

**CHEMISTRY**

Paper &amp; Solution

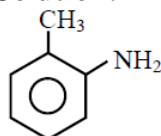
Code: 55/3

Max. Marks: 70

Time: 3 Hrs.

**General Instructions:**

- (i) All questions are compulsory.
- (ii) Questions number **1 to 8** are very short answer questions and carry **1** mark each.
- (iii) Questions **9 to 18** are short answer questions and carry **2** marks each.
- (iv) Question number **19 to 27** are also short-answer questions and carry **3** marks each.
- (v) Question number **28 to 30** are long-answer questions and carry **5** marks each.
- (vi) Use Log Tables, if necessary. Use of calculators is not allowed.

**1.** Write the structure of 2-aminotoluene**Solution:**

2-Amino toluene

**2.** Which aerosol depletes ozone layer ?**Solution:**

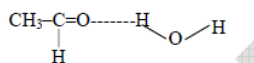
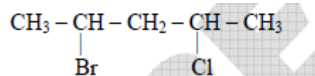
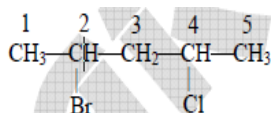
CFC's and NO

**3.** Of physisorption or chemisorption, which has a higher enthalpy of adsorption ?**Solution:**

Chemisorption has higher enthalpy of adsorption

**4.** Ethanal is soluble in water. Why ?**Solution:**

Due to formation of H-bond with water

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

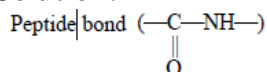
(2-Bromo-4-chloro pentane)

**6.** Name the method used for refining of copper metal.**Solution:**

Electrorefining

7. Write the name of linkage joining two amino acids.

**Solution:**



8. Give one example of a condensation polymer.

**Solution:**

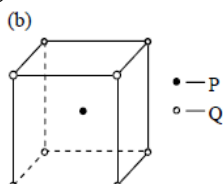
Nylon-6

9. (a) Why does presence of excess of lithium makes LiCl crystals pink ?

(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 ?

**Solution:**

(a) Presence of metal excess defect results due to presence of  $e^-$  at the position of  $-ve$  ions this results in generation of F-centre and LiCl become pink



Effective P atoms = 1

Effective Q atoms =  $1/8 \times 8 = 1$

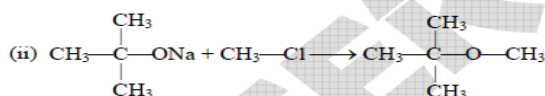
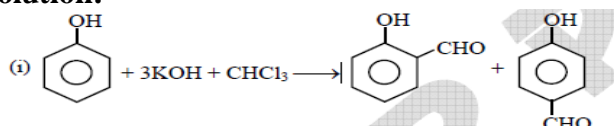
Formula of compound is PQ

10. Write the equations involved in the following reactions :

(i) Reimer – Tiemann reaction

(ii) Williamson's ether synthesis

**Solution:**



11. Define thermoplastic and thermosetting polymers. Give one example of each.

**OR**

What is a biodegradable polymer ? Give an example of a biodegradable aliphatic polyester.

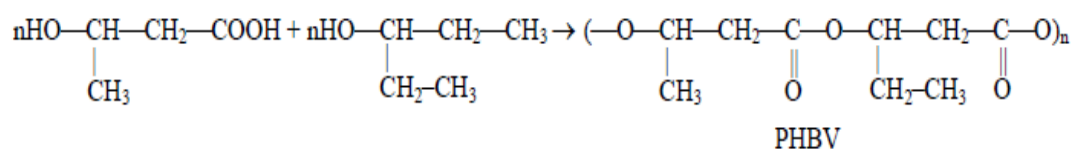
**Solution:**

Thermoplastic – polymers in which the intermolecular forces of attraction are in between those of elastomer and fibers are called thermoplastic Ex. PVC Thermosetting polymers – The cross linked polymer which have hard infusible and insoluble mass are called thermosetting polymer.

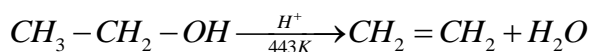
Ex. Bakelite

**OR**

Biodegradable polymer – Polymer, such as starch, cellulose protein, nucleic acid which control the various life processes and are decomposed by microorganism are called biodegradable polymer Ex. Poly hydroxyl butyrate-CO- $\beta$ -hydroxy valerate (PHBV)

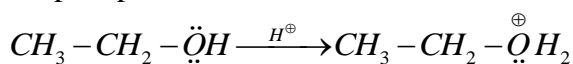


12. Explain the mechanism of the following reaction:

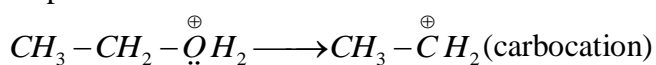


**Solution:**

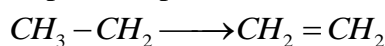
Step-I : protonation



Step-II : formation of carbocation



Step-III : deprotonation



13. How are interhalogen compounds formed ? What general compositions can be assigned to them ?

**Solution:**

Interhalogen compounds are formed due to combination of two different halogens. General formula of Interhalogen compounds are

- (i) AX
- (ii) AX<sub>3</sub>
- (iii) AX<sub>5</sub>
- (iv) AX<sub>7</sub>

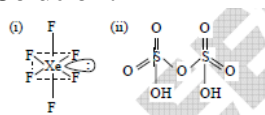
A = Less E.N. halogen

X = More E.N. halogen

14. Draw the structures of the following molecules

- (i) XeF<sub>6</sub>
- (ii) H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>

**Solution:**



15. Aluminium crystallizes in an fcc structure. Atomic radius of the metal is 125pm. What is the length of the side of the unit cell of the metal ?

**Solution:**

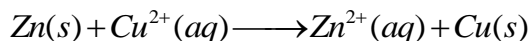
For F.C.C.

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

$$\sqrt{2}a = 4 \times 125 \text{ pm}$$

$$a = \frac{500}{\sqrt{2}} = 250\sqrt{2} = 353.5 \text{ pm}$$

16. The standard electrode potential ( $E^\circ$ ) for Danial cell is +1.1V. Calculate the  $\Delta G^\circ$  for the reaction



( $IF = 96500 \text{ C mol}^{-1}$ )

**Solution:**

$$\Delta G = -nFE_{\text{cell}}^0$$

$$= -2 \times 96500 \times 1.1$$

$$= -212300 \text{ J}$$

$$= -212.3 \text{ kJ}$$

17. (a) For a reaction  $A + B \rightarrow P$ , the rate law is given by

$$r = k[A]^{1/2}[B]^2$$

What is the order of this reaction ?

(b) A first order reaction is found to have a rate constant  $k = 5.5 \times 10^{-14} \text{ s}^{-1}$ . Find the half life of the reaction.

**Solution:**

$$(a) \text{ order of reaction is } = 2 + \frac{1}{2} = 2\frac{1}{2}$$

$$(b) t_{1/2} = \frac{0.693}{K} = \frac{0.693}{5.5 \times 10^{-14}} = 0.126 \times 10^{14} = 1.26 \times 10^{13} \text{ sec}$$

18. Outline the principles of refining of metals by the following methods

(i) Zone refining

(ii) Vapour phase refining

**Solution:**

(i) **Zone refining** : This method is used when very high degree of purity is required eg., Zn, Ga, Si, Ge, etc. This method is used when impurities have lower melting point than pure metal.

(ii) **Vapour phase refining**

In this method solid is converted into vapour phase by chemical reaction and when these vapours are heated at high temperature, again metal is obtained.

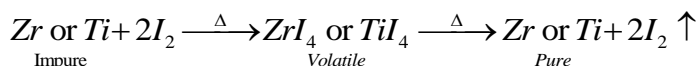
(a) **Mond's process** :

This process is used for purification of Ni. In this process volatile complex  $[\text{Ni}(\text{CO})_4]$  is formed.



(b) **Van-Arkel process** :

Used for Zr and Ti. They form their volatile iodide



19. Define the following terms given an example of each

(i) Associated colloids

(ii) Lyophilic solution

(iii) Adsorption

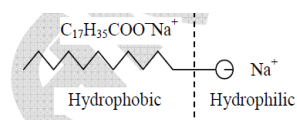
**Solution:**

**(i) Associated colloids :**

Certain substance form true solution at low concentration but as concentration become greater than critical micelle concentration the particles get associated to form colloidal particle and colloidal solution is obtained.

**Ex. soap**

Soap is sodium or potassium salt of fatty acid, when its concentration become greater than C.M.C. particles get associated to give colloidal solution.



**(ii) Lyophilic solution :**

When particles of dispersed phase are solvated by dispersion medium lyophilic colloidal solution is obtained.

This is more stable due presence of force of attraction between dispersed phase and dispersion medium.

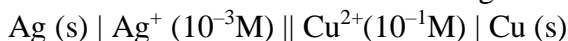
**Ex. Starch solution in  $H_2O$**

**(iii) Adsorption**

When particles of certain substance get associated at the surface of solid, it is called as adsorption. In other words we can say adsorption at the surface is called as adsorption.

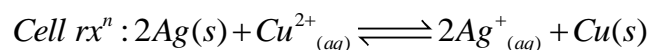
**Ex. Adsorption of gases by activated charcoal.**

**20.** Calculate the emf of the following cell at  $25^\circ C$



Given  $E^\circ_{cell} = +0.46V$  and  $\log 10^n = n$

**Solution:**



$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[Ag^+]^2}{[Cu^{+2}]}$$

$$= 0.46 - \frac{0.0591}{2} \log \frac{(10^{-3})^2}{(10^{-1})}$$

$$= 0.46 - \frac{0.0591}{2} \log(10^{-5})$$

$$= 0.46 - \frac{0.0591}{2} \times (-5)$$

$$= 0.46 + 0.14775 = 0.60775V$$

**21.** 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. After reading the above passage, answer the following questions :

(i) What values are displayed by Mrs. Anuradha ?

(ii) Name the vitamin whose deficiency causes 'pernicious anaemia'.

(iii) Give an example of water soluble vitamin.

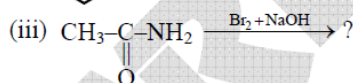
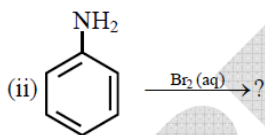
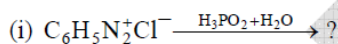
**Solution:**

(i) Self

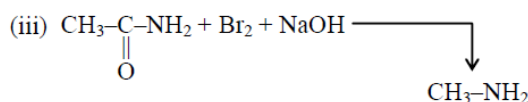
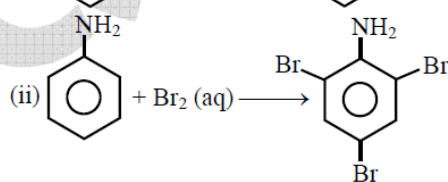
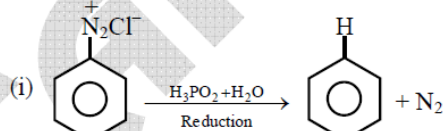
(ii) Vit-B12

(iii) Vit – C

**22.** Write the main products of the following reaction:



**Solution:**



**23.** 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.

$[R = 8.314 \text{ J K}^{-1} \text{ mole}^{-1}, \log 4 = 0.6021]$

**Solution:**

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\log 4 = \frac{E_a}{2.303 \times 8.314} \left( \frac{1}{293} - \frac{1}{313} \right)$$

$$0.6021 = \frac{E_a}{2.303 \times 8.314} \left( \frac{313 - 293}{293 \times 313} \right)$$

$$E_a = \frac{0.6021 \times 2.303 \times 8.314 \times 293 \times 313}{20}$$

$$= 52863.33 \text{ J}$$

$$= 52.863 \text{ kJ}$$

**24.** For the complex  $[\text{NiCl}_4]^{2-}$ , write

(i) The IUPAC name

- (ii) The hybridization type  
 (iii) The shape of the complex  
 (Atomic no. of Ni = 28)

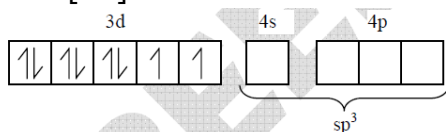
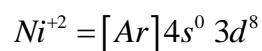
Or

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)  $\Delta_0 > P$   
 (ii)  $\Delta_0 < P$

**Solution:**

- (i) Tetrachloridonickelate(II) ion



$Cl^-$  is weak field ligand hence, pairing does not occur

Type of hybridization is  $sp^3$

- (iii) Tetrahedral

Or

It is the energy difference between lower energy and higher energy d-orbitals after splitting of d-orbitals

- (i)  $\Delta_0 > P$



- (ii)  $\Delta_0 < P$



**25.** Give reasons for the following :

- (i) Ethyl iodide undergoes  $S_N2$  reaction faster than ethyl bromide.  
 (ii)  $(\pm)$  2-Butanol is optically inactive.  
 (iii) C — X bond length in halobenzene is smaller than C — X bond length in  $CH_3 - X$ .

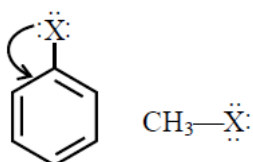
**Solution:**

- (i) Because in ethyl iodide, iodide (I) is act as a best L.G. among all the halide ion.

Rate of  $S_N2$  reaction  $\propto$  L.G. ability of L.G.

- (ii)  $(\pm)$  2-butanol is a racemic mixture which is optically inactive due to external compensation.

- (iii) Due to resonance in halobenzene it have less bond length value in comparsion to  $CH_3 - X$



**26.** (i) What class of drug is Ranitidine ?

- (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

**Solution:**

- (i) It is a Antacid
- (ii) In this case we use synthetic detergents because it gives foams with hard water
- (iii) 0.2% phenol is act as antiseptic.

**27.** Given reasons for the following :

- (i) Oxygen is a gas but sulphur is a solid
- (ii)  $O_3$  acts as a powerful oxidizing agent
- (iii)  $BiH_3$  is the strongest reducing agent amongst all the hydrides of group 15 elements

**Solution:**

- (i) In oxygen discrete  $O_2$  molecules are present while sulphur is polymeric
- (ii)  $O_3$  acts as a powerful oxidizing agent because it can produce nascent oxygen  $[O]$
- (iii) As we move top to bottom in hydrides of group 15 bonds length increases. Chance of H-removal also increases hence chance of oxidation increases and  $BiH_3$  is the strongest reducing agent amongst all the hydrides of group 15.

**28.**

(a) How will you convert the following :

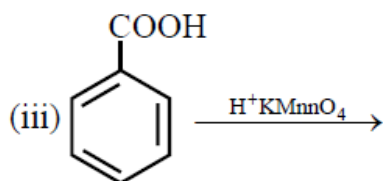
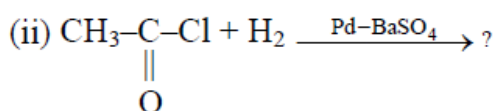
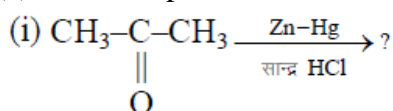
- (i) Propanone to Propan-2-ol
- (ii) Ethanal to 2-hydroxy propanoic acid
- (iii) Toluene to benzoic acid

(b) Give simple chemical test to distinguish between :

- (i) Pentan-2-one and Pentan-3-one
- (ii) Ethanal and Propanal

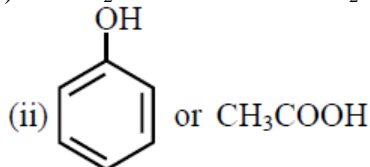
**OR**

(a) Write the products of the following reactions :



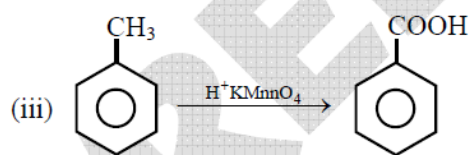
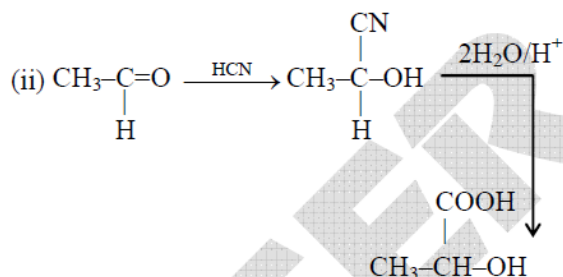
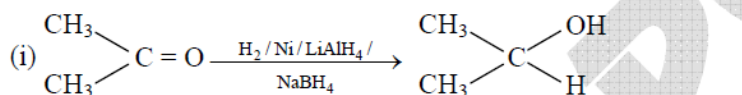
(b) Which acid of each pair shown here would you expect to be stronger ?

- (i)  $F-CH_2-COOH$  or  $Cl-CH_2-COOH$

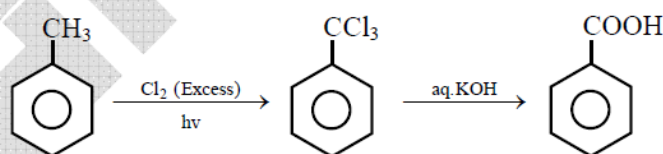
**Solution:**

(a)



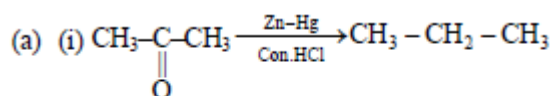


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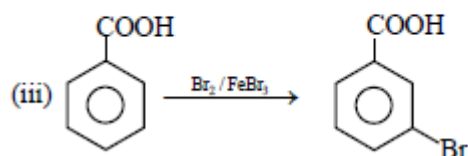
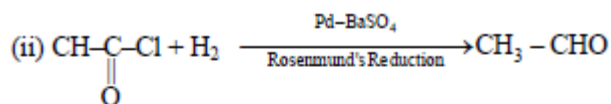


- (b) (i) Pentane 2-one gives +ve iodoform test but not pentane 3-one  
(ii) Ethanal gives +ve iodoform test but not propanal

OR



Clemenson's Reduction



- (b) (i)  $\text{F-CH}_2\text{COOH}$  is strong acid due to high -I power of F.  
(ii)  $\text{CH}_3\text{COOH}$ , due to more stable conjugate base  $\text{CH}_3\text{COO}^-$

29. (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 point of benzene by 0.40 K. Find the molar mass of the solute. ( $K_f$  for benzene =  $5.12 \text{ K kg mol}^{-1}$ )

OR

(a) Define the following terms :

- (i) Ideal solution  
(ii) Azeotrope  
(iii) Osmotic pressure

(b) A solution of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) in water is labelled as 10% by weight. What would be the molality of the solution ?

(Molar mass of glucose =  $180 \text{ g mol}^{-1}$ )

**Solution:**

(a) According to Raoult's law vapour pressure of a component is directly proportional to its mole fraction at a particular temperature

$$P_A \propto x_A$$

$$P_A = P_A^O x_A$$

Similarly 
$$P_B = P_B^O x_B$$

$$\therefore P_T = P_A^O x_A + P_B^O x_B$$

In Henry's law mole fraction of a gas at a particular temp. is proportional to the pressure exerted over gas

$$P_{\text{gas}} = k x_{\text{gas}}$$

$\therefore$  we can say for volatile substance it is a special case of Henry's law

$$(b) \Delta T_f = K_f m$$

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

$$0.40 = 5.12 \times \frac{1}{M_B} \times \frac{1000}{50}$$

$$M_B = \frac{512}{2} = 256 \text{ g/mol.}$$

**OR**

(a) (i) **Ideal solution** : Ideal solution is that solution which follows Raoult's law. In ideal solutions like force of attraction are equal to unlike force of attraction and therefore

$$(i) \Delta H_{\text{mixing}} = 0$$

$$(ii) \Delta V_{\text{mixing}} = 0$$

$$(iii) \Delta S_{\text{mixing}} > 0$$

(ii) **Azeotrope** : At a particular conc. the mixture two or more than two components boils at constant temp. Such mixture is called as azeotropic mixture. The components of the azeotropic mixture cannot be separated by distillation.

(iii) **Osmotic pressure** : When two solution (of same solvent) having different conc. are separated by semipermeable membrane the solvent particles move from less conc. to more conc. It results in rising of liquid level on more conc. side  $\therefore$  amount of external pressure required to be applied on more conc. side to stop the movement of solvent particles is called as osmotic pressure

$$(b) \text{Molality} = \frac{\% \text{ by wt}}{\text{mol. mass}} \times \frac{1000}{(100 - \% w/w)}$$

$$= \frac{10}{180} \times \frac{1000}{(100-10)}$$

$$= \frac{10}{180} \times \frac{1000}{90} = 0.617m.$$

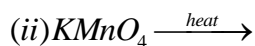
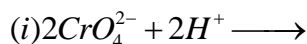
30. (a) Given reasons for the following :

(i)  $Mn^{3+}$  is a good oxidizing 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 equation :



Or

(a) Why do transition elements show variable oxidation states ?

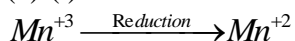
(i) name the elements showing maximum number of oxidation states among the first series of transition metals from Sc (Z = 21) to Zn (Z=30)

(ii) Name the element which shows only +3 oxidation state

(b) What is lanthanide contraction ? Name an important alloy which contains some of the lanthanoid metals

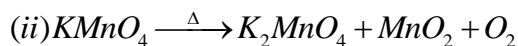
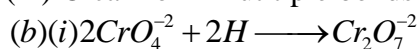
**Solution:**

(a) (i) Because +2 oxidation state of Mn is more stable than +3



(ii) Because values of  $IE_1 + IE_2$  are not regular for first row transition metals (3d series)

(iii) O can form multiple bonds while F can form single bond



Or

(a) Due to partially filled inner d-subshell

(i) Mn

(ii) Sc

(b) As atomic number increases atomic or ionic radius gradually decreases in lanthanoids, it is called as lanthanoid contraction Misch metal is an alloy which contains some lanthanoid metals.