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REV-00
MSC/09/16

2012/01/MSC - 03

M.Sc. CHEMISTRY
First Semester
Physical Chemistry - I
(MSC-03)

Duration: 3Hrs. Full Marks: 70

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

1. Answer the following questions (any four): $2 \times 4 = 8$

i) What is the physical significance of molecular partition function?
ii) Explain the term Protective Colloids in terms of Gold number.
iii) A certain gas has a density of 1.02504×10^{-3} kg dm^{-3} at 352 K and 1 atm pressure. Calculate the root mean square speed.
iv) Discuss the effect of temperature on the surface tension of a liquid.
v) Discuss the electro-osmosis phenomenon in colloidal solutions.
vi) How surfactants are classified into various groups? Discuss with examples.

2. Answer the following questions (any four): $3 \times 4 = 12$

i) The expression for the BET isotherm can be written as

$$\frac{p}{(p^o - p)V} = \frac{1}{CV_m} + \frac{C-1}{CV_m}\left(\frac{p}{p^o}\right)$$

Where V is the total volume and V_m is the volume of the adsorbate covering the monolayer. The slope and intercept of the plot of $\frac{p}{(p^o-p)V}$ against $\frac{p}{p^o}$ are 1.02×10^{-3} cm^{-3} and 3.4×10^{-6} cm^{-3}, respectively. Calculate C and V_m.

ii) A system comprised of four distinguishable particles has four levels of energy with the relative energy values of 0, 1, 2, 3. The total energy of the system is 3 and the degeneracy of the four levels are 3, 3, 4, 4 respectively. Find the most probable distribution of the particles.
iii) Discuss the thermodynamic principles which govern the micelle formation process of surfactants.
iv) Explain how the compression factor varies with pressure and temperature and describe how it reveals information about intermolecular interactions in real gases.
v) What is meant by electrical double layer? Explain the electrical double layer in a colloidal solution with examples.
vi) Show that for a van der Waals gas, the Boyle temperature $T_B = a/Rb$.

3. Answer the following questions (any two): $2 \times 5 = 10$

i) Explain the term: Flocculation value of an electrolyte. What is Hardy-Schulze rule? Explain clearly the role of ions of (i) opposite charge (ii) same charge on causing flocculation of the colloidal solutions.

ii) Derive the expression for Maxwell's distribution of molecular velocities. What is the physical significance of the distribution law?

iii) What do you mean by CMC of a surfactant? Discuss the various factors affecting the CMC of a surfactant.

4. Answer the following questions (any two): $2 \times 5 = 10$

i) What are the different basic types of reaction step in chain polymerization? Explain those. Show that Kinetic chain length is dependent upon the rate constant of chain initiation or termination.

ii) What do you mean by step polymerization? Give an example of it. Deduce the expression for rate equation of step polymerization in absence of catalyst and calculate the Degree of polymerization.

iii) Explain with examples the cationic and anionic polymerization.

5. Answer the following questions (any four): $4 \times 5 = 20$

i) Give the expression for matter wavelength of a particle of mass 'm' and moving with a velocity 'υ'. Discuss an experiment to show the validity of de Broglie matter wave.

ii) Define operator in Quantum Mechanics. Find the commutator of the operators: $\frac{d^2}{dx^2}$, $x\frac{d}{dx}$

iii) Give the postulates in Quantum Mechanics.

iv) Deduce Schrodinger time independent wave equation and give the interpretation of the wave function ψ.

v) Using the definition of Δx and Δp_x show that product is greater than $\frac{h}{4\pi}$ in case of particle in a box of length 'a', the wave function for the particle in a given box $\psi = \sqrt{\frac{2}{a}} sin\frac{n\pi x}{a}$.

vi) Write short notes on:

(a) Stationary states in Quantum Mechanics

(b) Group velocity and phase velocity.

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M.Sc. CHEMISTRY

First Semester

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(MSC - 03)

PART A: Objective

Duration: 20 minutes **Marks – 20**

Select the correct answer: **1 × 20 = 20**

i) The Langmuir adsorption isotherm is given by $\theta = \frac{Kp}{1+Kp}$, where p is the pressure of the adsorbate gas. The Langmuir adsorption isotherm, when a diatomic gas adsorbs as atoms on the surface of a solid is,

(a) $\theta = \frac{Kp}{1+Kp}$

(b) $\theta = \frac{2Kp}{1+2Kp}$

(c) $\theta = \frac{(Kp)^2}{1+(Kp)^2}$

(d) $\theta = \frac{(Kp)^{1/2}}{1+(Kp)^{1/2}}$

ii) The partition function for a two level system, the lower state (at energy zero) being nondegenerate and the upper state (at an energy E) being doubly degenerate,

(a) $q = 1 + 2e^{-\beta\varepsilon}$

(b) $q = 2 + e^{-\beta\varepsilon}$

(c) $q = 1 + 2e^{-\beta}$

(d) $q = 1 + 3e^{-\varepsilon\beta}$

iii) The kinetic energy of an ideal gas per molecule at 27°C,

(a) 6.21×10^{-2} J

(b) 8.35×10^{-2} J

(c) 1.62×10^{-2} kJ

(d) 3.74×10^{-2} kJ

iv) If stannic oxide sol is peptised by a small amount of sodium hydroxide, the sol will preferentially adsorb,

(a) Cl^- ion

(b) Sn^{4+} ion

(c) SnO_3^{2-} ion

(d) None of the above.

v) The diffusion coefficient, D of a perfect gas is increases, when

(a) Pressure of the gas increases

(b) Temperature of the gas increases

(c) Collision cross-section of the molecules increases

(d) Mean free path decreases.

vi) The excess pressure in a bubble of radius 0.0001 cm in water at 20 is given by,

(a) 2.45 atm
(b) 1.42 atm
(c) 7.12 mm
(d) 5.62 mm.

vii) The most probable speed for hydrogen gas at 0 is,

(a) 1.50x 10^3 m/sec
(b) 1.50x 10^5 m/sec
(c) 4.50x 10^2 m/sec
(d) 6.50x 10^4 m/sec.

viii) The total number of molecular collisions occurring per unit time per unit volume in a binary mixture of gases is,

(a) $\frac{1}{\sqrt{2}}(\pi\sigma^2 < C > \rho_1\rho_2)$
(b) $\frac{1}{2}(\pi\sigma^2 < C > \rho_1\rho_2)$
(c) $\frac{1}{\sqrt{2}}(\pi\sigma^2 < C > \rho^2)$
(d) $\frac{\sqrt{2}}{2}(\pi\sigma^2 < C > \rho_1\rho_2)$.

ix) The flocculation value of a colloidal solution is the

(a) The minimum concentration of the electrolyte
(b) The minimum concentration of the dispersed particles
(c) The amount of lyophilic colloid
(d) The amount of lyophobic colloid.

x) Among the following properties which one is not a transport phenomenon of a perfect gas,

(a) Diffusion
(b) Viscosity
(c) Thermal conductivity
(d) Surface Tension.

xi) When the dispersed phase is a liquid and dispersion medium is a gas, the resulting colloidal system will be

(a) Foam
(b) Aerosol
(c) Sol
(d) Gel.

xii) Which of the following is a chain growth polymer;

(a) Starch
(b) Polystyrene
(c) Polyester
(d) Protein

xiii) Natural rubber is a polymer of :

(a) Neoprene
(b) Isoprene
(c) Chloroprene
(d) Butadiene

xiv) Bakelite is a:

(a) Phenol formaldehyde resin
(b) Urea-formaldehyde resin
(c) Polyurea resin
(d) Polyurethane resin

xv) Polyvinyl alcohol can be prepared by:

(a) Polymerisation of acetylene

(b) Reaction of acetylene with H2So4 in presence of HgSO4
(c) Alkaline hydrolysis of polyvinyl acetate
(d) Polymerisation of vinyl alcohol

xvi) Which of the following is step polymer?
(a) Nylon-6,6
(b) Polyethylene
(c) Polyvinyl chloride
(d) Polystyrene

xvii) If, R_p= rate of propagation, R_i = rate of initiation, R_t = rate of termination, then the kinetic chain length can be expressed as:

(a) $\upsilon = \frac{R_p}{R_i}$ c) $\upsilon = \frac{R_i}{R_p}$

(b) $\upsilon = \frac{R_t}{R_p}$ d) $\upsilon = \frac{R_t}{R_i}$

xviii) $If, \overline{M_n}$= Number average molecular weight, $\overline{M_w}$= Weight average molecular weight, $\overline{M_v}$= Viscosity average molecular weight, then the polydispersity index of a polymer is expressed as:

(a) $\frac{\overline{M_v}}{\overline{M_w}}$
(b) $\frac{\overline{M_w}}{\overline{M_n}}$
(c) $\frac{\overline{M_v}}{\overline{M_n}}$
(d) $\frac{\overline{M_n}}{\overline{M_w}}$

xix) The weight average molecular weight of a polymer can be determined by the following method:
(a) Viscometric method
(b) Osmometric method
(c) Light scattering method
(d) Sedimentation method

xx) The physical significance of the second virial coefficient is that,
(a) It accounts for ternary collisions
(b) It accounts for binary collisions
(c) It doesn't account any collision
(d) It accounts for molecular vibrations

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