

## Rekha V.V.I. Questions for 2022 Examination

*Answers of below mentioned questions are present in your  
Rekha Examination Guide Part-II Chemistry – III (Hons.)*

1. Explain the following :
- (a)  $P-V$  adiabatic curve is steeper than  $P-V$  isotherm. **V. V. I.** ..... 9
- (b) Work done in a reversible isothermal process is maximum. .... 9
- (c) Under what condition  $\Delta H = \Delta E$  for a chemical reaction ? .... 10
- (d) Limitations of the 1st law of Thermodynamics. .... 10
- (e) Applications of first law of Thermodynamics. .... 10
- (f) Enthalpy change is equal to the heat absorbed by the system at constant pressure. .... 10
- (g) How are internal energy and enthalpy interrelated ? .... 11
- (h) Show that  $C_p - C_v = R$ . .... 11
- (i) "Entropy of the universe is always increasing." **V. V. I.**  
**Or,** The net entropy of the universe tends to increase. .... 11
- (j) Advantages of the phase rule. .... 11
- (k) Limitation of the phase rule. .... 12
- (l) For one component system, the triple point is invariant. **V. V. I.** .... 12
- (m) Difference between double and complex salts. **V. V. I.** .... 12
- (n)  $K_2SO_4 \cdot AlSO_4 \cdot 24H_2O$  is a double salt. **V. V. I.** .... 13
- (o) Fluorine is the most electronegative element in the periodic table. .... 13
- (p) Fluorine is the strongest oxidising agent.  
**Or,** Why fluorine is a stronger oxidising agent than other halogens ? .... 13
- (q)  $BF_3$  is lewis acid but  $NH_3$  is lewis base. **V. V. I.** .... 13
- (r)  $PbCl_2$  is stable but  $PbCl_4$  is unstable. **V. V. I.** .... 13
- (s) Nickel carbonyl is tetrahedral in shape and structure. .... 13
- (t) Carbon tetrachloride is non-polar. **V. V. I.** .... 14
- (u) Oxygen is paramagnetic. **V. V. I.** .... 14
- (v)  $SF_6$  molecule is octahedral in shape. .... 14
- (w)  $CH_4$  is tetrahedral and  $NH_3$  is pyramidal in shape.  
**Or,** Bond angle in  $NH_3$  is less than that of  $CH_4$  molecule. .... 15
- (x) Iodine is volatile solid, bromine is liquid and chlorine is gas at room temperature. .... 15
- (y)  $NO^+$  is more stable than  $NO$ . .... 15
- (z)  $HClO_4$  is stronger oxyacid than  $HClO$ . .... 16

**Group – A**  
**PHYSICAL CHEMISTRY**

**1. Thermodynamics**

1. What do you mean by extensive and intensive properties ?  
Explain with example. .... 17
2. Explain reversible and irreversible processes and thermodynamic equilibrium. .... 17
3. Explain the difference between the following : **V. V. I.**
  - (a) Perfect and imperfect differentials. .... 18
  - (b) Isothermal and adiabatic processes. .... 18
  - (c) Free energy and work function. .... 19
4. Find out the relationship of pressure and volume in adiabatic process.  
**Or,** Derive the relation between P, V and T for an adiabatic process. .... 19
5. State Kirchhoff's law. Derive its equation. .... 20
6. Explain the following : **V. V. I.**
  - (a) Heat of reaction .... 22
  - (b) Heat of formation .... 22
  - (c) Heat of neutralisation .... 23
7. (a) Explain heat capacity at constant volume ( $C_v$ ) and at constant pressure ( $C_p$ ).  
**Or,** Explain molar heat capacities  $C_p$  and  $C_v$ . .... 23  
(b) Show thermodynamically for an ideal gas  $C_p - C_v = R$  **V. V. I.** .... 24
8. (a) What are the limitations of first law of thermodynamics ? .... 24  
(b) State and explain second law of thermodynamics. .... 25
9. Describe Carnot's cycle for establishing the maximum convertibility of heat into work.  
**Or,** Explain Carnot's cycle and derive an expression for efficiency of Carnot's engine. **V. V. I.** .... 25
10. Deduce different forms of Gibbs Helmholtz Equation and discuss its two applications. .... 28
11. Derive Clapeyron-Clausius equation. Also, Discuss its application. .... 31
12. Write notes on the following : **V. V. I.**
  - (a) Enthalpy and its physical significance .... 33
  - (b) Hess's law .... 33
  - (c) Carnot's theorem .... 34
  - (d) Entropy and its physical signification .... 34
  - (e) Van't Hoff Reaction Isotherm .... 35
  - (f) Criteria of thermodynamic equilibrium and feasibility .... 36

## 2. Phase Rule Equilibrium

1. Explain reduced phase rule equation and the terms involved in it.  
**Or**, Explain Phase, Component and Degree of freedom. .... 36
2. Explain triple point and eutectic point. **V. V. I.** .... 38
3. Explain phase diagram of water system. **V. V. I.** .... 39
4. Discuss one component system with reference to sulphur system explaining phase diagram.  
**Or**, Giving phase diagram for the sulphur system, point out the possible invariant system in it. **V. V. I.** .... 41
5. Draw and explain the phase diagram of Pb–Ag.  
**Or**, Define two component system. Classify solid liquid equilibrium of two component system. .... 44
6. Describe phase diagram of KI.H<sub>2</sub>O system. .... 46

**Group – B**  
**INORGANIC CHEMISTRY**

### 1. Chemistry of d – block elements

1. Explain the general chemistry of transition series element. .... 48  
**Or**, What are d–block elements? Explain the following properties of these elements :
  - (i) Electronic configuration and variable oxidation state. .... 48
  - (ii) Ionization potential .... 49
  - (iii) Complex formation .... 50
2. Discuss the chemistry of Cr (Chromium) with respect to the following : **V. V. I.**
  - (a) Position in P.T. .... 50
  - (b) Occurrence / ore and extraction .... 51
  - (c) Important oxidation states .... 51
  - (d) Colour of the compounds .... 51
  - (e) Analytical Test. .... 52
3. Discuss the chemistry of Mn (Manganese) with respect to the following :
  - (a) Position in P.T. .... 53
  - (b) Occurrence / Ore and extraction .... 53
  - (c) Important oxidation state .... 54
  - (d) Analytical test. .... 55
4. Discuss the chemistry of Co (Cobalt) with respect to the following : **V. V. I.**
  - (a) Position in P.T. .... 55
  - (b) Occurrence / Ore and extraction .... 55
  - (c) Important oxidation states .... 56
  - (d) Colour of the compounds .... 56
  - (e) Analytical test. .... 56

5. Discuss the chemistry of Ni (Nickel) with respect to the following :
- |                                     |          |
|-------------------------------------|----------|
| (a) Position in P.T.                | ..... 57 |
| (b) Occurrence / Ore and extraction | ..... 57 |
| (c) Important oxidation states      | ..... 59 |
| (d) Analytical test.                | ..... 59 |

## 2. Co-ordination Compounds

- |  |          |
|--|----------|
| 1. Describe simple, double and complex salts with example.   | ..... 60 |
| 2. Give IUPAC names of the following : <b>V. V. I.</b>   |          |
| (i) $K_4[Fe(CN)_6]$  | ..... 60 |
| (ii) $[Ag(NH_3)_2Cl]$  | ..... 60 |
| (iii) $K_2[PtCl_4]$  | ..... 60 |
| (iv) $[Cr(H_2O)_4Cl_2]^+$  | ..... 60 |
| (v) $[Co(en)_2Cl(ONO)]^+$  | ..... 60 |
| (vi) $[Fe(H_2O)_2Cl_4]^-$  | ..... 60 |
| (vii) $[Cu(NH_3)_4]SO_4$   | ..... 60 |
| (viii) $[Co(NH_3)_5(CO_3)]Cl$  | ..... 61 |
| (ix) $[Co(en)_3]Cl_3$  | ..... 61 |
| (x) $[Co(NH_3)_6]Cl_3$   | ..... 61 |
| (xi) $K[Ag(CN)_2]$   | ..... 61 |
| (xii) $K_2[HgCl_4]$  | ..... 61 |
| (xiii) $K_3[Fe(CN)_6]$   | ..... 61 |
| (xiv) $Hg[Co(SCN)_4]$  | ..... 61 |
| (xv) $K_2[Zn(OH)_4]$   | ..... 61 |
| (xvi) $Fe[Fe(CN)_6]$   | ..... 61 |
| (xvii) $Na[Co(CO)_2)_4]$   | ..... 61 |
| (xviii) $[Cu(H_2O)(NH_3)Br_2]$   | ..... 61 |
| (xix) $[Ni(CO)_4]$   | ..... 61 |
| (xx) $[Fe(C_5H_5)_2]$  | ..... 61 |
| 3. Give an account of Werner's theory of Co-ordination compounds.  | ..... 61 |
| 4. Discuss isomerism in complex compounds.<br><b>Or,</b> What do you mean by isomerism in co-ordination compound ? Discuss various types of isomerism among co-ordination compounds. | ..... 62 |
| 5. Explain Sidgwick's theory. <b>V. V. I.</b><br><b>Or,</b> Explain Sidgwick's effective atomic number (EAN) rule. Give two example in support of and two in against of this rule.   | ..... 67 |
| 6. Calculate the effective atomic number (EAN) of central metal ion in the following complexes–  |          |
| (i) $[Cu(NH_3)_4]SO_4$   | ..... 68 |
| (ii) $K_4[Fe(CN)_6]$   | ..... 68 |
| (iii) $K_3[Fe(C_2O_4)_3]$  | ..... 68 |
| (iv) $[Co(NH_3)_4(H_2O)_2]Cl_3$  | ..... 68 |

7. Discuss the valence bond theory with examples.  
**Or**, Discuss the main postulates of valence bond theory for co-ordination complexes. .... 68
8. On the basis of Valence Bond Theory, predict the structure and magnetic properties of the following atom / ion / complex. **V. V. I.** .... 72

### 3. Chemistry of Fluorine

1. (a) Give an important ore for the extraction of fluorine. .... 76  
 (b) How is fluorine extracted and stored ? .... 76
2. Discuss the chemistry of fluorine. **V. V. I.**  
**Or**, Discuss the modern method of manufacture, properties and uses of fluorine. .... 77
3. Give a method to prepare HF and discuss its abnormal b.p.  
**Or**, Discuss the preparation and properties of hydrogen fluoride. .... 79
4. Why and how does fluorine differ from other members of halogen family ? .... 80
5. Write a short note on oxides of halogens. .... 81
6. Write a note on oxyacids of halogens. .... 82
7. (a) Fluorine does not form oxyacids. Why ?  
**Or**, Fluorine exists only in - 1 state while other halogens exhibit negative as well as positive oxidation states. Why ? .... 82  
 (b) Bond energy of HF is greater than that of HI. Why ? .... 82  
 (c)  $\text{NH}_4\text{BF}_2$  is well known but  $\text{NH}_4\text{HCl}_2$  or  $\text{NH}_4\text{HBr}_2$  does not exist. Why ? .... 82  
 (d) Electronegativity of halogen indicates that HF should be the most ionic and hence the strongest acid of all halogen hydra-acids but actually it is the weakest. Why ? **V. V. I.** .... 83

### 4. Oxides, Oxyacids and Peroxy acids of Sulphur

1. Describe the preparation, properties, structure and uses of Sodium thiosulphate or hypo. .... 83
2. Describe the preparation, properties, structure and uses of thionic acids. **V. V. I.** .... 85

### 5. Chemical Bonding

1. Discuss molecular orbital theory. **V. V. I.**  
**Or**, Give the salient features of molecular orbital theory. .... 89
2. Discuss the M.O. diagram of the following. Also, discuss its bond order and magnetic behaviour. **V. V. I.**  
 (a)  $\text{H}_2$  (b)  $\text{B}_2$  (c)  $\text{N}_2$  (d)  $\text{O}_2$  (e)  $\text{O}_2^+$  (f) CO (g) NO .... 89
3. Discuss electronegativity difference and dipole moment difference in determining the ionic character. **V. V. I.** .... 94

## 6. Analytical Test

1. Explain solubility product. Write down the application of it. **VVI** .... **95**
2. (a) What are interfering radicals ? ..... **95**  
 (b) How would you detect phosphate radical in the inorganic salt mixture? ..... **95**  
 (c) Discuss the principle or chemistry involved in the removal of phosphate radical by basic ethanoate method. .... **95**
3. (a) Why the removal of phosphate is essential after the separation of group II basic radicals ? ..... **96**  
 (b) Sometimes phosphate solution is added during the removal of phosphate radical by basic ethanoate method. Explain why ? ..... **96**  
 (c) In the removal of phosphate, neutral  $\text{FeCl}_3$  solution is needed. Why? Can  $\text{AlCl}_3$  or  $\text{CrCl}_3$  be used in place of  $\text{FeCl}_3$ ? ..... **96**
4. How is borate detected and removed ? ..... **97**
5. Write a short note on chromyl chloride test. **V. V. I.** ..... **97**

## 7. Water Pollution and its Control

1. Discuss water pollution with special reference to the following :  
 (a) D.O. (b) B.O.D. (c) C.O.D. .... **98**
2. Describe the sources of water pollution. How can it be controlled ? ..... **101**
3. Write a short note on Pollutants of Water. **V. V. I.** ..... **102**

## 8. Portland Cement

1. (a) Write a note on Portland cement. .... **103**  
 (b) Discuss the reaction taking place in rotary kiln during the manufacturing of Portland cement. .... **103**
2. Write a short note on setting of cement. **V. V. I.** ..... **104**

## CHEMISTRY – 3 (Hons.) (2021)

Answer Five questions, selecting at least one from each Group in which Q. No.1 is compulsory.

1. Explain any three of the following :
  - (a) Analytical test of fluoride ion.
  - (b) Dipole moment of  $\text{NH}_3$  is greater than  $\text{NF}_3$ .
  - (c) Free energy is extensive property while chemical potential is an intensive property.
  - (d) Under what condition  $\Delta H = \Delta E$  for a chemical reaction.
  - (e) Work done is isothermal and reversible process is maximum.

### **Group-A**

2.
  - (a) State and explain Second law of thermodynamics.
  - (b) Deduce Gibbs- Helmholtz equation.
3. Explain any three of the following :
  - (a) Internal energy and Enthalpy.
  - (b) Molar heat capacities  $C_p$  &  $C_v$ .
  - (c) Kirchhoff's Law.
  - (d) Adiabatic process.
4.
  - (a) Explain reduced phase rule equation.
  - (b) Draw and explain the phase diagram of  $\text{KI} - \text{H}_2\text{O}$ .
5. Write notes on any three of the following :
  - (a) Carnot's theorem
  - (b) Triple point
  - (c) Clausius – clapeyron equation
  - (d) First law of thermodynamics

### **Group-B**

6. Explain molecular orbital theory and from molecular orbital diagram draw the structure of  $\text{N}_2$ ,  $\text{N}_2^+$  and  $\text{N}_2^-$ .
7. Discuss the chemistry of Mn or Ni with respect to the following :
  - (i) Oxidation state
  - (ii) Ore and Extraction
  - (iii) Colour of the compound
  - (iv) Analytical test
  - (v) Uses
8.
  - (a) Discuss Valence Bond theory of Co-ordination compounds with two examples.
  - (b)  $\text{Ni}(\text{Co})_4$  is tetrahedral and diamagnetic.
9. Explain different types of Isomerism shown by co-ordination compound.
10. Write notes on any two of the following:
  - (i) Oxy acids of Sulphur
  - (ii) Properties of Fluorine
  - (iii) Werner theory of Co-ordination compounds.

## CHEMISTRY – 3 (Hons.) (2020)

Answer five questions, selecting at least one from each Group, in which Q. No. 1 is compulsory.

1. Explain any three of the following :
  - (a) Entropy of universe is always increasing. .... 11
  - (b) P-V adiabatic curve is steeper than P-V isotherm. .... 9
  - (c) For one component system, the triple point is on invariant. .... 12
  - (d) Carbon tetrachloride is non-polar. .... 14
  - (e)  $K_2SO_4 \cdot Al_2SO_4 \cdot 24H_2O$  is a double salt. .... 13

### Group-A

2. (a) Explain heat capacity of constant volume and at constant pressure. .... 23  
 (b) Show thermodynamically that for an ideal gas  $C_p - C_v = R$ . .... 24
3. Describe Carnot's cycle for establishing the maximum convertibility of heat into work. .... 25
4. (a) Explain triple point and eutectic point. .... 38  
 (b) Discuss the component system with reference to sulphur system explaining phase diagram. .... 41
5. Write notes on any three of the following :
  - (a) Free energy and work function .... 19
  - (b) Isothermal and adiabatic process .... 18
  - (c) Vant Hoff reaction isobar .... 35
  - (d) Hess Law .... 33

### Group-B

6. Discuss the Chemistry of Cr on Co with respect to the following : ....50-55
  - (i) Position in PT (ii) Oxidation State (iii) Ores and extraction
  - (iv) Colour of the Compound (v) Analytical test
7. (a) Discuss Molecular Orbital theory. .... 89  
 (b) Draw Molecular Orbital diagram of  $B_2$ ,  $O_2$  and  $O_2^+$ . .... 89
8. Discuss the modern method for manufacture properties and uses of Fluorine. .... 77
9. On the basis of Valence Bond theory predict the structure and magnetic property of the following : .... 72
  - (i)  $[Fe(CN)_6]^{4-}$  (ii)  $[Fe(CN)_6]^{3-}$  (iii)  $[CO(H_2O)_6]^{2+}$
  - (iv)  $[Ni(CN)_4]^{2-}$  (v)  $[Mn(NH_3)_6]^{2+}$
10. Write notes on any two of the following :
  - (a) EAN rule .... 67
  - (b) Werner theory of Coordination Compounds .... 61
  - (c) Solubility product .... 95
  - (d) Water Pollutants .... 102



## CHEMISTRY - 3 (Hons.) (2019)

Answer five questions, selecting at least one from each Group, in which Q. No.1 is compulsory.

1. Explain any three of the following :
  - (a)  $\text{PbCl}_2$  is stable but  $\text{PbCl}_4$  is unstable. .... 13
  - (b) Differentiate between double salt and complex salt. .... 12
  - (c) Oxygen is paramagnetic. .... 14
  - (d) Free energy is extensive property while chemical potential is an intensive property.
  - (e) First law of thermodynamics is the law of conservation of energy.

### Group-A

2. (a) State and explain second law of thermodynamics. .... 25  
 (b) Deduce Gibbs-Helmholtz equation. .... 28
3. Explain the following :
  - (a) Heat of Reaction .... 22
  - (b) Heat of Formation .... 22
  - (c) Heat of Neutralization .... 23
4. (a) Explain reduced phase rule equation and term involved. .... 36  
 (b) What is eutectic point ? .... 38
5. Write notes on any three of the following :
  - (a) Water system .... 39
  - (b) Van't Hoff reaction Isotherm .... 35
  - (c) Criteria of thermodynamics equilibrium and feasibility .... 36
  - (d) Carnot's theorem .... 34

### Group-B

6. Draw MO diagram of  $\text{O}_2$  and  $\text{O}_2^+$ . Compare their bond order, bond energy and magnetic property. .... 89
7. Explain the chemistry of Mn or Ni with respect to the following : ....53-57
  - (a) Position in PT
  - (b) Occurrence of extraction
  - (c) Oxidation state
  - (d) Analytical test
8. Discuss the preparation, properties and structure of the following :
  - (a) Thionic acids .... 85
  - (b) Sodium thiosulphate .... 83
9. (a) Discuss the isomerism in complex compounds. .... 62  
 (b) Give the IUPAC name of the following : .... 60
  - (i)  $\text{K}_2[\text{Ni}(\text{CN})_4]$
  - (ii)  $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
10. Write notes on any three of the following.
  - (a) Chromyl Chloride Test .... 97
  - (b) Dipole Moment .... 94
  - (c) Solubility Product and its Application .... 95
  - (d) Setting of Cement .... 104

## CHEMISTRY - 3 (Hons.) (2018)

Answer five questions, selecting at least one from each Group, in which Q.No. 1 is compulsory

1. Explain the following :

- (a) Under what condition  $\Delta H = \Delta E$  for a chemical reaction ? ..... 10
- (b) The net entropy of the universe tends to increase. .... 11
- (c) For one component system, the triple point is an invariant point. .... 12
- (d)  $\text{BF}_3$  is Lewis acid but  $\text{NH}_3$  is Lewis base. .... 13
- (e) Nickel carbonyl is tetrahedral in shape and structure. .... 13

### Group-A

- 2. (a) Explain heat capacity at constant volume and at constant pressure. .... 23
- (b) Show thermodynamically that for an ideal gas  $C_p - C_v = R$ . .... 24
- 3. Describe Carnot's cycle for establishing the maximum convertibility of heat into work. .... 25
- 4. (a) What are the limitations of first law of thermodynamics ? .... 24
- (b) State Kirchhoff's law. Derive its equation. .... 20
- 5. (a) Explain reduced phase rule equation. .... 36
- (b) Draw and explain the phase diagram of Pb-Ag. .... 44

### Group-B

- 6. Draw M.O. diagram of CO. Discuss its bond order and magnetic behaviour. .... 89
- 7. Predict the structure and magnetic properties of the following : .... 72
- (a)  $[\text{Fe}(\text{CN})_6]^{4-}$  (b)  $[\text{Fe}(\text{CN})_6]^{3-}$  (c)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- (d)  $[\text{Ni}(\text{CN})_4]^{2-}$  (e)  $[\text{Mn}(\text{NH}_3)_6]^{2+}$
- 8. Discuss the chemistry of Co or Cr with respect to the following : .....50-55
- (a) Position in P.T. (b) Occurrence and extraction
- (c) Important oxidation states (d) Analytical test
- 9. (a) Give one important ore for the extraction of fluorine. .... 76
- (b) How is fluorine extracted and stored ? .... 76
- 10. Write short notes on any three of the following :
- (a) Portland cement .... 103
- (b) Pollutants of water .... 102
- (c) Dipole moment .... 94
- (d) EAN rule .... 67

## Rekha V.V.I. Questions for 2022 Examination

*Answers of below mentioned questions are present in your  
Rekha Examination Guide Part-II Chemistry – IV (Hons.)*

### SHORT ANSWER TYPE QUESTIONS

1. Explain the following :
  - (a) Transport number of an ion is a function of absolute velocities of ions. ..... 9
  - (b) How is molar and equivalence conductivity related with specific conductivity ? ..... 10
  - (c) Effect of dilution on conductivity.  
**Or,** Equivalence conductivity increases with dilution. ..... 10
  - (d)  $\text{Li}^+$  aqueous moves slower than  $\text{Na}^+$  aqueous. ..... 11
  - (e) EMF of a Cell. **V. V. I.** ..... 11
  - (f) How does a Catalyst increase the speed of a reaction ?  
**Or,** Catalyst affect the rate of reaction. **V. V. I.** ..... 11
  - (g) Ethyl acetoacetate exhibits keto-enol tautomerism. **V. V. I.** ..... 13
  - (h) Chloroacetic acid is stronger acid than acetic acid. **V. V. I.** ..... 13
  - (i) Alcohols are stronger acids than alkanes. ..... 14
  - (j) Alkynes do not exhibit geometrical isomerism. ..... 14
  - (k) Tartaric Acid exhibits optical isomerism. ..... 14
  - (l) Lactic acid is optically active. **V. V. I.** ..... 16
  - (m) Glucose shows mutarotation. **V. V. I.** ..... 16
  - (n) Glucose and fructose show osazone formation. ..... 17
  - (o) Chair form of cyclohexane is more stable than boat form. ..... 17
  - (p) Nitrobenzene is metadirecting.  
**Or,**  $\text{NO}_2$  group in nitrobenzene is meta-directing. ..... 17
  - (q) Benzene undergoes electrophilic substitution reaction. ..... 18
  - (r) Benzene does not possess any dipole moment. ..... 18
  - (s) Phenol is acidic in nature.  
**Or,** Phenol is stronger acid than ethanol. ..... 18
  - (t) Benzaldehyde undergoes Cannizzaro reaction. ..... 19
  - (u) Methylamine is stronger base than ammonia. ..... 19
  - (v) Aniline is less basic than methylamine. ..... 19
  - (w) Aniline is weaker base than ammonia. **V. V. I.** ..... 20

**Group – A**  
**PHYSICAL CHEMISTRY**

**1. Electrochemistry**

1. (a) Define specific conductivity and molar conductivity.  
**Or,** Define specific, equivalent and molar conductivities.  
Give their units. .... 21
- (b) What is the effect of dilution on specific equivalent and molar conductivities ? .... 22
2. State and explain Ostwald's Dilution Law. Mention its limitations. **V. V. I.** .... 22
3. Explain Kohlrausch's law and its application.  
**Or,** Discuss Kohlrausch's law. How does it help in determining the equivalent conductivity of a weak electrolyte at infinite dilution ? .... 23
4. How is solubility and solubility product of a sparingly soluble salt determined conductometrically ? .... 25
5. Discuss conductometric titration of
  - (i) Strong acid with strong base .... 26
  - (ii) Weak acid with strong base .... 27
  - (iii) Strong acid with weak base .... 27
  - (iv) Weak acid with weak base .... 28
6. (a) What do you mean by transport number of ions ? How is transport number determined by Hittorf's method, when electrodes are not attached ? **V. V. I.** .... 28
- (b) Discuss different factors which influence transport number of ions. **V. V. I.** .... 31
- (c) Find out the expression which relates transport number with absolute velocities of ions. **V. V. I.** .... 32
7. What is Nernst equation for the potential of an electrode ? Can Nernst equation be applied to the cell reaction ? Apply this equation to a general reaction.  $aA + bB \longrightarrow cC + dD$  .... 32
8. What is E.M.F. of the cell ? Explain the application of E.M.F. .... 33
9. (a) What is glass electrode ? Explain. **V. V. I.** .... 34
- (b) How is pH of solution determined using glass electrode ? **VVI** .... 35
- (c) How is glass electrode superior to quinhydrone electrode ? Explain. **V. V. I.** .... 35
10. Write short notes on : **V. V. I.**
  - (a) Transport number determination by Moving Boundary Method .... 35
  - (b) Conductometric Titrations .... 36
  - (c) Potentiometric Titrations .... 37

(d) Electrode Potential	.....	37
(e) Reversible electrodes and its type	.....	38
(f) Hydrogen electrode	.....	39
(g) Calomel electrode	.....	40
(h) Reference Electrode	.....	41
(i) Quinhydrone Electrode	.....	41

## 2. Catalysis

1. Explain the following :-		
(a) Positive catalysis (or, accelerator)	.....	42
(b) Negative catalysis (or, inhibitor)	.....	42
(c) Autocatalysis	.....	43
2. Explain the general characteristics of catalysis.	.....	43
3. (a) Explain homogeneous and heterogeneous catalysis.	.....	45
(b) Discuss the mechanism of homogeneous and heterogeneous catalysis.	.....	46
4. Discuss the theory of heterogeneous catalytic reactions.		
<b>Or</b> , Explain the adsorption theory of catalysis. <b>V. V. I.</b>	.....	48
5. (a) Explain acid-base catalysis and its mechanism. <b>V. V. I.</b>	.....	49
(b) What do you mean by promoter and poison ? <b>V. V. I.</b>	.....	50
6. Explain enzyme catalysis with its mechanism.	.....	51
7. Write short notes on : <b>V. V. I.</b>		
(a) Acid-Base Catalysis	.....	54
(b) Enzyme Catalysis	.....	55

**Group – B**  
**ORGANIC CHEMISTRY**

### 1. Active Methylene Compound

1. Write a short note on Keto-enol tautomerism. <b>V. V. I.</b>	.....	56
2. (a) What are active methylene compounds ? Why is methylene group active ? Name three active methylene compounds.	.....	57
(b) How is ethyl acetoacetate synthesized ?	.....	58
(c) Discuss the synthetic application of ethyl acetoacetate.		
<b>Or</b> , Starting from ethyl acetoacetate how can you synthesize the following :		
(i) 2-Pentanone	.....	59
(ii) Acetylacetone	.....	60
(iii) Acetic acid and Diethyl acetic acid	.....	60
(iv) Succinic acid	.....	61
(v) Crotonic acid	.....	61
(vi) 4-Methyl uracid	.....	61

3. (a) Write down the synthesis of diethyl malonate. **V. V. I.** ..... 61  
 (b) Discuss the synthetic application of diethyl malonate. **VVI**  
**Or,** Starting from malonic ester (or, diethyl malonate),  
 how can you synthesize the following :
- (i) Butyric acid ..... 62  
 (ii) 2-methyl Butanoic acid ..... 62  
 (iii) Acetylacetic acid ..... 63  
 (iv) Succinic acid ..... 63  
 (v) Adipic acid ..... 63  
 (vi) Cinnamic acid ..... 63  
 (vii) Barbituric acid ..... 64

## 2. Hydroxy Acids & Dicarboxylic Acid

1. (a) What are hydroxy acids ?  
**Or,** Name three hydroxy acids and write down their structural formula. .... 64  
 (b) Discuss heating effect of  $\alpha$ ,  $\beta$  and  $\gamma$  hydroxy acids. .... 64
2. Give general methods of preparation of  $\alpha$ ,  $\beta$  &  $\gamma$  hydroxy acids. .... 66
3. (a) How is tartaric acid obtained from Argol ? Give its synthesis. **V. V. I.** ..... 67  
 (b) Give one more method of synthesis of tartaric acid. **V. V. I.** ..... 67  
 (c) How does it react with the following : **V. V. I.**
- (i)  $\text{PCl}_5$  (Phosphorous pentachloride) ..... 68  
 (ii) HI (Hydrogen iodide) ..... 68  
 (iii) HBr (Hydrogen bromide) ..... 68
4. (a) Establish a method to determine the structure of tartaric acid. .... 68  
 (b) Give important properties and uses of tartaric acid. .... 69
5. Discuss optical isomerism with special reference to lactic acid and tartaric acid. .... 70
6. (a) What is the natural source of lactic acid ? Give two methods of its manufacturing ? ..... 72  
 (b) What is the action of (i) heat, (ii)  $\text{H}_2\text{SO}_4$ , (iii)  $\text{I}_2$  and alkali on lactic acid ? ..... 73
7. (a) What is the natural source of citric acid and how is it isolated ? **V. V. I.** ..... 73  
 (b) Starting from acetone how would you synthesize citric acid ?  
**Or,** How can you synthesize citric acid ? **V. V. I.** ..... 74  
 (c) Discuss the heating effect on citric acid. .... 74
8. (a) Establish the structure of citric acid. .... 75  
 (b) Discuss the properties and uses of citric acid. .... 76

### 3. Carbohydrate

- |   |          |
|---|----------|
| 1. What are carbohydrates ? How are they classified ?                       | ..... 77 |
| 2. Establish the open chain structure of glucose.                           | ..... 78 |
| 3. Establish the constitution of fructose.                                  |          |
| <b>Or</b> , Establish the open chain structure of fructose. <b>V. V. I.</b> | ..... 79 |
| 4. How do you convert glucose to fructose and vice-versa ?                  |          |
| <b>Or</b> , Give the conversion of the following : <b>V. V. I.</b>          |          |
| (a) Glucose (Aldose) to Fructose (Ketose)                                   | ..... 81 |
| (b) Fructose (Ketose) to Glucose (Aldose)                                   | ..... 81 |
| (c) Aldo-pentose to Aldo-hexose.  | ..... 82 |
| 5. Draw the Haworth and Fischer projection formula for                      |          |
| (i) $\beta$ -D-glucopyranose  | ..... 82 |
| (ii) $\beta$ -D fructofuranose  | ..... 83 |
| (iii) $\alpha$ -D-fructose and  | ..... 83 |
| (iv) $\beta$ -D-fructose.   | ..... 83 |
| 6. Write short notes on : <b>V. V. I.</b>                                   |          |
| (a) Invert Sugar  | ..... 83 |
| (b) Osazone Formation   | ..... 84 |
| (c) Mutarotation  | ..... 85 |

### 4. Stereochemistry

- |  |          |
|--|----------|
| 1. (a) Explain conformational and configurational isomerism.                                 |          |
| <b>Or</b> , Distinguish between conformational and configurational isomers. <b>V. V. I.</b>  | ..... 86 |
| (b) Explain geometric (cis-trans) isomerism.   |          |
| <b>Or</b> , Discuss the geometric isomerism of maleic acid and fumaric acid. <b>V. V. I.</b> | ..... 87 |
| (c) Discuss geometric isomerism with reference to dichloroethene. <b>V. V. I.</b>            | ..... 87 |
| 2. (a) What do you understand by optical isomerism ?   | ..... 88 |
| (b) Discuss optical isomerism due to restricted rotation.                                    | ..... 89 |
| 3. Explain the conformation of <i>n</i> -butane.   | ..... 90 |
| 4. Write short notes on : <b>V. V. I.</b>  |          |
| (a) E/Z notations  | ..... 92 |
| (b) Conformation of Cyclohexane  | ..... 92 |

### 5. Name Reaction

- |   |          |
|---|----------|
| 1. Explain the following name reaction citing the mechanism : |          |
| (a) Reimer–Tiemann reaction <b>V. V. I.</b>                   | ..... 94 |
| (b) Perkin reaction   | ..... 94 |
| (c) Wurtz-Fittig reaction <b>V. V. I.</b>                     | ..... 94 |
| (d) Birch reduction   | ..... 95 |

- (e) Fries rearrangement **V. V. I.** ..... 95  
 (f) Benzoin condensation ..... 96  
 (g) Benzil-Benzilic acid rearrangement ..... 97  
 (h) Knoevenagel's reaction **V. V. I.** ..... 97  
 (i) Baeyer-Villiger oxidation ..... 99

## 6. Aromatic Compounds

1. Predict the product with mechanism :
  - (a) When benzene is treated with conc. sulphuric acid and nitric acid. (Nitration of benzene). ..... 100
  - (b) When benzaldehyde is treated with conc. KOH solution (Cannizzaro reaction). ..... 101
2. Write the mechanism of the following reactions :
  - (i) Sulphonation of Benzene ..... 102
  - (ii) Halogenation of Benzene ..... 103
3. Write a note on directive influence of substituent groups in benzene. ..... 104
4. (a) How is benzene diazonium chloride prepared ? Explain. **VVI** ..... 105  
 (b) Starting from benzene diazonium chloride how will you synthesise the following : (i) Phenol, (ii) Iodobenzene, (iii) Thiophenol, (iv) Chloro, Bromo and Cyanobenzene, (v) Nitrobenzene, (vi) Benzoic acid, (vii) Phenyl hydrazine **VVI** ..... 105
5. Predict the product and mechanism of the following : **V. V. I.**
  - (a) Phenol  $\xrightarrow[125^\circ C, 4-7 \text{ atm}]{CO_2}$  ..... 107
  - (b) Aniline  $\xrightarrow[HCl, 0-5^\circ C]{NaNO_2}$  ..... 108
  - (c) Benzene  $\xrightarrow[anhy. AlCl_3]{CH_3Cl}$  ..... 108
  - (d) Benzene Diazonium Chloride  $\xrightarrow[NaOH]{\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-}$  ..... 108
  - (e) Benzene chloride  $\xrightarrow[Na, \text{ dry ether}]{CH_3Cl}$  ..... 108
  - (f) Toluene  $\xrightarrow[FeCl_3]{Cl_2}$  ..... 108
  - (g) Benzene  $\xrightarrow[\Delta]{conc. H_2SO_4}$  ..... 108
6. Write short notes on : **V. V. I.**
  - (a) Aromaticity ..... 109
  - (b) Kekule structure of Benzene ..... 109
  - (c) Electrophilic Substitution Reaction ..... 110
  - (d) Diazonium salts ..... 111
  - (e) Methyl Orange ..... 112



## CHEMISTRY – 4 (Hons.) (2021)

1. Explain any three of the following :
  - (a)  $\text{Na}^+$  in aqueous solution moves faster than  $\text{Li}^+$  in aqueous solution.
  - (b) Transport number of an ion is function of absolute velocities of ions.
  - (c) Aniline is weaker base than methylamine.
  - (d) Phenol is acidic in nature.
  - (e) Nitro group in nitrobenzene is meta-directing.

### **Group-A**

2.
  - (a) Discuss specific conductance, equivalent conductance & molar conductance.
  - (b) How does dilution affect specific equivalent & molar conductivities?
3.
  - (a) Explain Kohlrausch's Law.
  - (b) Illustrate Nernst equation for electrode potential.
4. Write notes on any two of the following:
  - (a) Calomel electrode
  - (b) Promoters & Poison
  - (c) Acid base catalysis

### **Group-B**

5.
  - (a) Explain active methylene compounds. Why's the methylene group active?
  - (b) Write down the synthesis of ethyl acetoacetate.
  - (c) Starting for ethyl acetoacetate how can you synthesize the following:
    - (i) 2-Hexamone
    - (ii) Succinic acid
    - (iii) 4-Methyluracil
6.
  - (a) What are carbohydrates ? Explain with examples.
  - (b) Discuss the structure of glucose.
7.
  - (a) What are hydroxy acid? cite example.
  - (b) Discuss the optical isomerism of lactic acid.
8. Write an account of any three of the following:
  - (a) Benzil Benzilic acid rearrangement
  - (b) Perocin reactor
  - (c) Benzoin condensation
  - (d) Baeyer villiger oxidation
9.
  - (a) How is phenol obtained for coal tar ?
  - (b) Starting for phenol how can you obtain the following:
    - (i) Phenyl acetate
    - (ii) Benzoquinone
    - (iii) Azo dye
10. Write notes on any three of the following:
  - (a) Aromaticity
  - (b) Muta rotation
  - (c) Orientation in ions substituted aromatic compounds
  - (d) Geometrical isomers

## CHEMISTRY – 4 (Hons.) (2020)

Answer five questions, selecting one from each Group, in which Q. No. 1 is Compulsory.

1. Explain any three of the following :
- |  |       |    |
|--|-------|----|
| (a) Isomolar conductivity is related to specific conductivity. | ..... | 11 |
| (b) Catalysts affect rate of reaction,                         | ..... | 13 |
| (c) Ethyl acetoacetate shows keto-enol tautomerism.            | ..... | 16 |
| (d) Lactic acid is optically active.                           | ..... | 16 |
| (e) Glucose exhibit mutarotation.                              | ..... | 16 |

### Group-A

- |    |  |       |    |
|----|--|-------|----|
| 2. | (a) What do you mean by Transport number of ions? How is transport number determined by Hittorfs method, when electrodes are not attacked? | ..... | 28 |
|    | (b) Discuss the different factors which influence transport number of ions.  | ..... | 31 |
| 3. | (a) Discuss the theory of heterogeneous catalysis.   | ..... | 48 |
|    | (b) Explain the terms, promoters & poisons.  | ..... | 50 |
| 4. | Write notes on any two of the following :  |       |    |
|    | (a) Reversible electrodes  | ..... | 38 |
|    | (b) Enzyme catalysis   | ..... | 55 |
|    | (c) Conducto-metric titration.   | ..... | 36 |

### Group-B

- |     |  |       |     |
|-----|--|-------|-----|
| 5.  | (a) Name three active methylene compounds.                                 | ..... | 57  |
|     | (b) Write down the synthesis of diethyl malonate.                          | ..... | 61  |
|     | (c) Starting from malonic ester how can you synthesize the following.      |       |     |
|     | (i) Barbituric acid  | ..... | 64  |
|     | (ii) 2 - keto butanoic acid  | ..... | 62  |
|     | (iii) Cinnamic acid  | ..... | 63  |
| 6.  | (a) Establish the constitution of fructose.                                | ..... | 79  |
|     | (b) How can you convert fructose to glucose and vice versa?                | ..... | 81  |
| 7.  | Write an account of any three of the following :                           |       |     |
|     | (a) Reimer Tiemann Reaction  | ..... | 94  |
|     | (b) Wurtz - Fittig reaction  | ..... | 94  |
|     | (c) Fries rearrangement  | ..... | 95  |
|     | (d) Birch Reduction  | ..... | 95  |
| 8.  | (a) Discuss the natural source of citric acid and its isolator.            | ..... | 73  |
|     | (b) How can you synthesize citric acid?                                    | ..... | 74  |
|     | (c) Establish the structure of citric acid                                 | ..... | 75  |
| 9.  | (a) How is benzene diazonium chloride prepared?                            | ..... | 105 |
|     | (b) How can you synthesize the following from benzene diazonium chloride : | ..... | 105 |
|     | (i) Benzoic acid (ii) Phenyl hydrazine (iii) Bromo benzene.                |       |     |
| 10. | Write notes on any two of the following :                                  |       |     |
|     | (a) Conformation of Cyclohexane,   | ..... | 92  |
|     | (b) Osazone formation  | ..... | 84  |
|     | (c) Orientation in benzene   | ..... | 109 |

## CHEMISTRY - 4 (Hons.) (2019)

Answer five questions, selecting at least one from each Group, in which Q. No.1 is compulsory.

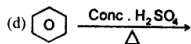
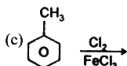
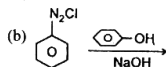
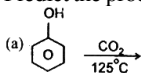
1. Explain any three questions in brief :
- |  |       |    |
|--|-------|----|
| (a) $\text{Li}^+$ aqueous moves slower than $\text{Na}^+$ aqueous. | ..... | 11 |
| (b) EMF of a cell.   | ..... | 11 |
| (c) Chloroacetic acid is stronger acid than acetic acid.           | ..... | 13 |
| (d) $-\text{NO}_2$ grp in Nitrobenzene is meta-directing.          | ..... | 17 |
| (e) Phenol is acidic in nature.                                    | ..... | 18 |

### Group-A

2. (a) Explain specific equivalent and molar conductance. .... 21  
 (b) Explain the effect of dilution on specific, equivalent and molar conductivities. .... 22
3. (a) What is Kohlrausch's law ? .... 23  
 (b) State and explain Ostwald's dilution law. .... 22
4. Write notes on the following :
- |   |       |    |
|---|-------|----|
| (a) Nernst equation for electrode potential | ..... | 32 |
| (b) Acid base catalysis                     | ..... | 54 |
| (c) Calomel electrode                       | ..... | 40 |

### Group-B

5. (a) What are active methylene compound ? Why is the methylene group active ? .... 57  
 (b) How is ethyl acetoacetate synthesized ? .... 58  
 (c) Give the synthesis of the following from ethyl acetoacetate.  
 (i) 4-Methyl Uracil .... 61  
 (ii) Succinic acid .... 61  
 (iii) 2-Pentanone .... 59
6. (a) What are carbohydrates ? .... 77  
 (b) Establish the cyclic structure of glucose. .... 78
7. (a) How is tartaric acid obtained from Argol ? .... 67  
 (b) Write down its synthesis. .... 67  
 (c) Give the reaction of tartaric acid with the following :  
 (i) Conc.  $\text{H}_2\text{SO}_4$   
 (ii) Phosphorous pentachloride .... 68  
 (iii) Hydrogen iodide .... 68
8. Write an account on any three of the following name reactions giving mechanism:
- |   |       |    |
|---|-------|----|
| (a) Perkin reaction                     | ..... | 94 |
| (b) Benzoin condensation                | ..... | 96 |
| (c) Benzil- Benzilic acid rearrangement | ..... | 97 |
| (d) Baeyer Villiger reaction            | ..... | 99 |
9. Predict the product giving the mechanism of any three of the following : .... 107



10. Write notes on any three of the following :
- |                        |                   |
|------------------------|-------------------|
| (a) E – Z nomenclature | (b) Methyl Orange |
| (c) Aromaticity        | (d) Mutarotation  |

## CHEMISTRY - 4 (Hons.) (2018)

*Answer five questions, selecting at least one from each Group in which Q.No. 1 is compulsory.*

1. Explain any five of the following :
  - (a) Transport number of an ion is function of absolute velocities of ions. ..... 9
  - (b) Catalysts affect the rate of reaction. ..... 11
  - (c) Ethyl acetoacetate exhibits keto-enol tautomerism. ..... 13
  - (d) Lactic acid is optically active. ..... 16
  - (e) Aniline is weaker base than ammonia. ..... 20

### Group-A

2. (a) Discuss the theory of heterogeneous catalysis. ..... 48
- (b) Explain the terms, promoters and poisons. ..... 50
3. (a) What is glass electrode ? Describe. ..... 34
- (b) How is pH of solution determined using glass electrode ? ..... 35
- (c) How is superior to quinhydrone electrode ? Explain. ..... 35
4. Write notes on any two of the following :
  - (a) Conductometric titration ..... 36
  - (b) Reversible electrodes ..... 38
  - (c) Enzyme catalysis ..... 55

### Group-B

5. (a) Name three hydroxy and write down their structural formula. ..... 64
- (b) Discuss heating effect of  $\alpha$ ,  $\beta$  and  $\gamma$  hydroxy acids. ..... 64
- (c) Discuss optical isomerism with special reference to lactic acid and tartaric acid. ..... 70
6. (a) How is diethyl malonate synthesised ? Discuss. ..... 61
- (b) Discuss the synthetic applications of diethyl malonate. ..... 62
7. (a) Establish open chain structure of fructose. ..... 79
- (b) Explain, how is glucose converted into fructose and vice-versa. ..... 81
8. Write an account of any three of the following :
  - (a) Reimer-Tiemann reaction ..... 94
  - (b) Wurtz-Fitting reaction ..... 94
  - (c) Birch reduction ..... 95
  - (d) Fries rearrangement ..... 95
9. (a) Explain conformational and configurational isomerism. ..... 86
- (b) Discuss geometrical isomerism with reference to dichloroethane. ..... 87
10. Write notes on any two of the following :
  - (a) Diazonium salt ..... 111
  - (b) Osazone formation ..... 84
  - (c) Electrophilic substitution reaction ..... 110
  - (d) Kekule structure of benzene ..... 109

