B.Sc. Semester-III Examination, 2022-23
CHEMISTRY [Honours]

Course ID : 31411   **Course Code : SH/CHE/301/C-5**

Course Title : Physical Chemistry-II

Time : 1 Hour 15 Minutes   Full Marks : 25

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 of the following:

$$1\times5=5$$

a)   "Oswald viscometer could be used for determination of viscosity coefficient of high viscous liquid."?— Justify/criticize.

b)   Draw the conductometric titration curve of KCl by $AgNO_3$.

c)   Express chemical potential in terms of internal energy.

d)   Write the expression of distribution coefficient when the solute undergoes dimerization in one layer.

e)   Why is a chemical equilibrium called a dynamic equilibrium?

f)   Write down the uncertainty relation involving energy and time.

g)   Show that the function $8e^{4x}$ is an Eigen function of the operator (d/dx). What is the Eigen value?

h)   Which of these functions could be acceptable wave functions?

   i) $\psi = e^{-x}\,(0,\,\infty)$

   ii) $\psi = e^{-x^2}\,(-\infty,\,\infty)$

2.   Answer any **two** questions of the following: $5\times2=10$

a)   Explain why the freezing point of water decreases with increase in pressure in the chemical potential versus temperature plot. Hence arrive at the theory of sublimation.   5

b)   i)   State Kohlrausch's law of independent migration of ions and explain it with an example.

   ii)   Explain high conductance of H^+ ion in water.   3+2

c)   i)   Prove that free energy of mixing is minimum at equal mole fraction of a binary mixture.

ii) A steel ball of sp. gravity 7.9 and diameter 4 *mm* took 50 second to fall a distance of 1 metre through an oil of sp. gravity 1.1. Calculate the viscosity of oil. 2+3

d) i) Draw a plot of kinetic energy of the ejected photo-electrons versus frequency of the incident radiation in a photo-electric experiment with three different metals. What inference regarding physical quantities may be drawn from such plot?

ii) Find $<x>$ for the ground stationary state of a particle in a three dimensional box. 3+2

3. Answer any **one** question of the following: $10 \times 1 = 10$

a) i) How can dissociation constant of a weak acid be determined by conductometric titration?

ii) Derive the thermodynamic relation that gives the rate of variation of equilibrium constant (K_p) with temperature.

iii) Assuming $log\gamma_i = -AZ_i^2 \sqrt{\mu}$, find the expression of $log\gamma_\pm$ in a solution having ionic strength μ. 3+4+3=10

b) i) Show that the eigenvalues of hermitian operator are always real.

ii) Show that the quantum mechanical operator corresponding to position and linear momentum does not commute. What is the significance of this result?

iii) Calculate the energy levels of the π network in octatetraene, C_8H_{10}, using particle in a one-dimensional box model. To calculate the box length, assume that the molecule is linear and use the values 135 pm and 154 pm for $C = C$ and $C - C$ bonds. What is the wavelength of the light required to induce a transition from the ground state to first excited state? 3+(2+1)+4=10

_____