Class XII Session 2026-27
Subject - Chemistry
Sample Question Paper - 3

Time Allowed: 3 hours **Maximum Marks: 70**

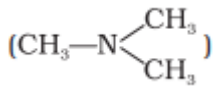
General Instructions:

Read the following instructions carefully.

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

Section A

1. Chloromethane on treatment with excess of ammonia yields mainly **[1]**

   a) N, N-Dimethylmethanamine 

   b) N–methylmethanamine (CH_3—NH—CH_3)

   c) Methanamine (CH_3NH_2)

   d) Mixture containing all these in equal proportion

2. Glucose and fructose are _____ of each other **[1]**

   a) functional group isomers b) nonisomers

   c) mirror image isomers d) homologues

3. Give IUPAC names of the following compound: **[1]**
   $CH_3CH_2CH_2CH(Br)CH(CH_3)CH_2CHO$

   a) 2 – Methyl – 3 – bromoheptanal b) 4 – Bromo – 3 – methylheptanal

   c) 3– Methyl – 3 – bromoheptanaldehyde d) 2 – Methyl – 3 – bromoheptanaldehyde

4. Dehydration of tertiary alcohols with Cu at 573 K gives: **[1]**

   a) Ketone b) Alkyne

   c) Aldehyde d) Alkene

5. The slope in the plot of [R] vs. time for a zero order reaction is **[1]**

a) +k

b) $\frac{-k}{2.303}$

c) $\frac{+k}{2.303}$

d) -k

6. Match the items given in column I with that in column II: **[1]**

Column I	Column II
(a) Resistivity	(i) S cm^2 mol^{-1}
(b) Conductance	(ii) ohm-m
(c) Specific Conductance	(iii) Siemens
(d) Molar Conductivity	(iv) S m^{-1}

a) (a) - (ii), (b) - (i), (c) - (iii), (d) - (iv)

b) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

c) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

d) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

7. Which of the following belongs to the class of alkyl halides? **[1]**

a) $CH_2 = CH - CH_2 - CH_2 - Cl$

b) $CH_2 = CH - \underset{\underset{CH_3}{|}}{CH} - CH_3$

c) $CH_2 = CH - Cl$

d) $CH_2 = C = CH_2 - Cl$

8. The two hormones which together regulate the glucose level in the blood **[1]**

a) Insulin and adrenaline

b) Insulin and thyroxine

c) Insulin and epinepherine

d) Insulin and glucagon

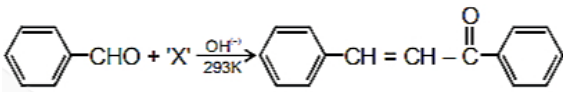
9. The role of a catalyst is to change _____. **[1]**

a) equilibrium constant

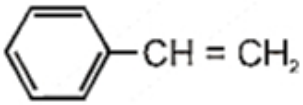
b) enthalpy of reaction

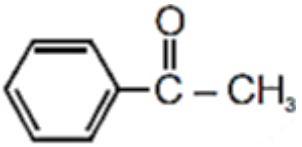
c) gibbs energy of reaction

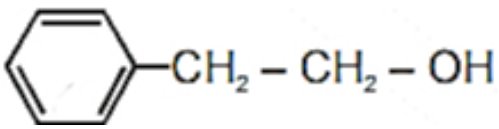
d) activation energy of reaction

10.  **[1]**

Identify ' X ' :

a) 

b) 

c) 

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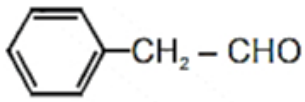
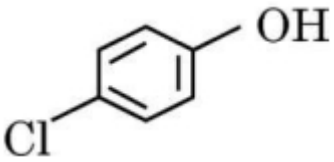
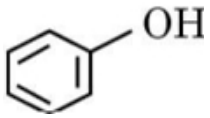
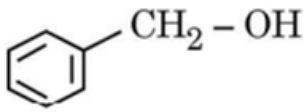
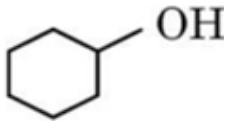


11. Which of the following is most acidic ? **[1]**

a) 

b) 

c) 

d) 

12. IUPAC name of product formed by reaction of methyl amine with two moles of ethyl chloride **[1]**

a) N-Methyl ethanamine
b) N,N-Dimethylethanamine
c) N,N-Diethylmethanamine
d) N-Ethyl-N-methylethanamine

13. **Assertion (A):** Disruption of the native structure of a protein is called denaturation. **[1]**
Reason (R): The change in colour and appearance of egg during cooking is due to denaturation.

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.

14. **Assertion (A):** RMgX on reaction with CO_2 gives $R-\overset{O}{\overset{||}{C}}-OH$ **[1]**

Reason (R): RMgX on reaction with carbonyl compounds give alcohols.

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):** Inversion of configuration is observed in S_N2 reaction. **[1]**
Reason (R): The reaction proceeds with the formation of carbocation.

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.

16. **Assertion (A):** The reaction of the alcohol with $SOCl_2$ is catalyzed by the presence of a tertiary amine (R_3N). **[1]**

Reason (R): Tertiary amine promotes the reaction by reacting with the by-product HCl.

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.

Section B

17. Calculate Λ_m° for $CaCl_2$ and $MgSO_4$ from the following data : $\Lambda_m^\circ\left(Ca^{2+}\right)$ = 119.0, Mg^{2+} = 106.0, Cl^- = 76.3 and SO_4^{2-} = 160.05 $cm^2\ mol^{-1}$ **[2]**

OR

How many g of chlorine can be produced by the electrolysis of molten NaCl with a current of 1 amp. for 15 min?

18. For a 5% solution of urea (Molar mass = 60 g/mol), calculate the osmotic pressure at 300 K. [R = 0·0821 L atm K^{-1} mol^{-1}] **[2]**

19. Which is a stronger reducing agent Cr^{3+} or Fe^{2+} and why? **[2]**

20. **Answer the following:** **[2]**

    i. What is the order of radioactive decay? **[1]**

    ii. For a reaction R $\rightarrow$ P, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactants. What is the order of reaction? **[1]**

21. How is aminomethane obtained from ethanal (acetaldehyde)? **[2]**

Section C

22. Calculate $\Lambda^\circ m$ for acetic acid and its degree of dissociation (α) if its molar conductivity is $48.1\Omega^{-1}\ cm^2\ mol^{-1}$. **[3]**

Given that

$\Lambda^\circ m(HCl) = 426\Omega^{-1}\ cm^2\ mol^{-1}$

$\Lambda^\circ m(NaCl) = 126\Omega^{-1}\ cm^2\ mol^{-1}$

$\Lambda^\circ m\left(CH_3COONa\right) = 91\Omega^{-1}\ cm^2\ mol^{-1}$

23. Write IUPAC names of the following coordination entities: **[3]**

a. $[Fe(en)_2Cl_2]^+$

b. $[Co(NH_3)_4\left(H_2O\right)Br]\,SO_4$

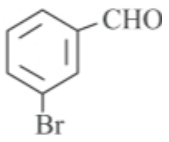
c. $[Ni(CN)_4]^{2-}$

24. Give the equations of reactions for the preparation of phenol from cumene. **[3]**

25. Complete the following: **[3]**

i. $CH_3CN \xrightarrow[2\cdot H_2O]{1.AlH(i-Bu)_2}$ 'A' $\xrightarrow[H^+]{H_2N-OH}$ 'B'

ii. Write IUPAC name of the following compound:



iii. Write chemical test to distinguish between the following compounds: Phenol and Benzoic acid

26. Zinc rod is dipped in 0.1 M solution of $ZnSO_4$ **[3]**

The salt is 95% dissociated at is dilution at 298 K . Calculate the electrode potential. Given:

$E^0(Zn^{2+}/Zn)$ = -0.76

27. a. Among the following, which will have inversion of configuration on reaction with aqueous alkali and why? **[3]**

i. 1-chloropropane

OR

ii. 2-chloro-2-methylpropane

b. Which of the following (A) or (B) will be the major product in the reaction given below? Give a suitable reason for your answer.

$$CH_3 - CH_2 - CH(Br) - CH_3 + \text{alc. } KOH \longrightarrow$$
$$CH_3 - CH_2 - CH = CH_2(\ A) + CH_3 - CH\ = CH - CH_3(B)$$

28. A reaction is first order in A and second order in B. **[3]**

a. Write the differential rate equation.

b. How is the rate affected on increasing the concentration of B three times?

c. How is the rate affected when the concentrations of both A and B are doubled?

Section D

29. **Read the following text carefully and answer the questions that follow:** **[4]**

Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups - monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellolose.

Another biomolecule : proteins are polymers of α-amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. Structure and shape of proteins can be studied at four different levels i.e. primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

i. What is the difference between a glycosidic linkage and peptide linkage? (1)

ii. Which amino acids are called essential amino acids? (1)

iii. What are the common types of secondary structures of proteins? Write any two forces which stabilise the secondary and tertiary structures of protein. (2)

OR

Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity? (2)

30. **Read the following text carefully and answer the questions that follow:** **[4]**

To explain bonding in coordination compounds various theories were proposed. One of the important theories was valence bond theory. According to that, the central metal ion in the complex makes available a number of empty orbitals for the formation of coordination bonds with suitable ligands. The appropriate atomic orbitals of the metal hybridise to give a set of equivalent orbitals of definite geometry.

The d - orbitals involved in the hybridisation may be either inner d-orbitals i.e., (n - 1) d or outer d - orbitals i.e. nd. For example, Co^{3+} forms both inner orbital and outer orbital complexes, with ammonia it forms $[Co(NH_3)_6]^{3+}$ and with fluorine it forms $[CoF_6]^{3-}$ complex ion.

i. Which of the following is not true for $[CoF_6]^{3-}$? (1)

a. It is paramagnetic.
b. It has coordination number of 6.
c. It is outer orbital complex.
d. It involves d^2sp^3 hybridisation.

ii. Write the structure and magnetic character of $[Co(NH_3)_6]^{3+}$? (1)

iii. Why $[CoF_6]^{3-}$ is paramagnetic? (2)

OR

Give one example for inner orbital or low spin complex? (2)

Section E

31. **Attempt either A or B** **[5]**

i. **Answer the following questions:** **[1]**

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

ii. How would you account for:

a. The E^o value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple or Fe^{3+}/Fe^{2+} couple.

b. Complete the following equation:

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

iii. What is the general valence shell configuration of f-block elements?

iv. Actinoid contraction is greater from element to element than lanthanoid contraction, why?

v. What is the most common oxidation state of lanthanoids and actinoids?

ii. **Answer the following questions:** **[1]**

i. Identify the following:

i. Oxo anion of chromium which is stable in acidic medium.
ii. The lanthanoid element that exhibits +4 oxidation state.

ii. Why first ionisation enthalpy of chromium is lower than that of Zn?

iii. Write the general configuration of d-block elements.

iv. La^{3+} (Z = 57) and Lu^{3+} (Z = 71) do not show any colour in solutions. Give reason.

v. Why are transition elements good catalysts?

32. **Attempt either A or B** **[5]**

i. **Answer the following questions:** **[1]**

i. Why is benzene diazonium chloride not stored and is used immediately after its preparation?

ii. How is the basic strength of aromatic amines affected by the presence of an electron releasing group?

iii. Arrange the following in increasing order of boiling point:
$C_2H_5OH, (CH_3)_2NH, C_2H_5NH_2$

iv. Write a short note on coupling reactions.

v. Give IUPAC name of $H_2N\text{-}CH_2\text{-}CH_2\text{-}CH{=}CH_2$

ii. **Answer the following questions:** **[1]**

i. Methyl amine is stronger base than ammonia. Give reason.

ii. Account for the following:

i. pK_b of aniline is more than that of methylamine.

ii. Primary amines have higher boiling points than tertiary amine.

iii. Explain briefly:

a. Carbylamine reaction

b. Gabriel phthalimide synthesis

iv. Out of $(CH_3)_3N$ and $(CH_3)_2NH$, which one is more basic in aqueous solution?

v. Draw the structure of 2-aminotoluene.

33. A solution containing 30 g of non-volatile solute exactly in 90 g of water has a vapour pressure of 2.8 kPa at 298 K. Further, 18 g of water is then added to the solution and the new vapour pressure becomes 2.9 kPa at 298 K. Calculate: **[5]**

i. molar mass of the solute

ii. vapour pressure of water at 298 K.

OR

a. Write two characteristics of non-ideal solution.

b. 2 g of benzoic (C_6H_5COOH) dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62 K. Molal depression constant for benzene is 4.9 K kg mol^{-1}. What is the percentage association of acid if it forms dimer in solution?

Solution

Section A

1.

(c) Methanamine (CH_3NH_2)

Explanation:

$CH_3Cl + NH_3 \rightarrow CH_3NH_2 + HCl$

Ammonia molecule is a nucleophile in nature as it has unpaired electrons. This nucleophile attacks the chloromethane CH_3Cl molecule and forms methylamine or methenamine by a nucleophilic substitution reaction mechanism. The carbon atom is partially positive in the molecule, due to the electronegativity of the halide attached which is partially negative. The electron-rich nucleophile attacks the positive ion, causing the halide ion to be separated from the molecule.

2. **(a)** functional group isomers

Explanation:

Glucose and fructose are both monosaccharides with the same molecular formula ($C_6H_{12}O_6$) but different structural formulas. They differ in the arrangement of their functional groups; glucose has an aldehyde group, while fructose has a ketone group. This difference in functional groups classifies them as functional group isomers.

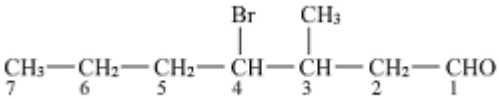
3.

(b) 4 – Bromo – 3 – methylheptanal

Explanation:

The IUPAC of the above compound will be more clear if we open up the structure:

The structure of the above compounds is (longest chain contain 7 carbon)



Hence the IUPAC name of the above compound is 4-Bromo-3-methylheptanal.

4.

(d) Alkene

Explanation:

Alkene

5.

(d) -k

Explanation:

The slope in the plot of [R] Vs. time for a zero-order reaction is –k.

6.

(c) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

Explanation:
(a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

7. **(a)** $CH_2 = CH - CH_2 - CH_2 - Cl$

Explanation:
$CH_2 = CH - CH_2 - CH_2 - Cl$

8.

(d) Insulin and glucagon

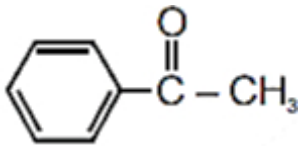
Explanation:
The role of insulin is to keep the blood glucose level within the narrow limit. Insulin is released in response to the rapid rise in blood glucose level. On the other hand hormone glucagon tends to increase the glucose level in the blood. The two hormones together regulate the glucose level in the blood.

9.

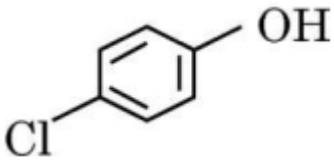
(d) activation energy of reaction

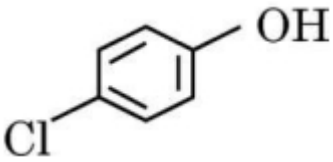
Explanation:
A catalyst lowers the activation energy of a reaction so as to faster the rate of reaction.

10.

(b) 

Explanation:
The solution identifies 'X' as option based on the visual characteristics and patterns present in the images. Each option presents a different arrangement or design, and option aligns best with the criteria or theme established by the question. The choice is likely based on specific features, such as shapes, colors, or symmetry, that are consistent with the intended identification of 'X'.

11. **(a)** 

Explanation:


12.

(d) N-Ethyl-N-methylethanamine

Explanation:
By alkylation reaction of methyl amine with two moles of ethyl chloride, N-Ethyl-N-methylethanamine is formed.

$$CH_3NH_2 + C_2H_5Cl \longrightarrow CH_3 - \underset{\displaystyle CH_2CH_3}{\overset{\displaystyle |}{NH}} \xrightarrow{C_2H_5Cl} CH_3 - \underset{\displaystyle C_2H_5}{\overset{\displaystyle |}{N}} - C_2H_5$$

(N−ethyl−N−methylethanamine)

13. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation:
Due to denaturation, a protein loses its biological activity. During denaturation, the protein molecule uncoils from a more random conformation and precipitates from the solution.

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

15. **(c)** A is true but R is false.
Explanation:
A is true but R is false.

16. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
In the reaction of the alcohol with $SOCl_2$, HCl is produced and tertiary amine promotes the reaction by reacting with HCl.

Section B

17. $\Lambda^{\circ}_{m(CaC_2)} = \Lambda^{\circ}_{m(Ca^{2+})} + 2\Lambda^{\circ}_{m(Cr^{-})}$
= 119 + (2 × 76.3) = 271.6 S cm^2 mol^{-1}
$\Lambda^{\circ}_{m(MgSO_4)} = \Lambda^{\circ}_{m(Mg^{2+})} + 2\Lambda^{\circ}_{m(SO_4^{2-})}$
= 106 + 160 = 266 S cm^2 mol^{-1}

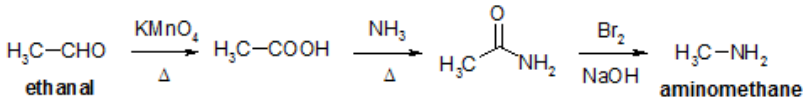
OR

Q = It
$= 1 \times 15 \times 60 = 900C$
The reaction is $\underset{2mol}{2Cl^-} \rightarrow \underset{1mol}{Cl_2} + \underset{2mol}{2e^-}$
$\therefore$ 2F produces 1 mol of Cl_2
1 mol of Cl_2 = 71g
$\therefore$ $2 \times 96500C$ produces 71g of Cl_2
900 C will produce $\frac{71}{2} \times \frac{900}{96500}$ g = 0.331 g of Cl_2

18. Osmotic pressure (π) = $\frac{W \times R \times T}{M \times V}$
W = 5 gm, R = 0·0821 L atm K^{-1} mol^{-1}
V(Volume in litres) = $\frac{100}{1000}$
= 0.1 litres, M = 60 gm/mole, T = 300 K
$\pi = \frac{5 \times 0.0821 \times 300}{60 \times 0.1}$
Osmotic pressure at 300K = 20.525 atm

19. Fe^{2+} is strong reducing agent because it will get oxidized to Fe^{3+}($3d^5$) which has half filled d-orbital which is more stable.

20. Answer the following:
(a) First order.
(b) For a reaction R $\rightarrow$ P, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactants. Thus, it follows first order reaction.

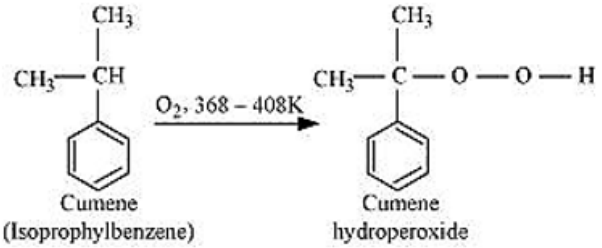
21. 

Section C

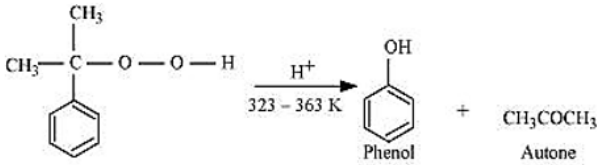
22. $\Lambda^{\circ}_{m(HAc)} = \Lambda^{\circ}_{m(HCl)} + \Lambda^{\circ}_{m(NaAc)} - \Lambda^{\circ}_{m(NaCl)}$
$= (426 + 91 - 126)$
$= 391\ S\ cm^{2}\ mol^{-1}$
$\alpha = \frac{\Lambda_m}{\Lambda^{\circ}_m}$
$= \frac{48.1}{391}$
$= 0.123$

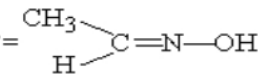
23. a. Dichloridobis(ethane-1,2-diamine) iron(III) ion
b. Tetraammineaquabromidocobalt(III) sulphate
c. Tetracyanidonickelate(II) ion

24. To prepare phenol, cumene is first oxidized in the presence of air of cumene hydro-peroxide.



Then, cumene hydroxide is treated with dilute acid to prepare phenol and acetone as by-products.



25. i. $A = CH_3CHO$, $B =$ 

ii. 3-Bromobenzaldehyde / 3-Bromobenzene carbaldehyde

iii. Benzoic acid gives brisk effervescence liberating carbon dioxide on reaction with sodium hydrogen carbonate while phenol does not. / In terms of chemical reaction mentioning brisk effervescence.

26. $\left[Zn^{2+}\right] = 0.1 \times \frac{95}{100} = 0.095M$
$Zn^{2+} + 2e^{-} \rightarrow Zn$
$E_{(Zn^{+}/Zn)} = E^{0}_{(Zn^{+}/Zn)} - \frac{0.0591}{2}\log\frac{1}{[Zn^{2+}]}$
$= -0.76V - \frac{0.0591}{2}\log\frac{1}{0.095}$
$= -0.76V - \frac{0.0591}{2}[\log 1000 - \log 95]$
$= -0.76 - \frac{0.0591}{2}[3.000 - 1.9777]$
$= -0.76V - \frac{0.0591}{2} \times 1.0223$
$= -0.76V - \frac{0.0604}{2} = 0.76 - 0.0302$
= - 0.7902 V

27. a. i. 1-Chloropropane 1° (Primary) alkyl halide/less sterically hindered carbon

b. (B)/$CH_3CH = CHCH_3$, as it has greater number of alkyl groups attached to the doubly bonded carbon atom./the preferred product is that alkene which has greater number of alkyl groups attached to the doubly bonded carbon atom/By Saytzeff rule

28. It is given that a reaction is first order in A and second order in B.

a. The differential rate equation will be
$-\frac{d[R]}{dt} = k[A][B]^2$

b. If the concentration of B is increased three times, then
$-\frac{d[R]}{dt} = k[A][3B]^2 = 9.k[A][B]^2$
Therefore, the rate of reaction will increase 9 times.

c. When the concentrations of both A and B are doubled,
$-\frac{d[R]}{dt} = k[A][B]^2 = k[2A][2B]^2 = 8.k[A][B]^2$
Therefore, the rate of reaction will increase 8 times.

Section D

29. i. Peptide linkage: A linkage formed when two amino acids are joined through – CONH – bond.
Glycosidic linkage: When two monosaccharides are joined through oxygen atom.

ii. Those which are not synthesised in the body and must be obtained through diet.

iii. α-helix and β-pleated sheet.
Hydrogen bond, van der Waals forces, disulphide linkages, electrostatic force of attraction.
OR
Loss of biological activity when native form of protein is subjected to change in temperature, pH, etc. Example, curdling of milk.
Secondary and tertiary structure lose their biological activity.

30. i. It involves d^2sp^3 hybridization.

ii. It is an octahedral, diamagnetic, and inner orbital complex.

iii. Due to presence of 4 unpaired electrons.
OR
$[Co(CN)_6]^{3-}$

Section E

31. Attempt either A or B

(a) Answer the following questions:

i. $Cr_2O_7^{2}/CrO_4^{2}/K_2Cr_2O_7/K_2CrO_4$

ii. a. Mn^{3+} changes to Mn^{2+} stable half-filled d5 configuration/much larger third ionization enthalpy of Mn whereas Cr^{3+} and Fe^{3+} have stable configuration.

b. $2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

iii. F-block elements are those in which the last electron enters the f orbital. F- orbital can accommodate maximum of 14 electrons.
The general electronic configuration of f-block elements is $(n-2)\ f^{1-14}\ (n-1)\ d^{0-1}ns^2$

iv. It is because of poor shielding of 4f and 5f electrons in actinoids whereas in lanthanoids there is poor shielding effect of 4f electrons only, that is why effective nuclear charge increases more from element to element in actinoids than lanthanoids.

v. The common oxidation states of

1. 4f series (Lanthanoids) have stable oxidation state as +3. Although +2 and +4 compounds also exist. For example: the formation of Ce(IV)is favoured by its noble gas configuration, but it is a strong oxidant reverting to the common +3 state.
2. 5f series (Actinoids) show in general +3 oxidation state. The elements, in the first half of the series frequently exhibit higher oxidation states. For example, the maximum oxidation state increases from +4 in Th to +5, +6 and +7.

(b) Answer the following questions:

i. i. $Cr_2O_7^{2-}$

ii. Cerium

ii. The electronic configuration of chromium and zinc are respectively:

Cr(24) = [Ar] $3d^5 4s^2$

Zn(30) = [Ar] $3d^{10} 4s^2$

It is easy to remove electron from 4 s^1 -orbital (unpaired) rather than from $4s^2$ -orbital (paired). Therefore, first ionisation enthalpy of Cr is less than Zn.

iii. D block elements are those elements in which the last electron enters the d orbital of the pen- ultimate shell.

For example : Sc (Atomic No. 21) has configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$. 4s orbital has lower energy than the energy of 3d orbital so, last electron enters d orbital (3d) of pen-ultimate shell .

Similarly Fe(Atomic No. 26) has configuration$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6 4s^2$
Cr (Atomic No. 24) and Cu (Atomic No. 29due to extra stability associated by half filled and fully filled orbital has following configuration :

Cr :$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5 4s^1$

Cu:$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10} 4s^1$

So, the general electronic configuration of d- block elements will be $(n-1)\,d^{1-10} ns^{1-2}$

iv. La^{3+} (lanthanum) have $4f^0$ and Lu^{3+} (lutetium) have $4f^{14}$ configuration. Because of the absence of unpaired electrons, these ions impart no colour to the solution.

v. The transition metals and their compounds are known for their catalytic activity. This activity is due to their ability to adopt multiple oxidation states and to form complexes.

32. Attempt either A or B

(a) Answer the following questions:

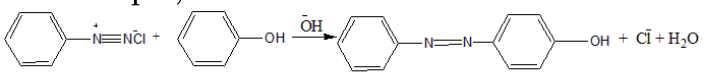
i. Benzene diazonium chloride is very unstable. Therefore, it cannot be generally stored and is used immediately after its preparation.

ii. Basic strength increases due to increase in electron density on nitrogen, which makes easy availability of lone pair of electrons.

iii. $(CH_3)_2NH < C_2H_5NH_2 < C_2H_5OH$

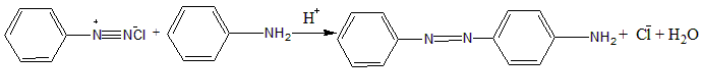
iv. **Coupling reaction:** The reactions in which a diazonium ion is joined or coupled to the ring of a phenol or an aromatic amine are called coupling reactions. The azo products obtained in the coupling reaction have an extended conjugated system having both the aromatic rings joined through the -N = N- bond. These compounds are often coloured and are used as dyes.

For example,



Phenol

Orange azo dye



Aniline

Yellow azo dye

v. $\overset{1}{H_2}N-\overset{2}{C}H_2-\overset{3}{C}H_2-\overset{4}{C}H=CH_2$

The IUPAC name is But-3-en-1-amine.

(b) Answer the following questions:

i. It is because the methyl group is electron releasing and increases electron density on nitrogen.

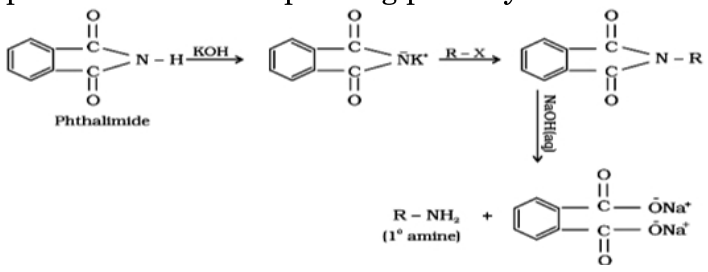
ii. i. lone pair of electrons are delocalised over benzene ring due to resonance, electron density decreases and hence less available for protonation.

ii. Presence of intermolecular hydrogen bonding in primary amines which is absent in tertiary amines.

iii. a. Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul-smelling substances.

$$R\text{ - }NH_2 + CHCl_3 + 3KOH \xrightarrow{\text{Heat}} R\text{ - }NC + 3KCl + 3H_2O$$

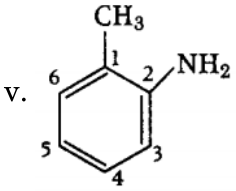
b. Phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine./



iv. $(CH_3)_2NH$ = Secondary amine

$(CH_3)_3$-N = Tertiary amine

Secondary amines are more basic than tertiary amines in aqueous solution due to steric factor. So, $(CH_3)_2NH$ is more basic in aqueous solution.

v. 

2-aminotoluene

33. i. Let, the molar mass of the solute be $Mgmol^{-1}$

Now, the no. of moles of solvent (water), $n_1 = \frac{90\ g}{18\ g\ mol^{-1}} = 5\,mol$

And, the no. of moles of solute, $n_2 = \frac{30\ g}{M\ mol^{-1}} = \frac{30}{M}\,mol$

$p_1 = 2.8\,kpa$

Applying the relation:

$\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1 + n_2}$

$\frac{p_1^0 - 2.8}{p_1^0} = \frac{\frac{30}{M}}{5 + \frac{30}{M}}$

$1 - \frac{2.8}{p_1^0} = \frac{\frac{30}{M}}{\frac{5M+30}{M}}$

$1 - \frac{2.8}{p_1^0} = \frac{30}{5M+30}$

$\frac{2.8}{p_1^0} = 1 - \frac{30}{5M+30}$

$\frac{2.8}{p_1^0} = \frac{5M+30-30}{5M+30}$

$\frac{2.8}{p_1^0} = \frac{5M}{5M+30}$

$\frac{p_1^0}{2.8} = \frac{5M+30}{5M} \ldots\ldots\ldots\ldots (i)$

After the addition of 18 g of water:

$n_1 = \frac{90+18g}{18} = 6\,mol$

$p_1 = 2.9\,kPa$

Again, applying the relation:

$\frac{p_1^0-p_1}{p_1^0} = \frac{n_2}{n_1+n_2}$

$\frac{p_1^0-2.9}{p_1^0} = \frac{\frac{30}{M}}{6+\frac{30}{M}}$

$1-\frac{2.9}{p_1^0} = \frac{\frac{30}{M}}{\frac{6M+30}{M}}$

$1-\frac{2.9}{p_1^0} = \frac{30}{6M+30}$

$\frac{2.9}{p_1^0} = 1-\frac{30}{6M+30}$

$\frac{2.9}{p_1^0} = \frac{6M+30-30}{6M+30}$

$\frac{2.9}{p_1^0} = \frac{6M}{6M+30}$

$\frac{p_1^0}{2.9} = \frac{6M+30}{6M} \ldots\ldots\ldots\ldots\ldots\ldots (ii)$

Dividing equation (i) by (ii), we have:

$\frac{2.9}{2.8} = \frac{\frac{5M+30}{5M}}{\frac{6M+30}{6M}}$

$\frac{2.9}{2.8} \times \frac{6M+30}{6} = \frac{5M+30}{5}$

$2.9 \times 5 \times (6M+30) = 2.8 \times 6 \times (5M+30)$

87M + 435 = 84 M +504

3M = 69

M = 23

Therefore, the molar mass of the solute is $23 gmol^{-1}$.

ii. Putting the value of M=23 in equation (i), we have:

$\frac{p_1^0}{2.8} = \frac{5\times23+30}{5\times23}$

$\frac{p_1^0}{2.8} = \frac{145}{115}$

$p_1^0 = 3.53$

Hence, the vapour pressure of water at 298 K is 3.53 kPa.

OR

a. The following are features of non-ideal solutions:
Raoult's Law does not apply to non-ideal solutions. The interactions between the solute and the solvent (B–B) and the solvent and the solute (A–A) are not the same as the solvent-solute (A–B) interaction, $\Delta H_{mix} \neq 0$

b. n = 2 (dimer)

$\Delta T_f = i\, K_f m$

i = 1.62 × 122 × 25/4.9 × 2 × 1000

i = 0.504

α = 2(1 - i)

α = 2(1 - 0.504)

= 0.992

= 99.2%