SAMPLE PAPER-02 (solved)

CHEMISTRY (Theory)

Class – XII

Time allowed: 3 hours — Maximum Marks: 70

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6** to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23** is value based question carrying **four** marks.
g) Questions **24** to **26** carry **five** marks each.
h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
i) Use of calculators is **not** permitted. However, you may use log tables if necessary.

---

1. Give the structure of Propane-1,2,3-tricarbaldehyde.

2. Give the IUPAC name of $C_6H_5 – CH_2 – CH_2 COOH$.
3. Identify all the possible monochloro structural isomers expected to be formed on free radical monochlorination of $(CH_3)_2CHCH_2CH_3$.
4. What is prosthetic group? Give its function.
5. Why the hydrolysis of ester is slow in the beginning and becomes faster after sometimes?
6. How is cast iron different from pig iron?
7. Give reasons:
   i. Aldehydes do not form stable hydrates but chloral exists as chloral hydrate.
   ii. Acetic acid can be halogenated in presence of red phosphorus and chlorine but formic acid cannot be halogenated.
8. Give the application of Henry's law on scuba drivers.
9. Explain Frenkel defect.

   Or

   Silver forms ccp lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver (Atomic mass = 107.9 u).
10. Write a note on order of a reaction.
11.
    a) Identify all the possible monochloro structural isomers expected to be formed on free radical monochlorination of $(CH_3)_2CHCH_2CH_3$.
    b) During the reaction of alcohols with KI, sulphuric acid is not used. Give reason.

c) Alkyl halides though polar, are immiscible with water. Why?

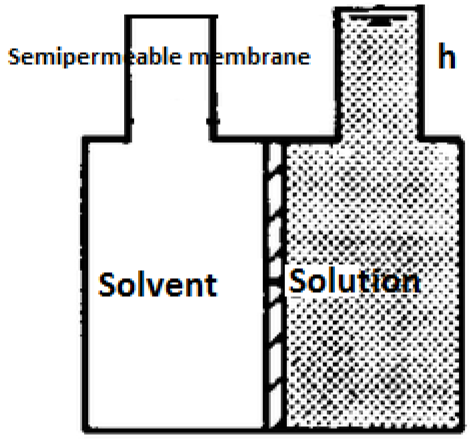
12. How the presence of sulphur dioxide is detected?
13. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively.
    a) Calculate the vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K.
    b) The mole fractions of each component in vapour phase.
14. Complete the following reactions:
    a) $HgCl_2 + PH_3 \rightarrow$
    b) $NaClO_3 + I_2 \rightarrow$
    c) $SCl_2 + NaF \rightarrow$
15. Define the term:
    a) Monosaccharides
    b) Oligosaccharides
    c) Polysaccharides
16. Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of $C_2H_6O_2$by mass.
17. Give the formulae of the following complexes:
    a) Tetraaminedichloridocobalt (III) ion
    b) Amminechloridobis (ethane-1,2-diamine) cobalt (III) ion
    c) Potassium trioxalatoaluminate (III)

    Or

    Give some limitations of valence bond theory.

18. Calculate the values of *E*a and *A*.

19. Differentiate globular proteins and fibrous proteins.
20. What are the different types of polymers based on the structure? Give an example each.
21. How are drugs classified?
22. Differentiate ideal and non-ideal solution.
23. if we apply pressure greater than the equilibrium osmotic pressure to the solution compartment shown below, pure solvent will flow from the solution to the solvent compartment.
    a. What is the name of this process
    b. Write an important application associated with this process. explain

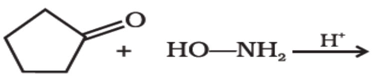


24. Give the name of the reagents to bring the following conversions:
    a. Allyl alcohol to propenal
    b. But-2-ene to ethanol
    c. Cyclohexanol to cyclohexanone
    d. Ethanenitrile to ethanol
    e. Hexan-1-ol to hexanal

Or

Complete the reactions:

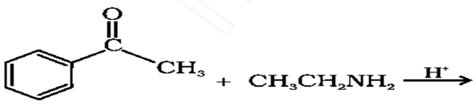
a.



b.

$$R\text{-}CH{=}CH\text{-}CHO + NH_2\text{-}\overset{\overset{O}{\|}}{C}\text{-}NH\text{-}NH_2 \xrightarrow{H^+}$$

c.



25.
   a) Give the important advantages of fuel cells over ordinary batteries.
   b) Define molar conductivity and equivalent conductivity.

Or

a) Represent the cell in which the following reaction takes place $Mg(s) + 2Ag^{+}(0.0001M) \rightarrow Mg^{2+}(0.130M) + 2Ag(s)$. Calculate its *E*(cell), if (cell) $E^{\Theta}_{cell} = 3.17$ V.

b) Calculate the equilibrium constant of the reaction: $Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$, if $E^{\Theta}_{cell} = 0.46$ V.

26.

a) The standard electrode potential for Daniell cell is 1.1V. Calculate the standard Gibbs energy for the reaction: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

b) If the limiting molar conductivities for Nacl, HCl and NaAc are 126.4, 425.9 and 91.0 S cm^2/mol respectively, then calculate Λ^0 for HAc.

Or

a) The conductivity of 0.001028 mol/L acetic acid is 4.95×10^{-5} S/cm. calculate its dissociation constant if the limiting molar conductivity for acetic acid is 390.5 S cm^2/mol.

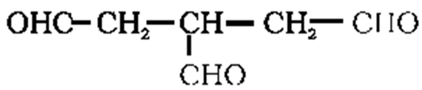
b) Give a short not on nickel – cadmium cell. Give its overall reaction during discharge.

SAMPLE PAPER-02 (solved)

CHEMISTRY (Theory)

Class – XII

Answers



1.

2.

3-Phenylpropanoic acid.

3.

i. $(CH_3)_2CHCH_2CH_2Cl$
ii. $(CH_3)_2CHCH(Cl)CH_3$
iii. $(CH_3)_2C(Cl)CH_2CH_3$
iv. $CH_3CH(CH_2Cl)CH_2CH_3$

4. It is a non-protein portion obtained by hydrolysis of conjugated proteins. The main function of the prosthetic group is to control the biological function of proteins.
5. This is due to the process of autocatalysis. In the beginning of the hydrolysis of ester gives an acid which starts as a catalyst later and so, the reaction becomes fast.
6. The iron obtained from blast furnace is pig iron. It contains about 4% of carbon and many impurities in small amount. Cast iron is obtained by melting pig iron with scrap iron and coke using hot air blast. It contains slightly lower carbon content and is extremely hard and brittle.
7.
   a) The reaction between water and aldehydes is a reversible reaction and so equilibrium lies almost towards left. On the other hand, in chloral the presence of three electron withdrawing chlorine atoms increases the positive charge on the carbonyl carbon. So, the weak nucleophiles readily add to the carbonyl group forming chloral hydrate and therefore shift the equilibrium towards right.
   b) Acetic acid can be halogenated due to the presence of α-carbon atom. However, formic acid has no α-hydrogen atom and so cannot be halogenated.
8. Scuba divers must cope with high concentrations of dissolved gases while breathing air at high pressure underwater. Increased pressure increases the solubility of atmospheric gases in blood. When the divers come towards surface, the pressure gradually decreases. This releases the dissolved gases and leads to the formation of bubbles of nitrogen in the blood. This blocks capillaries and creates a medical condition known as bends, which are painful and dangerous to life.

9. This defect is shown by ionic solids. The smaller ion (usually cation) is dislocated from its normal site to an interstitial site. It creates a vacancy defect at its original site and an interstitial defect at its new location. Frenkel defect is also called dislocation defect. It does not change the density of the solid. Frenkel defect is shown by ionic substance in which there is a large difference in the size of ions, for example, ZnS, AgCl, AgBr and AgI due to small size of Zn^{2+} and Ag^{+} ions.

Or

Since the lattice is ccp, the number of silver atoms per unit cell = z = 4
Molar mass of silver = 107.9 g mol^{-1}= 107.9×10^{-3} kg mol^{-1}
Edge length of unit cell = a = 408.6 pm = 408.6×10^{-12} m

$$Density\ d = \frac{z.M}{a^3.N_A}$$

$$= \frac{4x\left(107.9x10^{-3}\,kgmol^{-1}\right)}{\left(408.6x10^{-12}\,m\right)^3\left(6.022x10^{23}\,mol^{-1}\right)} = 10.5x10^3\,kgm^{-3}$$

= 10.5 g/cm^3.

10.
   i. Order of a reaction is an experimental quantity. It can be zero and even a fraction but molecularity cannot be zero or a non integer.
   ii. Order is applicable to elementary as well as complex reactions whereas molecularity is applicable only for elementary reactions. For complex reaction molecularity has no meaning.
   iii. For complex reaction, order is given by the slowest step and molecularity of the slowest step is same as the order of the overall reaction.

11.

a) In the given molecule, there are four different types of hydrogen atoms, so the replacement of these hydrogen atoms will give the following isomers, $(CH_3)_2CHCH_2CH_2Cl$ $(CH_3)_2CHCH(Cl)CH_3$ $(CH_3)_2C(Cl)CH_2CH_3CH_3CH(CH_2Cl)CH_2CH_3$
b) Since sulphuric acid is an oxidizing agent, it oxidizes HI produced during the reaction, thereby preventing the reaction to form alkyl iodide.
c) Alkyl halides are polar molecules and so their molecules are held together by dipole – dipole forces. But the molecules of water are held together by hydrogen bonds. When alkyl halides are added to water, the force of attraction between water and alkyl halide molecules are weaker than the forces of attraction already existing between alkyl halide-alkyl halide molecules and water – water molecules. Hence alkyl halides are immiscible with water.

12. Sulphur dioxide can be detected by the following tests:
a) It has a pungent characteristic smell.
b) It decolourises acidified potassium permanganate solution.
c) It turns blue litmus to red.
d) It turns acidified potassium dichromate solution green.

13.

Molar mass of CH_2Cl_2 = 12 x 1 + 1 x 2 + 35.5 2 = 85 g mol^{-1}

Molar mass of $CHCl_3$ = 12 x 1 + 1 x 1 + 35.5 3 = 119.5 g mol^{-1}

Moles of $CH_2Cl_2 = \frac{40}{85} = 0.47$ mol

Moles of $CHCl_3 = \frac{25.5}{119.5} = 0.213$ mol

Total number of moles = 0.683 mol

$x_{CH_2Cl_2} = \frac{0.47}{0.683} = 0.688$

$x_{CHCl_3} = 1.00 - 0.688 = 0.312$

Using equation,

$\rho_{total} = \rho_1^0 + (\rho_2^0 - \rho_1^0)x_2 = 200 + (415 - 200)\ 0.688 = 347.9$ mm Hg

14.

a) $3\ HgCl_2 + 2\ PH_3 \rightarrow Hg_3P_2 + 6\ HCl$

b) $2\ NaClO_3 + I_2 \rightarrow 2\ NaIO_3 + Cl_2$

c) $2\ SCl_2 + 4\ NaF \rightarrow SF_4 + 4\ NaCl + S$

15.

a) A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called a monosaccharide.

b) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis, are called oligosaccharides. They are further classified as disaccharides, trisaccharides, tetrasaccharides, etc., depending upon the number of monosaccharides, they provide on hydrolysis.

c) Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called polysaccharides.

16. Assume that we have 100 g of solution. Solution will contain 20 g of ethylene glycol and 80 g of water.

Molar Mass of $C_2H_6O_2$ = 12 2 + 1 6 + 16 2 = 62 g mol^{-1}

Moles of $C_2H_6O_2 = \frac{20g}{62gmol^{-1}} = 0.322mol$

Moles of water $= \frac{80g}{18gmol^{-1}} = 4.444mol$

$$x_{glycol} = \frac{\text{moles of } C_2H_6O_2}{\text{moles of } C_2H_6O_2 + \text{moles of } H_2O}$$

$$= \frac{0.322mol}{0.322mol + 4.444mol} = 0.068$$

Similarly $x_{water} = \frac{4.444\ mol}{0.322\ mol + 4.444\ mol} = 0.932$

17.

a) $[CoCl_2(NH_3)_4]^+$ion.
b) $[CoCl(en)_2(NH_3)]^{2+}$ ion.
c) $K_3[Al(C_2O_4)_3]$

Or

a) It involves a number of assumptions.
b) It does not distinguish between weak and strong ligands.
c) It gives only the qualitative explanations for complexes.
d) It does not explain the thermodynamic and kinetic stabilities of different coordination compounds.
e) It does not explain the detailed magnetic properties of the complexes.
f) It does not explain the spectral properties of the coordination compounds.
g) The rate constants of a reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively.

18.

$$\log\frac{k_2}{k_1}=\frac{E_a}{2.303R}\left[\frac{T_2-T_1}{T_1T_2}\right]$$

$$\log\frac{0.07}{0.02}=\left(\frac{E_a}{2.303x8.314JK^{-1}mol^{-1}}\right)\left[\frac{700-500}{700x500}\right]$$

0.544 = E_a x 5.714 x 10^{-4} / 19.15

E_a = 0.544 x 19.15 / 5.714 x 10^{-4} = 18230.8 J

Since k = $Ae^{-Ea/RT}$

0.02 = $Ae^{-18230.8/8.314x500}$

A = 0.02/0.012 = 1.61

19.

Globular proteins	Fibrous proteins
These proteins are cross linked condensation products of basic and acidic amino acids.	These proteins are linear condensation products.
These are soluble in water and insoluble in strong acids and bases.	These are insoluble in water but are soluble in strong acids and bases.
It includes all enzymes and hormones.	It includes bifroin in silk, collagen in tendons, myosin in muscles and keratin in hair.

20. Based on the structure, polymers are classified into three types namely,
   a. Linear polymers
   b. Branched chain polymers
   c. Cross linked polymers
   Linear polymers

These are polymers in which monomeric units are linked together to form long and linear chains. Example – PVC.

Branched chain polymers

These are polymers in which monomeric units are joined together to form chains with side chains or branches of different lengths. Example – starch.

Cross linked polymers

These are polymers in which monomeric units are cross linked to form a three dimensional network. Example – Bakelite.

21. Drugs are classified as follows:
    a) On the basis of pharmacological effect.
    b) On the basis of action on a particular biochemical process.
    c) On the basis of chemical structure.
    d) On the basis of molecular targets.

22.

Ideal solution	Non-ideal solution
The interactions between the components are similar to those in the pure components.	The interaction between the components are different from those in the pure components.
There is no enthalpy change on mixing.	There is enthalpy change on mixing.
There is no volume change on mixing.	There is volume change on mixing.

23.

a. This process is called Reverse –osmosis (RO).
b. An important application of reverse osmosis is the desalination of sea water. As compared to other methods, RO is more appealing, as it does not involve a phase change and is economically sound for large amounts of water.
   Sea water is approximately 0.7 M in NaCl, has an additional 60 atm would have to be applied on the sea water-side compartment to cause reverse osmosis.

24.

a.

$C_5H_5NH^+CrO_3Cl^-$ - PCC

b.

O_3/ H_2O – Zn dust

c.

Potassium dichromate in acidic medium

d.

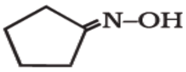
(DIBAL – H): (Diisobutyl) aluminium hydride

e.

$C_5H_5NH^+CrO_3Cl^-$ -PCC

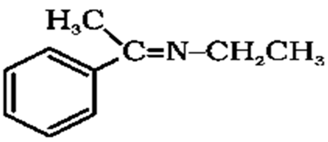
Or

a.



b.

c.



25.

a)

i. High efficiency – The fuel cells convert the energy of a fuel directly into electricity and so, they are more efficient than the conventional methods of generating electricity on a large scale by burning hydrogen, carbon fuels. The efficiency of fuel cell is 60 – 70% whereas the efficiency of conventional methods is about 40%.

ii. Pollution free – There are no objectionable by-products and so they do no cause pollution problems.

iii. Continuous source of energy – There is no electrode material to be replaced as in ordinary battery. The fuel can be fed continuously to produce power.

b)

Molar conductivity – It is defined as the conducting power of all the ions produced by dissolving one mole of an electrolyte in solution.
Equivalent conductivity – It is defined as the conducting power of all the ions produced by dissolving one gram equivalent of an electrolyte in solution.

Or

a)

The Cell can be written as $Mg|Mg^{2+}(0.130M)||Ag^+(0.0001M)|Ag$

$$E_{(cell)} = E^{\theta}_{(cell)} - \frac{RT}{2F} In \frac{\left[Mg^{2+}\right]}{\left[Ag^{+}\right]^2}$$

$$= 3.17V - \frac{0.059V}{2} \log \frac{0.130}{(0.0001)^2} = 3.17V - 0.21V = 2.96V$$

b) Calculate the equilibrium constant of the reaction: $Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$, if E^{Θ}_{cell}= 0.46 V.

Ans:

$$E^{\theta}_{(cell)} = \frac{0.059V}{2} \log K_c = 0.46V$$

$$logK_C = \frac{0.46Vx2}{0.059V} = 15.6$$

$$K_C = 3.92x10^{15}$$

26.

a) $\Delta_r G' = -nFE^{\theta}_{(cell)}$

N in the above equation is 2. F = 96487 C mol^{-1} and $E^{\theta}_{(cell)}$ =1.1 V

Therefore $\Delta_r G'$ = - 2 x 1.1 V x 96487 C mol^{-1}

= -21227 J mol^{-1}

= -212.27 kJ mol^{-1}

b)

$$\wedge^0_{m(HAC)} = \lambda^0_{H^+} + \lambda^0_{AC^-} = \lambda^0_{H^+} + \lambda^0_{Cl^-} + \lambda^0_{AC^-} + \lambda^0_{Na^+} - \lambda^0_{Cl^-} - \lambda^0_{Na^+}$$

$$= \wedge^0_{m(HCl)} + \wedge^0_{m(NaAc)} - \wedge^0_{m(NaCl)}$$

= (425.9 + 91.0 – 126.4) S cm^2 mol^{-1}

= 390.5 S cm^2 mol^{-1}

Or

a) $\wedge_m = \frac{k}{c} = \frac{4.95\ x\ 10^{-5} Scm^{-1}}{0.001028\ mol\ L^{-1}} x \frac{1000\ cm^3}{L} = 48.15\ S\ cm^3 mol^{-1}$

$$\alpha = \frac{\wedge_m}{\wedge^0_m} = \frac{48.15\ S\ cm^2\ mol^{-1}}{390.5\ S\ cm^2\ mol^{-1}} = 0.1233$$

$$k = \frac{c\alpha^2}{(1-\alpha)} = \frac{0.001028\ mol\ L^{-1} x (0.1233)^2}{1-0.1233} = 1.78x10^{-5} mol\ L^{-1}$$

b) Another important secondary cell is the nickel-cadmium cell which has longer life than the lead storage cell but more expensive to manufacture. The overall reaction during discharge is:

$Cd\ (s) + 2Ni(OH)_3\ (s) \rightarrow CdO\ (s) + 2Ni(OH)_2\ (s) + H_2O\ (l)$