U.G. 4th Semester Examination - 2026

CHEMISTRY

[MAJOR-V]

Course Code : CHEM-MJ-T-5

(Physical-2)

[NEP-2020]

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks. Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **five** questions : 2×5=10

i) Find the commutator: $\left[x, \frac{d}{dx}\right]$.

ii) Define equivalent conductance. How is it related to specific conductance?

iii) How does viscosity of gases and liquids vary with temperature?

iv) State and explain Le Chateller's Principle.

v) You have a test tube containing 10 ml 0.1N KCl solution. If the solution be diluted upto 20 ml with pure distilled water, what will be the change in specific conductance and equivalent conductance of the resulting diluted solution?

vi) Define transport number of ions. Give one example where transport number of the cation becomes negative value.

vii) Define partial molal quantities of thermodynamic parameters with mathematical expression in general.

viii) Show the nature of graphs of $\log K_p$ versus $\frac{1}{T}$ plots for exothermic and endothermic reactions.

2. Answer any **two** questions : 5×2=10

i) a) What do you mean by Nernst Distribution Law? Discuss the practical applications of this distribution law. 1+2

b) Considering viscosity, state the difference between Newtonian and non-Newtonian liquids. 2

ii) a) What do you mean by 'Reynold's number'? What is its importance? 1+1

b) A steel ball of density 8.0 g/ cc and radius 2.0 mm is found to fall with a velocity 1.0 cm/ sec in a liquid of density 1.8 g/ cc. Calculate the coefficient of viscosity of the liquid. 3

iii) a) Explain the terms fugacity and activity. How are they related to chemical potential? 2+1

b) Calculate the degree of dissociation and

hydrogen ion concentration at 25°C for a 0.01 molar solution of propionic acid (Given: dissociation constant of propionic acid is 1.32×10^{-5} at 25°C). 2

iv) a) Show how the equilibrium constant in terms of mole fraction (K_X) varies with pressure. 2

b) The dissociation constants of $CaCO_3$ at 900°C and 1000°C are 790 mm and 2940 mm respectively. Calculate the heat of dissociation of $CaCO_3$ at this temperature range. 3

3. Answer any **two** questions : 10×2=20

i) a) Briefly discuss how the concept of degeneracy arises for particles confined in a three dimensional cubical box. 4

b) The wave function for a particle in 1-D box is given by $\psi = A\ sin\frac{n\pi x}{a}$, where the symbols have their usual meanings. Evaluate the value of 'A' considering the normalisation of wave function. 3

c) Show that the two different wave functions for a particle in a 1D box are mutually orthogonal. 3

ii) a) Briefly discuss about different types of effects in connection with the Debye - Hückcl theory of ion atmosphere in dilute ionic solutions. 6

b) State the principles of Hittorf's and Moving boundary methods for determination of transport number of ions. 4

iii) a) Show that change in enthalpy and volume, for the mixing of ideal solutions, is zero. 3

b) Comment on asymmetric effect and relaxation effects. 3

c) Describe the principle for the determination of coefficient of viscosity of liquids by falling sphere method. 4

iv) a) Write down Poiseuille's equation explaining the meaning of the symbols in this equation. 2

b) According to Poiseuille's equation, how much the rate of flow through a narrow pipe should change if the diameter of the pipe is doubled? 2

c) Using the above equation how the relative viscosity of a solution can be determined by Ostwald's viscometer. 3

d) Briefly discuss the principle how the composition of a supplied sucrose solution can be determined by viscosimetric method. 3
