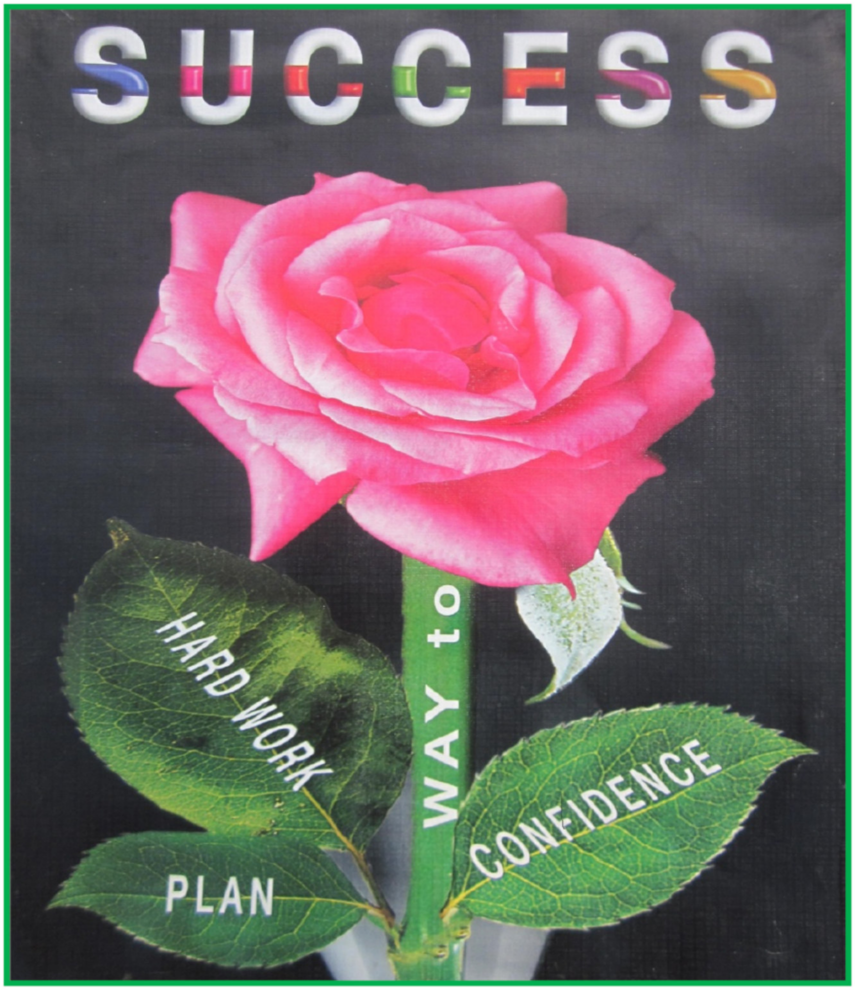
CHEMISTRY IS BASIC FOR OUR LIFE

+2 - CHEMISTRY



IMPOSSIBLE AND CANNOT ARE TWO WORDS THAT SHOULD NOT BE IN THE DICTIONARY OF THE STUDENTS...

NAME	**:**
CLASS	**:**
SCHOOL :	

P KATHIRVEL, M.Sc.,B.Ed., PG TEACHER IN CHEMISTRY, GBHSS - ANTHIYUR - ERODE. (Dt)

* உயர்வாக நினைத்தால் உயர்ந்திட முடியும் *

12-STD CHEMISTRY

1. METALLURGY

1. What is the difference between minerals and ores?

	Minerals	Ores
1.	Naturally occuring substances obtained by mining which contain the metals in free state or in the form of compounds	Minerals that contain high percentage of metal
2.	Metal can not be extracted easily from minerals	Metal can be extracted easily from ores
3.	All the minerals are not ores	All the ores are minerals
4.	Mineral of Al is Bauxite and Clay	Ore of Al is Bauxite

2. What are the various steps involved in extraction of pure metals from their ores?

- Concentration of the ore
- Extraction of crude metal
- Refining of crude metal

3. What is Flux? What is the role of quick lime in the extraction of Iron from Fe_2O_3?

- A chemical substance that forms an easily fusible slag with gangue
- Quick lime is used as a basic flux
- Quick lime combines with silica to form calcium silicate (slag).
- $CaO + SiO_2 \longrightarrow CaSiO_3$

4. Which type of ores can be concentrated by Gravity separation and froth flotation methods ? Give two examples for such ores.

- Gravity separation - Oxide ores - Haematite (Fe_2O_3), Tin stone (SnO_2)
- Froth flotation - Sulphide ores - Galena [PbS], Zinc blende [ZnS]

5. Describe a method for refining nickel.

Mond process

- Impure nickel + Carbon monoxide $\xrightarrow{350K}$ Nickel tetra carbonyl

  $Ni + 4CO \xrightarrow{350K} [Ni(CO)_4]_{(g)}$
- Nickel tetra carbonyl $\xrightarrow{460K}$ Pure nickel + Carbon monoxide

  $[Ni(CO)_4]_{(g)} \xrightarrow{460K} Ni + 4CO$

“முடியாது, இயலாது என்ற வார்த்தைகள் மாணவர்களின் அகராதியில் இருக்கக் கூடாது”

6. Explain zone refining process with an example

- Prninciple - Fractional crystallisation
- The impure metal is taken in the form of a rod
- When the metal rod is heated with mobile induction heater, the metal melts.
- The heater is slowly moved from one end to the other end, the pure metal crystallises.
- The impurity dissolves in the molten zone.
- When the heater moves the molten zone also moves.
- This process is repeated again and again to get the pure metal.
- This process is carried out in an inert gas atmosphere to prevent the oxidation of metals.
- Eg. Silicon (Si), Germanium (Ge) and Gallium (Ga)

7. Give the limitations of ellingham diagram.

- It does not explain rate of reaction.
- It does not give any idea about the possibility of other reactions taking place.
- ΔG is assume at equilibrium condition, but it is not always true.

8. Give the uses of zinc.

- Galvanizing iron to protect from rusting
- It produce die-castings in the automobile and electrical industries
- Zinc sulphide - to produce luminous paints, fluorescent lights and x-ray screens
- Zinc oxide - to Prepare Paints, rubber, Plastics, and Ink

9. Explain the electro metallurgy of Aluminium

Electro metallurgy of Aluminium : Hall - Herould process

- Cathode - Iron tank coated with Carbon
- Anode - Carbon rod
- Electrolyte - 20% Alumina + Cryolite + 10% Calcium Chloride (lower the melting point of the mixture)
- Temperature - Above 1270K
- Anodes are slowly consumed during the electrolysis.
- Pure Aluminium is deposited at the cathode and settles at the bottom.

$$4A\ell^{3+}(\text{melt}) + 6O^{2-}(\text{melt}) + 3C \longrightarrow 4A\ell_{(\ell)} + 3CO_2$$

10. Explain the following terms with suitable examples. (i) Gangue (ii) slag

(i) Gangue : The nonmetallic impurities and rocky materials associated with ore - SiO_2

(ii) Slag : The flux combines with gangue to form calcium slag - $CaSiO_3$

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

11. Give the basic requirements for vapour phase refining. Give examples.

- The metal should form a volatile compound with the reagent.
- The volatile compound decomposes to give the pure metal
- Mond process - Nickel
  Van-Arkel process - zirconium / titanium

12. Describe the role of the following in the process mentioned.

(i) Silica in the extraction of copper

Silica (flux) combines with ferrous oxide to give ferrous silicate (slag).

$$FeO + SiO_2 \longrightarrow FeSiO_3$$

(ii) Cryolite inthe extraction of aluminium

Cryolite - lower the melting point of the mixture

(iii) Iodine in the refining of zirconium

To form of volatile compound so as to give pure metal on decomposition

(iv) Sodium cyanide in froth flotation.

Sodium cyanide act as depressing agents.

It is used to selectively prevent other metal sulphides from coming to the froth.

13. Explain the principle of electrolytic refining with an example.

- Anode - Impure metal
- Cathode - Pure metal
- Electrolyte - Acidified aqueous solution of metal salts

During electrolysis pure metal is deposited at the cathode

Electrolytic refining of Silver

- Anode - Impure Silver
- Cathode - Pure Silver
- Electrolyte - Acidified aqueous solution of silver nitrate.

During electrolysis pure Silver is deposited at the cathode

$$Ag \longrightarrow Ag^+ + 1e^- \quad \text{(Anode)}$$

$$Ag^+ + 1e^- \longrightarrow Ag \quad \text{(Cathode)}$$

14. Using the Ellingham diagram given below. Predict the conditions under which

i) Aluminium might be expected to reduce magnesia.

At above 1600K aluminium can reduce magnesia

ii) Magnesium could alumina.

At below 1600K Magnesium can reduce alumina.

15. Write short note on electrochemical principles of metallurgy.

- When a more reactive metal is added to the solution containing the relatively less reactive metal ions, the more reactive metal will go into the solution.
- Gibbs free energy change for the electrolysis process is

$\Delta G^0 = -nFE^0$

n = number of electrons, F = Faraday,

E^0 is the electrode potential of the redox couple.

- In Spontaneous reaction : E^o is positive and ΔG^o is negative.

16. **Explain Auto reduction reaction**

Roasting of some ores give the metal even in the absence of a reducing agent..

$$HgS + O_2 \longrightarrow Hg + SO_2$$

17. What is Concentration? Give the methods of Concentration.

The process of removal nonmetallic impurities and rocky materials from the ore is called as concentration**.**

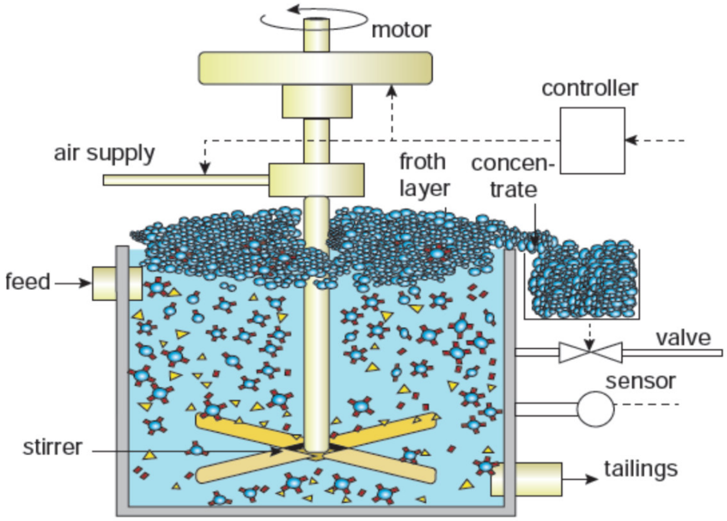
Types of Concentration

1. Gravity separation 2. Froth flotation
3. Leaching 4. Magnetic separation

18. Explain the Gravity separation

- High specific gravity of ore is separated from low specific gravity the gangue.
- The powdered ore is washed with a flowing current of water.
- The lighter gangue particles are washed away by water.
- Ex - Oxides ores like Tin Stone, Haematite.

19. **Explain the Froth Floatation process.**



- Galena, Zinc blende ore is concentrated by this method
- The metallic ore particles preferentially wetted by oil can be separated from gangue.
- Frothing agent - Pine oil
- Collector - Sodium Ethyl Xanthate
- Depressing agent - Sodium cyanide
- The powdered ore is mixed with water and pine oil.
- When air is passed, it produces froth.
- The ore particles rise to the surface and collected separately.
- The Impurities settles at the bottom of the container

20. **What is Leaching? Give the methods of Leaching.**

- The ore is crushed and dissolved in the suitable solvent.
- The metal is converted into a soluble salt.
- Insoluble Gangue particles are removed.
- Methods of Leaching

1.Acid leaching 2.Alkali leaching
3.Cyanide leaching 4. Ammonia leaching

21. **Explain any three methods of Leaching.**

1. Acid leaching

Sulphide ores like ZnS, PbS etc., can be done by treating them with hot aqueous H_2SO_4
The insoluble sulphide is converted into soluble sulphate and elemental sulphur.

$$2ZnS\,(s) + 2H_2SO_4\,(aq) + O_2(g) \longrightarrow 2ZnSO_4\,(aq) + 2S\,(s) + 2\,H_2O$$

2. Ammonia leaching

When a crushed ore containing nickel, copper is treated with aqueous ammonia.
Ammonia selectively leaches these metals by forming their soluble complexes.
From the ore leaving behind the gangue like alumina silicate.

3.Cyanide leaching

Gold is leached with dilute sodium cyanide solution. It is converted into soluble cyanide complex.

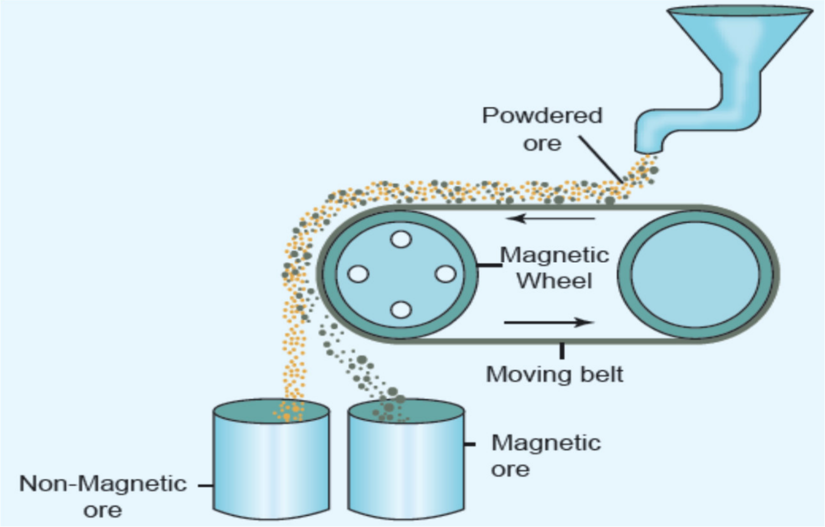
$$4Au\,(s) + 8CN^-\,(aq) + O_2\,(g) + 2H_2O\,(l) \longrightarrow 4[Au(CN)_2]^-\,(aq) + 4OH^-(aq)$$

Gold can be recovered by reacting the deoxygenated leached solution with zinc.

$$Zn\,(s) + 2[Au(CN)_2]^-\,(aq) \longrightarrow [Zn(CN)_4]^{-2}(aq) + 2Au\,(s)$$

22. **Explain the Magnetic separation process.**

- It is based on the difference in the magnetic properties of the ore and the impurities.
- It is used to concentrate ferromagnetic ores
- Tin stone can be separated from the wolframite impurities
- The powdered ore is added on an electro magnet containing a moving belt on a magnetic rollers.
- The magnetic ore falls near the magnet.
- The non magnet patrs fall away from the magnet.



வெற்றிக்கான முதல் படியே தன்னம்பிக்கை தான்...
தன்னம்பிக்கை இல்லாத ஒருவருக்கு வெற்றி ஒரு போதும் சாத்தியமாகாது.

23. **Define Roasting**

The Ore is oxidised by heated in the presence of Oxygen in a furnace below the melting point of the metal

$$2\,ZnS + 3\,O_2 \longrightarrow 2\,ZnO + 2\,SO_2$$

24. **Define Calcination**

The concentrated ore is strongly heated in the absence of air is called Calcination.

$$CaCO_3 \longrightarrow CaO + CO_2$$

25. **Define Smelting**

The ore is heating above the melting point in the presence of Flux and reducing agents like Carbon in a smelting furnace. The water molecules are removed as moisture.

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

26. **Explain Reduction by carbon**

In this method the oxide ore of the metal is mixed with coal and heated in a blas furnace.

$$ZnO + C \longrightarrow Zn + CO$$

27. **How Titanium is refined by the Van-Arkel method?**

- Impure Titanium + Iodine $\xrightarrow{550K}$ Titanium tetra-iodide

  $$Ti + 2I_2 \xrightarrow{550K} TiI_4\,(g)$$

- Titanium tetra-iodide $\xrightarrow[\text{Tungsten filament}]{1800K}$ Pure Titanium

  $$TiI_4\,(g) \xrightarrow{1800K\,/\,W} Ti + 2I_2$$

28. **What is Distillation?**

- The impure metal is heated to evaporated
- The vapours are condensed to get pure metal.
- This method is employed for low boiling volatile metals like zinc.

29. **Explain Liquation**

- This method is used to remove high melting point impurities from low melting point metals
- The impure metal is heated in the absence of air in a sloping furnace
- Pure metal melts and flows down and collected separately
- The impurities remain on the slope.
- Eg. Tin, Lead

30. **What is blistered copper?**

The metallic copper is solidified and it has blistered appearance due to evolution of SO_2 gas formed in this process. This copper is called blistered copper.

முயற்சிகள் தவறலாம்... ஆனால் முயற்சிக்க தவறாதே...

31. **What is mean by Ellingham diagram?**

The graphical representation of variation of the std.Gibbs free energy (ΔG^0) of reaction for the formation of various metal oxides with temperature is called Ellingham diagram

32. **What are the Observations of Ellingham diagram?**

- The formation metal oxides gives a positive slope. The value of ΔS is negative.
- The formation of Carbon monoxide gives a negative slope. The value of ΔS is positive. So Carbon monoxide is more stable at high temperature
- For MgO, due to phase transition, there is a sudden change in the slope at a particular temperature.

33. **What are the applications of Ellingham diagram**

- The Ellingham diagram for the formation of Ag_2O and HgO is at the upper part of the diagram. So, these oxides are unstable and decompose on heating even in the absence of a reducing agent.
- Ellingham diagram is used to predict the thermodynamic feasibility of reduction of metal oxides by another metal.
  Ex. Aluminium can be reduce Chromic oxide.
- Carbon line cuts the line of many metal oxides. Hence it can reduce all metal oxides at high temperature

34. **What is cementation**?

When Gold-cyanide complex reacting with zinc, Gold is reduced to its elemental state (zero oxidation sate). The process is called cementation.

35. **What is Anode mud?**

During electrolysis the less electropositive impurities settles at the bottom of the Anode. These are called as Anode mud.

36. **Explain the Alumino thermic process**

- Chromic oxide is mixed with Aluminium powder and heated in a fire clay crucible.
- A mixture of barium peroxide and Mg powder is placed over it
- When ignited large amount of heat is produed, Aluminium reduces Chromic oxide.

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

37. Give the uses of Aluminium

- Make cooking vessles
- Aluminium foil- packing materials for food
- Make medical equipments
- It is used in design of aeroplanes

38**. Give the uses of Iron (Fe)**

- Make cutting tools
- Make magnets,
- Make Bridges
- Make automobiles parts

39. Give the uses of Copper (Cu)

- Make wires
- Make coins & and water pipes
- Gold -Copper alloys - Make ornaments

40. Give the uses of Gold (Au)

- Make coins
- Gold -Copper alloys - Make ornaments
- Electro plating of watches
- Gold nanoparticles - Increasing the efficiency of solar cells

41. **Explain the Extraction of Copper from its ore**

1. Ore - Copper pyrites
2. Concentration - Froth Flotation process
3. Roasting

$$2CuFeS_2 + O_2 \longrightarrow Cu_2S + 2FeS + SO_2$$
$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$$

4. Smelting

$$FeO + SiO_2 \longrightarrow FeSiO_3$$
$$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$$
$$Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2$$

5. Electrolytic refining

- Anode - Impure Copper
- Cathode - Pure Copper
- Electrolyte - $CuSO_4$ + dil. H_2SO_4
  During electrolysis pure Copper is deposited at the cathode

2. P - BLOCK ELEMENTS - I

1. **Give examples for each of the following**
    - Icosogens – Boron (B), Aluminium (Al), Gallium, Indium, Thallium
    - Tetragens – Carbon (C), Silicon (Si), Germanium, Tin, Lead
    - Pnictogens – Nitrogen (N), Phosphorus(P), Arsenic, Antimony, Bismuth
    - Chalcogen – Oxugen (O), Sulphur (S), Selenium, Tellurium, Polonium
2. **Write a short note on anamolous properties of the first element of p-block.**
    - Small size
    - High ionisation enthalpy and high electronegativity
    - Absence of d-orbitals.
3. **Write a note on metallic nature of p-block elements.**
    - The tendency of an element to form a cation by loosing electrons is known as metallic character.
    - This character depends on the ionisation energy.
    - Generally on descending a group the ionisation energy decreases and hence the metallic character increases.
    - In p-block, the elements present in lower left part are metals while the elements in the upper right part are non metals.
4. **Describe briefly allotropism in p-block elements with specific reference to carbon.**
    - Some elements exist in more than one crystalline form in the same physical state. This is called allotropism.
    - Allotropes of carbon - Diamond, Graphite, Graphene, Fullerenes, Carbon nanotubes
5. **What is catenation ? Describe briefly the catenation property of carbon.**

    Catenation is an ability of an element to form chain of atoms.

    Carbon forms a wide range of compounds with C, H, N, S

    <u>Conditions</u>

    - Valency of element is greater than or equal to two
    - Element should have an ability to bond with itself
    - Self bond must be strong
    - Kinetic inertness of catenated compound towards other molecules
6. **How will you identify borate radical ? (or) Give Ethyl borate test**

    Boric acid + Ethanol $\xrightarrow{\text{Con. Sulpuric acid}}$ Tri Ethyl borate (greeen flame)

    $$B(OH)_3 + 3C_2H_5OH \xrightarrow{\text{con. } H_2SO_4} B(OC_2H_5)_3 + 3H_2O$$
7. **How will you convert boric acid to boron nitride?**

    Boric acid + Ammonia $\xrightarrow{800\text{–}1200K}$ Boron nitride

    $$B(OH)_3 + NH_3 \xrightarrow{800\text{–}1200K} BN + 3H_2O$$
8. **Write a short note on hydroboration?**

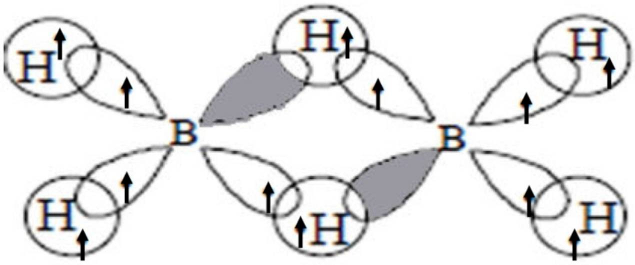
    Diborane + Alkene $\xrightarrow{\text{Ether}}$ Trialkylborane

    $$B_2H_6 + 6RCH{=}CHR \longrightarrow 2B(RCH\text{-}CH_2R)_3$$

9. **Give the uses of Borax**
   - To identify coloured metal ions.
   - To manufacture optical
   - As flux in metallurgy
   - Acts as preservative

10. **Give the uses of silicones.**
    - Lubricants
    - Water proof cloths
    - Insulating material in electrical motor
    - Low temperature vaccuum pumbs and High temperature oil baths
    - Mixed with paints to make them resistance towards sun light

11. **Describe the structure of Diborane**



- Two BH_2 units are linked by two bridged hydrogens.
- It has eight B-H bonds and 12 valance electrons
- The four terminal B-H bonds are 2c-2e bond
- The remaining four electrons have to be used for the two bridged B-H-B bonds (3C – 2e)
- In diborane, the boron is SP^3 hybridised
- The bridging hydrogen atoms are in a plane
- B–H–B bond formed by overlapping the half filled hybridised orbital of one boron, the empty hybridised orbital of the other boron and the half filled s orbital of hydrogen.
- It is also called as banana bond.

12. **Hydride of 2nd period alkali metal (A) on reaction with compound of Boron (B) to give a reducing agent (C). Identify A, B and C.**
    - Second period alkali metal A - Li

    Hydride of A + Boron compound (B) $\longrightarrow$ Reducing agent (C)

    $2LiH + B_2H_6 \longrightarrow 2LiBH_4$
    - A - Li,
    - B - B_2H_6,
    - C - $LiBH_4$.

ஒவ்வொருவர் முன்னேற்றத்திற்கும் அவரவர் தன்னம்பிக்கையே காரணம்...
நம்மை தவிர நம் முன்னேற்றத்தை தடுக்க யாராலும் முடியாது.....

13. **Write a note on Fischer Tropsch synthesis**

$$\text{Carbon monoxide} + H_2 \xrightarrow[500\,K - 700\,K]{Cu / 50atm} \text{Hydrocarbon}$$

$$nCO + 2nH_2 \xrightarrow[500\,K - 700\,K]{Cu / 50atm} C_nH_{2n} + nH_2O$$

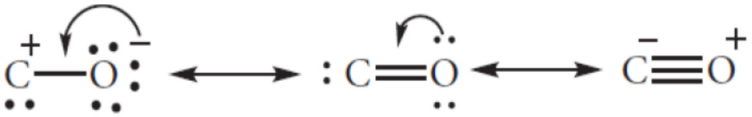
14. **CO is a reducing agent. Justify with an example.**

Carbon monoxide reduce iron oxide to iron

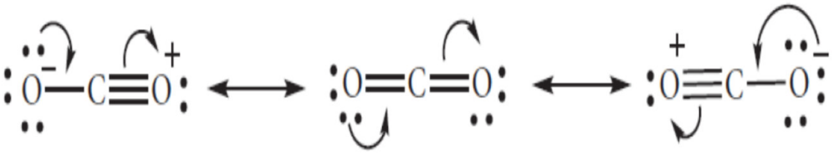
$$3CO + Fe_2O_3 \longrightarrow 2\,Fe + 3\,CO_2$$

15. **Give the structure of CO and CO_2**

CO - Linear structure



CO_2 - Linear structure



16. **Write a note on Zeolites?**

- Zeolites are three-dimensional crystalline solids containing aluminium, silicon, and oxygen.
- Si and Al atoms are tetrahedrally coordinated with oxygen atoms.
- They are Hydrated sodium alumino silicate ($NaO.\ Al_2O_3.\ x\ SiO_2.\ y\ H_2O$)
- They have porous structure in which the monovalent sodium ions and water molecules are loosely held.
- Water molecules move freely in and out of these pores
- They have crystalline structure looks like a honeycomb consisting of a network of interconnected tunnels and cages
- The crystal act as a molecular sieve

17. **From Aluminium to Thalium only a marginal difference in ionization enthalpy why?**

- Poor shielding effect.
- Highly Effective nuclear charge
- Presence of inner d and f electrons

18. **Boron form co-valent compounds why?**

- Small size
- High ionization energy
- Similarty in electronegativity with carbon

லட்சியம் இருக்குமிடத்தில்.. அலட்சியம் இருக்காது...

19. How to prepare Borax?

Colemanite + Sodium carbonate $\xrightarrow{\Delta}$ Borax

$$2Ca_2B_6O_{11} + 3Na_2CO_3 + H_2O \xrightarrow{\Delta} 3Na_2B_4O_7 + 3CaCO_3 + Ca(OH)_2$$

20. Write a note on Borax bead test.

$$Na_2B_4O_7.10H_2O \xrightarrow[-10H_2O]{\Delta} Na_2B_4O_7 \longrightarrow 2NaBO_2 + B_2O_3$$

21. **What is the action of heat on Boric acid**

- Boric acid $\xrightarrow{373K}$ Metaboric acid

$$4H_3BO_3 \xrightarrow{373\ K} 4HBO_2 + 4\,H_2O$$

- Metaboric acid $\xrightarrow{413K}$ Tetraboric acid

$$4HBO_2 \xrightarrow{413\ K} H_2B_4O_7 + H_2O$$

- Tetraboric acid $\xrightarrow{\text{red hot}}$ Boric anhydride

$$H_2B_4O_7 \xrightarrow{\text{Red hot}} 2B_2O_3 + H_2O$$

22. **Explain H_3BO_3 is a mono basic acid.**

- Boric acid is a weak monobasic acid
- It accepts hydroxyl ion rather than donating proton

$$B(OH)_3 + 2H_2O \rightleftharpoons H_3O^+ + [B(OH)_4]^-$$

23. **Write the action of diborane on ammonia (or)**
What is inorganic benzene? How to prepare it?

Diborane + Ammonia $\xrightarrow{\text{High T}}$ Borazole (or) Borazine (Inorganic benzene)

$$3B_2H_6 + 6NH_3 \xrightarrow[\text{Clossed vessel}]{\text{High temp}} 2B_3N_3H_6$$

24. **Write the equation for diborane react with metalhydride**

$$B_2H_6 + 2LiH \xrightarrow{\text{Ether}} 2LiBH_4$$

25. **Write the Laboratory preparation of Boron tri-fluoride.**

$$C_6H_5N_2BF_4 \xrightarrow{\Delta} BF_3 + C_6H_5F + N_2$$

26. **Give the uses of Boron**

- Boron is used as a rocket fuel igniter
- Moderator in nuclear reactors.
- Essential for the cell walls of plants.

27. **How will you prepare Aluminium chloride by McAfee Process?**

Aluminium chloride is obtained by heating a mixture of alumina and coke with chlorine.

$$2Al_2O_3 + 3C + 6Cl_2 \longrightarrow 4AlCl_3 + 3CO_2$$

28. **Give the uses of Boric acid**
    - Boric acid is used to food preservative
    - Manufacture of pottery glases
    - Antiseptic and Eye lotion.
    - Food preservative

29. **Give the uses of Diborane**
    - Diborane is used as a high energy fuel for propellant
    - Reducing agent in organic chemistry
    - Welding torches

30. **Give the uses of Aluminium chloride**
    - Aluminium chloride is used to manufacture on dyes, drugs and perfumes
    - It is used for the manufacture of petrol by cracking the mineral oils.
    - Anhydrous aluminium chloride is used as a catalyst in Friedel Crafts reaction

31. **How will you prepare potash alum?**
    - Alum stone is treated with excess of sulphuric acid
    - Then calculated quantity of potassium sulphate is added
    - The solution is crystallised to generate potash alum

$$K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3 + 6H_2SO_4 \longrightarrow K_2SO_4 + 3Al_2(SO_4)_3 + 12\,H_2O$$

$$K_2SO_4 + Al_2(SO_4)_3 + 24\,H_2O \longrightarrow K_2SO_4.Al_2(SO_4)_3.24\,H_2O$$

32. **What is burnt alum?**
- At 475 K - 500K potash alum loses water of hydration and swells up
- The swollen mass is known as burnt alum.

$$K_2SO_4.Al_2(SO_4)_3.24\,H_2O \xrightarrow{500\,K} K_2SO_4.Al_2(SO_4)_3 + 24\,H_2O$$

33. **Write the action of heat on potash alum.**

$$K_2SO_4.Al_2(SO_4)_3.24\,H_2O \xrightarrow{500\,K} K_2SO_4.Al_2(SO_4)_3 + 24\,H_2O$$

$$K_2SO_4.Al_2(SO_4)_3 \xrightarrow{\text{Red hot}} K_2SO_4 + Al_2O_3 + 3SO_3$$

34. **Give the uses of potash alum**.
    - Potash alum is used for purification of water
    - It is used for water proofing and textiles
    - It is used in dyeing and paper industries
    - It is used as a styptic agent to arrest bleeding.

35. **Write a short note on graphene**.
    - Graphene has a single planar sheet
    - Honeycomb crystal lattice.
    - Each carbon atom is sp^2 hybridised

இலட்சியம் இல்லாத இதயம், வெறும் சதைகோளம் தான்...

36. Write a short note on fullerences.

- Fullerences are discrete molecules such as C_{32}, C_{50}, C_{60}, C_{70}
- Cage like structures
- C_{60} molecules have a soccer ball like structure. It is called as buckyballs
- It has a fused ring structure consists of 20 six membered rings and 12 five membered rings
- Each carbon atom is sp^2 hybridised and aromatic character
- C-C bond distance is 1.44A° and C=C bond distance is 1.38A°

37. Write a short note on Carbon nano tubes

- Carbon nano tubes are stronger than steel
- Conduct electricity
- It is used for Nanoscale electronics
- Catalysis
- Polymers and medicine.

38. Differentiate Graphite and Diamond

	Graphite	**Diamond**
1.	Soft	Hard
2.	Conducts electricity	Do not conduct electricity
3.	It has free electrons	There is no free electrons
4.	SP^2 hybridised	SP^3 hybridised
5.	Hexagonal net arrangement	Tetrahedral arrangement
6.	Used as a lubricant.	Used for cutting Glasses and rock drilling

39. Write oxo process

Carbon monoxide is mixed with ethene and hydrogen gas to produce propanal.

$$CO + H_2 + CH_2{=}CH_2 \longrightarrow CH_3\text{-}CH_2\text{-}CHO$$

40. What is Producers Gas?

The mixture of carbon monoxide and nitrogen is called producer gas.

$$2C + O_2/N_2\ (air) \longrightarrow \underset{\text{Producers Gas}}{2CO + N_2}$$

41. Write notes on laboratory preparation of carbon-di-oxide.

$$CaCO_3 + 2\,HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

42. Describe Industrial preparation of carbon-di-oxide.

Carbon-di-oxide is produced by burning coke in excess of air.

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

43. **Write water gas equilibrium reaction.**

$$CO_2 + H_2 \rightleftharpoons \underset{\text{Water gas}}{CO + H_2O}$$

44. **Write Oxidising behaviour of carbon-di-oxide.**

$$CO_2 + Mg \longrightarrow 2MgO + C$$

45. **Write Acidic behaviour of carbon-di-oxide.**

The aqueous solution of carbon dioxide is acidic as it forms carbonic acid.

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

46. **Give the uses of carbon-di-oxide.**

- Carbon-di-oxide is used as fire extinguisher
- It is used in the production of Cool drinks
- It is important for photosynthesis.

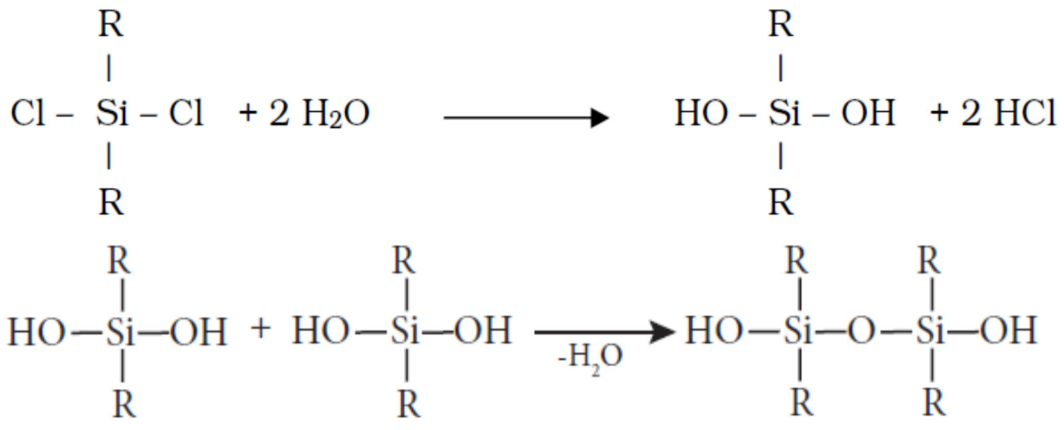
47. **Give the uses of carbon monoxide**

- Carbon monoxide is a good reducing agent
- It is an important ligand and forms carbonyl compound
- Water gas and producer gas are industrial fuels

48. **What is Silicones? Explain its preparation and uses?**

- Silicones are organo silicon polymers
- General empirical formula R_2SiO.
- **Preparation**

$$2RCl + Si \xrightarrow{Cu\,/\,570\,K} R_2SiCl_2$$



$$Cl-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-Cl + 2\,H_2O \longrightarrow HO-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-OH + 2\,HCl$$

$$HO-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-OH + HO-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-OH \xrightarrow[-H_2O]{} HO-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-O-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{Si}}-OH$$

Types of silicones

1. Linear Silicones - obtained by the hydrolysis of dialkyl silicon chlorides.
   - Silicone Rubbers - Bridged together by methylene groups
   - Silicone Resins - Obtained by blending Silicones with organic resins
2. Cyclic Silicones - Obtained by the hydrolysis of R_2SiCl_2
3. Cross linked Silicones - Obtained by the hydrolysis of $RSiCl_3$

49. **Give the Properties of silicones**

- Silicones are water repellent
- Thermal and electrical insulators
- Chemically they are inert.

50. **Explain the types of Silicates with example**

The mineral which contains silicon and oxygen in tetrahedral units $[SiO_4]^{4-}$ linked together in different patterns are called silicates

	Name of the Silicate	**Molecular formula**	**Sharing of Oxygen atoms**	**Examples**
1	Ortho (or) Neso Silicates	$[SiO_4]^{4-}$	No	Phenacite
2	Pyro (or) Soro Silicates	$[Si_2O_7]^{6-}$	1	Thortveitite
3	Cyclic (or) Ring Silicates	$[SiO_3]_n^{2n-}$	2	Beryl
4	Chain Silicates	$[SiO_3]_n^{2n-}$	2	Spodumene
5	Double chain Silicates	$[Si_4O_{11}]_n^{6n-}$	2	Asbestos
6	Sheet Silicates	$[Si_2O_5]_n^{2n-}$	3	Mica
7	Three dimensional Silicates	$[SiO_2]_n$	4	Quartz

51. **Complete the following reactions**

a. $B(OH)_3 + NH_3 \longrightarrow$
$B(OH)_3 + NH_3 \xrightarrow{\Delta} BN + 3H_2O$
b. $Na_2B_4O_7 + H_2SO_4 + H_2O \longrightarrow$
$Na_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow Na_2SO_4 + 4H_3BO_3$
c. $B_2H_6 + 2NaOH + 2H_2O \longrightarrow$
$B_2H_6 + 2NaOH + 2H_2O \longrightarrow 2NaBO_2 + 6H_2$
d. $B_2H_6 + CH_3OH \longrightarrow$
$B_2H_6 + 6CH_3OH \longrightarrow 2B(OCH_3)_3 + 6H_2$
e. $BF_3 + 9\ H_2O \longrightarrow$
$4BF_3 + 12H_2O \longrightarrow 4H_3BO_3 + 12HF$
f. $HCOOH + H_2SO_4 \longrightarrow$
$HCOOH + H_2SO_4 \longrightarrow CO + H_2SO_4 \cdot H_2O$
g. $SiCl_4 + NH_3 \longrightarrow$
$2SiCl_4 + NH_3 \xrightarrow[\text{Ether}]{\text{330 K}} Cl_3Si\text{-}NH\text{-}SiCl_3 + 2HCl$
h. $SiCl_4 + C_2H_5OH \longrightarrow$
$SiCl_4 + 4C_2H_5OH \longrightarrow Si(OC_2H_5)_4 + 4HCl$
i. $B + NaOH \longrightarrow$
$2B + 6NaOH \longrightarrow 2Na_3BO_3 + 3H_2$
j. $H_2B_4O_7 \xrightarrow{\text{Red hot}}$
$H_2B_4O_7 \xrightarrow{\text{Red hot}} 2B_2O_3 + H_2O$

3. P - BLOCK ELEMENTS - II

1. What is inert pair effect?

As we move down the group in p–block elements,

- The outer ns electrons become inert and do not involve in chemical reactions.
- Only np electrons take part in chemical reaction.
- This is known as inert pair effect.

2. Chalcogens belongs to p–block. Give reason.

- In these elements the last electron enters np orbital.
- Their general electronic configuration is ns^2np^4.

3. Explain why fluorine always exhibit an oxidation state of -1?

- Small size
- High electronegativity
- Absence of d-orbitals

4. Why fluorine is more reactive than other halogens?

- Small size
- High electronegativity
- The low value of F–F Bond dissociation energy.

5. What are interhalogen compounds? Give the preparation and examples.

Each halogen combines with other halogens to form a series of compounds called inter halogen compounds.

E.g : BrF, IF_5, IF_7

6. Give the Properties of inter halogen compounds

- The central atom will be the larger one
- It can be formed only between two halogen and not more than two halogens.
- They can undergo the auto ionization.
- They are strong oxidizing agents
- Fluorine can't act as a central metal atom being the smallest one

7. Noble gases have the largest ionisation energy. Why?

- Noble gases have completely filled orbital (ns^2np^6)in their outer most shell.
- They are extremely stable and have a small tendency to gain or lose electrons.

8. Give the hybridisation and structure of the following compounds.

Compounds	Hybridisation	Structure	bond pairs / lone pairs
BrF, ClF	sp^3	Linear	1 / 3
BrF_3, ClF_3	sp^3d	T shaped	3 / 2
BrF_5, IF_5	sp^3d^2	Square pyramidal	5 / 1
IF_7	sp^3d^3	Pentagonal bipyramidal	7 / 0

9. Write the valence shell electronic configuration of group-15 elements.

General electronic configuration - ns^2np^3

N	P	As	Sb	Bi
$2s^22p^3$	$3s^23p^3$	$4s^24p^3$	$5s^25p^3$	$6s^26p^3$

10. Give the uses of helium.

- Helium is used for filling air balloons.
- He - O_2 mixture is used by divers
- It is used in cryogenics
- It is used in electric arc welding of metals

11. Give the uses of Neon

- Neon is used in advertisement as neon sign
- The brilliant red glow is caused by passing electric current through neon gas under low pressure.

12. Give the uses of argon.

- Argon prevents the oxidation of hot filament
- Prolongs the life in filament bulbs

13. Give the uses of Krypton.

- Krypton is used in fluorescent bulbs, flash bulbs etc...
- It is used in airports as approaching lights as they can penetrate through dense fog.

14. Give the uses of Xenon and Radon.

Xenon

- Xenon is used in fluorescent bulbs, flash bulbs and lasers.
- It is used in high speed electronic flash bulbs used by photographers

Radon

Radon gas is sealed as small capsules and implanted in the body to destroy cancer growth

15. How will you prepare chlorine in the laboratory?

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

16. Give the equation for the reaction between chlorine with cold NaOH and hot NaOH.

- Chlorine + cold NaOH $\longrightarrow$ Sodium hypochlorite

$$Cl_2 + 2NaOH \longrightarrow NaOCl + NaCl + H_2O$$

- Chlorine + hot NaOH $\longrightarrow$ Sodium chlorates

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

17. Give the uses of sulphuric acid.

- As a drying agent.
- In the preparation of explosives
- In the manufacture of fertilizers
- In the manufacture of HCl, HNO_3

18. Give a reason to support that sulphuric acid is a dehydrating agent.

Sulphuric acid has strongly affinity towards water.

$$C_{12}H_{22}O_{11} + H_2SO_4 \longrightarrow 12C + H_2SO_4.11H_2O$$

$$HCOOH + H_2SO_4 \longrightarrow CO + H_2SO_4.H_2O$$

19. Sulphuric acid is dibasic acid Explain

Sulpuric acid react with base to give two types of salts namely sulphates and bisulphates.

$$H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$$

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$$

20. Write the reason for the anomalous behaviour of Nitrogen.

- Small size
- High electro negativity
- High ionization energy
- Form multiple bonds

21. What happens when PCl_5 is heated?

$$PCl_5 \longrightarrow PCl_3 + Cl_2$$

22. Give two equations to illustrate the chemical behaviour of phosphine.

1. **Thermal stability**

$$4PH_3 \xrightarrow{317K} P_4 + 6H_2$$

2. **Reducing property**

$$3AgNO_3 + PH_3 \longrightarrow Ag_3P + 3HNO_3$$

23. Explain the preparation of Ammonia by Haber's process

$$\text{Nitrogen} + \text{Hydrogen} \xrightarrow[\text{High T, Low P}]{\text{Fe}} \text{Ammonia}$$

$$N_{2(g)} + 3H_{2(g)} \overset{Fe}{\rightleftharpoons} 2NH_{3(g)} \qquad \Delta H^0_f = -22.0\ \text{kcal/mole}$$

24. How is Ammonia prepared from Urea?

Ammonia is formed by the hydrolysis of urea

$$NH_2CONH_2 + H_2O \longrightarrow 2NH_3 + CO_2$$

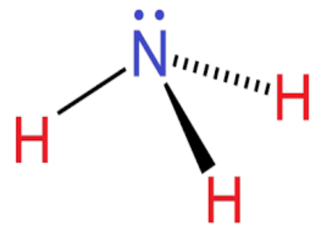
25. Write about the reducing property of Ammonia.

Ammonia reduces the metal oxides to metal

$$3PbO + 2NH_3 \longrightarrow 3Pb + N_2 + 3H_2O$$

26. Explain the structure of Ammonia molecule

- Molecular formula of Ammonia is NH_3
- Hybridisation sp^3
- Pyramidal shape
- N-H bond length is 1.016 Å and H-H bond length is 1.645 Å
- Bond Angle 107^0
- Tetrahedral with one lone pair of electrons



27. **Explain the preparation of Nitric acid by Ostwald's process**

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

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

$$6NO_2 + 3H_2O \longrightarrow 4HNO_3 + 2NO + H_2O$$

28. **Nitric acid solution becomes yellow on standing. Why?**

Nitric acid decomposes on exposure to sunlight into nitrogen dioxide, water and oxygen. So becomes yellow colour.

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

29. **Give a reaction between nitric acid and a basic oxide.**

Nitric acid reacts with a basic oxide to form salt and water.

$$3FeO + 10HNO_3 \longrightarrow 3Fe(NO_3)_3 + NO + 5H_2O$$

30. **Write about the oxidising property of Nitric acid (HNO_3)**

$$S + 2HNO_3 \longrightarrow H_2SO_4 + 2NO$$

31. **Prove that nitric acid is an nitrating agent**

$$C_6H_6 + HNO_3 \xrightarrow{H_2SO_4} C_6H_5NO_2 + H_2O$$

32. Write the uses of nitric acid

- Nitric acid is used as an oxidising agent.
- It is used in the preparation of aquaregia.
- Salts of nitric acid are used in photography ($AgNO_3$) and gunpowder for firearms ($NaNO_3$)

33. Write about the Allotropic forms of Sulphur?

1.White phosphorus 2. Red phosphorus 3. Black phosphorus 4. Scarlet phosphorus 5. Violet phosphorus

	White phosphorus	**Red phosphorus**
1	Poisonous in nature	It is not poisonous
2	Garlic smell	Odourless
3	It shows Phosphorescence	Does not show Phosphorescence.
4	Its ignition temperature is very low	It does not ignite at low temperatures
5	It undergoes spontaneous combustion in air at room temperature	It does not undergo spontaneous combustion

34. **What is phosphorescence?**

White phosphorus glows in the dark due to oxidation which is called phosphorescence.

35. **How will you prepare phosphine in the laboratory?**

$$P_4 + 3NaOH + 3H_2O \longrightarrow \underset{\text{sodium hypo phosphite}}{3NaH_2PO_2} + \underset{\text{Phosphine}}{PH_3\uparrow}$$

36. **How will you prepare phosphine from Phosphorous acid?**

$$\underset{\text{Phosphorous acid}}{4H_3PO_3} \xrightarrow{\Delta} \underset{\text{Ortho phosphoric acid}}{3H_3PO_4} + \underset{\text{Phosphine}}{PH_3 \uparrow}$$

37. **Write a short notes on Holmes signal**

- In a ship, a pierced container with a mixture of calcium carbide and calcium phosphide.
- When it thrown into sea, liberates phosphine and acetylene
- The liberated phosphine catches fire and ignites acetylene.
- These burning gases serve as a signal to the approaching ships.

38. **How will you prepare ozone in the laboratory?**

- At 20,000 V about 10% of oxygen is converted into ozonised oxygen.
- Pure ozone is obtained by the fractional distillation of liquefied ozonised oxygen.

$$\underset{\text{Oxygen}}{O_2} \rightleftharpoons \underset{\text{atomic oxygen}}{2(O)}$$

$$O_2 + (O) \rightleftharpoons \underset{\text{Ozone}}{O_3}$$

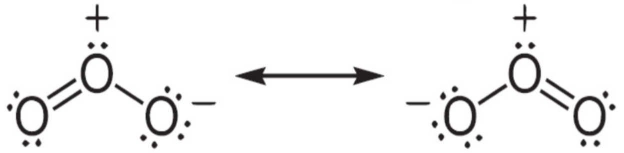
39. **Write about estimation of ozone. (or) Write about the oxidising property of ozone**

Ozone oxidises potassium iodide to iodine.

$$O_3 + 2KI + H_2O \longrightarrow 2KOH + O_2 + I_2$$

40. **Explain the structure of ozone**

- The ozone molecule has a bent shape and
- Symmetrical with delocalised bonding between the oxygen atoms



41. **Write the uses of oxygen**

- Oxygen is essential component of living organisms.
- Oxy-acetylene is used in welding
- Liquid oxygen is used as fuel in rockets

42. **How will you prepare SO_3 in contact process?**

$$2SO_2(g) + O_2(g) \xrightarrow[450^0C]{V_2O_5} 2SO_3(g)$$

43. **Write about the oxidising property of Sulphur dioxide.**

$$2Mg + SO_2 \longrightarrow 2MgO + S$$

44. **Write about the reducing property of Sulphur dioxide.**

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

45. **Write about the bleaching action of sulphur dioxide.**

$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2(H)$$

$$\underset{\text{Coloured}}{X} + 2(H) \longrightarrow \underset{\text{Colourless}}{XH_2}$$

This is due to its reduction and temporary effect.

46. **Give the uses of sulphur dioxide.**

- Sulphur dioxide is used in bleaching hair, silk, wool etc..
- It can be used for disinfecting crops and plants in agriculture.

47. **Explain the manufacture of chlorine by Deacon's process**

A mixture of air and HCl is passed through cuprous chloride chamber to form chlorine.

$$4HCl + O_2 \xrightarrow[Cu_2Cl_2]{400^0C} 2H_2O + Cl_2 \uparrow$$

48. **Write the preparation of Bleaching powder**

Calcium hydroxide + Chlorine ⟶ Bleaching powder

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

49. **Write about the oxidising property of chlorine**

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

50. **Write about the bleaching action of chlorine**

$$H_2O + Cl_2 \longrightarrow HCl + HOCl$$

$$HOCl \longrightarrow HCl + (O)$$

Colouring matter + Nascent oxygen ⟶ Colourless oxidation product

This is due to its oxidation and permanent effect.

51. **Give the uses of chlorine**

- Chlorine is used in Purification of drinking water
- Bleaching of cotton textiles, paper and rayon
- Extraction of gold and platinum

52. **HF is a weak acid, whereas all other halogen acids are strong acid. why?**

- HF is slightly ionised
- In HF, due to the presence of strong hydrogen bond
- The electro negativity difference is maximum in HF

53. **Why HF cannot be stored in glass bottles?**

Moist hydrofluoric acid HF (not dry) rapidly react with sodium silicate in glass.

$$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$$

$$Na_2SiO_3 + 6HF \rightarrow Na_2SiF_6 + 3H_2O$$

54. **What is Aquaregia?.Write its uses.**

- Aquaregia - 3 parts of con. HCl + 1 part of con HNO_3
- It is used for dissolving gold, platinum.

55. **Give the uses of hydrofluoric acid**

- Hydrochloric acid is used for the manufacture of chlorine
- It is used in the extraction of glue from bone
- It is used purification of bone black

56. **Give the oxidation state of halogen in the following.**

a) OF_2 Oxidation state of F $(+2) + 2F = 0$ $F = -2/2 = -1$	**b) O_2F_2** Oxidation state of F $(+1 \times 2) + 2F = 0$ $F = -2/2 = -1$
c) Cl_2O_3 Oxidation state of Cl $2Cl + (-2 \times 3) = 0$ $2Cl - 6 = 0$ $Cl = 6/2 = +3$	**c) I_2O_4** Oxidation state of I $2I + (-2 \times 4) = 0$ $2I - 8 = 0$ $I = 8/2 = +4$

57. Deduce the oxidation number of oxygen in hypofluorous acid – HOF.

$+1+X-1 = 0$

$X = 0$

Oxidation number of oxygen in HOF = 0

58. **Write about the preparation of XeF_2, XeF_4, XeF_6**

$$Xe + F_2 \xrightarrow[400^0C]{Ni} XeF_2$$

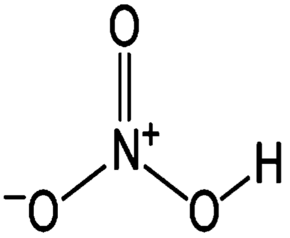
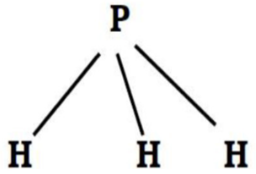
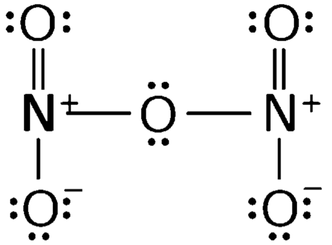
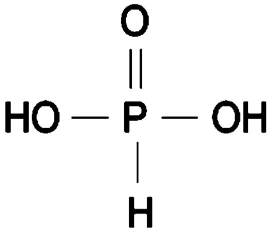
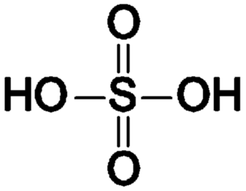
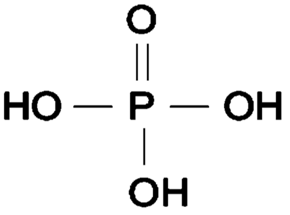
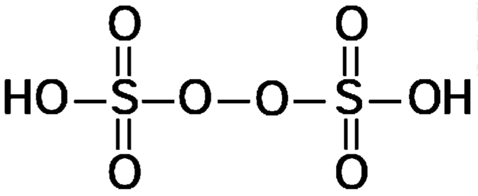
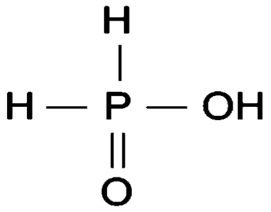
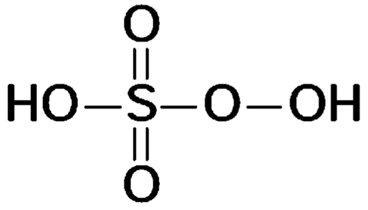
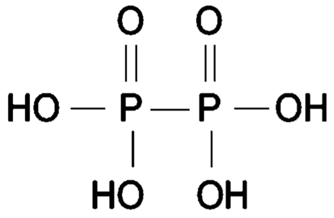
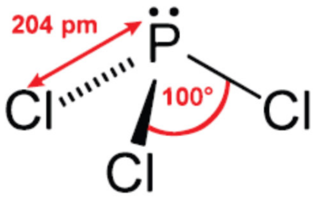
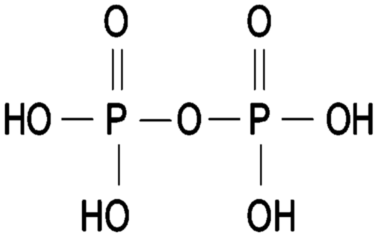
$$Xe + 2F_2 \xrightarrow[400^0C]{Ni/acetone} XeF_4$$

$$Xe + 3F_2 \xrightarrow[400^0C]{Ni/200\ atm} XeF_6$$

59. **Give the hybridisation and structure of the following compounds.**

Compounds	Hybridisation	Structure
XeF_2	sp^3d	Linear
XeF_4	sp^3d^2	Square planar
XeF_6	sp^3d^3	Distorted octahedron
$XeOF_2$	sp^3d	T Shaped
$XeOF_4$	sp^3d^2	Square pyramidal
XeO_3	sp^3d	Pyramidal

60. Write the molecular formula and structural formula for the following molecules.

Nitric acid - HNO_3 	**Phosphine - PH_3** **sp^3** - Pyramidal 
Dinitrogen pentoxide - N_2O_5 	**Orthophosphrous acid - H_3PO_3** 
Sulpuric acid - H_2SO_4 	**Phosphoric acid - H_3PO_4** 
Marshall's acid - $H_2S_2O_8$ 	**Hypophosphrous acid - H_3PO_2** 
Caro's acid - H_2SO_5 	**Hypophosphoric acid - $H_4P_2O_6$** 
Phosphorus trichloride - PCl_3  	**Pyrophosphoric acid - $H_4P_2O_7$** 

61. **Complete the following reactions.**

1. $NaCl + MnO_2 + H_2SO_4 \longrightarrow$

$4NaCl + MnO_2 + 4H_2SO_4 \longrightarrow Cl_2 + MnCl_2 + 4NaHSO_4 + 2H_2O$

2. $NaNO_2 + HCl \longrightarrow$

$NaNO_2 + HCl \longrightarrow HNO_2 + NaCl$

3. $P_4 + NaOH + H_2O \longrightarrow$

$P_4 + 3NaOH + 3H_2O \longrightarrow 3NaH_2PO_2 + PH_3 \uparrow$

4. $AgNO_3 + PH_3 \longrightarrow$

$3AgNO_3 + PH_3 \longrightarrow Ag_3P + 3HNO_3$

5. $Mg + HNO_3 \longrightarrow$

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

6. $KClO_3 \xrightarrow{\Delta}$

$2KClO_3 \xrightarrow[MnO_2]{\Delta} 2KCl + 3O_2$

7. $Cu + \overset{\text{Hot conc}}{H_2SO_4} \longrightarrow$

$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + 2H_2O + SO_2$

8. $Sb + Cl_2 \longrightarrow$

$2Sb + 3Cl_2 \longrightarrow 2SbCl_3$

9. $HBr + H_2SO_4 \longrightarrow$

$2HBr + H_2SO_4 \longrightarrow 2H_2O + Br_2 + SO_2$

10. $XeF_6 + H_2O \longrightarrow$

$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

11. $XeO_6^{4-} + Mn^{2+} + H^+ \longrightarrow$

$5XeO_6^{4-} + 2Mn^{2+} + 14H^+ \longrightarrow 2MnO_4^- + 5XeO_3 + 7H_2O$

12. $XeOF_4 + SiO_2 \longrightarrow$

$2XeOF_4 + SiO_2 \longrightarrow 2XeO_2F_2 + SiF_4$

13. $Xe + F_2 \xrightarrow[400^0C]{Ni / 200\ atm}$

$Xe + 3F_2 \xrightarrow[400^0C]{Ni /200\ atm} XeF_6$

4. TRANSITION ELEMENTS

1. What are transition metals? Give examples.

- Transition metals occupy from group 3 to group 12.
- Metals with incomplete filled d-orbital
- Elements placed between s and p-block
- Positive ions formed by these elements have unfilled d-orbitals
- 3d series - 4th period - Sc to Zn
  4d series - 5th period - Y to Cd
  5d series - 6th period - La, Hf to Hg
  6d series - 7th period - Ac, Rf to Cn (radioactive elements)

2. Compare the ionization enthalpies of first series of the transition elements.

As we move from left to right in a transition metal series, the ioniz ation enthalpy increases. This is due to increase in nuclear charge corresponding to the filling of d electrons.

- From Sc to Ti - increases
- From Ti to Cr - no change.
- From Cr to Fe - increases
- From Fe to Cu - slightly changes
- From Cu to Zn - increases

3. Explain the oxidation states of 4d series elements.

- The energies of ns and (n – 1)d orbitals are fairly close to each other
- The number of oxidation states increases with the number of electrons available
- It decreases as the number of paired electrons increases.
- The first and last elements show less number of oxidation states and the middle elements with more number of oxidation states.
- The oxidation states of 4d metals vary from +3 for Y and + 2 to +8 for Ru, Cd for +2.

4. Explain variable oxidation states of 3d series elements?

- The energies of (n-1)d and ns orbital are fairly close to each other
- The number of oxidation states increases with the number of electrons available
- It decreases as the number of paired electrons increases
- The first and last elements show less number of oxidation states and the middle elements with more number of oxidation states.
- The oxidation states of 3d metals vary from +3 for Sc and + 2 to +7 for Mn, Cu shows +1 and +2

5. Which metal in the 3d series exhibits +1 oxidation state most frequently and why?

- Cu is only exhibits +1 oxidation state
- Cu has electronic configuration [Ar] $3d^{10}4s^1$ and after losing one electron it acquires a stable $3d^{10}$ configuration which is more stable.

6. Transition metals show high melting points. Why?

- High attractive forces between the atoms
- Strong metallic bond.

7. What is the reason for d-block elements to form alloys?

- Similar atomic sizes and crystal structure
- One metal atom can be easily replaced by another metal atom to form an alloy.
- Ex: Gold-Copper alloy.

8. Why do transition elements form more number of complexes?

- Small size
- High positive charge density.
- Availability of low energy vacant (n-1)d orbitals to accept an electron pairs.

9. What are interstitial compounds?

An interstitial compound is formed when small atoms like carbon, hydrogen, boron, nitrogen are trapped in the interstitial holes in a metal lattice.

Ex : TiC

10. What are properties interstitial compounds?

- They are hard
- Electrical and thermal conductivity.
- High melting points
- Transition metal hydrides are powerful reducing agents
- Metallic carbides are chemically inert.

11. Write the electronic configuration of Ce^{4+} and Co^{2+}

- Electronic configuration of Ce^{4+} is [Xe] $4f^0 5d^0 6s^0$
- Electronic configuration of Co^{2+} is [Ar] $3d^7 4s^0$

12. Which is more stable? Fe^{3+} or Fe^{2+} explain.

- Electronic configuration of Fe^{3+} is [Ar] $3d^5$
- Electronic configuration of Fe^{2+} is [Ar] $3d^6$
- Fe^{3+} is more stable, since it has half filled 3d orbitals

13. Explain why Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing.

- E^0 value for Cr^{2+} is -0.91, E^0 Value for Mn^{3+} is +1.51V
- If E^0 of a metal is large and negative, the metal is a powerful reducing agent.
- Hence Cr^{2+} is strongly reducing

14. Which is stronger reducing agent Cr^{2+} or Fe^{2+}?

- E^0 value for Cr^{2+} is -0.91, E^0 Value for Fe^{2+} is -0.44V
- If E^0 of a metal is large and negative, the metal is a powerful reducing agent.
- Hence Cr^{2+} is strongly reducing

15. The $E^0_{M2+/M+}$ value for copper is positive. Suggest a possible reason for this.

- The elemental copper is more stable than Cu^{2+}.
- Copper has a high energy of atomization and low hydration energy
- Hence Cu^{2+} is easily reduce to elemental copper.

16. Why first ionization enthalpy of chromium is lower than that of zinc?

- Electronic configuration of Zn - [Ar] $4s^2 3d^{10}$
- Electronic configuration of Cr - [Ar] $4s^1 3d^5$
- While in case of Chromium electron is easily removed from half filled $3d^5$ orbital with less amount of energy.
- Hence first ionization enthalpy of chromium is lower.

17. Explain the variation in $E^O_{M3+/M2+}$, 3d series.

- The standard electrode potential for the M^{3+} / M^{2+} half-cell gives the relative stability between M^{3+} and M^{2+}.
- The negative values for Ti, V, and Cr indicate that the higher oxidation state is preferred.
- If we want to reduce such a stable Cr^{3+} ion, which has high negative value for reduction potential like zinc (E^0= -0.76 V) is required.
- The high reduction potential of M^{3+} / M^{2+} indicates Mn^{2+} is more stable than Mn^{3+}.

18. Why do Zirconium and Hafnium exhibit similar properties?

- 3d and 4d elements exhibit similar ionic radius due to lanthanoid contraction.
- Hence Zirconium and Hafnium exhibit similar properties

19. **Describe the preparation of potassium dichromate ($K_2Cr_2O_7$)**

- Ore - Chromite
- Concentration - Gravity separation
- Chromite + Sodium carbonate $\xrightarrow{O_2}$ Sodium chromate

$$4\,FeCr_2O_4 + 8\,Na_2CO_3 + 7\,O_2 \xrightarrow{900 - 1000^0C} 8\,Na_2CrO_4 + 2\,Fe_2O_3 + 8\,CO_2\uparrow$$

- Sodium chromate + con. H_2SO_4 $\longrightarrow$ Sodium-di-chromate

$$2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$$

- Sodium-di-chromate $\xrightarrow{KCl}$ Potassium-di-chromate

$$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$$

20. Write chromyl chloride test.

Potassium-di-chromate + Potassium chloride $\xrightarrow{con.H_2SO_4}$ Chromyl chloride (orange red vapours)

$$K_2Cr_2O_7 + 4KCl + 6H_2SO_4 \rightarrow 2CrO_2Cl_2 + 6\,KHSO_4 + 3H_2O$$

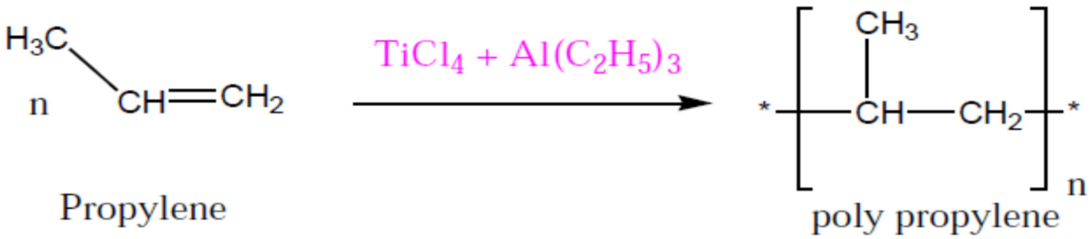
This reaction is used to confirm the presence of chloride ion in qualitative analysis.

21. Explain Hume-Rothery rule for alloy formation

- Both the solvent and the solute must have the same crystal structure and valence
- The difference between the atomic radii of solvent and solute is less than 15%
- Their electronegativity difference must be close to zero.

22. What is Zeigler-Natta catalyst? Mention its use.

- Mixture of $TiCl_4$ and Trialkyl aluminium is called a Zeigler-Natta catalyst
- It is used for polymerization



23. Give the difference between paramagnetism and diamagnetism

	Diamagnetism	**Paramagnetism**
1	Having paired electrons	Having unpaired electrons
2	Repelled by the magnetic field	Attracted by the magnetic field
3	Cu^{+}, Zn^{2+}	Ni^{2+}, Fe^{2+}

24. Write the Electronic configuration of Cr and Cu

- Expected electronic configuration Chromium (Z = 24)

  $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$

  Actual electronic configuration of Chromium

  $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

- Expected electronic configuration Copper (Z = 29)

  $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$

  Actual electronic configuration of Copper

  $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$

25. Which of the following is coloured?

Ti^{+2}	V^{+3}	Sc^{+2}	Cu^{+}	Sc^{+3}	Fe^{+3}	Ni^{+2}	Co^{+3}	Fe^{+2}	Ti^{+4}
d^2	d^2	d^1	d^{10}	d^0	d^5	d^8	d^6	d^5	d^0
Coloured	**Coloured**	**Coloured**	**Colourless**	**Colourless**	**Coloured**	**Coloured**	**Coloured**	**Coloured**	**Colourless**

26. Mn $^{2+}$ is more stable than Mn $^{4+}$ Why?

- Electronic configuration of Mn $^{4+}$ - [Ar] $3d^3$
- Electronic configuration of Mn $^{2+}$ - [Ar] $3d^5$
- Mn $^{2+}$ is more stable, since it has half filled orbitals

27. Explain why compounds of Cu $^{2+}$ are coloured but those of Zn^{2+} are colourless.

- Electronic configuration of Cu $^{2+}$ is [Ar] $3d^9$
  One unpaired electron, hence it is coloured
- Electronic configuration of Zn^{2+} is [Ar] $3d^{10}$
  No unpaired electrons. So colourless.

28. Sc^{3+} and Ti^{4+}ions are colourless why?

- Vacant $3d^0$ orbital
- No unpaired electrons
- Do not have d-d transaction.

29. Why are Cu$^+$ and Zn^{2+} are colourless.

- Completely filled d^{10} orbital
- No unpaired electrons
- Do not have d-d transaction.

30. Derive Standard electrode potential

Standard electrode potential is the value of the standard emf of a cell in which molecular hydrogen under 1atm pressure and 273K temperature is oxidised to solvated protons at the electrode.

31. Give the action of heat in Potassium dichromate

$$4\ K_2Cr_2O_7 \xrightarrow{\Delta} 4\ K_2CrO_4 + 2\ Cr_2O_3 + 3O_2\uparrow$$

32. Write the action of heat in Potassium permanganate

$$2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$$

33. Write the oxidising nature of Potassium dichromate

- It oxidises iodide ions to iodine

$$Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$$

- It oxidises sulphide ion to sulphur

$$Cr_2O_7^{2-} + 3S^{2-} + 14H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O$$

34. Write the oxidation of Potassium permanganate

In acid medium

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

In alkaline medium

$$MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2 + 4OH^-$$

In neutral medium

$$2MnO_4^- + 3H_2S \longrightarrow 2MnO_2 + 3S + 2OH^- + 2H_2O$$

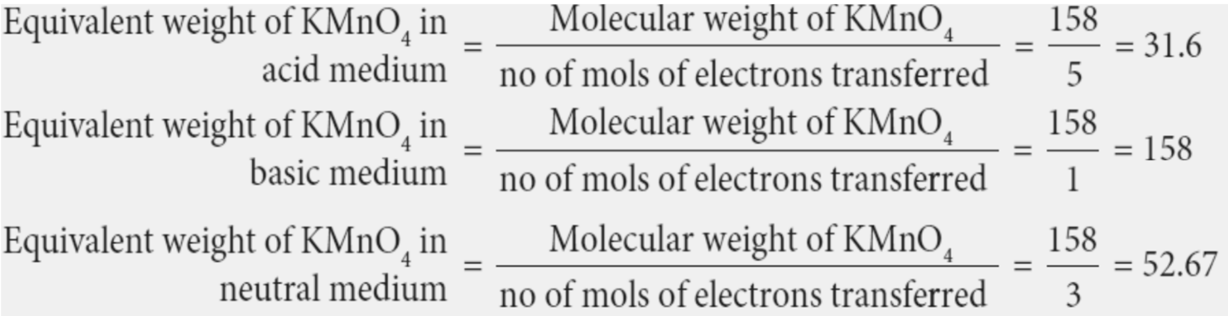
35. Give the uses of Potassium dichromate

- It used in leather tanneries
- It is used in dyeing and printing
- It is used as a strong oxidizing agent.

36. Give the uses of Potassium permanganate

- It is used for the treatment of various skin infections
- It is used as a strong oxidizing agent.
- It used in water treatment industries to remove iron and hydrogen sulphide

37. **Calculate the Equivalent weight of $KMnO_4$ in Acid, alkaline, neutral medium.**

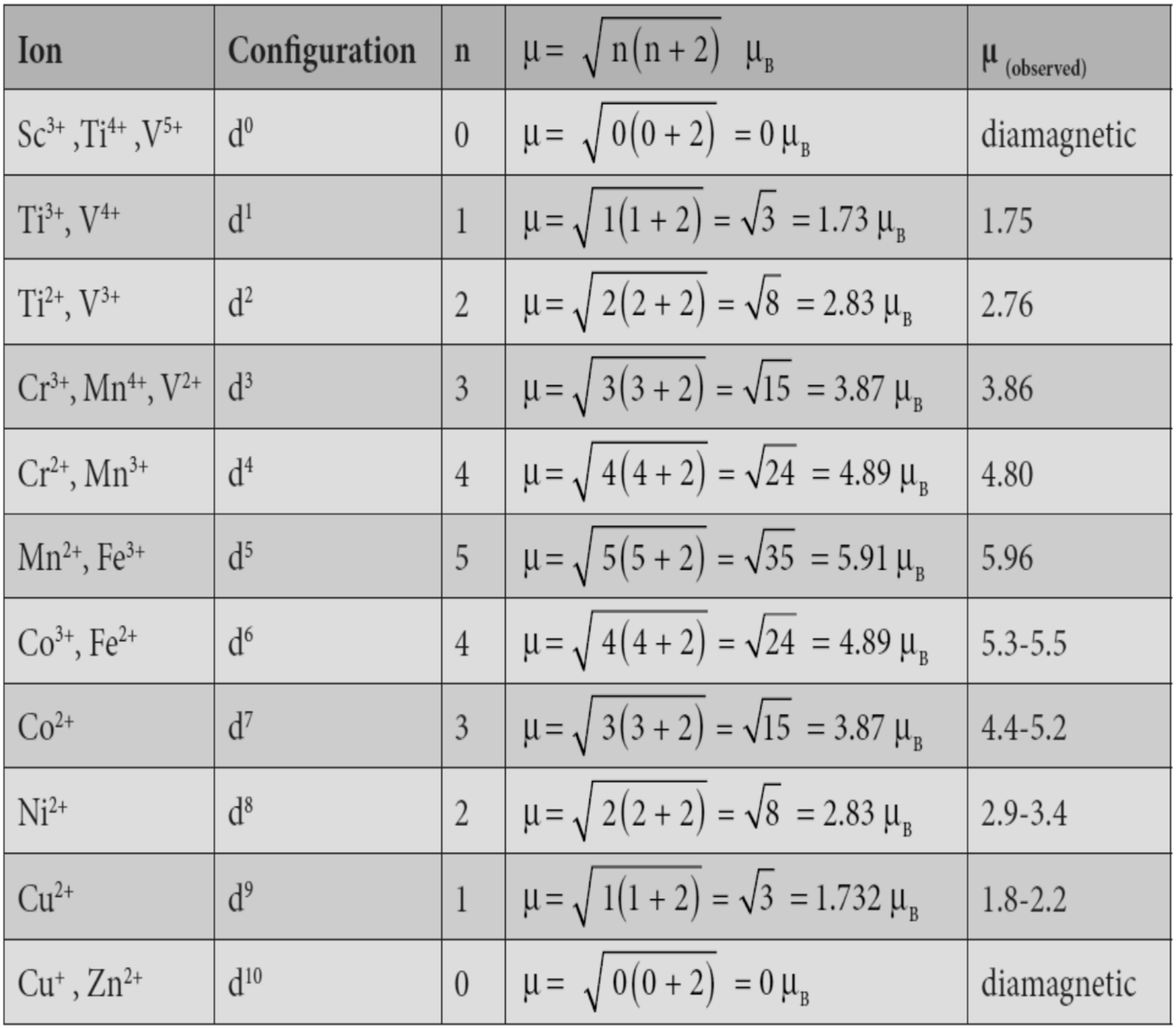


$$\text{Equivalent weight of } KMnO_4 \text{ in acid medium} = \frac{\text{Molecular weight of } KMnO_4}{\text{no of mols of electrons transferred}} = \frac{158}{5} = 31.6$$

$$\text{Equivalent weight of } KMnO_4 \text{ in basic medium} = \frac{\text{Molecular weight of } KMnO_4}{\text{no of mols of electrons transferred}} = \frac{158}{1} = 158$$

$$\text{Equivalent weight of } KMnO_4 \text{ in neutral medium} = \frac{\text{Molecular weight of } KMnO_4}{\text{no of mols of electrons transferred}} = \frac{158}{3} = 52.67$$

38. Calculate the number of unpaired electrons and magnetic moment.



Ion	Configuration	n	$\mu = \sqrt{n(n+2)}\ \mu_B$	$\mu_{\text{(observed)}}$
Sc^{3+}, Ti^{4+}, V^{5+}	d^0	0	$\mu = \sqrt{0(0+2)} = 0\ \mu_B$	diamagnetic
Ti^{3+}, V^{4+}	d^1	1	$\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.73\ \mu_B$	1.75
Ti^{2+}, V^{3+}	d^2	2	$\mu = \sqrt{2(2+2)} = \sqrt{8} = 2.83\ \mu_B$	2.76
Cr^{3+}, Mn^{4+}, V^{2+}	d^3	3	$\mu = \sqrt{3(3+2)} = \sqrt{15} = 3.87\ \mu_B$	3.86
Cr^{2+}, Mn^{3+}	d^4	4	$\mu = \sqrt{4(4+2)} = \sqrt{24} = 4.89\ \mu_B$	4.80
Mn^{2+}, Fe^{3+}	d^5	5	$\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.91\ \mu_B$	5.96
Co^{3+}, Fe^{2+}	d^6	4	$\mu = \sqrt{4(4+2)} = \sqrt{24} = 4.89\ \mu_B$	5.3-5.5
Co^{2+}	d^7	3	$\mu = \sqrt{3(3+2)} = \sqrt{15} = 3.87\ \mu_B$	4.4-5.2
Ni^{2+}	d^8	2	$\mu = \sqrt{2(2+2)} = \sqrt{8} = 2.83\ \mu_B$	2.9-3.4
Cu^{2+}	d^9	1	$\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.732\ \mu_B$	1.8-2.2
Cu^{+}, Zn^{2+}	d^{10}	0	$\mu = \sqrt{0(0+2)} = 0\ \mu_B$	diamagnetic

INNER-TRANSITION ELEMENTS

1. What are inner transition elements? Give an examples.

- Electrons are filled in (n-2)f orbitals
- 4f series – Lanthanoids – Ce to Lu (14 elements)
- 5f series – Actinoids – Th to Lr (14 elements).

2. Justify the position of Lanthanoids and Actinoids in the periodic table.

- Lanthanoids and Actinoids are grouped together and placed at the bottom of the periodic table.
- Lanthanoids – 4f series elements - group 3 and period 6 - from Ce to Lu - 14 elements
- Actinoids – 5f series elements - group 3 and period 7 - from Th to Lr - 14 elements
- All these elements have similar physical and chemical properties
- General electronic configuration of

  Lanthanoids - $[Xe]\ 4f^{1\text{-}14}\ 5d^{0\text{-}1}\ 6s^2$

  Actinoids - $[Rn]\ 5f^{0\text{-}14}\ 6d^{0\text{-}2}\ 7s^2$

3. What are actinides? Give three examples.

- Actinoids – 5f series elements
- Group 3 and period 7
- From Th to Lr - 14 elements
- All the actinoids are radioactive
- General electronic configuration of Actinoids - $[Rn]\ 5f^{0\text{-}14}\ 6d^{0\text{-}2}\ 7s^2$
- Ex. - Th, U, Lr.

4. Write the electronic configuration of of lanthanoids and actinoids.

- Lanthanoids - $[Xe]\ 4f^{1\text{-}14}\ 5d^{0\text{-}1}\ 6s^2$
- Actinoids - $[Rn]\ 5f^{0\text{-}14}\ 6d^{0\text{-}2}\ 7s^2$

5. Write the oxidation state of of lanthanoids and actinoids.

	Lanthanoids	Actinoids
Common Oxidation state	+3	+3
Other Oxidation states	+2, +4	+2, +4, +5, +6, +7

6. Why Europium (II) is more stable than Cerium (II)?

- Electronic configuration of Cerium (II) - $[Xe]4f^1\ 5d^1\ 6s^0$
- Electronic configuration of Europium (II) -$[Xe]4f^7\ 5d^0\ 6s^0$
- Europium (II) is more stable, since it has half filled orbitals

7. Why are Gd^{3+} and Lu^{3+} are colourless?

- Gd^{3+} has half filled $4f^7$ orbitals
- Lu^{3+} has completely filled $4f^{14}$ orbitals
- Hence there is no f-f transaction.
- So they are colourless.

8. Actinoid contraction is greater from element to element than the lanthanoid contraction, why?

- These 5f orbital have poor shielding effect than 4f orbital which leads to decrease in atomic or ionic radii.
- So Actinoid shows greater contraction.

9. Out of $Lu(OH)_3$ and $La(OH)_3$ which is more basic and why?

- $La(OH)_3$ is more basic.
- As we move from Ce^{3+} to Lu^{3+}, the basic character of Ln^{3+} decrease .
- Due to lanthanoid contraction, the decrease in the size of Ln^{3+} ions, the covalent character increases

10. What is lanthanoid contraction and what are the effects of lanthanoid contraction?

As we move across 4f series, the atomic and ionic radii of Lanthanoids show gradual decrease with increase in atomic number.

This decrease in ionic size is called Lanthanoid contraction.

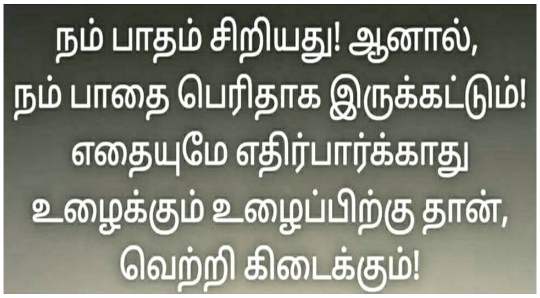
Cause of lanthanoid contraction - The shielding effect of 4f elelctrons are poor

Effects of lanthanoid contraction

- Size and radius of ions decreses
- Basicity decreases
- Covalent character increases
- The elements of second and third transition series resemble each other more closely.

11. Compare lanthanoids and actinoids.

	Lanthanoids	**Actinoids**
1.	Colourless	Coloured
2.	They show less tendency to form complexes.	They show greater tendency to form complexes
3.	They do not form oxocations	They do form oxocations
4.	Differentiating electrons enters in 4f orbital.	Differentiating electrons enters in 5forbital.
5.	Binding energy of 4f orbitals are higher	Binding energy of 5f orbitals are lower
6.	Oxidation state +2, +3, +4	Oxidation state +2, +3, +4, +5, +6, +7



நம் பாதம் சிறியது! ஆனால்,
நம் பாதை பெரிதாக இருக்கட்டும்!
எதையுமே எதிர்பார்க்காது
உழைக்கும் உழைப்பிற்கு தான்,
வெற்றி கிடைக்கும்!

5. COORDINATION CHEMISTRY

1. Give the difference between double salts and coordination compounds

	Double salt	Co-ordination compound
1	Dissociates to give simple ions in solutions.	Never dissociates to give simple ions.
2	Loose its identity	Does not loose its identity
3	Positive and negative ions are present	Simple and complex ions are present
4	Potash alum; $K_2SO_4.Al_2(SO_4)_3.24H_2O$	$K_4[Fe(CN)_6]$

2. Write the postulates of Werner's theory

The central metal atom exhibit two type of valence

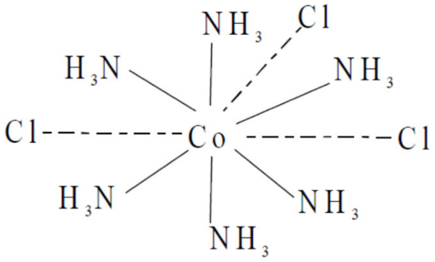
1. Primary valency 2. Secondary valency

PRIMARY VALENCY	SECONDARY VALENCY
Oxidation number of the central metal ion	Coordination number of the central metal ion
It is non directional	It is directional
Ionisable valency	Non ionisable valency
Always satisfied by negative ions	Satisfied by negative ions (or) neutral molecules (or) positive ions.

There are two spheres of attraction around a metal atom/ion in a complex.

1. The inner sphere (coordination sphere)
   The groups present in this sphere are firmly attached to the central metal ion.
2. The outer sphere (Ionsation sphere)
   The groups present in this sphere are loosely attached to the central metal ion.

Structure of compound $[Co(NH_3)_6]Cl_3$



Limitation of Werner's theory

It does not explain the colour and magnetic properties of coordination compounds.

3. What are the limitations of VB theory ?

- It does not explain the colour of the complex
- It considers only the spin only magnetic moments and does not consider the other components of magnetic moments.
- It does not provide a quantitative explanation as to why certain complexes are inner Orbital complexes and the others are outer orbital complexes for the same metal.

4. Define central atom / ion

- The central atom / ion is the one that occupies the central position in a coordination entity.
- Binds the ligands to itself by coordinate bonds.
- Act as a Lewis acid
- In $K_4[Fe(CN)_6]$ the central metal ion is Fe^{2+}

5. Define Ligands.

- Atoms or group of atoms bound to the central atom / ion
- Act a Lewis base
- In $K_4[Fe(CN)_6]$ the ligand is CN^-

6. Define coordination number.

- The number of ligand donor atom bonded to a central metal in a complex
- In $K_4[Fe(CN)_6]$ the coordination number of Fe^{2+} is 6.

7. Define coordination sphere (or) complex ion.

- The central metal atom and the ligands are enclosed in the square bracket with its net charge.
- In $K_4[Fe(CN)_6]$ the coordination sphere is $[Fe(CN)_6]^{4-}$

8. Define coordination polyhedron.

- The three dimensional special arrangement of ligands that are directly bonded to the central metal atom is called Coordination polyhedron.
- In $K_4[Fe(CN)_6]$ the coordination polyhedron is octahedral

9. Define oxidation state (number)

- Net charge
  = oxidation state of the central metal + [(no of ligands) x (charge on the ligand)]
- In $K_4[Fe(CN)_6]$ oxidation state Fe is +2

10. Explain the classification of complexes based on kind of ligands

1. Homoleptic complex :
   - The central metal ion / atom is coordinated to only one kind of ligand
   - $K_4[Fe(CN)_6]$
2. Heteroleptic complex :
   - The central metal ion / atom is coordinated to more than one kind of ligand.
   - $K_4[Fe(CN)_3 Br_3]$

11. Classify the following ligand based on the number of donor atoms

a) NH_3 b) en c) OX^{2-} d) pyridine

Ligand	Number of donor atoms	Type of ligand
NH_3	1 (1N)	Monodentate
en	2 (2N)	Bidentate
OX^{2-}	2 (2O)	Bidentate
pyridine	1 (1N)	Monodentate

12. Write the oxidation state, coordination number , nature of ligand, magnetic property and electronic configuration in octahedral crystal field for $K_4[Mn(CN)_6]$

Complex	**$K_4[Mn(CN)_6]$**
Central metal atom / ion	Mn^{2+}
Oxidation state	+2
Coordination number	6
Nature of ligand	CN^- strong ligand
Magnetic property	Paramaganetic
electronic configuration in octahedral crystal field	t_{2g}^5 e_g^o

13. In the complex, $[Pt(NO_2)(H_2O)(NH_3)_2]Br_2$ identify the following

Complex	**$[Pt(NO_2)(H_2O)(NH_3)_2]Br_2$**
Central metal atom / ion	Pt
Oxidation state	+2
Coordination number	4
Ligands and their types	NO_2^- - Nirito (anionic ligand) H_2O - aqua (neutral ligand) NH_3 - ammine (neutral ligand)
Coordination entity	$[Pt(NO_2)(H_2O)(NH_3)_2]^+$
IUPAC name	di-ammine aqua nirito-κN platinum (II)

14. Explain Valence bond theory (VBT)

- The ligand metal bond is covalent bond and formed by sharing of electrons between the central metal atom and the ligands.
- The ligand should contain atleast one filled orbital with a lone pair of electrons.
- To accept the electron pair donated by the ligands the central metal atom should contain vacant orbitals.
- The vacant orbital of the metal atom undergoes hybridization. Hybridization is the intermixing of atomic orbitals of same energy to give equal number of new orbitals of same energy.
- The vacant metal orbitals linearly overlap with the filled ligand orbitals to form metal ligand coordinate sigma bonds.
- The hybridized orbitals are directionsl in space and give geometry to the complex.

Coordination Number	**Hybridisation**	**Geometry**
2	sp	Linear
4	sp^3	Tetrahedral
4	dsp^2	Square planar

15. $[Ti(H_2O)_6]^{3+}$ is coloured, while $[Sc(H_2O)_6]^{3+}$ is colourless - Explain.

- Sc^{3+} have vacant d^o orbitals, No unpaired electrons.
  No d-d transaction. Therefore colourless
- Ti^{3+} ion has one unpaired electron for d-d transition, hence it is coloured

16. Arrange the following in order of increasing molar conductivity

i) $Mg[Cr(NH_3)Cl_5]$ ii) $[Cr(NH_3)_5Cl]_3[CoF_6]_2$ iii) $[Cr(NH_3)_3Cl_3]$

$[Cr(NH_3)_3Cl_3] < Mg[Cr(NH_3)Cl_5] < [Cr(NH_3)_5Cl]_3[CoF_6]_2$

17. What is the coordination entity formed when excess of liquid ammonia is added to an aqueous solution of copper sulphate?

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

Tetraamminecopper (II) sulphate

So, the coordination entity is $[Cu(NH_3)_4]^{2+}$

18. A solution of $[Ni(H_2O)_6]^{2+}$ is green whereas a solution of $[Ni(CN)_4]^{2-}$ is colourless. Explain.

- $[Ni(H_2O)_6]^{2+}$ - H_2O is a weaker ligand. Don't pair d electrons.
  Presence of unpaired electron, d-d transaction. Therefore green in colour.
- $[Ni(CN)_4]^{2-}$ - CN^- is a strong ligand, d electrons are paried.
  Absence of unpaired electron. No d-d transaction. Therefore colourless.

19. Discuss the types of structural isomerism.

Coordination isomerism

The interchange of ligands between the cationic and the anionic coordination entities

$$[Co(NH_3)_6][Cr(CN)_6] \leftrightarrows [Cr(NH_3)_6][Co(CN)_6]$$

Ionisation Isomerism

The exchange of counter ions with one or more ligands in the coordination entity.
These isomers will give different ions in solution

$$[Co(NH_3)_5Br]SO_4 \leftrightarrows [Co(NH_3)_5SO_4]Br$$

Linkage isomerism

When an ambidentate ligand is bonded to two different donor atoms by the central metal ion are called linkage isomers

$$[Cr(H_2O)_5NO_2]Br \leftrightarrows [Cr(H_2O)_5(ONO)]Br$$

Solvate (or) Hydrate isomers

When solvent molecules like water are exchange by the ligands in the crystal lattice of the coordination compounds is called solvate isomerism

$$[Cr(H_2O)_6]Cl_3 \leftrightarrows [Cr(H_2O)_5Cl]Cl_2.H_2O \leftrightarrows [Cr(H_2O)_4Cl_2]Cl\,2H_2O$$

Violet colour Pale green colour Dark green colour

20. Why tetrahedral complexes do not exhibit geometrical isomerism.

- All the four ligands are adjacent to one another in tetrahedral complex.
- As the relative positions of donor atoms of ligands attached to the central atom are same with respect to each other

21. Explain Optical isomerism with an example.

Conditions for Optically activity

Compounds with chiral atoms and Enantiomers

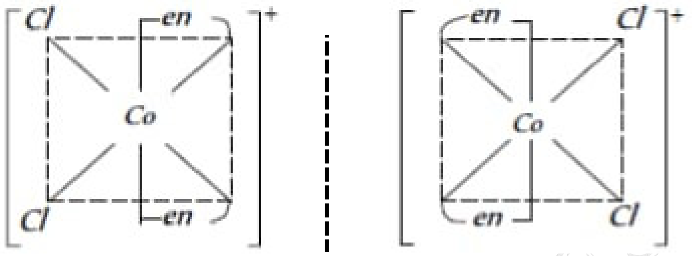
Types of Optical isomerism

1. Dextro Isomer - It rotate the plane of polarized light towards the right direction.
2. Laevo Isomer - It rotate the plane of polarized light towards the left direction.

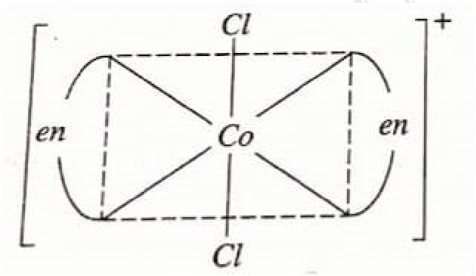
Ex : cis$[Co(en)_3]^{3+}$

22. Give the structures of isomers of $[CoCl_2(en)_2]^+$

- cis $[Co(en)_2Cl_2]^+$ - Optically active.



- trans $[Co(en)_2Cl_2]^+$ - Optically inactive.



23. List the features of crystal field theory.

- The bonding between the ligand and the central metal atom is an ionic bond.
- In the coordination compounds, the central metal atom and the ligands are considered as point charges for charged metal atoms and electric dipoles for neutral metal atom.
- In the isolated state,all the five d-orbitals are degenerate.
- The ligands form a spherical field of negative charge around the metal atom. Due to repulsion between the electrons, the energy of the five d-orbitals will increase.
- The ligands approach the metal atom in the bonding direction. Due to repulsion, the energies of e_g orbitals dx^2-y^2 and dz^2 lying along the axis will increase .
  the five d-orbitals will split into two sets. This is called crystal field splitting.
- When the ligand approaches further there will be an attraction between the negative charged ligand and the positive charged metal ion.
- The net energy decreases and leads to complex formation.

24. Define crystal field splitting energy?

Crystal field splitting energy $\Delta = h\, c\, \bar{\upsilon}$

h = Plank's constant c = velocity of light $\bar{\upsilon}$ = wave number

25. Define crystal field stabilizing energy (CFSE)

It is the energy difference between the electronic configuration of the ligand field and the isotropic field

CFSE $(\Delta E_O) = (E_{LF}) - (E_{ISO})$

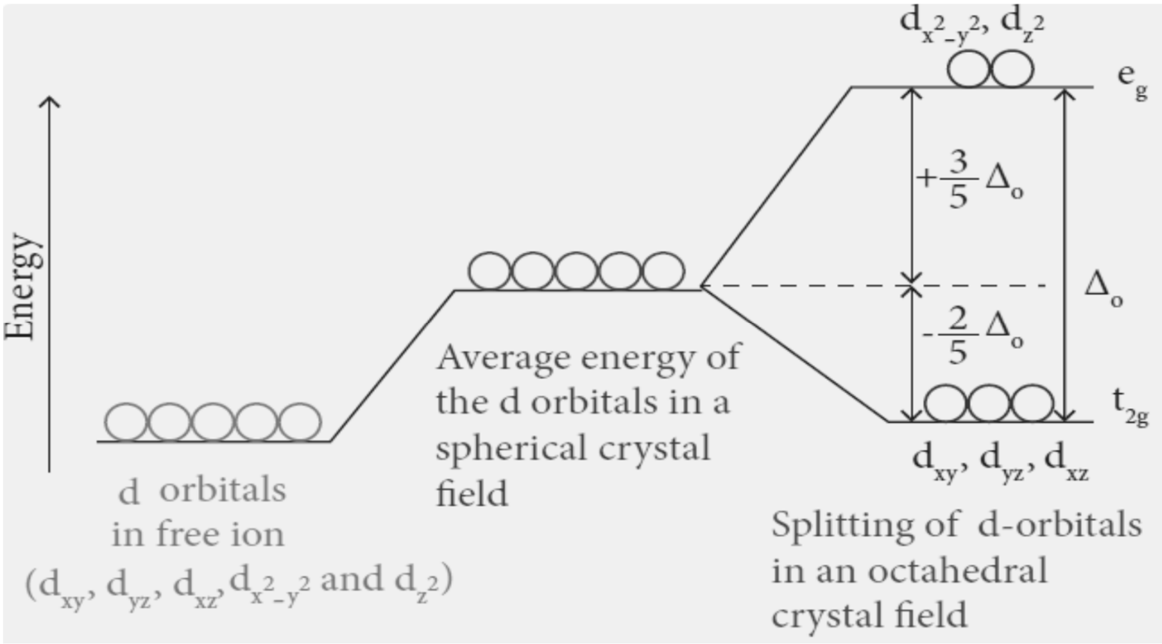
26. Give the IUPAC names for the following coordination compounds.

$Na_2[Ni(EDTA)]$	Sodium 2,2',2'',2'''- (ethane-1,2 diyldinitrilo) Tetraacetato nickelate(II)
$[Ag(CN)_2]^-$	dicyanidoargentate(I) ion
$[Ag(NH_3)_2]^+$	diammine silver(I) ion
$[Ag(NH_3)_2]Cl$	diammine silver(I) chloride
$[Co(en)_3]_2(SO_4)_3$	tris (ethane1,2-diamine) cobalt (III) sulphate
$[Co(ONO)(NH_3)_5]^{2+}$	penta ammine nitrito- κ -O-cobalt(III)ion
$[Co(NH_3)_5Cl]^{2+}$	Penta ammine chloride cobalt (III) ion
$[Fe(CN)_6]^{4-}$	Hexacyanido ferrate (II) ion
$[FeF_6]^{4-}$	Hexa fluorido ferrate (II) ion
$[Cu(NH_3)_4]SO_4$	Tetra ammine copper(II) sulphate
$[Cu(NH_3)_3(H_2O)_3]Cl_3$	Triammine triaqua copper (III) chloride
$[Cu(NH_3)_2Cl_2]$	Diammine dichlorido copper(II)
$[Pt(NH_3)_2Cl(NO_2)]$	Diammine chlorido nitrito- κ -N-platinum(II)

27. Write the formula for the following coordination compounds.

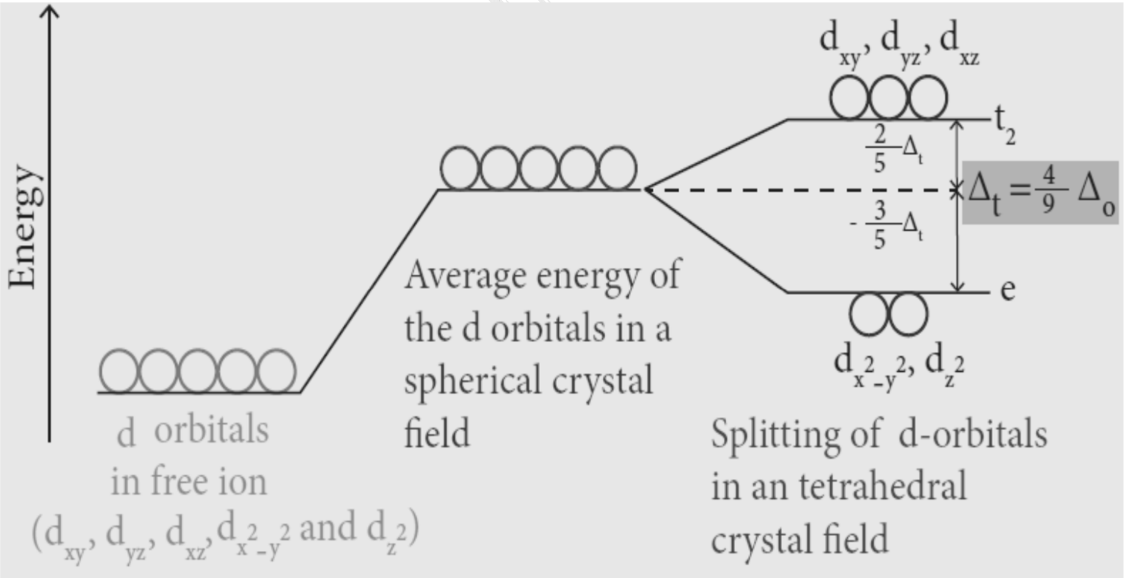
Potassium hexacyanido ferrate (II)	$K_4[Fe(CN)_6]$
Penta carbonyl iron(0)	$[Fe(CO)_5]$
Penta ammine nitrito- κ-N-cobalt(III)ion	**$[Co(NH_3)_5(NO_2)]^{2+}$**
Hexa ammine cobalt (III) sulphate	$[Co(NH_3)_6]_2(SO_4)_3$
Sodium tetrafluorido dihydroxido chromate(III)	**$Na_3[CrF_4(OH)_2]$**
Potassium trioxalato aluminate(III)	**$K_3[Al(C_2O_4)_3]$**

28. In an octahedral crystal field, draw the figure to show splitting of d orbitals.



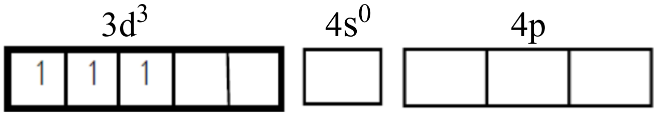
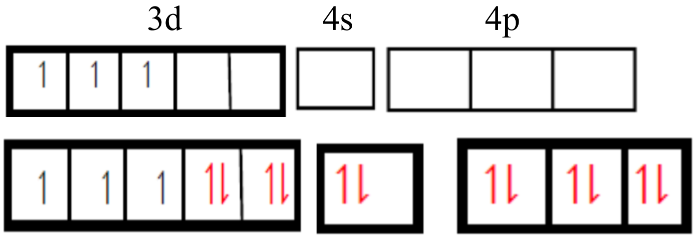
- When the ligand approaches the metal along the axis. e_g orbitals are closer to the ligands than the t_{2g} orbitals.
- To maintain the average energy, the energy of dx^2-y^2 and dz^2 orbitals will increased by $3/5\Delta_0$.
- The energy of dxy, dyz and dxz will decreased by $2/5\Delta_0$.
- Δ_0 is the crystal field splitting energy for octahedral complexes.

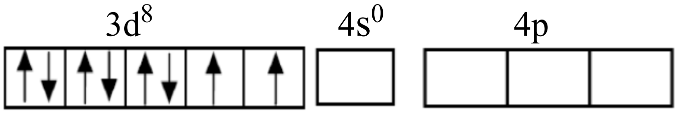
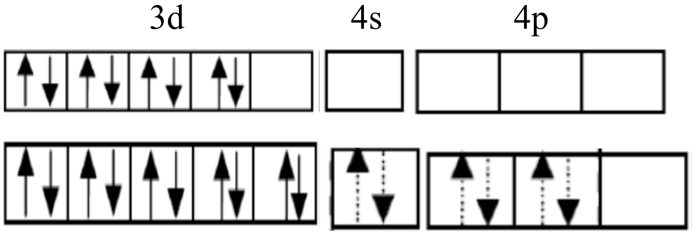
29. In an tetrahedral crystal field, draw the figure to show splitting of d orbitals.



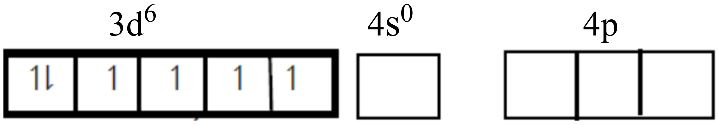
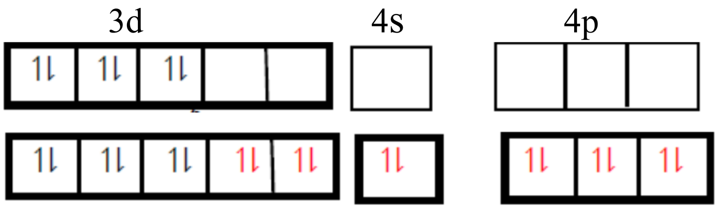
- When the ligand approaches the metal diagonally, the t_{2g} orbitals are closer to the ligands then the e_g orbitals.
- To maintain the average energy, the energy of dx^2-y^2 and dz^2 orbitals will decrease by $3/5\Delta t$.
- The energy of d_{xy}, d_{yz} and d_{xz} will increase by $2/5\Delta t$
- Δt is the crystal field splitting energy for tetrahedral complexes.

30. Based on VB theory explain why $[Cr(NH_3)_6]^{3+}$ is paramagnetic, while $[Ni(CN)_4]^{2-}$ is diamagnetic

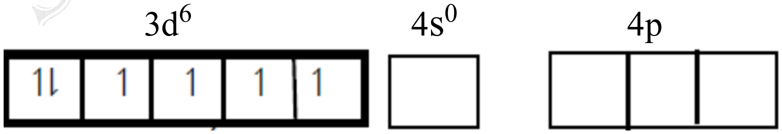
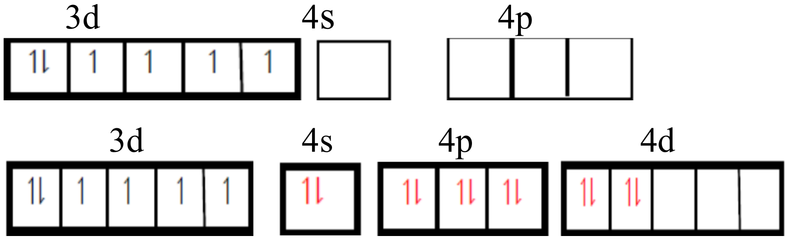
Complex	**$[Cr(NH_3)_6]^{3+}$**
Outer electronic configuration of $_{24}Cr$	$3d^4\ 4s^2$
Outer electronic configuration of Cr^{3+}	
Nature of ligand	NH_3 weak field ligand - no pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	d^2sp^3
Co ordination number	6
Geometry	Octahedral (Inner orbital complex)
Number of unpaired electon	3
Magnetic property	paraamagnetic
Magnetic moment	$\mu = \sqrt{n(n+2)} = \sqrt{3(3+2)} = 3.9BM$

Complex	**$[Ni(CN)_4]^{2-}$**
Outer electronic configuration of $_{28}Ni$	$3d^8\ 4s^2$
Outer electronic configuration of Ni^{2+}	
Nature of ligand	CN^- strong field ligand - pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	dsp^2
Co ordination number	4
Geometry	Square planer
Number of unpaired electon	0
Magnetic property	diamagnetic
Magnetic moment	$\mu_s = \sqrt{n(n+2)} = 0$ BM

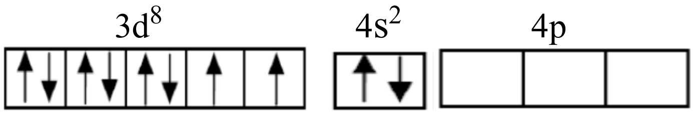
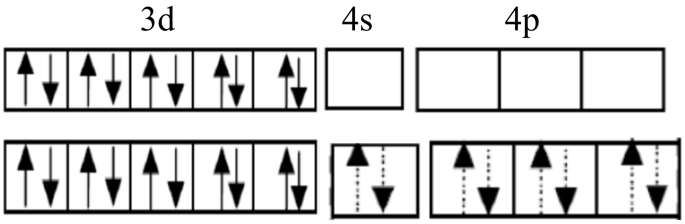
31. On the basis of VB theory explain the nature of bonding in $[Co(C_2O_4)_3]^{3-}$

Complex	$[Co(C_2O_4)_3]^{3-}$
Outer electronic configuration of $_{27}Co$	$3d^7\ 4s^2$
Outer electronic configuration of Co^{3+}	
Nature of ligand	$C_2O_4^{2-}$ strong field ligand - pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	d^2sp^3
Co ordination number	6
Geometry	Octahedral (Inner orbital complex)
Number of unpaired electon	0
Magnetic property	diamagnetic
Magnetic moment	$\mu_s = \sqrt{n(n+2)} = 0$ BM

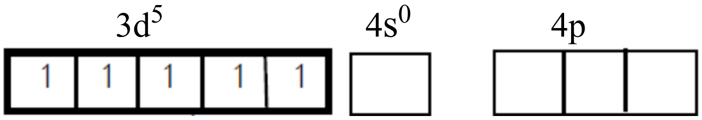
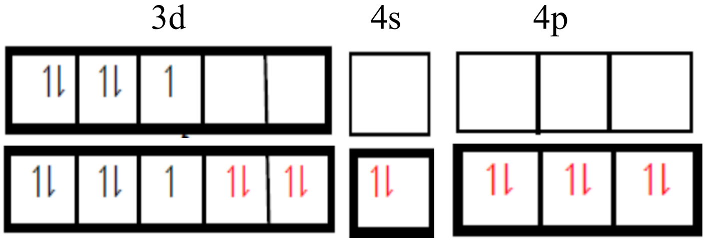
32. Show that $[CoF_6]^{3-}$ is octahedral and paramagnetic using VB theory

Complex	$[CoF_6]^{3-}$
Outer electronic configuration of $_{27}Co$	$3d^7\ 4s^2$
Outer electronic configuration of Co^{3+}	
Nature of ligand	F^- weak field ligand - no pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	sp^3d^2
Co ordination number	6
Geometry	Octahedral (outer orbital complex)
Number of unpaired electon	4
Magnetic property	Paramagnetic
Magnetic moment	$\mu_s = \sqrt{n(n+2)} = \sqrt{4(4+2)} = 4.9$ BM

33. On the basis of VB theory explain the nature of bonding in $[Ni(CO)_4]$

Complex	$[Ni(CO)_4]$
Outer electronic configuration of $_{28}Ni$	$3d^8\ 4s^2$
Outer electronic configuration of Ni^0	
Nature of ligand	CO strong field ligand - pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	sp^3
Co ordination number	4
Geometry	Tetrahedral
Number of unpaired electon	0
Magnetic property	diamagnetic
Magnetic moment	$\mu_s = \sqrt{n(n+2)} = 0$ BM

34. Show that $[Fe(CN)_6]^{3-}$ is octahedral and paramagnet using VB theory

Complex	$[Fe(CN)_6]^{3-}$
Outer electronic configuration of $_{26}Fe$	$3d^6\ 4s^2$
Outer electronic configuration of Fe^{3+}	
Nature of ligand	CN^- strong field ligand - pairing of 3d electrons
Outer orbital of metal atom in presence of ligands	
Hybridisation	d^2sp^3
Co ordination number	6
Geometry	Octahedral
Number of unpaired electon	1
Magnetic property	paramagnetic
Magnetic moment	$\mu = \sqrt{n(n+2)} = \sqrt{1(1+2)} = 1.73$BM

35. Give the uses of coordination compound.

Medicine

- Ca - EDTA - treatment of lead and radioactivity poisoning.
- Cis - platin - antitumor drug in cancer treatment.

Biologically

- Red blood corpuscles (RBC) : Fe^{2+}- Porphyrin complex
  Carrying oxygen from lungs to tissues and carbon dioxide from tissues to lungs
- Chlorophyll : Mg^{2+}- Porphyrin complex - Photosynthesis
- Carboxypeptidase : Zn^{2+} complex – digestion

Industry

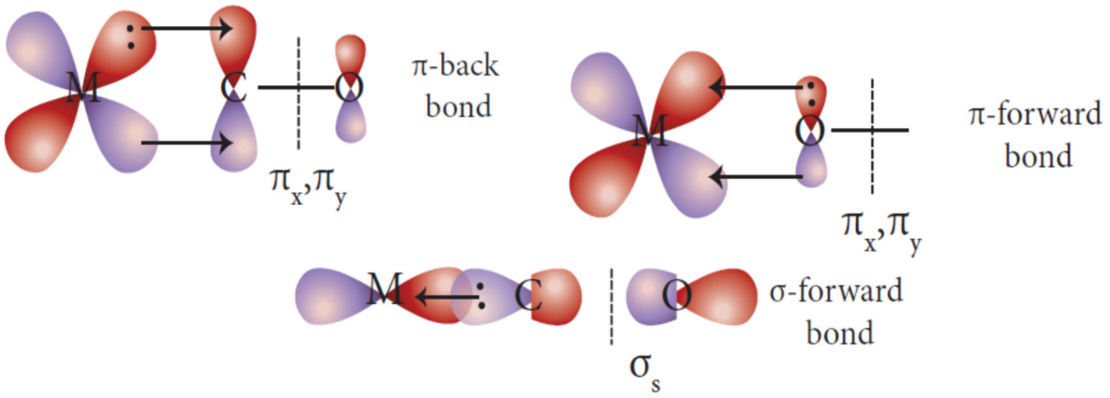
- Phthalo blue : Cu^{2+} complex - printing ink and in the packaging industry
- EDTA : 1. Separation of lanthanides,
  2. Softening of hard water
  3. Removing of lead poisoning.

Catalysts

- $[Rh(PPh_3)_3Cl]$ - Wilkinson's catalyst is used for hydrogenation of alkenes.
- $[TiCl_4] + Al(C_2H_5)_3$ - Ziegler-Natta catalyst is used in the polymerization of ethene.

36. Describe the nature of bonding in metallic carbonyls.

- In metal carbonyls, the bond between metal atom and the carbonyl ligand consists of two components.
- An electron pair donation from the carbon atom of carbonyl ligand into a vacant d-orbital of central metal atom.
- This electron pair donation forms M ← CO sigma bond.
- This sigma bond formation increases the electron density in metal d orbitals and makes the metal electron rich.
- In order to compensate for this increased electron density, a filled metal d-orbital interacts with the empty π* orbital on the carbonyl ligand and transfers the added electron density back to the ligand.
- This second component is called π-back bonding
- Thus in metal carbonyls, electron density moves from ligand to metal through sigma bonding and from metal to ligand through pi bonding, this synergic effect accounts for strong M ← CO bond in metal carbonyls.



37. Define stability constant

The stability constant (β) of a complex is the measure of its resistance to replaces one ligand by another

$$Cu^{2+} + 4NH_3 \rightleftharpoons \left[Cu(NH_3)_4\right]^{2+}$$

$$\beta = \frac{\left[Cu(NH_3)_4\right]^{2+}}{\left[Cu^{2+}\right]\left[NH_3\right]^4}$$

38. What is metal carbonyls? describe the Classification of metal carbonyls.

Metal carbonyls

The transition metal complexes of carbon monoxide, containing Metal- Carbon bond.

Ex. $[Ni(CO)_4]$

Classification

Based on the number of metal atoms present

1. Mono nuclear Carbonyls

These compounds contain only one metal atom - $[Ni(CO)_4]$

2. Poly nuclear carbonyls

These compounds contain more than one metal atom - $[Mn_2(CO)_{10}]$

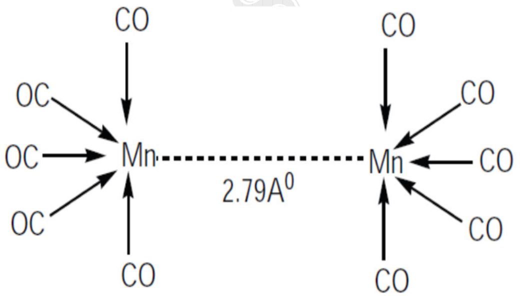
Based on the structure

1. **Non – bridged Carbonyls**

a. These compounds contain contain only terminal carbonyls -$[Ni(CO)_4]$

b. These compounds contain terminal carbonyls as well as Metal-Metal bonds.

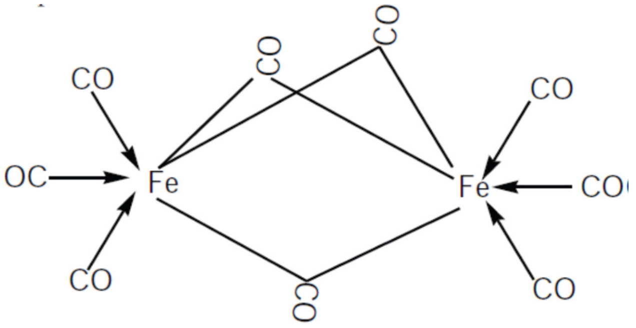
Ex. $[Mn_2(CO)_{10}]$



2. **Bridged carbonyls**

These will contain bridging carbonyl ligands along with terminalcarbonyl ligands and Metal-Metal bonds

Ex. - $[Fe_2(CO)_9]$



6. SOLID STATE

1. **What are the general characteristics of solids?**
   - ❖ Solids have definite volume and shape
   - ❖ Solids are rigid and incompressible
   - ❖ Solids have strong cohesive forces
   - ❖ Solids have short inter atomic distances.
2. **Describe classification of solids**

   I. Crystalline solids

   1. Ionic crystals - NaCl
   2. Covalent crystals - Diamond
   3. Molecular crystals - Glucose
   4. Metallic crystals - Au
   5. Atomic solids - frozen elements of Group 18

   II. Amorphous solids - Glass, rubber.
3. **Differentiate crystalline solids and amorphous solids.**

	Crystalline Solid	**Amorphous Solid**
1	Definite Shape	Irregular Shape
2	True Solids	Pseudo Solids
3	Anisotropic Nature	Isotropic Nature
4	Have Sharp Melting Point.	No Sharp Melting Point.
5	Orderly arrangement of constituents.	Random arrangement of Constituents.
6	Ex. - NaCl	Ex. - Glass

4. **What is meant by Isotropy and Anisotropy?**

Isotropy	**Anisotropy**
Uniformity in all direction.	Not Uniformity in all the direction
Same physical properties in all direction	Different physical properties in different direction.
Ex. - Glass	Ex. - NaCl

5. **Why ionic crystals are hard and brittle?**
   - ❖ The structural units of an ionic crystal are cations and anions.
   - ❖ They are bound together by strong electrostatic attractive forces.
   - ❖ Hence ionic crystals are hard and battle.
6. **What are the characteristics of ionic crystal?**
   - ❖ Hard
   - ❖ Dissolved in water.
   - ❖ High Melting Point.
   - ❖ Do not conduct electricity in solid state
   - ❖ Conduct electricity in molten state

7. **Ionic crystals do conduct electricity in molten state or solution but do not conduct electricity in solid state. Why?**

Ionic crystals do conduct electricity in molten state because, the ions are free to move in the molten state or solution.

8. **What is Covalent solids? What are the characteristics of Covalent crystal?**

In covalent solids, the atoms are bound together in a three dimensional network entirely by covalent bonds. Ex- Diamond

- Hard .
- High Melting Point.
- Poor thermal and electrical conductors

9. **What are molecular crystals?**

- The constituents are neutral molecules
- They are held together by weak van der Waals forces
- Ex.- Glucose

10. **Explain types of molecular crystals.**

1. Non-polar molecular crystals
   - Constituent molecules are held together by weak London forces.
   - Have low Melting Point.
   - Ex. naphthalene, anthracene

2. Polar molecular crystals
   - They are held together by relatively strong dipole-dipole interactions.
   - Have high Melting Point.
   - Solid CO_2, Solid NH_3

3. Hydrogen bonded molecular crystals
   - Constituent molecules areheld together by hydrogen bonds.
   - Soft solids
   - Solid ice, Glucose

11. **What is Metallic crystals? What are the characteristics of Metallic crystals?**

The lattice points are occupied by positive metal ions and a cloud of electrons pervades the space. Ex : Cu, Fe, Au

Characteristics of Metallic solids

- Hard and bright lustre
- Have high melting point.
- Electrical and thermal conductivity.

12. **Classify the following solids a. P_4 b. Brass c. Diamond d. NaCl e. Iodine**

a	P_4	Molecular solids
b	Brass	Metallic solids
c	Diamond	Covalent solids
d	NaCl	Ionic solids
e	Iodine	Molecular solids

13. **Define unit cell**

A basic repeating structural unit of crystalline solid is called unit cell.

14. **Define crystal lattice.**

The regular arrangement of atoms throughout the crystal is called a crystal lattice.

15. **What is meant by the term coordination number? What is the coordination number of atoms in sc, bcc, fcc structure?**

- ❖ The number of nearest neighbours that surrounding a particle in a crystal is called the coordination number of that particle.
- ❖ sc - 6, bcc - 8, fcc - 12

16. **What are primitive and non-primitive unit cell?**

Primitive unit cell - A unit cell contain only one lattice point
Made up from the lattice points at each of the corners.

Non –primitive cell - There are additional lattice point with in the unit cell .

17. **Explain briefly seven types of unit cell.**

S.No.	**Unit cell**	**Edge length**	**Edge angles**
1	Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90^0$
2	Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90^0$
3	Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90^0$
4	Hexagonal	$a = b \neq c$	$\alpha = \beta = 90^0, \gamma = 120^0$
5	Orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90^0$
6	Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = 90^0, \beta \neq 90^0$
7	Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90^0$

18. **What is the two dimensional coordination number of a molecule in square close packed layer?**

In this arrangement each sphere is in contact with four of its neighbors.
Hence its coordination number is 4.

19. **What is Bragg's equation?**

$$\boxed{n\lambda = 2d \sin\theta}$$

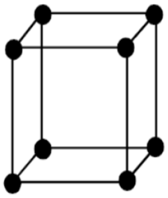
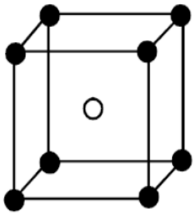
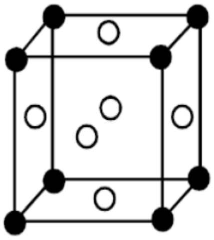
- ❖ n - order of diffraction
- ❖ λ - wavelength of X-ray
- ❖ d - inter planar distance between two successive planes
- ❖ θ - angle of diffraction

20. **Define Packing efficiency.**

$$\text{Packing efficiency} = \frac{\text{Total volume occupied by spheres in a unit cell}}{\text{Volume of the unit cell}} \times 100$$

sc - 52.38 %, bcc - 68 %, fcc - 74 %

21. **Draw the Cubic unit cell and Calculate the number of atoms in sc, bcc, fcc unit cell.**

Cubic unit cell	Number of atoms
<u>Simple Cubic (sc)</u> 	$\frac{N_c}{8} = \frac{8}{8} = 1$
<u>Body centred cubic (bcc)</u> 	$\frac{N_c}{8} + \frac{N_b}{1} = \frac{8}{8} + \frac{1}{1}$ $= 1 + 1 = 2$
<u>Face centred cubic (fcc)</u> 	$\frac{N_c}{8} + \frac{N_f}{2} = \frac{8}{8} + \frac{6}{2}$ $= 1 + 3 = 4$

22. **Define Imperfection in solids and give its types and advantages.**

The defects in the arrangement of the particles in a crystal, affects the physical and chemical properties. They are called as Imperfection in solids.

They are Four types.

1, Point defect, 2, Line defect 3, Interfacial defect 4, Volume defect

<u>Advantages of Imperfection in solids</u>

- ❖ Increases the electrical conductivity of semi conductor like Silicon
- ❖ Ferromagnetic substance can be magnetized and demagnetized by imperfection.

23. **Atoms X and Y form bcc crystalline structure. Atom X is present at the corners of the cube and Y is at the centre of the cube. What is the formula of the compound?**

Number of corner atoms (X) = Nc/8 = 8/8 = 1

Number of body centre atoms (Y) = Nb/1 = 1/1 = 1

Formula of the compound = XY

24. **Sodium metal crystallizes in bcc structure with the edge length of the unit cell is 4.3×10^{-8}cm. Calculate the radius of sodium atom.**

Edge length $a = 4.3 \times 10^{-8}$ cm

<u>Radius of sodium atom</u>

$$r = \frac{\sqrt{3}}{4} a = \frac{1.732 \times 4.3 \times 10^{-8}}{4}$$

$r = 1.86 \times 10^{-8}$ cm

25. **Explain the calculation of density of unit cell.**

$$\text{Density of unit cell} = \frac{\text{Mass of the unit cell}}{\text{Volume of the unit cell}}$$

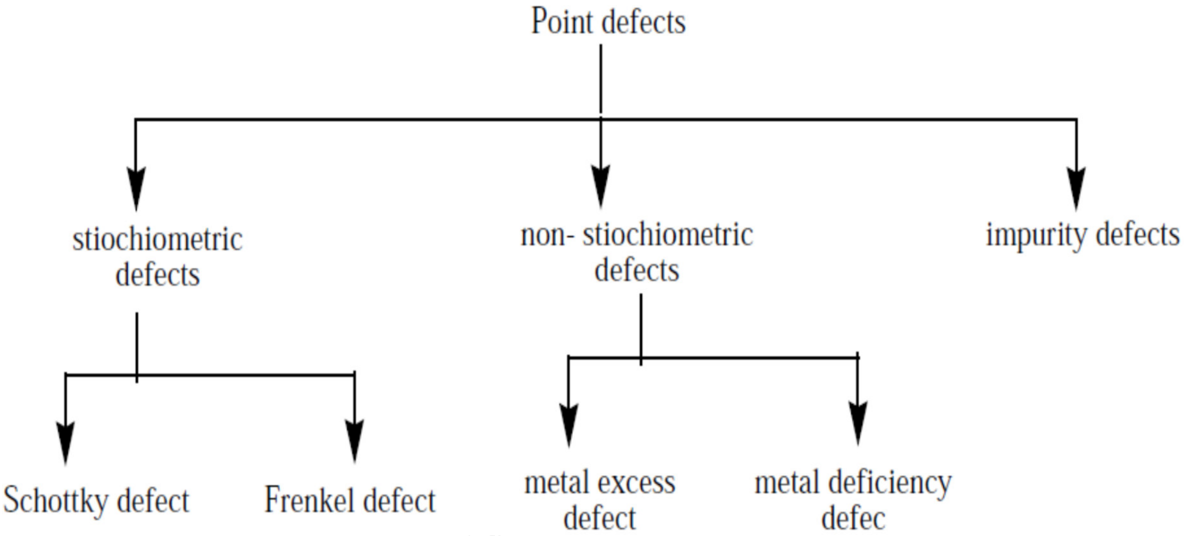
$$\text{Mass of unit cell} = n \times \frac{M}{N_A}$$

$$\text{Volume of the unit cell} = a \times a \times a = a^3$$

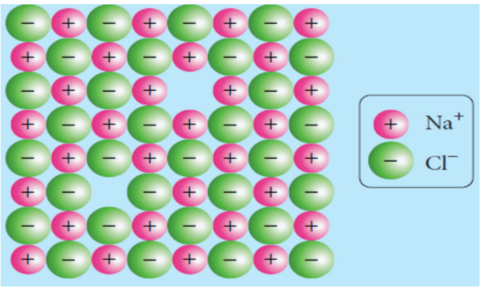
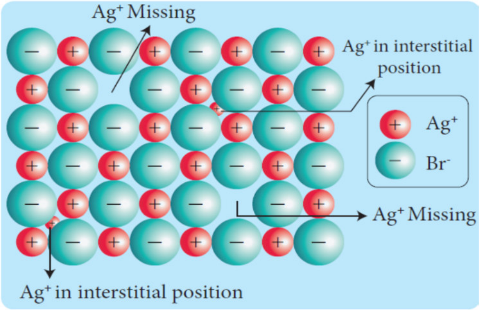
$$\textbf{Density of the unit cell } \rho = \frac{nM}{a^3 N_A}$$

26. **What are point defects and give the classifications of point defects**

Point defects are the deviations from ideal arrangement that occurs at some atoms in a crystalline substance.



27. **Explain Schottky defect and Frenkel defect. (or) Explain Stiochiometric defect.**

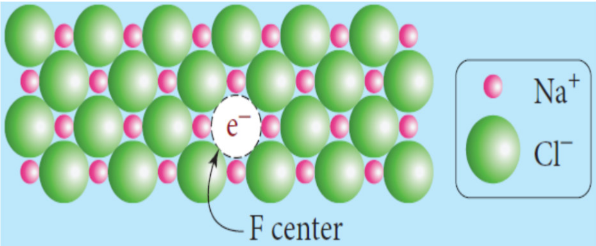
Schottky defect ❖ Arises due to the missing of equal number of cations and anions from the crystal lattice ❖ Ex: NaCl ❖ Size of anion and cation similar ❖ Lowers its density ❖ Does not change the stoichiometry of the crystal.	
Frenkel defect ❖ Arises due to dislocation of ions from its crystal lattice ❖ The ion which is missing from the lattice point occupies an interstitial position. ❖ Ex : AgBr ❖ Size of anion and cation differ ❖ Does not affect the density of crystal	

28. Write short notes on metal excess and metal deficiency defect with an example. (or) Explain Non-stiochiometric defect.

Metal excess defect

Arises due to presence of more number of metal ions as compared to anions

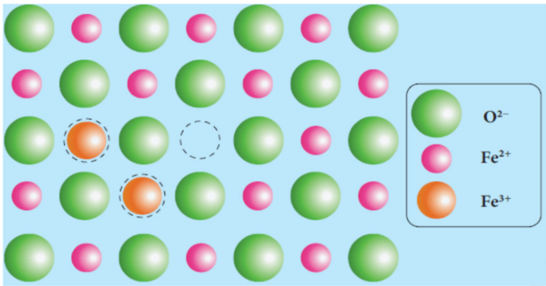
Ex : NaCl, ZnO



Metal deficiency defect

Arises due to the presence of less number of cations than the anions

Ex : FeO



29. Write a short note on impurity defect?

- A general method of introducing defects in ionic solids by adding impurity ions.
- Addition of CdI_2 to silver chloride yields solid solutions where the divalent cation Cd+2 occupies the position of Ag+.
- In order to maintain the electrical neutrality of the crystal, proportional number of Ag+ ions leaves the lattice.

30. Why ZnO turns yellow on heating ?

- On heating ZnO loses oxygen atom and forms a free Zn^{2+} ion.
- This Zn^{2+} ion and electrons occupy the interstitial position.
- This is due to formation of Metal excess defect.

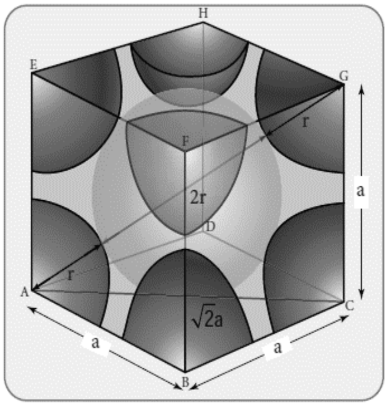
31. Distinguish between hexagonal close packing and cubic close packing.

Hexagonal close packing	Cubic close packing.
aba - arrangement	abc - arrangement
The unit cell has 6 spheres	The unit cell has 4 spheres
Tetrahedral voids of the second layer are covered by the spheres of the third layer.	Octahedral voids of he third layer may be placed over the second layer
The third layer is directly over a first layer	The third layer placed over the II-nd layer.

32. Distinguish tetrahedral and octahedral voids.

	Tetrahedral voids	Octahedral voids.
1	When the spheres of the second layer is above the voids of the first layer	When the spheres of the second layer partially covers the voids of the first layer
2	The number of Tetrahedral voids is given by ‘2n’.	The number of Octahedral voids is given by ‘n’.
3	3 spheres in the lower layer and one in the upper layer. Total 4 spheres	3 spheres in the lower layer and 3 in the upper layer. Total 6 spheres.
4	When the 4 spheres are joined the center gives a Tetrahedron.	When the 6 spheres are joined the centergives a Octahedron.

33. **Calculate the percentage efficiency of packing in case of body centered cubic crystal.**



In Δ ABC, $AC^2 = AB^2 + BC^2$

$$AC = \sqrt{AB^2 + BC^2}$$

$$AC = \sqrt{a^2 + a^2} = \sqrt{2a^2} = \sqrt{2}\mathbf{a}$$

In Δ ACG, $AG^2 = AC^2 + CG^2$

$$AG = \sqrt{AC^2 + CG^2}$$

$$AG = \sqrt{(\sqrt{2}\,a)^2 + a^2} = \sqrt{3a^2} = \sqrt{3}a$$

$$\sqrt{3}a = 4r$$

$$r = \frac{\sqrt{3}}{4}a$$

$$\text{volume of the sphere} = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{\sqrt{3}}{4}a\right)^3 = \frac{\sqrt{3}}{16}\pi a^3$$

Total number of spheres belong to a unit cell in bcc arrangement = 2

$$\text{the total volume of all spheres} = 2 \times \left(\frac{\sqrt{3}\,\pi\, a^3}{16}\right) = \frac{\sqrt{3}\,\pi\, a^3}{8}$$

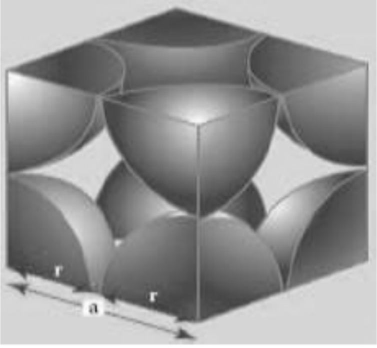
$$\text{Packing efficiency} = \frac{\text{Total volume occupied by spheres in a unit cell}}{\text{Volume of the unit cell}} \times 100$$

$$\text{Packing fraction} = \frac{\left(\frac{\sqrt{3}\,\pi\, a^3}{8}\right)}{\left(a^3\right)} \times 100$$

$$= 1.732 \times 3.14 \times 12.5 = 68\ \%$$

Packing Efficiency of body centered cubic crystal (bcc) = 68 %

34. **Calculate the percentage efficiency of packing in case of a simple cubic crystal (sc).**



Volume of the unit cell = a x a x a = a^3

$$\text{Radius of the sphere } (r) = \frac{a}{2}$$

$$\text{Volume of the sphere} = \frac{4\pi r^3}{3}$$

$$= \frac{4}{3}\pi\left(\frac{a}{2}\right)^3 = \frac{4}{3}\pi\left(\frac{a^3}{8}\right)$$

$$\text{Volume of the sphere} = \frac{\pi a^3}{6}$$

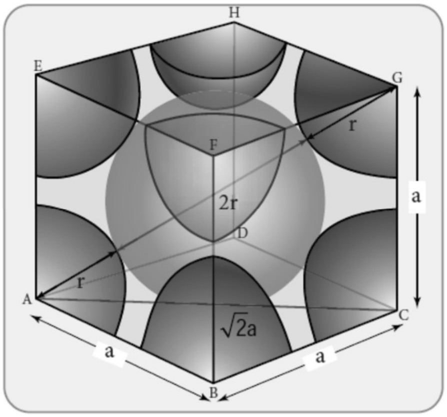
Total number of spheres belong to a unit cell in sc arrangement = 1

$$\text{Packing efficiency} = \frac{\text{Total volume occupied by spheres in a unit cell}}{\text{Volume of the unit cell}} \times 100$$

$$\text{Packing fraction} = \frac{\left(\frac{\pi a^3}{6}\right)}{(a^3)} \times 100 = \frac{100\,\pi}{6}$$

Packing Efficiencyof simple cubic crystal (sc) = 52.38 %

35. **Calculate the percentage efficiency of packing in case of a face centred cubic crystal**



In ΔABC

$$AC^2 = AB^2 + BC^2$$

$$AC = \sqrt{AB^2 + BC^2} = \sqrt{a^2 + a^2} = \sqrt{2a^2} = \sqrt{2}\,a$$

$$AC = 4r$$

$$4r = \sqrt{2}\,a$$

$$\text{Radius of the sphere } (r) = \frac{\sqrt{2}}{4}a$$

$$\text{volume of the sphere} = \frac{4}{3}\pi r^3$$

$$= \frac{4}{3}\pi\left(\frac{\sqrt{2}a}{4}\right)^3 = \frac{4}{3}\pi\left(\frac{2\sqrt{2}a^3}{64}\right) = \frac{\sqrt{2}\,\pi a^3}{24}$$

Total number of spheres belong to a unit cell in fcc arrangement = 4

$$\text{the total volume of all spheres} = 4 \times \left(\frac{\sqrt{2}\,\pi a^3}{24}\right) = \left(\frac{\sqrt{2}\,\pi a^3}{6}\right)$$

$$\text{Packing efficiency} = \frac{\text{Total volume occupied by spheres in a unit cell}}{\text{Volume of the unit cell}} \times 100$$

$$\text{packing efficiency} = \frac{\left(\dfrac{\sqrt{2}\,\pi\, a^3}{6}\right)}{(a^3)} \times 100$$

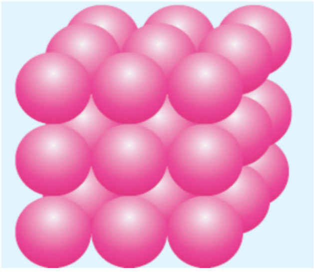
$$= \frac{\sqrt{2}\,\pi}{6} \times 100 = \frac{1.414 \times 3.14 \times 100}{6} = 74\%$$

Packing Efficiencyof face centred cubic crystal (fcc) = 74 %

36. Explain a) AAAA b) ABABAB c) ABCABC type of three dimensional packing with the help of neat diagram.

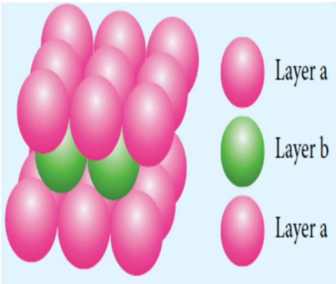
a) <u>AAAA three dimensional packing (sc-Arrangement)</u>

- This type can be obtained by repeating the AAAA type two dimensional arrangements in three dimensions
- Spheres in one layer sitting directly on top of those in the previous layer, so that all layers are identical.
- All spheres of different layers of crystal are perfectly aligned horizontally and also vertically
- Each sphere is in contact with 6 neighbouring spheres – 4 in its own layer, one above and one below.
- So the coordination number is 6.



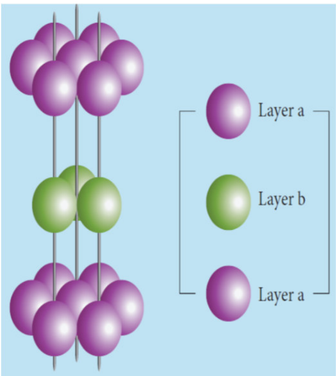
b) <u>ABABAB three dimensional packing (bcc-Arrangement)</u>

- The spheres in the first layer (A type) are slightly separated
- The second layer is formed by arranging the spheres in the depressions between the spheres in layer A.
- The third layer is the repeat of the first.
- This pattern ABABAB is repeated throughtout the crystal
- Each sphere is in contact with 8 neighbouring spheres – 4 above and 4 below.
- So the coordination number is 8.



c. <u>ABC ABC three dimensional packing (fcc- Arrangement)</u>

- The first layer is formed by arranging the spheres as in the case of two dimensional ABAB arrangements.
- The second row fit into the depression of first row.
- A tetrahedral voids and octahedral voids are formed in the first layer
- The third layer fit in octahedral voids of second layer.
- The third layer is different from other two layers
- Each sphere is in contact 12 neighbouring spheres- 6 in its own layer, 3 above and 3 below.
- So the coordination number is 12



7. CHEMICAL KINETICS

1. **Define Rate of a chemical reaction.**

The change in concentration of the species involved in a chemical reaction per unit time is called the rate of a reaction.

Unit: mol L^{-1} s^{-1}

2. **Define average rate and instantaneous rate.**

Average rate - The rate of the reaction, at a given interval of time during the reaction

Instantaneous rate - The rate of the reaction, at a particular instant during the reaction.

3. **Define rate law**

Rate law is the expression which relates the rate, the rate constant and the concentration of the reactants.

$$A + B \longrightarrow \text{Products}$$

Rate = k [A] [B]

4. **Define rate constant.**

Rate constant is equal to the rate of reaction, when the concentration of each of the reactants in unity.

$$A + B \longrightarrow \text{Products}$$

Rate = k [A] [B]

k = rate constant

If [A] = [B] = 1 mole

Rate = k

5. **Differentiate between rate and rate constant of a reaction**.

	Rate of a reaction	Rate constant of a reaction
1	It is measured as decrease in the conc. of the reactants or increase in the conc. of products.	It is equal to the rate of reaction, when the conc. of each of the reactants in unity.
2	It depends on the initial concentration of reactants	It does not depend on the initial concentration of reactants
3	It represents the speed at which the reactants are converted into products at any instant	It is a proportional constant

6. **What is an elementary reaction?**

Each and every single step in a reaction mechanism is called as Elementary reaction.

7. **Give the differences between order and molecularity of a reaction.**

	Order of a reaction	Molecularity of a reaction
1	It is the sum of the powers of concentration terms involved in the experimentally determined rate law.	It is the total number of reactant species that are involved in an elementary step.
2	zero (or) fractional (or) integer	Whole number
3	It is assigned for an overall reaction.	It is assigned for each elementary step of mechanism

8. **What is first order reaction?**
Give examples for the first order reaction.
A reaction whose rate depends on the reactant concentration raised to the first power is called a first order reaction

- Decomposition of N_2O_5
- Decomposition of SO_2Cl_2
- Decomposition of H_2O_2 aqueous solution
- Isomerisation of cyclopropane to propene

9. **Explain pseudo first order reaction with an example.**
In a second order reaction, when one of the reactants concentration is in excess of the other then the reaction follows a first order kinetics, such reactions are called Pseudo first order reactions.
Ex- Acid hydrolysis of an ester.

$$\mathbf{CH_3COO\ CH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH}$$

10. **What is zero order reaction?**
A reaction in which the rate is independent of the concentration of the reactant over a wide range of concentrations is called as zero order reaction.
Ex.- Photochemical reaction between H_2 and I_2

11. **Give exapmles for zero order reaction**

- Photochemical reaction between H_2 and I_2
- Decomposition of N_2O on hot platinumsurface
- Iodination of acetone in acid medium

12. **Define half life of a reaction.**
The half-life of a reaction is defined as the time required for the reactant concentration to reach one half its initial value.

13. **The rate constant for a first order reaction is 1.54×10^{-3} s^{-1} Calculate its half life time.**

$$t_{1/2} = \frac{0.6932}{k}$$

$$= 0.6932 / 1.54 \times 10^{-3}$$

$$= 450 \text{ s}$$

14. **Define Activation energy**
The minimum energy required by the molecules to react, and form the products is called Activation energy.

15. **Write Arrhenius equation and explains the terms involved**.

$$k = Ae^{-\left(\frac{E_a}{RT}\right)}$$

k = Rate constant
A = Frequency factor
E_a = Activation Energy
R = Gas constant
T = Temperature (K)

16. **List the factors affecting the reaction rate.**

1. Nature and state of the reactant
2. Concentration of the reactant
3. Surface area of the reactant
4. Temperature of the system
5. Catalyst

17. **How do nature of the reactant influence rate of reaction.**

- The net energy involved in a reaction dependent on the nature of the reactant and hence the rates are different for different reactants.
- Gas phase reactions are faster as compared to the reactions involving solid or liquid reactants.
- Ex.- Reaction of sodium metal with iodine vapours is faster than the reaction between solid sodium and solid iodine.

18. **How do concentrations of the reactant influence the rate of reaction?**

- The rate of a reaction increases with the increase in the concentration of the reactants.
- According to collision theory, the rate of a reaction depends upon the number of collisions between the reacting molecules.
- Higher the concentration, greater is the possibility for collision and hence the rate.

19. **Explain the effect of catalyst on reaction rate with an example.**

- A catalyst is substance which alters the rate of a reaction
- In the presence of a catalyst, the energy of activation is lowered
- Hence greater number of molecules can cross the energy barrier and change over to products.
- There by increasing the rate of the reaction.

20. **Derive integrated rate law for a first order reaction.**

$$A \longrightarrow \text{Products}$$

Rate = $K[A]^1$ (K - rate constant)

$$\frac{-d[A]}{dt} = k\,[A]^1$$

$$\frac{-d[A]}{[A]} = k\,dt$$

At, $t = 0 \Rightarrow [A] = [A_0]$

$t = t \Rightarrow [A] = [A]$

$$\int_{[A_0]}^{[A]} \frac{-d[A]}{[A]} = k\int_0^t dt$$

$$\left(-\ln[A]\right)_{[A_0]}^{[A]} = k\left(t\right)_0^t$$

$$-\ln[A] - \left(-\ln[A_0]\right) = k\,(t-0)$$

$$-\ln[A] + \ln[A_0] = kt$$

$$\ln\left(\frac{[A_0]}{[A]}\right) = kt$$

$$2.303\log\left(\frac{[A_0]}{[A]}\right) = kt$$

$$k = \frac{2.303}{t}\log\frac{[A_0]}{[A]}$$

21. Describe the graphical representation of first order reaction.

Rate constant of first order reaction is

$$k = \frac{2.303}{t}\log\frac{[A_0]}{[A]}$$

------- (1)

$$2.303\log\left(\frac{[A_0]}{[A]}\right) = kt$$

------- (2)

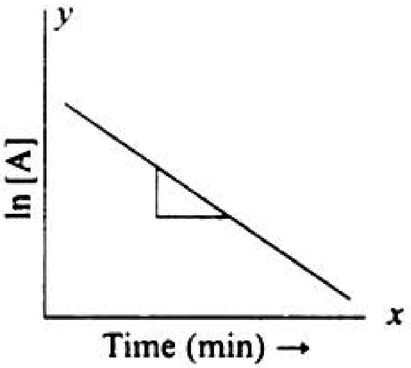
- Equation (2) can be written in the form y = mx + c as below

$$\ln[A_0] - \ln[A] = kt$$

$$\ln[A] = \ln[A_0] - kt$$

$$\Rightarrow y = c + mx$$

- If we follow the reaction by measuring the conc. of the reactants at regular time interval 't',
- A plot of ln[A] Vs t yields a straight line with a negative slope.
- From this, the rate constant is calculated.



22. **Show that for a first order reaction half life is independent of initial concentration**

$$k = \frac{2.303}{t}\log\frac{[A_0]}{[A]}$$

$$\text{at } t = t_{1/2} \;;\; [A] = {[A_0]}/{2}$$

$$k = \frac{2.303}{t_{1/2}}\log\frac{[A_0]}{[A_0]/2}$$

$$k = \frac{2.303}{t_{1/2}}\log 2 = \frac{2.303\text{x}0.3010}{t_{1/2}}$$

$$k = \frac{0.6932}{t_{1/2}}$$

$$t_{1/2} = \frac{0.6932}{k}$$

23. **Derive integrated rate law for a zero order reaction A $\longrightarrow$ product**

$$A \longrightarrow \text{Products}$$

$$\text{Rate} = k\,[A]^0 \quad (\text{k -Rate constant})$$

$$\frac{-d[A]}{dt} = k\,(1) \qquad \left(\because [A]^0 = 1\right)$$

$$-d[A] = k\,dt$$

$$\text{At, } t = 0 \Rightarrow [A] = [A_0] \quad \& \quad t = t \Rightarrow [A] = [A]$$

$$-\int_{[A_0]}^{[A]} d[A] = k\int_0^t dt$$

$$-([A])_{[A_0]}^{[A]} = k\,(t)_0^t$$

$$[A_0] - [A] = kt$$

$$k = \frac{[A_0] - [A]}{t}$$

24. **Derive the half life period of zero order reaction**

$$\text{Rate constant, } k = \frac{[A_0] - [A]}{t}$$

$$\text{at } t = t_{1/2} \;;\; [A] = [A_0]/2$$

$$k = \frac{[A_0] - [A_0]/2}{t_{1/2}}$$

$$k = \frac{[A_0]}{2t_{1/2}}$$

$$t_{1/2} = \frac{[A_0]}{2k}$$

நம்பிக்கை என்பது ஒரு நாளில் உதிர்ந்து விடும் பூவாக இருந்து விடக்கூடாது, மேலும் மேலும் மலரை உருவாக்கும் செடியாக இருக்க வேண்டும்...

25. Identify the order for the following reactions

(i) Rusting of Iron – First order reaction

(ii) Radioactive disintegration of $_{92}U^{238}$ - First order reaction

(iii) $2A + 3B \longrightarrow$ products ; rate = $k[A]^{1/2}[B]^2$

Order of overall reaction = ½ +2 = 2 ½ = 5/2

26. Write the rate law for the following reactions.

(a) A reaction that is 3/2 order in x and zero order in y

Rate = $k\,[x]^{3/2}\,[y]^0$

Rate = $k\,[x]^{3/2}$

(b) A reaction that is second order in NO and first order in Br_2

Rate = $k\,[NO]^2\,[Br_2]^1$

27. Explain the rate determining step with an example.

- The decomposition of hydrogen peroxide catalysed by I^-

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

- It is experimentally found that the reaction is first order with respect to both H_2O_2 and I^-, which indicates that I^- is also involved in the reaction.
- The mechanism involves the following steps.

Step -1

$$H_2O_2(aq) + I^-(aq) \longrightarrow H_2O(l) + OI^-(aq)$$

Step -2

$$H_2O_2(aq) + OI^-(aq) \rightarrow H_2O(l) + I^-(aq) + O_2(g)$$

Overall reaction

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

- Step 1 is the rate determining step, since it involves both H_2O_2 and I^-
- Hence the overall reaction is bimolecular.

28. The decomposition of Cl_2O_7 at 500K in the gas phase to Cl_2 and O_2 is a first order reaction. After 1 minute at 500K, the pressure of Cl_2O_7 falls from 0.08 to 0.04 atm. Calculate the rate constant in s^{-1}.

$$k = \frac{2.303}{t}\log\frac{[A_0]}{[A]}$$

$$k = \frac{2.303}{1\,\text{min}}\log\frac{[0.08]}{[0.04]}$$

$$k = 2.303\log 2 = 2.303 \times 0.3010 = 0.6932\,\text{min}^{-1}$$

$$k = \left(\frac{0.6932}{60}\right)s^{-1}$$

$$k = 1.153 \times 10^{-2}\ s^{-1}$$

29. Define Fraction of effective collisions (f)

$$f = e^{\frac{-E_a}{RT}}$$

f - Fraction of effective collision

E_a - Activation Energy

R - Gas constant

T- Temperature (K)

30. Explain briefly the collision theory of bimolecular reactions.

- Collision theory is based on the kinetic theory of gases.
- According to this theory, chemical reactions occur as a result of collisions between the reacting molecules.
- $A_2 + B_2 \longrightarrow 2AB$
- If consider the reaction, the rate would be proportional to the number of collisions per second.
- Rate α number of molecules colliding per litre per second (collision rate)
- Number of collisions α Concentration of reactants
- Collision rate α $[A_2]\,[B_2]$
- Collision rate = $Z\,[A_2]\,[B_2]$ (Z – constant)
- In order to react, the colliding molecules must possess a minimum energy called activation energy.
- The molecules that collide with less energy than activation energy will remain intact and no reaction occurs.
- Fraction of effective collisions $f = e^{-Ea/RT}$
- For a reaction having activation energy of 100 kJ mol^{-1} at 300K.

  $$f = e^{-40} \approx 4 \times 10^{-18}$$
- Thus, out of 10^{-18} collisions only four collisions are sufficiently energetic to convert reactants to products.
- The reactant collide with sufficient energy, they will not react unless the orientation of the reactant molecules is suitable for the formation of the transition state.
- The fraction of effective collisions (f) having proper orientation is given by the steric factor p.
- Rate = p x f x Collision rate
- Rate = $p\, e^{-Ea/RT}\, Z\,[A_2]\,[B_2]$ ------- 1
- As per the rate law, Rate = $k\,[A_2]\,[B_2]$ ------ 2
- On comparing equation (1) and (2),

  Rate constant $k = p\,Z\,e^{-Ea/RT}$

8. IONIC EQUILIBRIUM

1. Give the difference between acids and bases

	Acids	Bases
1	Sour taste	Bitter taste
2	It turns blue litmus paper Red.	It turns red litmus paper blue.
3	To give H^+ ions in water	To give OH^- ions in water.
4	Ex.- HCl, H_2SO_4	Ex.- NaOH, KOH

2. Explain the Arrhenius concept and Limitations of acid and bases

- An acid dissociates to give H^+ ions in water.

$$HCl + H_2O \rightleftharpoons H^+ + Cl^-$$

- A base dissociates to give OH^- ions in water.

$$NaOH + H_2O \rightleftharpoons Na^+ + OH^-$$

Limitations

- It does not explain the behaviour of acids and bases in non aqueous solvents like acetone, THF...
- It does not account for the basic nature of the substances like ammonia (NH_3) which do not possess OH^- ion

3. Explain the Lowry – Bronsted concept and Limitations of acid and bases

- An acid is a proton donar - HCl

$$HCl+H_2O \rightleftharpoons H_3O^+ + Cl^-$$

- A base is a proton acceptor - NH_3

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

Limitations

Substances like BF_3, $AlCl_3$.., that do not donate protons are known to behave as acids.

4. What are Lewis acids and bases? Give two example for each.

	Lewis acids	Lewis bases
1	Electron deficient molecule	Molecule with pair of electrons
2	Accepts an electron pair	Donates an electron pair
3	Positive ion	Anion (or) neutral molecule
4	Ex.- BF_3, $AlCl_3$, CO_2, Fe^{2+}	Ex.- NH_3, H_2O, F^-, $CH_2{=}CH_2$

5. **What are conjucate Acid - Base pairs?**

Chemical species that differ only by a proton are called conjugate acid - base pairs.

HCl & Cl^- , NH_4^+ & NH_3

6. Indentify the conjugate acid-base pair for the following reaction in aqueous solution.

$HS^-(aq) + HF \rightleftharpoons F^-(aq) + H_2S(aq)$ conjugate acid-base pair $\underset{\text{Base2}}{HS^-(aq)} + \underset{\text{Acid1}}{HF} \rightleftharpoons \underset{\text{Base1}}{F^-(aq)} + \underset{\text{Acid2}}{H_2S(aq)}$ conjugate acid-base pair	$HPO_4^{2-} + SO_3^{2-} \rightleftharpoons PO_4^{3-} + HSO_3^-$ conjugate acid-base pair $HPO_4^{2-} + SO_3^{2-} \rightleftharpoons PO_4^{3-} + HSO_3^-$ conjugate acid-base pair
$NH_4^+ + CO_3^{2-} \rightleftharpoons NH_3 + HCO_3^-$ conjugate acid-base pair $NH_4^+ + CO_3^{2-} \rightleftharpoons NH_3 + HCO_3^-$ conjugate acid-base pair	$\mathbf{NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+}$ conjugate acid-base pair $\underset{\text{acid 1}}{NH_4^+} + \underset{\text{base 2}}{H_2O} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 1}}{NH_3}$ conjugate acid-base pair
$H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$ conjugate acid-base pair $\underset{\text{acid 1}}{H_2SO_4} + \underset{\text{base 2}}{H_2O} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 1}}{HSO_4^-}$ conjugate acid-base pair	$CH_3COOH + H_2O \rightleftharpoons H_3O^+ + CH_3COO^-$ conjugate acid-base pair $\underset{\text{acid 1}}{CH_3COOH} + \underset{\text{base 2}}{H_2O} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 1}}{CH_3COO^-}$ conjugate acid-base pair

7. Account for the acidic nature of $HClO_4$ in terms of Bronsted - Lowry theory, identify its conjugate base.

$$HClO_4 \longrightarrow H^+ + ClO_4^-$$

$HClO_4$ is donate a proton. So it is an acid.

$$HClO_4 + H_2O \rightleftharpoons H_3O^+ + ClO_4^-$$

The conjugate base of $HClO_4$ is ClO_4^-

8. Define p^H

pH of a solution is defined as the negative logarithm of base 10 of the molar concentration of the hydronium ions present in the solution.

$p^H = -\log_{10}[H_3O^+]$

9. Define Ionic product of water. Give its value at room temperature.

The product of concentration of hydronium ion and hydroxyl ion of pure water is known as ionic product of water (Kw).

Ionic product of water at 25^0 c,

$$\mathbf{K_W = [H_3O^+][OH^-]} = 1 \times 10^{-7} \times 1 \times 10^{-7} = 1 \times 10^{-14}$$

10. Calculate the P^H of a) 0.001 M HCl b) 0.04 M HNO_3

0.001M HCl	**0.04M HNO_3**
$[H_3O^+] = 0.001 = 1x10^{-3}$ mol L^{-1}	$[H_3O^+] = 0.04 = 4x10^{-2}$ mol L^{-1}
$P^H = - \log_{10} [H_3O^+]$	$P^H = - \log_{10} [H_3O^+]$
$= - \log_{10} [1x10^{-3}]$	$= - \log_{10} [4x10^{-2}]$
$= - 1 x \log_{10} [1x10^{-3}]$	$= - \log_{10} [10^{-2}] - \log_{10} 4$
$= -1 x -3$	
$P^H = 3$	$P^H = 2 - 0.6021 = 1.40$

11.Calculate the P^H of $1.5 x 10^{-3}$ M $Ba(OH)_2$ solution.

$$Ba(OH)_2 \rightarrow Ba^{2+} + 2 OH^-$$

$\mathbf{2}[OH^-] = 2 x 1.5 x 10^{-3} M = 3 x 10^{-3} M$

$P^{OH} = - \log_{10} [OH^-]$

$= - \log_{10} (3 x 10^{-3}) = 3 - \log 3 = 3 – 0.48 = 2.52$

$P^H = 14 - P^{OH}$

$= 14 - 2.52 = 11.48$

12. Calculate the pH of 0.1M CH_3COOH solution. Dissociation constant is . $1.8 x 10^{-5}$

$pH=-\log[H^+]$

For weak acids,

$[H^+]=\sqrt{K_a \times C}$

$=\sqrt{1.8\times10^{-5}\times0.1}$

$=1.34\times10^{-3}M$ $\qquad pH=-\log\left(1.34\times10^{-3}\right)$

$=3 - \log1.34$

$= 3 - 0.1271$

$= 2.87$

13. Derive the relationship between pH and pOH

$P^H = - \log_{10} [H_3O^+]$

$P^{OH} = - \log_{10} [OH^-]$

$P^H + P^{OH} = - \log_{10} [H_3O^+] - \log_{10} [OH^-]$

$P^H + P^{OH} = - \log_{10} [H_3O^+][OH^-]$

Ionic product of water $K_w = [H_3O^+][OH^-]$

$P^H + P^{OH} = - \log_{10} K_w$ $\qquad (- \log_{10} K_w = p^Kw)$

$P^H + P^{OH} = p^Kw$

If $K_w = 1 x 10^{-14}$

$p^Kw = - \log_{10} (1 x 10^{-14}) = 14$

$$\boxed{P^H + P^{OH} = 14}$$

14. Define Oswald's Dilution law

Ostwald's dilution law relates the dissociation constant of the weak acid (Ka) with its degree of dissociation (α) and the concentration (C).

$$\alpha = \sqrt{\frac{K_a}{c}}$$

α = degree of dissociation, K_a = dissociation constant, C = concentration.

15. Derive an expression for Oswald's Dilution law

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

	CH_3COOH	H^+	CH_3COO^-
Initial number of moles	1	-	-
Number of moles Ionized	α	-	-
Number of moles at equilibrium	$1-\alpha$	α	α
Equilibrium concentration	$(1-\alpha)C$	αC	αC

The dissociation constant of acetic acid is,

$$k_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]} \qquad \alpha = \frac{\text{Number of moles dissociated}}{\text{total number of moles}}$$

$$k_a = \frac{(\alpha C)(\alpha C)}{(1-\alpha)C} = \frac{\alpha^2 C}{1-\alpha}$$

Weak acid dissociates only to a very small extent.

Compared to 1, α is so small

$K_a = \alpha^2 C$

(α = degree of dissociation, K_a = dissociation constant, C = concentration.)

$$\alpha^2 = \frac{K_a}{C}$$

$$\boxed{\alpha = \sqrt{\frac{K_a}{C}}}$$

16. Explain Common Ion effect with an example.

- When a salt of a weak acid is added to the acid itself, the dissociation of the weak acid is suppressed further. It is known as Common Ion effect.
- The addition of sodium acetate to acetic acid solution, the dissociation of acetic acid is suppressed
- In this case, CH_3COOH and CH_3COONa have the common ion, CH_3COO^-

17. Explain Buffer solution and its types

- Buffer is a solution which consists of a mixture of a weak acid and its conjugate base (or) a weak base and its conjugate acid.
- This buffer solution resists drastic changes in its pH upon addition of a small quantities of acids (or) bases.
- There are two types of buffer solutions.

1. Acidic buffer solution : weak acid and its salt.

$$CH_3\text{-}COOH + CH_3COONa$$

2. Basic buffer solution : weak base and its salt.

$$NH_4OH \ + \ NH_4Cl$$

18. What is Buffer capacity and buffer index

- Buffer capacity is defined as the number of gram equivalents of acid or base added to 1 litre of the buffersolution to change its pH by unity.
- Buffer index (β) is a quantitative measure of the buffer capacity.

$$\beta = \frac{dB}{d(pH)}$$

dB = number of gram equivalents of acid / base added to one litre of buffer solution.

$d(P^H)$ = The change in the pH after the addition of acid / base.

19. Explain buffer action

The buffer action in a solution containing CH_3COOH and CH_3COONa.

The dissociation of the buffer components occurs as below.

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+ \text{ -------- } 1$$

$$CH_3COONa \rightarrow CH_3COO^- + Na^+$$

If an acid is added to this mixture, it will be consumed by the conjugate base CH_3COO^- to form the undissociated weak acid.

The increase in the concentration of H^+ does not reduce the pH significantly.

$$CH_3COO^- + H^+ \rightarrow CH_3COOH$$

If a base is added, it will be neutralized by H_3O^+, and the acetic acid is dissociated to maintain the equlibrium. Hence the pH is not significantly altered.

$$H_3O^+ + OH^- \rightarrow 2H_2O \text{ -------- } 2$$

In Equation 1 + 2

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$$

$$H_3O^+ + OH^- \rightarrow 2H_2O$$

$$CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$$

---

20. Derive Henderson – Hasselbalch equation

$$HA + H_2O \rightleftharpoons [H_3O^+] + [A^-]$$

$$[H_3O^+] = K_a \frac{[acid]_{eq}}{[base]_{eq}}$$

due to common ion effect

$[Acid]_{aq} = [Acid]$; $[Base]_{aq} = [Salt]$

$$[H_3O^+] = K_a \frac{[acid]}{[salt]}$$

Reverse the sign on both sides

$$-\log [H_3O^+] = -\log K_a - \log \frac{[acid]}{[salt]}$$

We know that

$$pH = -\log [H_3O^+] \text{ and } pK_a = -\log K_a$$

$$pH = pK_a - \log \frac{[acid]}{[salt]}$$

$$pH = pK_a + \log \frac{[salt]}{[acid]}$$

Similarly for a basic buffer

$$pOH = pK_b + \log \frac{[salt]}{[base]}$$

21. Define Solubility Product.

The solubility product of a compound is defined as the product of the molar concentration of the constituent ions, each raised to the power of its stoichiometric co-efficient in a balanced equilibrium equation.

$$X_mY_n \rightleftharpoons mX^{n+} + nY^{m-}$$

$$K_{sp} = [X^{n+}]^m [Y^{m-}]^n$$

22. Write the uses of Solubility Product.

Solubility product finds useful to decide whether an ionic compound gets precipitated when solution that contains the constituent ions are mixed.

- Ionic product > Ksp, precipitation will occur and the solution is super saturated.
- Ionic product < Ksp, no precipitation and the solution is unsaturated.
- Ionic product = Ksp, equilibrium exist and the solution is saturated.

23. Write the expression for the solubility product of $Ca_3(PO_4)_2$ and Hg_2Cl_2

$Ca_3(PO_4)_2 \rightleftharpoons 3\,Ca^{2+} + 2\,PO_4^{3-}$ $S \quad 3\,S \quad 2\,S$ $K_{Sp} = [Ca^{2+}]^3\,[PO_4^{3-}]^2$ $K_{Sp} = (3S)^3\,(2S)^2$ $K_{Sp} = 27S^3 \times 4S^2$ $K_{Sp} = 108S^5$	$Hg_2Cl_2 \rightleftharpoons Hg_2 + 2Cl$ $S \quad S \quad 2S$ $K_{Sp} = [Hg_2^{2+}]\,[Cl^-]^2$ $K_{Sp} = (S)\,(2S)^2$ $K_{Sp} = 4S^3$

24. Derive an expression for the hydrolysis constant and degree of hydrolysis of salt of strong acid and weak base

- The reactions between a strong acid and a weak base,

$$HCl_{(aq)} + NH_4OH_{(aq)} \rightleftharpoons NH_4Cl_{(aq)} + H_2O_{(l)}$$

$$NH_4Cl_{(s)} \rightarrow NH_4^+{}_{(aq)} + Cl^-{}_{(aq)}$$

- NH_4^+ is a strong conjugate acid of the weak base NH_4OH and it has a tendency to react with OH^- from water to produce unionised NH_4OH

$$NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_4OH\,(aq) + H^+(aq)$$

- There is no such tendency shown by Cl^- and therefore $[H^+] > [OH^-]$ the solution is acidic and the pH is less than 7.
- The relationship between the K_h and K_b as

$$K_h \,.\, K_b = K_w$$

$$K_h = \frac{K_w}{K_b}$$

- Let us calculate the K_h value in terms of degree of hydrolysis (h) and the concentration of salt

$$K_h = h^2C \quad \text{மற்றும்} \quad [H^+] = \sqrt{K_h.C}$$

$$[H^+] = \sqrt{\frac{K_w}{K_b}.C}$$

$$pH = -\log\,[H^+]$$

$$= -\log\left(\frac{K_w.C}{K_b}\right)^{1/2}$$

$$= -\tfrac{1}{2}\log K_w - \tfrac{1}{2}\log C + \tfrac{1}{2}\log K_b$$

$$pH = 7 - \tfrac{1}{2}\,pK_b - \tfrac{1}{2}\log C.$$

9. ELECTROCHEMISTRY

1. Define anode and cathode

	Anode	Cathode
1	Oxidation occurs	Reduction occurs
2	Donates an electron	Accepts an electron

2. Define Molar Conductance

The conductance of 'V' m^3 of electrolytic solution containing of one mole of an electrolytic solution is called molar conductance.

$$\Lambda_m = \frac{\kappa \text{ x } 10^{-3}}{M} \quad Sm^2mol^{-1}$$

3. Define Equivalent Conductance

The conductance of 'V' m^3 of electrolytic solution containing one gram equivalent of an electrolytic solution is called Equivalent conductance.

$$\lambda_c = \frac{\kappa \times 10^{-3}}{C} \; S.m^2gram.eq^{-1}$$

4. What are the factors affecting electrolytic conductance?

- When temperature increases, the conductance will also increases.
- When dilution increases, the conductance will also increases.
- When the viscosity increases, the conductance will decreases.
- When the dielectric constant of the solvent increases, the conductance will also increases.

5. Explain the Temperature affects electrolytic conductance

- When temperature increases, the conductance will also increases.
- Reason : 1. Increases the kinetic energy of the ions
  2. Decreases the attractive force between the oppositely charged ions

6. Why does conductivity of a solution decrease on dilution of the solution?

- The number of ions per unit volume that carry the current in a solution decrease on dilution.
- When the number of ions decreases, the conductivity of a solution will decrease.

7. Why is AC current used instead of DC in measuring the electrolytic conductance?

- If we apply DC current through the conductivity cell, it will lead to the electrolysis of the solution taken in the cell.
- So, AC current is used for this measurement to prevent electrolysis

8. Write uni – univalent electrolyte Debye – Huckel and Onsagar equation.

$$\Lambda_m = \Lambda_m^0 - \left(A + B\Lambda_m^0\right)\sqrt{C}$$

A, B are the constants which depend only on the nature of the solvent and temperature.

9. Define Kohlraush law.

At infinite dilution, the limiting molar conductivity of an electrolyte is equal to the sum of the limiting molar conductivities of its constituent ions.

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$\left(\Lambda_m^0\right)_{NaCl} = \left(\lambda_m^0\right)_{Na^+} + \left(\lambda_m^0\right)_{Cl^-}$$

10. Mention the application of Kohlrausch's law.

- Calculation of degree of dissociation of weak electrolytes
- Calculation of solubility of sparingly soluble salts
- Calculation of molar conductance at infinite dilution of a weak electrolyte

11. How is Kohlrausch Law useful to determine the molar conductivity of weak electrolyte at infinite dilution.

The molar conductance of CH_3COOH can be calculated using the experimentally determined molar conductivities of strong electrolytes HCl, NaCl and CH_3COONa .

$$\Lambda^o_{CH_3COONa} = \lambda^o_{Na^+} + \lambda^o_{CH_3COO^-} \quad .....(1)$$

$$\Lambda^o_{HCl} = \lambda^o_{H^+} + \lambda^o_{Cl^-} \quad .....(2)$$

$$\Lambda^o_{NaCl} = \lambda^o_{Na^+} + \lambda^o_{Cl^-} \quad .....(3)$$

Equation 1+2-3

$$\left(\Lambda^o_{CH_3COONa}\right) + \left(\Lambda^o_{HCl}\right) - \left(\Lambda^o_{NaCl}\right) = \lambda^o_{H^+} + \lambda^o_{CH_3COO^-}$$

$$= \Lambda^o_{CH_3COOH}$$

12. State Faraday's Laws of electrolysis.

<u>Faraday's First Law</u>

The mass of the substance (m) liberated at an electrode during electrolysis is directly proportional to the quantity of charge (Q) passed through the cell.

$$m \ \alpha \ Q$$

<u>Faraday's Second Law</u>

When the same quantity of charge is passed through the solutions of different electrolytes, the amount of substances liberated at the respective electrodes are directly proportional to their electrochemical equivalents.

$$m \ \alpha \ Z$$

m – mass of the substance,   Z- electro chemical equivalent of the substance

13. Define Electrochemical equivalent (Z).

- The electrochemical equivalent is defined as the amount of substance deposited or liberated at the electrode by a charge of 1 coulomb.
- Unit - Kg C^{-1}

14. Define Electrochemical Cell

- Electrochemical cell is a device which converts chemical energy into electrical energy and vice versa.
- Electrochemical cells are mainly classified into the following two types.

1. **Galvanic Cell (Voltaic cell)** : It is a device in which a spontaneous chemical reaction generates an electric current i.e., it converts chemical energy into electrical energy.
2. **Electrolytic cell** : It is a device in which an electric current from an external source drives a nonspontaneous reaction i.e., it converts electrical energy into chemical energy.

15. Define Batteries. Mention its types

Batteries are used as a source of direct current at a constant voltage. They are two types,

1. Primary batteries (non - rechargeable) - Leclanche cell
2. Secondary batteries (rechargeable) - Lead storage battery

16. Why is anode in galvanic cell considered to be negative and cathode positive electrode?

In galvanic cell

- At anode – oxidation occurs and electrons are liberated. Hene it is negative.
- At cathode – Redution occurs and electrons are consumed. Hene it is positive.

17. Which of 0.1M HCl and 0.1 M KCl do you expect to have greater $\Lambda^o{}_m$ and why?

- 0.1M HCl and 0.1 M KCl do you expect to have greater $\Lambda^o{}_m$
- Reason : H^+ ion in aquous solution being smaller size than K^+ ion.
  H^+ ion have greater mobility.
  When mobility of ion increases, condutivity also increases.

18. Arrange the following solutions in the decreasing order of specific conductance.

i) 0.01M KCl ii) 0.005M KCl iii) 0.1M KCl iv) 0.25M KCl v) 0.5M KCl

specific conductance α concentration of solution

0.5M KCl > 0.25M KCl > 0.1M KCl > 0.01M KCl > 0.005M KCl

19. Is it possible to store copper sulphate in an iron vessel for a long time?

(Given : $E^0{}_{Cu^{2+}/Cu} = -0.34V$ & $E^0{}_{Fe^{2+}/Fe} = -0.44V$)

- It is not possible to store copper sulphate in an iron vessel for long time.
- Reason is that iron will oxidise and copper will get reduced from the given emf values.

20. How is measurement of electrode potential?

The emf of a cell is the sum of the electrode potentials at the cathode and anode,

$$E_{cell} = (E_{ox})_{anode} + (E_{red})_{cathode}$$

$(E_{ox})_{anode}$ = the oxidation potential at anode

$(E_{red})_{cathode}$ = the reduction potential at cathode.

21. Define electromotive force (emf).

The force that pushes the electrons away from the anode and pulls them towards cathode is called the electromotive force (emf)

22. What is corrosion? Name some process to protect metals from corrosion.

- The metal is oxidised by oxygen in presence of moisture. This redox process which causes the deterioration of metal is called corrosion
- Protection of metals form corrosion
  1. Coating metal surface by paint
  2. Galvanizing - by coating with zinc
  3. Cathodic protection - Alloy formation

23. Write a note on sacrificial protection.

Sacrificial protection (Cathodic protection)

- Sacrificial anode - Zinc
- Cathode - Iron
- So iron is protected, but Zn is corroded

24. Why aluminium undergo a slower rate of corrosion?

- Al^{3+}, which reacts with oxygen in air to forms a protective coating of Al_2O_3.
- This coating act as a protective film for the inner surface.
- So further corrosion is prevented.

25. Give the relationship between equilibrium constant and electromotive force (EMF)

$$\Delta G^o = -nFE^o_{cell}$$

$$\Delta G^o = -RT\ln K_{eq}$$

$$-nFE^o_{cell} = -RT\ln K_{eq}$$

$$E^o_{cell} = \frac{2.303\,RT}{nF}\log K_{eq}$$

26. Write the Galvanic cell notation

$$Zn_{(S)}\,|\,Zn^{2+}_{(aq)}\,||\,Cu^{2+}_{(aq)}\,|\,Cu_{(S)} \qquad E^0 = 1.1V$$

anode cathode

- single vertical bar (I) - phase boundary
- double vertical bar (II) - salt bridge

27. Two metals M_1 and M_2 have reduction potential values of -xV and +yV respectively. Which will liberate H_2 and H_2SO_4?

The metal M_1 will liberate H_2 from H_2SO_4

Reason: Metal M_1 having higher oxidation potential.

28. Reduction potential of two metals M1 and M2 are $E^o_{M1^{2+}/M1} = -2.3V$ and $E^o_{M1^{2+}/M2} = 0.2V$ Predict which one is better for coating the surface of iron. (Given : $E^o_{Fe^{2+}/MFe} = -0.44V$)

- Metals M_1 is better for coating the surface of iron.
- Reason : Metal M_1 having higher oxidation potential.

  Hence it prevent iron from rusting.

29. Derive an expression for Nernst equation.

$$xA + yB \rightleftharpoons lC + mD$$

$$Q = \frac{[C]^l\ [D]^m}{[A]^x\ [B]^y}$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

$$\Delta G = -nFE_{cell} \quad ; \Delta G^o = -nFE^o_{cell}$$

$$-nFE_{cell} = -nFE^o_{cell} + RT \ln \frac{[C]^l[D]^m}{[A]^x\ [B]^y}$$

Dividing by -nF on both sides,

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln \frac{[C]^l[D]^m}{[A]^x\ [B]^y}$$

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF} \log \frac{[C]^l[D]^m}{[A]^x\ [B]^y}$$

[$R = 8.314\ JK^{-1}mol^{-1}$, $T = 298K$, $1F = 96500\ Cmol^{-1}$]

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[C]^l[D]^m}{[A]^x\ [B]^y}$$

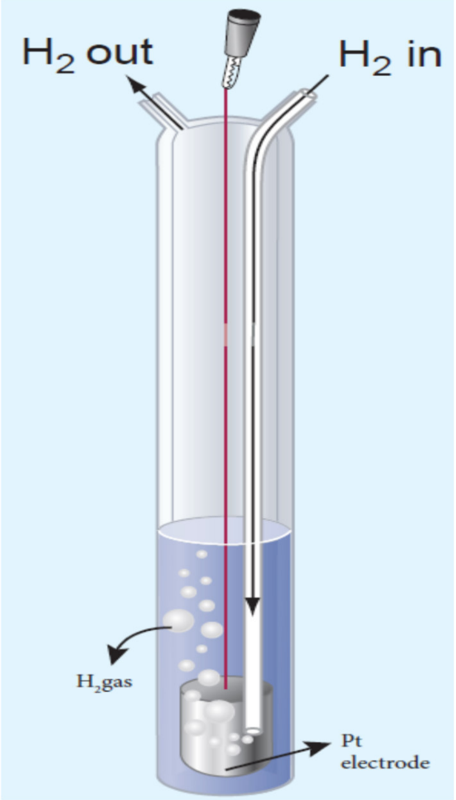
30. Define Std Hydrogen Electrode (SHE)

- The emf of a cell is the sum of the electrode potentials at the cathode and anode,

  $E_{cell} = (E_{ox})_{anode} + (E_{red})_{cathode}$
- Standard Hydrogen Electrode (**SHE**) is used as the reference electrode.
- Emf is zero volt.
- It consists of a platinum electrode in contact with 1M HCl solution and 1 atm hydrogen gas.
- The hydrogen gas is bubbled through the solution at 25°C
- SHE can act as a cathode as well as an anode. The Half cell reactions are given below
- Anode - oxidation

  $H_2 \longrightarrow 2H^+ + 2e^- \quad E^o = 0\ v$
- Cathode - reduction

  $2H^+ + 2e^- \longrightarrow H_2 \quad E^o = 0\ v$



31. Describe the electrolysis of molten NaCl using inert electrodes.

- The electrolytic cell consists of two electrodes one is cylindrical steel cathode and another one is graphite anode.
- They are dipped in molten sodium chloride.
- They are connected to the external DC power supply via a key
- Anode - oxidation

  $2Cl^- \longrightarrow Cl_2 + 2e^-$ $\quad E^0 = -1.36v$

- Cathode - reduction

  $Na^+ + e^- \longrightarrow Na$ $\quad E^0 = -2.71v$

- The overall reaction is,

  $2\,Na^+ + 2Cl^- \longrightarrow 2Na + Cl_2$ $\quad E^0 = -4.07v$

- The negative E^o value shows that the above reaction is a non spontaneous one.
- Hence, we have to supply a voltage greater than 4.07V to cause the electrolysis of molten NaCl.

32. Describe the construction of Daniel cell. Write the cell reaction.

- Daniel cell. It consists of two half cells.

  1. Oxidation half cell

     A metallic zinc strip that dips into an aqueous solution of zinc sulphate

  2. Reduction half cell

     A copper strip that dips into an aqueous solution of copper sulphate

- The electrolytes present in two half cells are connected using a salt bridge.
- The zinc and copper strips are externally connected using a wire through a switch (k) and a load
- The electrolytic solution present in the cathodic and anodic compartment are connected using an inverted U tube containing agar-agar gel mixed with an inert electrolytes (KCl)
- When the switch (k) closes the circuit, the electrons flows from zinc strip to copper strip.
- Anode - oxidation

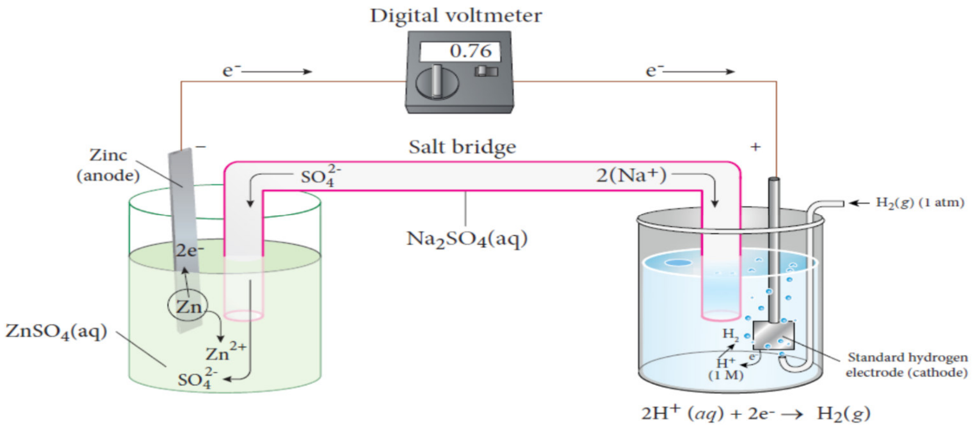
  $Zn \longrightarrow Zn^{2+} + 2e^-$

- Cathode - reduction

  $Cu^{2+} + 2e^- \longrightarrow Cu$

- The overall reaction is,

  $Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$



33. Explain the function of H_2 - O_2 fuel cell

- The galvanic cell in which the energy of combustion of fuels is directly converted into electrical energy is called the fuel cell.

  Fuel | Electrode | Electrolyte | Electrode | Oxidant

  Fuel : hydrogen
  Oxidant : oxygen
  Electrolyte : dil KOH
  Temperature : 200° C
  Pressure : 20 - 40 atm
  Inert electrodes : Porous graphite electrode containing Ni and NiO

- Hydrogen and oxygen gases are bubbled through the anode and cathode, respectively.
- Anode - oxidation

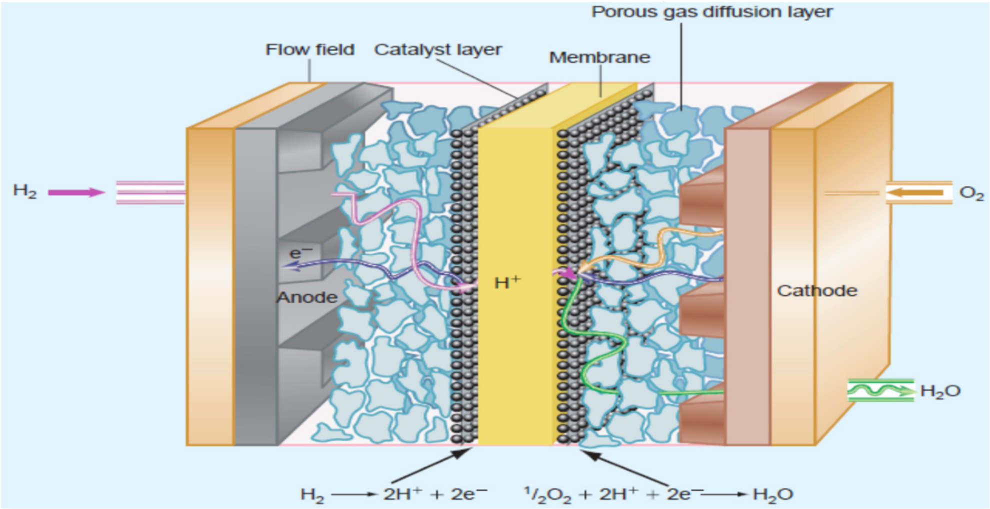
$$2H_2 + 4OH^- \longrightarrow 4H_2O + 4e^-$$

- Cathode - reduction

$$2H_2O + O_2 + 4e^- \longrightarrow 4OH^-$$

- The overall reaction is,

$$2H_2 + O_2 \longrightarrow 2H_2O$$



34. What is Electrochemical series?

The standard electrode potential at 298K for various metal - metal ion electrodes are arranged in the decreasing order of their standard reduction potential values is called electrochemical series.

The standard reduction potential (E°) is a measure of the oxidising tendency of the species.

35. Can Fe3+ oxidises bromide to bromine under standard conditions?

Given: $E^\circ_{Fe^{3+}|Fe^{2+}} = 0.771$ $E^\circ_{Br_2|Br^-} = 1.09V.$

$$E^\circ_{cell} = (E^\circ_{ox}) + (E^\circ_{red})$$
$$= -1.09 + 0.771$$
$$= -0.319V$$

E°_{cell} is – ve; ΔG is +ve and the cell reaction is non spontaneous.

Hence Fe^{3+} cannot oxidises Br^- to Br_2

10. SURFACE CHEMISTRY

1. Give two important characteristics of physisorption

- It is instantaneous
- It is non-specific
- No transfer of electrons

2. Differentiate physisorption and chemisorption

Physisorption	Chemisorption
It is instantaneous	It is very slow.
It is non-specific	It is very specific
Heat of adsorption is low	Heat of adsorption is high
Occurs at all sides	Occurs at fixed sites
No transfer of electrons	Transfer of electrons between the adsorbent and adsorbate
Multilayer of the adsorbate is formed	Monolayer of the adsorbate is formed.

3. In case of chemisorption, why adsorption first increases and then decreases with temperature?

- In chemisorption, adsorption first increases with rise in temperature due to the fact that formation of activated complex requires certain energy.
- The decrease at high temperature is due to desorption, as the kinetic energy of the adsorbate increases.

4. Heat of adsorption is greater for chemisorptions than physisorption. Why?

- In chemical adsorption, gas molecules are held to the surface by formation of strong chemical bonds and hence heat of adsorption is high.
- In physical adsorption, weak physical forces such as Vander Waals force of attraction, dipole-dipole interaction etc exist between adsorbent and adsorbate and hence heat of adsorption is low.

5. What are the factors which influence the adsorption of a gas on a solid?

1. Nature of adsorbent
2. Nature of adsorbate
3. Pressure
4. Concentration
5. Temperature

6. What are the Characteristics of adsorption?

- Adsorption is a spontaneous process
- Adsorption is exothermic
- Adsorption can occur in all interfacial surfaces

7. Which will be adsorbed more readily on the surface of charcoal and why? NH_3 or O_2?

- NH_3 will be adsorbed more readily on the surface of charcoal.
- The critical temperature of NH_3 is 406K. and O_2 is 154K
- The gases having high critical temperature will be adsorbed more readily

8. What is the difference between homogenous and hetrogenous catalysis?

Homogenous catalysis

The reactants, products and catalyst are present in the same phase.

$$2SO_{2(g)} + O_{2(g)} \overset{NO_{(g)}}{\rightleftharpoons} 2SO_3$$

Hetrogenous catalysis

The reactants, products and catalyst are present in the different phase.

$$N_2 + 3H_2 \overset{Fe}{\rightleftharpoons} 2NH_3$$

9. What are catalyst? Give an example.

Catalyst is defined as a substance which alters the rate of chemical reaction without itself undergoing chemical change

$$N_2 + 3H_2 \overset{Fe}{\rightleftharpoons} 2NH_3$$

Fe - catalyst

10. Write the characteristics of catalysts.

- Specific in nature
- Alters the speed of chemical reaction
- Needed in very small quantity.
- Does not change the nature of products.
- Does not affect the position of equilibrium

11. Write notes on a) Positive catalysis b) Negative catalysis c) Auto catalysis

a) Positive catalysis

It increases the rate of the reaction

In the manufacture of ammonia by Haber's process, Fe acts as a Positive catalyst

b) Negative catalysis

It decreases the rate of the reaction

In the decomposition of H_2O_2, glycerol acts as a negative catalyst.

c) Auto catalysis

In certain reactions one of the products formed acts as a catalyst to the reaction.

In the hydrolysis of ethylaetate, product acetic acid is auto catalyst

12. What do you mean by activity and selectivity of catalyst?

Activity : Ability of a catalyst to alter the rate of a reaction is called activity of catalyst

Selectivity : Ability of a catalyst to direct the reaction to give particular products.

13. What are promoters? Give one example

- Substance which increases the activity of a catalyst.
- In the manufacture of ammonia by Haber's process, Mo acts as a promoters to Fe catalyst

14. Write a note on catalytic poison

- Substance which decreases the activity of a catalyst.
- In the manufacture of ammonia by Haber's process, H_2S acts as a catalytic poison to Fe catalyst

15. Why is desorption important for a substance to act as good catalyst?

Desorption is important for a substance to act as good catalyst, so that after the reaction theproducts found on the surface separate out to create free surface again for other reactant molecules to approach the surface and react.

16. Explain intermediate compound formation theory of catalysis with an example.

It is based on a homogeneous catalysed reaction.

$$A + B \xrightarrow{C} AB$$

Step - I $A + C \longrightarrow AC$ (Intermediate compound)

Step - II $AC + B \longrightarrow AB + C$

(A, B - Reactants, AB - product C - Catalyst)

$$2SO_{2(g)} + O_{2(g)} \underset{}{\overset{NO_{(g)}}{\rightleftharpoons}} 2SO_3$$

Step - I $2NO + O_2 \longrightarrow 2NO_2$

Step - II $NO_2 + SO_2 \longrightarrow SO_3 + NO$

17. Describe adsorption theory of catalysis

- It is based on a heterogeneous catalysed reaction.
- Hydrogenation of ethylene in presence of a nickel catalyst.

$$A_{(g)} + B_{(g)} \xrightarrow{catalyst} C_{(g)} + D_{(g)}$$

- The various steps involved in a reaction
  1. Reactant molecules diffuse from the bulk to the catalyst surface.
  2. The reactant molecules are adsorbed on the surface of the catalyst.
  3. The adsorbed reactant molecules are activated to form activated complex, which is decomposed to form the products.
  4. The product molecules are desorbed.
  5. The products diffuse away from the surface of the catalyst.

18. What are Active centres?

- The surface of a catalyst is not smooth.
- It bears steps, cracks and corners.
- Hence the atoms on such locations of the surface are co-ordinatively unsaturated.
- So, they have much residual force of attraction. Such sites are called active centres

19. Describe some feature of catalysis by Zeolites.

- Zeolites are microporous, crystalline, hydrated, alumino silicates
- It is made of silicon and aluminium tetrahedron.
- As silicon is tetravalent and aluminium is trivalent, the zeolite matrix carries extra negative charge.
- To balance the negative charge, there are extra framework cations for H^+ or Na^+ ions.
- Zeolites carring protons are used as catalysts and they are extensively used in hydrocarbon fractions into gasoline, diesel,etc.
- Zeolites carring Na^+ ions are used as basic catalysts.
- Zeolites is their shape selectivity, the active sites namely protons are lying inside their pores. So, reactions occur only inside the pores of zeolites.

20. Give an account on Nano catalysis.

- Nano materials such a metallic nano particles, metal oxides, are used as catalyst in many chemical transformations.
- Nano catalysts carry the advantages of both homogeneous and heterogeneous catalysis.
- Nano catalysts give selective transformations
- Nano catalysts give excellent yield and show extremely high activity.
- Nano catalysts can be recovered and recycled

21. Write notes on Enzyme Catalysis.

- Enzymes are complex protein molecules with three dimensional structures.
- They catalyse the chemical reaction in living organism
- The yeast contains the enzyme zymase which converts glucose into ethanol.
- Mechanism of enzyme catalysed reaction

$$E+S \rightleftharpoons ES \rightarrow P+E$$

E = Enzyme, S = Reactant, ES = Activated complex, P = Products.

Special characteristics of Enzymes

- Highly specific in nature
- Effective and efficient conversion
- Enzymes can be inhibited i.e. poisoned.
- Enzyme catalysed reaction has maximum rate at optimum temperature.
- The rate of enzyme catalysed reactions varies with the pH of the system.

22. Write note on Freundlich adorption isotherm.

According to Freundlich,

$$\frac{x}{m} = K P^{\frac{1}{n}}$$

For adsorption of gases in solutions, with 'C' as concentration.

$$\frac{x}{m} = k C^{\frac{1}{n}}$$

where 'x' is the amount of adsorbate adsorbed on 'm' gm of adsorbent at a pressure of 'p'. K and n are constants.

Limitations :-

- Freundlichequation is purely empirical and valid over a limited pressure range.
- The values of constants 'k' and 'n' also found vary with temperature.
- No theoretical explanations were given.

COLLOIDS

23. What is the difference between a sol and a gel?

	Sol	**Gel**
Dispersion medium	liquid	Solid
Dispersed phase	Solid	liquid
Example	Ink, Paint	Butter, Cheese

24. Why are lyophillic colloidal sols are more stable than lyophobic colloidal sols?

- In lyophillic colloidal sols - definite attractive force exists between dispersion medium and dispersed phase.
- In lyophobic colloidal sols - no attractive force exists between the dispersed phase and dispersion medium.

25. Give the difference between lyophillic colloidal sols and lyophobic colloidal sols.

	Lyophillic colloidal sols	**Lyophobic colloidal sols**
1	Definite attractive force exists between dispersion medium and dispersed phase.	No attractive force exists between the dispersed phase and dispersion medium.
2	They are more stable	They are less stable
3	They will not get precipitated easily	They are precipitated readily

26. Comment on the statement: Colloid is not a substance but it is a state of substance.

- A colloid is formed when the size of the solute particle lies between 1nm to 200nm.
- A colloid is dependent on the size of the particle.
- Colloid is a homogeneous mixture of two substance in which one substance is dispersed in another substance

27. **Peptising agent is added to convert precipitate into colloidal solution. Explain. (or) What is Peptisation?**

The dispersion of a precipitated material into colloidal solution by the action of an electrolyte in solution is termed as peptisation

$$\underset{\text{Precipitate}}{AgCl} \xrightarrow{HCl} \underset{\text{Colloid}}{AgCl}$$

28. What is Tyndall effect?

- When beam of light is passed through colloidal solution, the path of light is illuminated by the scattering of light by colloidal particles.
- The phenomenon of scattering of light by the solution particles is called Tyndall effect.

29. Write a short note on Brownian movement

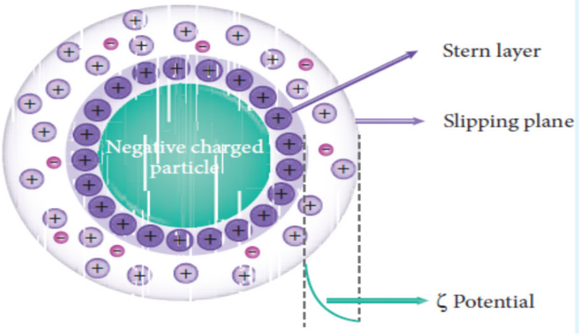
The colloidal sol particles are continuously bombarded with the molecules of the dispersion medium and hence they follow a zigzag, random, continuous movement. This is called Brownian movement.

30. Write the uses of Brownian movement

- To calculate Avogadro number.
- To understand the stability of colloids
- To confirm kinetic theory

31. What is Helmholtz double layer?

- The surface of colloidal particle adsorbs one type of ion due to preferential adsorption
- This layer attracts oppositely charged ions in the medium and hence at the boundary seprating the two electrical double layers are setup.
- This is called as Helmholtz electrical double layer.



32. Write a note on Electro osmosis.

- A sol is electrically neutral.
- Hence the medium carries an equal but opposite charge to that of dispersed particles.
- When sol particles are prevented from moving, under the influence of electric field.
- The dispersion medium moves in a direction opposite to that of the sol particles.
- This movement of dispersion medium under the influence of electric potential is called electro osmosis.

33. Explain any one method for coagulation (or) what is Electrophoresis?

The flocculation and settling down of the sol particles is called coagulation.

<u>Electrophoresis</u>

- In the electrophoresis, charged particles migrate to the electrode of opposite sign.
- It is due to neutralization of the charge of the colloids.
- The particles are discharged and so they get precipitated.

34. Mention the shapes of the following colloidal particles.

a) As_2S_3 b) $Fe(OH)_3$ sol & Blue gold sol c) W_3O_5 (or) Tungstic acid sol

Colloidal Particles	Shapes
As_2S_3	Spherical
Fe $(OH)_3$sol (blue gold sol)	Disc or plate like
W_3O_5 sol (tungstic acid sol)	Rod like

நீ ஏழையாக பிறப்பது உன் தவறில்லை....
ஏழையாகவே இறப்பது தான் உன் தவறு....

35. What happens when a colloidal sol of $Fe(OH)_3$ and As_2O_3 are mixed?

- $Fe(OH)_3$is positive sol, As_2O_3 is a negative sol
- When they are mixed charges are neutralized mutual coagulation takes place.

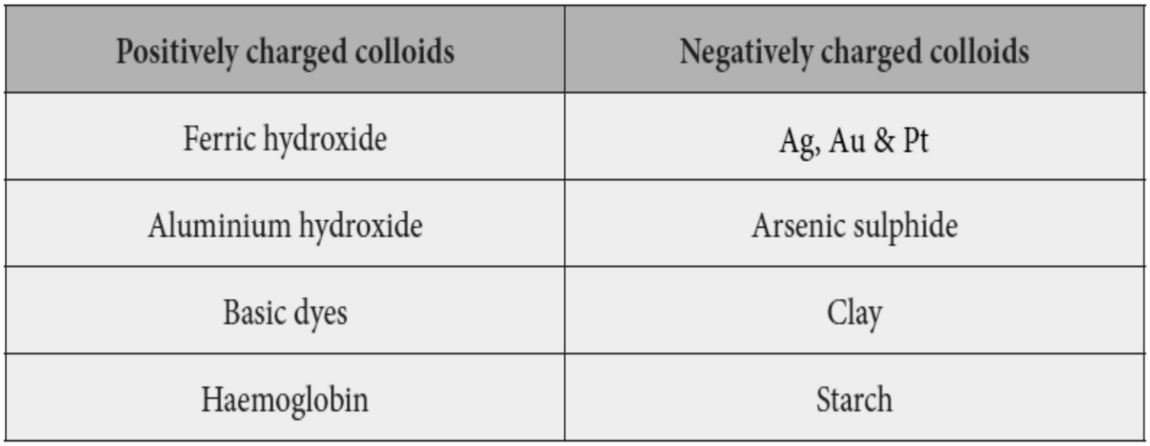
36. Addition of Alum purifies water. Why?

- Water containing suspended impurities are negatively charged.
- The Al^{3+} was present in alum coagulates the suspended impurities in water
- These impurities settle down and are removed by filtration, thus purifying the water

37. Why does bleeding stop by rubbing moist alum?

- Ions present in moist alum neutralizes the colloidal protein present in blood and coagulate it by forming a clot.
- Thus due to coagulation of blood, bleeding stops by rubbing with moist alum.

38. Give the examples of Positively charged colloids and Negatively charged colloids.



Positively charged colloids	Negatively charged colloids
Ferric hydroxide	Ag, Au & Pt
Aluminium hydroxide	Arsenic sulphide
Basic dyes	Clay
Haemoglobin	Starch

39. **What are Emulsions? What are the types of Emulsion?**

- Emulsions are colloidal solution in which a liquid is dispersed in an another liquid.
- There are two types of emulsions.
  1. Oil in water (O/W) - Milk
  2. Water in oil (W/O) - Stiff greases

40. What is Deemulsification? Write the various deemulsification techniques.

Emulsion can be separated into two separate layers.

The process is called Deemulsification.

Various deemulsification techniques are given below

1. Heating at high pressures.
2. Using ultrasonic waves.
3. Distilling of one component
4. By freezing one of the components.
5. By applying centrifugal force.

41. Give three uses of emulsions.

Food - milk, cream, butter

Medicines - Milk of magnesia is used for stomach troubles.

Rubber industry – produced for tyres, tubes

42. Define Gold number.

- Gold number is defined as the number of milligrams of hydrophilic colloid that will just prevent the precipitation of 10ml of gold sol on the addition of 1ml of 10% NaCl solution.
- Smaller the gold number greater the protective power.

43. Explain dispersion methods of preparation of colloids.

1. Mechanical dispersion

- The colloidal mill consists of two metal plates rotating in opposite direction at very high speed
- The solid is ground to colloidal dimension.
- Colloidal solutions of ink and graphite are prepared

2. Peptisation

The dispersion of a precipitated material into colloidal solution by the action of an electrolyte in solution is termed as peptisation

$$\underset{\text{Precipitate}}{AgCl} \xrightarrow{HCl} \underset{\text{Colloid}}{AgCl}$$

44. Explain chemical methods (Condensation Methods) of the preparation of colloids.

1. Hydrolysis

$$FeCl_3+3H_2O \rightarrow Fe(OH)_3+3HCl$$

2. **Oxidation**

$$H_2Se+O_2 \rightarrow 2H_2O+Se(sol)$$

3. Reduction

$$2AuCl_3+3HCHO+3H_2O \rightarrow 2Au(sol)+6HCl+3HCOOH$$

4. Double decompositon

$$As_2O_3+3H_2S \rightarrow As_2S_3+3H_2O$$

5. **Decompositon**

$$S_2O_3^{2-}+2H^+ \rightarrow \underset{sol}{S}+H_2O+SO_2$$

6. Exchange of solvent

$$P \text{ in alcohol} + \text{water} \rightarrow P_{sol}.$$

11. HYDROXY COMPOUNDS AND ETHERS

1. Markownikoff additon reaction (preparation of propanol from propylene)

Propylene $\xrightarrow{\text{con } H_2SO_4}$ 2-propanol

$$CH_3\text{-}CH{=}CH_2 + H_2O \xrightarrow{Conc.H_2SO_4} CH_3\text{-}CH(OH)\text{-}CH_3$$

2. Hydroboration **(preparation of alcohol from diborane)**

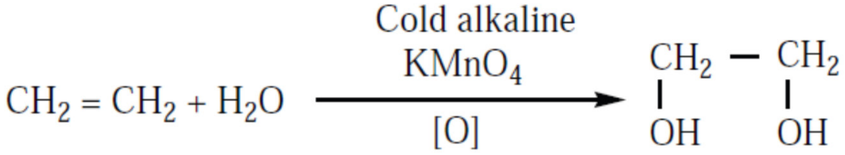
Diborane + Alkene $\longrightarrow$ Trialkyl borane $\xrightarrow{H_2O_2/NaOH}$ Alcohol

$$6CH_3-CH=CH_2 + B_2H_6 \longrightarrow 2(CH_3-CH_2-CH_2)_3B$$

$$(CH_3-CH_2-CH_2)_3B + 3H_2O_2 \xrightarrow{OH^-} 3CH_3-CH_2-CH_2-OH + B(OH)_3$$

3. Hydroxylation using Baeyer's reagent (or)
Preparation of Ethylene glycol from ethylene using Baeyer's reagent

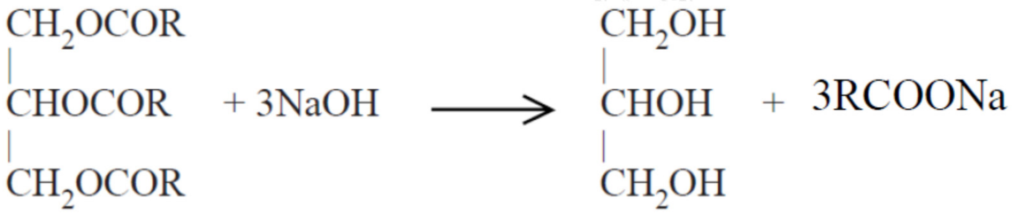
Ethylene + H_2O $\xrightarrow{\text{Baeyer's reagent}}$ Ethylene glycol



$$CH_2=CH_2 + H_2O \xrightarrow[\text{[O]}]{\text{Cold alkaline } KMnO_4} \underset{OH}{\underset{|}{CH_2}} - \underset{OH}{\underset{|}{CH_2}}$$

4. Saponification Reaction (preparation of Glycerol)

Natural fats $\xrightarrow{NaOH}$ Glycerol + Soap



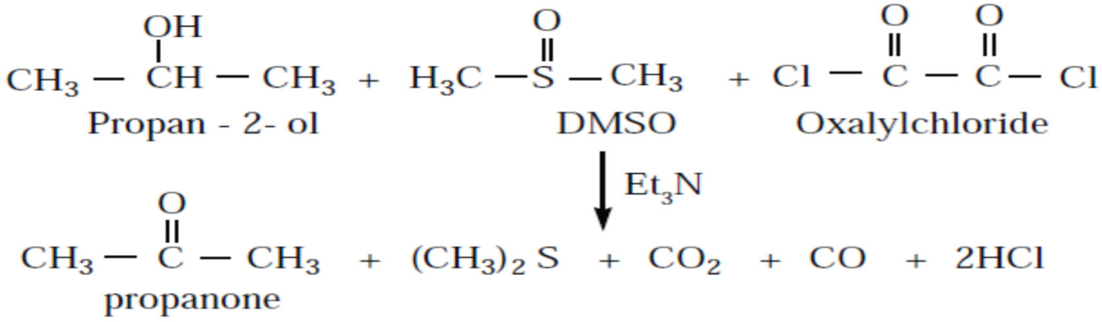
$$\begin{matrix} CH_2OCOR \\ | \\ CHOCOR \\ | \\ CH_2OCOR \end{matrix} + 3NaOH \longrightarrow \begin{matrix} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{matrix} + 3RCOONa$$

5. Biological oxidation

- The fermentation of the food consumed by an animal produces alcohol.
- To detoxify the alcohol, the liver produces ADH (alcohol dehydrogenase).
- ADH catalyses the oxidation of toxic alcohols into non-toxic aldehyde.
- NAD (Nicotinamide adenine dinucleotide) present in the animals act as an oxidising agent

$$\underset{\text{ethanol}}{CH_3CH_2OH} + NAD^+ \xrightarrow{ADH} \underset{\text{ethanal}}{CH_3CHO} + NADH + H^+$$

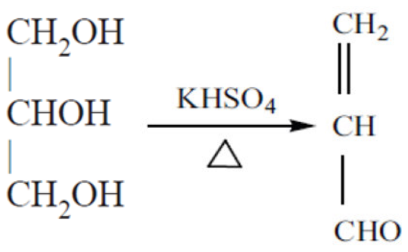
6. Swern oxidation Reaction



$$\underset{\text{Propan - 2- ol}}{CH_3-\overset{OH}{\overset{|}{C}H}-CH_3} + \underset{\text{DMSO}}{H_3C-\overset{O}{\overset{\|}{S}}-CH_3} + \underset{\text{Oxalylchloride}}{Cl-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-Cl} \xrightarrow{Et_3N} \underset{\text{propanone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} + (CH_3)_2S + CO_2 + CO + 2HCl$$

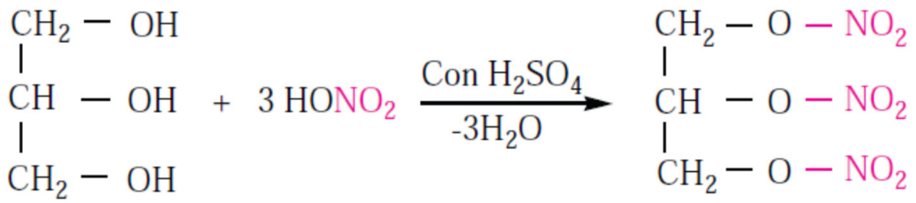
7. Dehydration of Glycerol (or) Preparation of Acrolein

Glycerol $\xrightarrow{KHSO_4 \text{ (or) con. } H_2SO_4}$ Acrolein



8. Preparation of TNG (or) GTN

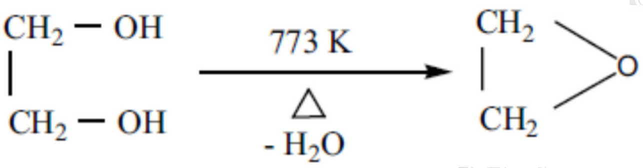
Glycerol + con.HNO_3 $\xrightarrow{con.H_2SO_4}$ TNG (Tri nitro glycerine)



9. Dehydration of Ethylene Glycol

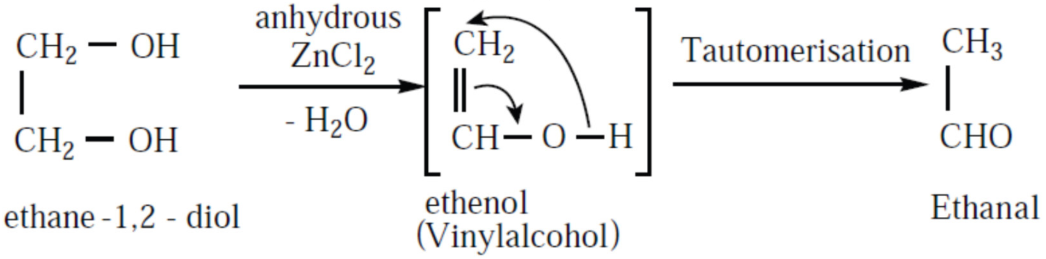
a. Convert Glycol to Oxirane

Ethyleneglycol $\xrightarrow{773K}$ Ethylene epoxides (Oxirane)



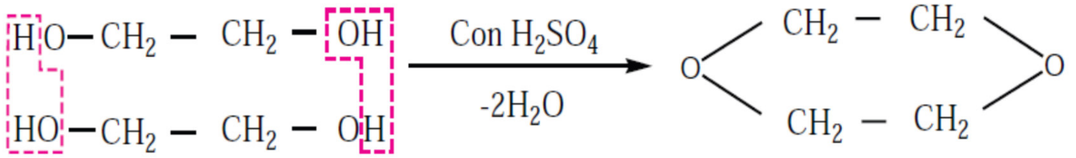
b. Convert Glycol to Acetaldehyde

Glycol $\xrightarrow{\text{Anhydrous Zinc chloride}}$ Acetaldehyde



c. Convert Glycol to 1,4 - dioxane

Glycol $\xrightarrow{con\ H_2SO_4}$ 1,4 - dioxane



10. Convert benzylchloride to benzylalcohol

$$C_6H_5CH_2Cl \xrightarrow{dil.\ NaOH} C_6H_5CH_2OH + NaCl$$

11. Convert benzyl alcohol to benzoic acid

$$C_6H_5CH_2OH \xrightarrow[(O)]{K_2Cr_2O_7\ /\ H^+} C_6H_5COOH$$

12. Primary alcohols are more acidic than secondary and tertiary alcohols. Why?

Increase in the number of alkyl groups decrease the acidity

1^0alcohols > 2^0alcohols > 3^0alcohols

13. How will you differentiate primary, secondary and tertiary alcohols by Lucas test?

Lucas test (Lucas reagent - Con. HCl / anhydrous $ZnCl_2$)

❖ Tertiary alcohol $\longrightarrow$ Immediately to form a turbidity

$$(CH_3)_3OH \xrightarrow{\text{con HCl /Anhydrous } ZnCl_2} (CH_3)_3\,Cl + H_2O$$

❖ Secondary alcohols $\longrightarrow$ 5-10 minutes to form a turbidity

$$(CH_3)_2CHOH \xrightarrow{\text{con HCl /Anhydrous } ZnCl_2} (CH_3)_2CHCl + H_2O$$

❖ Primary alcohols $\longrightarrow$ Turbidity appears only on heating

$$CH_3CH_2OH \xrightarrow{\text{con HCl /Anhydrous } ZnCl_2} \text{No reaction at room temperature}$$

14. Differentiate primary, secondary and tertiary alcohols by Victor meyer's method

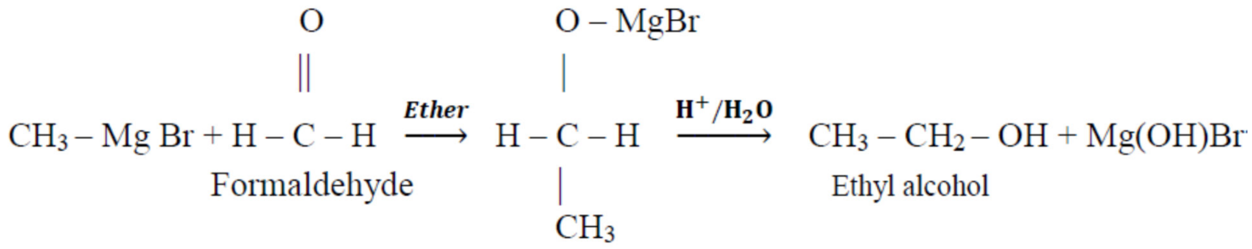
Victor meyer's method (1. P/I_2 2. $AgNO_2$ 3. HONO 4. KOH)

- ❖ Primary alcohol - red colour
- ❖ Secondary alcohol - blue colour
- ❖ Tertiary alcohol - Colourless

Primary alcohol	**Secondary alcohol**	**Tertiary alcohol**
$CH_3CH_2\text{-}OH$ $\big\downarrow P/I_2$ $CH_3CH_2\text{-}I$ $\big\downarrow AgNO_2$ $CH_3CH_2\text{-}NO_2$ $\big\downarrow ONOH$ $CH_3\underset{\underset{NOH}{\Vert}}{C}\text{-}NO_2$ $\big\downarrow KOH$ $CH_3\underset{\underset{NOK}{\Vert}}{C}\text{-}NO_2$ (red colour)	$(CH_3)_2CH\text{-}OH$ $\big\downarrow P/I_2$ $(CH_3)_2CH\text{-}I$ $\big\downarrow AgNO_2$ $(CH_3)_2CH\text{-}NO_2$ $\big\downarrow HONO$ $(CH_3)_2\underset{\underset{NO}{\vert}}{C}\text{-}NO_2$ $\big\downarrow KOH$ (blue colour)	$(CH_3)_3C\text{-}OH$ $\big\downarrow P/I_2$ $(CH_3)_3C\text{-}I$ $\big\downarrow AgNO_2$ $(CH_3)_3C\text{-}NO_2$ $\big\downarrow HONO$ No reaction (Colourless with KOH)

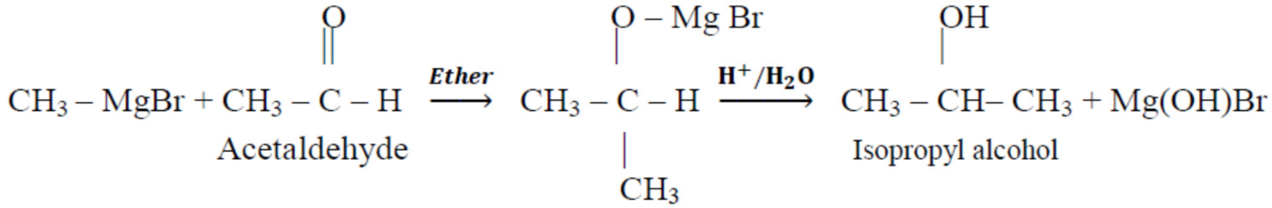
15. Preparation of primary, secondary and tertiary alcohols from Grignard reagent

Primary alcohol



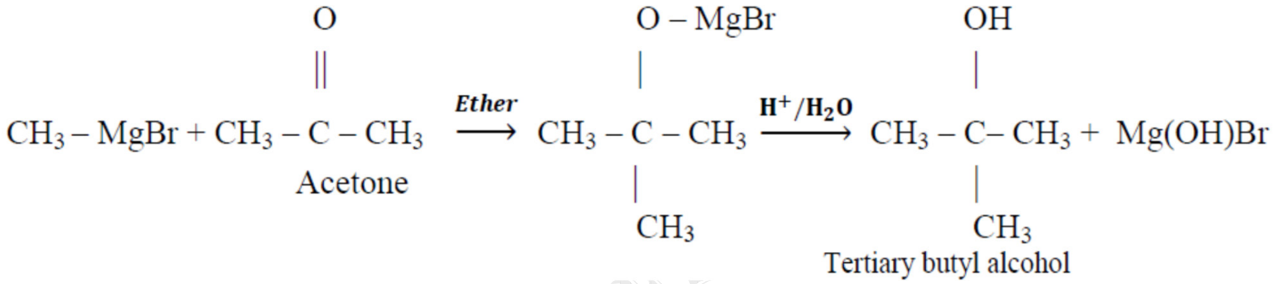
$$CH_3-MgBr+\underset{\text{Formaldehyde}}{H-\overset{\overset{O}{\|}}{C}-H}\xrightarrow{Ether}H-\underset{\underset{CH_3}{|}}{\overset{\overset{O-MgBr}{|}}{C}}-H\xrightarrow{H^+/H_2O}\underset{\text{Ethyl alcohol}}{CH_3-CH_2-OH}+Mg(OH)Br$$

Secondary alcohol



$$CH_3-MgBr+\underset{\text{Acetaldehyde}}{CH_3-\overset{\overset{O}{\|}}{C}-H}\xrightarrow{Ether}CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{O-Mg\,Br}{|}}{C}}-H\xrightarrow{H^+/H_2O}\underset{\text{Isopropyl alcohol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3}+Mg(OH)Br$$

Tertiary alcohol

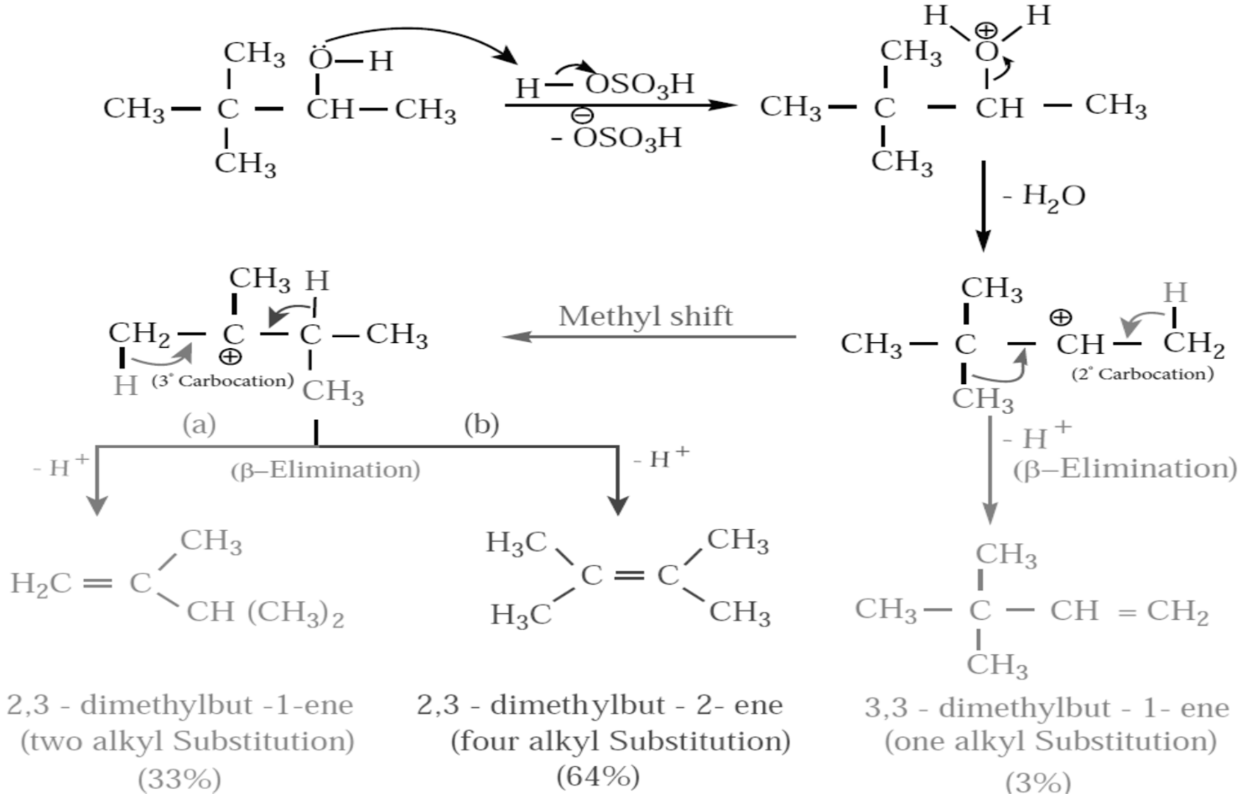


$$CH_3-MgBr+\underset{\text{Acetone}}{CH_3-\overset{\overset{O}{\|}}{C}-CH_3}\xrightarrow{Ether}CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{O-MgBr}{|}}{C}}-CH_3\xrightarrow{H^+/H_2O}\underset{\text{Tertiary butyl alcohol}}{CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}}-CH_3}+Mg(OH)Br$$

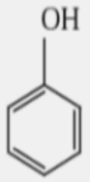
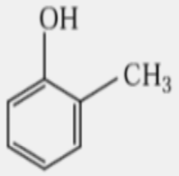
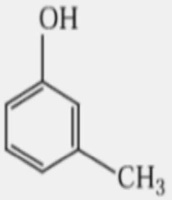
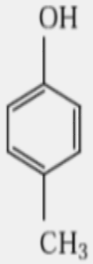
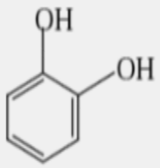
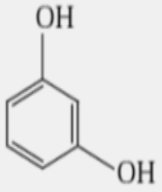
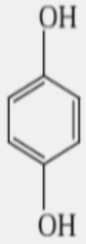
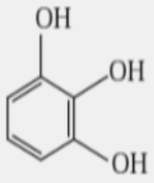
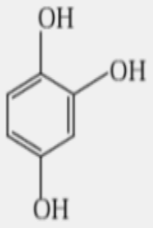
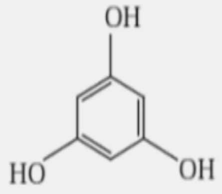
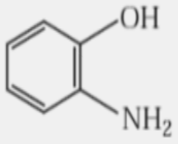
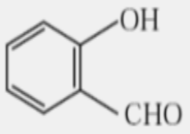
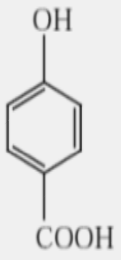
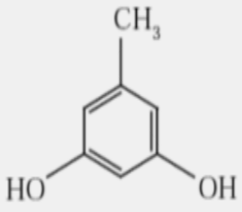
16. Explain Saytzeff's rule

During intramolecular dehydration, if there is a possibility to form a carbon - carbon double bond at different locations, the preferred location is the one that gives the more (highly) substituted alkene (stable alkene).

Ex. the dehydration of 3,3 - dimethyl- 2- butanol gives a mixture of alkenes.

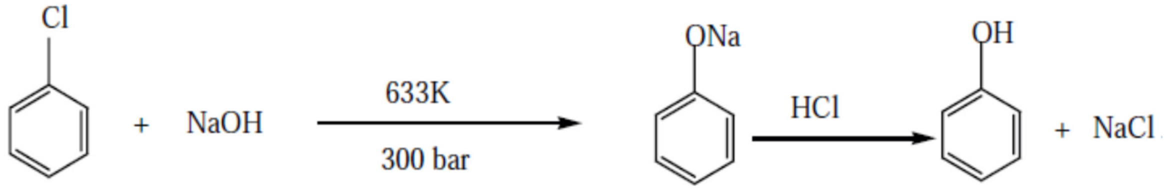


17. Explain the classification of phenol

Monohydric Phenol	Monohydric phenols				
					
	Common Name:	Phenol	o -cresol	m-cresol	p-cresol
	IUPAC Name :	Phenol	2-methyl phenol	3-methyl phenol	4-methyl phenol
Dihydric Phenol	Dihydric phenols				
					
	Common Name:	Catechol	Resorcinol	Quinol	
	IUPAC Name:	1,2-dihydroxy benzene	1,3-dihydroxy benzene	1,4-dihydroxy benzene	
Trihydric Phenol	Trihydric phenols				
					
	Common Name:	Pyrogallol	Hydroxyquinol	Phloroglucinol	
	IUPAC Name:	1,2,3-trihydroxy benzene	1,2,4-trihydroxy benzene	1,3,5-trihydroxy benzene	
Substituted phenol	Substituted phenols				
					
		o-amino phenol	o-hydroxy Benzaldehyde	p-hydroxy benzoic acid	Orcinol(or) 3,5-Dihydroxy toluene

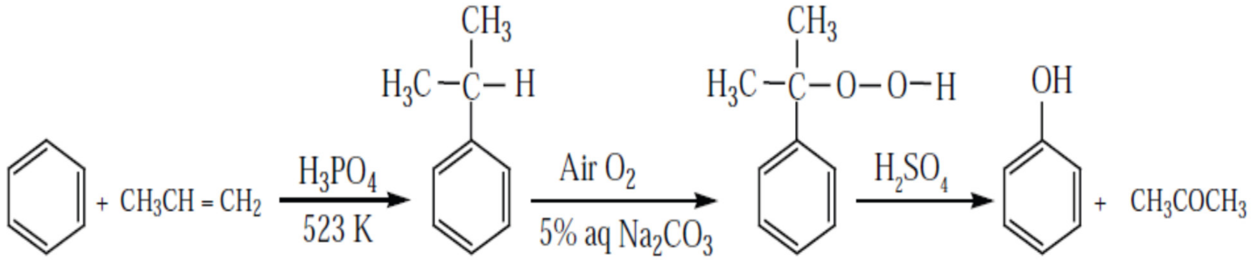
18. Explain Dows process (or) How is phenol prepared from choloro benzene

Choloro benzene + NaOH $\xrightarrow{633K/300bar}$ Sodium phenoxide $\xrightarrow{dil.HCl}$ Phenol



19. How is phenol prepared from Isopropyl benzene (cumene)

Benzene + propene $\xrightarrow[523K]{H_3PO_4}$ cumene $\xrightarrow[5\%\ aq\ Na_2CO_3]{air}$ cumene hydro peroxide $\xrightarrow{H_2SO_4}$ Phenol



20. Preparation of Phenol from Aniline

Aniline $\xrightarrow[273K]{NaNO_2/HCl}$ Benzene diazonium chloride $\xrightarrow{H_2O}$ Phenol

$C_6H_5NH_2 \xrightarrow[273K]{NaNO_2/HCl} C_6H_5N{=}NCl \xrightarrow{H_2O} C_6H_5OH + N_2 + HCl$

21. Preparation of benzene from Phenol (phenol react with zinc dust)

Phenol is converted to benzene on heating with zinc dust

$C_6H_5OH + Zn \xrightarrow{\Delta} C_6H_6 + ZnO$

22. Schotten-Baumann reaction (Formation of ester from phenol)

Phenol + Acetyl chloride $\xrightarrow{NaOH\ /\ pyridine}$ Phenyl acetate

$C_6H_5OH + CH_3COCl \xrightarrow{NaOH\ /\ pyridine} C_6H_5COOCH_3 + HCl$

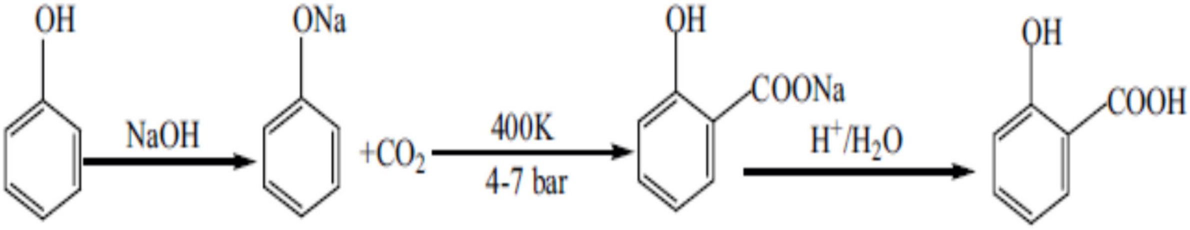
23. Preparation of Aniline from Phenol (phenol react with Ammonia)

Phenol + Ammonia $\xrightarrow{anhydrous\ ZnCl_2}$ Aniline

$C_6H_5OH + NH_3 \xrightarrow{anhydrous\ ZnCl_2} C_6H_5NH_2 + H_2O$

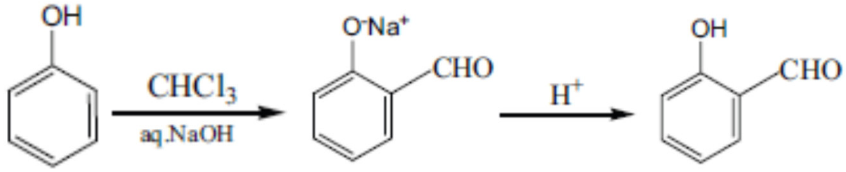
24. Kolbe's (or) Kolbe's Schmit reaction (Preparation of Salicyclic acid from Phenol)

Phenol $\xrightarrow{NaOH}$ Sodium phenoxide $\xrightarrow[400K]{CO_2}$ Sodium salicylate $\xrightarrow{H^+ / H_2O}$ Salicyclic acid



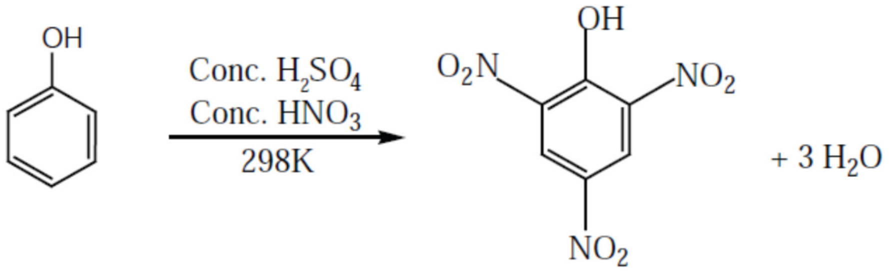
25. Riemer – Tiemann Reaction (Preparation of Salicylaldehyde from Phenol)

Phenol $\xrightarrow[H^+]{CHCl_3 / NaOH}$ Salicylaldehyde



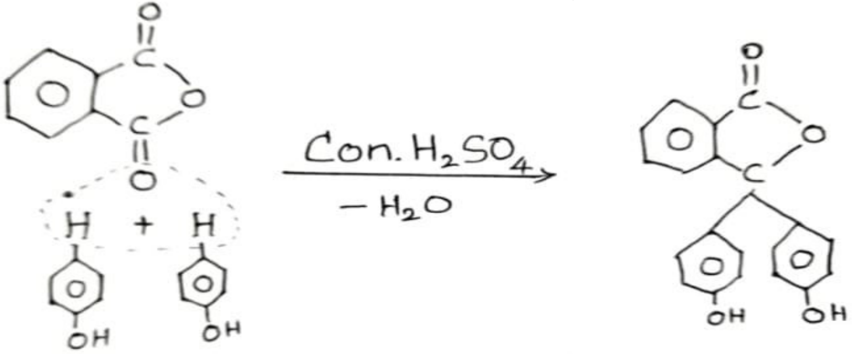
26. Preparation of Picric acid from Phenol (Nitration of Phenol))

Phenol $\xrightarrow{con.HNO_3 / H_2SO_4}$ Picric acid (2,4,6 - trinitro phenol)



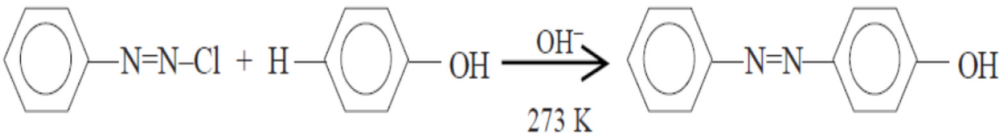
27. How will you prepare Phenolphthalein (or) Write a note on Phthalein reaction.

Phenol + Phthalic anhydride $\xrightarrow{con.\ H_2SO_4}$ Phenolphthalein

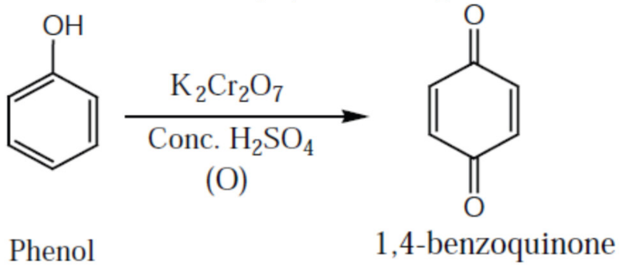


28. Coupling reaction (or) Phenol couples with benzene diazonium chloride (or) Dye test for Phenol

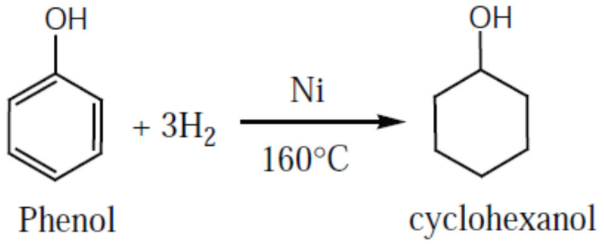
Phenol + Benzene diazonium chloride $\xrightarrow{NaOH}$ p-hydroxy azobenzene (red-orange dye)



29. Oxidation of Phenol (or) convert phenol to benzo quinone



30. Reduction of Phenol (or) convert phenol to Cyclohexanol



Phenol cyclohexanol

31. Write the test to differentiate alcohol and phenols (or) Test for phenol

Test	Phenol	Alcohol
Neutral $FeCl_3$	Purple colour	No reaction
NaOH	Sodium phenoxide	No reaction
Benzene diazonium chloride	Red orange dye	No reaction

32. **Explain the classification of Ether**

Ether

Simple Ether
Both alkyl or aryl groups attached to oxygen atom are same

Mixed Ether
Both alkyl or aryl groups attached to oxygen atom are different

Aliphatic ethers

Two alkyl groups are attached to etherial oxygen

C_2H_5-O- CH_3 (methoxy methane) C_2H_5-O- C_2H_5 (methoxy ethane)

Aromatic ethers

Any one or both the group attached to the etherial oxygen is aryl group

C_6H_5-O- C_6H_5 (phenoxy benzene) C_6H_5 -O- CH_3 (methoxy benzene)

33. Williamson's Ether synthesis (Preparation of diethyl ether)

Sodium ethoxide + Ethyl bromide $\xrightarrow{\text{Alcohol}}$ Diethyl ether

$$C_2H_5ONa + C_2H_5Br \xrightarrow{\text{Alcohol}} C_2H_5\text{-O-}C_2H_5 + NaBr$$

34. Draw the major product formed when 1-ethoxyprop-1-ene is heated with one equivalent of HI

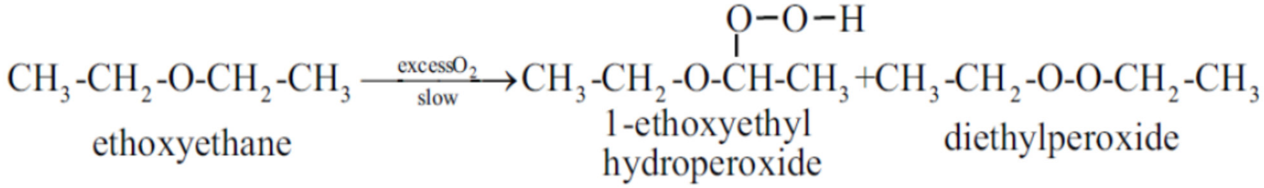
$$CH_3CH{=}CH\text{-O-}C_2H_5 + HI \xrightarrow{\Delta} CH_3CH{=}CH\text{-OH} + C_2H_5I$$

35. Identify the product (s) is / are formed when 1-methoxy propane is heated with excess HI. Name the mechanism involved in the reaction

Ethers having primary alkyl group undergo S_N^2 mechanism

$$CH_3CH_2CH_2\text{-O-}CH_3 + 2HI \xrightarrow{\Delta} CH_3CH_2CH_2I + CH_3I + H_2O$$

36. Write notes on auto oxidation of ethers (peroxide effect)



$$CH_3\text{-}CH_2\text{-}O\text{-}CH_2\text{-}CH_3 \xrightarrow[\text{slow}]{\text{excess}O_2} CH_3\text{-}CH_2\text{-}O\text{-}\overset{O-O-H}{\overset{|}{C}}H\text{-}CH_3 + CH_3\text{-}CH_2\text{-}O\text{-}O\text{-}CH_2\text{-}CH_3$$

37. What is metamerism? Give the structure and IUPAC name of metamers of 2-methoxy propane

Metamerism

It is due to the unequal distribution of carbon atoms on either side of the functional group

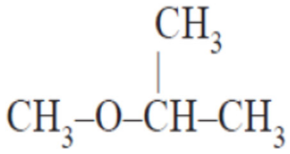
Metamers of 2-methoxy propane

$CH_3 - O - CH_2CH_2CH_3$

1-methoxy propane

$CH_3–CH_2–O–CH_2CH_3$

Ethoxy ethane



$$CH_3–O–\overset{CH_3}{\overset{|}{C}}H–CH_3$$

2-methoxy propane

38. C-O-C bond angle in Ether is slightly greater than the tetrahedral bond angle. Why?

The repulsive interaction between the two bulkier alkyl groups.

39. Give the uses of ethylene glycol

- Ethylene glycol is used as an antifreeze in automobile radiator
- Its dinitrate is used as an explosive with TNG.

40. **Give the uses of Glycerol**

- Sweetening agent
- Manufacture of cosmetics and transparent soaps
- Manufacture of dynamite
- Making printing inks and stamp pad ink.

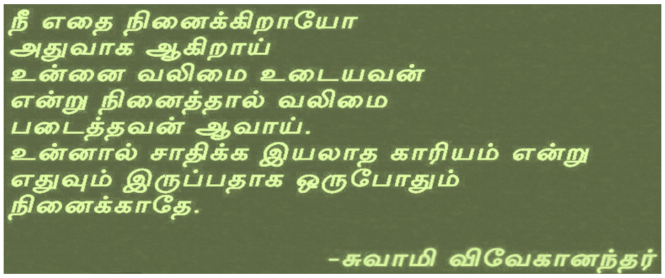
41. Write the uses of diethyl ether

- Anesthetic agent in surgery
- Used as a refrigerant.
- Solvent for organic reactions

42. Give the uses of phenol

Phenol is used for making

- Phenol formaldehyde resin (Bakelite).
- Drugs such as Salol, aspirin, etc.
- Phenolphthalein indicator.
- Explosive like picric acid.
- Antiseptic-carbolic lotion and carbolic soaps.



நீ எதை நினைக்கிறாயோ
அதுவாக ஆகிறாய்
உன்னை வலிமை உடையவன்
என்று நினைத்தால் வலிமை
படைத்தவன் ஆவாய்.
உன்னால் சாதிக்க இயலாத காரியம் என்று
எதுவும் இருப்பதாக ஒருபோதும்
நினைக்காதே.

-சுவாமி விவேகானந்தர்

43. Complete the following reactions

i) $CH_3\text{-}CH_2\text{-}OH \xrightarrow{P\,Br_3} A \xrightarrow{aq.NaOH} B \xrightarrow{Na} C$

$3CH_3CH_2OH \xrightarrow{PBr_2} \underset{(A)}{CH_3CH_2Br} + H_3PO_3$

$CH_3CH_2Br \xrightarrow{aqNaOH} \underset{(B)}{CH_3CH_2OH} + NaBr$

$2CH_3CH_2OH \xrightarrow{Na} \underset{(C)}{2CH_3CH_2ONa} + H_2$

ii) $C_6H_5\text{-}OH \xrightarrow{Zn\ dust} A \xrightarrow[Anhydrs\ AlCl_3]{CH_3Cl} B \xrightarrow{acid\ KMnO_4} C$

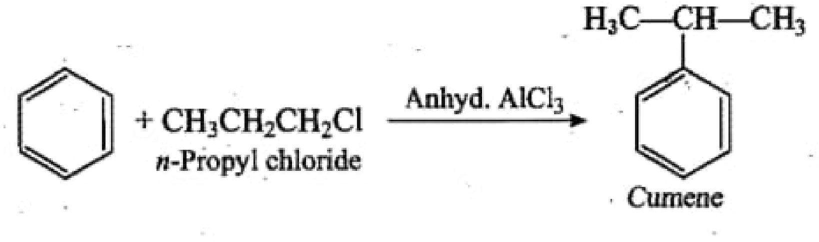
$C_6H_5OH \xrightarrow{Zn\ dust} \underset{(A)}{C_6H_6} + Zno$

$C_6H_6 \xrightarrow[Anhydrous\ AlCl_3]{CH_3Cl} \underset{(B)}{C_6H_5CH_3}$

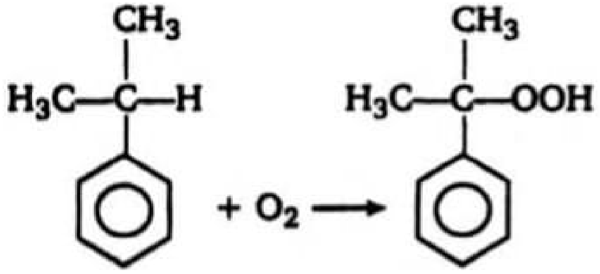
$C_6H_5CH_3 \xrightarrow[(O)]{Acid\ KMnO_4} \underset{(C)}{C_6H_5COOH}$

44. Phenol is distilled with Zn dust followed by Friedel-Crafts alkylation with propyl chloride to give a compound A. A on oxidation gives B. Identify A and B.

$\mathbf{C_6H_5OH + Zn \xrightarrow{\Delta} \underset{(A)}{C_6H_6} + ZnO}$



(B)



(C)

- **A – Benzene**
- **B – Cumene**
- **C – Cumene hydro peroxide**

12. CARBONYL COMPOUNDS

1. Write a note on Rosenmund Reduction Reaction
Name the catalyst and catalytic poison used in Rosenmund reduction

Acetyl chloride + H_2 $\xrightarrow{Pd / BaSO_4}$ Acetaldehyde

$CH_3COCl + H_2 \xrightarrow{Pd / BaSO_4} CH_3CHO + HCl$

Pd - Catalyst,

$BaSO_4$ - Catalytic poison (prevents the further reduced of aldehyde to alcohol)

2. Write a note on Stephen's Reaction.

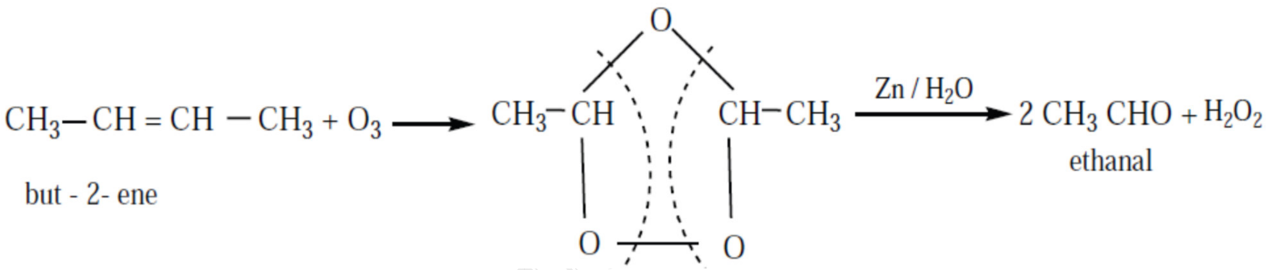
$$CH_3-C\equiv N \xrightarrow[(H)]{SnCl_2/HCl} CH_3-CH=NH \xrightarrow{H_3O^+} CH_3-CHO + NH_3$$

3. How will you prepare acetaldehyde from ethyne

$$HC\equiv CH + H-OH \xrightarrow[H_2SO_4]{HgSO_4} CH_3-CHO$$

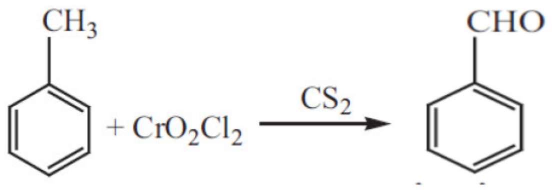
4. Ozonolysis of alkenes (Preparation aldehyde from alkene)

Alkene + ozone ⟶ Ozonide $\xrightarrow{Zn/ H_2O}$ Aldehydes

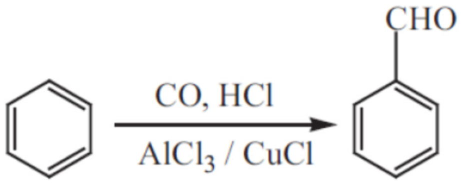


5. Etard reaction

Toluene + CrO_2Cl_2 $\xrightarrow{CS_2 / H_3O^+}$ Benzaldehyde

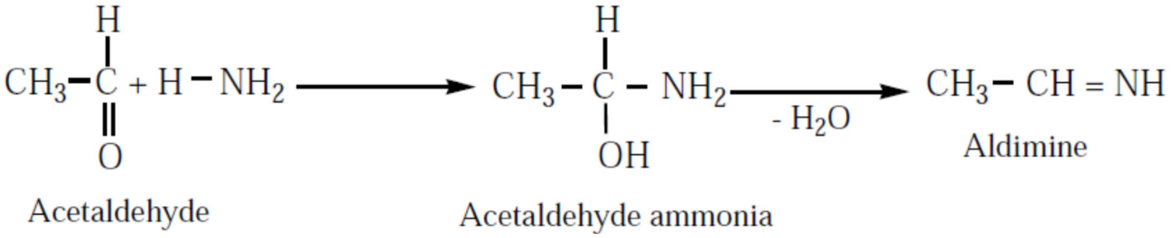


6. Gattermann – Koch reaction



Benzene Benzaldehyde

7. Acetaldehyde reaction with ammonia (Preparation of Aldimine)



$$CH_3-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle O}{\|}}{C}} + H-NH_2 \longrightarrow CH_3-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle OH}{|}}{C}}-NH_2 \xrightarrow[-H_2O]{} CH_3-CH=NH$$

8. How will you prepare Acetophenone from acetylchloride?

Friedel – Crafts acylation

Benzene + Acetylchloride $\xrightarrow{\text{anhydrous AlCl}_3}$ Acetophenone

$C_6H_6 + CH_3COCl \xrightarrow{\text{anhydrous AlCl}_3} C_6H_5COCH_3 + HCl$

9. How will you prepare Benzophenone from Benzoylchloride?

Friedel – Crafts benzylation

Benzene + Benzoylchloride $\xrightarrow{\text{anhydrous AlCl}_3}$ Benzophenone

$C_6H_6 + C_6H_5COCl \xrightarrow{\text{anhydrous AlCl}_3} C_6H_5COC_6H_5 + HCl$

10. What is Formalin and mention its uses ?

40% aqueous solution of Formaldehyde is called Formalin

Uses

- Preserving biological specimes
- It is used for Tanning

11. Write the test to differentiate Aldehydes and Ketones

- Aldehydes reduce Tollen's reagent ($Ag^+ \rightarrow Ag$)
- Aldehydes reduce Fehling's solution ($Cu^{2+} \rightarrow Cu_2O$)
- Aldehydes reduce Benedicts solution ($Cu^{2+} \rightarrow Cu_2O$)

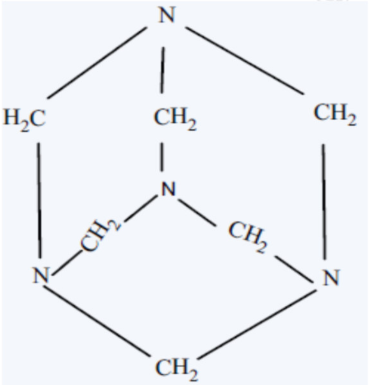
12. Write preparation of Urotropine and Mention its uses.

Formaldehyde + Ammonia $\longrightarrow$ Urotropine (Hexamethylene tetramine)

$$6CH_2O + 4NH_3 \longrightarrow (CH_2)_6N_4 + 6H_2O$$

Uses : - 1. It is used to treat urinary infection

2. It is used to prepare RDX explosive



13. How will you prepare Cinnamaldehyde from benzaldehyde

Claisen – Schmidt Condensation Reaction

Benzaldehyde **+** Acetaldehyde $\xrightarrow{\text{dil. NaOH}}$ Cinnamaldehyde

$C_6H_5CHO + CH_3CHO \xrightarrow{\text{dil. NaOH}} C_6H_5CH = CH\text{-}CHO + H_2O$

14. How will you prepare Cinnamic acid from benzaldehyde

Perkin's Reaction

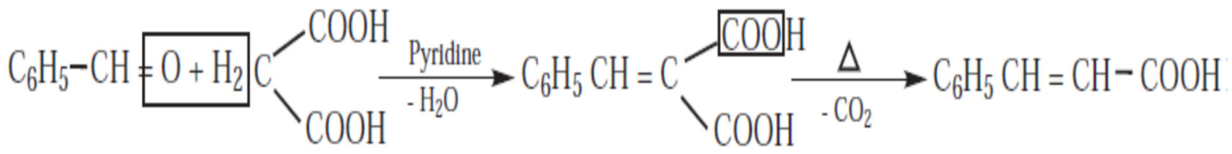
Benzaldehyde **+** Acetic anhydride $\xrightarrow{CH_3COONa}$ Cinnamic acid

$C_6H_5CHO + CH_3COOCOCH_3 \xrightarrow{CH_3COONa} C_6H_5CH = CHCOOH + CH_3COOH$

15. How will you prepare Cinnamic acid from benzaldehyde

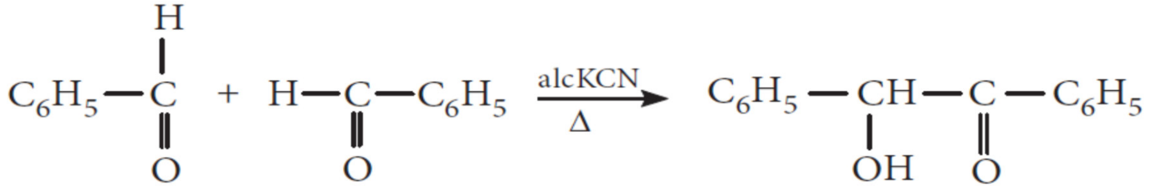
Knovenagal Reaction

Benzaldehyde + Malonic acid $\xrightarrow{\text{Pyridine} / -H_2O,\ -CO_2}$ Cinnamic acid



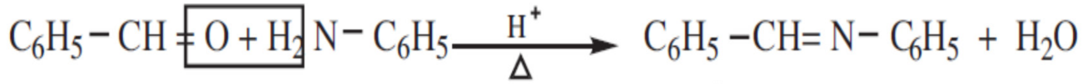
16. Benzoin Condensation Reaction

Benzaldehyde $\xrightarrow{\text{alc. KCN}}$ Benzoin



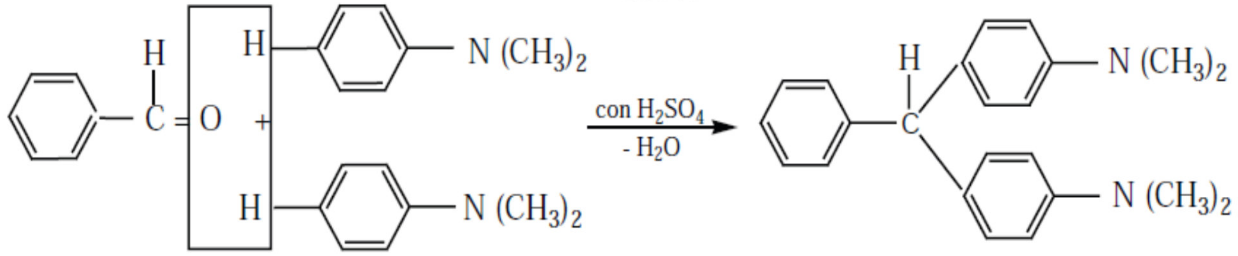
17. Preparation of schiff's base. (Benzaldehyde react with Aniline)

Benzaldehyde + Aniline $\xrightarrow{H^+}$ Benzal aniline (schiff's base)



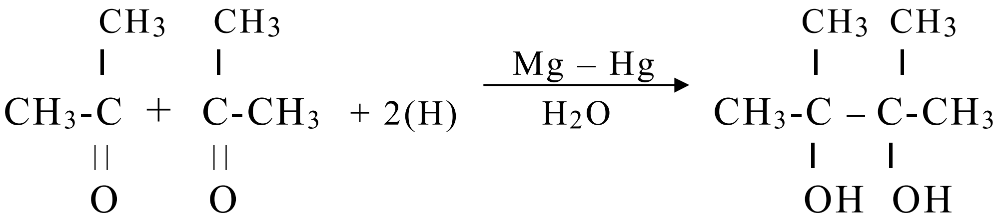
18. How will you prepare Malachitegreen from benzaldehyde

Benzaldehyde + N, N - Dimethyl aniline $\xrightarrow{con.H_2SO_4}$ Malachitegreen



19. Convert Acetone to Pinacols

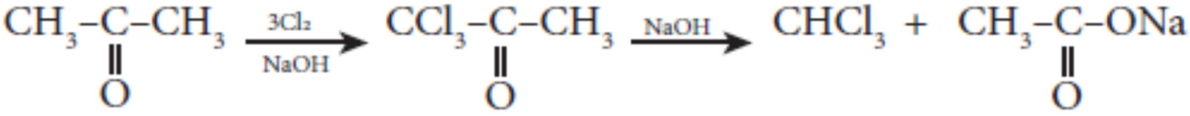
Ketones, on reduction with magnesium amalgam and water, are reduced to symmetrical diols known as pinacol.



$$\underset{\underset{O}{\|}}{\overset{\overset{CH_3}{|}}{CH_3\text{-}C}} + \underset{\underset{O}{\|}}{\overset{\overset{CH_3}{|}}{C\text{-}CH_3}} + 2(H) \xrightarrow[H_2O]{Mg - Hg} \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{CH_3\text{-}C}} - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C\text{-}CH_3}}$$

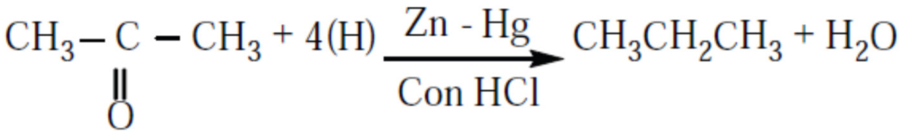
20. Haloform reaction

Acetaldehyde and methyl ketone containing $CH_3\underset{\underset{O}{\|}}{C}$- group only participate this reaction



21. Clemmensen Reduction Reaction (Acetone to Propane)

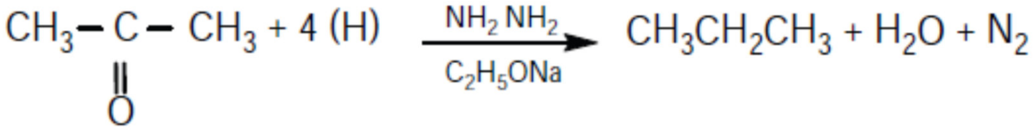
Acetone + 4(H) $\xrightarrow{\text{Zn-Hg / con. HCl}}$ Propane



$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + 4(H) \xrightarrow[\text{Con HCl}]{\text{Zn - Hg}} CH_3CH_2CH_3 + H_2O$$

22. Wolf Kishner Reduction Reaction (Acetone to Propane)

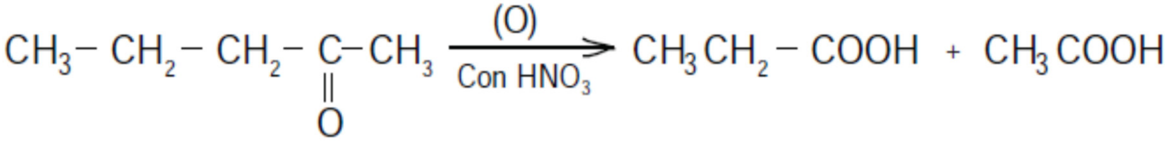
Acetone + 4(H) $\xrightarrow{N_2H_4 / C_2H_5ONa}$ Propane



$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + 4\ (H) \xrightarrow[C_2H_5ONa]{NH_2\,NH_2} CH_3CH_2CH_3 + H_2O + N_2$$

23. Explain Poppof's rule

When an asymmetric Ketone is oxidized, the Keto group stays with the small alkyl group.



$$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{Con } HNO_3]{(O)} CH_3CH_2-COOH + CH_3COOH$$

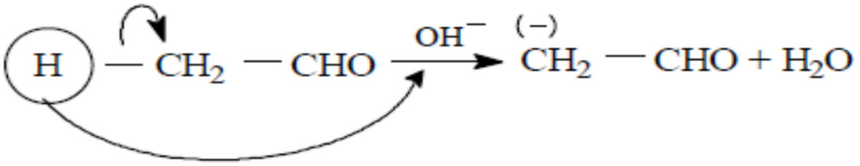
24. Explain Mechanism of Aldol condensation Reaction

Acetaldehyde $\xrightarrow{NaOH}$ Aldol (3-Hydroxy butanal)

$$CH_3-CHO + CH_3-CHO \xrightarrow{NaOH} CH_3-CH(OH)-CH_2-CHO$$

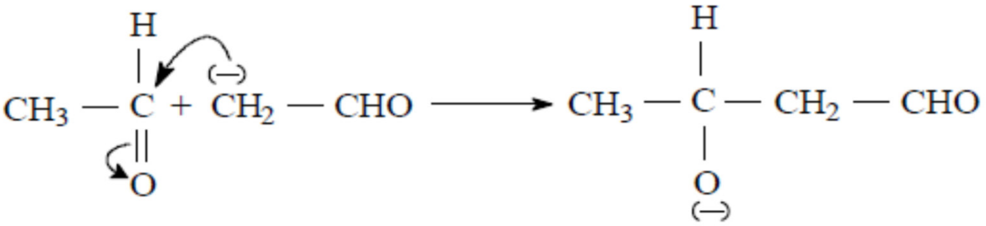
Mechanism

Step - I : The carbanion is formed as the α - H atom is removed as a proton by the base.



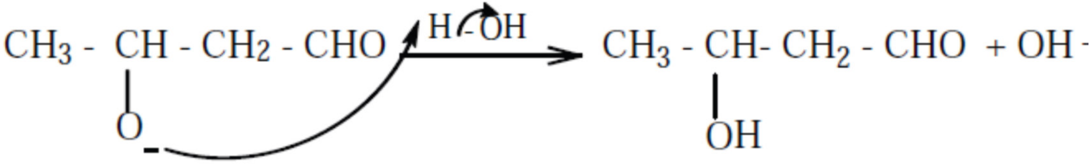
$$H-CH_2-CHO \xrightarrow{OH^-} \overset{(-)}{C}H_2-CHO + H_2O$$

Step - II : Form an alkoxide ion.



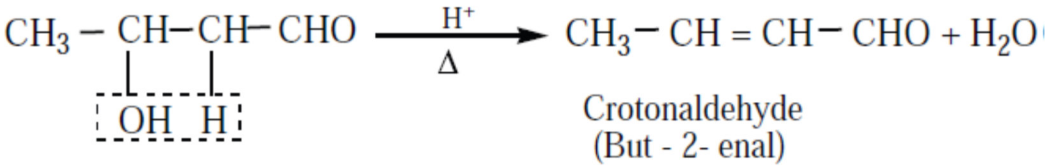
$$CH_3-\underset{\underset{O}{\|}}{\overset{\overset{H}{|}}{C}} + \overset{(-)}{C}H_2-CHO \longrightarrow CH_3-\underset{\underset{\overset{}{O^{(-)}}}{|}}{\overset{\overset{H}{|}}{C}}-CH_2-CHO$$

Step - III : The alkoxide ion formed is protonated by water to form aldol.



$$CH_3-\underset{\underset{O^-}{|}}{CH}-CH_2-CHO \xrightarrow{H-OH} CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CHO + OH^-$$

25. Convert Aldol to Crotonaldehyde



$$CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{H}{|}}{CH}-CHO \xrightarrow[\Delta]{H^+} CH_3-CH=CH-CHO + H_2O$$

Crotonaldehyde
(But - 2- enal)

26. Write a note on Crossed Aldol Condensation Reaction.

Formaldehyde + Acetaldehyde $\xrightarrow{\text{dilNaOH}}$ 3-hydroxy propanal

$$HCHO + CH_3CHO \xrightarrow{\text{dil NaOH}} HO\text{-}CH_2\text{-}CH_2\text{-}CHO$$

27. Write a note on Crossed Cannizaro reaction

$$\underset{\text{Benzaldehyde}}{C_6H_5CHO} + \underset{\text{Formaldehyde}}{HCHO} \xrightarrow{NaOH} \underset{\text{Benzyl alcohol}}{C_6H_5CH_2OH} + \underset{\text{sodium formate}}{HCOONa}$$

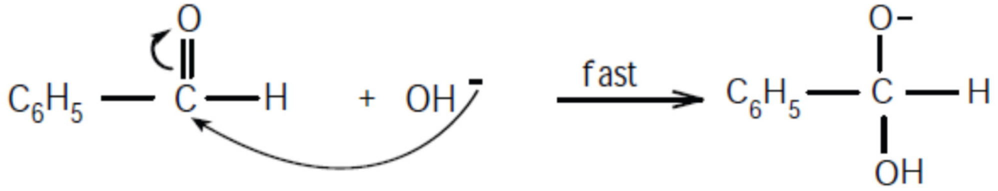
In crossed cannizaro reaction more reactive aldehyde is oxidized and less reactive aldehyde is reduced.

28. Mechanism of Cannizaro reaction (disproportionation reaction)

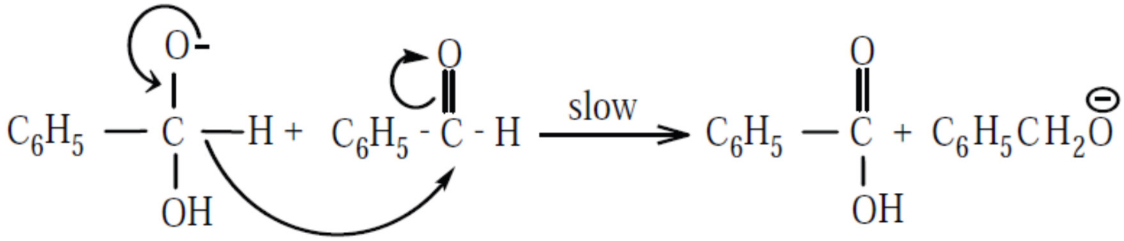
Cannizaro reaction is a characteristic reaction of aldehyde having no α – hydrogen.

$$C_6H_5CHO + C_6H_5CHO \xrightarrow{\text{dil NaOH}} C_6H_5CH_2OH + C_6H_5COONa$$

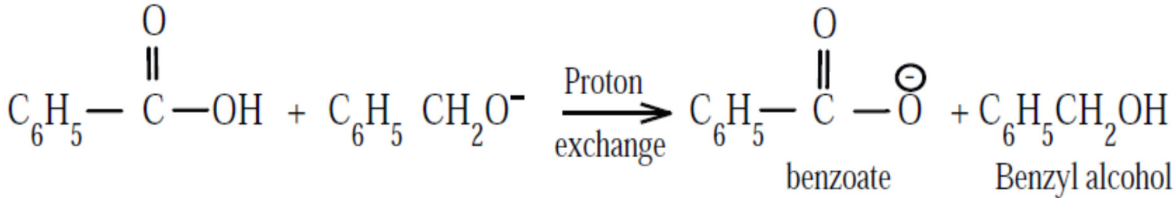
Step 1 : Attack of OH^- on the carbonyl carbon.



Step 2 : Hydride ion transfer



Step 3 : Acid – base reaction.



29. Uses of Aldehydes and Ketones

- **Formalin** - preserving biological specimens, tanning, Bakelite
- **Acetaldehyde** - silvering of mirrors
- **Paraldehyde** - medicine as a hypnotic
- **Benzaldehyde is used**
  (i) as a flavoring agent (ii) in perfumes (iii) in dye intermediates
- **Acetone**
  (i) as a solvent, (ii) nail polish remover (iii) preparation of sulphonal, hypnotic
  (iv) manufacture of cordite (v) manufacture of thermosoftening plastic Perspex.
- **Acetophenone** - perfumery and hypnotic
- **Benzophenone** - perfumery and benzhydrol eye drop.

CARBOXYLIC ACIDS

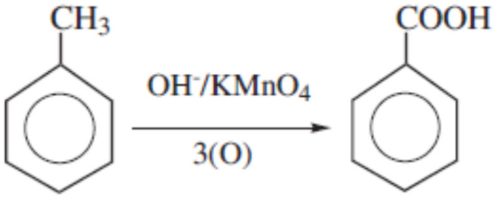
30. Give the tests for Carboxylic acids.

- Change Blue Litmus paper into Red Colour
- Brisk effervescence with Sodium bicarbonate solution.
- When heated with Alcohol and con.H_2SO_4, Fruity odour ester is obtained.

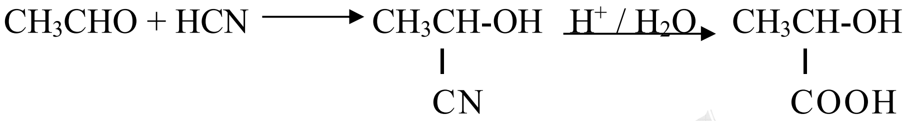
31. Benzoic acid does not undergo friedal craft's reaction. Give the reason

- Benzoic acid does not undergo friedal craft's reaction
- Reason - the strong deactivating nature of the carboxyl group.

32. Preparation of Benzoic acid from toluene

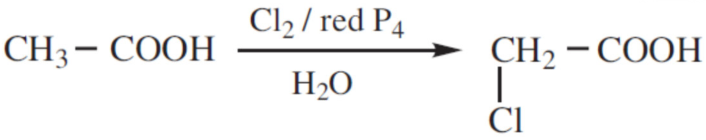


33. Preparation of Lactic acid from ethanal



$$CH_3CHO + HCN \longrightarrow \underset{\underset{CN}{|}}{CH_3CH\text{-}OH} \xrightarrow{H^+ / H_2O} \underset{\underset{COOH}{|}}{CH_3CH\text{-}OH}$$

34. Hell-Volhard-Zelinsky (HVZ) Reaction



$$CH_3 - COOH \xrightarrow[H_2O]{Cl_2 / red\ P_4} \underset{\underset{Cl}{|}}{CH_2} - COOH$$

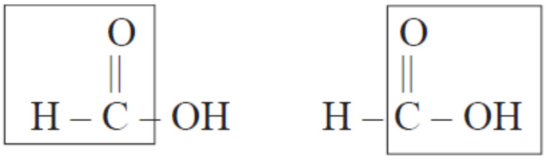
Acetic acid Monochloro Acetic acid

35. How is propanoic acid is prepared from an alcohol

$$\underset{\text{Propyl alcohol}}{CH_3CH_2CH_2OH} \xrightarrow{H^+ / K_2Cr_2O_7} \underset{\text{Propanoic acid}}{CH_3CH_2COOH}$$

**36. Write a note on reducing property of Formic acid (or)
How does formic acid differ from other carboxylic acid?**

- ➢ Formic acid contains both an aldehyde and acid group



$$\boxed{H - \overset{\overset{O}{\|}}{C}} - OH \qquad H - \boxed{\overset{\overset{O}{\|}}{C} - OH}$$

- ➢ Formic acid reduces Tollens reagent

$$HCOO^- + \underset{\text{Tollens reagent}}{2Ag^+} + 3OH^- \longrightarrow \underset{\text{Silver mirror}}{2Ag} + CO_3^{2-} + 2H_2O$$

- ➢ Formic acid reduces Fehling's solution.

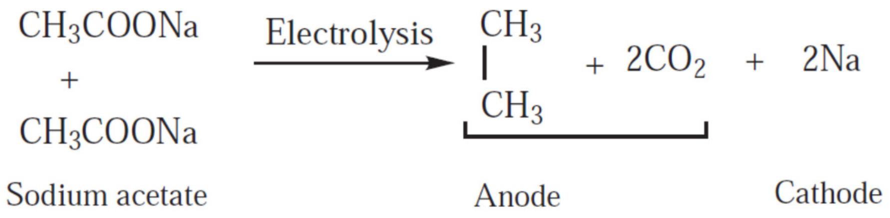
$$HCOO^- + \underset{\text{Fehling's solution}}{2Cu^+} + 5OH^- \longrightarrow \underset{\text{red precipitate}}{Cu_2O} + CO_3^{2-} + 3H_2O$$

37. Decarboxylation reaction

Sodium acetate + soda lime $\xrightarrow{\Delta}$ Methane

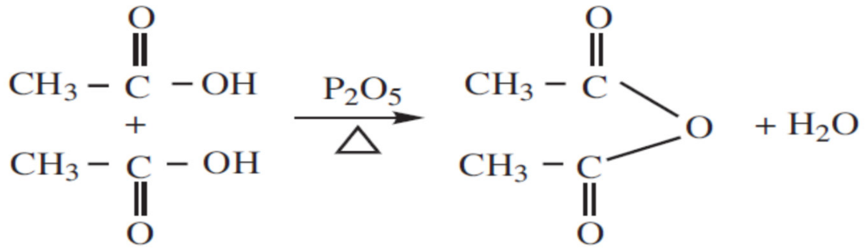
$CH_3COONa + NaOH \xrightarrow{CaO/\Delta} CH_4 + Na_2CO_3$

38. Preparation of Ethane from sodium acetate (Kolbe's electrolytic decarboxylation)



$$\begin{matrix} CH_3COONa \\ + \\ CH_3COONa \end{matrix} \xrightarrow{Electrolysis} \underbrace{\begin{matrix} CH_3 \\ | \\ CH_3 \end{matrix} + 2CO_2} + 2Na$$

39. Preparation of Acetic anhydride from acetic acid



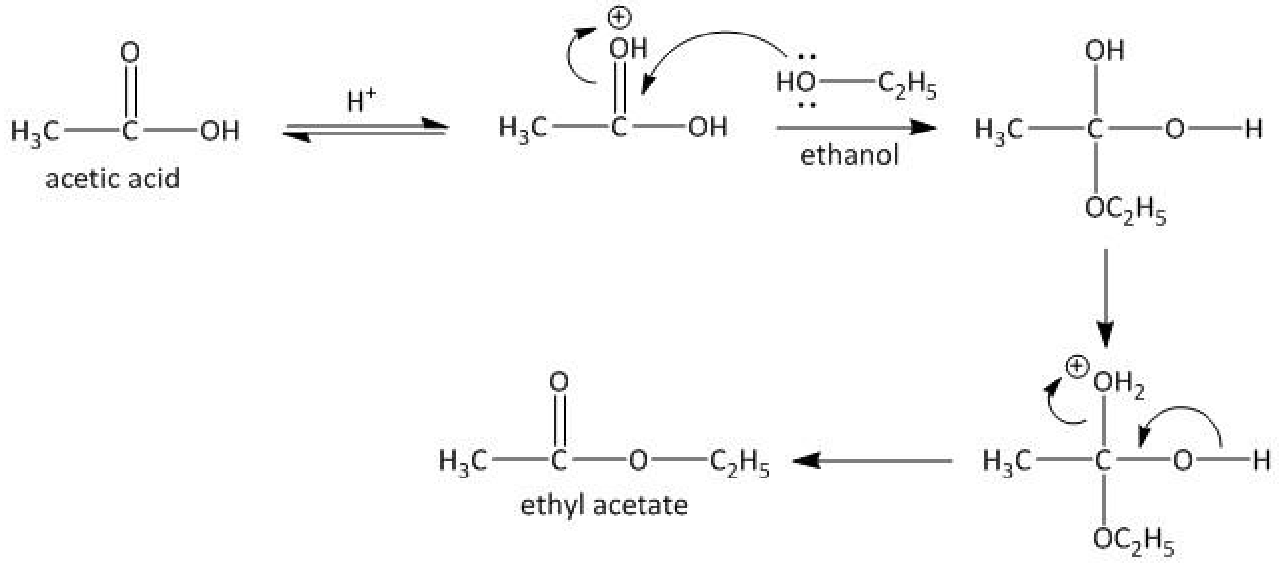
$$\begin{matrix} CH_3-\overset{\overset{O}{\|}}{C}-OH \\ + \\ CH_3-\underset{\underset{O}{\|}}{C}-OH \end{matrix} \xrightarrow[\Delta]{P_2O_5} \begin{matrix} CH_3-\overset{\overset{O}{\|}}{C} \\ \quad\quad O \\ CH_3-\underset{\underset{O}{\|}}{C} \end{matrix} + H_2O$$

40. Esterification Reaction

Acetic acid + Ethanol $\xrightarrow{con.H_2SO_4}$ Ethyl acetate

$CH_3COOH + C_2H_5OH \xrightarrow{con.\ H_2SO_4} CH_3COOC_2H_5 + H_2O$

<u>Mecanism of Esterification Reaction</u>

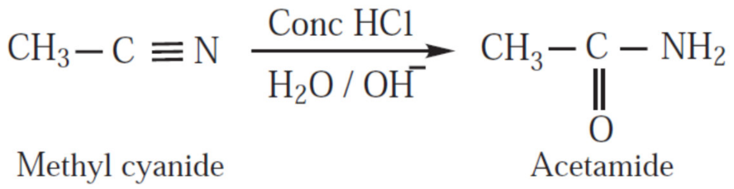


41. Trans Esterification Reaction (Preparation of Ethyl acetate from Methyl acetate)

Methyl acetate + Ethyl alcohol $\xrightarrow{H^+}$ Ethyl acetate + Methyl alcohol

$CH_3COOCH_3 + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + CH_3OH$

42. Preparation of Acetamide from methylcyanide



$$CH_3-C\equiv N \xrightarrow[H_2O/OH^-]{Conc\ HCl} CH_3-\underset{\underset{O}{\|}}{C}-NH_2$$

43. Uses of carboxylic acids and its derivatives

- **Formic acid -** (i) antiseptic (ii) preservation of fruit juice
  (iii) treatment of gout (iv) dehydration of hides
- **Acetic acid** - (i) table vinegar (ii) coagulating rubber latex
- **Benzoic acid** - (i) food preservative (ii) manufacture of dyes
  (iii) medicine as an urinary antiseptic
- **Acetic anhydride -** preparation of asprin and phenacetin

44. Compound (A) with molecular formula C_2H_3N on acid hydrolysis gives (B) which reacts with thionylchloride to give compound (C). Benzene reacts with (C) in presence of anhydrous $AlCl_3$ to give compound (D). Compound (C) on reduction with gives (E). Identify A, B, C, D, E. Write the equations.

- A which is methyl cyanide on hydrolysis gives acetic acid

$$\underset{(A)}{CH_3CN} \xrightarrow{H^+ / H_2O} \underset{(B)}{CH_3COOH}$$

- $$\underset{(B)}{CH_3COOH} \xrightarrow{SOCl_2} \underset{(C)}{CH_3COCl} + SO_2 + HCl$$
- $$\underset{Benzene}{C_6H_6} + \underset{(C)}{CH_3COCl} \xrightarrow{\text{anhydrous } AlCl_3} \underset{(D)}{C_6H_5COCH_3} + HCl$$
- $$\underset{(C)}{CH_3COCl} + H_2 \xrightarrow{Pd / BaSO_4} \underset{(E)}{CH_3CHO} + HCl$$

A	CH_3CN	Methyl cyanide
B	CH_3COOH	Acetic acid
C	CH_3COCl	Acetyl chloride
D	$C_6H_5COCH_3$	Acetophenone
E	CH_3CHO	Acetaldehyde

45. Identify A, B, C and D

$$\text{Ethanoic acid} \xrightarrow{SOCl_2} A \xrightarrow{Pd/BaSO_4} B \xrightarrow{NaOH} C \xrightarrow{\Delta} D$$

$$\underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{SOCl_2} \underset{(A)}{CH_3COCl} \xrightarrow{Pd / BaSO_4} \underset{(B)}{CH_3CHO}$$

$$\underset{(B)}{CH_3CHO} \xrightarrow{NaOH} \underset{(C)}{CH_3CH(OH)CH_2CHO} \xrightarrow{\Delta} \underset{(D)}{CH_3CH{=}CHCHO}$$

A	CH_3COCl	Acetyl chloride
B	CH_3CHO	Acetaldehyde
C	$CH_3CH(OH)CH_2CHO$	Aldol
D	$CH_3CH{=}CHCHO$	Crotonaldehyde

13. ORGANIC NITROGEN COMPOUNDS

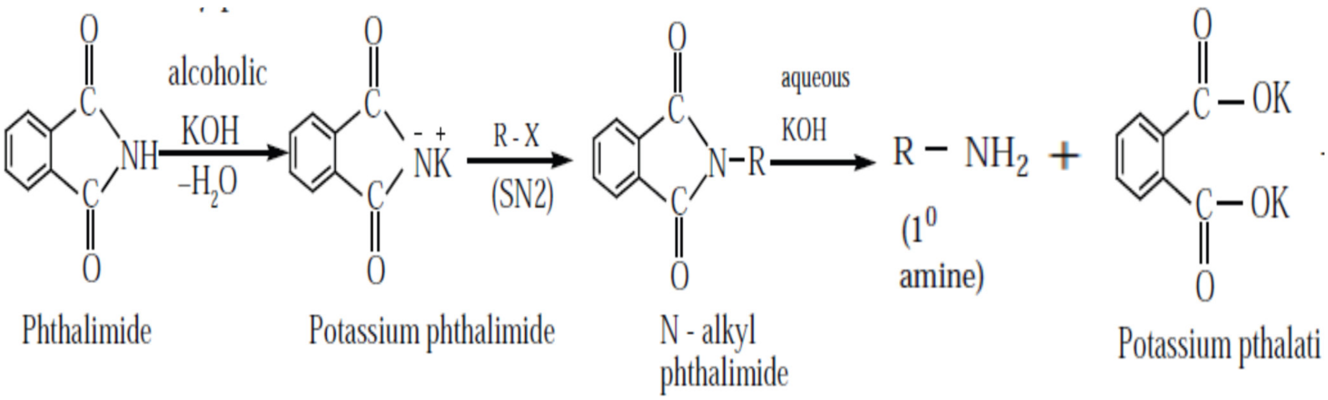
1. Hoffmann's degradation Reaction (Preparation of primary amine from Amide)

Amide $\xrightarrow{Br_2 / KOH}$ Primary amine

$$CH_3CONH_2 \xrightarrow{Br_2/ KOH} CH_3NH_2 + K_2CO_3 + KBr + H_2O$$

2. Gabriel Phthalimide Synthesis

Phthalimide $\xrightarrow{KOH}$ Pottasium Phthalimide $\xrightarrow{RX}$ N-Alkyl Phthalimide $\xrightarrow{KOH}$ Primary amine



3. Mendius reaction

$$CH_3CN \xrightarrow[4[H]]{Na(Hg) / C_2H_5OH} CH_3CH_2NH_2$$

Ethanenitrile Ethanamine

4. Sabatier – Mailhe method

$$C_2H_5OH \xrightarrow[Al_2O_3,\ -H_2O]{\ddot{N}H_3} C_2H_5 - \ddot{N}H_2 \xrightarrow[-H_2O]{C_2H_5OH} (C_2H_5)_2\ddot{N}H \xrightarrow[-H_2O]{C_2H_5OH} (C_2H_5)_3\ddot{N}$$

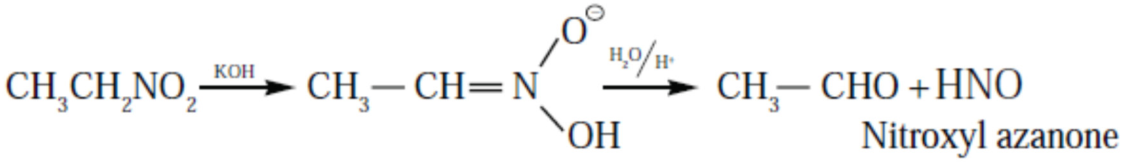
5. How is Chloropicrin prepared and mention its use ?

$$CH_3NO_2 + 3Cl_2 \xrightarrow{NaOH} CCl_3\,NO_2 + 3HCl$$

Chloropicrin (trichloronitromethane)

Uses – insecticide

6. Write a note on Nef carbonyl synthesis.



$$CH_3CH_2NO_2 \xrightarrow{KOH} CH_3-CH{=}N\overset{O^{\ominus}}{\underset{OH}{\diagdown}} \xrightarrow{H_2O/H^+} CH_3-CHO + HNO$$

Nitroxyl azanone

7. Write a note on Carbyl amine reaction. (Test for primary amines)

Methyl amine + Chloroform $\xrightarrow{KOH}$ Methylisocyanide

$$CH_3NH_2 + CHCl_3 + 3KOH \longrightarrow CH_3NC + 3KCl + 3H_2O$$

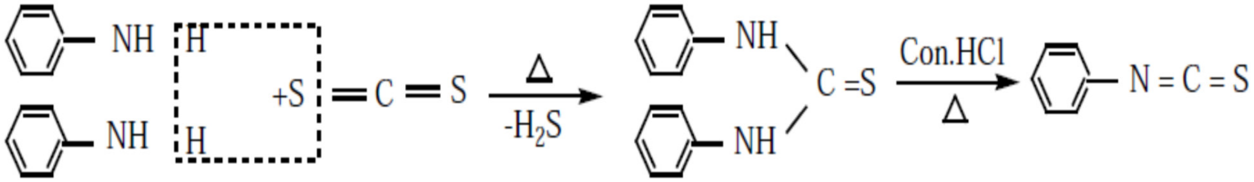
8. Write a note on Mustard Oil Reaction.

Methyl amine + Carbon disulphide $\xrightarrow{HgCl_2}$ Methyl isothiocyanate

$$CH_3NH_2 + S=C=S \longrightarrow CH_3-N=C=S + H_2S$$

9. Write a note on Hofmann – Mustard Oil Reaction.

Aniline + Carbon disulphide $\xrightarrow{\Delta}$ s-diphenyl Thiourea $\xrightarrow{con.HCl}$ Phenyl isothiocyanate



10. Write a note on Diazotization Reaction.

Aniline reacts with nitrous acid at 273K – 278 K to give benzene diazonium chloride

$$C_6H_5NH_2 + HNO_2 + HCl \xrightarrow{273-278\ K} C_6H_5N_2Cl + 2H_2O$$

11. How is Phenol prepared from benzene diazonium chloride?

$$C_6H_5\text{-}N_2Cl + H_2O \xrightarrow[283K]{\Delta} C_6H_5\text{-}OH + N_2 + HCl$$

12. Gattermann reaction

Benzene diazonium chloride $\xrightarrow{Cu/HCl}$ Chloro benzene

$C_6H_5N_2C\ell \xrightarrow{Cu\ /\ HCl} C_6H_5C\ell + N_2$ (OR)

$C_6H_5N_2C\ell \xrightarrow{CuCN\ /\ KCN} C_6H_5CN + N_2$

13. Write a note on Sandmeyer Reaction

Benzene diazonium chloride $\xrightarrow{Cu_2C\ell_2\ /\ HCl}$ Chloro benzene

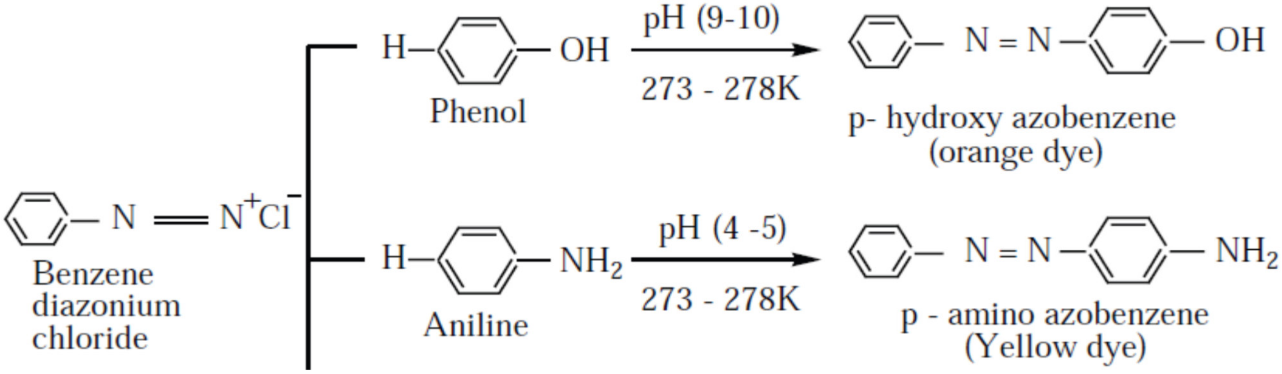
$C_6H_5N_2C\ell \xrightarrow{Cu_2C\ell_2\ /\ HCl} C_6H_5C\ell + N_2$

14. Write a note on Gomberg Reaction

Benzene diazonium chloride + Benzene $\xrightarrow{NaOH}$ Biphenyl

$$C_6H_5N_2Cl + C_6H_6 \xrightarrow{NaOH} C_6H_5-C_6H_5 + N_2 + HCl$$

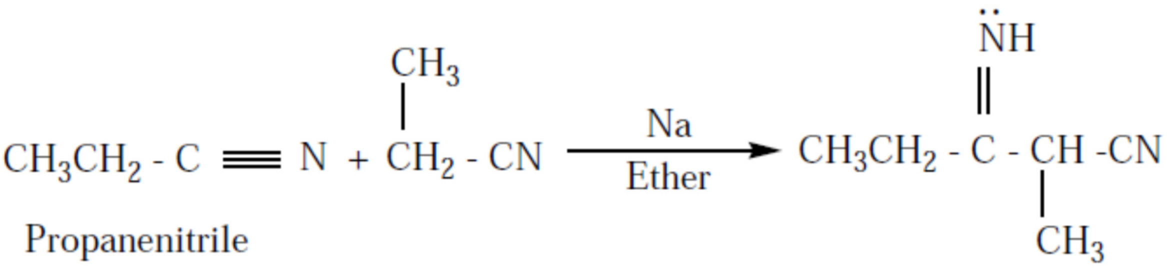
15. Coupling reactions of Benzene diazonium chloride



16. Baltz-schiemann reaction (Replacement of fluorine at Benzene diazonium chloride)

$$\underset{}{C_6H_5 - \overset{+}{N}_2\overset{-}{Cl}} + \underset{\text{Fluoroboric acid}}{HBF_4} \longrightarrow \underset{\text{Benzenediazonium fluoroborate}}{C_6H_5 - \overset{+}{N}_2\overset{-}{BF_4}} \xrightarrow{\Delta} \underset{\text{Fluorobenzene}}{C_6H_5 - F} + BF_3 + N_2$$

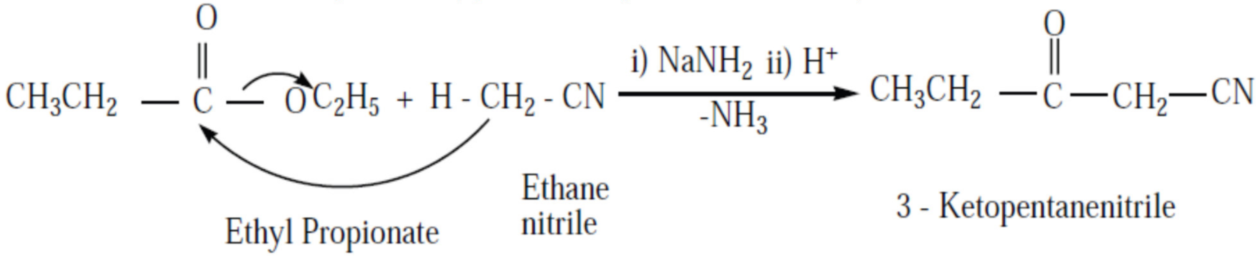
17. Write short note on Thope nitrile condensation reaction.



$$CH_3CH_2 - C \equiv N + CH_2(CH_3) - CN \xrightarrow[\text{Ether}]{\text{Na}} CH_3CH_2 - C(=\ddot{N}H) - CH(CH_3) - CN$$

3-imino-2-methyl pentanenitrile

18. Levine and Hause acetylation (cyanomethylation reaction)



$$CH_3CH_2 - \overset{O}{\overset{\|}{C}} - OC_2H_5 + H - CH_2 - CN \xrightarrow[-NH_3]{\text{i) } NaNH_2 \text{ ii) } H^+} CH_3CH_2 - \overset{O}{\overset{\|}{C}} - CH_2 - CN$$

19. Aniline does not undergo Fridel – Craft's Reaction. Why?

Aniline is basic in nature and it donates its lone pair to the lewis acid $AlCl_3$ to form an adduct which inhibits further the electrophilic substitution reaction.

20. Diazonium salts of aromatic amines are more stable than those of aliphatic amines. Give the reason

The stability of arene diazonium salt is due to the dispersal of the positive charge over the benzene ring.

21. pK_b of aniline is more than that of methylamine

- Aniline has higher pK_b than methylamine because methylamine is more acidic than anilineas in methylamine delocalisation of lone pair of electrons belonging to nitrogen occurs
- As a result resonance structures are formed which increase the acidic character of methylamine as a result it has lesser pK_b value

22. Ethyl amine is soluble in water whereas aniline is not Why ?

- When Ethyl amine forms intermolecular H – bond with water
- But Aniline does not form H – bond with water due to the presence of a large hydrophobic (C_6H_5 -) group.
- Hence Aniline is insoluble in water.

முடியாது என்று சொல்வது மூடநம்பிக்கை!
முடியுமா என்று கேட்பது அவநம்பிக்கை!
முடியும் என்று சொல்வதே தன்னம்பிக்கை!

23. How will you distinguish between Primary, Secondary and Tertiary amines?

Reagent	Primary amines	Secondary amines	Tertiary amines
Nitrous acid	Forms Alcohol	Forms N – Nitroso amine	Forms salt
Carbylamine reaction $CHCl_3$ / KOH	Forms Carbylamine	No reaction.	No reaction.
Mustard Oil Reaction CS_2 / $HgCl_2$	Forms alkyl isothiocyanate	No reaction.	No reaction.
Acetyl chloride	Forms N-alkyl acetmide	Forms N,N-di alkyl acetamide	No reaction.
Alkyl halides	3 molecules of alkyl halide, quarternary ammonium salt is formed.	2 molecules of alkyl halide, quarternary ammonium salt is formed.	One molecules of alkyl halide, quarternary ammonium salt is formed.

24. Distinguish between Primary, Secondary and Tertiary amines by Nitrous aid

- **Primary amines + Nitrous aid ⟶ Alcohol**

$$CH_3NH_2 + HNO_2 \xrightarrow{H_2O} CH_3OH + N_2$$

- **Secondary amines + Nitrous aid ⟶ N - Nitroso amine (yellow oil)**

$$(CH_3)_2NH + HNO_2 \xrightarrow{273\text{-}278K} (CH_3)_2N\text{-}N{=}O$$

- **Tertiary amines + Nitrous aid ⟶ Trialkyl ammonium nitrite**

$$(CH_3)_3N + HNO_2 \longrightarrow [(CH_3)_3\overset{+}{N}H]\,NO_2^{-}$$

25. There are two isomers with the formula CH_3NO_2. How will you distinguish them?

- Tautomerism of Nitro methane (CH_3NO_2)
- Nitroform - Aci-form

Nitroform	**Aci-form**
Less Acidic	More acidic
Eletrical conductivity is low	Eletrical conductivity is High
Dissolves in NaOH slowly	Dissolves in NaOH instantly

26. Write a note on the reduction of Nitro benzene under different conditions.

(a) Acid medium

Nitro benzene + 6[H] $\xrightarrow{Sn / HCl}$ Aniline

$$C_6H_5NO_2 + 6[H] \xrightarrow{Sn/HCl} C_6H_5NH_2 + 2H_2O$$

(b) Neutral medium

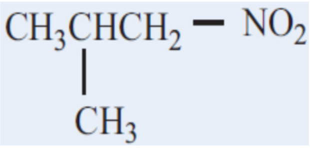
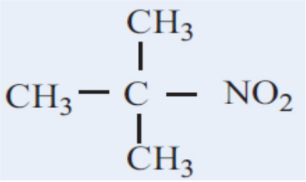
Nitro benzene + 4[H] $\xrightarrow{Zn / NH_4Cl}$ Phenyl hydroxylamine

$$C_6H_5NO_2 + 4[H] \xrightarrow{Zn/NH_4Cl} C_6H_5NHOH + H_2O$$

(c) Alkaline medium

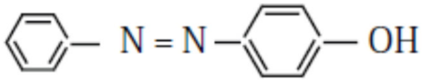
$C_6H_5N=O + O=NC_6H_5$ ↓ ↓ O O **Nitro benzene**	$\xrightarrow[6(H)]{Glucose / NaOH}$	$C_6H_5N=NC_6H_5$ ↓ O **Azoxy benzene**
$C_6H_5N=O + O=NC_6H_5$ ↓ ↓ O O **Nitro benzene**	$\xrightarrow[8(H)]{SnCl_2 / NaOH}$	$C_6H_5N=NC_6H_5$ **Azo benzene**
$C_6H_5N=O + O=NC_6H_5$ ↓ ↓ O O **Nitro benzene**	$\xrightarrow[10(H)]{Zn / NaOH}$	$C_6H_5NH-HNC_6H_5$ **Hydrozo benzene**

27. Write down the possible isomers of the $C_4H_9NO_2$ give their IUPAC names

$CH_3-CH_2-CH_2-CH_2-NO_2$ 1-nitrobutane	$CH_3-CH_2-\underset{NO_2}{\underset{\mid}{CH}}-CH_3$ 2-nitrobutane	$CH_3\underset{CH_3}{\underset{\mid}{CH}}CH_2-NO_2$ 2-methyl -1-nitropropane
$CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-NO_2$ 2-methyl -2-nitropropane	$CH_3-CH_2-CH_2-CH_2-O-N=O$ Butyl nitrite	

28. Identify A, B, C and D

$$\text{i)}\,C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273K]{HNO_2} B \xrightarrow{C_6H_5OH} C$$

A	$C_6H_5NH_2$	Aniline
B	$C_6H_5N_2C\ell$	Benzene diazonium chloride
C		p- hydroxy azo benzene

$$\text{ii)}\,C_6H_5N_2Cl \xrightarrow{CuCN} A \xrightarrow{H_2O / H^+} B \xrightarrow{NH_3} C$$

A	C_6H_5CN	Cyano benzene
B	C_6H_5COOH	Benzoic acid
C	$C_6H_5CONH_2$	Benzamide

Uses of organic nitrogen compounds

Nitroalkanes

1. Nitromethane is used as a fuel for cars
2. Chloropicrin (CCl_3NO_2) is used as an insecticide
3. Nitroethane is used as a fuel additive and precursor to explosive and they are good solvents for polymers, cellulose ester, synthetic rubber and dyes etc.,
4. 4% solution of ethylnitrite in alcohol is known as sweet spirit of nitre and is used as diuretic.

Nitrobenzene (Oil of mirbane)

1 Nitrobenzene is used to produce lubricating oils in motors and machinery.

2 It is used in the manufacture of dyes, drugs, pesticides, synthetic rubber, aniline and explosives like TNT, TNB

14. BIOMOLECULES

1. Explain the types of carbohydrates with an examples.

Types of carbohydrates

1. **Monosaccharides** - cannot be hydrolysed further simple sugars.
   Ex. - Aldoses - Glucose, Ketoses - Fructose
2. **Disaccharides** are sugars that yield two molecules of mono saccharides on hydrolysis.
   Ex. - Sucrose, Lactose, Maltose
3. **Polysaccharides** (non-sugars) consist of large number of monosaccharide units bonded together by glycosidic bonds
   Homopolysaccharides - composed of only one type of monosaccharides
   Ex. - starch, cellulose, glycogen
   Heteropolysaccharides - composed of more than one type of monosaccharides.
   Ex. - heparin, hyaluronic acid

2. Classify the following into monosaccharides, oligosaccharides and polysaccharides.

1. Glucose, Fructose - Monosaccharides
2. Sucrose, Maltose, Lactose - Oligosaccharides
3. Starch, cellulose - Polysaccharides

3. Why carbohydrates are generally optically active.

Carbohydrates are optically active as they have one or more chiral carbons.

The number of optical isomers depends on the number of chiral carbons

4. Write the importance of carbohydrates?

- Glucose - instant source of energy
- Cellulose - make paper, furniture and cloths
- Carbohydrate is stored in the body as glycogen and in plant as starch.
- In plants and animals - act as energy sources and structural polymers

5. What are reducing and non- reducing sugars?

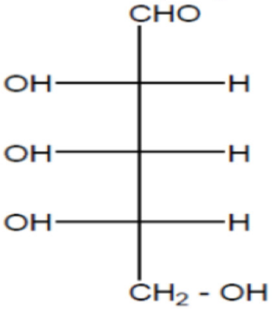
Reducing sugars

- These are carbohydrates which contain free aldehyde group.
- It reduces Tollens Reagent
- Glucose, Lactose

Non- reducing sugars

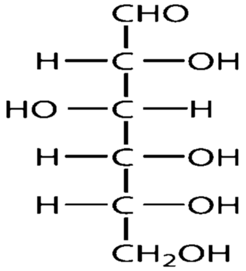
- These are carbohydrates which contain free ketonic group.
- It does not reduce Tollens Reagent
- Fructose, Sucrose

6. Is the following sugar, D- sugar or L–sugar?



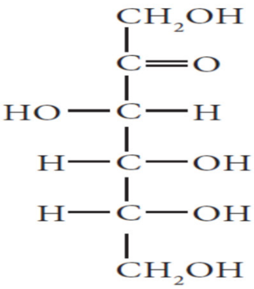
L – sugar

7. Elucidate the structure of glucose.



- Elemental analysis and molecular weight determination show that the molecular formula of glucose is $C_6H_{12}O_6$
- Glucose on reduction with P/HI it gives n-hexane
  It indicate the presence of six carbon atoms are bonded linearly.
- Glucose forms neutral solution with water. It indicate the absence of –COOH group
- Glucose reats with acetic anhydride in the presence of pyridine to give penta acetate.
  It indicate the presence of 5-OH groups.
- Glucose reacts with hydroxylamine to form oxime and with HCN to form cyanohydrin.
  It indicate the presence of carbonyl group.
- Glucose is reduced with Tollens Reagent and Fehlings solution.
  It indicate the presence of an aldehyde (-CHO) group
- Glucose gets oxidized to gluconic acid with bromine water.
  It indicate the – CHO group occupies one end of the carbon chain.
- Glucose gets oxidised to saccharic acid with conc. nitric acid.
  It indicate the other end is occupied by a primary alcohol group.

8. Elucidate the structure of fructose.

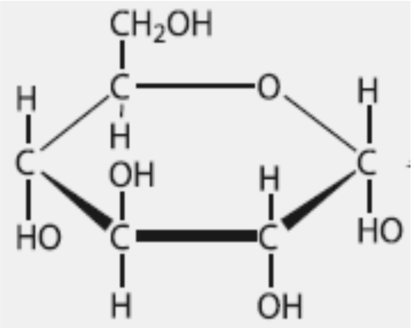
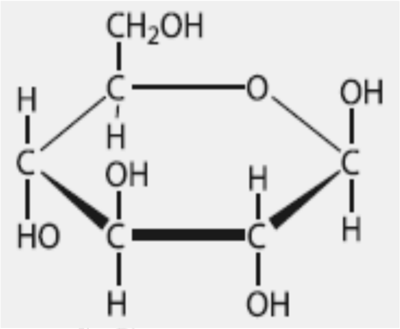


- Elemental analysis and molecular weight determination show that the molecular formula of fructose is $C_6H_{12}O_6$
- Fructose on reduction with P/HI it gives n-hexane
  It indicate the presence of six carbon atoms are bonded linearly.
- Fructose forms neutral solution with water. It indicate the absence of –COOH group
- Fructose reats with acetic anhydride in the presence of pyridine to give penta acetate.
  It indicate the presence of 5-OH groups.
- Fructose reacts with hydroxylamine to form oxime and with HCN to form cyanohydrin.
  It indicate the presence of carbonyl group.
- Fructose is not oxidized by bromine water. It indicate the absence of an aldehyde group.
- Partial reduction of fructose with sodium amalgam and water produces mixtures of sorbitol and mannitol which are epimers at the second carbon.
  It indicate the presence of a keto group.
- On oxidation with nitric acid, it gives glycollic acid and tartaric acids.
  This shows that a keto group is present in C-2.

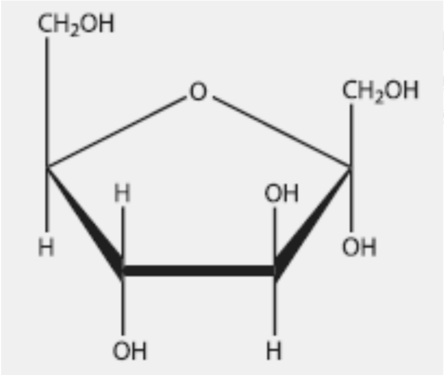
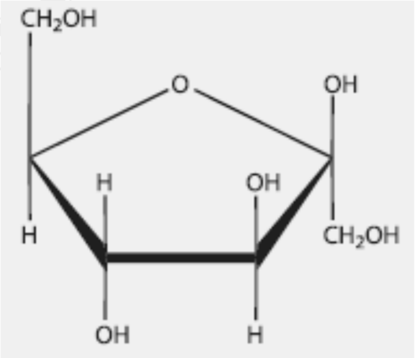
9. Give the difference between glucose and fructose.

	Glucose	Fructose
1	Aldohexose	Ketohexose
2	Dextro rotatory	Levo rotatory
3	It contains aldehyde group	It contains ketone group
4	It is reduced with Tollens Reagent	It does not reduced with Tollens Reagent
5	It is oxidized by bromine water	It does not oxidized by bromine water

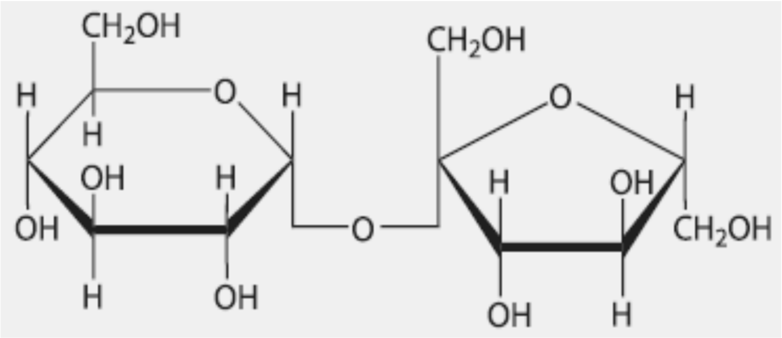
10. Write the structure of α-D(+) glucophyranose and β -D(+) glucophyranose.

α - D(+) glucophyranose	**β - D(+) glucophyranose**
	

11. Write the structure of α-D(+) fructo phyranose and β -D(+)fructo phyranose.

α-D(+) fructo phyranose	**β -D(+)fructo phyranose**
	

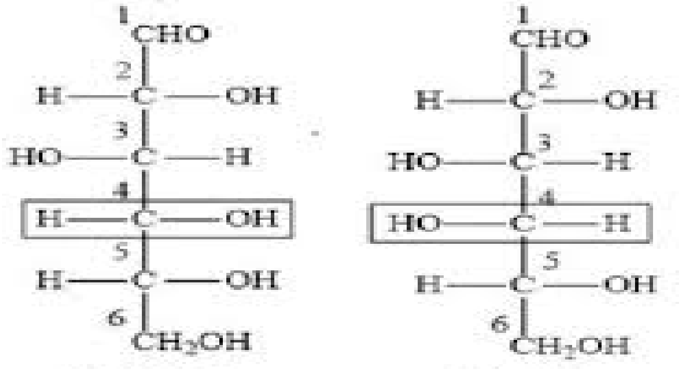
12. Write the structure of Sucrose



SELF CONFIDENCE IS A SUPER POWER.
ONCE YOU START TO BELIEVE IN YOURSELF, MAGIC STARTS HAPPENING

13. What is epimers? What is epimerisation?

- Sugar differing in configuration at an asymmetric centre is known as epimers.
- The process by which one epimer is converted into other is called epimerisation and it requires the enzymes epimerase.
- Galactose is converted to glucose by this manner in our body.
- Glucose and Galactose are epimers at C4 carbon



14. What is anomers?

- ❖ One of the hydroxyl group of glucose reacts with the aldehyde group to form a cyclic structure.
- ❖ This also results in the conversion of the achiral aldehyde carbon into a chiral one leading to the possibility of two isomers.
- ❖ These two isomers differ only in the configuration of C1 carbon. These isomers are called **anomers.**
- ❖ The two anomeric forms of glucose are called α- and β-forms.

15. What is called mutarotation?

- ❖ The specific rotation of pure α- and β-(D) glucose are 112º & 18.7º respectively.
- ❖ However, when a pure form of any one of these sugars is dissolved in water, slow interconversion of α-D glucose and β-D glucose via open chain form occurs until equilibrium is established giving a constant specific rotation + 53º.
- ❖ This phenomenon is called **mutarotation**.

16. What is called invert sugar?

- ❖ Sucrose and glucose are dextrorotatory compounds, while fructose is levo rotatory.
- ❖ During hydrolysis of sucrose the optical rotation of the reaction mixture changes from dextro to levo.
- ❖ Hence, sucrose is also called as invert sugar.

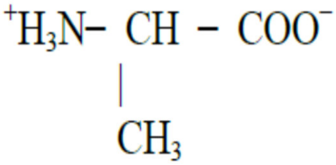
17. What is called isoelectric point.

- ❖ Amino acid have both carboxyl group and amino group their properties differ from regular amines and carboxylic acids.
- ❖ The carboxyl group can lose a proton and become negatively charged or the amino group can accept a proton to become positively charged depending upon the pH of the solution.
- ❖ At a specific pH the net charge of an amino acid is neutral and this pH is called isoelectric point.

18. What is called zwitter ions.

- ❖ In aqueous solution the proton from carboxyl group can be transferred to the amino group of an amino acid leaving these groups with opposite charges.
- ❖ Despite having both positive and negative charges this molecule is neutral and has amphoteric behaviour.
- ❖ These ions are called zwitter ions.

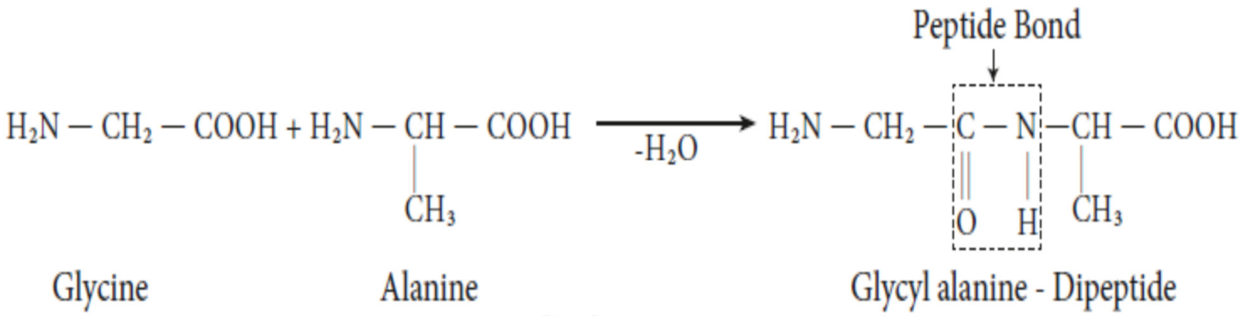
19. Write the Zwitter ion structure of alanine.



$$^{+}H_3N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COO^{-}$$

20. Write a short note on peptide bond. (or) Write the structure of all possible dipeptides which can be obtained form glycine and alanine

The carboxyl group of the first amino acid react with the amino group of the second amino acid to form peptide bond.



21. Give the difference between primary and secondary structure of proteins.

	Primary structure	Secondary structure
1	It is arrangement of amino acids in the polypeptide chain	Amino acids in the polypeptide chain forms hydrogen bond between carbonyl-oxygen and amine-hydrogen.
2	It changes can alter the overall structure and function of a protein.	α-helix and β-strands are two sub structures formed by proteins.

22. How are proteins classified based on their structure? Explain.

Proteins are classified into two major types.

1.Fibrous proteins 2.Globular proteins

<u>1.Fibrous proteins</u>

- Fibrous proteins are linear molecules.
- Insoluble in water
- They are held together by disulphide-hydrogen bonds
- Keratin, Collagen

<u>2.Globular proteins</u>

- Globular proteins are spherical shape.
- Soluble in water
- They have many functions including catalysis
- Insuline, Myoglobin

23. Write a note on formation of α -helix.

- The α -helix sub-structure formed by proteins
- The amino acids are arranged in a right handed helical structure.
- They are stabilised by the hydrogen bond between the carbonyl oxygen of one amino acid with amino hydrogen of the fifth residue.
- The side chains of the residues protrude outside of the helix.
- Each turn contains 3.6 residues and is about 5.4 A°long.

24. Write a note on denaturation of Proteins.

- Each protein has a unique three-dimensional structure formed by interactions such as disulphide bond, hydrogen bond and electrostatic interactions.
- These interactions can be disturbed when the protein is exposed to a higher temperature or alteration of pH.
- It leads to the loss of the three-dimensional structure.
- The process of a losing its higher order structure without losing the primary structure, is called denaturation.
- When a protein denatures, its biological function is also lost.

25. Give the importance of proteins.

- Proteins are used for for transporting and control the movement of molecules.
- Antibodies help the body to fight various diseases.
- Insulin and glucagon control the glucose level in the blood.
- Proteins are used to store metals such as iron.
- Proteins such as keratin, collagen act as structural back bones.

26. Define enzymes.

- Enzymes are biocatalysts that catalyse a specific biochemical reaction
- They accelerate the reaction rate in the orders of 10^5
- They are highly specific.
- Sucrase enzyme catalyses the hydrolysis of sucrose to fructose and glucose.

27. What are the functions of lipids in living organisms.

- Lipids are the integral component of cell membrane.
- They yield more energy than carbohydrates and proteins.
- They act as protective coating in aquatic organisms.
- Lipids of connective tissues give protection to internal organs.
- Lipids act as emulsifier in fat metabolism.

28. How are vitamins classified?

1. Fat soluble Vitamins

- These vitamins absorbed with fatty food
- They are stored in livers.
- They do not dissolve in water.
- Vitamin A, D, E and K.

2. Water soluble Vitamins

- They can't be stored
- Vitamins B (B_1, B_2, B_3, B_5, B_6, B_7, B_9, B_{12}) and Vitamin C

29. Name the Vitamins whose deficiency cause
i) Night blindness ii) Beri-Beri iii) Anaemia iv) Scurvy v) Rickets vi) Blood clotting

Defiiency disease	Vitamins
Night blindness	A
Beri-Beri	B_1
Anaemia	B_{12}
Scurvy	C
Rickets	D
Blood clotting	K

30. What are hormones? Give examples.

- Hormone is an organic substance that is secreted by one tissue.
- It limits the blood stream and induces a physiological response in other tissues.
- It is an intercellular signaling molecule.
- Insulin, androgen, estrogen

31. How are Hormones are classified according to the distance over which they act?

1. Endocrine hormones - Insuline
2. Paracrine hormones - Interleukin-1
3. Autocrine hormones - Interleukin-2

32. What type of linkages hold together monomers of DNA?

Monomers of DNA are linked together by phospho-di-ester bond between 5'OH group of one nucleotide and 3'OH group on another nucleotide.

33. Give the difference between Hormones and Vitamins.

	Hormones	**Vitamins**
1	Secreted by tissues and Endocrine glands	Obtained from diet.
2	It is an intercellular signalling molecule	Act as co enzymes.
3	It induces biological response in other tissues	They are essential for normal growth and maintenance of our health.
4	Insulin, androgen	Vitamins A, B, C, D, E, K

34. What are nucleoside, nucleotide and polynucleotide?

- Sugar + Base ⟶ Nucleoside
- Nucleoside + Phosphoric acid ⟶ Nucleotide
- n- Nucleotide ⟶ Polynucleotide (Nucleic Acid)

35. What are the different types of RNA which are found in cell?

1. Ribosomal RNA (r-RNA)
2. Messenger RNA (m-RNA)
3. Transfer RNA (t-RNA)

36. Give any three difference between DNA and RNA.

	DNA	RNA
1	Deoxyribose sugar	Ribose sugar
2	Double stranded molecules	Single stranded molecules
3	It is longt lived.	It is short lived.
4	It is stable	It is unstable
5	It can replicate itself	It cannot replicate itself
6	Base pair A = T, G ≡ C	Base pair A = U, C ≡ G

37. Write notes on DNA finger printing.

- DNA finger printing method separates the fragments based on their size.
- The extracted DNA is cut at specific points along the strand with restriction of enzymes.
- DNA fragments of varying lengths which were analysed by gel electrophoresis technique.
- The gel containing the DNA fragments is then transferred to a nylon sheet using a technique called blotting.
- Then, the fragments will undergo auto radiography in which they were exposed to DNA probes.
- A piece of X-ray film was then exposed to the fragments, and a dark mark was produced at any point where a radioactive probe had become attached.
- The resultant pattern of marks could then be compared with other samples.

15. CHEMISTRY IN EVERDAY LIFE

1. What are drugs? How are they classified?

- A drug is substance that is used to modify physiological systems or pathological states for benefit of the recipient.
- It is used for the purpose of diagnosis, prevention cure or relief of a disease.

Classification of drugs:

i. The chemical structure
ii. Pharmacological effect
iii. Target system (drug action)
iv. Site of action (molecular target)

2. How the tranquilizers work in body?

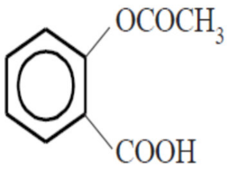
- They are neurologically active drugs.
- They acts on the central nervous system by blocking the neuro transmitter dopamine in the brain.
- The treatment of stress, sleep disorders and severe mental diseases.
- Major tranquilizers - Haloperidol, clozapine
- Minor tranquilizers - Valium, alprazolam

3. Name one substance which can act as both analgesic and antipyretic

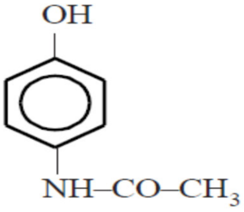
- Aspirin
- Paracetamol

4. Write the structural formula of Aspirin and Paracetamol

Aspirin
(Acetylsalicylic acid)



Paracetamol
(Acetaminophen)



5. What are narcotic and non - narcotic drugs. Give examples.

Narcotic drugs (Opioids)

- Relive pain and produce sleep.
- Used for either short term or long-term relief of severe pain
- Morphine, codeine

Non - narcotic drugs (Analgesics)

- Reduce pain without causing impairment of consciousness.
- Used for short-term pain relief like headache, muscle strain, etc..
- Aspirin, Paracetamol..

நீங்கள் மகத்தான பணியைச் செய்ய பிறந்தவர்கள் என்பதில் நம்பிக்கை வையுங்கள்…

6. What are antacids? Give examples?

- Antacids are neutralize the acid in the stomach that causes acidity.
- Ranitidine, Omeprazole, Milk of Magnesia

7. What are antibiotics (or) Antimicrobials ?

- Inhibits bacterial cell wall biosynthesis
- To treat skin, dental, ear infections, urinary tract infections, pneumonia
- Penicillins, Ampicillin

8. What are Antihistamines?

- To provide relief from the allergic effects
- Cetirizine, levocetirizine

9. How do antiseptics differ from disinfectants?

Antiseptics	Disinfectants
Stop the growth of microorganisms	Stop the growth of microorganisms
Applied to living tissue	Applied to inanimate objects
Eg. H_2O_2, Povidone-iodine	Eg. H_2O_2, alcohol

10. What are anti fertility drugs? Give examples.

- Antifertility drugs are synthetic hormones that suppresses fertilisation.
- It is used in birth control pills.
- Synthetic oestrogen - Menstranol
- Synthetic progesterone - Norethynodrel

11. What are food additives?

- The substances are added to improve the quality of food are called food additives
- They also increase the shelf life of food
- Aroma compounds, Food colours, Vitamins and minerals

12. What are the advantages of food additives?

- Flavouring agents enhance the aroma of the food
- Vitamins and minerals reduces the mall nutrient
- Preservatives reduce the product spoilage and extend the shelf-life of food

13. What are food preservatives?

- Preservatives are capable of inhibiting or arresting the process of fermentation or other decomposition of food by growth of microorganisms
- Aceticacid - preparation of pickles
- Sodium metabisulphite - preservatives for fresh vegetables and fruits.

14. Write short notes on Antioxidant with example.

- Antioxidants are substances which retard the oxidative deteriorations of food
- BHT (Butyl hydroxy toluene)
  BHA (Butyl hydroxy anisole)

15. What are sugar substituents?

- Sugar substituents are used like sugars for sweetening.
- They are metabolised without the influence of insulin.
- Eg. Sorbitol, Mannitol.

16. What are artificial sweetening agents?

- Synthetic compounds which imprint a sweet sensation and possess no nutritional value
- Saccharin, Sucralose

17. Which sweetening agent are used to prepare sweets for a diabetic patient?

Saccharin, Sucralose, Alitame, Aspartame

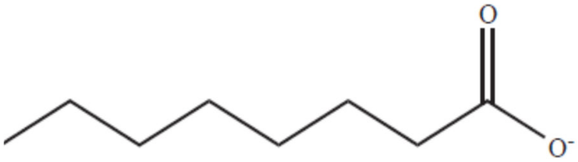
18. Write a note on synthetic detergents.

Synthetic detergents containing sodium salts of alkyl hydrogen sulphates.

There are three types of detergents.

1. Anionic detergent - Sodium Lauryl sulphate (SLS)
2. Cationic detergent - n-hexa decyl trimethyl ammonium chloride
3. Non-ionic detergent – Penta erythrityl stearate

19. Explain the mechanism of cleansing action of soaps and detergents



- The cleansing action of soap is directly related to the structure of palmitate ion
- The structure of palmitate exhibit dual polarity
  1. Polar - Carboxyl portion (hydrophilic). It is soluble in water.
  2. Non polar - Hydrocarbon portion (hydrophobic). It is soluble in oils and greases
- When the soap is added to an grease part of the cloth. The hydrocarbon part dissolve in the grease, leaving the carboxylate end exposed on the grease surface.
- At the same time the carboxylate groups are strongly attracted by water, thus leading to the formation of small droplets called micelles
- When the water is rinsed away the grease goes with it.
- As a result, the cloth gets free from dirt and the droplets are washed away with water.

20. Write a note on vulcanization of rubber

- Natural rubber is mixed with 3-5% sulphur and heated at 100-150˚C causes cross linking of the cis-1,4-polyisoprene chains through disulphide (-S-S-) bonds.
- The properties of natural rubber can be modified by the process called vulcanization.
- 1 to 3% sulphur rubber is soft and stretchy
- 3 to 10% sulphur rubber is harder but flexible.

21. Write a note on co –polymer.

A polymer containing two or more different kinds of monomer units is called a co-polymer

Buna –S, Buna –N

22. What are Condensation polymers? Give examples.

Condensation polymers are formed by the reaction between functional groups an adjacent monomers with the elimination of simple molecules like H_2O, NH_3 etc….

Eg. Nylon-6,6, Terylene, Bakelite

23. What are bio degradable polymers? Give examples.

- Bio degradable polymers are readily decomposed by microorganisms in the environment
- These polymers are used in medical field such as surgical sutures, plasma substitute.
- Eg. Polylactic acid (PLA), Polyglycolic acid (PGA), PHB

24. Classify the following as linear, branched or cross linked polymers

Linear polymers	Cross linked polymers	Branched polymers
LDPE **HDPE** Teflon Orlon (PAN)	**Nylon-6,6** **Bakelite** Terylene Melamine	Buna - N Buna - S Neoprene

25. Give the differene between thermoplastic and thermosetting plastic

	Thermoplastic	Thermosetting plastic
1	Linear polymers	Cross linked polymers
2	They become soft on heating	Do not become soft on heating
3	They can be remolded	They can not be remoulded
4	PVC, Polyethene	E.g. Bakelite, Formaldehyde

26. LDPE - Low Density polyethylene

$$n\,CH_2 = CH_2 \xrightarrow[1000\ atm]{200^{\circ} - 300^{\circ}C} -\!\!(CH_2-CH_2)\!\!-_n$$

Uses - making toys, insulation for cables

27. HDPE – High Density Polyethylene

$$\text{Ethene} \xrightarrow[273K\ /\ 6\text{-}7atm]{\text{Zeiglar – Natta catalyst}} \text{HDPE}$$

Uses - making bottles, pipes

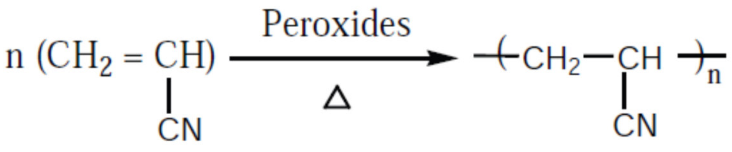
28. Preparation of Teflon (PTFE)

$$\text{Tetrafluroethylene} \xrightarrow{O_2\ /\ \Delta} \text{Teflon}$$

$$n\,CF_2=CF_2 \xrightarrow{\Delta} -\!\!(CF_2-CF_2)\!\!-_n$$

Uses - coating articles and making non - stick utensils.

29. Preparation of Orlon (polyacrylonitrile – PAN)

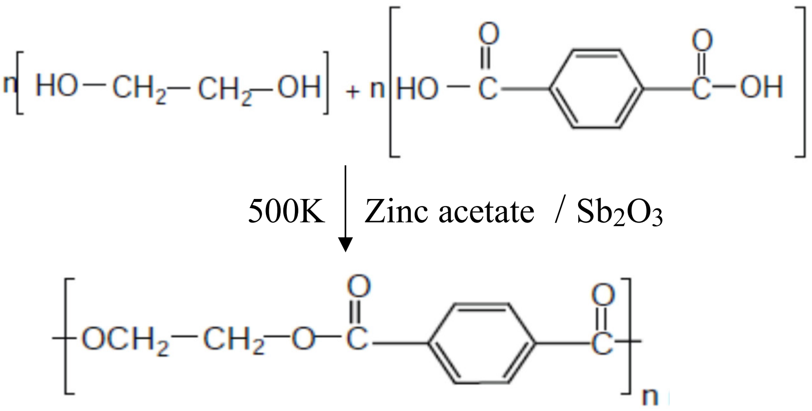


$$n\,(\underset{\displaystyle CN}{CH_2 = \underset{|}{CH}}) \xrightarrow[\Delta]{\text{Peroxides}} -\!\!(CH_2-\underset{\displaystyle CN}{\underset{|}{CH}})\!\!-_n$$

Uses - making blankets, sweaters

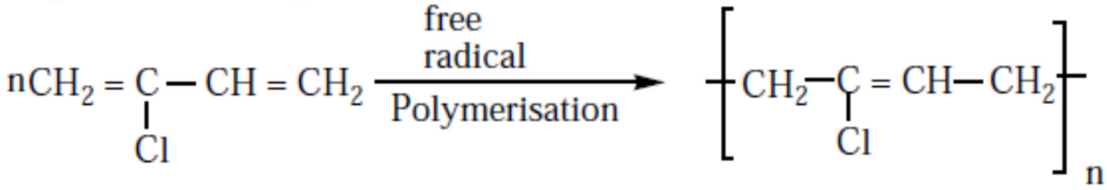
30. Preparation of Terylene (Dacron)

Ethylene glycol + Terepathalic acid $\xrightarrow{\text{500K / zinc acetate / } Sb_2O_3}$ Terylene



Uses - Blending with wool fibres and as glass reinforcing materials in helmets.

31. Preparation of Neoprene

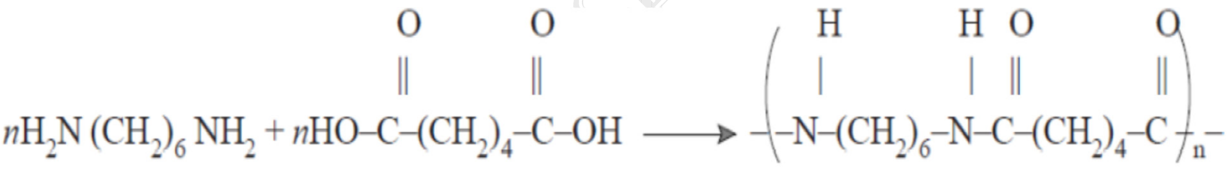


$$nCH_2=\underset{\underset{Cl}{|}}{C}-CH=CH_2 \xrightarrow[\text{Polymerisation}]{\text{free radical}} \left[CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2 \right]_n$$

Uses: It is used in the manufacture of chemical containers, conveyer belts..

32. Preparation of Nylon 6,6

Hexamethylene diamine + Adipic acid ⟶ Nylon 6,6

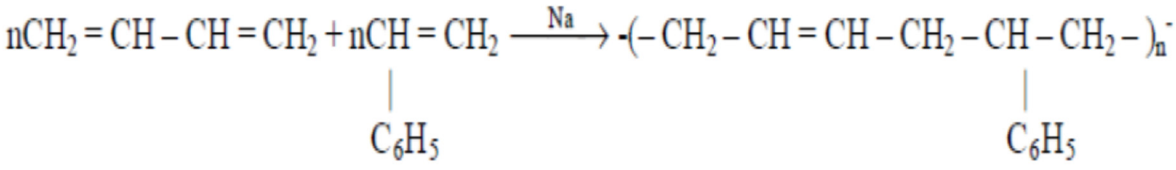


$$nH_2N(CH_2)_6NH_2 + nHO-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}-OH \longrightarrow \left(-\overset{\overset{H}{|}}{N}-(CH_2)_6-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}- \right)_n$$

Uses - textiles, making cards

33. Preparation of Buna - S

1,3-butadiene + Styrene ⟶ Buna - S
(Vinyl benzene)

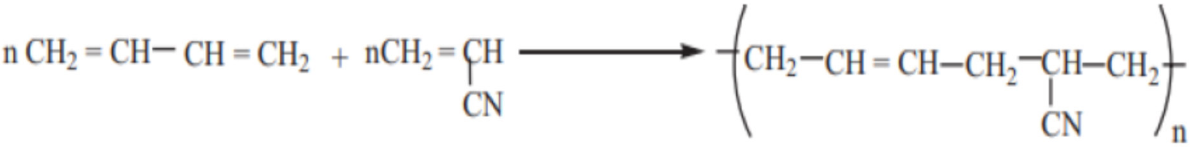


$$nCH_2=CH-CH=CH_2+n\underset{\underset{C_6H_5}{|}}{CH}=CH_2 \xrightarrow{Na} (-CH_2-CH=CH-CH_2-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-)_n$$

Uses - making tyres and belts.

34. Preparation of Buna-N

1,3-butadiene + Vinyl cyanide ⟶ Buna-N
(acrylonitrile)



$$n\,CH_2=CH-CH=CH_2 + nCH_2=\underset{\underset{CN}{|}}{CH} \longrightarrow \left(CH_2-CH=CH-CH_2-\underset{\underset{CN}{|}}{CH}-CH_2 \right)_n$$

Uses - making hoses and tanklinings.


நமது பிறப்பு ஒரு சம்பவமாக
இருக்கலாம்
ஆனால், இறப்பு ஒரு சரித்திரமாக
இருக்க வேண்டும்...

+2 CHEMISTRY BOOK BACK ONE MARK QUESTIONS

1.METALLURGY

1. Bauxite has the composition

   a) Al_2O_3 b) $Al_2O_3.nH_2O$ c) $Fe_2O_3.2H_2O$ d) none of these

2. Roasting of sulphide ore gives the gas (A).(A) is a colourless gas. Aqueous solution of (A) is acidic. The gas (A) is

   a)CO_2 b) SO_3 c) SO_2 d) H_2S

3. Which one of the following reaction represents calcinations?

   a) $2Zn + O_2 \rightarrow 2ZnO$ b) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

   c) $MgCO_3 \rightarrow MgO + CO_2$ a) (a) and (c)

4. The metal oxide which cannot be reduced to metal by carbon is

   a) PbO b) Al_2O_3 c) ZnO d) FeO

5. Which of the metal is extracted by Hall-Heroult process?

   a) Al b) Ni c) Cu d) Zn

6. Which of the following statements, about the advantage of roasting of sulphide ore before reduction is not true?

   a) ΔG_f^0 of sulphide is greater than those for CS_2 and H_2S

   b) ΔG_r^0 is negative for roasting of sulphide ore to oxide

   c) Roasting of the sulphide to its oxide is thermodynamically feasible.

   d) Carbon and hydrogen are suitable reducing agents for metal sulphides

7. Match items in column -I with the items of column II and assign the correct code.

Column-I		Column-II	
A	Cyanide process	(i)	Ultrapure Ge
B	Froth floatation process	(ii)	Dressing of ZnS
C	Electrolytic reduction	(iii)	Extraction of Al
D	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

	A	B	C	D
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iii)	(iv)	(v)	(i)
(c)	(iv)	(ii)	(iii)	(i)
(d)	(ii)	(iii)	(i)	(v)

8. Wolframite ore is separated from tinstone by the process of

   a) Smelting b) Calcination c) Roasting d) Electromagnetic separation

9. Which one of the following is not feasible.

   a) $Zn(s)+Cu^{2+}(aq) \rightarrow Cu(s)+Zn^{2+}(aq)$ b) $Cu(s)+Zn^{2+}(aq) \rightarrow Zn(s)+Cu^{2+}(aq)$

   c) $Cu(s)+2Ag^{+}(aq) \rightarrow 2Ag(s)+Cu^{2+}(aq)$ d) $Fe(s)+Cu^{2+}(aq) \rightarrow Cu(s)+Fe^{2+}(aq)$

10. Electrochemical process is used to extract

    a) Iron b) Lead c) Sodium d) silver

11. Flux is a substance which is used to convert

    a) Mineral into silicate b) Infusible impurities to soluble impurities

c) Soluble impurities to infusible impurities d) All of these

12. Which one of the following ores is best concentrated by froth – floatation method?
a) Magnetite b) Haematite c) Galena d) Cassiterite

13. In the extraction of aluminium from alumina by electrolysis, cryolite is added to
a) Lower the melting point of alumina b) Remove impurities from alumina
c) Decrease the electrical conductivity d) Increase the rate of reduction

14. Zinc is obtained from ZnO by
a) Carbon reduction b) Reduction using silver
c) Electrochemical process d) Acid leaching

15. Extraction of gold and silver involves leaching with cyanide ion. silver is later recovered by (NEET-2017)
a) Distillation b) Zone refining
c) Displacement with zinc d) liquation

16. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
a) Fe b) Cu c) Mg d) Zn

17. The following set of reactions are used in refining

$Zr(\text{impure}) + 2I_2 \xrightarrow{523\ K} ZrI_4$: $ZrI_4 \xrightarrow{1800\ K} Zr\ (\text{pure}) + 2I_2$

a) Liquation b) van Arkel process c) Zone refining d) Mond's process

18. Which of the following is used for concentrating ore in metallurgy?
a) Leaching b) Roasting c) Froth floatation d) Both (a) and (c)

19. The incorrect statement among the following is
a) Nickel is refined by Mond's process b) Titanium is refined by Van Arkel's process
c) Zinc blende is concentrated by froth floatation
d) In the metallurgy of gold, the metal is leached with dilute sodium chloride solution

20. In the electrolytic refining of copper, which one of the following is used as anode?
a) Pure copper b) Impure copper c) Carbon rod d) Platinum electrode

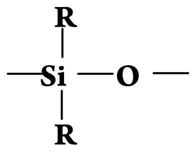
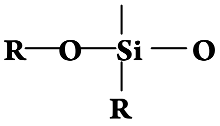
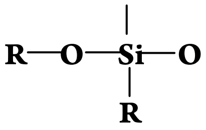
21. Which of the following plot gives Ellingham diagram
a) ΔS Vs T b) ΔG^0 Vs T c) ΔG^0 Vs 1/T d) ΔG^0 Vs T^2

22. In the Ellingham diagram, for the formation of carbon monoxide
a) $(\Delta S^0/\Delta T)$ is negative b) $(\Delta G^0/\Delta T)$ is positive
c) $(\Delta G^0/\Delta T)$ is negative
d) initially $(\Delta G^0/\Delta T)$ is positive, after 700^0C $(\Delta G^0/\Delta T)$is negative

23. Which of the following reduction is not thermodynamically feasible?
a) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$ b) $Al_2O_3 + 2Cr \rightarrow Cr_2O_3 + 2Al$
c) $3TiO_2 + 4Al \rightarrow 2Al_2O_3 + 3Ti$ d) none of these

24. Which of the following is not true with respect to Ellingham diagram?
a) Free energy changes follow a straight line. Deviation occurs when there is a phase change.
b) The graph for the formation of CO2 is a straight line almost parallel to free energy axis..
c) Negative slope of CO shows that it becomes more stable with increase in temperature.
d) Positive slope of metal oxides shows that their stabilities decrease with increase in temperature.

2. p – BLOCK ELEMENTS - I

1. An aqueous solution of borax is
   a) neutral b) acidic c) basic d) amphoteric
2. Boric acid is an acid because its molecule (NEET)
   a) contains replaceable H^+ ion b) gives up a proton
   c) combines with proton to form water molecule
   d) accepts OH^- from water, releasing proton.
3. Which among the following is not a borane?
   a) B_2H_6 b) B_3H_6 c) B_4H_{10} d) none of these
4. Which of the following metals has the largest abundance in the earth's crust?
   a) Aluminium b) calcium c) Magnesium d) sodium
5. In diborane, the number of electrons that accounts for banana bonds is
   a) six b) two c) four d) three
6. The element that does not show catenation among the following p-block elements is
   a) Carbon b) silicon c) Lead d) germanium
7. Carbon atoms in fullerene with formula C_{60}have
   a) Sp^3 hybridised b) Sp hybridised
   c) Sp^2 hybridised d) partially SP^2 and partially Sp^3 hybridised
8. Oxidation state of carbon in its hydrides
   a) +4 b) -4 c) +3 d) +2
9. The basic structural unit of silicates is (NEET)
   a) $(SiO_3)^{2-}$ b) $(SiO_4)^{2-}$ c) $(SiO)^-$ d) $(SiO_4)^{4-}$
10. The repeating unit in silicone is
    a) SiO_2 b) 
    $-\underset{R}{\overset{R}{Si}}-O-$
    c) 
    $R-O-\underset{R}{\overset{|}{Si}}-O$
    d) 
    $R-O-\underset{R}{\overset{|}{Si}}-O$
11. Which of these is not a monomer for a high molecular mass silicone polymer?
    a) Me_3SiCl b) $PhSiCl_3$ c) $MeSiCl_3$ d) Me_2SiCl_2
12. Which of the following is not sp^2 hybridised?
    a) Graphite b) graphene c) Fullerene d) dry ice
13. The geometry at which carbon atom in diamond are bonded to each other is
    a) Tetrahedral b) hexagonal c) Octahedral d) none of these
14. Which of the following statements is not correct?
    a) Beryl is a cyclic silicate b) $MgSiO_4$ is an orthosilicate
    c) $[SiO_4]^{4-}$is the basic structural unit of silicates d) Feldspar is not aluminosilicate

15. Match items in column - I with the items of column – II and assign the correct code.

Column-I		Column-II	
A	Borazole	1	$B(OH)_3$
B	Boric acid	2	$B_3N_3H_6$
C	Quartz	3	$Na_2[B_4O_5(OH)_4]8H_2O$
D	Borax	4	SiO_2

	A	B	C	D
(a)	2	1	4	3
(b)	1	2	4	3
(c)	1	2	4	3
(d)	none of these			

16. Duralumin is an alloy of

a) Cu,Mn b) Cu,Al,Mg c) Al,Mn d) Al,Cu,Mn,Mg

17. The compound that is used in nuclear reactors as protective shields and control rods is

a) Metal borides b) metal oxides c) Metal carbonates d) metal carbide

18. The stability of +1 oxidation state increases in the sequence

a) Al <Ga<In<Tl b) Tl<In<Ga<Al c) In<Tl<Ga<Al d) Ga<In<Al<Tl

3.p – BLOCK ELEMENTS-II

1. In which of the following, NH_3 is not used?

a) Nessler's reagent

b) Reagent for the analysis of IV group basic radical

c) Reagent for the analysis of III group basic radical d) Tollen's reagent

2. Which is true regarding nitrogen?

a) least electronegative element b) has low ionisation enthalpy than oxygen

b) c) d- orbitals available d) ability to form Pπ- Pπ bonds with itself

3. An element belongs to group 15 and 3 rd period of the periodic table, its electronic configuration would be

a) $1s^22s^22p^4$ b) $1s^22s^22p^3$ c) $1s^22s^22p^63s^23p^2$ d) $1s^22s^22p^63s^23p^3$

4. Solid (A) reacts with strong aqueous NaOH liberating a foul smelling gas(B) which spontaneously burn in air giving smoky rings. A and B are respectively a) P4 (red) and PH3 b) P4 (white) and PH3 c) S8 and H2 S d) P4 (white) and H2 S

a) P_4(red) and PH_3 b) P_4(white) and PH_3

c) S_8 and H_2S d) P_4(white) and H_2S

5. On hydrolysis, PCl_3gives

a) H_3PO_3 b) PH_3 c) H_3PO_4 d) $POCl_3$

6. P_4O_6 reacts with cold water to give

a) H_3PO_3 b) $H_4P_2O_7$ c) HPO_3 d) H_3PO_4

7. The basicity of pyrophosphorous acid ($H_4P_2O_5$)is

a) 4 b) 2 c) 3 d) 5

8. The molarity of given orthophosphoric acid solution is 2M. its normality is

a) 6N b) 4N c) 2N d) none of these

9. Assertion : bond dissociation energy of fluorine is greater than chlorine gas

   Reason : chlorine has more electronic repulsion than fluorine

   a) Both assertion and reason are true and reason is the correct explanation of assertion.

   b) Both assertion and reason are true but reason is not the correct explanation of assertion.
   c) Assertion is true but reason is false.
   d) Both assertion and reason are false.
10. Among the following, which is the strongest oxidizing agent?
   a) Cl_2 b) F_2 c) Br_2 d) I_2
11. The correct order of the thermal stability of hydrogen halide is
   a) HI > HBr > HCl > HF b) HF > HCl > HBr > HI
   c) HCl> HF > HBr > HI d) HI > HCl > HF > HBr
12. Which one of the following compounds is not formed?
   a) $XeOF_4$ b) XeO_3 c) XeF_2 d) NeF_2
13. Most easily liquefiable gas is
   a) Ar b) Ne c) He d) Kr
14. XeF_6 on complete hydrolysis produces
   a) $XeOF_4$ b) XeO_2F_2 c) XeO_3 d) XeO_2
15. Which of the following is strongest acid among all?
   a) HI b) HF c) HBr d) HCl
16. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules? (NEET)
   a) $Br_2>I_2>F_2>Cl_2$ b) $F_2>Cl_2>Br_2>I_2$ c) $I_2>Br_2>Cl_2>F_2$ d) $Cl_2>Br_2>F_2>I_2$
17. Among the following the correct order of acidity is (NEET)
   a) $HClO_2<HClO<HClO_3<HClO_4$ b) $HClO_4<HClO_2<HClO<HClO_3$
   c) $HClO_3<HClO_4<HClO_2<HClO$ d) $HClO<HClO_2<HClO_3<HClO_4$
18. When copper is heated with conc HNO_3 it produces
   a) $Cu(NO_3)_2$, NO and NO_2 b) $Cu(NO_3)_2$ and N_2O
   c) $Cu(NO_3)_2$ and NO_2 d) $Cu(NO_3)_2$ and NO

4. TRANSITION AND INNER TRANSITION ELEMENTS

1. Sc (Z=21) is a transition element but Zinc (Z=30) is not because
   a) both Sc3+ and Zn2+ ions are colourless and form white compounds.
   b) in case of Sc, 3d orbital are partially filled but in Zn these are completely filled
   c) last electron as assumed to be added to 4s level in case of zinc
   d) both Sc and Zn do not exhibit variable oxidation states
2. Which of the following d block element has half filled penultimate d sub shell as well as half filled valence sub shell?
   a) Cr b) Pd c) Pt d) none of these
3. Among the transition metals of 3d series, the one that has highest negative (M^{2+}/ M) standard electrode potential is
   a) Ti b) Cu c) Mn d) Zn

4. Which one of the following ions has the same number of unpaired electrons as present in V^{3+}?

a) Ti^{3+} b) Fe^{3+} c) Ni^{2+} d) Cr^{3+}

5. The magnetic moment of Mn^{2+} ion is

a) 5.92 BM b) 2.80 BM c) 8.95 BM d) 3.90 BM

6. The catalytic behaviour of transition metals and their compounds is ascribed mainly due to

a) their magnetic behaviour b) their unfilled d orbitals

c) their ability to adopt variable oxidation states

d) their chemical reactivity

7. The correct order of increasing oxidizing power in the series

a) $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$ b) $Cr_2O_7^{2-} < VO_2^{+} < MnO_4^{-}$

c) $Cr_2O_7^{2-} < MnO_4^{-} < VO_2^{+}$ d) $MnO_4^{-} < Cr_2O_7^{2-} < VO_2^{+}$

8. In acid medium, potassium permanganate oxidizes oxalic acid to

a) oxalate b) Carbon dioxide c) acetate d) acetic acid

9. Which of the following statements is not true?

a) on passing H_2S, through acidified $K_2Cr_2O_7$ solution, a milky colour is observed.

b) $Na_2Cr_2O_7$ is preferred over $K_2Cr_2O_7$ in volumetric analysis

c) $K_2Cr_2O_7$ solution in acidic medium is orange in colour

d) $K_2Cr_2O_7$ solution becomes yellow on increasing the pH beyond 7

10. Permanganate ion changes to ________ in acidic medium

a) MnO_4^{2-} b) Mn^{2+} c) Mn^{3+} d) MnO_2

11. How many moles of I_2 are liberated when 1 mole of potassium dichromate react with potassium iodide?

a) 1 b) 2 c) 3 d) 4

12. The number of moles of acidified $KMnO_4$ required to oxidize 1 mole of ferrous oxalate(FeC_2O_4) is

a) 5 b) 3 c) 0.6 d) 1.5

13. Which one of the following statements related to lanthanons is incorrect?

a) Europium shows +2 oxidation state.

b) The basicity decreases as the ionic radius decreases from Pr to Lu.

c) All the lanthanons are much more reactive than aluminium.

d) Ce^{4+} solutions are widely used as oxidising agents in volumetric analysis.

14. Which of the following lanthanoid ions is diamagnetic?

a) Eu^{2+} b) Yb^{2+} c) Ce^{2+} d) Sm^{2+}

15. Which of the following oxidation states is most common among the lanthanoids?

a) 4 b) 2 c) 5 d) 3

16. Assertion : Ce^{4+} is used as an oxidizing agent in volumetric analysis.

Reason : Ce^{4+} has the tendency of attaining +3 oxidation state.

a) Both assertion and reason are true and reason is the correct explanation of assertion.

b) Both assertion and reason are true but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false. d) Both assertion and reason are false.

17. The most common oxidation state of actinoids is
a) +2 b) +3 c) +4 d) +6

18. The actinoid elements which show the highest oxidation state of +7 are
a) Np,Pu,Am b) U,Fm,Th c) U,Th,Md d) Es,No,Lr

19. Which one of the following is not correct?
a) $La(OH)_3$ is less basic than $Lu(OH)_3$
b) In lanthanoid series ionic radius of Ln^{3+} ions decreases
c) La is actually an element of transition metal series rather than lanthanide series
d) Atomic radii of Zr and Hf are same because of lanthanide contraction

5.COORDINATION CHEMISTRY

1. The sum of primary valence and secondary valence of the metal M in the complex $[M(en)_2(Ox)]Cl$ is
a) 3 b) 6 c) -3 d) 9

2. An excess of silver nitrate is added to 100ml of a 0.01 M solution of pentaaquachloridochromium(III) chloride. The number of moles of AgCl precipitated would be
a) 0.02 b) 0.002 c) 0.01 d) 0.2

3. A complex has a molecular formula $MSO_4Cl.6H_2O$.The aqueous solution of it gives white precipitate with Barium chloride solution and no precipitate is obtained when it is treated with silver nitrate solution. If the secondary valence of the metal is six, which one of the following correctly represents the complex?
a) $[M(H_2O)_4Cl]SO_4.2H_2O$ b) $[M(H_2O)_6]SO_4$
c) $[M(H_2O)_5Cl]SO_4.H_2O$ d) $[M(H_2O)_3Cl]SO_4.3H_2O$

4. Oxidation state of Iron and the charge on the ligand NO in $[Fe(H_2O)_5NO]SO_4$ are
a) +2 and 0 respectively b) +3 and 0 respectively
c) +3 and -1 respectively d) +1 and -1 respectively

5. As per IUPAC guidelines, the name of the complex $[Co(en)_2(ONO)Cl]Cl$ is
a) chlorobisethylenediaminenitritocobalt(III) chloride
b) chloridobis(ethane-1,2-diamine)nitro -κ–O cobaltate (III) chloride
c) chloridobis(ethane-1,2-diammine)nitrito -κ–O cobalt(II)) chloride
d) chloridobis(ethane-1,2-diammine)nitrito-κ–O cobalt(III) chloride

6. IUPAC name of the complex $K_3[Al(C_2O_4)_3]$ is
a) potassiumtrioxalatoaluminium(III) b) potassiumtrioxalatoaluminate(II)
c) potassiumtrisoxalatoaluminate(III) d) potassiumtrioxalatoaluminate(III)

7. A magnetic moment of 1.73 BM will be shown by one among the following (NEET)
a) $TiCl_4$ b) $[CoCl_6]^{4-}$ c) $[Cu(NH_3)_4]^{2+}$ d) $[Ni(CN)_4]^{2-}$

8. Crystal field stabilization energy for high spin d^5 octahedral complex is
a) $- 0.6\ \Delta_0$ b) 0 c) $2(P- \Delta_0)$ d) $2(P+\Delta_0)$

9. In which of the following coordination entities the magnitude of Δ_0 will be maximum?
a) $[Co(CN)_6]^{3-}$ b) $[Co(C_2O_4)_3]^{3-}$ c) $[Co(H_2O)_6]^{3+}$ d) $[Co(NH_3)_6]^{3+}$

10. Which one of the following will give a pair of enantiomorphs?
a) $[Cr(NH_3)_6][Co(CN)_6]$ b) $[Co(en)_2Cl_2]Cl$

c) $[Pt(NH_3)_4][PtCl_4]$ d) $[Co(NH_3)_4Cl_2]NO_2$

11. Which type of isomerism is exhibited by $[Pt(NH_3)_2Cl_2]$?

a) Coordination isomerism b) Linkage isomerism

c) Optical isomerism d) Geometrical isomerism

12. How many geometrical isomers are possible for $[Pt(Py)(NH_3)(Br)(Cl)]$?

a) 3 b) 4 c) 0 d) 15

13. Which one of the following pairs represents linkage isomers?

a) $[Cu(NH_3)_4][PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$

b) $[Co(NH_3)_5(NO_3)]SO_4$ and $[Co(NH_3)_5(ONO)]$

c) $[Co(NH_3)_4(NCS)_2]Cl$ and $[Co(NH_3)_4(SCN)_2]Cl$

d) both (b) and (c)

14. Which kind of isomerism is possible for a complex $[Co(NH_3)_4Br_2]Cl$?

a) geometrical and ionization b) geometrical and optical

c) optical and ionization d) geometrical only

15. Which one of the following complexes is not expected to exhibit isomerism?

a) $[Ni(NH_3)_4(H_2O)_2]^{2+}$ b) $[Pt(NH_3)_2Cl_2]$

c) $[Co(NH_3)_5SO_4]Cl$ d) $[FeCl_6]^{3-}$

16. A complex in which the oxidation number of the metal is zero is

a) $K_4[Fe(CN)_6]$ b) $[Fe(CN)_3(NH_3)_3]$

c) $[Fe(CO)_5]$ d) both (b) and (c)

17. Formula of tris(ethane-1,2-diamine)iron II phosphate

a) $[Fe(CH_3\text{-}CH(NH_2)_2)_3](PO_4)_3$ b) $[Fe(H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2)_3](PO_4)$

c) $[Fe(H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2)_3](PO_4)_2$ d) $[Fe(H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2)_3]_3(PO_4)_2$

18. Which of the following is paramagnetic in nature?

a) $[Zn(NH_3)_4]^{2+}$ b) $[Co(NH_3)_6]^{3+}$ c) $[Ni(H_2O)_6]^{2+}$ d) $[Ni(CN)_4]^{2-}$

19. Fac-mer isomerism is shown by

a) $[Co(en)_3]^{3+}$ b) $[Co(NH_3)_4(Cl)_2]^{+}$ c) $[Co(NH_3)_3(Cl)_3]$ d) $[Co(NH_3)_5Cl]SO_4$

20. Choose the correct statement.

a) Square planar complexes are more stable than octahedral complexes

b) The spin only magnetic moment of $[Cu(Cl)_4]^{2-}$ is 1.732 BM and it has square planar structure.

c) Crystal field splitting energy (Δ_0) of $[FeF_6]^{4-}$ is higher than the (Δ_0) of $[Fe(CN)_6]^{4-}$

d) crystal field stabilization energy of $[V(H_2O)_6]^{2+}$ is higher than the crystal field stabilization of $[Ti(H_2O)_6]^{2+}$

6. SOLID STATE

1. Graphite and diamond are

a) Covalent and molecular crystals b) ionic and covalent crystals

c) both covalent crystals d) both molecular crystals

2. An ionic compound A_xB_y crystallizes in fcc type crystal structure with B ions at the centre of each face and A ion occupying corners of the cube. the correct formula of A_xB_y is

a) AB b) AB_3 c) A_3B d) A_8B_6

3. The ratio of close packed atoms to tetrahedral hole in cubic packing is

a) 1:1 b) 1:2 c) 2:1 d) 1:4

4. Solid CO_2 is an example of

a) Covalent solid b) metallic solid c) molecular solid d) ionic solid

5. Assertion : monoclinic sulphur is an example of monoclinic crystal system

Reason: for a monoclinic system, $a \neq b \neq c$ and $\alpha = Y = 90^0$ $\beta \neq 90^0$

a) Both assertion and reason are true and reason is the correct explanation of assertion.

b) Both assertion and reason are true but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false.

d) Both assertion and reason are false.

6. In calcium fluoride, having the flurite structure the coordination number of Ca^{2+}ion and F^- Ion are (NEET)

a) 4 and 2 b) 6 and 6 c) 8 and 4 d) 4 and 8

7. The number of unit cells in 8 gm of an element X (atomic mass 40) which crystallizes in bcc pattern is (NA is the Avogadro number)

a) $6.023 x 10^{23}$ b) $6.023 x 10^{22}$ c) $60.23 x 10^{23}$ d) $[6.023 x 10^{23}/8 x 40]$

8. In a solid atom M occupies ccp lattice and (⅓) of tetrahedral voids are occupied by atom N. find the formula of solid formed by M and N.

a) MN b) M_3N c) MN_3 d) M_3N_2

9. The ionic radii of A^+ and $B^-$are $0.98 X 10^{-10}$m and $1.81 X 10^{-10}$m . the coordination number of each ion in AB is

a) 8 b) 2 c) 6 d) 4

10. CsCl has bcc arrangement, its unit cell edge length is 400pm, its inter atomic distance is

a) 400pm b) 800pm c) $\sqrt{3}$ x 100 pm d) $\left(\frac{\sqrt{3}}{2}\right)$ x 400pm

11. A solid compound XY has NaCl structure. if the radius of the cation is 100pm , the radius of the anion will be

a) $\left(\frac{100}{0.414}\right)$ b) $\left(\frac{0.732}{100}\right)$ c) 100 x 0.414 d) $\left(\frac{0.414}{100}\right)$

12. The vacant space in bcc lattice unit cell is

a) 48% b) 23% c) 32% d) 26%

13. The radius of an atom is 300pm, if it crystallizes in a face centered cubic lattice, the length of the edge of the unit cell is

a) 488.5pm b) 848.5pm c) 884.5pm d) 484.5pm

14. The fraction of total volume occupied by the atoms in a simple cubic is

a) $\left(\frac{\pi}{4\sqrt{2}}\right)$ b) $\left(\frac{\pi}{6}\right)$ c) $\left(\frac{\pi}{4}\right)$ d) $\left(\frac{\pi}{3\sqrt{2}}\right)$

15. The yellow colour in NaCl crystal is due to

a) excitation of electrons in F centers b) reflection of light from Cl- ion on the surface

c) refraction of light from Na+ ion d) all of the above

16. If 'a' stands for the edge length of the cubic system; sc , bcc, and fcc. Then the ratio of radii of spheres in these systems will be respectively

a) $\left(\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a\right)$ b) $\left(\sqrt{1}a : \sqrt{3}a : \sqrt{2}a\right)$

c) $\left(\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a\right)$ d) $\left(\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a\right)$

17. If 'a' is the length of the side of the cube, the distance between the body centered atom and one corner atom in the cube will be

a) $\left(\frac{2}{\sqrt{3}}\right)a$ b) $\left(\frac{4}{\sqrt{3}}\right)a$ c) $\left(\frac{\sqrt{3}}{4}\right)a$ d) $\left(\frac{\sqrt{3}}{2}\right)a$

18. Potassium has a bcc structure with nearest neighbor distance 4.52 A0 . its atomic weight is 39. its density will be

a) 915 kg m^{-3} b) 2142 kg m^{-3} c) 452 kg m^{-3} d) 390 kg m^{-3}

19. Schottky defect in a crystal is observed when

a) unequal number of anions and cations are missing from the lattice

b) equal number of cations and anions are missing from the lattice

c) an ion leaves its normal site and occupies an interstitial site

d) no ion is missing from its lattice.

20. The cation leaves its normal position in the crystal and moves to some interstitial position, the defect in the crystal is known as

a) Schottky defect b) F center c) Frenkel defect d) non-stoichiometric

21. Assertion: due to Frenkel defect, density of the crystalline solid decreases.

Reason: in Frenkel defect cation and anion leaves the crystal.

a) Both assertion and reason are true and reason is the correct explanation of assertion.

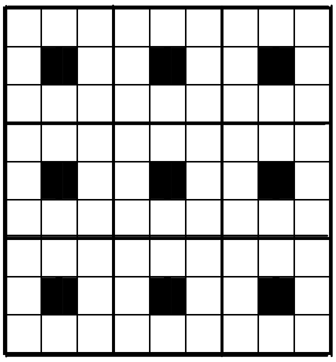
b) Both assertion and reason are true but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false. d) Both assertion and reason are false

22. The crystal with a metal deficiency defect is

a) NaCl b) FeO c) ZnO d) KCl

23. A two dimensional solid pattern formed by two different atoms X and Y is shown below. The black and white squares represent atoms X and Y respectively. the simplest formula for the compound based on the unit cell from the pattern is

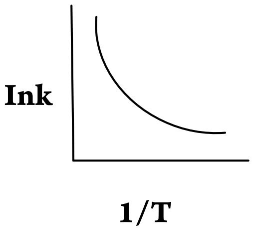


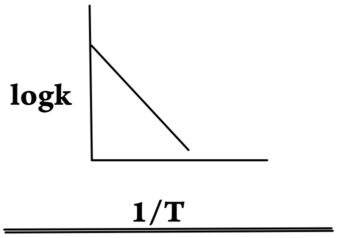
a) XY_8 b) X_4Y_9

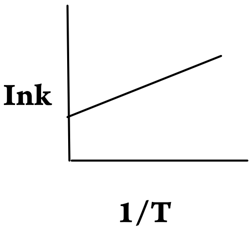
c) XY_2 d) XY_4

7.CHEMICAL KINETICS

1. **For a first order reaction A → B the rate constant is x min−1 . If the initial concentration of A is 0.01M , the concentration of A after one hour is given by the expression.**
   a) $0.01e^{-x}$ b) $1X\ 10^{-2}\ (1-\ e^{-60x})$ c) $(1X\ 10^{-2})e^{-60x}$ d) none of these
2. **A zero order reaction X →Product, with an initial concentration 0.02M has a half life of 10 min. if one starts with concentration 0.04M, then the half life is**
   a) 10 s b) 5 min
   c) 20 min d) cannot be predicted using the given information
3. **Among the following graphs showing variation of rate constant with temperature (T) for a reaction, the one that exhibits Arrhenius behavior over the entire temperature range is**
   a) b) c) d) both (b) and (c)







4. **For a first order reaction A → product with initial concentration x mol L−1 , has a half life period of 2.5 hours. For the same reaction with initial concentration $\left(\frac{x}{2}\right)$ mol L^{-1} the half life is**
   a) (2.5X2)hours b) $\left(\frac{2.5}{2}\right)$ hours c) 2.5 hours
   d) Without knowing the rate constant, $t_{1/2}$ cannot be determined from the given data
5. **For the reaction, $2NH_3 \rightarrow N_2 + 3H_2$, if $\frac{-dt[NH_3]}{dt} = k_1[NH_3], \frac{d[N_2]}{dt} = k_2\ [NH_3],$ $\frac{d[H_2]}{dt} = k_3[NH_3]$then the relation between K_1 , K_2 and K_3**
   a) $k_1=k_2=k_3$ b) $k_1=3k_2=2k_3$ c) $1.5k_1=3k_2=k_3$ d) $2k_1=k_2=3k_3$
6. **The decomposition of phosphine (PH_3) on tungsten at low pressure is a first order reaction. It is because the (NEET)**
   a) rate is proportional to the surface coverage
   b) rate is inversely proportional to the surface coverage
   c) rate is independent of the surface coverage
   d) rate of decomposition is slow
7. **For a reaction Rate = K $[acetone]^{3/2}$ then unit of rate constant and rate of reaction respectively is**
   a) (mol L^{-1} s^{-1}), (mol$^{-1/2}$ $L^{1/2}$ s^{-1}) b) (mol$^{-1/2}$ $L^{1/2}$ s^{-1}), (mol L^{-1} s^{-1})
   c) (mol $^{1/2}$ $L^{1/2}$ s^{-1}), (mol L^{-1} s^{-1}) d) (mol L s^{-1}), (mol $^{1/2}$ $L^{1/2}$ s)
8. **The addition of a catalyst during a chemical reaction alters which of the following quantities? (NEET)**

a) Enthalpy b) Activation energy c) Entropy d) Internal energy

9. Consider the following statements :

(i) increase in concentration of the reactant increases the rate of a zero order reaction.

(ii) rate constant k is equal to collision frequency A if Ea = 0

(iii) rate constant k is equal to collision frequency A if Ea = ∞

(iv) a plot of ln ln (k) vs T is a straight line.

(v) a plot of ln ln (k) vs (1/T) is a straight line with a positive slope.

Correct statements are

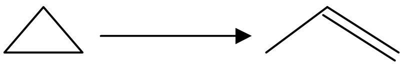
a) (ii) only b) (ii) and (iv) c) (ii) and (v) d) (i), (ii) and (v)

10. In a reversible reaction, the enthalpy change and the activation energy in the forward direction are respectively $-x$ kJ mol^{-1} and y kJ mol^{-1} · Therefore,the enery of activation in the backward direction is

a) $(y-x)kJmol^{-1}$ b) $(x+y)Jmol^{-1}$ c) $(x-y)kJmol^{-1}$ d) $(x+y)\ X10^{3}\ Jmol^{-1}$

11. What is the activation energy for a reaction if its rate doubles when the temperature is raised from 200K to 400K? ($R=8.314\ JK^{-1}\ mol^{-1}$)

a) 234.65 kJ mol^{-1} b) 434.65 kJ mol^{-1} c) 2.305 kJ mol^{-1} d) 334.65J mol^{-1}

12.  ; This reaction follows first order kinetics. The rate constant at particular temperature is $2.303X10^{-2}$ $hour^{-1}$ · The initial concentration of cyclopropane is 0.25 M. What will be the concentration of cyclopropane after 1806 minutes? (log2=0.3010)

a) 0.125 M b) 0.215 M c) 0.25X2.303M d) 0.05 M

13. For a first order reaction, the rate constant is 0.6909 min^{-1}.the time taken for 75% conversion in minutes is

a) $\left(\frac{3}{2}\right)\log 2$ b) $\left(\frac{2}{3}\right)\log 2$ c) $\left(\frac{3}{2}\right)\log\left(\frac{3}{4}\right)$ d) $\left(\frac{2}{3}\right)\log\left(\frac{4}{3}\right)$

14. In a first order reaction x → y; if k is the rate constant and the initial concentration of the reactant x is 0.1M, then, the half life is

a) $\left(\frac{\log 2}{k}\right)$ b) $\left(\frac{0.693}{(0.1)k}\right)$ c) $\left(\frac{\ln 2}{k}\right)$ d) none of these

15. Predict the rate law of the following reaction based on the data given below $2A + B \rightarrow C+3D$

Reaction number	[A] (min)	[B] (min)	Initial rate (Ms^{-1})
1	0.1	0.1	x
2	0.2	0.1	2x
3	0.1	0.2	4x
4	0.2	0.2	8x

a) rate = $k[A]^{2}[B]$ b) rate = $k\ [A]\ [B]^{2}$ c) rate = $k\ [A][B]$ d) rate = $k\ [A]^{1/2}[B]^{3/2}$

16. Assertion: rate of reaction doubles when the concentration of the reactant is doubles if it is a first order reaction. Reason: rate constant also doubles

a) Both assertion and reason are true and reason is the correct explanation of assertion.

b) Both assertion and reason are true but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false. d) Both assertion and reason are false.

17. The rate constant of a reaction is $5.8 \times 10^{-2}\ s^{-1}$. The order of the reaction is

a) First order b) zero order c) Second order d) Third order

18. For the reaction $N_2O_5\ (g) \rightarrow 2NO_2(g) + \frac{1}{2}\ O_2\ (g)$, the value of rate of disappearance of N_2O_5 is given as $6.5 \times 10^{-2}\ molL^{-1}\ s^{-1}$. The rate of formation of NO_2 and O_2 is given respectively as

a) $(3.25 \times 10^{-2}\ mol\ L^{-1}\ s^{-1})$ and $(1.3 \times 10^{-2}\ mol\ L^{-1}\ s^{-1})$

b) $(1.3 \times 10^{-2}\ mol\ L^{-1}\ s^{-1})$ and $(3.25 \times 10^{-2}\ mol\ L^{-1}\ s^{-1})$

c) $(1.3 \times 10^{-1}\ mol\ L^{-1}\ s^{-1})$ and $(3.25 \times 10^{-2}\ mol\ L^{-1}\ s^{-1})$ d) None of these

19. During the decomposition of H_2O_2 to give dioxygen, 48 g O_2 is formed per minute at certain point of time. The rate of formation of water at this point is

a) $0.75\ mol\ min^{-1}$ b) $1.5\ mol\ min^{-1}$ c) $2.25\ mol\ min^{-1}$ d) $3.0\ mol\ min^{-1}$

20. If the initial concentration of the reactant is doubled, the time for half reaction is also doubled. Then the order of the reaction is

a) Zero b) one c) Fraction d) none

21. In a homogeneous reaction $A \rightarrow B+C+D$, the initial pressure was P_0 and after time t it was P. expression for rate constant in terms of P_0, P and t will

a) $k=\left(\frac{2.303}{t}\right)\log\left(\frac{2P_o}{3P_o - P}\right)$ b) $k=\left(\frac{2.303}{t}\right)\log\left(\frac{2P_o}{P_o - P}\right)$

c) $k=\left(\frac{2.303}{t}\right)\log\left(\frac{3P_o - P}{2P_o}\right)$ d) $k=\left(\frac{2.303}{t}\right)\log\left(\frac{2P_o}{3P_o - 2P}\right)$

22. If 75% of a first order reaction was completed in 60 minutes , 50% of the same reaction under the same conditions would be completed in

a) 20 minutes b) 30 minutes c) 35 minutes d) 75 minutes

23. The half life period of a radioactive element is 140 days. After 560 days , 1 g of element will be reduced to

a) $\left(\frac{1}{2}\right)g$ b) $\left(\frac{1}{4}\right)g$ c) $\left(\frac{1}{8}\right)g$ d) $\left(\frac{1}{16}\right)g$

24. The correct difference between first and second order reactions is that (NEET)

a) A first order reaction can be catalysed; a second order reaction cannot be catalysed.

b) The half life of a first order reaction does not depend on $[A_0]$; the half life of a second order reaction does depend on $[A_0]$.

c) The rate of a first order reaction does not depend on reactant concentrations; the rate of a second order reaction does depend on reactant concentrations.

d) The rate of a first order reaction does depend on reactant concentrations; the rate of a second order reaction does not depend on reactant concentrations.

25. After 2 hours, a radioactive substance becomes $\left(\frac{1}{16}\right)^{th}$ of original amount. Then the half life (in min) is

a) 60 minutes b) 120 minutes c) 30 minutes d) 15 minutes

8.IONIC EQUILIBRIUM

1. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.24×10^{-4} $molL^{-1}$ solubility product of $Ag_2C_2O_4$ is (NEET – 2017)

a) $2.42 \times 10^{-8} mol^3\ L^{-3}$ b) $2.66 \times 10^{-12} mol^3\ L^{-3}$

c) $4.5 \times 10^{-11} mol^3\ L^{-3}$ d) $5.619 \times 10^{-12} mol^3\ L^{-3}$

2. Following solutions were prepared by mixing different volumes of NaOH of HCl different concentrations. (NEET – 2018)

i. 60 ml $\frac{M}{10}$ HCl + 40 ml $\frac{M}{10}$ NaOH ii. 55 ml $\frac{M}{10}$ HCl + 45 ml $\frac{M}{10}$ NaOH

iii. 75 ml $\frac{M}{5}$ HCl + 25 ml $\frac{M}{5}$ NaOH iv. 100 ml $\frac{M}{10}$ HCl + 100 ml $\frac{M}{10}$ NaOH

pH of which one of them will be equal to 1?

a) iv b) i c) ii d) iii

3. The solubility of $BaSO_4$ in water is 2.42×10^{-3} gL^{-1} at 298K. The value of its solubility product (K_{sp}) will be (NEET -2018). (($BaSO_4$ Given molar mass of =233g mol^{-1})

a) $1.08 \times 10^{-14} mol^2\ L^{-2}$ b) $1.08 \times 10^{-12} mol^2\ L^{-2}$

c) $1.08 \times 10^{-10} mol^2\ L^{-2}$ d) $1.08 \times 10^{-8} mol^2\ L^{-2}$

4. pH of a saturated solution of $Ca(OH)_2$ is 9. The Solubility product (K_{sp}) of $Ca(OH)_2$

a) 0.5×10^{-15} b) 0.25×10^{-10} c) 0.125×10^{-15} d) 0.5×10^{-10}

5. Conjugate base for Bronsted acids H_2O and HF are

a) OH^- and H_2FH^+ respectively b) H_3O^+ and F^- respectively

c) OH^- and F^- respectively d) H_3O^+ and H_2F^+ respectively

6. Which will make basic buffer?

a) 50 mL of 0.1M NaOH + 25mL of 0.1M CH_3COOH

b) 100 mL of 0.1M CH_3COOH + 100mL of 0.1M NH_4OH

c) 100 mL of 0.1M HCl + 200mL of 0.1M NH_4OH

d) 100 mL of 0.1M HCl + 100mL of 0.1M NaOH

7. Which of the following fluro compounds is most likely to behave as a Lewis base?

a) BF_3 b) PF_3 c) CF_4 d) SiF_4

8. Which of these is not likely to act as Lewis base?

a) BF_3 b) PF_3 c) CO d) F^-

9. The aqueous solutions of sodium formate, anilinium chloride and potassium cyanide are Respectively

a) acidic, acidic, basic b) basic, acidic, basic

c) basic, neutral, basic d) none of these

10. The percentage of pyridine (C_5H_5N) that forms pyridinium ion (C_5H_5NH) in a 0.10M aqueous pyridine solution (K_b for $C_5H_5N = 1.7 \times 10^{-9}$) is

a) 0.006% b) 0.013% c) 0.77% d) 1.6%

11. Equal volumes of three acid solutions of pH 1,2 and 3 are mixed in a vessel. What will be the H^+ ion concentration in the mixture?

a) 3.7×10^{-2} b) 10^{-6} c) 0.111 d) none of these

12. The solubility of AgCl(s) with solubility product 1.6×10^{-10} in 0.1M NaCl solution would be

a) 1.26×10^{-5} M b) 1.6×10^{-9} M c) 1.6×10^{-11} M d) Zero

13. If the solubility product of lead iodide is 3.2×10^{-8}, its solubility will be

a) 2×10^{-3}M b) 4×10^{-4} M c) 1.6×10^{-5}M d) 1.8×10^{-5}M

14. MY and NY3 , are insoluble salts and have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true with regard to MY and NY ?

a) The salts MY and NY3 are more soluble in 0.5M KY than in pure water

b) The addition of the salt of KY to the suspension of MY and NY3 will have no effect on their solubility's

c) The molar solubilities of MY and NY3 in water are identical

d) The molar solubility of MY in water is less than that of NY3

15. What is the pH of the resulting solution when equal volumes of 0.1M NaOH and 0.01MHCl are mixed?

a) 2.0 b) 3 c) 7.0 d) 12.65

16. The dissociation constant of a weak acid is 1×10^{-3} . In order to prepare a buffer solution with a pH=4, the [Acid]/[Salt]

a) 4:3 b) 3:4 c) 10:1 d) 1:10

17. The pH of 10^{-5}M KOH solution will be

a) 9 b) 5 c) 19 d) none of these

18. $H_2PO_4^-$ the conjugate base of

a) PO_4^{3-} b) P_2O_5 c) H_3PO_4 d) HPO_4^{2-}

19. Which of the following can act as Lowry – Bronsted acid as well as base?

a) HCl b) SO_4^{2-} c) HPO_4^{2-} d) Br^-

20. The pH of an aqueous solution is Zero. The solution is

a) slightly acidic b) strongly acidic c) neutral d) basic

21. The hydrogen ion concentration of a buffer solution consisting of a weak acid and its salts is given by

a) $\left[H^+\right] = \dfrac{Ka\ [acid]}{[salt\ ]}$ b) $\left[H^+\right] = K_a\ [salt]$

c) $\left[H^+\right] = K_a\ [acid]$ d) $\left[H^+\right] = \dfrac{Ka\ [salt]}{[acid]}$

22. Which of the following relation is correct for degree of hydrolysis of ammonium acetate?

a) $h = \sqrt{\frac{K_h}{C}}$ b) $h = \sqrt{\frac{K_a}{K_b}}$ c) $h = \sqrt{\frac{K_w}{K_a.K_b}}$ d) $h = \sqrt{\frac{K_a.K_b}{K_w}}$

23. Dissociation constant of NH_4OH is $1.8X10^{-5}$ the hydrolysis constant of NH_4Cl would be

a) $1.8 X 10^{-19}$ b) $5.55X 10^{-10}$ c) $5.55 X 10^{-5}$ d) $1.80 X 10^{-5}$

9. ELECTRO CHEMISTRY

1. The number of electrons that have a total charge of 9650 coulombs is

a) $6.22 X 10^{23}$ b) $6.022 X 10^{24}$ c) $6.022 X 10^{22}$ d) $6.022 X 10^{-34}$

2. Consider the following half cell reactions:

$Mn^{2+} + 2e^- \longrightarrow Mn$, $E^0=-1.18V$ $Mn^{2+} \longrightarrow Mn^{3+}+e^-$ $E^0=-1.51V$

The E^0 for the reaction $3Mn^{2+} \longrightarrow Mn + 2Mn^{3+}$, and the possibility of the forward reaction are respectively.

a) 2.69V and spontaneous b) -2.69 and non spontaneous

c) 0.33V and Spontaneous d) 4.18V and non spontaneous

3. The button cell used in watches function as follows

$Zn(s) + Ag_2O(s) + H_2O (l) \rightleftharpoons 2Ag (s) + Zn^{2+} (aq) +2OH^- (aq)$ $E^0 =0.76V$ half cell potentials are $Ag_2O(s)+H_2O (l) 2e^- \longrightarrow 2Ag (s)+ 2OH^- (aq)$ $E^0 =0.34V$ The cell potential will Be

a) 0.84V b) 1.34V c) 1.10V d) 0.42V

4. The molar conductivity of a 0.5 mol dm-3 solution of AgNO3 with electrolytic conductivity of $5.76 X10^{-3} S cm^{-1}$ at 298 K is

a) $2.88 Scm^2mol^{-1}$ b) $11.52 Scm^2mol^{-1}$ c) $0.086 Scm^2mol^{-1}$ d) $28.8 Scm^2mol^{-1}$

5.

Electrolyte	KCl	KNO_3	HCl	NaOAC	NaCl
Λ_{-} (Scm^2mol^{-1})	149.9	145	426.2	91	126.5

Calculate Λ^0_{HOAC} using appropriate molar conductances of the electrolytes listed above at infinite dilution in water at 25°C .

a) 517.2 b) 552.7 c) 390.7 d) 217.5

6. Faradays constant is defined as

a) charge carried by 1 electron b) charge carried by one mole of electrons

c) charge required to deposit one mole of substance

d) charge carried by $6.22 X 10^{10}$ electrons.

7. How many faradays of electricity are required for the following reaction to occur ?

$MnO_4^- \longrightarrow Mn^{2+}$

a) 5F b) 3F c) 1F d) 7F

8. A current strength of 3.86 A was passed through molten Calcium oxide for 41minutes and 40 seconds. The mass of Calcium in grams deposited at the cathode is (atomic mass of Ca is 40 g/mol and 1F = 96500C).

a) 4 b) 2 c) 8 d) 6

9. During electrolysis of molten sodium chloride, the time required to produce 0.1mole of chlorine gas using a current of 3A is

a) 55 minutes b) 107.2 minutes c) 220 minutes d) 330 minutes

10. The number of electrons delivered at the cathode during electrolysis by a current of 1A in 60 seconds is (charge of electron =1.6 X 10^{-19} C)

a) 6.22 X 10^{23} b) 6.022 X 10^{20} c) 3.75 X 10^{20} d) 7.48X 10^{23}

11. Which of the following electrolytic solution has the least specific conductance

a) 2N b) 0.002N c) 0.02N d) 0.2N

12. While charging lead storage battery

a) $PbSO_4$ on cathode is reduced to Pb b) $PbSO_4$ on anode is oxidised to PbO_2

c) $PbSO_4$ on anode is reduced to Pb d) $PbSO_4$ on cathode is oxidised to Pb

13. Among the following cells

I) Leclanche cell II) Nickel – Cadmium cell III) Lead storage battery IV) Mercury cell

Primary cells are

a) I and IV b) I and III c) III and IV d) II and III

14. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

a) Zinc is lighter than iron b) Zinc has lower melting point than iron

c) Zinc has lower negative electrode potential than iron

d) Zinc has higher negative electrode potential than iron

15. Assertion : pure iron when heated in dry air is converted with a layer of rust.

Reason : Rust has the composition Fe_3O_4

a) if both assertion and reason are true and reason is the correct explanation of assertion.

b) if both assertion and reason are true but reason is not the correct explanation of assertion.

c) assertion is true but reason is false d) both assertion and reason are false.

16. In H_2-O_2 cell the reaction occurs at cathode is

a) $O_2(g) + 2H_2O\ (l) + 4e^- \longrightarrow 4OH^-\ (aq)$

b) $H^+(aq) + OH^-\ (aq) \longrightarrow H_2O(l)$

c) $2H_{2(g)} + O_2(g) \longrightarrow 2H_2O(g)$

d) $H^+ + e^- \longrightarrow \frac{1}{2} H_2$

17. The equivalent conductance of M/36 solution of a weak monobasic acid is 6 mhocm^{2}equiv^{-1} and at infinite dilution is 400 mhocm^{2}equiv^{-1}. The dissociation constant of this acid is

a) 1.25 X 10^{-6} b) 6.25 X 10^{-6} c) 1.25 X 10^{-4} d) 6.25 X 10^{-5}

18. A conductivity cell has been calibrated with a 0.01M, 1:1 electrolytic solution (specific conductance ($\kappa = 1.25 \times 10^{-3}$ Scm^{-1}) in the cell and the measured resistance was 800 Ω at 25^0 C. The cell constant is,

    a) 10^{-1} cm^{-1} b) 10^1 cm^{-1} c) 1 cm^{-1} d) 5.7×10^{-12}

19. Conductivity of a saturated solution of a sparingly soluble salt AB (1:1 electrolyte) at 298K is 1.85×10^{-5} S m^{-1}. Solubility product of the salt AB at 298K $(\Lambda_m^0)_{AB} = 14 \times 10^{-3}$ S m^2 mol^{-1}.

    a) 5.7×10^{-12} b) 1.32×10^{-12} c) 7.5×10^{-12} d) 1.74×10^{-12}

20. In the electrochemical cell: $Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$, the emf of this Daniel cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0 M and that $CuSO_4$ changed to 0.01M, the emf changes to E_2. From the above, which one is the relationship between E_1 and E_2?

    a) $E_1 < E_2$ b) $E_1 > E_2$ c) $E_1 \geq E_2$ d) $E_1 = E_2$

21. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below

    $$BrO_4^- \xrightarrow{1.82V} BrO_3^- \xrightarrow{1.5V} HBrO \xrightarrow{1.595V} Br_2 \xrightarrow{1.0652V} Br^-$$

    Then the species undergoing disproportionation is

    a) Br_2 b) BrO_4^- c) BrO_3^- d) HBrO

22. For the cell reaction

    $2Fe^{3+}(aq) + 2I^-(aq) \longrightarrow 2Fe^{2+}(aq) + I_2(aq)$ E^0 cell =0.24V at 298K. The standard Gibbs energy (ΔG^0) of the cell reactions is :

    a) -46.32 KJ mol^{-1} b) -23.16 KJ mol^{-1} c) 46.32 KJ mol^{-1} d) 23.16 KJ mol^{-1}

23. A certain current liberated 0.504 gm of hydrogen in 2 hours. How many grams of copper can be liberated by the same current flowing for the same time through copper sulphate solution

    a) 31.75 b) 15.8 c) 7.5 d) 63.5

24. A gas X at 1 atm is bubbled through a solution containing a mixture of 1MY^- and 1MZ^- at 25^0C . If the reduction potential of Z>Y>X, then

    a) Y will oxidize X and not Z b) Y will oxidize Z and not X

    d) Y will oxidize both X and Z d) Y will reduce both X and Z

25. Cell equation : $A + 2B^- \longrightarrow A^{2+} + 2B$; $A^{2+} + 2e^- \longrightarrow A$ $E^0 = +0.34V$ and $\log_{10}K = 15.6$ at 300K for cell reactions find E^0 for $B^+ + e^- \longrightarrow B$ (AIIMS – 2018)

    a) 0.80 b) 1.26 c) -0.54 d) -10.94

10. SURFACE CHEMISTRY

1. For Freundlich isotherm a graph of Log X/m is plotted against log p. The slope of the line and its y – axis intercept respectively corresponds to

    a) 1/n , k b) log 1/n , k c) 1/n , log k d) log1/n , log k

2. Which of the following is incorrect for physisorption?

    a) reversible b) increases with increase in temperature

    c) low heat of adsorption d) increases with increase in surface area

3. Which one of the following characteristics are associated with adsorption? (NEET)

    a) ΔG and ΔH are negative but ΔS is positive b) ΔG and ΔS are negative but ΔH is positive

c) ΔG is negative but ΔH and ΔS are positive d) ΔG, ΔH and ΔS all are negative.

4. Fog is colloidal solution of

a) solid in gas b) gas in gas c) liquid in gas d) gas in liquid

5. Assertion : Coagulation power of Al^{3+} is more than Na^+.

Reason : greater the valency of the flocculating ion added, greater is its power to cause precipitation

a) if both assertion and reason are true and reason is the correct explanation of assertion.

b) if both assertion and reason are true but reason is not the correct explanation of assertion.

c) assertion is true but reason is false d) both assertion and reason are false.

6. Statement : To stop bleeding from an injury, ferric chloride can be applied. Which comment about the statement is justified?

a) It is not true, ferric chloride is a poison.

b) It is true, Fe^{3+} ions coagulate blood which is a negatively charged sol

c) It is not true; ferric chloride is ionic and gets into the blood stream.

d) It is true, coagulation takes place because of formation of negatively charged sol with Cl^-

7. Hair cream is

a) gel b) emulsion c) solid sol d) sol.

8. Which one of the following is correctly matched?

a) Emulsion	-	Smoke
b) Gel	-	butter
c) foam	-	Mist
d) whipped cream	-	sol

9. The most effective electrolyte for the coagulation of As_2S_3 Sol is

a) NaCl b) $Ba(NO_3)_2$ c) $K3[Fe(CN)_6]$ d) $Al_2(SO_4)_3$

10. Which one of the is not a surfactant?

a) $CH_3{-}(CH_2)_{15}{-}N^+{-}(CH_3)_2{-}CH_2Br$ b) $CH_3{-}(CH_2)_{15}{-}NH_2$

c) $CH_3{-}\ (CH_2)_{16}{-}CH_2{-}OSO_2^-\ Na^+$ d) $OHC{-}(CH_2)_{14}{-}CH_2{-}COO^-\ Na^+$

11. The phenomenon observed when a beam of light is passed through a colloidal solution is

a) Cataphoresis b) Electrophoresis c) Coagulation d) Tyndall effect

12. In an electrical field, the particles of a colloidal system move towards cathode. The coagulation of the same sol is studied using (i) K_2SO_4 (ii) Na_3PO_4 (iii)$K_4[Fe(CN)_6]$ and (iv) NaCl Their coagulating power should be

a) II > I > IV > III b) III > II > I > IV

c) I > II > III > IV d) none of these

13. Collodion is a 4% solution of which one of the following compounds in alcohol – ether mixture?

a) Nitroglycerine b) Cellulose acetate c) Glycoldinitrate d) Nitrocellulose

14. Which one of the following is an example for homogeneous catalysis?

a) manufacture of ammonia by Haber's process

b) manufacture of sulphuric acid by contact process

c) hydrogenation of oil d) Hydrolysis of sucrose in presence of dil HCl

15. Match the following

A) V_2O_5	i) High density polyethylene
B) Ziegler – Natta	ii) PAN
C) Peroxide	iii) NH_3
D) Finely divided Fe	iv) H_2SO_4

	A	B	C	D
(a)	(iv)	(i)	(ii)	(iii)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(ii)	(iii)	(iv)	(i)
(d)	(iii)	(iv)	(ii)	(i)

16. The coagulation values in millimoles per litre of the electrolytes used for the coagulation of As_2S_3 are given below

I) NaCl=52 II) $BaCl_2 = 0.69$ III) $MgSO_4 = 0.22$ The correct order of their coagulating power is

a) III > II > I b) I > II > III c) I > III > II d) II > III > I

17. Adsorption of a gas on solid metal surface is spontaneous and exothermic, then

a) ΔH increases b) ΔS increases c) ΔG increases d) ΔS decreases

18. If x is the amount of adsorbate and m is the amount of adsorbent, which of the following relations is not related to adsorption process?

a) $x/m = f(P)$ at constant T b) $x/m = f(T)$ at constant P

c) $P = f(T)$ at constant x/m d) $x/m = PT$

19. On which of the following properties does the coagulating power of an ion depend ? (NEET – 2018)

a) Both magnitude and sign of the charge on the ion.

b) Size of the ion alone

c) The magnitude of the charge on the ion alone

d) The sign of charge on the ion alone.

20. Match the following

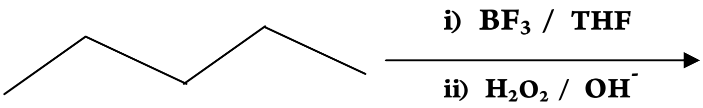
A) Pure nitrogen	-	i) Chlorine
B) Haber process	-	ii) Sulphuric acid
C) Contact process	-	iii) Ammonia
D) Deacons Process	-	iv) sodium azide (or) Barium azide

	A	B	C	D
(a)	(i)	(ii)	(iii)	(iv)
(b)	(ii)	(iv)	(i)	(iii)
(c)	(iii)	(iv)	(ii)	(i)
(d)	(iv)	(iii)	(ii)	(i)

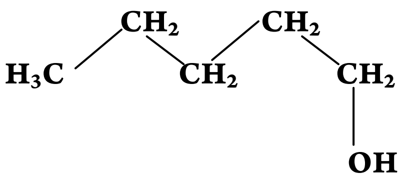
11.HYDROXY COMPOUNDS AND ETHERS

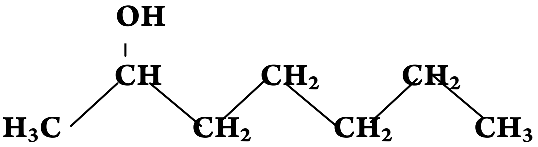
1. An alcohol (x) gives blue colour in Victormeyer's test and 3.7g of X when treated with metallic sodium liberates 560 mL of hydrogen at 273 K and 1 atm pressure what will be the possible structure of X?
   a) $CH_3–CH(OH)CH_2–CH_3$ b) $CH_3–CH(OH)–CH_3$
   c) $CH_3–C(OH)(CH_3)_2$ d) $CH_3–CH_2–CH(OH)–CH_2–CH_3$

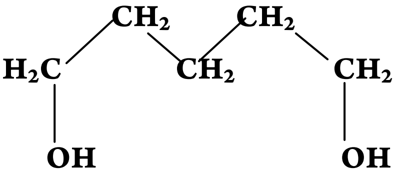
2. Which of the following compounds on reaction with methyl magnesium bromide will give tertiary alcohol.
   a) benzaldehyde b) propanoic acid c) methyl propanoate d) acetaldehyde

3. 

X . The 'X' is

a) 

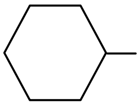
b) 

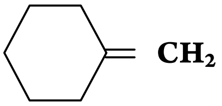
c) 

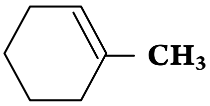
d) None of these

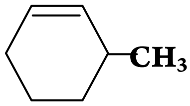
4. In the reaction sequence, Ethene $\xrightarrow{HOCl}$ A $\xrightarrow{X}$ ethan -1,2-diol . A and X respectively are
   a) Chloroethane and NaOH b) ethanol and H_2SO_4
   c) 2 – chloroethan -1-ol and $NaHCO_3$ d) ethanol and H_2O

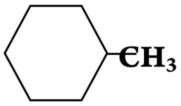
5. Which one of the following is the strongest acid
   a) 2 - nitrophenol b) 4 – chlorophenol
   c) 4 – nitrophenol d) 3 – nitrophenol

6.  CH_2-OH on treatment with Con H_2SO_4, predominately gives

a) 

b) 

c) 

d) 

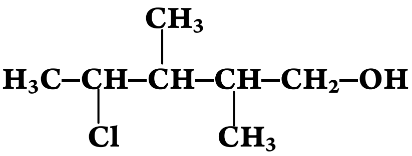
7. Carbolic acid is
   a) Phenol b) Picric acid c) benzoic acid d) phenylacetic acid

8. Which one of the following will react with phenol to give salicyladehyde after hydrolysis.
   a) Dichloro methane b) trichloroethane c) trichloro methane d) CO_2

9. $(CH_3)_3–C–CH(OH)–CH_3 \xrightarrow{Con\ H_2SO_4}$ X (major product)
   a) $(CH_3)_3–C–CH=CH_2$ b) $(CH_3)_2C=C(CH_3)_2$

c) $CH_2=C(CH_3)-CH_2-CH_3$ d) $CH_2=C(CH_3)-CH_2-CH_2-CH_3$

10. The correct IUPAC name of the compound,



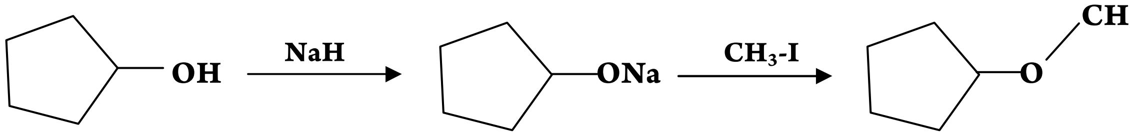
$H_3C-\underset{Cl}{CH}-\overset{CH_3}{CH}-\underset{CH_3}{CH}-CH_2-OH$

a) 4–chloro–2,3–dimethyl pentan–1-ol b) 2,3–dimethyl–4-chloropentan -1-ol
c) 2,3,4–trimethyl–4- chlorobutan -1-ol d) 4–chloro–2,3,4–trimethyl pentan–1-ol

11. Assertion : Phenol is more acidic than ethanol
Reason: Phenoxide ion is resonance stabilized
a) both assertion and reason are true and reason is the correct explanation of assertion.
b) both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false d) both assertion and reason are false.

12. In the reaction Ethanol $\xrightarrow{PCl_5}$ X $\xrightarrow{alc\ KOH}$ Y $\xrightarrow[298K]{H_2SO_4\ /H_2O}$ Z. The 'Z' is

a) ethane b) ethoxyethane c) ethylbisulphite d) ethanol

13. 

The reaction

Can be classified as
a) dehydration b) Williamson alcoholsynthesis
c) Williamson ether synthesis d) dehydrogenation of alcohol

14. Isopropylbenzene on air oxidation in the presence of dilute acid gives

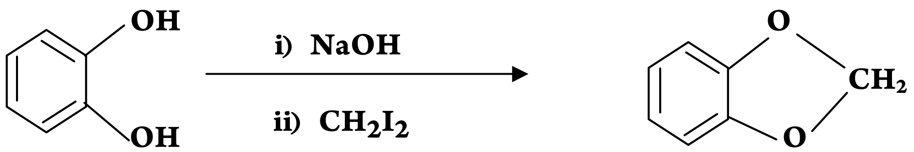
a) C_6H_5COOH b) $C_6H_5COCH_3$ c) $C_6H_5CO\ C_6H_5$ d) C_6H_5OH

15. Assertion : Phenol is more reactive than benzene towards electrophilic substitution reaction
Reason : In the case of phenol, the intermediate arenium ion is more stabilized by resonance.
a) if both assertion and reason are true and reason is the correct explanation of assertion.
b) if both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false d) both assertion and reason are false.

16. $HO-CH_2CH_2-OH$ on heating with periodic acid gives

a) methanoic acid b) Glyoxal c) methanal d) CO_2

17. Which of the following compound can be used as artifreeze in automobile radiators?
a) methanol b) ethanol c) Neopentyl alcohol d) ethan -1, 2-diol

18. 

The reactions is an example of
a) Wurtz reaction b) cyclic reaction c) Williamson reaction d) Kolbe reactions

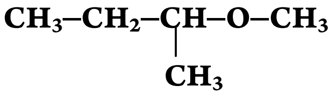
19. One mole of an organic compound (A) with the formula C_3H_8O reacts completely with two moles of HI to form X and Y. When Y is boiled with aqueous alkali it forms Z. Z answers the iodoform test. The compound (A) is

a) propan – 2-ol b) propan -1-ol c) ethoxy ethane d) methoxy ehane

20. Among the following ethers which one will produce methyl alcohol on treatment with hot HI?

a) $(H_3C)_3C–O–CH_3$ b) $(CH_3)_2–CH–CH_2–O–CH_3$

c) $CH_3–(CH_2)_3–O–CH_3$ d)



$CH_3–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–O–CH_3$

21. Williamson synthesis of preparing dimethyl ether is

a) S_N1 reactions b) S_N2 reaction

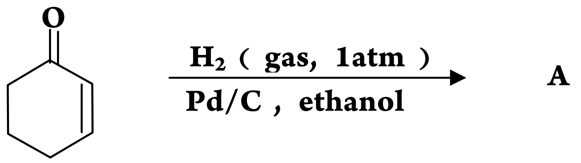
c) electrophilic addition d) electrophilic substitution

22. On reacting with neutral ferric chloride, phenol gives

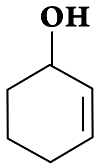
a) red colour b) violet colour c) dark green colour d) no colouration.

12.CARBONYL COMPOUNDS AND CARBOXYLIC ACIDS

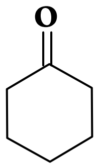
1. The correct structure of the product 'A' formed in the reaction (NEET)



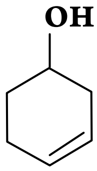
a)



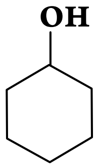
b)



c)



d)



2. The formation of cyanohydrin from acetone is an example of

a) nucleophilic substitution b) electrophilic substitution

c) electrophilic addition d) Nucleophilic addition

3. Reaction of acetone with one of the following reagents involves nucleophilic addition followed by elimination of water. The reagent is

a) Grignard reagent b) Sn / HCl

c) hydrazine in presence of slightly acidic solution d) hydrocyanic acid

4. In the following reaction,

$HC \equiv CH \xrightarrow[HgSO_4]{H_2SO_4} X$ Product 'X' will not give

a) Tollen's test b) Victor meyer test c) Iodoform test d) Fehling solution test

5. $CH_2=CH_2 \xrightarrow[ii)Zn/H_2O]{i)O_3} X \xrightarrow{NH_3} Y$. 'Y' is

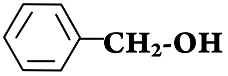
a) Formaldelyde b) di acetone ammonia

c) hexamethylene tetraamine d) oxime

6. Predict the product Z in the following series of reactions

$$\text{Ethanoic acid} \xrightarrow{PCl_5} X \xrightarrow[\text{Anhydrous } AlCl_3]{C_6H_6} Y \xrightarrow[\text{ii)}H_3O^+]{\text{i)}CH_3MgBr} Z$$

a) $(CH_3)_2C(OH)C_6H_5$ b) $CH_3CH(OH)C_6H_5$

c) $CH_3CH(OH)CH_2\text{-}CH_3$ d) 

7. Assertion : 2,2 – dimethyl propanoic acid does not give HVZ reaction.

Reason : 2,2, dimethyl propanoic acid does not have α- hydrogen atom

a) if both assertion and reason are true and reason is the correct explanation of assertion.
b) if both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false d) both assertion and reason are false.

8. Which of the following represents the correct order of acidity in the given compounds

a) $F\text{-}CH_2COOH > CH_3COOH > Br\text{-}CH_2COOH > Cl\text{-}CH_2COOH$

b) $F\text{-}CH_2COOH > Cl\text{-}CH_2COOH > Br\text{-}CH_2COOH > CH_3COOH$

c) $CH_3COOH > Cl\text{-}CH_2COOH > F\text{-}CH_2COOH > Br\text{-}CH_2COOH$

d) $Cl\text{-}CH_2COOH > CH_3COOH > Br\text{-}CH_2COOH > I\text{-}CH_2COOH$

9. Benzoic acid $\xrightarrow[\text{ii) } \Delta]{\text{i)}NH_3} A \xrightarrow{NaOBr} B \xrightarrow{NaNO_2/HCl} C$ " C " is

a) anilinium chloride b) O – nitro aniline

c) benzene diazonium chloride d) m – nitro benzoic acid

10. Ethanoic acid $\xrightarrow{P/Br_2}$ 2–bromoethanoic acid. This reaction is called

a) Finkelstein reaction b) Haloform reaction

c) Hell–Volhard–Zelinsky reaction d) none of these

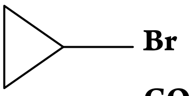
11. CH3Br $\xrightarrow{KCN} (A) \xrightarrow{H_3O^+} (B) \xrightarrow{PCl_5} (C)$ Product (C) is

a) acetylchloride b) chloro acetic acid

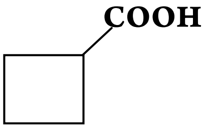
c) α-chlorocyano ethanoic acid d) none of these

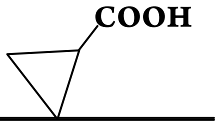
12. Which one of the following reduces tollens reagent

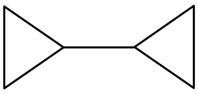
a) formic acid b) acetic acid c) benzophenone d) none of these

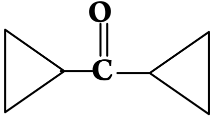
13. 

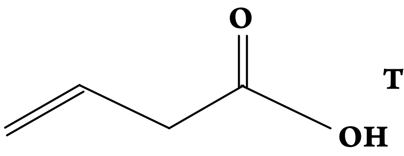
$\xrightarrow[\text{ii) } CO_2]{\text{i)Mg,ether}} A \xrightarrow{H_3O^+} B$ 'B' is

a) 

b) 

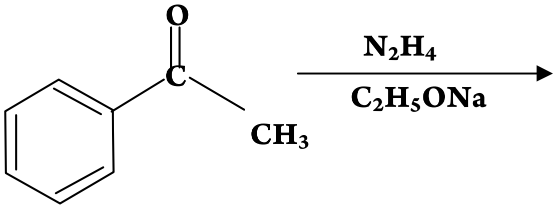
c) 

d) 

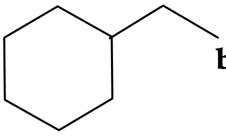
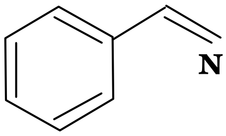
14. 

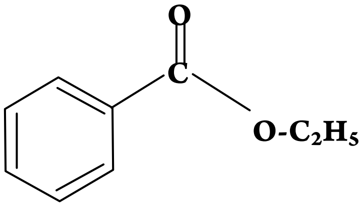
The IUPAC Name of

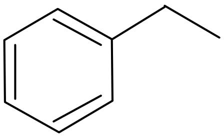
a) but – 3- enoicacid **b) but – 1- ene-4-oicacid**
c) but – 2- ene-1-oic acid **d) but -3-ene-1-oicacid**

15. 

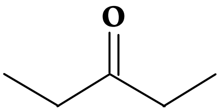
Identify the product formed in the reaction

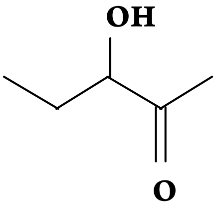
a) 
b) 

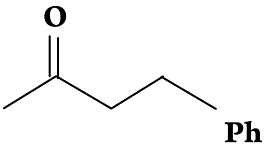
c) 

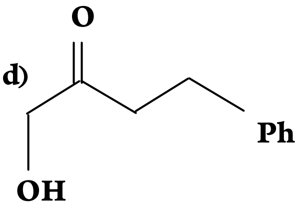
d) 

16. In which case chiral carbon is not generated by reaction with HCN

a) 

b) 

c) 

d) 

17. Assertion : p – N, N – dimethyl aminobenzaldehyde undergoes benzoin condensation
Reason : The aldehydic (-CHO) group is meta directing
a) if both assertion and reason are true and reason is the correct explanation of assertion.
b) if both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false **d) both assertion and reason are false.**

18. Which one of the following reaction is an example of disproportionation reaction
a) Aldol condensation **b) cannizaro reaction**
c) Benzoin condensation **d) none of these**

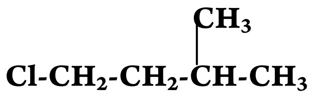
19. Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid
a) Phenylmethanal **b) ethanal** **c) ethanol** **d) methanol**

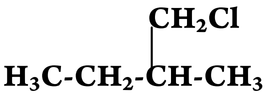
20. The reagent used to distinguish between acetaldehyde and benzaldehyde is
a) Tollens reagent **b) Fehling's solution**
c) 2,4 – dinitrophenyl hydrazine **d) semicarbazide**

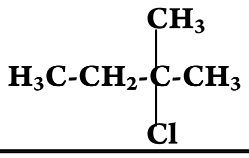
21. Phenyl methanal is reacted with concentrated NaOH to give two products X and Y. X reacts with metallic sodium to liberate hydrogen X and Y are
a) sodiumbenzoate and phenol **b) Sodium benzoate and phenyl methanol**
c) phenyl methanol and sodium benzoate **d) none of these**

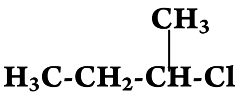
22. In which of the following reactions new carbon – carbon bond is not formed?
a) Aldol condensation b) Friedel craft reaction
c) Kolbe's reaction d) Wolf kishner reduction

23. An alkene "A" on reaction with O_3 and Zn $-H_2O$ gives propanone and ethanol in equimolar ratio. Addition of HCl to alkene "A" gives "B" as the major product. The structure of product "B" is

a) 
$Cl\text{-}CH_2\text{-}CH_2\text{-}\overset{CH_3}{\overset{|}{C}}H\text{-}CH_3$

b) 
$H_3C\text{-}CH_2\text{-}\overset{CH_2Cl}{\overset{|}{C}}H\text{-}CH_3$

c) 
$H_3C\text{-}CH_2\text{-}\underset{Cl}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}\text{-}CH_3$

d) 
$H_3C\text{-}CH_2\text{-}\overset{CH_3}{\overset{|}{C}}H\text{-}Cl$

24. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their (NEET)
a) more extensive association of carboxylic acid via van der Waals force of attraction
b) formation of carboxylate ion
c) formation of intramolecular H-bonding d) formation of intermolecular H – bonding

13. ORGANIC NITROGEN COMPOUNDS

1. Which of the following reagent can be used to convert nitrobenzene to aniline
a) Sn/HCl b)Zn-Hg/NaOH c) $LiAlH_4$ d) All of these

2. The method by which aniline cannot be prepared is
a) degradation of benzamide with Br_2/NaOH
b) potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH solution.
c) reduction of Nitrobenzene with $LiAlH_4$
d) reduction of Nitrobenzene by Sn/HCl .

3. Which one of the following will not undergo Hofmann bromamide reaction
a) $CH_3CONHCH_3$ b) $CH_3CH_2CONH_2$ c) CH_3CONH_2 d) $C_6H_5CONH_2$

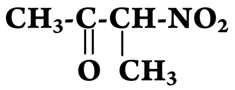
4. Assertion : Acetamide on reaction with KOH and bromine gives acetic acid
Reason : Bromine catalyses hydrolysis of acetamide.
a) if both assertion and reason are true and reason is the correct explanation of assertion.
b) if both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false d) both assertion and reason are false.

5. $CH_3CH_2Br \xrightarrow[\triangle]{aq\ NaOH} A \xrightarrow[\triangle]{KMnO_4/H^+} B \xrightarrow[\triangle]{NH_3} C \xrightarrow{Br_2/NaOH} D$. 'D' is

a) bromomethane b) α -bromo sodium acetate
c) methanamine d) acetamide

6. Which one of the following nitro compounds does not react with nitrous acid
a) $CH_3\text{-}CH_2\text{-}CH_2\text{-}NO_2$ b) $(CH_3)_2\text{-}CH\text{-}CH_2NO_2$

c) $(CH_3)_3C-NO_2$

d) 

$CH_3-\underset{\overset{\|}{O}}{C}-\underset{\overset{|}{CH_3}}{CH}-NO_2$

7. Aniline + benzoylchloride $\xrightarrow{NaOH}$ $C_6H_5-NH-CO-C_6H_5$ this reaction is known as

a) Friedel – crafts reaction　　b) HVZ reaction

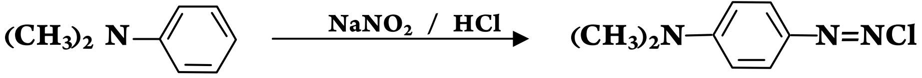
c) Schotten – Baumann reaction　　d) none of these

8. The product formed by the reaction an aldehyde with a primary amine (NEET)

a) carboxylic acid　b) aromatic acid　c) schiff 's base　d) ketone

9. Which of the following reaction is not correct.

a) $CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH + N_2$

b) 

c) $CH_3CONH_2 \xrightarrow{Br_2/NaOH} CH_3NH_2$　　d) none of these

10. When aniline reacts with acetic anhydride the product formed is

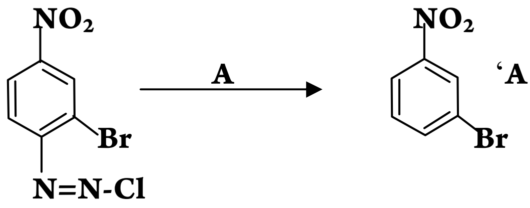
a) o – aminoacetophenone　　b) m-aminoacetophenone

c) p – aminoacetophenone　　d) acetanilide

11. The order of basic strength for methyl substituted amines in aqueous solution is

a) $N(CH_3)_3 > N(CH_3)_2H > N(CH_3)H_2 > NH_3$　　b) $N(CH_3)H_2 > N(CH_3)_2H > N(CH_3)_3 > NH_3$

c) $NH_3 > N(CH_3)H_2 > N(CH_3)_2H > N(CH_3)_3$　　d) $N(CH_3)_2H > N(CH_3)H_2 > N(CH_3)_3 > NH_3$

12. 

'A' is

a) H_3PO_2 மற்றும் H_2O　b) H^+/ H_2O　c) $HgSO_4/ H_2SO_4$　d) Cu_2Cl_2

13. $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273K]{NaNO_2/HCl} B \xrightarrow[283K]{H_2O} C$ 'C' is

a) C_6H_5-OH　b) $C_6H_5-CH_2OH$　c) C_6H_5-CHO　d) $C_6H_5-NH_2$

14. Nitrobenzene on reaction with Con HNO_3/H_2SO_4 at 80-100°C forms which one of the following products?

a) 1,4 – dinitrobenzene　　b) 2,4,6 – tirnitrobenzene

c) 1,2 – dinitrobenzene　　d) 1,3 – dinitrobenzene

15. $C_5H_{13}N$ reacts with HNO_2 to give an optically active compound – The compound is

a) pentan – 1- amine　　b) pentan – 2- amine

c) N,N – dimethylpropan -2-amine　　d) diethyl methyl amine

16. Secondary nitro alkanes react with nitrous acid to form

a) red solution　b) blue solution　c) green solution　d) yellow solution

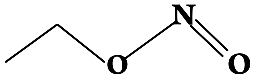
17. Which of the following amines does not undergo acetylation?

a) t – butylamine　b) ethylamine　c) diethylamine　d) triethylamine

18. Which one of the following is most basic?

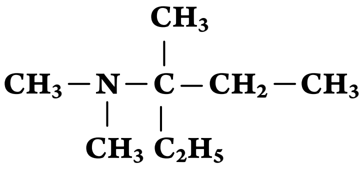
a) 2,4 – dichloroaniline　　b) 2,4 – dimethyl aniline

c) 2,4 – dinitroaniline d) 2,4 – dibromoaniline

19.  When is reduced with Sn/HCl the pair of compound formed are

a) Ethanol, hydroxylamine hydrochloride b) Ethanol, ammonium hydroxide

c) Ethanol, NH_2OH d) $C_3H_5NH_2$, H_2O

20. 

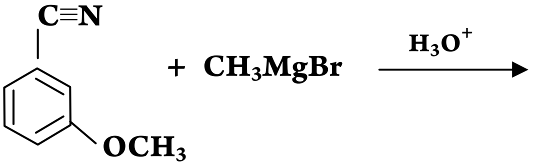
$CH_3-N(CH_3)-C(CH_3)(C_2H_5)-CH_2-CH_3$ IUPAC name for the amine

a) 3 – Bimethylamino – 3 – methyl pentane

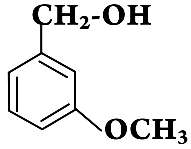
b) 3 (N,N – Triethyl) – 3- amino pentane

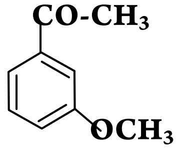
c) 3 – N,N – trimethyl pentanamine

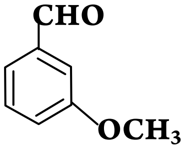
d) N,N – dimethyl – 3- methyl - pentan - 3 amine

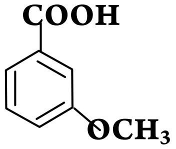
21. 

Product 'P' in the above reaction is

a) 

b) 

c) 

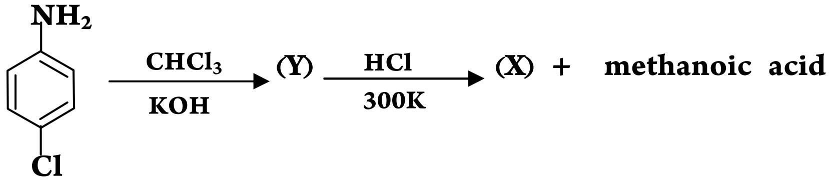
d) 

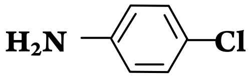
22. Ammonium salt of benzoic acid is heated strongly with $P_2O_5$and the product so formed is reduced and then treated with $NaNO_2/HCl$ at low temperature. The final compound formed is

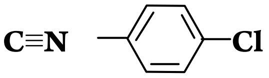
a) Benzene diazonium chloride b) Benzyl alcohol

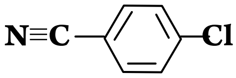
c) Phenol d) Nitrosobenzene

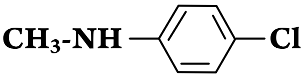
23. Identify X in the sequence given below.



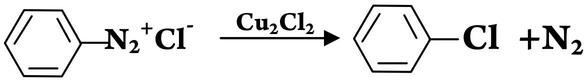
a) 

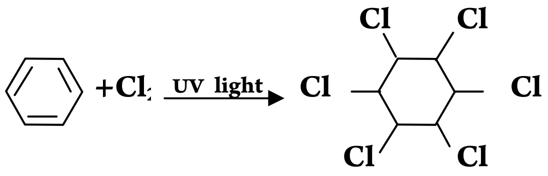
b) 

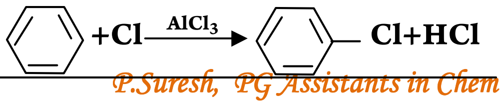
c) 

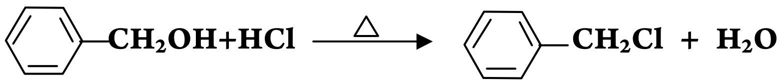
d) 

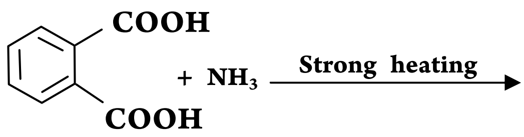
24. Among the following, the reaction that proceeds through an electrophilic substitution, is :

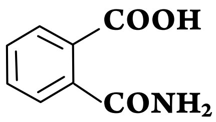
a) 

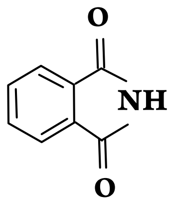
b) 

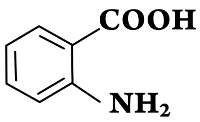
c) 

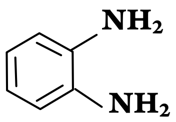
d) 

25. **The major product of the following reaction** 

a) 

b) 

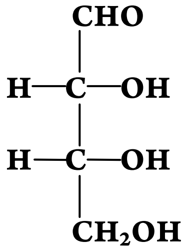
c) 

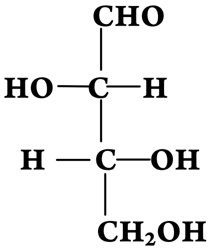
d) 

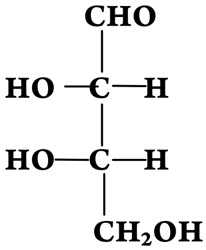
14.BIO MOLECULES

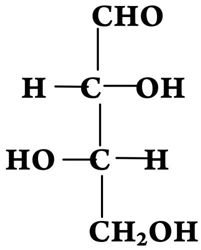
1. **Which one of the following rotates the plane polarized light towards left?** **(NEET Phase – II)**
   a) D(+) Glucose (b) L(+) Glucose (c) D(-) Fructose d) D(+) Galactose

2. **The correct corresponding order of names of four aldoses with configuration given below Respectively is, (NEET Phase – I)**









a) L-Erythrose, L-Threose, L-Erythrose, D-Threose
b) D-Threose,D-Erythrose, L-Threose, L-Erythrose,
c) L-Erythrose, L-Threose, D-Erythrose, D-Threose
d) D-Erythrose, D-Threose, L-Erythrose, L-Threose

3. **Which one given below is a non-reducing sugar? (NEET Phase – I)**
   a) Glucose b) Sucrose c) maltose d) Lactose.

4. **Glucose** $\xrightarrow{(HCN)}$ **Product** $\xrightarrow{(Hydrolysis)}$ **Product** $\xrightarrow{(HI+Heat)}$ **A , the compound A is**
   a) Heptanoic acid b) 2-Iodohexane c) Heptane d) Heptanol

5. **Assertion: A solution of sucrose in water is dextrorotatory. But on hydrolysis in the presence of little hydrochloric acid, it becomes levorotatory. (AIIMS)**
   Reason : Sucrose hydrolysis gives equal amounts of glucose and fructose. As a result of this change in sign of rotation is observed.
   a) If both accretion and reason are true and reason is the correct explanation of assertion
   b) If both assertion and reason are true but reason is not the correct explanation of assertion
   c) If assertion is true but reason is false. d) if both assertion and reason are false.

6. **The central dogma of molecular genetics states that the genetic information flows from (NEET Phase – II)**

   a) Amino acids → Protein → DNA

   b) DNA → Carbohydrates → Proteins

   c) DNA → RNA → Proteins

   d) DNA → RNA → Carbohydrates

7. **In a protein, various amino acids linked together by (NEET Phase – I)**

   a) Peptide bond b) Dative bond c) α - Glycosidic bond d) β - Glycosidic bond

8. **Among the following the achiral amino acid is (AIIMS)**

   a) 2-ethylalanine b) 2-methylglycine c) 2-hydroxymethylserine d) Tryptophan

9. **The correct statement regarding RNA and DNA respectively is (NEET Phase – I)**

   a) The sugar component in RNA is an arabinos and the sugar component in DNA is ribose

   b) The sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose

   c) The sugar component in RNA is an arabinose and the sugar component in DNA is 2'-deoxyribose

   d) The sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose

10. **In aqueous solution of amino acids mostly exists in,**

    a) NH_2-CH(R)-COOH b) NH_2-CH(R)-COO^-

    c) H_3N^+-CH(R)-COOH d) H_3N^+-CH(R)-COO^-

11. **Which one of the following is not produced by body?**

    a) DNA b) Enzymes c) Harmones d) Vitamins

12. **The number of sp2 and sp3 hybridised carbon in fructose are respectively**

    a) 1 and 4 b) 4 and 2 c) 5 and 1 d) 1 and 5

13. **Vitamin B2 is also known as**

    a) Riboflavin b) Thiamine c) Nicotinamide d) Pyridoxine

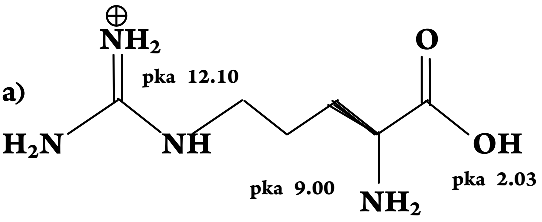
14. **The pyrimidine bases present in DNA are**

    a) Cytosine and Adenine b) Cytosine and Guanine

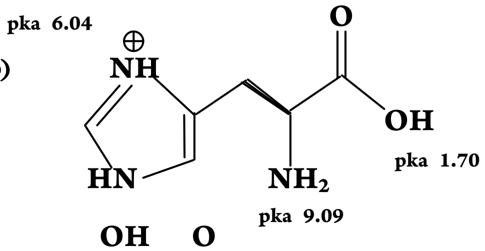
    c) Cytosine and Thiamine d) Cytosine and Uracil

15. **Among the following L-serine is**

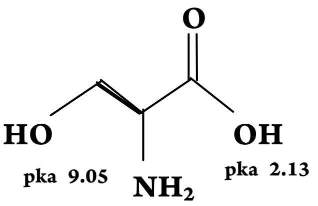
a)



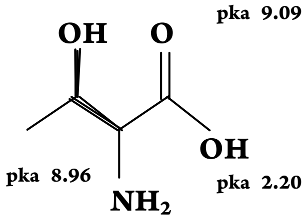
b)



c)



d)



16. The secondary structure of a protein refers to

    a) fixed configuration of the polypeptide backbone b) hydrophobic interaction

    c) sequence of α-amino acids d) α-helical backbone.

17. Which of the following vitamins is water soluble?

    a) Vitamin E b) Vitamin K c) Vitamin A d) Vitamin B

18. Complete hydrolysis of cellulose gives

    a) L-Glucose b) D-Fructose c) D-Ribose d) D-Glucose

19. Which of the following statement is not correct?

    a) Ovalbumin is a simple food reserve in egg-white

    b) Blood proteins thrombin and fibrinogen are involved in blood clotting

    c) Denaturation makes protein more active

    d) Insulin maintains the sugar level of in the human body.

20. Glucose is an aldose. Which one of the following reactions is not expected with glucose?

    a) It does not form oxime b) It does not react with Grignard reagent

    c) It does not form osazones d) It does not reduce tollens reagent

21. If one strand of the DNA has the sequence 'ATGCTTGA', then the sequence of complementary strand would be

    a) TACGAACT b) TCCGAACT c) TACGTACT d) TACGRAGT

22. Insulin, a hormone chemically is

    a) Fat b) Steroid c) Protein d) Carbohydrates

23. α -D (+) Glucose and β-D (+) glucose are

    a) Epimers b) Anomers

    c) Enantiomers d) Conformational isomers

24. Which of the following are epimers

    a) D(+)-Glucose and D(+)-Galactose (b) D(+)-Glucose and D(+)-Mannose

    c) Neither (a) nor (b) (d) Both (a) and (b)

25. Which of the following amino acids are achiral?

    a) Alanine b) Leucine c) Proline d) Glycine

15.CHEMISTRY IN EVERYDAY LIFE

1. Which of the following is an analgesic?

   a) Streptomycin b) Chloromycetin c) Asprin d) Penicillin

2. Antiseptics and disinfectants either kill or prevent growth of microorganisms. Identify which of the following statement is not true.

   a) dilute solutions of boric acid and hydrogen peroxide are strong antiseptics.

   b) Disinfectants harm the living tissues.

   c) A 0.2% solution of phenol is an antiseptic while 1% solution acts as a disinfectant.

   d) Chlorine and iodine are used as strong disinfectants.

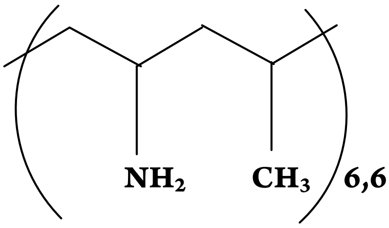
3. Drugs that bind to the receptor site and inhibit its natural function are called

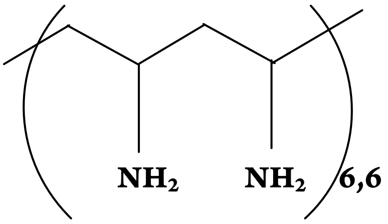
   a) antagonists b) agonists c) enzymes d) molecular targets

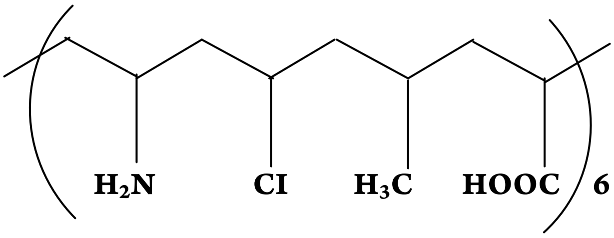
4. Aspirin is a/an

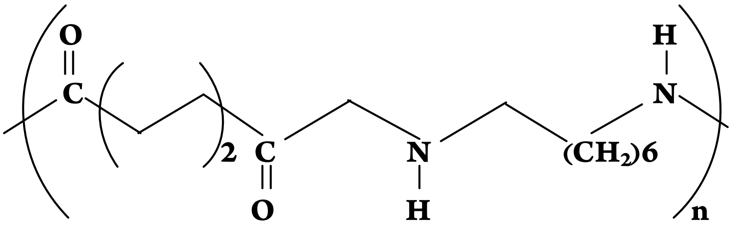
a) acetylsalicylic acid
b) benzoyl salicylic acid
c) chlorobenzoic acid
d) anthranilic acid

5. Which one of the following structures represents nylon 6,6 polymer?

a)


b)


c)


d)


6. Natural rubber has

a) alternate cis- and trans-configuration
b) random cis- and trans-configuration
c) all cis-configuration
d) all trans-configuration

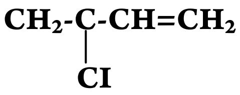
7. Nylon is an example of

a) polyamide
b) polythene
c) polyester
d) poly saccharide

8. Terylene is an example of

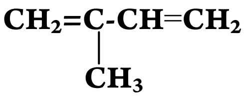
a) Polyamide
b) polythene
c) polyester
d) polysaccharide

9. Which is the monomer of neoprene in the following?

a)

$CH_2\text{-}\underset{\displaystyle CI}{\underset{|}{C}}\text{-}CH{=}CH_2$

b) $CH_2\text{-}CH\text{-}C{\equiv}CH$

c) $CH_2{=}CH\text{-}CH{=}CH_2$

d)

$CH_2{=}\underset{\displaystyle CH_3}{\underset{|}{C}}\text{-}CH{=}CH_2$

10. Which one of the following is a bio-degradable polymer?

a) HDPE
b) PVC
c) Nylon 6
d) PHBV

11. Non stick cook wares generally have a coating of a polymer, whose monomer is

a) ethane
b) prop-2-enenitrile
c) chloroethene
d) 1,1,2,2-tetrafluoroethane

12. Assertion: 2-methyl-1,3-butadiene is the monomer of natural rubber

Reason: Natural rubber is formed through anionic addition polymerisation.

a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) if both assertion and reason are true but reason is not the correct explanation of assertion.
c) assertion is true but reason is false.
d) both assertion and reason are false.

13. Which of the following is a co-polymer?
    a) Orlon b) PVC c) Teflon d) PHBV

14. The polymer used in making blankets (artificial wool) is
    a) polystyrene b) PAN c) polyester d) polythene

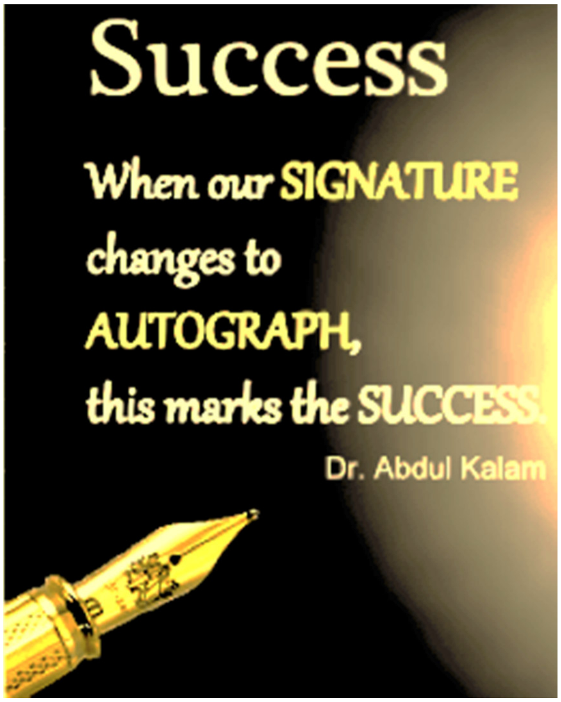
15. Regarding cross-linked or network polymers, which of the following statement is incorrect? (NEET)
    a) Examples are Bakelite and melamine
    b) They are formed from bi and tri-functional monomers
    c) They contain covalent bonds between various linear polymer chains
    d) They contain strong covalent bonds in their polymer chain

*****முடியும் என முயற்சி செய்*****

உண்மை உழைப்பு உயர்வு

"ஒருமைக்கண் தான்கற்ற கல்வி ஒருவற்கு
எழுமையும் ஏமாப்பு உடைத்து"

[ஒரு பிறப்பில் தான் கற்ற கல்வியானது
ஒருவனுக்கு அப்பிறப்பிற்கு மட்டும் அல்லாமல்
ஏழு பிறப்பிலும் உதவும் தன்மையுடையதாகும்]



ஜெயிக்கணும் என்று ஆசைப்படுபவர்கள் எல்லாம் ஜெயிப்பதில்லை
ஜெயிக்கணும் என்று முடிவெடுப்பவர்களே ஜெயிக்கின்றார்கள்.......

வாழ்த்துக்களுடன்......

ப. கதிர்வேல், M.Sc., B.Ed.,
முதுகலை ஆசிரியர் (வேதியியல்)
அரசு ஆண்கள் மேல்நிலைப்பள்ளி
அந்தியூர், ஈரோடு (Dt)