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UG/3rd Sem/CHEM(H)/T/19

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,

$$t_+ = \frac{u_+}{u_{++}u_-}$$ 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 :

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

$PV_m = RT + AP + BP^2$ where V_m is the molar volume. 2

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

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

(b) Justify the existance of a non-zero point energy in case of a quantum hermonic oscillator in the light of Heisenberg uncertainty pronciple. 2

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

[Turn Over]

(b) In the determination of viscosity coefficient $\left(\eta/x\right)$ 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 1.0×10^{-10}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_o and the dissociation constant of a weak electrolyte graphically. 3

(b) Identify the location of nodes in the wave

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 $\left[\hat{x}, \hat{H}\right]$ 4

(b) Determine the eigen value when $\psi(x) = A.x.\exp\left(-x^2/2\right)$ 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, $\frac{\hbar}{i}\frac{d}{dx}$ is Hermitian. 4
