CBSE-XII-2013 EXAMINATION

CHEMISTRY

Paper & Solution

Code: 55/3

Time: 3 Hrs.

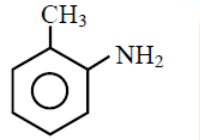
Max. Marks: 70

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 ?

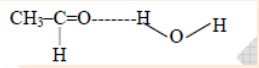
Solution:

Chemisorption has higher enthalpy of adsorption

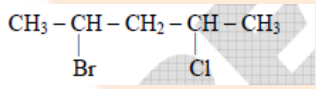
4. Ethanal is soluble in water. Why ?

Solution:

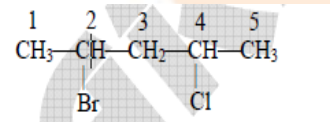
Due to formation of H-bond with water



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:

Peptide bond (—C(=O)—NH—)

8. Give one example of a condensation polymer.

Solution:

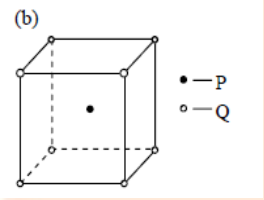
Nylon-6

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

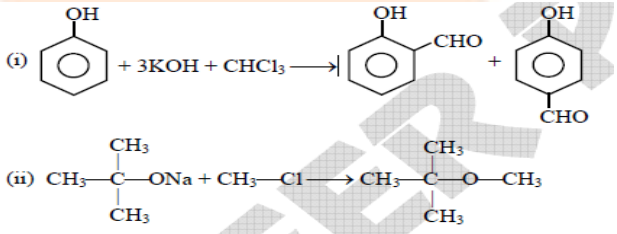
(b)



Effective P atoms = 1
Effective Q atoms = 1/8 × 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

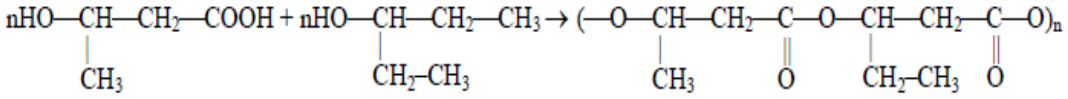
What is a biodegradable polymer ? Give an example of a biodegradable aliphatic polyester.

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-β-hydroxy valerate (PHBV)



PHBV

12. Explain the mechanism of the following reaction:

$$CH_3-CH_2-OH \xrightarrow[443K]{H^+} CH_2=CH_2+H_2O$$

Solution:

Step-I : protonation

$$CH_3-CH_2-\ddot{O}H \xrightarrow{H^{\oplus}} CH_3-CH_2-\overset{\oplus}{\ddot{O}}H_2$$

Step-II : formation of carbocation

$$CH_3-CH_2-\overset{\oplus}{\ddot{O}}H_2 \longrightarrow CH_3-\overset{\oplus}{C}H_2 \text{(carbocation)}$$

Step-III : deprotonation

$$CH_3-CH_2 \longrightarrow CH_2=CH_2$$

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

Solution:

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

(i) AX

(ii) AX3

(iii) AX5

(iv) AX7

A = Less E.N. halogen

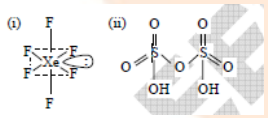
X = More E.N. halogen

14. Draw the structures of the following molecules

(i) XeF_6

(ii) $H_2S_2O_7$

Solution:



15. Aluminium crystalizes 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.

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

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

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

16. The standard electrode potential (E°) for Danial cell is +1.1V. Calculate the ΔG° for the reaction

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

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

Solution:

$\Delta G=-nFE^{0}_{cell}$

$=-2\times 96500\times 1.1$

$=-212300\,J$

$=-212.3\,kJ$

17. (a) For a reaction A + B → 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 = 5.5×10^{-14} s^{-1}. Find the half life of the reaction.

Solution:

(a) 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 folliowing 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 $[Ni(CO)_4]$ is formed.

$$\underset{\text{impure}}{Ni}+4CO\xrightarrow{\Delta}\underset{\text{volatile}}{[Ni(CO)_4]}\xrightarrow{\Delta}\underset{Pure}{Ni}+4CO\uparrow$$

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

Used for Zr and Ti. They form their volatile iodide

$$\underset{\text{Impure}}{Zr\text{ or }Ti}+2I_2\xrightarrow{\Delta}\underset{Volatile}{ZrI_4\text{ or }TiI_4}\xrightarrow{\Delta}\underset{Pure}{Zr\text{ or }Ti}+2I_2\uparrow$$

19. Define the following terms given an example of each

(i) Associated colloids

(ii) Lyophillic solution

(iii) Adsorption

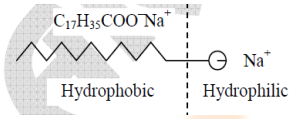
Solution:

(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 collidal 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) Lyophillic solution :

When particles of dispersed phase are solvated by disperssion medium lyophillic 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°C

Ag (s) | Ag^+ (10^{-3}M) || Cu^{2+}(10^{-1}M) | Cu (s)

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

Solution:

$$Cell\ rx^n : 2Ag(s) + Cu^{2+}_{(aq)} \rightleftharpoons 2Ag^+_{(aq)} + Cu(s)$$

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

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

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

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

$$= 0.46 + 0.14775 = 0.60775\,V$$

21. Shanti, aa domestric helper of Mrs. Anuradha, fainted while mopping the floor. Mrs. Anuradha immediatel 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 :

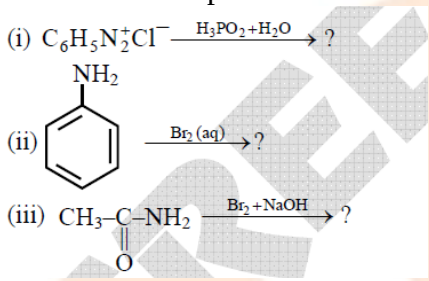
(i) What values are displayed by Mrs. Anuradha ?

(ii) Name the vitamin whose deficiency causes 'pernicious anaemia'.
(iii) Give an example of waer soluble vitamin.

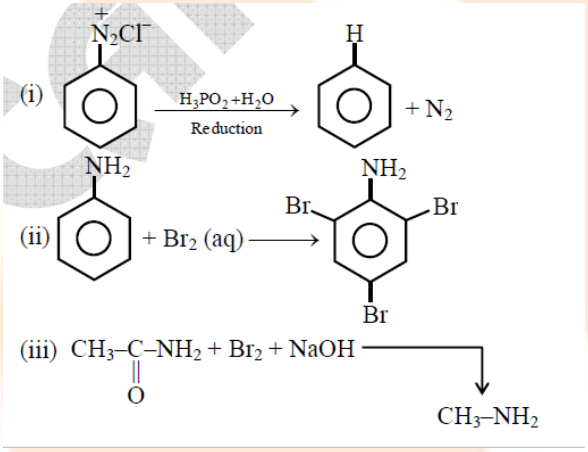
Solution:

(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.
$\left[R = 8.314\ J\ K^{-1}\ mole^{-1}, \log 4 = 0.6021\right]$

Solution:

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

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

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

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

$$= 52863.33\ J$$

$$= 52.863\ kJ.$$

24. For the complex $\left[NiC1_4\right]^{-2}$, *write*

(i) The IUPAC name

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

Or

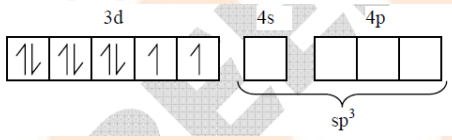
What is meant by crystal field splitting energy ? On the basis of crystal field theory, write the electronic configuration of d4 in terms of t2g and eg in an octahedral field when
(i) $\Delta_0 > P$
(ii) $\Delta_0 < P$

Solution:

(i) Tetrachloridonickelate(II)ion

$(ii)\left[NiC1_4\right]^{-2}$

$Ni^{+2} = \left[Ar\right]4s^0\ 3d^8$



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

$(i)\Delta_0 > P$

$t_2^4\ eg^0$

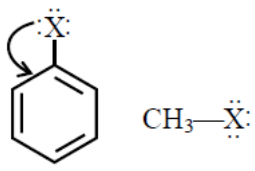
$(ii)\Delta_0 < P$

$t_{2g}^3 eg^1$

25. Give reasons for the following :
(i) Ethyl iodide undergoes S_{N^2} reaction faster than ethyl bromide.
(ii) (±) 2-Butanol is optically inactive.
(iii) C —— X bond length in halobenzene is smaller than C —— X bond length in CH_3 — X.

Solution:

(i) Because in ethyl iodide, iodide (I) is act as a best L.G. among all the halide ion.
Rate of $S_{N^2} reaction \propto$ L.G. ability of L.G.
(ii) (±) 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

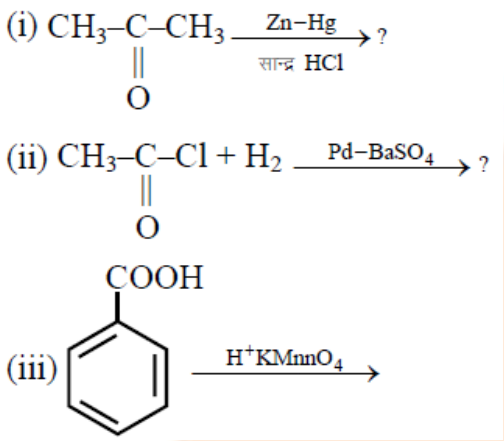
Solution:
(i) It is a Antacid
(ii) In this case we use synthetic detergents because it gives foams with hard water
(iii) 0.2% phenol is act as antiseptic.

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.

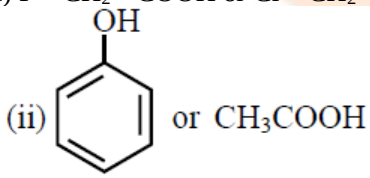
28.
(a) How will you convert the following :
(i) Propanone to Propan-2-ol
(ii) Ethanal to 2-hydroxy propanoic acid
(iii) Toluene to benzoic acid
(b) Give simple chemical test to distinguish between :
(i) Pentan-2-one and Pentan-3-one
(ii) Ethanal and Propananl

OR

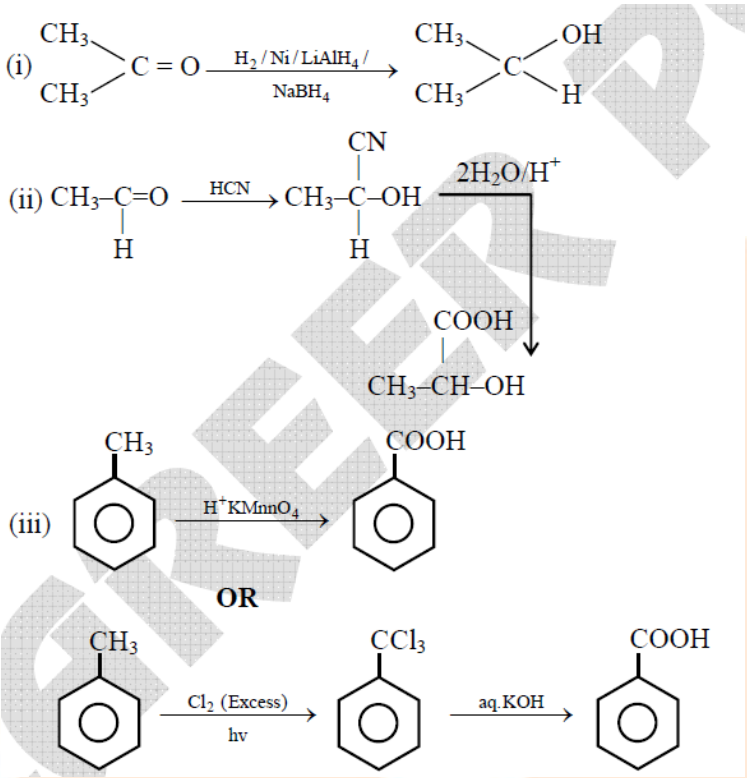
(a) Write the products of the following reactions :



(b) Which acid of each pair shown here would you expect to be stronger ?
(i) F – CH_2 – COOH or Cl – CH_2 – COOH

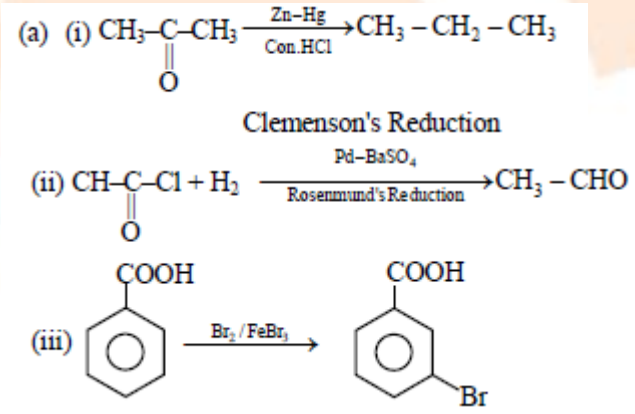


Solution:
(a)



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

OR



(b) (i) F-CH_2–COOH is strong acid due to high -I power of F.
(ii) CH_3–COOH, due to more stable conjugate base CH_3–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 K kg mol^{-1})

OR

(a) Define the following terms :
(i) Ideal solution
(ii) Azeotrope
(iii) Osmotic pressure
(b) A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution ?
(Molar mass of glucose = 180 g mol^{-1})

Solution:

(a) According to Raoults 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 $P_B = P_B^O x_B$

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

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

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

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

$(b) \Delta T_f = K_f m$

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

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

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

OR

(a) (i) Ideal solution : Ideal solution is that solution which follows Raoults law. In ideal solutions like force of attraction are equals to unlike force of attraction and therefore

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

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

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

(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 seperated by distillation.

(iii) Osmotic pressure : When two solution (of same solvent) having different conc. are seperated by semipermeable membrane the solvent particles moves 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 in called as osmotic pressure

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

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

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

30. (a) Given reasons for the following :

(i) Mn^{3+} is a good oxidizing agent

(ii) $E^{\circ}_{M2+/M}$ 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 :

$(i) 2CrO_4^{2-} + 2H^+ \longrightarrow$

$(ii) KMnO_4 \xrightarrow{heat}$

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 transtition 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

$Mn^{+3} \xrightarrow{Reduction} Mn^{+2}$

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

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

$(b)(i) 2CrO_4^{-2} + 2H \longrightarrow Cr_2O_7^{-2}$

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

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 cantraction Misch metal is an alloy which contains some lanthanoid metals.