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]
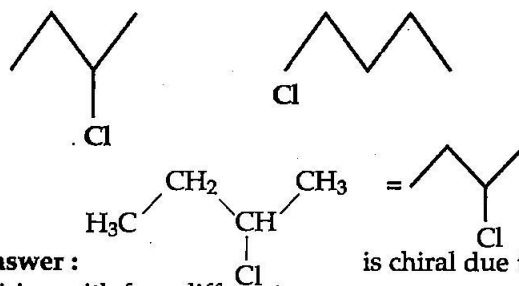
Answer : is chiral due to pairing with four different groups.

5. **Which of the following is a natural polymer ?** [1]
   Buna-S, Proteins, PVC Economics type
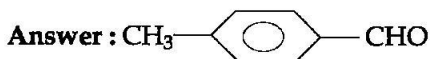   **Answer :** Protein, is a natural polymer having amino acid as a monomer.

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 : CH_3—⬡— CHO

** 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 $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)** [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 $R \rightarrow P$, the variation in the concentration (R) Vs. time (t) plot is given as [2]
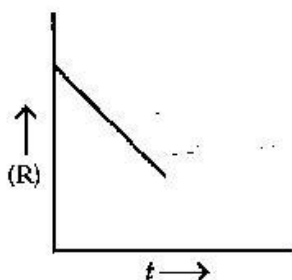
    (i) Predict the order of the reaction.

    (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.
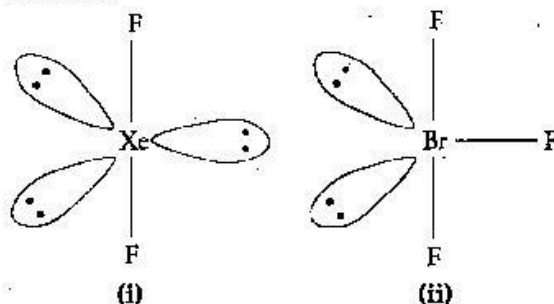

Anode : $Cu \longrightarrow Cu^{2+} + 2e^-$
Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$
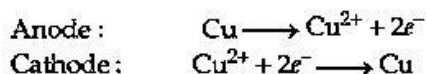
14. Complete the following equations : [2]

    (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]
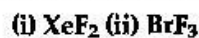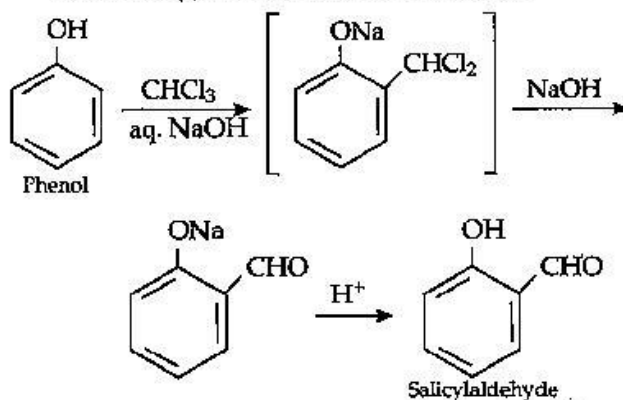
    Answer :

16. Write the equations involved in the following reactions : [2]
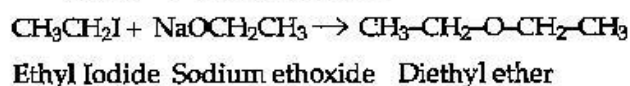
    (i) Reimer-Tiemann reaction

    (ii) Williamson synthesis
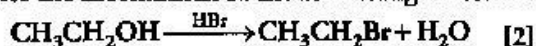
    Answer : (i) Reimer Tiemann reaction :

    (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 :

    $CH_3CH_2OH \xrightarrow{\text{HBr}} CH_3CH_2Br + H_2O$ [2]

    Answer : S_N2 Mechanism

    1. $H-Br \rightleftharpoons H^+ + \overset{..}{\underset{..}{:}}Br$

    $CH_3-CH_2\overset{..}{\underset{..}{O}}H + H^+ \rightleftharpoons CH_3-CH_2\overset{+}{\underset{..}{O}}H_2$

    Ethyl oxonium ion
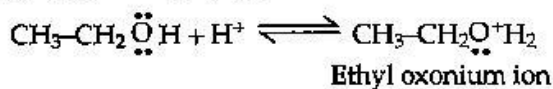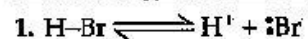
2.
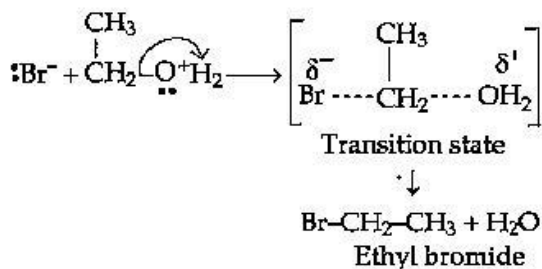
18. Write the name of monomers used for getting the following polymers : [2]

(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

$$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$$
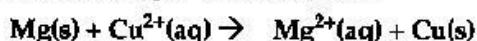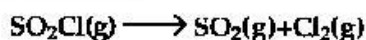
Given : $E^0_{cell} = 2.71$ V, 1 F = 96500 C mol^{-1}

(b) Name the type of cell that was used in Apollo space program for providing electrical power. [3]

Answer : (a) $Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$

$\Delta_r G^\circ = -nFE^\circ_{cell}$

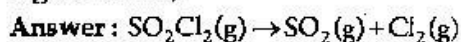$= -2 \times 96500 \times 2.71$

$= -523.03 \text{ kJ mol}^{-1}$

(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 : $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

$dt_1 \; t = 0 \quad P_0 \ldots\ldots\ldots\ldots 0$

At $t = t \quad P_0 - P \ldots\ldots\ldots\ldots P$

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) $(CH_3)_3 P = O$ 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 $[Co(en)_3]^{3+}$?
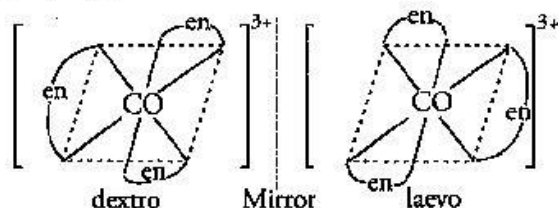
(en = ethane-1, 2-diamine)

** 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 $[CO(en)_3]^{3+}$

dextro   Mirror   laevo

(iii) $[Ni(Cl)_4]^{2-}$, Ni is in +2 oxidation state with the electronic configuration $3d^84s^0$. 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 $3d^84s^2$. Co is a strong ligand it causes $4s$ electrons to shift to $3d$ and pair up $3d$ electrons. Therefore, $Ni(CO)_4$ is diamagnetic.

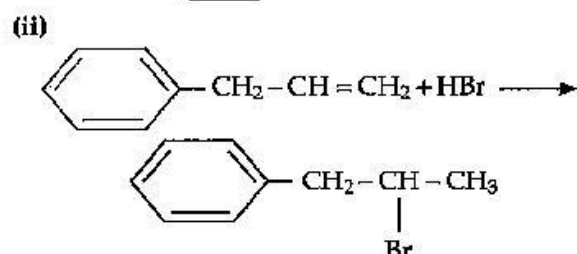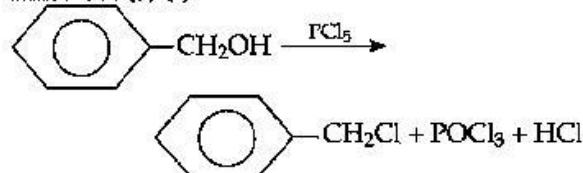**24. (a)** Draw the structure of major monohalo products in each of the following reactions :

(i)

(ii)
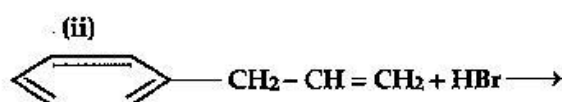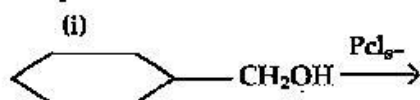
(b) Which halogen compound in each of the following pairs will react faster in S_N2 reaction :

(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.
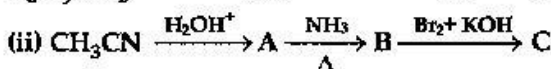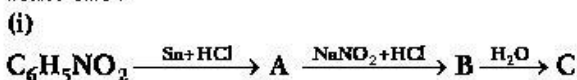
25. Account for the following :

(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
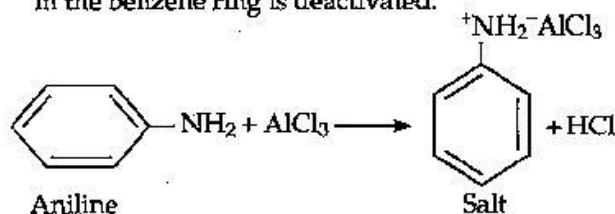
(iii) Due to steric hindrance and solvation effect in case of $(CH_3)_3N$, it is less basic than $(CH_3)_2NH$ in aqueous solution.

OR

(i) $C_6H_5NO_2 \xrightarrow{Sn+HCl} C_6H_5NH_2$
                         (A)
                 Benzylamine
                         ↓

(C) $C_6H_5OH \xleftarrow{H_2O} C_6H_5N_2^+Cl^-$
(Phenol)   (B)
           Benzene diazonium chloride

(ii) $CH_3CN \xrightarrow{H_2O/H^+} CH_3COOH \xrightarrow[\Delta]{NH_3}$
                  (A) CH_3CONH_2
           Acetic acid   Ethanamide (B)
                           ↓ Br_2+KOH

                    CH_3NH_2(C)
                    Methanamine
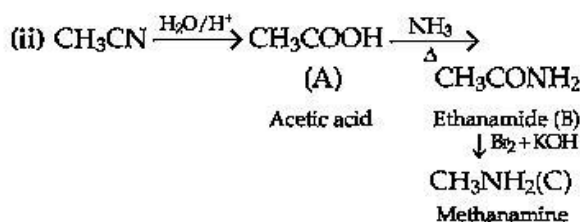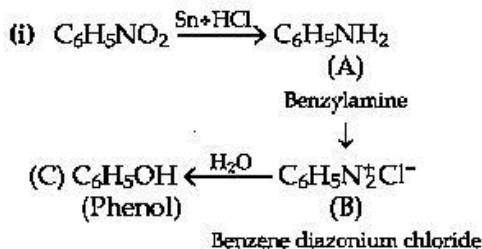
26. Define the following terms related to proteins : **[3]**

(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

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

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.)

$\therefore \dfrac{15}{60} = \dfrac{x}{180}$

$x = 45$ 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

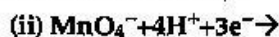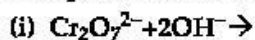Volume of solution = $\dfrac{100 \text{ g}}{1.2 \text{ g mL}^{-1}}$ = 83.33 mL = 0.083 L

Molarity = $\left(\dfrac{10}{180}\right).\dfrac{1000}{83.33} = 0.67 \text{ mol L}^{-1}$

Molality = $\dfrac{10}{180}.\dfrac{1000}{90} = 0.617 \text{ mol kg}^{-1}$

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) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
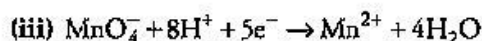
(iv) Mn^{3+} is more paramagnetic as it has four unpaired electrons while Cr^{3+} has only three.

$Mn^{+3} = [Ar]\, 4s^0 3d^4$

$Cr^{+3} = [Ar]\, 4s^0 3d^3$
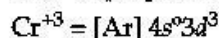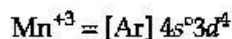
30. (a) Write the products formed when CH_3CHO reacts with the following reagents :

(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) $Cl\cdot CH_2COOH$ 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 acetaldehyde with hydrogen cyanide it gives 2-Hydroxypropanenitrile as product.

$$CH_3-CHO + HCN \longrightarrow H_3C - \underset{\underset{CN}{|}}{\overset{\overset{H}{|}}{C}} - OH$$
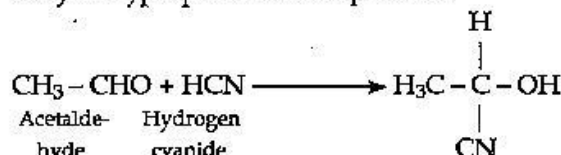
Acetaldehyde   Hydrogen cyanide   2-Hydroxypropanenitrile.

(ii) On reaction of acetaldehyde with Hydroxylamine (NH_2-OH) it gives acetaldoxime.

$$CH_3-CHO + NH_2-OH \longrightarrow CH_3 - CH = NOH + H_2O$$

Acetaldehyde   Hydroxylamine   Acetaldoxime
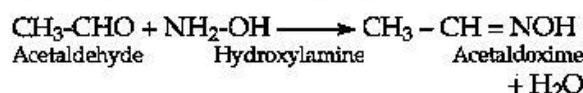
(iii) When 2 molecules of acetaldehyde reacts with each other in presence of dil NaOH, 3-Hydroxybutanal is obtained. This is a aldol reaction and further proceeds the reaction when heated.

$$CH_3-CHO + CH_3-CHO \xrightarrow{dil.NaOH}$$

Acetaldehyde   Acetaldehyde

$$CH_3-CH-CH_2-CHO$$
$$\underset{\underset{\text{(aldol reaction)}}{\underset{\text{3-Hydroxybutanal}}{OH}}}{|}$$
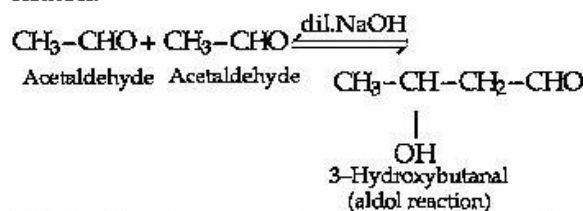
(b) (i) Phenol reacts with $FeCl_3$ to give violet coloured precipitate while benzoic acid give buff coloured precipitate.

$$3C_6H_5OH + FeCl_3 \longrightarrow (C_6H_5O)_3Fe + 3HCl$$
Phenol   Violet Colour

$$3C_6H_5COOH + FeCl_3 \longrightarrow (C_6H_5COO)_3Fe$$
Benzoic-acid   Buff colour
$$+ 3HCl$$

(ii) Propanone gives iodoform test but propanal does not.

$$CH_3 - \underset{\underset{O}{\|}}{C}H - CH_3 \xrightarrow{I_2 + NaOH} CHI_3 \text{(Iodoform)}$$

$$CH_3 - CH_2 - CHO \xrightarrow{I_2 + NaOH} \text{No reaction}$$
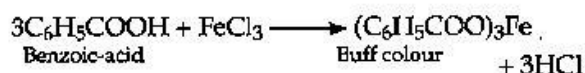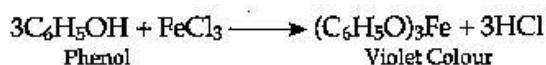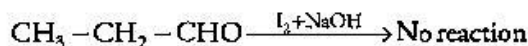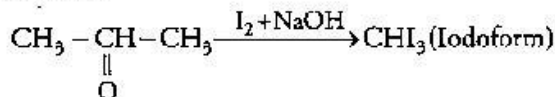
OR

(a) (i) Because of –I effect of Cl atom in

ClCH$_2$COOH and +I effect of CH$_3$ group in CH$_3$COOH the electron density in the O–H bond in ClCH$_2$COOH is much lower than CH$_3$COOH. Hence ClCH$_2$COOH acid is stronger acid than CH$_3$COOH.

(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) $2HCHO \xrightarrow{NaOH} CH_3OH + H\,COONa$
Formaldehyde   Methyl alcolol

(c) $CH_3CH_2CH_2COCH_3$, being a methyl ketone gives iodo form test.

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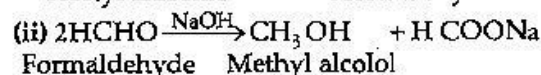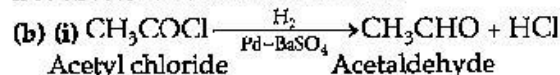# Chemistry 2014 (Outside Delhi)   SET II

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.

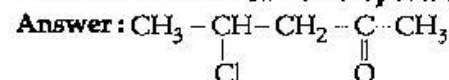3. Why does NO$_2$ dimerise ?**   [1]

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 : $CH_3 - \underset{\underset{Cl}{|}}{C}H - CH_2 - \underset{\underset{O}{\|}}{C} - CH_3$

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)
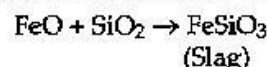
(ii) NaCN is used as a depressant as it forms zinc complex, Na$_2$[Zn(CN)$_4$] on the surface of ZnS thereby preventing it from forming froth.

11. Complete the following equations :   [2]
(i) Ag + PCl$_5$·**
(ii) CaF$_2$ + H$_2$SO$_4$·
Answer :
(ii) CaF$_2$ + H$_2$SO$_4$ → CaSO$_4$ + 2HF
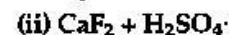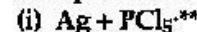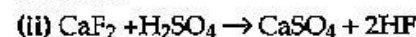
12. Draw the structures of the following :   [2]
(i) XeF$_4$
(ii) HClO$_4$
Answer : (i)

(ii) $HO - \underset{\underset{O}{|}}{\overset{\overset{O}{\uparrow}}{Cl}} \rightarrow O$
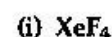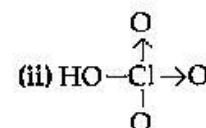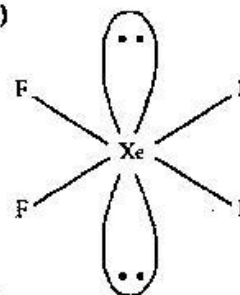
13. (i) Write the type of magnetism observed when the magnetic moment are oppositely aligned and cancel out each other.**
(ii) Which stoichiometric defect does not change the density of the crystal ?**   [2]

** 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 :
$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$
Lactose   D-(+)   D-(+)
                Glucose   Galactose
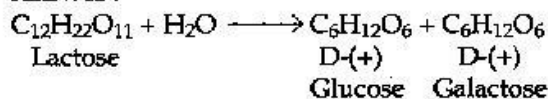
8. Write the structure of 2-hydroxybenzoic acid. [1]
Answer :

9. Complete the following equations : [2]
(i) $Cu + 2H_2SO_4$ (Conc.) $\rightarrow$
(ii) $XeF_2 + H_2O \rightarrow$

Answer :
(i) $Cu + conc.\ 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$

(ii) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$
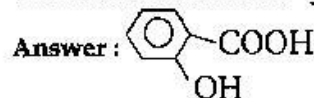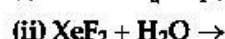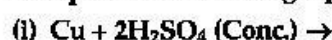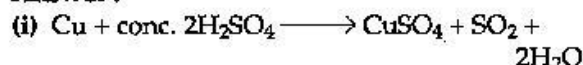
10. Draw the structure of the following : [2]
(i) XeO_3

(ii) H_2SO_4

Answer :

(i)   (ii)
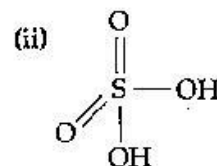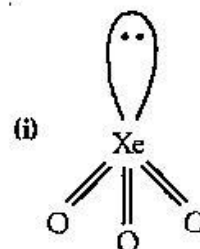
11. Write the name of monomers used for getting the following polymers : [2]
(i) Teflon (ii) Buna-N
Answer : (i) Tetrafluoroethene

(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 ?**

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]

$$CH_3-CH-CH_2-COOH$$
$$|$$
$$OH$$
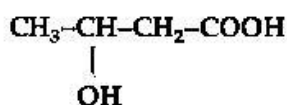
Answer : 3-hydroxybutan-1-oic acid

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]

$$\begin{array}{ccccc} A^+ & B^- & A^+ & B^- & A^+ \\ B^- & O & B^- & A^+ & B^- \\ A^+ & B^- & A^+ & O & A^+ \\ B^- & A^+ & B^- & A^+ & B^- \end{array}$$
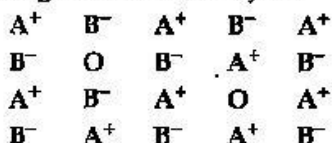
Answer the following questions :

(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}, ΔT_f = 0.48 K

From the formula,

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

Mass of solute, $W_B = \dfrac{\Delta T_f \times M_B \times W_A}{K_f \times 1000}$

$$= \frac{0.48 \times 256 \times 75}{5.12 \times 1000}$$

$$= \frac{(0.48 K)(256 \text{ g mol}^{-1})(0.075 \text{ kg})}{(5.12 \text{ K kg mol}^{-1})}$$

$$= 1.8 \text{ g}$$

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,

$$P = P_A + P_B$$
$$P_A = P_A^0 \times A$$
$$P_B = P_B^0 \times B$$

$\therefore \qquad P = P_A^0 \times A + P_B^0 \times B$

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.) $\rightarrow$
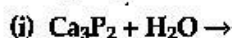
OR

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) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$
Calcium   Phosphine
hydroxide

(ii)

$Cu + 2H_2SO_4$ (conc.) $\rightarrow CuSO_4 + SO_2 + 2H_2O$
Copper (II)   Suphur
Suphate   dioxide

OR

(i)

$$\underrightarrow{\quad HI < HBr < HCl < HF \quad}$$
Increasing order of Bond Dissociation Energy.

(ii) $\underrightarrow{\quad H_2O < H_2S < H_2Se < H_2Te \quad}$
Increasing acidic character

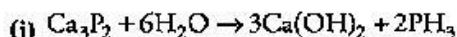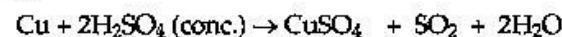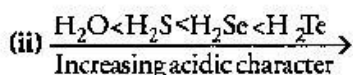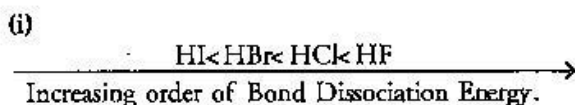**16.** Write the IUPAC name of the complex [Cr(NH₃)₄Cl₂]⁺. What type of isomerism does it exhibit ? **[2]**

Answer : Tetraamminedichloridochromium(III) ion. The complex exhibits geometric (cis-trans) isomerism.

Cis-isomer

trans-isomer
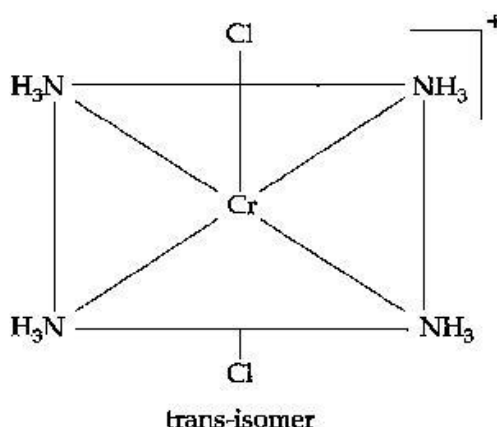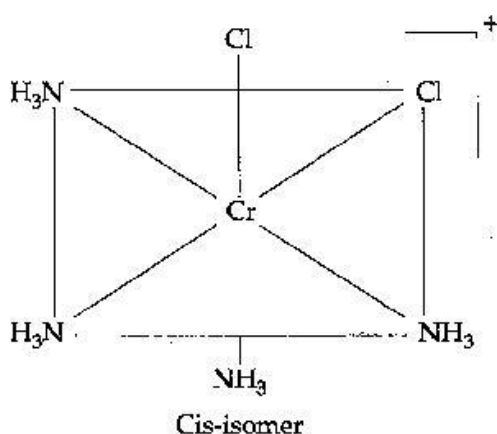
17. (i) Which alkyl halide from the following pair is chiral and undergoes faster S_N2 reaction ? **[2]**

(a)   (b)
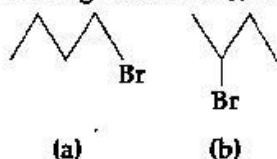
(ii) Out of S_N1 and S_N2, which reaction occurs with

(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.
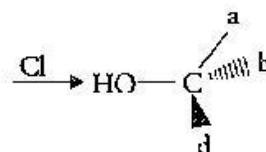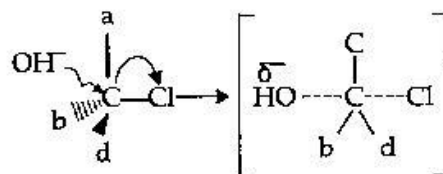
(b) Racemisation in S_N1 reaction is due to attack of nucleophile on both sides of the planar carbocation.

(R)

$$OH + HO - C^{a}{\quad}^{b}_{\quad d}$$

(S)

Racemic forms
(Optically inactive mixture)
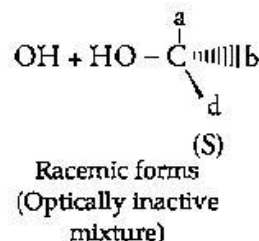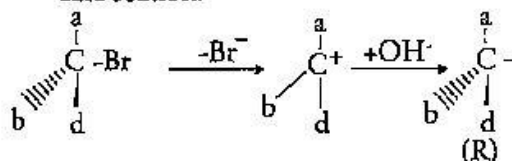
18. Draw the structure of major monohalo product in each of the following reactions : **[2]**

(i) $\cdots$ OH $\xrightarrow{SOCl_2}$

(ii)

$CH_2 - CH - CH_2 + HBr \xrightarrow{Peroxide}$

Answer : (i) OH $\xrightarrow{SOCl_2}$ Cl

(ii) $CH_2 - CH - CH_2 + HBr \xrightarrow{Peroxide}$
$CH_2 - CH_2CH_2Br$
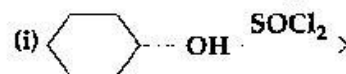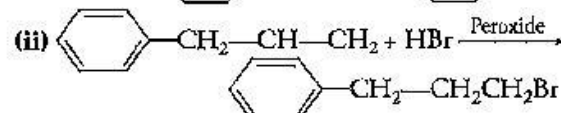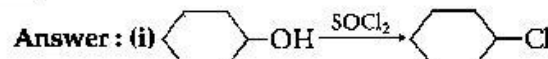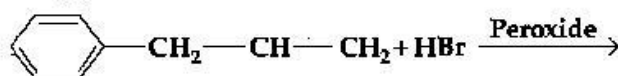
19. (a) In reference to Freundlich adsorption isotherm, write the expression for adsorption of gases on solids in the form of an equation. **[3]**

(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
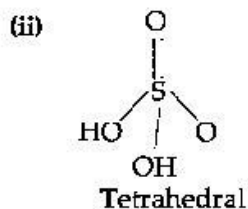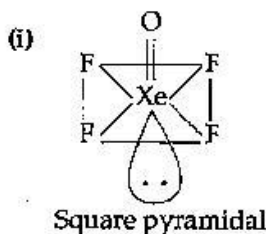
21. Account for the following : [3]

(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+}.

$$Fe + 2HCl \rightarrow FeCl_2 + H_2.$$

**Answer is not given due to change in present syllabus.
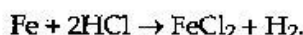
(iii) An ozone molecule is a resonance hybrid of the molecule in which there is single bond with one terminal oxygen and double bond with other terminal oxygen of the central oxygen atom.
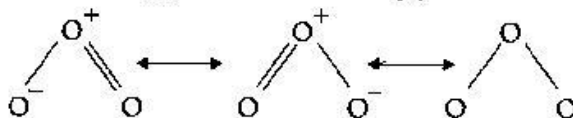
So, neither single or double bond is pure. Thus both O – O bond lengths are equal.

22. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume : [3]

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$
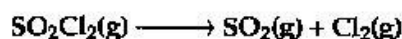
Experiment	Time/s^{-1}	Total pressure/ atm
1	0	0.4
2	100	0.7

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.

(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 $\Rightarrow$ open structure of Glucose.

$$CHO \cdot (CHOH)_4 - CH_2OH$$

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]

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$
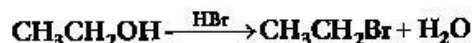
(b) Write the equation involved in Reimer-Tiemann reaction.

Answer : (a) Mechanism of the reaction

$$HBr \longrightarrow H^+ + Br$$

$$CH_3-\overset{+}{C}H_2 \xrightarrow{Br^-} CH_3-CH_2-Br$$
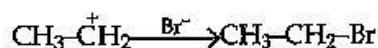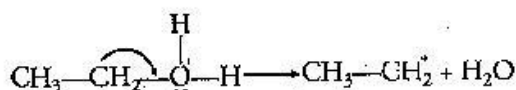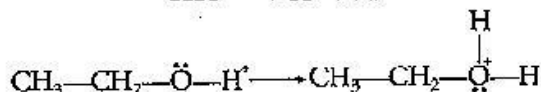
This is an S_N2 reaction mechanism.

(b)

Salicylaldehyde
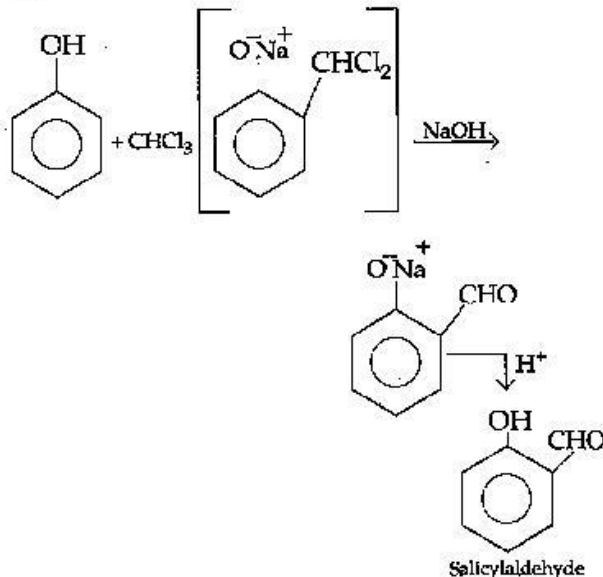
Reimer-Tiemann reaction

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)

$CH_3COOH \xrightarrow{NH_3} A \xrightarrow{Br_2+KOH} B \xrightarrow{CHCl_3+NaOH} C$
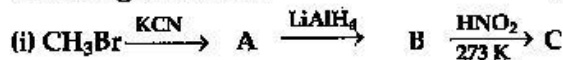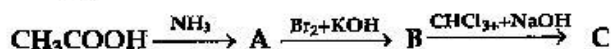
OR

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) $CH_3Br \xrightarrow{KCN} \underset{\substack{(A) \\ \text{Ethanenitrile}}}{CH_3CN} \xrightarrow{LiAlH_4} \underset{\substack{(B) \\ \text{Ethaneamine}}}{CH_3CH_2NH_2}$

$\xrightarrow[273K]{HNO_2} \underset{\substack{(C) \\ \text{Ethanol}}}{C_2H_5OH + N_2 + HCl}$

(ii)

$CH_3COOH \xrightarrow{NH_3} \underset{\substack{(A) \\ \text{Ethanamide}}}{CH_3CONH_2} \xrightarrow[\substack{\text{Hoffman's} \\ \text{Bromide} \\ \text{reaction}}]{Br + KOH}$

$\underset{\substack{(B) \\ \text{Methanamine}}}{CH_3NH_2} \xrightarrow[\substack{\text{Carbylamine} \\ \text{reaction}}]{CHCl_3 + NaOH} \underset{\substack{(C) \\ \text{Methyl} \\ \text{isonitrite} \\ \text{(Methyl} \\ \text{Carbylamine)}}}{CH_3NC}$
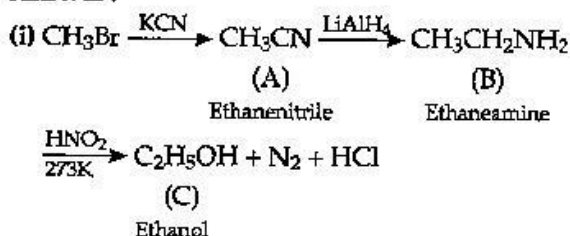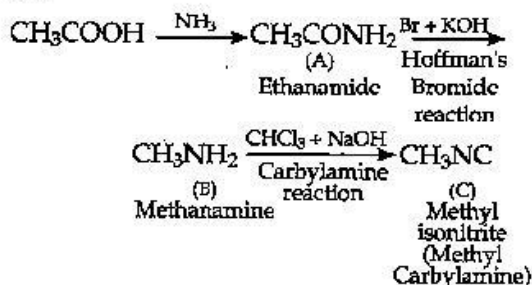
OR

(i) Nitrobenzene to Aniline

(ii) Ethanoic acid into methanamine

$CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow[NaOH]{Br_2} CH_3NH_2$
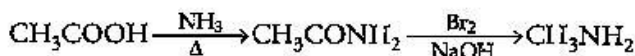
(iii) Aniline into N-Phenylethanamide

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 $1.29 \times 10^{-2} \Omega^{-1} cm^{-1}$.

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}]
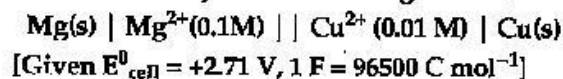
[5]

Answer : (a) (i) The limiting molar conductivity is the molar conductivity of a solution when the concentration approaches zero (infinite dilution, $C \rightarrow 0$).

(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
$= 1.29 \times 10^{-2} \Omega^{-1} cm^{-1} \times 100\Omega$

$= 1.29\ cm^{-1}$

∴ Conductivity (K_2)

$= \dfrac{\text{Cell constant}}{\text{Resistance}}$

$= \dfrac{1.29\ cm^{-1}}{520\Omega} = 2.48 \times 10^{-3} \Omega^{-1} cm^{-1}$

Molar Conductivity (Λ_m)

$= \dfrac{K_2 \times 1000}{C_2}$

$= \dfrac{2.48 \times 10^{-3} \times 1000\ Scm^{-1}}{0.02\ mol\ cm^{-3}}$

$= 1.24 \times 10^2$ 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

$\underset{\text{1 mole}}{Cu^{2+}} + 2e^- \rightarrow \underset{\text{2 moles}}{Cu}$

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

$$E_{cell} = E°_{cell} - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71 - \frac{0.059}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 2.71 - 0.0295 \log 10$$

$$= 2.71 - 0.0295$$

$$= 2.6805 \text{ V}$$

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 3d transition series which shows maximum number of oxidation states. Why does it show so ?

(ii) Which transition metal of 3d series has positive $E°_{(M^{2+}/M)}$ 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 conc H_2SO_4 gives orange solution of $Na_2Cr_2O_7$.

$$2Na_2CrO_4 + H_2SO_4 \longrightarrow Na_2Cr_2O_7 + NaSO_4$$
$$\text{Yellow} \qquad\qquad \text{Orange} \qquad + H_2O$$

(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 5f, 6d and 7s orbitals, actinoids show wide range of oxidation states.

OR

(i) Manganese shows maximum number of oxidation states in 3d 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 $E°_{(Cu^{2+}/Cu)}$ value i.e. +0.34. This is because Cu has high value of $\Delta_a H$ and low value of $\Delta hyd\, H$. $\Delta_i H$ required is not compensated by the energy released. Therefore, $E°(Cu^{2+}/Cu)$ is positive.

(iii) $E°_{(Cr^{3+}/Cr^{2+})} = -0.4V$ and $E°_{(M^{3+}/Mn^{2+})} = +1.5V$ 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) (cyclohexanone) $=O + H_2N-OH \xrightarrow{H^+}$

(ii) $2C_6H_5CHO + \text{Conc. NaOH} \longrightarrow$

(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.
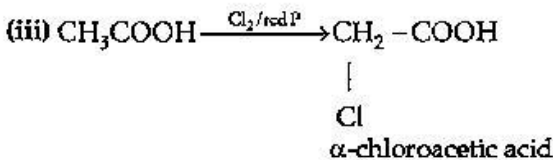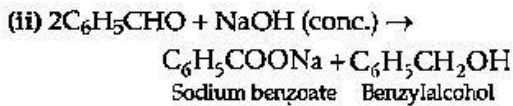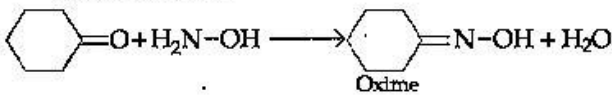
(ii) Carboxylic acid is a stronger acid than phenol.

(b) Write the chemical equations to illustrate the following name reactions :

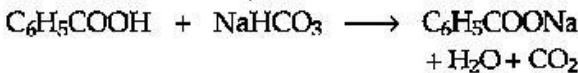**(i)** Wolff-Kishner reduction   **(ii)** Aldol condensation

(iii) Cannizzaro reaction

Answer : (a) (i)

$$\text{Oxime}$$

(ii) $2C_6H_5CHO + NaOH \text{ (conc.)} \rightarrow$

$$\underset{\text{Sodium benzoate}}{C_6H_5COONa} + \underset{\text{Benzylalcohol}}{C_6H_5CH_2OH}$$

(iii) $CH_3COOH \xrightarrow{Cl_2/\text{red P}} CH_2-COOH$

$$\underset{\underset{\alpha\text{-chloroacetic acid}}{Cl}}{|}$$

(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

$$CH_3COCH_3 + 3NaOH \xrightarrow[\Delta]{NaOH, I_2} CH_3COONa + CHI_3$$
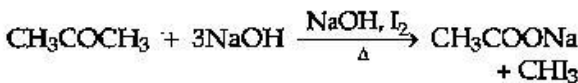
OR

(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

$$\text{I} \qquad\qquad \text{II}$$

phenoxide ion

$$\text{I} \qquad \text{II} \qquad \text{III} \qquad \text{IV}$$
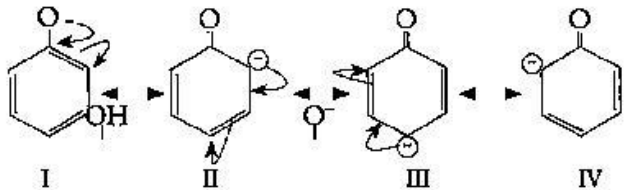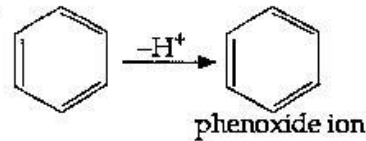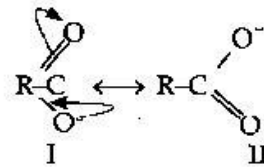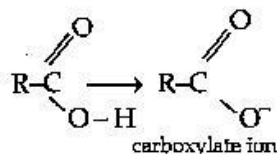
The reason for greater stability of carboxylate ion is that it involves equivalent resonance in which negative charge is present on oxygen atom all the time whereas, in phenoxide ion, out of total four resonating structures, in three structures, negative charge is present on carbon atom which makes it less stable.
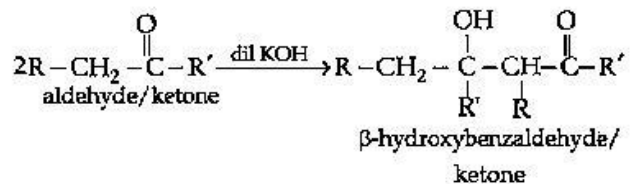
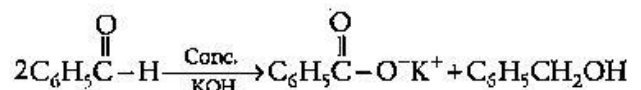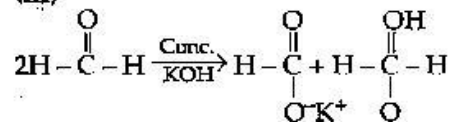**(b) (i)** Reduction of aldehyde or ketone to respective hydrocarbon.
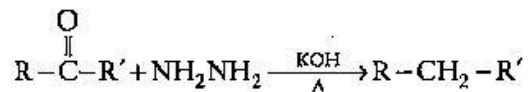
R = any alkyl group.

R' = –H or any alkyl group

(ii) Formation of β-hydroxyaldehyde or β-hydroxy ketone from aldehydes and ketones respectively.

β-hydroxybenzaldehyde/ ketone

(iii)

$$2C_6H_5\overset{O}{\underset{||}{C}}-H \xrightarrow[KOH]{Conc.} C_6H_5\overset{O}{\underset{||}{C}}-O^-K^+ + C_6H_5CH_2OH$$

Chemistry 2014 (Delhi)　　　　SET II
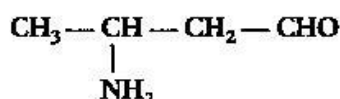
Time allowed : 3 hours　　　　　　　　　　**Maximum marks : 70**

> **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]**

$$CH_3 - CH - CH_2 - CHO$$
$$\qquad\ \ |$$
$$\qquad NH_2$$

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]**
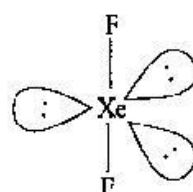
(i) XeF_2　　　　　(ii) BrF_3
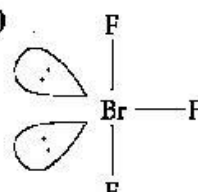
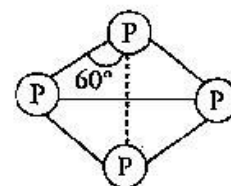(b) Write the structural difference between white phosphorus and red phosphorus.
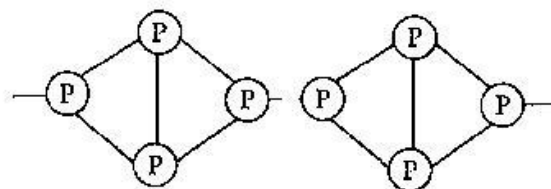
Answer : (a)

(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.
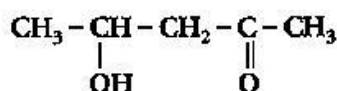
Chemistry 2014 (Delhi)

Time allowed : 3 hours

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]

$$CH_3 - CH - CH_2 - C - CH_3$$
$$\qquad | \qquad\qquad\quad ||$$
$$\qquad OH \qquad\quad O$$

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.

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

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.

$HOOC (CH_2OH)_4.CH_2OH$.

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SET III

Maximum marks : 70

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 : (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)
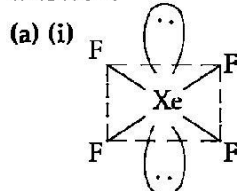
22. Account for the following :

(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 : $CH_3CH_2CH_2CH_2CH_2CH_3$

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