Class-XII Session 2022-23
Subject - Chemistry
Sample Question Paper - 27
With Solution

BLUE PRINT

S. No.	Chapter Name	Section-A		Section-B		Section-C		Section-D		Section-E		Total Marks
		(MCQs & A/R) 1 Mark		(VSA) 2 Marks		(SA) 3 Marks		(Case Study) 4 Marks		(LA) 5 Marks		
		Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	
1	Solutions	7	1	21	2			32	4			7
2	Electrochemistry	3, 12	2	24	2	26, 27. a	4					8
3	Chemical Kinetics	4, 13	2							34	5	7
4	d -and f -Block Elements	16	1			27. b, c, d	2			35	5	8
5	Coordination Compounds	17	1	19	2	29	3					6
6	Haloalkanes and Haloarenes	5, 8	2	20	2	30	3					7
7	Alcohols, Phenols and Ethers	6, 9	2					31	4			6
8	Aldehydes, Ketones and Carboxylic Acids	18	1	22	2					33	5	8
9	Amines	1, 10, 14	3	23	2	28 a	1					6
10	Biomolecules	2, 11, 15	3	25	2	28 b, c	2					7
	Total Marks (Total Questions)	18	18	7	14	5	15	2	8	3	15	70

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

General Instructions

Read the following instructions carefully

(a) *There are 35 questions in this question paper with internal choice.*

(b) *SECTION A consists of 18 multiple-choice questions carrying 1 mark each.*

(c) *SECTION B consists of 7 very short answer questions carrying 2 marks each.*

(d) *SECTION C consists of 5 short answer questions carrying 3 marks each.*

(e) *SECTION D consists of 2 case- based questions carrying 4 marks each.*

(f) *SECTION E consists of 3 long answer questions carrying 5 marks each.*

(g) ***All questions are compulsory.***

(h) ***Use of log tables and calculator are not allowed.***

SECTION-A

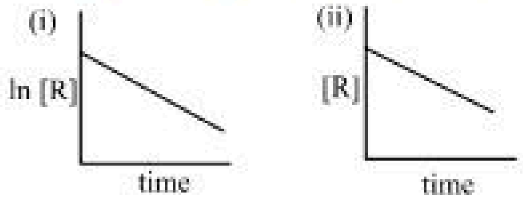
The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Which of the following is not a property of diazonium salts?
(a) Diazonium salts are colourless crystalline solids.
(b) Being ionic in nature they are soluble in water.
(c) Most of these salts decomposes when dried.
(d) The aqueous solutions of these salts are poor conductors of electricity

2. In fibrous proteins, polypeptide chains are held together by
(a) van der waals forces (b) electrostatic forces of attraction
(c) hydrogen bonds (d) covalent bonds

3. For the galvanic cell Zn | Zn^{2+} (0.1M) || Cu^{2+} (1.0M)|Cu the cell potential increase if:
(a) $[Zn^{2+}]$ is increased (b) $[Cu^{2+}]$ is increased
(c) $[Cu^{2+}]$ is decreased (d) surface area of anode is increased

4. The given plots represents the variation of the concentration of a reactant R with time for two different reactions (i) and (ii). The respective orders of the reactions are:



(a) 1, 0 (b) 1, 1 (c) 0, 1 (d) 0, 2

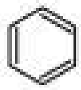
OR

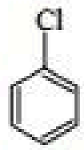
The following results were obtained during kinetic studies of the reaction;
2A + B → Products

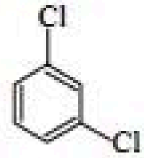
Experiment	[A] (in mol L^{-1})	[B] (in mol L^{-1})	Initial Rate of reaction (in mol L^{-1} min^{-1})
I	0.10	0.20	6.93×10^{-3}
II	0.10	0.25	6.93×10^{-3}
III	0.20	0.30	1.386×10^{-2}

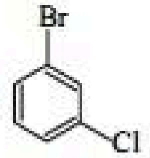
The time (in minutes) required to consume half of A is:
(a) 5 (b) 10 (c) 1 (d) 100

5. Arrange the following compounds in the increasing order of their densities.

(i) 

(ii) 

(iii) 

(iv) 

(a) (i)< (ii)< (iii)< (iv) (b) (i)< (iii)< (iv)< (ii) (c) (iv)< (iii)< (ii)< (i) (d) (ii)< (iv)< (iii)< (i)

6. The major reason that phenol is a better Bronsted acid than cyclohexanol is that:
(a) it is a beter proton donor.
(b) the cyclohexyl group is an electron donating group by induction, which destabilizes the anion formed in the reaction by resonance.
(c) phenol is able to stabilize the anion formed in the reaction.
(d) the phenyl group is an electron withdrawing group by induction, which stabilizes the anion formed in the reaction.

7. For a dilute solution, Raoult's law states that:
(a) the lowering of vapour pressure is equal to the mole fraction of solute
(b) the relative lowering of vapour pressure is equal to the mole fraction of solute
(c) the relative lowering of vapour pressure is proportional to the amount of solute in solution
(d) the vapour pressure of the solution is equal to the mole fraction of solvent

8. Reaction of $C_6H_5CH_2Br$ with aqueous sodium hydroxide follows ....
(a) S_N1 mechanism
(b) S_N2 mechanism
(c) Any of the above two depending upon the temperature of reaction
(d) Saytzeff rule

9. How many alcohols with molecular formula $C_4H_{10}O$ are chiral in nature?
(a) 1 (b) 2 (c) 3 (d) 4

10. Which of the following is not a primary amine?
(a) *tert*-Butylamine (b) *sec*-Butylamine (c) *iso*-Butylamine (d) Dimethylamine

11. In both DNA and RNA, heterocylic base and phosphate ester linkages are at –
(a) C'_5 and C'_1 respectively of the sugar molecule (b) C'_1 and C'_5 respectively of the sugar molecule
(c) C'_2 and C'_5 respectively of the sugar molecule (d) C'_5 and C'_2 respectively of the sugar molecule

12. Which of the following is a merit of Ni–Cd cell over lead storage battery?
(a) Ni–Cd cell can be re-used.
(b) Ni–Cd cell is comparatively economical to manufacture
(c) Ni–Cd cell has comparatively longer life
(d) All the above are the merits of Ni–Cd cell over lead storage battery.

13. Which of the following statements best describes how a catalyst works?
(a) A catalyst changes the potential energies of the reactants and products.
(b) A catalyst decreases the temperature of the reaction which leads to a faster rate.
(c) A catalyst lowers the activation energy for the reaction by providing a different reaction mechanism.
(d) A catalyst destroys some of the reactants, which lowers the concentration of the reactants.

14. Correct order of increasing basic character is
(a) $NH_3 < PhNH_2 < Et_2NH < EtNH_2 < Et_3N$ (b) $PhNH_2 < NH_3 < Et_3N < Et_2NH$
(c) $PhNH_2 < NH_3 < Et_2NH < Et_3N$ (d) $Et_3N < PhNH_2 < Et_2NH < NH_3$

In the following questions (Q. No. 15 - 18) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is wrong statement.
(d) Assertion is wrong, but reason is correct statement.

15. **Assertion:** The two strands of DNA are complementary to each other
Reason: The hydrogen bonds are formed between specific pairs of bases.

16. **Assertion:** Ce^{4+} is used as an oxidising agent in volumetric analysis.
Reason: Ce^{4+} has the tendency of attaining + 3 oxidation state.

17. **Assertion:** Linkage isomerism arises in coordination compounds because of ambidentate ligand.
Reason: Ambidentate ligand like NO_2 has two different donor atoms i.e., N and O.

18. **Assertion:** Aldol condensation can be catalysed both by acids and bases.
Reason: β-Hydroxyaldehydes or ketones readily undergo acid-catalysed dehydration.

SECTION-B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. Give (a) linkage isomer of $[Cr(CN)(H_2O)_5]^{2+}$
(b) ionisation isomer of $[PtCl_2(NH_3)_4]\,Br_2$

20. (a) Out of chlorobenzene and chloromethane, which is more reactive towards nucleophilic substitution reactions?
(b) Explain why thionyl chloride method is preferred for preparing alkyl chlorides from alcohols?

21. The vapour pressure of ethanol and methanol are 44.5 mm and 88.7 mm Hg respectively. A solution is prepared by mixing 60 g of ethanol and 40 g of methanol. Assuming the solution to be ideal, calculate the vapour pressure of the solution.

22. What happens when
(a) Propanone is treated with methylmagnesium iodide and then hydrolysed, and
(b) Benzene is treated with CH_3COCl in presence of anhydrous $AlCl_3$?

23. Give reasons :
(a) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.
(b) Aniline does not give Friedel-Crafts reaction.

24. Resistance of a conductivity cell filled with 0.1 M KCl is 100 ohm. If the resistance of the same cell when filled with 0.02 M KCl solution is 520 ohms, calculate the conductivity and molar conductivity of 0.02 M KCl solution. Conductivity of 0.1 M KCl solution is $1.29 \times 10^{-2}\ ohm^{-1}\ cm^{-1}$.

OR

For the cell: $Zn(s)\,|\,Zn^{2+}\,(2\,M)\,||\,Cu^{2+}\,(0.5\,M)\,|\,Cu(s)$
(a) Write equation for each half-reaction
(b) Calculate cell potential at 25°C.
[Given: $E^\circ_{Zn^{2+}|Zn} = -0.76\,V$; $E^\circ_{Cu^{2+}|Cu} = +0.34\,V$]

25. (a) Write the name of two monosaccharides obtained on hydrolysis of lactose sugar.
(b) Why Vitamin C cannot be stored in our body ?

OR

(a) What is the difference between a nucleoside and nucleotide ?
(b) Enzymes are least reactive at optimum temperature. "Justify the statement".

SECTION-C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. Calculate the emf of the following cell at 298 K :
$Fe(s)\,|\,Fe^{2+}(0.001\,M)\,||\,H^+(1\,M)\,|\,H_2\,(g)\,(1\,bar),\,Pt\,(s)$

(Given $E^\circ_{cell} = +0.44V$)

27. (a) What is the purpose of using salt bridge in electro chemical cell?

How would you account for any two of the following?
(b) Transition metals exhibit variable oxidation states.
(c) Zr (Z = 40) and Hf (Z = 72) have almost identical radii.
(d) Transition metals and their compounds act as catalyst.

OR

Complete any two of the following chemical equations :

(b) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow$

(c) $2CrO_4^{2-} + 2H^+ \longrightarrow$

(d) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow$

28. (a) Why aniline does not undergo Friedel-Crafts reaction?
(b) What is the basic structural difference between glucose and fructose?
(c) Write the products obtained after hydrolysis of lactose.

29. What is spectrochemical series? Explain the difference between a weak field ligand and a strong field ligand.

OR

Write the name, the structure and the magnetic behaviour of each one of the following complex:

(At no. of Ni = 28, Pt = 78)

(a) $[Pt(NH_3)_2Cl(NO_2)]$ (b) $Ni(CO)_4$

30. The following compounds are given to you:

2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane

(a) Write the compound which is most reactive towards S_N2 reaction.
(b) Write the compound which is optically active.
(c) Write the compound which is most reactive towards β-elimination reaction.

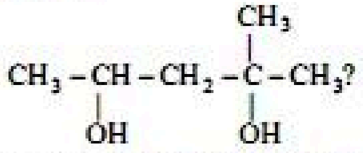
SECTION-D

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. Alcohols and phenols are the most important compounds used in our daily life. Alcohols are prepared by hydration of alkenes, fermentation of glucose, reduction of aldehydes, ketones, carboxylic acids, and esters. Alcohols are soluble in water. Boiling points increase with the increase in molar mass and decrease with branching. Alcohols on dehydration give alkene at 443K, follow carbocation mechanism. Excess of alcohol at 413K on dehydration with conc. H_2SO_4 also follows the carbocation mechanism but gives diethyl ether. Alcohols undergo nucleophilic substitution reactions, esterification with carboxylic acids, and derivatives like amides, acid halides, acid anhydride. Phenol is prepared from cumene, diazonium salts, anisole, and chlorobenzene. Phenol is used to prepare salicylaldehyde, salicylic acid, aspirin, methyl salicylate, *p*-benzoquinone. Phenol undergoes electrophilic substitution reaction at *o* & *p*-position.

Answer the following questions :

(a) The IUPAC name of



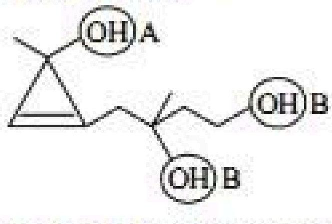
$CH_3-\underset{OH}{CH}-CH_2-\overset{CH_3}{\underset{OH}{C}}-CH_3$?

(b) What happens when Acid catalyzed hydration of alkenes except ethene takes place?

(c) Alcohols react as nucleophiles in the reactions involving cleavage of O–H bond—Justify.

OR

How do you distinguish between solicylic acid and phenol?



Explain the under of basic character of hydroxy groups in the above molecule.

32. The normal boiling point of a substance is the temperature at which the vapour pressure equals 1 atm. If a nonvolatile solute lowers the vapour pressure of a solvent, it must also affect the boiling point. Because the vapour pressure of the solution at a given temperature is less than the vapour pressure of the pure solvent, achieving a vapour pressure of 1 atm for the solution requires a higher temperature than the normal boiling point of the solvent. Thus the boiling point of a solution is always greater than that of the pure solvent. The magnitude of the increase in the boiling point is related to the magnitude of the decrease in the vapour pressure. The decrease in the vapour pressure is proportional to the concentration of the solute in the solution. Hence the magnitude of the increase in the boiling point must also be proportional to the concentration of the solute.

Answer the following questions :

(a) Assume three samples of juices A, B and C have glucose as the only sugar present in them. The concentration of sample A, B and C are 0.1M, .5M and 0.2 M respectively. Which one will have the highest freezing point?

(b) What happen to the boiling point and freezing pointof water when a non volatile solid is added to pure water?

(c) Polar solutes dissolve in a polar solvent and non-polars in non-polar solvents—Explain.

OR

Scuba drivers may experience a condition called Bends. To avoid this, the tanks used by scuba drivers are filled with air diluted with helium—Explain this phenomenon.

SECTION-E

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

33. (a) Write the products formed when benzaldehyde reacts with the following reagents:

(i) CH_3CHO in presence of dilute NaOH

(ii) H_2N-NH- 

(iii) Conc. NaOH

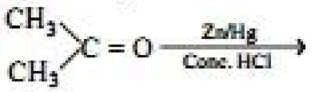
(b) Distinguish between the following:

(i) $CH_3-CH=CH-CO-CH_3$ and
$CH_3-CH_2-CO-CH=CH_2$

(ii) Benzaldehyde and benzoic acid.

OR

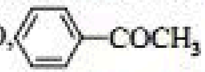
(a) Write the final products in the following:

(i) 
$$(CH_3)_2C=O \xrightarrow[\text{Conc. HCl}]{\text{Zn/Hg}}$$

(ii) 

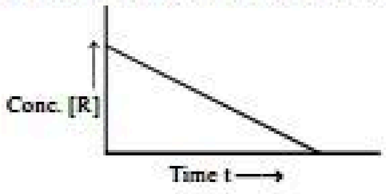
(iii) $CH_2=CH-CH_2-CN \xrightarrow[(b)H_3O^+]{(a)DIBAL-H}$

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

CH_3COCH_3, HCHO, CH_3CHO, 

(c) Draw the structure of 2, 4-DNP derivative of acetaldehyde.

34. (a) Consider the reaction R → P for which the change in concentration of R with time is shown by the following graph:



(i) Predict the order of reaction.

(ii) What does the slope of the curve indicate?

(b) The rate of reaction quadruples when temperature changes from 293 K to 313 K. Calculate E_a assuming that it does not change with time. $[R = 8{\cdot}314\ JK^{-1}\ mol^{-1}]$

OR

(a) Draw the plot of *ln k* vs 1/T for a chemical reaction. What does the intercept represent? What is the relation between slope and E_a?

(b) A first order reaction takes 30 minutes for 20% decomposition. Calculate $t_{1/2}$ [log 2 = 0·3010]

35. (a) Explain why:

(i) Zn^{2+} salts are colourless while Ni^{2+} salts are coloured.

(ii) Why is copper sulphate pentahydrate coloured?

(iii) +2 oxidation state of manganese is quite stable while the same is not true for iron.

(b) The electronic configuration of an element is $3d^5\,4s^1$. Write its

(i) most stable oxidation state, and (ii) most oxidising state.

Solutions

SAMPLE PAPER-10

1. (d) The aqueous solutions of diazonium salts are good conductors of electricity.

2. (c) Polypeptide chains, in fibrous proteins, are held together by disulphide and hydrogen bonds.

3. (b) For the given cell

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059V}{2} \log \frac{[Zn^{2+}(aq)]}{[Cu^{2+}(aq)]}$$

The cell potential decreases with increase in $[Zn^{2+}(aq)]$ and increases with increase in $[Cu^{2+}(aq)]$.

4. (a) In graph (i), ln [Reactant] vs time is linear with positive intercept and negative slope. Hence it is 1st order In graph (ii), [Reactant] vs time is linear with positive intercept and negative slope. Hence, it is zero order.

5. (a) Density is directly related to molecular mass. Higher the molecular mass, higher will be the density of the compound. The order of molecular mass is benzene < chlorobenzene < dichlorobenzene < bromochlorobenzene

6. (d)

7. (b) $P_{Solution} = P^{\circ}_{solution}\, x_{Solvent}$

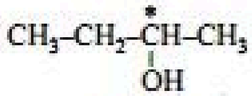
$$\frac{P^{\circ} - P}{P^{\circ}} = x_{solute}$$

8. (a) In $C_6H_5CH_2Br$ carbocation is $C_6H_5\overset{\oplus}{C}H_2$ which is stable due to resonance.

9. (a) Following are the three possible isomers of butanol

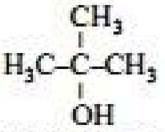
(i) $CH_3CH_2 - CH_2 - CH_2OH$

Butan–1–ol
no chiral carbon

(ii) 

$CH_3{-}CH_2{-}\overset{*}{C}H(OH){-}CH_3$

Butan –2 – ol
1-Chiral Carbon

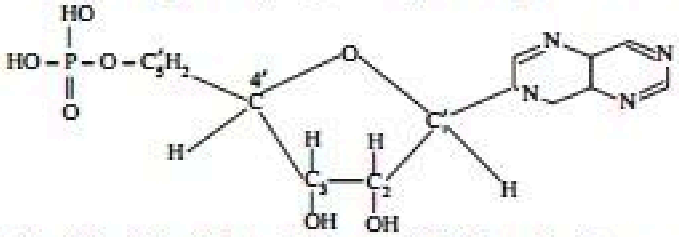
(iii) 

$H_3C{-}C(CH_3)(OH){-}CH_3$

2 – methylpropan – 2 – ol
No Chiral Carbon

10. (d) $(CH_3)_2NH$ is a secondary amine.

11. (b) In DNA and RNA heterocyclic base and phosphate ester are at C_1' and C_5' respectively of the sugar molecule.



12. (c) Ni – Cd cells have longer half-life than lead-storage battery.

13. (c) The path of the reaction changes by decreasing the E_a.

14. (b) $PhNH_2 < NH_3 < Et_3N < Et_2NH$

15. (a)

16. (a) The element which can reduce itself acts as an oxidising agent.

17. (a) Ambidentate ligand like NO_2 has two different donor atoms i.e. N and O. Thus, it can form coordinate bonds through N and O both or we can say that it can form linkage isomers.

18. (a) Both carbanion (formed in presence of a base) and enol (formed in presence of an acid) act as nucleophiles and hence add on the carbonyl group of aldehydes and ketones to give aldols.

19. (a) $[Cr(NC)(H_2O)_5]^{2+}$ (b) $[Pt Br_2(NH_3)_4]Cl_2$

20. (a) Chloromethane is more reactive towards nucleophillic substitution reaction since it is an alkyl halide.

(b) Thionyl chloride method is preferred for preparing alkyl chlorides from alcohols because the by products of the reaction, *i.e.*, SO_2 and HCl being gases escape into the atmosphere leaving behind alkyl chloride in almost pure state. (½+1 = 1½ marks)

21. No. of moles of methanol (n_B)

$$= \frac{\text{Mass of } CH_3OH}{\text{Gram molar mass}} = \frac{(40\text{ g})}{(32\text{ g mol}^{-1})} = 1.25\text{ mol} \quad (\tfrac{1}{4}\text{ mark})$$

No. of moles of ethanol (n_A)

$$= \frac{\text{Mass of } C_2H_5OH}{\text{Gram molar mass}} = \frac{(60\text{ g})}{(46\text{ g mol}^{-1})} = 1.30\text{ mol} \quad (\tfrac{1}{4}\text{ mark})$$

Mole fraction of methanol (x_B)

$$= \frac{n_B}{n_B + n_A} = \frac{(1.25\text{ mol})}{(1.25\text{ mol} + 1.30\text{ mol})} = 0.49 \quad (\tfrac{1}{4}\text{ mark})$$

Mole fraction of ethanol (x_A)

$$= \frac{n_A}{n_A + n_B} = \frac{(1.30\text{ mol})}{(1.25\text{ mol} + 1.30\text{ mol})} = 0.51 \quad (\tfrac{1}{4}\text{ mark})$$

Vapour pressure of pure methanol $(P^{\circ}_B) = 88.7$ mm Hg

Vapour pressure of pure ethanol $(P^{\circ}_A) = 44.5$ mm Hg

Partial vapour pressure of methanol

$$(P_B) = P^{\circ}_B x_B = (88.7\text{ mm} \times 0.49) = 43.46\text{ mm Hg}$$

(¼ mark)

Partial vapour pressure of ethanol

$$(P_A) = P^{\circ}_A x_A = (44.5\text{ mm} \times 0.51) = 22.70\text{ mm Hg}$$

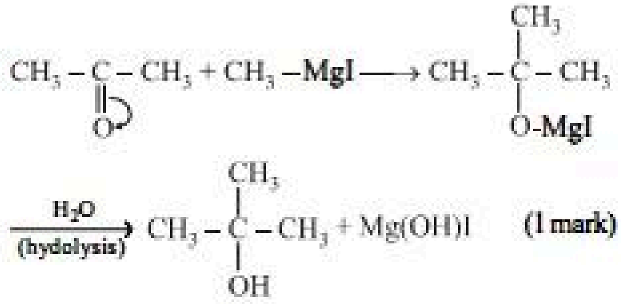
(¼ mark)

Since the solution is ideal in nature,
Total vapour pressure of solution

$$(P) = P_A + P_B = (22.70 + 43.46) = 66.16\text{ mm Hg}$$

(½ mark)

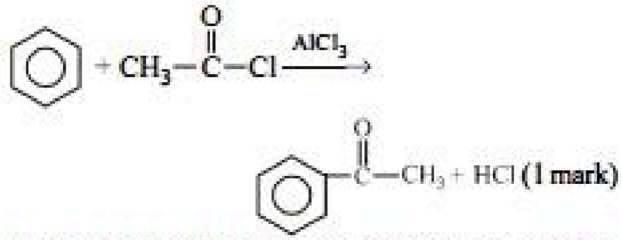
22. (a)



$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + CH_3-MgI \longrightarrow CH_3-\underset{\underset{O\text{-}MgI}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$$

$$\xrightarrow[\text{(hydolysis)}]{H_2O} CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3 + Mg(OH)I \quad \text{(1 mark)}$$

(b)



$$C_6H_6 + CH_3-\overset{\overset{O}{\|}}{C}-Cl \xrightarrow{AlCl_3} C_6H_5-\overset{\overset{O}{\|}}{C}-CH_3 + HCl \text{ (1 mark)}$$

23. (a) Ammonolysis yields a mixture of primary, secondary, tertiary and quaternary salts. The separation of pure primary amines from ammonolysis of alkyl halide is a difficult process. (1 mark)

(b) Aniline does not give friedel-crafts reaction as it forms anilinium chloride salt which deactivates the ring for further acylation and alkylation reaction. (1 mark)

24. Calculation of cell constant (1 mark)

Resistance of KCl solution (R) = 100 ohm

Conductivity (specific conductance) (κ)

$= 1.29\times10^{-2}\ \text{ohm}^{-1}\ \text{cm}^{-1}$

Specific conductance $(\kappa) = \dfrac{1}{R}\times \text{cell constant}$

Cell constant

$= \kappa\times R = \left(1.29\times10^{-2}\ \text{ohm}^{-1}\ \text{cm}^{-1}\right)\times\left(100\ \text{ohm}\right)$

$= 1.29\ \text{cm}^{-1}$, (½ mark)

Specific conductance of 0.02 M KCl solution

Resistance of KCl solution (R) = 520 ohm

Cell constant of the cell $(l/a) = 1.29\ \text{cm}^{-1}$

Specific conductivity $(\kappa) = \dfrac{1}{R}\times \text{cell constant}$

$= \left(\dfrac{1}{520}\ \text{ohm}^{-1}\right)\times\left(1.29\ \text{cm}^{-1}\right)$

$= 2.48\times10^{-3}\ \text{ohm}^{-1}\ \text{cm}^{-1}$ (½ mark)

Molar conductivity of 0.02 M KCl solution

Concentration (C)

$= 0.02\ \text{M} = 0.02\ \text{mol L}^{-1} = \dfrac{0.02\text{mol}}{1\text{L}} = \dfrac{0.02\ \text{mol}}{1000\ \text{cm}^3}$

$= 2.0\times10^{-5}\ \text{mol cm}^{-3}$

Molar conductance (Λ_m)

$= \dfrac{\kappa}{C} = \dfrac{(2.49\times10^{-3}\text{ohm}^{-1}\text{cm}^{-1})}{(2.0\times10^{-5}\text{mol cm}^{-3})}$

$= 124.5\ \text{ohm}^{-1}\ \text{cm}^2\text{mol}^{-1}$ (1 mark)

OR

(a) The cell reactions are (½ mark)

$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$(anode) (¼ mark)

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ (cathode)

(b) $E^\circ_{cell} = E_{cathode} - E_{anode} = 0.34 - (-0.76)$

$= 0.34 + 0.76 = 1.10\ V$ (½ mark)

from Nernst equation

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$E_{cell} = 1.1 - \frac{0.059}{2}\log\frac{[2]}{[0.5]}$$

$$= 1.1 - \frac{0.059}{2}(\log 20 - \log 5)$$

$$= 1.1 - \frac{0.059}{2}\times 0.6021$$

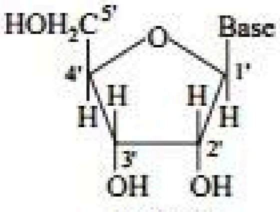
$= 1.1 - 0.0177 = 1.09\ V$ (1 mark)

25. (a) Two monosaccharides obtained on hydrolysis of lactose sugar are b-D-glucose and b-D-galactose.

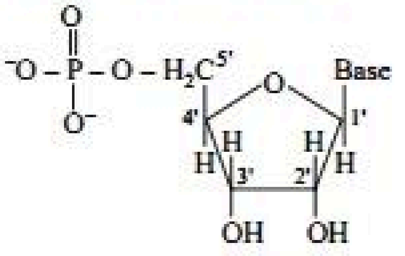
(b) Vitamin C cannot be stored in our body because it is water soluble in nature so it repeatedly gets eliminated through urine.

OR

(a) When a base (purine or pyrimidine) get attached to 1′ position of a pentose sugar a nucleoside is formed. When a nucleoside is further linked to phosphoric acid at 5′ position of the sugar moiety, we get a nucleotide.



Nucleoside



Nucleotide

(1 mark)

(d) Enzymes are most reactive at optimum temperature. The optimum temperature for enzyme activity lies between 40°C to 60°C.

26. $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$, n = 2 (½ mark)

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[Fe^{2+}]}{[H^+]^2}$$

$$= (0.44) - \frac{0.0591}{2}\log\frac{10^{-3}}{(1)^2}$$

$$= 0.44 + 0.0886 = 0.5286\ V$$

27. (a) Salt bridge is used to complete the circuit so that current can flow. (1 mark)

(b) The energy difference between $(n-1)\,d$ and ns orbitals of transition metal atoms is very small, so the electrons from both these orbitals can participate in bonding and hence they show variable oxidation states. (1 mark)

(c) Due to Lanthanoid contraction, Hf has size similar to that of Zr. (1 mark)

Note

Lanthanoid contraction is due to the poor shielding of one 4f electron by another in the same sub-shell. Lanthanoid contraction causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series.

(d) The transition metals and their compounds behave as catalyst due to the presence of partly filled *d*-orbitals and exhibiting various oxidation states. They form unstable intermediate complex with reactants and thus lowering the energy of activation. They also provide a suitable surface for the reaction to occur. (1 mark)

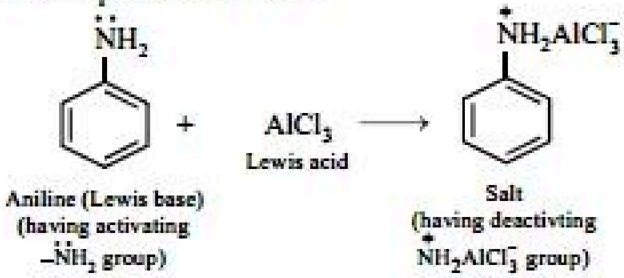
OR

(b) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$ (1 mark)

(c) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$ (1 mark)

(d) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$ (1 mark)

28. (a) Aniline, being a Lewis base, reacts with the Lewis acid ($AlCl_3$, catalyst for Friedel-Craft reaction) to form a salt. Thus the catalyst $AlCl_3$ is consumed. Moreover, the product has positive charge on N, which is deactivating for electrophilic substitution.



(1 mark)

(b) Glucose:

- It is a aldohexose and contains aldehyde functional group. (½ mark)

Fructose:

- It is a ketohexose contains ketone functional group. (½ mark)

(c) The products of hydrolysis of lactose are b-D-glucose and b-D-galactose.(1 Mark)

29. The arrangement of ligands in order of their increasing field strengths, *i.e.*, increasing crystal field splitting energy (CFSE) values is called spertrochemical series. (1 mark)

The ligands with small value of CFSE (Δ_o) are called *weak field ligands* whereas those with large value of CFSE (Δ_o) are called *strong field ligands*. (2 marks)

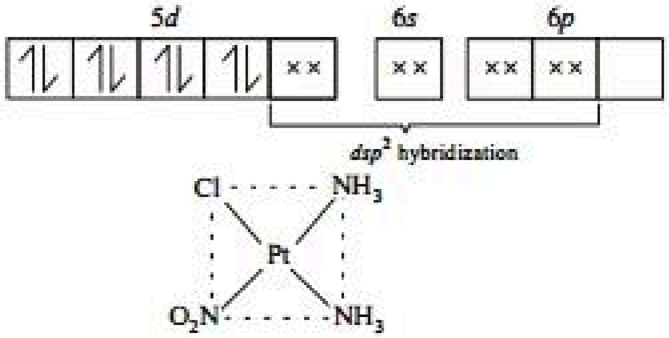
In general, ligands can be arranged in a series in the order of increasing field strength as given below.

$$I^- < Br^- < S^{2-} < SCN^- < Cl^- < N_3^- < F^- < \text{urea} < OH^- < C_2H_5-OH$$
$$< C_2O_4^{2-} < O^{2-} < H_2O < NCS^- < \text{gly} < NH_3, \text{Py} < \text{en}, SO_3^{2-} < NH_2OH$$
$$< \text{bpy}, \text{phen} < NO_2^- < CH_3^- < C_6H_5^- < R_3P < CN^- < CO$$

OR

(a) $[(Pt(NH_3)_2)Cl(NO_2)]$

IUPAC name : Diamminechloridonitrito-N-platinum (II)



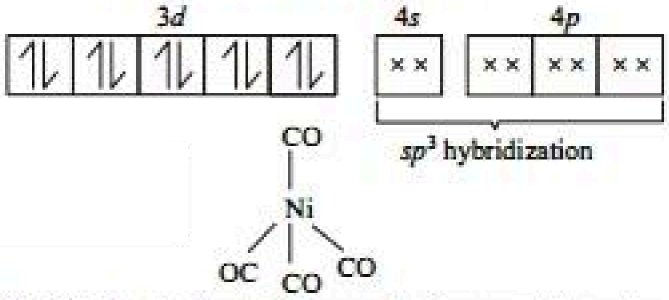
$[Pt(NH_3)_2Cl(NO_2)]$ has square planar shape and is diamagnetic in nature. (1½ marks)

(b) $[Ni(CO)_4]$

IUPAC name : Tetracarbonylnickel (0)

$Ni = 3d^8 4s^2$

CO transfers the 4*s* electrons into 3*d* orbitals and makes the 4*s* orbital available for bonding in $Ni(CO)_4$

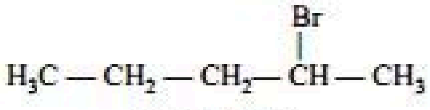


$Ni(CO)_4$ has tetrahectral shape and is diamagnetic in nature. (1½ mark)

30. Structure of the given compounds are :

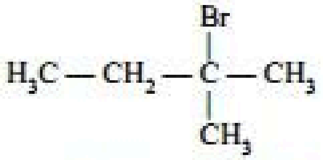
$H_3C-CH_2-CH_2-CH_2-CH_2-Br$

1-Bromopentane
(A)



$H_3C-CH_2-CH_2-CH(Br)-CH_3$

2-Bromopentane
(B)



$H_3C-CH_2-C(Br)(CH_3)-CH_3$

2-Bromo-2-methylbutane
(C)

(a) As we can see in the above figures, (A), contains the least steric hindrance so towards the S_N2 reaction 1-bromopentane will be most reactive. (1 mark)

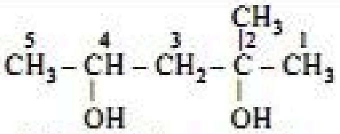
(b) 2-Bromopentane (figure B) contain chiral carbon in it. So, this compound is optically active. (1 mark)

(c) 2-Bromo-2-methylbutane will be most reactive towards the β-elimination since it will form most stable alkene (on account of highest no of α-hydrogens) (1 mark)

Note

The identity of the nucleophile or base also determines which mechanism is favoured. E_2 *reactions require strong bases whereas* S_N2 *reactions require good nucleophiles. Therefore, a good nueleophile (i.e., weak base) will favour* S_N2 *while a weak nucleophile (i.e, strong base) will favour* E_2.

31. (a)



$$\overset{5}{C}H_3-\underset{OH}{\overset{4}{C}H}-\overset{3}{C}H_2-\underset{OH}{\overset{CH_3}{\overset{|2}{C}}}-\overset{1}{C}H_3$$

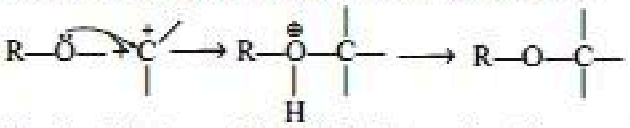
(1 mark)

2-Methyl-2, 4-pentanediol.

(b) Secondary or tertiary alcohol is formed. (1 mark)

(c) Alcohols are versatile compounds. They react both as nucleophiles and electrophiles. (2 marks)

The lone pair of alcoholic 'o' attacks the moleophile when it acts as nucleophile and the O – H bond breaks.



The bond between C—O is broken when they react as electrophiles. Protonoted alcohol react in this manner.

$$R—CH_2OH + H^+ \longrightarrow R—CH_2—OH_2 \xrightarrow{Br^{\ominus}} R—CH_2—Br + H_2O$$

OR

Salicylic ā

Phenol

correct order of basic character of —OH groups: A > B > C. stability of the carbocation is proportional to the basic nature of OH group. Leaving of $(OH)_A$ produces the carbocation which is stabilized by resonance with the π-orbitals of 3-membered ring. Leaving of $(OH)_B$ leads to tertiary carbocation and that of $(OH)_C$ forms the primary carbocation.

32. (a) Since the concentration of sample A is less, so it will show less depression in freezing point. Consequently, its freezing point will be higher than other solutions.(1 mark)

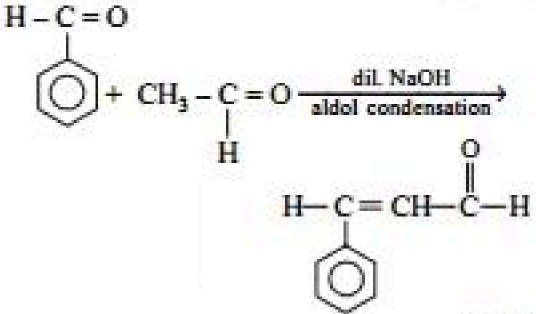
(b) When non-volatile solid is added to pure solvent the boiling point of solution increases and freezing point of solution decreases. (½ + ½ = 1 mark)

(c) A solute dissohies in a solvent if intermoleculer interactions are similar between solute and solvent or more than the individuals. Azcotropic mixture is a non-ideal solution which has the same composition in liquid phase and vapour phase. They less may have different boiling points either greater or than both the constituent components.

OR

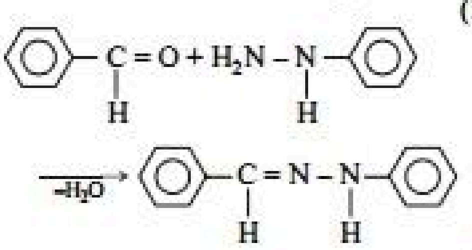
Scuba divers must cope with high concentrations of dissolved gases while breathing air at high pressure underwater. Increased pressure increases the solubility of atmospheric gases in blood. When the divers come towards surface, the pressure gradually decreases. This releases the dissolved gases and leads to the formation of bubbles of nitrogen in the blood. This blocks capillaries and creates a medical condition known as bends, which are painful and dangerous to life. To avoid bends, as well as, the toxic effects of high concentrations of nitrogen in the blood, the tanks used by scuba divers are filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen). (2 marks)

33. (a) (i)



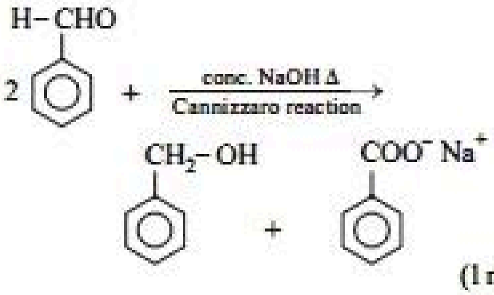
(1 mark)

(ii)



(1 mark)

(iii)



(1 mark)

(b) (i) $CH_3CH{=\!=}CH-COCH_3$ and

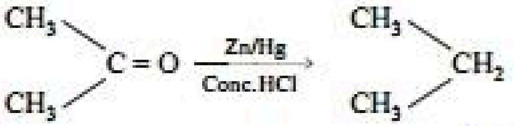
$CH_3CH_2-CO-CH{=\!=}CH_2$

can be distinguished by the iodoform test as the first compound contains a methyl ketonic group $(-\underset{\overset{\|}{O}}{C}-CH_3)$ and undergoes iodoform test, whereas the other compound does not. (1 mark)

(ii) Benzaldehyde does not react with sodium bicarbonate ($NaHCO_3$) whereas benzoic acid evolves carbon dioxide upon reaction with $NaHCO_3$ because of its acidic character. (1 mark)

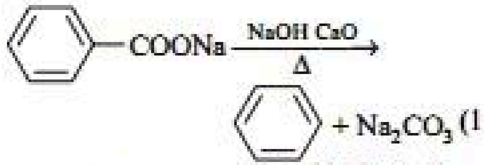
OR

(a) (i)



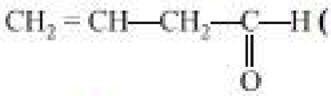
(1 mark)

(ii)



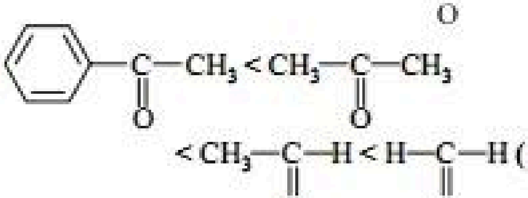
(1 mark)

(iii) $CH_2 = CH - CH_2 - CN \xrightarrow[\text{(b) } H_3O]{\text{(a) DIBAL–H}}$



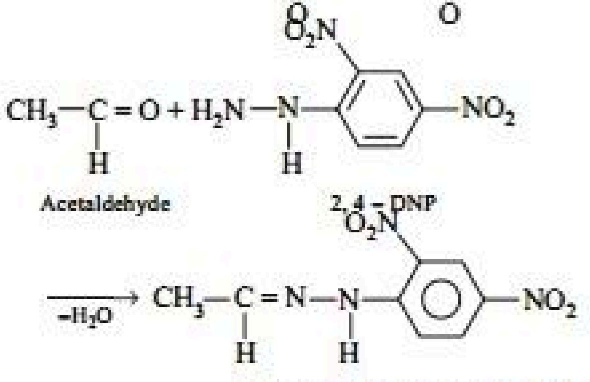
$CH_2 = CH - CH_2 - \underset{\underset{O}{\|}}{C} - H$ (1 mark)

(b)



$C_6H_5-\underset{\underset{O}{\|}}{C}-CH_3 < CH_3-\underset{\underset{O}{\|}}{C}-CH_3 < CH_3-\underset{\underset{O}{\|}}{C}-H < H-\underset{\underset{O}{\|}}{C}-H$ (1 mark)

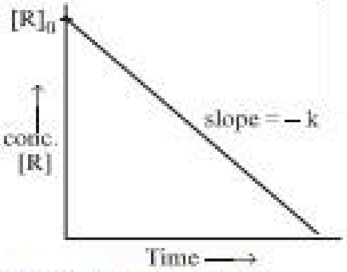
(c)



(1 mark)

34. (a) (i) It is a zero order reaction (1 mark)

(ii)



$R = -kt + [R]_0;\ y = mx + c$

The slope of the curve is negative which means concentration of reactant is decreasing with time.

(1 mark)

(b) $T_1 = 293$ K ; $k_1 = k$

$T_2 = 313$ K ; $k_2 = 4k$

$$\log\frac{k_1}{k_2} = \frac{E_a}{2.303R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$ (1 mark)

$$\log\frac{1}{4} = \frac{E_a}{2.303\times 8.314}\left[\frac{1}{313} - \frac{1}{293}\right]$$

$$-0.6020 = \frac{E_a}{2.303\times 8.314}\left[\frac{293-313}{(313)(293)}\right]$$ (1 mark)

$$E_a = \frac{-0.6020\times 2.303\times 8.314\times 313\times 293}{-20}$$

$E_a = 52854.55\ J\ mol^{-1} = 52.854\ kJ\ mol^{-1}$ (1 mark)

OR

(a) $k = Ae^{-E_a/RT}$ (Arrhenius equation)

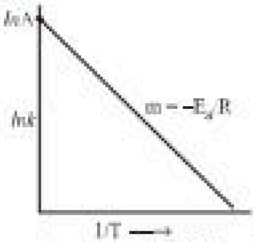
$$\ln k = \ln A - \frac{E_a}{RT}$$

$y = c + mx$

$y = \ln k;\ x = 1/T$

$c = \ln A$ and $m = -E_a/R$

A plot of $\ln k$ v/s $\frac{1}{T}$ for a chemical reaction is as straight line. (1 mark)



The intercept represents $\ln A$, where A = frequency factor or pre-exponential factor.

$$\text{slope} = \frac{-E_a}{R};\ E_a = -(\text{slope} \times R)$$ (1 mark)

Note

High temperature and low activation energy favour larger rate constant, and therefore speed up the reaction. Arrhenius equation is generally a combination of the concepts of activation energy and the Maxwell-Boltzmann distribution.

(b) For first order reaction

$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$ (1 mark)

20% compound has been decomposed in 30 min. i.e. 80% compound is left.

$$k = \frac{2.303}{30}\log\frac{100}{100-20} = \frac{2.303}{30}\log 1.25$$

$$= \frac{2.303}{30}\times 0.0969 = 0.0074\ \text{min}^{-1}$$ (1 mark)

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.0074} = 93.64\ \text{min}$$ (1 mark)

35. (a) (i) Zn^{2+} with configuration [Ar] $3d^{10}$ has all filled d-orbitals. Therefore, its salts are colourless. Ni^{2+} with configuration [Ar] $3d^8$ has some half-filled d-orbitals. Therefore, its salts are coloured. (1 mark)

(ii) In copper sulphate pentahydrate, $CuSO_4{\cdot}5H_2O$, Cu^{2+} ion has unpaired electron in $3d$-orbital. Due to this, Cu^{2+} ion can have $d - d$ transition when exposed to visible radiation. (1 mark)

(iii) The electronic configuration of both the ions are: Mn^{2+} : $[Ar]3d^5$; Fe^{2+} : $[Ar]3d^6$

The Mn^{2+} ion has more symmetrical configuration than Fe^{2+} ion and therefore, it is more stable. (1 mark)

Thus, + 2 oxidation state of manganese is quite stable while that of iron is not.

(b) (i) The most stable oxidation state is + 3, *i.e.*, Cr^{3+}. (1 mark)

(ii) The most oxidising state is + 6, *i.e.*, Cr^{6+} state. In $K_2Cr_2O_7$, Cr is in + 6 oxidation state and during oxidation it changes to + 3 state.

$Cr^{6+} + 3e^- \longrightarrow Cr^{3+}$ (1 mark)