CBSE Sample Paper 6

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. The CFSE for octahedral $[CoCl_6]^{4-}$ is x cm^{-1}. The CFSE for tetrahedral $[CoCl_4]^{2-}$ will be:

(a) x cm^{-1}

(b) less than x cm^{-1}

(c) greater than x cm^{-1}

(d) none of the above 1

2. Fe^{3+} ion is more stable than Fe^{2+} because:

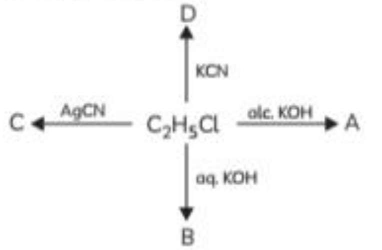
(a) more the charge on the atom, more the stability.

(b) configuration of Fe^{2+} is $3d^6$ while Fe^{3+} is $3d^5$

(c) Fe^{2+} has a larger size than Fe^{3+}.

(d) Fe^{3+} ions are colored hence more stable. 1

3. Identify A, B, C and D:



(a) A = C_2H_4, B = C_2H_5OH, C = C_2H_5NC, D = C_2H_5CN

(b) A = C_2H_5OH, B = C_2H_4, C = C_2H_5CN, D = C_2H_5NC

(c) A = C_2H_4, B = C_2H_5OH, C = C_2H_5CN, D = C_2H_5NC

(d) A = C_2H_5OH, B = C_2H_4, C = C_2H_5NC, D = C_2H_5CN 1

4. Schiff's base is:

(a) a substituted imine

(b) a substituted amine

(c) a substituted nitrile

(d) none of the above 1

5. Complete the given analogy:

Methanoic acid: Rubber industry:: Sodium benzoate: ....

(a) Food preservative industry

(b) Perfume industry

(c) Soap industry

(d) Leather industry 1

6. Identify the final product of the reaction sequence.

$$\text{Phenol} \xrightarrow[\text{distillation}]{Zn} X \xrightarrow[AlCl_3]{CH_3COCl} Y$$

(a) Benzophenone

(b) Acetophenone

(c) Diphenyl

(d) Methyl salicylate 1

7. Match the items of Column I with items of Column II:

	Column-I (Distinguish)		Column- II (Test)
(A)	Methanol and Ethanol	(i)	Lucas reagent
(B)	Phenol and Cyclohexanol	(ii)	Sodium metal
(C)	Methanol and Diethyl ether	(iii)	Iodoform Test
(D)	*n*-Butyl alcohol and tert-Butyl alcohol	(iv)	Ferric chloride

(a) (A) – (iv), (B) – (i), (C) – (iii), (D) – (ii)
(b) (A) – (ii), (B) – (iii), (C) – (i), (D) – (iv)
(c) (A) – (iii), (B) – (iv), (C) – (ii), (D) – (i)
(d) (A) – (ii), (B) – (iii), (C) – (iv), (D) – (i) 1

8. Reaction of toluene with a halogen in presence of lewis acid is an example of:
(a) Electrophilic elimination
(b) Nucleophilic substitution
(c) Electrophilic substitution
(d) Free radical addition 1

9. Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1}. What is its molar conductivity?
(a) 18.5 S cm^2 mol^{-1}
(b) 28.6 S cm^2 mol^{-1}
(c) 19.2 S cm^2 mol^{-1}
(d) 32.76 S cm^2 mol^{-1} 1

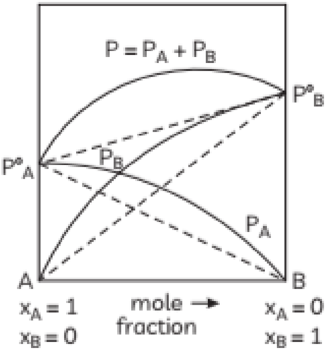
10. Which of the following is a secondary allylic alcohol?
(a) But-3-en-2-ol (b) But-2-en-2-ol
(c) Prop-2-enol (d) Butan-2-ol 1

11. Distinguish between phenol and benzyl alcohol?
(a) Add neutral $FeCl_3$. Phenol gives violet colour whereas benzyl alcohol does not.
(b) Fehling's test
(c) Tollen's test
(d) Iodoform test 1

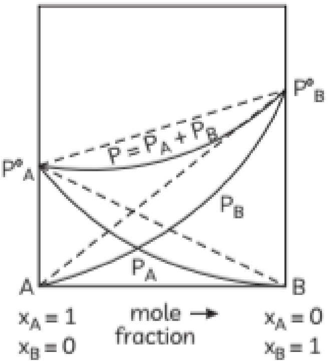
12. Which of the following cannot be made by using Williamson Synthesis?
(a) Methoxybenzene
(b) Benzyl p-nitrophenyl ether
(c) tert-Butyl methyl ether
(d) Di tert-butyl ether 1

13. For water and nitric acid mixture which of the given graph is correct?

(a)



(b)



(c) Both of these
(d) None of these 1

14. Water- HCl mixture:
(I) shows positive deviations
(II) forms minimum boiling azeotrope
(III) shows negative deviations
(IV) forms maximum boiling azeotrope
(a) (I) and (II) (b) (II) and (III)
(c) (III) and (IV) (d) (II) and (III) 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: One molar aqueous solution has always higher concentration than one molal solution.
Reason: One molar solution contains less solvent than one molal solution. 1

16. Assertion: Fehling solution oxidises acetaldehyde to acetic acid but not benzaldehyde to benzoic acid.
Reason: The C–H bond of CHO group in benzaldehyde is stronger than in acetaldehyde. 1

17. Assertion: The primary valency is ionizable and are satisfied by positive ions.

Reason: Central atom/ions in coordination compounds also acts as Lewis acid. 1

18. Assertion: Electrolysis of NaCl solution gives chlorine at anode instead of O_2.

Reason: Formation of oxygen at anode requires overvoltage. 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. Give the structures of (i) and (ii) in the following reactions:

(A) $CH_3CONH_2 \xrightarrow{Br_2/KOH} (i) \xrightarrow{CHCl_3/alc.KOH} (ii)$

(B) $C_6H_5NO_2 \xrightarrow{Fe/HCl} (i) \xrightarrow{CH_3COCl/Pyridine} (ii)$

OR

Give reasons for the following:

(A) Aniline does not undergo Fridel-Crafts reaction.

(B) Although $-NH_2$ is o- and p- directing group yet aniline on nitration gives a significant amount of m-nitroaniline. 2

20. Write the major product in the following reactions:

(A) 

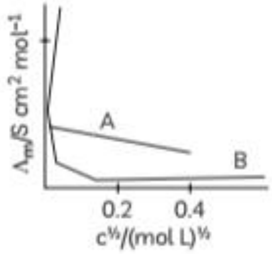
(B) $CH_3CH_2Br \xrightarrow{AgCN}$ 2

21. Give reason for the following:

(A) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic? (atomic number of Ni = 28)

(B) Chelating complexes are more stable than unchelated complexes. 2

22. The given curve is obtained when molar conductivity ($\wedge_m$) is plotted against the square root of concentration, $c^{1/2}$ for two electrolytes A and B.



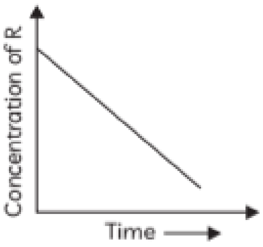
(A) How do you account for the increase in the molar conductivity of the electrolyte A on dilution?

(B) As seen from the graph, the value of limiting molar conductivity ($\wedge^\circ_m$) for electrolyte B cannot be obtained graphically. How can this value be obtained? 2

23. In the following reaction:

$$Q + R \rightarrow \text{Products}$$

The time taken for 99% reaction of Q is twice the time taken for 90% reaction of Q. The concentration of R varies with time as shown in the figure.

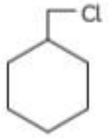


What is the overall order of the reaction? Give the units of the rate constant for the same. Write the rate expression for the above reaction.

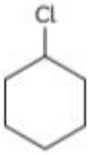
OR

Rate constant for a first order reaction has been found to be $2.54 \times 10^{-3}\ s^{-1}$. Calculate its three fourth life. 2

24. (A) In the following pairs of halogen compounds, which would undergo S_N1 reaction faster? Explain.



and



(I) (II)

(B) Amongst the isomeric dihalobenzenes which isomer has the highest melting point and why? 2

25. Deduce the acidic strength of following in decreasing order.

(A) Acetic acid, monochloroacetic acid, trichloroacetic acid

(B) p-Hydroxybenzoic acid, benzoic acid and p-toluic acid. 2

SECTION - C

15 Marks

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

26. **Answer the following questions:**

(A) **Propanamine and N, N-dimethylmethanamine contains the same number of carbon atoms, even though propanamine has higher boiling point than N,N- dimethylmethanamine. Why?**

(B) **Write the reaction involved in Hoffmann bromamide degradation reaction.**

(C) **Give one chemical test to distinguish between aniline and ethanamine.** 3

27. **A non reducing disaccharide 'A' on hydrolysis with dilute acid gives an equimolar mixture of D–(+)–glucose and D– (–) –fructose.**

$$\text{(i)} + H_2O \xrightarrow{HCl} C_6H_{12}O_6 + C_6H_{12}O_6$$

$$[\alpha]D = +66.5° \quad +52.5° \quad -92.4°$$

(A) **Identify (i). What is the mixture of D–(+)–glucose and D–(–)–fructose known as? Name the linkage that holds the two units in the disaccharide.**

(B) **α-Amino acids have relatively higher melting points than the corresponding halo acids. Explain.** 3

28. **Answer any three questions:**

(A) **Give an example of application of coordination compounds in medicinal chemistry.**

(B) **Give IUPAC name of $[Co(en)_3]^{3+}$**

(C) **Draw structure of $[Mn_2(CO)_{10}]$.**

(D) **Write the hybridization and shape of $[Fe(CN)_6]^{3-}$.**

(Atomic number of Fe = 26) 3

29. **(A) Give reason :**

(i) **Highest oxidation state of a metal exhibited in its oxide or fluoride only.**

(ii) **In volumetric analysis of $KMnO_4$ vs Mohr's salt, H_2SO_4 and not HCl is added to Mohr's salt solution to provide acidic medium.**

(B) **Give the structure of $Cr_2O_7^{2-}$.** 3

30. **Account for the following:**

(A) **Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing.**

(B) **Cu^{2+} is more stable in aqueous solution though Cu^+ has d^{10} configuration.**

(C) **The d^1 configuration is highly unstable in ions.**

OR

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 giving reason for your choice of answer:

(A) **Which ion is most stable in an aqueous solution?**

(B) **Which ion is a strong oxidizing agent?**

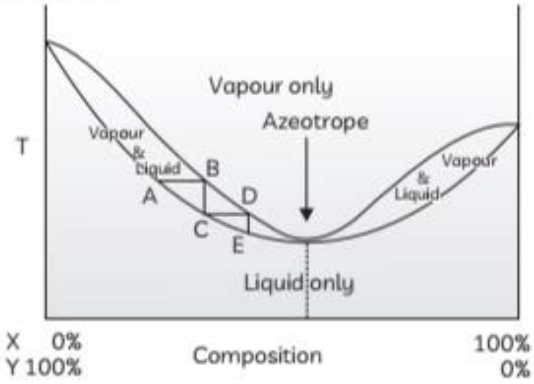
(C) **Which ion is colourless?** 3

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. *Solutions are homogeneous mixtures of two or more than two components. The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions. If the vapour pressure of such a solution is either higher or lower than that predicted by Raoult's law, then the solution exhibits positive deviation or negative deviation from Raoult's law. Respectively some liquids on mixing, form azeotropes which are binary mixtures having the same composition in liquid and vapour phase. There are two types of azeotropes called minimum boiling azeotrope and maximum boiling azeotrope shown in the following graph. Some properties of the solution depend on the number of solute particles irrespective of their nature relative to the total number of particles present in the solution. Such properties are called colligative properties.*



(A) Name the example of the solution which will show positive deviation from Raoult's law. 1

(B) What is azeotrope mixture? 1

(C) (i) If k_f value of H_2O is 1.86 K/kg/mol. What is the value of ΔT_f for 0.1 m solution of non-volatile solute is?

(ii) What is the reason behind low concentration of oxygen in blood and tissues of people living at high altitudes?

OR

The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5 g when added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then, is 0.845 bar. What is the molar mass of the solid substance? 2

32. *Biomolecules, also called biological molecules, are one of numerous substances that are produced by cells and living organisms. Biomolecules have a wide range of sizes and structures and perform a vast array of functions. The four major types of biomolecules are carbohydrates, lipids, nucleic acids and proteins.*

Carbohydrates, which are made up primarily of molecules containing atoms of carbon, hydrogen, and oxygen, are essential energy sources and structural components of all life. They are among the most abundant biomolecules on Earth. Proteins are major structural elements of cells. They also serve as transporters, moving nutrients and other molecules in and out of cells and as enzymes and catalysts for the vast majority of chemical reactions that take place in living organisms. Nucleic acids, namely DNA and RNA, have the unique function of storing an organism's genetic code.

(A) Why the concentration of zwitter ion is maximum for neutral amino acid at its isoelectric point? 1

(B) Which compound is formed when glucose is reacted with NH_2OH? 1

(C) Classify carbohydrates on the basis of taste.

OR

Describe the following nature of glucose with the help of reaction.

(i) Reducing agent

(ii) Oxidation 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) Write Etard reaction.

(B) Arrange the following in increasing order of their reactivity towards nucleophilic addition reaction:

$C_6H_5\text{-}CO\text{-}CH_3$, CH_3CHO, CH_3COCH_3

(I) (II) (III)

(C) (A) and (B) are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer (B) forms yellow precipitate of iodoform whereas isomer (A) does not form any precipitate. Write the formula of (A) and (B).

(D) Predict the products of following reactions:

(i) $CH_3COCH_3 \xrightarrow{NH_2NH_2}$

(ii) $CH_3CH_2CH{=}CHCN \xrightarrow{(i\text{-}Bu)_2AlH,\,H_2O}$

5

34. (A) State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decreases with dilution?

(B) Calculate the E°_{cell} of the following cell at 298K:

$$2Al_{(s)} + 3Cu^{2+}_{(aq)}\ (0.01M) \rightarrow 2Al^{3+}_{(aq)}\ (0.01M) + 3Cu_{(s)}$$

Given that $E_{cell} = 1.98V$

OR

(A) Define electrochemical cell. What happens if external potential applied becomes greater than E°_{cell} of electrochemical cell?

(B) Conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S/cm. Calculate its molar conductivity and degree of dissociation.

(Given: $\lambda^\circ_{(H^+)} = 349.5\ Scm^2/mol$ and $\lambda^\circ_{(HCOO^-)} = 50.5\ Scm^2/mol$) 5

35. (A) Consider the following data for reaction between A and B to give C:

Exp. No.	Initial conc. of A (mol L^{-1})	Initial conc. of B (molL^{-1})	Initial rate (mol $L^{-1}s^{-1}$)
1.	0.10	1.00	2.1×10^{-3}
2.	0.20	1.00	8.4×10^{-3}
3.	0.20	2.00	8.4×10^{-3}

Determine the order of reaction with respect to A and with respect to B and the overall order of reaction.

(B) If half life for a zero order reaction is 2 years with initial concentration of reactant being 0.004M, what will be its rate constant?

OR

(A) Write integrated rate equation for first order reaction and also identify the units of rate constant.

(B) Draw a graph between time and concentration of reactant for zero order reaction. What does the slope of graph signify?

(C) Give an example of pseudo first order reaction. 5

SOLUTION

SECTION - A

1. *(b) less than x cm^{-1}*

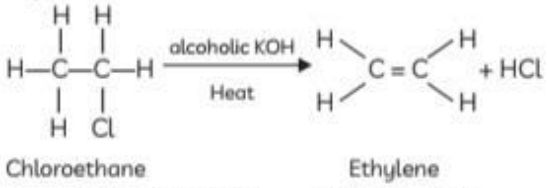
Explanation: The crystal field splitting in the tetrahedral field is intrinsically smaller than in the octahedral field. For most purposes the relationship may be represented as $\Delta_t = \frac{4}{9}\Delta_0$

2. *(b) configuration of Fe^{2+} is $3d^6$ while Fe^{3+} is $3d^5$*

Explanation: $3d^5$ configuration is more stable due to singly occupied half-filled orbitals.

3. *(a) $A = C_2H_4$, $B = C_2H_5OH$, $C = C_2H_5NC$, $D = C_2H_5CN$*

Explanation:



$$CH_3{-}Cl + \underset{(aq)}{KOH} \longrightarrow \underset{\text{Methanol}}{CH_3OH} + KCl$$

$$\underset{\text{Ethyl bromide}}{CH_3{-}CH_2{-}Br} + AgCN \longrightarrow$$

$$\underset{\text{Ethyl isocyanide}}{CH_3{-}CH_2{-}N \equiv C} + AgBr$$

$$CH_3CH_2Cl + KCN \xrightarrow{S_N2} CH_3CH_2CN + KOH$$

4. *(a) a substituted imine*

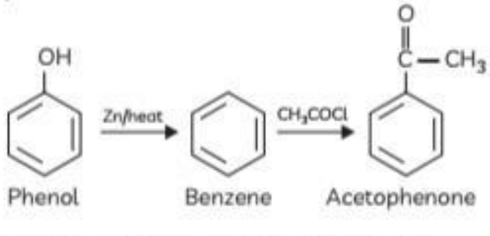
Explanation: Schiff's bases are aldehyde or ketone-like compounds in which the carbonyl group is replaced by an imine or azomethine group.

5. *(a) Food preservative industry*

Explanation: Sodium benzoate is best known as a preservative used in processed foods and beverages to extend shelf life.

6. *(b) Acetophenone*

Explanation:



7. (A) *(c) (A) – (iii), (B) – (iv), (C) – (ii), (D) – (i)*

Explanation: (A) Methanol and Ethanol by Iodoform test,

(B) Phenol and Cyclohexanol by Ferric chloride,

(C) Methanol and Diethyl ether by Sodium metal,

(D) n-Butyl alcohol and tert-Butyl alcohol by Lucas Reagent

8. *(c) Electrophilic substitution*

Explanation: Toluene reacts with a halogen in the presence of iron (III) chloride giving ortho and para halo compounds. Electrophile Cl^+ attacks to electron rich benzene ring and replaces hydrogen. So, the reaction is the electrophilic substitution reaction.

9. *(d) 32.76 S cm^2 mol^{-1}*

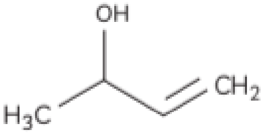
Explanation: $\wedge^\circ_m = \frac{k \times 1000}{M}$

$$= \frac{7.896 \times 10^{-5} S\,cm^{-1} \times 1000\,cm^3 L^{-1}}{0.00241\,mol\,L^{-1}}$$

$= 32.76\ S\ cm^2\ mol^{-1}$.

10. *(a) But-3-en-2-ol*

Explanation:



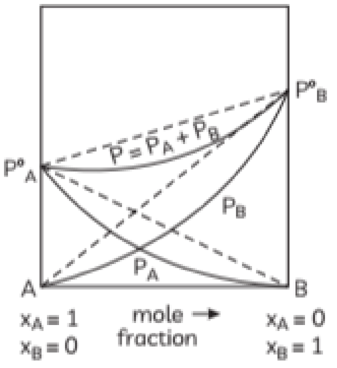
11. *(a) Add neutral $FeCl_3$. Phenol gives violet colour whereas benzyl alcohol does not.*

Explanation: Ferric chloride can be used to distinguish between phenol and benzyl alcohol because, phenols react with neutral ferric chloride solution to give blue, violet or green colouration whereas alcohols do not react.

12. *(d) Di tert – butyl ether*

Explanation: In Williamson's synthesis, primary alkyl halide is always taken otherwise alkene is the major product. Hence, di-tert-butyl ether cannot be made.

13. *(b)*



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.

14. *(c) III and IV*

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.

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

Explanation: for aqueous solution,

$$\text{density} = \frac{\text{mass of solution}}{\text{Volume of solution}} = 1$$

$$\therefore \quad \frac{\text{mass of solvent}}{\text{Volume of solution}} < 1$$

$$\therefore \quad \text{Molarity} < \text{Molality}$$

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

Explanation: Fehling solution is weak oxidising agent and benzaldehyde is weak reducing agnet. Hence, it does not react with Fehling solution. Due to +R effect of benzene ring, the electron density in the carbonyl group of benzaldehyde increases. This in turn, increase the electron density in the C–H bond of aldehyde group. As a result, the C–H bond becomes stronger.

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

Explanation: The primary valency in a coordination compound is the number of negative ions which are equivalent to the charge on the metal ion.

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

Explanation: Generally, the one with the lower value is preferred but in this case chlorine is produced at anode. This is because formation of oxygen at anode requires overvoltage.

SECTION - B

19. (A)

$$\begin{tikzcd} CH_3CONH_2 \arrow[r, "Br_2 + KOH"] & \underset{(i)}{CH_3NH_2} \arrow[d, "CHCl_3 + KOH(alc)"'] \\ & \underset{(ii)}{CH_3NC} \end{tikzcd}$$

(B)

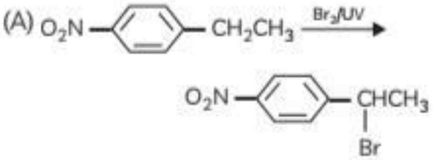
$$\begin{tikzcd} C_6H_5NO_2 \arrow[r, "Br_2 + KOH"] & \underset{(i)}{C_6H_5NH_2} \arrow[d, "CH_3\,COCl/Pyridine"'] \\ & \underset{(ii)}{C_6H_5NHCl} \end{tikzcd}$$

OR

(A) Aniline does not undergo Friedel craft's reactions because the reagent $AlCl_3$ (the Lewis acid which is used as a catalyst in Friedel crafts reaction), being electron deficient acts as a Lewis base. and attacks on the lone pair of nitrogen present in aniline to form an insoluble complex which precipitates out and the reaction does not proceed.

(B) Although $-NH_2$ is o/p directing group, yet aniline on nitration gives a significant amount of m-nitroaniline because nitration is carried out in an acidic medium (a mixture of concentrated HNO_3 and concentrated H_2SO_4). In an acidic medium, aniline is protonated to give anilinium ion (which is meta-directing).

20. (A)



(B) $CH_3CH_2Br \xrightarrow{AgCN} CH_3CH_2NC$

21. (A) Though both $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ are tetrahedral, their magnetic characters are different. This is due to a difference in the nature of ligands. Cl^- is a weak field ligand and it does not cause the pairing of unpaired 3d electrons. Hence, $[NiCl_4]^{2-}$ is paramagnetic.

(B) Chelating complex is more stable than unchelated complex because the ligand is attached to the metal ion from many points and form ring like structures. Thus, there is a strong force of attraction between the metal and the ligand.

22. (A) From the graph, electrolyte A is a strong electrolyte which is completely ionised in solution. With dilution, the ions are far apart from each other and hence the molar conductivity increases.

(B) Electrolyte B is weak electrolyte and to determine the value of limiting molar conductivity for electrolyte B, indirect method based upon Kohlrausch law of independent migration of ions is used.

23. For reactant Q, $t_{99\%} = 2 \times t_{90\%}$

Therefore, order of reaction w.r.t reactant Q = 1

From the graph, order of reaction w.r.t reactant, R = 0

So, overall order of reaction = 1 + 0 = 1

Unit of rate constant, $k = \text{time}^{-1}$

Rate expression: Rate = $k[Q][R]^0$

or $\boxed{\text{Rate} = k[Q]}$

OR

$k = 2.54 \times 10^{-3}\ \text{sec}^{-1}$

For a first reaction:

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

For 3/4th life $a - x = a - \frac{3}{4}a$

$$t_{3/4} = \frac{2.303}{2.54\times10^{-3}}\log\frac{a}{a-\frac{3}{4}a}$$

$$= \frac{2.303}{2.54\times10^{-3}}\log\frac{a}{\frac{1}{4}a}$$

$$= \frac{2.303}{2.54\times10^{-3}}\log 4$$

$$= \frac{2.303}{2.54\times10^{-3}}\times 0.6020$$

$$= 545.82\ \text{sec.}$$

24. (A) In the given compounds, (I) is a primary halide while (II) is secondary halide.

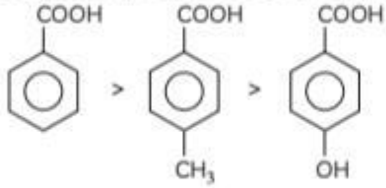
We know that due to steric hindrance, secondary halide is more reactive compared to primary halide towards $S_N{}^1$ reaction.

Hence, (II) is secondary halide therefore undergoes $S_N{}^1$ reaction faster.

(B) Amongst the isomeric dihalobenzenes para-isomer has the highest melting point. This is due to greater symmetry of para-isomer that first in crystal lattice better as compared to ortho and meta isomers.

25. (A) $CCl_3COOH > CH_2ClCOOH > CH_3COOH$

(B)



SECTION - C

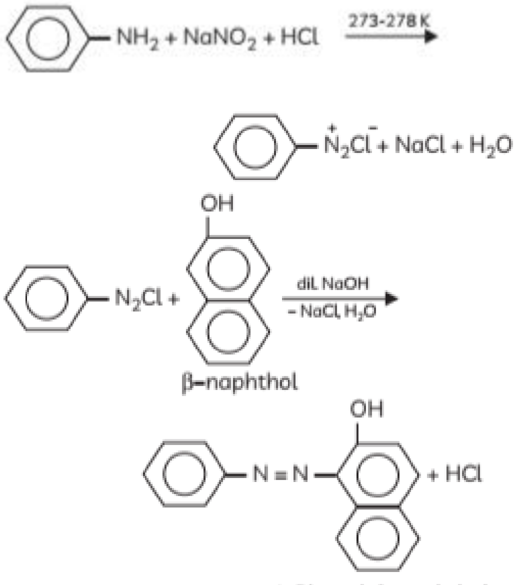
26. (A) Due to presence of two H-atoms on N-atoms of 1^0 amines, they undergo extensive intermolecualar H-bonding while 3^0 amines due to absence of hydrogen atoms on the N-atom, do not undergo hydrogen bonding, propanamine has higer boiling point than N, N-dimethylmethanamine.

(B) When an amide is treated with Br_2 in aqueous or ethanolic solution of NaOH, degradation of amide results in formation of primary amine.

Primary amine formed contains one carbon less than the number of carbon atoms in amide.

$$R-CO-NH_2 + Br_2 + 4NaOH \rightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

(C) Aniline forms diazonium salt with $NaNO_2$/HCl which gives orange-red dye with β-naphthol. Ethylamine does not give this test.



1-Phenyl-2-naphthol
(Orange-Red-dye)

27. (A) (i) is sucrose ($C_{12}H_{22}O_{11}$).

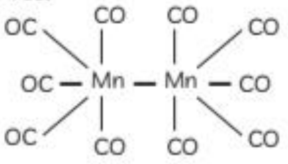
The mixture of D-(+)- glucose and D-(-) -fructose is known as invert sugar. The linkage which holds the two monosaccharide units through oxygen atom is called glycosidic linkage.

(B) α-amino acids act as zwitter ions , ($H_3N^+-CHR-COO^-$) or dipolar ions. Due to this dipolar salt-like structure, they have string dipole-dipole interactions. Therefore, their melting points are higher than the corresponding halo acids which do not exist as zwitter ions.

28. (A) Cisplatin: $[PtCl_2(NH_3)_2]$ is used in cancer chemotherapy.

(B) Tris (ethylenediamine)cobalt (III)

(C) $[Mn_2(CO)_{10}]$

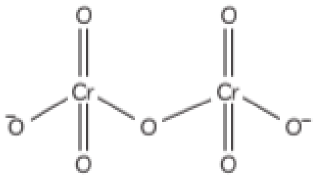


(D) d^2sp^3, octahedral shape

29. (A) (i) The highest oxidation state of a metal exhibited in its oxide or fluoride only since fluorine and oxygen are the most electronegative elements. The highest oxidation state shown by any transition element is + 8.

(ii) $KMnO_4$ which is the indicator, oxidises HCl to Cl_2 as HCl is a mild reducing agent. Due to which, the purpose of the experiment is not served. So, dilute sulphuric acid is used.

(B) The structure of $Cr_2O_7^{2-}$ is:



30. (A) Cr^{2+} is strongly reducing in nature. It has a d^4 configuration. While acting as a reducing agent, it gets oxidized to Cr^{3+} (electronic configuration, d^3). This d^3 configuration can be written as t_{2g}^3 configuration, which is a more stable configuration. In the case of Mn^{3+} (d^4), it acts as an oxidizing agent and gets reduced to Mn^{2+} (d^5). This has an exactly half-filled d-orbital and is highly stable.

(B) Cu^{2+} has a smaller size than Cu^+ as it contains 2 electrons less than Cu^+.

So, due to its small size the charge of the ion remains concentrated and is not spread widely. Due to this accumulation of charge, the polar water molecules can easily make bonds with the Cu^{2+} ions and release a higher amount of energy, thus making the hydration enthalpy very high.

(C) The ions in d^1 configuration tend to lose one more electrons to get into stable d^0 configuration. Also, the hydration or lattice energy is more than sufficient to remove the only electron present in the d-orbital of these ions. Therefore, they act as reducing agents.

OR

(A) Cr^{3+}, half filled t_{2g}^{3}

(B) Mn^{3+}, due to stable d^5 configuration in Mn^{2+}.

(C) Ti^{4+}, No unpaired electrons so no d-d transition.

SECTION - D

31. (A) Methanol and acetone

Explanation: Acetone + Methanol is an example of solution showing positive deviation from Raoult's law as acetone-methanol attractions are weaker that acetone- acetone and methanol-methanol attractions.

(B) Azeotrope, a mixture of liquids that has a constant boiling point because the vapour has the same composition as the liquid mixture. The boiling point of an azeotropic mixture may be higher or lower than that of any of its components.

(C) (i) $\Delta T_f = K_f \times \text{molality} = 1.86 \times 0.1$

$= 0.186$ K

(ii) low atmospheric pressure

Explanation: Because at high altitude, the partial pressure of oxygen is less than partial pressure of xoygen at the ground level.

OR

$P^\circ = 0.850$ bar, $P_s = 0.845$ bar

$W_B = 0.5$ g, $M_B = ?$

weight of solvent (benzene), $W_A = 39.0$ g

and molecular weight of benzene, $M_A = 78$ g

As we know, $\frac{P^\circ - P_s}{P^\circ} = X_B = \frac{n_B}{n_A}$

$$\frac{0.850-0.845}{0.850} = \frac{\frac{W_B}{M_B}}{\frac{W_A}{M_A}} = \frac{\frac{0.5}{M_B}}{\frac{39}{78}}$$

$$\Rightarrow \quad \frac{0.005}{0.850} = \frac{0.5\times 2}{M_B}$$

$$\Rightarrow \quad M_B = \frac{0.850\times 1}{0.005} = 170g$$

So, molcular mass of solid = 170 g.

32. (A) The concentration of zwitter ion is maximum for neutral amino acid at its isoelectric point as the net charge is zero at this point.

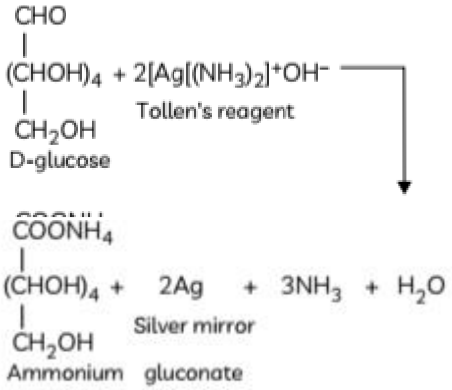
(B) Oxime is formed.

(C) **Sugars:** Carbohydrates which are sweet in taste are called carbohydrates. They are soluble in water and are crystalline in nature. Some of the examples are glucose, sucrose and lactose etc.

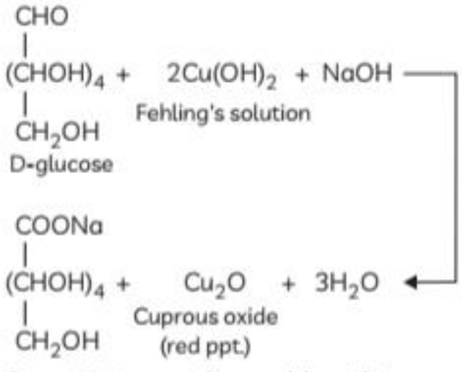
Non-sugars: Carbohydrates which are sweet in taste are called non-sugar carbohydrates. They are insoluble in water and are amorphous in nature. Examples of non-sugars are starch, cellulose *etc.*

OR

(i) Since, D-glucose is oxidized easily, it acts as a reducing agent and also can reduce the Tollen's reagent as well as Fehling's solution.

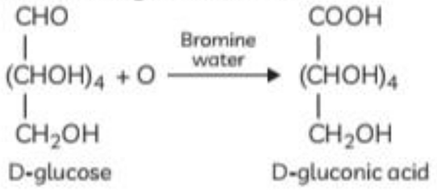


$$\underset{\text{D-glucose}}{CHO-(CHOH)_4-CH_2OH} + \underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]^+OH^-} \longrightarrow \underset{\text{Ammonium gluconate}}{COONH_4-(CHOH)_4-CH_2OH} + \underset{\text{Silver mirror}}{2Ag} + 3NH_3 + H_2O$$



$$\underset{\text{D-glucose}}{CHO-(CHOH)_4-CH_2OH} + \underset{\text{Fehling's solution}}{2Cu(OH)_2} + NaOH \longrightarrow COONa-(CHOH)_4-CH_2OH + \underset{\text{Cuprous oxide (red ppt.)}}{Cu_2O} + 3H_2O$$

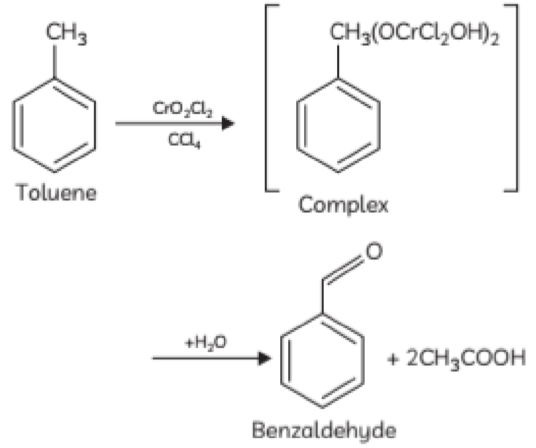
(ii) On oxidation with a mild oxidizing agent such as bromine water, -CHO group converts to carboxylic acid group and a monocarboxylic acid is formed, the product is called D-gluconic acid.



$$\underset{\text{D-glucose}}{CHO-(CHOH)_4-CH_2OH} + O \xrightarrow{\text{Bromine water}} \underset{\text{D-gluconic acid}}{COOH-(CHOH)_4-CH_2OH}$$

SECTION - E

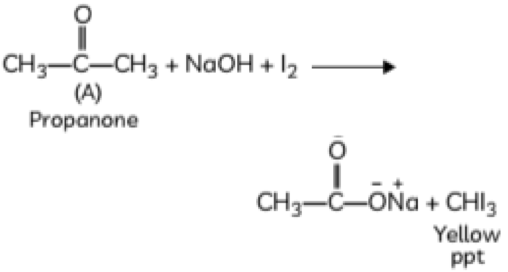
33. (A) Etard Reaction:



(B) Nucleophilic addition order: III > I > II.

Explanation: Nucleophiles are negatively entity positivity of carbon is carbonyl group facilitates nucleophilic addition.

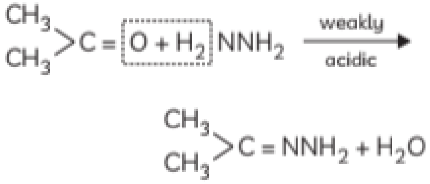
(C) The functional isomers are CH_3COCH_3[A] and CH_3CH_2CHO[B]. The isomer [A] has a methyl ketonic group (CH_3CO-) and responds to iodoform test while the isomer [B] does not since this group is not present.



$$\underset{\substack{(A)\\ \text{Propanone}}}{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3} + NaOH + I_2 \longrightarrow CH_3-\overset{\overset{\displaystyle \bar{O}}{\|}}{C}-\overset{-}{O}\overset{+}{Na} + \underset{\substack{\text{Yellow}\\ \text{ppt}}}{CHI_3}$$

$$\underset{\substack{(B)\\ \text{Propanal}}}{C_2H_5CHO} + NaOH + I_2 \longrightarrow \text{No ppt.}$$

(D) (i)



$$\begin{matrix}CH_3\\ CH_3\end{matrix}\!\!>C=\boxed{O+H_2}NH_2 \xrightarrow[\text{acidic}]{\text{weakly}} \begin{matrix}CH_3\\ CH_3\end{matrix}\!\!>C=NNH_2+H_2O$$

(ii) $CH_3CH_2CH=CHCN \xrightarrow{(i\text{-}Bu)_2AlH, H_2O} CH_3CH_2CH=CHCHO$

34. (A) Kohlrausch law of independent migration of ions: The law states that limiting molar conductivity of an electrolyte can be represented by the sum of the individual contributions of the anion and cation of the electrolyte.

$$\Lambda^\circ = \nu_+\lambda^\circ_+ + \nu_-\lambda^\circ_-$$

On dilution, the conductivity (k) of the electrolyte decreases as the number of ions per unit volume of solution decreases.

(B) $Al(s) \mid Al^{3+}(aq)\ (0.01M) \parallel Cu^{2+}(aq)\ (0.01\ M) \mid Cu(s)$

LHE $[(Al(s) \rightarrow Al^{3+}(aq)] + 3e^-)] \times 2$ (Oxidation at anode)

RHE $[Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)] \times 3$ (Reduction at cathode)

$\therefore \quad n = 6$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

$$E^\circ_{cell} = E_{cell} + \frac{0.0591}{n}\log\frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

$$= 1.98 + \frac{0.0591}{6}\log\frac{(0.01)^2}{(0.01)^3}$$

$$= 1.98 + \frac{0.0591}{6}\log 10^2$$

$$= 1.98 + \frac{0.0591}{6}2\log 10$$

$$= 1.98 + \frac{0.0591}{6}\times 2$$

$[\because \log 10 = 1]$

$= 1.98 + 0.0197$

So, $E^\circ_{cell} = 1.9997\ V$

OR

(A) If external potential applied becomes greater than E°_{cell} of electrochemical cell, then the reaction gets reversed. It starts acting as an electrolytic cell and vice-versa. When the opposing voltage greater than the cell potential is applied, the cell reaction stops altogether and no current flows through the cell.

(B) $$\Lambda_m = \frac{1000\times K}{M}\,S\,cm^2\,mol^{-1}$$

$$\Lambda_m = \frac{1000\times 5.25\times 10^{-5}}{2.5\times 10^{-4}}\,S\,cm^2\,mol^{-1}$$

$= 210\ S\ cm^2\ mol^{-1}$

$\Lambda_m^0(HCOOH) = \lambda^\circ(HCOO^-) + \lambda^\circ(H^+)$

$= (50.5 + 349.5)\ S\ cm^2\ mol^{-1}$

$= 400\ S\ cm^2\ mol^{-1}$

$\alpha = \Lambda_m / \Lambda^\circ_m$

$\alpha = 210/400 = 0.525$

35. (A) We know that

$$\text{Rate} = k[A]^x[B]^y$$

case I:

$$2.1 \times 10^{-2} = k[0.1]^x[1.00]^y \qquad ...(1)$$

case II:

$$8.4 \times 10^{-3} = k[0.2]^x[1.00]^y \qquad ...(2)$$

Eq. (1) ÷ Eq. (2)

$$\frac{2.1\times10^{-3}}{8.4\times10^{-3}} = \frac{k[0.1]^x[1.00]^y}{k[0.2]^x[1.00]^y}$$

$$\Rightarrow \quad \frac{1}{4} = \frac{[0.1]^x}{[0.2]^x}$$

$$\Rightarrow \quad \frac{1}{4} = \left(\frac{1}{2}\right)^x$$

$$\Rightarrow \quad \left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^x$$

So, order of reaction w.r.t. A = 2

Now, from case II:

$$(8.4 \times 10^{-3}) = (0.2)^z(2.00)^y \qquad ...(3)$$

Eq. (3) ÷ Eq. (1)

$$\frac{8.4\times10^{-3}}{2.1\times10^{-3}} = \frac{(0.2)^z(2.00)^y}{(0.1)^z(1.00)^y}$$

$$\Rightarrow \quad 4 = (2)^z \times 2^y$$

$$\Rightarrow \quad 2^y = 1$$

$$\Rightarrow \quad 2^y = 2^0$$

So, order of reaction w.r.t. B = 0

And overall order of reactions

$$n = x + y$$

$$\Rightarrow \quad n = 2 + 0 = 2$$

$$\Rightarrow \quad n = 2.$$

(B) Given $[R_0] = 0.004$ M, $t_{1/2} = 2$ years

$$k = \frac{[R_0]}{2\times t_{1/2}}$$

$$\Rightarrow \quad k = \frac{[0.004]}{2\times2}$$

$$\text{So,} \quad \boxed{k = 0.001 \text{ mol L}^{-1} \text{ yr}^{-1}}$$

OR

(A) Integrated rate equation for first order reaction

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

where $[R_0]$ = Initial conc. of reactant

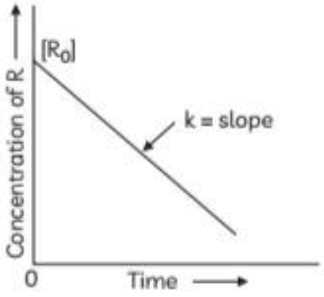
and $[R]$ = Final conc. of reactant

unit of rate constant for first order reac.

$$= s^{-1}\ (\text{time}^{-1})$$

(B) Plot showing variation in the concentration vs time for a zero-order reaction is represented as follows:

Concentration decrease linearly with a constant slope with time for zero-order reaction.



Slope of graph represents k.

(C) In the reaction,

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6,$$

water is present in large excess. Hence, it will not appear in the rate law expression. Thus, it is an example of pseudo first order reaction.