PRACTICE PAPER 4
CHEMISTRY THEORY (043)

MM:70 **Time: 3 Hours**

General Instructions:
Read the following instructions carefully.

a) There are 33 questions in this question paper. All questions are compulsory.
b) Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
c) Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
d) Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
e) Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
f) There is no overall choice. However, internal choices have been provided.
g) Use of calculators and log tables is not permitted.

SECTION A (OBJECTIVE TYPE)

1. **1. Read the passage given below and answer the following questions: (1x4=4)**

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

In this question, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a) If assertion and reason both are correct statements and reason is correct explanation for assertion.
b) If assertion and reason both are correct statements but reason is not correct explanation for assertion
c) If assertion is correct statement but reason is wrong statement.
d) If assertion is wrong statement but reason is correct statement

(i). **Assertion (A)**: Carboxylic acids contain a carbonyl group but do not give characteristic reactions of the carbonyl group.
Reason (R): Due to resonance, the electrophilic nature of the carboxyl carbon is greatly reduced as compared to the carbonyl carbon in aldehydes and ketones.

(ii). **Assertion (A)**: Compounds containing –CHO group are easily oxidised to corresponding carboxylic acids.
Reason (R): Carboxylic acids can be reduced to alcohols by treatment with $LiAlH_4$.

OR

Assertion (A): CH_3CHO gives Iodoform test but CH_3CH_2CHO does not.
Reason (R): CH_3CHO contains CH_3 group at α position of carbonyl carbon.

(iii). **Assertion (A)**: Formaldehyde is a planar molecule.
Reason (R): It contains sp^3 hybridisation.

(iv). **Assertion (A)**: Fehling solution oxidizes acetaldehyde to acetic acid as well as benzaldehyde to benzoic acid.
Reason (R): The C—O bond of –CHO group in acetaldehyde is stronger than in benzaldehyde.

2. The particles of colloidal solution possess electric charge which is responsible for stability of these solutions. The charge on colloidal particles arises because of selective adsorption of ions which are common with their own lattice. The presence of charge on colloidal particles can be determined with the help of a phenomenon known as electrophoresis. However, when some electrolyte is added, the charge on the particles of dispersed phase gets neutralised and precipitation takes place. This process is called coagulation which is given by Hardy Schulze rule. According to these rules the ions carrying the charge opposite to that of sol is directly proportional to the fourth power of the valency of the ion. Coagulation can also occur by mutual precipitation, by electrophoresis, by persistent dialysis or by heating or cooling.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i)The charge of colloidal particles can be determined by the phenomenon
(a) electrodialysis
(b) electrophoresis
(c) Bredig's arc method
(d) electro-osmosis

(ii)Which of the following electrolyte is most effective for coagulation $Fe(OH)_3$ sol?
(a) $K_3[Fe(CN)_6]$
(b) $Na_2C_2O_4$
(c) K_2SO_4
(d) KCl

OR

Which of the following is correct on basis of flocculating power in Hardy-Schulze rule.
(a) $Al^{3+} > Ba^{2+} > Na^+$
(b) $Al^{3+} < Ba^{2+} < Na^+$
(c) $Al^{3+} < Ba^{2+} > Na^+$
(d) $Al^{3+} > Ba^{2+} < Na^+$

(iii) The stability of colloidal solution is due to
(a) size of colloidal particles
(b) charge of colloidal particles
(c) movement of colloidal particles under applied electric field

(d) tendency to show tyndall effect

(iv) Which of the following electrolyte require maximum concentration to cause coagulation of As_2S_3 sol ?
(a) $AlCl_3$
(b) $MgSO_4$
(c) $K_3[Fe(CN)_6]$
(d) KCl

3. If limiting molar conductivity of Ca^{2+} and Cl^- are 119.0 and 76.3 S cm^2 mol^{-1}, then the value of limiting molar conductivity of $CaCl_2$ will be
(a) 195.3 S cm^2 mol^{-1}
(b) 271.6 S cm^2 mol^{-1}
(c) 43.3 S cm^2 mol^{-1}
(d) 314.3 S cm^2 mol^{-1}.

4. Curdling of milk is an example of:
a) breaking of peptide linkage
b) hydrolysis of lactose
c) breaking of protein into amino acids
d) denaturation of protein

5. People add sodium chloride to water while boiling eggs. This is to
(a) decrease the boiling point.
(b) increase the boiling point.
(c) prevent the breaking of eggs.
(d) make eggs tasty.

6. Which of the following has magnetic moment value of 5.9 B.M.?
(a) Fe^{2+}
(b) Fe^{3+}
(c) Ni^{2+}
(d) Cu^{2+}

OR

Which of the following is not a diamagnetic ion: (Atomic numbers of Sc, V, Mn and are 21, 23, 25 and 30 respectively)
(a) Co^{2+}
(b) Sc^{3+}
(c) Zn^{2+}
(d) Mn^{7+}

7. Which one of the following characteristics of the transition metals is associated with higher catalytic activity?
(a) High enthalpy of atomisation

(b) Paramagnetic behaviour
(c) Colour of hydrate ions
(d) Variable oxidation states

8. Identify the end product (C) in the following sequence:

$$C_2H_5OH \xrightarrow[\text{Pyridine}]{SOCl_2} A \xrightarrow{KCN\ (alc.)} B \xrightarrow{2H_2O/H^+} C$$

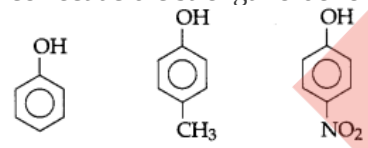
(a) $C_2H_5CH_2NH_2$ (b) $C_2H_5CONH_2$
(c) C_2H_5COOH (d) $C_2H_5NH_2 + HCOOH$

9. Identify X and Y in the following sequence

$$C_2H_5Br \xrightarrow{X} Product \xrightarrow{Y} C_3H_7NH_2$$

(a) X = KCN, Y = $LiAlH_4$
(b) X = KCN, Y = H_3O^+
(c) X = CH_3Cl, Y = $AlCl_3$ HCl
(d) X = CH_3NH_2, Y = HNO_2

10. The correct acidic strength order of the following



I II III

is –

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

11. Aniline is less basic than ethylamine. This is due to
(a) Conjugation of lone pair of nitrogen with the ring
(b) The insoluble nature of aniline
(c) More K_b value of aniline
(d) Hydrogen bonding

OR

Glucose is:

(a) Vitamin
(b) Disaccharide
(c) Reducing sugar
(d) Nucleic acid

In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

12. **Assertion (A):** When a solution is separated from the pure solvent by a semi- permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.
Reason (R): Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

13. **Assertion (A)**: Total number of octahedral voids present in unit cell of cubic close packing including the one that is present at the body centre, is four.
Reason (R): Besides the body centre, there is one octahedral void present at the centre of each of the six faces of the unit cell and each of which is shared between two adjacent unit cells.

14. **Assertion (A):** SF_6 cannot be hydrolysed but SF_4 can be.
Reason (R): Six F atoms in SF_6 prevent the attack of H_2O on sulphur atom of SF_6.

15. **Assertion (A):** The α-hydrogen atom in carbonyl compounds is not acidic.
Reason (R): The anion formed after the loss of α -hydrogen atom is resonance stabilised

OR

Assertion (A): Phenol is more basic than alcohols
Reason (R): Phenoxide ion is resonance stabilised

16. **Assertion (A):** Addition reaction of water to but-l-ene in acidic medium yields-butan-2-ol.
Reason (R): Addition of water in acidic medium proceeds through the formation of secondary carbocation.

SECTION B

The following questions, Q. No 17 – 25 are short answer type and carry 2 marks each.

17. With the help of resonating structures explain the effect of presence of nitro group at ortho position of chlorobenzene towards nucleophilic substitution reaction. (2)

OR

Write the chemical equation involved in Reimer-Tiemann reaction. (2)

18. 18 g of glucose, $C_6H_{12}O_6$ (Molar mass – 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K) (2)

19. (i) $[NiCl_4]^{2-}$ is paramagnetic, whereas $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why?
(ii) Explain $[Co(NH_3)_6]^{3+}$ is inner orbital complex , whereas $[Ni(NH_3)_6]^{2+}$ is an orbital complex.[Atomic number of Co=27,Ni=28] (1X2=2)

20. Nitrogen pentoxide decomposes according to equation:
$2N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2(g)$.
This first order reaction was allowed to proceed at 40°C and the data below were collected :

(a) Calculate the rate of reaction in 1st 20 minutes.
(b) Calculate the rate constant. Include units with your answer.
(Use $\log_{10}1.39 = 0.14$) (1X2=2)

$[N_2O_5](M)$	0.400	0.289	0.209	0.151	0.109
Time(min)	0	20	40	60	80

21. The First order reaction takes 20 min for 25% decomposition. Calculate the time when 75% of the reaction will be completed. (2)

22. Write the mechanism for the formation of ethoxy ethane from ethanol. (2)

OR

Write the mechanism of acid catalysed dehydration of ethanol. (2)

23. Draw the structures of (i) $HClO_3$ (ii) H_2SO_3 (2)

24. A compound forms ccp structure. What is the total number of voids in 0.5 mol of compound? How many of these are tetrahedral voids? (2)

25. How are the following conversions carried out?
(i) Benzyl chloride to benzyl alcohol.
(ii) Methyl magnesium bromide to 2-methyl- propan-2-ol. (1X2=2)

SECTION C

(Q. No 26 -30 are Short Answer Type II carrying 3 mark each.)

26. How would you account for the following?
(i) Many of the transition elements are known to form interstitial compounds.
(ii) With the same d-orbital configuration (d^4) Cr^{2+} is a reducing agent while Mn^{3+} is an oxidizing agent
(iii) The enthalpies of atomization of transition elements are quite high. (1X3=3)

27. (i) Arrange the following in the decreasing order of their basic strength in aqueous solutions: CH_3NH_2, $(CH_3)_2$ NH, $(CH_3)_3N$ and NH_3
(ii) Give the chemical tests to distinguish between the following pairs of compounds:
Methylamine and Dimethylamine
(iii) How will you convert Benzene to Aniline? (1X3=3)

28. An element occurs in bcc structure. It has a cell edge length of 250 pm. Calculate the molar mass if its density is 8.0 g cm^{-3}. Also calculate the radius of an atom of this element. (3)

OR

An element crystallises in bcc structure with the radius of 1.25 Ă. Calculate edge length & number of unit cell present in $1cm^3$ volume. (3)

29. (i) Amino acids behave like salt rather than simple amines or carboxylic acids. Explain
(ii)Coagulation of egg white on boiling is an example of denaturation of protein. Explain it in terms of structural changes
(iii)Form a dipeptide glycylalanine with glycine and alanine: Alanine $CH_3CH(COOH)(NH_2)$,Glycine $CH_2(NH_2)(COOH)$ (1X3=3)

30. (a) Account for the following : (2)
(i) SF_6 is kinetically inert.
(ii) Bleaching of flowers by Cl_2 is permanent while that of SO_2 is temporary.
(b) Draw the structure of $H_2S_2O_8$ (1)

SECTION D

Q. No 31 to 33 are long answer type carrying 5 marks each.

31. (a) Complete the following chemical reaction equations : (2)
(i) $XeF_4 + H_2O \rightarrow$
(ii) NaOH (hot and conc.) + $Cl_2 \rightarrow$
(b) X' has a boiling point of 4.2K, lowest for any known substance. It is used as a diluent for oxygen in modern diving apparatus. Identify the gas 'X'. Which property of this gas makes it usable as diluent? Why is the boiling point of the gas 'X' so low? (3)

OR

(a) Give the formula and describe the structure of noble gas species which is isostructural with:

(i) ICl_4^- (ii) IBr_2^- (iii) BrO_3^- (3)

(b) How are XeO_3 and $XeOF_4$ prepared? (2)

32. (a) Write the chemical reaction involved in Wolff-Kishner reduction.
(b) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction:

$C_6H_5COCH_3$, CH_3— CHO, CH_3COCH_3

(c) Why carboxylic acid does not give reactions of carbonyl group?
(d) Write the product in the following reaction.

$$CH_3CH_2CH = CH—CH_2CN \xrightarrow[2.\ H_2O]{1.\ (i—Bu)_2\ AlH}$$

(e) 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 formulae of A and B. (1X5= 5)

OR

An organic compound (A) of molecular formula $C_8H_{16}O_2$ was hydrolysed with dil. H_2SO_4 to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on hydration gives but-1-ene. Identify (A), (B) & (C) and write the reactions involved. (5)

33. (i) Conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation. (3)
Given : $\lambda^0(H^+) = 349.5$ Scm^2 mol^{-1}
and $\lambda^0(HCOO^-) = 50.5$ Scm^2 mol^{-1}.
(ii) A voltaic cell is set up at 25°C with the following half cells:
Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)
The reaction occurs when the cell generates an electric current. Determine the cell potential.
$(E^\circ_{Ni^{2+}/Ni} = -0.25V, E^\circ_{Al^{3+}/Al} = -1.66V)$.
(2)

OR

(i) The resistance of a conductivity cell containing 0.001M KCl solution at 298K is 1500 Ohm. What is the cell constant if conductivity of 0.001M KCl solution at 298K is 0.146×10^{-3} Scm^{-1} (2).
(ii) The cell in which the following reaction occurs:
$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$ has $E^\circ_{cell} = 0.236V$ at 298 K
Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction. (3)