Q.1 Volume occupied by scc is- [1]

(a) 74% (b) 68 (c) 52.4% (d) 75%

Ans. (c) 52.4%

Q.2 With increase in temperature the conductivity of semi conductor [1]

(a) Decreases (b) Increases (c) No change (d) Increases then decreases

Ans. (b) Increases

Q.3 In the coagulation of solution $As_2S_3$ which has maximum coagulating value [1]

(a) NaCl (b) KCl (c) $BaCl_2$ (d) $AlCl_3$

Ans. (a) NaCl

Q.4 Metal always found in free state is [1]

(a) Gold (b) Silver (c) Copper (d) Sodium

Ans. (a) Gold

Q.5 Which has maximum unpaired electrons [1]

(a) $Zn^{+2}$ (b) $Fe^{+2}$ (c) $Ni^{+2}$ (d) $Cu^{+2}$

Ans. (b) $Fe^{+2}$

Q.6 Which is not tranquillizer [1]

(a) Luminal (b) Seconal (c) Valium (d) Bithanol

Ans. (d) Bithanol

Q.7 What is smelting? [1]

Ans. The process of extracting a metal by heating the metal oxide with a suitable reducing agent is called smelting. e.g.

$$PbO + C \rightarrow Pb + CO$$

$$WO_3 + 3H_2 \rightarrow W + 3H_2O$$

$$CuO + CO \rightarrow Cu + CO_2$$

$$Cr_2O_3 + 2AI \rightarrow 2Cr + Al_2O_3.$$

Q.8 Rate of reaction $=[H_2]^0[Cl_2]^0$, according to rate law equation. Predict the order of reaction. [1]

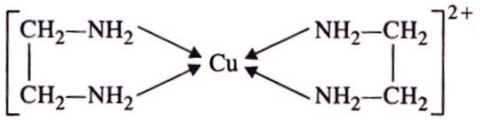
Ans. Order of reaction = zero.

Q.9 Name the metal present in green leaves.

Ans. Mg.

Q.10 Define chelating ligands. [1]

Ans. **Chelating ligands:** When a di or polydetate ligand uses its two or more donor atoms to bind a single metal ion. It is said to be a chelating ligand.e.g.




bis(ethane-1,2-diamine)copper(II) ion

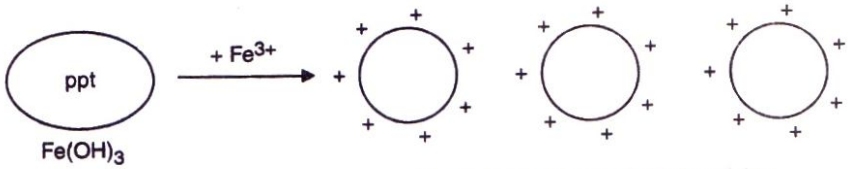
Q.11 Define coagulation and peptisation. [2]

Ans. **Coagulation:** The process of aggregation of colloidal particles into an insoluble precipitate by the addition of some suitable electrolyte is called coaulation. The ion of the electrolyte which neutralizes the charge on the colloidal particles is called effective ion.

(a) For negatively charged sols like $As_2S_3$ sol, the effective ion is cation of the electrolyte.

(b) For positively charged sols like $Fe(OH)_3$ sol, the effective ion is anion of the electrolyte.

**Peptisation:** The process of conversion of a freshly prepared precipiatate into collioidal solution by adding suitable electrolyte is called peptization and the electrolyte ($FeCl_3, HCl\ etc$) being used is called peptizing agent.




Positively charged colloidal particles

Q.12 Differentiate between ideal and non-ideal solutions . [2]

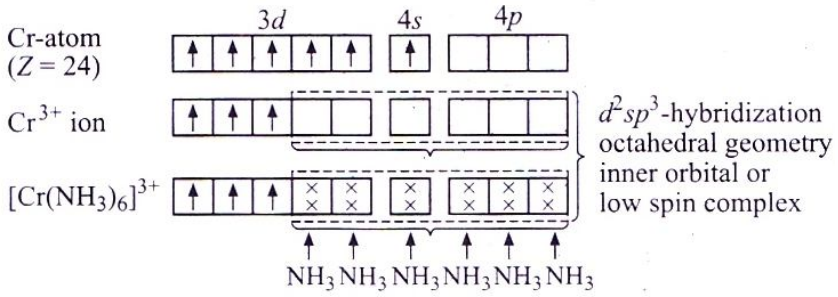
Ans. **Differentiate between ideal and non-ideal solutions**

| S. No | Ideal solutions | Non-ideal solutions |
|---|---|---|
| 1. | The interactions between unlike molecules are of the same order as between like molecules. | The interations between unlilke molecules are different from those between like molecules. |
| 2. | There is no charge in volume on mixing i.e., $\Delta V_{mixing} = 0$. | Change in volume occurs on mixing i.e., $\Delta V_{mixing} \neq 0$. |
| 3. | There is no change in enthalpy on mixing i.e., $\Delta H_{mixing} = 0$. | Enthalpy change occurs on mixing i.e., $\Delta H_{mixing} \neq 0$ |
| 4. | Each component obey Raoult's law at all temperatures and concentrations. | They do not obey Raoult's law. They show positive or negative deviations. |

Q.13 Discuss the geometry, nature and magnetic behavior of $[Cr(NH_3)_6]^{+3}$ ion on the basis of VBT.[2]

Ans. **$[Cr(NH_3)_6]^{+3}$ ion:** The electronic configuration of chromium $(Z = 24)$ $is$ $[Ar]3d^5 4s^1$. The oxidation state of $Cr$ in the complex is +3, i.e., $Cr^{3+}$ ion is formed by less of one 4s and two of $3d$ $-$electrons. In $Cr^{3+}$ ion, two 3d, one 4s and three 4p-orbitals are vacant. These six orbitals hybridize $(d^2sp^3 - hybridization)$ to form six hybrid orbitals directed towards the apices of an octahedron. Six pairs of electrons, one from each $NH_3$ molecule, occupy the six vacant hybrid orbitals. The complex has octahedral geometry.

Since the complex contains three unpaired electrons, hence it is paramagnetic.




Q.14 Explain: [2]

(i) Ferromagnetism (ii) Ferri magnetism

Ans. **(i) Ferromagnetism:** The property by virtue of which certain substances are very strongly attracted by a magnetic field is called ferromagnetism and such substances are called ferromagnetic substances. These substances can also be permanently magnetized.

Example: Iron, nickel, cobalt, gadolinium, $CrO_2$ etc.

**(ii) Ferri magnetism:** The property by virtue of which certain substances which are expected to be ferromagnetic but are in fact weakly attracted by magnetic fields is called ferrimagnetism and such substances are called ferromagnetic substances.

Example: Magnetite $(Fe_3O_4)$, Ferrites like $MgFe_2O_4, ZnFe_2O_4$ etc.

Q.15 How can you distinguish primary, Secondary and Tertiary alcohols by lucas test? [2]

Ans. **Lucas test:** This test is based upon the difference in reactivity of primary $(1^0)$, secondary $(2^0)$, and tertiary $(3^0)$, alcohols with conc. HCl. Alcohols react with an equimolar micture of concentrated hydrochloric acid and anhydrous zinc chloride at room temperature to form alkyl halides.

$$\underset{\text{Alkyl alcohol}}{R\text{—OH}} + \underset{\text{(conc.)}}{HCl} \xrightarrow[\text{Anhyd.}]{ZnCl_2} \underset{\text{Alkyl halide}}{R\text{—Cl}} + H_2O$$

The three types of alcohols undergo this reaction at different rates. The rates of reaction with Lucas reagent $[conc.\,HCl + ZnCl_2\ (anhydrous]$ folow the following order:

Tertiary Alcohol> secondary Alcohol? Primary Alcohol.

$$R-CH_2OH + HCl \xrightarrow[\text{Anhyd.}]{ZnCl_2} \underset{\text{and hence no turbidity at room temperature}}{\text{No reaction}}$$
*primary* Alcohol (conc.)

$$R_2CH-OH + HCl \xrightarrow[\text{Anhyd.}]{ZnCl_2} R_2CH-Cl + H_2O$$
*secondary* Alcohol (conc.) — Turbidity appears in about 5 minutes

$$R_3C-OH + HCl \xrightarrow[\text{Anhyd.}]{ZnCl_2} R_3C-Cl + H_2O$$
*tertiary* Alcohol (conc.) — Turbidity appears immediately

The alkyl chloride formed is insoluble in the medium, thus the solution becomes cloudy before it separates as a distinct layer. The following observations are made:

(a) If cloudiness (white turbidity) appears immediately, the alcohol is tertiary.

(b) If cloudiness appears in about 5 minutes, the alcohol is secondary.

(c) If the solution remains clear, i.e., no cloudiness is formed, the alcohol is primary.

Q.16 Explain: [2]

(i) Variable oxidation state of d-block elements

(ii) d-block elements form alloys.

Ans. **(i) Variable oxidation state of d-block elements**: The variable oxidation uses of transition elements are due to the availability of both $(n-1)d$ and $ns$-electrons for bond formation, as the energies of penultimate d-orbitals and ultimate s-orbital are nearly same. The sum total of $ns$ and unpaired $(n-1)d$ - electrons determines the highest oxidation state shown by a transition element.

**(ii) d-block elements form alloys:** The tendency of transition metals to form alloys can be explained on the basis of their atomic sizes. The atomic size of transition metals are very similar and hence in the crystal lattice, atoms of one metal can readily replaced with atoms of another transition metals. This result in the formation of alloys.

Q.17 Explain: [2]

(i) Cannizzaro Reaction

(ii) De-carboxylation Reaction.

Ans. **(i) Cannizzaro Reaction:** Aldehydes that have no $\alpha$ –hydrogen undergo intermolecular oxidation-reduction (disprotionation) when they are treated with concentrated alkali solution. This reaction, known as Cannizzaro Reaction, yields a mixture of an alcohol and a salt of carboxylic acid.

$$\underset{\text{Formaldehyde}}{2HCHO} + \underset{(50\%)}{NaOH} \longrightarrow \underset{\text{Methyl alcohol}}{CH_3OH} + \underset{\text{Sodium formate}}{HCOONa}$$

$$\underset{\text{Benzaldehyde}}{2C_6H_5—CHO} + \underset{(50\%)}{NaOH} \longrightarrow \underset{\text{Benzyl alcohol}}{C_6H_5—CH_2OH} + \underset{\text{Sodium benzoate}}{C_6H_5—COO^-Na^+}$$

**(ii) De-carboxylation Reaction:** The reaction whereby a carboxylic acid loses $CO_2$ is called a decarboxylation. When sodium salt of a monocarboxylic acid is heated strongly at 630 K with sodalime, a molecule of carbon dioxide is eliminated as carbonate along with the formation of alkance.

$$\underset{\text{Sodium carboxylate}}{R—COONa} + NaOH \xrightarrow[630K]{CaO} \underset{\text{Alkane}}{R—H} + Na_2CO_3$$

$$\underset{\text{Sodium acetate}}{CH_3COONa} + NaOH \xrightarrow[630K]{CaO} \underset{\text{Methane}}{CH_4} + Na_2CO_3$$

$$\underset{\text{Sodium propionate}}{CH_3CH_2COONa} + NaOH \xrightarrow[630K]{CaO} \underset{\text{Ethane}}{CH_3—CH_3} + Na_2CO_3$$

$$\underset{\text{Sodium benzoate}}{C_6H_5COONa} + NaOH \xrightarrow[630K]{CaO} \underset{\text{Benzene}}{C_6H_6} + Na_2CO_3$$

Q.18 Explain: [2+1]

(a) Molality is prepared over molarity why?

(b) Give the example of pseudohalogen.

Or

(a) Which has higher boliling point 0.1 M NaCl or 0.1 M Glucose?

(b) Define Analgesics.

Ans. **(a) Molality is prepared over molarity:** Molality is a mass/mass relationship. So it does not changes with temperature. On the other hand, molarity is a mass/volume relationship and such changes with change in temperature.

**(b) Example of pseudohalogen:** Cyanogen $(CN)_2$, thiocyanogen $(SCN)_2$ Cobalt tetracarbonyl $Co(CO)_4$, Dicobalt octacarbonyl $CO_2(CO)_8$.

Or

(a) 0.1 M NaCl.

**(b) Analgesics:** Medicines used for relieving pain in the body by acting on the central nervous system are called analgeics.

**Example:** Morphine, Codeine, Analgin, Naproxen.

Q.19 (a) Explain why Haloalkanes give cyanide with KCN(alc.) and isocyanide with $AgCN(alc.)$. [2+1]

(b) What is the monomer of natural rubber?

Ans. (a) KCN is an ionic solid which ionizes in polar solvents like ethanol to give $CN^-$ ions.

$$K^+CN^- \rightleftharpoons K^+ + CN^-$$

Attack of $CN^-$ on alkyl halides gives Alkyl cyanide as the main product.

$$R - X + CN^- \rightarrow R - C \equiv N + X^-$$

On the other hand, AgCN is a covalent solid in which Ag – CN bond has a large covalent character. As such, it does not give $CN^-$ ions to act as neucleophiles. Here $Ag - c \equiv \dot{N}$ itself act as a necleophile with the lone pair of electrons on nitrogen acting as electrophilic centre.

$$Ag - C \equiv N: \quad + \quad R - X \rightarrow R - N \overrightarrow{=} C + AgX$$

(b) Monomer of natural rubber is isoprene

$$CH_2 = \underset{\underset{CH_3}{|}}{C} - CH = CH_2$$

2-Methyl -1, 3-butadiaene

Q.20 (a) What is Activation energy? [1+1+1]

(b) What are the units of rate constant for second order reaction?

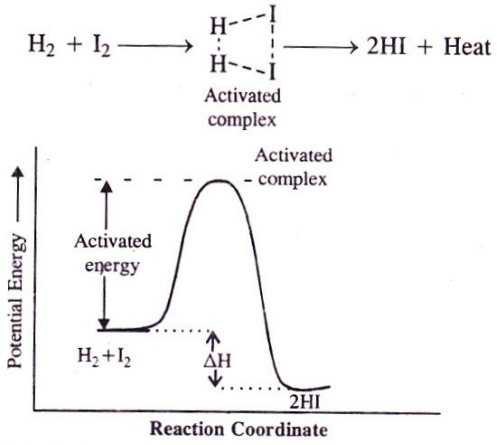
(c) Write Arrhenius equation.

Ans. **(a) Activation energy:** It is the excess energy required by the reacants to undergo chemical reaction. It is equal kto the excess to the different between the threshold energy meeded for the reaction and the average kinetic energy of all reacting molecules.

Activation energy = Threshold energy – Average kinetic energy of reactant molecules.

Larger the activation energy slower is the reaction and smaller the activation energy, faster is the reaction.

Consider an exothermic reaction,



(b) **Units of rate constant for second order reaction:** $L\ mol^{-1}S^{-1}$.

(c) Arrhenius equation: $k \propto e^{-E_a/RT}$

$$k = Ae^{-E_a/RT}$$

Here, A is a constant of proportionality and is known as frequency factor.

Q.21 (a) Draw the structure of $XeF_4$. [1+1+1]

(b) Define interhalogen compounds.

(c) Draw structure of $SF_6$.

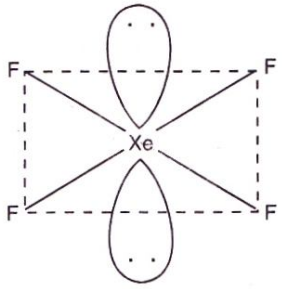
Or

(a) $H_2SO_4$ is viscous in nature why?

(b) All bonds in $PCl_5$ are not equivalent why?

(c) $H_3PO_3$ is diprotic, why?

Ans. **(a) Structure of $XeF_4$:** In $XeF_4$, Xe is $sp^3d^2$-hybrised with two fully and four half filled hybridised orbitals. Therefore, $XeF_4$ has a square planar in which Xe atom is present in the centre of a squre and the four bond pairs are directed towards its four corners and two lone pair lie above and below the square plance.



Structure of $XeF_4$
(Square planar)

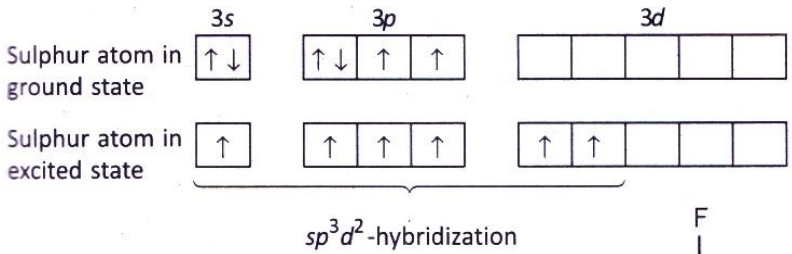
**(b) Interhalogen compounds:** Halogens have a tendency to combine mutally to form covalent compounds, called interhalogen compounds. The formation of these compounds is due to small electronegativity difference between the combining halogen atoms e.g.,

$$I_2 + Cl_2 \longrightarrow 2ICl$$
Iodine monochloride

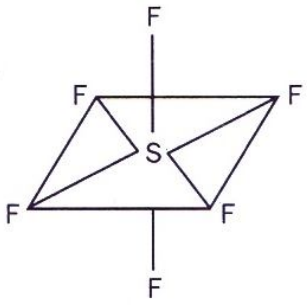
$$I_2 + 5F_2 \xrightarrow{\Delta} 2IF_5$$
Iodine pentafluoride

$$Cl_2 + 3F_2 \xrightarrow{\Delta} 2ClF_3$$
Chlorine trifluoride

**(c) Structure of $SF_6$:** S form hexafluorides showing the maximum valency of six. This involve $sp^3d^2 -$ hybridization.

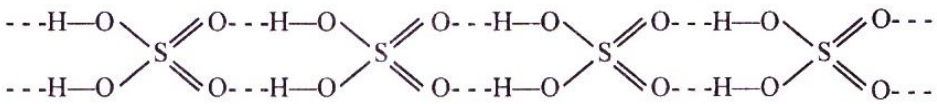



Thus. Hexaflouides possess octahedral structure.




Or

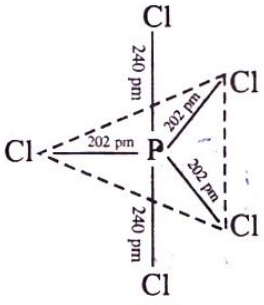
(a) $H_2SO_4$ is viscous in nature because hydrogen bonding in conc. $H_2SO_4$ as shown below:



Extensive hydrogen bonding in conc. $H_2SO_4$. Due to this hydrogen bonding the intermolecular forces are quite strong. Therefore, conc. $H_2SO_4$ is viscous.

(b) Ground state electronic configuration of phosphorus (Z = 15) is as follows:

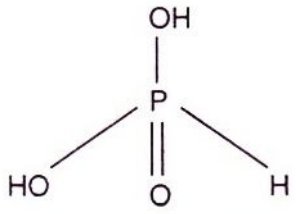
$$P(Z = 15): 1s^2 2s^2 2p^6 3s^2 3p_x^1 3p_y^1 3p_z^1$$




Structure of $PCl_5$ in gas phase

To form five bonds in $PCl_5$, the pair of electrons in 3s-orbital unpair with the promotion of one electron to empty 3d-orbital. This is followed by $sp^3d$- hybridization which gives five half filled equivalent orbitals for the formation of five sigma bonds with five chlorine atoms. Thus $PCl_5$ has trigonal bipyramidal geomatery. In $PCl_5$ the three equatorial P-Cl bonds are equivalent while the two kaxial bonds are different. The two axial P-Cl bonds are longer thab three equatorial P-Cl bonds.

**(c) $H_3PO_3$ is diprotic:** It is diprotic acid because it has only two $-OH$ groups.




Structure of $H_3PO_3$

Q.22 (a) Explain Ni-Cd storage cell. [2+1]

(b)Define secondary cells.

Or

(a) Define Faraday's First Law.

(b) Differentiate between Primary and Secondary cells.

Ans. **(a) Ni-Cd storage cell:** It is also a common storage battery. It is more expensive than the lead storage attery but it is light, therefore, used in calculators, portable oower tools, etc.

It is a voltaic cell consisting of an anode of cadmium and a cathode of hybrated nickel oxide on nickel. The electrolyte in the cell is aqueous solution of potassium hydrolyte in the cell is aqueous solution of potassium hydroxide. Electrode processes are given below:

**Anode:** $Cd(s) + 2OH^-(aq) \longrightarrow Cd(OH)_2 + 2e^-$

**Cathode:** $NiO_2(s) + 2H_2O(l) + 2e^- \longrightarrow Ni(OH)_2 + 2OH^-$

$$Cd(s) + NiO_2(s) + 2H_2O(l) \longrightarrow Cd(OH)_2 + Ni(OH)_2$$

The potential of this cell is about 1.4 volt.

In the recharging of the cell the process is reversed.

**(b) Secondary cells:** Once a dry cell is completely discharged (has come to equilibrium), the cell is not reversed or recharged and it is normally discharged.

The cell in which original reactants are regeneratedf passing direct current from external source, i.e., it is recharged, is called secondary cell. Some examples of secondary cells are: lead storage battery and Nickel-Cadmium storage cell.

Or

**(a) Faraday's First Law:** When an electric current is passed through an electrolyte, the amount of substance deposited is proportional to the quantity of electric charge passed through the electrolyte.

If W be the mass of the substance deposited by passing Q coulomb of charge, then according to the law, we have the relation:

$$W \propto Q$$

A coulomb is the quantity o charge when a current of one ampere is passed for one second. Thus, amount of charge in coulombs,

$$Q = \text{Current in amperes} \times \text{Time in seconds}$$

$$= i \times t$$

So, $W \propto i \times t$

Or $W = Z \times i \times t$

Where, Z is a constant, known as electrochemical equivalent and is characteristic of the substance deposited.

(b) **Primary Cells**: In this cell, once the chemicals have been consumed, further reaction is not possible. It cannot be regenerated or recharged by reversing the current flow through the cell using an external direct current source of electrical energy. The most common example of this cell is a dry cell.

**(b) Secondary cells:** Once a dry cell is completely discharged (has come to equilibrium), the cell is not reversed or recharged and it is normally discharged.

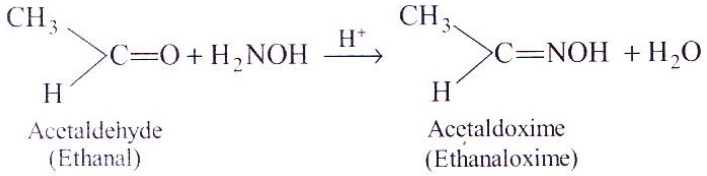
The cell in which original reactants are regeneratedf passing direct current from external source, i.e., it is recharged, is called secondary cell. Some examples of secondary cells are: lead storage battery and Nickel-Cadmium storage cell.

Q.23 (a) Give reaction of $CH_3CHO$ with $NH_2OH$. [1+1+1]

(b) Define elastomer.

(c) Explain Wolf-Kishner Reduction.

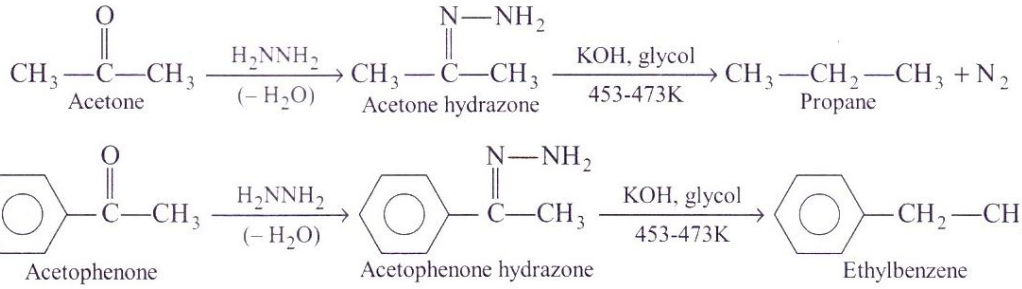
Ans. **(a) Reaction of $CH_3CHO$ with $NH_2OH$:**




**(b) Elastomer:** These are the polymers having very weak intermolecular forces of attraction between the polymer chains.

Vulcanised rubber is a very important elastomer and other examples are natural rubber, Buna-S or SBR [a copolymer of butadiene (75%), styrene (25%)] and neoprene.

**(c) Wolf-Kishner Reduction:** The reaction involves the nucleophilic of hydrazine followed by elimination of water to form a hydrazone. On heating with KOH or potassium tert-butoxide in a high boiling solvent such as ethylene glycol hydrazone decomposes with the loss of nitrogen to form hydrocarbon.




Q.24 (a) Which group of elements in modern periodic table is known as Chalcogens? [1+1+1]

(b) Cu(I) compounds are colourless whereas Cu(II) compounds are coloured, why?

(c) Many transition elements act as good catalyst . Why?

Ans. (a) Group-16, elements.

(b) Electronic configuration of Cu (Z = 29), $Cu^{+} and\ Cu^{2+}$ are as follows:

$$Cu(Z = 29): [Ar]^{18}3d^{10}4s^{1}$$

$$Cu^{+} : [Ar]^{18}3d^{10}\ and\ Cu^{2+} : [Ar]^{18}3d^{9}$$

Cu(I) is colourless because it has $3d^{10}$ configuration and there is no unpaired electron on the other hand Cu(II) has $3d^{9}$ configuration and there is unpaired electron. So Cu(II) is colourless.

(c) Many transition netals and their compounds are found to act as catalyst. Because of the presence of the incomplelte d-subshell, they can form unstable intermediate products with the reactants. These intermediates give reaction path of lower activation energy and therefore increase the rate of reaction.

**For example:**

(i) Finally divided nickel, platinum and palladium are used as a catalyst in hydrogenation.

(ii) $V_2O_5$ is used for the is used for the oxidation of $SO_2\ to\ SO_3$ in the Contact process for the manufacture of $H_2SO_4$.

(iii) Iron and molybdenum are used as catalyst in the manufacture of ammonia from $N_2\ and\ H_2$ in Haber's process.

Q.25 (a) What are essential and non-essentail amino acids? [2+1]

(b) Give chemical name of Vitamin-A.

Ans. (a) **Essential amino acids:** Amino acids which cannot be synthesized in the body and must therefore be obtained through diet are known as essential amino acid.

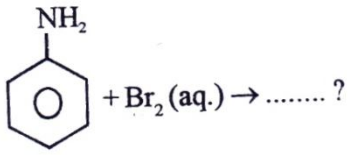
**For example:** Lysine, valine, leucine etc.

**Non-essentail amino acids:** Amino acids which can be synthesized in the body are known as non-essential amino acids.

**For example:** Gylcine, alanine, proline etc.

(b) Thiamine.

Q.26 (a) Explain the basically of Primary, Secondary and Tertiary ammines. [1+1+1+1]

(b) 


(c) Convert ethylcyanide to propylamine.

Or

(a) Convert ethylamine to methylamine.

(b) Convert Nitrobenezene into benzene diazonium chloride.

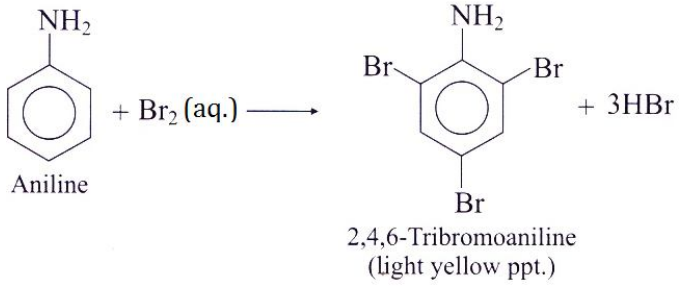
(c) What is Hinsberg Reagent?

(d) Why aniline is less basic than ethylamine?

Ans. (a) The crowding of alkyl groups cover nitrogen atom from all sides and thus, makes the approach and bonding by a proton relatively difficult which results the maximum steric strain in tertiary amines. The electrons are there but the path is blocked, resulting the reduced in its basically.

The order of basic nature of various amines has been found to vary with the nature of alkyl groups.

| Alkyl group | Relative strength |
|---|---|
| $CH_3—$ | $R_2NH > RNH_2 > R_3N > NH_3$ |
| $C_2H_5—$ | $R_2NH > R_3N > RNH_2 > NH_3$ |

(b) 


(c) $CH_3 - CH_2 - C \equiv N + 4[H] \xrightarrow[\text{or } LiAlH_4]{H_2/\text{Raney Ni}} CH_3 - CH_2 - CH_2 - NH_2.$

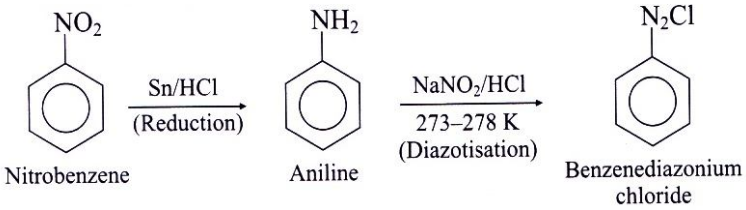
Or

(a) $CH_3 - CH_2 - NH_2 \xrightarrow{NaNO_2,2HCl} CH_3 - CH_2 - N_2Cl$

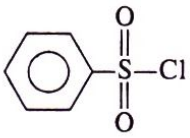
$\xrightarrow{H_2O} CH_3 - CH_2 - OH \xrightarrow{KMnO_4} CH_3 - \overset{O}{\overset{\|}{C}} - OH \xrightarrow{NH_3} CH_3 - \overset{O}{\overset{\|}{C}} - NH_2$

$\xrightarrow{Br_2/4KOH} CH_3 - NH_2 + 2KBr + K_2CO_3$

(b) **Nitrobenezene into benzene diazonium chloride:**



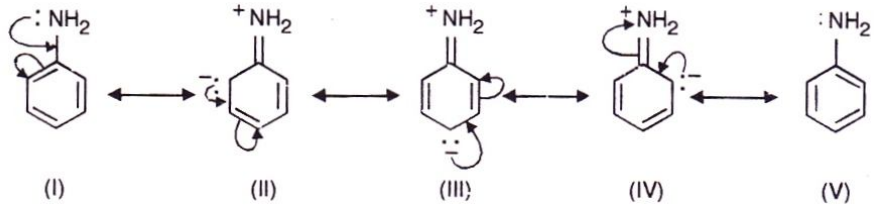

**(c) Hinsberg Reagent:** It is benezenesulphonyl chloride.




Benzenesulphonyl chloride

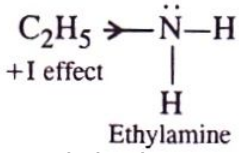
**(d) Aniline is less basic than ethylamine:-**

Aniline may be regarded as a resonanace hybrid of the following five contributing structures $(I - V)$.




Due to resonance, the lone of electron on the nitrogen atom gets delocalised over the benzene ring and thus it is less easily available for protonation. At the same time nitrogen acquires some positive charge (II to IV) and this repels the incoming proton.

On the other hand, in ethylamine, the delocalization of lone pair of electrons on the nitrogen atom by resonance is not possible. Moreever, the electron density on the nitrogen is increased by the electron releasing inductive effect (+1 effect) of ethyl group.




Ethylamine

Hence aniline is weaker base than ethylamine.

Q.27 (a) What is Tollen's Reagent? [1+1+1]

(b) Give synthesis of Buna-S.

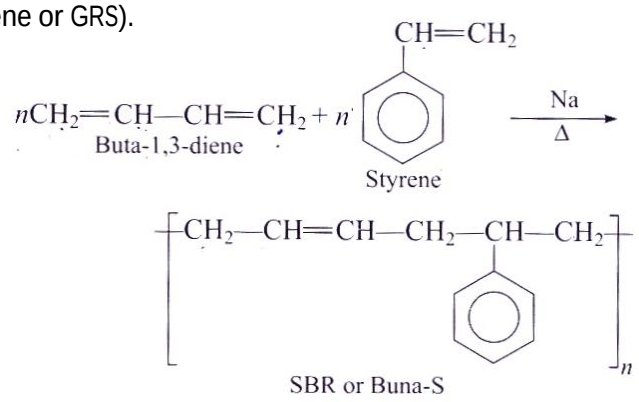
(c) Name the enzyme which convents glucose into ethanol.

(d) Reaction of $CH_3CHO$ with $NH_2NH_2$.

Ans. **(a) Tollen's Reagent:** It is Ammonical Silver Nitrate

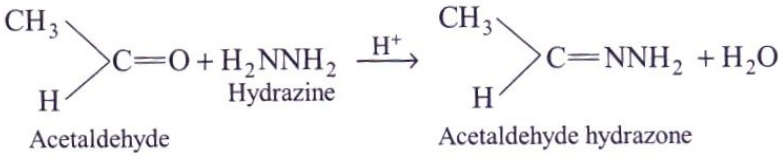
$$2[Ag(NH_3)_2]^+$$
$$Tollen's\ regent$$

**(b) Synthesis of Buna-S:**Buna-S rubber is a copolymer of three moles of butadiene and one mole of styrene in presence of sodium. In Buna-S, 'Bu' stands for butadiene 'na' for symbol of sodium (Na) which is polymerizing agent and S stands for styrene. It is an elastomer, (General purpose Rubber Styrene or GRS).




(c) Zymase.

**(d) Reaction of $CH_3CHO$ with $NH_2NH_2$:**




Q.28 (a) Haloalkanes are polar in nature though they are practically insolub;e in water, why? [2+1+1]

(b) Why Nitrogen is less reactive?

(c) Define Molar conductivity.

Ans. **(a)Due to different states of hybridization of C-atom:** In chlorobenzene, carbon atom is $sp_2$-hybridised while in cycloheyl chloride, carbon atom is $sp_3$-hybridised. As electronegativity of $sp_3$-hybridised C-atom is more than that of $sp_2$-hybridised C-ato. It decreases the magnitude of negative charge on chlorine atom in chlorobenzene. This decreases the polarity of the $C-Cl$ bond in chlorobenzene and hence its dipole moment.

In water, the $H_2O$ molecules are held together by strong H-bond. Despite the polarity of alkyl halides, alkyl halides cannot form H-bond with water molecules. As alkyl halides cannot form

new bonds with water molecules, it cannot break the strong H-bond present between water molecules. Thus, alkyl halides, though polar, are immiscible (not soluble) with water.

(b) **Nitrogen is less reactive:** Nitrogen exists as a diatomic molecule ($N \equiv N$).Due to the presence of a triple bond between the two N-atoms, the bond dissociation energy is large. As a result, nitrogen is inert and unreactive in its elemental state.

**(c) Molar conductivity:** The Molar conductance of an electrolytic solution is defined as the conductance of all the ions produced by ionization of 1 g mole of an electrolyte. It is denoted by $A_m$ or $\mu$.

Mathematically, it may be defined as,

$$\Lambda_m = \kappa \times V \qquad \text{.....(i)}$$

Where, V = volume of an electrolytic solution containing 1g mole of electrolyte

Let molarity of solution be 'M'

$\therefore$ $$V = \frac{1000}{M} \qquad \text{.....(ii)}$$

From equation (i) and (ii), $\Lambda_m = \kappa \times \frac{1000}{M}$ .....(iii)

Its unit are $ohm^{-1}cm^2mol^{-1}$.