Sample Paper 4 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. The half-life for a first order reaction is 4 minutes. The time after which 99.9% reaction gets completed is:
(a) 32 minutes
(b) 40 minutes
(c) 16 minutes
(d) 8 minutes

Ans : (b) 40 minutes

For a first order reaction,

$$t_{1/2} = \frac{0.693}{k}$$

$$4 = \frac{0.693}{k}$$

$$k = \frac{0.693}{4} \qquad \ldots(1)$$

Also,

$$t = \frac{2.303}{k} \log_{10} \frac{a}{a-x}$$

$$t = \frac{2.303 \times 4}{0.693} \log \frac{100}{(100 - 99.9)}$$

[from eq. (1)]

$$= \frac{2.303 \times 4}{0.693} \log 1000$$

$$= \frac{2.303 \times 4 \times 3}{0.693}$$

$$= 39.9 \simeq 40 \text{ minutes}$$

Important MCQ Qestion For Class 12 Chemistry

2. In the following reaction:

$$CH_3 - CH = CH - CH_2OH \xrightarrow{PCC} \ldots\ldots$$

The product formed is:
(a) $CH_3 - CH = CH - CHO$
(b) $CH_3 - CH_2 - CH_2 - CHO$
(c) $CH_3 - CHO$ and CH_3CH_2OH
(d) $CH_3 - CH = CH - COOH$

Ans : (a) $CH_3 - CH = CH - CHO$

Pyridimium chlorochromate(PCC) is a mild oxidising agent and works better for the oxidation of primary alcohols to aldehydes in a good yield.

3. In the nitration of benzene using a mixture of conc. H_2SO_4 and conc. HNO_3, the species which initiate the reaction is _____.
(a) NO^+
(b) NO_2
(c) NO_2^-
(d) NO_2^+

Ans : (d) NO_2^+

In the nitration of benzene with a mixture of concentrated HNO3 and concentrated H2SO4 the active species involved is the nitronium ion NO2+ It is electrophile and obtained during the reaction of nitric acid and sulphuric acid.

4. The reagent with which acetaldehyde and acetone both react easily is:
(a) Grignard reagent
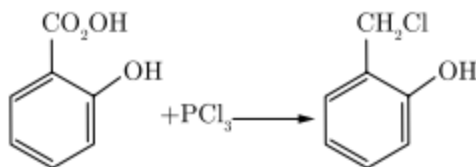(b) Schiff's reagent
(c) Tollen's reagent
(d) Fehling solution

Ans : (a) Grignard reagent

Acetaldehyde and acetone both react with a Grignard reagent to give secondary and tertiary alcohols respectively. While Fehling's reagent, Tollen's reagent, and Schiff's reagent are reduced by only aldehydes (i.e, acetaldehyde)

5. o-hydroxy benzyl alcohol when reacted with PCl_3 gives the product as (IUPAC name):
    (a) o- hydroxy-benzyl chloride
    (b) o-chloromethylchlorobenzene
    (c) 4-hydroxymethylphenol
    (d) 2- chloromethylphenol

    Ans :   (d) 2-chloromethylphenol

   o-hydroxy benzyl alcohel reacted with PCl_3 gives the product 2-chloromethylphenol.The raction is as follows:

    $$CO_2OH \quad\quad CH_2Cl$$

    +PCl₃ ⟶ (structure: o-hydroxy benzyl alcohol with CO₂OH and OH reacting to give benzene ring with CH₂Cl and OH)

6. The relationship between rate constant and half-life period for a first order reaction is:
    (a) $t_{1/2} = 0.693k$ (b) $t_{1/2} = k/0.693$
    (c) $t_{1/2} = \dfrac{0.693}{k}$ (d) $k = \dfrac{t_{1/2}}{0.693}$

    Ans :   (c) $t_{1/2} = \dfrac{0.693}{k}$

    The relationship between rate constant and the half life period for a first order reaction is given by :

    $$t_{1/2} = \dfrac{0.693}{k}$$

7. The following curve is obtained when molar conductivity λ_m (y-axis) is plotted against the square root of concentration $C^{1/2}$ (x-axis) for two electrolytes A and B.
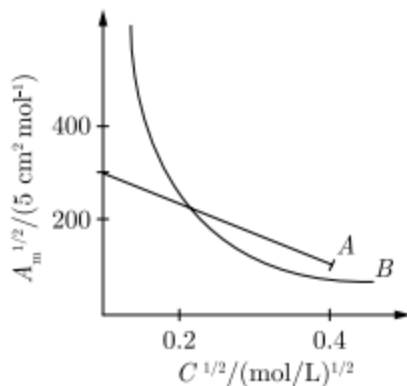
    What can you infer about the nature of the two electrolytes A and B?
    (a) A is weak electrolyte and B is strong electrolyte
    (b) A is strong electrolyte and B is weak electrolyte
    (c) A and B both are strong electrolytes
    (d) A and B both are weak electrolytes

    Ans :   (b) A is strong electrolyte and B is weak electrolyte.

    The molar conductivity increases slowly with dilution for strong electrolytes. Weak electrolytes have lower molar conductivities and lower degree of dissociation at higher concentrations which increases steeply at lower concentrations.

8. $KMnO_4$ acts as an oxidising agent in alkaline medium. When alkaline $KMnO_4$ is treated with KI, iodide ion is oxidised to:
    (a) IO^- (b) I_2
    (c) IO_4^- (d) IO_3^-

    Ans :   (d) IO_3^-

    $KMnO_4$ acts as an oxidising agent in alkaline medium. When alk. $KMnO_4$ is treated with KI, iodide ion is oxidised to IO_3^-,

    $$2KMnO_4 + H_2O + KI \longrightarrow 2MnO_4 + 2KOH + KIO_3$$
    or, $I^- + 6OH^- \longrightarrow IO_3^- + 3H_2O + 6e^-$
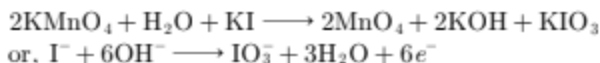
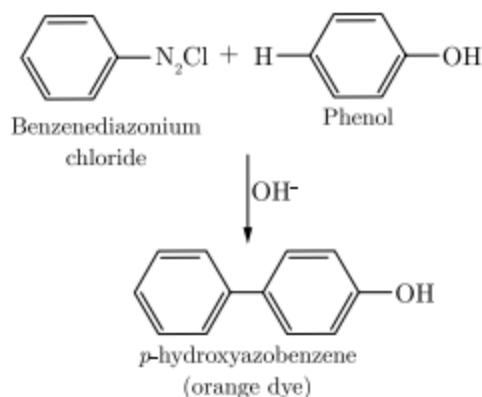   **Important MCQ Qestion For Class 12 Chemistry**

9. The magnitude of CFSE (crystal field splitting energy, Δ_0) can be related to the configuration of d-orbital in a coordination entity as:
    (a) if $\Delta_0 < P$, the configuration is $t_{2g}^3 e_g^1 =$ week field ligand and high spin complex
    (b) if $\Delta_0 > P$, the configuration is $t_{2g}^4 e_g^0 =$ strong field ligand and high spin complex
    (c) if $\Delta_0 > P$, the configuration is $t_{2g}^3 e_g^1 =$ strong field ligand and low spin complex
    (d) if $\Delta_0 = P$, the configuration is $t_{2g}^4 e_g^1 =$ strong field ligand and high spin complex

    Ans :   (c) if $\Delta_0 > P$, the configuration is $t_{2g}^3 e_g^1 =$ strong field ligand and low spin complex

    If CFSE $(\Delta_0) < P$ (Energy required for pairing), the electrons do not pair up and fourth electron goes to e_g of higher energy. Hence, high spin complex is formed. Pairing of electrons does not take place in case of weak field ligands.

10. Benzene diazonium chloride reacts with phenol in weakly alkaline medium to give:
    (a) p-hydroxyphenol   (b) Chlorobenzene
    (c) Biphenyl ether   (d) Benzene

Ans :   (a) p-hydroxyphenol

Benzenediazonium
chloride   Phenol

OH^-

p-hydroxyazobenzene
(orange dye)

11.   Consider the following given compounds :
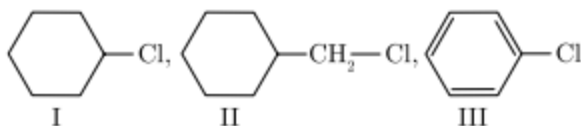

    I   II   III

Which of the following is the correct order of reactivity towards $S_N 2$ reaction?

(a) I > III > II   (b) II > I > III
(c) II > III > I   (d) III > I > II

Ans :   (c) II> III > I

An alkyl group at the α- carbon, being bigger in size then H-atom, tends to block the approach of the nucleophile to carbon due to steric hindrance in $S_N 2$ mechanism and makes the reaction difficult to occur. Therefore option (c) is correct.

12.   Consider the given figure and mark the correct option.
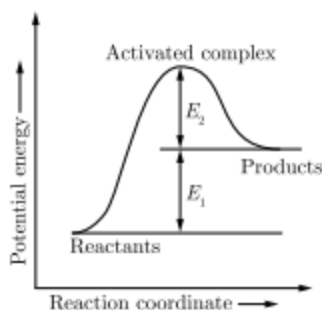
(a) Activation energy of both forward and backward reaction is $E_1 + E_2$ and reactant is more stable than product.

(b) Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.

(c) Activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.

(d) Activation energy of backward reaction is E_1 and product is more stable than reactant.

Ans :   (b) Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.

The product is less stable since the forward reaction is not favourable. The reaction is endothermic ($\Delta H > 0$). Therefore option (a) is correct.

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 :** Aliphatic amines are weaker bases than ammonia and aromatic amines are stronger bases than ammonia.

     Reason : $+/-$ effect of alkyl groups on aliphatic amines increase the electron density on nitrogen atom. Aromatic amines are weaker due to electron withdrawing nature of the aryl group.

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

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

(c) Assertion is false but Reason is true.

(d) Assertion is true but Reason is false.

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

Aliphatic amines are stronger bases than ammonia due to $+/$(electron releasing) effect of alkyl groups. The electron density on N increases and lone pair of electrons can be donated easily.

Aromatic amines are much weaker bases than ammonia. In aromatic amines, the $-NH_2$ group is attached to a $-C_6H_5$ group i.e. an electron withdrawing group. So, the availability of a lone pair of electrons on N is decreased making them weaker bases.

14.   **Assertion :** Only α-amino acids are obtained on hydrolysis of proteins.

     Reason : In zwitter ionic form, amino acids show amphoteric behaviour.

(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 true but Reason is false.

(d) Assertion is false but Reason is true.

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

Amino acids have a chiral centre and when they are linked together, they form chains that twist one way but not the other. So , only a-amino acids are obtained.

15. **Assertion :** Actinoids form relatively less stable complexes as compared to lanthanides.
Reason : Actinoids can utilise their $5f$ orbitals along with $6d$ orbitals in bonding, but lanthanoids do not use their $4f$ orbital for bonding.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is false but Reason is true.
(d) Assertion is true but Reason is false.

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

Actinoids form relatively more stable complexes as compared to lanthanoids because actinoids can use their $5f$ orbitals along with $6d$ orbitals in bonding but lanthanoids do not use their $4f$ orbitals for bonding.

**Important MCQ Qestion For Class 12 Chemistry**

16. **Assertion :** Ethers have specific dipole moment values.
Reason : The $C - O$ bond is polar in nature.
(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 true but Reason is false.
(d) Assertion is false but Reason is true.

Ans : (a) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
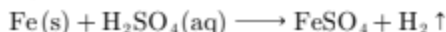
Ethers are bent molecules and the polarities of bonds present in them cancel out each other.
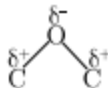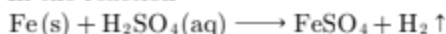

SECTION-B

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. Is the following reaction possible? Explain with reason.
$$Fe(s) + H_2SO_4(aq) \longrightarrow FeSO_4 + H_2 \uparrow$$

Ans :

In the reaction
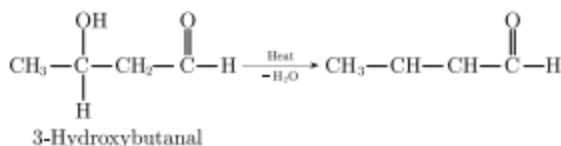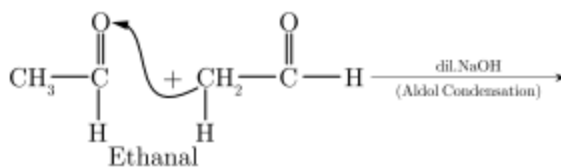$$Fe(s) + H_2SO_4(aq) \longrightarrow FeSO_4 + H_2 \uparrow$$
atoms of Fe (which is placed below hydrogen in the electrochemical series or standard electrode potential of Fe is more negative than H) are able to give electrons. Hence, Fe displaces H_2 from H_2SO_4. Thus, this reaction is possible.
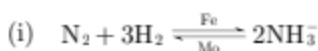
18. A compound (A) on oxidation gives B $(C_2H_4O_2)$, (A) reacts with dil. NaOH and on subsequent heating forms (C). The compound (C) on catalytic hydrogenation gives (D). Identify A, B, C, D and write down the reaction involved.
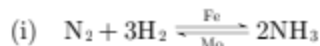
Ans :

Since the compound (A) upon oxidation gives the compound B $(C_2H_4O_2)$, it is excepted to be an aldehyde with the formula C_2H_4O. It is ethanal. The reactions involved are given:

19. Write the order of following reactions with reason:
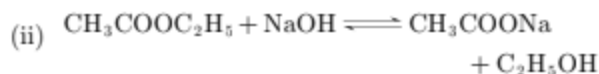
(i) $N_2 + 3H_2 \xrightleftharpoons[Mo]{Fe} 2NH_3^-$

(ii) $CH_3COOC_2H_5 + NaOH \rightleftharpoons CH_3COONa$

Ans :

(i) $N_2 + 3H_2 \xrightleftharpoons[Mo]{Fe} 2NH_3$

The velocity of this reaction does not depend upon the concentration of N_2 and H_2. So it is a zero order reaction.

(ii) $CH_3COOC_2H_5 + NaOH \rightleftharpoons CH_3COONa$
$$+ C_2H_5OH$$

Since, concentration of one mole of each reactant is changing, so it is a second order reaction.

20. Give the plausible explanation for the following:
   (i) Glucose doesn't 2, 4-DNP test.
   (ii) The two strands in DNA are not identical but are complementary.

Ans :

(i) Because the —CHO group in glucose involved in hemiacetal formation and cyclic structure of glucose, it is not free to react with 2, 4-DNP reagent.

(ii) In the helical structure of DNA, the two strands are held together by hydrogen bonds between specific pairs of bases. Cytosine forms hydrogen bond with guanine, while adenine forms hydrogen bond with thymine. As a result, the two strands are complementary to each other.
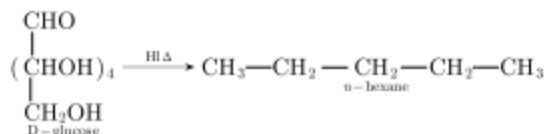
or

What happens when D-glucose is treated with the following? Give equation to support your answer.
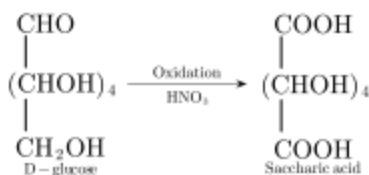(i) HI
(ii) HNO_3

Ans :

(i) n-hexane is formed.

$$\underset{\text{D-glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow{HI\,\Delta} \underset{\text{n-hexane}}{CH_3-CH_2-CH_2-CH_2-CH_3}$$

(ii) Saccharic acid is formed

$$\underset{\text{D-glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow[HNO_3]{\text{Oxidation}} \underset{\text{Saccharic acid}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \end{array}}$$
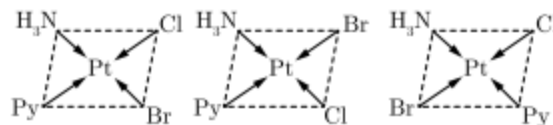
21. Write all the geometrical isomers of $[Pt(NH_3)(Br)(Cl)(Py)]$ and how many of these will exhibit optical isomers?

Ans :

Following three geometrical isomers are possible for the given compounds:

Isomers of this type do not exhibit optical isomerism. Optical isomerism is rare in square planar or tetrahedral complexes. In these complexes, it is possible only when they have asymmetric chelating ligand.

Important MCQ Qestion For Class 12 Chemistry

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. How will you distinguish between the following pairs of compounds ?
   (i) Chloroform and carbon tetrachloride
   (ii) Benzyl chloride and chlorobenzene.

Ans :

(i) Heat the two compounds separately with aniline and alcohol KOH. Chloroform gives pungent and irritating smell of an isocyanide while carbon tetrachloride does not.

$$CHCl_3 + 3KOH(alc.) + C_6H_5NH_2 \xrightarrow{Heat} C_6H_5N$$
$$= C + 3KCl + 3H_2O$$
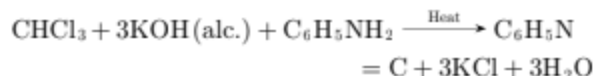
(ii) Add a few drops of NaOH and $AgNO_3$ separately to both the compounds. Benzyl chloride gives a white precipitate while chlorobenzene does not.

$$AgCl + NaNO_3$$
(white ppt.)
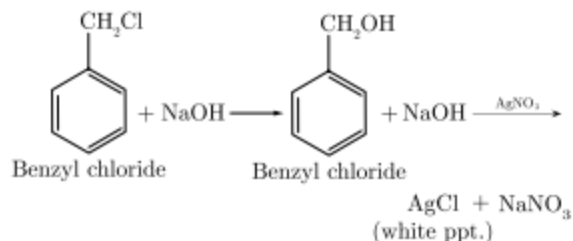
23. Show that for a first order reaction, time required for completion of 99% of reaction is twice the time required for completion of 90% of reaction.

Ans :

Given, $[R]_0 = 100$ (suppose)

Then, $[R] = 100 - 99$

(for 99% completion of reaction)

As we know that,

For first order reaction,

$$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

Here, $t = t_{99\%}$

After substituting the values, we get

$$t_{99\%} = \frac{2.303}{k} \log \frac{100}{1}$$

$$= \frac{2.303}{k} \log 100$$

$$t_{99\%} = \frac{2.303 \times 2}{k} \qquad \text{...(1)}$$

For 90% completion of reaction,

$$t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$$

$$t_{90\%} = \frac{2.303}{k} \qquad \text{...(2)}$$

After comparing equation. (1) and (2), we get

$$t_{99\%} = 2 \times t_{90\%}$$

Important MCQ Qestion For Class 12 Chemistry

**24.** Give reasons for the following: (Any three)
(i) Aniline cannot be prepared by the ammonolysis of chlorobenzene under normal conditions.
(ii) N-ethylethanamine boils at 329.3K and butanamine boils at 350.8K. although both are isomeric in nature.
(iii) Acylation of aniline is carried out in the presence of pyridine.
(iv) Acetylation of aniline reduces its activation effect.

Ans :

(i) In case of chlorobenzene, the $C-Cl$ bond is quite difficult to break as it acquires a partial double bond character due to conjugation. So under the normal conditions, ammonolysis of chlorobenzene does not yield aniline.
(ii) Primary and secondary amines are engaged in intermolecular association due to hydrogen

bonding between nitrogen of one and hydrogen of another molecule. Due to the presence of three hydrogen atoms, the intermolecular association is more in primary amines than in secondary amines as there are two hydrogen atoms available for hydrogen bond formation in it.
(iii) During the acylation of aniline, stronger base pyridine is added. This is done in order to remove the HCl so formed during the reaction and to shift the equilibrium to the right hand side.
(iv) Due to electron withdrawing effect of the acetyl group, the lone pair of electrons on N-atom is attracted by acetyl group. As a result, lone pair of electrons on N-atom is not exclusively available for donation to the benzene ring and hence, activating effect of the $-NH_2$ group is reduced.
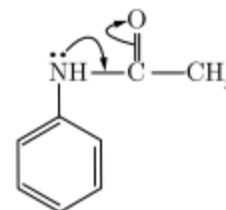
25. (i) Write the IUPAC name of the following complex : $K_2[PdCl_4]$
(ii) Using crystal field theory, write the electronic configuration of d^5 ion, if $\Delta_o > P$.
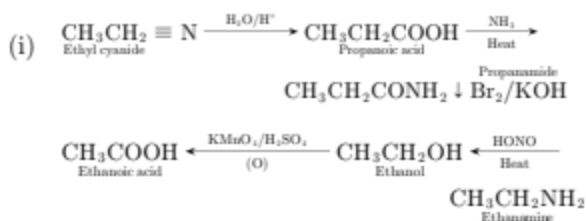(iii) What are homoleptic complexes?

Ans :

(i) Potassium tetrachloridopalladate(II)
(ii) Electronic configuration $= t_{2g}^5 e_g^0$.
(iii) Complexes in which a metal is bound to only one kind of donor groups are known as homoleptic complexes.
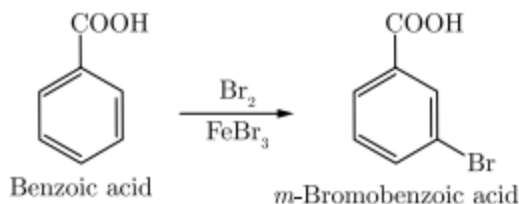
26. How are following conversions carried out?
(i) Ethyl cyanide to ethanoic acid
(ii) Butan-1-ol to butanoic acid
(iii) Benzoic acid to m-bromobenzoic acid.

Ans :

(i) $\underset{\text{Ethyl cyanide}}{CH_3CH_2 \equiv N} \xrightarrow{H_2O/H^+} \underset{\text{Propanoic acid}}{CH_3CH_2COOH} \xrightarrow[\text{Heat}]{NH_3}$

$\underset{\text{Propanamide}}{CH_3CH_2CONH_2} \downarrow Br_2/KOH$

$\underset{\text{Ethanoic acid}}{CH_3COOH} \xleftarrow[\text{(O)}]{KMnO_4/H_2SO_4} \underset{\text{Ethanol}}{CH_3CH_2OH} \xleftarrow[\text{Heat}]{HONO}$

$\underset{\text{Ethanamine}}{CH_3CH_2NH_2}$

(ii) $CH_3CH_2CH_2CH_2OH \xrightarrow[\text{(O)}]{KMnO_4/H_2SO_4}$
Butan-1-ol

$CH_3CH_2CH_2COOH$
Butanoic acid

(iii)

Benzoic acid   m-Bromobenzoic acid

27. The boiling point of solution obtained by dissolving 6 g urea (NH_2CONH_2) in 200 g water, is 100.28C. What will be the freezing point of this solution? For water molal elevation constant and molal depression constant are respectively 0.52°C molal⁻¹ and 1.86°C molal⁻¹.

Ans :

On dissolving 6 g urea (NH_2CONH_2) in 200 g water, the molality of obtained solution,

$$m = \frac{\text{Mass of urea/Molar mass of urea}}{\text{Mass of water (in kg)}}$$

$$= \frac{6g/60 \text{ g mol}^{-1}}{0.2 \text{ kg}} = 0.5 \text{ m}$$

Given, $K_b = 0.52°\text{C molal}^{-1}$ and $K_f = 1.86°C \text{ molal}^{-1}$
Elevation in boiling point $(\Delta T_b) = K_b \times$ molality of solution
Depression in freezing point $(\Delta T_f) = K_f \times$ molality of solution.

$$\Delta T_b = 0.52 \times 0.5 = 0.26°C$$

$$\Delta T_f = 1.86 \times 0.5 = 0.93°C$$

ΔT_b = Boiling point of solution − Boiling point of solvent (water)

$$= 100.28°C - 100°C = 0.28°C$$

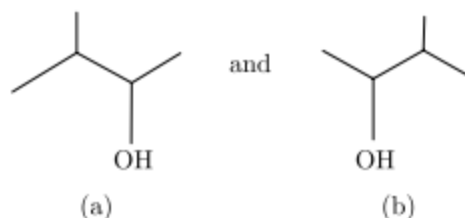$$T_f = \frac{0.93}{0.26} \times 0.28 = 1.0015°C$$

ΔT_f = Freezing point of solvent (water) − Freezing point of solution

$1.0015°C = 0°C -$ freezing point of solution or

freezing point of solution $= -1.0015°C$

Important MCQ Qestion For Class 12 Chemistry

28. (i) Identify the chiral molecule in the following pair:


(a)   (b)

(ii) Write the structure of the product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.

(iii) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.

Ans :
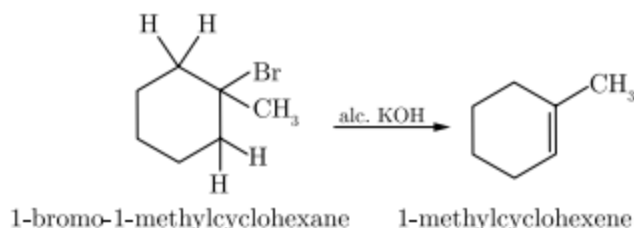
(i) Molecule (a) is chiral as its mirror image is non-superimposable.

Mirror
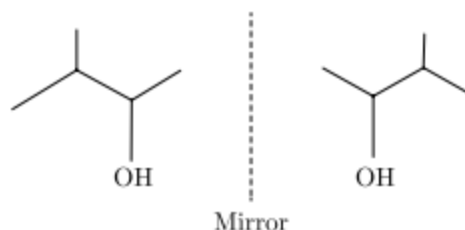
(ii) Toluene is formed. This is known as Wurtz-Fittig reaction.

Chlorobenzene

Toluene
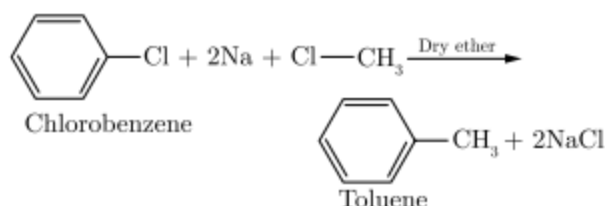
(iii) 1-methylcyclohexene is formed.

1-bromo-1-methylcyclohexane   1-methylcyclohexene

β-hydrogen on each side of Br atom are equivalent because of which only one alkene will be formed.

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. **Solubility in Binary Solutions**

    Binary solutions can be of nine different types depending upon the nature of the solute and solvent whether solid, liquid or gas. They may be further classified as solid, liquid and gaseous solutions based on the component which acts as the solvent. However, the liquid solutions are the most important. Both solids and gases dissolve in liquids resulting in homogeneous mixtures, i.e. solutions. The solubility is governed by number of factors such as nature of solute and solvent, temperature, pressure etc. The concentrations of the solutions can be expressed in different ways such as normality, molarity, molality, mole fraction etc. Out of these, molality and mole fraction are better as they do not change with the change in temperature.

    Based on the above passage, answer the .following questions:

    (i) Solubility curve of $Na_2SO_4 \cdot 10H_2O$ in water with temperature is given as:
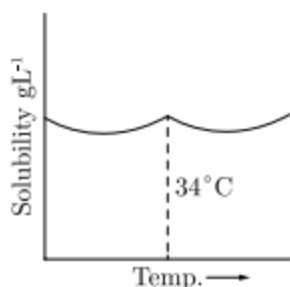
    What do you infer about the temperature variation of curve with solubility process?

    (ii) On what factor does the maximum amount of a solid solute that can be dissolved in a specified amount of a given liquid solvent not depend upon?

    (iii) What is the molality of a sulphuric acid solution in which mole fraction of water is 0.85?

    or

    How much amount of salt is contained in 1000 g of a 4% solution of salt?

    Ans :

    (i) Solubility process is endothermic till 34°C and is exothermic after —34°C.

    (ii) The maximum amount of a solid solute that can be dissolved in a specified amount of a given

liquid solvent does not depend upon pressure.

(iii) If n_1 and n_2 are the number of moles of water and H_2SO_4 respectively, then

$$X_{water} = \frac{n_1}{n_1 + n_2} = 0.85 \qquad \text{...(1)}$$

$$X_{H_2SO_4} = \frac{n_2}{n_1 + n_2} = -1 - 0.85$$
$$= 0.15 \qquad \text{...(2)}$$

Dividing eq. (2) by eq. (1),

$$\frac{n_2}{n_1} = \frac{0.15}{0.85}$$

Now, $n_1 = \frac{1000}{18} = 55.55$

Hence, $n_2 = \frac{0.15}{0.85} \times 55.55 = 9.8$ moles

Hence, molality of solution $= 9.8$

or

Total weight of solution $= 1000$ g

% of solute $= 4\%$

Weight of solute (salt) $= \frac{4}{100} \times 1000 = 40$ g

So,   amount of salt $= 40$ g

<div style="border:1px solid black">

Important MCQ Qestion For Class 12 Chemistry

</div>

30. The basic chemical formula of DNA is now well established. As shown in figure, it consists of a very long chain, the backbone of which is made up of alternate sugar and phosphate groups, joined together in regular $3'5'$ phosphate di-ester linkages. To each sugar is attached a nitrogenous base, only four different kinds of which are commonly found in DNA.
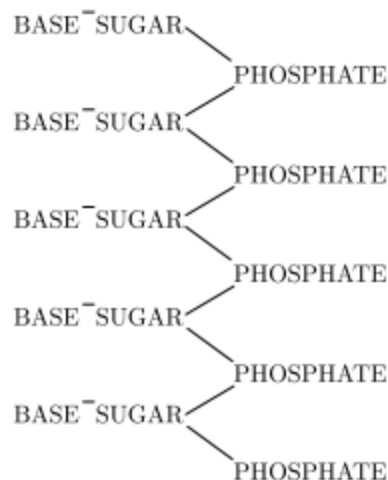
Two of these–adenine and guanine are purines, and the other two thymine and cytosine are pyrimidines. A fifth base, 5-methyl cytosine, occurs in smaller amounts in certain organisms, and a sixth, 5-hydroxy-methyl-cytosine, is found instead of cytosine in the T even phages. It should be noted that the chain is unbranched, a consequence of the regular internucleotide linkage. On the other hand the sequence of the different nucleotides is, as far as can be ascertained, completely irregular. Thus, DNA has some features which are regular, and some which are irregular. A similar conception of the DNA molecule as a long thin fibre is obtained from physicochemical analysis involving sedimentation, diffusion, light scattering, and viscosity measurements. These techniques indicated that DNA is a very asymmetrical structure approximately 20. A wide and many thousands of angstorms long. Estimates of its molecular weight currently center between 5×10^6 and 10^7 (approximately 3×10^4 nucleotides). Surprisingly each of these measurements tend to suggest that the DNA is relatively rigid, a puzzling finding in view of the large number of single bonds (5 per nucleotide) in the phosphate-sugar back bone. Recently these indirect inferences have been confirmed by electron microscopy.

Based on the above passage answer the following questions:

(i) A nitorgenous based is attached to each sugar and only four of its kinds are commonly found in DNA. Name the purines present in DNA.

(ii) Which of the four kinds of nitrogenous bases commonly found in DNA has been replaced in some organisms?

(iii) As shown in figure, DNA has a long chain. What is the backbone of DNA made up of and how is it joined?

or

As given, DNA has some regular and some irregular features. Which features of DNA are regular and which are irregular? Which analysis provide the same concept of DNA?

Ans :

(i) The purines present in DNA are adenine and guanine.

(ii) Cytosine has been replaced in some organisms.

(iii) The backbone of DNA is made up of alternate sugar and phosphate groups. They are pined together in regular $3'5'$ phosphate di-ester linkages in which a nitrogenous base is attached to each sugar.

or

DNA molecules have regular inter-nucleotide linkages and irregular sequence of the different nucleotides. The same concept of DNA is provided from physiochemical analysis that involves sedimentation, diffusion, light scattering and viscosity measurements.

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. Explain the following observations:
   (i) d-block elements exhibit more oxidation states as compared to elements of f-block.
   (ii) Cu^+ salts are colourless, whereas Cu^{2+} salts are coloured. (Atomic number of $Cu = 29$).
   (iii) Mn^{2+} ion is more stable than Mn^{3+} ion.
   (iv) Transition elements form several complex compounds.
   (v) Zn^{2+} salts are white whereas Cu^{2+} salts are blue.

Ans :

(i) d-block elements contain a large number of unpaired electrons which take part in bond formation, because of which effective nuclear charge is less. So, they exhibit more number of oxidation states as compared to f-block elements. In f-block, effective nuclear charge becomes more effective due to weak shielding effect of f-orbitals and hence, less electrons take part in bond formation.

(ii) Cu^+ ion does not have unpaired electrons, so it can not exhibit $d-d$ transition. Thus, Cu^+ salts are colourless. Cu^{2+} salts are coloured because they have an unpaired electron, so they can show $d-d$ transition. They scatter blue colour by absorbing light from visible region.

(iii) $Mn^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5$ (half-filled) whereas in Mn^{3+}, d-subshell of third shell is incomplete.

$Mn^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^4$ (incomplete) Half filled subshell $(3d^5)$ is more stable that partially filled subshell $(3d^4)$. So, Mn^{2+} ion is more stable than Mn^{3+} ion.

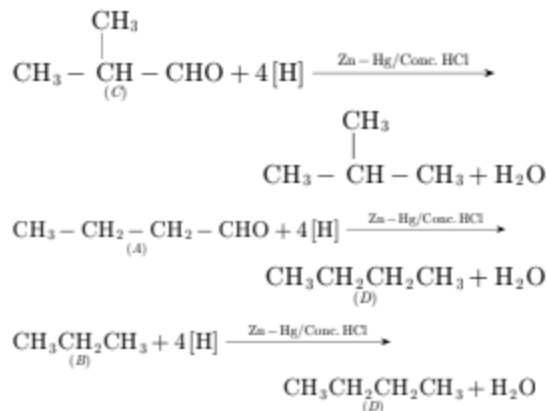(iv) Transition elements form a large number of complex compounds. This is because of the following reasons:
(a) Their small size and high charge density.
(b) The availability of vacant subshells.
(c) Their different oxidation states.

(v) $Zn^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}$

In Zn^{2+} configuration, d-subshell is completely filled, due to which the salt is colourless or white.
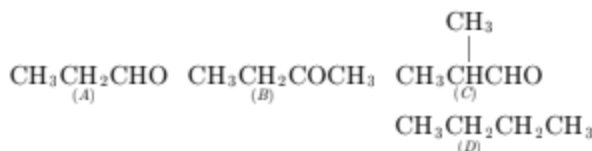
$Cu^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^9$

In Cu^{2+} configuration, d-subshell is partially filled due to which the salt is coloured or blue.

32. A, B and C are three non-cyclic functional isomers of a carbonyl compound with molecular formula C_4H_8O. Isomers A and C give positive Tollen's test whereas isomer B does not give Tollen's test but gives positive Iodoform test. Isomers A and B on reduction with Zn (Hg)/Conc. HCl give the same product D.
(i) Write the structure of A, B, C and D.
(ii) Out of A, B and C isomers, which one is least reactive towards addition of HCN?

Ans :

(i) The possible functional isomers of carbonyl compound with molecular formula, C_4H_8O are:

$$CH_3 - \overset{\underset{|}{CH_3}}{CH} - CHO, \ CH_3CH_2CH_2CHO,$$

$$CH_3CH_2 - \overset{\overset{O}{\|}}{C} - CH_3$$
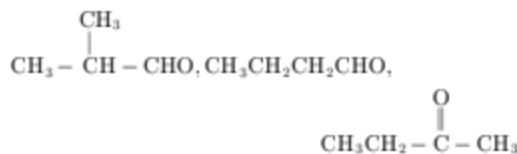
(a) Isomers A and C gives positive Tollen's test, thus they must be aldehydes

$$\underset{Aldehyde}{RCHO} + 2\underset{Tollen's\ reagent}{[Ag(NH_3)_2]} \xrightarrow{\Delta} RCOO^- + \underset{Silver\ mirror}{2Ag\downarrow}$$
$$+ 2H_2O + 4NH_3\uparrow$$

$$CH_3 - \overset{\underset{|}{CH_3}}{CH} - CHO \text{ and } CH_3CH_2CH_2CHO$$

(b) Isomer B does not given Tollen's, but gives positive test thus it must be a ketone with CH_3CO- group.

$$RCOCH_3 \xrightarrow{NaoX} RCOONa + CHX_3 (X = Cl, Br, I)$$

(c) Isomers A and B on reduction with Zn(Hg)/ conc. HCl give some product D.

$$\underset{(C)}{CH_3 - \overset{\underset{|}{CH_3}}{CH} - CHO} + 4[H] \xrightarrow{Zn - Hg/Conc.\ HCl}$$
$$CH_3 - \overset{\underset{|}{CH_3}}{CH} - CH_3 + H_2O$$

$$\underset{(A)}{CH_3 - CH_2 - CH_2 - CHO} + 4[H] \xrightarrow{Zn - Hg/Conc.\ HCl}$$
$$\underset{(D)}{CH_3CH_2CH_2CH_3} + H_2O$$

$$\underset{(B)}{CH_3CH_2CH_3} + 4[H] \xrightarrow{Zn - Hg/Conc.\ HCl}$$
$$\underset{(D)}{CH_3CH_2CH_2CH_3} + H_2O$$

COMMON ERRQR

Hence, the structure of A, B, C and D are :

$$\underset{(A)}{CH_3CH_2CHO} \ \ \underset{(B)}{CH_3CH_2COCH_3} \ \ \underset{(C)}{CH_3\overset{\underset{|}{CH_3}}{CH}CHO}$$
$$\underset{(D)}{CH_3CH_2CH_2CH_3}$$

(ii) The isomer B is least reactive towards addition of HCN. Since, aldehyde are more reactive towards nucleophilic addition reactions than ketones due to inductive and steric effects.
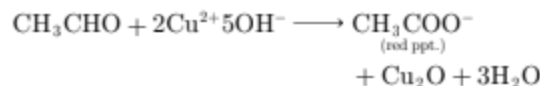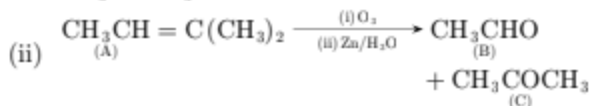
or

An alkene 'A' (Mol. formula C_5H_{10}) on ozonolysis gives a mixture of two compounds 'B' and 'C'. Compound 'B' gives positive Fehling's test and also forms iodoform on treatment with I_2 and NaOH. Compound 'C' does not give Fehling's test but forms iodoform.
(i) Identify the compounds A, B and C.
(ii) Write the reaction for ozonolysis and formation of iodoform from B and C.

Ans :

(i) Compound A is an alkene, on ozonolysis it will give carbonyl compounds. As both B and C have $C=O$ group.
B gives positive Fehling test so it is an aldehyde and it gives iodoform test so it is so it has $CH_3C = O$ group. This means the aldehyde is acetaldehyde. C does not give Fehling test, so it is a ketone. It gives positive iodoform test so it is a methylketone means it has $CH_3C = O$ group. Compound A (C_5H_{10}) on ozonolysis gives B (CH_3CHO) + C (CH_3COR). So C is CH_3COCH_3.
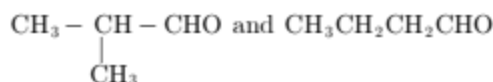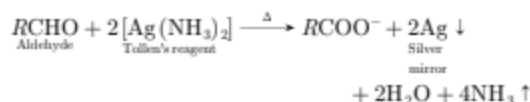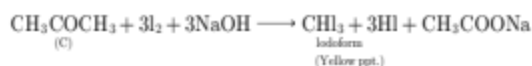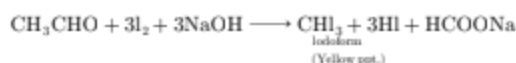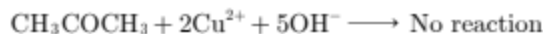
(ii)
$$\underset{(A)}{CH_3CH = C(CH_3)_2} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_2} \underset{(B)}{CH_3CHO}$$
$$+ \underset{(C)}{CH_3COCH_3}$$

$$CH_3CHO + 2Cu^{2+} 5OH^- \longrightarrow \underset{(red\ ppt.)}{CH_3COO^-}$$
$$+ Cu_2O + 3H_2O$$

$$CH_3COCH_3 + 2Cu^{2+} + 5OH^- \longrightarrow \text{No reaction}$$

$$CH_3CHO + 3I_2 + 3NaOH \longrightarrow \underset{\substack{\text{Iodoform}\\\text{(Yellow ppt.)}}}{CHI_3} + 3HI + HCOONa$$

$$\underset{(C)}{CH_3COCH_3} + 3I_2 + 3NaOH \longrightarrow \underset{\substack{\text{Iodoform}\\\text{(Yellow ppt.)}}}{CHI_3} + 3HI + CH_3COONa$$

33. (i) Write the cell reaction and calculate the emf of the following cell at 298 K :

$$Sn(s) \mid Sn^{2+}(0.004\ M) \parallel H^+(0.020\ M) \mid H_2(g)(1\ bar)$$
$$\mid Pt(s)$$
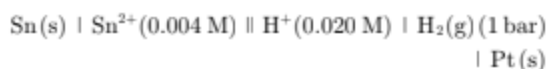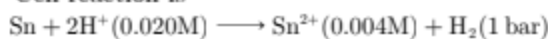
(Given: $E^°_{Sn^{2+}/Sn} = -0.14\ V$)

(ii) Give reasons :

  (a) On the basis of $E^°$ values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

  (b) Conductivity of CH_3COOH decreases on dilution.

Ans :

(i) $Sn(s) \mid Sn^{2+}(0.004\ M) \parallel H^+(0.020\ M) \mid H_2(g)$
$$(1\ bar) \mid Pt(s)$$

Cell reaction is
$$Sn + 2H^+(0.020M) \longrightarrow Sn^{2+}(0.004M) + H_2(1\ bar)$$

$$E^°_{Cell} = E^°_{H^+,\frac{1}{2}H_2} - E^°_{Sn^{2+}/Sn}$$

$$= 0 - (-0.14\ V)$$

$$= 0 + 0.14\ V = 0.14\ V$$

For calculation of emf we apply Nernst equation:

$$E_{Cell} = E^°_{Cell} - \frac{0.0591}{n}\log\frac{[Sn^{2+}] \times P_{H_2}}{[H^+]^2}$$

$$= 0.14 - \frac{0.0591}{2}\log\frac{[0.004] \times 1}{[0.020]^2}$$

$$= 0.14 - \frac{0.0591}{2}\log\frac{0.004}{0.0004}$$

$$= 0.14 - \frac{0.0591}{2}\log 10 = 0.14 - \frac{0.0591}{2}$$

$$= 0.11\ V$$

(ii)

  (a) From standard oxidation potential it is clear that oxygen gas should be evolved at anode but its rate of evolution is very low. In order to increase this, we have to increase the voltage of external battery. Because of which chloride ions get oxidised easily and Cl_2 gas is evolved at anode.

  (b) On dilution number of CH_3COOH ions per unit volume decreases.
Hence, conductivity decreases.

or

(i) Out of the following pairs, predict with reason which pair will allow greater conduction of electricity:

  (a) Silver wire at 30°C or silver wire at 60°C.

  (b) 0.1 M CH_3COOH solution or 1 M CH_3COOH solution.

  (c) KCl solution at 20°C or KCl solution at 50°C.

(ii) Give two points of differences between electrochemical and electrolytic cells.

Ans :

(i)

  (a) Silver wire at 30°C, because as temperature decreases, resistance decreases so conduction increases.

  (b) 0.1 M CH_3COOH; because on dilution degree of ionisation increases hence conduction increases.

  (c) KCl solution at 50°C; because at high temperature mobility of ions increases and hence conduction increases.

(ii)

	Basis of difference	Electrochemical cell	Electrolytic cell
(a)	Electrode polarity	Anode- negative Cathode- positive	Anode- positive Cathode- negative
(b)	Energy conservation	It converts chemical energy to electrical energy.	It converts electrical energy to chemical energy.

Important MCQ Qestion For Class 12 Chemistry

□□□□□□□