2020

Time : 3 hours

Full Marks : 100

Pass Marks : 45

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

*Answer any **five** questions in which Q. No.1 is compulsory.*

1. Explain any **four** or the following : 5×4 = 20

   (a) Eigenvalues of Hermitian operator are real.

   (b) Specific conductivity of an electrolyte decreases while molar conductivity increases with dilution.

   (c) HBr in Infrared active but H_2 is not.

   (d) Physical adsorption decreases with increase in temperature.

   (e) Carbon tetrachloride does not passes dipolemoment.

   (f) Electron can not exist in the nucleus.

2. Discuss the solution of Schrodinger wave equation for a particle in a three-dimensional cubic box with edges of length 'a' assuming that the potential energy is zero within the box and infinite outside the box. What is meant by degeneracy of energy levels ? 15+5 = 20

3. (a) Explain the singnificance of chemical potential. How does chemical potential vary with temperature ? 5+5 = 10

   (b) Derive Gibbs-Duhem equation and discuss its one application. 7+3 = 10

4. Discuss Activated Complex theory of reaction rates and obtain expression for rate constant in term of entropy of activation and energy of activation. 10+5+5 = 20

5. (a) State and explain Stark's Law of photochemical equivalence and also define Quantom Yield. 7+3 = 10

(b) Discuss the kinetics of the following photochemical reaction : 10

$$H_2(g) + Br_2(g) \xrightarrow{h\upsilon} 2\,HBr(g)$$

6. (a) Derive an expression for liquid junction potential in Concentration Cell with transference.

10

(b) How is Concentration Cell with transference converted into concentration cell without transference ? Explain. 10

7. (a) What is spectroscopy ? Discuss Born-Oppenheimer approximation. Discuss selection rule for different types of spectra.

2+3+7 = 12

(b) What is force constant ? Find its relationship with IR frequency. 3+5 = 8

8. Derive an expression for Langmuir's adsorption Isotherm. Show that at normal pressures, Langmuir's Unimolecular adsorption isotherm becomes identical with Freundlich adsorption isotherm. 15+5 = 20

9. (a) Discuss Clausius-Mossotti equation and its significance. 10

(b) Explain BF_3 and SF_6 are non-polar but $CHCl_3$ and H_2O are Polar molecules. 10

10. Write notes on any **two** of the following : 20

(a) Zero point energy and its significance

(b) Fluorescence and Phosphorescence

(c) Third Law of thermodynamics