U.G. 3rd Semester Examination - 2019

CHEMISTRY

[HONOURS]

Course Code : CHEM(H)CC-05-T

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 from the following: 2×5=10

i) Write the dimension and SI unit of the coefficient of viscosity.

ii) Explain why the ion conductance value of H^+ ion in aqueous solution is so high.

iii) Explain briefly what you mean by 'asymmetric effect' with reference to an electrolyte solution.

iv) Prove that $\left(\frac{\delta\mu_i}{\delta P}\right)_{T, n_1, n_2, \ldots, n_j} = \left(\frac{\partial V}{\partial n_i}\right)_{P, T, n_1, n_2, \ldots, n_i}$.

v) Write two characteristics of a Hermitian Operator.

vi) Which of the following functions are well behaved?

a) $\sin x$

b) $\tan x$;

Explain with reason.

[Turn over]

vii) Prove that position and momentum operators do not commute with each other.

viii) Explain the effect of inert gas upon gaseous reaction: $2NH_3=N_2+3H_2$.

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

i) Explain the term 'transport number of ions'. How can it be determined by the "Moving Boundary Method"? 2+3

ii) Deduce Gibbs-Duhem Relations and write the significance. 4+1

iii) a) A steel ball of radius 2 mm is found to fall with a uniform velocity of 1 cm/sec in a liquid of density 1.8 gm/cc and viscosity 54 poise. Find out density of steel. 3

b) Explain the effect of temperature upon viscosity of a gas. 2

iv) a) Show that $\left[P_x.x^n\right]=\frac{h}{2\pi i}nx^{n-1}$. 3

b) Which of the following operators are linear?

I) $\hat{A}\psi=\lambda\psi$ and

II) $\hat{B}\phi=\frac{1}{\phi}$ 2

3. Answer any **two** questions from the following: $10\times2=20$

i) a) Starting from Reaction Isotherm deduce "Vant Hoff Isobar and Isochore". Write the significance of Vant Hoff Isobar. 3+2+2

b) The equilibrium constant (k_p) for the dissociation $2H_2S(g) \rightleftharpoons 2H_2(g)+S_2(g)$ is 0.0118 at 1065°C, find the value of k_p at 1200°C, if heat of dissociation is 424 kcal in this temperature range. 3

ii) a) On the basis of what experimental observations Kohlrausch proposed the law of independent migration of ions? Explain this law. How this law has been applied to evaluate the equivalent conductance at infinite dilution (λ_0) value for a weak electrolyte. 2+1+2

b) Explain the conductometric titration curve of a mixture of strong acid and weak acid by using strong base. 2

c) The specific conductance at 25°C of a saturated solution of $SrSO_4$ in water is 1.482×10^{-4} $ohm^{-1}cm^{-1}$, while that of water is 1.5×10^{-6} $ohm^{-1}cm^{-1}$. The molar

ion conductances of Sr^{++} and SO_4^{-2} are 118.9 and 160. Calculate the solubility product of $SrSO_4$. 3

iii) a) Using particle in a one-dimensional box problem show that the translational energy of a particle is quantized. Also prove that acceptable wave functions are orthogonal to each other in this case.

b) An X-ray photon of wavelength 0.3 Å is scattered through an angle 45° by a loosely bound electron. Find the wavelength of the scattered photon after Compton shift. (4+2)+4=10

iv) a) Discuss the differences between the effect of increasing concentration on equivalent conductance for weak and strong electrolytes. 3

b) Calculate the mean ionic activity coefficient of (i) 0.01(M) Na_2SO_4 solution and (ii) 0.001(M) $K_3Fe(CN)_6$ solution at 25°C. 4

c) An electron has a speed of 300 m/s accurate to 0.01%. With what fundamental accuracy can we locate the position of the electron? 3