) Jasmine - $CH_3COOC_6H_5$ - Benzyl acetate

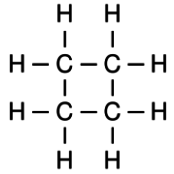
$CH_3 - COOH + C_2H_5 - OH \rightarrow CH_3COOC_2H_5 + H_2O$

(Ethanoic acid) (Ethanol) (Ethyl Ethanoate)

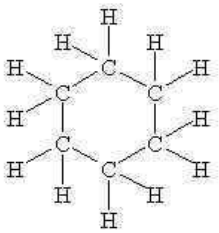
Ring Compounds

Alicyclic

Cyclobutane

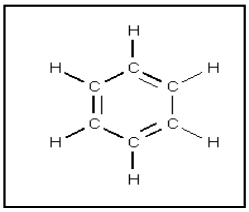


Cyclohexane

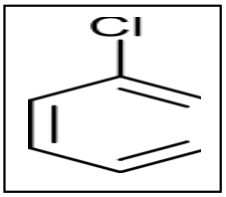


Aromatic

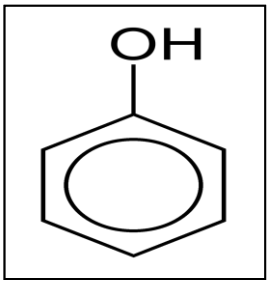
Benzene



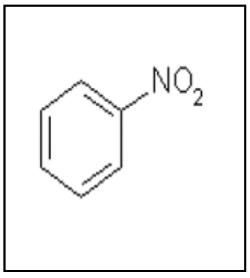
Chlorobenzene



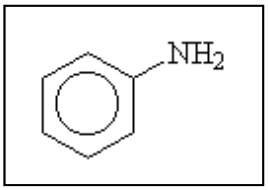
Phenol



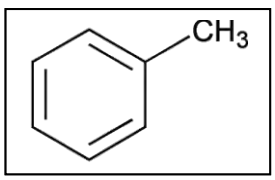
Nitrobenzene



Amino Benzene



Methyl Benzene



8. CHEMISTRY IN DAILY LIFE

Medicines: Used in the areas of treatment, prevention and disinfection

Category	Usage	Examples
1. Antipyretics	Reducing body temperature	Paracetamol, Aspirin
2. Analgesics	Relieve pain	Aspirin, Novalgin
3. Antiseptics	Control germs in wounds	Dettol, Tincture Iodine
4. Antacids	Reduce acidity	Magnesium hydroxide, Magnesium carbonate
5. Anesthetics	To become unconscious	Chloroform, Iodoform
6. Antibiotics	Kill bacteria that cause diseases	Penicillin, Ambicillin, Amoxicillin

- Unhealthy practices regarding the uses of medicines.

‣Self treatment ‣Over dosage ‣Incomplete uses ‣Unscientific treatment ‣Uses of expired medicines

Polymers: ‣Natural (Cotton,Rubber,Silk,Wool,Starch) ‣Synthetic (Plastic,Glass,Cement,Synthetic rubber)

Plastics – Alexander Parkkes: Two types.

‣Thermoplastic – It can be moulded again and again by heating (Physical change-recycle type). eg: nylon,PVC,polyethene

‣Thermosetting – It cannot be reshaped by heating (Chemical change). eg: Bakelite, Terylene, Polyester

Important: Scientific recycling of thermoplastics controls solid wastes up to a boundary

Pesticides (Used to control pests in the agricultural lands): Two types

‣Bio pesticides: Tobacco extract, Garlic extract, Neem seed extract.

‣Chemical pesticides: Endosulfan (Organo chloride), Malathion (Organophosphate)

‣Advantages: control pests, easy to prepare, suitable to more lands, destroy almost all pests.

‣Disadvantages: destruction of eco-friendly pests, pollution, causes diseases, extinct small living organisms.

Cement: Aluminate+Silicate

Limestone and clay are heated at a high temperature (1500^0C) in a rotary klin. The raw material produced is cement clinker. This is powdered after mixing with 2% gypsum (Calcium Sulphate) forms cement. The gypsum is added to control the setting time of cement. Setting is the process in which cement mixed with water.

Glass: Super Cooled Liquid.

Glass	Contents	Uses
Soda Glass	Silica, Na_2CO_3,$CaCO_3$	Window, mirror glass
Hard Glass	Silica, K_2CO_3,$CaCO_3$	Laboratory, factory equipments
Optic(Flint) Glass	Silica, K_2CO_3,Na_2CO_3, PbO	Lens and Prism
Borosilicate Glass	Silica, Na_2CO_3,$CaCO_3$, Al_2O_3, B_2O_3	Laboratory, factory equipments
Fibre Glass	Produces fibers by mixing plastics to melted glass	Furniture, Bullet proof objects
Safety Glass	A plastic sheet is pasted in between two glass sheets by heating	Wind shield in vehicles

Coloured Glass: Iron Oxide (Red), Copper Oxide (Green), Cobalt Oxide (Blue), Manganese dioxide (Purple)

Green Chemistry: Paul Anastas (Father)
Manufacturing goods without causing environmental problems and ensuring the protection of the living beings.