# SAMPLE PAPER 10

# CHEMISTRY PAPER 1
## (THEORY)

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*Maximum Marks: 70*

*Time Allowed: Three Hours*

*(Candidates are allowed **additional 15 minutes** for **only** reading the paper.*

*They must **NOT** start writing during this time.)*

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*This paper is divided into four sections – A, B, C and D.*
*Answer **all** questions.*
***Section – A** consists of **one** question **having sub-parts** of **one** mark each.*
***Section – B** consists of **ten** questions of **two** marks each.*
***Section – C** consists of **seven** questions of **three** marks each, and*
***Section – D** consists of **three** questions of **five** marks each.*
***Internal choices have been provided in one question each in Section B,***
***Section C and Section D.***
*All working, including rough work, should be done on the same sheet as, and adjacent to the*
*rest of the answer.*
*The intended marks for questions or parts of questions are given in brackets [ ].*
*Balanced equations must be given wherever possible and diagrams where they are helpful.*
*When solving numerical problems, all essential working must be shown.*
*In working out problems, use the following data:*
*Gas constant $R = 1.987$ cal deg$^{-1}$ mol$^{-1}$ = $8.314$ JK$^{-1}$ mol$^{-1}$ = $0.0821$ dm$^3$ atm K$^{-1}$mol$^{-1}$*
*1 L atm = 1 dm$^3$ atm = 101.3 J,  1 Faraday = 96500 coulombs,   Avogadro's number = $6.023 \times 10^{23}$*

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# SECTION A – 14 MARKS

## Question 1

**(A) Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:**
*[does, increases, does not, $k^0$, 5, ethanol, $[R]^0$, 4, $K^+$, ethene, $CN^-$, remains same, decreases, $k[R]^0$]*

**(i)** For a zero order reaction, rate _____ depend on the concentration of any reactant. Therefore, it can be written as rate =_____.

**(ii)** The quantity of ions generated upon the dissolution of potassium ferrocyanide, $K_3[Fe(CN)_6]$, in water is _____. This indicates that _____ functions as the ligand in the coordination compound.

**(iii)** Chloroethane reacts with aq. KOH to form _____ main product while alcoholic KOH form _____as the chief product.

**(iv)** As the carbon chain length of alcohols increases, the boiling point _____, and the solubility in water _____.

**(B) Select and write the correct alternative from the choices given below:**

**(i)** How long would it take to deposit 50 g of Al from an electrolytic cell containing $Al_2O_3$ using a current of 105 amperes?

    **(a)** 1.54 h
    **(b)** 1.42 h
    **(c)** 1.32 h
    **(d)** 2.15 h

**(ii)** Of the following complex ions, which is diamagnetic in nature?

    **(a)** $[NiCl_4]^{2-}$

    **(b)** $[Ni(CN)_4]^{2-}$

    **(c)** $[CuCl_4]^{2-}$

    **(d)** $[CoF_6]^{3-}$

**(iii)** Transition elements form alloys easily because they have

    **(a)** Same atomic number
    **(b)** Same electronic configuration
    **(c)** Nearly same atomic size
    **(d)** None of the above

**(iv)** Which of the following does not react with Hinsberg reagent?

    **(a)** $C_2H_5NH_2$
    **(b)** $(CH_3)_2NH$
    **(c)** $(CH_3)_3N$
    **(d)** $CH_3CH(NH_2)CH_3$

**(v)** The solution that forms maximum boiling azeotropes is

    **(a)** Carbon disulphide – Acetone
    **(b)** Benzene - Toluene
    **(c)** Acetone – Chloroform
    **(d)** $n$-Hexane – $n$-Heptane

**(vi)** **Assertion**:  $H^+$ ion cannot oxidize copper.

**Reason**: Reduction potential of $Cu^{2+}/Cu$ is greater than $H^+/H$.

**(a)** Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
**(b)** Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
**(c)** Assertion is true but Reason is false.
**(d)** Assertion is false but Reason is true.

**(vii)** <u>**Assertion**</u>:  Aliphatic amines are weaker base than ammonia.

<u>**Reason**</u>: +I effect of alkyl group results in high electron density on nitrogen atom.

**(a)** Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
**(b)** Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
**(c)** Assertion is true but Reason is false.
**(d)** Assertion is false but Reason is true.

**(c) Read the passage given below carefully and answer the questions that follow.**

In order to account for the extent of association and dissociation. Van't Hoff introduces a factor called van't Hoff factor ($i$). It is defined as: the ration of the normal (theoretical) and expected (observed) Molar mass. In case of association, the magnitude of experimental mass is greater than theoretical molar Mass. In case of dissociation, the magnitude of experimental mass is less than theoretical molar Mass. In case of no association or dissociation, the magnitude of experimental molar mass is equal to theoretical   molar mass, so van't Hoff factor value is equal to one.

**(i)** What is the van't Hoff factor for a compound which undergoes dimerisation in an organic solvent?

**(ii)** A compound X undergoes tetramerization in a given organic solvent. What is the van't Hoff factor?

**(iii)** How much molecular mass of NaCl is obtained experimentally using colligative properties?

# SECTION B – 20 MARKS

## Question 2

**(i)** Arrange the following compounds in the increasing order of their acid strengths:
   4-nitrophenol, phenol, 2,4,6-trinitrophenol

**(ii)** Phenol exhibits a significantly shorter C-O bond compared to ethanol. Provide an explanation for this difference.

## Question 3

Give a reason for each of the following:

**(i)** Salts of cuprous ($Cu^+$) ions appear colorless, while salts of cupric ($Cu^{2+}$) ions exhibit color.

**(ii)** Zinc, with an atomic number of 30, not considered a transition element.

## Question 4

Give balanced chemical equations to convert the following:
**(i)** Ethanol to methylamine
**(ii)** Cinnamic acid to (3-chloropropyl) benzene

## Question 5

Answer the following:

**(i)** Why does $K_2Cr_2O_7$ act as a powerful oxidizing agent in acidic medium?

**(ii)** Why does Mn(II) ion show maximum paramagnetic character amongst the bivalent ions of first transition series?

## Question 6

Identify and specify the presence of a chiral center, if applicable, in the given molecules. Determine the number of stereoisomers for those molecules that contain a chiral center.

**(i)** 1,2-dibromopropanez

**(ii)** 4-chloro-pent-1-ene

## Question 7

Elaborate on the electrochemical nature of the corrosion process in iron and elucidate the reactions involved when iron undergoes corrosion in the atmosphere.

## Question 8

What happens when (write chemical reactions only)

        **(a)** Propanone is treated with dilute $BaOH_2$?

        **(b)** Phenol reacts with $CO_2$ in the presence of NaOH followed by acidification?

## Question 9

Rakesh mixes 0.30 g of acetic acid with 100 g of benzene and notices that the boiling point increases by 0.0633 °C. Can you help Rakesh figure out the molecular weight of acetic acid? Also, based on this, what can we say about the form of the acetic acid molecules in the solution?
(Given, $K_b$ for benzene is 2.53 K kg mol$^{-1}$, and the atomic weights are C = 12, H = 1, O = 16)

                              [*Help means you are to calculate in your answer script*]

## Question 10

**(i)** Why does *o*-toluic acid exhibit higher acidic strength than benzoic acid?

**(ii)** How will you obtain cinnamic acid from benzaldehyde? *(Write chemical reaction only.)*

## Question 11

**(i)** Actinoid contraction is greater from element to element than lanthanoid contraction
**(ii)** A transition metal exhibits higher oxidation states in oxides and fluorides.

# SECTION C – 21 MARKS

## Question 12

The initial rate of reaction: **A + 5B + 6C → 3D + 3E** has been determined by measuring the rate of disappearance of A under the following conditions:

| Expt. No. | $[A]_0$ (M) | $[B]_0$ (M) | $[C]_0$ (M) | Initial rate (M min$^{-1}$) |
|---|---|---|---|---|
| 1. | 0.02 | 0.02 | 0.02 | $2.08 \times 10^{-3}$ |
| 2. | 0.01 | 0.02 | 0.02 | $1.04 \times 10^{-3}$ |
| 3. | 0.02 | 0.04 | 0.02 | $4.16 \times 10^{-3}$ |
| 4. | 0.02 | 0.02 | 0.04 | $8.32 \times 10^{-3}$ |

**(i)** Determine the order of reaction with respect to each reactant.

**(ii)** What is the rate constant?

**(iii)** Calculate the initial rate of the reaction when the concentration of all the reactants is 0.01 M.

## Question 13

**(i)** Arrange the following compounds in the ascending order of their basic strength and give reasons for your answer:

Methylamine, Aniline, Ethylamine, Diethyl ether

**(ii)** Propanamine and N, N-dimethylmethanamine contain the same number of carbon atoms, even though propanamine has higher boiling point than N, N-dimethylmethanamine. Give reason.
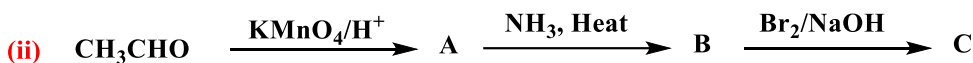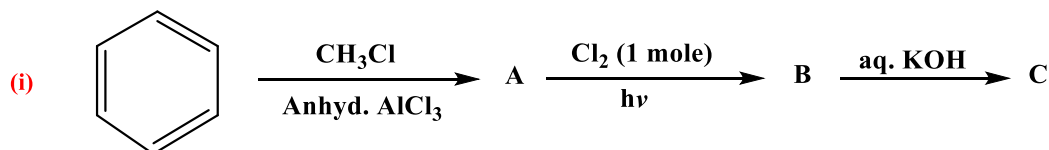
## Question 14

**(i)** Name the bases present in RNA? Which one of these is not present in DNA

**(ii)** Write the chemical equation for the reaction of glucose with HI.

**(iii)** Water soluble vitamins must be supplied in diet regularly. Why?

## Question 15

**(i)** What type of deviation from Raoult's Law is expected when phenol and aniline are mixed with each other? What change in the net volume of the mixture is expected? Graphically represent the deviation.

**(ii)** The vapour pressure of pure water at a certain temperature is 23.80 mm Hg. If 1 mole of a nonvolatile non-electrolytic solute is dissolved in 100 g water, Calculate the resultant vapour pressure of the solution.

## Question 16

Identify the compounds [A], [B] and [C].

**(i)**   $\underset{\text{Anhyd. AlCl}_3}{\overset{\text{CH}_3\text{Cl}}{\longrightarrow}}$ **A** $\underset{h\nu}{\overset{\text{Cl}_2 \text{ (1 mole)}}{\longrightarrow}}$ **B** $\overset{\text{aq. KOH}}{\longrightarrow}$ **C**

**(ii)**   $CH_3CHO$ $\overset{\text{KMnO}_4/\text{H}^+}{\longrightarrow}$ **A** $\overset{\text{NH}_3, \text{ Heat}}{\longrightarrow}$ **B** $\overset{\text{Br}_2/\text{NaOH}}{\longrightarrow}$ **C**

## Question 17

**(i)** How will the following be obtained? (Give chemical equations only)

    **(a)** Isopropyl alcohol to iodoform

    **(b)** 2-Chloropropane to 1-propanol

    **(c)** Aniline to chlorobenzene

## Question 18

**(i)** During nuclear explosion, one of the products is $^{90}$Sr with half-life of 28.1 years. If 1µg of $^{90}$Sr was absorbed in the bones of a newly born baby instead of calcium. How much of it will remain after 10 years if it is not lost metabolically.

**(ii)** The rate of the reaction becomes two times when the temperature is increased from 400 K to 410 K. Calculate the activation energy ($E_a$) for the reaction. [R = 8.314 J K$^{-1}$ mol$^{-1}$]

# SECTION D – 15 MARKS

## Question 19

**(i)** Give a reason for each of the following:

**(a)** Dialkyl cadmium is considered superior to Grignard's reagent for the preparation of ketones from acid chlorides.

**(b)** Benzoic acid undergoes nitration predominantly at meta position but not at ortho and para positions.

**(ii)** An organic compound with the molecular formula $C_7H_7NO_2$, exhibits three isomeric forms. Among them, isomer 'A' possesses the highest melting point. Upon reduction, 'A' transforms into compound 'B' with the molecular formula $C_7H_9N$. Subsequent treatment of 'B' with $NaNO_2/HCl$ at 0-5 °C results in the formation of compound 'C'. Further, when 'C' undergoes a reaction with $H_3PO_2$, it converts to 'D' with the formula $C_7H_8$. 'D', upon additional reaction with $CrO_2Cl_2$ followed by hydrolysis, gives rise to 'E', identified as $C_7H_6O$. Provide the structural representations of compounds A to E and the chemical equations involved.

## Question 20

**(i)** Consider the complex, $Na_2[Ni(CN)_4]$, and answer the following:

**(a)** State whether the complex is paramagnetic or diamagnetic.

**(b)** What is the state of hybridization of $Ni^{2+}$ ion in the complex?

**(ii)** On the basis of Crystal Field Theory, write the electronic configuration of $d^4$ in terms of $t_{2g}$ and $e_g$ in an octahedral field when $\Delta_o > P$.

**(iii)** When a coordination compound $CrCl_3.6H_2O$ is treated with excess $AgNO_3$, 2 moles of AgCl are precipitated per of the compound. Write:

   **(a)** The structural formula of the complex

   **(b)** IUPAC name of the complex

## Question 21

**(i) (a)** Calculate the degree of dissociation of 0.0024 M $CH_3COOH$ if conductivity of the solution is 8.0 x $10^{-5}$ S cm$^{-1}$. [Given, $\lambda_{H^+}^0 = 349.6$ S cm$^2$ mol$^{-1}$ and , $\lambda_{CH_3COO^-}^0 = 40.9$ S cm$^2$ mol$^{-1}$]

**(b)** Calculate the $E_{cell}$ and $\Delta G$ of the cell where the following cell reaction takes place:

Ni(s)  +  $2Ag^+$ (0.002 M) → $Ni^{2+}$ (0.160 M)  +  2Ag(s)

(Given: $E_{Ni^{2+}/Ni}^o = -0.25$ V;   $E_{Ag^+/Ag}^o = 0.80$ V)

**OR**

**(ii) (a)** Find the cell constant and specific conductance for a cell by examining the resistance of a decinormal salt solution situated between two platinum electrodes. The electrodes, spaced 1.8 cm apart with a collective area of 5.4 cm$^2$, exhibit a measured resistance of 50 ohms. Calculate the cell constant and specific conductance of the solution using the given dimensions and resistance value.

**(b)** State two functions of salt bridge in electrochemical cell.

**(c)** Calculate the potential of the following cell reaction at 298 K.
$Sn^{4+}$(1.5 M) + Zn(s) $\rightarrow$ $Sn^{2+}$(0.50 M) + $Zn^{2+}$(2.0 M)
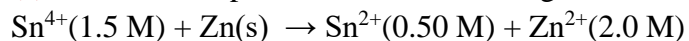
The standard potential $E^0$ of the cell is 0.89 V. Whether the potential of the cell will increase or decrease, if the concentration of $Sn^{4+}$ is increased in the cell?

***************************** The End *****************************