CBSE Sample Paper 8

Class XII 2022-23

Chemistry

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

General Instructions:

1. There are 35 questions in this question paper with internal choice.
2. SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 7 very short answer questions carrying 2 marks each.
4. SECTION C consists of 5 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

18 Marks

(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. If limiting molar conductivity of Ca^{2+} and Cl^- are 119.0 and 76.3 S cm^2 mol^{-1}, then the value of limiting molar conductivity of $CaCl_2$ will be:

(a) 195.3 S cm^2 mol^{-1}

(b) 271.6 S cm^2 mol^{-1}

(c) 43.3 S cm^2 mol^{-1}

(d) 314.3 S cm^2 mol^{-1} 1

2. Curdling of milk is an example of:

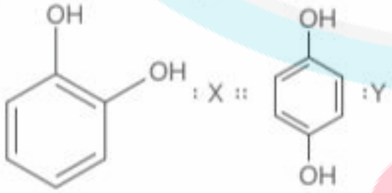
(a) breaking of peptide linkage

(b) hydrolysis of lactose

(c) breaking of protein into amino acids

(d) denaturation of protein 1

3. Complete the following analogy:



(a) X : Catechol, Y : Hydroquinone

(b) X : Catechol, Y : Resorcinol

(c) X : Resorcinol, Y : Catechol

(d) X : Hydroquinone, Y : Catechol 1

4. Diamagnetic species is weakly repelled by external magnetic field. Which of the following is not a diamagnetic ion: (Atomic numbers of Sc, Co, Mn and Cu are 21, 27, 25 and 29 respectively)?

(a) Co^{2+} (b) Sc^{3+}

(c) Cu^{2+} (d) Mn^{2+} 1

5. Order of a chemical reaction can be fractional also. Which of the following, is an example of a fractional order reaction?

(a) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

(b) $NO + O_3 \rightarrow NO_2 + O_2$

(c) $2NO + Br_2 \rightarrow 2NOBr$

(d) $CH_3CHO \rightarrow CH_4 + CO$ 1

6. When $CH_3CHBrCH_2CH_3$ is reacted with alcoholic KOH, the major product is:

(a) $CH_3 - CH = CH - CH_3$

(b) $CH_2 = CH - CH_2 - CH_3$

(c) $CH_3 - CH(OH) - CH_2 - CH_3$

(d) $CH_3 - CH_2 - CH_2 - CH_3$ 1

7. IUPAC name of $[Pt(NH_3)_3 Br(NO_2)Cl] Cl$ is:

(a) Triamminechloridobromidonitroplatinum (IV)chloride

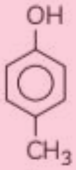
(b) Triamminebromidonitrochloridoplatinum (IV)chloride

(c) Triamminebromidochloridonitroplatinum (IV)chloride

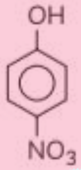
(d) Triamminenitrochloridobromiodoplatinum (IV)chloride 1

8. The correct acidic strength order of the following is:

I



II



III

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

(c) (II) > (III) > (I) (d) (I) > (III) > (II) 1

9. Aniline is less basic than ethylamine. This is due to:

(a) conjugation of lone pair of nitrogen with the ring

(b) the insoluble nature of aniline

(c) more K_b value of aniline

(d) hydrogen bonding 1

10. Which of the following alcohol is most soluble in water?

(a) Propanol (b) Butanol

(c) Pentanol (d) Hexanol 1

11. Which of the ligands has largest CFSE value?

(a) CO (b) NH_3

(c) F^- (d) H_2O 1

12. What is the coordination number of Pt in $[Pt(NH_3)_4Br_2]^{2+}$?

(a) 4 (b) 6

(c) 2 (d) 3 1

13. What do you conclude about the order of the reaction?

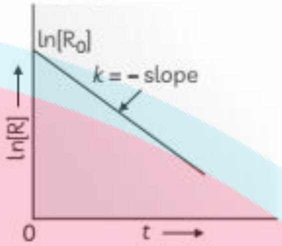
(a) It is a first order reaction.

(b) It is a second order reaction.

(c) It is a third order reaction.

(d) It is a pseudo unimolecular reaction. 1

14. What is the unit of the order of the reaction depicted in the graph?



(a) $molL^{-1}sec^{-1}$ (b) sec^{-1}

(c) $molL^{-1}$ (d) $mol^{-2}Ls^{-1}$ 1

In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false

(d) (A) is false but (R) is true

15. Assertion (A): Fructose reduces Fehling's solution and Tollens' reagent.

Reason (R): Fructose does not contain any aldehyde group. 1

16. Assertion (A): It is possible to make a cell with a pair of same type of half cells.

Reason (R): Change in concentration varies the electrode potential. 1

17. Assertion (A): All collisions of reactant molecules lead to product formation.

Reason (R): Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to the compound formation. 1

18. Assertion (A): $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless.

Reason (R): *d-d* transition is not possible in $[Sc(H_2O)_6]^{3+}$. 1

SECTION - B

14 Marks

(The following questions are very short answer type with internal choice in two questions and carry 2 marks each.)

19. (A) Give one example of coordination isomerism.

(B) Calculate the number of unpaired electeon in Cr^{3+}, Ti^{3+} and V^{3+} and identify the most stable ion in aqueous solution. 2

20. Give simple tests to distinguish between the following pairs of compounds:

(A) Pentan-2-one and Pentan-3-one

(B) Benzaldehyde and Acetophenone 2

21. What is meant by the following terms?

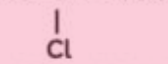
(A) Cyanohydrin

(B) Acetal

OR

Arrange the following compounds in increasing order of their property as indicated:

(A) CH_3COCH_3, $C_6H_5 — CO — C_6H_5$, CH_3CHO (reactivity towards nucleophilic addition reactions)

(B) 
$Cl—\underset{\displaystyle Cl}{\underset{|}{CH}}—COOH$, $Cl—CH_2—COOH$, $CCl_3—COOH$ (acidic character) 2

22. (A) Differentiate between hormones and vitamins.

(B) Give the chemical name of the following:

(i) Vitamin E

(ii) Vitamin C 2

23. On the basis of electrochemical series, elaborate the following:

(A) Compound Au_2O_3 decomposes on hearing.

(B) Zn can displace hydrogen from dil HCl but Cu cannot. 2

24. (A) Draw the plot of ln [R] vs t for a first order reaction. What is the slope?

(B) A first order reaction takes 30 minutes for 90% decomposition. Calculate k.

Given: $\log_{10} = 1$ 2

25. (A) Give any two differences between double salts and complexes?

(B) Explain how $[FeF_6]^{3-}$ is paramagnetic and outer orbital complex.

OR

(A) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_0 < P$.

(B) Write the hybridization and shape of $[Ni(CN)_4]^{2-}$. (Atomic number of Ni = 28) 2

SECTION - C **15 Marks**

(The following questions are short answer type with internal choice in two questions and carry 3 marks each.)

26. Write the mechanism for the formation of ethoxy ethane from ethanol. 3

27. How would you account for the following?

(A) Many of the transition elements are known to form interstitial compounds.

(B) With the same d-orbital configuration (d^4) Cr^{2+} is a reducing agent while Mn^{3+} is an oxidizing agent.

(C) The enthalpies of atomization of transition elements are quite high. 3

28. Answer the following questions:

(A) Write the formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number.

(B) Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids.

(C) Name the element showing the maximum number of oxidation states among the first series of transition metals from Sc (Z = 21) to Zn (Z = 30).

OR

The standard electrode potential for the M^{3+}/M^{2+} half-cell gives the relative stability between M^{3+} and M^{2+}. The reduction potential values are tabulated as below.

Reaction	Standard reduction potential (V)
$Ti^{3+} + e^- \rightarrow Ti^{2+}$	– 0.37
$V^{3+} + e^- \rightarrow V^{2+}$	– 0.26
$Cr^{3+} + e^- \rightarrow Cr^{2+}$	– 0.41
$Mn^{3+} + e^- \rightarrow Mn^{2+}$	+ 1.51
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	+ 0.77
$Co^{3+} + e^- \rightarrow Co^{2+}$	+ 1.81

(A) What does the negative values for titanium, vanadium and chromium indicate?

(B) What does reduction potential of Mn^{3+}/Mn^{2+} indicate about the stability of these oxidation states?

(C) The E^0 value of the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple or Fe^{3+}/Fe^{2+} couple. 3

29. Answer any three questions:

(A) What type of linkage is present in disaccharides?

(B) Write one source and deficiency disease of vitamin B_{12}.

(C) Write the difference between DNA and RNA.

(D) What are the expected products of hydrolysis of lactose? 3

30. A solution containing 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution. 3

SECTION - D

8 Marks

(The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.)

31. *The various classes of organic compounds containing carbonyl groups are aldehydes, ketones, carboxylic acids and their derivatives. The carbonyl carbon of the simplest aldehyde, formaldehyde is bonded to two hydrogen atoms. All other aldehydes contain the carbonyl carbon bonded to a hydrogen atom and to an alkyl group. The carbonyl carbon of a ketone is bonded to two alkyl groups. Carboxylic acids are obtained by the oxidation of primary alcohols or aldehydes. They are also obtained by the hydrolysis of nitriles, acid chlorides, esters, anhydrides and amides.*

(A) **Why carboxylic acids contain a carbonyl group but do not give characteristic reactions of the carbonyl group?** 1

(B) **State the geometry of formaldehyde.** 1

(C) **How will you differentiate the following compound.**

(i) **Benzaldehyde and acetaldehyde**

(ii) **Formic acid and acetic acid.**

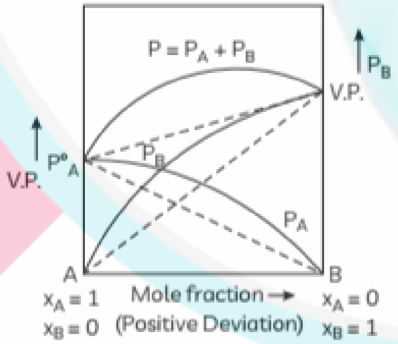
OR

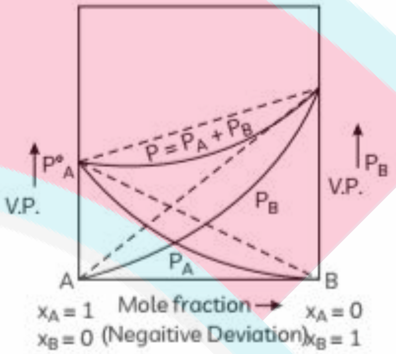
Explain the feature of following:

(i) **Iodoform**

(ii) **Schiff's test** 2

32. *An ideal solution may be defined as the solution which obeys Raoult's law exactly over the entire range of concentration. The solutions for which vapour pressure is either higher or lower than that predicted by Raoult's law are called non-ideal solutions.*





Non-ideal solutions can show either positive or negative deviations from Raoult's law depending on whether the A-B interactions in solution are stronger or weaker than A - A and B - B interactions.

(A) **Name any two examples of ideal solution(s)?** 1

(B) **If liquids A and B form an ideal solution, then what is the Gibbs free energy of mixing?** 1

(C) (i) **Draw a graph for water and nitric acid mixture.**

(ii) **Water-HCl mixture shows maximum or minimum boiling azeotropes?**

OR

A 2 litre flask contains 4g of hydrogen and 128 g of hydrogen iodide. Find out their active masses. 2

SECTION - E

15 Marks

(The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.)

33. (A) Arrange the following in the decreasing order of their basic strength in aqueous solutions:

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ and NH_3

(B) Give the chemical tests to distinguish sh between the following pair of compounds: Methylamine and Dimethylamine

(C) How will you convert Benzene to Aniline?

(D) Write reactions of the final alkylation product of aniline with excess of methyl iodide in the presence of sodium carbonate solution.

OR

(A) Account for the following:

(i) N-ethylethanamine boils at 329.3K and butanamine boils at 350.8K, although both are isomeric in nature.

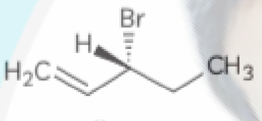
(ii) Acylation of aniline is carried out in the presence of pyridine.

(B) What is the best reagent to convert nitrile to primary amine?

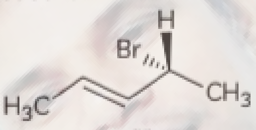
(C) Why does acetylation of -NH_2 group of aniline reduce its activating effect?

(D) Under what reaction conditions (acidic/basic) the coupling reaction of aryl diazonium chloride with aniline is carried out? 5

34. (A) Identify the compound that on hydrogenation produces an optically active compound from the following compounds, giving reason.



(I)



(II)

(B) Out of chlorobenzene and benzyl chloride, identify the compound which gets hydrolysed by aqueous NaOH and why?

(C) Give the IUPAC name of the product formed when:

(i) 1- methyl cyclohexene is treated with HI.

(ii) chloroethane is treated with silver nitrite

OR

(A) Distinguish enantiomer from racemic mixture.

(B) 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_N1 reaction.

(ii) Write the compound which is optically active

(iii) Write the compound which is most reactive towards β-elimination reaction.

(C) Arrange the following in decreasing order of reactivity:

R-Cl, R-Br, R-I 5

35. (A) The resistance of a conductivity cell containing 0.001M KCl solution at 298K is 1500 Ohm. What is the cell constant if conductivity of 0.001M KCl solution at 298K is 0.146×10^{-3} S cm^{-1}.

(B) The cell in which the following reaction occurs:

$2Fe^{3+}_{(aq)} + 2I^-_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + I_2(s)$ has $E^\circ_{cell} = 0.236$ Volt at 298 K

Calculate the standard Gibbs-energy and the equilibrium constant of the cell reaction. 5

SOLUTION

SECTION - A

1. *(b) 271.6 S cm^2 mol^{-1}*

Explanation: From Kohlrausch's Law,

$$\Lambda_{CaCl_2} = \Lambda_{Ca^{2+}} + 2\Lambda_{Cl^-}$$

$$\Rightarrow \quad \Lambda_{CaCl_2} = 119 + 2 \times 76.3$$

$$= 119 + 152.6$$

$$= 271.6 \text{ cm}^2 \text{ mol}^{-1}$$

The limiting molar conductivity of $CaCl_2$ is 271.6 cm^2 mol^{-1}.

2. *(d) denaturation of protein*

Explanation: Curdling of milk is an example of denaturation of proteins where the formation of lactic acid by microbial action results in denaturation.

3. *(a) X : Catechol , Y : Hydroquinone*

Explanation: When –OH group is attached at the oetho position of phenol, then the compound formed is called catechol when –OH group is attached at the para position, then the compound is called hydroquinone.

4. *(b) Sc^{3+}*

Explanation: Co^{2+} (Z = 27): $[Ar]_{18}3d^7$ (3 unpaired electrons)

Cu^{2+} (Z = 29) : $[Ar]_{18}3d^9$ (1 unpaired electrons)

Mn^{2+} (Z = 25): $[Ar]_{18}3d^5$ (5 unpaired electrons)

Sc^{3+} (Z = 21): $[Ar]_{18}3d^0$ (No unpaired electron)

Sc^{3+} with no unpaired electron will be diamagnetic

5. *(d) $CH_3CHO \rightarrow CH_4 + CO$*

Explanation: $CH_3CHO \rightarrow CH_4 + CO$

$$\text{Rate} = k[CH_3CHO]^{3/2}$$

6. *(a) $CH_3-CH=CH-CH_3$*

Explanation: If the dehydrohalogenation of an alkyl halide can yield more than one alkene, then according to the Saytzeff rule, the main product is the most highly substituted alkene.

7. *(c) Triamminebromidochloridonitroplatinum (IV)chloride*

8. *(b) (III) > (I) > (II)*

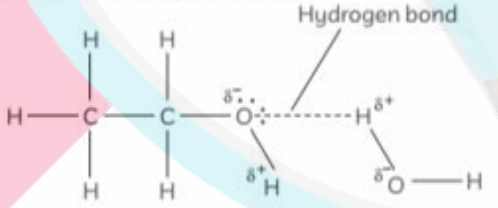
Explanation: Presence of EWG increases the acidic character.

9. *(a) conjugation of lone pair of nitrogen with the ring*

Explanation: Lone pair of electrons on the nitrogen atom of aniline is involved in resonance and is not easily available for donation to protons. So, aniline is less basic than ethylamine.

10. *(a) Propanol*

Explanation: Propanol is most soluble in water because the lower alcohols are highly soluble in water due to the presence of –OH group in the alcohols it forms H-bond with itself and molecular association takes place which causes the increase in the boiling point of the corresponding alcohols due to the increase in the number of carbon atoms and thus high temperature is required to break this association of bonds and thus the solubility in water increases. The extent of the hydrogen bonding in alcohols depends on the number of the carbon atoms attached in the chain and takes place as shown below:



11. *(a) CO*

Explanation: CO is the strongest field ligand causes the highest CFSE, Δ_o as a ligand.

12. *(a) 4*

Explanation: Let the coordination number of Pt in $[Pt(NH_3)_4Br_2]^{2+}$ be x

$$x + (0 \times 4) - 2 = 2$$
$$x - 2 = 2$$
$$x = 2 + 2$$
$$x = 4$$

13. *(a) It is a first order reaction.*

Explanation: The plot of in [R] vs time is a straight line with negative slope. It is characteristic of first order reaction.

14. *(b) sec^{-1}*

Explanation: For first order reaction, the unit of the rate constant is sec^{-1}.

15. *(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).*

Explanation: Fructose on warming with dilute alkali, gives rise to an equilibrium mixture of glucose, fructose and mannose. The ability of fructose to reduce Fehling solution and Tollen's reagent is probably due to the isomerisation of fructose to glucose and mannose (this is called Lobry de Bruyn and Elkenstein rearrangement).

16. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: It is possible to make a cell with a pair of same type of half cells as change in concentration varies the electrode potential.

17. *(d) (A) is false but (R) is true*

Explanation: Correct assertion is "only effective collision lead to formation of product." Reason defines correct meaning of effective collision, and criterion of collision theory for completion of reaction. Only those collisions in which molecules have correct orientation and sufficient energy lead to formation of product.

18. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless because $[Ti(H_2O)_6]^{3+}$ has unpaired election for d-d transition. So, it is coloured.

SECTION - B

19. (A) Coordination isomerism arises when both the cation and anion are complexes and the ligands are exchanged. For example, $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$

(B) No. of unpaired e^-,

Cr^{3+} : 3
Ti^{3+} : 1
V^{3+} : 2

Among them, Cr^{3+} is the most stable as it has stable configuration *i.e.*, t_{2g}^{3}.

20. (A) Iodoform test: Pentan–2-one contains $CH_3CO–$ group and as such it will give iodoform test with NaOI $[NaOH + I_2]$ while no such group is there in pentan -3- one and so it will not give iodoform test.

$$CH_3COCH_2CH_2CH_3 + 2NaOI \rightarrow CH_3CH_2CH_2COONa + \underset{\substack{\text{Iodoform}\\\text{(yellow ppt)}}}{CHI_3} + 2\,NaOH$$

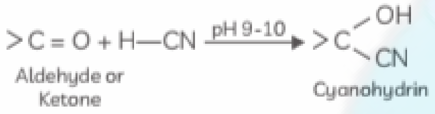
(B) Benzaldehyde is an aromatic aldehyde while acetophenone is a methyl ketone. These may be distinguished as follows.

Iodoform test: Acetophenone, due to the presence of $CH_3CO–$ group, will give iodoform test with NaOI $(NaOH + I_2)$, while benzaldehyde will not give this test.

$$\underset{\text{Acetophenone}}{CH_3COC_6H_5} + 3NaOI \rightarrow C_6H_5COONa + \underset{\substack{\text{Iodoform}\\\text{(yellow ppt.)}}}{CHI_3}$$

$$C_6H_5CHO + NaOI \rightarrow \text{No yellow ppt}$$

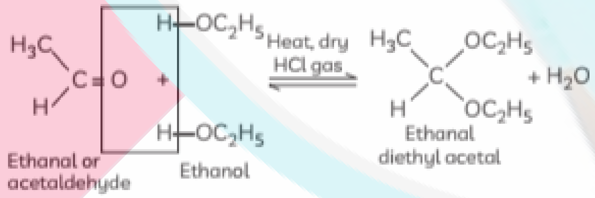
21. (A) –OH group and cyano group are present on same carbon atom. Addition of HCN to carbonyl group in weakly acidic medium forms cyanohydrin.



$$\underset{\substack{\text{Aldehyde or}\\\text{Ketone}}}{>C=O} + H—CN \xrightarrow{pH\ 9\text{-}10} \underset{\text{Cyanohydrin}}{>C\begin{matrix}OH\\CN\end{matrix}}$$

(B) Acetal:

Terminal C atom has two alkoxy groups. Two equivalents of monohydric alcohol add to 1 equivalent of aldehyde in presence of dry HCl gas.

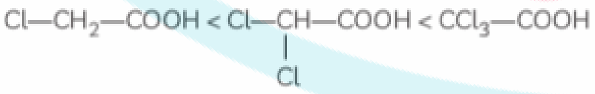


OR

(A) $C_6H_5—CO—C_6H_6 < CH_3COCH_3 < CH_3CHO$

Explanation: Ketones are less reactive towards nucleophilic addition reactions due to more steric hinderance.

(B)



$$Cl—CH_2—COOH < Cl—\underset{\substack{|\\Cl}}{CH}—COOH < CCl_3—COOH$$

Explanation: More the number of electron withdrawing groups (Cl^-), more the acidic character.

22. (A) **Hormones:**

(1) Hormones are produced in the endocrine or ductless glands.

(2) Hormones are not stored in the body. These are produced as and when required.

Example: Insulin

Vitamins:

(1) Vitamins are stored in the body upto certain extent. 3. They are needed in small quantity.

(2) Excess vitamins are excreted.

Example: Vitamin A, B, C, D, E and K

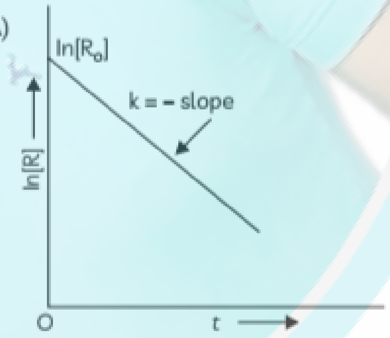
(B) (i) Tocopherol

(ii) Ascorbic acid

23. (A) Oxide gold (III) on thermal breakdown to create gold and oxygen. The temperature range for this reaction is 160 – 290°C.

(B) In electrochemical series, Zn is placed above hydrogen but Cu is placed below hydrogen. Therefore, Zn can displace hydrogen from dil. HCl but Cu cannot.

24. (A)



(B) For first order reaction,

$$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$$

Given, $t = 30$ min,

$[R_1] = 100,$

$[R] = 10$

So, $$k = \frac{2.303}{30} \log \frac{100}{10}$$

$$= 0.076 \times \log 10$$

$$= 0.076\ min^{-1}$$

25. (A) The difference between Double salt and Complex salt are:

S.No.	Double Salt	Complex Salt
(1)	These exist only in solid state and dissociate into constituent species in their solution.	They retain their identity in solid as well as in solution state.
(2)	They lose their identity in dissolved state.	They do not lose their identity in dissolved state.

(B) In $[FeF_6]^{3-}$ complex

Oxidation number of Fe = + 3

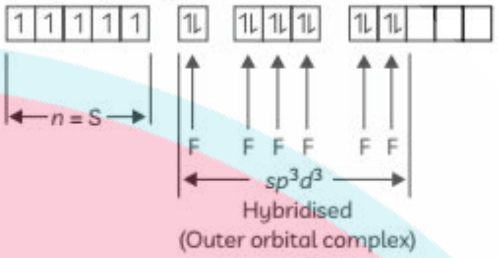
Coordination Number Fe = 6

Coordination orbitals = 6

$$Fe \rightarrow Fe^{3+} + 3e^-$$

$$Fe^{3+} \rightarrow (26 - 3) - [Ar]_{18}$$

$[FeF_6]^{3-}$ (Strongly Paramagnetic)



Here F^- is a weak field ligand and it obeys. Hund's rule of leaving maximum number of unpaired electron (n = 5) and it uses one 40, three 4p and two 4d orbitals which are sp^3d^2 hybridised. So it is an outer orbital complex.

OR

(A) $t^3_{2g}\ e_g\ \Delta_0 < P$, the configuration will be t_{2g}, e_g and it is in the case of weak field ligands and high spin complex will be formed.

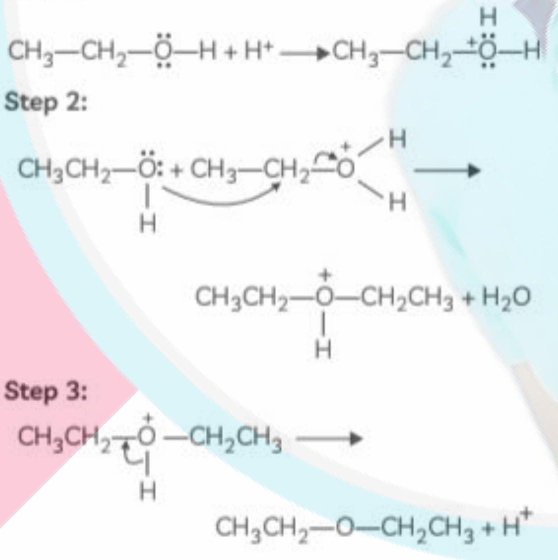
(B) dsp^2, square planar.

SECTION - C

26. $2C_2H_5OH \xrightarrow[413K]{Conc.H_2SO_4} CH_3CH_2{-}O{-}CH_2{-}CH_3$

Mechanism: Formation of ether follows S_N^2 mechanism.

Step 1:



Step 2:

Step 3:

27. (A) Many of the transition elements are known to form interstitial compounds because of unpaired electrons in the d-orbital. Transition elements have vacant interstitial sites and are able to trap small atoms like H, C or N to form such compound.

(B) As Cr^{3+} has stable t^3_{2g} configuration so Cr^{2+} has a tendency to change to Cr^{3+} hence it is a reducing agent. Mn^{3+} changes to Mn^{2+} $(3d)^5$ which is half filled state configuration. Hence, Mn^{3+} acts as oxidising agent.

(C) The enthalpies of atomization of a transition metal are high because they have a large number of unpaired electrons and hence have strong metallic bonding.

28. (A) An oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number is $Cr_2\ O_7^{2-}$. Here, oxidation number of Cr is + 6 which is equal to its group number.

(B) Similarity : Both lanthanoids and actinoids show contraction in size and irregularity in their electronic configuration.

Difference: Actinoids show wide range of oxidation states but lanthanoids do not.

(C) Mn (Z = 25) has the maximum number of unpaired electrons present in the d-subshell so it shows maximum oxidation states (+ 2 to + 7)

OR

(A) The negative values for titanium, vanadium and chromium indicate that the higher oxidation state is preferred.

(B) The high reduction potential of Mn^{3+}/Mn^{2+} indicates Mn^{2+} is more stable than Mn^{3+}. Mn^{3+} has a $3d^4$ configuration while that of Mn^{2+} is $3d^5$. The extra stability associated with a half filled *d*-sub shell makes the reduction of Mn^{3+} very feasible

$$(E^\circ = +1.51V).$$

(C) Because Mn^{3+} has the outer electronic configuration of $3d^4$ and Mn^{2+} has the outer electronic configuration of $3d^5$. Thus, the conversion of Mn^{3+} to Mn^{2+} will be a favourable reaction since $3d^5$ is a very stable configuration as it is half filled configuration. Hence, E° value for Mn^{3+}/Mn^{2+} couple is positive.

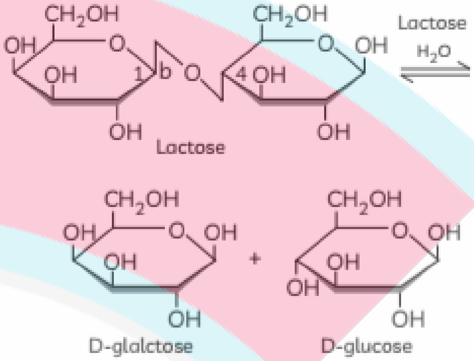
Fe^{3+} to Fe^{2+} undergoes a change in outer electronic configuration from $3d^5$ to $3d^6$. The configuration of the resultant are not stable and hence have a lower E° value.

29. (A) Glycosidic linkage, an oxide linkage, is present in disaccharides and polysaccharides to connect monosaccharides units.

(B) Vitamin B_{12} is present in animal tissues, eggs, curd and almonds.

(C) DNA contains β-D-2-deoxyribose as the pentose sugar, whereas RNA contains β-D-ribose as the pentose sugar.

(D) On hydrolysis, lactose gives D-galactose and β-D-glucose



30. For isotonic solutions,

$$\pi\ (\text{urea}) = \pi\ (\text{glucose})$$

$$\pi\ (\text{urea}) = \frac{nRT}{V} = \frac{15}{60} \times \frac{RT}{1}$$

$$\pi\ (\text{glucose}) = \frac{nRT}{V} = \frac{w}{180} \times \frac{RT}{1}$$

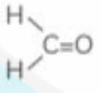
Now, $$\frac{15}{60}RT = \frac{w}{180}RT$$

$$\therefore \quad w = \frac{15 \times 180}{60} = 45g$$

SECTION - D

31. (A) Carboxylic acids contain a carbonyl group but do not give characteristic reaction of the carbonyl group because of resonance, the electrophilic nature of the carboxyl carbon is greatly reduced as compared to the carbonyl carbon is aldehyde and ketones.

(B) Formaldehyde is planar molecule due to sp^2 hybridized carbon atom.



Formaldehyde

(C) (i) Fehling's solution can be used to distinguish benzaldehyde from acetaldehyde as benzaldehyde (aromatic aldehyde) does not reduce Fehling's solution, but acetldehyde (aliphatic aldehyde) reduces Fehling's solution.

(ii) Formic acid gives silver mirror with Tollen's reagent wile acetic acid does not.

OR

(i) Iodoform test is used to check the presence of carbonyl compounds with the structure $R{-}CO{-}CH_3$ or alcohols with the structure $R{-}CH(OH){-}CH_3$ in a given unknown substance.

(ii) Schiff's reagent is the aqueous solution of Rosaniline hydrochloride decolorised by SO_2.

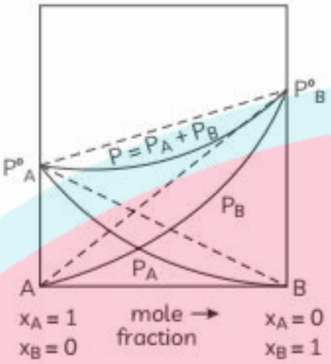
32. (A) (1) Bromoethane and iodoethane

(2) *n*-Heptane and *n*-hexane

Explanation: A solution where the interaction of component molecules does not vary from the interactions of each component's molecules. The ideal solutions are those at all concentrations and temperatures that obey Raoult's law.

(B) For ideal solutions, the value of the Gibbs free energy is always negative as mixing of ideal solutions is a spontaneous process.

(C) (i)



Explanation: Two liquids HNO_3 (A) and water (B) form a maximum boiling azeotrope when mixed in the ratio of 68% and 32% respectively because the forces between the particles in the mixture are stronger than the mean of the forces between the particles in the pure liquids.

(ii) This mixture shows maximum boiling azeoteopes.

Explanation: Negative deviations from Raoult's Law: New stronger forces must exist in the mixture than in the original liquids. These are cases where the molecules break away from the mixture less easily than they do from the pure liquids.

OR

Mass of hydrogen = 4 g

Mol. mass of hydrogen = 2

Volume of the flask = 2 litre

Active mass of hydrogen = 422× = 1 mol L^{-1}

Mass of HI = 128 g

Mol. mass of HI = 128

Volume of the flask = 2 litre

Active mass of hydrogen iodide

$$= \frac{128}{128 \times 2} = 0.5 \text{ mol } L^{-1}.$$

SECTION - E

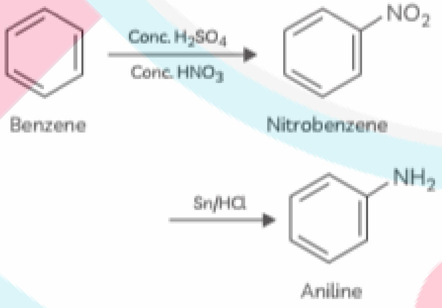
33. (A) Correct order is $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

Explanation: +I group, like R—groups, increases the electron density on nitrogen which increases the basicity (electron rich is basic) of amine. Of the given amines, more the number of R—groups on nitrogen more is the basic nature of amine. Basicity also depends on the steric hindrance. More is the steric hindrance less is the basicity.

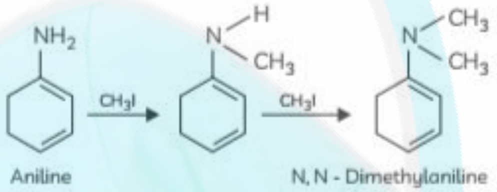
(B) Methylamine and dimethylamine can be distinguished by the **carbylamine test.**

Carbylamine test: Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form foul-smelling isocyanides or carbylamines.

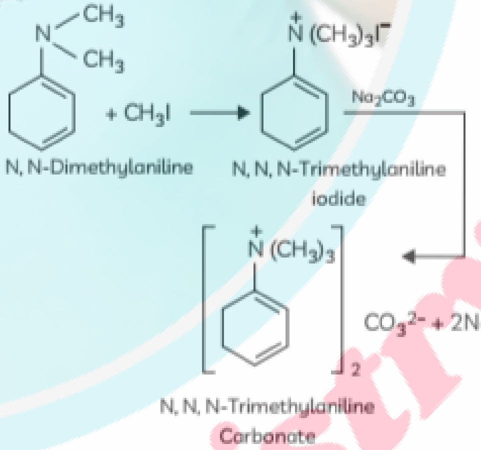
(C) Benzene to Aniline



(D) Aniline reacts with methyl iodide to produce N, N-dimethylaniline.



With excess methyl iodide, in the presence of Na_2CO_3 solution, N, N-dimethylaniline produces N, N, N-trimethylanilinium carbonate.



OR

(A) (i) 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. Thus, butanamine boils at 350.8K while N-ethylethanamine boils at 329.3K.

(ii) During the acylation of aniline, stronger base pyridine is added. This done in order to remove the HCl so formed during the reaction and to shift the equilibrium to the right hand side.

(B) $LiAlH_4$ and sodium/alcohol are the best reagents for converting nitrile to a primary amine. The nitriles are transformed into a corresponding primary amine through reduction.

(C) The acetylation of $—NH_2$ group of aniline reduces its activating effect because the lone pair of electrons on the nitrogen of acetanilide interacts with oxygen atom due to resonance.

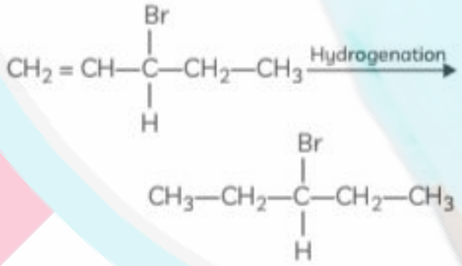
(D) Coupling reaction of aryl diazonium chloride with aniline is carried out in mildly acidic conditions, *i.e.* pH = 4–5.

34. (A) Any compound is said to be optically inactive when:

(1) It can show enantiomerism-It forms non-super imposable mirror images of each other.

(2) It has a chiral carbon-A chiral carbon is one which is bonded to four different molecules.

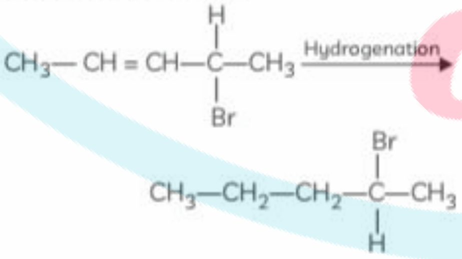
Hydrogenation of (I):



$$CH_2=CH-\underset{H}{\overset{Br}{C}}-CH_2-CH_3 \xrightarrow{\text{Hydrogenation}} CH_3-CH_2-\underset{H}{\overset{Br}{C}}-CH_2-CH_3$$

The product formed by the hydrogenation of compound (I) does not have a chiral carbon. Therefore, it is not optically active.

Hydrogenation of (II):



$$CH_3-CH=CH-\underset{Br}{\overset{H}{C}}-CH_3 \xrightarrow{\text{Hydrogenation}} CH_3-CH_2-CH_2-\underset{H}{\overset{Br}{C}}-CH_3$$

The product formed by the hydrogenation of compound (II) has a chiral carbon. Therefore, it is optically active.

(B) Benzyl chloride gets easily hydrolysed by aqueous NaOH as chlorobenzene has partial double bond character in the Cl-C bond. The lone pairs delocalised in the ring strengthens Cl-C bond reducing its reactivity. Whereas benzyl chloride undergoes S_N^1 reaction to form stable benzyl carbocation.

(C) (i) 1-Methyl-1-iodocyclohexane.

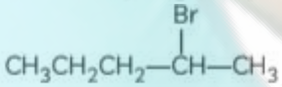
(ii) Nitroethane ($CH_3CH_2NO_2$)

OR

(A) A racemic mixture is a 50:50 mixture of two enantiomers. Because they are mirror images, each enantiomer rotates plane-polarized light in an equal but opposite direction and is optically inactive. If the enantiomers are separated, the mixture is said to have been resolved.

(B) (i) 2-Bromo-2-methylbutane will be most reactive towards S_N^1 due to maximumhindrance and formation of stable carbocation. Tertiary alkyl halides are most reactive for S_N^1 reaction.

(ii) 2-Bromopentane has a chiral carbon in it. So, this compound is optically active.



$$CH_3CH_2CH_2-\overset{Br}{CH}-CH_3$$

(iii) 2-Bromo-2-methyl pentane will give a stable elimination product. (Most stable alkene *i.e.*, more substituted)

(C) R–I > R–Br > R–Cl

Explanation: The reactivity of alkyl halides mostly corresponds to bond energy and electronegativity of the halide, if we consider R-F here the bond energy is very high and the F atom is highly electronegative thus proving to be a weak leaving group, on the other hand R-I has a relatively less bond energy thus proving to be a good leaving group, that's why it is highly reactive.

35. (A) $K = \frac{1}{R} \times \text{cell constant}$

$K = 0.146 \times 10^{-3}\ S\ cm^{-1}$,

$$R = 1500 \text{ Ohm}$$

$$0.146 \times 10^{-3} = \frac{1}{1500} \times \text{cell constant}$$

$$\text{cell constant} = 0.146 \times 10^{-3} \times 1500$$

$$= 219 \times 10^{-3} = 0.219 \text{ cm}^{-1}$$

(B) $$\Delta_r G^\circ = -nFE^\circ_{cell}$$

$$= -2 \times 96500 \times 0.236$$

$$= -45.548 \text{ kJ/mol}$$

As $$E^0_{cell} = +\frac{0.0591}{2}\log K_c$$

$$\frac{0.236 \times 2}{0.0591} = \log K_c$$

or $$K_c = + \text{antilog } 8.0$$

$$K_c = 10^8$$