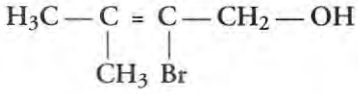
Chemistry 2017 (Outside Delhi) SET I

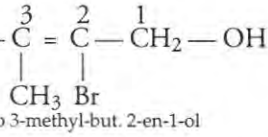
Time allowed : 3 hours **Maximum marks : 70**

1. **Write the formula of the compound of phosphorus which is obtained when conc. HNO_3 oxidises P_4.**** [1]

2. **Write the IUPAC name of the following compound :** [1]



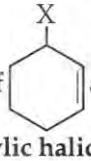
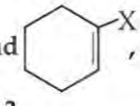
Answer :

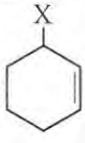


2-Bromo 3-methyl-but. 2-en-1-ol

3. **What is the effect of adding a catalyst on** [1]
   (a) Activation energy (E_a), and
   (b) Gibbs energy (ΔG) of a reaction ?

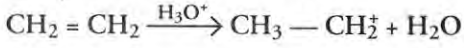
   Answer : On adding a catalyst
   (a) Activation energy of the reaction decreases.
   (b) Gibbs energy doesn't change.

4. **Out of**  **and**  **, which is an example of allylic halide ?** [1]

Answer :  is an example of allylic halide

5. **What type of colloid is formed when a liquid is dispersed in a solid ? Give an example.** [1]
   Answer : When a liquid is dispersed in solid, 'gel' colloid is formed. **Examples** Jelly, butter, cheese, curd etc.

6. **(a) Arrange the following compounds in the increasing order of their acid strength :** [2]
   ***p*-cresol, *p*-nitrophenol, phenol**
   (b) Write the mechanism (using curved arrow notation) of the following reaction :

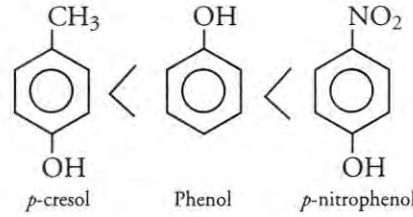


OR

Write the structures of the products when Butan-2-ol reacts with the following :
   (a) CrO_3
   (b) $SOCl_2$

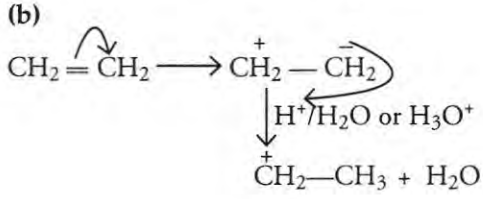
Answer :

(a)



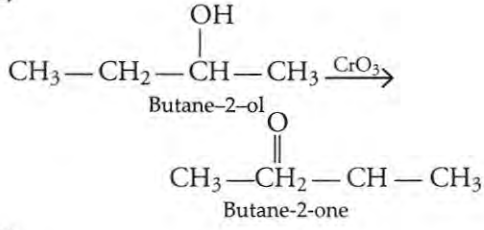
p-cresol Phenol *p*-nitrophenol

(b)



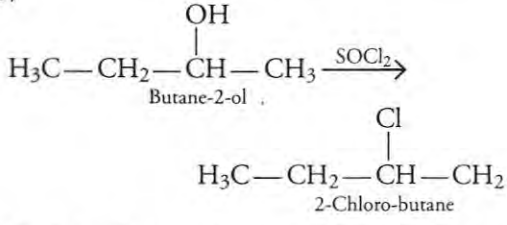
OR

(a)



Butane–2–ol Butane-2-one

(b)

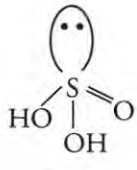


Butane-2-ol 2-Chloro-butane

7. **Calculate the number of unit cells in 8.1g of aluminium if it crystallises in a face-centred cubic (f.c.c.) structure. (Atomic mass of Al= 27 g mol^{-1})**** [2]

8. **Draw the structures of the following :**
   (a) H_2SO_3
   (b) $HClO_3$ [2]

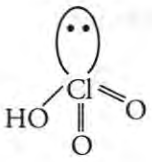
Answer : (a)



****Answer is not given due to the change in present syllabus.**

H_2SO_3

(b)



$HClO_3$

9. Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell. [2]

Answer : Electrolytic cells are generally used is hearing aids. At cathode, reduction of metal takes place and at anode, oxidation of metal takes place.

Cathode : $M + e^- \longrightarrow M^+$

Anode : $M^+ \longrightarrow M + e^-$

10. Using IUPAC norms write the formulae for the following :

(a) Sodium dicyanidoaurate (I)

(b) Tetraamminechloridonitrito-N-platinum (IV) sulphate [2]

Answer : (a) Sodium dicyanoaurate (I)

$Na\,[Au\,(CN)_2]$

(b) Tetraammine chloridonitrito–N–platinum (IV) Sulphate $[Pt\,(NH_3)_4(Cl)\,(NO_2)]SO_4$

11. (a) Based on the nature of intermolecular forces, classify the following solids :**

Silicon carbide, Argon

(b) ZnO turns yellow on heating. Why ?**

(c) What is meant by groups 12-16 compounds ? Give an example. [3]**

12. (a) The cell in which the following reaction occurs :

$2Fe^{3+}\,(aq) + 2I^-(aq) \longrightarrow 2Fe^{2+}\,(aq) + I_2(s)$

has E^o_{cell} = 0.236 V at 298 K. Calculate the standard Gibbs energy of the cell reaction. (Given : 1F = 96,500 C mol^{-1})

(b) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours ? (Given : 1 F = 96,500 C mol^{-1}) [3]

Answer : (a) $\Delta G^o = -nF\,E^o cell$

$= -2 \times 96500 \times 0.236$

$= -45.548$ kJ/mol

(b) According to Faraday's first law the amount of metal deposited (W).

$W = i \times t$

$= 0.5 \times 7200$

$= 3600C$

$\because$ $1F = 96500$ C mol^{-1}

That is e^- flows from 96500 C = 1 mol

$\therefore$ e^- flows from 3600 C $= \dfrac{1 \times 3600}{96500\ mol}$

$= 0.037$ mol.

No. of electrons $= 0.037 \times 6.023 \times 10^{23}$

$= 0.2246 \times 10^{23}$

$= 22.46 \times 10^{21}$ electrons

13. (a) What type of isomerism is shown by the complex $[Co(NH_3)_5\,(SCN)]^{2+}$?

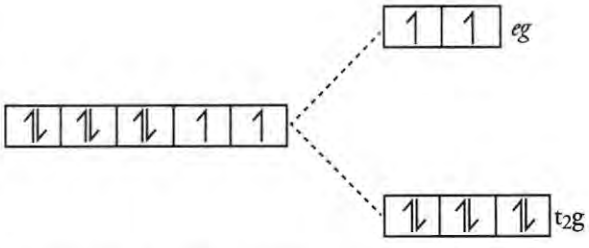
(b) Why is $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic ? (Atomic number of Ni = 28)

(c) Why are low spin tetrahedral complexes rarely observed ? [3]

Answer : (a) Linkage isomerism

(b) $[NiCl_4]^{2-}$, $Ni^{2+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^8$

Cl^- is a weak field ligand.

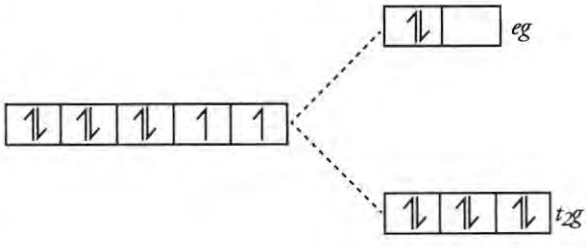


2 electrons are unpaired in $[NiCl_4]^{2-}$ which provides paramagnetism to the complex.

$[Ni(CN)_4]^{2-}$

$Ni^{2+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^8$

CN^- is a strong field ligand



no electron is unpaired in $[Ni\,(CN)_4]^{2-}$ That's why the complex is diamagnetic.

****Answer is not given due to the change in present syllabus.**

(c) In tetrahedral complex, CFSE is very low and it is difficult for the tetrahedral complexes to exceed the pairing energy. Usually electrons prefer to move to higher energy orbitals for pairing. Thus they usually forms high spin complexes.

$$(CFSE)_{\text{tetrahedral}} = \frac{4}{9}(CFSE)_{\text{octahedral}}$$

14. Write one difference in each of the following :

(a) Multimolecular colloid and Associated colloid

(b) Coagulation and Peptization

(c) Homogeneous catalysis and Heterogeneous catalysis **[3]**

OR

(a) Write the dispersed phase and dispersion medium of milk.

(b) Write one similarity between physisorption and chemisorption.

(c) Write the chemical method by which $Fe(OH)_3$ sol is prepared from $FeCl_3$.

Answer :

(a) Multimolecular colloids are the colloids in which the dispersed phase consists of aggregates of atoms or molecules with molecular size less than 1nm whereas associated colloids are the substances that are dissolved in a medium, behave as normal electrolytes at low concentration but as colloids at higher concentration.

(b) Coagulation is the process of precipitation of a colloidal solution by the addition of excess of an electrolyte whereas peptization is the process responsible for the formation of stable dispersion of colloidal particles in dispersion medium.

(c) Homogeneous catalysis is the one in which the phases of the reactants and the catalysts are the same whereas in heterogeneous catalysis the phases of the reactants and the catalysts are not the same.

OR

(a) Milk

Dispersed phase — Liquid

Dispersion medium— Liquid

(b) Both physisorption and chemisorption depends on the surface area. Both increases with an increase in the surface area.

(c) $Fe(OH)_3$ sol is prepared from $FeCl_3$ by hydrolysis method.

$$FeCl_3 \longrightarrow Fe^{3+} + 3Cl^-$$

$$Fe(OH)_3 + Fe^{3+} \longrightarrow [Fe(OH)_3]Fe^{3+}$$

(Colloidal solution)

15. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed.

Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021) **[3]**

Answer : For first order reaction.

$$K = \frac{2.303}{t}\log\frac{a}{a-x}$$

$a \rightarrow$ initial amount

$a - x \rightarrow$ amount left after time

for 25% decomposition :

$$K = \frac{2.303}{20}\log\frac{100}{75} \quad \text{.....(1)}$$

for 75% decomposition :

$$K = \frac{2.303}{t}\log\frac{100}{25} \quad \text{.....(2)}$$

K is constant throughout the process eq. (1) = eq. (2)

Thus on comparing eq. (1) and eq. (2) we have

$$\frac{2.303}{20}\log\frac{100}{75} = \frac{2.303}{t}\log\frac{100}{25}$$

$$\frac{1}{20}(\log 100 - \log 75) = \frac{1}{t}(\log 100 - \log 25)$$

$$\frac{1}{2}[2 - 1.875] = \frac{1}{t} \quad [2 - 1.398]$$

$$\frac{0.125}{2} = \frac{0.602}{t}$$

$$t = \frac{1.204}{0.125}$$

$$t = 9.632 \text{ minutes}$$

16. The following compounds are given to you :

2-Bromopentane, 2-Bromo-2-methylbutane, 1–Bromopentane

(a) Write the compound which is most reactive towards S_N2 reaction.

(b) Write the compound which is optically active.

(c) Write the compound which is most reactive towards β-elimination reaction. **[3]**

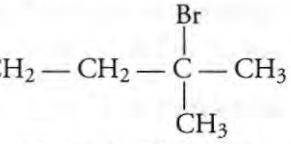
Answer :

(a) 1-bromopentane > 2-bromopentane > 2-bromo-2-methylpentane (Reactivity towards, S_N2 reaction)

(b) 2-bromopentane

$CH_3CH_2CH_2CHBrCH_3$

(c)



2-bromo-2-methylpentane

This compound is most reactive towards β-elimination.

17. Write the principle of the following :

(a) Zone refining

(b) Froth floatation process

(c) Chromatography [3]

Answer :

(a) Zone refining

1. This process is used for the metals which are required in very high purity like silicon, germanium, boron, gallium etc.
2. This method is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.
3. In this method, impure metal is casted into a thin bar.

(b) Froth floatation process

1. This method is based on the principle that difference in the wetting properties of the ore and gangue particles with water and oil.
2. This method is used for the extraction of those metals in which the ore particles are preferentially wetted by oil and gangue by water.
3. This method has been used for the concentration of sulphide ores like PbS, ZnS, $CuFeS_2$ etc.

(c) Chromatography

1. This is a modern method of purification based on the difference in the adsorbing capacities of the metal and its impurities on a suitable adsorbent.
2. This technique is based on the principle that different components of a mixture are differently adsorbed on an adsorbent.

18. Write the structures of compounds A, B and C in the following reactions :

(a) $CH_3COOH \xrightarrow{NH_3/\Delta} A \xrightarrow{Br_2/KOH(aq)} B$

$\xrightarrow{CHCl_3+alc.\ KOH} C$

(b) $C_6H_5N_2^+BF_4^- \xrightarrow[\Delta]{NaNO_2/Cu} A \xrightarrow{Fe/HCl} B$

$\xrightarrow{CH_3COCl/pyridine} C$ [3]

Answer :

(a) $CH_3COOH \xrightarrow{NH_3/\Delta} \underset{(A)}{CH_3CONH_2} \xrightarrow{Br_2/KOH\ (aq)}$

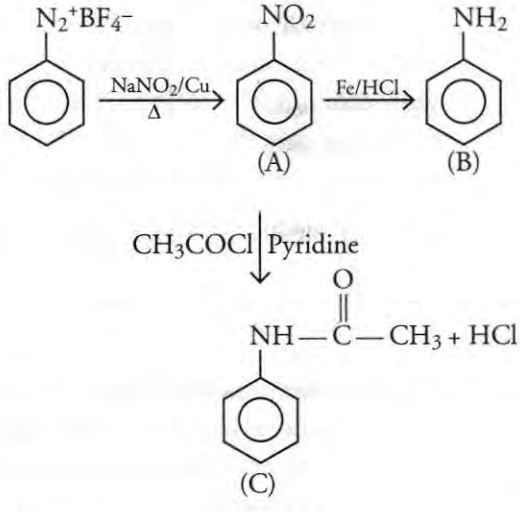
$\underset{(C)}{CH_3NC} \xrightarrow{CH_3Cl_3 + alc\ KOH} \underset{(B)}{CH_3NH_2}$

(A) $CH_3CONH_2 \rightarrow$ Acetamide

(B) $CH_3NH_2 \rightarrow$ Methylamine

(C) CH_3NC—Methylisocyanide

(b)



(A) Nitrobenzene — $C_6H_5NO_2$

(B) Aniline — $C_6H_5NH_2$

(C) Acetanilide — $C_6H_5NHCOCH_3$

19. Write the structures of the monomers used for getting the following polymers :

(a) Nylon-6,6

(b) Melamine-formaldehyde polymer

(c) Buna-S [3]

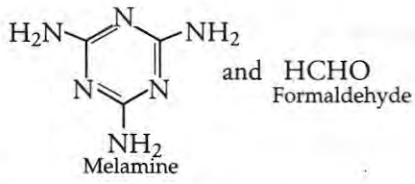
Answer :

(a) Monomers of Nylon-6,6

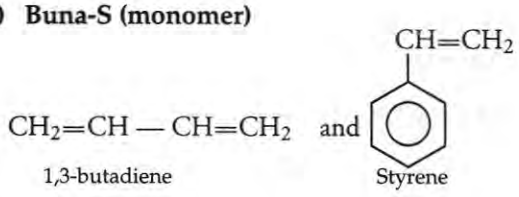
$H_2N—(CH_2)_6—NH_2$ and $HOOC—(CH_2)_4—COOH$

Hexamethylenediamine Adipic acid

(b) Monomers of Melamine-formaldehyde polymer



(c) Buna-S (monomer)



20. Define the following : [3]

(a) Anionic detergents

(b) Limited spectrum antibiotics

(c) Antiseptics

Answer :

(a) Anionic detergents : These detergents contain anionic hydrophilic group. These are manufactured from long chain of alcohols. These long chain alcohols are treated with conc. H_2SO_4 to form alkyl hydrogen sulphates of high molecular mass and then are neutralized with alkali to form salts.

$$\underset{\text{Lauryl alcohol}}{CH_3(CH_2)_{10}CH_2OH} \xrightarrow{H_2SO_4} \underset{\text{Lauryl sulphonate}}{CH_3(CH_2)_{10}OSO_3H} \xrightarrow[(aq.)]{NaOH} \underset{\text{Sodium lauryl sulphonate}}{CH_3(CH_2)_{10}OSO_3^-Na^+}$$

(b) Limited Spectrum Antibiotics : The antibiotics which are effective against single organism or disease are called limited spectrum antibiotics, example–streptomycin.

(c) Antiseptics : The chemical substances that are used to either kill or prevent the growth of micro-organisms are called antiseptics. These are not harmful to living tissues and can be safely applied on wounds, cuts, ulcers etc., example Soframycin.

21. Give reasons for the following :

(a) Red phosphorus is less reactive than white phosphorus.**

(b) Electron gain enthalpies of halogens are largely negative.

(c) N_2O_5 is more acidic than N_2O_3.** [3]

Answer :

(b) Electron gain enthalpies of halogens are largely negative in their respective periods. This is due to the fact that the atoms of these elements have only one electron less than the stable noble gas ($ns^2\ np^6$) configuration. Therefore, they have maximum tendency to accept an additional electron.

****Answer is not given due to the change in present syllabus.**

22. Give reasons for the following :

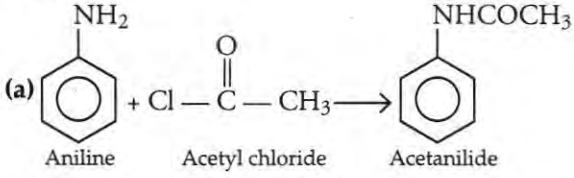
(a) Acetylation of aniline reduces its activation effect.

(b) CH_3NH_2 is more basic than $C_6H_5NH_2$.

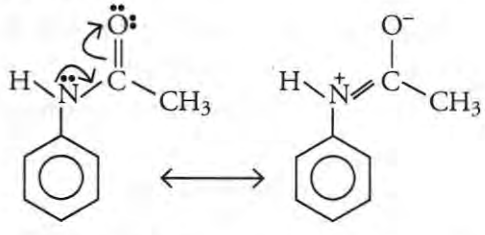
(c) Although-NH_2 is *o/p* directing group, yet aniline on nitration gives a significant amount of m-nitroaniline. [3]

Answer :

(a)

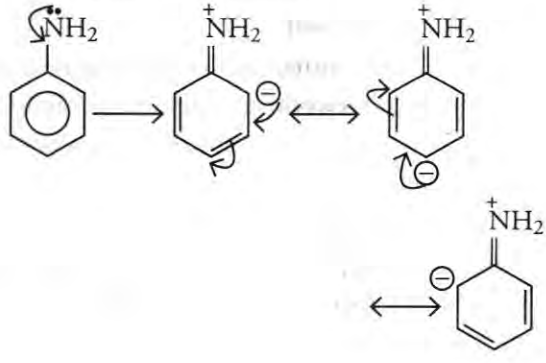


In acetanilide, the oxygen atom of the group withdraws electrons from $\ddot{N}H_2$ group as shown below :



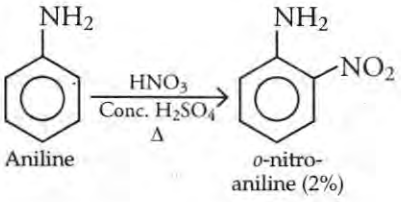
As a result, the electron pair on nitrogen gets displaced to the carboxyl group. Therefore, the unshared pair of electron on nitrogen is less available for donation of the electron to aromatic ring.

(b) In aniline, lone pair of e^- present on 'N' is in conjugation with the benzene ring and become less available for protonation because of resonance.

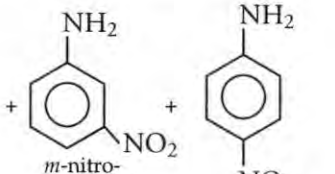


This conjugation of lone pair of e^- is not present in case of methyl amine and lone pair of e^- of 'N' are fully available for protonation. That's why the basicity order of aniline and methyl amine is :

(c) $CH_3NH_2 > C_6H_5NH_2$



Aniline *o*-nitro-aniline (2%)



m-nitro-aniline (47%) *p*-nitro-aniline (51%)

The reason for the formation of large amount of *m*-nitroaniline is that under strongly acidic conditions, aniline gets protonated to anilinium ion ($-NH_3^+$ group). This is a deactivating group and is meta-directing in nature.

23. After watching a programme on TV about the presence of carcinogens (cancer causing agents) Potassium bromate and potassium iodate in bread and other bakery products, Rupali a Class XII student decided to make others aware about the adverse effects of these carcinogens in foods. She consulted the school principal and requested him to instruct the canteen contractor to stop selling sandwiches, pizzas, burgers and other bakery products to the students. The principal took an immediate action and instructed the canteen contractor to replace the bakery products with some protein and vitamin rich food like fruits, salads, sprouts, etc. The decision was welcomed by the parents and the students.

After reading the above passage, answer the following questions :

(a) What are the values (at least two) displayed by Rupali ?**

(b) Which polysaccharide component of carbohydrates is commonly present in bread ?

(c) Write the two types of secondary structures of proteins.

(d) Give two examples of water soluble vitamins. **[4]**

Answer :

(b) Starch

(c) **1.** α-helix structure.

2. β-pleated sheet structure.

(d) Vitamin B and Vitamin C

24. (a) Account for the following :

(i) Transition metals show variable oxidation states.

(ii) Zn, Cd and Hg are soft metals.

(iii) E° value for the Mn^{3+}/Mn^{2+} couple is highly positive (+1.57 V) as compared to Cr^{3+}/Cr^{2+}.

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements. **[5]**

OR

(a) Following are the transition metal ions of 3*d* series :

$$Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}$$

(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)

Answer the following :

(i) Which ion is most stable in an aqueous solution and why ?

(ii) Which ion is a strong oxidising agent and why ?

(iii) Which ion is colourless and why ?

(b) Complete the following equation :

(i) $2MnO_4^- + 16\,H^+ + 5S^{2-} \longrightarrow$

(ii) $KMnO_4 \xrightarrow{Heat}$

Answer

(a) (i) Transition metal ions shows variable oxidation states due to the participation of (n-1) *d* electrons in addition to outer *ns*–electrons because the energies of ns and (*n*–1)*d* subshells

****Answer is not given due to the change in present Syllabus.**

are almost equal. As a result of which the electrons of $(n-1)d$ and ns subshell both part in bond formation.

(ii) Zn, Cd and Hg are soft metals because of their completely filled $3d$, $4d$ and $5d$ orbitals respectively Due to completely filled d-orbitals these metals are reluctant to form Zn–Zn, Cd–Cd and Hg–Hg bonds.

(iii) Highly positive value of E^o for Mn^{3+}/Mn^{2+} shows that Mn^{2+} (d^5) is particularly stable. While low value of E^o for Cr^{3+}/Cr^{2+} shows that Cr^{2+} (d^4) is less stable than Cr^{3+} (d^3)

(b) Similarity : In lanthanoids and actinoids both the added electron enters the antipenultimate shell $4f$ and $5f$ respectively.

Difference : Lanthanoids show a common oxidation state of +3 while actinoids show different oxidation states other than +3.

OR

(a) $Ti^{4+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6$

$V^{2+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3$

$Mn^{3+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$

$Cr^{3+} = 1s^2\,2s^2\,2p^6\,3s^2\,3d^3$

(i) Ti^{4+} is most stable in an aqueous solution because of full filled valence shell ($3s^2\ 3p^6$) onfiguration (noble gas configuration).

(ii) Mn^{3+} is the strong agent as it oxidises other species it will reduce itself by taking an electron and will stabilise its configuration to $3d^5$.

(iii) Ti^{4+} is colourless due to absence of unpaired electrons ($3s^2\ 3p^6$)

(b) (i) $2MnO_4^- + 16H^+ + 5S^{2-} \longrightarrow 2Mn^{2+} + 5S + 8H_2O$

(ii) $2KMnO_4 \xrightarrow{Heat} K_2MnO_4 + MnO_2 + O_2$

25. (a) A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K.

Given :

Molar mass of sucrose = 342 g mol^{-1}

Molar mass of glucose = 180 g mol^{-1}

(b) Define the following terms :

(i) Molality (m)

(ii) Abnormal molar mass **[5]**

OR

(a) 30 g of urea (M=60 g mol^{-1}) is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23.8 mm Hg.

(b) Write two differences between ideal solutions and non-ideal solutions.

Answer :

(a) T_o (freezing point of water) = 273.15K

T_s (freezing point of sucrose solution) = 269.15K

Weight of sucrose in solution = 10 g

Weight of glucose in solution = 10 g

Molar mass of sucrose = 342 g mol^{-1}

Molar mass of glucose = 180 g mol^{-1}

Freezing point of glucose = x

Depression in freezing point

$$\Delta T_f = \frac{K_f \times W_B \times 1000}{W_A \times 1000}$$

$$K_f = \frac{\Delta T_f \times W_A \times M_B}{W_B \times 1000}$$

In case of sucrose solution

$$K_f = \frac{(273.15 - 269.15) \times 90 \times 342}{10 \times 1000} \quad ....(1)$$

In case of glucose solution

$$K_f = \frac{(273.15 - x) \times 90 \times 180}{10 \times 1000} \quad ....(2)$$

$\because$ K_f is constant

thus equation (1) = equation (2)

$$\frac{(273.15-269.15) \times 90 \times 342}{10 \times 1000} = \frac{273.15 - x \times 90 \times 180}{10 \times 1000}$$

$$4 \times 342 = (273.15 - x) \times 180$$

$$(273.15 - x) = \frac{40 \times 342}{180} = 7.6$$

$$x = 265.55 \text{ K}$$

So, freezing point of glucose solution = 265.55 K.

(b) (i) Molality : It is the number of moles of the solute dissolved per 1000 g of the solvent. It is denoted by *m*.

$$\text{Molality} = \frac{\text{Moles of solute}}{\text{Mass of solvent (in gram)}} \times 1000$$

(ii) Abnormal molar mass : Those solute that dissociate or associate in solution, show abnormal molar mass in solution.

for example, Molar mass of ethanoic acid is greater than normal molar mass.

$$\underset{\text{Ethanoic acid}}{2CH_3COOH} \rightleftharpoons (CH_3COOH)_2$$

Molar mass of KCl in solution is reduced than normal molar mass.

$$KCl \rightleftharpoons K^+ + Cl^-$$

OR

(a) $W_B = 30\,g$ $M_B = 60\,g\,mol^{-1}$

$W_A = 846\,g$ $M_A = 18\,g\,mol^{-1}$

$P^\circ = 23.8\,mm\,Hg$

$P_s = x$

Relative lowering of vapour pressure

$$\frac{P^\circ - P_s}{P^\circ} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\frac{23.8 - x}{23.8} = \frac{30 \times 18}{60 \times 846}$$

$$23.8 - x = \frac{23.8}{94}$$

$$23.8 - x = 0.253$$

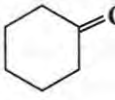
$$x = 23.8 - 0.253 = 23.547$$

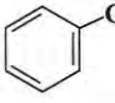
So, vapour pressure of water for this solution = 23.597 mmHg

(b)

	Ideal Solutions	Non-ideal Solutions
1.	The interactions between the components are similar to those in the pure components.	The interactions between the components are different from those of the pure components.
2.	There is no enthalpy change on mixing $\Delta H_{mix} = 0$	There is enthalpy change on mixing $\Delta H_{mix} \neq 0$

26. (a) Write the product(s) in the following reactions :

(i)  **+ HCN ⟶ ?** **[5]**

(ii)  **+ NaOH $\xrightarrow[\Delta]{CaO}$?**

(iii) $CH_3 - CH = CH - CN \xrightarrow[(b)\ H_2O]{(a)\ DIBAL\text{–}H} ?$

(b) Give simple chemical tests to distinguish between the following pairs of compounds :

(i) Butanal and Butan-2-one

(ii) Benzoic acid and Phenol

OR

(a) Write the reactions involved in the following :

(i) Etard reaction

(ii) Stephen reduction

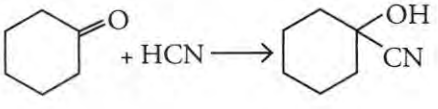
(b) How will you convert the following in not more than two steps :

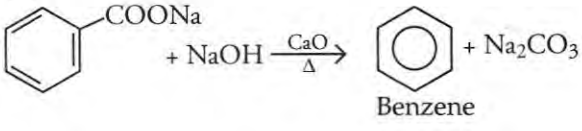
(i) Benzoic acid to Benzaldehyde

(ii) Acetophenone to Benzoic acid

(iii) Ethanoic acid to 2-Hydroxyethanoic acid

Answer : (a)

(i) 

(ii) 

(iii) $CH_3 - CH = CH - CN \xrightarrow[(b)\ H_2O]{(a)\ DIBAL\text{-}H} CH_3 - CH = CH - CHO$

(b) (i) Butanal and Butan-2-one

1. $CH_3CH_2CH_2CHO + 2[Ag(NH_3)_2]^+ + 3OH^-$
   Butanal ↓ Tollen's reagent
   $CH_3CH_2CH_2COO^- + 2Ag + 2H_2O + 4NH_3$

This reaction is known as silver mirror test—

2. $CH_3 - CH_2 - \underset{\text{Butan-2-one}}{\overset{\overset{O}{\|}}{C}} - CH_3 + 2[Ag(NH_3)_2]^+$ (Tollen's reagent) → No reaction $+ 3OH^-$

Thus Butanal gives silver mirror test with Tollen's reagent whereas Butan-2-one does not.

(ii) Benzoic acid and phenol

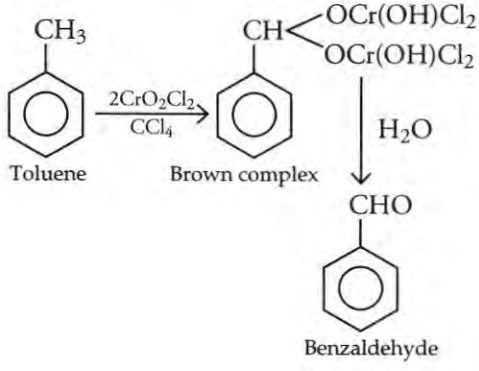
(1) $C_6H_5COOH + NaHCO_3 \longrightarrow C_6H_5COONa + H_2O + CO_2$
Benzoic acid; Sodium bicarbonate; Sodium benzoate

(b) $C_6H_5OH + NaHCO_3 \longrightarrow$ No reaction
Phenol; Sodium bicarbonate

Thus, Benzoic acid gives sodium benzoate on reaction with sodium bicarbonate whereas phenol gives no reaction with sodium bicarbonate.

OR

(a) (i) Etard reaction : The oxidation of toluene to benzaldehyde with chromyl chloride (CrO_2Cl_2) dissolved in CCl_4 or CS_2.



(ii) Stephen reaction : The partial reduction of alkyl or aryl cyanides to the corresponding aldehydes with a suspension of anhydrous $SnCl_2$ in ether saturated with HCl at room temperature followed by hydrolysis.

$SnCl_2 + 2HCl \longrightarrow SnCl_4 + 2[H]$

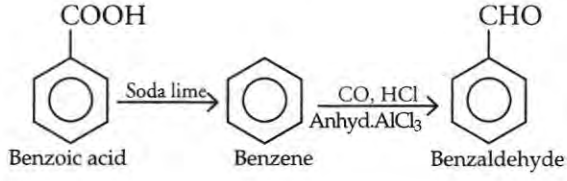
$CH_3C \equiv N + 2[H] + 2HCl \longrightarrow CH_3CH \equiv NH.HCl \xrightarrow[boil]{H_2O}$
Acetaldoxime hydrochloride

$CH_3CHO + NH_4Cl$
Acetaldehyde

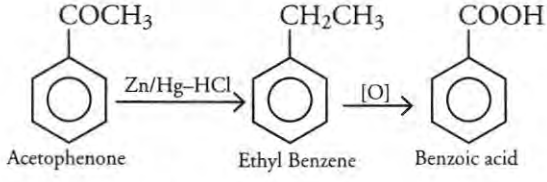
$C_6H_5 - C \equiv N + 2[H] + 2HCl \longrightarrow C_6H_5CH = NH.HCl$
Benzaldoxime hydrochloride

$\xrightarrow[Boil]{H_2O} C_6H_5CHO + NH_4Cl$
Benzaldehyde

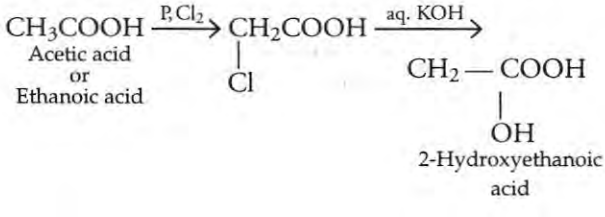
(b) (i) Benzoic acid to Benzaldehyde



(ii) Acetophenone to Benzoic acid



(iii) Ethanoic acid to 2-hydroxyethanoic acid

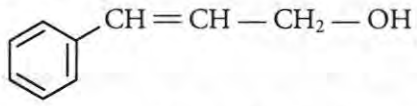


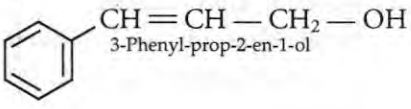
Chemistry 2017 (Outside Delhi) SET II

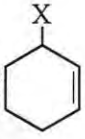
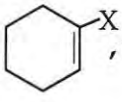
Time allowed : 3 hours **Maximum marks : 70**

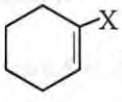
Note : Except for the following questions, all the remaining questions have been asked in previous sets.

3. Write the IUPAC name of the following compound. [1]



Answer : 
3-Phenyl-prop-2-en-1-ol

5. Out of  **and**  **, which is an example of vinylic halide ?** [1]

Answer :  is an example of vinylic halide.

6. Using IUPAC norms write the formulae for the following :

(a) Tris (ethane-1, 2-diamine) chromium (III) chloride.

(b) Potassium tetrahydroxozincate (II). [2]

Answer :(a) $[Cr(en)_3]Cl_3$

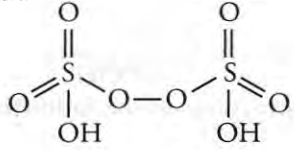
(b) $K_2[Zn(OH)_4]$

7. Draw the structures of the following : [1]

(a) $H_2S_2O_8$

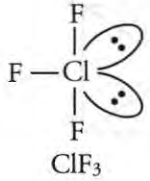
(b) ClF_3

Answer :(a)



$H_2S_2O_8$

(b)



ClF_3

8. Write the name of the cell which is generally used in inverters. Write the reactions taking place at the anode and the cathode of this cell. [2]

Answer : Lead storage battery is commonly used in inverters.

Reactions taking place at anode

$$Pb(s) \longrightarrow Pb^{2+}(aq) + 2e^-$$

$$Pb^{2+}_{(aq.)} + SO_4^{2-}{}_{(aq)} \longrightarrow PbSO_4(s)$$

The overall reaction at anode is

$$Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$$

Reactions taking place at cathode.

$$PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$$

11. (a) Write the principle of vapour phase refining.

(b) Write the role of dilute NaCN in the extraction of silver.

(c) What is the role of collectors in the froth floatation process ? Give an example of a collector. [2]

Answer :

(a) Vapour phase refining : This method is based on the principle that certain metals are converted to their volatile compounds while the impurities are not affected during compound formation–C.

(b) NaCN is used to leach the silver ore in the presence of air. Pure silver is obtained by replacement in the process of extraction of silver.

$$Ag_2S + 4NaCN \longrightarrow \underset{\text{Sodium dicyano-argentate}}{2Na[Ag(CN)_2]} + Na_2S$$

$$2Na[Ag(CN)_2] + Zn \longrightarrow 2Ag(s) + \underset{\text{Sodium tetracyanozincate (II)}}{Na[Zn(CN_4)](aq)}$$

(c) In the froth floatation process, collectors enhances the non-wettability of the mineral particles. Example of collectors are pine oil, eucalyptus oil, fatty acids etc.

16. **Define the following :**
    (b) Narrow spectrum antibiotics.
    (c) Antacids [3]

    Answer :

    (b) Narrow spectrum antibiotics : The antibiotics which are effective mainly against gram-positive or gram-negative bacteria are called narrow spectrum antibiotics Example: Penicillin.

    (c) Antacids : The chemical substances which neutralizes excess acids in the gastric juices and gives relief from acid indigestion, acidity, heart burns and gastric ulcers are called antacids. Example Sodium hydrogen-carbonate (baking soda) in water.

17. **Write the structures of the monomers used for getting the following polymers :**
    (a) Polyvinyl chloride (PVC)
    (c) Buna-N [3]

    Answer : (a) Monomer of polyvinyl chloride (PVC)

    Vinyl chloride $CH_2 = CH - Cl$

    (c) Monomer of Buna-N

    $H_2C = CH - CH = CH_2$ and $CH_2 = CH - CN$
    1, 3-butadiene Acrylonitrile

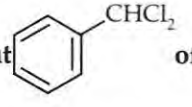
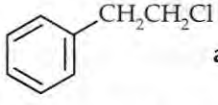
22. **(a) Based on the nature of intermolecular forces, classify the following solids :****
    Benzene, Silver
    (b) AgCl shows Frenkel defect while NaCl does not. Give reason.**
    (c) What type of semiconductor is formed when Ge is doped with Al ?** [3]
    Answer :

●●

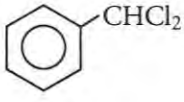
Chemistry 2017 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

1. **Out**  **of**  **and ,**

which is an example of a benzylic halide ? [1]

Answer :  is an example of benzylic halide.

3. **Write the formula of the compound of iodine which is obtained when conc. HNO_3 oxidises I_2.** [1]

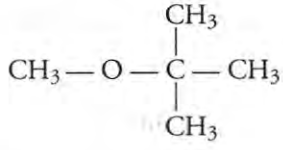
Answer : Iodic acid, HIO_3 is obtained on the oxidation of I_2 by HNO_3.

$$I_2 + 10HNO_3 \longrightarrow \underset{\text{Iodic acid}}{2HIO_3} + 10NO_2 + 4H_2O$$

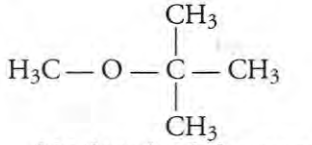
4. **What type of colloid is formed when a gas is dispersed in a liquid ? Give an example.** [1]

Answer : 'Foam' colloid is formed when a gas is dispersed in a liquid. For example whipped cream or soda water.

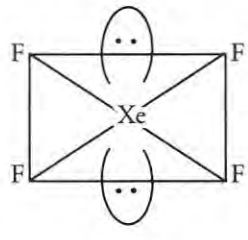
5. **Write the IUPAC name of the following compound :**

 [1]

Answer :


2-Methoxy-2methyl-propane

6. **Draw the structures of the following :**
   (a) XeF_4
   (b) BrF_5

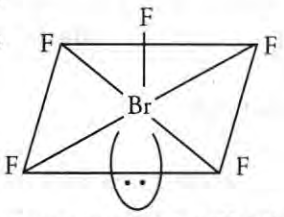
 [2]

****Answer is not given due to the change in present Syllabus.**

Answer :

(a) XeF_4

(b) BrF_5



7. Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell. [2]

Answer : Dry cells are used in transistors.

At anode

$$Zn \longrightarrow Zn^{2+} + 2e^-$$

At cathode

$$2NH_4^+(aq) + 2MnO_2(s) + 2e^- \longrightarrow 2MnO(OH) + 2NH_3$$

9. Using IUPAC norms write the formulae for the following :

(a) Potassium trioxalatoaluminate (III).

(b) Dichloridobis (ethane-1, 2-diamine) cobalt (III) [2]

Answer :

(a) $K_3[Al(Ox)_3]$

(b) $[CoCl_2(en)_2]^+$

14. (a) Based on the nature of intermolecular forces, classify the following solids :**

Sodium sulphate, Hydrogen

(b) What happens when $CdCl_2$ is doped with AgCl?**

(c) Why do ferrimagnetic substances show better magnetism than antiferromagnetic substances?** [3]

15. (a) Write the principle of electrolytic refining.

(b) Why does copper obtained in the extraction from copper pyrites have a blistered appearance ?

(c) What is the role of depressants in the froth floatation process ? [3]

Answer :

(a) Electrolytic refining : This method is based on the principle of electrolysis. In this method impure metal is made to act as anode and a strip of same metal in pure form is used as cathode. Both anode and cathode are placed in a suitable electrolytic bath containing soluble salt of same metals.

(b) In the extraction of copper from $CuFeS_2$, SO_2, N_2 and O_2 escape from the metal. As the metal solidifies, the dissolved gases escape producing blisters on the metal surface, which provides blister appearance to copper.

(c) Depressents are used to prevent certain types of particles from forming the froth with air bubbles. For example : NaCN can be used as a depressent in the separation of ZnS and PbS.

19. Define the following :

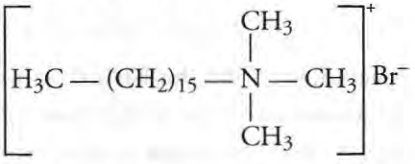
(a) Cationic detergents

(b) Broad spectrum antibiotics

(c) Tranquilizers [3]

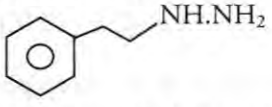
Answer :

(a) Cationic detergents : These are the quaternary ammonium salts of amines with acetates, chlorides or bromides as anions. The cationic part possesses a long hydrocarbon chain with a positive charge on nitrogen atom. Example. Cetyltrimethyl ammonium chloride.



(b) Broad spectrum antibiotics : Antibiotics which kills or inhibit a wide range of gram-positive and gram-negative bacteria are called broad spectrum antibiotics. Example Chloramphenicol.

(c) Tranquilizers : The chemical substances used for the treatment of stress, fatigue, mild and severe mental diseases are called tranquilizers. Example : Phenelzine (Nardil).



20. Write the structures of the monomers used for getting the following polymers :

(a) Teflon

(c) Neoprene [3]

Answer :

(a) Monomer of Teflon :

$F_2C = CF_2$

Tetrafluoroethene

(c) Neoprene (monomer) :

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

Chloroprene or
2-chlorobuta-1,3-diene

●●

****Answer is not given due to the change in present Syllabus.**

Chemistry 2017 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION-A

1. Write the formula of an oxo-anion of Manganese (Mn) in which it shows the oxidation state equal to its group number. [1]

Answer : Manganese belongs to group number 7 and its oxidation state in $KMnO_4$ is +7 i.e.,

$$KMnO_4$$

$$1 + x + 4(-2) = 0$$

$$1 + x - 8 = 0$$

$$x = 7$$

Thus, the formula of the oxo-anion is $KMnO_4$.

2. Write IUPAC name of the following compound :

$(CH_3CH_2)_2NCH_3$ [1]

Answer : N-Ethyl-N-methylethanamine.

3. For a reaction R $\longrightarrow$ P, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactants. What is the order of reaction ? [1]

Answer : Since half life is independent of the initial concentration of the reactants. Thus it is a first order Reaction. Formula for half-life of the first order reaction.

$$t_{1/2} = \frac{0.693}{K}$$

4. Write the structure of 1-bromo-4-chlorobut-2-ene. [1]

Answer : $BrCH_2CH = CHCH_2Cl$

5. Write one similarity between physisorption and Chemisorption. [1]

Answer : Physisorption and chemisorption both are the surface phenomenon and both increases the surface area during the process of adsorption.

SECTION-B

6. Complete the following reactions :

(i) $NH_3 + 3Cl_2$(excess) $\longrightarrow$

(ii) $XeF_6 + 2H_2O \longrightarrow$

OR

What happens when

(i) $(NH_4)_2Cr_2O_7$ is heated ?

(ii) H_3PO_3 is heated ?

Write the equations. [2]

Answer :

(i) $NH_3 + 3Cl_2$ (excess) $\longrightarrow NCl_3 + 3HCl$.

(ii) $XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$

OR

(i) $(NH_4)_2Cr_2O_7(s) \longrightarrow Cr_2O_3(s) + N_2(g) + 4H_2O(g)$

(ii) $4H_3PO_3 \longrightarrow 3H_3PO_4 + PH_3$.

7. Define the following terms :

(i) Colligative properties

(ii) Molality (m) [2]

Answer : (i) Colligative properties are those which depends on number of moles of solute irrespective of their Nature.

(ii) Molality is defined as the number of moles of solute dissolved per kg of the solvent. It is independent of temperature.

$$\text{Molality} = \frac{\text{Moles of solute}}{\text{Mass of solvent in kilograms}}$$

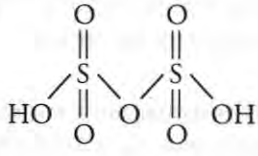
8. Draw the structures of the following :

(i) $H_2S_2O_7$

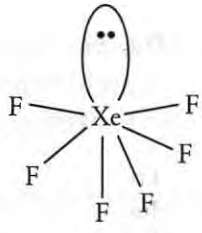
(ii) XeF_6 [2]

Answer :

(i) $H_2S_2O_7$



(ii) XeF_6



9. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity ($\wedge_m$) is 39.05 S cm^2 mol^{-1}.

Given $\wedge^\circ$ (H^+) = 349.6 S cm^2 mol^{-1} and $\wedge^\circ$ (CH_3COO^-) = 40.9 S cm^2 mol^{-1}. [2]

Answer : Given : Molar conductivity ($\wedge_m$) for acetic acid = 39.05 S cm^2 mol^{-1}.

$$\wedge^\circ (H^+) = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\wedge^\circ (CH_3COO^-) = 40.95 \text{ S cm}^2 \text{ mol}^{-1}$$

We know that :

$$\wedge^{\circ}_m (CH_3COOH) = \wedge^{\circ}(H^+) + \wedge^{\circ}(CH_3COO^-)$$
$$390.5 = 349.6 + 40.9$$
$$390.5 = 390.5$$

also; $$\alpha = \frac{\wedge_m}{\wedge_{m^{\circ}}}$$
$$\alpha = \frac{39.05}{390.5}$$
$$\alpha = 0.1$$

Thus, the degree of dissociation of acetic acid is 0.1.

10. Write the equations involved in the following reactions :
(i) Wolff–Kishner reduction
(ii) Etard reaction. [2]

Answer :(i) Wolff-Kishner reduction :

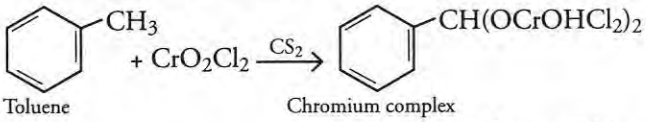
$$CH_3-\underset{\underset{H}{|}}{C}=O + \underset{\text{Hydrazine}}{NH_2NH_2} \xrightarrow{-H_2O} CH_3-\underset{\underset{H}{|}}{C}=NNH_2$$

Acetaldehyde — Hydrazone

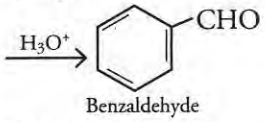
$$\xrightarrow[453\text{-}473\ K]{KOH} CH_3-CH_3 + N_2$$

Glycol

(ii) Etard Reaction :



Toluene — Chromium complex



Benzaldehyde

SECTION-C

11. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water, if freezing point of pure water is 273.15K.
[Given :(Molar mass of sucrose = 342 g mol^{-1})
(Molar mass of glucose = 180 g mol^{-1}] [3]

Answer : Given : Freezing point of = 269.15 K
10% solution of glucose
Freezing point of pure water = 273.15 K
Molar mass of sucrose = 342 g mol^{-1}.
Molar mass of glucose = 180 g mol^{-1}.
We know that :

$$\Delta T_f = K_f \times m$$

Also; $$m = \frac{W_2 \times 1000}{M_2 \times M_1}$$

For the sucrose solution :

$$273.15 - 269.15 = \frac{K_f \times 10 \times 1000}{342 \times 90}$$
$$4 \times 242 \times 90 = K_f \times 10 \times 1000$$
$$\frac{4 \times 342 \times 90}{10 \times 1000} = K_f$$
$$K_f = 12.3 \text{ k kg/mol}$$

For the glucose solution :

$$\Delta T_f = K_f \times m$$
$$= \frac{12.3 \times 10\cancel{0} \times 100\cancel{0}}{18\cancel{0} \times 9\cancel{0}}$$
$$\Delta T_f = 7.6 \text{ K}$$

Thus $$T_f = 273.15 - 7.6$$
$$T_f = 265.5 \text{ K}$$

The freezing point of 10% glucose in water is 265.5 K.

12. (a) Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes.
Given : Molar mass of Ag = 108 g mol^{-1}, 1F = 96500 C mol^{-1})
(b) Define fuel cell [3]

Answer :
(a) Given :
Current = 2 amperes
Time = 15 minutes
Molar mass of Ag = 108 g mol^{-1}
1F = 96500 C mol^{-1}
Amount of metal deposited (m) = ZQ
$Q = It$
$= 2 \times 15 \times 60 = 1800$ C
Silver deposited
$Ag^+ + 2e^- \rightarrow Ag(s)$
1 mole of electron or 1×96500 C of current deposit silver = 108 g
1800 C of current will deposit

$$= \frac{108 \times 1800}{96500}$$

Amount of Ag deposited = 2.01g
(b) Fuel cell is the cell which converts the energy of combustion of fuels directly into electrical energy.

13. (i) What type of isomerism is shown by the complex $[Co(NH_3)_6]Cr(CN)_6]$?
(ii) Why a solution of $[Ni(H_2O)_6]^{2+}$ is green while a solution of $[Ni(CN)_4]^{2-}$ is colourless ? (At no. of Ni= 28)
(iii) Write the IUPAC name of the following complex : [3]
$[Co(NH_3)_5(CO_3)]Cl$.

Answer :
(i) Both shows coordination isomerism because both cationic and anionic entities and isomers differ in the distribution of ligands in the coordination entity of cationic and anionic part.
(ii) In $[Ni(H_2O)_6]^{2+}$ Ni is in +2 oxidation state

with electronic configuration $3d^8$. In the presence of weak ligand H_2O the two unpaired electrons do not pair up and hence the complex has two unpaired electrons. Therefore, it is coloured and shows *d-d* transitions which absorbs red light and emits green complimentary light.

In case of $[Ni(CN)_4]^{2-}$ Ni also shows +2 oxidation state but CN ligand is strong ligand and two unpaired electrons undergo pairing, to no *d-d* transitions takes place and it shows no colour.

(iii) Pentaamminecarbonatocobalt(III) chloride.

14. Write one difference in each of the following :

(i) Lyophobic sol and Lyophilic sol.

(ii) Solution and Colloid

(iii) Homogeneous catalysis and Heterogeneous catalysis. [3]

Answer :

(i) Lyophobic colloidal sols are not hydrated and have weak affinity with the dispersion medium whereas lyophilic colloidal sols are heavily hydrated and have strong affinity with the dispersion medium.

(ii) Solution is a homogeneous mixture of solute and solvent whereas colloid is the heterogeneous mixture of dispersed phase and dispersion medium.

(iii) Homogeneous catalysis is the catalysis in which the reactants and the catalysts are in the same phase whereas in the heterogeneous catalysis the reactants and the catalysts are in the different phases.

15. Following data are obtained for reaction :

$N_2O_5 \rightarrow 2NO_2 + 1/2O_2$

t/s	0	300	600
$[N_2O_5]$/mol L^{-1}	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

(a) Shows that it follows first order reaction.

(b) Calculate the half-life.

(Given log 2=0.3010, log 4= 0.6021) [3]

Answer :

(a) $K = 2.303/t \log [A_0]/[A]$

$= 2.303/300 \log 1.6 \times 10^{-2}/0.8 \times 10^{-2}$

$= 2.303/300 \log 2 = 2.31\times10^{-3}\ s^{-1}$

$=$ At 600 s, $K = 2.303/t \log [A_0]/[A]$

$= 2.303/300 \log 1.6 \times 10^{-2}/0.4\times10^{-2}$

$= 2.303/600 \log 4 = 2.31\times10^{-3}\ s^{-1}$

Since K is constant when using first order equation therefore, it follows first order kinetics.

(b) $t_{½} = 0.693/k$

$= 0.693/2.31\times10^{-3} = 300$ s

Thus, the half life of the reaction is 300 s.

16. Following compounds are given to you :

2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane

(i) Write the compound which is most reactive towards S_N2 reaction.

(ii) Write the compound which is optically active.

(iii) Write the compound which is most reactive towards β-elimination reaction. [3]

Answer : (i) 1-Bromopentane is most reactive towards S_N2 reaction as it follows the order $1^o > 2^o > 3^o$.

(ii) 2-Bromopentane is optically active.

(iii)2-Bromo-2-methylbutane is most reactive towards β-elimination reaction.

17. (a) Write the principle of method used for the refining of germanium.

(b) Out of PbS and $PbCO_3$ (ores of lead), which one is concentrated by froth floatation process preferably ?

(c) What is the significance of leaching in the extraction of aluminium ? [3]

Answer : (a) Zone refining method is used for the refining of germanium and it is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.

(b) PbS, Sulphide ore has more tendency to stick to the oil which comes on the surface being lighter and easily skimmed off so PbS is concentrated by froth floatation method.

(c) Leaching of alumina is done to remove the impurities like SiO_2 by using NaOH solution and pure alumina is obtained.

18. Write structures of compounds A,B and C in each of the following reactions : [3]

(i) $C_6H_5Br \xrightarrow{Mg/dry\ ether} A \xrightarrow[(b)\ H_3O^+]{(a)\ CO_{2(g)}} B \xrightarrow{PCl_5} C$

(ii) $CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} A \xrightarrow{dil.\ NaOH} B \xrightarrow{\Delta} C$

OR

Do the following conversions in not more than two steps :

(a) Benzoic acid to Benzaldehyde

(b) Ethyl benzene to Benzoic acid

(c) Propanone to Propene

Answer :

(i)

$$C_6H_5Br \xrightarrow[dry\ ether]{Mg/} \underset{(A)}{C_6H_5MgBr} \xrightarrow[(b)\ H_3O^+]{(a)\ CO_2(g)}$$

$$\underset{(B)}{C_6H_5COOH} \xrightarrow{PCl_5} \underset{(C)}{C_6H_5COCl}$$

(ii)

$$CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} \underset{(A)}{CH_3CHO} \xrightarrow{\text{dil. NaOH}}$$

$$\underset{(B)}{CH_3CH(OH)CH_2CHO} \xrightarrow{\Delta} \underset{(C)}{CH_3CH{=}CHCHO}$$

OR

(a)

$$\underset{\text{Benzoic acid}}{C_6H_5COOH} \xrightarrow{SOCl_2} C_6H_5COCl \xrightarrow[BaSO_4]{H_2/Pd} \underset{\text{Benzaldehyde}}{C_6H_5CHO}$$

(b)

$$\underset{\text{Ethylbenzene}}{C_6H_5C_2H_5} \xrightarrow[\Delta]{KMnO_4\text{-}KOH} C_6H_5COOK \xrightarrow{H_3O^+} \underset{\text{Benzoic acid}}{C_6H_5COOH}$$

(c)

$$\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow{NaBH_4} CH_3CH(OH)CH_3 \xrightarrow[\text{dehydration}]{\text{Conc. } H_2SO_4} \underset{\text{Propene}}{CH_3CH{=}CH_2}$$

19. Write the structure of the monomers used for getting the following polymers :

(i) Dacron **[3]**

Answer : (i) Monomers of Dacron :

$$\underset{\text{Ethylene glycol}}{HOH_2C-CH_2OH} \text{ and } \underset{\text{Terephthalic acid}}{HOOC-C_6H_4-COOH}$$

21. Give reasons :

(i) Thermal stability decreases from H_2O to H_2Te.

(ii) Fluoride ion has higher hydration enthalpy than chloride ion.

(iii) Nitrogen does not form pentahalide.** **[3]**

Answer :

(i) As we move down in a group atomic radius increases as a result bond length increases. Larger the bond length lesser will be the bond dissociation enthalpy. So thermal stability decreases from O to Te.

(ii) Fluoride ion is the smallest ion in the group and it has high charge density and charge size ratio. That is why it has high hydration enthalpy.

SECTION-E

24. (a) Account for the following :

(i) Transition metals form large number of complex compounds.

(ii) The lowest oxide of transition metal is basic whereas the highest oxide is amphoteric or acidic.

(iii) E° value for the Mn^{3+}/Mn^{2+} couple is highly positive (+1.57 V) as compare to Cr^{3+}/Cr^{2+}.

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements. **[5]**

OR

(a) (i) How is the variability in oxidation states of transition metals different from that of the *p*-block elements ?

(ii) Out of Cu^+ and Cu^{2+}, which ion is unstable in aqueous solution and why ?

(iii) Orange colour of $Cr_2O_7^{2-}$ ion changes to yellow when treated with an alkali. Why ?

(b) Chemistry of actinoids is complicated as compared to lanthanoids. Give two reasons.

Answer :

(i) Transition metals forms large number of complexes due to :

1. Small size of atoms and ions of transition metals.
2. High nuclear charge.
3. Presence of incompletely filled *d*-orbitals.

(ii) As the oxidation state increases the size of ion goes on decreasing thus the covalent character increases as a result of this amphoteric and acidic strength increases. While in case of lower oxides of transition metals ionic size increases and thus basic character increases.

(iii) Because Mn^{2+} has $3d^5$ as a stable oxidation state which is half filled and stable. Mn has very high third ionization energy for change from d^5 to d^4 but in case of Cr^{3+}, $3d^3$ is more stable due to completely half filled t_{2g}^3 orbitals (crystal field spitting theory) and that is why Mn^{3+}/Mn^{2+} is highly positive as compared to Cr^{3+}/Cr^{2+}.

(b) Both Lanthanoids and Actinoids have the t_3 oxidation state and both show contraction or irregular electronic configuration while the major defference between the lanthanoids and actinoids is actinoids are radioactive while lanthanoids are not; radioactive in nature.

OR

(a) (i) In *p* block elements the difference in oxidation state is 2 and in transition elements the difference is 1.

(ii) Cu^+ is unstable in aq. solution because it undergoes disproportion reaction and has low hydration enthalpy.

**** Answer is not given due to change in present syllabus.**

(iii) In alkaline medium dichromate ions $Cr_2O_7^{2-}$ changes to chromate ion CrO_4^{2-}, which is yellow in colour due to which the colour changes when treated with an alkali.

(b) Chemistry of actinoids is complicated as compared to lanthanoids due to the following reasons :

1. They show multiple oxidation states namely +5, +6 and +7 oxidation states respectively which permits the formation of higher oxidation states through the removal of the periphery electrons.
2. They are radioactive and have a strong propensity to form complex reactions because of its unstable isotopes, some actinoids are formed naturally by radioactive decay.

25. (a) An element has atomic mass 93g mol^{-1} and density 11.5 g cm^{-3}. If the edge length of its unit cell is 300 pm, identify the type of unit cell.**

(b) Write any two differences between amorphous solids and crystalline solids. [5]**

OR

(a) Calculate the number of unit cells in 8.1 g of aluminium if it crystallizes in a f.c.c. structure. (Atomic mass of Al = 27 g mol^{-1})

(b) Give reasons :**

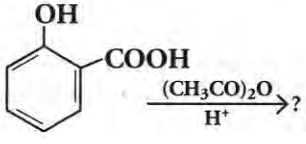
(i) In stoichiometric defects, NaCl exhibits Schottky defect and not Frenkel defect.

(ii) Silicon on doping with phosphorous forms *n*-type semiconductor.

(iii) Ferrimagnetic substances show better magnetism than antiferromagnetic substances.

26. (a) Write the product(s) in the following reactions :

(i)



(ii)

$$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - O - CH_2 - CH_3 \xrightarrow{HI} ? + ?$$

(iii)

$$CH_3 - CH = CH - CH_2 - OH \xrightarrow{PCC} ?$$

Answer is not given due to the change in present Syllabus.

(b) Give simple chemical tests to distinguish between the following pairs of compounds :

(i) Ethanol and Phenol

(ii) Propanol and 2-methylpropan-2-ol [5]

OR

(a) Write the formula of reagents used in the following reactions :

(i) Bromination of phenol to 2, 4, 6-tribromophenol

(ii) Hydroboration of propene and then oxidation to propanol.

(b) Arrange the following compound groups in the increasing order of their property indicated :

(i) *p*-nitrophenol, ethanol, phenol (acidic character)

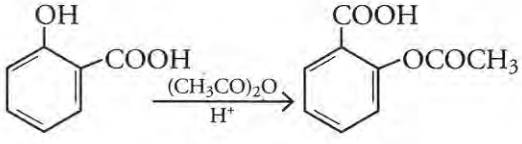
(ii) Propanol, propane, Propanal (boiling point)

(c) Write the mechanism (using curved arrow notation) of the following reaction :

$$CH_3 - CH_2 - \overset{+}{O}H_2 \xrightarrow{CH_3CH_2OH} CH_3 - CH_2 - \underset{\displaystyle H}{\overset{+}{\underset{|}{O}}} - CH_2 - CH_3 + H_2O$$

Answer :

(a) (i)



(ii)

$$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - O - CH_2 - CH_3 \xrightarrow{HI} (CH_3)_2CHOH + CH_3CH_2I$$

(iii)

$$CH_3 - CH = CH - CH_2 - OH \xrightarrow{PCC} CH_3CH = CHCHO$$

(b) (i) Ethanol and phenol : When neutral ferric chloride is added to both the compounds phenol gives violet coloured complex whereas ethanol does not gives this complex when treated with ferric chloride solution.

(ii) Propanol and 2-methyl propan-2-ol : When both the solutions were treated with anhydrous $ZnCl_2$ and conc. HCl (Luca's test) the 2-methylpropan-2-ol gives the turbidity

immediately whereas propanol does not gives the turbidity immediately.

OR

(a) (i) Aq-Br_2

(ii) B_2H_6 and then H_2O_2 and OH^-

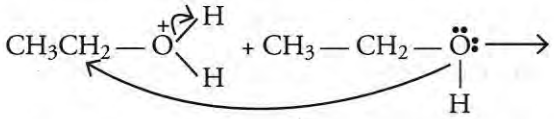
(b) (i) Ethanol < Phenol < *p*-Nitrophenol.

(ii) Propane < Propanal < Propanol

(c) $CH_3 - CH_2 - OH_2^+ \xrightarrow{CH_3CH_2OH}$

$$CH_3 - CH_2 - \overset{+}{O}(H) - CH_2 - CH_3 + H_2O$$

Mechanism for this above reaction is :



$$CH_3 - CH_2 - \overset{+}{O}(H) - CH_2 - CH_3 + H_2O$$

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Chemistry 2017 (Delhi) SET II

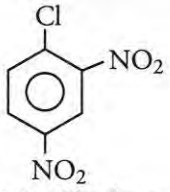
Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION-A

1. Write the structure of 2, 4-dinitrochlorobenzene. [1]

Answer :



(2, 4-dinitrochlorobenzene)

4. Write IUPAC name of the following compound :

$CH_3NHCH(CH_3)_2$ [1]

Answer : N-methylpropan-2-amine.

5. Write the formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number. [1]

Answer : Chromium belongs to group number 6 and its oxidation state in $K_2Cr_2O_7$ is +6 *i.e.*,

$$K_2Cr_2O_7$$

$$1 \times 2 + 2x + (-2 \times 7) = 0$$

$$2 + 2x - 14 = 0$$

$$2x - 12 = 0$$

$$2x = 12$$

$$x = 6$$

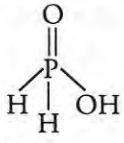
Thus, the formula of the oxo-anion is $K_2Cr_2O_7$

SECTION-B

7. Draw the structures of the following :

H_3PO_2 [2]

Answer :



8. Define the following terms :

(i) Ideal solution

(ii) Molarity (M) [2]

Answer : (i) Ideal solutions are those solutions that obeys Raoult's law over entire range of concentration. Example : Benzene and toluene, *n*-heptane and *n*-hexane.

(ii) Molarity is defined as the number of moles of solute dissolved per liter of solution.

$$M = \frac{W_b \times 1000}{M_b \times V}$$

9. Complete the following reactions : [2]

(i) $Cl_2 + H_2O \rightarrow$

(ii) $XeF_6 + 3H_2O \rightarrow$

OR

What happens when

(i) conc. H_2SO_4 is added to Cu ?

(ii) SO_3 is passed through water ?
Write the equations.

Answer : (i) $Cl_2 + H_2O \rightarrow 2HCl + [O]$

(ii) $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

OR

(i) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

(ii) $SO_3 + H_2O \rightarrow H_2SO_4$

10. Write the reactions involved in the following :
(i) Hell-Volhard-Zelinsky reaction
(ii) Decarboxylation reaction **[2]**

Answer :

(i) Hell-Volhard Zelinsky reaction :

$$\underset{\text{Acetic acid}}{CH_3COOH} \xrightarrow[-HCl]{+Cl_2,\ Red\ P} \underset{\substack{\text{Monochloro}\\ \text{acetic acid}}}{CH_2Cl.COOH} \xrightarrow[-HCl]{+Cl_2,\ Red\ P} \underset{\substack{\text{Dichloro acetic}\\ \text{acid}}}{CHCl_2.COOH} \xrightarrow[-HCl]{+Cl_2,\ Red\ P} \underset{\substack{\text{Trichloro acetic}\\ \text{acid}}}{CCl_3.COOH}$$

(ii) Decarboxylation reaction :

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

SECTION-C

13. Write the principles of the following methods :
(i) Vapour phase refining **[3]**

Answer : (i) Vapour phase refining : It is based on the principle that the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal.

15. Define the following :
(iii) Disinfectants **[3]**

Answer : (iii) Disinfectants : These are the substances that are applied to non-living objects to destroy microorganisms that are present on the objects. Example : 1-2% Phenol solution.

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Chemistry 2017 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

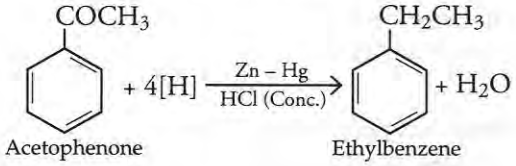
SECTION-A

4. Write the structure of 3-Bromo-2-methylprop-1-ene. **[1]**
Answer : $BrCH_2(CH_3)C = CH_2$

5. Write IUPAC name of the following compound :
$(CH_3)_2N–CH_2CH_3$) **[1]**
Answer :N,N-dimethylethanamine

SECTION-B

6. Write the reactions involved in the following reactions :
(i) Clemmensen reduction
(ii) Cannizzaro reaction **[2]**
Answer : (i) Clemmensen reduction :

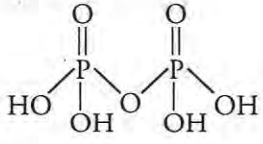


(ii) Cannizzaro reaction :

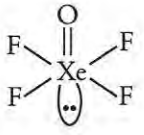
$$\underset{\text{Benzaldehyde}}{2C_6H_5CHO} \xrightarrow{\text{Conc. KOH}} \underset{\text{Benzylalcohol}}{C_6H_5CH_2OH} + \underset{\text{Sodium benzoate}}{C_6H_5COO^-Na^+}$$

7. Draw the structures of the following :
(i) $H_4P_2O_7$
(ii) $XeOF_4$ **[2]**

Answer : (i)
$H_4P_2O_7$



(ii) $XeOF_4$



8. Define the following terms :
(ii) van't Hoff factor (*i*) **[2]**

Answer : (ii) van't Hoff factor (i) : It is defined as the extent of dissociation or association or the ratio of the observed colligative property to the calculated colligative property.

10. Complete the following chemical equations : [2]
(i) $F_2 + 2Cl^- \rightarrow$
(ii) $2XeF_2 + 2H_2O \rightarrow$

OR

What happens when
(i) HCl is added to MnO_2 ?
(ii) PCl_5 is heated ?
write the equations involved.

Answer : (i) $F_2 + 2Cl^- \rightarrow 2F^- + Cl_2$
(ii) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

OR

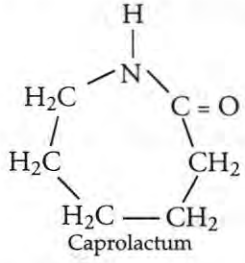
(i) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

(ii) $PCl_5 \xrightarrow{\Delta} PCl_3 + Cl_2$

SECTION-C

14. Write the structures of the monomers used for getting the following polymers :
(i) Nylon-6 **[3]**

Answer : (i) Monomers of Nylon-6 :



Caprolactum

19. Write one difference between each of the following :
(i) Multimolecular colloid and Macromolecular colloid
(ii) Sol and Gel
(iii) O/W emulsion and W/O emulsion **[3]**

Answer :
(i) In multimolecular colloids a large number of atoms or smaller molecules of a substance aggregates together to form species having size in the colloidal range. Example : Sulphur sol whereas in macro-molecular colloids the colloidal particles are large molecules having colloidal dimensions. Example : Starch.
(ii) In sol the dispersing phase is solid and dispersing medium is liquid; Example : paint, gold sol etc., whereas in Gel the dispersing phase is liquid and dispersing medium is solid; Example : Jelly, butter etc.
(iii) In O/W emulsion, oil is the dispersed phase while water is the dispersion medium. Example : milk, vanishing cream etc whereas in W/O emulsion water is the dispersed phase while oil is the dispersion medium. Example: Cold cream, butter etc.

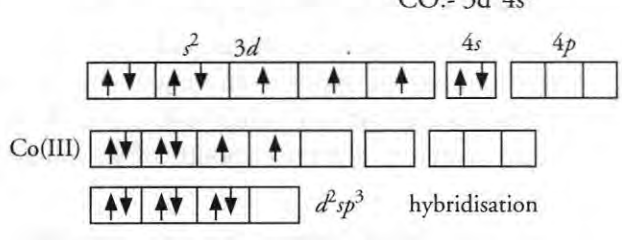
20. (i) What type of isomerism is shown by the complex $[Co(en)_3]Cl_3$?
(ii) Write the hybridisation and magnetic character of $[Co(C_2O_4)_3]^{3-}$
(At. no. of Co = 27)
(iii) Write IUPAC name of the following Complex $[Cr(NH_3)_3Cl_3]$. **[3]**

Answer :

(i) Since the given coordinate compound does not have a plane of symmetry and the ligand attached is bidentate ligand so it will show optical isomerism.

(ii) $[Co(C_2O_4)_3]^{3-}$ Co is in + 3 oxidation state with electronic configuration of $3d^6$ Oxalate is a strong field ligand so pairing of electrons take place.

CO:- $3d^7 4s^2$



(iii) Triamminetrichloridochromium(III).

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