

2019

B.Sc.

3rd Semester Examination
CHEMISTRY (Honours)

Paper - C 5-T

Full Marks : 40

Time : 2 Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.
Illustrate the answers wherever necessary.*

Group - A

1. Answer any *five* questions : 2×5=10
- (a) Discuss how viscosity of a liquid changes with temperature. 2
- (b) Show that $\left(\frac{\partial \mu_i}{\partial P}\right)_{T,N} = \bar{V}_i$, where the terms have their usual significances. 2

[Turn Over]

- (c) An exactly 1 molal aqueous solution of mannitol has a vapour pressure of 17.222 mm of mercury at 20°C. At the same temperature, the vapour pressure of pure water is 17.535 mm. Calculate the activity of water in the given solution. 2
- (d) Analyse whether a reaction may be spontaneous in a direction with positive ΔG° . 2
- (e) The fugacity coefficient of a certain gas at 200K and 50 bar is 0.72. Calculate the difference of its chemical potential from that of a perfect gas in the same state. 2
- (f) Define the transport number of an ion and show that for a solution of a single electrolyte,
- $$t_+ = \frac{u_+}{u_+ + u_-} \quad 2$$
- (g) Light of wavelength 552 nm or greater will not eject photoelectrons from a potassium surface. What is the work function (in eV) of potassium? 2
- (h) Determine, citing reasons, whether each of the following functions is acceptable or not as a wave function over the indicated intervals :

$$\sin^{-1}x \quad [-1, 1] \quad \text{and} \quad 1/x \quad [0, \infty] \quad 2$$

Group - B

Answer any *four* questions : [4×5 = 20]

2. (a) Derive an expression for the fugacity of a gas which obeys the equation of state. 3

$$PV_m = RT + AP + BP^2 \text{ where } V_m \text{ is the molar volume.} \quad 2$$

- (b) Discuss the principle of the 'falling sphere method' for the determination of the viscosity coefficient $\left(\frac{\eta}{x}\right)$ of a liquid.

3. (a) Find the expression for ΔG_{mix} and ΔS_{mix} for an ideal binary solution. 3

- (b) Justify the existence of a non-zero point energy in case of a quantum harmonic oscillator in the light of Heisenberg uncertainty principle. 2

4. (a) State with justification whether each of the following properties increases or decreases as intermolecular attractions increase : viscosity of a liquid; normal boiling point. 2

[Turn Over]

- (b) In the determination of viscosity coefficient $\left(\frac{\eta}{x}\right)$ of a liquid by Poiseuille's method, what will be percentage error in η if the radi^{ng}(r) is measured with an error of -0.5% ? 3
5. (a) Estimate the minimum uncertainty in the x component of the velocity of an electron whose position is measured to an uncertainty $1.0 \times 10^{-10}\text{m}$. 3
- (b) A function that beomes infinite at a point must not be quadratically integrable. Justify or criticize. 2
6. (a) Define ionic mobility (u). Derive a relation between ionic mobility and ionic conductance (λ). 3
- (b) Draw and explain the conductometric titration curve for HCl vs. NaOH titration. 2
7. (a) Derive from Ostwald's dilution law, a suitable equation which may be used to determine Λ_0 and the dissociation constant of a weak electrolyte graphically. 3
- (b) Identify the location of nodes in the wave

(5)

functions with $n = 4$ for a particle in a one-dimensional box. 2

Group - C

Answer any *one* question : [1×10 = 10]

8. (a) Evaluate the commutator $[\hat{x}, \hat{H}]$ 4

(b) Determine the eigen value when

$$\psi(x) = A.x.\exp\left(-x^2/2\right) \text{ and } \hat{H} = -\frac{d^2}{dx^2} + x^2$$

4

(c) Prove that the operator $-\frac{\hbar^2}{2m} \frac{d^2}{dx^2}$ is a linear operator. 2

9. (a) Derive Poiseuille's equation for viscosity of a liquid. 4

(b) Write down Fick's 1st and 2nd law of diffusion. 2

(c) Define Hermitian operator. Confirm that the

operator, $\frac{\hbar}{i} \frac{d}{dx}$ Hermitian. 4