Chemistry 2011 (Outside Delhi) SET I

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

1. **Define 'order of a reaction'.** [1]
Answer : The sum of powers of the concentrations of the reactants in the rate law expression is called the order of a reaction.

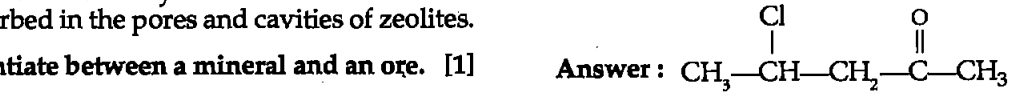
2. **What is meant by 'shape selective catalysis' ?** [1]
Answer : Catalysis using selective absorbents like zeolites as catalyst is called shape selective catalysis. In this catalysis small sized molecules are absorbed in the pores and cavities of zeolites.

3. **Differentiate between a mineral and an ore.** [1]
Answer :

S.No.	Mineral	Ore
1.	These are naturally occurring chemical substances obtained from earth crust by mining.	Ores are those minerals from which metals can be extracted profitably and conveniently.
2.	All minerals are not ores.	All ores are minerals.

4. **What is meant by 'lanthanoid contraction' ?** [1]
Answer : The lanthanoid contraction refers to the steady and regular decrease in atomic radii along the period from La^{+3} to Lu^{+3}.

5. **Write the IUPAC name of the following compound :**
$$CH_2 = CHCH_2Br$$ [1]
Answer : 3-Bromo-1-propene

6. **Draw the structure of 4-chloropentan-2-one.** [1]
Answer :


7. **How would you convert ethanol to ethene ?** [1]
Answer :
$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[H_2SO_4]{\text{warm conc.}} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$$

8. **Rearrange the following in an increasing order of their basic strengths :** [1]
$C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ and CH_3NH_2.
Answer :
$$C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$$

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

9. Explain how you can determine the atomic mass of an unknown metal if you know its mass density and the dimensions of unit cell of its crystal.** [2]

10. Calculate the packing efficiency of a metal crystal for a simple cubic lattice.** [2]

Answer : Edge length = a

11. State the following : [2]

(i) Raoult's law in its general form in reference to solutions.

(ii) Henry's law about partial pressure of a gas in a mixture.

Answer : (i) Raoult's Law : The partial vapour pressure of each component of a solution is equal to the vapour pressure of pure component multiplied by its mole fraction in the solution.

$$P = P_A x_A + P_B x_B$$

Where

P = Total vapour pressure of solution.

P_A and P_B = vapour pressure of components A and B.

x_A and x_B = mole fractions of components A and B.

(ii) Henry's Law : It states that the partial pressure of gas in vapour phase (P) is directly proportional to mole fraction of gas (x) in the solution and is expressed as

$$P = K_H.x$$

where K_H is Henry constant.

12. What do you understand by the rate law and rate constant of a reaction ? Identify the order of a reaction if the units of its rate constant are : [2]

(i) $L^{-1}mol\ s^{-1}$

(ii) $L\ mol^{-1}\ s^{-1}$

Answer : Rate law of a chemical reaction is the expression relating the rate of reaction to the concentrations or pressures of various reactants taking part in the reaction.

The rate of reaction at unit concentration of all reactants is known as the rate constant (K)

(i) Zero order (ii) Second order

13. The thermal decomposition of HCO_2H is a first order reaction with a rate constant of $2.4 \times 10^{-3}\ s^{-1}$ at a certain temperature. Calculate how long will it take for three-fourths of initial quantity of HCO_2H to decompose. (log 0.25 = –0.6021) [2]

Answer : $t = \frac{2.303}{k} \log \frac{a}{a-x}$

$k = 2.4 \times 10^{-3}$

$x = \frac{3}{4} = 0.75$

$$t = \frac{2.303}{2.4\times10^{-3}} \log \frac{1}{1-0.75}$$

$$= \frac{2.303}{2.4\times10^{-3}} \log 0.25$$

$$= \frac{2.303}{2.4\times10^{-3}} \times 0.6020 = 577.6 \text{ sec.}$$

14. Describe the principle controlling each of the following processes : [2]

(i) Vapour phase refining of titanium metal

(ii) Froth floatation method of concentration of a sulphide ore

Answer : (i) Titanum is converted to its volatile form which is evaporated and then decomposed to give pure titanium.

(ii) The ore particles get adsorbed on oil droplets and come to the surface where they can be collected as froth gangue is wetted by water and gets settle down.

15. How would you account for the following : [2]

(i) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4) Mn^{3+} is an oxidizing agent.

(ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.

Answer : (i) Cr^{2+} has configuration d^4 which easily changes to d^3 due to stable half filled t^2g orbitals. Therefore, Cr^{2+} is reducing agent and Mn^{3+} easily changes to Mn^{2+} and acts as an oxidizing agent.

(ii) Due to presence of more unpaired electrons and more number of partially filled orbitals in the middle of a transition series,these metals exhibit the greatest number of oxidation states.

16. Complete the following chemical equations : [2]

(i) $MnO_4(aq) + S_2O_3^{2-}(aq) + H_2O(l) \rightarrow$

(ii) $CrO_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \rightarrow$

OR

State reasons for the following :

(i) Cu (i) ion is not stable in an aqueous solution.

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

(ii) Unlike Cr^{3+}, Mn^{2+}, Fe^{3+} and the subsequent other M^{2+} ions of the 3*d* series of elements, the 4*d* and the 5*d* series metals generally do not form stable cationic species.

Answer :

(i) $8MnO_4^-(aq) + 3S_2O_3^{2-}(aq) + H_2O(l) \rightarrow 8MnO_2(s) + 6SO_4^{2-}(aq) + 2OH^-(aq)$

(ii) $Cr_2O_7^{2-}(aq) + 6Fe^{2+}(q) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$

OR

(i) Cu^{2+} is more stable than Cu^+ because hydration energy of Cu^{2+} is high and it is therefore, stable in aqueous solution. Therefore, Cu^+ disproportionates to Cu^{2+} and Cu.

$$2Cu^+ \rightarrow Cu^{2+} + Cu$$

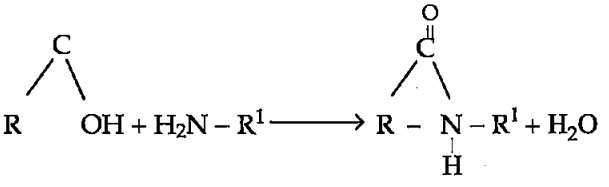
(ii) Because of Lanthanoid contraction, expected increase in size does not occur. That is why they do not form stable cations.

17. Explain what is meant by the following : [2]

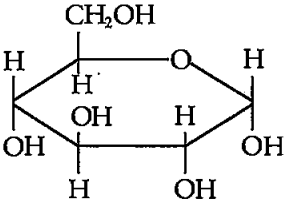
(i) Peptide linkage

(ii) Pyranose structure of glucose

Answer : (i) Peptide linkage is the peptide bond formed between amino acids. It is a covalent bond formed between amino group of one molecule and carboxylic acid group of another molecule, causing the release of one molecule of water.



(ii) Cyclic structure of glucose is called pyranose because it resembles pyran ring. Its structure includes a six membered ring with 5-carbon atoms and one oxygen atom having no double bonds.



18. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA. [2]

Answer :

	DNA	RNA
1.	Sugar present in DNA, is 2-deoxy D-ribose	In RNA, sugar is D-ribose
2.	DNA is double stranded molecule	RNA is single stranded molecule
3.	DNA can replicate	RNA can not replicate

Adenine, cytonine and guanine are bases present in both DNA and RNA

19. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming that the gene fragment is a non-electrolyte, calculate its molar mass. [3]

Answer : Given, V = 35 ml, T = 298 k, π = 0.335 torr, $W_2 = 8.95 \times 10^{-3}$ g

M_2 = ?

$$\pi = CRT \Rightarrow \pi = \frac{W_2 RT}{M_2 V} \text{ or } M_2 = \frac{W_2 RT}{\pi V}$$

$$= \frac{8.95 \times 10^{-3} \times 0.0821 \times 298 \times 760 \times 1000}{0.335 \times 35}$$

$$= \frac{166416.3716}{11.725} = 14193.3 \text{ g mol}^{-1}$$

$M_2 = 1.42 \times 10^4$ g mol^{-1}

20. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes. [3]

OR

Explain what is observed when

(i) an electric current is passed through a Solution

(ii) a beam of light is passed through a Solution

(iii) an electrolyte (say NaCl) is added to ferric hydroxide sol

Answer : Colloids can be classified into two types where the dispersion medium is water. They are as follows :

1. Hydrophillic Colloids or Lyophillic : The substances when mixed with dispersion medium form colloidal solution directly are called hydrophilic colloids. They are quite stable, reversible solutions and can't get precipated easily. *e.g.*, Gum starch, etc.

2. Hydrophobic Colloids or Lyophobic : The substances which do not form colloidal solution with dispersion medium are called hydrophobic colloids. They are unstable, irreversible solutions and can be easily precipitated. *e.g.*, Metals and their sulphides.

OR

(i) When electric current is passed through a solution, then positively charged ions move

towards cathode and negatively charged ions move towards anode. Then they get coagulate. This is known as Electrophoresis.

(ii) When a beam of strong light is passed through solution, light gets scattered by the colloidal particles and path of light becomes visible. This is known as Tyndall effect.

(iii) When NaCl is added to ferric hydroxide sol then a negatively charged solution is obtained with absorption of OH^- ion.

21. How would you account for the following : [3]

(i) H_2S is more acidic than H_2O.

(ii) The N–O bond in NO_2^- is shorter than the N–O bond in NO_3^-

(iii) Both O_2 and F_2 stabilize high oxidation states but the ability of oxygen to stabilize the higher oxidation state exceeds that of fluorine.

Answer : (i) Size of sulphur is larger than oxygen due to which S–H bond length increases and hence the bond dissociation energy of S–H is less than O–H. Therefore S–H easily loses H^+ and is more acidic than H_2O.

(ii) Due to tendency of nitrogen to form $p\pi$–$p\pi$ multiple bonds, there is a difference in N–O bond lengths of NO_2 and NO_3.

(iii) Due to the property of oxygen to form double bonds with the metal atoms, oxygen stabilizes the higher oxidation state even more than fluorine.

22. Explain the following terms giving a suitable example in each case : [3]

(i) Ambident ligand

(ii) Denticity of a ligand

(iii) Crystal field splitting in an octahedral field

Answer : (i) Ligands which can ligate to the central atom in two places ligands such as SCN which can attach at either S atom or N atom are called ambidentate ligand.

(ii) The number of donor atoms of a ligand when bound with central atom in a coordination complex is called its denticity.

(iii) The splitting of five degenerate *d*-orbitals in two sets, one with three orbitals and another with two orbitals is known as crystal field splitting.

23. Rearrange the compounds of each of the following sets in order of reactivity towards S_N2 displacement : [3]

(i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bro-mopentane

(ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methyl-butane, 2-Bromo-3-methylbutane

(iii) 1-Bromobutane, 1-Bromo-2,2-dimethylpropane, 1- Bromo-2-methylbutane.

Answer : (i) 1-bromopentane > 2-bromopentane > 2-bromo-2-methylbutane.

(ii) 1-bromo-3 methylbutane > 2-bromo-3-methylbutane > 2-bromo-2-methyl butane.

(iii) 1-bromobutane > 1-bromo-3-methylbutane > 1-bromo-2-, 2-dimethylpropane.

24. How would you obtain the following : [3]

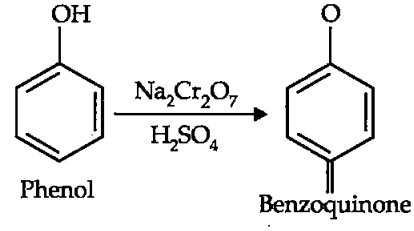
(i) Benzoquione from phenol

(ii)2-Methylpropan-2-ol from methylmagnesium bromide

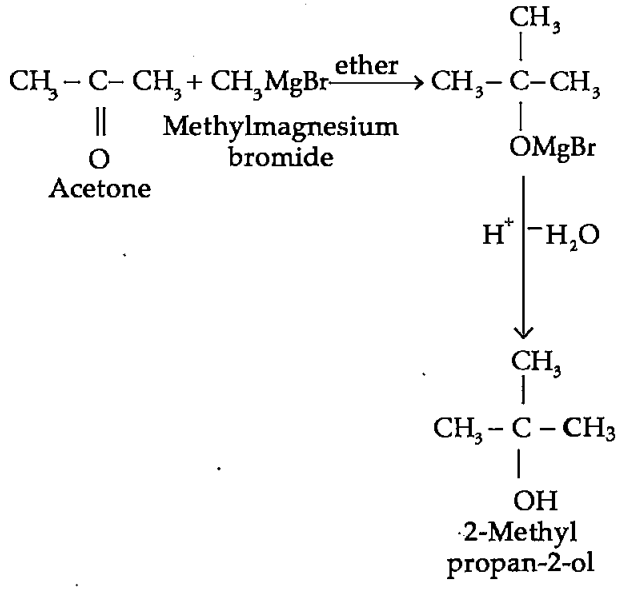
(iii) Propan-2-ol from propene

Answer :

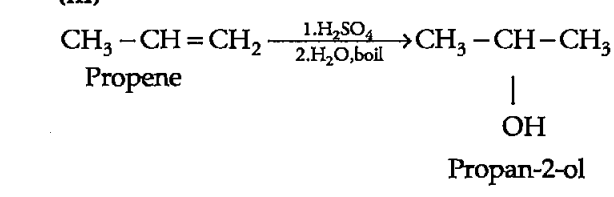
(i)



(ii)



(iii)



25. State reasons for the following : [3]

(i) pK_b value for aniline is more than that for methylamine.

(ii) Ethylamine is soluble in water whereas aniline is not soluble in water.

(iii) Primary amines have higher boiling points than tertiary amines.

Answer : (i) Higher value of pK_b means lower basicity, therefore, aniline is less basic than methylamine because in aniline the lone pair of electrons on N atom gets delocalized over the benzene ring and remains unavailable for protonation due to resonance but this is absent in methylamine.

(ii) Ethylamine forms H-bonds with water therefore, it is soluble in water but aniline does not form H-bonds with water due to its larger hydrocarbon part and is insoluble in water.

(iii) In primary amines, two H-atoms are attached to N-atom and they undergo intermolecular H-bonding, but tertiary amines due to the absence of H-atom on N-atom do not undergo H-bonding . Therefore, primary amines have higher boiling point than tertiary amines.

26. Draw the structures of the monomers of the following polymers : [3]
(i) Polythene (ii) PVC (iii) Teflon

Answer : (i) Ethene $—CH_2 = CH_2—$

(ii) Vinyl chloride $—CH_2 = CHCl—$

(iii) Tetraflouroethylene $—CF_2 = CF_2—$

27. What are the following substances ? Give one example of each. [3]
(i) Food preservatives
(ii) Synthetic detergents
(iii) Antacids

Answer : (i) Chemicals added to food to prevent its spoilage by killing or preventing the growth of microorganisms like bacteria, yeasts and moulds.

e.g., sodium benzoate.

(ii) Synthetic detergents are sodium or potassium salts of long chain sulphonic acids. They don't precipitate in hard water. *e.g.*, Sodium laurylsulphate.

(iii) Antacids are chemicals consumed to get relief from acidity in the stomach by neutralizing excess acid. *e.g.*, milk of magnesia.

28. (a) What type of a battery is lead storage battery ? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery. [5]
(b) Calculate the potential for half-cell containing
0.10 M $K_2Cr_2O_7$ (*aq*), 0.20 M Cr^{3+} (aq) and 1.0 × 10^{-4} M H^+ (aq). The half-cell reaction is and the standard electrode potential is given as E° = 1.33 V.

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$

OR

(a) How many moles of mercury will be produced by electrolyzing 1.0 M $Hg(NO_3)_2$ solution with a current of 2.00 A for 3 hours ? [$Hg(NO_3)_2 = 200.6\ g\ mol^{-1}$]

(b) A voltaic cell is set up at 25°C with the following half-cells Al^{3+} (0.001 M) and Ni^{2+} (0.50 M). Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

(Given : $E^\circ_{Ni^{2+}|Ni} = -0.25V$, $E^\circ_{Al^{3+}|Al} = -1.66\ V$)

Answer : (a) Lead storage battery is a secondary cell (rechargable). The electrode reaction is as follows :

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

At cathode :

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

Overall reaction :

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

(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$0.1\,M \quad 10^{-4}\,M \quad 0.2\,M$

$$E = E^\circ - \frac{0.059}{6} \log \frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}][H^+]^{14}}$$

$$E = 1.33 - \frac{0.059}{6} \log \frac{(0.20)^2}{(0.10)(10^{-4})^{14}}$$

$E = 1.33\ V - 0.55\ V$

$E = 0.78\ V$

OR

(a) $Hg^{2+} + 2e^- \rightarrow Hg$

Quantity of electricity (Q) = I × *t* = 2 × 3 × 60 × 60 = 21600C

2F (2 × 96500 C) deposits Hg = 1 mole

$\because$ 1C deposits *e* Hg = $\frac{1}{2 \times 96500}$

$\therefore$ 21600 C deposits *e* Hg

$$= \frac{1}{2 \times 96500} \times 21600$$

$$= 0.1119 \text{ mole}$$

(b) $2Al + 3Ni^{2+} \rightarrow 3Ni - 2Al^{3+}$

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n}\log\frac{[Al^{3+}]^2}{[Ni^{+2}]^3}$$

$$E_{cell} = E^{\circ}_{Ni^{2+}/Ni} - E^{\circ}_{Al^{3+}/Al} - \frac{0.059}{6}\log\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

$$E_{cell} = -0.25 - (-1.66) - \frac{0.059}{6}\log\frac{[0.001]^2}{[0.50]^3}$$

$$E_{cell} = 1.41 - 0.00985\log\frac{1}{125}$$

$$E_{cell} = 1.41 - 0.00985 \times -2.0969$$
$$= 1.41 + 0.0206 = 1.43V$$

29. (a) Draw the structures of the following molecules : [5]

(i) $(HPO_3)_3$ (ii) BrF_3**

(b) Complete the following chemical equations :

(i) $HgCl_2 + PH_3 \longrightarrow$

(ii) $SO_3 + H_2SO_4 \longrightarrow$

(iii) $XeF_4 + H_2O \longrightarrow$

OR

(a) What happens when

(i) Chlorine gas is passed through a hot concentrated solution of NaOH ?

(ii) Sulphur dioxide gas is passed through an aqueous solution of a Fe(III) salt ?

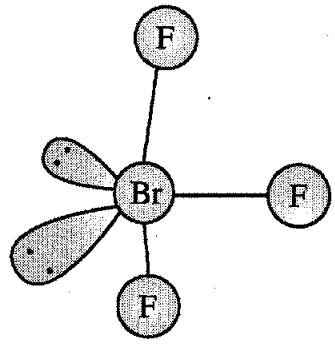
(b) Answer the following :

(i) What is the basicity of H_3PO_3 and why ?**

(ii) Why does fluorine not play the role of a central atom in interhalogen compounds ?

(iii) Why do noble gases have very low boiling points ?

Answer : (a) (ii) BrF_3



(b) (i) $3HgCl_2 + 2PH_3 \rightarrow Hg_3P_2 + 6HCl$

(ii) $SO_3 + H_2SO_4 - H_2S_2O_7$

(iii) $6XeF_4 + 12H_2O - 4Xe + 2XeO_3 + 24HF + 3O_2$

OR

(a)(i)

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

(ii) $2Fe^{3+} + SO_2 + 2H_2O - 2Fe^{2+} + SO_4^{2-} + 4H^+$

(b)(ii) Since fluorine is the most electro-negative halogen, it does not acts as a central atom in interhalogen compounds due to absence of *d*-orbital.

(iii) Noble gases are monoatomic with weak Vander Waals forces of attraction and hence have low boiling points.

30. (a) Illustrate the following name reactions : [5]

(i) Cannizzaro's reaction

(ii) Clemmensen reduction

(b) How would you obtain the following :

(i) But-2-enal from ethanal

(ii) Butanoic acid from butanol

(iii) Benzoic acid from ethylbenzene

OR

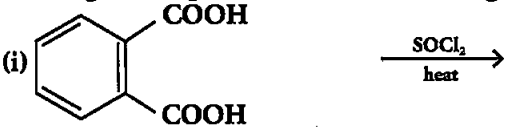
(a) Give chemical tests to distinguish between the following :

(i) Benzoic acid and ethyl benzoate

(ii) Benzaldehyde and acetophenone

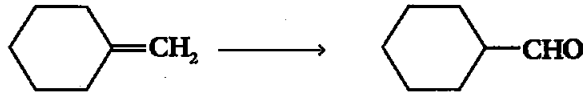
(b) Complete each synthesis by giving missing reagents or products in the following :

(i)



(ii) $C_6H_5CHO \xrightarrow{H_2HCONHNH_2}$

(iii)



Answer : (a) (i) Aldehydes having no α -hydrogen atom undergoes self oxidation and reduction on treatment with concentrated alkali and produce alcohol and carboxylic acid salt.

(ii)

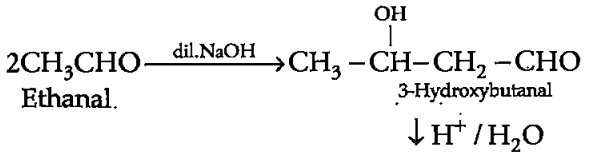
$$\underset{\text{Formaldehyde}}{2HCHO} \xrightarrow[\text{conc.}]{NaOH} \underset{\text{methanol}}{CH_3-OH} + \underset{\text{sodium formate}}{H-COONa}$$

(ii) Reduction of aldehydes and ketones to their respective hydrocarbons. On treating with zinc amalgam and concentrated hydro-chloric acid

$$\underset{\text{Ethanal}}{CH_3CHO} \xrightarrow[HCl]{Zn-Hg} \underset{\text{Ethane}}{CH_3CH_3} + H_2O$$

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

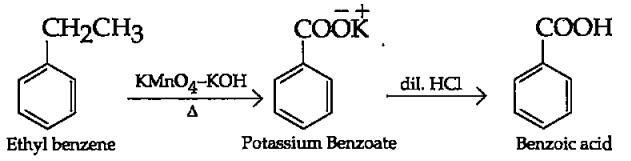
(b)(i)



(ii) $CH_3CH_2CH_2CH_2OH \xrightarrow{CrO_3-H_2SO_4} CH_3CH_2CH_2COOH$

Butan 1 ol — Butanoicacid

(iii)



OR

(a) (i) Benzoic acid gives CO_2 gas on reacting with $NaHCO_3$ but ethyl benzoate does not

(ii) Acetophenone gives iodoform test but benzaldehyde does not

$C_6H_5COCH_3 + 4NaOH + 3I_2 \rightarrow$

Acetophenone Sod.hypoiodide

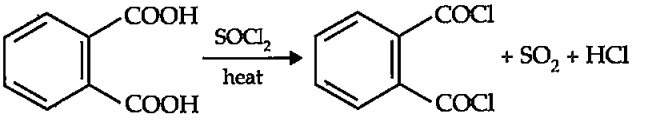
$C_6H_5COONa + CHI_3 + 3H_2O + 3NaI$

Sod.benzote Iodoform (yellow ppt.)

$C_6H_5CHO + NaOI \rightarrow$ No yellow ppt. of Iodoform

(Benzaldehyde)

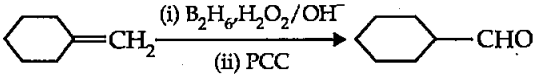
(b)(i)



(ii)

$C_6H_5CHO \xrightarrow{H_2NCONHNH_2} C_6H_5CH = NNHCONH_2 + H_2O$

(iii)



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Chemistry 2011 (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 set.

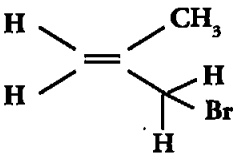
2. What are lyophobic colloids ? Given one example for them. [1]

Answer : Colloids in which the colloidal particles have no affinity for the dispersion medium and they do not form colloidal solution are lyophobic colloids, like, $Al(OH)_3$ and As_2S_3 sols.

3. Why is it that only sulphide ores are concentrated by 'froth floatation process' ? [1]

Answer : Due to the affinity of heavy oil droplets to adsorb sulphide particles. The ore particles come on the surface as froth, gangue particles are wetted by water and get settle down.

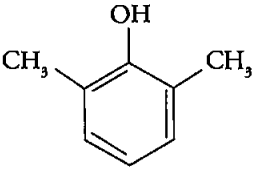
5. Write the IUPAC name of the following compound: [1]



Answer : 3-Bromo-2-methyl prop-1-ene

6. Draw the structure of 2, 6-Dimethylphenol. [1]

Answer :



9. Define the following terms in relation to crystalline solids :** [2]

(i) Unit Cell

(ii) Coordination number

12. A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is reduced to half ? What is the unit of rate constant for such a reaction ? [2]

Answer : $\text{Rate} = K[A]^2 = ka^2$

If $[A] = \frac{1}{2}a$, then $\text{Rate} = K\left(\frac{a}{2}\right)^2 = \frac{1}{4}ka^2$

$\therefore$ $\text{Rate} = \frac{1}{4}$ of original rate

The unit of rate constant is $L\ mol^{-1}\ s^{-1}$

14. Describe the principle controlling each of the following processes : [2]

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

(i) Zone refining of metals

(ii) Electrolytic refining of metals

Answer : (i) Zone refining of Metals : It is based on the principle that impurities are more soluble in molten state of metal than in the solid state.

(ii) Electrolytic refining : Impure metal is made of anode, thin sheet of pure metal is made of cathode and a salt of the metal is used as an electrolyte. On passing current, metal from anode goes into the solution and ions in the solution reduce on cathode leading to deposition of pure metal.

15. Explain giving a suitable reason for each of the following : [2]

(i) Transition metals and their compounds are generally found to be good catalysts.

(ii) Metal-metal bonding is more frequent for the 4*d* and the 5*d* series of transition metals than that for the 3*d* series.

Answer : (i) Due to presence of vacant orbitals and tendency to form large number of oxidation states, transition metals have a high tendency to form complexes and hence acts as a catalysts.

(ii) In transition metals of 4*d* and 5*d* series the 4*d* and 5*d* electrons are at greater distance from the nucleus therefore they are less tightly held to the atom by the nucleus and hence contribute more to metallic bonding as compared to transition metals of 3*d* series.

19. What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50°C ? The freezing point depression constant (K_f) for water is 1.86°C/m. Assume Van't Hoff factor for NaCl is 1.87. (Molar mass of NaCl = 58.5 g) [3]

Answer : Given, $M_2 = 58.5\ g\ mol^{-1}$

$W_1 = 65\ g$, $\Delta T_f = 7.5°C$

$K_f = 1.86\ K\ kg\ mol^{-1}$

$i = 1.87$

$$\Delta T_f = \frac{iK_f \times W_2 \times 1000}{W_1 \times M_2}$$

$$W_2 = \frac{\Delta T_f . W_1 \times M_2}{i \times K_f \times 1000} = \frac{7.5 \times 65 \times 58.5}{1.87 \times 1.86 \times 1000}$$

$$= \frac{28518.75}{3478.2} = 8.1999$$

$\therefore$ Mass of NaCl to be dissolved $W_2 = 8.1999\ g = 8.209 g$.

22. Write the structures and names of all the stereoisomers of the following compounds : [3]

(i) $[Co(en_3)]Cl_3$ (ii) $[Pt(NH_3)_2Cl_2]$

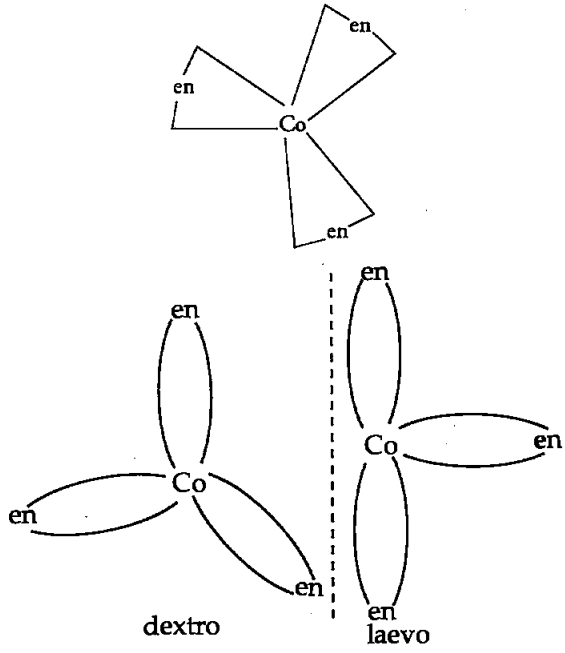
(iii) $[Fe(NH_3)_4Cl_2]Cl$

Answer : (i) Stereoisomerism is of two types :

(1) Geometrical isomerism

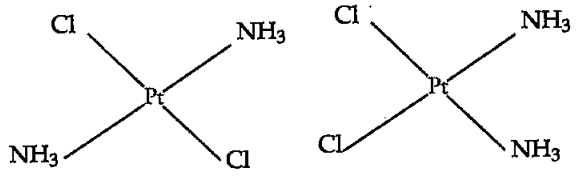
(2) Optical isomerism

$[Co(en)_3]Cl_3$: Tris (ethylenediammine) cobalt (III) chloride



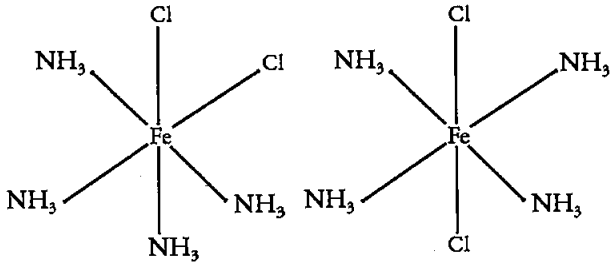
(ii) $[Pt(NH_3)_2Cl_2]$ Diammine dichloridoplatinum(ii)

Geometrical isomers



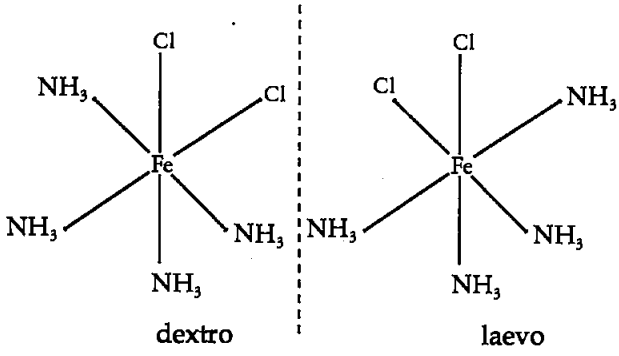
cis-form trans-form

(iii) $[Fe(NH_3)_4Cl_2]Cl$ Tetraammine dichloride iron (III) chloride



cis-form trans-form

Optical isomer Only cis form



27. (a) Differentiate between a disinfectant and an antiseptic. Give one example of each.

(b) What is tincture of iodine and what is it used for ? **[3]**

Answer : (a)

	Disinfectant	Antiseptic
1.	Chemical substances used to kill microorganisms	Chemical substances which prevent growth of microorganisms and may even kill them.
2.	They are applied on non-living objects	They are safe to apply on living tissues.
3.	They are used in drains, toilets, floors etc.	They are used on wounds, cut, ulcers etc.
4.	Example : Phenol (1%)	Example : Soframycin

Answer : (b) 2-3% solution of iodine in alcohol and water is called tincture iodine and is widely used as an antiseptic.

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Chemistry 2011 (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. Define 'activation energy' of a reaction. **[1]**

Answer : Activation energy is the minimum energy that is to be provided to the reactants for the reaction to take place.

2. What is meant by 'reverse osmosis' ? **[1]**

Answer : When a pressure higher than osmotic pressure is applied the solvent will flow from the solution into the pure solvent through the semipermeable membrane, called reverse osmosis.

3. What type of ores can be concentrated by magnetic separation method ? **[1]**

Answer : Ores with different magnetic properties and impurities which are magnetic in nature can be concentrated by magnetic separation method.

e.g. Chromite (Fe O. Cr_2O_3), Magnetite (Fe_3O_4)

14. Describe the principle controlling each of the following processes : **[2]**

(i) Preparation of cast iron from pig iron.

(ii) Preparation of pure alumina (Al_2O_3) from bauxite ore.

Answer : (i) Preparation of cast iron from pig iron : The iron obtained from blast furnace is called pig iron. Cast iron is prepared by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content (about 3%). It is extremely hard and brittle.

(ii) Preparation of pure alumina from bauxite ore : The principal ore of aluminium is bauxite $Al_2O_3.xH_2O$. Bauxite is concentrated by digesting the powdered ore with concentrated solution of NaOH at 473-523K. The Al_2O_3 is leached out as sodium aluminate. The sodium aluminate is neutralized by passing CO_2 gas and hydrated Al_2O_3 is precipitated which is filtered, dried and heated to give pure Al_2O_3.

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \rightarrow 2Na[Al(OH)_4](aq)$$

$$2Na[Al(OH)_4](aq) + CO_2(g) \rightarrow Al_2O_3.xH_2O + 2NaHCO_3(aq)$$

$$\underset{\text{Hydrated alumina}}{Al_2O_3.xH_2O} \xrightarrow{1470K} \underset{\text{(pure alumina)}}{Al_2O_3(s)} + xH_2O(g)$$

15. Explain giving reasons : **[2]**

(i) Transition metals and their compounds generally exhibit a paramagnetic behaviour.

(ii) The chemistry of actinoids is not so smooth as that of lanthanoids.

Answer : (i) Transition metals and their compounds exhibit a paramagnetic behaviour due to presence of unpaired electrons in the Penultimate shell of *d*-orbital.

(ii) Lanthanoids show limited number of oxidation states, +2, +3, +4 because of large energy gap between 4*f* and 5*d* subshells. Actinoids show a number of oxidation states +4, +5, +6, +7 due to small energy difference between 5*f*, 6*d* and 7*s* subshells.

18. Write such reactions and facts about glucose which cannot be explained by its open chain structure. [2]

Answer : Limitations of open chain structure of glucose :

(i) Glucose does not forms $NaHSO_3$ as addition product.

(ii) Glucose penta-acetate does not reacts with NH_2OH due to absence of aldehyde group.

21. How would you account for the following : [3]

(i) NF_3 is an exothermic compound but NCl_3 is not.**

(ii) The acidic strength of compounds increase in the order :

$$PH_3 < H_2S < HCl$$

(ii) As electronegativity increases in the same period from left to right so their electronegativity is in the increasing order P < S < Cl. Therefore, acidic strength increases in the order,

$$PH_3 < H_2S < HCl$$

(iii) SF_6 is protected by six F atoms and hence does not allow to attack on sulphur atom.

22 Write the state of hybridization, the shape and the magnetic behaviour of the following complex entitles : [3]

(i) $[Cr(NH_3)_4Cl_2]Cl$

(ii) $[Co(en)_3]Cl_3$

(iii) $K_2[Ni(CN)_4]$

Answer : (i) d^2sp^3, octahedral, diamagnetic

(ii) d^2sp^3, octahedral, diamagnetic

(iii) dsp^2, square planar, diamagnetic

26. Write the names and structures of the monomers of the following polymers : [3]

(i) Buna-S

(ii) Dacron

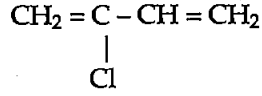
(iii) Neoprene

Answer : (i) Buna-S : 1,3-Butadiene

$CH_2 = CH - CH = CH_2$ and styrene $C_6H_5CH = CH_2$

(ii) Dacron : Ethylene glycol $HOCH_2CH_2OH$, Terephthalic acid

(iii) Neoprene : Chloroprene



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Chemistry 2011 (Delhi) SET I

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

1. 'Crystalline solids are anisotropic in nature'. What does this statement mean ?** [1]

2. Express the relation between conductivity and molar conductivity of a solution held in a cell. [1]

Answer : The molar conductivity of a solution is related to conductivity of that solution as :

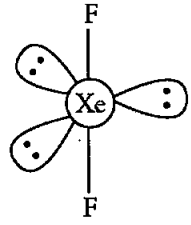
$$\Lambda_m = \frac{K}{C} = \frac{\text{Conductivity}}{\text{Concentration}}$$

3. Define 'Electrophoresis'. [1]

Answer : Electrophoresis is the phenomenon of movement of colloidal particles under the applied electric field.

4. What is the structure of XeF_2 molecule ? [1]

Answer :

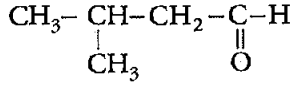


5. Write the IUPAC name of the following compound : $(CH_3)_3CCH_2Br$ [1]

Answer : 1-bromo-2, 2-dimethylpropane

6. Draw the structure of 3-methylbutanal. [1]

Answer :



7. Arrange the following compounds in an increasing order of their solubility in water : [1]

$C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

Answer : $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

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

8. Define Biodegradable polymers. [1]

Answer : Bio-degradable polymers are natural polymers that disintegrated themselves over a period of time by enzymatic hydrolysis. *e.g.*, starch, cellulose, etc.

9. The chemistry of corrosion of iron is essentially an electro-chemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere. [2]

Answer : According to electrochemical theory of rusting, the impure iron surface behaves like small electrochemical cell in the presence of water containing dissolved oxygen or carbon dioxide. In this cell pure iron acts as an anode and impure iron surface acts as cathode. Moisture having dissolved CO_2 or O_2 acts as an electrolyte. The reactions at cathode and anode are as follows :

At anode : $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

At cathode : $H_2O + CO_2 \rightleftharpoons \underset{\text{Carbonic acid}}{H_2CO_3}$

Net Reaction : $2Fe(s) + O_2(g) + 4H^+ \rightarrow 2Fe^{2+} + 2H_2O$

$H_2CO_3 \rightleftharpoons 2H^+ + CO_3^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

$H^+ + e^- \rightarrow H$

$4H + O_2 \rightarrow 2H_2O$

10. Determine the values of equilibrium constant (K_c) and ΔG° and for the following reaction : [2]

$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$, $E^\circ = 1.05V (1F = 96500\ C\ mol^{-1})$

Answer : According to the formula

$\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 1.05$

or $\Delta G^\circ = -202650\ J\ mol^{-1} = -202.65\ KJ\ mol^{-1}$

Now $\Delta G^\circ = -202\,650\ J\ mol = 1$

$R = 8.314\ J/mol$, $T = 298\ K$

$$\log K = \frac{\Delta G^\circ}{2.303RT} \Rightarrow \log K = \frac{-202650}{2.303 \times 8.314 \times 298}$$

$$\log K = \frac{-202650}{5705.84831} = 35.52$$

$K = \text{Antilog of } 35.52 \quad \therefore K = 0.35 \times 10^7$

11. Distinguish between 'rate expression' and 'rate constant' of a reaction. [2]

Answer : Rate constant is the rate of reaction when the concentration of each reactant is taken as unity.

Rate expression expresses the rate of reaction in terms of molar concentrations of the reactants with each term raised to their power, which may or may not be same as the stoichiometric coefficient of that reactant in the balanced chemical equation.

12. Give reason for : [2]

(i) The N-O bond in NO_2^- is shorter than the N-O bond in NO_3^- **

(ii) SF_6 is kinetically an inert substance.

OR

State reasons for each of the following :

(i) All the P-Cl bonds in PCl_5 molecules are not equivalent.**

(ii) Sulphur has greater tendency for catenation than oxygen.

(ii) SF_6 is kinetically inert due to high oxidizing power and electronegativity of fluorine atom which causes steric hindrance and it unables to further react with any other atom.

OR

(ii) Sulphur has a much greater tendency for catenation than oxygen because of its bigger size and low electronegativity due to which the S-S bond is stronger than O-O bond and there is more interelectronic repulsion in O-O than in S-S bond.

13. Assign reasons for the following : [2]

(i) Copper (I) ion is not known in aqueous solution.

(ii) Actinoids exhibit greater range of oxidation states than lanthanoids.

Answer : (i) In aqueous solution Cu^+ undergoes disproportionation to form a more stable Cu^{2+} ion.

$$2Cu^+(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$$

The higher stability of Cu^{2+} ion in aqueous solution may be attributed to its greater negative $\Delta_{hyd}H$ than that of Cu^+ ion. It compensates the second ionisation enthalpy of Cu involved in the formation of Cu^{2+} ions.

(ii) Actinoids exhibit greater range of oxidation states than lanthanoids. This is because there is less energy difference between 5*f* and 6*d* orbitals belonging to actinoids than the energy difference between 4*f* and 5*d* orbitals in case of lanthanoids.

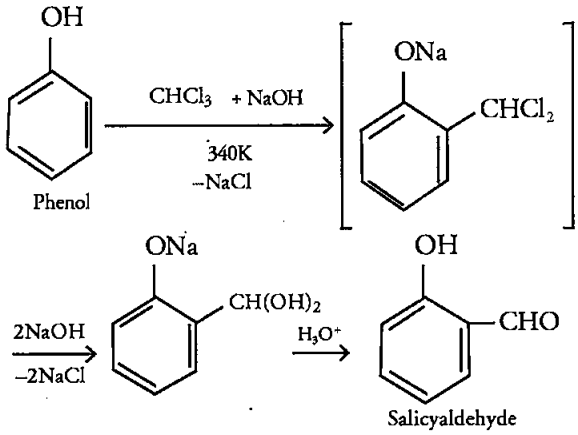
14. Explain the following giving one example for each : [2]

(i) Reimer-Tieman reaction.

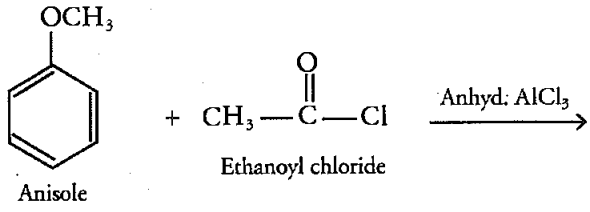
(ii) Friedel Craft's acetylation of anisole.

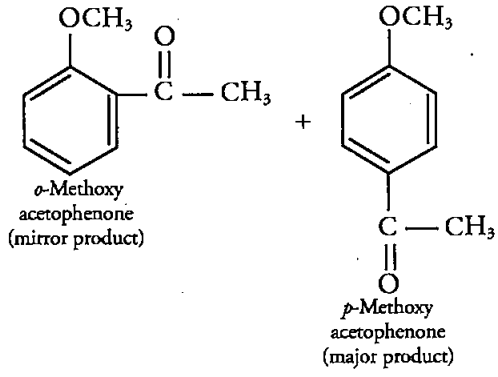
Answer : (i) When phenol is treated with chloroform in presence of aqueous NaOH at 340 K followed by hydrolysis gives salicylaldehyde.

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



(ii) When anisole is treated with acetylchloride in presence of anhydrous $AlCl_3$, 2-methoxy acetophenone is formed.





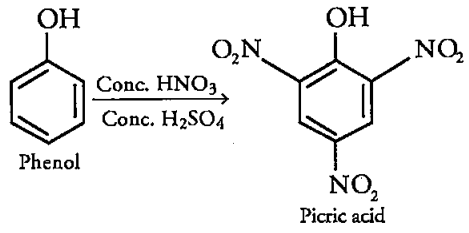
15. How would you obtain : [2]

(i) Picric acid (2, 4, 6-Trinitrophenol) from phenol.

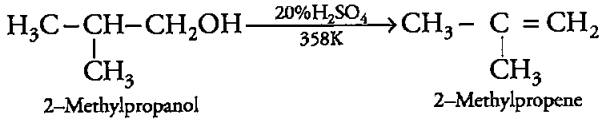
(ii) 2-Methylpropene from 2-methylpropanol ?

Answer :

(i)

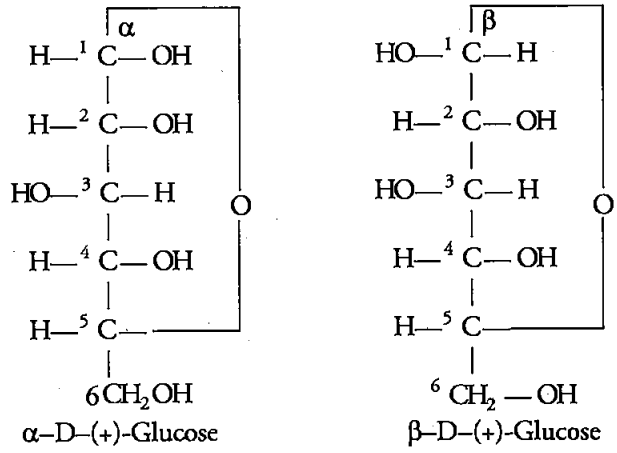


(ii)



16. What is essentially the difference between α-form of glucose and β-form of glucose ? Explain. [2]

Answer : In α-form of glucose OH group lies at C1 towards right but in β-form of glucose it is towards left. This is because OH group at C1 in glucose is chiral.



17. Describe what you understand by primary structure and secondary structure of proteins.[2]

Answer : Primary structure of proteins refer to the sequence in which amino acids are joined together by peptide linkage. The sequence of amino acids in primary structure is very specific. Any change in the sequence of amino acids creates a different protein with different biological activity.

Secondary structure of proteins refers to the conformation which arises due to the coiling of polypeptide chain due to intramolecular hydrogen bonding between carbonyl (>C=O) and –NH groups. Depending upon the size of –R group, there are two secondry structures of protein, *i.e.*, α-Helix and β-Pleated sheet like structure.

18. Mention two important uses of the following[2]

(i) Bakelite (ii) Nylon-6

Answer : Bakelite : It is used in the manufacture of electrical switches, protective coatings, barrels, etc.

Nylon-6 : It is used in making Fabrics, tyre cords, mountaineering ropes etc.

19. Silver crystallizes in face-centered cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom. (Assume the atoms just touch each other on the

diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms).** **[3]**

20. Nitrogen pentoxide decomposes according to equation : **[3]**

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

The first order reaction was allowed to proceed at 40°C and the data below were collected :

$[N_2O_5](M)$	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

(i) Calculate the rate constant. Include units with your answer.

(ii) What will be the concentration of N_2O_5 after 100 minutes ?

(iii) Calculate the initial rate of reaction.

Answer : (i) We know that

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

Substituting the values we get,

$$k = \frac{2.303}{20} \log \frac{0.400}{0.289}$$

$$k = \frac{2.303}{20} \log 1.3840$$

or $$k = 0.11515 \log 1.3840$$

$\therefore$ $$K = 0.0163 \text{ min}^{-1}$$

(ii) Using the formula, $k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$

or $$\log \frac{0.400}{[A]} = \frac{0.0163 \times 100}{2.303}$$

or $$\log \frac{0.400}{[A]} = 7.0777$$

$\therefore$ $$[A] = 0.078M$$

(iii) Initial rate, $R = k[N_2O_5]$

$$= 0.0163 \times 0.400$$

$$= 0.00652 \text{ M min}^{-1}$$

21. Explain how the phenomenon of adsorption finds application in each of the following processes : **[3]**

(i) Production of vacuum

(ii) Heterogeneous catalysis

(iii) Froth Floatation Process

OR

Define each of the following terms :

(i) Micelles

(ii) Peptization

(iii) Desorption

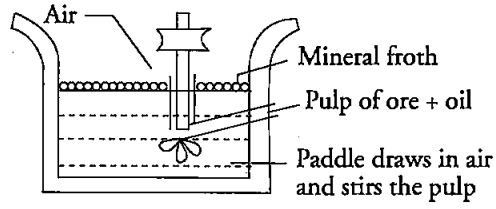
Answer : (i) In vacuum flask activated charcoal is placed between the walls of the flask so that any gas which enters into annular space either due to glass imperfection or diffusion through glass is adsorbed and create a vacuum.

(ii) If the catalysts and reactants are present in different phase, the process of catalysis is called as heterogenous catalysis. For example, manufacture of NH_3 from N_2 and H_2 by Haber's process using iron as catalyst

$$N_{2(g)} + 3H_{2(g)} \xrightarrow{Fe(s)} 2NH_{3(g)}$$

In this process, the reactants are in gaseous phase whereas catalyst is in solid phase.

(iii) This method is used for removing gangue from sulphide ores. In this powdered ore is mixed with collectors (*e.g.*, pine oil, fatty acids etc.) and froth stabilizers (*e.g.*, cresols, aniline) which enhance non-wettability of the mineral particles and froth stabilisation respectively. As a result of which ore comes with froth and gangue remains in the solution.



OR

(i) When soaps and detergents are added to water, a cluster of charged particle is formed by the aggregation of variety of molecules. Thus formed is called micelle.

(ii) The process of converting a fresh precipitate into colloidal particles by shaking it with the dispersion medium in the presence of a small amount of a suitable electrolyte is called peptization.

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

(iii) The process of removal of adsorbed substance from the surface of a solid or a liquid by heating or by reducing pressure is called desorption.

22. Describe the principle behind each of the following processes : [3]

(i) Vapour phase refining of a metal.

(ii) Electrolytic refining of a metal

(iii) Recovery of silver after silver ore was leached with NaCN.

Answer : (i) Vapour Phase Refining : The impure metal is first converted to its unstable volatile compound which is evaporated and then decomposed by heating at higher temperature to give pure metal, leaving behind the impurities.

(ii) In this method impure metal is made anode and a thin sheet of pure metal is made cathode, and are put in a suitable electrolyte containing soluble salt of same metal. On passing current the more basic metal remains in the solution and the less basic one go to the anode and gets deposited as anode mud.

(iii) NaCN acts as a leaching agent or oxidizing agent, thus oxidizes Ag to Ag^+ which then combines with CN^- ions to form respective soluble complex.

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

Soluble complex

23. Complete the following chemical equations : [3]

(i) $MnO_4^- + C_2O_4^{2-} + H^+ -$

(ii) $KMnO_4 \xrightarrow{\text{Heated}}$

(iii) $Cr_2O_7^{2-} + H_2S + H^+ \rightarrow$

Answer :

(i) $MnO_4^- \; 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

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

(iii)

$$Cr_2O_7^{2-} + 8H^+ + 3H_2S \rightarrow 2Cr^{3+} + 3S + 7H_2O$$

24. Write the name, stereochemistry and magnetic behaviour of the following : [3]

(At. Nos. Mn = 25, Co = 27, Ni = 28

(i) $K_4[Mn(CN)_6]$

(ii) $[Co(NH_3)_5Cl]Cl_2$

(iii) $K_2[Ni(CN)_4]$

Answer : (i) Potassiumhexacyanomanganate(II)

Shape : Octahedral

Magnetic Behaviour : Paramagnetic (one unpaired electron)

Hybridization : d^2sp^3

(ii) Pentaamminechloridocobalt (III) chloride

Shape : Octahedral

Hybridization : d^2sp^3

Magnetic Behaviour : Dimagnetic (no unpaired electrons)

(iii) Potassiumtetracyanonicklate(II)

Shape : Square planar

Hybridization : dsp^2

Magnetic Behaviour : Dimagnetic (no unpaired electrons)

25. Answer the following : [3]

(i) Haloalkanes easily dissolves in organic solvents, why ?

(ii) What is known as a racemic mixture ? Give an example.

(iii) Of the two bromoderivatives, $C_6H_5CH(CH_3)Br$ and $C_6H_5CH(C_6H_5)Br$, which one is more reactive in S_N1 substitution reaction and why ?

Answer : (i) Haloalkanes dissolve in organic solvents because the new intermolecular attraction between haloalkanes and organic solvent molecules have the same strength as the one being broken in the separate haloalkanes and solvent molecules.

(ii) Racemic mixture is an equimolar mixture of two enantiomers and is hence optically inactive. *e.g.* (± butan-2-ol)

(iii) The carbocation intermediate derived from $C_6H_5CH(C_6H_5)Br$ *i.e.* $C_6H_5\overset{+}{C}HC_6H_5$ is more stable as compared to the carbocation $C_6H_5\overset{+}{C}HCH_3$ obtained from $C_6H_5CH(CH_3)Br$ because it is stabilized by two phenyl groups due to resonance.

26. (a) Explain why an alkylamine is more basic than ammonia ? [3]

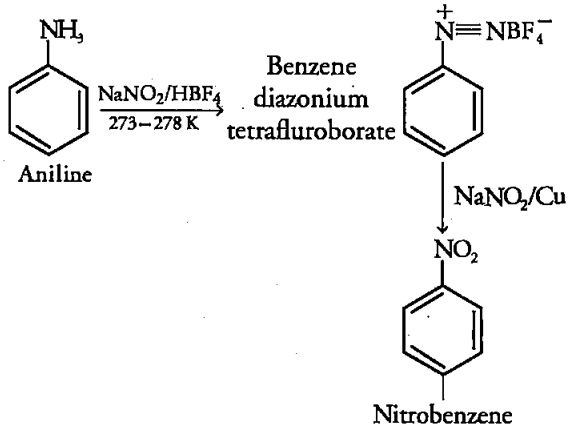
(b) How would you convert :

(i) Aniline to nitrobenzene

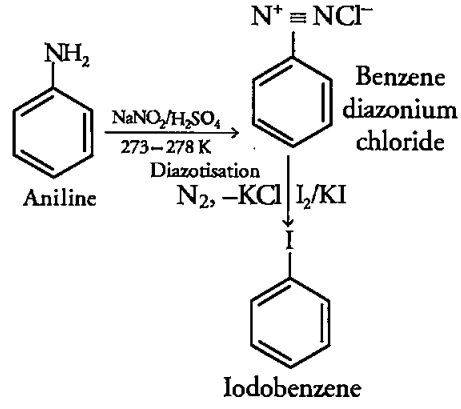
(ii) Aniline to iodobenzene

Answer : (a) Alkyl groups are electron donating groups and increases the electron density on nitrogen in alkylamine making them more basic than ammonia.

(b) (i) $C_6H_5NH_2 \xrightarrow[HCl]{NaNO_2} C_6H_5N_2^+Cl^- \xrightarrow{NaNO_2} C_6H_5NO_2$



(ii)



27. Describe the following giving one example for each : [3]

(i) Detergents (ii) Food preservatives

(iii) Antacids

Answer : (i) Detergents are soluble salts of sodium potassium sulphonic acids unlike soaps they are non-biodegradble but they can be conveniently used both with soft and hard water. *e.g.* Sodium alkylbenzene sulphonate.

(ii) Food preservatives are chemicals used to preserve food by preventing microbial growth *e.g.* Sodium benzoate, Table salt, etc.

(iii) The substances which are taken to neutralize the excess acid and maintaining the pH to an appropriate level in stomach are called antacids. There are two types of anatacids systemic antacids, *e.g.*, $NaHCO_3$ and non-systemic *e.g.* Milk of magnesia.

28. (a) Differentiate between molality and molarity of a solution. How does a change in temperature influence their values ? [5]

(b) Calculate the freezing point of an aqueous solution containing 10.50 g of $MgBr_2$ in 200 g of water. (Molar mass of $MgBr_2$ = 184 g) (K_f for water = 1.86 K kg mol^{-1}

OR

(a) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property ? Explain.

(b) Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. (K_b for water = 0.512 K kg mol^{-1}, Molar mass of NaCl = 58.44 g)

Answer : (a) Molarity is the number of moles of solute dissolved in 1 litre of solution. It is temperature dependent.

$$M = \frac{W \times 1000}{\text{Molecular mass} \times V}$$

Molality is the number of moles of solute dissolved per 1 kg of the solvent. It is temperature independent.

$$M = \frac{W \times 1000}{M_2 \times W}$$

Molality is independent of temperature, whereas molarity is a function of temperature because volume depends on temperature and mass does not.

(b) Since $MgBr_2$ is an isotonic compound. Hence undergoes complete dissociation

	$MgBr_2 \rightarrow$	Mg^{2+} +	$2Br^-$
Initial moles	1	0	0
After dissociation	0	1	2

Total number of moles = 1 + 2 = 3

Thus, $i = \frac{3}{1} = 3$

Using the formula

$DT_f = iK_f m \qquad T_f^\circ - T_f = iK_f m$

or $0°C - T_f = 3 \times 1.86 \times \frac{10.50}{184} \times \frac{1000}{200}$

or $-T_f = \frac{58590}{30800} = 1.59°C$

$\therefore T_f = 1.59°C$

or $T_f = -1.59°C$ or 271.41 K

OR

(a) Osmosis is the phenomenon of flow of solvent through a semi-permeable membrane from the region of higher concentration to the region of lower concentration.

The osmotic pressure of a solution is the excess pressure that must be applied to the solution to prevent the passage of solvent molecule through a semi-permeable membrane into the solution.

Yes, osmotic pressure is a colligative property as it depends only on the amount of solute present in the solution.

(b) Initial moles after dissociation

$NaCl \rightarrow Na^+ + Cl^-$

1 0 0

0 1 1

(Total no. of moles 1 + 1 = 2)

$\therefore \qquad i = \frac{2}{1} = 2$

Initial moles after dissociation

$DT_b = iK_b m$

$T_b - T_b^\circ = 2 \times 0.512 \times \frac{15 \times 1000}{58.44 \times 250}$

or $T_b - 373\ K = \frac{15360}{14610} = 1.05\ K$

or $T_b = 1.05\ K + 373\ K$

$\therefore T_b = 374.05\ K$

29. Give chemical tests to distinguish between : [5]

(i) Propanal and propanone

(ii) Benzaldehyde and acetophenone

(b) How would obtain :

(i) But-2-enal from ethane

(ii) Butanoic acid from butanol

(iii) Benzoic acid from ethylbenzene

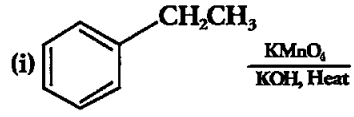
OR

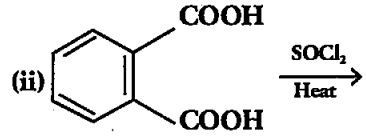
(a) Describe the following giving linked chemical equations

(i) Cannizzaro reaction

(ii) Decarboxylation

(b) Complete the following chemical equations :

(i) 

(ii) 

(iii) $C_6H_5CONH_2 \xrightarrow{H_2O/Heat}$

Answer : (a) (i) Propanal on treatment with Fehlings solution gives a red ppt. of cuprous oxide while propanone does not responds to this test.

$CH_2CH_2CHO + 2Cu^{2+} + 5OH^- -$

Fehling solution

$CH_3CH_2COONa + Cu_2O\downarrow + 3H_2O$

Red ppt.

(ii) Acetophenone on treatment with I_2^+NaOH undergoes iodoform test to give yellow ppt. of iodoform that benzaldehyde does not

$C_6H_5COCH_3 + 4NaOH + 3I_2 \rightarrow$

$C_6H_5COONa + CHI_3\downarrow + 2H_2O + 3NaI$

Sod. benzoate Iodoform (yellow ppt)

$C_6H_5CHO \xrightarrow[NaOH + I_2]{} \text{No reaction}$

(b) (i)

$2CH_3CHO \xrightarrow[2.\Delta]{1.NAOH} CH_3-CH(OH)-CH_2-CHO \downarrow H^+H_2O$

Ethanal (Aldol condensation) $CH_3-CH=CH-CHO + H_2O$

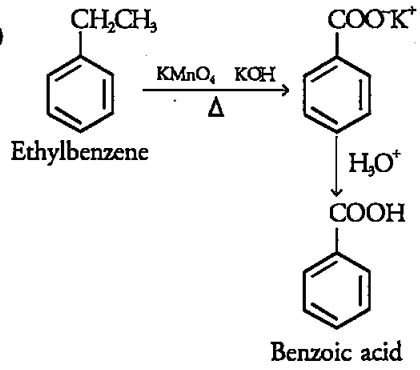
But–2–enal

(ii)

$CH_3CH_2CH_2CH_2OH \xrightarrow[dil.H_2SO_4]{alk.KMnO_4} CH_3CH_2CH_2COOH + H_2O$

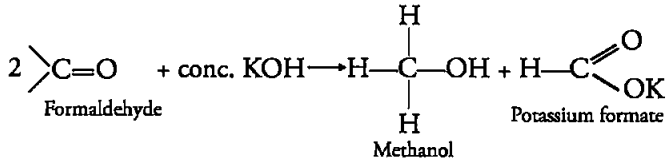
Butanol Butanoic acid

(iii)



OR

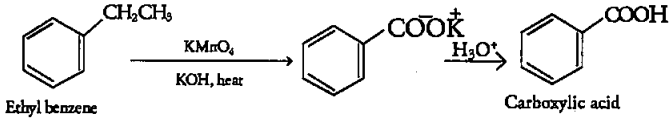
(a) (i) An aldehyde with no α-hydrogen atom undergoes self-reduction and oxidation in presence of conc. alkali to form alcohol and carboxylic acid salt.



(ii) Sodium acetate undergoes decarboxylation (removal of CO_2) in presence of soda lime to give hydrocarbon.

$$\underset{\text{Sod. acetate}}{CH_3COONa} \xrightarrow[Ca/\Delta]{NaOH} \underset{\text{Methane}}{CH_4} + Na_2CO_3$$

(b) (i)



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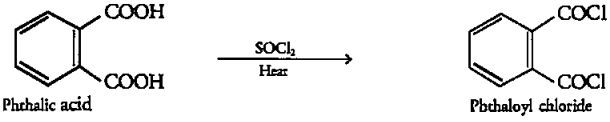


(iii) $\underset{\text{Benzamide}}{C_6H_5CONH_2} \xrightarrow[\text{Heat}]{H_3O^+} \underset{\text{Benzoic acid}}{C_6H_5COOH} + NH_3$

30. (a) Explain the following : [5]

(i) NF_3 is an exothermic compound whereas NCl_3 is not.**

(ii) F_2 is most reactive of all the four common halogens.

(b) Complete the following chemical equations :

(i) $C + H_2SO_4(conc) \rightarrow$

(ii) $P_4 + NaOH + H_2O \rightarrow$

(iii) $Cl_2 + F_2 \rightarrow$

OR

(a) Account for the following :

(i) The acidic strength decreases in the order $HCl > H_2S > PH_3$

(ii) Tendency to form pentahalides decreases down the group in group 15 of the periodic table.**

(b) Complete the following chemical equations :

(i) $P_4 + SO_2Cl_2 \rightarrow$

(ii) $XeF_2 + H_2O \rightarrow$

(iii) $I_2 + HNO_3$ (conc.) $\rightarrow$

Answer : (a) (ii) Fluorine is most reactive of all the four common halogens because of its low bond dissociation energy due to which it readily dissociates into atoms and reacts with other substances readily.

(b) (i) $C + 2H_2SO_4 \rightarrow CO_2 + 2H_2O + 2SO_2$ (Conc.)

(ii) $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

(iii) $Cl_2 + \underset{\text{(excess)}}{3F_2} \xrightarrow{473K} 2ClF_3$

OR

(a) (i) Because of decrease in electronegativity from chlorine to phosphorus, the dissociation enthalpy from HCl to HP increases, and their tendency to release H^+ ion decreases and thus acidic strength decreases.

(b) (i) $P_4 + 10SO_2Cl_2 \rightarrow \underset{\text{Phosphorus Pentachloride}}{4PCl_5} + 10SO_2$

(ii) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

(iii) $I_2 + 10HNO_3(Conc.) \rightarrow 2HIO_3 + 4H_2O + 10NO_2$

●●

Chemistry 2011 (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 set.

1. Which stoichiometric defect in crystals decreases the density of a solid ? [1]**

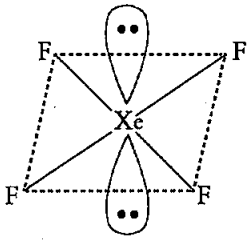
3. What is meant by shape-selective catalysis of reactions ? [1]

Answer : The reaction that depends for shape selective catalysts uses zeolites as catalyst for reaction on the shape and size of pores and of reactants and products.

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

4. Draw the structure of XeF_4 molecule [1]

Answer :



9. Explain what is meant by (i) a peptide linkage, (ii) a glycosidic linkage ? [2]

Answer : (i) Peptide linkage is present in proteins to bind together amino acids. The linkage involves the carboxyl group of one amino acid and amine group of another amino acids.

(ii) Glycosidic linkage is the (–C–O–C–) linkage present between two molecules of a monosaccharide to form a disaccharide.

10. Name the bases present in RNA. Which one of these is not present in DNA. [2]

Answer : Four bases present in RNA are Adenine, Guanine, Cytosine and Uracil. Uracil is not present in DNA.

22. Explain the role of each the following in the extraction of metals from their ores : [3]

(i) CO in the extraction of nickel.

(ii) Zinc in the extraction of silver.

(iii) Silica in the extraction of copper.

Answer : (i) CO is used in the vapour phase refining of nickel.

$$Ni + 4CO \xrightarrow[330-350\ K]{\Delta} Ni(CO)_4$$

$$Ni + (CO)_4 \xrightarrow{450-470K} Ni + 4CO$$

(ii) Zinc acts as a reducing agent which reduces cyanide complex of silver into pure silver.

$$2[Ag(CN)_2]^-(aq) + Zn(s) \rightarrow 2Ag^+(s) + [Zn(CN)_4]^{2-}$$

Dicyano silver (I) ion Silver (aq)

(iii) Silica is used to remove impurities in the form of metal oxides as slag.

$$FeO + SiO_2 \rightarrow \underset{(slag)}{FeSiO_3}$$

24. For the complex $[Fe(en)_2Cl_2]Cl$, identify the following : [3]

(i) Oxidation number of iron.

(ii) Hybrid orbitals and shape of the complex.

(iii) Magnetic behaviour of the complex.

(iv) Number of its geometrical isomers.

(v) Whether there may be optical isomer also.

(vi) Name of the complex.

Answer : (i) +3

(ii) d^2sp^3 octahedral shape.

(iii) paramagnetic

(iv) 2 geometrical isomers, cis and trans.

(v) Only cis-isomers shows optical isomerism

(vi) Dichloridobis (ethylenediamine) iron(III) chloride

27. Explain the following terms with one suitable example for each : [3]

(i) A sweetening agent for diabetic patients

(ii) Enzymes

(iii) Analgesics

Answer : (i) Artificial Sweetening agents are chemicals that sweeten food. However, unlike natural sweetners, they do not add calories to the body, not harmful to diabtic patients. *e.g.* Saccharin, aspartame.

(ii) Enzymes are biocatalysts which are structurally globular proteins. They are sensitive to substrate, pH and temperature changes. *e.g.*, Trypsin

(iii) Analgesics are chemical substances which reduces pain without causing impairment of consciousness, mental confusion, in coordination of paralysis or some other disturbance of nervous system. *e.g.*, Aspirin, (non-narcotic analgesic) and Morphine (narcotic analgesic)

28. (a) State the following : [5]

(i) Henry's law about partial pressure of a gas in a mixture.

(ii) Raoult's law in its general form in reference to solutions.

(b) A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming the gene fragment is non-electrolyte, find its molar mass.

OR

(a) Difference between molarity and molality in a solution. What is the effect of tempe-

rature change on molarity and molality in a solution?

(b) What would be the molar mass of a compound if 6.21 g of it dissolved in 24.0 g of chloroform form a solution that has a boiling point of 68.04°C ? The boiling point of pure chloroform is 61.7°C and the boiling point elevation constant, K_b for chloroform is 3.63°C/m.

Answer : (a)(i) Henry's law states that the partial pressure of gas in vapour phase is directly proportional to its mole fraction in the solution.

(ii) Raoult's law states that for a solution with volatile components, the partial vapour pressure of each component present in the solution is proportional to its mole fraction in the solution.

or $M_2 = \frac{W_2RT}{\pi V}$

$\therefore$ Molar mass, $M_2 = 1.42 \times 10^4$ g mol^{-1}

(b) Given : $W_2 = 8.95$ mg $= 8.95 \times 10^{-3}$ g

$V = 35$ mL $\quad \pi = 0.335$ torr

$T = 25°C = 298$ K $\quad M_2 = ?$

Substituting all the values in the given formula

$\pi = CRT$

$\pi = \frac{W_2RT}{M_2V}$

OR

(a) Molarity is defined as the number of moles of solute present in 1 litre of solution, while molality is defined as the number of moles of solute present in 1 kg of solvent. Molality does not have any effect of change in temperature because mass does not changes with temperature, whereas molarity changes with temperature.

(b) Given : $W_2 = 6.21$ g

$W_1 = 24$ g

$K_b = 3.63°C/m$

$\Delta T_b = T_b - T_b^\circ = 68.04 - 61.7 = 6.34°C$

$M_2 = ?$

From the formula,

$M_2 = \frac{100 \times K_b \times W_2}{\Delta T_b \times W_1}$

$= \frac{1000 \times 3.63 \times 6.21}{6.34 \times 24}$

$= 148.14$ g mol^{-1}

$\therefore$ Molar mass of the compound, M = 148.14 g mol^{-1}

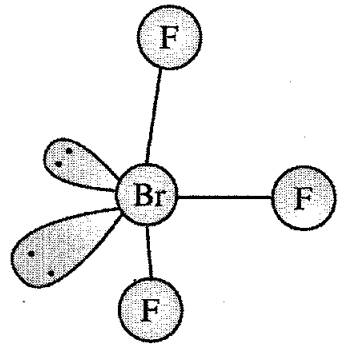
Chemistry 2011 (Delhi) SET III

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

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

4. Draw the structure of BrF_3 molecule [1]

Answer :



8. In nylon 6, 6 what does the designation '6, 6' mean ? [1]

Answer : 6, 6-refers to the number of carbon atoms in each of its monomer, adipic acid and hexamethyldiamine

9. What type of a battery is lead storage battery ? Write the anode and the cathode reactions and the overall reactions occurring in a lead storage battery. [2]

Answer : The lead storage battery is a secondary cell which is rechargeable. During discharging, the electrode reaction occurs as follows :

At anode :

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

At cathode :

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

Net reaction :

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

10. Two half-reaction of an electrochemical cell are given below :

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$, $E^\circ = +1.51$V

$Sn^{2+}(sq) \rightarrow Sn^{4+}(aq) + 2e^-$, $E^\circ = +0.15V$

Construct the redox equation from the standard potential of the cell and predict it the reaction is reactant favoured or product favoured. [2]

Answer : The redox reactions at anode and cathode can be represented as :

At anode (oxidation) :

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^- \times 5E^\circ = +0.15\ V$

At cathode (reduction) :

$[MnO_4^{-2}(aq) + 8H+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)] \times 2E^\circ = +1.51V$

The Net

$R \times M = 2MnO_4^- + 16H^+ + 5Sn^{2+} \rightarrow 2Mn^{2+} + 5Sn^{4+} + 8H_2O$

Now,

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$
$$= 1.51 - 0.15$$
$$= +1.36\ V$$

$\therefore$ The positive value of E°_{cell} favours formation of product.

13. Assign reasons for each of the following : [2]

(i) Transition metals generally form coloured compounds.

(ii) Manganese exhibits the highest oxidation state of +7 among the 3d series of transition elements.

Answer : (i) Due to presence of unpaired electrons and d-d transition, the transition metals are generally coloured.

(ii) Manganese (Z = 25), has the maximum number of unpaired electrons. Thus, it shows oxidation states from +2 to +7 which is maximum in number as compared to other elements of transition series.

18. Name the sub-groups into which polymers are classified on the basis of magnitude of intermolecular forces. [2]

Answer : Elastomers : They have weakest intermolecular forces of attraction.

Fibres : They have strong intermolecular forces of attraction among its molecules.

Thermoplastics Polymers : They are semifluid substances having low molecular weight.

Thermosetting Polymers – They have intermolecular forces intermediate between those of elastomers and fibres.

19. The density of lead is 11.35 g cm^{-3} and the metal crystallizes with *fcc* unit cell. Estimate the radius of lead atom. (At. mass of lead = 207 g mol^{-1} and $N_A = 6.02 \times 10^{23}$ mol^{-1})** [3]

26. Complete the following chemical equations : [3]

(i)

$$CH_3CH_2Cl \xrightarrow{NaCN} (A) \xrightarrow[Ni/H_2]{reduction} (B)$$

(ii) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

(iii)

$$R-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow[H_2O]{LiAlH_4}$$

Answer :

(i) $CH_3CH_2Cl \xrightarrow{NaCN} CH_3-CH_2-C\equiv N$

$\xrightarrow{\text{Reduction}}$

Chloroethane — Propanenitrile $CH_3-CH_2-CH_2-NH_2$ Propan-1-amine

(ii)

$$\underset{\text{Benzene diazonium chloride}}{C_6H_5N_2Cl} + H_3PO_2 + H_2O \longrightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + H_3PO_3 + HCl$$

(iii)

$$\underset{\text{Alkanamide}}{R-\overset{\overset{O}{\|}}{C}-NH_2} \xrightarrow[H_2O]{LiAlH_4} \underset{\text{Alkanamine}}{R-CH_2-NH_2}$$

27. Answer the following questions : [3]

(i) Why do soaps not work in hard water ?

(ii) What are the main constituents of dettol ?

(iii) How do antiseptics differ from disinfectants ?

Answer : (i) Hard water contains insoluble chloride of calcium and magnesium which forms insoluble ppt. (scum) with soap and thus cannot be rinsed off easily.

(ii) The main constituents of dettol are chloroxylenol and α-terpine.

(iii) Antiseptics : These are chemical substances which either kill or prevent the growth of micro-organism but do not cause harm to the living tissues.

Disinfectants : These are chemical substances which kill the microbes. They are toxic in nature and thus causes harm to the tissues of the skin.

●●

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

Chemistry 2012 (Outside Delhi) SET I

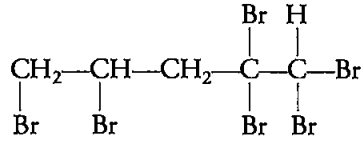
Time allowed : 3 hours **Maximum marks : 70**

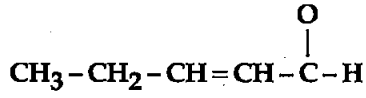
1. **How may the conductivity of an intrinsic semiconductor be increased ?**** [1]

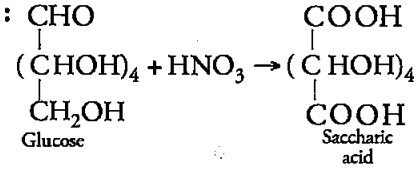
2. **Define 'peptization'.** [1]
Answer : The process of conversion of freshly prepared precipitate into a colloidal solution by adding suitable electrolyte is called peptization.

3. **How is copper extracted from a low grade ore of it ?** [1]
Answer : Copper from its low grade ore is leached out using acid or bacteria and then Cu^{2+} ions in the solution are reduced to copper by treating it with Hydrogen or Iron. This method is called hydrometallurgy.

4. **Which is a stronger reducing agent, SbH_3 or BiH_3, and why ?**** [1]

5. **What happens when bromine attacks**
$CH_2 = CH - CH_2 - C \equiv CH$? [1]
Answer :
$CH_2{=}CHCH_2C^{\circ}CH + Br_2 \rightarrow$
$CH_2{=}CH{-}CH_2{-}C(Br){=}CH{-}Br$
And if Br_2 is in excess then


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

Answer : Pent-2-enal

7. **Write the structure of the product obtained when glucose is oxidised with nitric acid.** [1]
Answer :

Glucose — Saccharic acid

8. **Differentiate between disinfectants and antiseptics.** [1]
Answer : Antiseptics are used on living tissues to kill or prevent the growth of microorganisms. It does not cause any harm to the living tissues *e.g.* 0.2% solution of phenol.
Disinfectants are used on non-living objects to kill the micro-organisms. They are harmful to the living tissues and hence, cannot be applied to the skin *e.g.* 1% solution of phenol.
$M = 0.2085\ S\ cm^{-1}$

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

9. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity. [2]

OR

The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution.

Answer : $CG^* = k$

Where, C = conductance, G^* = cell constant, k = conductivity

$$G^* \times \frac{1}{R} k \Rightarrow G^* = Rk$$

$$\therefore \Lambda_m = \frac{k \times 1000}{M} Scm^2 mol^{-1}$$

OR

Given : M = 1.5 M

$\Lambda_m = 138.9\ S\ cm^2\ mol^{-1}$

$$\Lambda_m = \frac{1000K}{M}$$

$$M = \frac{k.\Lambda_m}{1000} = \frac{1.5 \times 138.9}{1000}$$

$M = 0.2085\ S\ cm^{-1}$

10. A reaction is of second order with respect to a reactant. How is its rate affected if the concentration of the reactant is (i) doubled (ii) reduced to half ? [2]

Answer : (i) Rate increases by four times,

$R' = 2R \Rightarrow r = k[2R]^2 = 4kR^2$

(ii) Rate is reduced by ¼ times,

$$R' = \frac{1}{2}R \Rightarrow r = k\left[\frac{R}{2}\right]^2 = \frac{k}{4}R^2$$

11. Which methods are usually employed for purifying the following metals : [2]

(i) Nickel, (ii) Germanium.

Mention the principle behind each one of them.

Answer : (i) Mond's Process : In this method Nickel form volatile complex with Co which decomposes on heating to give pure nickel.

(ii) Zone Refining : It is based on the principle that the impurities are more soluble in the molten state than in the solid state of metal.

12. Explain the following facts giving appropriate reason in each case : [2]

(i) NF_3 is an exothermic compound whereas NCl_3 is not.

(ii) All the bond in SF_4 are not equivalent.

Answer : (i) The bond energy of F-F bond is lower that of N-F bond So NF_3 is an exothermic compound whereas bond energy of Cl-Cl bond is higher than N-Cl bond so NCl_3 is an endothermic compound.

(ii) SF_4 has see-saw structure with bond pairs at two equatorial and two axial positions. Hence, all the bonds in SF_4 are not equivalent.

13. Complete the following chemical reaction equations : [2]

(i) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow$

(ii) $MnO_4^- + NO_2^- + H^+ \longrightarrow$

Answer :

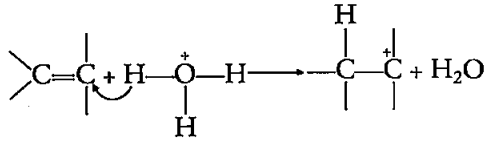
(i) $Cr_2O_7^{2-} + 14H^+ + 6I^- \rightarrow 2Cr^{3+} + 7H_2O + 3I_2$

(ii)

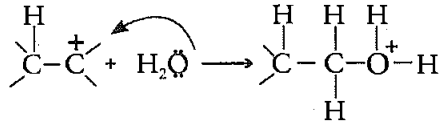
$2MnO_4^- + 5NO_2^- + 6H^+ \rightarrow 2Mn^{2+} + 3H_2O + 5NO_3^-$

14. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol. [2]

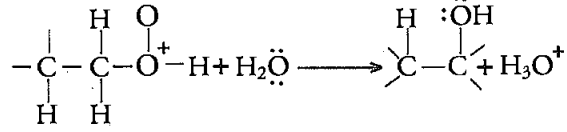
Answer : Step1 : Carbocation is formed due to electrophilic attack by H_3O^+.



Step 2 : Nucleophilic water attacks the carbocation.



Step 3 : Deprotonation to form an alcohol



15. Explain the following behaviours : [2]

(i) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.

(ii) Ortho-nitrophenol is more acidic than ortho-methoxyphenol.

Answer : (i) Due to the formation of hydrogen bonds by alcohols with water molecules.

(ii) The phenoxide ion is more stable for *o*-nitrophenol as nitro group is electron withdrawing due to resonance while methoxy group is electron donating via resonance.

16. Describe the following giving the relevant chemical equation in each case : [2]

(i) Carbylamine reaction

(ii) Hofmann's bromamide reaction.

Answer : (i) Carbylamine Reaction : When

aliphatic and aromatic primary amines are heated with chloroform and ethanolic KOH solution, they form isocyanides or carbylamines which are foul smelling substances.

$$R-NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} \underset{\text{Isocyanide}}{R-NC} + 3KCl + 3H_2O$$

(ii) Hofmann's Bromamide Reaction : In this reaction, primary amines are prepared by treating an amide with Br_2 in an aqueous or alcoholic solution of NaOH

$$R-\overset{O}{\overset{\|}{C}}-NH_2 + Br_2 + 4NaOH \rightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

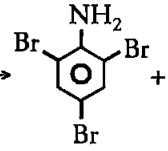
17. Complete the following reaction equations : [2]

(i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

(ii) $C_6H_5NH_2 + Br_2(aq.) \longrightarrow$

Answer :

(i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow C_6H_6 + N_2 + H_2PO_3 + HCl$

(ii) $C_6H_5NH_2 + 3Br_{2(aq)} \rightarrow$  $+ 3HBr$

18. What are food preservatives? Name two such substances. [2]

Answer : Chemicals used to prevent spoilage of food by preventing growth of microorganisms like bacteria, fungus etc are called food preservatives. Sodium benzoate, nitrogen gas are two such substances which are used as food preservatives.

19. Copper crystallizes with face centred cubic unit cell. If the radius of copper atom is 127.8 pm, Calculate the density of copper metal. [3]
(Atomic mass of Cu = 63.55 u and Avogadro's number $N_A = 6.02 \times 10^{23}$ mol^{-1})**

OR

Iron has a body centred cubic unit cell with the cell dimension of 286.65 pm. Density of iron is 7.87 g cm^{-3}. Use this information to calculate Avogadro's number. (Atomic mass of Fe = 56.0 u)**

20. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity. [3]

Answer :

$A = \pi r^2 = 3.14 \times (0.5)^2 = 0.785$ cm^2, $l = 50$ cm

$$R = \frac{\rho l}{A} \quad \rho = \frac{AR}{l} = \frac{5.55\times10^{-3}\times0.785}{50}$$

$$\rho = 87.18\ \Omega\ \text{cm}$$

$$\text{Conductivity, } K = \frac{1}{\rho} = 0.01147\ \text{S cm}^{-1}$$

$$\text{Molar Conductivity} = \frac{1000\times K}{C} = \frac{0.01147\times1000}{0.05}$$

$$\Lambda_m = 229.4\ \text{S cm}^2\text{mol}^{-1}$$

21. The reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ contributes to air pollution whenever a fuel is burnt in air at a high temperature. At 1500 K, equilibrium constant K for it is 1.0×10^{-5}. Suppose in a case $[N_2] = 0.80$ mol L^{-1} and $[O_2] = 0.20$ mol L^{-1} before any reaction occurs. Calculate the equilibrium concentrations of the reactants and the product after the mixture has been heated to 1500 K. [3]

Answer :

	$N_2(g)$	+ $O_2(g)$	$\rightleftharpoons$ $2NO(g)$
Initial conc.	0.80	0.20	0
at equilibrium	$0.80 - x$	$0.20 - x$	$2x$
Initial conc. at : equilibrium	$0.80-x$	0.80	$0.20\ 2x$

$$K = \frac{[NO]^2}{[O_2][N_2]} = \frac{(2x)^2}{(0.8-x)(0.2-x)} = 10^{-5}$$

$$\Rightarrow \quad \frac{(4x)^2}{0.16 - 1x + x^2} = 10^5$$

$$\Rightarrow \quad 400000x^3 = x^2 - x + 0.16$$

$$\Rightarrow 399999\,x^2 + x - 0.16 = 0$$

$$b^2 - 4ac = (1)^2 - 4(399999)(-0.16)$$

$$= 1 + 255999.36 = 256000.36$$

$$\Rightarrow \quad \sqrt{b^2 - 4ac} = \sqrt{256000.36} = 505.96$$

$$x = \frac{-1 \pm 505.96}{2\times399999} = \frac{504.96}{2\times399999}$$

$$= 0.63 \times 10^{-3}$$

$[NO] = 2x = 2 \times 0.63 \times 10^{-3} = 1.26 \times 10^{-3}$ mol/litre

22. Explain the following terms giving a suitable example for each : [3]

(i) Aerosol, (ii) Emulsion, (iii) Micelle.

Answer : (i) An aerosol is a colloid in which dispersed phase is a solid and dispersion medium is a gas *eg.*, Dust, smoke.

(ii) Emulsion is a colloid solution in which both the dispersed phase and dispersion medium are in liquid state. *eg.*, Milk and cod liver oil.

(iii) They are associated colloids showing colloidal behaviour at high concentration and

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

strong electrolytes at low concentration. *e.g.*, Soap.

23. How would you account for the following : [3]

(i) Among lanthanoids, Ln (III) compounds are predominant. However, occasionally in solution or in solid compounds, +2 and +4 ions are also obtained.

(ii) The $E^\circ_{m^{2+}/m}$ for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behaviour.

(iii) The metallic radii of the third (5*d*) series of transition metals are nearly the same as those of the corresponding members of the second series.

Answer : (i) Some lanthanoid show +2 and +4 oxidation states in ionic solutions or solid components due to the extra stability that arises because of empty half-filled or fully filled 4*f*-subshell.

(ii) This is because copper has high enthalpy of atomization and low enthalpy of hydration. Hence, $E^\circ_{Cu^{2+}/Cu}$ is positive.

(iii) This is because of lanthanoid contraction the metallic radii of the third (5*d*) series of transition metals are nearly the same as those of the corresponding members of the second series.

24. Name the following coordination entities and draw the structures of their steroisomers : [3]

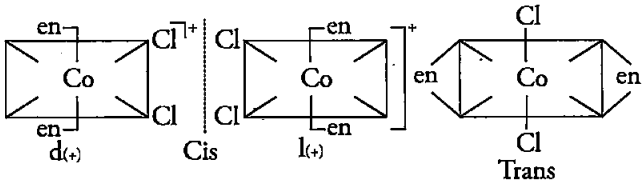
(i) $[Co(en)_2Cl_2]^+$ (en = ethan-1, 2-diamine)

(ii) $[Cr(C_2O_4)_3]^{3-}$

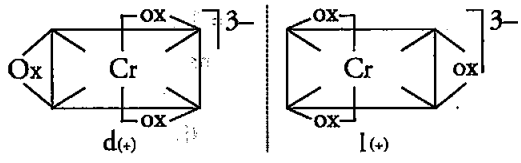
(iii) $[Co(NH_3)_3Cl_3]$

(Atomic numbers Cr = 24, Co = 27)

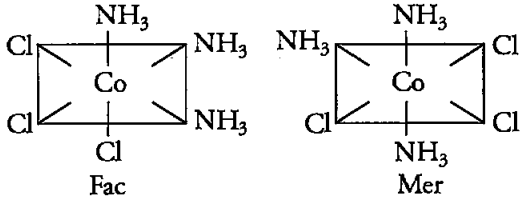
Answer : (i) $[Co(en)_2Cl_2]^+$ dichloridobis (ethan-1,2 diamine) cobalt **(III)** ion



(ii) $[Cr(C_2O_4)_3]^{3-}$: Trioxalatochromate **(III)** ion



(iii) $[Co(NH_3)_3Cl_3]$ triamminetrichloridocobalt **(III)**



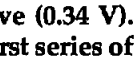
25. Answer the following questions : [3]

(i) What is meant by chirality of a compound ? Give an example.

(ii) Which one of the following compounds is more easily hydrolyzed by KOH and why ?

$CH_3CHClCH_2CH_3$ or $CH_3CH_2CH_2Cl$

(iii) Which one undergoes S_N2 substitution reaction faster and why ?



Answer : (i) Chirality is the property of a molecule to have non-superimposable mirror images. These molecules contain one asymmetric carbon atom.

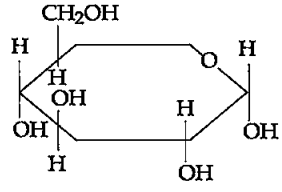
e.g., Butan - 2- ol

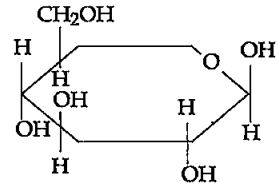
(ii) $CH_3CHClCH_2CH_3$ is more easily hydrolyzed due to the formation of more stable secondary carbocation.

(iii) $CH_3CH_2CH_2Cl$ undergoes S_N2 substitution reaction faster because it is a better leaving group due to its large size and less electronegativity.

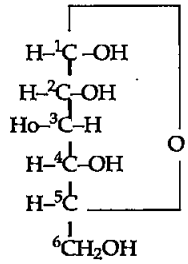
26. What is essentially the difference between α-glucose and β-glucose ? What is meant by pyranose structure of glucose ? [3]

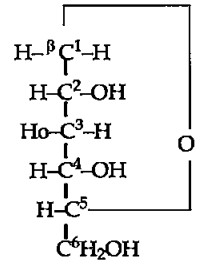
Answer : α-glucose and α-glucose are two cyclic hemiacetal forms of glucose which differ only in the configuration of hydroxyl group (–OH) at anomeric carbon. Such isomers are called anomers. The six-membered cyclic structure of glucose is called pyranose structure.





Pyranose Structure of Glucose : The six membered ring contains oxygen atom because of its resemblance with pyran it is called pyranose form.





27. Differentiate between thermoplastic and thermosetting polymers. Give one example of each. [3]

Answer : Thermoplastic Polymers : These

polymers do not have cross-links between their chains and hence can be reshaped upon heating eg. Polyethylene, Polypropene etc.

Thermosetting Polymers : These polymers have cross-links between their chains and hence cannot be reshaped upon heating. *eg.* Bakelite, Melamine etc.

28. (a) Define the following terms : [5]

(i) Mole fraction

(ii) Ideal solution.

(b) 15.0 g of an unknown molecular material was dissolved in 450 g of water. The resulting solution was found to freeze at –0.34 °C. What is the molar mass of this material ? (K_f for water = 1.86 K kg mol^{-1})

OR

(a) Explain the following :

(i) Henry's law about dissolution of a gas in a liquid.

(ii) Boiling point elevation constant for a solvent.

(b) A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C. What mass of glycerol was dissolved to make this solution ? (K_b for water = 0.512 K kg mol^{-1}).

Answer : (a) (i) The ratio of number of moles of a solute (components of a mixture) to the total number of moles in the mixture is called mole fraction $x_A = \frac{n_A}{n_A + n_B}$ or $x_B = \frac{n_B}{n_A + n_B}$

(ii) A solution that obey's Raoult's law at all temperature and concentration is called an ideal solution.

(b) Given : $W_2 = 15.0$ g, $\Delta T_f = 0.34$°C

$W_1 = 450$ g, $K_f = 1.86$ K kg mol^{-1}

from the formula, $DT_f = \frac{1000.K_f \times W_2}{W_1 \times M_2}$

$$M_2 = \frac{1000\ K_f \times W_2}{\Delta T_f \times W_1} = \frac{1000 \times 1.86 \times 15}{0.34 \times 450}$$

$M_2 = 182.35$ g/mol

OR

(a)(i) Henry's law states that at a constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas. *i.e.*, $p = K_H x$

(ii) The boiling point elevation constant for a solvent is defined as the elevation in boiling point when the molality of the solution is unity.

(b) Given :

$W_1 = 500$ g

$K_b = 0.512$ K kg mol^{-1}

$\Delta T_b = (100.42 - 100)$°C

$= 0.42$°C

$$\Delta T_b = \frac{1000 \times K_b \times W_2}{W_1 \times W_2}$$

$$W_2 = \frac{\Delta T_b \times W_1 \times M_2}{100 \times Kb} = \frac{0.42 \times 500 \times 92}{1000 \times 0.512}$$

$W_2 = 37.7$ g

29. (a) Draw the molecular structures of the following compounds : [2,3]

(i) N_2O_5 **(ii) $XeOF_4$.**

(b) Explain the following observations :

(i) Sulphur has a greater tendency for catenation than oxygen.

(ii) I-Cl is more reactive than I_2.

(iii) Despite lower value of its electron gain enthalpy with negative sign, fluorine (F_2) is a stronger oxidizing agent than Cl_2.

OR

(a) Complete the following chemical equations :

(i) $Cu + HNO_3$ (dilute) →

(ii) $XeF_4 + O_2F_2$ →

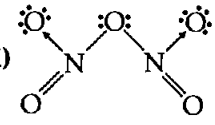
(b) Explain the following observations :

(i) Phosphorus has greater tendency for catenation than nitrogen.

(ii) Oxygen is a gas but sulphur a solid.

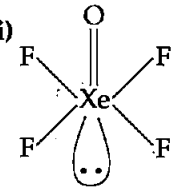
(iii) The halogens are coloured. Why ?

Answer : (a) (i)



N_2O_5

(ii)



$XeOF_4$

(b) (i) Due to strong S—S bond and less interelectronic repulsion, sulphur has greater tendency for catenation.

(ii) I—Cl bond is polar and hence more reactive compound to I_2 in which I—I bond is non-polar.

(iii) Due to high electronegativity and small size of fluorine, it acts as a stronger oxidizing agent.

OR

(a) (i) $3Cu + 8HNO_3$ (dil.) $\longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(ii) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

(b)(i) Catenation (*i.e.* linking of atoms of the same kind with one another) is related to the atom-atom bond energy. Greater the atom-atom bond energy, greater is the catenation. Because of low N—N bond energy (163.8 kJ mol^{-1}) nitrogen shows little tendency for catenation. P—P bond energy (201×10^{-6} kJ/mol) is quite high, hence, it shows more tendency for catenation than nitrogen.

(ii) Oxygen forms $p\pi - p\pi$ multiple bonds. Due to small size and high electronegativity oxygen exists as diatomic (O_2) molecule. These molecules are held together by weak van der Waals' forces. Hence O_2 is a gas at room temperature.
Sulphur because of its bigger size and lower electronegativity, prefer to form S—S single bonds. Further because of stronger S—S than O—O single bonds, sulphur has a much greater tendency for catenation than oxygen. Thus, sulphur because of its higher tendency for catenation and lower tendency for $p\pi - p\pi$ multiple bonds, forms octa atomic (S_8) molecules, having eight-membered puckered ring structure. Because of bigger size, the force of attraction holding the S_8 molecule together are much stronger. Hence, sulphur is a solid at room temperature.

(iii) All halogens are coloured. It is due to the reason that their molecules absorb light in the visible region as a result of which their electrons get excited to higher energy levels while the remaining light is transmitted. The colour of the halogens is actually the colour of this transmitted light.

30. (a) Write a suitable chemical equation to complete each of the following transformations : [2, 3]

(i) Butan-1-ol to butanoic acid

(ii) 4-Methylacetophenone to benzene-1, 4-dicarboxylic acid

(b) An organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1, 2-benzenedicarboxylic acid. Identify the compound.

OR

(a) Give chemical tests to distinguish between :

(i) Propanol and propanone

(ii) Benzaldehyde and acetophenone

(b) Arrange the following compounds in an increasing order of their property as indicated :

(i) Acetaldehyde, Acetone, Methyl tert-butyl ketone (reactivity towards HCN)

(ii) Benzoic acid, 3, 4-dinitrobenzoic acid, 4-Methoxy-benzoic acid (acid strength)

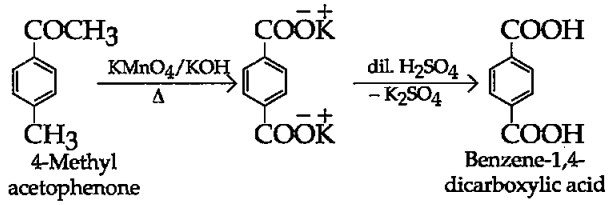
(iii) $CH_3CH_3CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$(acid strength)

Answer : (a) (i)

$$CH_3CH_2CH_2CH_2OH \xrightarrow{KMnO_4} CH_3CH_2CH_2COOH$$

Butan-1-ol — Butanoic acid

(ii)

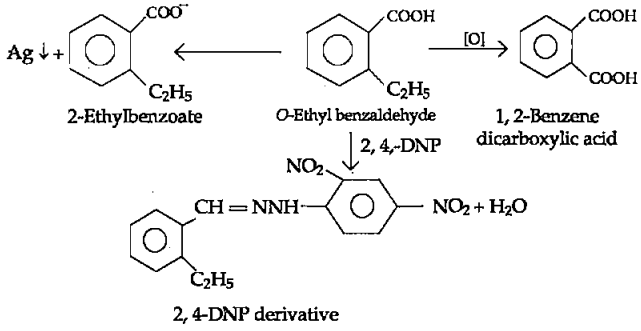


4-Methyl acetophenone — Benzene-1,4-dicarboxylic acid

(b) 1. The given compound with molecular formula $C_9H_{10}O$ forms a 2, 4-DNP derivatitve and reduces Tollen's reagent It must be an aldehyde.

2. As the compond undergoes cannizzaro reaction, therefore CHO group is directly attached to the benzene ring.

3. On vigrous oxidation, it gives 1, 2-benzene dicarboxylic acid, therefore, it must be an ortho-substituted benzaldehyde.



2-Ethylbenzoate — *O*-Ethyl benzaldehyde — 1, 2-Benzene dicarboxylic acid

2, 4-DNP derivative

OR

Answer : (a) (i) Iodoform Test : This test is given by propanone and not by propanol. Propanone on reacting with hot NaOH/I_2 gives a yellow precipitate of CHI_3 while propanol does not.

$$2NaOH + I_2 \rightarrow NaI + NaOI + H_2O$$

$$CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 + 3NaOI \rightarrow \underset{\text{yellow ppt.}}{CHI_3} + \underset{\text{Sodium acetate}}{CH_3COONa} + 2NaOH$$

Sodium hypo-Iodite

(ii) Silver Mirror Test : Benzaldehyde being an aldehyde reduces Tollens' reagent to give silver

mirror test but acetophenone being a ketone does not give this test.

$$\underset{\text{Benzaldehyde}}{C_6H_5CHO} + 2[Ag(NH_3)_2]^+ + 3OH^- \xrightarrow{\text{Heat}} \underset{\text{Tollens' reagent}}{}$$

$$C_6H_5COO^- + 2H_2O + 2Ag\downarrow + 4NH_3$$
Silver mirror

(b) (i) Methyl tert - butyl ketone < Acetone < Acetaldehyde.

(ii) 4-methoxybenzoic acid < benzoic acid < 3,4 dinitrobenzoic acid

(iii) $(CH_3)_2CHCOOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$

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Chemistry 2012 (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 set.

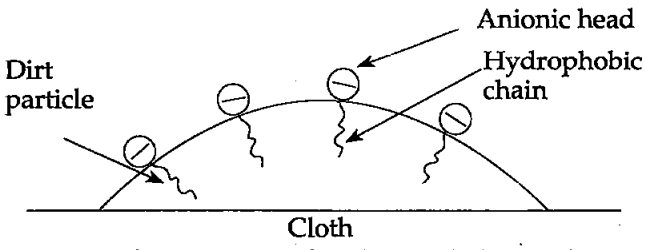
1. **Which stoichiometric defect increases the density of a solid ?**** [1]

2. **What is meant by 'shape selective catalysis' ?** [1]
Answer : Zeolites are shape selective catalysts and shape selective catalysis depends upon the structure of the pores present in the catalyst and size of the reactant and product molecules. ZSM-5 is an example of shape selective catalyst, which is used in converting alcohol directly into gasoline.

3. **What is the role of collectors in Froth Floatation process ?** [1]
Answer : Collectors help in attachment of ore particle to an air bubble in froth *e.g.*, Sodium xanthates.

6. **Write the IUPAC name of Ph – CH = CH – CHO.** [1]
Answer : 3-phenyl prop-2-enal

17. **Explain the cleaning action of soap. Why do soaps not work in hard water ?** [2]
Answer : When soap is rubbed on dirty cloth in water, concentration of soap becomes greater than (CMC) critical micelle concentration, micelle formation takes place. These micelles get adsorb at the dirt or grease



In such a manner that hydrophobic end get adsorbs and anionic head remains at the surface.

Therefore dirt particle become negatively charged and when rinsing is done, this particle moves along with water and clothes become free from dirt or grease.

In soap sodium or potassium salts of fatty acids are present *e.g.*, $C_{17}H_{35}COO^-Na^+$ (sodium stearate) when it is added in hard water, presence of calcium or magnesium salts makes insoluble salts of Ca or Mg with carboxylate ion called scum which stick to cloth as gummy mass.

20. **A voltaic cell is set up at 25°C with the following half cells :**

Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)

Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential. [3]

$E_{Ni^{2+}/Ni} = -0.25$ V and $E^\circ_{Al^{3+}/Al} = -1.66$ V. ($\log 8 \times 10^{-6} = -0.54$)

Answer :

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

$Ni^{2+} + 2e^- \rightarrow Ni$

$2Al + 3Ni^{2+} \rightarrow 2Al^{3+} + 3Ni$

$E^\circ_{cell} = E^\circ_{red} - E^\circ_{ox}$

$E^\circ cell = (-0.25) - (-1.66)$

$= 1.41$ V

$$E^\circ_{Mn+/M} = E^\circ_{cell} = \frac{0.0591}{6} \log \frac{[Al^{+3}]^2}{[Ni^{+2}]^3}$$

$$E^\circ_{Mn+/M} = 1.41 = \frac{0.0591}{6} \log \frac{(1\times10^{-3})^2}{(5\times10^{-1})^3}$$

$$= 1.41 - 0.00985 \log \frac{1000\times10^{-3}}{125\times10^{-3}}$$

$$= 1.41 - 0.00985 \log 2\times10^{-6}$$

$$= 1.41 - (0.00985 \times -0.54)$$

$$= 1.41 - 0.005319 = 1.415 \text{ V}$$

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

23. Explain the following observations :

(i) Many of the transition elements are known to form interstitial compounds.

(ii) There is a general increase in density from titanium (Z = 22) to copper (Z = 29).

(iii) The members of the actinoid series exhibit a larger number of oxidation states than the corresponding members of the lanthanoid series. **[3]**

Answer : (i) Transition elements are known to form interstitial compounds because these elements are capable of entrapping smaller atoms of other elements such as H,C and N in the interstitial sites in their crystal lattice.

(ii) It is due to increase in atomic mass whereas atomic size decreases from Ti to Cu .Therfore, density goes on increasing.

(iii) Because of the comparable energies of 5*f*, 6*d* and 7*s* orbitals in actinoids, they exhibit larger number of oxidation states than the corresponding members of lanthanoid series.

27. Explain the following terms giving a suitable example for each : **[3]**

(i) Elastomers

(ii) Condensation polymers

(iii) Addition polymers.

Answer : (i) Elastomers : Their polymer chain are held together by weakest intermolecular forces so that they can be stretched. That is why they exhibit elastic properties and are rubber-like solids. *eg.*, : Buna–S, Buna–N etc.

(ii) Condensation Polymers : They are formed by repeated condensation reaction between two different bi or tri-functional monomeric units with the elimination of smaller molecules such as water, alcohol, HCl etc. *e.g.*, : Nylon 6, 6.

(iii) Addition Polymers : They are formed by the repeated addition of monomer molecules having double or triple bonds. *eg* : Polyethylene.

30. (a) Draw the structures of the following molecules : **[5]**

(i) H_3PO_2, (ii) ClF_3.**

(b) Explain the following observations :

(i) Nitrogen is much less reactive than phosphorus.**

(ii) Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.

(iii) Sulphur has a greater tendency for catenation than oxygen in the same group.

OR

(a) Draw the structures of the following molecules :

(i) N_2O_5, ** (ii) $HClO_4$.

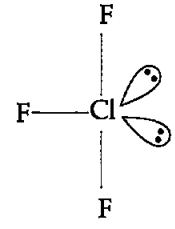
(b) Explain the following observations :

(i) H_2S is more acidic than H_2O.

(ii) Fluorine does not exhibit any positive oxidation state.

(iii) Helium forms no real chemical compound.

(ii)



T shape, ClF_3
sp^3d hybridisation

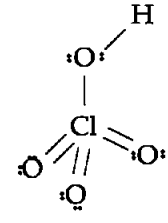
b(i) Due to N≡N triple bond in N_2 molecule, it is inert and hence is less reactive as compared to phosphorous which has P-P single bond,which makes it more reactive.

(ii) In case of HF, average two intermolecular hydrogen bonds are present. As a result, Vander Waals forces of attraction increases in water molecule and hence, boiling point increases.

(iii) Because S–S bond is stronger than O–O bonds as there is more interelectronic repulsion in O–O than in S–S.

OR

(a)(ii)



Perchloric acid
($HClO_4$)

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

(b) (i) Because bond dissociation enthalpy of H–S bond in H_2S is less than that of H–O bond in H_2O.

(ii) Flourine is the most electronegative element in nature and it has no *d*-orbitals and therefore, there is no scope for electron promotion. Hence, it can show only –1 oxidation state in its compounds.

(iii) Because it is an inert gas and has very high ionization enthalpy, therefore no real chemical compound of helium is known.

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Chemistry 2012 (Outside Delhi) SET III

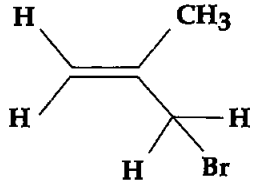
Time allowed : 3 hours **Maximum marks : 70**

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

1. What are *n*-type semiconductors ?** [1]

4. What is the basicity of H_3PO_2 acid and why ? ** [1]

5. Write the IUPAC name of the following : [1]



Answer : 3 Bromo-2-methyl propene.

7. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain. [1]

Answer :

$$\begin{array}{l}\text{CHO}\\|\\(\text{CHOH})_4\\|\\\text{CH}_2\text{OH}\end{array} + \text{HI} \xrightarrow{\Delta}$$

$$\underset{\text{n–hexane}}{\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3}$$

8. What is the cause of a feeling of depression in human beings ? Name a drug which can be useful in treating this depression. [1]

Answer : The inability to achieve one's goal and extra work may cause the level of noradrenaline low, as a result the signal-sending activity becomes low and the person suffers from depression. Tranquilizers such as Equanil can help in treating depression.

11. Explain the role of each of the following : [2]

(i) NaCN in the extraction of silver.

(ii) SiO_2 in the extraction of copper.

Answer : **(i)** Dil. NaCN solution is used to leach silver (Ag) from silver ore in the presence of air. The silver metal is obtained by replacement.

$$4Ag + 8CN^- + 2H_2O + O_2 \rightarrow 4[Ag(CN)_2]^- + 4OH^-$$

$$2[Ag(CN)_2] + Zn \rightarrow [Zn(CN)_4]^{2} + 2Ag$$

(ii) SiO_2 is used to remove impurity and it reacts with FeO to form easily removable feasible slag

$$FeO + SiO_2 \rightarrow \underset{\text{slag}}{FeSiO_3}$$

22. Write three distinct features of chemisorption which are not found in physisorption. [3]

Answer : The three distinct features of chemisorption are :

(i) It is irreversible.

(ii) It occurs by chemical bond formation and hence requires activation energy.

(iii) It is highly specific in nature.

23. Explain each of the following observations : [3]

(i) With the same *d*-orbital configuration (d^4), Cr^{2+} is a reducing agent while Mn^{3+} is an oxidising agent.

(ii) Actinoids exhibit a much larger number of oxidation states than the lanthanoids.

(iii) There is hardly any increase in atomic size with increasing atomic numbers in a series of transition metals.

Answer : **(i)** Cr^{2+} is reducing because when it loses one electron to form Cr^{3+}: $[Ar]3d^3$, it has three unpaired electrons in lower energy *d*-orbitals which are more stable whereas M^{3+} is oxidizing because after gaining one electron it becomes Mn^{2+} which has more stable electronic configuration due to half-filled *d*-orbitals Mn^{2+}:$[Ar]3d^5$

(ii) Due to comparable energies of 5*f*, 6*d* and 7*s* orbitals and unpaired electrons in these orbitals, actinoids exhibit much larger number of oxidation states than the lanthanoids.

(iii) Because along transition series, nuclear charge increases which tends to decrease the size but the addition of electrons in the penultimate *d*-subshell increases the screening effect which counter balances the effect of increased nuclear charge. Thus, atomic radii does not change.

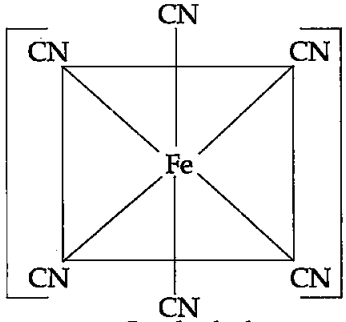
**** Answer is not given due to change in present syllabus.**

24. Name the following coordination entities and describe their structures : [3]

(i) $[Fe(CN)_6]^{4-}$ (ii) $[Cr(NH_3)_4Cl_2]^+$ (iii) $[Ni(CN)_4]^{2-}$

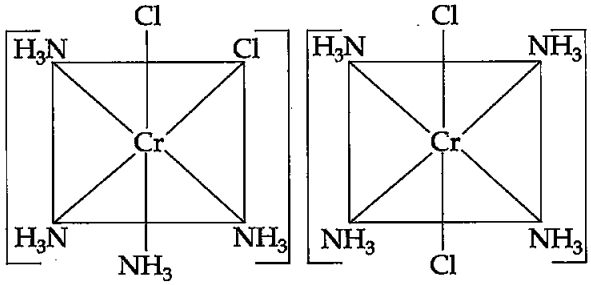
(Atomic Numbers Fe = 26, Cr = 24, Ni = 28)

Answer : (i) $[Fe(CN)_6]^{4-}$: Hexacyanoferrate (II) ion.



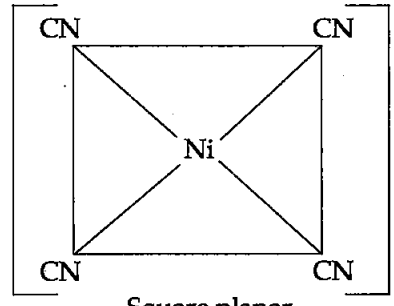
Octahedral

(ii) $[Cr(NH_3)_4Cl_2]^+$: Tetraamminnedichlorido Chromium (III) ion



cis form (Octahedral) trans-form (Octahedral)

(iii) $[Ni(CN)_4]^{2-}$: Tetracyanonickelate (II) ion



Square planar

26. Define the following as related to proteins : [3]

(i) Peptide linkage

(ii) Primary structure

(iii) Denaturation.

Answer : (i) Peptide linkage is the amide linkage between two amino acids to form proteins and polypeptides. CO-NH is peptide linkage.

(ii) The simple linear structure of a protein molecule in a specific sequence in which various amino acids are present.

(iii) When a protein in its native form is subjected to any physical change like change in temperature or chemical change like change in pH, the H-bonds gets disturbed. Due to this globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein.

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Chemistry 2012 (Delhi) SET I

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

1. What is meant by 'doping' in a semiconductor ? [1]**

2. What is the role of graphite in the electrometallurgy of aluminium ? [1]

Answer : Graphite is used as anode and useful for the reduction of Al_2O_3 into Al.

3. Which one of PCl_4^+ and PCl_4^- is not likely to exist and why ? [1]**

4. Give the IUPAC name of the following compound.

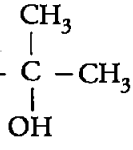
$CH_2 = C - CH_2Br$

CH_3

Answer : 3-bromo-2-methylpropene

5. Draw the structural formula of 2-methyl-propan-2ol molecule. [1]

Answer :



6. Arrange the following compounds in an increasing order of their reactivity in nucleophilic addition reactions : ethanol, propanal, propanone, butanone.

Answer : Butanone < Propanone < Proponal < Ethanol

7. Arrange the following in the decreasing order of their basic strength in aqueous solutions :

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3$ N and NH_3 [1]

Answer : $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

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

8. Define the term, 'homopolymerisation' giving an example. [1]

Answer : Polymerisation involving the presence of only one monomer is called homopolymerisation. *e.g.*, polyethene is a homopolymer

$$n(CH_2 = CH_2) \rightarrow \text{-}(CH_2 - CH_2)\text{-}_n$$

Ethene Polyethene

9. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18 °C. Determine the Van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1}) [2]

OR

Define the following terms :

(i) Mole fraction (ii) Isotonic solutions

(iii) Van't Hoff factor (iv) Ideal solution

Answer : Given,

$\Delta T_b = 373.18 - 373. = 0.18$ K.

$K_b = 0.512$ K kg mol^{-1}

$m = 1$

$\Delta T_b = i K_b m$

$$i = \frac{\Delta T_b}{K_b m} = \frac{0.18}{0.512 \times 1} = 0.35$$

OR

(i) Ratio of the number of moles of a component in a mixture to the total number of moles in the mixture is called the mole fraction of that component. It is denoted by '*x*'.

(ii) Two solutions having the same molar concentration are said to be isotonic solutions. *e.g.*, All intravenous injections must be isotonic with body fluids.

(iii) The ratio of observed colligative property to the calculated colligative property is called the Van't Hoff factor. It is denoted by '*i*'.

(iv) Solutions that follow Raoult's law at all temperatures and concentrations are called ideal solutions.

0. What do you understand by the 'order of a reaction' ? Identify the reaction order from each of the following units of reaction rate constant : [2]

(i) L^{-1} mol s^{-1}

(ii) L mol^{-1} s^{-1}

Answer : The sum of the powers to which the concentration of reactants are raised in the rate law expression is called the order of a reaction.

(i) Zero order reaction

(ii) Second order reaction.

11. Name the two groups into which phenomenon of catalysis can be divided. Give an example of each group with the chemical equation involved. [2]

Answer : Catalysis can be positive, that is, it increases the rate of the reaction or negative *i.e.*, decreases the rate of reaction. Depending on the phase of the reactants and the catalyst, catalysis can be :

(i) Homogenous Catalysis : The reactants and catalyst are in the same phase.

e.g., $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

(ii) Heterogeneous catalysis : The reactants and catalyst are in different phase.

$4NH_3(g) + 5SO_2(g) \xrightarrow{Pt(s)} 4NO + 5S + 6H_2O$

12. What is meant by coagulation of a colloidal solution ? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out. [2]

Answer : The process of setting of colloidal particles is called coagulation of sol. Methods of coagulation are :

(i) Electrophoresis : In this process, the colloidal particles move towards opposite charged electrodes and get discharged and precipitated.

(ii) Mixing two Oppositely Charged Sols : Equal proportions of oppositely charged sols are mixed, they get neutralized and get precipitated.

(iii) Dialysis : Electrolytes are removed from the sol and colloid becomes unstable and gets coagulated.

13. Describe the principle involved in each of the following processes. [2]

(i) Mond process for refining of Nickel.

(ii) Column chromatography for purification of rare elements.

Answer : **(i)** Nickel combined with carbon monoxide to form volatile complex which is further decomposed to get back pure nickel.

$$Ni(g) + 4CO(g) \xrightarrow{330\text{-}350K} \underset{\text{Nickel tetracarbonyl}}{Ni(CO)_4(g)}$$

$$Ni(CO)_4(g) \xrightarrow[450\text{–}470K]{\Delta} \underset{\text{Nickel}}{Ni} + 4CO$$

(ii) The basic principle involved in column chromatography is that different elements present in a mixture are adsorbed on adsorbent at different extents.

14. Explain the following giving an appropriate reason in each case. [2]

(i) O_2 and F_2 both stabilize higher oxidation states of metals but O_2 exceeds F_2 in doing so.

(ii) Structures of xenon fluorides cannot be explained by Valence Bond approach.

Answer : (i) Due to the difference in atomic size of oxygen and fluorine and the property of oxygen to form multiple bonds with metals, O_2 exceeds F_2, stabilize higher oxidation states.

(ii) For explaining the structures of xenon fluorides, we need to use VSEPR and hybridization theories because in VBT, covalent bonds are formed by overlapping of half filled atomic orbital. But xenon has fully filled electronic configuration.

15. Complete the following chemical equations : [2]

(i) $Cr_2O_7^{2-} + H^+ + I^-$

(ii) $MnO_4^- + NO_2^- + H^+ \rightarrow$

Answer :

(i) $Cr_2O_7^{2-} + 14H^+ + 6I^- \rightarrow 2Cr^{3+} + 7H_2O + 3I_2$

(ii) $2MnO_4^- + 5NO_2^- + 6H^+ \rightarrow 2Mn^{2+} + 3H_2O + 5O_3^-$

16. What is meant by (i) peptide linkage (ii) biocatalysts ? [2]

Answer : (i) Peptides linkage is the amide bond that helps to connect amino acids to form proteins. It is formed between –COOH and $–NH_2$ group of two amino acids with the loss of water molecule.

(ii) Biocatalysts are enzymes that catalyses the biochemical reactions in the bodies of living organisms. *e.g.*, Amylase.

17. Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecule. [2]

Answer : Two reactions which can't be explained by open chain structure of glucose are :

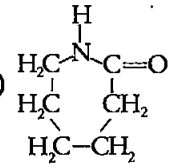
(i) Despite having the aldehyde group, glucose does not gives 2, 4 –DNP test.

(ii) The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free –CHO group.

18. Draw the structure of the monomer for each of the following polymers : [2]

(i) Nylon 6, (ii) Polypropene.

Answer :

(i) 
Caprolactum

(ii) $CH_3—CH=CH_2$
Propene

19. Tungsten crystallizes in body centered cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom ? [3]**

OR

Iron has a body centered cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (At mass of Fe = 55.845 u)**

20. Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2K. (K_f for water = 1.86 K kg mol^{-1}) [3]

Answer : Given,

$$K_f = 1.86 \text{ K kg mol}^{-1}$$

$$i = 2, \Delta T_f = 2K$$

$$M = 74.5$$

$$\Delta T_f = iMK_f$$

$$2 = 2 \times 1.86, \frac{\text{Mass of KCl}}{74.5}$$

$$\text{Mass of KCl} = \frac{74.5}{1.86} = 40.05 \text{ gm}$$

21. For the reaction [3]

$2NO(g) + Cl_2(g) \longrightarrow 2NOCl(g)$

the following data were collected. All the measurements were taken at 263 K :

Experiment No.	Initial [NO] (M)	Initial $[C_2]$ (M)	Initial rate of disappearance of Cl_2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

(a) Write the expression for rate law.

(b) Calculate the value of rate constant and specify its units.

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

(c) What is the initial rate of disappearance of Cl_2 in exp. 4 ?

Answer : (a) Rate law $k = k[NO]^2[Cl_2]^1$

(b) $R = k[NO]^2[Cl_2]^1$

$$k = \frac{R}{[NO]^2} = \frac{0.60}{(0.15)^2(0.15)^1}$$

$$= \frac{0.60}{(0.15)^3} = 177.75 \text{ mol}^{-2}\text{L}^2 \text{ min}^{-1}$$

(c) $R_4 = k[NO]^2[Cl_2]^1$

$= 177.75 \times (0.25)^2 (0.25)$

$= 2.78$ M/min.

22. How would you account for the following ? [3]

(i) Many of the transition elements are known to form interstitial compounds.

(ii) The metallic radii of the third (5*d*) series of transition metals are virtually the same as those of the corresponding group members of the second (4*d*) series.

(iii) Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical.

Answer : (i) Transition metal lattice have voids and hence these voids can trap small atoms like H, C and N to form interstitial compounds.

(ii) It is because electrons first fill the 4*f* orbitals and than the 5*d*-orbitals causing decline in radii of third (5*d*) series.

(iii) This is because of the comparable energies of 5*f*, 6*d* and 7*s* orbitals so all of them can participate

23. Give the formula of each of the following coordinat... ntities : [3]

(i) Co^{3+} ion is bound to one Cl^-, one NH_3 molecule and two bidentate ethylene diamine (en) molecules.

(ii) Ni^{2+} ion is bound to two water molecules and two oxalate ions.

Write the name and magnetic behavior of each of the above coordination entities.

(At. Nos. Co = 27, Ni = 28)

Answer : (i) $[Co(NH_3)(en)_2Cl]^{2+}$ Amminebis (ethylenediamine) chlorido cobalt (III) ion, diamagnetic.

(ii) $[Ni(H_2O)_2 (C_2O_4)_2]^{2-}$

Diaquadioxalatonickelate (II) ion, paramagnetic.

24. Although chlorine is an electron withdrawing group, yet it is ortho, para-directing in electrophilic aromatic substitution reactions. Explain why it is so ? [3]

Answer : Due to resonance, electron density is increased on ortho and para positions for electron donating (via resonance) groups like chlorine. Thus chlorine is an electron withdrawing group yet it electrophilic is ortho, para-direction in aromatic substitution reaction.

25. Draw the structure and name the product formed if the following alcohols are oxidized. Assume that an excess of oxidizing agent is used. [3]

(i) $CH_3CH_2CH_2CHt_2OH$, (ii) 2-butanol

(iii) 2-methyl-l-propanol

Answer : (i)

$$\underset{\text{Butan-1-ol.}}{CH_3-CH_2-CH_2-CH_2-OH} \xrightarrow[CrO_3-H_2SO_4]{[O]} \underset{\text{Butanoic acid}}{CH_3-CH_2-CH_2-COOH}$$

(ii)

$$\underset{\text{But-2-enol}}{CH_3-CH=CH_2-CH_2-OH} \xrightarrow[PCC]{[O]} \underset{\text{Butanoic acid}}{CH_3-CH=CH-CHO}$$

(iii)

$$\underset{\text{2-methyl propan-1-ol}}{CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-OH} \xrightarrow{[O]} \underset{\text{2-MethylPropanoic acid}}{CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH-COOH}$$

26. Write chemical equations for the following conversions : [3]

(i) Nitrobenzene to benzoic acid.

(ii) Benzyl chloride to 2-phenylethanamine.

(iii) Aniline to benzyl alcohol.

Answer : (i)

$$\underset{\text{(Nitrobenzene)}}{(C_6H_5NO_2} \xrightarrow[BaSO_4]{H_2/Pd} \underset{\text{Aniline}}{C_6H_5NH_2} \xrightarrow[HCl]{NaNO_2} \underset{\text{Benzenediazonium chloride}}{C_6H_5\overset{+}{N}_2Cl^-)} \downarrow CuCN$$

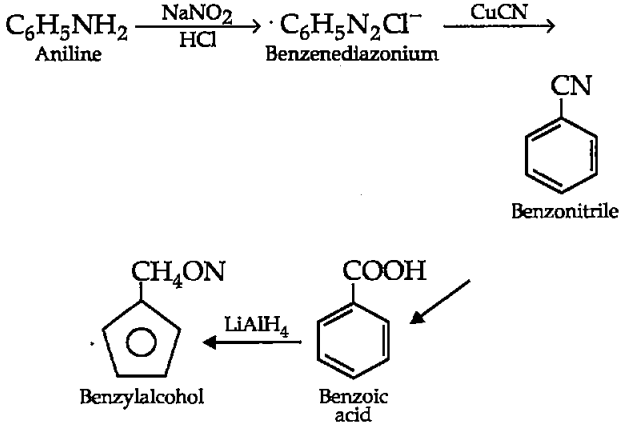
$$\underset{\text{Benzoic acid}}{C_6H_5COOH} \xleftarrow[H^+]{H_2O} \underset{\text{Benzonitrile}}{C_6H_5-CN}$$

(ii)

$$\underset{\text{Benzylcholride}}{C_6H_5-CH_2Cl} + KCN \longrightarrow \underset{\text{Phenylethanenitrile}}{C_6H_5-CH_2-CN}$$

$$\xrightarrow{LiAlH_4 \downarrow} \underset{\text{2-phenylethana mine}}{C_6H_5CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH_2}}}$$

(iii)



27. What are the following substances ? Give one example of each one of them. [3]

(i) Tranquilizers

(ii) Food preservatives

(iii) Synthetic detergents.

Answer : (i) Tranquilizers are drugs that act on the central nervous system to get relief from anxiety, stress etc. They are used in treatment of stress related mental disorders *eg.*,Equanil.

(ii) These are chemicals used to preserve food by protecting it against microbial growth. *e.g.*, Sodium benzoate.

(iii) Synthetic detergents have all the properties of soap but they do not precipitate in hard water. *e.g.*, Sodium *p*-dodecyl benzenesulphonate.

28. (a) What type of a battery is the lead storage battery ? Write the anode and the cathode reactions and the overall reactions occurring in a lead storage battery when current is drawn from it. [2],[3]

(b) In the button cell, widely used in watches, the following reaction takes place.

$$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow$$

$$Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$$

Determine E° and ΔG° for the reaction

(Given : $E^\circ_{Ag^+/Ag} = +0.80V, E^\circ_{Zn^{2+}/Zn} = -0.76$ V)

OR

(a) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.

(b) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1} ?

Answer : (a) Lead storage battery is secondary cell and can be recharged by passing current through it.

At anode : $Pb_{(s)} + SO_4^{2-}{}_{(aq)} \longrightarrow PbSO_{4(s)} + 2e^-$

At cathode : $PbO_{2(s)} + SO_4^{2-}{}_{(aq)} + 4H^+ + 2e^- \longrightarrow PbSO_{4(s)} + 2H_2O$

Overall cell reaction :

$$Pb + PbO_2 + H_2SO_4\,(aq) \rightarrow 2PbSO_4 + 2H_2O$$

(b) $E^\circ cell = 0.8 - (-0.76) = 1.56$ V

$\Delta G^\circ = -nFE^\circ_{Cell}$

$= -2 \times 96500 \times 1.56$

$= -301$ kJ mol^{-1}

OR

(a) Molar conductivity of a solution is the conductance of the solution with one mole of electrolyte placed between electrodes 1 cm apart. With dilution, molar conductivity of weak electrolytes increases sharply and for strong electrolytes also, it increases.

(b) $k = 0.146 \times 10^{-3}$ cm$^{-1}\Omega^{-1}$

$R = 1500\Omega$

$$\text{Specific conductance} = \frac{\text{Cell constant}}{\text{Resistance}}$$

$$\text{Cell constant} = \kappa R = 0.146 \times 10^{-3} \times 1500$$

$$= 0.219 \text{ cm}^{-1}$$

29. (a) Complete the following chemical reactions. equations : [2],[3]

(i) $P_4 + SO_2Cl_2 \rightarrow$**

(ii) $XeF_6 + H_2O \rightarrow$

(b) Predict the shape and asked the angle (90° or more or less) in each of the following cases :

(i) SO_3^{2-} **and the angle O–S–O**

(ii) ClF_3 **and the angle F–Cl–F**

(iii) XeF_2 **and the angle F–Xe–F**

OR

(a) Complete the following chemical equations:

(i) $NaOH + Cl_2 \rightarrow$

(hot and conc.)

(ii) $XeF_4 + O_2F_2 \rightarrow$

(b) Draw the structures of the following molecules :

(i) H_3PO_2**

(ii) $H_2S_2O_7$

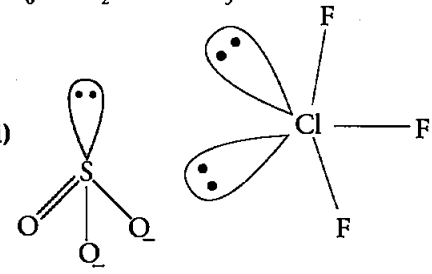
(iii) $XeOF_4$

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

Answer :

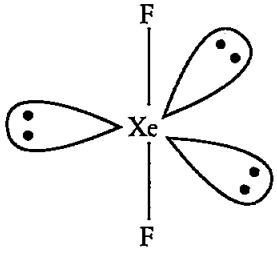
(ii) $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

(b) (i)



SO_3^{2-} more than 90°

ClF_3 less than 90°



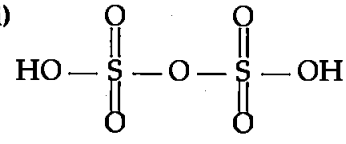
XeF_2 more than 90^0

OR

(a)(i) $6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$

(ii) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

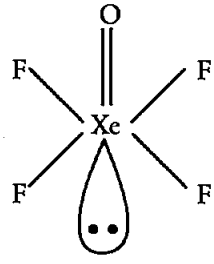
(ii)



Disulphuric acid

$H_2S_2O_7$

(iii)



$XeOF_4$

30. (a) Illustrate the following name reactions giving suitable example in each case : [2],[3]

(i) Clemmensen reduction

(ii) Hell-Volhard-Zelinsky reaction

(b) How are the following conversions carried out ?

(i) Ethylcyanide to ethanoic acid

(ii) Butan-l-ol to butanoic acid

(iii) Benzoic acid to *m*-bromobenzoic acid

OR

(a) Illustrate the following reactions giving a suitable example for each :

(i) Cross aldol condensation, (ii) Decarboxylation

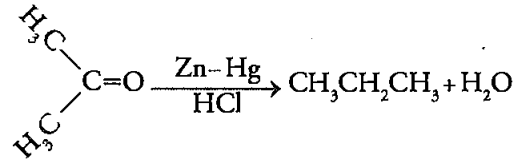
(b) Give simple tests to distinguish between the following pairs of compounds :

(i) Pentan-2-one and Pentan-3-one

(ii) Benzaldehyde and Acetophenone

(iii) Phenol and Benzoic acid

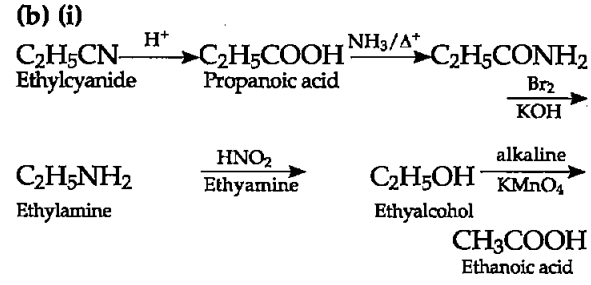
Answer : (a) (i) Aldehydes and ketones are reduced to CH_2 group on treatment with zinc-amalgam and conc. HCl.



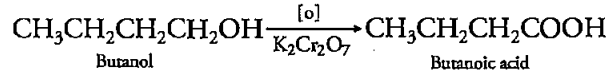
(ii) Carboxylic acids containing α-hydrogen atom gives halo carboxylic acids on treatment with halogens in the presence of red phosphorous.

$$CH_3COOH + Cl_2 \xrightarrow{\text{Red P}} ClCH_2COOH + HCl$$

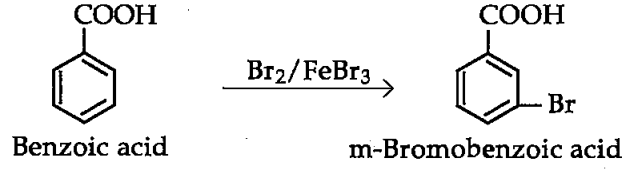
(b) (i)



(ii)

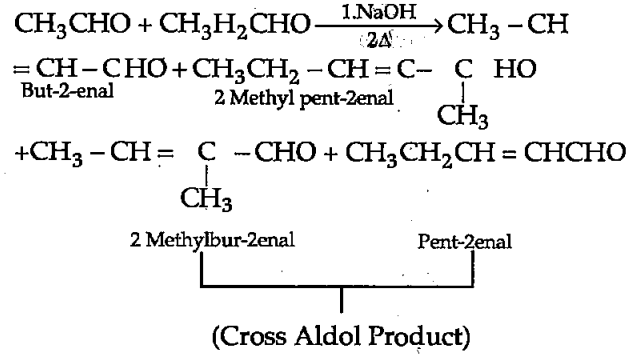


(iii)



OR

(a) (i) When aldol condensation is carried out between two different aldehydes or ketones it is called cross aldol condensation.



(ii) Carboxylic acid lose carbon dioxide to form hydrocarbon, when their salts are heated with sodium. The reaction is known as decarboxylation reaction

$$R-COONa \xrightarrow[Heat]{NaOH\&CaO} R-H + Na_2CO_3$$

(b)(i) Pentan-2-one gives iodoform test but pentan-3-one does not.

$$\underset{\text{Pentan-2-one}}{CH_3CH_2CH_2\overset{O}{\overset{\|}{C}}CH_3} + 3NaOI \rightarrow CH_3CH_2CH_2COONa + \underset{\substack{\text{Iodoform}\\\text{(yellow ppt)}}}{CHI_3\downarrow} + 2NaOH$$

$$\underset{\text{Pentan-3-one}}{CH_3CH_2\overset{O}{\overset{\|}{C}}CH_2CH_3} + NaOI \rightarrow \text{No yellow ppt. of Iodoform.}$$

(ii) Benzaldehyde does not gives iodoform test but Acetophenone gives iodoform test.

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \rightarrow \underset{\substack{\text{Iodoform}\\\text{(yellow ppt.)}}}{CHI_3\downarrow} + C_6H_5COONa + 2NaOH$$

$$\underset{\text{Benzaldehyde}}{C_6H_5CHO} + NaOI \rightarrow \text{No yellow ppt. of Iodoform}$$

(iii) Phenol gives violet colour with neutral $FeCl_3$ solution but benzoic acid does not.

$$\underset{\text{Phenol}}{6C_6H_5OH} + FeCl_3 \rightarrow \underset{\text{Violet colour}}{[Fe(OC_6H_5)_6]^{3-}} + 3H^+ + 3HCl$$

$$3C_6H_5COOH + FeCl_3 \rightarrow \underset{\text{Buff Colour}}{(C_6H_5COO)_3Fe} + 3HCl$$

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Chemistry 2012 (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 set.

1. Write a point of distinction between a metallic solid and an ionic solid other than metallic luster.** [1]

11. Describe a conspicuous change observed when : [2]

(i) a solution of NaCl is added to a sol of hydrated ferric oxide.

(ii) a beam of light is passed through a solution of NaCl and then through a sol.

Answer : (i) Coagulation of ferric hydroxide sol. would take place.

(ii) NaCl solution is transparent so when beam of light is passed, no tyndall effect is produced. But on passing through solution the path of light becomes visible due to Tyndall effect.

13. Describe the following : [2]

(i) The role of cryolite in electro-metallurgy of aluminium.

(ii) The role of carbon monoxide in the refining of crude nickel.

Answer : (i) Cryolite lowers the melting point of the mixture and brings conductivity. Therefore, it is mixed with alumina during metallurgy of aluminium.

(ii) Carbon monoxide forms a volatile complex with nickel. The volatile complex is then subjected to high temperature to get pure metal through decomposition.

$$\underset{\text{Impure}}{Ni} + 4CO \xrightarrow{300-350K} \underset{\text{(Nickel tetracarbonyl)}}{Ni(CO)_4}$$

$$Ni(CO_4) \xrightarrow{400-450K} \underset{\text{Pure}}{Ni} + 4CO$$

14. What is meant by (i) peptide linkage, (ii) biocatalysts ? [2]

Answer : (i) Peptide Linkage : It is the linkage between amino acids, formed due to loss of a water molecule and amide linkage is formed.

$$\text{-}\overset{O}{\overset{\|}{C}}\text{-}NH\text{-}$$

(ii) Biocatalysts : Biocatalysts are enzymes which are used to perform chemical reactions on organic compounds.

18. Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA ? [2]

Answer :

	DNA	RNA
1.	DNA has deoxyribose sugar.	1. RNA has ribose sugar.
2.	It has double helical structure.	2. It is single strand-ed.
3.	It is less reactive due to presence of C-H bonds.	3. It has larger grooves so it is more reactive.

DNA contains thymine base and uracil base is present in RNA.

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

23. How would you account for the following ? [3]

(i) With the same d-orbital configuration (d^4) Cr^{2+} is a reducing agent while Mn^{3+} is an oxidizing agent.

(ii) The actinoids exhibit a larger number of oxidation states than the corresponding members in the lanthanoid series.

(iii) Most of the transition metal ions exhibit characteristic in colours in aqueous solutions.

Answer : (i) Cr^{2+} has d^4 configuration. It gets oxidized to Cr^{3+} with electronic configuration d^3 which is more stable. Therefore, Cr^{2+} is a reducing agent. Mn^{3+} has d^4 configuration. It gets reduced to Mn^{+2} with d^5 configuration. This is half-filled d-orbital and is stable. Therefore Mn^{3+} is an oxidizing agent.

(ii) Because 5*f*, 6*d* and 7*s* energy levels has small energy gap in the actinoid series. Due to these orbitals actinoids exhibit large number of oxidation states.

(iii) Due to partial absorption of visible light the electron from one orbital gets promoted to another orbital of the *d* subshell. Due to the presence of unpaired electrons transition metals are coloured.

30. (a) Give a possible explanation for each one of the following: [2],[3]

(i) There are two $-NH_2$ groups in semicarbazide. However, only one such group is involved in the formation of semicarbazones.

(ii) Cyclohexanone forms cyanohydrin in good yield but 2, 4, 6-trimethylcyclohexanone does not.

(b) An organic compound with molecular formula $C_9H_{10}O$ forms 2, 4, –DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1, 2-benzene-di-carboxylic acid. Identify the compound.

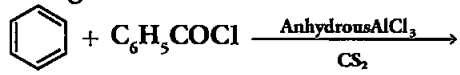
OR

(a) Give chemical tests to distinguish between

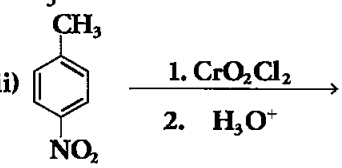
(i) Phenol and Benzoic acid

(ii) Acetophenone and Benzophenone

(b) Write the structures of the main products of following reactions :

(i) 

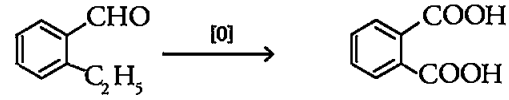
(ii) $H_3C-C\equiv C-H \xrightarrow{Hg^{2+},H_2SO_4}$

(iii) 

Answer : (a) (i) Semicarbazide show resonance involving one of the two $-NH_2$ groups, which is attached to the carboxyl carbon atom. Due to which electron density on $-NH_2$ group involved in resonance decreases. So it cannot act as nucleophile. Other $-NH_2$ group can act as nucleophile to produce semicarbazones with aldehydes and ketones.

(ii) In cyclohexanone CN^- can easily attack without any steric hindrance. But in 2, 4, 6 – Trimethylcyclohexanone due to presence of methyl groups steric hindrance is produced and CN^- cannot attack effectively.

(iii) $C_9H_{10}O$ is aldehyde because it reduces Tollen's reagent. It undergoes Cannizaro's reaction therefore it is substituted benzaldehyde. It gives 1, 2, Benezene-di carboxylic acid. The compound is 2-Ethylbenzaldehyde.



2Ethylbenzaldehyde 1,2-Benzene-dicarboxylic acid

OR

(a)(i) Phenol gives violet colour with neutral $FeCl_3$ solution but benzoic acid does not.

$$\underset{\text{Phenol}}{6C_6H_5OH} + FeCl_3 \rightarrow \underset{\text{Violet colour}}{[Fe(OC_6H_5)]^{3-}} + 3H^+ + HCl$$

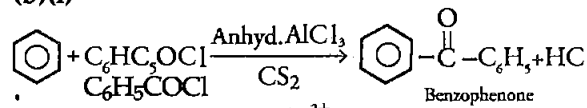
$$\underset{\text{Benzoic acid}}{3C_6H_5COOH} + FeCl_3 \rightarrow \underset{\text{Buff Colour}}{(C_6H_5COO)_3Fe} + 3HCl$$

(ii) Acetophenone gives iodoform test but benzophenone does not

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \xrightarrow{\Delta} C_6H_5COONa + \underset{\substack{\text{Iodoform}\\\text{(yellow ppt)}}}{CHI_3} + 2NaOI$$

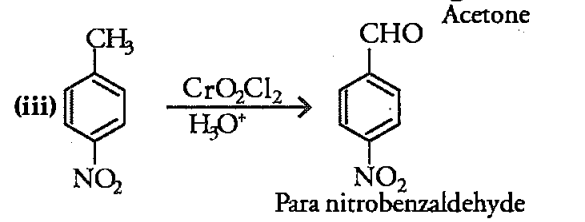
$$\underset{\text{Benzophenone}}{C_6H_5COC_6H_5} \xrightarrow{NaOI} \text{No yellow ppt of Iodoform}$$

(b)(i)



(ii) $CH_3-C\equiv C-H \xrightarrow[H_2SO_4]{Hg^{2+}} CH_3-\underset{\underset{O}{\|}}{C}-CH_3$ Acetone

(iii)



Para nitrobenzaldehyde

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Chemistry 2012 (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.

3. Out of PH_3 and H_2S, which is more acidic and why ? [1]

Answer : H_2S is more acidic than PH_3 due to smaller size and higher electronegativity of sulphur. Therefore S-H bond is polar than P-H bond and easy to remove.

5. Draw the structure of hex-1-en-3-ol compound. [1]

Answer :

$$CH_3CH_2CH_2\underset{\displaystyle OH}{\underset{|}{C}}H-CH=CH_2$$

12. Explain the following terms giving one example for each : [2]

(i) Micelles

(ii) Aerosol.

Answer : (i) Micelles are aggregates which exhibit colloidal behaviour at higher concentration, with the hydrophilic part outside and the hydrophobic part towards the oil and dirt particle. *e.g.*, soap.

(ii) An aerosol is a colloid of fine solid particle or liquid drops in air or another gas. It can be natural or artificial. e.g. dust particle and smoke.

20. 15.0 g of an unknown molecular material was dissolved in 450 g of water. The resulting solution was found to freeze at –0.34 °C. What is the molar mass of this material ? (K_f for water = 1.86 K kg mol^{-1}) [3]

Answer : Given,

$W_1 = 15$ g, $W_2 = 450$ g

$K_f = 1.86$ K kg/mol

$\Delta T_f = -0.34°C$

$$\Delta T_f = \frac{K_f \times W_2 \times 1000}{W_1 \times M_2}$$

$$M_2 = \frac{K_f \times W_2 \times 1000}{W_1 \times \Delta T_f} = \frac{1.86 \times 15 \times 1000}{450 \times 0.34}$$

$M_2 = 182.35$ g / mol

22. Explain the following observations giving an appropriate reason for each : [3]

(i) The enthalpies of atomization of transition elements are quite high.

(ii) There occurs much more frequent metal-metal bonding in compounds of heavy transition metals (*i.e.*, 3rd series).

(iii) Mn^{2+} is much more resistant than Fe^{2+} towards oxidation.

Answer : (i) Due to the presence of metallic bonds as a result of large number of valence electrons.

(ii) The presence of valence electrons and unpaired *d*-orbital electrons help heavy transition metals to form metallic bonds.

(iii) Due to stability of Mn^{2+} because of half filled-subshell ($3d^5$) it does not gets oxidized. But Fe^{2+} has $3d^6$ configuration and it can lose one electron to become $3d^5$ which is stable. Therefore it is easily oxidized.

23. Write the name, the structure and the magnetic behavior of each of the following complexes : [3]

(i) $(Pt(NH_3)Cl(NO_2)]$, (ii) $(Co(NH_3)_4Cl_2]Cl$

(iii) $Ni(CO)_4$

(At. Nos. Co = 27, Ni = 28, Pt = 78)

Answer : (i) Amminechloridonitrito–N-platinum **(ii)**, trigonal planar, diamagnetic.

(II) Tetra-ammine dichlorido cobalt **(III)** chloride, octahedral, diamagnetic

(iii) Tetracarbonyl nickel (0), Tetrahedral, diamagnetic

27. Explain the following terms giving one example of each type: [3]

(i) Antacids,

(ii) Disinfectants,

(iii) Enzymes.

Answer : (i) Substances consumed to reduce acidity in the stomach by neutralizing excess HCl produced by the stomach. *e.g.* Milk of magnesia.

(ii) Disinfectants are chemicals used to kill microorganism, applied only to non-living objects like floors and drains. *e.g.* 1% phenol solution.

(iii) Enzymes are structurally globular proteins that catalyse biochemical reactions in living organisms *e.g.* Trypsin.

30. Draw the molecular structures of following compounds : [2],[3]

(i) XeF_6 (ii) $H_2S_2O_8$

(b) Explain the following observations :

(i) The molecules NH_3 and NF_3 have dipole moments which are of opposite direction.**

(ii) All the bonds of PCl_5 molecule are not equivalent.**

(iii) Sulphur in vapour state exhibits paramagnetism.

OR

(a) Complete the following chemical equations:

(i) $XeF_4 + SbF_5 \rightarrow$ (ii) $Cl_2 + F_2$ (excess) $\rightarrow$

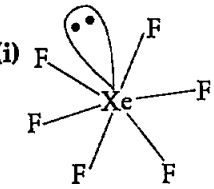
(b) Explain each of the following :**

(i) Nitrogen is much less reactive than phosphorus.

(ii) The stability of +5 oxidation state decreases down group 15.

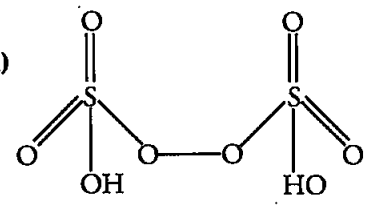
(iii) The bond angles (O-N-O) are not of the same value in NO_2^- and NO_2^+.

Answer : (a) (i)



XeF_6

(ii)



$(H_2S_2O_8)$

(b) (i) Fluorine is more electronegative than nitrogen while hydrogen is less electronegative than nitrogen resulting in opposite dipole moments of NH_3 and NF_3. Dipole points towards N in NH_3 and towards F in NF_3.

OR

(a) (i) $XeF_4 + SbF_5 \rightarrow [XeF_3]^+[SbF_6]^-$

(ii) $Cl_2 + \underset{\text{(excess)}}{3F_2} \rightarrow 2ClF_3$

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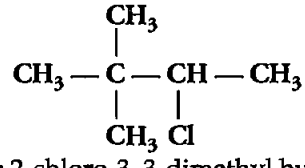
Chemistry 2013 (Outside Delhi) SET I

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

1. **Of physisorption or chemisorption, which has a higher enthalpy of adsorption ?** [1]
   Answer : Chemisorption.
2. **Name the method used for refining of copper metal.** [1]
   Answer : Electrolytic refining of copper metal.
3. **Name two poisonous gases which can be prepared from chlorine gas.** [1]
   Answer : Chloropicrin or tear gas (CCl_3NO_2) and phosgene gas ($COCl_2$).
4. **Write the IUPAC name of the following compound :** [1]



   Answer : 2-chloro-3, 3-dimethyl butane.
5. **Rearrange the following compounds in the increasing order of their boiling points:** [1]
   CH_3–CHO, CH_3–CH_2–OH_2, $CH_3 - CH_2 - CH_3$
   Answer : $CH_3CH_2CH_3 < CH_3CHO < CH_3CH_2OH$
6. **Write the structure of N-methylethanmine.** [1]
   Answer : $CH_3 - \underset{\underset{H}{|}}{N} - CH_2 - CH_3$

7. What are the products of hydrolysis of sugar ? [1]

Answer : Glucose and fructose.

8. Is $(CH_2 - \underset{\underset{Cl}{|}}{CH})$ a homopolymer or a copolymer ? [1]

Answer : Homopolymer.

9. Account for the following : ** [2]

(i) Schottky defects lower the density of related solids.

(ii) Conductivity of silicon increases on doping it with phosphorus.

10. Aluminium crystallizes in an FCC structure. Atomic radius of the metal is 125 pm, what is the length of the side of the unit cell of the metal ? [2]

11. The standard electrode potential (E°) for Daniell cell is + 1.1 V. Calculate Δ G° for the reaction : [2]

$Zn\,(s) + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu\,(s)$

(1 F = 96500 C/mol)

Answer : $n = 2,\ E^\circ_{cell} = 1.1$ volt, $1F = 96500\ C\ mol^{-1}$

$\Delta_r G^\circ = -nFE^\circ_{cell}$

$= -2 \times 96500 \times 1.1$

$= -212.3\ kJ\ mol^{-1}$

12. For a reaction A + B → P, the rate law is given by [2]

$r = k[A]^{1/2}[B]^2$

(a) What is the order of this reaction ?

(b) A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14}\ s^{-1}$. Find the half life of the reaction.

Answer : (a) Order of reaction $= \frac{1}{2} + 2 = 5/2$

(b) For first order reaction,

$$\text{Half life } (t_{1/2}) = \frac{0.693}{k}$$

$$= \frac{0.693}{5.5 \times 10^{-14}} = 1.26 \times 10^{13}$$

13. (a) Name the method used for removing gangue from sulphide ores. [2]

(b) How is wrought iron different from steel ?

Answer : (a) Froth floatation method.

(b) Wrought iron is the purest form of iron with 0.2-0.5% carbon and steel is an alloy of iron. Wrought iron is produced from cast iron.

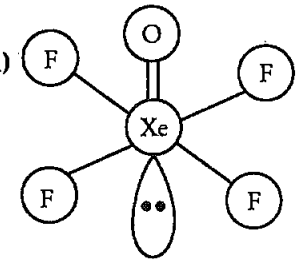
Steel is an alloy of iron and other elements. It has carbon content of 0.1-1.5%.

They also have different properties, industrial and decorative applications.

14. Draw the structures of the following molecules: [2]

(i) $XeOF_4$ (ii) H_3PO_3**

Answer : (i)



15. How are interhalogen compounds formed ? What general compositions can be assigned to them ? [2]

Answer : Interhalogen compounds are formed by direct combination of halogens or by reaction of halogen on lower interhalogen compounds. The general composition of interhalogen compounds are :

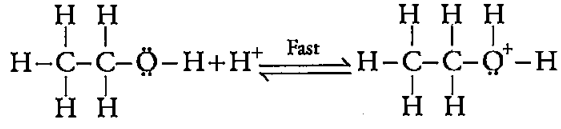
$$XX',\ XX'_3,\ XX'_5,\ XX'_7$$

16. Explain the mechanism of the following reaction : [2]

$$CH_3 - CH_2 - OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2 + H_2O$$

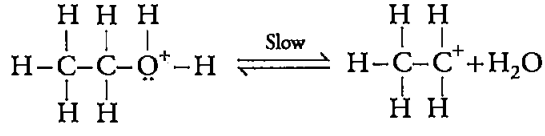
Answer : Mechanism : It involves three steps :

1. Formation of protonated alcohol

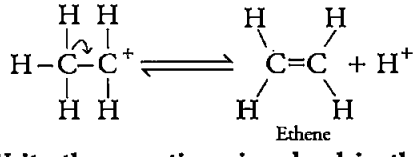


Ethanol

2. Formation of carbocation



3. Formation of ethene by elimination of a proton



Ethene

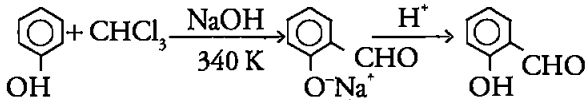
17. Write the equations involved in the following reactions : [2]

(i) Reimer-Tiemann reaction

(ii) Williamson ether synthesis

Answer : (i)

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



(Phenol) (Salicyladehyde)

(ii) $C_6H_5-ONa \xrightarrow{CH_3I} C_6H_5-OCH_3 + NaI$

Sodium Phenoxide Methyoxy Benzene

18. Define thermoplastic and thermosetting polymers. Give one example of each. [2]

OR

What is a biodegradable polymer ? Give an example of biodegradable aliphatic polyester.

Answer : Thermoplastic Polymers : They are plastics which becomes soft on heating and can be remoulded. They have less forces e.g. Polythene.

Thermosetting Polymers : They do not become soft on heating and cannot be remoulded. They have strong force of attraction *e.g.* bakelite.

OR

Natural polymers such as starch and cellulose that naturally disintegrate themselves, over a period of time are called biodegradable polymers. Example of biodegradable aliphatic polyester is PHBV (Poly-β-hydroxybutyrate-co-β-hydroxy Vaterate).

19. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature. [3]

[R = 8.314 J/K mol^{-1}, log 4 = 0.6021

Answer : Given,

$T_1 = 293K$, $T_2 = 313$ K.

$R = 8.314\ J\ K^{-1}\ Mol^{-1}$

$\log 4 = 0.6021$

$$Ea = \frac{2.303RT_1T_2}{T_2 - T_1}\log\frac{K_2}{K_1}$$

$$Ea = \frac{2.303\times8.314\times293\times313}{20}\times\log4$$

$$Ea = 52.86\ k\ J\ mol^{-1}$$

20. What are the characteristics of the following colloids ? Give one example of each. [3]
(i) Multimolecular colloids (ii) Lyophobic sols (iii) Emulsions.

Answer : (i) On dissolution, a large number of atoms or molecules of a substance aggregate to form colloidal particles. This colloid is called a multimolecular colloid. *e.g.* Sulphur sol.

(ii) The colloids in which there is no affinity between the particles of dispersed phase and dispersion medium are called lyophobic colloids. They are not stable, that is easily coagulated and irreversible. They are produced only by special methods. eg. As_2S_3 sol, $Fe(OH)_3$ sol.

(iii) Emulsions are colloids in which both dispersed phase and dispersing medium are liquid and immiscible with each other *eg.* Milk, cod liver oil, etc.

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

21. Give reasons for the following : [3]
(i) When R is an alkyl group $R_3P = 0$ exist but $R_3N = 0$ doesn't.
(ii) $PbCl_4$ is more covalent than $PbCl_2$.
(iii) N_2 is much less reactive at room temperature.**

Answer : (i) Due to absence of d-orbitals, N cannot form $p\pi-d\pi$ multiple bonds. Thus, it cannot expand its covalency beyond 4. In $R_3N = 0$, N has covalency 5 so it does not exist. On the other hand, due to presence of d-orbitals, P forms $p\pi-d\pi$ multiple bonds and expand its covalency beyond 4. In $R_3P=0$ covalency of P is 5 hence it exists.

(ii) Because 'Pb' is in +4 oxidation state in $PbCl_4$ and has high charge/size ratio than Pb^{2+}. According to Fazan's rule, a higher charge on cation or anion makes compound more covalent, +4 state is more stable than +2 state. Hence $PbCl_4$ is more covalent than $PbCl_2$

22. For the complex $[NiCl_4]^{2-}$, write [3]
(i) the IUPAC name
(ii) the hybridization type
(iii) the shape of the complex
(Atomic no. of Ni = 28)

OR

What is meant by crystal field splitting energy ? On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when
(i) $\Delta_o > P$
(ii) $\Delta_o < P$

Answer : (i) Tetrachloridonickelate (II) ion

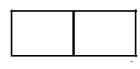
(ii) sp^3 hybridisation

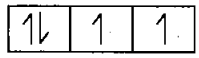
(iii) Tetrahedral shape.

OR

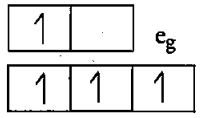
In octahedral complexes, the d-orbitals split into two sets, one with two orbitals of high energy (t_{2g}) and three orbitals with lower energy (e_g). The difference in energy levels of these sets is the crystal field splitting energy.

(i) When $\Delta_0 > P$, electronic configuration is $t_{2g}^4\ e_g^0$.





(ii) When $\Delta_0 < P$, electronic configuration is $t_{2g}^3 e_g^1$



23. Give reasons for the following : [3]

(i) Ethyl iodide undergoes S_N2 reaction faster than ethyl bromide.

(ii) (±) 2-Butanol is optically inactive.

(iii) C–X bond length in halobenzene is smaller than C–X bond length in CH_3–X.

Answer : (i) I^- ion is better leaving group than Br^-ion, therefore, ethyl iodide reacts faster than ethyl bromide in S_N2 reaction.

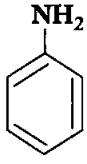
(ii) (±) 2-butanol is optically inactive because it is racemic mixture *i.e.* it has enantiomers in equal amount and hence they cancel each other's rotation of plane polarised light.

(iii) In halobenzene halogen atom is attached to sp^3 hybridized carbon while in CH_3-X sp^2 hybridized carbon which is smaller in size than sp^3 hybridized carbon attached to the halogen. Therefore C–X bond in halobenzene is shorter than in CH_3–X.

24. Complete the following reactions : [3]

(i) $CH_3CH_2NH_2 + CHCl_3 + Alc.KOH \rightarrow$

(ii) $C_6H_5N_2^+Cl^- \xrightarrow[\text{Room Temp.}]{\text{Water}}$

(iii)  + HCl (aq.) $\longrightarrow$

Answer :

(i)

$$CH_3CH_2NH_2 + CHCl_3 + 3KOH_{(aq)} \rightarrow CH_3CH_2-NC + 3KCl + 3H_2O$$

(ii)

$$C_6H_5N_2^+Cl^- \xrightarrow[(\text{room temp.})]{H_2O} C_6H_5OH + N_2 + HCl$$

(iii) $C_6H_5NH_2 + HCl(aq) \rightarrow C_6H_5NH_3Cl$

25. (i) What class of drug is Ranitidine ? [3]

(ii) If water contains dissolved Ca^{2+} ions, out of soaps and synthetic detergents, which will you use for cleaning clothes ?

(iii) Which of the following is an antiseptic ?

0.2% phenol, 1% phenol

Answer : (i) Antacid.

(ii) Soap gets precipitated in hard water hence it can't be used to wash clothes. On the other hand, synthetic detergents do not precipitate in hard water because its calcium salt is soluble in water. Therefore, it can be used to wash clothes in hard water.

(iii) 0.2% phenol.

26. Calculate the emf of the following cell at 25°C : [3]

$$Ag(s)\left|Ag^+(10^{-3}M)\right\|Cu^{2+}(10^{-1}M)\left|Cu(s)\right.$$

Given $E^0_{cell} = +0.46V$ & $\log 10^n = n$.

Given cell notation is incorrect correct cell formula is

$$Cu^{2+}(10^{-1}M)\left|Cu(s)\right\|Ag^+(10^{-3}M)\left|Ag(s)\right.$$

Answer : According to Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\frac{[Cu^{2+}]}{[Ag^-]^2}$$

$$= 0.46 - \frac{0.0591}{2}\log\frac{10^{-1}}{[10^{-3}]^2}$$

$$= 0.46 - \frac{0.591}{2}\log 10^5$$

$$= 0.46 - \frac{0.0591}{2}\times 5$$

$$= 0.46 - 0.14775$$

$$E_{cell} = 0.31V$$

27. Shanti, a domestic helper of Mrs. Anuradha, fainted while mopping the floor. Mrs. Anuradha immediately took her to the nearby hospital where she was diagnosed to be severely 'anaemic'. The doctor prescribed an iron rich diet and multivitamins supplement to her. Mrs. Anuradha supported her financially to get the medicines. After a month, Shanti was diagnosed to be normal.

(i) What values are displayed by Mrs. Anuradha ?**

(ii) Name the vitamin whose deficiency causes 'pernicious anaemia'. [3]

(iii) Give an example of a water soluble vitamin.

(ii) Pernicious anaemia is caused due to deficiency of Vitamin B_{12}.

(iii) Vitamin C and Vitamin B.

28. (a) State Raoult's law for a solution containing volatile components. How does Raoult's law become a special case of Henry's law ?

(b) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing

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

point of benzene by 0.40 K. Find the molar mass of the solute. (K_f for benzene = 5.12 K kg/ mol) [5]

OR

(a) Define the following terms :

(i) Ideal solution (ii) Azeotrope

(iii) Osmotic pressure.

(b) A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution ?

(Molar mass of glucose = 180 g/mol)

Answer : (a) Raoult's law states that the partial pressure of a vapour of a component in the solution is directly proportional to its mole fraction in the solution.

Raoult's law becomes a special case of Henry's law as it states that the partial pressure of gas in vapour phase is directly proportional to the mole fraction of the gas in the solution.

(b) $$M = \frac{1000.k_f.w_2}{w_1.\Delta T_f} = \frac{1000 \times 5.12 \times 1}{50 \times 0.4}$$

$$M = 256\,g$$

OR

(a) (i) A solution that obeys Raoult's law over all ranges of temperature and concentration and shows no attractive forces between components, is called as ideal solution.

(ii) A liquid mixture which distill at constant temperature without undergoing any change in its composition is called Azeotropes.

(iii) The minimum external pressure required to prevent osmosis is known as osmotic pressure.

(b) Given :

Molecular Mass of Glucose (M_B) = 180

% by wt. = (W_B) = 10

Molality (m) = ?

We know

$$m = \frac{W_B \times 1000}{M_B \times W_A}$$

$$W_A = 100 - 10 = 90$$

$$m = \frac{10 \times 1000}{90 \times 180}$$

$$m = 0.617\ m$$

29. (a) Give reasons for the following : [5]

(i) Mn^{3+} is a good oxidising agent.

(ii) $E^\circ_{M^{2+}/M}$ values are not regular for first row transition metals (3d series).

(iii) Although 'F' is more electronegative than 'O', the highest Mn fluoride is MnF_4, whereas the highest oxide is Mn_2O_7.

(b) Complete the following equations :

(i) $2CrO_4^{2-} + 2H^+ \rightarrow$ **(ii)** $KMnO_4 \xrightarrow{\Delta}$

OR

(a) Why do transition elements show variable oxidation states ?

(i) Name the element showing maximum number of oxidation states among the first series of transition metals from Sc (Z = 21) to Zn (Z = 30).

(ii) Name the element which shows only +3 oxidation state.

(b) What is lanthanoid contraction ? Name an important alloy which contains some of the lanthanoid metals.

Answer : (i) Mn^{+3} has electronic configuration $3d^4\ 4^\circ$. It gains one electron on reduction and become $3d^5 4^\circ$ which is half filled stable configuration. Hence it is a good oxidizing agent.

(ii) Due to extra stability of half and fully filled d-orbitals and variations in ionization energies $E^\circ_{M^{2+}/M}$ values are not regular.

(iii) Due to the ability of oxygen to form multiple bonds with metals and because oxygen stabilizes the highest oxidation state even more than fluorine.

(b)(i) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

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

OR

(a) Due to the presence of incomplete d-orbitals, transition elements shows variable oxidation states.

(i) Manganese shows oxidation states from +2 to +7.

(ii) Scandium (Sc).

(b) Lanthanide contraction refers to the steady and regular decrease in atomic size along the period from La^{3+} to Lu^{3+} eg. Misch metal alloy which contains 95% lanthanoids and 5% iron.

30. (a) How will you convert the following : [5]

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

(i) Propanone to Propan-2-ol

(ii) Ethanal to 2-hydroxy propanoic acid

(iii) Toluene to benzoic acid

(b) Give simple chemical test to distinguish between :

(i) Pentan-2 -one and Pentan-3 -one

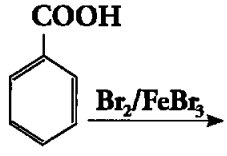
(ii) Ethanal and Propanal

OR

(a) Write the products of the following reactions :

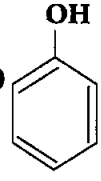
(i) $CH_3\text{-}CO\text{-}CH_3 \xrightarrow[\text{Conc.HCl}]{\text{Zn - Hg}} ?$

(ii) $CH_3\text{-}CO\text{-}Cl \xrightarrow{Pd - BaSO_4} ?$

(iii) 

(b) Which acid of each pair shown here would you expect to be stronger ?

(i) $F-CH_2-COOH$ or $Cl-CH_2-COOH$

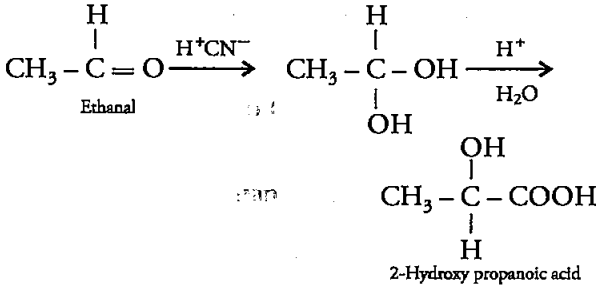
(ii) 

or CH_3COOH

Answer : (a)

(i) $\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow[NaBH_4]{LiAlH_4 \text{ or}} \underset{\text{Propan-2-ol}}{CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3}$

(ii)



(iii) $\underset{\text{Co/Mn acetate}}{C_6H_5^+-CH_3 \xrightarrow{O_2}} C_6H_5-COOH$

(b) (i) Pentan-2-one gives iodoform test but pentan-3-one does not

$$\underset{\text{Pentan-2-one}}{CH_3-\overset{\displaystyle O}{\overset{||}{C}}-CH_2-CH_3} + 3NaOI \xrightarrow[\text{heat}]{NaOH/I_2} \underset{\text{Iodoform}}{CHI_3\downarrow} + \underset{\text{sodium hypoidite}}{2NaOH + CH_3CH_2CH_2COONa}$$

$$\underset{\text{Pentan-3-one}}{CH_3-CH_2-\overset{\displaystyle O}{\overset{||}{C}}-CH_2-CH_3} \xrightarrow[NaOH/I_2]{3NaOI} \rightarrow \text{No reaction}$$

(ii) Ethanal gives iodoform test but propanal does not.

$$\underset{\text{Sodium formate}}{H-\overset{\displaystyle O}{\overset{||}{C}}-ONa} + \underset{\text{Idoform}}{CHI_3} + 3NaOI + 3H_2O$$

$$\underset{\text{Propanal}}{CH_3-CH_2-\overset{\displaystyle O}{\overset{||}{C}}-H} + I_2 + NaOH \rightarrow \text{No Reaction}$$

OR

(a) (i)

$$\underset{\text{Acetone}}{CH_3-CO-CH_3} \xrightarrow[\text{Conc. HCl}]{Zn-Hg} \underset{\text{Propane}}{CH_3CH_2CH_3} + H_2O$$

(ii)

$$\underset{\text{Acetyl chloride}}{CH_3-CO-Cl} + H_2 \xrightarrow[BaSO_4]{Pd} \underset{\text{Acetaldehyde}}{CH_3-CHO} + HCl$$

(iii)

$$\underset{\text{Benzoic acid}}{C_6H_5\text{-}COOH} \xrightarrow{Br_2/FeBr_3} \underset{\text{m-bromo-benzoic acid}}{\text{O-COOH (Br)}} + HBr$$

(b) (i) F–CH_2–COOH is a stronger acid than Cl–CH_2–COOH, because F is more electronegative than Cl, so it will favour release of H^+ ion faster by dragging electron density towards itself more as compared to Cl.

(ii) Acetic acid CH_3COOH is stronger acid than phenol. Acetic acid forms carboxylate ion and phenol forms phenoxide ion. Carboxylate ion is more stable than phenoxide ion due to resonance.

●●

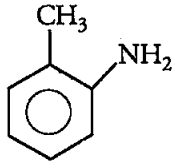
Chemistry 2013 (Outside Delhi) SET II

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

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

1. Write the structure of 2-aminotoluene. [1]

Answer :



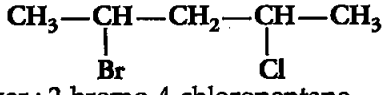
2. Which aerosol depletes ozone layer ? [1]

Answer : Chloroflurocarbon (CFCs) present in aerosols depletes ozone layer.

4. Ethanal is soluble in water. Why ? [1]

Answer : Ethanal is soluble in water due to Hydrogen bonding.

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



Answer : 2-bromo-4-chloropentane.

7. Write the name of linkage joining two amino acids. [1]

Answer : Peptide linkage.

8. Give one example of a condensation polymer. [1]

Answer : Dacron or Nylon–6, 6.

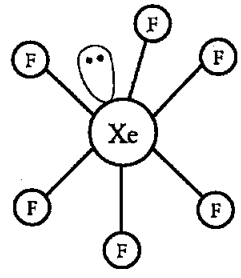
9. (a) Why does presence of excess of lithium makes LiCl crystals pink ?** [2]

(b) A solid with cubic crystal is made of two elements P and Q Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound ?**

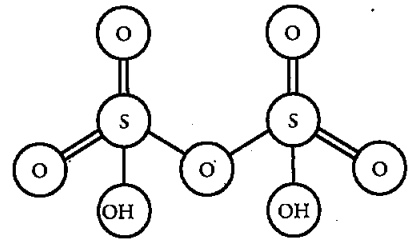
14. Draw the structures of the following molecules : [2]

(i) XeF_6 (ii) $H_2S_2O_7$

Answer : (i)



(ii)



18. Outline the principles of refining of metals by the following methods : [2]

(i) Zone refining (ii) Vapour phase refining

Answer : (i) This method is based on the principle that the impurities are more soluble in the molten state than in the solid state of metal.

(ii) In this process the metal is converted to its volatile compound, collected elsewhere and then decomposed to give pure metal.

19. Define the following terms giving an example of each : [2]

(i) Associated colloids (ii) Lyophilic sol

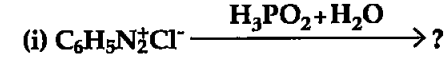
(iii) Adsorption.

Answer : (i) Associated colloids are colloidal substances which at low concentrations behave as normal electrolytes but at higher concentration they aggregate to form colloids. eg. Soaps and detergents.

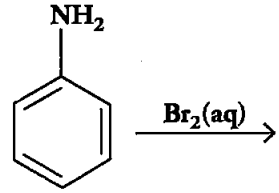
(ii) Lyophilic sols are the colloids in which the particles of dispersed phase have a strong affinity for the dispersion medium. They are reversible in nature because on precipitation they can be easily converted back to colloidal form by adding dispersion medium. *eg.* Starch sol.

(iii) The aggregation of a substance on the surface of liquid or solid is known as adsorption eg. Adsorption of poisonous gases on charcol.

22. Write the main products of the following reactions : [2]

(i) 

(ii)



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

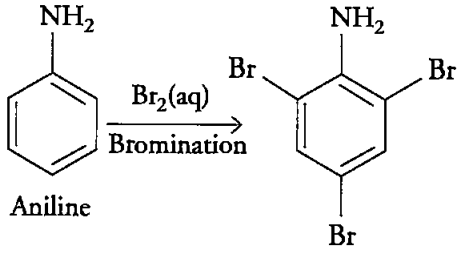
(iii) $CH_3-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2+NaOH} ?$

Answer : (i)

$C_6H_5N_2^+Cl^- \xrightarrow{H_3PO_2 + HCl} C_6H_6 + N_2 + HCl + H_3PO_3$

Benzenediazonium chloride — Benzene

(ii)



Aniline — 2,4,6-Tribromoaniline

(iii)

$CH_3-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2+4NaOH} CH_3NH_2 + 2NaBr + Na_2CO_3 + 2H_2O$

Acetamide — Methylamine

27. Give reasons for the following : [3]

(i) Oxygen is a gas but sulphur is a solid.

(ii) O_3 acts as a powerful oxidising agent.

(iii) BiH_3 is the strongest reducing agent amongst all the hydrides of Group 15 elements.**

Answer : (i) Oxygen is smaller in size than sulphur. Due to small size, it can effectively form $p\pi - p\pi$ bonds, and forms diatomic O_2 molecule. The intermolecular forces in oxygen are weak van der Waals forces, which causes it to exists as gas. On the other hand, sulphur does not form strong S=S double bonds and exists as puckered structure held together by covalent bonds and exists as polyatomic molecule. So, it exists as solid.

(ii) O_3 act as powerful oxidising agent because it decompose to give nascent oxygen.

●●

Chemistry 2013 (Outside Delhi) SET III

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

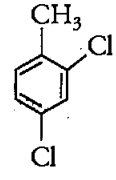
Note: Except for the following questions, all the remaining questions have been asked in previous sets.

1. What is especially observed when a beam of light is passed through a colloidal solution ? [1]

Answer : Tyndall effect is observed due to scattering of light.

2. What is the basicity of H_3PO_3 and why ? [1]**

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



Answer : 2, 4–dichlorotoluene

8. Write the structure of prop-2-en-1-amine. [1]

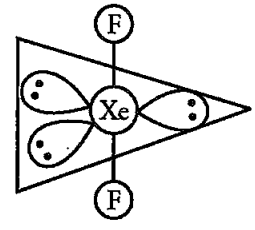
Answer : $H_2C=CH-CH_2-NH_2$

12. Draw the structures of the following molecules : [2]

(i) N_2O_5 (ii) XeF_2**

Answer :

(ii)



13. (a) What change occurs when AgCl is doped with $CdCl_2$?**

(b) What type of semiconductor is produced when silicon is doped with boron ? [2]**

18. Name the principal ore of aluminium. Explain the significance of leaching in extraction as aluminium. [2]

Answer : Bauxite ($Al_2O_3.2H_2O$) is the principal ore of aluminium. The significance of leaching in extraction of aluminium is to prepare pure alumina from the bauxite ore in the following steps :

$Al_2O_3 + 2NaOH + 3H_2O \xrightarrow[\Delta]{473\text{-}523\ K} 2Na[Al(OH)_4]$

(s) (aq) (Cl) — Sod.metaaluminate (aq)

$SiO_2 + 2NaOH \xrightarrow[\Delta]{473\text{–}523K} Na_2SiO_3 + H_2O$

Sodium Silicate

After filtration of impurities sodium meta aluminate is neutralized by passing CO_2.

$$\underset{(aq)}{2Na[Al(OH)_4]} + \underset{(q)}{2CO_2} \rightarrow \underset{(s)}{Al_2O_3.xH_2O\downarrow} + \underset{(aq)}{2NaHCO_3}$$

$$\underset{(s)}{Al_2O_3\,xH_2O} \xrightarrow{1473K} \underset{\text{Alumina}\ (s)}{Al_2O_3} + \underset{(g)}{xH_2O}$$

19. Define the following terms with an example in each case : [3]

(i) Macromolecular Sol (ii) Peptization

(ii) Emulsion.

Answer : (i) Macromolecular sol : They are molecules of large size having high molecular masses. Due to long chain, the van der Waals forces are stronger. Eg. rubber, nylon, etc.

(ii) Peptization : It is the process of converting a precipitate into colloidal solution by shaking it with dispersion medium in the presence of small amount of electrolyte. E.g. A preciptate of AgI can be peptized by shaking with a dilute solution of silver nitrate.

(iii) Emulsion : A type of colloidal solution in which both the dispersed phase and dispersion medium are liquid and are immiscible with each other is called emulsion. Ex. milk.

21. Give reasons for the following : [3]

(i) Though nitrogen exhibits +5 oxidation state, it does not form pentahalide.**

(ii) Electron gain enthalpy with negative sign of flourine is less than that of chlorine.

(iii) The two oxygen-oxygen bond lengths in ozone molecules are identical.

(ii) Due to small size, fluorine atom has high electro negativity and strong electron – electron repulsions in its compact 2p orbitals, its electron gain enthalpy is less than that of chlorine.

(iii) The two oxygen bond lengths in ozone are identical due to resonance.

●●

Chemistry 2013 (Delhi) SET I

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

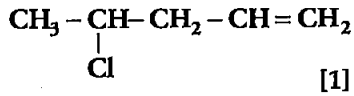
1. How many atoms constitute one unit cell of a face-centered cubic crystal ? [1]**

2. Name the method used for refining of Nickel metal. [1]

Answer : Method used for refining of nickel metal is Mond's process.

3. What is the covalency of nitrogen in N_2O_5 ?[1]**

4. Write the IUPAC name of :



[1]

Answer : 4-chloropent-1-ene.

5. What happens when CH_3-Br is treated with KCN ? [1]

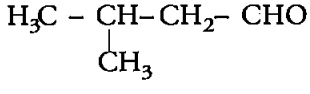
Answer :

$$\underset{\text{Methyl Bromide}}{CH_3Br} + \underset{\text{Potassium cyanide}}{KCN} \rightarrow \underset{\text{Methyl Cyanide}}{CH_3CN} + \underset{\text{Potassium Bromide}}{KBr}$$

It is a nucleophilic substitution reaction.

6. Write the structure of 3-methyl butanal. [1]

Answer :



7. Arrange the following in increasing order of their basic strength in aqueous solution : CH_3NH_2, $(CH_3)_3N$, $(CH_3)_2NH$. [1]

Answer :

$$\underset{3^\circ\text{amine}}{(CH_3)_3N} < \underset{1^\circ\text{amine}}{CH_3NH_2} < \underset{2^\circ\text{amine}}{(CH_3)_2NH}$$

8. What are the types of RNA molecule which perform different functions ? [1]

Answer : Three types of RNA molecules which perform different functions are :

(i) Messenger RNA (m-RNA)

(ii) Transfer RNA (t-RNA)

(iii) Ribosomal RNA (r-RNA)

9. 18 g of glucose, $C_6H_{12}O_6$ (Molar Mass = 180g/mol) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil ? [2] (K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K)

Answer : Given,

Weight of solvent (H_2O) (W_1) = 1 kg

Weight of solute ($C_6H_{12}O_6$) (W_2) = 18 gm

Molar mass of solute (M_2) = 180 g/mol

K_b = 0.52 K kg mol^{-1}

T_b° = 373.15 K

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

We know that

$$\therefore \Delta T_b = \frac{K_b \times 1000 \times W_2}{M_2 \times W_1}$$

$$= \frac{0.52 \times 1000 \times 18}{180 \times 1000}$$

$$= 0.052\,K$$

$$\therefore \Delta T_b = T_b - T_b^\circ = 0.052$$

$$0.052 = T_b - 373.15$$

$$T_b = 373.202\,K$$

Hence, boiling point of solution is 373.202 K

10. The conductivity of 0.20 M solution of KCl at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity. [2]

Answer : Given $k = 0.025\,S\,cm^{-1}$

Molarity, M = 0.20 M

Molar conductivity

$$(\Lambda m) = \frac{\kappa \times 1000}{M}$$

$$= \frac{0.025 \times 1000}{0.20}$$

$$\therefore \Lambda_m = 125\,S\,cm^2 mol^{-1}$$

11. Write the dispersed phase and dispersion medium of the following colloidal system : [2]

(i) Smoke (ii) Milk.

OR

What are lyophilic and lyophobic colloids ? Which of these sols can be easily coagulated on addition of small amounts of electrolytes ?

Answer : (i) Dispersed Phase in Smoke : Solid, dispersion medium in smoke : Gas

(ii) Dispersed Phase in Milk : Fats (liquid), dispersion medium in milk: Water (liquid)

OR

Answer : Lyophilic Colloids : These are the colloidal solutions in which dispersed phase has great affinity for dispersion medium. Such solutions are quite stable and are reversible in nature. e.g. starch, proteins, etc.

Lyophobic Colloids (Liquid Hating) : These are the colloidal solutions in which dispersed phase has very little affinity for the dispersion medium. Such solutions are unstable and are irreversible in nature. *eg.*, (As_2S_3 Sol).

Lyophobic colloids can be easily coagulated because on addition of small amount of electrolyte, the charge on colloidal particles is removed, as a result the particles will come closer to each other and then aggregate to form a cluster which settle down under the force of gravity.

12. Write the differences between physisorption and chemisorption with respect to the following : [2]

(i) Specificity (ii) Temperature dependence (iii) Reversibility and (iv) Enthalpy change

Answer :

S. No.	Point of difference	Physisorption	Chemisorption
(i)	Specificity	It is not specific in nature *i.e.*, all gases are adsorbed on all solids to some extent.	This is highly specific in nature. *i.e.*, it occurs only when there is some possibility of compound formation between the gas being adsorbed and the solid being adsorbent.
(ii)	Temperature dependence	Low temperature is favourable for physisorption. It decreases with increase in temperature	High temperature is favourable for chemisorptions. It increases with the increase in temperature.
(iii)	Reversibility	It is reversible in nature.	It is irreversible in nature.
(iv)	Enthalpy change	Enthalpy of adsorption is low *i.e.*, 20-40 $kJmol^{-1}$	Enthalpy of adsorption is high *i.e.*, 40-4000 $kJ\,mol^{-1}$

13. (a) Which solution is used for the leaching of silver metal in the presence of air in the metallurgy of silver ?

(b) Out of 'C' and 'CO', which is a better reducing agent at the lower temperature range in the blast furnace to extract iron from the oxide ore ? [2]

Answer : (a) Dilute solution *i.e.*, 0.5% NaCN and KCN is used for leaching of silver metal in the presence of air.

$$4Ag + 8NaCN + 2H_2O + O_2 \rightarrow 4Na[Ag(CN)_2] + 4NaOH$$

Sodium. dicyanoargentate (I)

(b) Out of C and CO, CO is a better reducing agent at lower temperature range in the blast furnace to extract iron from the oxide ore because

in Ellingham diagram $\Delta G_{(CO, CO_2)} < \Delta G_{(Fe, FeO)}$ SO, CO will reduce FeO to Fe and will oxidized to CO_2.

$$FeO + CO \xrightarrow{1123\,K} Fe + CO_2$$

14. What happens when [2]

(i) PCl_5 is heated ? **(ii) H_3PO_3 is heated ?**

Write the reaction involved.

Answer : (i) PCl_5 on heating gives PCl_3 and Cl_2.

$$PCl_5 \xrightarrow{Heat} PCl_3 + Cl_2$$

(ii) H_3PO_3 on heating gives orthophosphoric acid and phosphine.

$$4H_3PO_3 \xrightarrow{\Delta} \underset{\text{orthophosphoric acid}}{3H_3PO_4} + \underset{\text{Phosphine}}{PH_3}$$

15. (a) Which metal in the first transition series (3*d* series) exhibits + 1 oxidation state most frequently and why ?

(b) Which of the following cations are coloured in aqueous solutions and why ? [2]

Sc^{3+}, V^{3+}, Ti^{4+}, Mn^{2+}

(Atomic Nos. Sc = 21, V = 23, Ti = 22, Mn = 25)

Answer : (a) Cu is the only metal in the first transition series (3*d* series) which exhibits +1 oxidation state more frequently. This is because the electronic configuration of Cu is $3d^{10}\,4s^1$ and after losing one s electron it acquires a stable $3d^{10}$ configuration.

(b) The colour of cations depend upon the number of unpaired electrons present in *d*-orbital. The electronic configuration of the following cations is as follows :

Sc (Atomic number 21) = $3d^1 4s^2$ and $Sc^{3+} = 3d^0 4s^0$. As d-orbital is empty, it is colourless.

V (atomic number 23) = $3d^3 4s^2$ and $V^{3+} = 3d^2 4s^0$. As *d*-orbital is having 2 unpaired electrons, it undergoes *d-d* transition and depicts green colour.

Ti (Atomic number 22) = $3d^2 4s^2$ and $Ti^{+4} = 3d^0 4s^0$. As '*d*' orbital is empty, it is colourless.

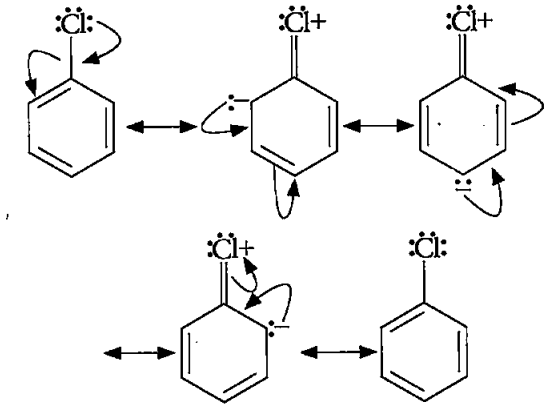
Mn(Atomic number 25) = $3d^5 4s^2$ and $Mn^{+2} = 3d^5 4s^0$. As '*d*' orbital has 5 unpaired electrons, it depicts pink colour.

Thus, V^{3+} and Mn^{2+} ions are coloured in their aqueous solution due to the presence of unpaired electron.

16. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same. [2]

Answer : Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction because of the following reasons :

1. Resonance Effect : The electron pair on chlorine atom is in conjugation with the benzene-electrons of the benzene ring which results in the following resonating structures :



This results in delocalization of electrons of C-Cl bond and a partial double bond character develops in the bond, which makes it difficult for the nucleophile to cleave the C-Cl bond.

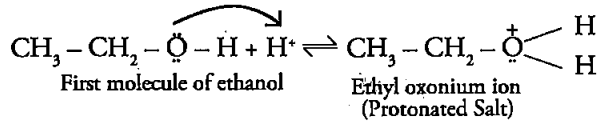
2. The nucleophile suffers repulsion from the increased electron density on the benzene ring as a result the nucleophile is unable to make a close approach for the attack on the molecule.

17. Explain the mechanism of the following reaction: [2]

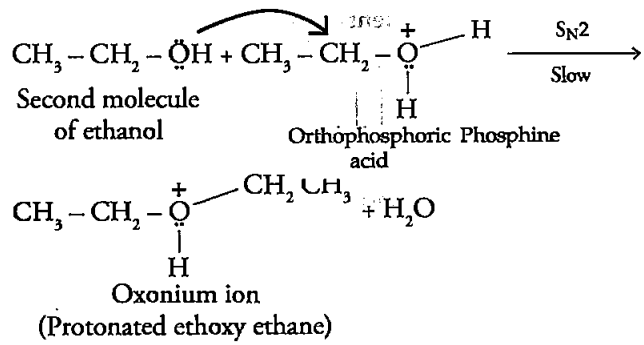
$$2CH_3—CH_2—OH \xrightarrow[413\,K]{H^+} CH_3CH_2—O—CH_2—CH_3 + H_2O$$

Answer : The mechanism of the reaction is given below :

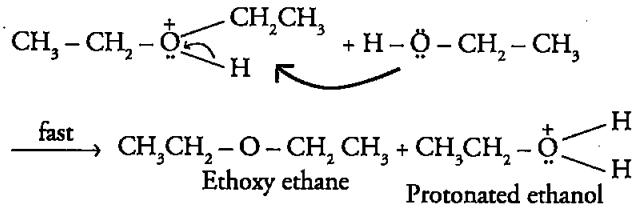
Step 1 : Protonation of alcohol



Step 2 : Attack by nucleophile on protonated alcohol molecule



Step 3 : Loss of proton : to form ethoxy ethane



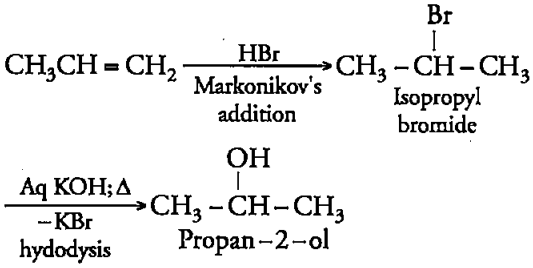
Ethoxy ethane Protonated ethanol

18. How will you convert : [2]

(i) Propene to Propan-2-ol ?

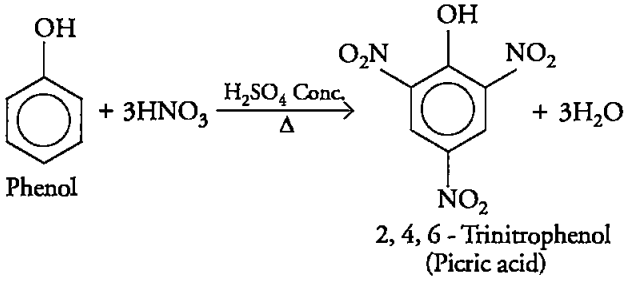
(ii) Phenol to 2, 4, 6 – trinitrophenol ?

Answer : **(i)** When H_2SO_4 is added to propene, propan-2-ol is formed. The addition of H_2SO_4 takes place in accordance with Markovnikov's rule.



Isopropyl bromide Propan–2–ol

(ii) When concentrated nitric acid is added to phenol in the presence of sulphuric acid it gives 2, 4, 6 – trinitrophenol.



Phenol 2, 4, 6 - Trinitrophenol (Picric acid)

19. (a) What type of semiconductor is obtained when silicon is doped with boron ?** [3]

(b) What type of magnetism is shown in the following alignment of magnetic moments ?**

(c) What type of point defect is produced when AgCl is doped with $CdCl_2$?**

20. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25°C, assuming that it is completely dissociated. [3]

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

($R = 0.0821$ L atm K^{-1} mol^{-1}, Molar mass of $K_2SO_4 = 174$ g mol^{-1})

Answer : We know

$$\pi = iCRT \Rightarrow \pi = \frac{inRT}{V} \Rightarrow \pi = i \times \frac{w}{M} \times \frac{1}{V} RT$$

Given : $w = 2.5 \times 10^{-2}$, g = 0.025 g

V = 2 L, T = 25°C = 298 K

$M = K_2SO_4 = 2 \times 39 + 32 + 4 \times 16 = 174$ g mol^{-1}

K_2SO_4 dissociates completely as

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

Ions produced = 3 *i.e.*, $i = 3$

$$\text{Hence, } \pi = \frac{3 \times 0.025\text{g}}{174\,\text{g mol}^{-1}} \times \frac{1}{2\text{L}} \times 0.0821 \times 298\text{ K}$$

$$\pi = 5.27 \times 10^{-3}\text{ atm}$$

21. Calculate the emf of the following cell at 298 K : [3]

Fe(s) | Fe^{2+} (0.001 M) | | H^+ (1M) | H_2(g) (1 bar), Pt(s)

(Given $E^\circ_{cell} = +0.44$ V)

Answer :

At anode : $Fe \rightarrow Fe^{2+} + 2e^-$

At cathode: $2H^+ + 2e^- \rightarrow H_2$

So, total number of electrons (n) transferred = 2

Given that : $E^\circ_{cell} = +0.44$ V

Temperature (T) = 298 K

We know,

$$E_{cell} = E^\circ_{cell} - \left(\frac{2.303RT}{nF}\right) \log \frac{a_{oxi}}{a_{red}}$$

$$E_{cell} = E^\circ_{cell} - \left(\frac{0.05916\text{ V}}{n}\right) \log \frac{[Fe^{2+}]}{[H^+]^2}$$

$$= 0.44 - \frac{0.5916}{2} \log \frac{0.001}{1}$$

$$= 0.44 - 0.02955 \times (-3)$$

$$= 0.44 + 0.08865$$

$$\therefore\ E_{cell} = 0.53\text{ V}$$

22. How would you account for the following ? [3]

(i) Transition metals exhibit variable oxidation states.

(ii) Zr (Z = 40) and Hf (Z = 72) have almost identical radii.

(iii) Transition metals and their compounds act as catalyst.

OR

Complete the following chemical equations:

(i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow$

(ii) $2CrO_4^{2-} + 2H^+ \rightarrow$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow$

Answer : (i) The variable oxidation states of transition elements is due to the participation of ns and $(n-1)d$-electrons in bonding. Lower oxidation state is exhibited when ns-electrons take part in bonding. Higher oxidation states are exhibited when $(n-1)$ d-electrons take part in bonding.

(ii) This is because atomic radii of $4d$ and $5d$ transition elements are nearly same. This similarity in size is a consequence of lanthanide contraction which is due to weak shielding of d-electrons. As a result, the radii of Hf becomes nearly equal to that of Zr.

(iii) The catalytic activity of transition elements and their compound is due to the following reasons :

1. Due to their tendency to show variable oxidation state transition metal form instable intermediate compounds and provides a new path for the reaction with lower activation energy.

2. In some cases, the transition metals provide a suitable large surface area with free valencies or ion which reactant can adsorbed.

OR

(i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

(ii) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+}$ 10CO 8H O $+10CO_2 + 8H_2O$

23. Write the IUPAC names of the following coordination compounds : [3]

(i) $[Cr(NH_3)_3Cl_3]$

(ii) $K_3[Fe(CN)_6]$

(iii) $[CoBr_2(en)_2]^+$, **(en = ehylenediamine)**

Answer : (i) Triamminetrichloridochromium(III)

(ii) Potassium hexacyanoferrate(III)

(iii) Dibromidobis-(ethylene-diammine) cobalt (III) ion

24. Give the structures of A, B and C in the following reactions: [3]

(i)

$$C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C$$

(ii)

$$C_6H_5NO_2 \xrightarrow{Sn + HCl} A \xrightarrow[273K]{NaNO_2+HCl} B \xrightarrow[\Delta]{H_2O/H^+} C$$

Answer : (i)

$$\underset{\text{Benzene diazonium chloride}}{C_6H_5N_2^+Cl^-} \xrightarrow{CuCN} \underset{\text{(A) Benzonitrile}}{C_6H_5CN} \xrightarrow{H_2O/H^+}$$

$$\underset{\text{(B) Benzoic acid}}{C_6H_5COOH} \xrightarrow[\Delta]{NH_3} \underset{\text{Ammonium benzoate}}{C_6H_5COO^-NH_4^+} \xrightarrow{\Delta} \underset{\text{(C) Benzamide}}{C_6H_5CONH_2}$$

(ii)

$$\underset{\text{Nitrobenzene}}{C_6H_5NO_2} \xrightarrow{Sn+HCl} \underset{\text{(A) Aniline}}{C_6H_5NH_2} \xrightarrow[273K]{NaNO_2+HCl} \underset{\text{(B) Benzene diazonium Chloride}}{C_6H_5N^+ \equiv NCl^-} \xrightarrow[\Delta]{H_2O/H^+} \underset{\text{(C) Phenol}}{C_6H_5OH}$$

25. Write the names and structures of the monomers of the following polymers : [3]

(i) Buna–S **(ii) Neoprene**

(iii) Nylon-6, 6

Answer : (i) Buna - S :

$CH_2 = \underset{\underset{\text{stryene}}{C_6H_5}}{\underset{|}{CH}}$ and $\underset{\text{Buta–1,3–diene}}{CH_2 = CH - CH = CH_2}$

(ii) Neoprene :

$$\underset{\text{Chloroprene}}{CH_2 = CH - \overset{\overset{Cl}{|}}{C} = CH_2}$$

(iii) Nylon-6, 6 :

$$\underset{\text{Adipic acid}}{HO - \overset{\overset{O}{\|}}{C} - (CH_2)_4 - \overset{\overset{O}{\|}}{C} - OH} \text{ and } \underset{\text{Hexamethylenediamine}}{H_2N - (CH_2)_6 - NH_2}$$

26. After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rich food like sprouts, salad, fruits etc. This decision was welcomed by the parents and the students. [3]

After reading the above passage, answer the following questions :

(a) What values are expressed by Sonali and the Principal of the school ?**

(b) Give two examples of water-soluble vitamins.

Answer :

(b) The two water soluble vitamins are vitamin B and Vitamin C (Ascorbic acid).

27. (a) Which one of the following is a food preservative ? **[3]**

Equanil, Morphine, Sodium benzoate

(b) Why is bithional added to soap ?

(c) Which class of drugs is used in sleeping pills ?

Answer : (a) Sodium benzoate is used as a food preservative whereas equanil is a tranquilizer and morphine is a narcotic analgesic.

(b) Bithional is an antiseptic so it is added to soaps to reduce the odours produced by bacterial decomposition of organic matter on the skin.

(c) Tranquilizers relieve stress, fatigue by inducing sense of well being, so they are used in sleeping pills.

28. (a) A reaction is second order in A and first order in B. **[5]**

(i) Write the differential rate equation.

(ii) How is the rate affected on increasing the concentration of A three times ?

(iii) How is the rate affected when the concentrations of both A and B are doubled ?

(b) A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction.

(Given : log 1.428 = 0.1548)

OR

(a) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

(b) Rate constant 'k' of a reaction varies with temperature 'T' according to the equation :

$$\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$

Where E_a is the activation energy. When a graph is plotted for log k Vs. $\frac{1}{T}$, a straight line with a slope of –4250 K is obtained. Calculate 'E_a' for the reaction. (R = 8.314 JK^{-1} mol^{-1})

Answer : (a) (i) A reaction is second order in A and first order in B.

$$\text{Rate} = \frac{-d[R]}{dt} = K[A]^2[B]$$

(ii) On increasing the concentration of 'A' three times *i.e.* 3A; the rate of reaction becomes 9 times of the initial rate.

Rate = $K[3A]^2[B] = 9K[A]^2[B]$ = 9 times rate.

(iii) On increasing the concentration of A and B as 2A and 2B. The rate of reaction becomes 8 times of the initial rate.

Rate = $K[2A]^2[2B] = 8K[A]^2[B]$ = 8 times rate

(b)

	A	→	P
$t =$	0		0
$t = t\ (a\text{-}x)$	x		

Now, it takes 40 min for 30% decomposition *i.e.* reactant left after 40 min is 70% of its initial concentration.

$$\text{So, } (a-x) = \frac{70}{100} \times a = \frac{7}{10}a$$

Using the formula,

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

$$= \frac{2.303}{40}\log\frac{a}{(7/10)a}$$

$$= 0.00891\,\text{min}^{-1}$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.008913}$$

$$\therefore \quad t_{1/2} = 77.78 \text{ min}$$

OR

(a) For a first order reaction,

	A	→	P
At, t=0	a		0
At, t=t	$(a\text{-}x)$		x

$$t_{99\%} = \frac{2.303}{K}\log\frac{100}{1} \qquad \text{eq. (i)}$$

$$t_{90\%} = \frac{2.303}{K} = \frac{100}{10} \qquad \text{eq. (ii)}$$

on Comparing eq (i) and (ii)

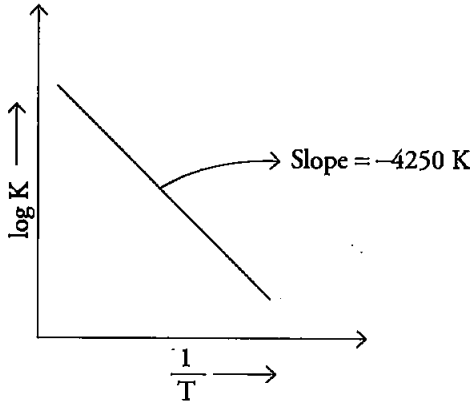
$$\frac{t_{99\%}}{t_{90\%}} = \frac{\log 100}{\log 1} \quad \therefore \ t_{99\%} = 2t_{90\%}$$

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

$\therefore$ the time required for 99% completion of 1st order reaction is twice the time required for 90% completion.

(b) We know that, $\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$

The above equation is like $y = mx + c$, where if we plot 'y' vs 'x' we get a straight line with slope 'm' and intercept 'c'.



Hence, slope is equal to $= \frac{-E_a}{2.303\ R}$

$\frac{-E_a}{2.303R} = -4250\ K$

$\therefore Ea = 4250 \times 2.303 \times 8.314\ (JK^{-1}\ mol^{-1})$

$= 81{,}375.3535\ Jmol^{-1}$

$Ea = 81.3733\ kJ\ mol^{-1}$

29. (a) Give reasons for the following : [5]

(i) Bond enthalpy of F_2 is lower than that of Cl_2.

(ii) PH_3 has lower boiling point than NH_3.**

(b) Draw the structures of the following molecules :

(i) BrF_3 (ii) $(HPO_3)_3$ (iii) XeF_4**

OR

(a) Account for the following :

(i) Helium is used in diving apparatus.

(ii) Flourine does not exhibit positive oxidation state.

(iii) Oxygen shows catenation behaviour less than sulphur.

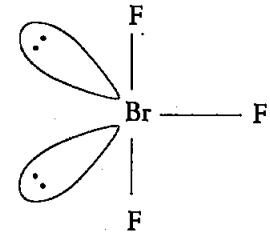
(b) Draw the structures of the following molecules.

(i) XeF_2 (ii) $H_2S_2O_8$

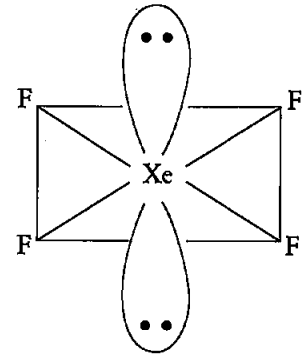
****Answer is not given due to change in present syllabus.**

Answer : (a) (i) Bond enthalpy of F_2 is lower than that of Cl_2 because 'F' atom is small in size and due to this the electron-electron repulsions between the lone pairs of F–F electrons are very large. Thus, the bond dissociation energy of F_2 is lower than that of Cl_2.

(b) (i) BrF_3, Bent T-shape



(iii) XeF_4, square planar



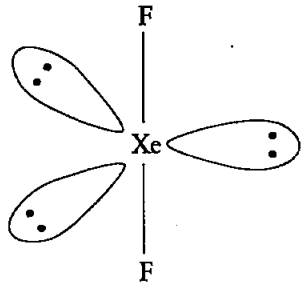
OR

(a)(i) Helium mixed with oxygen under pressure is given to sea-divers for artificial respiration because of its very low solubility in blood. Air is not given because nitrogen present in air being soluble in blood will give a painful sensation called bends by bubbling out blood on moving from high pressure to the atmospheric pressure. Thus, oxygen-helium mixture is used.

(ii) Fluorine being the most electronegative atom does not exhibit positive oxidation state because, it does not have d-orbitals for octet expansion and therefore, it shows only a negative oxidation state of –1.

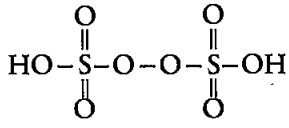
(iii) Oxygen shows catenation behaviour less than sulphur because the oxygen atom is smaller in size as compared to sulphur due to this the lone pair of electron in O–O bonds in oxygen experiences more repulsion as compared to the S–S bonds and thus, S–S forms strong bond.

(b) XeF_2,



XeF_2, Shape : Linear

(ii) $H_2S_2O_8$



30. (a) Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons. [5]

(b) How will you bring about the following conversions?

(i) Propanone to propane

(ii) Benzoyl chloride to benzaldehyde

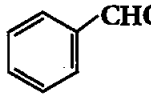
(iii) Ethanal to but-2-enal.

OR

(a) Complete the following reactions :

(i) $2H-\underset{\underset{O}{\|}}{C}-H \xrightarrow{\text{Conc·KOH}}$

(ii) $CH_3COOH \xrightarrow{Br_2/P}$

(iii)  $\xrightarrow[273-283\ K]{HNO_3/H_2SO_4}$

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

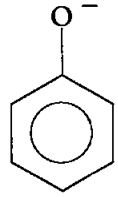
(i) Ethanal and Propanal

(ii) Benzoic acid and Phenol.

Answer : (a) On losing a proton, carboxylic acids forms carboxylate ion and phenol forms phenoxide ion as follows :

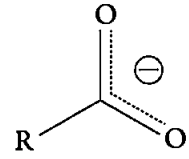
RCOO–

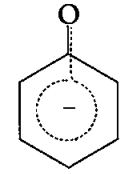
Carboxylate ion



Phenoxide ion

Now, the negative charge is delocalized in both molecules as follows :





The conjugate base of carboxylic acid has two resonance structures in which negative charge is declocalized over two oxygen atoms which stabilizes the carboxylate ion.

On the other hand, in phenoxide ion the charge is delocalized over entire molecule on the less electronegative atom, thus resonance of phenoxides is not important in comparison to resonance in carboxylate ion.

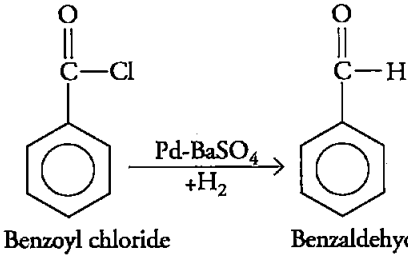
Further, in carboxylate ion the negative charge is effectively delocalized over two oxygen atoms whereas it is less effectively delocalized over one oxygen atom and less electronegative carbon atom.

Thus, phenol is less acidic than carboxylic acids. In other words, carboxylic acids are stronger acids than phenol.

(b) (i) Conversion of propanone to propane :

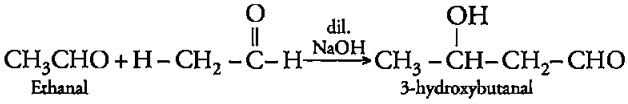
$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{Reduction}]{NaBH_4,\ CH_3OH} \underset{\text{2–Propanol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3} \xrightarrow[443K]{\text{Conc.}H_2SO_4} \underset{\text{Propene}}{CH_3-CH=CH_2} \xrightarrow[Ni]{+H_2} \underset{\text{Propane}}{CH_3-CH_2-CH_3}$$

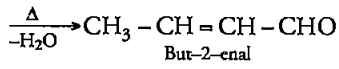
(ii) Conversion of benzoyl chloride to benzaldehyde :



Benzoyl chloride Benzaldehyde

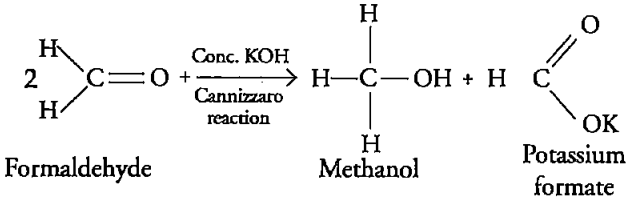
(iii) On treatment with dilute alkali, ethanol produces 3-hydroxybutanal gives But-2-enal on heating



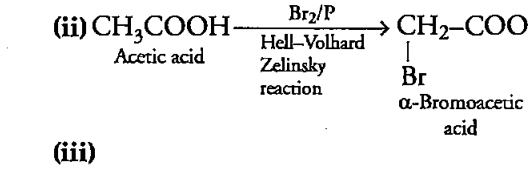


OR

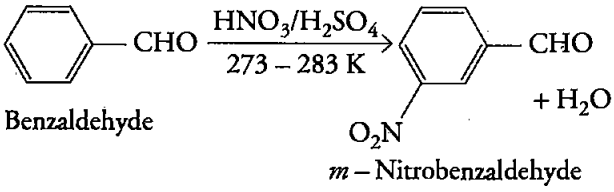
(a)(i)



(ii)

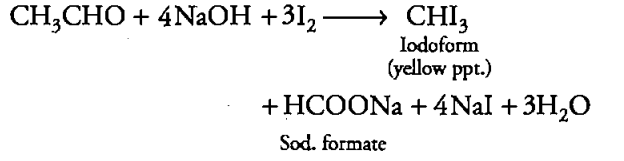


(iii)



(b) (i) Ethanol and Propanal :

Iodoform Test : When ethanol is treated with sodium hydroxide and ammonia, iodoform is obtained.

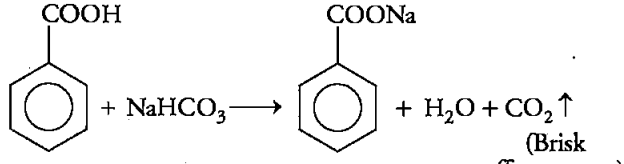


Propanal does not give this test

$CH_3CH_2CHO + 4NaOH + 3I_2 \rightarrow$ No reaction

(ii) Benzoic acid and phenol :

$NaHCO_3$ Test : When benzoic acid is treated with $NaHCO_3$ brisk efferversence of CO_2 gas were evolved.



Phenol does not give this test :

$C_6H_5OH + NaHCO_3 \rightarrow$ No reaction

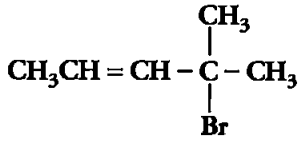
●●

Chemistry 2013 (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 set.

1. **What type of stoichiometric defect is shown by AgCl ?**** [1]
2. **Write the IUPAC name of :** [1]



Answer : 4-Bromo-4-methylpent-2-ene

4. **What type of bonding helps in stabilizing the α-helix structure of proteins ?** [1]

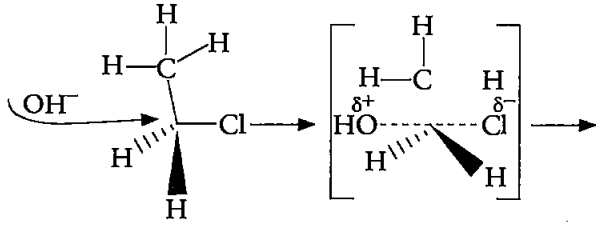
Answer : Hydrogen bonding between the NH group of each amino acid residue and the >C = O of an adjacent turn of the helix helps in stabilizing the α-helix structure of proteins.

6. **What inspired N. Bartlett for carrying out reaction between Xe and PtF_6 ?** [1]

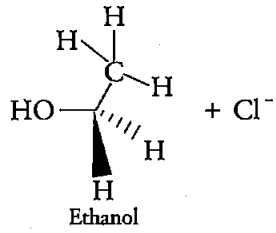
Answer : N. Bartlett observed that the first ionization enthalpy of molecular oxygen is almost identical with that of xenon. So after preparing red coloured compound $O_2^+PtF_6^-$ he made efforts to prepare $Xe^+PtF_6^-$ by mixing PtF_6 and Xe.

7. **What happens when ethyl chloride is treated with aqueous KOH ?** [1]

Answer : When C_2H_5Cl reacts with aq. KOH, substitution Nucleophilic bimolecular (S_N2) reaction takes place and Ethanol is formed.



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



Ethanol

And inversion of configuration also takes place.

8. Write the structure of 4-chloropentan-2-one. [1]

Answer : $CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

9. How will you convert the following ? [2]

(i) Propan-2-ol to propanone.

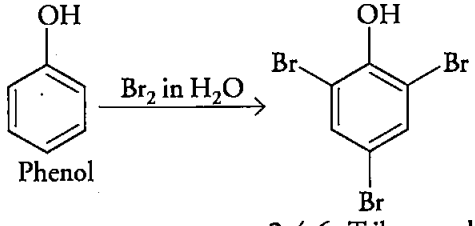
(ii) Phenol to 2, 4, 6 – tribromophenol ?

Answer : (i) Propan-2-ol to propanone :

$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow{K_2Cr_2O_7 + H_2SO_4} CH_3-\overset{\overset{O}{\|}}{C}-CH_3$$

Propane–2–ol Propanone

(ii) Phenol to 2, 4, 6-tribromophenol:



Phenol 2,4,6–Tribromophenol

11. What is the difference between oil/water (O/W) type and water/oil (W/O) type emulsions? Give an example of each type. [2]

Answer : Emulsion of oil-in-water has oil as dispersed phase and water as dispersion medium. For example, Milk etc.

Emulsion of water-in-oil has water as dispersed phase and oil as dispersion medium. For example, Cod liver oil etc.

17. (a) Which of the following ores can be concentrated by froth floatation method and why ?

Fe_2O_3, ZnS, Al_2O_3

(b) What is the role of silica in the metallurgy of Copper ? [2]

Answer : (a) Only sulphide ores are concentrated by this process because pine oil selectively wets the sulphide ore and hence bring it to the froth.

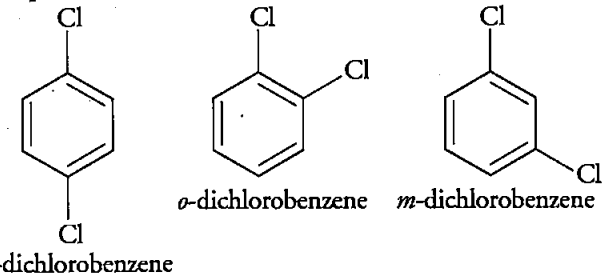
(b) Silica is added in the reverberatory furnance during the extraction of copper to remove iron oxide present in the ore. Iron oxide reacts with silica and is removed as slag of iron silicate.

$$FeO + SiO_2 \rightarrow \underset{\text{Slag}}{FeSiO_3}$$

18. (a) Why does *p*-dichlorobenzene has a higher m.p. than its *o*- and *m*- isomers? [2]

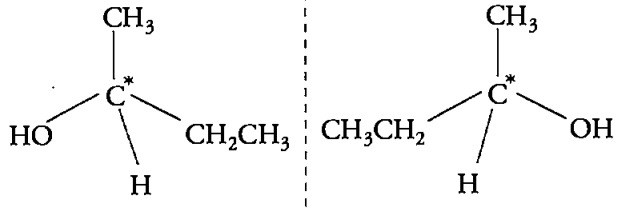
(b) Why is (–) – Butan-2-ol optically inactive ?

Answer : (a) p-dichlorobenzene has higher melting point than ortho and meta isomer. This is because the para isomer is having a symmetrical structure and therefore, its packing is more efficient as compared to the ortho and meta isomer, therefore, it shows higher melting point.



p-dichlorobenzene *o*-dichlorobenzene *m*-dichlorobenzene

(b) The (±) – Butan-2-ol is optically inactive because it is racemic mixture and exists in two enantiomeric forms which are non-superimposable mirror images of each other. Both the isomers are present in equal amounts therefore, it does not rotate the plane of polarized light and is optically inactive.



50% – (+) Butan -2-ol 50% – (–) Butan -2-ol

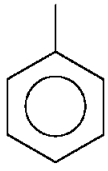
23. Write the names and structures of the monomers of the following polymers : [3]

(i) Polystyrene

(ii) Dacron

(iii) Teflon

Answer : Polymers with their monomers and their structures:

Polymer	Monomer	Structure
(i) Polystyrene	Styrene (Vinyl benzene)	$CH = CH_2$ 
(ii) Dacron	1. Ethylene glycol 2. Terephthalic acid	1. $HOH_2C - CH_2OH$ 2. $HOOC - C_6H_4 - COOH$
(iii) Teflon	Tetrafluoroethene	$CF_2 = CF_2$

27. Write the types of isomerism exhibited by the following complexes : [3]

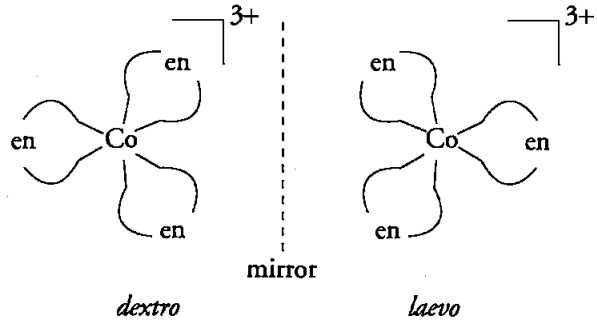
(i) $[Co(NH_3)_5Cl]SO_4$

(ii) $[Co(en)_3]^{3+}$

(iii) $[Co(NH_3)_6]\,[Cr(CN)_6]$

Answer : (i) Ionisation isomerism

(ii) Optical isomerism



(iii) Coordination isomerism

●●

Chemistry 2013 (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. What type of substances would make better Permanent Magnets, Ferromagnetic or Ferrimagnetic ?** [1]

3. What is the composition of 'Copper matte' ? [1

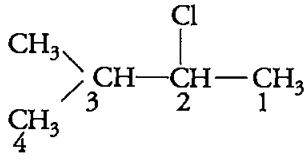
Answer : Composition of 'Copper matte' is Cu_2S and FeS.

5. What is a glycosidic linkage ? [1]

Answer : The linkage between the two monosaccharide units through oxygen atom accompanied by the loss of a water molecule is called glycosidic linkage.

6. Write the IUPAC name of $(CH_3)_2CH.CH(Cl)CH_3$ [1]

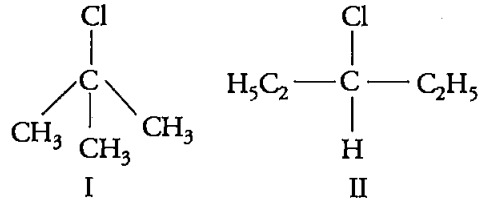
Answer :



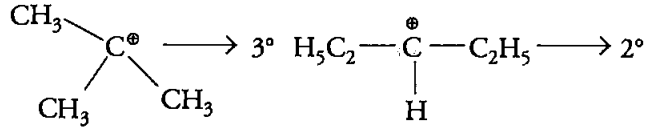
2-Chloro-3-methylbutane

7. Which compound in the following pair undergoes faster S_N1 reaction ? [1]

Answer :



The carbocation formed when compounds I and II undergo S_N1 reaction are shown below :

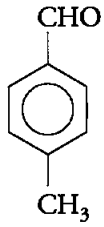


As 3° carbocation is more stable than 2° carbocation, hence compound I undergoes faster S_N1 reaction.

8. Write the structure of *p*-Methylbenzaldehyde molecule.

Answer : [1]

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



9. What is the difference between multi-molecular and macromolecular colloids ? Give one example of each. [2]

Answer : Difference between Multi-molecular and Macromolecular colloids :

Point of Difference	Multi-molecular Colloid	Macro-molecular Colloid
Definition	When a large number of atoms or small molecules (having diameters of less than 1 nm) of a substance combine together in a dispersion medium to form aggregates having size in the colloidal range, the colloidal solutions thus formed are called multimolecular colloid.	When substances which have very high molecular masses are dispersed in suitable dispersion medium, the resulting colloidal solutions are known as macromolecular colloids.
Example	Gold sol, sulphur sol.	Starch, cellulose.

14. (a) Give an example of zone refining of metals.

(b) What is the role of cryolite in the metallurgy of aluminum ? [2]

Answer : (a) Zone Refining of Metals : This method is used for production of semiconductor and other metals of very high purity like germanium, silicon, boron, gallium and indium.

(b) Role of Cryolite in Metallurgy of Aluminium : Cryolite is added to lower the melting point of mixture and to increase the conductivity of electrolyte.

17. Account for the following : [2]

(i) The C—Cl bond length in chlorobenzene is shorter than that in CH_3—Cl.

(ii) Chloroform is stored in closed dark brown bottles.

Answer : (i) This is due to partial double bond character to C-Cl bond (due to resonance in C_6H_5Cl).

(ii) Chloroform in the presence of air gets oxidized to phosgene. Phosgene is carbonyl chloride and is represented as $COCl_2$. To prevent the formation of phosgene, chloroform is stored in dark coloured bottles. The reaction represented as $CHCl_3 + \frac{1}{2}O_2 \rightarrow COCl_2 + HCl$

18. How will you convert : [2]

(i) Propene to Propan-1-ol? (ii) Ethanal to Propan-2-ol ?

Answer :

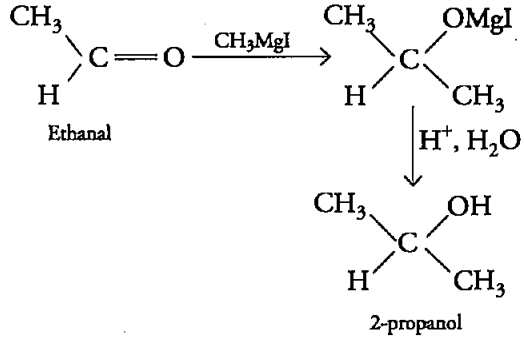
(i)

$$\underset{\text{Propene}}{CH_3CH=CH_2} + HBr \xrightarrow{\text{Peroxide}}$$

$$CH_3CH_2CH_2Br + KOH_{(aq.)} \downarrow \Delta$$

$$\underset{\text{Propan–1–ol}}{CH_3CH_2CH_2OH}$$

(ii)



23. Give the structures of products A, B and C in the following reactions : [3]

(i)

$$CH_3CH_2Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0°C]{HNO_2} C$$

(ii)

$$CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOH+Br_2} B \xrightarrow{CHCl_3+Alc.KOH} C$$

Answer :

(i)

$$CH_3CH_2Br \xrightarrow{KCN} \underset{A}{CH_3CH_2CN} \xrightarrow{LiAlH_4} \underset{B}{CH_3CH_2CH_2NH_2} \xrightarrow[0°C]{HNO_2} \underset{C}{CH_3CH_2CH_2OH}$$

(ii)

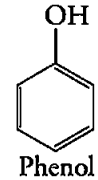
$$CH_3COOH \xrightarrow[\Delta]{NH_3} \underset{A}{CH_3CONH_2} \xrightarrow{NaOH+Br_2} \underset{B}{CH_3NH_2} \xrightarrow{CHCl_3+Alc.KOH} \underset{C}{CH_3NC}$$

27. Write the names and structures of the monomers of the following polymers : [3]

(i) Bakelite (ii) Nylon-6 (iii) Polythene

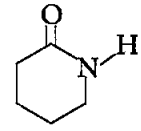
Answer :

(i)



Phenol and HCHO Formaldehyde

(ii)



Caprolactam

(iii) $CH_2=CH_2$

Ethene

Chemistry 2014 (Outside Delhi) SET I

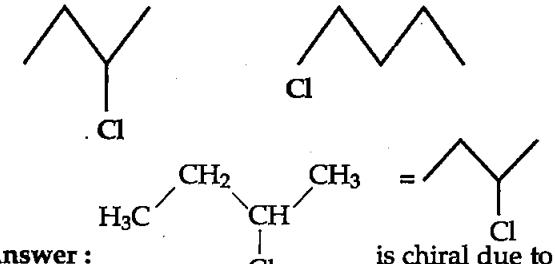
Time allowed : 3 hours **Maximum marks : 70**

1. **What is the effect of temperature on chemisorption ?** [1]
Answer : Chemisorption initially increases then decreases with rise in temperature. The initial increase is due to the high energy of activation and the decrease afterwards is due to the exothermic nature of adsorption equilibrium.

2. **What is the role of zinc metal in the extraction of silver ?** [1]
Answer : Zinc is used as a reducing agent to recover silver from its cyanide complex. It reduces Ag^+ to Ag and itself get oxidised to Zn^{2+}.

3. **What is the basicity of H_3PO_3 ?**** [1]

4. **Identify the chiral molecule in the following pair :**



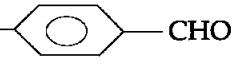
[1]

Answer : is chiral due to pairing with four different groups.

5. **Which of the following is a natural polymer ?** [1]
Buna-S, Proteins, PVC Economics type
Answer : Protein, is a natural polymer having amino acid as a monomer.

6. **The conversion of primary aromatic amines into diazonium salts is known as _____.** [1]
Answer : Diazotisation reaction.

7. **What are the products of hydrolysis of sucrose ?** [1]
Answer : The products of Hydrolysis of sucrose are : Glucose and Fructose

8. **Write the structure of *p*-methylbenzaldehyde.** [1]
Answer : 

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

9. An element with density 2.8 g cm^{-3} forms a *f.c.c.* unit cell with edge length 4×10^{-8}cm. Calculate the molar mass of the element. (Given $N_A = 6.022 \times 10^{23}$ mol^{-1})** [2]

10. (i) What type of non-stoichiometric point defect is responsible for the pink colour of LiCl ?**

(ii) What type of stoichiometric defect is shown by NaCl ?** [2]

OR

How will you distinguish between the following pairs of terms ?**

(i) Tetrahedral and octahedral voids

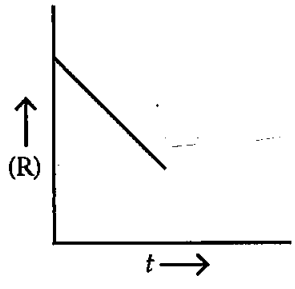
(ii) Crystal lattice and unit cell

11. State the Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decreases with dilution ? [2]

Answer : It states that the limiting molar / Conductivity of an electrolyte can be expressed as sum of individual contribution of anion and cation of the electrolyte.

With dilution, the number of ions per unit volume of electrolytes decreases and hence, conductivity decreases.

12. For a chemical reaction R→P, the variation in the concentration (R) Vs. time (*t*) plot is given as [2]



(i) Predict the order of the reaction.

(ii) What is the slope of the curve ?

Answer : (i) Zero order reaction

(ii) Slope of the curve is (–K). *i.e.*, negative slope.

13. Explain the principle of the method of electrolytic refining of metals. Give one example. [2]

Answer : In electrolytic method, the impure metal is made anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. The more basic metal remains in the solution and the less basic ones go to the anode mud.

For *e.g.* : Copper is refined using an electrolytic method, the net result of electrolysis is the transfer of copper in pure form from the anode to the cathode.

Anode : $Cu \longrightarrow Cu^{2+} + 2e^-$

Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$

14. Complete the following equations : [2]

(i) $P_4 + H_2O \longrightarrow$**

(ii) $XeF_4 + O_2F_2 \longrightarrow$

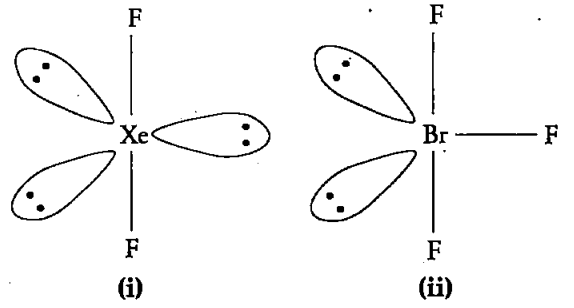
Answer :

(ii) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

15. Draw the structures of the following :

(i) XeF_2 **(ii)** BrF_3 [2]

Answer :

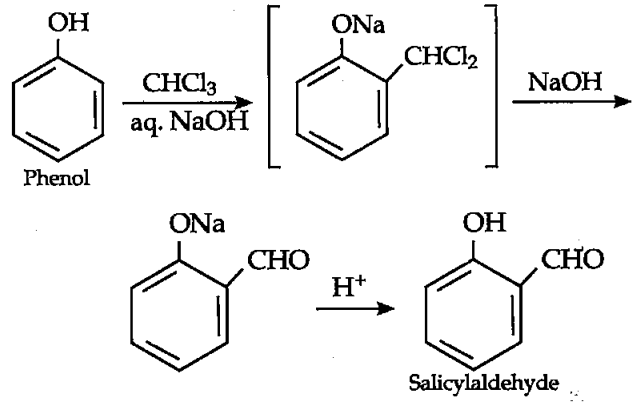


16. Write the equations involved in the following reactions : [2]

(i) Reimer-Tiemann reaction

(ii) Williamson synthesis

Answer : (i) Reimer Tiemann reaction :



(ii) Williamson synthesis :

$CH_3CH_2I + NaOCH_2CH_3 \rightarrow CH_3{-}CH_2{-}O{-}CH_2{-}CH_3$

Ethyl Iodide Sodium ethoxide Diethyl ether

17. Write the mechanism of the following reaction :

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$ [2]

Answer : S_N2 Mechanism

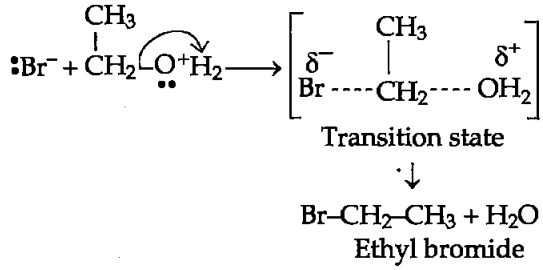
1. $H{-}Br \rightleftharpoons H^+ + :Br^-$

$CH_3{-}CH_2\ddot{O}H + H^+ \rightleftharpoons CH_3{-}CH_2\overset{+}{\ddot{O}}H_2$

Ethyl oxonium ion

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

2.



18. Write the name of monomers used for getting the following polymers : [2]

(i) Bakelite (ii) Neoprene

Answer : (i) Phenol and formaldehyde are the monomers used for the formation of Bakelite.

(ii) Chloroprene is the monomer used to prepare Neoprene.

19. (a) Calculate $\Delta_r G^0$ for the reaction

$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$

Given : $E^0_{cell} = 2.71$ V, 1 F = 96500 C mol^{-1}

(b) Name the type of cell that was used in Apollo space program for providing electrical power. [3]

Answer : (a) $Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$

$$\Delta_r G^\circ = -nFE^\circ_{cell}$$
$$= -2 \times 96500 \times 2.71$$
$$= -523.03 \text{ kJ mol}^{-1}$$

(b) Hydrogen-oxygen fuel cells and solar cells.

20. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume :

$$SO_2Cl(g) \longrightarrow SO_2(g) + Cl_2(g)$$

Experiment	Time (s^{-1})	Total pressure (atm)
1	0	0.4
2	100	0.7

Calculate the rate constant. (Given : log 4 = 0.6021, log 2 = 0.3010) [3]

Answer : $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

dt_1 $t = 0$ P_0 0

At $t = t$ $P_0 - P$ ..... P

The total pressure of the thermal decomposition of SO_2Cl_2 time t.

$$P_t = (P_0 - P) + P + P$$
$$P_t = P_0 + P$$

Hence, $P = P_t - P_0$

$$\therefore \quad P_0 - P = P_0 - (P_1 - P_0)$$
$$= 2P_0 - P_t$$

We know,

$$SO_2Cl_2 \rightarrow SO_2 + Cl_2$$

At $t = 0$ s 0.4 atm 0 atm 0 atm

At $t = 100$ s $(0.4 - x)$ atm x atm x atm

$$P_t = 0.4 - x + x + x = 0.4 + x$$
$$0.7 = 0.4 + x$$
$$x = 0.3$$

for first order reaction.

$$K = \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$$
$$= \frac{2.303}{100} \log \frac{0.4}{2 \times 0.4 - 0.7} = \frac{2.303}{100} \log \frac{0.4}{0.1}$$
$$K = \frac{2.303 \times 0.602}{100}$$
$$K = 1.386 \times 10^{-2} \text{ s}^{-1}$$

21. What are emulsions ? What are their different types ? Give one example of each type. [3]

Answer : Emulsions are colloids in which both the dispersed phase and dispersing medium are liquid. It is a mixture of two or more liquids that are normally immiscible. They are of two types :

(i) Oil in water type emulsions (O/W) : In such emulsions, oil is the dispersed phase and water is the dispersed medium.

e.g., Milk, Vanishing cream.

(ii) Water in oil type emulsions (W/O) : In such emulsions, water is the dispersed phase and oil is the dispersed medium.

e.g., Butter, Cod liver oil.

22. Given reasons for the following :

(i) $(CH_3)_3P = O$ exists but $(CH_3)_3N = O$ does not.**

(ii) Oxygen has less electron gain enthalpy with negative sign than sulphur.

(iii) H_3PO_2 is a stronger reducing agent than H_3PO_3.** [3]

(ii) Due to small size and high electronegativity of oxygen compared to sulphur, oxygen has less electron gain enthalpy.

23. (i) Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]Cl$.

(ii) What type of isomerism is exhibited by the complex $[Co(en)_3]^{3+}$?

(en = ethane-1, 2-diamine)

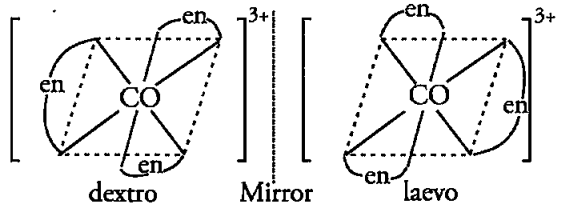
**** Answer is not given due to change in present syllabus.**

(iii) Why is $[NiCl_4]^{2-}$ paramagnetic but $[Ni(CO)_4]$ is diamagnetic [3]

(At. nos. : Cr = 24, Co = 27, Ni = 28)

Answer : (i) Tetraammine dichlorido chromium(III) chloride

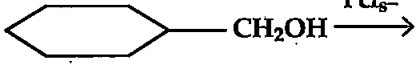
(ii) Optical isomerism is shown by the complex $[CO(en)_3]^{3+}$



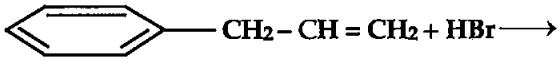
(iii) $[Ni(Cl)_4]^{2-}$, Ni is in +2 oxidation state with the electronic configuration $3d^8 4s^0$. As Cl^- is a weak ligand it cannot pair up the electrons in $3d$ orbitals therefore, $[NiCl_4]^{2-}$ is paramagnetic. In $[Ni(CO)_4]$, Ni is in 0 oxidation state with the electronic configuration $3d^8 4s^2$. Co is a strong ligand it causes $4s$ electrons to shift to $3d$ and pair up $3d$ electrons. Therefore, $Ni(CO)_4$ is diamagnetic.

24. (a) Draw the structure of major monohalo products in each of the following reactions :

(i)



(ii)

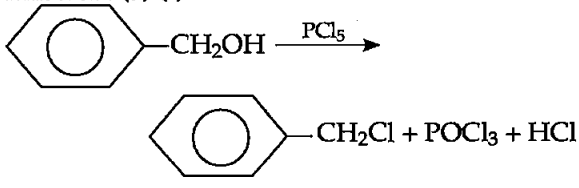


(b) Which halogen compound in each of the following pairs will react faster in S_N2 reaction :

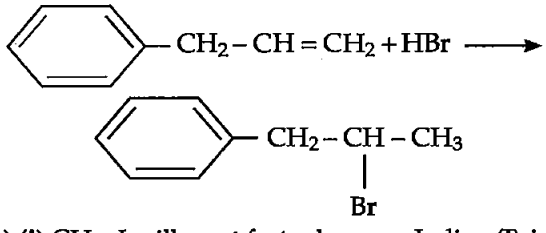
(i) CH_3Br or CH_3I

(ii) $(CH_3)_3C–Cl$ or $CH_3 – Cl$ [3]

Answer : (a) (i)



(ii)



(b) (i) $CH_3–I$ will react faster because Iodine (I)-is a better leaving group.

(ii) $CH_3–Cl$ will react faster because it is a primary halide and it undergoes S_N2 reaction faster.

25. Account for the following :

(i) Primary amines ($R-NH_2$) have higher boiling point than tertiary amines (R_3N).

(ii) Aniline does not undergo Friedel-Crafts reaction.

(iii) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution. [3]

OR

Give the structures of A, B and C in the following reactions :

(i)

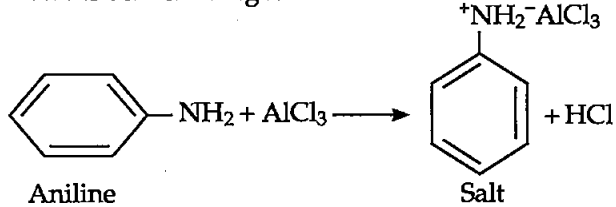
$$C_6H_5NO_2 \xrightarrow{Sn+HCl} A \xrightarrow{NaNO_2+HCl} B \xrightarrow{H_2O} C$$

(ii)

$$CH_3CN \xrightarrow{H_2OH^+} A \xrightarrow[\Delta]{NH_3} B \xrightarrow{Br_2+KOH} C$$

Answer : (i) Due to intermolecular hydrogen bonding in primary amines (presence of more number of H-atoms). They have high boiling point in comparison to tertiary amines.

(ii) Aniline does not undergo Friedel-Crafts reaction because Aniline is basic in nature and reacts with $AlCl_3$ to form a salt. The positive charge on the N-atom, electrophilic substitution in the benzene ring is deactivated.



Aniline Salt

(iii) Due to steric hindrance and solvation effect in case of $(CH_3)_3N$, it is less basic than $(CH_3)_2NH$ in aqueous solution.

OR

(i)

$$C_6H_5NO_2 \xrightarrow{Sn+HCl} \underset{\text{(A) Benzylamine}}{C_6H_5NH_2} \xrightarrow{} \underset{\text{(B) Benzene diazonium chloride}}{C_6H_5N_2^+Cl^-} \xrightarrow{H_2O} \underset{\text{(Phenol)}}{C_6H_5OH}\ \text{(C)}$$

(ii)

$$CH_3CN \xrightarrow{H_2O/H^+} \underset{\text{(A) Acetic acid}}{CH_3COOH} \xrightarrow[\Delta]{NH_3} \underset{\text{Ethanamide (B)}}{CH_3CONH_2} \xrightarrow{Br_2+KOH} \underset{\text{Methanamine}}{CH_3NH_2}\ \text{(C)}$$

26. Define the following terms related to proteins : [3]

(i) Peptide linkage

(ii) Primary structure

(iii) Denaturation

Answer : (i) Peptide linkage is the amide linkage formed by —COOH group of one α-amino acid and —NH_2 group of other α-amino acid by lose of a water molecule.

(ii) The sequence in which various amino acids are arranged in a linear structure with no intermediate bonding is called primary structure of a protein.

(iii) When a protein in its native form is subjected to a change, such as temperature, pressure etc. Due to this protein loses its biological activity and this is called denaturation of a protein *e.g.*, curdling of milk.

27. On the occasion of World Health Day.

Dr. Satpal organized a 'health camp' for the poor farmers living in a nearby village. After check-up, he was shocked to see that most of the farmers suffered from cancer due to regular exposure to pesticides and many were diabetic. They distributed free medicines to them. Dr. Satpal immediately reported the matter to the National Human Rights Commission (NHRC). On the suggestions of NHRC, the government decided to provide medical care, financial assistance, setting up of super-speciality hospitals for treatment and prevention of the deadly disease in the affected villages all over India.

(i) Write the values shown by (a) Dr. Satpal (b) NHRC ?**

(ii) What type of analgesics are chiefly used for the relief of pains of terminal cancer ?

(iii) Give an example of artificial sweetener that could have been recommended to diabetic patients. [3]

Answer :

(ii) Narcotic analgesics like morphine and heroin.

(iii) Aspartame.

28. (a) Define the following terms :

(i) Molarity **(ii) Molal elevation constant (k_b)**

(b) A solution containing 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 190 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution. [2,3]

OR

(a) What type of deviation is shown by a mixture of ethanol and acetone ? Give reason.

(b) A solution of glucose (molar mass = 180 g mol^{-1}) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution ? (Density of solution = 1.2 g mL^{-1})

Answer : (a) (i) The number of moles of a solute present in one litre of solution is known as its molarity.

(ii) The elevation in boiling point of a solution when one mole of non-volatile solute is dissolved in one kilogram of a volatile solvent is known as molal elevation constant (K_b).

$$\Delta T_b = \frac{K_b \times W_B \times 1000}{M_B \times W_A}$$

W_B = Mass of solute

M_B = Molar mass of solute

W_A = Mass of solvent.

(b) For isotonic solution,

$\pi_1 = \pi_2$

$C_1 = C_2$ (at same temp.)

or $n_1 = n_2$ (at same Vol.)

$$\therefore \frac{15}{60} = \frac{x}{180}$$

$x = 45$ g, mass of glucose per litre of solution.

OR

(a) The mixture of ethanol and acetone shows positive deviation from Raoults law. In pure ethanol hydrogen bond exist between the molecules. On adding acetone to ethanol, acetone molecules get in between the molecules of ethanol thus breaking some of the hydrogen bonds and weakening the molecular interactions this leads to an increase in vapour pressure resulting in positive deviation from Raoult's law.

(b) Mass of glucose = 10 g

Mass of solution = 100 g

Mass of water = 100–10 = 90 g

$$\text{Volume of solution} = \frac{100\text{ g}}{1.2\text{ g mL}^{-1}} = 83.33\text{ mL} = 0.083\text{ L}$$

$$\text{Molarity} = \left(\frac{10}{180}\right).\frac{1000}{83.33} = 0.67 \text{mol L}^{-1}$$

$$\text{Molality} = \frac{10}{180}.\frac{1000}{90} = 0.617 \text{ mol kg}^{-1}$$

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

29. (a) Complete the following equations :

(i) $Cr_2O_7^{2-} + 2OH^- \rightarrow$

(ii) $MnO_4^- + 4H^+ + 3e^- \rightarrow$

(b) Account for the following :

(i) Zn is not considered as a transition element.

(ii) Transition metals form a larger number of complexes.

(iii) The E value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple. **[2,3]**

OR

(i) With reference to structural variability and chemical reactivity, write the difference between lanthanoids and actionoids.

(ii) Name a member of the lanthanoid series which is well known to exhibit +4 oxidation state.

(iii) Complete the following equation :

$$MnO_4^- + 8H^+ + 5e^- \rightarrow$$

(iv) Out of Mn^{3+} and Cr^{3+}, which is more paramagnetic and why ? (atomic nos : Mn=25, Cr=24) **[5]**

Answer: (a) (i) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

(ii) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

(b) (i) Zinc has $3d^{10}4s^2$ configuration with no unpaired *d*-orbital electron and hence it is not considered as a transition element.

(ii) Transition metals have vacant orbitals to accommodate lone pairs of electrons for bond formation and have high charge density, therefore, they form complexes.

(iii) Due to high stability of Mn^{2+} (due to its half-filled 3d sub shell) than Mn^{3+} while Cr^{+3} is more stable than Cr^{+2}.

OR

(i)

	Actinoids	Lanthanoids
1.	Actinoids have stronger tendency to form complexes.	Lathanoids form less complexes.
2.	They show more number of oxidation states.	They show less number of oxidation states.
3.	They are radioactive.	Lanthanoids except promethium are not radioactive.

(ii) Cerium (Ce) is lanthanoid element, which is well known to exhibit +4 oxidation state.

(iii) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

(iv) Mn^{3+} is more paramagnetic as it has four unpaired electrons while Cr^{3+} has only three.

$Mn^{+3} = [Ar]\ 4s^0 3d^4$

$Cr^{+3} = [Ar]\ 4s^0 3d^3$

30. (a) Write the products formed when CH_3CHO reacts with the following reagents :

(i) HCN (ii) H_2N-OH

(iii) CH_3CHO in the presence of dilute NaOH

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

(i) Benzoic acid and Phenol

(ii) Propanal and Propanone. **[3,2]**

OR

(a) Account for the following: **(2, 2, 1)**

(i) Cl^-CH_2COOH is a stronger acid than CH_3COOH.

(ii) Carboxylic acids do not give reactions of carbonyl group.

(b) Write the chemical equations to illustrate the following name reactions :

(i) Rosenmund reduction

(ii) Cannizzaro's reaction

(c) Out of $CH_3CH_2-CO-CH_3$ and $CH_3CH_2-CH_2-CO-CH_3$, which gives iodoform test ?

Answer : (a) (i) On reaction of acetaldehyele with hydrogen cyanide it gives 2-Hydroxypropanenitrile as product.

$$\underset{\text{Acetaldehyde}}{CH_3-CHO} + \underset{\text{Hydrogen cyanide}}{HCN} \longrightarrow \underset{\text{2-Hydroxypropanenitrile.}}{H_3C-\overset{\overset{H}{|}}{\underset{\underset{CN}{|}}{C}}-OH}$$

(ii) On reaction of acetaldehyde with Hydroxylamine (NH_2-OH) it gives acetaldoxime.

$$\underset{\text{Acetaldehyde}}{CH_3-CHO} + \underset{\text{Hydroxylamine}}{NH_2-OH} \longrightarrow \underset{\text{Acetaldoxime}}{CH_3-CH=NOH} + H_2O$$

(iii) When 2 molecules of acetaldehyde reacts with each other in presence of dil NaOH, 3-Hydroxybutanal is obtained. This is a aldol reaction and further proceeds the reaction when heated.

$$\underset{\text{Acetaldehyde}}{CH_3-CHO} + \underset{\text{Acetaldehyde}}{CH_3-CHO} \overset{\text{dil.NaOH}}{\rightleftharpoons} \underset{\text{3-Hydroxybutanal (aldol reaction)}}{CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CHO}$$

(b) (i) Phenol reacts with $FeCl_3$ to give violet coloured precipitate while benzoic acid give buff coloured precipitate.

$3C_6H_5OH + FeCl_3 \longrightarrow (C_6H_5O)_3Fe + 3HCl$
Phenol — Violet Colour

$3C_6H_5COOH + FeCl_3 \longrightarrow (C_6H_5COO)_3Fe + 3HCl$
Benzoic-acid — Buff colour

(ii) Propanone gives iodoform test but propanal does not.

$CH_3-\underset{\underset{O}{\|}}{CH}-CH_3 \xrightarrow{I_2+NaOH} CHI_3$ (Iodoform)

$CH_3-CH_2-CHO \xrightarrow{I_2+NaOH}$ No reaction

OR

(a) (i) Because of –I effect of Cl atom in $ClCH_2COOH$ and +I effect of CH_3 group in CH_3COOH the electron density in the O–H bond in $ClCH_2COOH$ is much lower than CH_3COOH. Hence $ClCH_2COOH$ acid is stronger acid than CH_3COOH.

(ii) In carboxylic acids, the carboxyl group is not free as it is involved in resonance

(b) (i) $CH_3COCl \xrightarrow[Pd-BaSO_4]{H_2} CH_3CHO + HCl$
Acetyl chloride — Acetaldehyde

(ii) $2HCHO \xrightarrow{NaOH} CH_3OH + HCOONa$
Formaldehyde — Methyl alcolol

(c) $CH_3CH_2CH_2COCH_3$, being a methyl ketone gives iodo form test.

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Chemistry 2014 (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 set.

1. Why is adsorption always exothermic ? [1]
Answer : Adsorption being a surface phenomenon leads to decrease in surface energy and hence is exothermic in nature.

2. Name the method used for refining of Nickel. [1]
Answer : Mond's process is used for refining of Nickel.

3. Why does NO_2 dimerise ?** [1]

4. Based on molecular forces, what type of polymer is neoprene ? [1]
Answer : Elastomer.

5. What are the products of hydrolysis of maltose ? [1]
Answer : Two molecules of α-D-glucose

6. Write the structure of 4-chloropentan-2 one. [1]
Answer : $CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$

9. Write the name of monomers used for getting the following polymers : [2]
(i) Terelyne (ii) Nylon-6, 6
Answer : (i) Ethylene glycol and Terephthalic acid.
(ii) Adipic acid and Hexamethylene diamine.

10. Describe the role of the following : [2]
(i) SiO_2 in the extraction of copper from copper matte.
(ii) NaCN in froth floatation process.

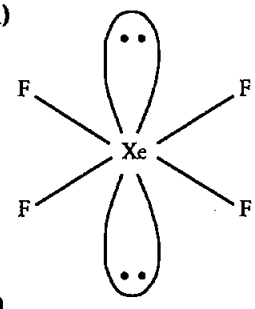
Answer : (i) SiO_2 (Silica) acts as a flux in the extraction of copper from copper matte to remove ferrous oxide as ferrous silicate slag.

$FeO + SiO_2 \rightarrow FeSiO_3$ (Slag)

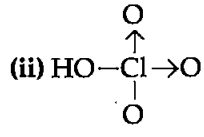
(ii) NaCN is used as a depressant as it forms zinc complex, $Na_2[Zn(CN)_4]$ on the surface of ZnS thereby preventing it from forming froth.

11. Complete the following equations : [2]
(i) $Ag + PCl_5$·**
(ii) $CaF_2 + H_2SO_4$·
Answer :
(ii) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

12. Draw the structures of the following : [2]
(i) XeF_4
(ii) $HClO_4$
Answer : (i)



(ii)



13. (i) Write the type of magnetism observed when the magnetic moment are oppositely aligned and cancel out each other.**
(ii) Which stoichiometric defect does not change the density of the crystal ?** [2]

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

14. Define the following terms : [2]

(i) Fuel cell

(ii) Limiting molar conductivity ($\Lambda°m$)

Answer : (i) Fuel cell is a device that converts chemical energy from combustion of a fuel into electric energy through a chemical reaction.

(ii) Molar conductivity of electrolyte at infinite dilution or when concentration approaches zero is called limiting molar conductivity. It is expressed as $\Lambda°m$

19. Define the following terms : [3]

(i) Glycosidic linkage

(ii) Invert sugar

(iii) Oligo saccharides

Answer : (i) The linkage between two monosaccharide units through oxygen atom is known as glycosidic linkage.

(ii) Sucrose is called invert sugar as it produces equimolar quantities of glucose and fructose on hydrolysis it gives an equimolar mixture of D – (+)-glucose, and D – (–)–fructose, which is laevo rotatory. This change of specific rotation from dextrorotation to laevo-rotation is called inversion of sugar and the mixture so obtained is called invert sugar.

(iii) Carbohydrate which on hydrolysis give two to ten molecules of monosaccharides are called oligosaccharide *e.g.* sucrose.

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Chemistry 2014 (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. What are the dispersed phase and dispersion medium in milk ? [1]

Answer : Dispersed phase is oil or fat and dispersion medium is water.

2. Name the method used for refining of copper metal. [1]

Answer : Electrolytic refining.

3. Why does NH_3 act as a Lewis base ? [1]

Answer : Due to the presence of lone pair on nitrogen in NH_3, It can donate its lone pair of electrons and it forms coordinate bonds with Lewis acids and acts as Lewis base.

5. Which of the following is a fibre ? [1]

Nylon, Neoprene, PVC

Answer : Nylon

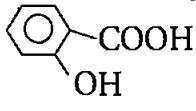
6. Write the products of hydrolysis of lactose. [1]

Answer :

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{D-(+) Glucose}}{C_6H_{12}O_6} + \underset{\text{D-(+) Galactose}}{C_6H_{12}O_6}$$

8. Write the structure of 2-hydroxybenzoic acid. [1]

Answer :



9. Complete the following equations : [2]

(i) $Cu + 2H_2SO_4$ (Conc.) $\rightarrow$

(ii) $XeF_2 + H_2O \rightarrow$

Answer :

(i) $Cu + \text{conc. } 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$

(ii) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

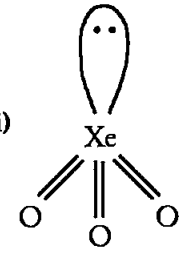
10. Draw the structure of the following : [2]

(i) XeO_3

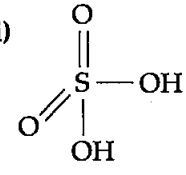
(ii) H_2SO_4

Answer :

(i)



(ii)



11. Write the name of monomers used for getting the following polymers : [2]

(i) Teflon (ii) Buna-N

Answer : (i) Tetrafluoroethene

(ii) 1,3-Butadiene and Acrylonitrile

13. (i) Write the type of magnetism observed when the magnetic moment are aligned in parallel and anti-parallel directions in unequal numbers.** [2]

(ii) Which stoichiometric defect decreases the density of the crystal ?**

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

14. Define the following terms :

(i) Molar conductivity (Λm)

(ii) Secondary batteries [2]

Answer : (i) Molar conductivity is defined as the conducting power of all the ions produce by dissolving one mole of an electrolyte in solution.

$$\Lambda_m = \frac{K}{C}$$

(ii) Secondary batteries are those batteries which can be recharged by passing electric current through them and hence can be used over again *e.g.* Lead storage battery.

17. Write the principle behind the froth floatation process. What is the role of collectors in this process ? [2]

Answer : Froth floatation method has been in use for removing gangue from sulphide ores. In this process, a suspension of the powdered ore is made with water. Collectors (*e.g.* pine oils, fatty acids, etc.) enhance non-wettability of the mineral particles and used to skim the froth off the surface.

23. Define the following terms : [3]

(i) Nucleotide

(ii) Anomers

(iii) Essential amino acids

Answer : (i) A Nucleotide contain all the three basic components of nucleic acid *i.e.*, pentose sugar, a nitrogeneous base and a phosphoric acid. When nucleoside is linked to phosphoric acid at 5' position of sugar moiety, we get a nucleotide.

(ii) The carbohydrate which differ in configuration at the glycosidic carbon (*i.e.*, C_1 in aldoses and C_2 in ketoses) are called anomers. *e.g.* α-D-(+) glucose and β-D-(+) glucose.

(iii) Essential amino acids are those amino acids which cannot be synthesised by the body and need to be consumed through diet. *eg.* Valine.

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Chemistry 2014 (Delhi) SET I

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

1. Give one example each of 'oil in water' and 'water in oil' emulsion. [1]

Answer : Oil in water – Milk

Water in oil – Butter

2. Which reducing agent is employed to get copper from the leached low grade copper ore ? [1]

Answer : Scrap iron is used as reducing agent to obtain copper metal from the solution containing copper.

$$Cu^{2+}(aq) + Fe(s) \rightarrow Cu(s) + Fe^{2+}(aq)$$

3. Which of the following is more stable complex and why ? $[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$ [1]

Answer : NH_3 is a unidentate ligand and $H_2NCH_2CH_2NH_2$(en) is a bidentate ligand. Chelating ligands form more stable complexes compared to non-chelating ligands. Thus, $[Co(en)_3]^{3+}$ is more stable.

4. Write the IUPAC name of the compound. [1]

$$CH_3–\underset{\displaystyle OH}{\underset{|}{CH}}–CH_2–COOH$$

Answer : 3-hydroxybutan-1-oic acid

5. Which of the following isomers is more volatile: *o*-nitrophenol or *ph*-nitrophenol ? [1]

Answer : *o*-nitrophenol is more volatile because of the presence of intra-molecular hydrogen bonding.

6. What are isotonic solutions ? [1]

Answer : Two or more solutions having same osmotic pressure are called isotonic solutions. *e.g.* 0.5 M NaCl, 0.5 M KCl and 1M glucose are isotonic.

7. Arrange the following compounds in increasing order of solubility in water : [1]

$$C_6H_5NH_2,\ (C_2H_5)_2NH,\ C_2H_5NH_2$$

Answer : $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

8. Which of the two components of starch is water soluble ? [1]

Answer : Amylose is the water soluble content of starch between Amylose and Amylopectin.

9. An element with density 11.2 gm cm^{-3} forms f.c.c. lattice with edge length 4×10^{-8}cm. Calculate the atomic mass of the element. (Given $N_A = 6.022 \times 10^{23} mol^{-1}$)** [2]

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

10. Examine the given defective crystal** [2]

A^+	B^-	A^+	B^-	A^+
B^-	O	B^-	A^+	B^-
A^+	B^-	A^+	O	A^+
B^-	A^+	B^-	A^+	B^-

Answer the following questions :

(i) What type of stoichiometric defect is shown by crystal ?

(ii) How is the density of the crystal affected by this defect ?

(iii) What type of ionic substances show such defect ?

11. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}). [2]

Answer : Given, $M_B = 256\ g\ mol^{-1}$, $W_A = 75\ g$

$K_f = 5.12\ kg\ mol^{-1}$, $\Delta T_f = 0.48K$

From the formula,

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

$$\text{Mass of solute, } W_B = \frac{\Delta T_f \times M_B \times W_A}{K_f \times 1000}$$

$$= \frac{0.48 \times 256 \times 75}{5.12 \times 1000}$$

$$= \frac{(0.48K)(256\ g\,mol^{-1})(0.075\ kg)}{(5.12\ K\,kg\,mol^{-1})}$$

$$= 1.8\ g$$

12. Define an ideal solution and write one of its characteristics. [2]

Answer : A solution which obeys Raoult's law at all temperatures and concentrations is called an ideal solution.

For an ideal solution,

$$P = P_A + P_B$$

$$P_A = P_A^0 \times A$$

$$P_B = P_B^0 \times B$$

$$\therefore \quad P = P_A^0 \times A + P_B^0 \times B$$

Where, P = Total pressure and P_A, P_B, P^0_A, P^0_B and X_A, X_B are partial pressure, pressure of pure component and mole fraction of component A and B respectively.

Characteristics : In ideal solution, no volume or enthalpy change takes place while mixing to form such a solution, *i.e.*, $\Delta H_{mix} = 0$ and $\Delta V_{mix} = 0$.

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

13. Write two differences between 'order of reaction' and 'molecularity of reaction'. [2]

Answer :

	Molecularity	Order of Reaction
1.	It is the number of reacting species taking part in an elementary reaction.	It is equal to the sum of all the exponents of all the reactants present in the rate law expression.
2.	It is a theoretical concept and cannot be zero or fractional.	It is determined experimentally and can be equal to zero or can have fractional value.

14. Outline the principles behind the refining of metals by the following methods : [2]

(i) Zone refining method

(ii) Chromatographic method

Answer : (i) Zone refining Method : This method is employed when impurities are more soluble in the melt than in solid form of the metal. It is used to obtain metals such as Germanium (Ge), Silicon (Si), Gallium (Ga), etc in their purest form.

(ii) Chromatographic Method : This method is used when the impurities are not very different in chemical properties from the element to be purified. The components of the mixture show different mobility on the stationary phase, *i.e.*, the components are adsorbed differently on the adsorbent.

15. Complete the following chemical equations : [2]

(i) $Ca_3P_2 + H_2O \rightarrow$

(ii) $Cu + H_2SO_4$ (conc.) $\rightarrow$

OR

Arrange the following in order of property indicated against each set :

(i) HF, HCl, HBr, HI : increasing bond dissociation enthalpy

(ii) H_2O, H_2S, H_2Se, H_2Te, : increasing acidic character.

Answer :

(i) $Ca_3P_2 + 6H_2O \rightarrow \underset{\text{Calcium hydroxide}}{3Ca(OH)_2} + \underset{\text{Phosphine}}{2PH_3}$

(ii)

$$Cu + 2H_2SO_4\ (conc.) \rightarrow \underset{\text{Copper (II) Suphate}}{CuSO_4} + \underset{\text{Suphur dioxide}}{SO_2} + 2H_2O$$

OR

(i)

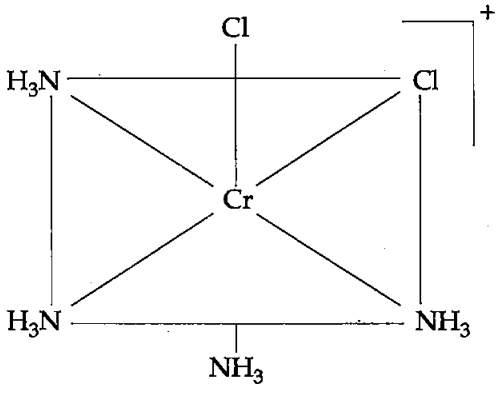
$$HI < HBr < HCl < HF$$

Increasing order of Bond Dissociation Energy.

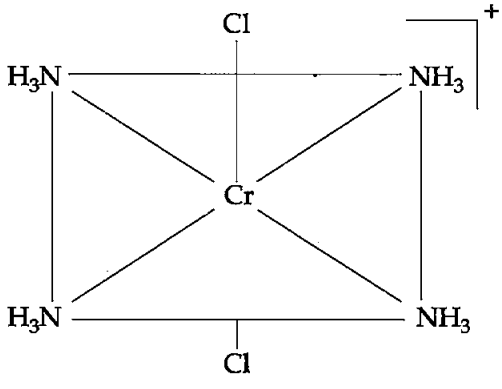
(ii) $H_2O < H_2S < H_2Se < H_2Te$ (Increasing acidic character)

16. Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]^+$. What type of isomerism does it exhibit ? **[2]**

Answer : Tetraamminedichloridochromium(III) ion. The complex exhibits geometric (cis-trans) isomerism.

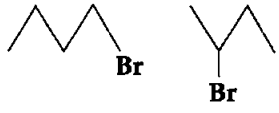


Cis-isomer



trans-isomer

17. (i) Which alkyl halide from the following pair is chiral and undergoes faster S_N2 reaction ? **[2]**



(a) **(b)**

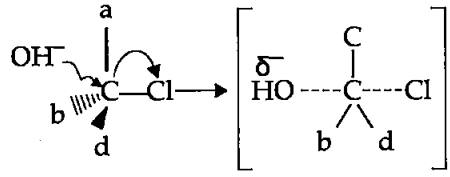
(ii) Out of S_N1 and S_N2, which reaction occurs with

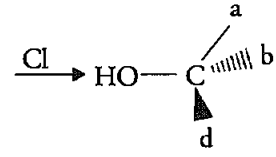
(a) Inversion of configuration

(b) Racemisation

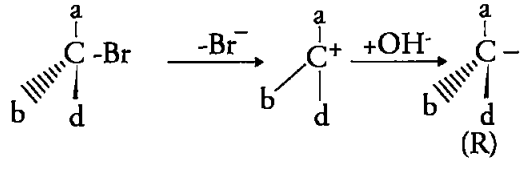
Answer : (i) Compound **(b)**, *i.e.*, $CH_3CHBrCH_2CH_3$ possesses chiral centre and undergoes faster S_N2 reaction.

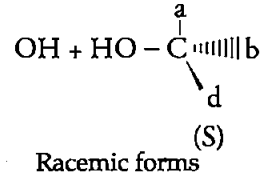
(ii) (a) Inversion of configuration results in S_N2 reaction as there is formation of intermediate transition state in which there is simultaneous attack and migration of leaving group.





(b) Racemisation in S_N1 reaction is due to attack of nucleophile on both sides of the planar carbocation.

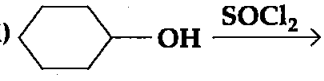




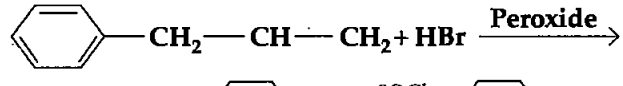
Racemic forms (Optically inactive mixture)

18. Draw the structure of major monohalo product in each of the following reactions : **[2]**

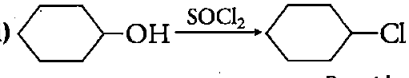
(i)



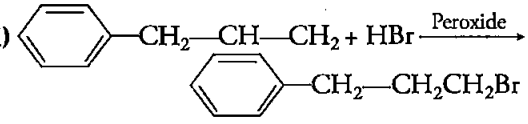
(ii)



Answer : (i)



(ii)



19. (a) In reference to Freundlich adsorption isotherm, write the expression for adsorption of gases on solids in the form of an equation. **[3]**

(b) Write an important characteristic of lyophilic sols.

(c) Based on type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid.

Answer : (a) Expression for Freundlich adsorption isotherm-

$\frac{x}{m} = kp\frac{1}{n}$ (where $n > 1$) *Or*

$\log (x/m) = \log k + \frac{1}{n} \log p$

Where, x = mass of the gas adsorbed (adsorbate)

m = mass of the adsorbent (solid)

p = pressure of the gas

n and k are constants, which depend on the nature of the adsorbate and adsorbent.

(b) Lyophilic sols are stable and reversible in nature

(c) Associated colloid : Soap solution or detergent solution.

Multimolecular colloid: Sulphur sol or Gold sol.

20. (a) Draw the structures of the following molecules : [3]

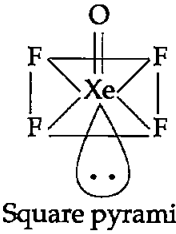
(i) $XeOF_4$

(ii) H_2SO_4

(b) Write the structural difference between white phosphorus and red phosphorus**

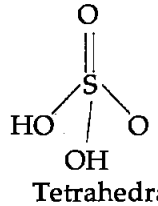
Answer : (a)

(i)



Square pyramidal

(ii)



Tetrahedral

21. Account for the following : [3]

(i) PCl_5 is more covalent than PCl_3.**

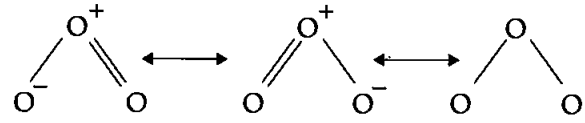
(ii) Iron on reaction with HCl forms $FeCl_2$ and not $FeCl_3$.

(iii) The two O-O bond lengths in the ozone molecule are equal.

Answer : (ii) As HCl is a mild oxidising agent and thus the hydrogen gas produced in the reaction prevents further oxidation of Fe^{2+} to Fe^{3+}.

$$Fe + 2HCl \rightarrow FeCl_2 + H_2.$$

(iii) An ozone molecule is a resonance hybrid of the molecule in which there is single bond with one terminal oxygen and double bond with other terminal oxygen of the central oxygen atom.



So, neither single or double bond is pure. Thus both O – O bond lengths are equal.

22. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume : [3]

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$

Experiment	Time/s^{-1}	Total pressure/ atm
1	0	0.4
2	100	0.7

Calculate the rate constant.

(Given : log 4 = 0.6021, log 2 = 0.3010)

Answer : $SO_2Cl_2 \rightarrow SO_2 + Cl_2$

At $t = 0$ 0.4 0 0

At $t = 100$ $0.4 - x$ x x

$$P_t = 0.4 - x + x + x$$

$$0.7 = 0.4 + x$$

$$x = 0.3$$

$$K = \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$$

$$= \frac{2.303}{100} \log \frac{0.4}{2 \times 0.4 - 0.7}$$

$$= \frac{2.303}{1000} \log \frac{0.4}{0.1}$$

$$K = \frac{2.303 \times 0.602}{100}$$

$$= 1.38 \times 10^{-2} s^{-1}$$

23. (i) Give two examples of macromolecules that are chosen as drug targets. [3]

(ii) What are antiseptics ? Give an example.

(iii) Why is use of aspartame limited to cold foods and soft drinks ?

Answer : (i) Proteins, enzymes, nucleic acids and lipids are called drug targets as drug interacts with these macromolecules.

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

(ii) Antiseptics are the chemical substances which prevent the growth of micro-organism and are capable of killing them without harming the human tissues. These are applied on wounds, ulcer, cuts and diseased skin surfaces, *e.g.* savlon, 0.2% solution of phenol, dettol, iodine tincture etc.

(iii) Aspartame decomposes on heating hence it is used as an artificial sweetner for foods and soft drinks at low temperatures.

24. (i) Deficiency of which vitamin causes night-blindness ?

(ii) Name the base that is found in nucleotide of RNA only.

(iii) Glucose on reaction with HI gives n-hexane. What does it suggest about the structure of glucose ? [3]

Answer : (i) Vitamin A.

(ii) Uracil

(iii) Glucose exists in acyclic straight six membered carbon chain ⇒ open structure of Glucose.

$$CHO - (CHOH)_4 - CH_2OH$$

25. After the ban on plastic bags, students of a school decided to make the people aware of the harmful effects of plastic bags on the environment and Yamuna River. To make the awareness more impactful, they organized rally by joining hands with other schools and distributed paper bags to vegetable vendors, shopkeepers and departmental stores. All the students pledged not to use polythene bags in the future to save the Yamuna River. [3]

After reading the above passage, answer the following questions :

(i) What values are shown by the students ?**

(ii) What are bio-degradable polymers ? Give one example.

(iii) Is polythene a condensation or the addition polymer ?

Answer :

(ii) Polymers that are decomposed over a period of time either by itself or by the action of micro-organisms are called biodegradable polymers. PHBV (Poly β-hydroxy butrate Co-β-hydroxy valerate)

(iii) Polythene is an addition polymer.

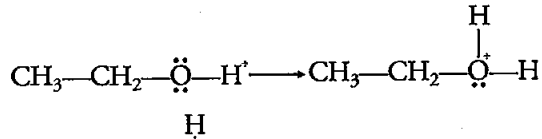
26. (a) Write the mechanism of the following reaction : [3]

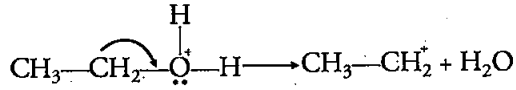
$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

(b) Write the equation involved in Reimer-Tiemann reaction.

Answer : (a) Mechanism of the reaction

$$HBr \longrightarrow H^+ + Br^-$$

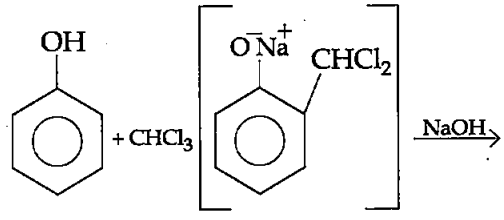


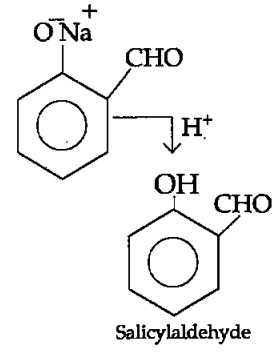


$$CH_3-\overset{+}{C}H_2 \xrightarrow{Br^-} CH_3-CH_2-Br$$

This is an S_N2 reaction mechanism.

(b)





Reimer-Tiemann reaction

27. Give the structures of A, B and C in the following reactions : [3]

(i) $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273\ K]{HNO_2} C$

(ii)

$$CH_3COOH \xrightarrow{NH_3} A \xrightarrow{Br_2+KOH} B \xrightarrow{CHCl_3+NaOH} C$$

OR

How will you convert the following ?

(i) Nitrobezene into aniline.

(ii) Ethanoic acid into methanamine.

(iii) Aniline into N-phenylethanamide.

(Write the chemical equations involved.)

Answer :

(i) $CH_3Br \xrightarrow{KCN} \underset{(A)}{CH_3CN} \xrightarrow{LiAlH_4} \underset{(B)}{CH_3CH_2NH_2}$

Ethanenitrile — Ethaneamine

$\xrightarrow[273K]{HNO_2} \underset{(C)}{C_2H_5OH} + N_2 + HCl$

Ethanol

(ii)

$CH_3COOH \xrightarrow{NH_3} \underset{(A)}{CH_3CONH_2} \xrightarrow[\text{Hoffman's Bromide reaction}]{Br + KOH}$

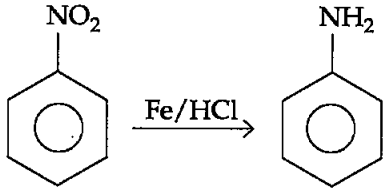
Ethanamide

$CH_3NH_2 \xrightarrow[\text{Carbylamine reaction}]{CHCl_3 + NaOH} \underset{(C)}{CH_3NC}$

(B) Methanamine — (C) Methyl isonitrite (Methyl Carbylamine)

OR

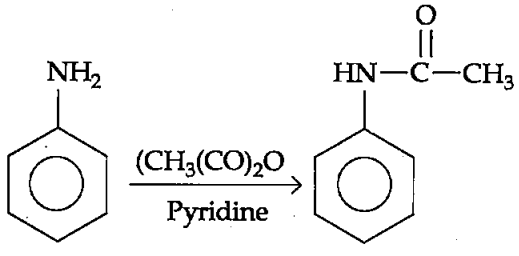
(i) Nitrobenzene to Aniline



(ii) Ethanoic acid into methanamine

$CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow[NaOH]{Br_2} CH_3NH_2$

(iii) Aniline into N-Phenylethanamide



28. (a) Define the following terms : [2,3]

(i) Limiting molar conductivity

(ii) Fuel cell

(b) Resistance of a conductivity cell filled with 0.1 mol L^1 KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is 1.29 × $10^{-2}\Omega^{-1}cm^{-1}$.

OR

(a) State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu.

(b) Calculate *emf* of the following cell at 298 K :

Mg(s) | Mg^{2+}(0.1M) || Cu^{2+} (0.01 M) | Cu(s)

[Given E^0_{cell} = +2.71 V, 1 F = 96500 C mol^{-1}]

[5]

Answer : (a) (i) The limiting molar conductivity is the molar conductivity of a solution when the concentration approaches zero (infinite dilution, $C \to 0$).

(ii) A fuel cell is a galvanic cell in which the heat energy of the fuel is directly converted into electrical energy.

(b) Given, $R_1 = 100\Omega$

C_1 (Concentration of KCl solution) = 0.1 mol L^{-1}

$K_1 = 1.29 \times 10^{-2}\Omega^{-1}cm^{-1}$

$R_2 = 520\Omega$

C_2 (Concentration of KCl solution) = 0.02 mol L^{-1}

Cell constant (G) = conductivity × resistance

$= 1.29 \times 10^{-2}\Omega^{-1}cm^{-1} \times 100\Omega$

$= 1.29\ cm^{-1}$

$\therefore$ Conductivity (K_2)

$$= \frac{\text{Cell constant}}{\text{Resistance}}$$

$$= \frac{1.29\,cm^{-1}}{520\Omega} = 2.48 \times 10^{-3}\Omega^{-1}cm^{-1}$$

Molar Conductivity (Λ_m)

$$= \frac{K_2 \times 1000}{C_2}$$

$$= \frac{2.48 \times 10^{-3} \times 1000\ Scm^{-1}}{0.02\ mol\ cm^{-3}}$$

$$= 1.24 \times 10^2 \text{ or } 124\ Scm^2\ mol^{-1}$$

OR

(a) The mass of substance deposited or liberated at any eletrode is proportional to the quantity of electric charge passed through an electrolysis cell.

Reduction of 1mol of Cu^{2+} to 2 moles Cu

$$\underset{1\text{ mole}}{Cu^{2+}} + 2e^- \to \underset{2\text{ moles}}{Cu}$$

One mole of electrons carry 1F charge. Since 2

moles of electrons are required for reduction of 1 mol of Cu^{2+}, So charge required is 2F.

(b) $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71 - \frac{0.059}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$= 2.71 - 0.0295 \log 10$

$= 2.71 - 0.0295$

$= 2.6805$ V

29. (a) How do you prepare : [2,3]

(i) K_2MnO_4 from MnO_2 (ii) $Na_2Cr_2O_7$ from Na_2CrO_4

(b) Account for the following :

(i) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.

(ii) The enthalpy of atomization is lowest for Zn in 3d series of the transition elements.

(iii) Actinoid elements show wide range of oxidation states.

OR

(i) Name the elements of 3*d* transition series which shows maximum number of oxidation states. Why does it show so ?

(ii) Which transition metal of 3*d* series has positive $E^\circ_{(M^{2+}/M)}$ value and why ?

(iii) Out of Cr^{3+} and Mn^{3+}, which is a stronger oxidizing agent and why ?

(iv) Name a member of the Lanthanoid series which is well known to exhibit +2 oxidation state.

(v) Complete the following equation

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow$$

Answer : (a)(i) Pyrolusite is fused with KOH in presence of atmospheric oxygen or an oxidizing agent (KNO_3 or $KClO_3$) to give potassium permanganate.

$$2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} 2K_2MnO_4 + 2H_2O$$

(ii) Acidification of yellow solution of sodium chromate with green core H_2SO_4 gives orange solution of $Na_2Cr_2O_7$.

$$\underset{\text{Yellow}}{2Na_2CrO_4} + H_2SO_4 \longrightarrow \underset{\text{Orange}}{Na_2Cr_2O_7} + NaSO_4 + H_2O$$

(b)(i) The electronic configuration of Mn^{2+} is [Ar] $3d^5$ and Fe^{2+} is [Ar] $3d^6$. As it is clear from the electronic configuration, Mn^{2+} is already in half-filled stable d^5 configuration whereas Fe^{2+} ion by losing one electron it can attain stable d^5 configuration. Thus, Mn^{2+} shows stability while Fe^{+2} can be easily oxidized to Fe^{3+} state.

(ii) Unpaired electrons account for stronger metallic bond. Zinc lacks unpaired electrons as it has electronic configuration of [Ar] $3d^{10}\ 4s^2$, thus metallic bonding is the weakest. So, Zn has the lowest enthalpy of atomization.

(iii) Due to comparable energies of 5*f*, 6*d* and 7*s* orbitals, actinoids show wide range of oxidation states.

OR

(i) Manganese shows maximum number of oxidation states in 3*d* transition series. This is because all the five *d*-orbital electrons are unpaired *i.e* [Ar] $3d^5 4s^2$. Thus, Mn shows oxidation states from +2 to +7.

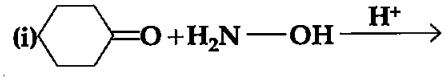
(ii) Cu has positive $E^\circ_{(Cu^{2+}/Cu)}$ value *i.e.* +0.34. This is because Cu has high value of $\Delta_a H$ and low value of Δhyd H. $\Delta_i H$ required is not compensated by the energy released. Therefore, $E^\circ(Cu^{2+}/Cu)$ is positive.

(iii) $E^\circ_{(Cr^{3+}/Cr^{2+})} = -0.4$V and $E^\circ_{(M^{3+}/Mn^{2+})} = +1.5$V The negative value of E° shows the stability of Cr^{3+} and high positive value of E° in case of manganese shows that Mn^{3+} is easily converted to Mn^{2+}. Thus, Mn^{2+} is stronger oxidizing agent than Cr^{3+}.

(iv) Europium shows +2 oxidation state owing to its half-filled electronic configuration.

(v) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

30. (a) Write the products of the following reactions : [2,3]

(i) 

(ii) $2C_6H_5CHO$ + Conc. NaOH $\longrightarrow$

(iii) $CH_3COOH \xrightarrow{Cl_2/P}$

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

(i) Benzaldehyde and Benzoic acid

(ii) Propanal and Propanone

OR

(a) Account for the following :

(i) CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.

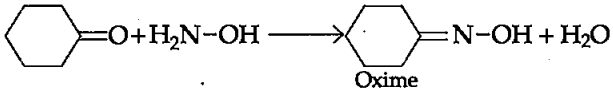
(ii) Carboxylic acid is a stronger acid than phenol.

(b) Write the chemical equations to illustrate the following name reactions :

(i) Wolff-Kishner reduction (ii) Aldol condesnation

(iii) Cannizzaro reaction

Answer : (a) (i)



(ii) $2C_6H_5CHO + NaOH\ (conc.) \rightarrow C_6H_5COONa + C_6H_5CH_2OH$

Sodium benzoate Benzylalcohol

(iii) $CH_3COOH \xrightarrow{Cl_2/red\ P} CH_2(Cl)-COOH$

α-chloroacetic acid

(b) (i) Benzoic acid reacts with $NaHCO_3$ to produce effervescence of CO_2 gas but benzaldehyde does not

$$C_6H_5COOH + NaHCO_3 \longrightarrow C_6H_5COONa + H_2O + CO_2$$

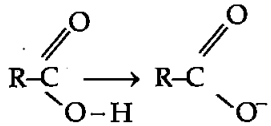
(ii) Propanone gives iodoform test but propanal does not because propanone has CH_3CO- group

$$CH_3COCH_3 + 3NaOH \xrightarrow[\Delta]{NaOH,\ I_2} CH_3COONa + CHI_3$$

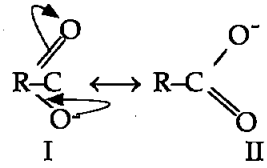
OR

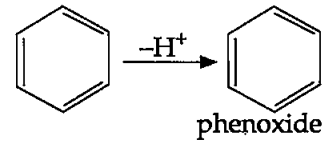
(a) (i) CH_3CHO is more reactive than CH_3COCH_3 because the reactivity of compound depends on the steric hindrance due to the groups present around the carbonyl group. More the steric hindrance, less will be the reactivity of the compound. Therefore, due to the presence of more electrophilic carbonyl carbon in CH_3CHO, it is more reactive than CH_3COCH_3.

(ii) Carboxylic acid is stronger than phenol because of resonance, stabilisation of more electronegative oxygen atom in carboxylate ion than carbon atom in phenoxide ion.

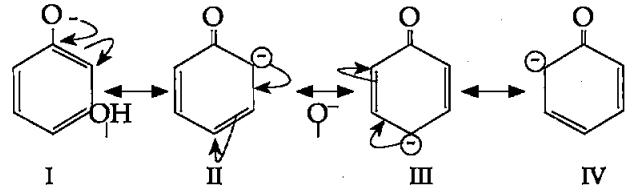


carboxylate ion





phenoxide ion



The reason for greater stability of carboxylate ion is that it involves equivalent resonance in which negative charge is present on oxygen atom all the time whereas, in phenoxide ion, out of total four resonating structures, in three structures, negative charge is present on carbon atom which makes it less stable.

(b) (i) Reduction of aldehyde or ketone to respective hydrocarbon.

$$R-\overset{O}{\overset{\|}{C}}-R' + NH_2NH_2 \xrightarrow[\Delta]{KOH} R-CH_2-R'$$

R = any alkyl group.

R' = –H or any alkyl group

(ii) Formation of β-hydroxyaldehyde or β-hydroxy ketone from aldehydes and ketones respectively.

$$2R-CH_2-\overset{O}{\overset{\|}{C}}-R' \xrightarrow{dil\ KOH} R-CH_2-\underset{R'}{\overset{OH}{\underset{|}{\overset{|}{C}}}}-CH(R)-\overset{O}{\overset{\|}{C}}-R'$$

aldehyde/ketone

β-hydroxybenzaldehyde/ ketone

(iii)

$$2H-\overset{O}{\overset{\|}{C}}-H \xrightarrow[KOH]{Conc.} H-\underset{O^-K^+}{\overset{O}{\overset{\|}{C}}}+H-\overset{OH}{\overset{\|}{C}}-H$$

$$2C_6H_5\overset{O}{\overset{\|}{C}}-H \xrightarrow[KOH]{Conc.} C_6H_5\overset{O}{\overset{\|}{C}}-O^-K^+ + C_6H_5CH_2OH$$

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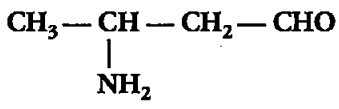
Chemistry 2014 (Delhi) SET II

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

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

1. Give one example each of sol and gel. [1]
Answer : Sol-paint, gel-butter

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



Answer : 3-aminebutan-1-al

5. Some liquids on mixing form 'azeotropes'. What are 'azeotropes' ? [1]
Answer : Azeotropes are mixtures with fixed concentrations of components such that they boil at constant temperatures. *e.g.* 95% ethanol and 5% water by mass mixture.

7. Which component of starch is a branched polymer of α-glucose and insoluble in water ? [1]
Answer : Amylopectin is a branched polymer of α-glucose and insoluble in water.

9. State Henry's law. What is the effect of temperature on the solublity of a gas in a liquid. [2]
Answer : Henry's law states that "the partial pressure of the gas in vapour phase (p) is directly proportional to the mole fraction of gas (x) in the solution."

$$p = K_H x$$

(K_H–Henry's law constant)

The solubility of a gas in liquid decreases with rise in temperature as dissolution of a gas in a liquid is an exothermic process.

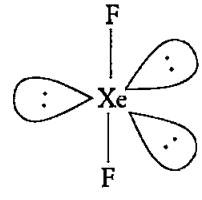
10. Define the following terms : [2]
(i) Pseudo first-order reaction
(ii) Half-life period of reaction ($t_{1/2}$).
Answer : (i) Reactions which are actually not first order but behave as first order under certain conditions like excess of one of the reactants, is a psuedo first order reaction. *e.g.* Acid hydrolysis of ethyl acetate.
(ii) The time taken for the concentration of reactants to be reduced to half of its initial concentration is called the half life of a reaction.

11. Write the principle behind the following methods of refining : [2]
(i) Hydraulic washing
(ii) Vapour-phase refining
Answer : (i) Hydraulic washing is based on the differences in densities or gravities of the ore and the gangue particles. The lighter gangue particles are washed away and the heavier ores are left behind.
(ii) In Vapour phase refining method the metal is converted into its volatile compound and is collected elsewhere. It is then thermally decomposed to get the pure metal. *e.g.* Mond's process.

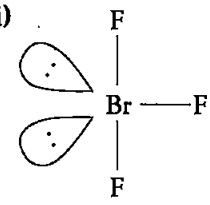
22. (a) Draw the structures of the following : [3]
(i) XeF_2 **(ii) BrF_3**
(b) Write the structural difference between white phosphorus and red phosphorus.

Answer : (a)

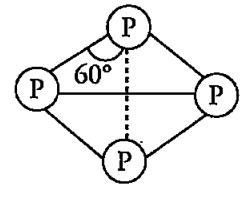
(i)



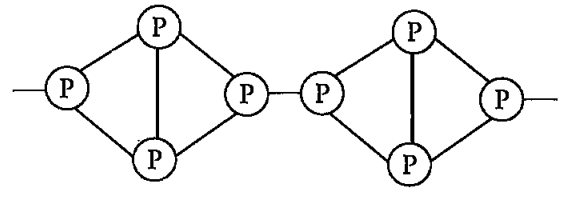
(ii)



(b) White phosphorus consist of discrete tetrahedral P_4 molecule with six P-P covalent bonds.



Red Phosphorus has polymeric structure in which P_4 tetrahedral are linked together through P-P covalent bond to form chain.



23. Account for the following : [3]

(i) Bi(V) is a stronger oxidizing agent than Sb(V).

(ii) N – N single bond is weaker than P – P single bond.**

(iii) Noble gases have very low boiling points.

Answer : (i) Due to inert pair effect +3 oxidation state of Bi is more stable than its +5 oxidation state while oxidation state of Sb is more stable than its +3 oxidation state. Therefore, Bi (V) can accept a pair of electrons to form more stable Bi (III) more easily than Sb (V).

(ii) N has small size so lone pair is more concentrated over N hence repulsion takes place and bond becomes weak but P has large size therefore, no repulsion takes place and Hence, bond becomes strong.

(iii) Noble gas are monoatomic with weak Vander Waals forces of attraction, Hence, noble gases have very low boiling point.

24. (i) Name the sweetening agents used in the preparation of sweets for a diabetic patient. [3]

(ii) What are antibioties ? Give an example.

(iii) Give two example of macromolecules that are chosen as drug targets.

Answer : (i) Sucralose.

(iii) Carbohydrate, lipid, proteins, enzymes, nucleic acid.

27. (i) Deficiency of which vitamin causes rickets ? [3]

(ii) Give an example for each of fibrous protein and globular protein.

(iii) Write the product formed on reaction of D-Glucose with Br_2 water.

Answer : (i) Vitamin D.

(ii) Fibrous protein : Keratin or myosin

Globular protein : Insulin or albumin.

(iii) Gluconic acid *i.e.*

$HOOC(CH_2OH)_4.CH_2OH$.

●●

Chemistry 2014 (Delhi) SET III

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

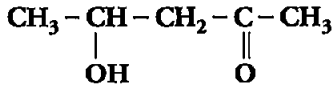
Note : Except for the following questions, all the remaining questions have been asked in previous sets.

1. Give one example each of lyophobic sol and lyophillic sol. [1]

Answer : Lyophobic sol : Metal sol or metal sulphide.

Lyophilic sol : Gum, Starch, gelatin.

2. Write the IUPAC name of the compound. [1]



Answer : 4-Hydroxypentan-2-one.

3. What type of intermolecular attractive interaction exists in the pair of methanol and acetone ? [1]

Answer : Hydrogen bonding (intermolecular)

6. Name the products of hydrolysis of sucrose. [1]

Answer : Glucose and fructose.

9. State Raoult's law for the solution containing volatile components. What is the similarity between Raoult's law and Henry's law ? [2]

Answer : Raoult's law states that the partial pressure of the vapour of a volatile component in a solution is directly proportional to its mole fraction in the solution.

Raoult's law is a special case of Henry's law.

10. Explain the following terms : [2]

(i) Rate constant (k)

(ii) Half life period of reaction ($t_{½}$).

Answer : (i) Rate constant (k) is the rate of reaction when the concentration of reactants is unity.

(ii) Half life period ($t_{½}$) of reaction is the time in which the concentration of reactant is reduced to half of its initial concentration.

11. Write the principles of the following methods : [2]

(i) Froth floatation method **(ii) Electrolytic refining**

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

Answer : **(i)** It is based on the difference in wetting qualities of gangue and the sulphide ore particles with water and oil. Whereas the ore particles are wetted by oil, the gangue or the earthy particles are wetted by water.

(ii) In this process a slab of impure copper is used as anode and a thin sheet of pure copper as cathode. The copper sulphate is used as electrolytic solution. By passing electricity through the cell copper is dissolved from the anode and deposited on cathode. The impurities either remain in solution or collect as an insoluble gangue.

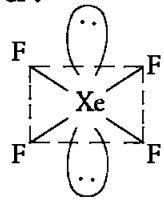
20. (a) Draw structure of the following compounds :

(i) XeF_4 **(ii) N_2O_5****

(b) Write the structural difference between white phos phorus and red phosphorus. **[3]**

Answer :

(a) (i)



22. Account for the following :

(i) Sulphur in vapour form exhibit paramagnetic behaviour.

(ii) $SnCl_4$ is more covalent than $SnCl_2$.

(iii) H_3PO_2 is stronger reducing agent than H_3PO_3. **[2]**

Answer : (i) In vapour form sulphur partly exits as S_2 molecule which have two unpaired electrons in the antibonding p molecular orbitals like O_2 molecule and hence exhibits paramagnetism.

(ii) It is due to higher oxidation state (+4) of Sn in $SnCl_4$ or because of it high polarising power which increases the covalent character of bond formation between the central atom and the atoms around it.

(iii) It is because of two P–H bonds in H_3PO_2 whereas there is only one P–H bond in H_3PO_3.

23. (i) What are disinfectants ? Give an example. **[3]**

(ii) Give two examples of macromolecules that are chosen as drug targets.

(iii) What are anionic detergents ? Give an example.

Answer : **(i)** Chemicals which are used to kill micro-organisms and applied on non-living objects like floors and drains are called disinfectants *e.g.* 1% phenol solution.

(ii) Proteins, amino acids and enzymes.

(iii) Detergents in which the anionic part of the molecule is responsible for cleansing action are called anionic detergents *eg.* Sodium laurylsulphate.

24. (i) Deficiency of which vitamin causes scurvy ?

(ii) What type of linkage is responsible for the formation of proteins ?

(iii) Write the product formed when glucose is treated with HI. **[3]**

Answer : (i) Vitamin-C

(ii) Peptide linkage

(iii) *n*-hexane : $CH_3CH_2CH_2CH_2CH_2CH_3$

●●

Chemistry 2015 (Outside Delhi) SET I

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

1. Write the formulae of any two oxoacids of sulphur. [1]

Answer : Oxoacids of sulphur are chemical compounds that contain sulphur, oxygen and hydrogen. Two oxoacids of sulphur are :

1. Peroxodisulphuric acid : $H_2S_2O_8$
2. Dithionic acid : $H_2S_2O_6$.

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

$$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - O - CH_2 - CH_3$$

Answer : Ethoxy-2-methyl propane.

3. A delta is formed at the meeting point of sea water and river water. Why ? [1]

Answer : River water is the negatively charged colloidal solution whereas sea water contains a number of electrolytes the meeting point of sea water and river water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

4. Which would undergo S_N1 reactions faster in the following pair : [1]

$CH_3 - CH_2 - CH_2 - Br$ and $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

Answer :

$$CH_3 - CH_2 - CH_2 - Br \xrightarrow{-Br^-} CH_3 - CH_2 - CH_2^+ \quad \text{..... (i)}$$

$$CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3 \xrightarrow{-Br^-} CH_3 - CH - CH_3 \quad \text{..... (ii)}$$

During S_N1 reaction carbocation **(i)** and **(ii)** are formed. Out of **(i)** and **(ii)**, **(ii)** is more stable due to +I effect of two methyl group.

Thus $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$ gives faster S_N1 reaction than

$CH_3 - CH_2 - CH_2 - Br$.

5. What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy 2/3rd of tetrahedral voids ?** [1]

6. Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids. [2]

Answer : Similarity

1. Both involve the filling of *f*-orbital (*i.e.* 4*f* and 5*f*)
2. Both show contraction *i.e.* Lanthanoide contraction and actinoide contraction.

Difference between lanthanoids and Actinoids :

	Lanthanoids	Actinoids
1.	Except Pm (promethium) all lanthanoids are non-radioactive.	Actinoids are radioactive.
2.	Lathanoids do not show wide range of oxidation state.	Actinoids shows the wide range of oxidation state.
3.	Lanthanoids ions are generally coloured.	Actinoid ions are colourless

7. (i) Write down the IUPAC name of the following complex : $[Co(NH_3)_5Cl]^{2+}$

(ii) Write the formula for the following complex: Potassium tetrachloridonickelate (II). [2]

Answer :

(i) $[Co(NH_3)_5Cl]^{2+}$: Pentaamminechlorocobalt (III) ion

(ii) Potassium tetrachloridonickelate(II) : $K_2[NiCl_4]$

8. Write the reagents required in the following reactions :

(i) $CH_2 = CH - CH_2OH \xrightarrow{?} CH_2 = CH - CHO$

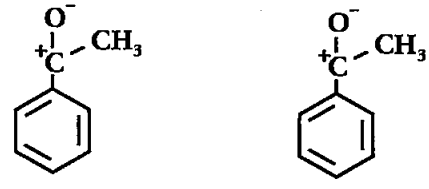
(ii) $CH_3 - COOH \xrightarrow{?} CH_3\,CONH_2$ [2]

OR

Arrange the following compounds in increasing order of their property as indicated :

(i) CH_3COCH_3, $C_6H_5COCH_3$, CH_3CHO **(reactivity towards nucleophilic addition reaction)**

(ii) $Cl - CH_2 - COOH$, $F - CH_2 - COOH$, $CH_3 - COOH$ **(acidic character).**



[2]

Answer : (i) $CH_2 = CH - CH_2OH$

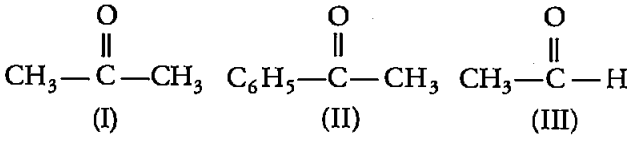
** Answer not given due to change in present syllabus

$$CH_3-CH=CH_2 \xrightarrow[\text{in isopropanol}\ (C_5H_5NHCrO_3Cl)\ \text{or}\ Cu\ \text{at}\ 573\ K]{\text{Pyridinium Chloro chromate}} CH_2=CH-CHO$$

(ii) $CH_3-COOH \xrightarrow{NH_4OH\ \text{or liq}\ NH_3/\Delta} CH_3-CO-NH_2$

OR

(i)



(I) (II) (III)

Nucleophiles are negatively charged entity, positivity of carbon in carbonyl group facilitates nucleophilic addition. Thus positivity of carbon in carbonyl group is in order III > I > II. Due to +I effect of $-CH_3$ group and benzene ring π-cloud, positivity of carbonyl carbon is decreased so much than (I) and (II). Thus nucleophilic addition order III > I > II.

(ii) $Cl-CH_2-COOH \xrightarrow{-H^+} Cl-CH_2-C(=O)-O^-$ ....(i)

$F-CH_2-COOH \xrightarrow{-H^+} F-CH_2-C(=O)-O^-$ ....(ii)

$CH_3-COOH \xrightarrow{-H^+} CH_3-C(=O)-O^-$ ....(iii)

The stability order II > I > III. Due to +I effect of $-CH_3$ group electron density of oxygen is more. But in (I) and (II), –I effect of –F is more than –Cl. Thus II is more stabilized than I. Thus acidity order is II > I > III.

9. **(i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution ? What change in temperature would you observe after mixing liquids X and Y ?**

(ii) What happens when we place the blood cell in water (hypotonic solution) ? Give reason. **[2]**

Answer : (i) Negative deviation of Raoult's law occurred. There is a elevation of boiling point *i.e.*, temperature of the solution increases.

(ii) When blood cell is placed in water (hypotonic solution), water penetrate to blood cell and blood cell gets bulged and then disrupt.

10. **Calculate the time to deposit 1.27 g of copper at cathode when a current of 2A was passed through the solution of $CuSO_4$.**

(Molar mass of Cu = 63.5 g mol^{-1}, 1 F = 96500 C mol^{-1}). **[2]**

Answer : $Cu^{2+} + 2e^- \rightarrow Cu$

63.5 g of copper deposited by 2 × 96500 C

$\therefore$ 1.27 g of copper will be deposited by

$$\frac{2\times 96500\times 1.27}{63.5}\ C = 3860\ C$$

We know $Q = It$

Here I = 2A and Q = 3860 C

$$t = \frac{Q}{I} = \frac{3860}{2} = 1930\ s.$$

11. **A solution is prepared by dissolving 10 g of non-volatile solute in 200 g of water. It has a vapour pressure of 31.84 mm Hg at 308 K. Calculate the molar mass of the solute.**

(Vapour pressure of pure water at 308 K = 32 mm Hg). **[3]**

Answer : According to Raoult's law,

$$\frac{P^\circ - P}{P^\circ} = \frac{w\times M}{m\times W}$$

Where

$P^\circ \rightarrow$ Vapour pressure of pure water

$P \rightarrow$ Vapour pressure of solution

$w \rightarrow$ Weight of solute

$m \rightarrow$ Molecular weight of solute

$W \rightarrow$ Weight of solvent

$M \rightarrow$ Molecular weight of solvent

Thus, $\frac{32-31.84}{32} = \frac{10\times 18}{m\times 200}$

or, 0.005 m = 0.9 or, m = 180

Thus molar mass of the solute 180 gm./mol

12. **(i) Name the method of refining to obtain silicon of high purity.**

(ii) What is the role of SiO_2 in the extraction of copper ?

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

Answer : (i) Zone refining is the method of refining to obtain silicon of high purity.

(ii) SiO_2 combined with the iron in the copper ore to form iron(II) silicate slag which is easily removed. Thus it (SiO_2) acts as a flux to remove the impurity of Iron oxide.

$$\underset{\text{gauge}}{FeO} + \underset{\text{flux}}{SiO_2} \longrightarrow \underset{\text{slag}}{FeSiO_3}$$

(iii) In froth flotation process, depressant prevents the formation of froth. It is used to separate two sulphide ore by preventing the formation of froth of one sulphide ore and allowing the other to form the froth *e.g.*, NaCN a depressant selectively prevents ZnS from coming in froth but allows PbS to come with the froth.

13. (i) Which one of the following is a polysaccharide :
Starch, maltose, fructose, glucose.
(ii) Write one difference between α-helix and β-pleated sheet structures of protein.
(iii) Write the name of the disease caused by the deficiency of vitamin B_{12}. **[3]**

Answer : (i) Starch is a polysaccharide.

(ii)

	α-helix	β-pleated
1.	It is rod like structure.	It is sheet like structure.
2.	It is stabilized by intra-molecular hydrogen bonding.	It is stabilized by in-termolecular hydro-gen bonding.

(iii) Pernicious Anaemia caused by the deficiency of Vitamin B_{12}.

14. (i) What type of isomerism is shown by the complex $[Cr(H_2O)_6]Cl_3$?
(ii) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o > P$.
(iii) Write the hybridization and shape of $[CoF_6]^{3-}$.
(Atomic number of Co = 27). **[3]**

Answer : (i) Hydration isomerism is shown by the complex $[Cr(H_2O)_6]Cl_3$.

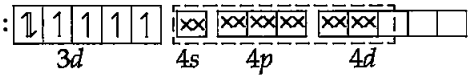
$[Cr(H_2O)_5Cl]Cl_2(H_2O)$;

$[Cr(H_2O)_3Cl_3]3(H_2O)$.

(ii) Since $\Delta_o > P$ it is on splitting $t_{2g}^4 e_g^0$

(iii) $[CoF_6]^{3-}$: sp^3d^2 hybridisation and the shape is octahedral.

$[CoF_6]^{3-}$:



$[CoF_6]^{3-}$ has four unpaired electron. Thus it is paramagnetic.

15. How can the following conversion be carried out :
(i) Aniline to bromobenzene
(ii) Chlorobenzene to 2-chloroacetophenone
(iii) Chloroethane to butane. **[3]**

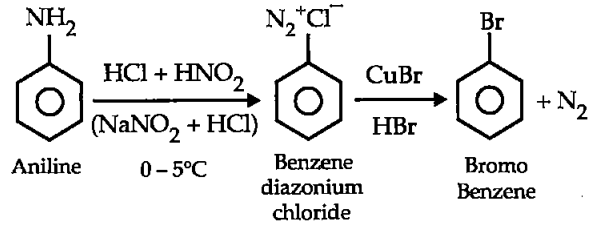
OR

What happens when
(i) Chlorobenzene is treated with $Cl_2/FeCl_3$
(ii) Ethyl chloride is treated with $AgNO_2$
(iii) 2-bromopentane is treated with alcoholic KOH ?

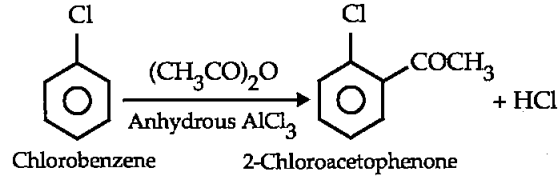
Write the chemical equations in support of your answer.

Answer :

(i)



(ii)

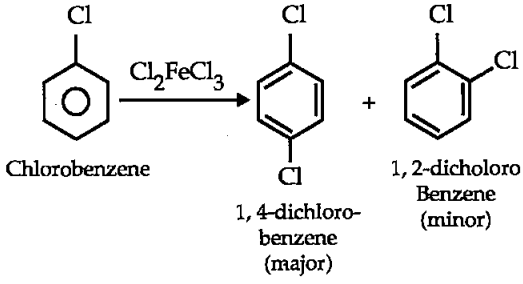


(iii)

$$\underset{\text{Chloroethane}}{2CH_3CH_2Cl} \xrightarrow[\text{Na}]{\text{dry ether}} \underset{\text{butane}}{CH_3CH_2CH_2CH_3} + 2NaCl$$

OR

(i)



(ii)

$$\underset{\text{Chloroethane}}{CH_3CH_2Cl} \xrightarrow{AgNO_2} \underset{\text{Nitroethane}}{CH_3CH_2NO_2} + AgCl$$

(iii)

$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-CH_2-CH_3 \xrightarrow{\text{Alc. KOH}}$$

$$CH_2=CH-CH_2-CH_2-CH_3.$$
pent-1-ene (minor product)

$$+$$

$$CH_3-CH_2-CH=CH-CH_3$$
pent-2-ene (major product)

16. Examine the given defective crystal :**

X^+	Y^-	X^+	Y^-	X^+
Y^-	O	Y^-	X^+	Y^-
X^+	Y^-	X^+	O	X^+
Y^-	X^+	Y^-	X^+	Y^-

Answer the following questions :

(i) Is the above defect stoichiometric or non-stoichiometric ?

(ii) Write the term used for this type of defect. Give an example of the compound which shows this type of defect.

(iii) How does this defect affect the density of the crystal ? **[3]**

17. Conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S cm^{-1}.

Calculate its molar conductivity and degree of dissociation.

Given : $\lambda_{(H^+)} = 349.5$ S cm^2 mol^{-1} and $\lambda^0_{(HCOO^-)} = 50.5$ S cm^2 mol^{-1}. **[3]**

Answer : We know molar conductivity

$$\therefore (\lambda_m) = \frac{1000 \times \text{conductivity (k)}}{\text{concentration (c)}}$$

$$\therefore \lambda_m = \frac{1000 \times 5.25 \times 10^{-5}}{2.5 \times 10^{-4}} = 210 \text{ cm}^2 \text{ Mol}^{-1}$$

$$\lambda^0 HCOOH = \lambda^0_{H^+} + \lambda^0_{(HCOO^-)} = (349.5 + 50.5) = 400 \text{ S cm}^2\text{mol}^{-1}$$

$$\therefore \alpha = \frac{\lambda_m}{\lambda_0} = \frac{210}{400} = 0.52$$

or, $\alpha = 52.5\ \%$

18. Write any three differences between Physisorption and Chemisorption. **[3]**

Answer :

	Physisorption	Chemisorption
1.	It forms multimolecular layers	It forms unimolecular layers
2.	It is reversible	It is irreversible
3.	Its does not require activation energy	It requires activation energy
4.	It is not very specific	It is very specific
5.	Force of attraction are Vander Waals forces	Force of attraction are chemical bond

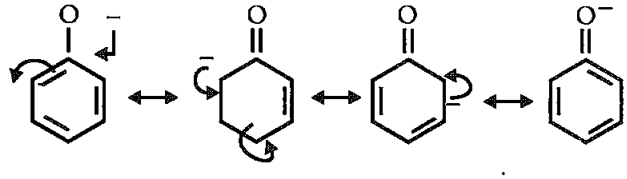
19. Give reasons for the following :

(i) Phenol is more acidic than methanol.

(ii) The C – O – H bond angle in alcohols is slightly less than the tetrahedral angle (109°28').

(iii) $(CH_3)_3C - O - CH_3$ on reaction with HI gives $(CH_3)_3C - I$ and $CH_3 - OH$ as the main products and not $(CH_3)_3C - OH$ and $CH_3 - I$. **[3]**

Answer : (i) Phenoxide ion is more stabilized than $CH_3 - O^-$ ion because of resonance :



Thus phenol is more acidic than $CH_3 - OH$.

(ii) Due to presence of lone pair on oxygen which causes repulsion, the bond angle in alcohol is slightly less than tetrahedral angle (109.28').

(iii) Since $(CH_3)_3\,C^{\oplus}$ is more stabilized through +I effect of three methyl group thus $(CH_3)_3\,C - I$ and $CH_3 - OH$ formed on treatment of HI with – $(CH_3)_3C - O - CH_3$.

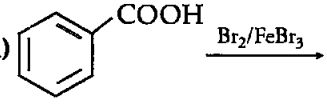
$$Me_3C - O - Me \rightarrow Me_3C^{\oplus} + Me - O^- \xrightarrow{H^+I^-}$$

$$Me_3C - I + MeOH.$$

20. Predict the products of the following reactions : **[3]**

(i) $CH_3 - \underset{\underset{CH_3}{|}}{C}(=O) \xrightarrow{H_2N-NH_2} ?$

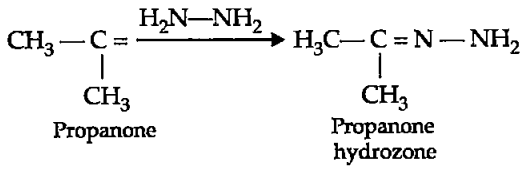
(ii) $C_6H_5 - CH_3 \xrightarrow[(b)\ H^+]{(a)\ KMnO_4/KOH} ?$

(iii) 

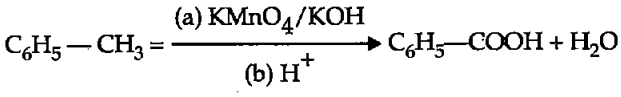
**** Answer is not given due to change in present syllabus.**

Answer :

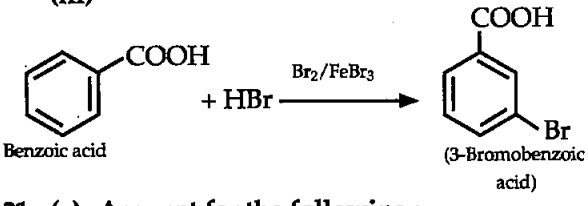
(i)



(ii)



(iii)



21. (a) Account for the following :

(i) Cu^+ is unstable in an aqueous solution.

(ii) Transition metals form complex compounds.

(b) Complete the following equation :

$$Cr_2O_7^{2-} + 8H^+ + 3NO_2^- \rightarrow$$ **[3]**

Answer :

(a) (i) $2Cu^+(aq) \rightarrow Cu^{2+}_{(aq)} + Cu(s)$

The higher stability of Cu^{2+} ion in aqueous solution is due to its greater negative charge than Cu. It compensates the second ionisation enthalpy of Cu involved in the formation of Cu^{2+} ions.

(ii) Since transition metals have unfilled or partially filled *d*-orbital thus to satisfy its octate forms complex compounds.

(b) $Cr_2^{+6}O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$3NO_2^- + H_2O \rightarrow \overset{+5}{N}O_3^- + 2H^+ + 2e^-] \times 3$

$Cr_2O_7^{2-} + 3NO_2^- + 8H^+ \rightarrow 2Cr^{3+} + 3NO_3^- + 4H_2O$

22. Write the names and structures of the monomers of the following polymers :

(i) Terylene

(ii) Buna-S

(iii) Neoprene **[3]**

Answer : (i) Terylene Monomer is Ethylene Glycol ($HO - CH_2 - CH_2 - OH$) and Terephthalic acid (HO_3C —  — $COOH$).

(ii) Buna-S Monomer is Styrene (— $CH = CH_2$) and 1,3-Butadiene ($H_2C = CH - CH = CH_2$).

(iii) Neoprene Monomer is Chloroprene

$$\left(\begin{array}{c} Cl \\ | \\ H_2C = C - CH = CH_2 \end{array} \right).$$

23. Seeing the growing cases of diabetes and depression among young children, Mr. Chopra, the principal of one reputed school organized a seminar in which he invited parents and principals. They all resolved this issue by strictly banning junk food in schools and introducing healthy snacks and drinks like soup, lassi, milk, etc. in school canteens. They also decided to make compulsory half an hour of daily physical activities for the students in the morning assembly. After six months, Mr. Chopra conducted the health survey in most of the schools and discovered a tremendous improvement in the health of the students.

After reading the above passage, answer the following questions :

(i) What are the values (at least two) displayed by Mr. Chopra ?**

(ii) As a student, how can you spread awareness about this issue ?

(iii) Why should antidepressant drugs not be taken without consulting a doctor ?

(iv) Give two examples of artificial sweeteners. **[4]**

Answer :

(ii) Awareness can be spread by performing nukkad natak in community, displaying posters, cartoons and slogans and by conducting seminars.

(iii) Antidepressant drugs have lots of side effects like indigestion, headache, stomach aches, drowsiness, weight gain. That is why it should not be taken without consulting with doctors.

(iv) Example of artificial sweeteners are Aspartame, Saccharin, Sucralose etc.

24. (a) Account for the following :

(i) Acidic character increases from HF to HI.

(ii) There is a large difference between the melting and boiling points of oxygen and sulphur.

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

(iii) Nitrogen does not form pentahalide.**

(b) Draw the structures of the following :

(i) ClF_3

(ii) XeF_4 [5]

OR

(i) Which allotrope of phosphorus is reactive and why ?**

(ii) How are the supersonic jet aeroplanes responsible for the depletion of ozone layer ?

(iii) F_2 has lower bond dissociation enthalpy than Cl_2. Why ?

(iv) Which noble gas is used in filling balloons for meteorological observations ?

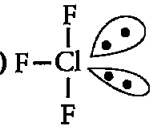
(v) Complete the following equation :

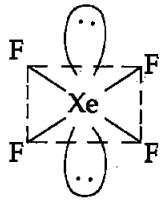
$$XeF_2 + PF_5 \rightarrow$$ [5]

Answer : (a) (i) Size of halide ions is of the order $F^- < Cl^- < Br^- < I^-$ with increase in size negative charge is dispersed throughout ions and ions gets stabilized. Thus acidity order

HF < HCl < HBr < HI.

(ii) Due to presence of vacant *d*-orbital and combining forms of sulphur (S_8) which is not present in oxygen, the cohesive energy of sulphur is more than oxygen leading to large melting point and boiling point.

(b) (i)  Shape→T-shaped

(ii)  Shape→Square planar

OR

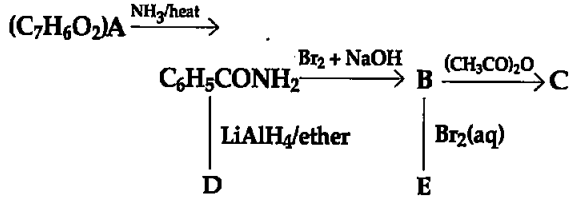
(ii) The exhaust emitted from supersonic jet aeroplane contains CO_2, NO and other particles which are the killers of stratospheric ozone layer along with the supersonic sound produced by these aeroplanes are destroy ozone layer.

(iii) Due to smaller size and high electro-negativity of fluorine, more energy is required to break the bond of F_2 than Cl_2. Thus F_2 has lower bond dissociation energy than Cl_2.

(iv) Helium (He) gas is used in filling balloons for meteorological observations because it is non-inflammable and light gas.

(v) $XeF_2 + PF_5 \rightarrow [XeF]^+ [PF_6]^-$.

25. An aromatic compound 'A' of molecular formula $C_7H_6O_2$ undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions : [5]



OR

(a) Write the structures of main products when benzene diazonium chloride reacts with the following reagents :

(i) $H_3PO_2 + H_2O$

(ii) CuCN/KCN

(iii) H_2O

(b) Arrange the following in the increasing order of their basic character in an aqueous solution :

$C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$

(c) Give a simple chemical test to distinguish between the following pair of compounds :

$C_6H_5 - NH_2$ and $C_6H_5 - NH - CH_3$ [5]

Answer :

A : C_6H_5COOH (Benzoic acid)

B : $C_6H_5NH_2$ (Aniline)

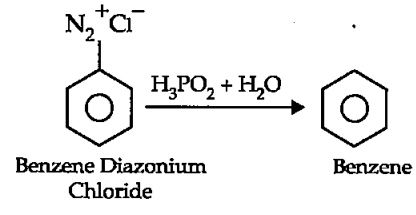
C : $C_6H_5NHCOCH_3$ (N-phenyl ethanamide)

D : $C_6H_5CH_2NH_2$ (Benzylamine)

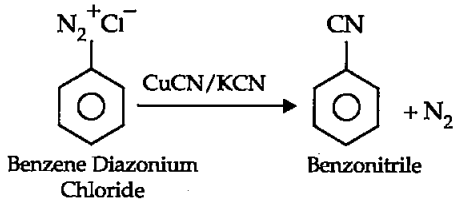
E : $C_6H_4(Br)_3(NH_2)$ (2, 4, 6-Tribromoaniline)

OR

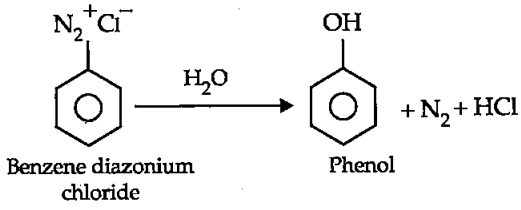
(a) (i)



(ii)



(iii)



(b) $C_2H_5NH_2 < (C_2H_5)_3N < (C_2H_5)_2NH$

+I effect of three C_2H_5 group increases the enormous availability of lone pair of nitrogen atom than +I effect of 2 ethyl group. Thus the order of basicity is I < III < II.

(c) $C_6H_5 - NH_2$ (Primary amine) and

$C_6H_5 - NH - CH_3$ (Secondary amine) can be distinguished by Hinsberg's test. In this test amines are allowed to react with Hinsberg's reagent, benzenesulphonyl chloride ($C_6H_5SO_2Cl$). Primary amines reacts with this reagent to form N-alkylbenzene sulphonyl amide which is soluble in alkali but secondary amines gives sulphonamide which is insoluble in alkali.

26. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	10	20
$[CH_3COOCH_3]$/mol L^{-1}	0.10	0.05	0.025

(a) Show that it follows pseudo first order reaction, as the concentration of water remains constant.

(b) Calculate the average rate of reaction between the time interval 10 to 20 seconds.

(Given : log 2 = 0.3010, log 4 = 0.6021). **[5]**

OR

(a) For a reaction A + B → P, the rate is given by Rate = $k[A][B]^2$

(i) How is the rate of reaction affected if the concentration of B is doubled ?

(ii) What is the overall order of reaction if A is present in large excess ?

(b) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction.

Answer : (a) $[A]_0 = 0.01$ Mol/L

$[A] = 0.05$ Mol/L at time $t = 10\ s$.

$$k = \frac{2.303}{10}\log\frac{0.10}{0.05}$$

$$k = \frac{2.303}{10}\log\frac{0.10}{0.05}$$

$$k = 0.0693\ s^{-1}$$

$$t = 20s$$

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]} = \frac{2.303}{10}\log\frac{0.10}{0.05}$$

$k = 0.0693\ s^{-1}$, Thus its pseudo first order reaction.

(b) The average rate constant is

$$\frac{-\Delta[R]}{\Delta t} = \frac{\Delta[CH_3COOCH_3]}{\Delta t}$$

$$= \frac{[0.025\text{mol L}^{-1} - 0.05\text{mol L}^{-1}]}{20s - 10s} = \frac{0.025}{10s}\ \text{mol L}^{-1}$$

$$= 0.0025\ \text{mol L}^{-1}\text{s}^{-1}$$

OR

(a) (i) Since the given reaction has order two with respect to reactant B, thus if the concentration of B is doubled in the given reaction, then the rate of reaction will become four times.

(ii) It the concentration of B is doubled *i.e.*; $[B]^2$ the overall reaction will be two, because if A is present in large excess, then the reaction will be independent of the concentration of A and will be dependent only on the concentration of B. Order of reaction = 2.

(b) $t_{1/2} = 30$ min

$$[R] = [R]_0 - 90\%\ \text{of}\ [R]_0$$

$$= [R]_0 - \frac{90[R]_0}{100}$$

$$[R] = \frac{[R]_0}{10}$$

$$K = \frac{0.693}{t_{1/2}} = \frac{0.693}{30} = 0.0231\ \text{min}^{-1}$$

$$t = \frac{2.303}{K}\log\frac{[R]_0}{[R]}$$

$$t = \frac{2.303}{0.0231}\log\frac{[R]_0}{[R]} - \frac{2.303}{0.0231}\log 10$$

$$t = 99.7\ \text{min}$$

Note :All questions are same in outside Delhi Set II and III.

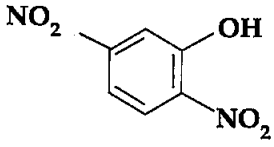
●●

Chemistry 2015 (Delhi) SET I

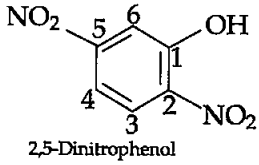
Time allowed : 3 hours **Maximum Marks : 70**

1. **What is the basicity of H_3PO_4 ?**** [1]

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

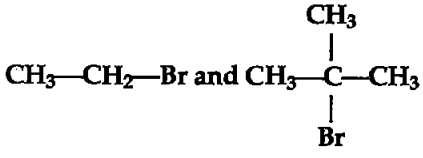


Answer :



2,5-Dinitrophenol

3. **Which would undergo S_N2 reaction faster in the following pair and why ?** [1]



Answer : Primary alkyl halides will undergo S_N^2 reactions faster than tertiary alkyl halides because of less steric hindrance experienced by the approaching nucleophile. Hence, out of the given pair, primary alkyl halide (CH_3CH_2Br) would undergo S_N^2 reaction faster.

4. **Out of $BaCl_2$ and KCl, which one is more effective in causing coagulation of a negatively charged colloidal Sol ? Give reason.** [1]

Answer : According to the Hardy-Schulze rule, greater the valency of a flocculating ion, the greater is its power to cause precipitation. Between Ba^{2+} (from $BaCl_2$) and K^+ (from KCl), Ba^{2+} has greater valency. Therefore, $BaCl_2$ will be more effective in causing the coagulation of a negatively charged colloidal sol.

5. **What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy 1/3 rd of tetrahedral voids ?**** [1]

6. **What are the transition elements ? Write two characteristics of the transition elements.** [2]

Answer : Elements which in their ground state or in any of their oxidation state have partially filled *d*-orbital are called transition elements. The name 'transition' given to the elements of *d*-block is only because of their position between *s*-block and *p*-block elements.

The two characteristics of transition elements are :

1. They show variable oxidation states.
2. They generally form coloured compounds.

7. **(i) Write down the IUPAC name of the following complex :**

$[Cr(NH_3)_2Cl_2(en)]Cl$ (en = ethylenediamine)

(ii) Write the formula for the following complex :

Pentaamminenitrito-o-Cobalt(III). [2]

Answer :

(i) Diamminedichloridoethylenediaminechromium(III) chloride.

(ii) $[Co(NH_3)_5(ONO)]^{2+}$.

8. **Name the reagents used in the following reactions :**

(i) $CH_3 - CO - CH_3 \xrightarrow{?} CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(ii) $C_6H_5 - CH_2 - CH_3 \xrightarrow{?} C_6H_5 - COO^- K^+$ [2]

Answer :

(i) Sodium borohydride ($NaBH_4$)/$LiAlH_4$/H_2, Pt

(ii) Alkaline potassium permanganate ($KMnO_4$, KOH).

9. **What is meant by positive deviations from Raoult's law ? Give an example. What is the sign of $\Delta_{mix}H$ for positive deviation ?** [2]

OR

Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law ? Give an example.

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

Answer : Positive deviation from Rauolt's law means that the observed vapour pressure is greater than expected, and it occurs when the A – B attractions are weaker than the average of the attractions in the pure component of the mixture. For example : A mixture of ethanol and acetone shows a positive deviation from Raoult's law.

In case of solutions showing positive deviations, absorption of heat takes palce; *i.e.*, $\Delta_{mix}H$ has a positive (+) sign.

OR

Azeotropes are the binary mixtures which have the same composition in liquid and vapour phases and boil at a constant temperature.

A minimum-boiling azeotrope is formed by solutions showing a large positive deviation from Raoult's law at a specific composition.

Example : $C_2H_5OH + H_2O$ (An ethanol-water mixture)

10. (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution :

$Ag^+(aq) + e^- \longrightarrow Ag(s)$; $E^\circ = +.80$ V

$H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g)$; $E^\circ = 0.00$ V

On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why ?

(b) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with decrease in concentration ? **[2]**

Answer : (a) The relationship between the standard free energy change and emf of a cell reaction is given by :

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

Thus, more positive the standard reduction potential of a reaction, the more negative is the standard free energy change associated with the process and consequentely, the higher is the feasibility of the reaction.

Since $E^\circ_{Ag^+/Ag}$ has a greater positive value than $E^\circ_{H^+/H}$, the reaction which is feasible at the cathode is given by

$$Ag^+(aq) + e^- \longrightarrow Ag(s)$$

(b) The limiting molar conductivity of an electrolyte is defined as its molar conductivity when the concentration of the electrolyte in the solution approaches zero.

The conductivity of an electrolyte solution is the conductance of ions present in a unit volume of the solution. The number of ions (responsible for carrying current) decreases when the solution is diluted or the concentration is decreased. As a result, the conductivity of an electrolyte solution decreases with the decrease in concentration.

11. 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the Van't Hoff factor and predict the nature of solute (associated or dissociated).

(Given : Molar mass of benzoic acid = 122 g mol^{-1}, K_f for benzene = 4.9 K kg mol^{-1}) **[3]**

Answer : We know that the depression in freezing point by

Given : Mass of solute (W_B) *i.e.*, C_6H_5COOH = 3.9 g

$$\text{Mass of solvent } (W_A) = 49 \text{ g} = \frac{49}{1000} \text{ kg}$$

Molar mass of $C_6H_5COOH (M_S) = 122$ g/mol

$$K_f = 4.9 \text{ K kg/mol}$$

$$\Delta T_f = 1.62 \text{ K}$$

To find : Van't Hoff factor $(i = ?)$

We know that the depression in freezing point is given by :

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

$$\Delta T_f = i \times K_f \times \frac{W_B}{M_S} \times \frac{1}{W_A(\text{kg})}$$

$$i = \frac{\Delta T_f \times M_S \times W_A(\text{kg})}{K_f \times W_B}$$

$$i = \frac{1.62 \times 122 \times 49}{4.9 \times 3.9 \times 1000}$$

Since, $i < 1$, hence solute benzoic acid (C_6H_5COOH) will under go association in benzene.

12. (i) Indicate the principle behind the method used for the refining of zinc.

(ii) What is the role of silica in the extraction of copper ?

(iii) Which form of the iron is the purest form of commercial iron ? **[3]**

Answer : (i) Zinc is a metal having low boiling point and it is refined by distillation method which is used for metals having low boiling points.

(ii) During extraction of Copper, FeS or FeO is present as impurity hence SiO_2 is added as flux to form silicate (slag) which can be removed easily as it floats over molten copper (Cu)

$$\underset{\text{impurity}}{FeS(s)} + O_2(g) \longrightarrow FeO(s) + SO_2(g)$$

$$\underset{\text{impurity}}{FeO(s)} + \underset{\text{flux}}{SiO_2(s)} \longrightarrow \underset{\text{Iron silicate (slag)}}{FeSiO_3(g)}$$

(iii) Wrought iron is purest form of commercial iron.

13. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length 4.05 × 10^{-8}cm. If its density is 2.7 g cm^{-3}, what is the nature of the cubic unit cell ?** **[3]**

14. (a) How would you account for the following :

(i) Actinoid contraction is greater than lanthanoid contraction.

(ii) Transition metals form coloured compounds.

(b) Complete the following equation :

$$2MnO_4^- + 6H^+ + 5NO_2^- \longrightarrow$$ **[3]**

Answer : (a) (i) The 5 *f*-orbitals (in case of actinoids) have a poorer shielding effect than 4 *f*-orbitals (in lanthanoids). Thus, the effective nuclear charge experienced by electrons in valence shells in case of actinoids is much more than that experienced by electrons in valence shells in case of lanthanoids. Hence, the contraction in size in actinoids is greater than that in lanthanoids.

(ii) In the presence of ligands, the *d*-orbitals of transition metal ions split up into two sets of orbitals having different energies. Thus, the transition of electrons takes place from one set to another. The energy required for these transitions is quite less and falls in the visible region of radiation. The ions of transition metals absorb the radiation of a particular wavelength and the rest is reflected, imparting colour to the solution.

(b) $2MnO_4^- + 6H^+ + 5NO_2^- \longrightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$

15. (i) Draw the geometrical isomers of complex $[Pt(NH_3)_2Cl_2]$.

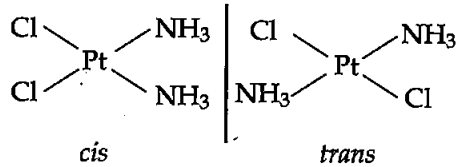
(ii) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_0 < P$.

(iii) Write the hybridization and magnetic behaviour of the complex $[Ni(CO)_4]$.

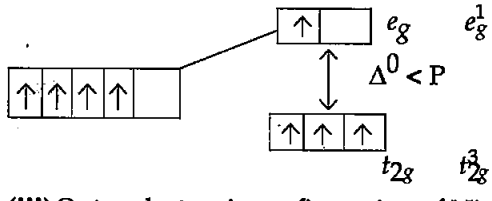
(At. no. of Ni = 28). **[3]**

Answer :

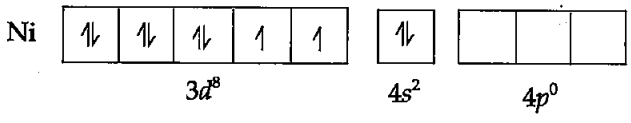
(i) Geometrical isomers of complex $[Pt(NH_3)_2Cl_2]$.



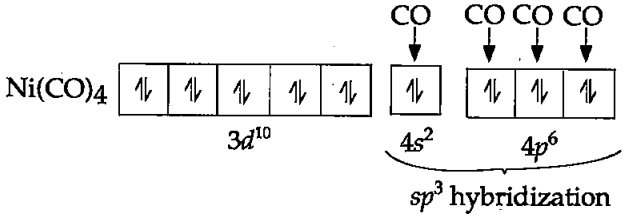
(ii) On the basis of crystal field theory, for a d^4 ion if, $\Delta_0 < P$. then complex is a high spin complex formed by association of weak field ligands with the metal ion. As a result, the fourth electron enters one of the e_g orbitals, thereby, exhibiting the electronic configuration $t_{2g}^3 e_g^1$.



(iii) Outer electronic configuration of Ni atom in ground state.



Outer electronic configuration of Ni atom in $Ni(CO)_4$



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

Carbonyl, CO being a strong field ligand causes the pairing of valence electrons in the Ni atom against the Hund's Rule of Maximum Multiplicity . This results in the formation of an inner orbital complex, $[Ni(CO)_4]$. Since the complex $[Ni(CO)_4]$ has no unpaired electron, it is diamagnetic in nature and posses tetrahedral shape.

16. Calculate emf of the following cell at 25°C :

$Fe|Fe^{2+}(0.001M) \mid H^+(0.01M) \mid \mid H_2(g)$ (1bar) Pt(s) $E°(Fe^{2+} \mid Fe) = -0.44$ V $E°(H^+/H_2) = 0.00$ V. [3]

Answer : For the given cell representation, the cell reaction will be

$$Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$$

The standard emf of the cell will be

$$E°_{cell} = E°_{H^+/H_2} - E°_{Fe^{2+}/Fe}$$

$$E°_{cell} = 0 - (-0.44) = 0.44 \text{ V}$$

The Nernst equation for the cell reaction at 25°C will be

$$E_{cell} = E°_{cell} \frac{0.0591}{n} \log \frac{[Fe^{2+}]}{[H^+]^2}$$

$$= 0.44 - \frac{0.0591}{2} \log \frac{0.001}{(0.01)^2}$$

$$= 0.44 - \frac{0.0591}{2} \log 10$$

$$= 0.44 - \frac{0.0591}{2}$$

$$E_{cell} = 0.4105 \text{ V}^2 \approx 0.41 \text{ V}$$

17. Give reasons for the following observations :

(i) Leather gets hardened after tanning.

(ii) Lyophilic sol is more stable than lyophobic sol.

(iii) It is necessary to remove CO when ammonia is prepared by Haber's process. [3]

Answer : **(i)** Animal skin (hide) is colloidal in nature and has postively charged colloidal particles. When a hide is soaked in tanning, mutual coagulation takes place and as a result, leather get hardened.

(ii) The stability of lyophillic solution depends on the two factors, the presence of a charge and the solvation of colloide particles. On the other hand, the stability of lyophobic solutions is only because of the presence of a charge. Thus, lyophilic solution is more stable than lyophobic solution due to the extensive solvation.

(iii) It is necessary to remove CO when ammonia is prepared by Haber's process because in this process the CO act as a poison and adversely affects the activity of iron catalyst, used in the process.

18. Write the names and structures of the monomers of the following polymers :

(i) Nylon-6, 6

(ii) PHBV

(iii) Neoprene. [3]

Answer :

	Polymer	Name of Monomer(s)	Structure of Monomer(s)
(i)	**Nylon-6, 6**	Hexamethylenediamine and adipic acid	$H_2N-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-NH_2$ Hexamethylenediamine $HOOC-CH_2-CH_2-CH_2-CH_2-COOH$ Adipic acid
(ii)	**PHBV**	3-Hydroxypentanoic acid and 3-Hydroxybutanoic acid.	$CH_3-CH_2-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_2-COOH$ 3-Hydroxypentanoic acid $CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_2-COOH$ 3-Hydroxybutanoic acid
(iii)	**Neoprene**	Chloroprene	$H_2C=\underset{\displaystyle Cl}{\underset{\vert}{C}}-\underset{\displaystyle H}{\underset{\vert}{C}}=CH_2$ Chloroprene

19. Predict the products of the following reactions :

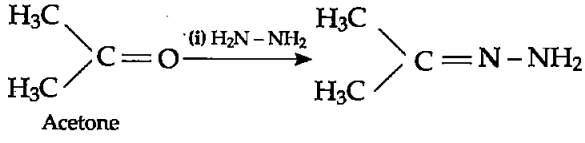
(i) $CH_3-\underset{\underset{CH_3}{|}}{C}=O \xrightarrow[\text{(ii) KOH/Glycol, }\Delta]{\text{(i) } H_2N-NH_2}$

(ii) $C_6H_5-CO-CH_3 \xrightarrow{NaOH/I_2} ? + ?$

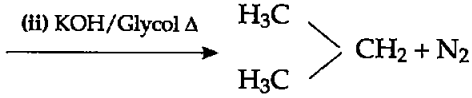
(iii) $CH_3COONa \xrightarrow[\Delta]{NaOH/CaO} ?$ [3]

Answer :

(i)



Acetone



Propane

(Wolff Kishner Reduction)

(ii) $C_6H_5-CO-CH_3 \xrightarrow[\Delta]{NaOH/I_2}$ Acetophenone $CHI_3\downarrow + C_6H_5COONa$

Iodoform

(Yellow)

(Haloform Reaction)

(iii) $CH_3-COONa \xrightarrow[\Delta]{NaOH/CaO} CH_4 + Na_2CO_3$

Sodium acetate — Methane

(Decarboxylation Reaction)

20. How do you convert the following :

(i) Phenol to anisole

(ii) Propan 2-ol to 2-methylpropan-2-ol

(iii) Aniline to phenol [3]

OR

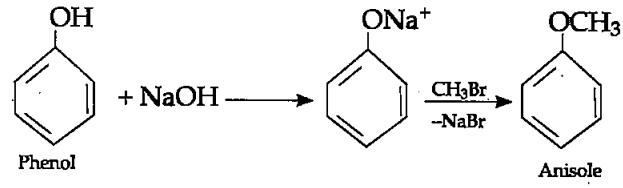
(b) Write the mechanism of the following reaction :

$2CH_3CH_2OH \xrightarrow{H^+} CH_3CH_2-O-CH_2CH_3$

(b) Write the equation involved in the acetylation of Salicylic acid. [3]

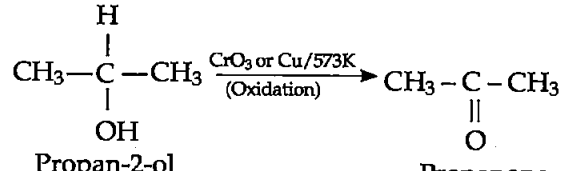
Answer :

(i)

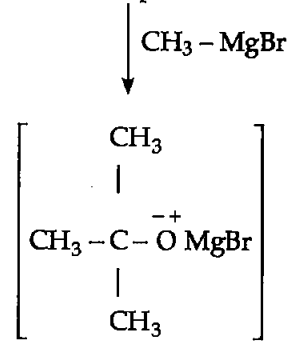


Phenol — Anisole

(ii)

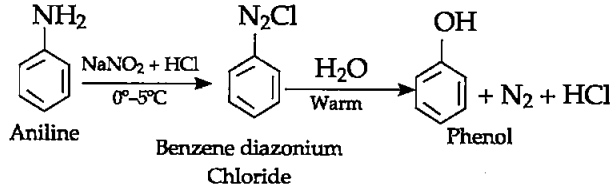


Propan-2-ol — Propanone



2-methylpropan-2-ol

(iii)



Aniline — Benzene diazonium Chloride — Phenol

OR

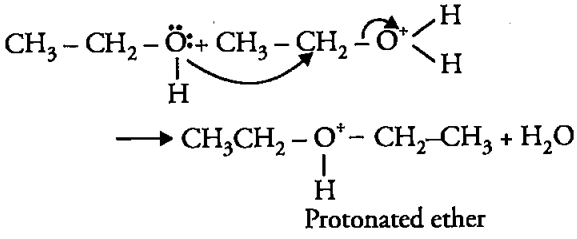
(a) The given reaction follows 5_N2 mechanism as shown below :

Step 1 : Protonation

$CH_3-CH_2-\ddot{O}-H + H^+ \rightarrow CH_3-CH_2-{}^{+}O(H)-H$

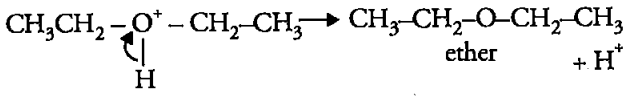
Protonated alcohol

Step 2 : Nucleophilic attack (5_N2)

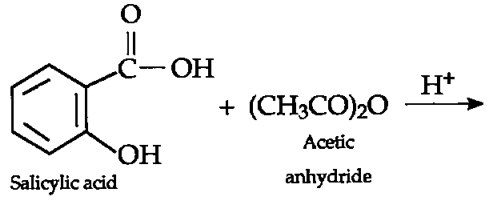


Protonated ether

Step 3 :

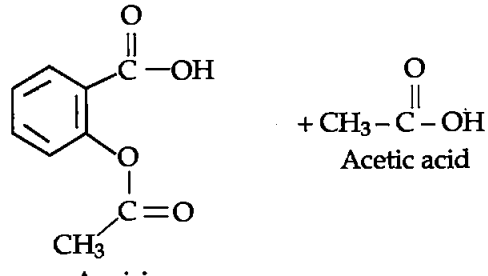


(b) Acetylation of Salicyclic acids.



Salicylic acid

Acetic anhydride



Aspirin

Acetic acid

21. (i) Which one of the following is a disaccharide : Starch, Maltose, Fructose, Glucose ?

(ii) What is the difference between fibrous protein and globular protein ?

(iii) Write the name of vitamin whose deficiency causes bone deformities in children. [3]

Answer : (i) Maltose is a disaccharide, as it contains α-D-glucose units.

(ii)

	Fibrous Proteins	Globular Proteins
1.	In fibrous proteins, the polypeptide chains, run parallel and are held together by strong hydrogen and disulphide bonds.	In globular proteins, the polypeptide chains are folded looped or tursted around themselves, giving these proteins a spherical structure.
2.	They are usually insoluble in water.	They are usually soluble in water.
3.	They are structural proteins. For example, keratin is present in nails and hair, collagen is present in tendons and myosin is present in muscles.	They are functional proteins. For example, most enzymes and some harmones like insulin.

(iii) Deficiency of Vitamin D causes the bone deformities in children.

22. Give reasons :

(a) *n*-Butyl bromide has higher boiling point than *t*-butyl bromide.

(b) Racemic mixture is optically inactive.

(c) The presence of nitro group (–NO_2) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions. [3]

Answer : (a) *n*-butyl bromide is a straight chain molecule having larger surface area and therefore, has stronger intermolecular forces. On the other hand, *t*-butyl bromide $(CH_3)_3$ CBr is branched molecule, so it has a smaller surface area. Hence, it has weaker intermolecular force.

(b) Racemic mixture is an equimolar solution of two enantiomers (*d* and *l* forms) and thus, the rotation due to one isomer is cancelled by the rotation due to another. Therefore, it has zero optical rotation and hence, it is optically inactive.

(c) This is because nitro group (–NO_2) at o/p positions withdraw the electrons from the benzene ring. The reduced electron density at o/p positions for haloarenes facilitate the attack of nucleophile. The negative charge in the Carbanion formed, at o/p positions with respect to halogen atom is stabilised through resonance and due to the presence of nitro groups (NO_2) respectively.

23. Mr. Roy, the principal of one reputed school organized a seminar in which he invited parents

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

and principals to discuss the serious issue of diabetes and depression in students. They all resolved this issue by strictly banning the junk food in school and to introduce healthy snacks and drinks like soup, lassi, milk etc. in school canteens. They also decided to make compulsory half an hour physical activities for the students in the morning assembly daily. After six months, Mr. Roy conducted the health survey in most of the schools and discovered a tremendous improvement in the health of students.

After reading the above passage, answer the following :

(i) What are the values (at least two, displayed by Mr. Roy ?**

(ii) As a student, how can you spread awareness about this issue ?

(iii) What are tranquilizers ? Give an example.

(iv) Why is use of aspartame limited to cold foods and drinks ? **[4]**

Answer :

(ii) As a student, I can spread awareness regarding diabetes and depression among students by conducting seminars, health camps, debates, distribution of pemplates, and workshops by doctors. So as to highlight the needs to follow healthy eating.

(iii) Tranquilizers are neurologically active drugs that induce a sense of well being and are used to treat stress, anxiety and mild or severe mental disease. They perform their function by inhibiting the message transfer mechanism from nerve to receptor *e.g.*, equanil, meprobamate and iproniazid etc.

(iv) The use of aspartame is limited to foods and cold drinks because aspartame is unstable at cooking temperature.

24. (a) Account for the the following :

(i) Acidic character increases from HF to HI.

(ii) There is large difference between melting and boiling points of oxygen and sulphur.

(iii) Nitrogen does not form pentahalide.

(b) Draw the structures of the following :

(i) ClF_3 **(ii) XeF_4** **[5]**

OR

(i) Which allotrope of phosphorus is more reactive and why ?

(ii) How the supersonic jet aeroplanes are responsible for the depletion of ozone layers ?

(iii) F_2 has lower bond dissociation enthalpy than Cl_2. Why ?

(iv) Which noble gas is used in filling balloons for meteorological observations ?

(v) Complete the equation :

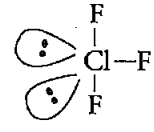
$$XeF_2 + PF_5 \longrightarrow$$

Answer : (a) (i) The acidic strength of the hydrohalic acids increases from HF to HI because the stability of the acids decreases from HF to HI on account of decrease in bond dissociation enthalpy of H – X bond from HF to HI.

(ii) The difference in melting point and boiling point of oxygen and sulphur is due to the difference in their atomicities oxygen exists as a diatomic (O_2) molecule, while sulphur exists as a polyatomic (S_8) molecule and also oxygen is small in size and have high electronegativities.

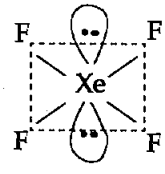
(iii) Being an element of second period, Nitrogen has no '*d*' orbitals and its maximum covalency is restricted to four. Hence, due to the non-availability of *d*-orbitals, it can't form pentahalides.

(b) (i) Structure of ClF_3



Bent-T-Shaped

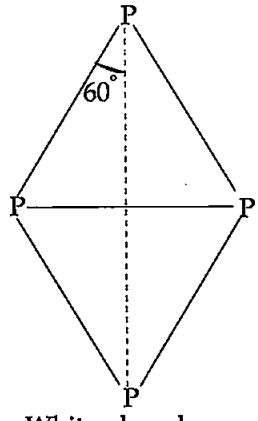
(ii) Structure of XeF_4



Square planar

OR

(i) White phosphorus is most reactive of all the allotropes of phosphorus. It is because it exists as P_4 discrete tetrahedral units with 60° angle, which results in angular strain and makes it highly reactive.



White phosphorus

(ii) Since supersonic jets fly in the stratosphere near the ozone layer, they are responsible for the depletion of ozone layer. The oxide emitted from the exhausts of supersonic jet aeroplanes readily combine with ozone to form nitrogen dioxide and diatomic oxygen.

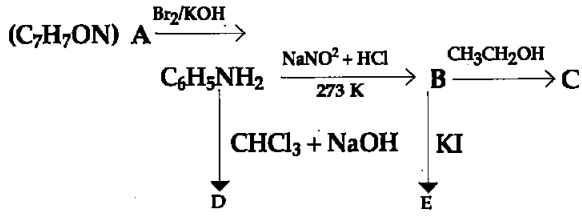
$$NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$$

(iii) The size of a fluorine atom is very small as compared to a chlorine atom. Therefore, the repulsion between electrons in the outer most shell of the two atoms in a fluorine molecule is much greater than that in a chlorine molecule. Hence, it requires less energy to break up the fluorine molecule, making its bond dissociation energy lesser than that of chlorine molecule.

(iv) Helium, gas is used for filling of balloons for meteorological observations.

(v) $XeF_2 + PF_5 \longrightarrow [XeF]^+ [PF_6]^-$

25. An aromatic compound 'A' of molecular formula C_7H_7ON undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions.



[5]

OR

(b) Write the structures of main products when aniline reacts with the following reagents :

(i) Br_2 water

(ii) HCl

(iii) $(CH_3CO)_2O$/pyridine.

(b) Arrange the following in the increasing order of their boiling point :

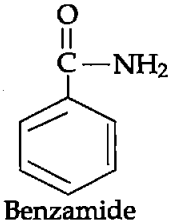
$C_2H_5NH_2$, C_2H_5OH, $(CH_3)_3N$

(c) Give a simple chemical test to distinguish between the following pair of compounds :

$(CH_3)_2NH$ and $(CH_3)_3N$.

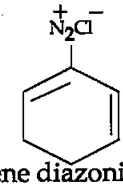
Answer :

(A)



Benzamide

(B)

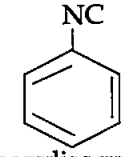


Benzene diazonium chloride

(C)

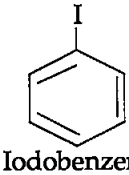
Benzene

(D)



Phenylisocyanide

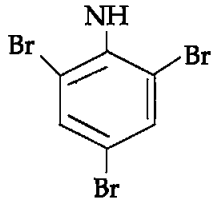
(E)



Iodobenzene

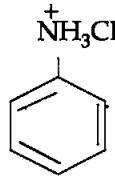
OR

(a)(i)



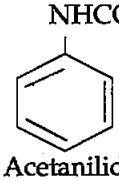
2, 4, 6-Tribromo aniline

(ii)



Anilinium Chloride

(iii)



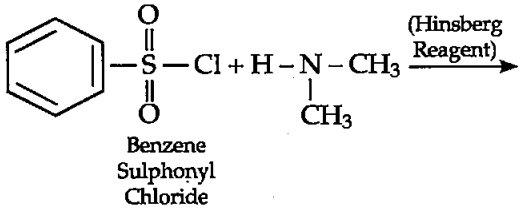
Acetanilide

(b) Ethanol has high boiling point then ethylamine because oxygen, being more electronegative forms strong extensive hydrogen bond as compared to that of nitrogen. In trimethylamine there is no hydrogen and hence has the lowest boiling point.

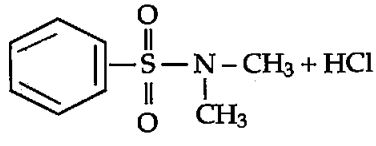
Increasing order or boiling point.

$$(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH.$$

(c) $(CH_3)_2NH$ reacts with benzene sulphonyl chloride (Hinsberg reagent) as follows :



Benzene Sulphonyl Chloride



N, N - Dimethyl benzenesulphonamide.

$(CH_3)_3N$ does not react with benzene sulphonyl chloride.

26. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$[CH_3COOCH_3]$ / mol L^{-1}	0.60	0.30	0.15

(i) Show that it follows pseudo first order reaction, as the concentration of water remains constant.

(ii) Calculate the average rate of reaction between the time interval 30 to 60 seconds.

(Given log 2 = 0.3010, log 4 = 0.6021) **[5]**

OR

(a) For a reaction A + B → P, the rate is given by

$$\text{Rate} = k[A][B]^2$$

(i) How is the rate of reaction affected if the concentration of B is doubled ?

(ii) What is the overall order of reaction if A is present in large excess ?

(b) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction.

(log 2 = 0.3010)

Answer :

For the hydrolysis of methyl acetate in aqueous solution :

(i) $$K = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

where $[A]_0$ = Initial concentration of reactant

[A] = Final concentration of reactant.

At $t_1 = 30$ sec,

$$K = \frac{2.303}{30} \log \frac{0.60}{0.30}$$

$$K = 0.07677 \log 2$$

$$K = 0.0231\ s^{-1}$$

for $t = 60$ sec

$$K = \frac{2.303}{60} \log \frac{0.60}{0.15}$$

$$K = 0.07677 \log 2$$

$$K = 0.0231\ s^{-1}$$

$\therefore$ K is same for both the cases hence it is pseudo first order reaction.

(ii) Average rate of reaction between the time interval of 30 – 60 seconds is given by

$$K = \frac{-\Delta[CH_3COOCH_3]}{\Delta t}$$

$$K = -\left(\frac{0.15-0.30}{60-30}\right)$$

$$= \frac{0.15}{30} = 0.005 \text{ mol } L^{-1}s^{-1}$$

OR

(a) (i) Since the given reaction has order two with respect to reactant B, thus if the concentration of B is doubled in the given reaction, then the rate of reaction will become four times.

(ii) If the concentration of B is doubled *i.e.*; $[B]^2$ the overall reaction will be two, because if A is present in large excess, then the reaction will be independent of the concentration of A and will be dependent only on the concentration of B.

Order of reaction = 2.

(b) $t_{½} = 30$ min

$[R] = [R]_0 - 90\%$ of $[R]_0$

$$= [R]_0 - \frac{90[R]_0}{100}$$

$$[R] = \frac{[R]_0}{10}$$

$$K = \frac{0.693}{t_{½}} = \frac{0.693}{30} = 0.0231 \text{ min}^{-1}$$

$$t = \frac{2.303}{K}\log\frac{[R]_0}{[R]}$$

$$t = \frac{2.303}{0.0231}\log\frac{[R]_0}{\frac{[R]_0}{10}}$$

$$= \frac{2.303}{0.0231}\log 10$$

$$t = 99.7 \text{ min}$$

Note : All questions of Delhi Set-II are from Delhi Set I and Delhi Set-III are from Set I and II.

●●

Chemistry 2014 (Outside Delhi) SET I

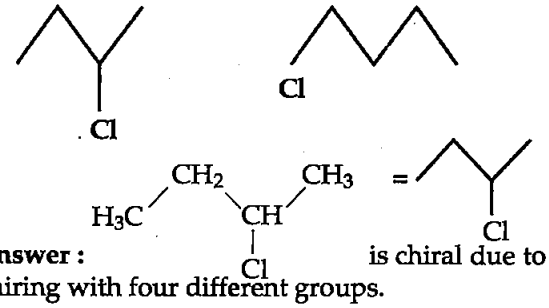
Time allowed : 3 hours **Maximum marks : 70**

1. **What is the effect of temperature on chemisorption ?** [1]
Answer : Chemisorption initially increases then decreases with rise in temperature. The initial increase is due to the high energy of activation and the decrease afterwards is due to the exothermic nature of adsorption equilibrium.

2. **What is the role of zinc metal in the extraction of silver ?** [1]
Answer : Zinc is used as a reducing agent to recover silver from its cyanide complex. It reduces Ag^+ to Ag and itself get oxidised to Zn^{2+}.

3. **What is the basicity of H_3PO_3 ?**** [1]

4. **Identify the chiral molecule in the following pair :** [1]

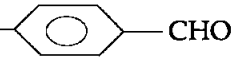


Answer : is chiral due to pairing with four different groups.

5. **Which of the following is a natural polymer ?** [1]
Buna-S, Proteins, PVC Economics type
Answer : Protein, is a natural polymer having amino acid as a monomer.

6. **The conversion of primary aromatic amines into diazonium salts is known as _____.** [1]
Answer : Diazotisation reaction.

7. **What are the products of hydrolysis of sucrose ?** [1]
Answer : The products of Hydrolysis of sucrose are : Glucose and Fructose

8. **Write the structure of *p*-methylbenzaldehyde.** [1]
Answer : 

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

Chemistry 2016 (Outside Delhi) SET I

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

1. **What type of magnetism is shown by a substance if moments of domains are arranged in same direction ?**** [1]

2. $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - Cl$ and $CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - Cl$,

   which is more reactive towards S_N1 reaction and why ? [1]

   Answer : $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - Cl$, is more reactive towards SN^1 reaction as secondary (2°) carbonation formed as the reaction intermediate $\left(CH_3 - CH_2 - \overset{\oplus}{\underset{\underset{CH_3}{|}}{C}}\right)$ is more stable than primary (1°) carbocation $\left(CH_3\ \underset{\underset{CH_3}{|}}{CH} - \overset{\oplus}{CH_2}\right)$.

3. **On adding NaOH to ammonium sulphate a colourless gas with pungent odour is evolved which forms a blue coloured complex with Cu^{2+} ion. Identify the gas.** [1]

   Answer : The gas evolved is ammonia (NH_3).

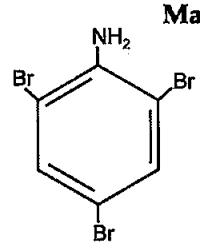
   $(NH_4)_2SO_4(aq) + 2NaOH \rightarrow Na_2SO_4(aq) + 2H_2O(l) + 2NH_3(g)$

   Ammonia react with solution of Cu^{2+} ion to form a deep blue coloured complex, $\left[Cu(NH_3)_4\right]^{2+}$.

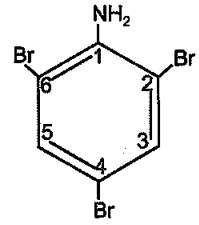
4. **Write the main reason for the stability of colloidal solutions.** [1]

   Answer : All the colloidal particles in a given solution carry the same charge and the dispersion medium has an opposite and equal charge; the system as a whole being electrically neutral. This is the main reason for the stability of the colloidal solution.

5. **Write the IUPAC name of the given compound.** [1]



Answer :



2,4,6-Tribromoaniline.

6. **When a coordination compound $CrCl_3.6H_2O$ is mixed with $AgNO_3$, 2 mole of AgCl are precipitated per mole of the compound. Write** [2]

   (i) Structural formula of the complex.

   (ii) IUPAC name of the complex

   Answer : (i) Structural formula of the complex is $[Cr(H_2O)_5Cl]Cl_2 . H_2O$, because two moles of chlorine are outside coordination entity to form two moles of AgCl from per mole compound.

   (ii) Pentaaquachlorido Chromium(III) chloride monohydrate.

7. **From the given cells :** [2]

   Lead storage cell, Mercury cell, Fuel cell and Dry cell

   Answer the following :

   (i) Which cell is used in hearing aids ?

   (ii) Which cell was used in Apollo Space Programme ?

   (iii) Which cell is used in automobiles and inverters ?

   (iv) Which cell does not have long life ?

   Answer : (i) Hearing aid–Mercury cell.

   (ii) Apollo Space Programme–Fuel cell.

   (iii) Automobile and inverters–Lead storage cell.

   (iv) Cell does not have long life–Dry cell.

8. **When chromite ore $FeCr_2O_4$ is fused with NaOH in presence of air, a yellow coloured compound**

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

(A) is obtained which on acidification with dilute sulphuric acid gives a compound (B), compound (B) on reaction with KCl forms a orange coloured crystalline compound (C). [2]

(i) Write the formulae of the compounds (A), (B) and (C).

(ii) Write one use of compound (C).

OR

Complete the following chemical equations :

(i) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow$

(ii) $Cr_2O_3^{2-} + 3Sn^{2+} + 14\,H^+ \rightarrow$

Answer : (i) On fusing chromite ore with Sodium hydroxide in presence of air, yellow coloured "sodium chromate" (A) is formed.

$$FeCr_2O_4 + 16\,NaOH + 7O_2 \rightarrow \underset{(A)}{8Na_2CrO_4} + 2\,Fe_2O_3 + 8H_2O$$

On acidification with dil. H_2SO_4 it forms sodium dichromate (B).

$$\underset{(A)}{2Na_2CrO_4} + H_2SO_4 \rightarrow \underset{(B)}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O.$$

Compound (B) *i.e.* sodium dichromate forms potassium dichromate, orange coloured crystals (C) on treating with KCl.

$$\underset{(B)}{Na_2Cr_2O_7} + 2KCl \rightarrow \underset{(C)}{K_2Cr_2O_7} + 2NaCl.$$

The formula of compounds are :

(A) Sodium chromate —Na_2CrO_4

(B) Sodium dichromate —$Na_2Cr_2O_7$

(C) Potassium dichromate —$K_2Cr_2O_7$

(ii) Potassium dichromate, $K_2Cr_2O_7$ is most commonly used as on oxidizing agent in various laboratory and industrial applications.

OR

(i) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

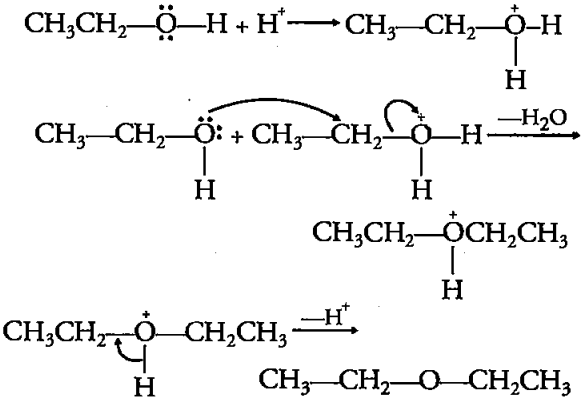
(ii) $Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow 3Sn^{4+} + 2Cr^{3+} + 7H_2O$

9. Write the mechanism of the following reaction : [2]

$$2CH_3CH_2OH \xrightarrow[413K]{Conc.H_2SO_4} CH_3CH_2 - O - CH_2 - CH_3$$

Answer : Formation of ether from alcohol is a nucleophilic bimolecular reaction (S_N2). A protonated alcohol is attacked by another alcohol molecule.

Reaction Steps :



10. For a reaction : $2NH_3\,(g) \xrightarrow[Rate = k]{Pt} N_2\,(g) + 3H_2\,(g)$

(i) Write the order and molecularity of this reaction.

(ii) Write the unit of *k*. [2]

Answer : (i) For any reaction ; Rate = K [A] order

[A] = concentration of reactant.

Hence its a zero order reactions and its molecularity is two.

(ii) Unit of K for a zero order reaction is mol L^{-1} sec^{-1}.

11. The rate constant for the first order decomposition of H_2O_2 is given by the following equation :

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T} K$$

Calculate E_a for this reaction and rate constant K if its half-life period be 200 minute. (Given : R = 8.314 J K^{-1} mol^{-1}) [3]

Answer : According to Arrhenius equation

$$\log k = \log A - \frac{1.0 \times 10^4}{T} K \quad ...(i)$$

So equating similar terms in the equations

$$\log K = 14.2 - \frac{1.0 \times 10^4}{T} K \quad ...(ii)$$

On comparing the equation no. **(i)** and **(ii)**

$$\frac{E_a}{2.303\,RT} = \frac{1.0 \times 10^4}{T} K;$$

$$E_a = \frac{2.30 \times R \times T \times 1.0 \times 10^4}{T} K$$

$\Rightarrow E_a = 2.303 \times 8.314\ K^{-1}\ Mol^{-1} \times 1.0 \times 10^4\ K$

$= 19.14 \times 10^4$ J Mol^{-1} = 191.4 kJ mol^{-1}

For a first order reaction :

$$t_{½} = \frac{0.693}{200} \quad \text{...(iii)}$$

$$t_{½} = 200 \text{ min}$$

$$K = \frac{0.693}{200} = 3.465 \times 10^{-3} \text{ min}^{-1}.$$

12. (i) Differentiate between adsorption and absorption.

(ii) Out of $MgCl_2$ and $AlCl_3$, which one is more effective in causing coagulation of negatively charged sol and why ?

(iii) Out of sulphur sol and proteins, which one forms multimolecular colloids ? **[3]**

Answer : (i)

	Adsorption	Absorption
1.	It is a surface phenomenon, Adsorbate molecules are held at the surface of adsorbent.	Absorption occurs in the bulk of absorbing substance.
2.	Initially, rate of adsorption is rapid.	Absorption occurs at uniform rate.
3.	The concentration of the adsorbent surface is much more than that in the bulk.	Absorbed material is uniformly distributed throughout the bulk means concentration is same throughout and it is essentially a bulk phenomenon.
4.	E.g., water vapours on silica gel.	E.g., Water vapours are absorbed by anhydrous $CaCl_2$.

(ii) According to Hardy-Schulze law the ions carrying opposite charge to that on sol are responsible for coagulation of the sol. These are called active ions. Hence as the sol is negative, Mg^{2+} and Al^{3+} ions will cause coagulation.

As coagulation power of electrolyte is proportional to the valency of oppositely charged ion, so $AlCl_3$ will be more effective than $MgCl_2$.

(iii) Sulphur sol will form the multimolecular colloid. A sol of sulphur consists of colloidal particles which are aggregates of S_8 molecules.

13. Give reasons : **[3]**

(i) C–Cl bond length in chlorobenzene is shorter than C–Cl bond length in CH_3–Cl.

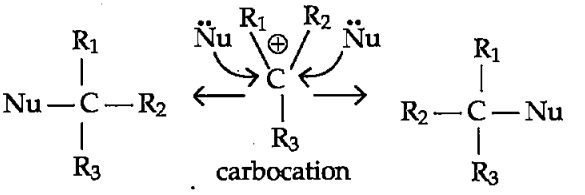
(ii) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

(iii) S_N1 reactions are accompanied by racemization in optically active alkyl halides.

Answer : (i) C – Cl bond length in chlorobenzene is shorter than CH_3–Cl, C–Cl bond as in chlorobenzene due to resonance C–Cl bond has partial double bond character which reduces the bond length.

(ii) In cyclohexyl chloride, carbon in C–Cl bond is sp^3 hybridised whereas in chlorobenzene C–Cl bond carbon is sp^2 hybridised, sp^2 is more electronegative than sp^3 carbon. Hence C–Cl bond of chlorobenzene is less polar.

(iii) In S_N1 reaction a carbocation intermediate is formed. In case of optically active alkyl halide the attack of nucleophile in the next step to carbocation can occur from both the faces of the trigonal planar species in equal probability. Thus 50 : 50 racemic mixture is obtained.



14. An element crystallizes in a f.c.c. lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2×10^{24} atoms. ** **[3]**

15. Give reasons : **[3]**

(i) Mn shows the highest oxidation state of +7 with oxygen but with flourine it shows the highest oxidation state of +4

(ii) Transition metals show variable oxidation states.

(iii) Actinoids show irregularities in their electronic configurations.

Answer : (i) Mn shows the highest oxidation state of +7 with oxygen because it can form $p\pi$-$d\pi$ multiple bonds. On the other hand Mn shows

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

highest oxidation state of +4 with flourine because it can form only single bond.

(ii) Transition metals show variable oxidation state because of use of ns and (n–1) d shell electrons while bonding as the shells have similar energy.

(iii) Actinoids show irregularities in their electronic configurations because *6d*, *7s* and *5f* electrons or shells have less energy difference and electrons can be accommodated in any of them.

16. Write the main product(s) in each of the following reactions : [3]

(i) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-O-CH_3 + HI \rightarrow$

(ii) $CH_3-CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6}$

(iii) $C_6H_5-OH \xrightarrow[(ii)\ CO_2,\ H^+]{(i)\ aq.\ NaOH}$

Answer : (i) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-O-CH_3 + HI \longrightarrow$

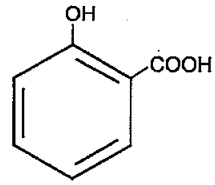
$$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-I + CH_3OH$$

(ii) $3CH_3-CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6}$

$3CH_3-CH_2-CH_2-OH + B(OH)_3$

Antimarkovnikov addition.

(iii) $C_6H_5OH \xrightarrow[(ii)\ CO_2,\ H^+]{(i)\ aq.\ NaOH}$



Salicylic acid

17. (i) Name the method of refining of metals such as Germanium.

(ii) In the extraction of Al, impure Al_2O_3 is dissolved in conc. NaOH to form sodium aluminate and leaving impurities behind. What is the name of this process ?

(iii) What is the role of coke in the extraction of iron from its oxides ? [3]

Answer : (i) Zone refining method is used for refining of metals such as germanium which is based on the principle that the impurities are more soluble in the molten state (melt) than in the solid state of the metal.

(ii) Leaching : This method consists of treating the powdered ore with a suitable reagent which can selectively dissolve the ore but not the impurities.

(iii) Coke act as a reducing agent and it reduces the iron ore hematite.

18. Calculate e.m.f. of the following cell at 298 K. [3]

$2Cr(s) + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3\ Fe\ (s)$

Given : $E^\circ_{(Cr^{3+}\ |\ Cr)} = -0.74$ V $E^\circ_{(Fe^{2+}\ |\ Fe)} = -0.44$ V

Answer : $Cr\,|\,Cr^{3+}(0.01M)\ ||\ Fe^{2+}(0.1M)\,|\,Fe_{(s)}$.

The half cell reactions for they given cell :

$Cr \rightarrow Cr^{3+} + 3e^-] \times 2$

$Fe^{2+} + 2e^-\ Fe\ ] \times 3$

Hence $n = 6$, $T = 298$ K, $R = 8.314\ J\ K^{-1}\ mol^{-1}$.

Nernst equation for the cell ;

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF}\log\frac{[Cr^{3+}]^2}{[Fe^{2+}]^3}$$

$$E^\circ cell = [E^\circ_R - E^\circ_L]V$$

$$[-0.44-(-0.74)]V = +0.30\ V.$$

$$E_{cell} = 0.30\ V - \frac{2.303\times8.314\times298}{6\times96500}\log\frac{[0.01]^2}{[0.1]^3}$$

$$= 0.30V - \frac{0.059}{6}\log\frac{[10^{-2}]^2}{[0.1]^3}$$

$$= 0.30 - \frac{0.059}{6}\log 10^{-1}\ V = 0.30\ V - \frac{0.059}{6}(-1)\ V$$

$$= 0.30\ V + \frac{0.059}{6}\ V = 0.30 + 0.0098$$

$$= 0.3098\ V$$

19. (i) Write the name of two monosaccharides obtained on hydrolysis of lactose sugar.

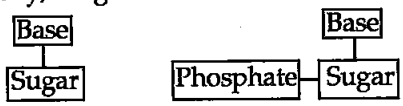
(ii) Why Vitamin C cannot be stored in our body?

(iii) What is the difference between a nucleoside and nucleotide ? [3]

Ans : (i) The two monosaccharides are β-D-galactose and β-D-glucose.

(ii) Vitamin C is, a water soluble vitamin and hence get excreted by urine. So it cannot be stored in body and needs to be supplemented regularly.

(iii) When a base (purine or pyriamidine) get attached to 1′ position of a pentose sugar a nucleoside is formed. When a nucleoside is further linked to phosphoric acid at 5′ position of sugar moeity, we get a nucleotide.

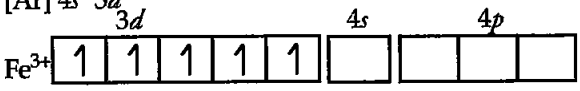


20. (a) For the complex $[Fe(CN)_6]^{3-}$, write the hybridization type, magnetic character and spin nature of the complex. (At number Fe = 26).

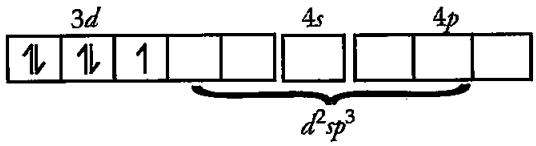
(b) Draw one of the geometrical isomers of the complex $[Pt\ (en)_2\ Cl_2]^{2+}$, which is optically active ? **[3]**

Answer : (a) $[Fe(CN)_6]^{3-}$, Fe, Z = 66 $[Ar]\ 4s^2\ 3d^6$

Fe has +3 oxidation state : Electronic configuration; $[Ar]\ 4s^0\ 3d^5$



CN^- is a strong field ligand hence pairing will take place to accommodate 6 pair of ligand electrons.



Hence the complex has d^2sp^3 hybridization.

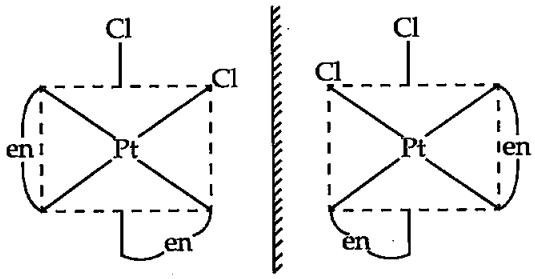
Type : Octahedral complex, inner orbital complex.

Magnetic character : One unpaired electron hence paramagnetic.

It will have a total electron spin moment of 1 electron :

$(\mu) = \sqrt{1(1+2)} = \sqrt{3}$ BM, ∴ Low spin complex

(b) $[Pt\ (en)_2Cl_2]^{2+}$, that is isomer is optically active.



Cis isomer Mirror

Optically active.

21. Write the structure of A, B and C in the following :

(i)

$$C_6H_5—CO—NH_2 \xrightarrow{aq./KOH} A \xrightarrow[0–5°\ C]{NaNO_2 + HCl} B \xrightarrow{KI} C$$

(ii)

$$CH_3—Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow{CHCl_3 + alc\ KOH} C$$

[3]

Answer : (i) $C_6H_5—CO—NH_2 \xrightarrow{Br_2/aq.\ KOH}$ $C_6H_5NH_2$ (A) Aniline

$\xrightarrow[0–5°C]{NaNO_2 + HCl}$ $C_6H_5N^+{}_2Cl^-$ (B) Benzene diazonium chloride

$\xrightarrow{KI}$ C_6H_5I (C) Iodobenzene

(ii)

$$CH_3Cl \xrightarrow{KCN} CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2$$

(A) Ethanenitrile (B) Ethanamine

$\xrightarrow{\Delta}$ CH_3CH_2NC (C) (Ethyl isocyanide) ← CH_3Cl + alc. KOH

22. (i) What is the role of *t*-butyl peroxide in the polymerization of ethane ?

(ii) Identify the monomers in the following polymer :

$—[NH—(CH_2)_6—NH—CO—(CH_2)_4—CO—]_n$

(iii) Arrange the following polymers in the increasing order of their intermolecular forces.

Polystyrene, Terylene, Buna-S. **[3]**

OR

Write the mechanism of free radical polymerisation of ethene.

Ans : (i) Polymerisation of ethene to low density polyethene (L.D.P.) needs presence of a free radical generating initiator (catalyst). *t*-butyl peroxide helps in starting the chain of radical formations.

(ii) $\left[-NH—[CH_2]_6NH—\overset{\overset{O}{\|}}{C}—(CH_2)_4—\overset{\overset{O}{\|}}{C}-\right]_n$

This is Nylon–6, 6 and its monomers are :

hexamethylene diamine

$H_2N—(CH_2)_6—NH_2$ and adipic acid

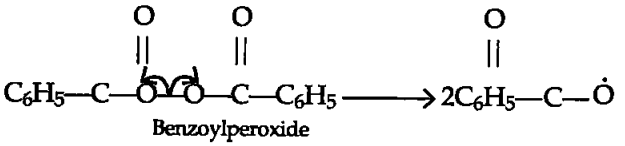
HOOC—$(CH_2)_4$—COOH.

(iii) Buna–S <Polystyrene <Terylene
(Elastomer)(Thermoplast) (Fibre)

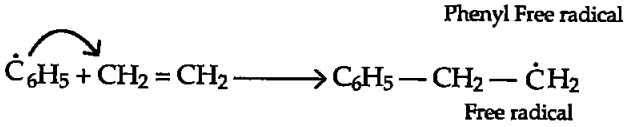
OR

Mechanism of Polymerisation of ethene.

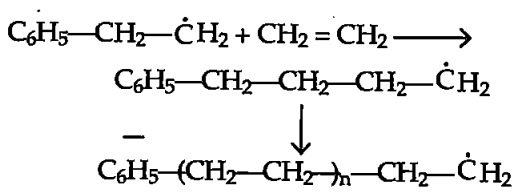
(1) Initiation : The process starts with the formation of a free radical by addition of catalyst free radical like phenyl or benzoyl etc., generating a new and larger free radical.



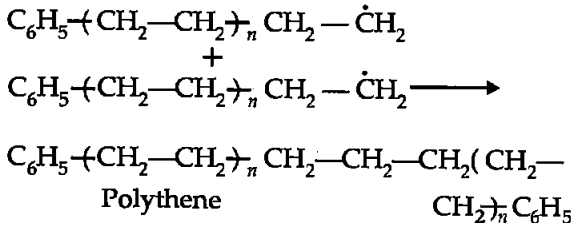
$\longrightarrow 2\dot{C}_6H_5$
Phenyl Free radical



(2) Propagation : The radical reacts with another molecule of ethene thus forming a bigger radical molecule. The process continues till the required length of chain we need.



(3) Chain Termination : When free radical combine with each other the chain terminates resulting in formation of a polymer.



23. Due to hectic and busy schedule Mr. Angad made his life full of tensions and anxiety. He started taking sleeping pills to overcome the depression without consulting the doctor. Mr. Deepak a close friend of Mr. Angad advised him to stop taking sleeping pills and suggested to change his lifestyle by doing Yoga, meditation and some physical exercise. Mr. Angad followed his friend's advice and after few days he started feeling better. After reading the above passage answer the following : [4]

(i) What are the values (at least two) displayed by Mr. Deepak?**

(ii) Why is it not advisable to take sleeping pills without consulting doctor?

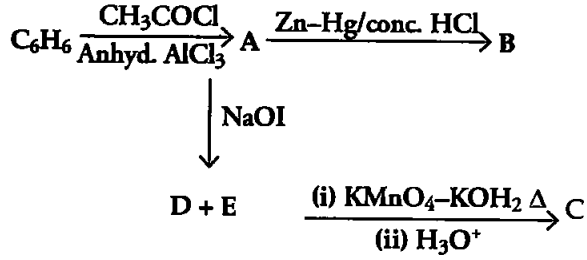
(iii) What are tranquilizers ? Give two examples.

Answer :

(ii) Sleeping pills are tranquilizers and may cause harmful side effects as they slow down the working of the brain and nervous system. Hence a doctor must be consulted to regularise the doses of such drugs.

(iii) Tranquilizers are a class of drugs or chemicals which are used to treat stress and mental disease. Example : Iproniazid and Equanil.

24. (a) Write the structures of A, B, C, D and E in the following reactions : [5]



OR

(a) Write the chemical equation for the reaction involved in Cannizzaro reaction.

(b) Draw the structure of the semicarbazone of ethanal.

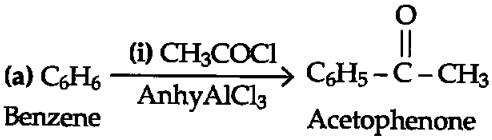
(c) Why pKa of $F–CH_2–COOH$ is lower than that of $Cl–CH_2–COOH$?

(d) Write the product in the following reaction;

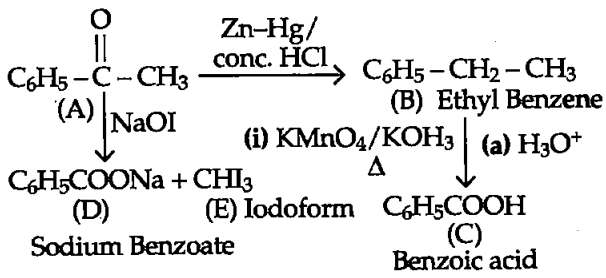
$$CH_3-CH=CH-CH_2CN \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL-H}$$

(e) How can you distinguish between propanal and proanone ?

Answer :

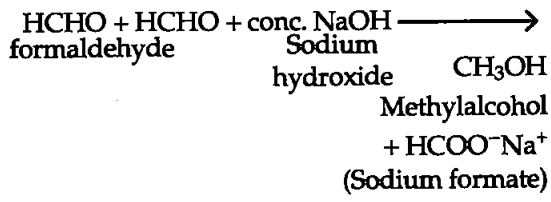


** Answer is not given due to change in the present syllabus

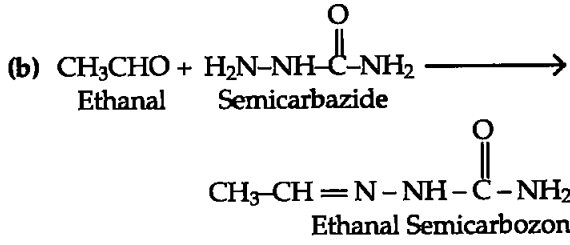


OR

(a) For aldehydes which do not have α-hydrogen atom self oxidation and reduction takes place in presence of concentrated alkali. This produces one mole of alcohol and one mole of salt of carboxylic acid. This is called Cannizzaro's reaction.

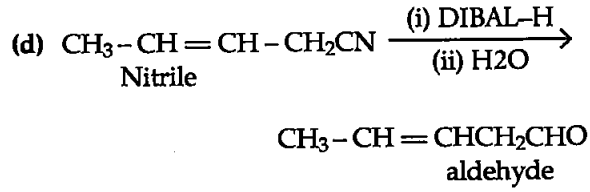


(b)

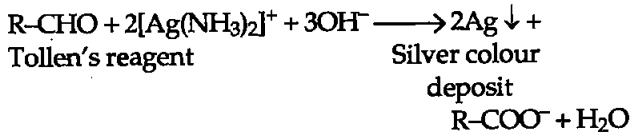


(c) pKa of $F-CH_2-COOH$ is lower than that of pKa of $Cl-CH_2-COOH$ as $F-CH_2-COOH$ is a stronger acid. This is because of higher electronegativity of F atom than Cl atom.

(d)



(e) Tollen's reagent will give a positive test of silver mirror formation with propanal, while propane does not gives this test since aldehydes can oxidise Tollens' reagent to metallic silver but ketones cannot.



25. (a) Calculate the freezing point of solution when 1.9 g (of $MgCl_2$ (M = 95 g/mol) was dissolved in 50 g of water, assuming $MgCl_2$. Undergoes complete ionization. [5]

(K_f for water = 1.86 K kg mol^{-1})

(b) (i) Out of 1 M glucose and 2 M glucose, which one has a higher boilling point and why ?

(ii) What happens when the external pressure applied becomes more than the osmotic pressure of solution ?

OR

(a) When 2.56 g of sulphur was dissolved in 100 g of CS_2, the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_X).[5]

(K_f for CS_2 = 3.83 K kg $mole^{-1}$, Atomic mass of sulphur = 32 g/mol^{-1}).

(b) Blood cells are isotonic with 0.9% sodium chloride solution what happens if we place blood cells in a solution containing.

(i) 1.2% sodium chloride solution ?

(ii) 0.4% sodium chloride solution ?

Answer : (a) $MgCl_2$ on ionisation gives 3 ions each mole.

$$MgCl_2(s) \longrightarrow Mg^{2+}(aq) + 2Cl^-(q)$$

Hence Vant's Hoff factor, $i = 3$

$$\Delta T_f = T_{f(water)} - T_{f(MgCl_2)} = i \times K_f \times m$$

$$m(\text{molality}) = \frac{1.9\text{g} \times 1000\text{g}}{95\text{g mol}^{-1} \times 50\text{g}} = 0.4 \text{ mole}$$

$\therefore$ $T_g(\text{water}) = 273$ K

Hence $\Delta T_f = 273\text{ K} - T_{f(MgCl_2)}$

$= 3 \times 1.86\text{ K.kg mol}^{-1} \times 0.4\text{ molkg}^{-1}$

$= 2.23$ K.

$T_{f(MgCl_2)} = (273 - 2.23)\text{ K} = 270.77$ K

(b) (i) 2M glucose will have higher boiling point because boiling point of a solution of a non-volatile liquid increases with increase in concentration

(ii) When the external pressure exerted on the solution is higher than the osmotic pressure, pure solvent starts flowing out of the solution through the semi permeable membrane. This process is known as reverse-osmosis.

OR

(a) Weight of sulphur (W_2) = 2.5 g, $W_1(CS_2)$ = 100 g,

$\Delta T_f = 0.383$ K

$M_2 = 32$ g/mol

$K_f = 3.83$ K kg/ mol

Applying the formula

$$\Delta T_f = \frac{k_f \times W_2 \times 1000}{W_1 \times M}$$

$$0.383 = \frac{3.83 \times 2.56 \times 1000}{100 \times M}$$

$$M = 256 \text{ g/Mol}$$

Formula of Sulphur : One atom of S = 32 g mol^{-1} atoms of S in molecule

$$= \frac{256 \text{ gmol}^{-1}}{32 \text{ gmol}^{-1}} = 8.$$

Formula = S_8

(b) (i) 1.2 % Sodium chloride is hypertonic than blood cells, hence cells will shrink. Plasmolyis will take place.

(ii) 0.4% Sodium chloride solution is hypotonic than blood cell, so cells will swell. Endo osmosis will take place.

26. (a) Account for the following : **[5]**

(i) Ozone is thermodynamically unstable.

(ii) Solid PCl_5 is ionic in nature.**

(iii) Fluorine forms only one oxoacid HOF.

(b) Draw the structure of : (i) BrF_5, (ii) XeF_4

OR

(i) Compare the oxidising action of F_2 and Cl_2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.

(ii) Write the conditions to maximize the yield of H_2SO_4 by contact process.

(iii) Arrange the following in the increasing order of property mentioned.

(a) H_3PO_3, H_3PO_4, H_3PO_2 (Reducing Characters)**

(b) NH_3, PH_3, AsH_3, SbH_3, BiH_3 (Base strength)**

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

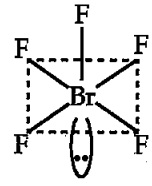
Answer : (a) (i) Ozone easily decompose to give nascent oxygen :

$$O_3 \rightarrow O_2 + [O]$$

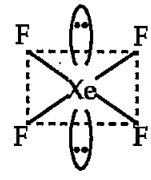
because the reaction is exothermic, (ΔH = negative). and results in the increases in entropy (ΔS = positive). Overall Gibb's energy change is quite high and negative.

(iii) Due to high electronegativity and small size fluorine forms only one oxoacid, HOF.

(b) (i) BrF_5



(ii) XeF_4



OR

(i) Fluorine is a much stronger oxidizing agent than chlorine. The oxidizing power depends on three factors.

(a) Bond dissociation energy.

(b) Electron gain enthalpy.

(c) Hydration enthalpy.

The electron gain enthalpy of chlorine is more negative than that of Fluorine. However, the bond dissociation energy of fluorine is much lesser than that of chlorine. Also, because of its small size, the hydration energy of fluorine is much higher than that of chlorine. Therefore, the latter two factors compensate more than for the less negative electron gain enthalpy of fluorine. Thus, fluorine is a much stronger oxidizing agent than chlorine.

(ii) The condition necessary to maximize the yield of H_2SO_4 by contact process are.

(a) A moderately low temperature of about 720 K and high pressure of about 2 bar yields maximum H_2SO_4 acid.

(b) Its an exothermic reaction and forward reaction causes decrease in pressure.

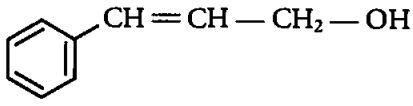
Note : All questions are same in outside Delhi Set II and III and Delhi Set-I, II and III

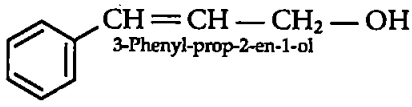
Chemistry 2017 (Outside Delhi) SET II

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

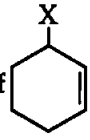
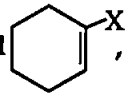
Note : Except for the following questions, all the remaining questions have been asked in previous sets.

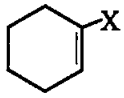
3. Write the IUPAC name of the following compound. [1]



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) $[Cr(en)_3]Cl_3$

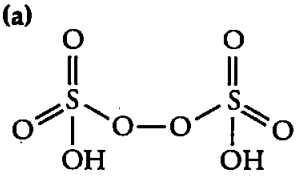
(b) $K_2[Zn(OH)_4]$

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

(a) $H_2S_2O_8$

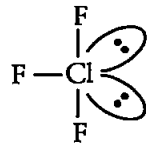
(b) ClF_3

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]

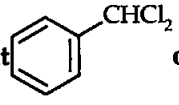
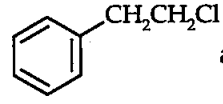
Answer :

●●

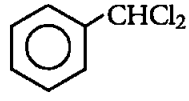
Chemistry 2017 (Outside Delhi) SET III

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]

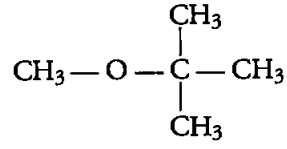
Answer : Iodic acid, HIO_3 is obtained on the oxidation of I_2 by HNO_3.

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

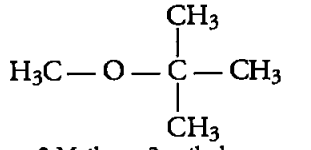
4. **What type of colloid is formed when a gas is dispersed in a liquid ? Give an example.** [1]

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 :

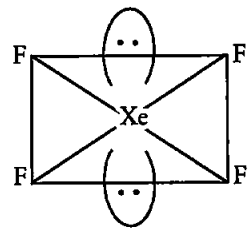


2-Methoxy-2methyl-propane

6. **Draw the structures of the following :**

(a) XeF_4

(b) BrF_5

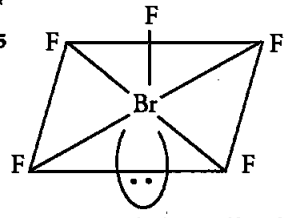
 [2]

****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 :

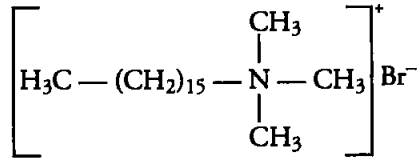
(a) Cationic detergents

(b) Broad spectrum antibiotics

(c) Tranquilizers [3]

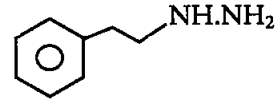
Answer :

(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 ⟶ 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) ⟶

(ii) $XeF_6 + 2H_2O$ ⟶

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) ⟶ $NCl_3 + 3HCl$.

(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.

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

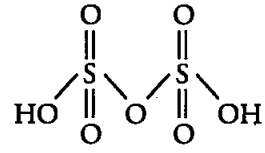
8. Draw the structures of the following :

(i) $H_2S_2O_7$

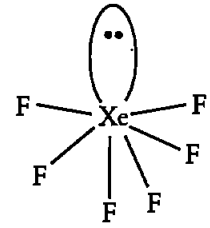
(ii) XeF_6 [2]

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 Scm^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 :

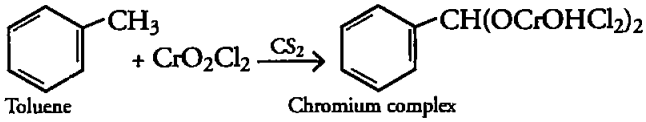
$$CH_3-\underset{\underset{H}{|}}{C}=O + \underset{\text{Hydrazine}}{NH_2NH_2} \xrightarrow{-H_2O} CH_3-\underset{\underset{H}{|}}{C}=NNH_2$$

Acetaldehyde — Hydrazone

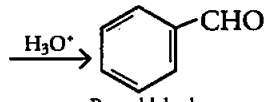
$$\xrightarrow[453\text{-}473\ K]{KOH} CH_3-CH_3 + N_2$$

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 :

$$\Delta T_f = K_f \times m$$
$$= \frac{12.3 \times 1\cancel{0} \times 100\cancel{0}}{18\cancel{0} \times 9\cancel{0}}$$
$$\Delta T_f = 7.6 \text{ K}$$

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

$= 2.303/300 \log 1.6\times10^{-2}/0.8\times10^{-2}$

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

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

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

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

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

(b) $t_{1/2} = 0.693/k$

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

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 $1° > 2° > 3°$.

(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)

$$CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} \underset{(A)}{CH_3CHO} \xrightarrow{dil.\ NaOH} CH_3CH(OH)CH_2CHO \xrightarrow{\Delta} \underset{(B)}{CH_3CH=CHCHO} \quad \underset{(C)}{}$$

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)

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

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

(i) Dacron **[3]**

Answer : (i) Monomers of Dacron :

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

Terephthalic acid

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 :**

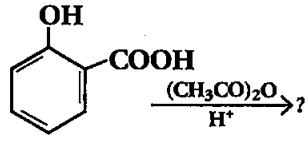
(i) In stoichiometric defects, NaCl exhibits Schottky defect and not Frenkel defect.

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

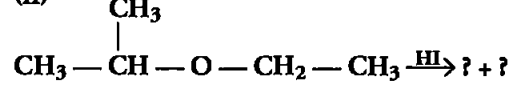
(iii) Ferrimagnetic substances show better magnetism than antiferromagnetic substances.

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

(i)



(ii)



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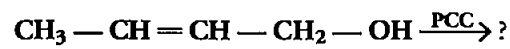


****Answer is not given due to the change in present Syllabus.**

(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

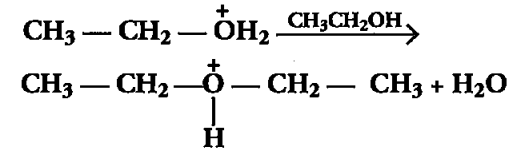
(ii) Hydroboration of propene and then oxidation to propanol.

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

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

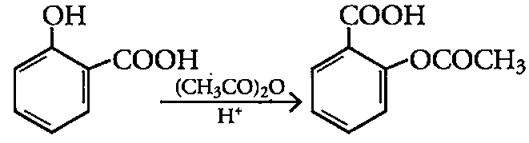
(ii) Propanol, propane, Propanal (boiling point)

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

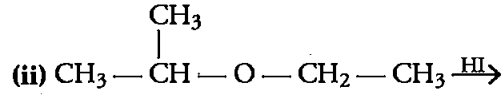


Answer :

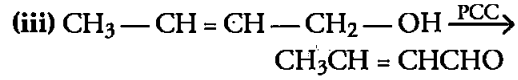
(a) (i)



(ii)



(iii)



(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^-

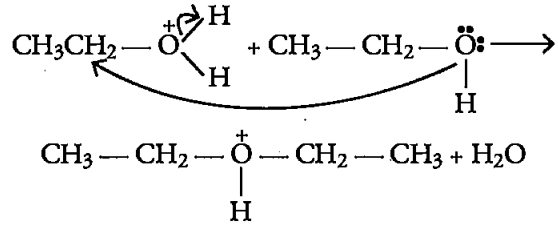
(b) (i) Ethanol < Phenol < *p*-Nitrophenol.

(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

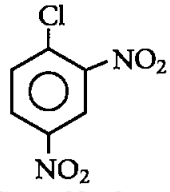
Time allowed : 3 hours **Maximum marks : 70**

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.*,

$$K_2Cr_2O_7$$

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

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

$$2x - 12 = 0$$

$$2x = 12$$

$$x = 6$$

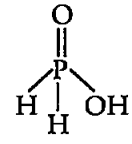
Thus, the formula of the oxo-anion is $K_2Cr_2O_7$

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 :

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

(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.

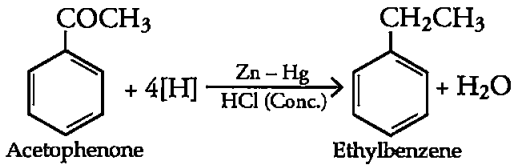
SECTION-A

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 :



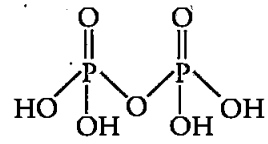
Acetophenone Ethylbenzene

(ii) Cannizzaro reaction :

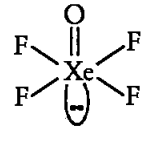
$$\underset{\text{Benzaldehyde}}{2C_6H_5CHO} \xrightarrow{\text{Conc. KOH}} \underset{\text{Benzylalcohol}}{C_6H_5CH_2OH} + \underset{\text{Sodium benzoate}}{C_6H_5COO^-Na^+}$$

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) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

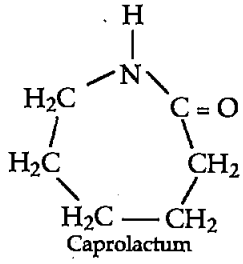
OR

(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.

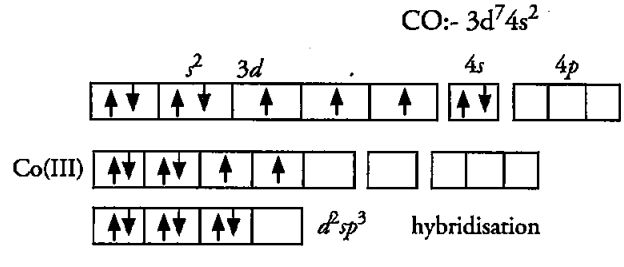
(iii) In O/W emulsion, oil is the dispersed phase while water is the dispersion medium. Example : milk, vanishing cream etc whereas in W/O emulsion water is the dispersed phase while oil is the dispersion medium. Example: Cold cream, butter etc.

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.



(iii) Triamminetrichloridochromium(III).

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Chemistry 2018

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

1. **Analysis shows that FeO has a non-stoichiometric composition with formula $Fe_{0.95}O$. Give reason.**** [1]

2. **CO(g) and H_2(g) react to give different products in the presence of different catalysts. Which ability of the catalyst is shown by these reactions ?** [1]

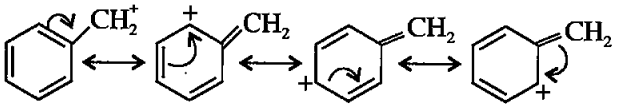
   Answer : CO(g) and H_2(g) react in presence of different catalysts to give different products, this shows that action of a catalyst is highly selective in nature.

3. **Write the coordination number and oxidation state of Platinum in the complex $[Pt(en)_2 Cl_2]$.[1]**

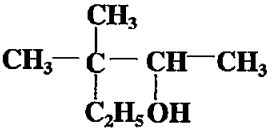
   Answer : Coordination number : 6; Oxidation state : +2

4. **Out of chlorobenzene and benzyl chloride, which one gets easily hydrolysed by aqueous NaOH and why ?** [1]

   Answer : Benzyl chloride would be easily hydrolysed compared to chlorobenzene. In the given reaction condition, hydrolysis proceeds by nucleophilic substitution mechanism and the benzylic carbonium ion formed after losing the leaving group (—Cl) is better stabilized (through resonating structures) hence reacts easily.



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



   Answer : The IUPAC name would be 3, 3-Dimethy1-pentan-2-o1.

6. **Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g of water.**
   (K_f of water = 1.86 K kg mol^{-1}) [2]

   Answer : Molality (m) of given solution of Glucose :

$$m = [(60/180)\ \text{g mol}^{-1}/250\ \text{g}] \times 1000$$
$$= 1.33\ \text{mol kg}^{-1}$$

   Now, depression in freezing point is given by,
   $\Delta T_f = K_f m$
   Putting the given values,

$$\Delta T_f = K_f m$$
$$= 1.86 \times 1.33$$
$$= 2.5$$

   So, freezing point of the solution would be
   273.15 K – 2.5 K = 270.65 K.

7. **For the reaction** [2]

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

   the rate of formation of NO_2(g) is 2.8×10^{-3} Ms^{-1}. Calculate the rate of disappearance of N_2O_5(g).

   Answer : Rate of reaction for the given reaction can be given as,

$$\text{Rate} = 1/2\ \{-\Delta[N_2O_5]/\Delta t\}$$

   or $\{-\Delta[N_2O_5]/\Delta t\} = 1/2\ \{[NO_2/\ \Delta t]\}$

   So, rate of disappearance of N_2O_5 would be half of rate of production of NO_2 (given $2.8 \times 10^{-3} Ms^{-1}$). So, the rate of disappearance of N_2O_5 is 1.4×10^{-3} $M s^{-1}$.

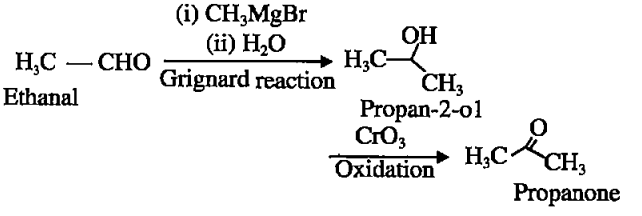
8. **Among the hydrides of Group-15 elements, which have the****
   (a) lowest boiling point ? [2]
   (b) maximum basic character ?
   (c) highest bond angle ?
   (d) maximum reducing character ?

9. **How do you convert the following ?** [2]
   (a) Ethanal to Propanone
   (b) Toluene to Benzoic acid

   OR

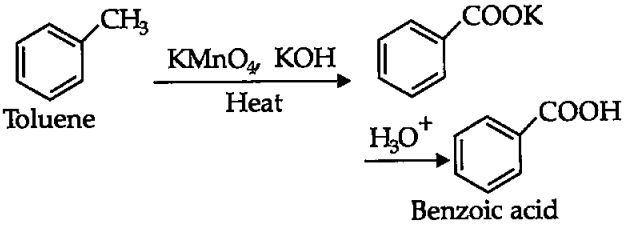
   Account for the following :
   (a) Aromatic carboxylic acids do not undergo Friedel- Crafts reaction.
   (b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.

   Answer : (a) Conversion of ethanal to Propanone :



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

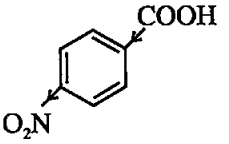
(b) Conversion of toluene to benzoic acid :



OR

(a) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction because the carboxyl group is deactivating for electrophilic substitution reaction, secondarily, the catalyst aluminium chloride gets bonded to the carboxyl group.

(b) pK_a value of 4-Nitrobenzoic acid is lower than benzoic acid, which means 4-Nitrobenzoic acid is more acidic than the benzoic acid. Being an electron withdrawing group, the—NO_2 group withdraws electrons towards itself resulting in ease of carboxylic proton release, hence increasing the acidity.



10. Complete and balance the following chemical equations :

(a) $Fe^{2+} + MnO_4^- + H^+ \rightarrow$

(b) $MnO_4^- + H_2O + I^- \rightarrow$ [2]

Answer :

(a) $5\,Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$

(b) $2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2\,OH^- + IO_3^-$

11. Give reasons for the following : [3]

(a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

(b) Aquatic animals are more comfortable in cold water than in warm water.

(c) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.

Answer :

(a) Molar masses of macromolecules like polymers and proteins are measured through osmotic pressure method. The osmotic pressure method uses 'molarity' of solution (instead of molality) which has a large magnitude even for dilute solutions, given that polymers have poor solubility, osmotic pressure measurement is used for determination of their molar masses. Macromolecules such as proteins are not stable at high temperatures and because measurement of osmotic pressure is done at around room temperature, it is useful for determination of molar masses of proteins.

(b) Solubility of gases in liquid decreases on increasing the temperature. Hence, the availability of dissolved oxygen in water is more at lower temperatures hence, the aquatic animals feel more comfortable at lower temperatures than at the higher temperatures.

(c) Elevation of boiling point is a colligative property and hence depends on the number of solute particles in the solution. Now, 1 M KCl would have twice the number of solute particles, as KCl dissociates into K^+ and Cl^-, compared to sugar solution (as sugar does not undergo any dissociation). So, elevation of boiling point is nearly double for 1 M KCl solution compared to 1 M sugar solution.

12. An element 'X' (At. mass = 40 g mol^{-1}) having f.c.c. structure, has unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. ($N_A = 6.022 \times 10^{23}\ mol^{-1}$)** [3]

13. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction. (Given : log 2 = 0.3010, log 4 = 0.6021, R = 8.314 $JK^{-1}\ mol^{-1}$) [3]

Answer : Rate constant for a first order reaction is given by,

$$k = \frac{2.303}{t} \log \frac{[R_0]}{[R_t]}$$

So, at 300 K,

$$k_{300} = \frac{2.303}{40} \log \left(\frac{100}{50}\right)$$

$$= 0.058 \times \log 2$$

$$= 0.058 \times 0.301$$

$$= 0.017$$

$$k_{320} = \frac{2.303}{20} \log \left(\frac{100}{50}\right)$$

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

$$= 0.11 \times \log 2$$

$$= 0.11 \times 0.3010 = 0.034$$

Now, $$\log \frac{k_{320}}{k_{300}} = \left(\frac{E_a}{2.303R}\right)\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Putting the values,

$$\log \frac{0.034}{0.017} = \left(\frac{E_a}{2.303 \times 8.314 JK^{-1}mol^{-1}}\right)\left[\frac{320-300}{320\times 200}\right]K$$

$$0.3010 = \frac{E_a}{19.14(0.0002)}$$

$$E_a = 28{,}805.7 \text{ J mol}^{-1} = 28.80 \text{ kJ mol}^{-1}$$

14. What happens when [3]

(a) a freshly prepared precipitate of $Fe(OH)_3$ is shaken with a small amount of $FeCl_3$ solution ?

(b) persistent dialysis of a colloidal solution is carried out ?

(c) an emulsion is centrifuged ?

Answer :

(a) When $FeCl_3$ is added to a freshly prepared precipitate of $Fe(OH)_3$, a positively charged sol of hydrated ferric oxide is formed due to adsorption of Fe^{3+} ions.

(b) When persistent dialysis of colloidal solution is carried out, traces of electrolytes present in the sol are removed almost completely leaving the colloids unstable and finally coagulation takes place.

(c) Emulsions are centrifuged to separate them into constituent liquids.

15. Write the chemical reactions involved in the process of extraction of Gold. Explain the role of dilute NaCN and Zn in this process. [3]

Answer : Extraction of gold involves leaching the metal with dilute solution of NaCN or KCN in the presence of air (for O_2) from which the metal is obtained later by replacement method (using Zinc).

The reactions involved are :

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

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

16. Give reasons :

(a) E^o value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Fe^{3+}/Fe^{2+}.

(b) Iron has higher enthalpy of atomization than that of copper .

(c) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured. [3]

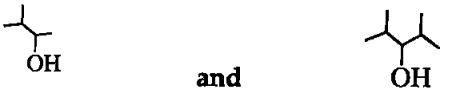
Answer :

(a) Mn^{2+} has a d^5 configuration, and the extra stability of half filled d-orbitals is compromised when another electron is taken out to give Mn^{3+}, On the contrary Fe^{3+} attains a half filled orbital configuration when Fe^{2+} gets oxidized to Fe^{3+}. Hence, the E° value for Mn^{3+}/Mn^{2+} couple has more positive E° value.

(b) Fe has a $3d^6 4s^2$ outer electronic configuration whereas Cu has $3d^{10}\ 4s^1$ configuration. Now, more the number of unpaired electrons in d-orbital, more favourable are interatomic attractions and thus higher atomization enthalpies. Hence, Fe having 4 unpaired d-electrons has more enthalpy of atomization than copper having no unpaired d-electron.

(c) Sc^{3+} has a $3d^0$ configuration whereas Ti^{3+} has a $3d^1$ configuration. As there are no electrons in d orbital for Sc^{3+} ion, there is no transition of electrons by absorption of energy and hence no emission in visible range imparting colour to the Sc^{3+} ion.

17. (a) Identify the chiral molecule in the following pair : [3]



(i) (ii)

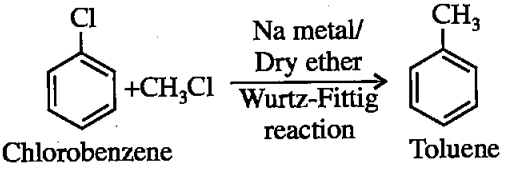
(b) Write the structure of the product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.

(c) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1 methylcyclohexane with alcoholic KOH.

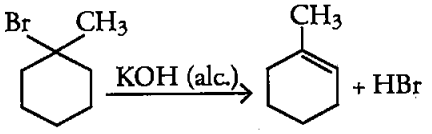
Answer :

(a) The molecule **(i)** is a chiral molecule.

(b) Chlorobenzene reacts with methyl chloride in presence of sodium metal and dry ether to give toluene. This reaction is known as Wurtz-Fittig reaction.



(c) In the 1-bromo-1-methylcyclohexane, all β-hydrogen atoms are equivalent. Thus dehydrohalogenation takes place, in the reaction of this compound with KOH.



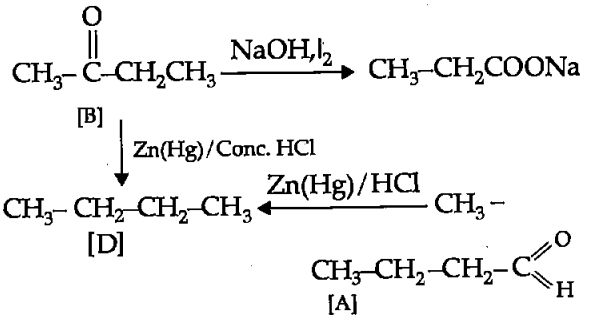
18. (A), (B) and (C) are three non-cyclic functional isomers of a carbonyl compound with molecular formula C_4H_8O. Isomers (A) and (C) give positive Tollen's test whereas isomer (B) does not give Tollen's test but gives positive Iodoform test. Isomers (A) and (B) on reduction with Zn (Hg)/conc. HCl give the same product (D).

(a) Write the structures of (A), (B), (C) and (D).

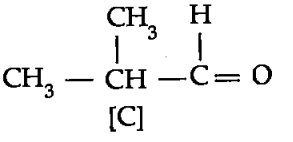
(b) Out of (A), (B) and (C) isomers, which one is least reactive towards addition of HCN ? **[3]**

Answer :

(a) Compound A and C give positive Tollen's test which indicates that they are aldehydes. Compound C gives Iodoform test which means it contains a carbonyl group with a methyl group attached to the carbonyl carbon so, with formula C_4H_8O the structure of compound would be $CH_3COCH_2CH_3$ (Butanone). Now upon reduction with Zn(Hg)/conc. HCl, the corresponding alkanes are obtained, so reduction of B gives Butane (D), so the isomer A have to be a linear chain aldehyde (Butanal), giving Butane (compound D) on reduction. So, the last isomer possible is compound C, 2-Methyl propanaldehyde. The reactions involved are shown below with the structures of compounds :

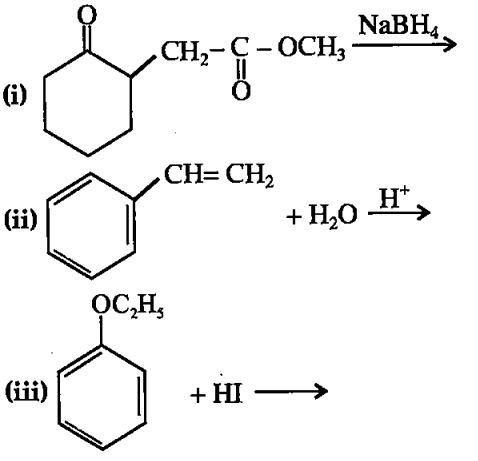


isomer of [A] is compound [C] whose structure is



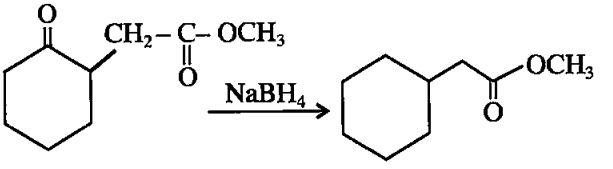
(b) Out of the three isomers A, B and C, compound B (Butanone) would be least reactive towards addition of HCl as the carbonyl carbon is sterically hindered and most reactive would be compound A (Butanal) towards addition of HCN.

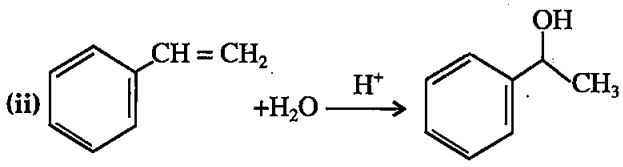
19. Write the structures of the main products in the following reactions : **[3]**

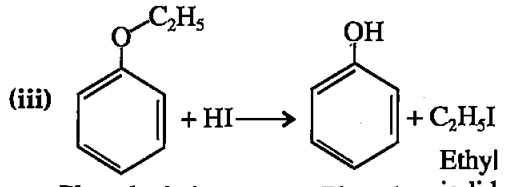


Answer :

(i) Sodium borohydride doesn't reduce esters, so product would be,



(ii) 

(iii) 

20. (a) Why is bithional added to soap ? [3]

(b) What is tincture of iodine ? Write its one use.

(c) Among the following, which one acts as a food preservative ?

Aspartame, Aspirin, Sodium Benzoate, Paracetamol

Answer :

(a) Bithional is added to soaps to impart antiseptic properties to soap.

(b) Tincture of iodine is 2-3 percent mixture of iodine in alcohol water mixture. It is used as an antiseptic.

(c) Sodium benzoate is used as a food preservative.

21. Define the following with an example of each : [3]

(a) Polysaccharides

(b) Denatured protein

(c) Essential amino acids

OR

(a) Write the product when D-glucose reacts with conc. HNO_3.

(b) Amino acids show amphoteric behaviour. Why ?

(c) Write one difference between α–helix and β-pleated structures of proteins.

Answer :

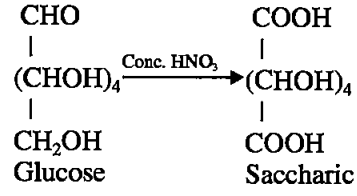
(a) Polysaccharides : Polysaccharides are food storage materials and most commonly found carbohydrates in nature. These are the compound which are formed of large number of monosaccharide units joined together by glycosidic linkages. Example. Starch, main storage polysaccharide of plants.

(b) Denatured protein : Proteins have an unique three dimensional structure in their native form. If the native form of protein is subjected to any physical change (such as temperature change) or any chemical change (such as change in pH), the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled due to which protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structures of proteins are destroyed but 1° structure remains intact. Coagulation of egg white is an example of denaturation of protein.

(c) Essential amino acids : The amino acids which are not synthesized in our body and have to be obtained through diet are known as essential amino acids. Example : Tryptophan

OR

(a) D-Glucose gets oxidized to give saccharic acid, a dicarboxylic acid on reacting with nitric acid.



(b) Amino acids show amphoteric behaviour due to the presence of both acidic (carboxylic group) and basic (amino group) in the same molecule. So, in basic medium the carboxyl group can lose a proton and in acidic medium amino group can accept a proton.

(c) In α-helix structure the polypeptide chain forms all possible hydrogen bonds by twisting into a right handed screw (helix) with the —NH group of each amino acid residue gets hydrogen bonded to the —C = O of an adjacent turn of the helix (intra.molecular bonding), whereas in

β -structure all peptide chains are stretched out to nearly maximum extension and then laid side by side which are held together by intermolecular hydrogen bonds (intermolecular bonding).

22. **(a) Write the formula of the following coordination compound :**
Iron (III) hexacyanoferrate (II)

(b) What type of isomerism is exhibited by the complex $[Co(NH_3)_5 Cl]SO_4$?

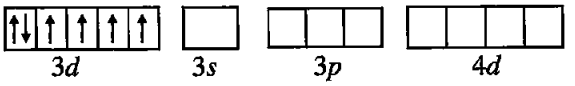
(c) Write the hybridisation and number of unpaired electrons in the complex $[CoF_6]^{3-}$. (Atomic number of Co =27) [3]

Answer :

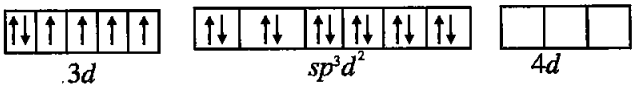
(a) Molecular formula of Iron(III) α – cyanoferrate(II) is $Fe_4[Fe(CN)_6]_3$

(b) $[Co(NH_3)_5Cl]SO_4$ will show Ionisation isomerism and the possible isomers are $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$

(c) Electronic configuration of Co^{3+} ion is,



Electronic configuration of sp^3d^2 hybridized (as F^- is a weak field ligand) orbitals of Co^{3+}, with six pairs of electrons from six F^- ions.



There are 4 unpaired electrons in $[CoF_6]^3$.

23. **Shyam went to a grocery shop to purchase some food items. The shopkeeper packed all the items in polythene bags and gave them to Shyam. But Shyam refused to accept the polythene bags and asked the shopkeeper to pack the items in paper bags. He informed the shopkeeper about the heavy penalty imposed by the government for using polythene bags. The shopkeeper promised that he would use paper bags in future in place of polythene bags.** [4]

Answer the following :

(a) Write the values (at least two) shown by Shyam.**

(b) Write one structural difference between low-density polythene and high-density polythene.

(c) Why did Shyam refuse to accept the items in polythene bags ?

(d) What is a biodegradable polymer ? Give an example.

Answer :

(b) Low density polythene has branched chain structure, whereas the high density polythene has linear chain structure.

(c) Shyam refused to take the items in polythene bags as polythene is non-biodegradable neither recyclable,

(d) Biodegradable polymers contain functional groups similar to functional groups present in biopolymers, so they get degraded in environment by certain microorganisms and thus are environment friendly. For example : Poly β -hydroxybutyrate-co- β - hydroxyvalerate (PHBV).

24. **(a) Give reasons :** [5]

(i) H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not.

(ii) When Cl_2 reacts with excess of F_2, ClF_3 is formed and not FCl_3.

(iii) Dioxygen is a gas while Sulphur is a solid at room temperature.

(b) Draw the structures of the following :

(i) XeF_4

(ii) $HClO_3$

OR

(a) When concentrated sulphuric acid was added to an unknown salt present in a test tube a brown gas (A) was evolved. This gas intensified when copper turnings were added to this test tube. On cooling, the gas (A) changed into a colourless solid (B).

(i) Identify (A) and (B).

(ii) Write the structures of (A) and (B).

(iii) Why does gas (A) change to solid on cooling ?

(b) Arrange the following in the decreasing order of their reducing character :

HF, HCl, HBr, HI

(c) Complete the following reaction :

$XeF_4 + SbF_5 \rightarrow$

Answer :

(a) (i) In H_3PO_3 (orthophosphorus acid) oxidation state of phosphorus is +3 and it contains one P-H bond in addition to P=O and P–OH bonds. These type of oxoacids tend to undergo disproportionation to give orthophosphoric acid (P has +5 state) and phosphine (P has +3 state). Whereas in H_3PO_4 (orthophosphoric

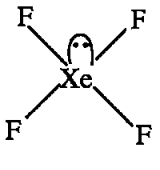
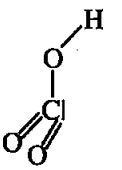
****Answer is not given due to the change in present syllabus.**

acid), Phosphorus is in +5 state hence no disproportionation takes place in H_3PO_4.

(ii) When Cl_2 reacts with excess of F_2, ClF_3 is formed and not FCl_3 because Fluorine can't expand its valency and can show only –1 oxidation state, whereas Cl can expand its valency due to the availability of *d*-orbitals.

(iii) Dioxygen is a gas while sulphur is a solid at room temperature this is because sulphur have S_8 molecules and these are packed to give different crystal structure, whereas dioxygen is a diatomic molecule (O_2) and it does not have enough intermolecular attraction and thus exists in gaseous form.

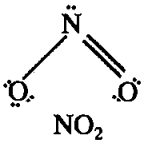
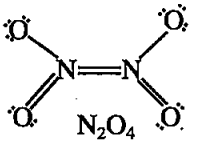
(b)

(i) XeF_4 is square planar in structure	(ii) $HClO_3$ or chloric acid
	

OR

(a) (i) The brown gas A is NO_2 or nitrogen dioxide. On cooling it dimerises to N_2O_4 and solidifies as a colourless solid.

$$2NO_2 \underset{\text{Heat}}{\overset{\text{Cool}}{\rightleftharpoons}} N_2O_4$$

(ii)  

(iii) Compoud A, that is, NO_2 contains odd number of valence electrons. It behaves as a typical odd molecule. On dimerization, it is converted to stable N_2O_4 molecule with even number of electrons (thus colourless) and have better intermolecular forces to get solidified. Thus, it changes to solid on cooling.

(b) Decreasing order of reducing character-

$$HI > HBr > HCl > HF$$

(c) $XeF_4 + SbF_5 \rightarrow [XeF_3]^+ + [SbF_6]^-$

25. (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K : [5]

Sn(s) | Sn^{2+} (0.004 M) || H^+ (0.020 M) | H_2(g) (1 bar) | Pt (s)

(Given : $E^\circ_{Sn^{2+}/Sn} = -0.14V$)

(b) Give reasons :

(i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

(ii) Conductivity of CH_3COOH decreases on dilution.

OR

(a) For the reaction

2 AgCl(s) + H_2(g) (1 atm) → 2Ag(s) + 2H^+ (0.1M) + 2Cl^- (0.1M),

$\Delta G^\circ = -43600$ J at 25°C.

Calculate the e.m.f. of the cell.

[$\log 10^{-n} = -n$]

(b) Define fuel cell and write its two advantages.

Answer :

(a) The half cell reactions can be written as;

$$Sn^{2+} + 2e^- \rightarrow Sn$$

$$E_{cell} = -0.14 + \frac{0.0591}{2} (\log [Sn^{2+}])$$

$$= -0.11 \times (\log 0.004)\ V$$

$$= 0.26\ V \quad \text{.....(i)}$$

$$2H^+ + 2e^- \rightarrow H_2$$

$$E_{cell} = 0.0 + 0.0591\ (\log [H^+])$$

$$= 0.0591 \times (-1.7)$$

$$= -0.10V \quad \text{.....(ii)}$$

Considering,

$2H^+(aq) + Sn(s) \rightarrow Sn^{2+}(aq) + H_2(g)$, as the cell reaction

So, E_{cell} will be,

$$E_{cell} = 0.26\ V - (-0.10)\ V$$

$$= 0.36\ V$$

(b) (i) During the electrolysis of aqueous NaCl, there are two possible reactions at anode,

$$Cl^-(aq) \rightarrow \frac{1}{2} Cl_2(g) + e^-;\ E_{cell} = 1.36\ V$$

$$2\ H_2O(l) \rightarrow O_2\ (g) + 4H^+\ (aq) + 4e^-;\ E_{cell} = 1.23\ V$$

The reaction at anode with lower value of E_{cell} is preferred and therefore, water

should get oxidized to give O_2 but on account of over potential of oxygen, Cl^- gets oxidized preferably, liberating Cl_2 gas.

(ii) Conductivity of CH_3COOH decreases on dilution because the number of ions per unit volume that carry the current in a solution decreases on dilution.

OR

(a) E°_{cell} can be obtained from the formula, $\Delta G^\circ = -nE^\circ_{cell}$

$$E^\circ_{cell} = \frac{\Delta G^\circ}{nF}$$

$$= \frac{-43600\ J}{1 \times 96487\ C\ mol^{-1}}$$

$$= -0.45\ V$$

Now, let us consider the given reaction equation,

$2AgCl(s) + H_2(g)\ (1\ atm) \rightarrow 2Ag(s) + 2H^+\ (0.1\ M) + 2\ Cl^-\ (0.1\ M)$

or $AgCl(s) + \frac{1}{2} H_2\ (g)\ (1\ atm) \rightarrow Ag\ (s) + H^+\ (0.1\ M) + Cl^-\ (0.1\ M)$

According to Nernst equation :

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log \frac{[product]}{[reactant]}$$

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log \frac{[H^+][Cl^-][Ag]}{[AgCl][H_2]^{1/2}}$$

As the activity of solid and H_2 gas at 1 atm is taken unity, the equation becomes,

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log ([H^+]\ [Cl^-]) \quad .....(i)$$

Now, putting the values in equation (i) above,

$$E_{cell} = -0.45 - (0.059) \log (0.1 \times 0.1)$$

$$= -0.51 \log (10^{-2})$$

$$= -0.51 \times (-2)$$

$$= 1.02\ V$$

So, EMF of the given cell is 1.02 V

(b) Galvanic cells that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol etc. directly into electrical energy are called fuel cells.

Advantages of fuel cells are :

1. Fuel cells produce electricity with an efficiency of about 70% compared to thermal plants whose efficiency is about 40%.
2. Fuel cells are pollution free.

26. (a) Write the reactions involved in the following : [5]

(i) Hofmann bromamide degradation reaction

(ii) Diazotisation

(iii) Gabriel phthalimide synthesis

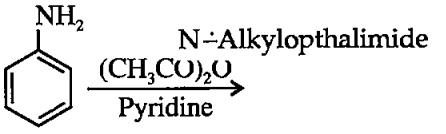
(b) Give reasons :

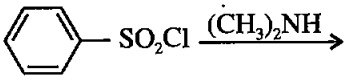
(i) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

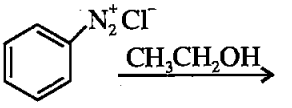
(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts.

OR

(a) Write the structures of the main products of the following reactions :.

(i) 

(ii) 

(iii) 

(b) Give a simple chemical test to distinguish between Aniline and N, N-dimethylaniline.

(c) Arrange the following in the increasing order of their pK_b values :

$C_6H_5NH_2$, $C_2H_5NH_2$, $C_6H_5NHCH_3$

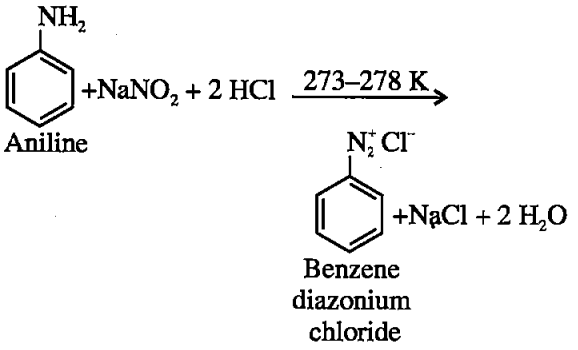
Answer :

(a) (i) Hofmann bromamide degradation reaction : Acetamide can be considered for example. In this reaction, Acetamide (CH_3CONH_2) undergoes Hofmann degradation in presence of Bromine and NaOH to give Methanamine.

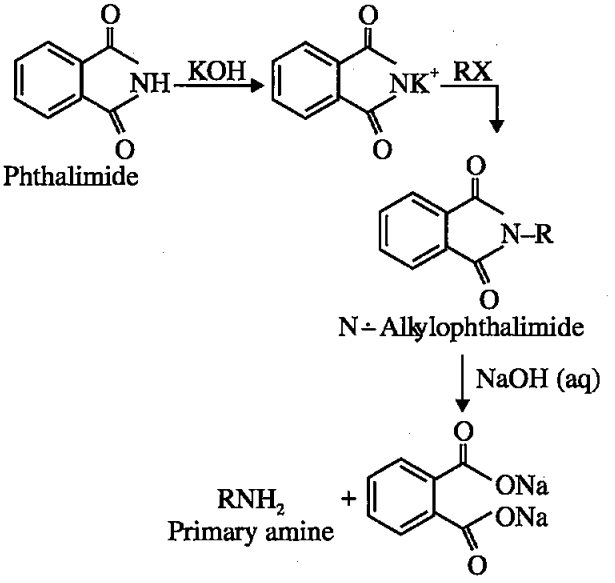
$$CH_3CONH_2 + Br_2 + 4NaOH \rightarrow CH_3NH_2$$

$Na_2CO_3 + 2NaBr + 2H_2O$

(ii)Diazotisation : The conversion of primary aromatic amines into diazonium salts is known as diasotisation.



(iii) Gabriel phthalimide synthesis : This reaction is used for the preparation of primary amines. Phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine.

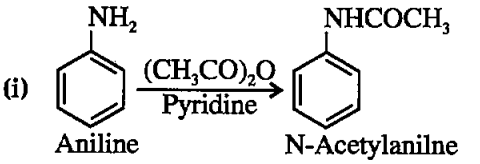


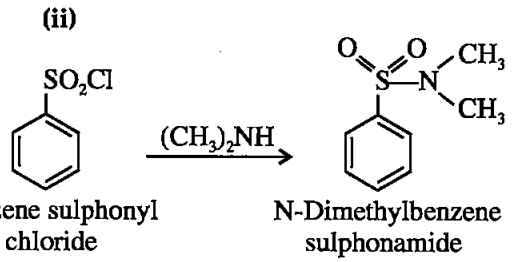
(b) (i) $(CH_3)_2$ NH is more basic than $(CH_3)_3N$ in aqueous solutions because, in $(CH_3)_3N$ the lone pair of electrons on nitrogen atom is responsible for its basicity are quite hindered by the three methyl groups, hence are less available. Due to which it is less basic as compared to $(CH_3)_2NH$.

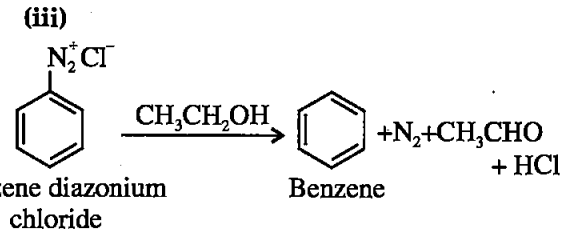
(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts because the positive charge on nitrogen atom is stabilized by the resonance with attached phenyl group.

OR

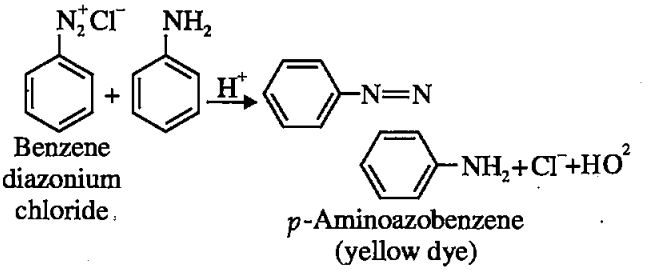
(a)

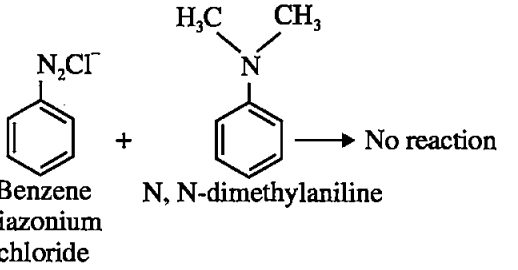






(b) Aniline can be distinguished from N, N-dimethyl aniline by diazo coupling reaction. Aniline would react with benzene diazonium chloride to give a yellow dye, whereas N, N-dimethyl aniline won't undergo this reaction.





(c) Increasing order of pK_b values is

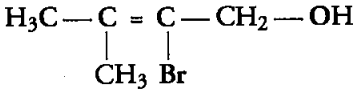
$C_2H_5NH_2 < C_6H_5NH_2 < C_6H_5NH_2CH_3$

Chemistry 2017 (Outside Delhi) SET I

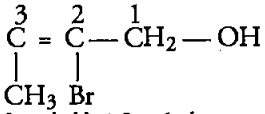
Time allowed : 3 hours **Maximum marks : 70**

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]



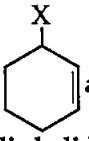
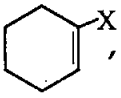
Answer :

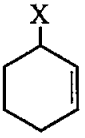


2-Bromo 3-methyl-but. 2-en-1-ol

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

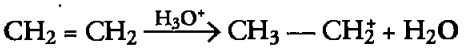
   Answer : On adding a catalyst
   (a) Activation energy of the reaction decreases.
   (b) Gibbs energy doesn't change.

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 :



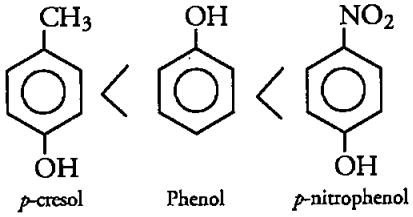
OR

Write the structures of the products when Butan-2-ol reacts with the following :

(a) CrO_3
(b) $SOCl_2$

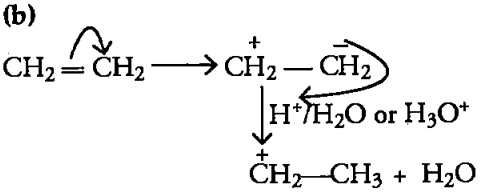
Answer :

(a)



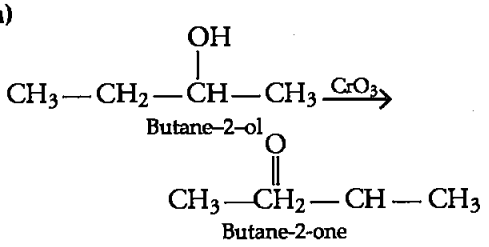
p-cresol Phenol *p*-nitrophenol

(b)



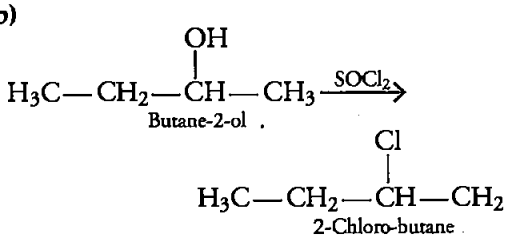
OR

(a)



Butane-2-ol Butane-2-one

(b)

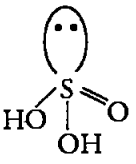


Butane-2-ol 2-Chloro-butane

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]

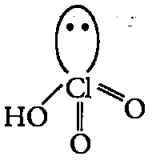
Answer : (a)



****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°_{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) $\Delta G^\circ = -nF\,E^\circ cell$

$= -2 \times 96500 \times 0.236$

$\doteq -45.548$ 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 $[Co(NH_3)_5\,(SCN)]^{2+}$?

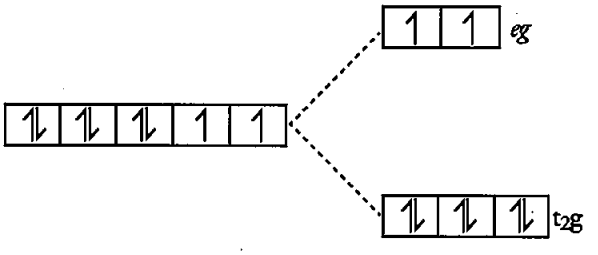
(b) Why is $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic ? (Atomic number of Ni = 28)

(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.

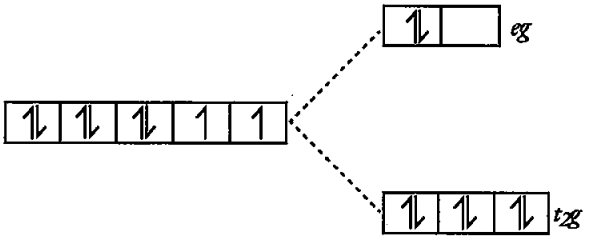


2 electrons are unpaired in $[NiCl_4]^{2-}$ which provides paramagnetism to the complex.

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

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

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.

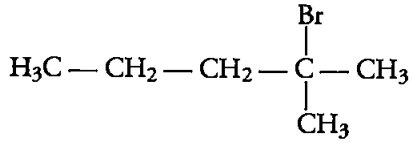
(c) Write the compound which is most reactive towards β-elimination reaction. **[3]**

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 :

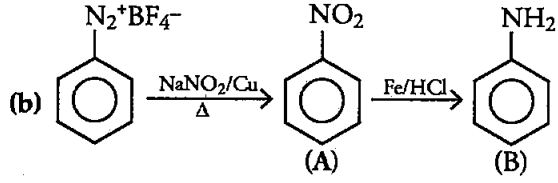
(a) $CH_3COOH \xrightarrow{NH_3/\Delta} \underset{(A)}{CH_3CONH_2} \xrightarrow{Br_2/KOH\ (aq)}$

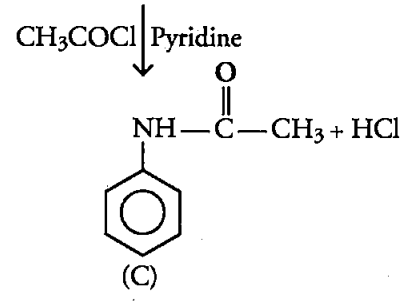
$\underset{(C)}{CH_3NC} \xrightarrow{CH_3Cl_3 + alc\ KOH} \underset{(B)}{CH_3NH_2}$

(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]**

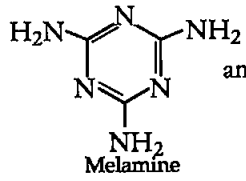
Answer :

(a) Monomers of Nylon-6,6

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

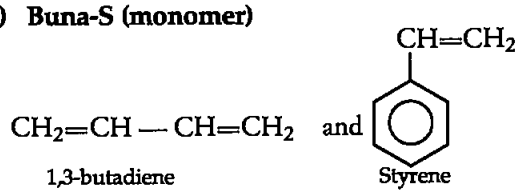
Hexamethylenediamine Adipic acid

(b) Monomers of Melamine-formaldehyde polymer



Melamine and HCHO Formaldehyde

(c) Buna-S (monomer)



1,3-butadiene and Styrene

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.**

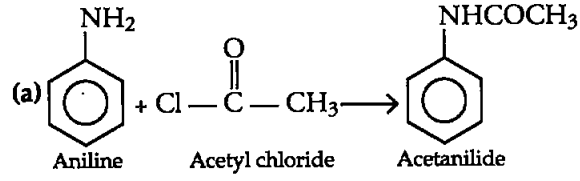
22. Give reasons for the following :

(a) Acetylation of aniline reduces its activation effect.

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

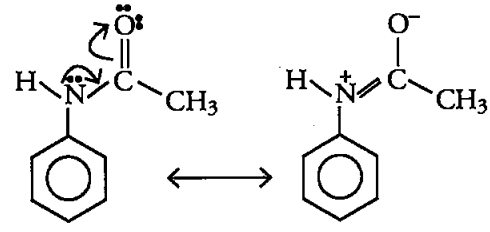
(c) Although-NH_2 is *o/p* directing group, yet aniline on nitration gives a significant amount of m-nitroaniline. [3]

Answer :



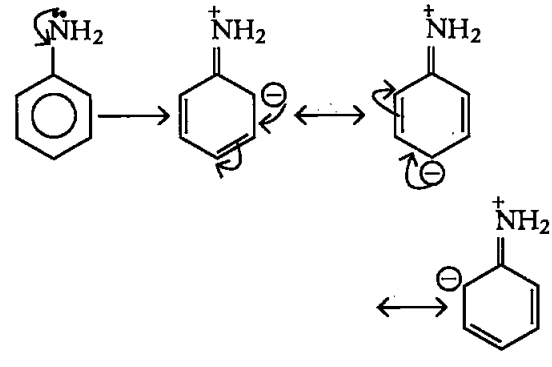
Aniline Acetyl chloride Acetanilide

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



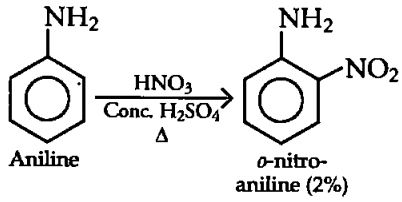
As a result, the electron pair on nitrogen gets displaced to the carboxyl group. Therefore, the unshared pair of electron on nitrogen is less available for donation of the electron to aromatic ring.

(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.

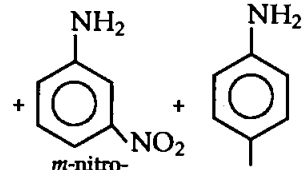


This conjugation of lone pair of e^- is not present in case of methyl amine and lone pair of e^- of 'N' are fully available for protonation. That's why the basicity order of aniline and methyl amine is :

(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 *3d* 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° for Mn^{3+}/Mn^{2+} shows that Mn^{2+} (d^5) is particularly stable. While low value of E° 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

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

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

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

$$23.8 - x = 0.253$$

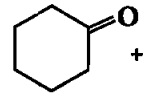
$$x = 23.8 - 0.253 = 23.547$$

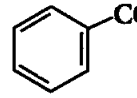
So, vapour pressure of water for this solution = 23.597 mmHg

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

(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

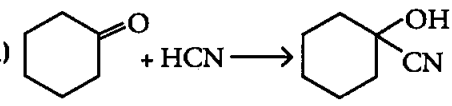
(b) How will you convert the following in not more than two steps :

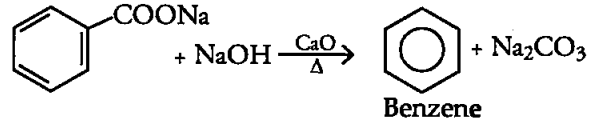
(i) Benzoic acid to Benzaldehyde

(ii) Acetophenone to Benzoic acid

(iii) Ethanoic acid to 2-Hydroxyethanoic acid

Answer : (a)

(i) 

(ii) 

Benzene

(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. $CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 + 2[Ag(NH_3)_2]^+$
   Butan-2-one ↓ 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

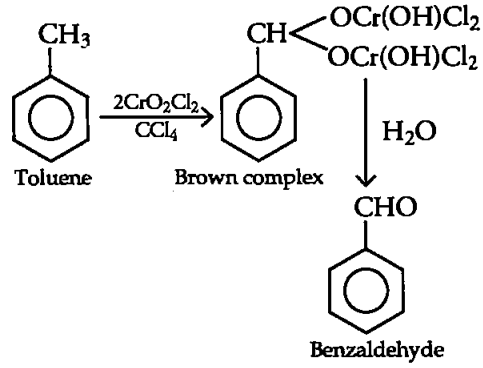
(1) $C_6H_5COOH + NaHCO_3 \longrightarrow C_6H_5COONa + H_2O + CO_2$
Benzoic acid; Sodium bicarbonate; Sodium benzoate

(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.



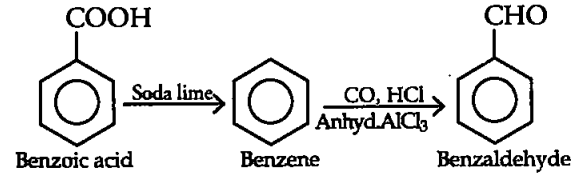
(ii) Stephen reaction : The partial reduction of alkyl or aryl cyanides to the corresponding aldehydes with a suspension of anhydrous $SnCl_2$ in ether saturated with HCl at room temperature followed by hydrolysis.

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

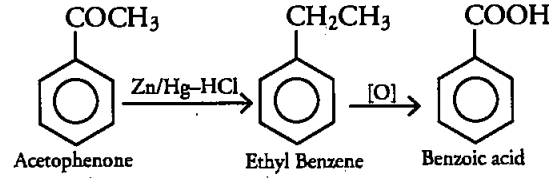
$$CH_3C \equiv N + 2[H] + 2HCl \longrightarrow CH_3CH \equiv NHHCl \xrightarrow[boil]{H_2O} CH_3CHO + NH_4Cl$$
Acetaldoxime hydrochloride; Acetaldehyde

$$C_6H_5 - C \equiv N + 2[H] + 2HCl \longrightarrow C_6H_5CH = NH.HCl \xrightarrow[Boil]{H_2O} C_6H_5CHO + NH_4Cl$$
Benzaldoxime hydrochloride; Benzaldehyde

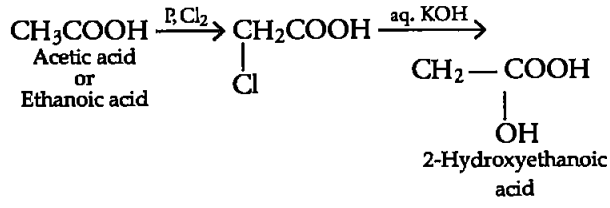
(b) (i) Benzoic acid to Benzaldehyde



(ii) Acetophenone to Benzoic acid



(iii) Ethanoic acid to 2-hydroxyethanoic acid



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Chemistry 2019 (Outside Delhi) SET I

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

General Instructions :

(i) **All** questions are compulsory.

(ii) Section A : Questions number 1 to 5 are very short answer questions and carry 1 mark each.

(iii) Section B : Questions number 6 to 12 are short answer questions and carry 2 marks each.

(iv) Section C : Questions number 13 to 24 are also short answer questions and carry 3 marks each.

(v) Section D : Questions number 25 to 27 are long answer questions and carry 5 marks each.

(vi) There is no overall choice. However, an internal choice has been provided in two questions of one mark, two questions of two marks, four questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions

(vii) Use of log tables, if necessary. Use of calculators is **not** allowed.

SECTION-A

1. **Out of KCl and AgCl, which one shows Schottky defect and why ?**** [1]

OR

Why does ZnO appear yellow on heating ?**

2. **Arrange the following in decreasing order of basic character :** [1]

$C_6H_5NH_2$, $(CH_3)_3N$, $C_2H_5NH_2$

Answer : Decreasing order of basic character :

$CH_3CH_2NH_2 > (CH_3)_3N > C_6H_5NH_2$

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

Answer :

Sols are formed when a solid is dispersed in liquid. Example – Paints.

4. **Out of Chlorobenzene and Cyclohexyl chloride, which one is more reactive towards nucelophilic substitution reaction and why ?** [1]

Answer : Cyclohexyl chloride is more reactive towards nucleophilic substitution reaction, because the carbon bearing the chlorine atom is deficient in electron and seeks a nucleophile. In Chlorobenzene the carbon bearing the halogen is a part of aromatic ring and is electron rich due to the electron density in the ring.

5. **What is the basic structural difference between starch and cellulose ?** [1]

OR

Write the products obtained after hydrolysis of DNA.

Answer : Starch consists of two components-amylose and amylopectin. Amylose is a long linear chain of α- D -(+)-glucose units joined by C_1-C_4 glycosidic linkage (α-link). Amylopectin is a branched-chain polymer of α-D-glucose units, in which the chain is formed by C_1-C_4 glycosidic linkage and the branching occurs by C_1-C_6 glycosidic linkage. On the other hand, cellulose is a straight-chain polysaccharide of β-D-glucose units joined by C_1-C_4 glycosidic linkage (β-link).

OR

Hydrolysis of DNA yields a pentose sugar (β-D-2deoxyribose), phosphoric acid and nitrogen containing heterocyclic compounds called bases (Adenine, Guanine, Cytosine and Thymine).

SECTION-B

6. **Write balanced chemical equations for the following processes :**

(a) Cl_2 is passed through slaked lime.

(b) SO_2 gas is passed through an aqueous solution of Fe (III) salt. [2]

OR

(a) Write two poisonous gases prepared from chlorine gas.

(b) Why does Cu^{2+} solution give blue colour on reaction with ammonia ?

Answer : (a) Cl_2 is passed through slaked lime to give bleaching powder [$Ca(OCl)_2$]

$$2Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + 2H_2O$$

(b) When SO_2 gas is passed through an Fe(III) aqueous solution, Fe(III) is reduced to Fe(II) ion :

$$2Fe^{3+} + SO_2 + 2H_2O \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$$

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

OR

(a) Two poisonous gases prepared from chlorine – Phosgene ($COCl_2$) and tear gas (CCl_3NO_2).

(b) Nitrogen in ammonia has a lone pair of electrons, which makes it a Lewis base. It donates the electron pair and forms linkage with metal ions-

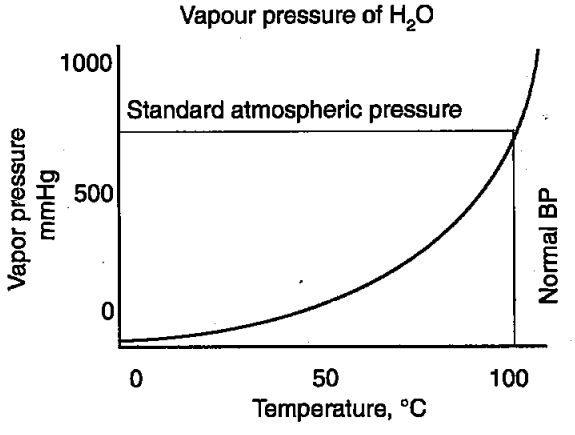
$$Cu^{2+}(aq) + 4NH_3(aq) \rightleftharpoons [Cu(NH_3)_4]^{2+}(aq)$$
(Blue) (Deep blue)

7. **Give reasons :**

(a) Cooking is faster in pressure cooker than in cooking pan.

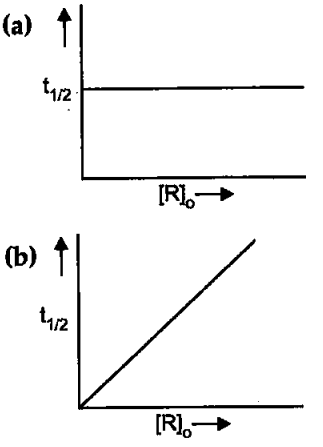
(b) Red Blood Cells (RBC) shrink when placed in saline water but swell in distilled water. [2]

Answer : (a) Boiling points increase on increasing the pressure in case of liquids. Water used for cooking attains higher temperature than usual boiling temperature inside the pressure cooker due to the existing high pressure inside the pressure cooker vessel. This leads to faster flow of water inside the vegetables or grains etc. resulting in faster cooking of food in a pressure cooker than in the cooking pan.



(b) Red blood cells shrink when placed in saline water because of exosmosis, *i.e.*, water comes out from the cell to surrounding (more concentrated) to equate the concentration. Whereas, when placed in distilled water concentration within the cell becomes more than the surrounding, hence water comes inside and endosmosis takes place to equate the concentrations.

8. **Define order of reaction. Predict the order of reaction in the given graphs :**



where $[R]_0$ is the initial concentration of reactant and $t_{1/2}$ is half-life. [2]

Answer : It is defined as the sum of powers to which the concentration terms are raised in the rate law equation.

(a) In this graph as $t_{1/2}$ is independent of initial reactant concentration, it is a first order reaction.

(b) In this graph as $t_{1/2}$ is directly proportional to initial concentration of reactant hence, it is a zero order reaction.

9. **When $FeCr_2O_4$ is fused with Na_2CO_3 in the presence of air it gives a yellow solution of compound (A). Compound (A) on acidification gives compound (B). Compound (B) on reaction with KCl forms an orange coloured compound (C). An acidified solution of compound (C) oxidises Na_2SO_3 to (D). Identify (A), (B), (C) and (D).** [2]

Answer :

$$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$
Sodium chromate (yellow) A

$$Na_2Cr_2O_4 + H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$$
Sodium dichromate
(B)

$$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$$
Potassium dichromate
(C)

$$K_2Cr_2O_7 + 3Na_2SO_3 + 4H_2SO_4 \rightarrow Cr_2(SO_4) + 3Na_2SO_4 + K_2SO_4 + 4H_2O$$
Chromium sulphate (D)

10. **Write IUPAC name of the complex $[Co(en)_2(NO_2)Cl]^+$. What type of structural isomerism is**

shown by this complex ? [2]

OR

Using IUPAC norms, write the formulae for the following complexes :

(a) Hexaaquachromium (III) chloride

(b) Sodium trioxalatoferrate (III)

Answer : IUPAC name of $[Co(en)_2(NO_2)Cl]^+$ is Chlorobis(ethane-1,2-diamine)nitrocobalt(III).

This compound shows geometrical isomerism.

OR

(a) Hexaaquachromium(III) chloride–

$[Cr(H_2O)_6]Cl_3$

(b) Sodium trioxalatoferrate(III) –

$Na_3[Fe(C_2O_4)_3]$

11. (a) Although both $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ have sp^3 hybridisation yet $[NiCl_4]^{2-}$ is paramagnetic and $[Ni(CO)_4]$ is diamagnetic. Give reason. (Atomic no. of Ni = 28).

(b) Write the electronic configuration of d^5 on the basis of crystal field theory when

(i) $\Delta_0 < P$ and

(ii) $\Delta_0 > P$ [2]

Answer : (a) $[NiCl_4]^{2-}$ is a high spin complex and there are two unpaired electrons with $3d^8$ electronic configuration of central metal atom, hence it is paramagnetic. Whereas in $[Ni(CO)_4]$ Ni is in zero oxidation state and contains no unpaired electrons, hence it is diamagnetic in nature.

(b) (i) Electronic configuration of d^5 when $\Delta_0 < P$ is given as $t_{2g}^3 e_g^2$

(ii) Electronic configuration of d^5 when $\Delta_0 > P$ is given as $t_{2g}^5 e_g^0$

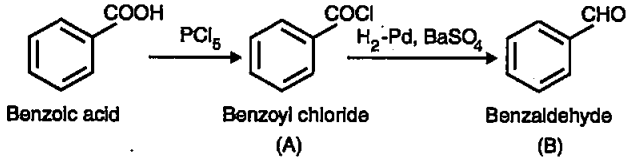
12. Write structures of main compounds A and B in each of the following reactions : [2]

(a) $C_6H_5COOH \xrightarrow{PCl_5} A \xrightarrow{H_2\text{-Pd-BaSO}_4} B$

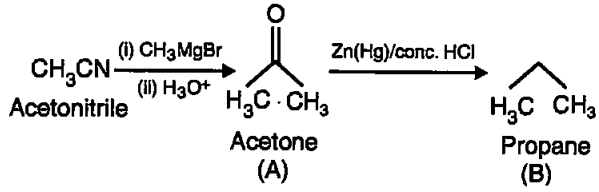
(b) $CH_3CN \xrightarrow[(ii)\ H_3O^+]{(i)\ CH_3MgBr} A \xrightarrow{Zn(Hg)/conc.\ HCl} B$

Answer :

(a)



(b)



SECTION–C

13. The following data were obtained for the reaction :

A+ 2B → C

Experiment	[A]/M	[B]/M	Initial rate of formation of C/M min^{-1}
1	0·2	0·3	$4·2 \times 10^{-2}$
2	0·1	0·1	$6·0 \times 10^{-3}$
3	0·4	0·3	$1·68 \times 10^{-1}$
4	0·1	0·4	$2·40 \times 10^{-2}$

(a) Find the order of reaction with respect to A and B.

(b) Write the rate law and overall order of reaction.

(c) Calculate the rate constant (k). [3]

Answer : The reaction is-

$$A + 2B \rightarrow C$$

(a) It can be seen that when concentration of A is doubled keeping B constant, then the rate increases by a factor of 4 (from 4.2×10^{-2} to 1.68 $\times 10^{-1}$). This indicates that the rate depends on the square of the concentration of the reactant A. Also, when concentration of reactant B is made four times, keeping the concentration of reactant A constant, the reaction rate also becomes 4 times (2.4×10^{-2} to 6.0×10^{-3}). This indicates that the rate depends on concentration of reactant B to the first power.

(b) So, the rate equation will be :

$$Rate = k[A]^2[B]$$

Overall order of reaction will be 2+1 = 3.

(c) Rate constant can be calculated by putting the values given.

$$4.2 \times 10^{-2}\ M\ min^{-1} = k\ (0.2)^2(0.3)\ M$$

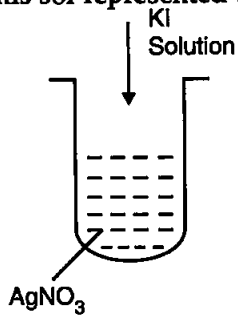
$$k = \frac{0.042}{0.012}$$

$$= 3.5\ min^{-1}$$

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

(b) Why is physisorption reversible whereas chemisorption is irreversible ?

(c) A colloidal sol is prepared by the method given in the figure. What is the charge of AgI colloidal particles formed in the test tube ? How is this sol represented ? **[3]**



Answer : (a) In dust the dispersed phase is solid particles and dispersion medium is air (gas).

(b) Physisorption occurs only because of physical attractive forces, like van der Waals forces between molecules of adsorbate and adsorbent, hence that can be reversed on application of bigger forces but chemisorption occurs due to chemical reaction between molecules of adsorbate and adsorbent, and hence can't be reversed.

(c) When KI solution is added to $AgNO_3$ a positively charged sol results due to absorption of Ag^+ ions from dispersion medium–AgI/Ag^+(positively charged)

15. An element X with an atomic mass of 81 u has density 10·2 g cm^{-3} . If the volume of unit cell is 2·7 × 10^{-23} cm^3, identify the type of cubic unit cell. (Given : $N_A = 6·022 \times 10^{23}$ mol^{-1})** **[3]**

16. A solution containing 1·9 g per 100 mL of KCl (M = 74·5 g mol^{-1}) is isotonic with a solution containing 3 g per 100 mL of urea (M = 60 g mol^{-1}). Calculate the degree of dissociation of KCl solution. Assume that both the solutions have same temperature. **[3]**

Answer : Two solutions having same osmotic pressure at a given temperature are called isotonic solution. Now in the given problem, the KCl and urea solutions are given to be isotonic.

Osmotic pressure π is given by the equation – $\pi = (n_2/V)RT$, where, n_2= moles of solute, V = volume of a solution in litre.

Also, $n_2 = w_2/M_2$, where w_2 = grams of solute and M_2 = molar mass of solute.

The other given information are–

Molar mass of KCl = 74.5 g mol^{-1}

Weight of KCl, w_2 = 1.9 g, V = 100 mL

So, for KCl–

$$\pi = (w_2/M_2 \times V)RT$$

$$\pi RT_{KCl} = 1.9/(74.5 \times 100)$$

$$= 2.55 \times 10^{-4}$$

Now as the solutions are isotonic at same temperature :

$$\pi RT_{KCl} = \pi RT_{Urea}$$

Hence, substituting the values for urea :

$$2.55 \times 10^{-4} = 3/M_2 \times 100$$

$$M_2 = 117.6$$

So, the experimentally determined molecular weight of urea is found to be as 117.6, so the degree of dissociation can be given as :

Osmotic pressure (π) =

$$\frac{\text{Experimentally determined molecular weight}}{\text{Actual molecular weight}}$$

$$= 117.6 / 60$$

$$= 1.96 \approx 2$$

$$\alpha = \frac{i-1}{n-1} = \frac{1.96-1}{2-1} = 96\%$$

So, Urea diamerised in the given experimental solution.

17. Write the name and principle of the method used for refining of (a) Zinc, (b) Germanium, (c) Titanium. **[3]**

Answer : (a) Distillation is used for refining zinc. As zinc is a low boiling metal, the impure metal is evaporated and the pure metal is obtained as a distillate.

(b) Zone refining is used for refining Germanium. This method is based on principle that the impurities are more soluble in the melt than in the solid state of the metal.

(c) Titanium is refined by van Arkel method. This method is used for removal of oxygen and nitrogen present as impurity. The crude metal is heated in an evacuated vessel with iodine to obtain metal iodide, which volatilizes being covalent. Later this metal iodide is decomposed through electrical heating to obtain the pure metal.

18. Give reasons for the following :

(a) Transition metals form complex compounds.

(b) E° values of (Zn^{2+}/Zn) and (Mn^{2+}/Mn) are more negative than expected.

(c) Actinoids show wide range of oxidation states. **[3]**

Answer : (a) Transition elements have partly filled d-orbitals due to which they have variable oxidation states which enables them to

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

bind with a variety of ligands and hence form complex compounds.

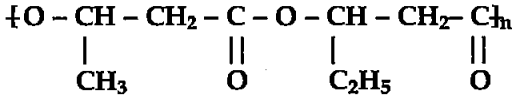
(b) Oxidation of Zn to Zn^{2+} leads to a completely filled d^{10} configuration in Zn^{2+}, making it more stable. Also, Mn/Mn^{2+} conversion leads to a half filled stable d^5 configuration of Mn^{2+} ion. Hence, E° value for $Zn/Zn^2$and Mn/Mn^{2+}conversion have negative values.

(c) Actinoids show wide range of oxidation states due to their partially filled *f*-orbitals and they have comparable energies as well.

19. Write the structures of monomers used for getting the following polymers :
(a) Nylon-6 **(b) Terylene**
(c) Buna-N **[3]**

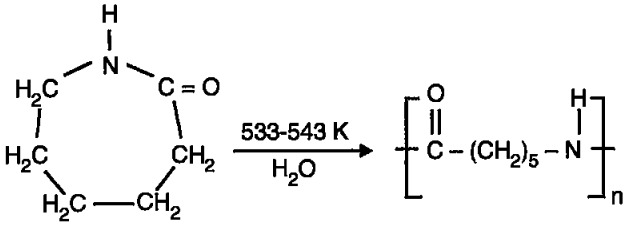
OR

(a) Is $\{CH_2–CH(C_6H_5)\}_n$ homopolymer or copolymer ? Give reason.
(b) Write the monomers of the following polymer :



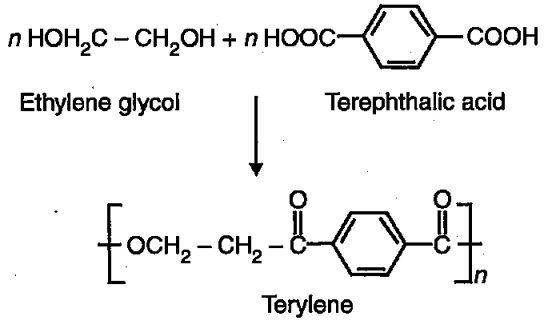
(c) Write the role of benzoyl peroxide in polymerisation of ethene.

Answer :
Structures of monomers—
(a) Caprolactum is monomer of Nylon-6



Caprolactum Nylon 6

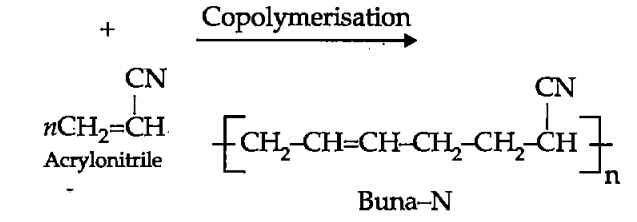
(b) Ethylene glycol and terephthalic acid polymerise to give Terylene –



Ethylene glycol Terephthalic acid

Terylene

(c) 1,3-Butadiene and Acrylonitrile polymerise to give Buna-N—

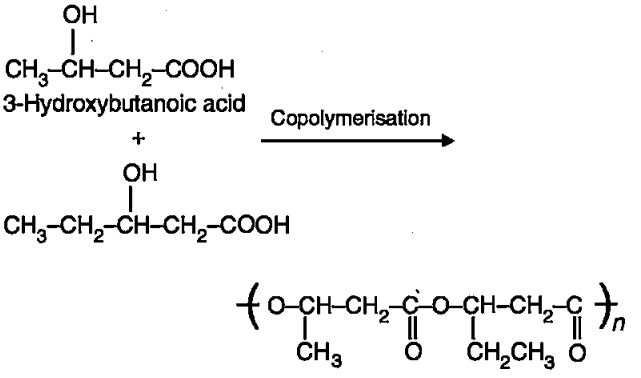


1, 3-Butadiene Acrylonitrile Buna–N

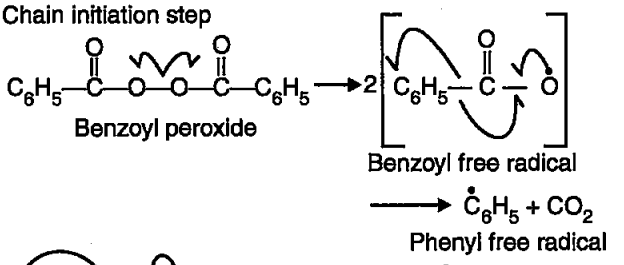
OR

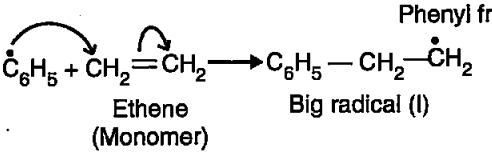
(a) $\{CH_2-CH(C_6H_5)\}$ is a homopolymer as it is formed by addition polymerization of monomer $CH_2 = CHC_6H_5$(Styrene).

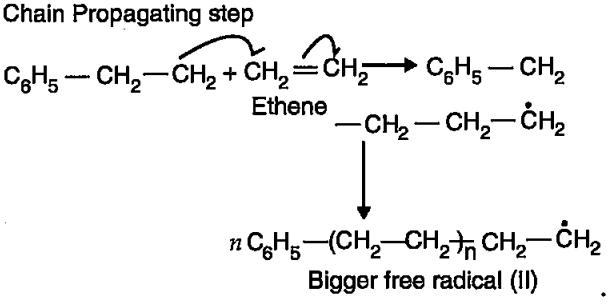
(b) The monomers are 3-Hydroxybutanoic acid and 3-Hydroxypentanoic acid—



(c) Benzoyl peroxide acts as free radical initiator in polymerization of ethene.







20. (a) Pick out the odd one from the following

on the basis of their medicinal properties : Equanil, Seconal, Bithional, Luminal

(b) What types of detergents are used in diswashing liquids ?

(c) Why is the use of aspartame limited to cold foods ? [3]

OR

Define the following terms with suitable example of each :

(a) Antibiotics

(b) Antiseptics

(c) Anionic detergents

Answer : (a) 'Bithionol' is the odd one here, as it is an antiseptic whereas others are tranquilizers.

(b) Liquid dishwashing detergents are non-ionic type.

(c) Aspartame is an artificial sweetener which is unstable at cooking temperature hence its use is limited to cold foods.

OR

(a) Antibiotics –These are the compounds (produced by microorganisms or synthetically) which either inhibit the growth of bacteria or kill bacteria. Example : Penicillin.

(b) Antiseptics – These are the chemicals used to kill or prevent the growth of microorganisms when applied to the living tissues. Example – Soframicin.

(c) Anionic detergents – These are sodium salts of sulphonated long chain alcohols or hydrocarbons. In these the anionic part of the molecule is involved in the cleansing action. Example – Sodium lauryl sulphate.

21. Among all the isomers of molecular formula C_4H_8Br, identify :

(a) the one isomer which is optically active.

(b) the one isomer which is highly reactive towards S_N2.

(c) the two isomers which give same product on dehydrohalgenation with alcoholic KOH. [3]

Answer : The possible isomers are :

1. $H_3C-CH_2-CH_2-CH_2-Br$

1-Bromobutane

2. $H_3C-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$

2-Bromobutane

3. $H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2Br$

1-Bromobutane-2-methylpropane

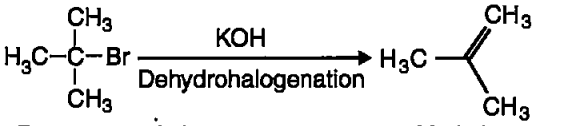
4. $H_3C-\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-Br$

2-Bromo-2-methylpropane

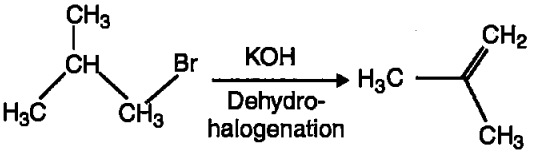
(a) 2- Bromobutane is optically active as C-2 is a chiral carbon here having all the four different groups attached to it.

(b) 1-Bromobutane being primary alkyl halide is highly reactive towards S_N2 reaction.

(c) 2- Bromo-2-methylpropane and 1-Bromo-2-methylpropane would give same product after dehydrohalogenation.



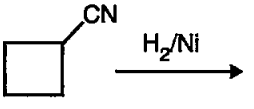
2-Bromo-2-methyl propane — 2-Methylpropene



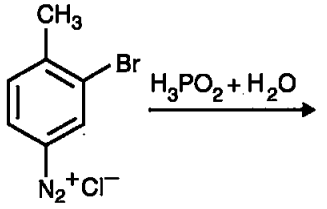
2-Methylpropene

22. Complete the following reactions : [3]

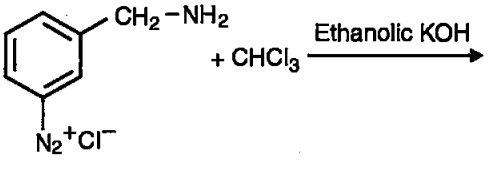
(a)



(b)



(c)



OR

How do you convert the following :

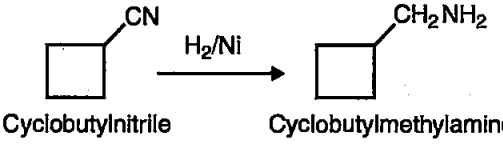
(a) N-phenylethanamide to *p*-bromaniline

(b) Benzene diazonium chloride to nitrobenzene

(c) Benzoic acid to aniline

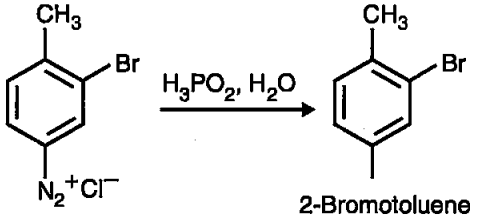
Answer :

(a)



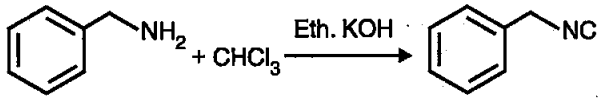
Cyclobutylnitrile Cyclobutylmethylamine

(b)



2-Bromo-4-methylbenzene diazonium chloride — 2-Bromotoluene

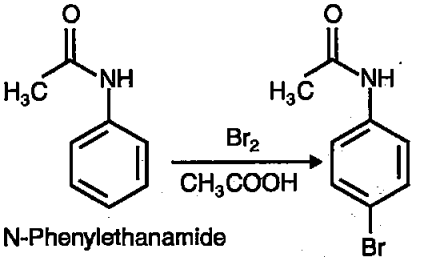
(c)



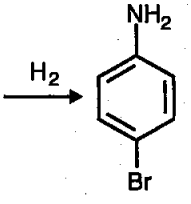
Ethyl amine Benzyl isocyanide

OR

(a)

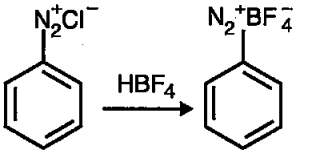


N-Phenylethanamide p-Bromoacetanilide

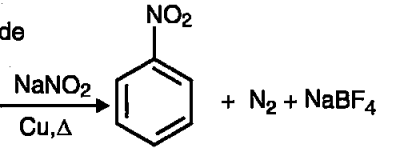


p-Bromoaniline

(b)

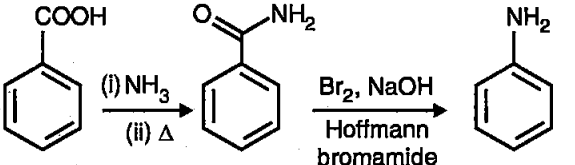


Benzene diazonium chloride



Nitrobenzene

(c)



Benzoic acid Benzamide Aniline

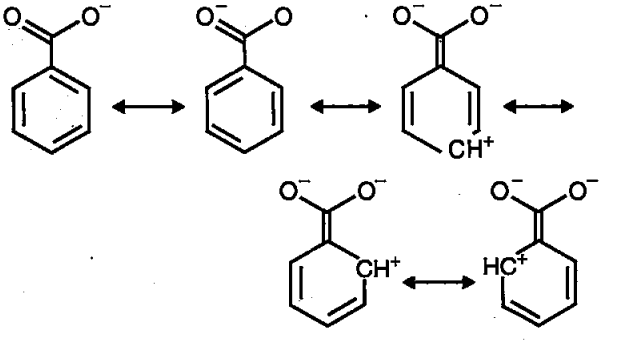
23. (a) Give reasons :

(i) Benzoic acid is a stronger acid than acetic acid.

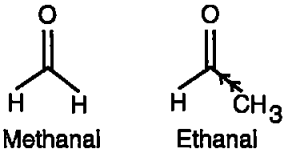
(ii) Methanal is more reactive towards nucleophilic addition reaction than ethanal.

(b) Give a simple chemical test to distinguish between propanal and propanone. [3]

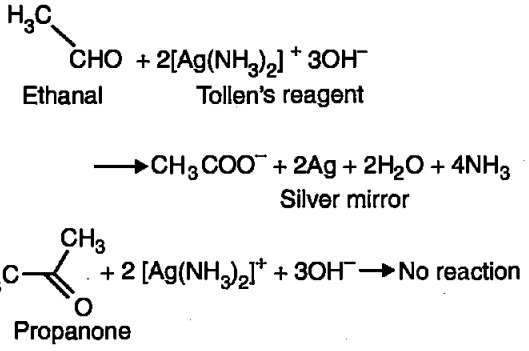
Answer : (a) (i) Benzoic acid is a stronger acid than acetic acid because the benzoate anion (conjugate base of benzoic acid) formed after loss of H^+ is stabilized by resonance, whereas acetate ion (CH_3COO^-) has no such extra stability. Hence, Benzoic acid has more tendency of losing proton compared to acetic acid hence more acidic.



(ii) Methanal is more reactive towards nucleophilic addition reaction than ethanal because in ethanal there is a methyl group attached to the carbonyl carbon (centre for nucleophile attack) and +I effect of the methyl group decreases the nucleophilicity of carbonyl carbon by increasing the electron density at carbonyl carbon.



(b) Propanal and propanone can be distinguished using Tollen's reagent by silver mirror test. Propanal being an aldehyde reacts with Tollen's reagent to give silver deposition whereas propanone being a ketone does not give the reaction.

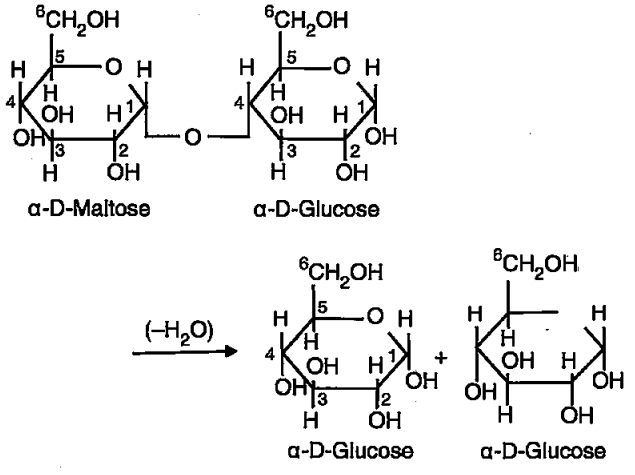


24. (a) What are product of hydrolysis of maltose ?
(b) What type of bonding provides stability to α-helix structure of protein ?
(c) Name the vitamin whose deficiency causes pernicious anaemia. **[3]**

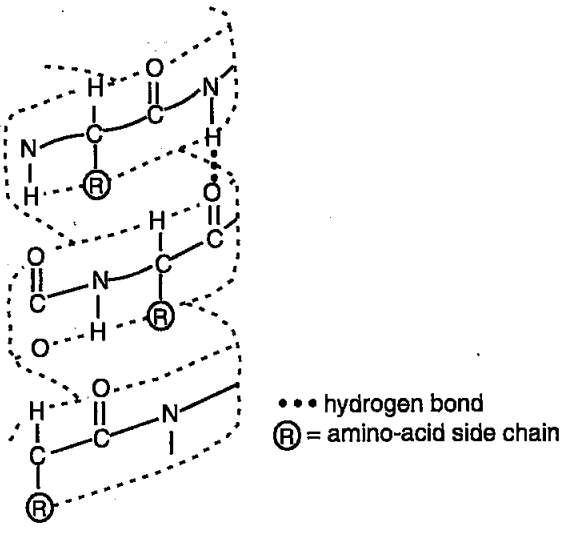
OR

Define the following terms :
(a) Invert sugar
(b) Native protein
(c) Nucleotide

Answer : (a) On hydrolysis maltose gives two molecules of α-D-glucose.



(b) α-Helix structure of proteins is stabilized by hydrogen bonds between –NH group of each amino acid and –COOH group of amino acid at adjacent turn.



(c) Deficiency of Vitamin B_{12} causes pernicious anaemia.

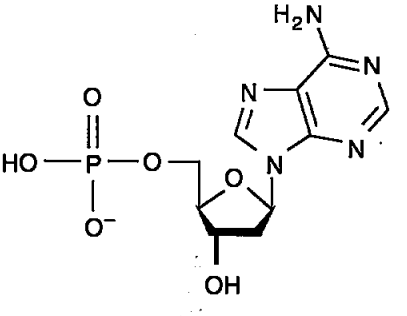
OR

(a) Invert sugar – It is a mixture of glucose and fructose obtained after hydrolysis of sucrose. Sucrose is dextrorotatory, but after hydrolysis gives a mixture of dextrorotatory glucose and levorotatory fructose which outweighs in magnitude and hence the whole mixture becomes levorotatory hence the mixture obtained is called invert sugar.

(b) Native protein – Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein.

(c) Nucleotide –They are building blocks of DNA/RNA. These consist of a pentose sugar moiety attached to a nitrogenous base at 1′ position and a phosphoric acid molecule at 5′ position.

Example :



SECTION-D

25. (a) The conductivity of 0·001 mol L^{-1} acetic acid is $4·95 \times 10^{-5}$ S cm^{-1}. Calculate the dissociation constant if Λ_m^0 for acetic acid is 390·5 S cm^2 mol^{-1}.
(b) Write Nernst equation for the reaction at 25°C :

2 Al (s) + 3 Cu^{2+} (aq)→2 Al^{3+} (aq) + 3 Cu (s)

(c) What are secondary batteries ? Give an example. [5]

OR

(a) Represent the cell in which the following reaction takes place :

2Al (s) + 3 Ni^{2+} (0·1M) → 2Al^{3+} (0·01 M) + 3 Ni (s)

Calculate its emf if E^0_{cell} = 1·41 V.

(b) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte ? How can you obtain limiting molar conductivity (Λ^0_m) for weak electrolyte ?

Answer : (a) Conductivity Λ_m of solution is given by the following equation :

$\Lambda_m = \frac{k}{c}$, where k is dissociation constant and c is the concentration of solution.

Here, given.

Conductivity, $k = 4.95 \times 10^{-5}$ S cm^{-1}

Limiting molar conductivity,

$\Lambda^0_m = 390.5$ S cm^2 mol^{-1}

Concentration,

$$c = 0.001 \text{ mol } L^{-1}$$
$$= 1 \times 10^{-3} \text{ mol } L^{-1}$$

Substituting the given values in above equation

Molar conductivity,

$$\Lambda_m = \left(\frac{49.5 \times 10^{-5} \text{S cm}^{-1}}{1 \times 10^{-3} \text{ mol L}^{-1}}\right) 10^3 \text{cm}^3 \text{L}^{-1}$$
$$= 49.5 \text{ S cm}^2 \text{ mol}^{-1}$$

Now, degree of dissociation α, is given by

$$\alpha = \frac{\Lambda_m}{\Lambda^\circ_m}$$

Putting the values,

$$\alpha = \frac{49.5}{390.5} \text{ S cm}^2 \text{ mol}^{-1}$$
$$= 0.1267$$

Dissociation constant, k, for acetic acid, can be given as

$$k = \frac{c\alpha^2}{(1-\alpha)}$$
$$= \frac{[1 \times 10^{-3} \text{mol L}^{-1} \times (0.1267)^2]}{(1 - 0.1267)}$$
$$= \frac{0.016 \times 10^{-3} \text{mol L}^{-1}}{0.8733}$$
$$= 1.8 \times 10^{-5} \text{ mol L}^{-1}$$

(b) Nernst equation for the given reaction can be written as

$$E_{cell} = \frac{E^\circ_{cell} - RT}{2F \ln\left(\frac{[Al_3{}^+]^2}{[Cu^{2+}]^3}\right)}$$

(c) A secondary battery can be recharged after use, by passing current through it in opposite direction so that it can be used again. Example : The most important secondary cell is lead storage cell. It consists of lead anode and a grid of lead packed with lead dioxide as cathode. A 38% solution of sulphuric acid is used as an electrolyte.

OR

(a) The cell can be represented as

$Al \mid Al^{3+}(0.01 \text{ M}) \mid\mid Ni^{2+}(0.1) \mid Ni$

Cell potential is given by the following equation in this case

$$E_{cell} = \frac{E^\circ_{cell} - RT}{2F \ln\left(\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}\right)}$$

Given

E°_{cell} = 1.41 V, concentration of Al^{3+} ions is 0.01M and Ni^{2+} ions is 0.1 M

Putting the values in equation

$$E_{cell} = \frac{1.41 \text{ V} - 0.059}{2 \log\left(\frac{0.01^2}{0.1^3}\right)}$$

$$= 1.38 \text{ V} \log\left(\frac{1 \times 10^{-4}}{1 \times 10^{-3}}\right)$$
$$= 1.38 - (-1)$$
$$= 2.38 \text{ V}$$

So, emf of the cell is 2.38 V.

(b) For strong electrolytes the molar conductivity is increased only slightly on dilution. A strong electrolyte is completely dissociated in solution and thus, furnishes all ions for conductance. However, at higher concentrations, the dissociated ions are close to each other and thus, the interionic attractions are greater. These forces retard the motion of the ions and thus, conductivity is low. With decrease in concentration (dilution), the ions move away from each other thereby feeling less attractive forces from the counter ions. This results in an increase in molar conductivity with dilution. The molar conductivity approaches a maximum limiting value at infinite dilution designated as $\Lambda_m{}^0$.

In case of weak electrolytes as the solution of a weak electrolyte is diluted, its ionization is increased. This results in more number of ions in solution and thus, there is an increase in molar conductivity, also there is a large increase in the value of molar conductivity with dilution, especially near infinite dilution. However, the conductance of a weak electrolyte never approaches a limiting value. Or in other words it is not possible to find conductance at infinite dilution (zero concentration).

So, limiting molar conductivity for weak electrolytes is obtained by using Kohlrausch law, from the limiting molar conductivities of individual ions (λ°).

Kohlrausch law of independent migration of ions states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and the cation of the electrolyte.

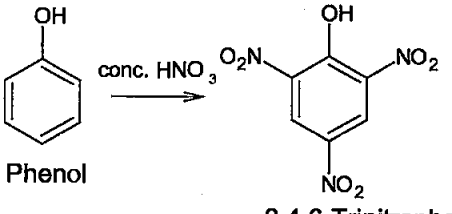
$$\Lambda^\circ_m = \lambda^\circ_+ + \lambda^\circ$$

26. (a) Give equation of the following reactions :
(i) Phenol is treated with conc. HNO_3.
(ii) Propene is treated with B_2H_6 followed by H_2O_2/OH^-.
(iii) Sodium t-butoxide is treated with CH_3Cl.
(b) How will you distinguish between butan–1–ol and butan–2–ol ?
(c) Arrange the following in increasing order of acidity :
Phenol, ethanol, water [5]

OR

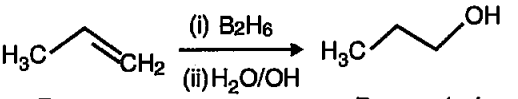
(a) How can your obtain Phenol from (i) Cumene, (ii) Benzene sulphonic acid, (iii) Benzene diazonium chloride ?
(b) Write the structure of the major product obtained from dinitration of 3-methylphenol.
(c) Write the reaction involved in Kolbe's reaction.

Answer : (a) (i) Phenol is treated with conc. HNO_3 to obtain 2,4,6-trinitrophenol picric acid.



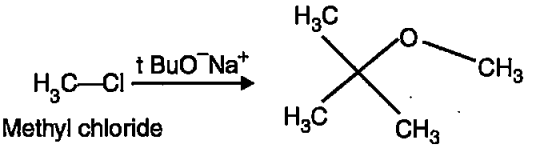
Phenol — 2,4,6-Trinitrophenol

(ii) Propene undergoes hydroboration-oxidation when treated with B_2H_6 followed by hydrogen peroxide in basic medium to give propan-1-ol.



Propene — Propan-1-ol

(iii) Methyl tert-butyl ether is produced when sodium tert-butoxide is treated with methyl chloride.



Methyl chloride — Methyl tert-butyl ether

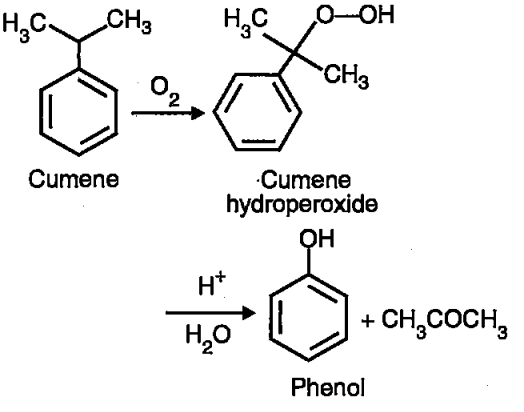
(b) Butan-1-ol and Butan-2-ol can be distinguished using Lucas reagent ($ZnCl_2$+HCl), where butan-2-ol would react with Lucas reagent in around 5 minutes to give a white precipitate of 2-chlorobutane, whereas butan-1-ol won't give any reaction at room temperature.

(c) Increasing order of acidity can be given as

Ethanol < water < phenol

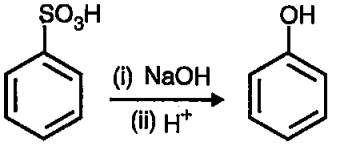
OR

(a) (i) Phenol from cumene



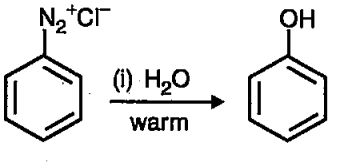
Cumene — Cumene hydroperoxide — Phenol

(ii) Phenol from benzene sulphonic acid



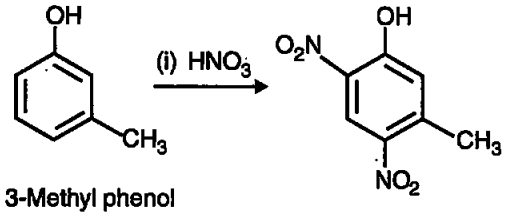
Benzene sulphonic acid — Phenol

(iii) Phenol from benzene diazonium chloride



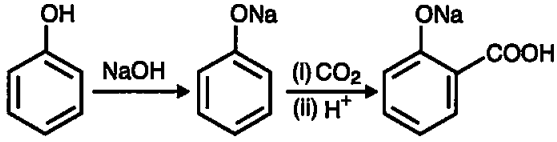
Benzene diazonium chloride — Phenol

(b) The combined influence of –OH and $-CH_3$ groups determine the position of the entering groups, also the sterically hindered positions are not substituted.



3-Methyl phenol 3-Methyl-4, 6 dinitrophenol

(c) In Kolbe's reaction phenol is reacted with CO_2 in presence of sodium hydroxide, followed by acidification, to give a carboxylic acid group on 2-position of phenol-



Phenol Sodium phenoxide 2-Hydroxybenzoic acid (Salicylic acid)

27. (a) Account for the following :

(i) Tendency to show – 3 oxidation state decreases from N to Bi in group 15.**

(ii) Acidic character increases from H_2O to H_2Te.

(iii) F_2 is more reactive than ClF_3, whereas ClF_3 is more reactive than Cl_2.

(b) Draw the structure of (i) XeF_2, (ii) $H_4P_2O_7$. [5]

OR

(a) Give one example to show the anomalous reaction of fluorine.

(b) What is the structural difference between white phosphorous and red phosphorous ?**

(c) What happens when XeF_6 reacts with NaF ?

(d) Why is H_2S a better reducing agent than H_2O ?

(e) Arrange the following acids in the increasing order of their acidic character :

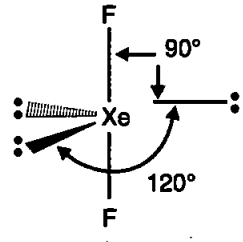
HF, HCl, HBr and HI

Answer : (a) (ii) Acidic character increases from H_2O to H_2Te due to decrease in E—H bond dissociation enthalpy down the group. Thus it becomes easy to lose proton going down the group.

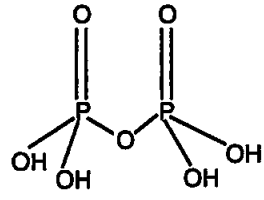
(iii) F_2 is more reactive than ClF_3 because of small size of fluorine atom F—F bond, bond dissociation enthalpy is low (thus is reactive).

Whereas ClF_3 is more reactive than Cl_2 because ClF_3 is an interhalogen compound with weak Cl—F bond (compared to Cl—Cl bond) due to difference in atomic sizes (hence ineffective overlap of orbitals).

(b) (i) Structure of XeF_2 is linear.



(ii) Structure of $H_4P_2O_7$:



OR

(a) Fluorine reacts with cold sodium hydroxide solution to give OF_2.

$2F_2(g) + 2NaOH(aq) \rightarrow 2NaF(aq) + OF_2(g) + H_2O(l)$

(c) XeF_6 reacts with NaF as follows :

$XeF_6 + NaF \rightarrow Na^+[XeF_7]^-$

(d) Ability to reduce is judged by ease with which an atom can donate its electrons to the species which is getting reduced. Now, the size of oxygen atom in H_2O is smaller than that of Sulphur atom in H_2S, due to which the lone pair of electrons on oxygen are more attracted by the oxygen nucleus, making it difficult to donate the electrons (by oxygen compared to Sulphur, while in H_2S the influence of nucleus is less on lone pair of electrons of sulphur and hence, it can give away its electrons, easily compared to oxygen, and thus acts as a better reducing agent.

(e) The increasing order of acidic character can be written as

$HF < HCl < HBr < HI$

●●

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

Chemistry 2019 (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 the previous set.

SECTION-A

2. Arrange the following in increasing order of pK_b values :
$C_6H_5CH_2NH_2$, $C_6H_5NHCH_3$, $C_6H_6NH_2$ [1]
Answer : These can be arranged in increasing order of pK_b values as follows :

$C_6H_5CH_2NH_2 < C_6H_5NHCH_3\ C_6H_5NH_2$

3. 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 a solid, a 'gel' is formed. Example : Butter.

4. Out of chlorobenzene and *p*-nitrochlorobenzene, which one is more reactive towards nucleophilic substitution reaction and why ? [1]
Answer : *p*-Nitro chlorobenzene would be more reactive towards nucleophilic substitution reaction compared to chlorobenzene. In chlorobenzene the carbon bearing the halogen is a part of aromatic ring and is electron rich due to the electron density in the ring so, it does not attract the nucleophile. The $-NO_2$ substitution lessens the electron density on the benzene ring due to its electron withdrawing nature, making the electron density on ring less compared to chlorobenzene, hence *p*-nitro chlorobenzene attracts nucleophiles better.

SECTION-B

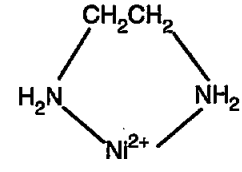
7. Give reasons :
(a) A decrease in temperature is observed on mixing ethanol and acetone.
(b) Potassium chloride solution freezes at a lower temperature than water. [2]
Answer: (a) Upon mixing molecules of ethanol and acetone have strong intermolecular attractions due to which heat is evolved from reaction system and hence cooling of mixture is observed.
(b) Potassium chloride solution is a solution of non -volatile solute KCl and water solution. We know that, at the freezing point of a substance, the solid phase (here ice) is in dynamic equilibrium with the liquid phase. A solution freezes when its vapour pressure equals the vapour pressure of pure solid solvent. Now, according to Raoult's law when a non -volatile solid is added to the solvent (in this case it is KCl), its vapour pressure decreases and now it would become equal to that of solid solvent at lower temperature. Thus, the freezing point of solvent decreases.

10. Define the following terms with a suitable example of each : [2]
(a) Chelate complex
(b) Ambidentate ligand

OR

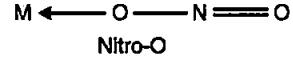
Using IUPAC norms, write the formulae for the following complexes :
(a) Tetraamminediaquacobalt (III) chloride
(b) Dibromidobis (ethane-1, 2-diamine) platinum (IV) nitrate

Answer : (a) Chelate complex –Chelate complexes are coordination or complex compound consisting of a central metal atom attached to a large molecule, called a ligand, in a cyclic or ring structure. The ligands are bi- or polydentate *i.e.*, they can attach to metal atom through two or more than two binding sites. An example of a chelate ring occurs in the ethylenediamine-nickel complex.

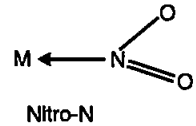


A chelate complex

(b) Ambidentate ligand : Ligands which can ligate (attach to metal atom) through two different atoms is called ambidentate ligand. One example of such ligand is NO_2^-, this can bind through both the atoms, nitrogen and oxygen.



Nitro-O



Nitro-N

OR

IUPAC names

(a) Tetramminediaquacobalt(III)chloride

$[Co(NH_3)_4(H_2O)_2]Cl_3$

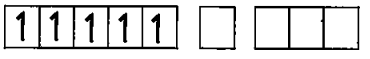
(b) Dibromidobis(ethane-1,2-diamine) platinum(IV) nitrate –$[PtBr_2(en)_2](NO_3)_2$

11. (a) Using valence bond theory, write the hybri-disation and magnetic character of the complex $[Fe(CN)_6]^{4-}$. (Atomic no. of Fe = 26)
(b) Write the electronic configuration of d^6 on the basis of field theory when
(i) $\Delta_0 < P$ and
(ii) $\Delta_0 > P$ **[2]**

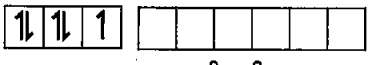
Answer : (a) $[Fe(CN)_6]^{4-}$ is a low spin or inner orbital complex as CN^- is a strong field ligand.

Hybridisation Scheme

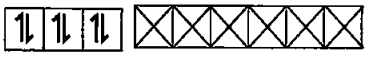
Orbitals of Fe^{3+} ion



d^2sp^3 hybridised orbitals of Fe^{3+}



$[Fe(CN)^6]^{3-}$ (Inner orbitals/Low spin complex)



6 pairs of electrons from 6 CN molecules

$[Fe(CN)_6]^{4-}$ is diamagnetic as there is no unpaired electron left.

(b) (i) Electronic configuration of d^6 when $\Delta_0 < P$, that is in case of weak field ligand

$t_{2g}^4 e_g^2$

$dxy^2, dxz^1, d_{yz}^1, d_{x^2y^2}^1, d_{z^2}^1$

(ii) Electronic configuration of d^6 when $\Delta_0 > P$, that is in case of strong field ligand

$t_{2g}^6 e_g^0$

$dxy^2, dxz^2, d_{yz}^2, d_{x^2y^2}^0, d_{z^2}^0$

SECTION C

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

(b) Why is adsorption exothermic in nature ?

(c) Write Freundlich adsoption isortherm for gases at high pressure. **[3]**

Answer : (a) Dispersed phase of milk is liquid and dispersion medium of milk is liquid.

(b) During the process of adsorption molecules of adsorbate and adsorbent come closer to form physical or chemical bonds hence getting stabilized, in this process heat is evolved leading the overall process to be exothermic.

(c) Freundlich adsorption isotherm for gases at high pressure.

It is an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature :

$$x/m = k\,p^{1/n} (n > 1)$$

Where, x is the mass of the gas adsorbed on mass m of the adsorbent at pressure p, k and n are constants which depend on the nature of the adsorbent and the gas at a particular temperature.

The relationship is generally represented in the form of a curve x/m is plotted against the pressure. This curve always approach saturation towards high pressure, thus indicating that at adsorption though increases with increase in pressure but till a limit and at high pressures no further adsorption is observed.

15. Write the name and principle of the method used for refining of (a) Tin, (b) Copper, (c) Nickel. **[3]**

Answer : (a) Tin : It is refined through liquation. In this method a low melting metal like tin is made to flow on a sloping surface, where the higher melting impurities are left behind and the lower melting metal is collected at the slope end.

(b) Copper : It is refined through electrolytic refining. Anode is made of impure copper and pure copper stripes are taken as cathode. They are dipped in acidified solution of copper sulphate as electrolyte. The net result of electrolysis is the transfer of copper in pure form from the anode to the cathode and the impurities gets deposited as anode mud.

(c) Nickel : It is refined through Mond's process. In this process, Nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl.

$$Ni + 4\,CO \xrightarrow{330-350\ K} Ni(CO)_4$$

The carbonyl is subjected to higher temperature

so that it is decomposed giving the pure metal.

$$Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$$

16. Give reason for the following :

(a) Transition metals show variable oxidation states.

(b) E° value of (Zn^{2+}/Zn) is negative while that of (Cu^{2+}/Cu) is positive.

(c) Higher oxidation state of Mn with fluorine is +4 whereas with oxygen is +7. **[3]**

Answer : (a) Transition metals show variable oxidation states because their *d*-orbitals are incompletely filled and different arrangements of electrons are possible according to the chemical environment of metal ion hence, the ions can occupy variable oxidation states.

(b) E° value for Zn/Zn^{2+} is negative because conversion of Zn to Zn^{2+} gives it a completely filled d^{10} configuration and extra stability gained by Zn^{2+}. Whereas, conversion of Cu to Cu^{2+}does not give any extra stability, hence it has a positive E° value.

(c) Mn has the highest oxidation state of +4 with fluorine but with oxygen it is +7. This is due to the ability of oxygen to form multiple bonds with the metal ion, whereas fluorine being of small size and devoid of *d*-orbitals can't form multiple bonds.

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

(a) Nylon-6, 6

(b) Bakelite

(c) Buna-S **[3]**

OR

(a) Write one example each of :

(i) Thermoplastic polymer

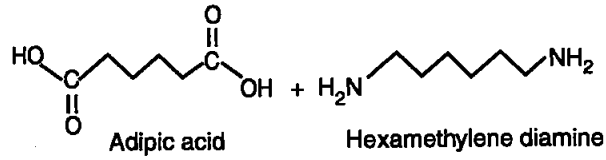
(ii) Elastomers

(b) Arrange the following polymers in the increasing order of their intermolecular forces :

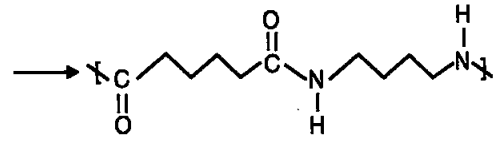
Polythene, Nylon-6, 6, Buna-S

(c) Which factor provides crystalline nature to a polymer like Nylon ?

Answer : (a) Monomers of Nylon-6, 6 are adipic acid and hexamethylene diamine.

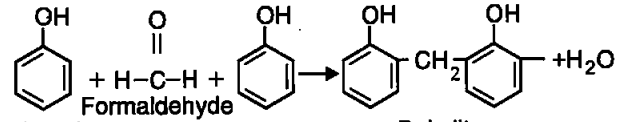


Adipic acid Hexamethylene diamine



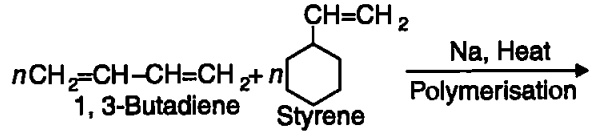
Nylon 6, 6

(b) Monomers of bakelite are phenol and formaldehyde :

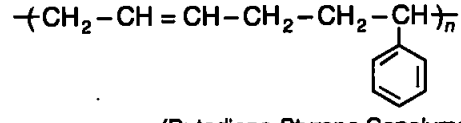


Phenol Bakelite

(c) Monomers of Buna-S are 1, 3-Butadiene and Styrene



1, 3-Butadiene Styrene



(Butadiene-Styrene Copolymer)
(SBR or BUNA-S)

OR

(a)(i) Example of thermoplastic polymer – polythene, polystyrene.

(ii) Example of elastomer – Neoprene.

(b) In increasing order of their intermolecular force, they can be arranged as :

Buna-S < Polythene < Nylon-6, 6

(c) Strong intermolecular forces between the polymer molecules, such as hydrogen bonding leads to closed packed structure, thus imparting crystalline nature to the polymers.

●●

Chemistry 2019 (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 the previous sets.

SECTION-A

1. **Out of Chlorobenzene and Cyclohexyl chloride, which one is more reactive towards nucleophilic substitution reaction and why ?** [1]

Answer : Cyclohexyl chloride is more reactive towards nucleophilic substitution reaction, because the carbon bearing the chlorine atom is deficient in electron and seeks a nucleophile. In Chlorobenzene the carbon bearing the halogen is a part of aromatic ring and is electron rich due to the electron density in the ring.

2. **Arrange the following in decreasing order of solubility in water :**

$(C_2H_5)_2NH$, $C_2H_5NH_2$, $C_6H_5NH_2$ [1]

Answer : Decreasing order of solubility in water is :

$C_2H_5NH_2 > (C_2H_5)_2NH_2 > C_6H_5NH_2$

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

Answer : Aerosol is the type of colloid formed when solid is dispersed in gas. Example : smoke and dust.

5. **What is the difference between amylose and amylopectin ?** [1]

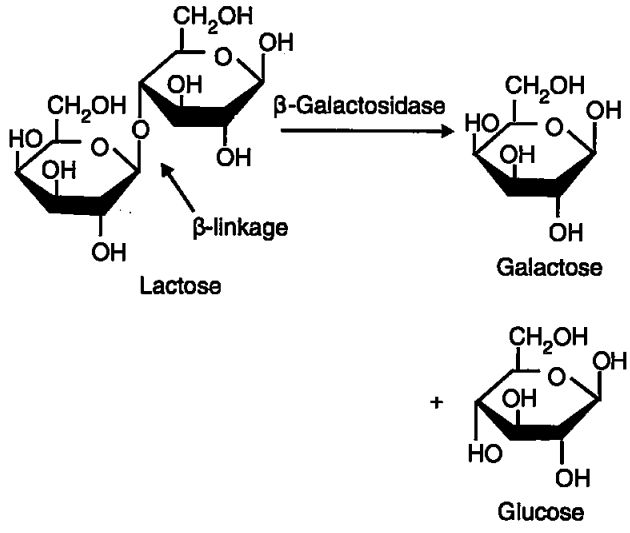
OR

Write the products obtained after hydrolysis of lactose.

Answer : Amylose is a long linear chain of α-D-(+)-glucose units joined by C_1-C_4 glycosidic linkage (α-link), whereas Amylopectin is a branched-chain polymer of α-D-glucose units, in which the chain is formed by C_1-C_4 glycosidic linkage and the branching occurs by C_1-C_6 glycosidic linkage.

OR

Galactose and Glucose are the products obtained after hydrolysis of lactose.



SECTION-B

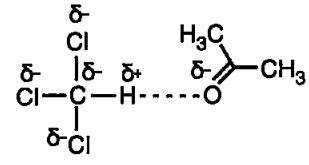
7. **Give reasons :**

(a) An increase in temperature is observed on mixing chloroform and acetone.

(b) Aquatic animals are more comfortable in cold water than in warm water. [2]

Answer :

(a) A mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law. This is because chloroform molecule is able to form hydrogen bond with acetone molecule as shown by the following figure :



Hydrogen bonding between chloroform and acetone

This decreases the escaping tendency of molecules for each component, and consequently the vapour pressure decreases and the temperature of the solution is increased because of stability attained by the molecule by associating and releasing energy.

(b) Solubility of gases in liquid increases on decreasing temperature, hence cold water has more dissolved oxygen because of which aquatic species find themselves more comfort-

able in cold water as compared to hot water.

10. Define the following terms with a suitable example of each : [2]

(a) Polydentate ligand

(b) Homoleptic complex

OR

Using IUPAC norms, write the formulae for the following complexes :

(a) Potassium tri (oxalato) chromate (III)

(b) Hexaaquamanganese (II) sulphate.

Answer : (a) Polydentate ligands : Ligands with several donor atoms are called polydentate ligands. These can bond with metal ion in a complex with the different donor atoms present in them. Example : $N(CH_2CH_2NH_2)_3$.

(b) Homoleptic complex : Complexes in which a metal atom is bound to only one kind of donor groups, *e.g.*, $[Co(NH_3)_6]^{2+}$ are known as homoleptic complex.

OR

(a) $K_3[Cr(C_2O_4)_3]$

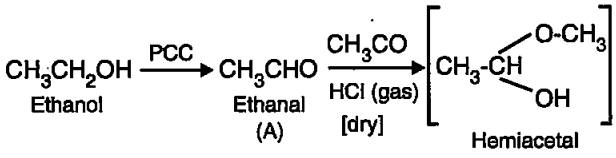
(b) $[Mn(H_2O)_6]SO_4$

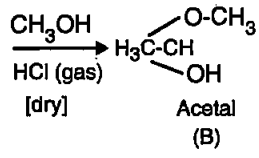
12. Write structures of main compounds A and B in each of the following reactions : [2]

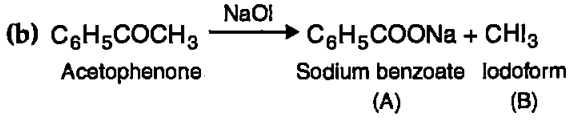
(a) $CH_3CH_2OH \xrightarrow{PCC} A \xrightarrow{CH_3OH/dry\ HCl(g)} B$

(b) $C_6H_5COCH_3 \xrightarrow{NaOI} A + B$

Answer : (a)





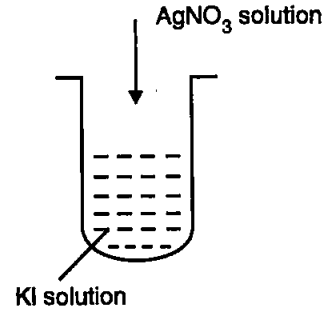


SECTION-C

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

(b) Why does physiosorption decrease with increase in temperature ?

(c) A colloidal sol is prepared by the method given in the figure. What is the charge on AgI colloidal particles formed in the test tube ? How is this sol represented ? [3]



Answer : (a) Butter is an example of 'Gel' type of colloid. Here the dispersed phase is liquid and dispersion medium is solid.

(b) Physisorption occurs because of physical attractive forces, like van der Waals forces between molecules of adsorbate and adsorbent, hence that can be reversed on application of bigger forces. Hence, when temperature is increased, the movement of adsorbed molecules increases, resulting in disturbed attractive forces, detachment of adsorbed molecules from adsorbent surface hence physisorption decreases.

(c) When $AgNO_3$ solution is added to KI, silver iodide, AgI, is precipitated. The precipitated silver iodide adsorbs iodide ions from dispersion medium and negatively charged colloidal sol results. It can be shown as AgI/I^- (negatively charged).

17. Write the principle of the following :

(a) Hydraulic washing

(b) Chromatography

(c) Froth-floatation process [3]

Answer : (a) Hydraulic washing : This method of concentration of ores is based on the differences in gravities of the ore and the gangue particles. It is a type of gravity separation. An upward stream of running water is used to wash the powdered ore. The lighter gangue particles are washed away and the heavier ores are left behind.

(b) Chromatography : Chromatography is a physical method of separation of a mixture in which the components to be separated are distributed between two phases, stationary and mobile phase. The stationary phase may be a solid or a liquid supported on a solid or a gel. The mobile phase may be either a liquid or a gas.

(c) Froth floatation process : Froth floatation is a physicochemical method of concentrating fine minerals. This process utilizes the differ-

ence in surface properties of valuable mineral and gangue (impurity) particles. For example, removal of gangue from sulphide ores.

18. Give reasons for the following :
(a) Transition metals have high enthalpies of atomization.
(b) Manganese has lower melting point even though it has a higher number of unpaired electrons for bonding.
(c) Ce^{4+} is a strong oxidising agent. **[3]**

Answer : (a) Transition element have high effective nuclear charge and a large number of valence electrons ($(n-1)$ d electrons). So, as a result of greater number of electrons participating, very strong metallic bonds are formed. As a result of the strong inter-atomic metallic bonding, the transition metals have high enthalpies of atomization.

(b) Manganese has lower melting point even though it has a higher number of unpaired electrons for bonding. Melting point depends on the intermolecular or interatomic forces. Stronger the forces, higher the melting point. In Mn there is half filled $3d$ sub-shell ($3d^5$ configuration) which makes it stable and hence, it does not make additional covalent bonds with nearby atoms hence, it has less melting point.

(c) Ce^{4+} is a strong oxidising agent because Ce^{4+} oxidizes others and itself gets reduced to the common and preferred 3+ oxidation state of lanthanoid elements.

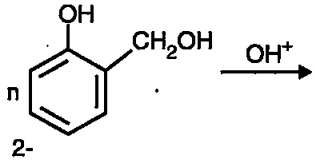
19. Write the structures of monomers used for getting the following polymers :
(a) Novolac
(b) Neoprene
(c) Buna-S **[3]**

OR

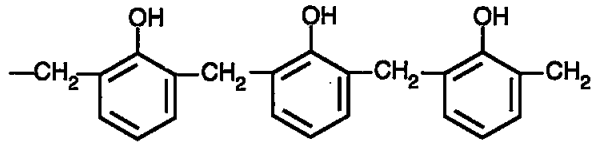
(a) Write on example each of
(i) Cross-linked polymer
(ii) Natural polymer
(b) Arrange the following in the increasing order of their intermolecular forces :
Terylene, Buna-N, Polystyrene
(c) Define biodegradable polymers with an example.

Answer :

(a) Novolac is polymer of 2-hydroxymethyl phenol which is obtained by reaction of phenol and formaldehyde.

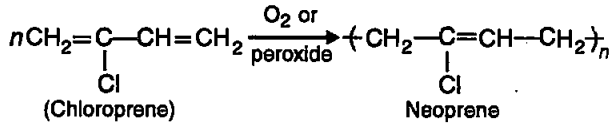


2-Hydroxymethylphenyl phenol



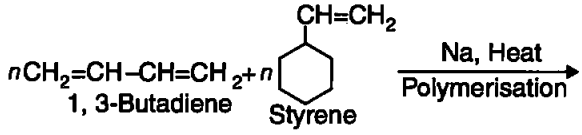
Novalac

(b) Neoprene is polymer of chloroprene or 2-chloro-1,3-butadiene—

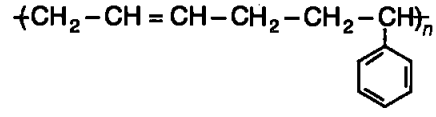


(Chloroprene) Neoprene

(c) Buna-S is a polymer of 1, 3-Butadiene and Styrene monomers.



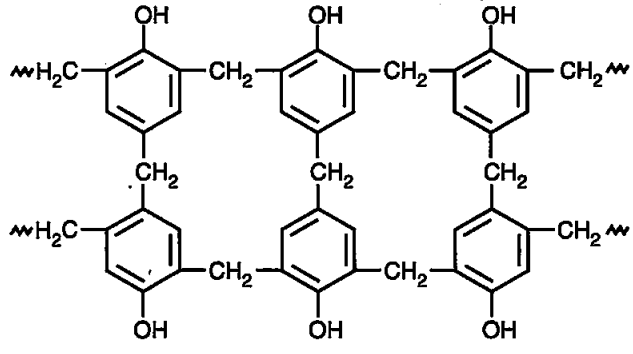
1, 3-Butadiene Styrene



(Butadiene-Styrene Copolymer)
(SBR or BUNA-S)

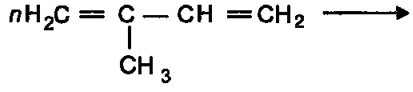
OR

(a) (i) Bakelite is an example of cross-linked polymer—

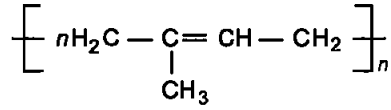


Bakelite

(ii) Rubber is an example of natural polymer—



Isoprence
[2-methyl butadiene]



Natural rubber
[Poly isoprene]

(b) Increasing order of their molecular forces :

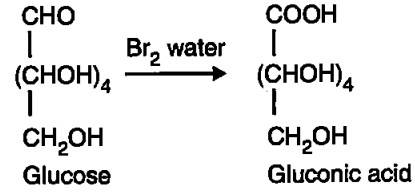
Buna-N < Polystyrene < Terylene

(c) Biodegradable polymer : These are synthetic polymers designed so as to contain functional groups similar to ones present in biopolymers. These are thus easily degraded by environmental degradation process hence, known as Biodegradable polymers.

Example : Poly β-hydroxybutyrate-co-β-hydroxy valerate (PHBV).

23. (a) Write the product when D-glucose reacts with Br_2 (aq). [3]

Answer : (a) When D-glucose reacts with Bromine (aq.) gluconic acid is formed.



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Chemistry 2019 (Delhi) SET I

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

SECTION–A

1. Out of NaCl and AgCl, which one shows Frenkel defect and why ? ** [1]

2. Arrange the following in increasing order of boiling points :

$(CH_3)_3N$, C_2H_5OH, $C_2H_5NH_2$ [1]

Answer : Increasing order of boiling point would be :

$(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$

3. Why are medicines more effective in colloidal state ? [1]

OR

What is difference between an emulsion and a gel ?

Answer : Medicines are effective in colloidal state because in colloidal state they have large surface area and are easily assimilated in body.

OR

Emulsions are the colloids made up of liquids dispersed in liquid dispersion medium whereas gels are liquids dispersed in solid dispersion medium. For example : milk is an emulsion whereas butter is a gel.

4. Define ambidient nucleophile with an example. [1]

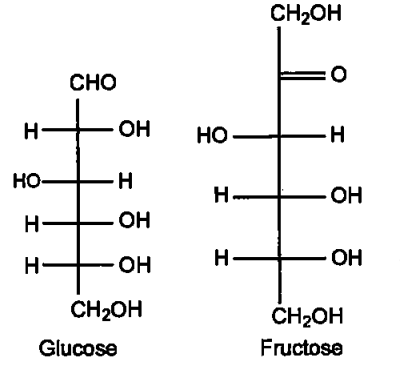
Answer : Ambidient nucleophiles are the ones which can attack through two different atoms present in the same nucleophilic species, such as NO_2^-. This can attack the electrophilic center either through nitrogen or the oxygen.

5. What is the basic structural difference between glucose and fructose ? [1]

OR

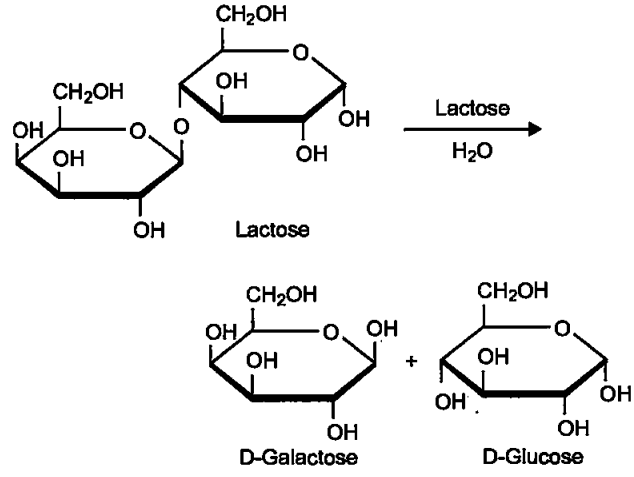
Write the products obtained after hydrolysis of lactose.

Answer : Both glucose and fructose have the molecular formula $C_6H_{12}O_6$ but Glucose has an aldehydic functional group at C-1 (in its open chain structure) and Fructose has a ketonic functional group at C-2. Glucose is an aldohexose whereas fructose is a ketohexose.



OR

The products obtained after hydrolysis of lactose are β-D-glucose and β-D-galactose.



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

SECTION–B

6. Write balanced chemical equations for the following processes :
(i) XeF_2 undergoes hydrolysis.
(ii) MnO_2 is heated with conc. HCl. [2]

OR

Arrange the following in order of property indicated for each set :
(i) H_2O, H_2S, H_2Se, H_2Te– increasing acidic character
(ii) HF, HCl, HBr, HI –decreasing bond enthalpy

Answer : (i) XeF_2 undergoes hydrolysis to give Xe, HF and O_2

$$2XeF_2\ (s) + 2H_2O\ (l) \rightarrow 2Xe\ (g) + 4HF\ (aq) + O_2\ (g)$$

(ii) MnO_2 is heated with conc. HCl to give $MnCl_2$, Cl_2 and H_2O^-

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$$

OR

(i) Increasing order of acidity–

$$H_2O < H_2S < H_2Se < H_2Te$$

(ii) Decreasing bond enthalpy–

$$HF > HCl > HBr > HI$$

7. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations. [2]

Answer : Raoult's law states that for any solution the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction.

The solutions which obey Raoult's law at all concentrations are known as ideal solutions. The two important properties of ideal solutions are as follows :

1. Enthalpy of mixing of the pure components to form the solution is zero

$$\Delta H_{mix} = 0$$

2. Volume of mixing of the pure components to form the solution is zero

$$\Delta V_{mix} = 0$$

8. For a reaction

$$2H_2O_2 \xrightarrow[\text{Alkaline medium}]{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below :
(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ **(slow)**
(2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ **(fast)**
(i) Write rate law for the reaction.
(ii) Write the overall order of reaction.
(iii) Out of steps (1) and (2), which one is rate determining step ? [2]

Answer : (i) Rate law of the reaction is given by :

$$\text{Rate} = -d[H_2O]/dt = k[H_2O_2][I^-]$$

(ii) As the rate law shows that the reaction is first order with H_2O_2 and I^- both, hence the overall order of the reaction becomes 1+1 = 2.

(iii) Step no. 1 is the slowest among two steps, hence this is the rate determining step.

9. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C) and (D). [2]

Answer : The reaction sequence can be written as–

$$2MnO_2 + 4KOH + O_2 \xrightarrow{KNO_3} \underset{\substack{\text{Potassium}\\\text{manganate (A)}\\\text{Green}}}{2K_2MnO_4} + 2H_2O$$

$$\underset{\text{(A)}}{3MnO_4^{2-}} + 4H^+ + \longrightarrow \underset{\substack{\text{Potassium}\\\text{permanganate (B)}\\\text{Purple}}}{2MnO_4^-} + MnO_2 + 2H_2O$$

$$\underset{\text{(B)}}{2KMnO_4} + H_2O + KI \xrightarrow{\text{Alkaline}} 2MnO_2 + 2KOH + \underset{\substack{\text{Potassium}\\\text{iodate (C)}}}{KIO_3}$$

$$\underset{\text{(B)}}{10KI + 2KMnO_4} + 16HCl + \longrightarrow 2MnCl_2 + 8H_2O + 5I_2 + 12KCl$$

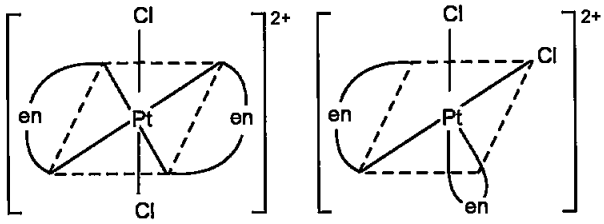
Iodine (D)

10. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex. [2]

OR

Using IUPAC norms write the formulae for the following :
(i) Hexaamminecobalt (III) sulphate
(ii) Potassium trioxalatochromate (III)

Answer : Dichlorido bis(ethane-1, 2-diammine platinum(II)



OR

(i) Hexaamminecobalt(III) sulphate

$[Co(NH_3)_6]_2(SO_4)_3$

(ii) Potassium trioxalatochromate(III)

$K_3[Cr(C_2O_4)_3]$

11. Out of $[CoF_6]^{3-}$ and $\{Co(en)_3]^{3+}$, which one complex is :

(i) paramagnetic

(ii) more stable

(iii) inner orbital complex and

(iv) high spin complex

(Atomic no. of Co = 27) **[2]**

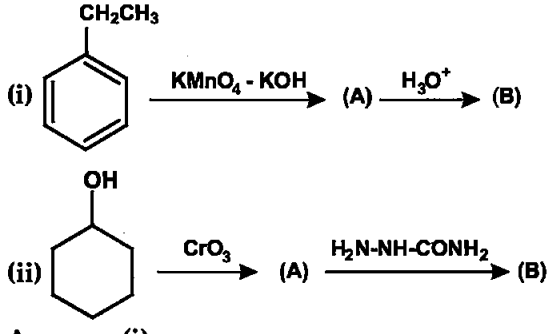
Answer : (i) $[CoF_6]^{3-}$ is paramagnetic as it has four unpaired electrons.

(ii) $[Co(en)_3]^{3+}$ is more stable.

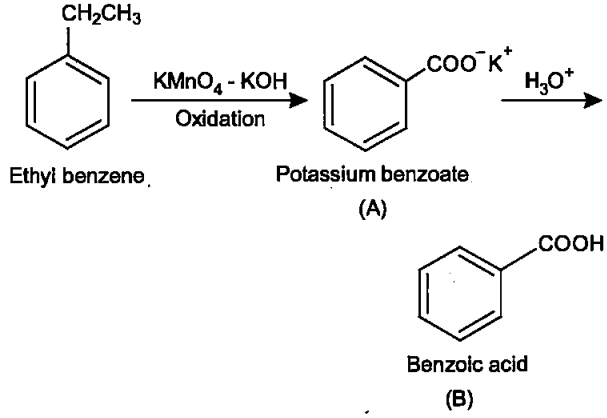
(iii) $[Co(en_3)]^{3+}$ is inner orbital complex.

(iv) $[CoF_6]^{3-}$ is high spin complex.

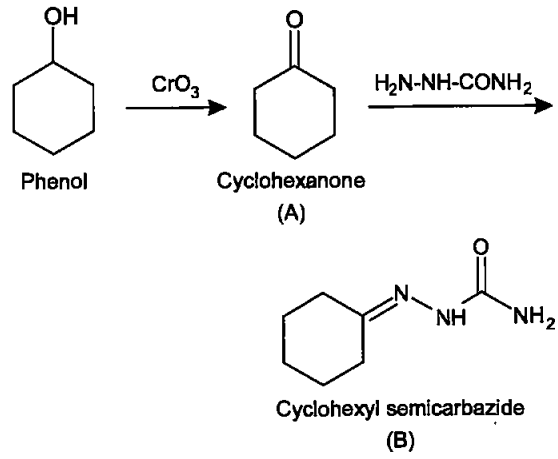
12. Write structures of compound A and B in each of the following reactions : **[2]**



Answer : (i)



(ii)



SECTION–C

13. The decomposition of NH_3 on platinum surface is surface is zero order reaction. If rate constant (k) is 4, × 10^{-3} Ms^{-1}, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M. **[3]**

Answer : Rate law for a zero order reaction can be given as–

$k = [R]^0 - [R] / t$

Substituting the given values–

$4 \times 10^{-3} Ms^{-1} = (0.1 - 0.064)\ M / t$

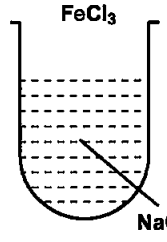
$t = 0.036\ M / 4 \times 10^{-3} Ms^{-1}$

$= 9\ s$

So, the time taken would be 9 seconds.

14. (i) What is the role of activated charcoal in gas mask ?

(ii) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube ? How is the sol represented ? **[3]**



(iii) How does chemisorption vary with temperature ?

Answer : (i) Activated charcoal present in gas mask adsorbs the harmful suffocating gases which surround the user and protects them from the particulate matter and ashes present in coal mines.

(ii) In the given method, $FeCl_3$ is being added to the NaOH solution to give a sol of hydrated ferric oxide, $Fe_2O_3.xH_2O$. The sol formed preferentially adsorbs the negatively charged OH^- present in the solution and hence acquire a negative charge on sol particles. The negatively charged sol formed can be represented as

$Fe_2O_3.\ x\ H_2O/OH^-$ (negatively charged)

(iii) Chemisorption increases with temperature upto a certain extent as then after it starts decreasing, chemisorption occurs due to a chemical reaction between adsorbate and adsorbent, and chemical reactions increase with increase in temperature.

15. An element crystallizes in fcc lattice and with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3}. Calculate the number of atoms in 108 g of the element.** [3]

16. A 4% solution (w/w) of sucrose (M = 342 g mol^{-1}) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose (M = 180 g mol^{-1}) in water. (Given : Freezing point of pure water = 273.15 K) [3]

Answer : Depression in freezing point can be shown by the given formula–

$$\Delta Tf = k_f m$$

The difference in freezing point,

$$\Delta T_f = 273.15 - 271.15 = 2\ K$$

and $$m = \frac{(w_2 \times 1000)}{(m_2 \times w_1)}$$

For 4% sucrose solution in water–

$$2K = \frac{k_f \times 4 \times 1000}{342 \times 96}$$

$$k_f = 16.42\ K\ kg/mol$$

Now for 5% glucose solution–

$w_2 = 5$ g; $m_2 = 180$ g mol^{-1}; $w_1 = 100 - 5$ g $= 95$ g

$$273.15 - T_{f\,glucose} = \frac{16.42 \times 5 \times 1000}{180 \times 95}$$

$$273.15 - T_{f\,glucose} = 1.877$$

$$T_{f\,glucose} = 273.15 - 4.8$$

$$T_{f\,glucose} = 268.35$$

So, freezing point of 5% solution of glucose is 268.35 K.

17. (a) Name the method of refining which is
(i) used to obtain semiconductor of high purity.
(ii) used to obtain low boiling metal.
(b) Write chemical reactions taking place in the extraction of copper from Cu_2S. [3]

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

Answer : (a) (i) Zone refining is being used for production of semiconductors like germanium, silicon, boron, gallium etc. of high purity.

(ii) Distillation method is used to obtain low boiling metals such as zinc and mercury.

(b) Chemical reactions involved in extraction of Cu from Cu_2S are :

Cu_2S ore is heated in a reverberatory furnace after mixing with silica. In the furnace, iron oxide 'slags of' as iron silicate and copper is produced in the form of copper matte. This contains Cu_2S and FeS.

The reactions undergo as given below.

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$$

$$FeO + SiO_2 \rightarrow FeSiO_3$$

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

$$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$$

18. Give reasons for the following :
(i) Transition elements and their compounds act as catalysts.
(ii) E^o value for (Mn^{2+} / Mn) is negative whereas for (Cu^{2+} / Cu) is positive.
(iii) Actinoids show irregularities in their electronic configuration. [3]

Answer : (i) Transition elements and their compounds act as catalyst due to their ability to adopt multiple oxidation states and to form complexes.

(ii) Mn^{2+} has d^5 configuration (stable half-filled configuration) and it prefers to stay in +2 oxidation state, so, E^o value for Mn^{2+}/ Mn is negative.Whereas, the high energy to transform Cu(s) to Cu^{2+} (aq) is not balanced by its hydration enthalpy, hence Cu^{2+} is not favored over Cu^o state and it has positive E^o value.

(iii) Actinoids show irregularities in their oxidation states due to extra stability of empty, half filled and fully filled *f* subshells.

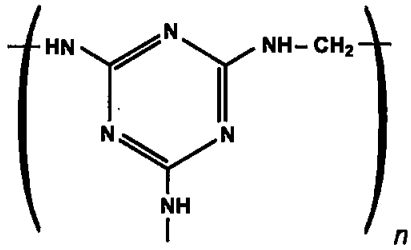
19. Write the structures of monomers used for getting the following polymers :
(i) Nylon–6,6
(ii) Glyptal
(iii) Buna-S [3]

OR

$$\left[\begin{array}{l}CH_3\\ |\\ CH_2—CH\end{array}\right]_n$$

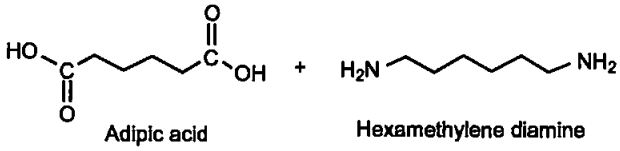
(i) Is a homopolymer or copolymer ? Give reason.

(ii) Write the monomers of the following polymer :

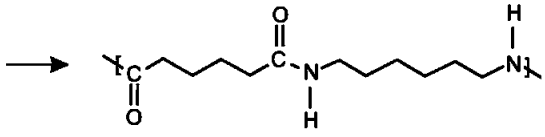


(iii) What is the role of Sulphur in vulcanization of rubber ?

Answer : (i) Monomers of Nylon-6,6 are adipic acid and hexamethylene diamine.

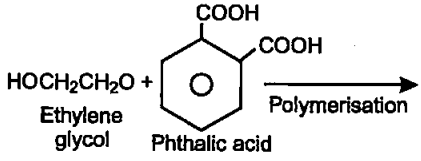


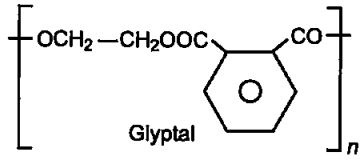
Adipic acid Hexamethylene diamine



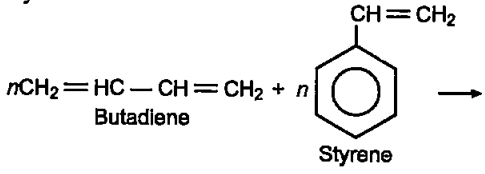
Nylon 6,6

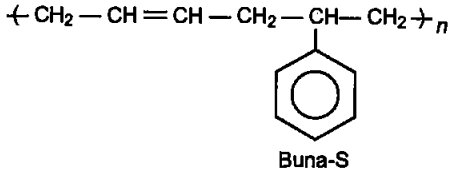
(ii) Monomers of glyptal are ethylene glycol and phthalic acid.





(iii) Monomers of Buna-S are Butadiene and Styrene.

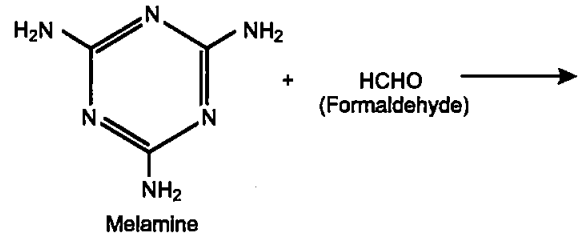




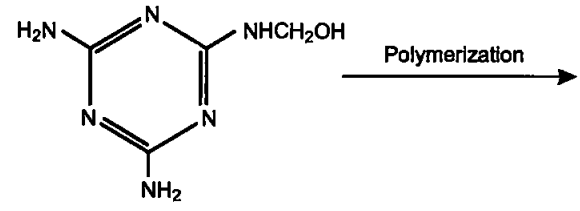
OR

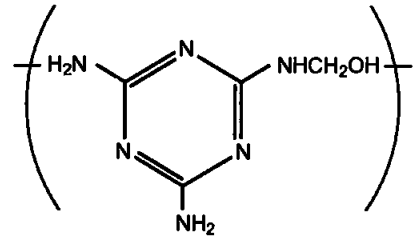
(i) $-CH_2-CH_2(CH_3)-$ is a homopolymer and the monomer from which it is obtained is $CH_2=CH(CH_3)$.

(ii) The given polymer is melamine polymer and the monomers are Melamine and Formaldehyde.



Melamine





Melamine polymer

(iii) Natural rubber becomes soft at high temperatures. In the vulcanisation process, sulphur forms cross links at the reactive sites of double bonds in rubber monomers and thus the rubber gets stiffened.

20. (i) What type of drug is used in sleeping pills ?

(ii) What type of detergents are used in toothpastes ?

(iii) Why the use of alitame as artificial sweetener is not recommended ? **[3]**

OR

Define the following terms with a suitable example in each :

(i) Broad-spectrum antibiotics

(ii) Disinfectants

(iii) Cationic detergents

Answer : (i) Tranquilizers are used in sleeping pills.

(ii) Anionic detergents are used in toothpastes.

(iii) It is difficult to control the sweetness of food by using alitame hence its use is not recommended.

OR

(i) Broad spectrum antibiotics : Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria are said

to be broad spectrum antibiotics. Ampicillin is an example.

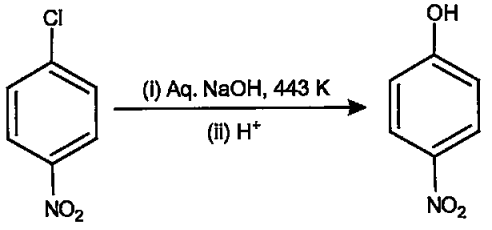
(ii) Disinfectants : These are chemicals which are applied to inanimate objects such as floors, drainage system, instruments etc. Example is 1% solution of phenol.

(iii) Cationic detergents : These are quarternary ammonium salts of amines with acetates, chlorides or bromides as anions. Example is Cetyltrimethyl ammonium bromide.

21. (i) Out of $(CH_3)_3C–Br$ and $(CH_3)_3C–I$, which one is more reactive towards S_N1 and why ?
(ii) Write the product formed when *p*-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification.
(iii) Why *dextro* and *laevo* – rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation ? [3]

Answer : (i) $(CH_3)_3C–I$ is more reactive than $(CH_3)_3C—Br$ towards S_N1 reaction because, C–I bond being weaker than C–Br bond (due to larger size of I^- compared to Br^-) forms the tertiary carbocation easily.

(ii) 4-Nitrophenol is formed as product when *p*-nitro chlorobenzene is heated with NaOH at 443 K and acidified later.

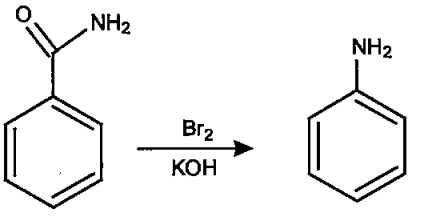


4-Nitrochlorobenzene 4-Nitrophenol

(iii) *Dextro-* and *laevo-* rotatory isomers of Butan-2-ol are stereoisomers of each other and have same physical properties. As they have same boiling points, thus it is difficult to isolate them through fractional distillation.

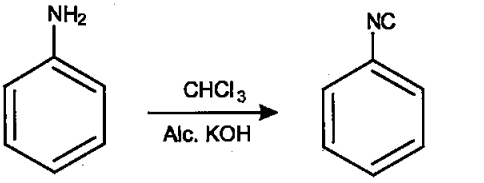
22. An aromatic compound 'A' on heating with Br_2 and KOH forms a compound 'B' of molecular formula C_6H_7N which on reacting with $CHCl_3$ and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C. [3]

Answer : As the chemical combination Br_2 and KOH are used for Hofmann Bromamide reaction where an amide is reduced to amine, the compound B, C_6H_7N seems to be Aniline. The reaction can be suggested as follows :



Benzamide (A) Aniline (B)

Then aniline undergoes carbylamine reaction to give the foul smelling compound C.



Aniline (B) Phenyl isocyanide (C)

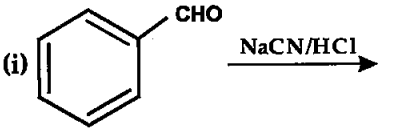
IUPAC names are as follows :

Compound A – Benzamide

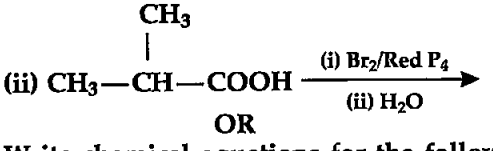
Compound B – Aniline or Benzenamine

Compound C – Isocyanobenzene or phenylisocyanide.

23. Complete the following reactions : [3]

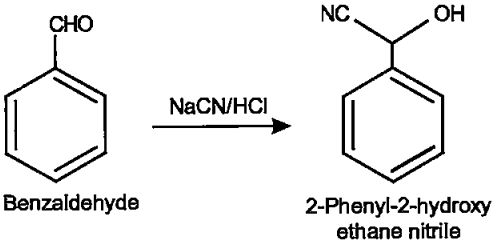


(ii) $(C_6H_5CH_2)_2Cd + 2CH_3COCl$



OR

Write chemical equations for the following reactions :
(i) Propanone is treated with dilute $Ba(OH)_2$.
(ii) Acetophenone is treated with Zn(Hg)/ conc. HCl.
(iii) Benzoyl chloride is hydrogenated in presence of $Pd/BaSO_4$.
Answer : (i)

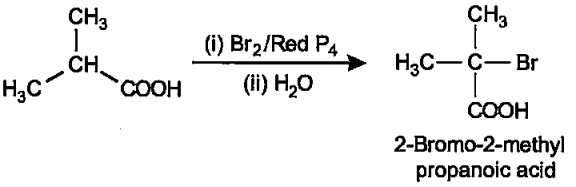


Benzaldehyde 2-Phenyl-2-hydroxy ethane nitrile

(ii) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \longrightarrow 2\,CH_3COCH_2C_6H_5 + CdCl_2$

Methyl benzyl ketone

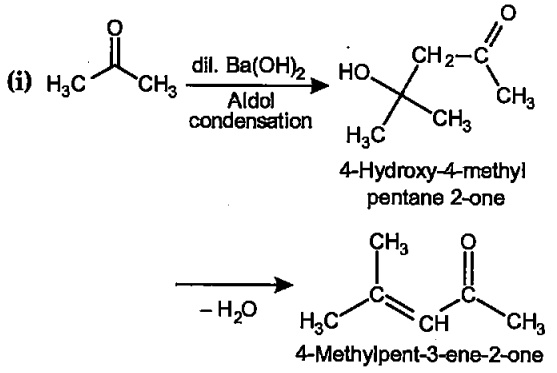
(iii)



2-Bromo-2-methyl propanoic acid

OR

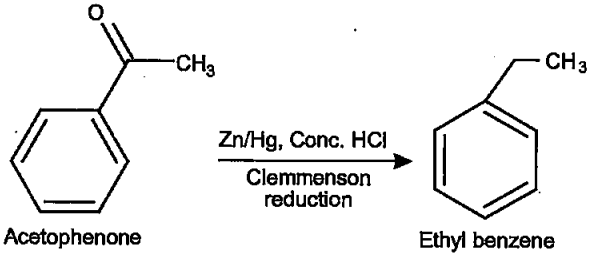
(i)



4-Hydroxy-4-methyl pentane 2-one

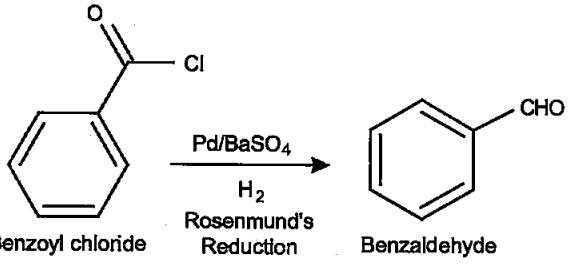
4-Methylpent-3-ene-2-one

(ii)



Acetophenone Ethyl benzene

(iii)



Benzoyl chloride Benzaldehyde

24. Differentiate between the following :

(i) Amylose and Amylopectin

(ii) Peptide linkage and Glycosidic linkage

(iii) Fibrous proteins and Globular proteins. [3]

OR

Write chemical reactions to show that open structure of D-glucose contains the following :

(i) Straight chain

(ii) Five alcohol groups

(iii) Aldehyde as carbonyl group.

Answer : (i) Difference between Amylose and Amylopectin —

S.No.	Amylose	Amylopectin
1.	Water soluble.	Water insoluble.
2.	Constitutes about 15-20% of starch.	Constitutes about 80-85% of starch.
3.	It has un-branched chain.	It has branched chain.

(ii) Difference between Peptide linkage and Glycosidic linkage —

S.No.	Peptide linkage	Glycosidic linkage
1.	It is an amide formed between –COOH group of one amine and $–NH_2$ group of second amino acid molecule.	It is an oxide linkage, that is two monosaccharides are joined through an oxygen atom.
2.	It is found in protein molecules.	It is found in carbohydrate molecules.

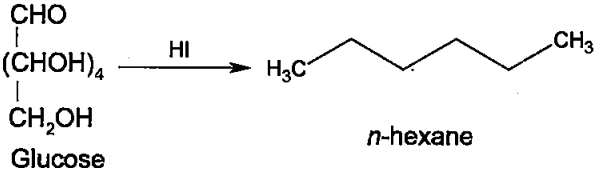
(iii) Difference between Fibrous proteins and Globular Proteins —

S.No.	Fibrous protein	Globular protein
1.	In these polypeptide chains run parallel and are held together by hydrogen and disulphide bonds.	In these chains of polypeptide coil around to give a spherical shape.
2.	Usually insoluble in water. Examples are Keratin and myosin.	Usually soluble in water. Examples are albumin and insulin.

OR

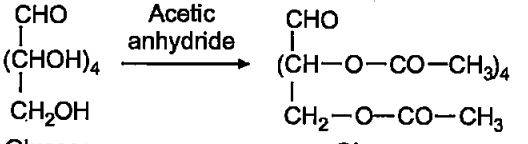
(i) Open chain structure of Glucose is straight chain can be shown as follows–

On prolonged heating with HI, it forms *n*-hexane, this shows that glucose has straight open chain structure.



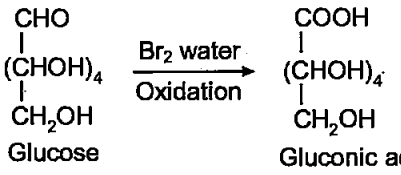
Glucose *n*-hexane

(ii) On acetylation with acetic anhydride, glucose gives glucose pentaacetate, this shows that glucose has five alcoholic groups.



Glucose Glucose pentaacetate

(iii) Glucose gets oxidized to six carbon carboxylic acid (Gluconic acid) on reaction with a mild oxidising agent like bromine water. This indicates that the carbonyl group is present as an aldehydic group.

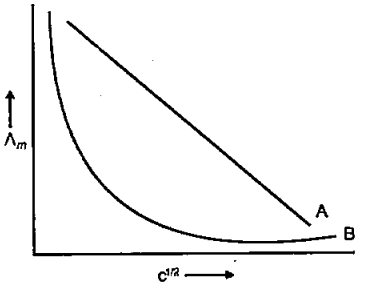


SECTION–D

25. **E°_{cell} for the given redox reaction is 2.71 V**
$Mg_{(s)} + Cu^{2+}_{(0.01\ M)} \rightarrow Mg^{2+}_{(0.001\ M)} + Cu_{(s)}$
Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is
(i) less than 2.71 V and
(ii) greater than 2.71 V. **[5]**

OR

(a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8g of Fe deposited at the cathode of cell X. How long did the current flow ? Calculate the mass of Zn deposited at the cathode of cell Y.
(Molar mass : Fe = 56 g mol^{-1}, Zn = 65.3 g mol^{-1}, 1F = 96500 C mol^{-1})
(b) In the plot of molar conductivity (Λ_m) vs square root of concentration ($c^{1/2}$) following curves are obtained for two electrolytes A and B :



Answer the following :
(i) Predict the nature of electrolytes A and B.
(ii) What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes A and B ?
Answer : The cell can be represented as :

$Mg\,|\,Mg^{2+}\,(0.001\ M)\,||\,Cu^{2+}\,(0.01\ M)\,|\,Cu$

$$E_{cell} = \frac{E^{\circ}_{cell} - RT}{2F\ \ln\left(\frac{[Mg^{2+}]}{[Cu^{2+}]}\right)}$$

Putting the given values,

$$E_{cell} = \frac{E^{\circ}_{cell} - RT}{2F\ \ln\left(\frac{[Mg^{2+}]}{[Cu^{2+}]}\right)}$$

$$= 2.71 - \left(\frac{0.059}{2}\right) \log\left(\frac{0.001}{0.01}\right)$$

$$= 2.68 - (-1)$$

$$= 3.68\ V$$

(i) When external opposite potential is less than 2.71 V then electron flows from Mg rod to Cu rod hence current flows from Cu to Mg.

(ii) When external opposite potential is greater than 2.71 V then electron flows from Cu rod to Mg rod and current flows from Mg to Cu.

OR

(a) Charge = Current × Time

Now, in the given experiment, 2.8 g of iron was deposited or

$\frac{2.8}{56}$ = 0.05 moles of iron were deposited.

Now, as it is a 2 electron transfer process :
1 mol of iron is deposited by 2 × 96500 C of charge
Hence, 0.05 mol of iron will need 0.05 × 2 × 96500 C of charge

= 9650 C

So,
9650 C = 2 A × t
Time = 4825 seconds = 80.41 minutes
Similarly,
So, same amount of charge will flow to deposit Zn as well, keeping that in mind
2 × 96500 C of charge can deposit 1 mol of Zn
Hence, 9650 C of charge would deposit

$$= \left(\frac{1}{2} \times 96500\ C\right) \times 9650 = 0.05\ mol$$

Weight of Zinc deposited

= 0.05 mol × 65.3 g mol^{-1} = 3.26 g

(b) (i) The electrolyte A is a strong electrolyte, and the electrolyte B is a weak electrolyte.

(ii) On extrapolation for electrolyte A limiting value of conductance is obtained that is conductance at zero concentration or infinite dilution.

The curve obtained for a strong electrolyte shows that there is a small decrease in molar conductivity with increase in concentration. In other words, the molar conductivity is increased only slightly on dilution (for observing dilution effects, go towards zero on X-axis). A strong electrolyte is completely

dissociated in solution and thus, furnishes all ions for conductance. However, at higher concentrations, the dissociated ions are close to each other and thus, the inter-ionic attractions are greater. These forces retard the motion of the ions and thus, conductivity is low. With decrease in concentration (dilution), the ions move away from each other thereby feeling less attractive forces from the counter ions. This results in an increase in molar conductivity with dilution. The molar conductivity approaches a maximum limiting value at infinite dilution designated as Λ_m^0.

For electrolyte B :

The curve obtained for B shows that there is a large increase in the value of molar conductivity with dilution, especially near infinite dilution. This is because as the solution of a weak electrolyte is diluted, its ionization is increased. This results in more number of ions in solution and thus, there is an increase in molar conductivity. However, the conductance of a weak electrolyte never approaches a limiting value. Or in other words it is not possible to find conductance at infinite dilution (zero concentration).

26. (a) How do you convert the following :

(i) Phenol to Anisole

(ii) Ethanol to Propan–2–ol

(b) Write mechanism of the following reaction :

$$CH_3OH \xrightarrow[443\ K]{H_2SO_4} CH_2 = CH_2 + H_2O$$

(c) Why phenol undergoes electrophilic substitution more easily than benzene ? [5]

OR

(a) Account for the following :

(i) *o*–nitrophenol is more steam volatile than *p*-nitrophenol.

(ii) *t*-butyl chloride on heating with sodium methoxide gives 2-methylpropene instead of *t*-butyl methylether.

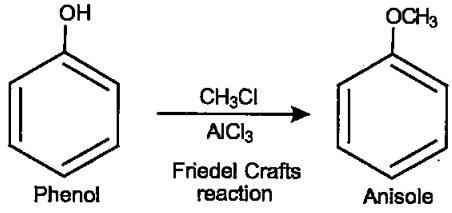
(b) Write the reaction involved in the following :

(i) Riemer Tiemann reaction

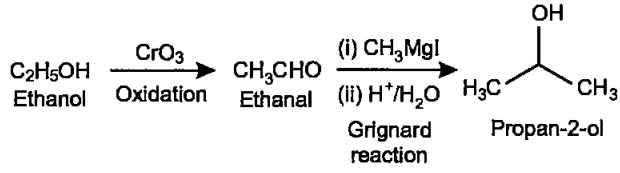
(ii) Friedal Crafts Alkylation of Phenol

(c) Give simple chemical test to distinguish between Ethanol and Phenol.

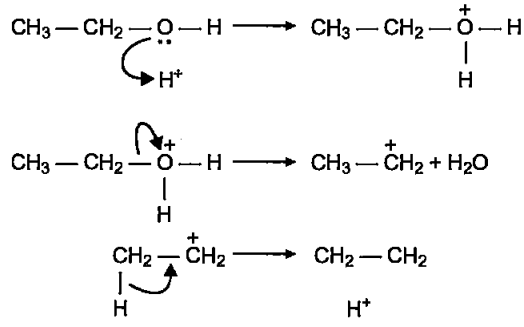
Answer : (a) (i) Conversion of phenol to anisole can be done as follows.



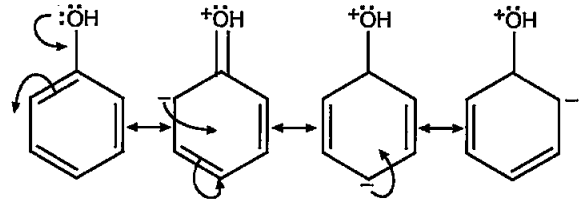
(ii) Ethanol can be converted to propan-2-ol through the following sequence :



(b) The mechanism of dehydration of ethanol to give ethene can be written as follows :

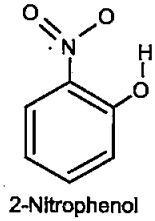


(c) The –OH group in phenol increases the electron density on the benzene ring hence electrophilic substitution reaction is more prominent in phenol compared to benzene. The lone pair of oxygen on phenolic–OH group takes part in the resonance and makes the ring electron rich, hence activating the ring for incoming electrophiles.

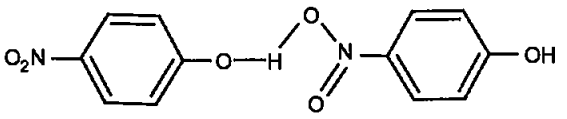


OR

(a) (i) This difference arises due to the difference in extent of association of molecules with each other. In *o*-nitrophenol the nitro and hydroxyl group present in same molecule forms a hydrogen bond (intra-molecular) and thus have least association with nearby molecules, whereas in *p*-nitrophenol the nitro and hydroxyl groups of adjacent molecules form hydrogen bonds (intermolecular) which result in long range association of molecules. Hence, large amount of energy is required to break the intermolecular hydrogen bonds hence, high boiling point than the 2-nitrophenol molecules.

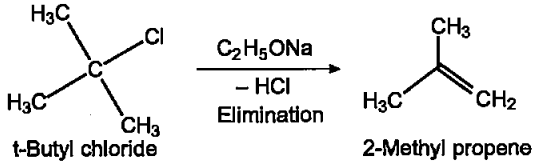


2-Nitrophenol



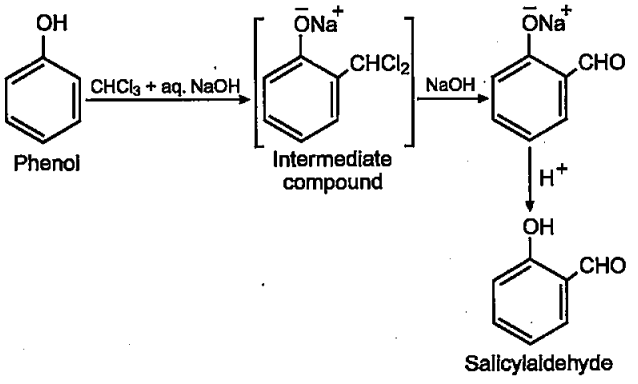
4-Nitrophenol

(ii) Sodium methoxide acts as strong base and extracts a proton from one of the methyl groups of *t*-butyl chloride giving rise to a primary carbanion which quickly loses Cl - to give a double bond, hence the product formed is 2-methyl propene.



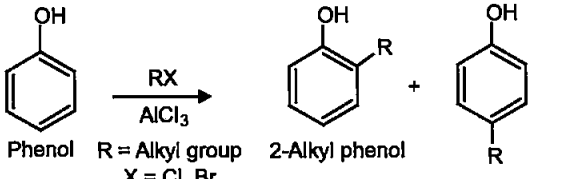
t-Butyl chloride 2-Methyl propene

(b) (i) Reimer-Tiemann reaction :



Phenol Intermediate compound Salicylaldehyde

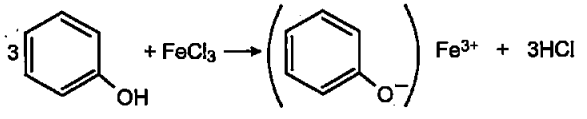
(ii) Friedal Crafts alkylation of phenol can be shown as following :



Phenol R = Alkyl group X = Cl, Br 2-Alkyl phenol 4-Alkyl phenol

(c) Chemical test to distinguish between ethanol and phenol :

On adding neutral $FeCl_3$, phenol gives a violet coloured solution but ethanol does not.



27. Give reasons for the following :
(i) Sulphur in vapour state shows para-magnetic behaviour.
(ii) N-N bond is weaker than P—P bond.**
(iii) Ozone is thermodynamically less stable than oxygen.

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

(b) Write the name of gas released when Cu is added to
(i) dilute HNO_3 and
(ii) conc. HNO_3 **[5]**

OR

(a) (i) Write the disproportionation reaction of H_3PO_3.**
(ii) Draw the structure of XeF_4.
(b) Account for the following :
(i) Although Fluorine has less negative electron gain enthalpy yet F_2 is strong oxidizing agent.
(ii)Acidic character decreases from N_2O_3 to Bi_2O_3 in group 15.**
(c) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.

Answer : (a) (i) In vapour phase sulphur partly exists as S_2 molecule and S_2 molecule like O_2 molecule has two unpaired electrons in anti-bonding π orbital, hence it shows paramagnetic behaviour.

(iii) Ozone (O_3) is thermodynamically less stable than dioxygen (O_2) because decomposition of ozone into dioxygen results in the liberation of heat (ΔH is negative) and increase in entropy (ΔS is positive). These two effects reinforce each other.

(b) (i) When Cu is added to dil. HNO_3 Nitrogen monoxide (NO) is released–

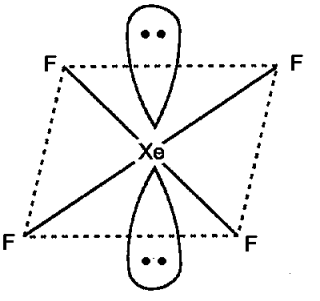
$$3Cu + 8HNO_3 \text{ (dil.)} \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

(ii) When Cu is added to conc. HNO_3 Nitrogen dioxide (NO_2) is released :

$$Cu + 4HNO_3\text{(conc.)} \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

OR

(a) (ii) Structure of XeF_4



(b) (i) Although Fluorine has less electron gain enthalpy yet it is a strong oxidising agent due to its low enthalpy of dissociation of F—F

bond and high enthalpy of hydration of F^- ion.

(c) Sulphur dioxide behaves as a reducing agent when moist, this property is being used for its test in laboratory. It decolorizes the purple coloured potassium permanganate(VII) solution :

$$5SO_2+2KMnO_4+2H_2O \rightarrow 2H_2SO_4+2MnSO_4+K_2SO_4$$

Purple colour solution — light brown colour

●●

Chemistry 2019 (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 set.

SECTION–A

2. Arrange the following in increasing order of base strength in gas phase : [1]

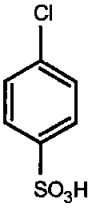
$(CH_2H_5)_3N$, $C_2H_5NH_2$, $(C_2H_3)_2NH$

Answer : In gas phase the basicity order will be –

$(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2$

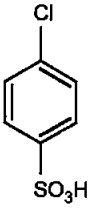
3. Why conductivity of silicon increasies on doping with phosphorus ?** [1]

5. Write IUPAC name of the given compound :



[1]

Answer :



4-Chlorobenzene-1-sulphonic acid

SECTION-B

8. Write two differences between an ideal solution and a non-ideal solution. [2]

Amswer : Differences between Ideal and non-ideal solutions–

S.No.	Ideal solution	Non-ideal solution
1.	Follows Raoult's law.	Does not follo Raoult's law.
2.	2. $\Delta H_{mix} = 0$, $\Delta V_{mix} = 0$	$\Delta H_{mix} \neq 0$, $\Delta V_{mix} \neq 0$

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

10. Write IUPAC of the complex $[Cr(NH_3)_4Cl_2]^+$. Draw structures of geometrical isomers for this complex. [2]

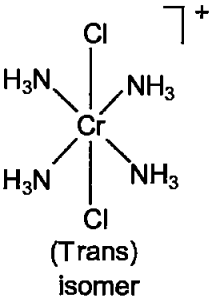
OR

Using IUPAC norms write the formulae for the following :

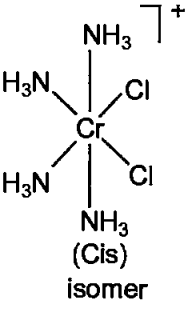
(i) Pentamminenitrito-O-cobalt(III) chloride

(ii) Potassium tetracyanidonickelate (II)

Answer : The IUPAC name for $[Cr(NH_3)_4Cl_2]^+$ is tetraammine dichlorochromium(III) :



(Trans) isomer



(Cis) isomer

OR

(i) Pentamminenitritocobalt(III)chloride :

$[Co(NH_3)_5ONO]Cl_2$

(ii) Potassium tetracyanidonickelate (II) :

$K_2[Ni(CN)_4]$

11. Out of $[CoF_6]^{3-}$ and $[Co(C_2O_4)]^{3-}$, which one complex is :

(i) diamagnetic

(ii) more stable

(iii) outer orbital compelx and

(iv) low spin complex ?

(Atomic no. of (Co = 27) [2]

Answer : $[Co(C_2O_4)_3]^{3-}$ has d^2sp^3 hybridisation (low spin complex) and $[CoF_6]^{3-}$ has sp^3d^2 hybridisation (high spin complex).

(i) $[Co(C_2O_4)_3]^{3-}$ is diamagnetic

(ii) $[Co(C_2O_4)_3]^{3-}$ is more stable.

(iii) $[CoF_6]^{3-}$ is outer orbital complex

(iv) $[Co(C_2O_4)_3]^{3-}$ is low spin complex.

SECTION-B

17. (i) Write the role of 'CO' in the purification of nickel.

(ii) What is the role of silica in the extraction of copper ?
(iii) What type of metals are generally extracted by electrolytic method ? [3]

Answer : (i) Role of CO in purification of Nickel : Mond process is the technique used to purify nickel. The impure nickel reacts with carbon monoxide at 50-60° C to form the gas nickel carbonyl, leaving the impurities as solids. Nickel carbonyl is subjected to higher temperature so that it is decomposed giving the pure metal.

$$Ni + 4CO \xrightarrow{330\text{-}350\ K} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450\text{-}470\ K} Ni + 4CO$$

(ii) Role of silica in extraction of Copper : The role of silica in the metallurgy of copper is to remove the iron oxide obtained during the process of roasting. If the sulphide ore of copper contains iron, then silica (SiO_2) is added as flux before roasting.

$$FeO + SiO_2 \rightarrow FeSiO_3(slag)$$

(iii) Metals whose ions easily get reduced in solution or molten state are generally extracted by electrolytic method.

18. **Give reasons for the following :**
(i) Transition metals form alloys.
(ii) Mn_2O_3 is basic whereas Mn_2O_7 is acidic.
(iii) Eu^{2+} is a strong reducing agent. [3]

Answer : (i) Transition metal forms alloys because the atomic sizes of transition metals are very similar to each other. As the atomic sizes are very similar, one metal can replace the other metal from its lattice and form a solid solution. This solid solution is known as alloy.

(ii) In Mn_2O_3 manganese has +3 oxidation state, it has lone pairs of electrons which can be donated (Lewis base), hence it is basic in nature. Whereas in Mn_2O_7 manganese has +7 oxidation state. Higher oxidation states are short of electrons, meaning they can accept electrons and thus function as Lewis acids. So, Mn_2O_7 is acidic.

(iii) Reducing agent is that which can reduce other species and itself gets oxidized. Eu^{2+} readily changes to the common +3 oxidation state shown by the lanthanides by losing one more electron. So, Eu^{2+} is regarded as a strong reducing agent.

20. **(i) Why bithional is added in soap ?**
(ii) Why magnesium hydroxide is a better antacid than sodium bicarbonate ?
(ii) Why soaps are biodegradable whereas detergents are non-biodegradable ? [3]

OR

Define the following terms with a suitable example in each :
(i) Antibiotics
(ii) Artificial sweeteners
(iii) Analgesics

Answer : (i) Bithional is added in soap to impart antiseptic properties to soap.

(ii) Sodium bicarbonate if taken in excess can make the stomach alkaline in turn stimulating more acid release, hence magnesium hydroxide is better antacid than sodium bicarbonate because being insoluble, it does not increase the pH above neutrality.

(iii) Soaps are sodium or potassium salts of long chain fatty acids whereas the hydrocarbon portion of synthetic detergents contain highly branched hydrocarbon chain which is not easy for the bacteria to degrade. Hence, soaps are biodegradable but synthetic detergents are not.

OR

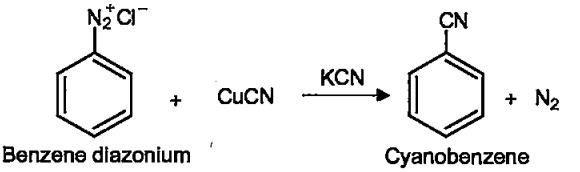
(i) Antibiotics : They are the compounds (produced by microorganisms or synthetically) which either inhibit the growth of bacteria or kill bacteria. Example : Penicillin.

(ii) Artificial sweeteners : They are the compounds which make the food sweet in taste without adding calories to the food. Example – Aspartame.

(iii) Analgesics : These are the compounds which reduce or abolish pain without causing impairment of consciousness, mental confusion or any other disturbances to central nervous system. They are of two types, Narcotic (Morphine) and non-narcotic (Example : Paracetamol).

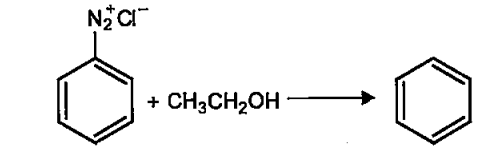
21. **Write the structures of main products when benzene diazonium chloride reacts with the following reagents.**
(i) CuCN
(ii) CH_3CH_2OH
(iii) KI [3]

Answer :
The products will be as follows :
(i)

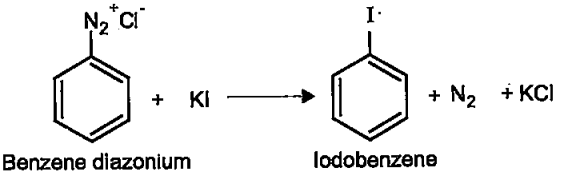


Benzene diazonium chloride — Cyanobenzene

(ii)



(iii)



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Chemistry 2019 (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

1. **Arrange the following in decreasing order of solubility in water :**

   $(CH_3)_3N$, $(CH_3)_2NH$, CH_3NH_2 [1]

   Answer : Decreasing order of solubility in water is–

   $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$

2. **What type of stoichiometric defect is shown by ZnS and why ?**** [1]

3. **Write one sterochemical difference between S_N1 and S_N2 reactions.** [1]

   Answer : Products of S_N1 reactions are usually racemic in nature, whereas Products of S_N2 reactions have inverted configuration compared to the starting reactant.

SECTION-B

7. **State Henry's law and write its two applications.** [2]

   Answer : Henry's law states that the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present above the surface of liquid or solution.

   The most commonly used form of above law can be put as–

   'The partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution:.

   $$p = K_H x$$

   Applications :

   1. To increase the solubility of CO_2 in soft drinks and soda water, the sealing is done under high pressure.

   2. Tanks used by scuba divers are filled with air diluted with helium gas in order to avoid accumulation of nitrogen in bubbles in their blood. As increased pressure underwater increases solubility of nitrogen in the blood.

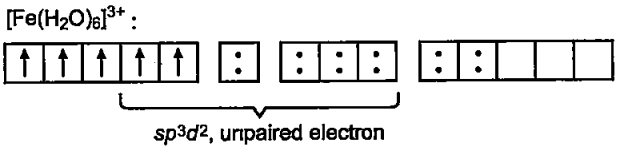
11. **Write the hybridization and magnetic character of following complexes:**

    (a) $[Fe(H_2O)_6]^{2+}$

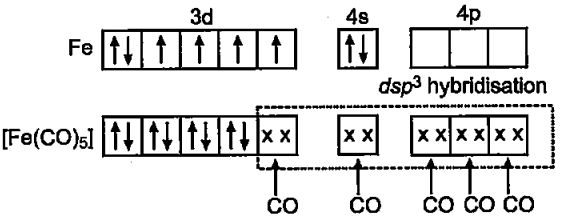
    (b) $[Fe(CO)_5]$

    (Atomic no. of Fe = 26) [2]

    Answer : (a) The hybridisation in $[Fe(H_2O)_6]^{3+}$ is sp^3d^2. As there are five unpaired electrons, it is strongly paramagnetic in nature.



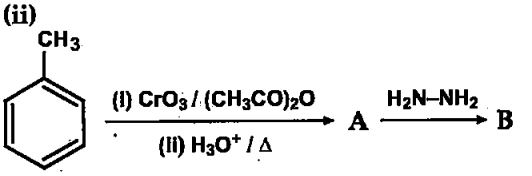
(b) $[Fe(CO)_5]$ has dsp^3 hybridisation and no unpaired electron, hence it is diamagnetic in nature.



12. **Write structures of main compounds A and B in each of the following reactions :** [2]

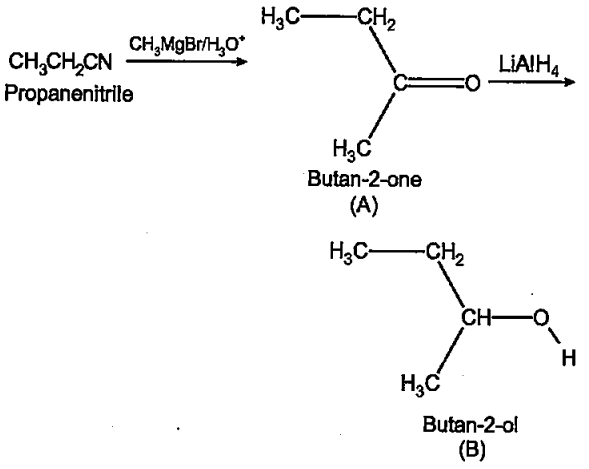
    (i) $CH_3CH_2CN \xrightarrow{CH_3MgBr\,/\,H_2O^+} A \xrightarrow{LiAlH_4} B$

    (ii)

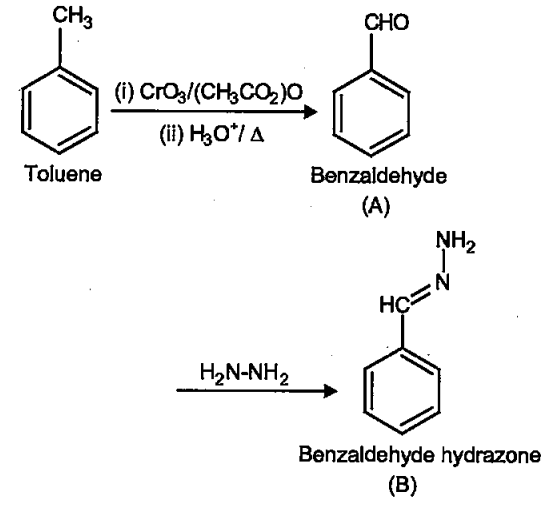


** **Answer is not given due to change in present syllabus.**

Answer : (i)



(ii)



SECTION-C

17. How will you convert the following :
(i) Impure nickel to pure nickel
(ii) Zinc blende to zinc metal
(ii) $[Ag(CN)_2]^-$ to Ag **[3]**

Answer : (i) Impure nickel can be converted to pure nickel by Mond's process. In this process, Nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl

$$Ni + 4CO \xrightarrow{330\text{-}350\ K} Ni(CO)_4$$

The carbonyl is subjected to higher temperature so that it is decomposed giving the pure metal.

(ii) Zinc can be obtained from zinc blende as follows :

$$\underset{\text{Zinc blende}}{2ZnS} + \underset{\text{From air}}{O_2} \xrightarrow{\text{Roasting}} 2\,ZnO + 2SO_2$$

$$\underset{\text{Zinc oxide}}{ZnO} + C \xrightarrow{\text{Reduction}} Zn + CO_2$$

(iii) $[Ag(CN)_2]^{2-}$ can be converted into Ag by treating with zinc (a more electropositive element than silver). Hence, on treatment with zinc metal, Zn oxidizes to furnish Zn^{2+} ions, which go into solution replacing the Ag^+ ions, which are in turn reduced to metallic silver and deposited in pure form.

$$2[Ag(CN)_2]^{2-}(aq) + Zn(s) \rightarrow [Zn(CN)_4]^{2-}(aq) + 2Ag(s)$$

18. Give reasons for the following :
(i) The transition metals generally form coloured compounds.
(ii) E° value for (Mn^{3+}/Mn^{2+}) is highly positive than that for (Cr^{3+}/Cr^{2+}) couple.
(iii) The chemistry of actinoids elements is not so smooth as that of the lanthanoids. **[3]**

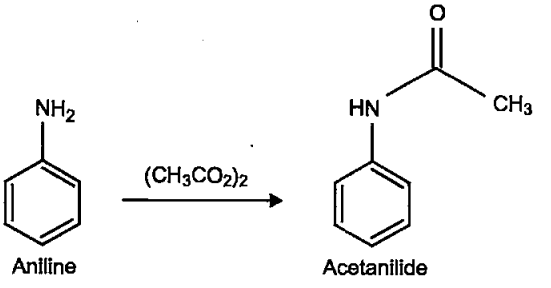
Answer : (i) Transition metals have partly filled *d*-orbitals. So, the single electrons available in *d*-orbitals absorb energy and go to higher unoccupied electronic energy levels. When they come back, they emit energy in visible range and hence impart colour.

(ii) E° value for Mn^{3+}/Mn^{2+} is highly positive because Mn^{2+} has a stable d^5 configuration and it is reluctant to lose one electron to achieve the 3+ state. Cr^{2+} has $3d^4$ configuration and losing another electron to achieve $3d^3$ configuration is not that difficult, hence the E° value is not more positive compared to Mn^{3+}/Mn^{2+}.

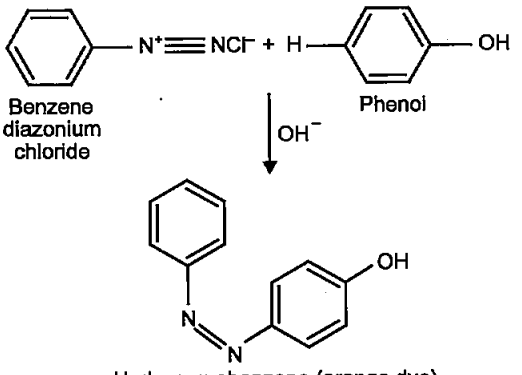
(iii) Chemistry of actinoid elements is not so smooth in view of their ability to exist in different oxidation states. Also, many of the actinoid elements are radioactive which makes the study of these elements difficult.

22. Write equations of the following reactions :
(i) Acetylation of aniline
(ii) Coupling reaction
(iii) Carbyl amine reaction **[3]**

Answer : (i) Acetylation of aniline :



(ii) Coupling reaction : Benzene diazonium chloride reacts with other suitable aromatic compounds to give azo compounds. This reaction is known as coupling reaction.



p-Hydroxyazobenzene (orange dye)

(iii) Carbylamine reaction : Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines.

$$C_2H_5NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} C_2H_5NC + 3KCl + 3H_2O$$

Ethylamine Chloroform Potassium hydroxide Ethyl isonitrile

24. Define the following with a suitable example in each :

(i) Oligosaccharides

(ii) Denaturation of protein

(iii) Vitamins **[3]**

OR

Write the reactions involved when D-glucose is treated with the following reagents :

(i) Br_2 water

(ii) H_2N–OH

(iii) $(CH_3CO)_2O$

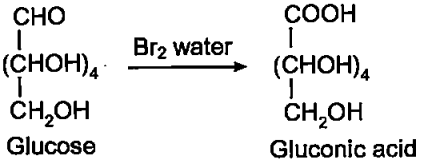
Answer : (i) Oligosaccharide : Carbohydrates that yield two to ten monosaccharide units on hydrolysis are known as oligosaccharides. They are further classified as disaccharides, trisaccharides, tertrasaccharides etc., depending upon the number of monosaccharides they provide upon hydrolysis. Disaccharides are the most common, *e.g.*, maltose.

(ii) Denaturation of protein : Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. When a native protein is subjected to physical change like temperature, chemical or pH change, the hydrogen bonds within the protein structure are disturbed causing globules to unfold and α-helix to uncoiled. The secondary and tertiary structures of protein molecule is destroyed, in turn losing their biological activity, this is known as denaturation of protein. Example is coagulation of egg white on boiling.

(iii) Vitamins : These are the organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of organisms. Example – Vitamins A, B, C, D etc.

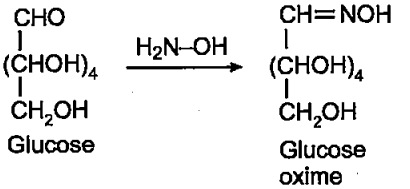
OR

(i) Reaction of glucose with Br_2 water (a mild oxidising agent) gives gluconic acid, this reaction indicates that carbonyl group of glucose is an aldehydic group :



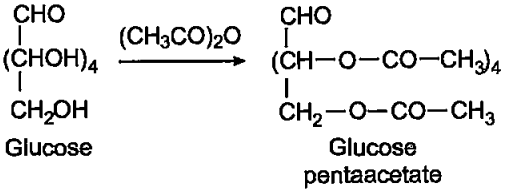
Glucose Gluconic acid

(ii) Reaction of glucose with H_2N—OH (hydroxylamine) gives oxime, this reaction confirms that there is a carbonyl group present in glucose :



Glucose Glucose oxime

(iii) Reaction of glucose with $(CH_3CO)_2O$ (acetic anhydride) gives glucose pentaacetate, this reaction confirms that there are five hydroxyl groups present in glucose :



Glucose Glucose pentaacetate

●●