Sample Paper 3 Solutions

Class XII 2023-24

Chemistry

Time: 3 Hours **Max. Marks: 70**

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

SECTION-A

Directions (Q. Nos. 1-16) : The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Electrolytic reduction of nitrobenzene in strongly acidic medium gives the final product:

(a) *p*-aminophenol

(b) azobenzene

(c) aniline

(d) phenyl hydroxyl amine

Ans : (c) aniline

The electrolytic reduction of nitrobenzene in strongly acidic medium produces phenylhydroxylamine which rearranges to *p*-Aminophenol. In weakly acidic medium, aniline is obtained whereas in alkaline medium, various mono and di-nuclear reduction products (such as nitrosobenzene, phenylhydroxylamine, azoxybenzene, azobenzene and hydrazobenzene) are obtained.

2. The value of rate constant for a first order reaction is $2.303 \times 10^{-2}\ s^{-1}$. What will be the time required to reduce the concentration to 1/10th of its initial concentration ?

(a) 10 s (b) 2303 s

(c) 23.03 s (d) 100 s

Ans : (d) 100 s

Let initial concentration be a.

Then, final concentration $(a - x) = \frac{1}{10}$ of $a = \frac{a}{10}$

For first order reaction,

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

$$= \frac{2.303}{2.303 \times 10^{-2}}\log\frac{a}{a/10}$$

$$= 100 \log 10$$

$$t = 100\ s$$

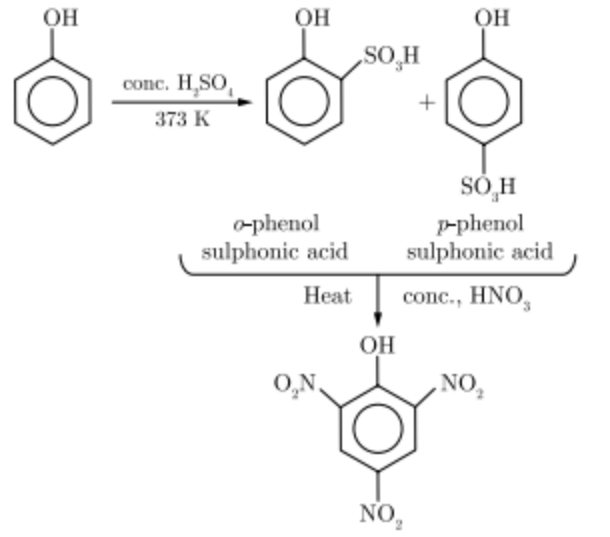
Important MCQ Question For Class 12 Chemistry

3. Long time nitration of phenol with mixture of conc. HNO_3 and concentrated H_2SO_4 gives:

(a) picric acid (b) *o*-nitrophenol

(c) nitrobenzene (d) *p*-nitrophenol

Ans : (a) picric acid



4. The reaction between $RNH_2 + CHCl_3 + KOH$ (alc.) is known as:

(a) Coupling reaction

(b) Carbylamine reaction

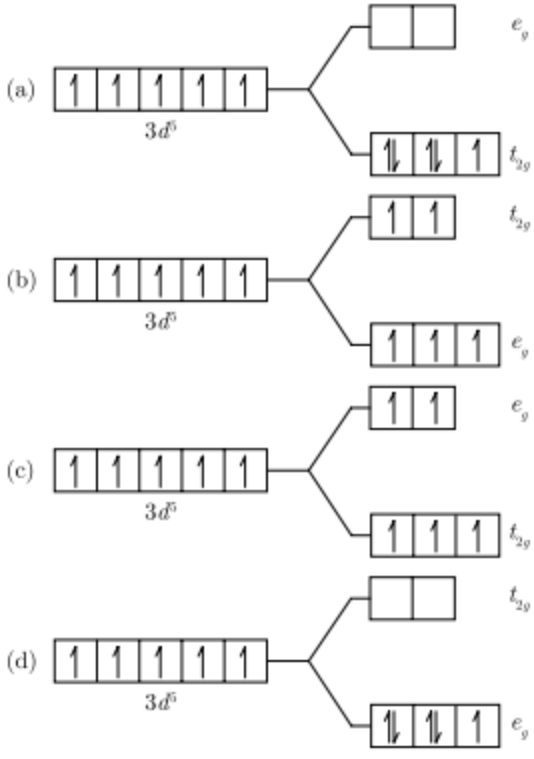
(c) Hoffmann bromamide reaction

(d) Schmidt reaction

Ans : (b) Carbylamine reaction

The reaction to used is distinguish between one degree .2 degree and 3 degree amines. It is called Carbylamine reaction.

5. Which of the following energy level diagram for $[FeF_6]^{3-}$ is correct on the basis of crystal field theory?



Ans : (b) $t_{2g}^6 e_g^3$

In $[Cu(NH_3)_6]^{2+}$, oxidation state of Cu $= +2$

$$Cu^{2+} = 3d^9$$

$$3d^9 = t_{2g}^6 e_g^3$$

6. Metallic radii of some transition elements are given below:

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128

Which of these elements will have highest density ?

(a) Cu (b) Fe

(c) Ni (d) Co

Ans : (c) Ni

On moving left to right along period, metallic radius decreases while mass increases. Decrease in metallic radius coupled with increase in atomic mass results in increase in density of metal. Hence Cu will have highest density.

7. Which of the following does not reduce Fehling's solution?

(a) CH_3CHO

(b) HCHO

(c) CH_3COOH

(d) HCOOH

Ans : (c) CH_3COOH

Fehling's test is used for the detection of -CHO group being aldehyde ethanal and 2-methyl propanal refused the Fehling solution. Formic acid also has aldehydic (-CHO) thus, it will also reduce Fehling solution.

8. How much ethyl alcohol must be added to 1L of water so that the solution will freeze at –14°C ? (K_f for water = 1.86°C/mol)

(a) 10.5 mol (b) 9.5 mol

(c) 7.5 mol (d) 8.5 mol

Ans : (c) 7.5 mol

Given, $\Delta T_f = -14^\circ C$

$K_f = 1.86^\circ C/mol$

$W_1 = 1L = 1000\ ml$

As we know that, $\Delta T_f = K_f \times m$

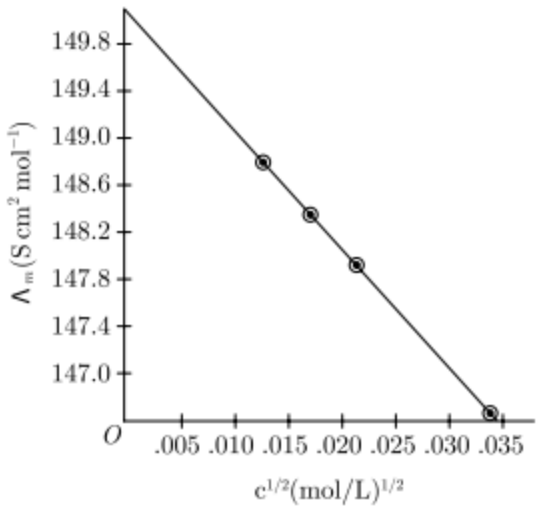
$$\Delta T_f = K_f \frac{n_2 \times 1000}{W_1}$$

After substituting the values ,we get

$$14 = 1.86 \times \frac{n_2 \times 1000}{1000}$$

$$n_2 = 7.5\ mol$$

9. The molar conductivity of KCl solutions at different concentrations at 298 K is shown in the graph:



Determine the value of Λ°_m for KCl using the graph.

(a) 151.2 S cm^2 mol^{-1}

(b) 149.9 S cm^2 moL^{-1}

(c) 150.0 S cm^2 mol^{-1}

(d) 152.0 S cm^2 mol^{-1}

Ans : (c) 150.0 S cm^2 mol^{-1}

The plot of Λ_m and $C^{1/2}$ is nearly a straight line. From the intercept ($C^{1/2} = 0$) we find that

$$\Lambda^\circ_m = 150.0\,\text{S cm}^2\,\text{mol}^{-1}$$

10. Consider the following reaction:

$$CH_3 - CH = CH_2 \xrightarrow[2.\,aq.\,KOH]{1.\,HBr}$$

The major end product is :

(a) $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

(b) $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(c) $CH_3 - CH_2 - CH_2 - Br$

(d) $CH_3 - CH_2 - CH_2 - OH$

Ans : (d) $CH_3 - CH_2 - CH_2 - OH$

$$CH_3CH = CH_2 \xrightarrow{HBr} CH_3CH_2CH_2Br \xrightarrow{aq.KOH} CH_3CH_2CH_2OH$$

11. Williamson's synthesis of preparing dimethyl ether is an :

(a) S_N2 reaction

(b) S_N1 reaction

(c) Elimination reaction

(d) Nucleophilic addition reaction

Ans : (a) S_N2 reaction

Williamson's synthesis is used to prepare diethyl ether. This is the industrial process for making ethers. Sodium ethoxide is heated with ethyl iodide to form diethyl ether.

12. In reaction $A \longrightarrow B$, the rate of reaction is doubled on increasing the concentration of the reactants four times. The order of the reaction is :

(a) $\frac{1}{2}$ (b) 2

(c) 4 (d) Zero

Ans : (a) $\frac{1}{2}$

Order should be half so that rate will increase two times as concentration will be increased by 4 times.

Directions (Q. Nos. 13-16) : Each of the following questions consists of two statements, one is Assertion and the other is Reason. Give answer :

13. **Assertion :** $(CH_3)_3COH$ when heated with conc. H_2SO_4 gives iso-butylene as the main product and not di-tertiary butyl ether.

Reason : All alcohols readily dehydrates with conc. H_2SO_4.

(a) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(c) Assertion is false but Reason is true.

(d) Assertion is true but Reason is false.

Ans : (d) Assertion is true but Reason is false.

Higher is the stability of carbocation, more easily it can be dehydrated. Thus, dehydration of alcohols follows the order:

$$3^\circ \text{ alcohol} > 2^\circ \text{ alcohol} > 1^\circ \text{ alcohol}$$

14. **Assertion :** In presence of enzyme, substrate molecule can be attacked by the reagent effectively.
Reason : Active sites of enzymes hold the substrate molecule in a suitable position.

(a) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(c) Assertion is false but Reason is true.

(d) Assertion is true but Reason is false.

Ans : (b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

15. **Assertion :** Cu cannot liberate hydrogen from acids.
Reason : Cu has positive electrode potential.

(a) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(c) Assertion is false but Reason is true.

(d) Assertion is true but Reason is false.

Ans : (b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Active site of enzymes holds the substrate molecule in a suitable position so that it can be attacked by the reagent effectively.

16. **Assertion :** Hoffmann's bromamide reaction is given by primary amines.
Reason : Primary amines are more basic than secondary amines.

(a) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(b) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(c) Assertion is false but Reason is true.

(d) Assertion is true but Reason is false.

Ans : (d) Assertion is true but Reason is false.

Hoffmann's bromamide reaction is given by primary amines because in this degradation reaction, migration of an alkyl group takes place from carbonyl carbon of the amide of the nitrogen atom. Reason is false as secondary amines are more basic than primary amines because they can donate their lone pair more easily and the extra inductive effect stabilises the charge on the nitrogen atom.

SECTION-B

Directions (Q. Nos. 17-21) : This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2-}$ are of different colours in dilute solutions. Why?

Ans :

In both the complexes, Fe is in +2 oxidation state with $3d^6$ configuration i.e., it contains four unpaired electrons. In the presence of weak field ligand H_2O, these remain unpaired, whereas in the presence of strong field ligand CN^-, these pair up and the complex has no unpaired electron. Due to the difference in number of unpaired electrons, these two complexes give different colours in dilute solutions.

18. What is the effect of denaturation on the structure of proteins?

Ans :

Denaturation of proteins is done either by change in temperature (upon heating) or by bringing a change in the pH of the medium. As a result, the hydrogen bonding is disturbed and the proteins lose their biological activity i.e., their nature changes. During the denaturation, both the tertiary and secondary structures of proteins are destroyed while the primary structures remain intact.

19. HgO decomposes on heating but MgO does not. Explain with reason.

Ans :

The oxides of the elements which are placed above Cu in the electrochemical series or which have standard reduction potential less than $+0.34\,V$, get decomposed on heating. Since Hg is placed above Cu whereas Mg is placed below it, so HgO gets decomposed on heating but MgO does not.

$$2HgO\,(s) \xrightarrow{\Delta} 2Hg + O_2\uparrow$$

$$MgO\,(s) \xrightarrow{\Delta} \text{No effect.}$$

20. For the reaction $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$, the rate of formation of $NO_2(g)$ is $2.8 \times 10^{-3}\,M\,s^{-1}$. Calculate the rate of disappearance of $N_2O_5(g)$.

Ans :

For the reaction,

$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$,
Overall rate of reaction can be given as under :

$$-\frac{1}{2}\frac{d(N_2O_5)}{dt} = +\frac{1}{4}\frac{d(NO_2)}{dt} = +\frac{d(O_2)}{dt}$$

Given, $\frac{d(NO_2)}{dt} = 2.8 \times 10^{-3}\,Ms^{-1}$

$$-\frac{d(N_2O_5)}{dt} = ?$$

$$-\frac{1}{2}\frac{d(N_2O_5)}{dt} = +\frac{1}{4}\frac{d(NO_2)}{dt}$$

or $\frac{d(N_2O_5)}{dt} = \frac{1}{4} \times 2 \times 2.8 \times 10^{-3}\,M\,s^{-1}$
$= 1.4 \times 10^{-3}\,M\,s^{-1}$

or

What do you mean by rate of a reaction? For the reaction $NO_2(g) + CO(g) \longrightarrow CO_2(g) + NO(g)$, the proposed mechanism is as follows :
(i) $NO_2 + NO_2 \longrightarrow NO + NO_3$ (slow)
(ii) $NO_3 + CO \longrightarrow CO_2 + NO_2$ (fast)
What is the velocity (rate) of reaction?

Ans :

The rate of change in concentration of reactant with time is called velocity (rate) of reaction.
For reaction : $NO_2(g) + CO(g) \longrightarrow NO(g)$
The rate of the reaction is decided by slow reaction [step (i)] of the proposed mechanism. Thus,
$Velocity\,(rate)\,of\,reaction = k(NO_2)(NO_2) = k(NO_2)^2$

21. Write the structures of A, B, C and D in the following reactions :

$$\underset{\text{Benzoyl chloride}}{C_6H_5COCl} \xrightarrow{H_2/Pd-BaSO_4} [A] \xrightarrow{NaOH\,(conc.)} B + C$$

$$\xrightarrow{CH_3MgBr/H_3O^+} [D]$$

Ans :

$$\underset{\text{Benzoyl chloride}}{C_6H_5COCl} \xrightarrow{H_2/Pd-BaSO_4} \underset{\text{Benzaldehyde}}{C_6H_5CHO} \xrightarrow{NaOH(conc.)}$$

$$\underset{\text{Benzyl alcohol}\ (B)}{C_6H_5CH_2OH} + \underset{\text{Sod. benzoate}\ (C)}{C_6H_5COONa} \xrightarrow{CH_3MgBr/H_3O^+}$$

$$\underset{\text{2-Phenylethanol}\ (D)}{C_6H_5CH(OH)CH_3}$$

SECTION-C

Directions (Q. Nos. 22-28) : This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. In a reaction $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$, the concentration of N_2O_5 decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes, Calculate the average rate of this reaction and rate of production of NO_2 during this period.

Ans :

$$\text{Average rate of this reaction} = -\frac{1}{2}\frac{\Delta\,(N_2O_5)}{\Delta\,t}$$
$$= -\frac{1}{2}\frac{(0.4 - 0.5)}{10\ \text{minutes}}\ \text{mol L}^{-1}$$
$$= \frac{0.1}{20}\text{mol L}^{-1}\,\text{min}^{-1}$$
$$= 0.005\ \text{mol L}^{-1}\,\text{min}^{-1}$$

For the given equation,
$\frac{1}{2} \times$ Rate of disappearance of N_2O_5
$= \frac{1}{4} \times$ Rate of formation of NO_2
Rate of formation of NO_2

$$= 4 \times \left[-\frac{1}{2}\frac{\Delta\,(N_2O_5)}{\Delta\,t}\right]$$
$$= 4 \times 0.005$$
$$= 0.02 \times \text{mol L}^{-1}\,\text{min}^{-1}$$

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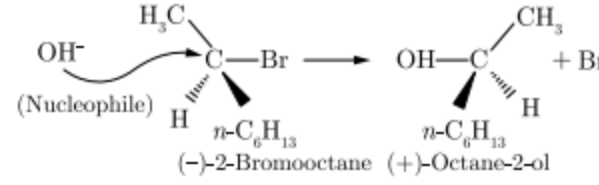
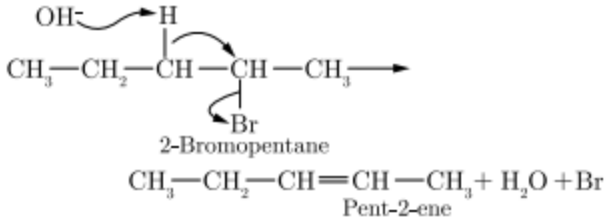
23. Propose the mechanism of the reaction taking place when :
(i) (–)-2-Bromooctane reacts with sodium hydroxide to form (+)-Octane-2-ol.
(ii) 2-Bromopentane is heated with KOH(alc.) to form alkene.

Ans :

(i) In this reaction, there is an inversion of configuration since OH^- ion (nucleophile) attacks from a side opposite to the side where Br atom is present.



(ii) In this reaction, bimolecular elimination (E_2-elimination) takes place.



24. The following compounds are given to you :
2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane

(i) Write the compound which is most reactive towards S_N2 reaction.
(ii) Write the compound which is optically active.
(iii) Write the compound which is most reactive towards β elimination reaction.

Ans :

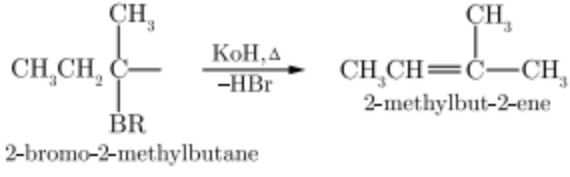
(i) S_N2 reaction involves the formation of transition state. Higher the steric hindrance, lesser the stability of transition state and lower is their reactivity towards S_N2.

$$\underset{\substack{1-\text{bromopentane}\\(1^\circ)}}{CH_3CH_2CH_2CH_2CH_2Br} > \underset{\substack{2-\text{bromopentane}\\(2^\circ)}}{CH_3CH(Br)CH_2CH_2CH_3} > \underset{\substack{2-\text{bromo}-2-\text{methylbutane}\\(3^\circ)}}{CH_3C(Br)(CH_3)CH_2CH_3}$$

(ii) Among the given compounds, 2-bromopentane is optically active due to presence of chiral carbon (*)

$$CH_3\overset{*}{C}HCH_2CH_2CH_3$$
$$\quad\;\; BR$$
2-bromopentane

(iii) 2-bromo-2-methylbutane is most reactive towards 13 -elimination reaction because in this case more substituted alkene is the major product.



25. What happens when: (Any three)

(i) formic acid reacts with conc. H_2SO_4.
(ii) acetic acid reacts with Cl_2 in the presence of red P?
(iii) calcium acetate is heated?
(iv) $CH_3 - O - CH_3$ is heated with HI.

Ans :

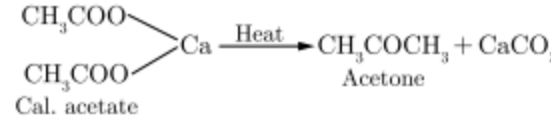
(i) Dehydration takes place resulting in CO

$$HCOOH \xrightarrow[-H_2O]{H_2SO_4(\text{heat})} CO$$

(ii) Trichloroacetic acid is formed

$$CH_3COOH \xrightarrow[\text{Red P}]{3Cl_2} CCl_3COOH + 3HCl$$

(iii) Acetic is formed



(iv) Methanol is formed.

$$\underset{\text{Methanol}}{CH_3 - OH} + CH_3 - I \quad (\text{Iodomethane})$$

$$CH_3 - O - CH_3 + HI \longrightarrow CH_3 - OH + CH_3 - I$$

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26. (i) At low pressure and high temperature, water evaporates rapidly, why?
(ii) Calculate the molality of a solution when 20 g NaOH is dissolved in 440 g of solvent.

Ans :

(i) At low pressure and high temperature, the kinetic energy of water molecules increases. Due to which more molecules leave the water surface and gets converted into vapour phase. That's why, evaporation of water occurs rapidly.

(ii) Given,

Mass of NaOH, $W = 20\text{ g}$

Mass of solvent $= 440\text{ g}$

$$= \frac{440}{1000}\text{ kg} = 0.44\text{ kg}$$

Molar mass of NaOH $= 23 + 16 + 1$

$$= 40\text{ g mol}^{-1}$$

Molality of NaOH solution,

$$m = \frac{\text{Mass of NaOH}}{\text{Molar mass of NaOH} \times \text{mass of solvent}}$$

$$= \frac{20}{40 \times 0.44}$$

$$= 1.136\text{ mol kg}^{-1}$$

27. A solution of $[Ni(H_2O)_6]^{2+}$ is green but a solution of $[Ni(CN)_4]^{2-}$ is colourless. Explain.

Ans :

Ni in $[Ni(H_2O)_6]^{2+}$ has $3d^8$ configuration and is in oxidation state, in this complex it contains two unpaired electrons which remain unpaired due to the presence of weak field ligand, H_2O. Due to the presence of unpaired electrons, these show $d-d$ transition $d-d$ transition absorbs red light and emits its complementary green colour.
In case of $[Ni(CN)_4]^{2-}$ also, Ni has $3d^8$ configuration and oxidation state but due to the presence of strong field ligand CN^-, the two unpaired electrons present in $3d$-orbitals, pair up. Thus, in this complex Ni does not have any unpaired electron. So no $d-d$ transition is possible, thus, it is colourless.

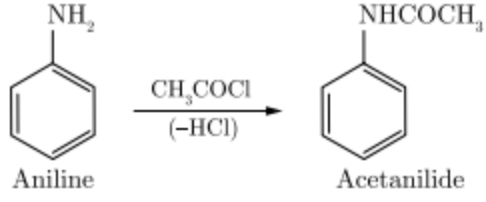
28. How will you convert (Give only chemical equation):
(i) Propanamide to ethylamine
(ii) Ethyl amine to methane
(iii) Aniline to acetanilide.

Ans :

(i) $\underset{\text{Propanamide}}{CH_3CH_2CONH_2} \xrightarrow[(-2KBr,\ -K_2CO_3,\ -2H_2O)]{Br_2+4KOH} \underset{\text{Ethylamine}}{CH_3CH_2NH_2}$

(ii) $\underset{\text{Ethylamine}}{C_2H_5NH_2} + \underset{\text{Grignard reagent}}{CH_3MgX} \longrightarrow \underset{\text{Methane}}{CH_4} + C_2H_5NHMgX$

(iii)

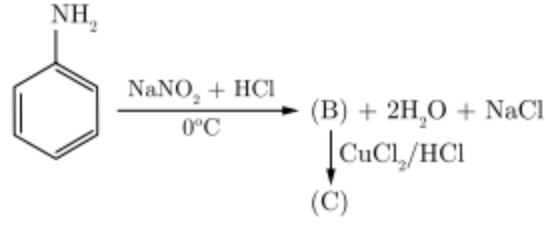


or

Identify A, B and C in the following equations :

(i) $C_6H_5NO_2 \xrightarrow[6[H]]{Sn/HCl} (A) + H_2O$

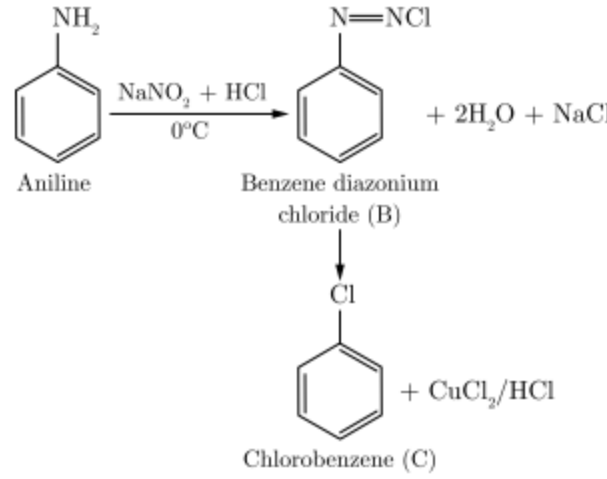
(ii)



Ans :

(i) $\underset{\text{Nitrobenzene}}{C_6H_5NO_2} \xrightarrow[Sn/HCl]{6(H)} \underset{\text{Aniline }(A)}{C_6H_5NH_2} + 2H_2O$

(ii)



Important MCQ Question For Class 12 Chemistry

SECTION-D

Directions (Q. Nos. 29-30) : The following questions are case-based questions. Each question has an internal choice and carries 4 marks each. Read the passage carefully and answer the questions that follow.

29. Molar conductivity of a solution is the conductance of solution containing one mole of electrolyte, kept between two electrodes having unit length between them and large cross-sectional area, so as to contain the electrolyte. In other words, molar conductivity is the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross-section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte.
It is denoted by Λ_m.
The molar conductivity is related to conductivity as:

$$\Lambda_m = k \times V = \frac{1000}{C} \times k = k \times \frac{1000}{\text{Molarity}}$$

Unity of Λ_m (molar conductivity) shall be ohm^{-1} cm^{-1} mol^{-1} or S cm^2 mol^{-1}.
Thus, knowing molar concentration (C) and conductivity (k), Λ_m can be calculated. Λ°_m is called molar conductivity at infinite dilution. The molar conductivity of strong electrolytes is found to

vary with concentration according to the equation,

$$\Lambda_m^C = \Lambda^\circ{}_m - A\sqrt{C}$$

This equation is called Debye-Huckel Onsager equation.

Here, A is constant depending upon the type of electrolyte taken and nature of solvent and temperature.

In the context of given passage, answer the following questions:

(i) The molar conductivity of HCl increases with dilution. Can you suggest what may be the reason for this?

(ii) Here are given the different molarities of NaCl. Which of them will exhibit the highest molar conductivity?
0.005 M NaCl, 0.1 M NaCl, 0.5 M NaCl, 0.01 M NaCl.

(iii) Molar conductivity of a solution is $1.26 \times 10^2\,\Omega^{-1}\,cm^2\,mol^{-1}$. Its molarity is 0.01. What will be its specific conductivity?

or

(iv) The conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5}\,S\,cm^{-1}$. What shall be the molar conductivity of the solution in S cm^{-1} mol^{-1} ?

Ans :

(i) The molar conductivity of HCl increases with dilution due to decrease in interionic forces.

(ii) 0.005MNaCl will exhibit the highest molar conductivity as it has the lowest concentration of solute. Molar conductivity increases with increase in dilution.

(iii) We know that molar conductivity and the specific conductance are related as

$$\Lambda_m = \frac{k \times 1000}{M}$$

Given, $\Lambda_m = 1.26 \times 10^2\,\Omega^{-1}\,cm^2\,mol^{-1}$

and $M = 0.01\,M$

Hence, $1.26 \times 10^2 = \frac{k \times 1000}{0.01}$

or, $k = 1.26 \times 10^{-3}$

Hence, the specific conductivity $= 1.26 \times 10^{-3}$

or

(iv)

Given, $k = 7.896 \times 10^{-5}\,S\,cm^{-1}$

$M = 0.00241\,M$

We have, molar conductivity,

$$\Lambda_m = \frac{k \times 1000}{M} = \frac{7.896 \times 10^{-5} \times 1000}{0.00241} = 32.76\,S\,cm^2\,mol^{-1}$$

Hence, the molar conductivity of the solution is $32.76\,S\,cm^2\,mol^{-1}$.

30. Amines constitute an important class of organic compounds derived by replacing one or more hydrogen atoms of ammonia molecule by alkyl/ aryl groups. Amines are usually formed from nitro compounds, halides, amides, etc. They exhibit hydrogen bonding which influences their physical properties. Alkyl amines are found to be stronger bases than ammonia. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Reactions of amines are governed by availability of the unshared pair or electrons on nitrogen. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Reactivity of aromatic amines can be controlled by acylation process.

In the context of given passage, answer the following questions :

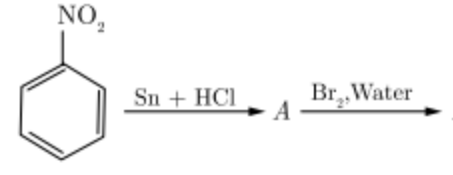
(i) Why does aniline not give Friedel-Crafts reaction?

(ii) Arrange the following in the increasing order of their pK_b values :
$C_6H_5NH_2$, NH_3, $C_2H_5NH_2$, $(CH_3)_3N$

(iii) How can you distinguish between $CH_3CH_2NH_2$ and $(CH_3CH_2)_2$ NH by Hinsberg test?

or

(iv) Write the structures of A and B in the following reactions:

(a) 

(b) $CH_3CH_2CONH_2 \xrightarrow{Br_2/alc.\,KOH} A \xrightarrow[Pyridine]{CH_3COCl} B$

Ans :

(i) Aniline forms salt with the lewis acid catalyst i.e., $AlCl_3$, which is used in Friedel-craft reaction. Further, nitrogen of aniline acquires positive charge and hence acts as a strong deactivating group for further reaction. So, aniline doesn't give Friedal-Crafts reaction.

(ii) $C_6H_5NH_2 < NH_3 < C_2H_5NH_2 < (CH_3)_3N$

(iii) When ethylamine is shaken with benzene sulphonyl chloride (Hinsberg's reagent) and aqueous KOH solution, it gives a clear solution.

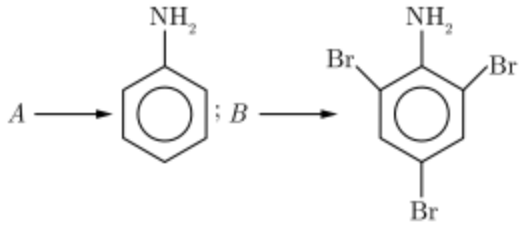
$C_6H_5SO_2Cl + CH_3CH_2NH_2 \rightarrow C_6H_5SO_2NHCH_2CH_3$

$\xrightarrow{KOH} \underset{\text{Potassium salt (Clear solution)}}{[C_6H_5SO_2 - N - CH_2CH_3]K} + H_2O$

White diethylamine is 2° amine, on similar treatment it forms an insoluble substance.

or

(iv) (a)



(b) $A \longrightarrow CH_3CH_2NH_2$

$B \longrightarrow CH_3CH_2NHCOCH_3$

SECTION-E

Directions (Q. Nos. 31-33) : The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31. (i) Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes.
(Given : Molar mass of Ag $= 108\,g\,mol^{-1}$, $1F = 96500\,C\,mol^{-1}$)

(ii) What do you mean by fuel cell?

(iii) Write Cu, Na, Mg and Ag in the decreasing order of electrochemical series with the help of the following reactions:s

$$Cu + 2Ag^{+} \longrightarrow Cu^{2+} + 2Ag$$
$$2Na + Mg^{2+} \longrightarrow 2Na^{+} + Mg$$
$$Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$$

Ans :

(i) Given,

Current, $I = 2\,A$

Time, $t = 15\,min$

Quantity of electricity passed will be

$$Q = I \times t$$
$$= 2 \times 15 \times 60 = 1800\,C$$

Electrolysis of $AgNO_3$

$Ag^{+} + e^{-} \longrightarrow Ag(s)$

Atomic mass of $Ag = 108\,g\,mol^{-1}$

As, 96500 C deposit 108 g of Ag

1800 C will deposit $= \frac{108 \times 1800}{96500}$ g of Ag

$= 2.014$ g of Ag

(ii) **Fuel Cell :** The galvanic cells in which chemical energy of combustion of fuels like hydrogen, methane etc. is converted into electrical energy are called fuel cells.

(iii) Since Cu reduces Ag^{+} ions into Ag metal, so it is placed below Ag in the electrochemical series.
Thus, E°_{Cu} is less positive as compared to E°_{Cu} or it is more negative than E°_{Ag}.

$$E^{\circ}_{Cu} > E^{\circ}_{Ag} \quad \text{(Negative value)}$$

Further, Na reduces Mg^{2+} into Mg so Na is placed below Mg in the electrochemical series. Thus, E°_{Na} is more negative than E°_{Mg}.

$$E^{\circ}_{Na} > E^{\circ}_{Mg} \quad \text{(Negative value)}$$

Mg reduces Cu^{2+} ions into Cu metal. So, Mg is placed below Cu in the electrochemical series. Thus, E°_{Mg} is more negative as compared to E°_{Cu}.

$$E^{\circ}_{Mg} > E^{\circ}_{Cu} \quad \text{(Negative value)}$$

The decreasing order of electrode potential (negative value) of the given metals is :

$$Na > Mg > Cu > Ag$$

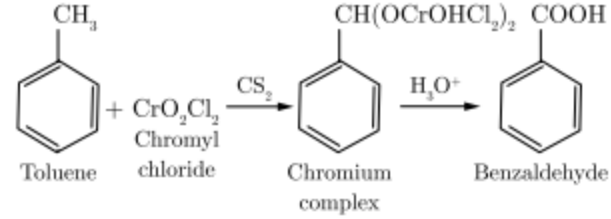
32. (i) Write the reaction involved in the following :
(a) Etard reaction
(b) Stephan reduction

(ii) How will you convert the following in not more than two steps :
(a) Benzoic acid to Benzaldehyde
(b) Acetophenone to Benzoic acid
(c) Ethanoic acid to 2-hydroxyethanoic acid.

Ans :

(i)

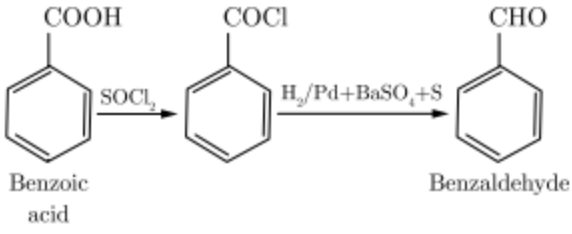
(a) **Etard Reaction :** Toluene reacts with chromyl chloride in presence of CS_2 followed by hydrolysis produces benzaldehyde.



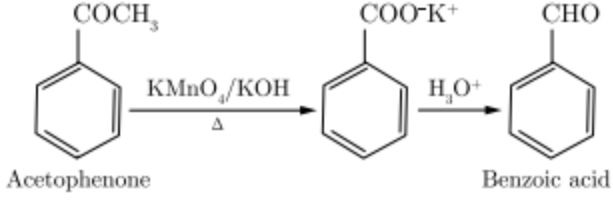
(b) **Stephan Reduction**

$$R-CN+2(H)\xrightarrow[\text{Reduction}]{SnCl_2+HCl}\underset{\text{Imine}}{RCH=NH}\xrightarrow{H_3O^+}RCHO$$

(ii) (a) Benzoic acid to Benzaldehyde



(b) Acetophenone to Benzoic acid



(c) Ethanoic acid to 2-hydroxy ethanoic acid

$$\underset{\text{Ethanoic acid}}{CH_3COOH}\xrightarrow{Cl_2/\text{red }P}ClCH_2COOH\xrightarrow{KOH(aq)}\underset{2-\text{hydroxy ethanoic acid}}{OH-CH_2COOH}$$

Important MCQ Question For Class 12 Chemistry

or

(i) An organic compound [A] with molecular formula $C_8H_{16}O_2$ was hydrolysed with dilute sulphuric acid to give a carboxylic acid [B] and an alcohol [C]. Oxidation of [C] with chromic acid produced [B]. The alcohol [C] on dehydration gave but-1-ene. Write equations for the reactions involved.

(ii) How many asymmetric carbon atoms are created during the complete reduction of benzil (PhCOCOPh) with $LiAlH_4$? Also write the number of possible stereoisomers formed as the product.

Ans :

(i)

(a) The available data shows that the compound [A] upon hydrolysis gave carboxylic acid [B] and an alcohol [C]. It must be an ester.

(b) Since the alcohol (C) upon oxidation with chromic acid gave back the carboxylic acid (B), both the acid and alcohol must have the same number of carbon atoms (four each).

(c) The alcohol (C) upon dehydration gave an alkene.

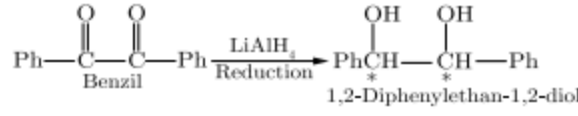
The equation for the reaction are gave :

$$\underset{\substack{\text{Butylbutanoate (A)}\\(C_8H_{16}O_2)}}{CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3}\xrightarrow{H_2O/H^+}\underset{\text{Butanoic acid (B)}}{CH_3CH_2CH_2COOH}+\underset{\text{Butan}-1-\text{ol (C)}}{CH_3CH_2CH_2CH_2OH}$$

$$\underset{\text{Butanoic acid (B)}}{CH_3CH_2CH_2COOH}\xleftarrow[\text{(Oxidation)}]{H_2CrO_4}\underset{\text{Butan}-1-\text{ol (C)}}{CH_3CH_2CH_2CH_2OH}$$

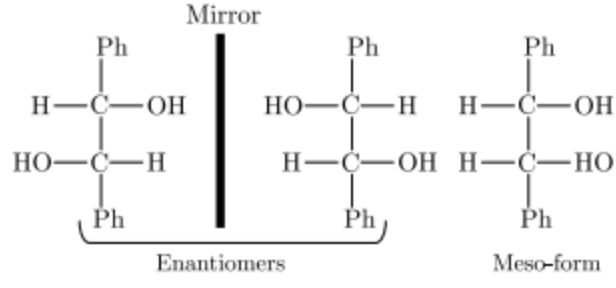
$$\xrightarrow[-H_2O]{\text{(Dehydration)}}\underset{\text{But}-1-\text{ene}}{CH_3CH_2CH=CH_2}$$

(ii) As a result of reduction of benzil, two asymmetric (chiral) carbon atoms are created:



$$\underset{\text{Benzil}}{Ph-C-C-Ph}\xrightarrow[\text{Reduction}]{LiAlH_4}\underset{1,2-\text{Diphenylethan}-1,2-\text{diol}}{PhCH-CH-Ph}$$

Three stereoisomers are possible for the above compound.



33. (i) Account for the following :

(a) Copper (I) compounds are white whereas Copper (II) compounds are coloured.

(b) Chromates change their colour when kept in an acidic solution.

(c) Zn, Cd, Hg are considered as d-block elements, but not as transition elements.

(ii) Calculate the spin-only moment of Co^{2+} ($Z=27$) by writing the electronic configuration of Co and Co^{2+}.

Ans :

(i)

(a) Cu^{+} $(3d^{10})$ compounds are white because of absence of unpaired electrons while Cu^{2+} $(3d^{9})$ compounds are coloured due to unpaired electrons and they show d-d transition.

(b) Chromates change their colour when kept in an acidic solution; because they change to dichromate's $(Cr_2O_7^{2-})$.

(c) Zn, Cd and Hg are considered as d-block elements, but not as transition elements due to completely filled d-orbitals in their ground state as well as in excited state.

(ii) Electronic configuration of

$Co(Z = 27) = (Ar)3d^7\,4s^2$

$Co^{2+} = (Ar)3d^7$

By the electronic configuration of Co^{2+} ion, it is clear that it has 3 unpaired electrons. Hence, Spin-only moment of Co^{2+},

$$\mu = \sqrt{n(n+2)}$$

$$\mu = \sqrt{3(3+2)} = \sqrt{15}$$

$$= 3.92\,\text{B.M}$$

or

(i) Following are the transition metal ions of $3d$ series :

$Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}$

(Atomic numbers :

$Ti = 22, V = 23, Mn = 25, Cr = 24$)

Answer the following :

(a) Which ion is most stable in an aqueous solution and why?

(b) Which ion is a strong oxidising agent and why?

(c) Which ion is colourless and why?

(ii) Complete the following equations :

(a) $2MnO_4^- + 16H^+ + 5S^{2-} \longrightarrow$

(b) $KMnO_4 \xrightarrow{\text{heat}}$

Ans :

(i)

(a) Out of the given four ions, Cr^{3+} is most stable due to crystal field splitting theory. In Cr^{3+}, t_{2g} is half-filled. Hence, it is most stable among the given other ions.

(b) Out of the given four ions, Mn^{3+} is strongest oxidising agent because Mn^{3+} can easily be changed into Mn^{2+} which has d^5 configuration. It is a stable half-filled configuration.

(c) Out of the given four ions, Ti^{4+} is colourless because it has no unpaired electrons for excitation to the higher energy level.

(ii)

(a) $2MnO_4^- + 16H^+ + 5S^{2-} \longrightarrow 2Mn^{2+} + 8H_2O + 5s$

(b) $\underset{\text{Potassium permanganate}}{2KMnO_4} \xrightarrow{\Delta} \underset{\text{Potassium manganate}}{K_2MnO_4} + \underset{\text{Manganese Oxide}}{MnO_2} + O_2\uparrow$

□□□□□□□