Bachelor of Science (B.Sc.) Semester–I Examination

CHEMISTRY (Physical Chemistry) (New and Old)

Compulsory Paper–2

(Old Course)

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) All **FIVE** questions are compulsory and carry equal marks.

(2) Draw diagrams wherever necessary.

1. (A) Derive Kinetic gas equation, $PV = \frac{1}{3}mnu^2$ for an ideal gas. 5

(B) Define critical volume, critical temperature and critical pressure.

The critical constants of NH_3 are T_c = 405 K, P_c = 112.04 atm. Find the value of V_c and van der Waal's constant 'b'. ($R = 8.314\ J\ K^{-1}\ mol^{-1}$). 5

OR

(C) State and explain Maxwell's law of distribution of molecular velocities. 2½

(D) The most probable velocity of a gas at NTP is 570.4 ms^{-1}. Calculate its molecular weight. 2½

(E) Discuss the pressure correction applied by van der Waal to general gas equation. 2½

(F) For a gas obeying van der Waal's equation, prove that $P_cV_c = \frac{3}{8}RT_c$. 2½

2. (A) What are symmetry elements ? Define and explain centre of symmetry, axis of symmetry and plane of symmetry. 5

(B) Derive Bragg's equation. How crystal structure of NaCl can be determined by Bragg's method ? 5

OR

(C) State and explain Hauy's law of rationality of indices. 2½

(D) Calculate the interplanar spacing between (1 0 0), (1 1 0) and (1 1 1) planes for face centered cubic lattice. 2½

(E) Discuss briefly Bravais lattices. 2½

(F) Discus powder method for determination of crystal structure. 2½

3. (A) What are liquid crystals ? Discuss structure and properties of nematic and cholesteric liquid crystals. 5

(B) How can surface tension of a liquid be determined by capillary rise method ?

A glass capillary of diameter 0.10 cm is dipped in water. Calculate the height to which liquid will rise if density and surface tension of water are $0.9984 \times 10^3\ kg\ m^{-3}$ and $0.0727\ Nm^{-1}$ respectively. (Given : g = 9.806 ms^{-2}). 5

OR

(C) Discuss the following intermolecular forces in liquid :

(i) Dipole–Dipole interactions.

(ii) Dipole–Induced dipole interactions. 2½

(D) Write a note on seven segment cell. 2½

(E) Benzene takes 46 seconds to flow through an Ostwald viscometer, while water takes 56 seconds. Calculate the viscosity of benzene if densities of water and benzene are 0.9984×10^3 kg m^{-3} and 0.8106×10^3 kg m^{-3} respectively.

(Given : coefficient of viscosity of water = 1.008×10^{-3} kg ms^{-1}). 2½

(F) What is refractive index of the medium ? How is it determined by Abbe's refractometer ? 2½

4. (A) State the assumptions of Langmuir adsorption isotherm and derive an expression of Langmuir adsorption isotherm. 5

(B) Define and discuss homogenous and heterogeneous catalysis with suitable examples using solid. liquid and gas catalysts. 5

OR

(C) How BET equation can be used for the determination of surface area of the adsorbent ? 2½

(D) Discuss the applications of adsorption. 2½

(E) State any five characteristics of catalyst. 2½

(F) Explain the role of molybdenum in the manufacture of ammonia in the Habber's process. 2½

5. Attempt any **ten** questions :

(i) Give the relationship between average velocity and most probable velocity.

(ii) What is meant by free path ?

(iii) Define Boyle temperature.

(iv) The Weiss indices of a plane are 3, 3 and ∞. Find the Miller indices.

(v) Identify the crystal system having $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^o$

(vi) What are lattice planes ?

(vii) Define specific viscosity of solution.

(viii) What is thermography ?

(ix) What is constitutive property of parachor ?

(x) What is the effect of temperature on chemical adsorption ?

(xi) Give two examples of enzyme catalysis.

(xii) What are inhibitors ? 1×10=10

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N.B. :— (1) All **FIVE** questions are compulsory and carry equal marks.

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1. (A) Derive an expression of work done for reversible and isothermal process. 2 moles of an ideal gas expands isothermally and reversibly from initial volume of 2.5 dm^3 to the final volume of 20 dm^3 at 25ºC. Calculate the amount of heat absorbed 'q' during the process. 5

(B) Define bond energy. Explain how it can be used to calculate the heat of reaction. Calculate ΔH for the reaction, $C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$ from the following data :

E_{C-H} = 414 KJ, $E_{o=o}$ = 499 KJ, $E_{c=0}$ = 724 KJ, E_{O-H} = 460 KJ and $E_{C=C}$ = 619 KJ. 5

OR

(C) State and explain Joule–Thomson effect. 2½

(D) Differentiate between Reversible and Irreversible processes. 2½

(E) State and explain Hess's law of constant heat of summation. 2½

(F) Define the following terms :

(i) Homogeneous and Heterogeneous systems.

(ii) State function and path function. 2½

2. (A) Derive Kinetic gas equation, $PV = \frac{1}{3}mnu^2$ for an ideal gas. 5

(B) Define critical volume, critical temperature and critical pressure. The critical constants of NH_3 are T_c = 405 K, P_c = 112.04 atm. Find the value of V_c and van der Waal's constant 'b'. ($R = 8.314\ J\ K^{-1}\ mol^{-1}$). 5

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(C) State and explain Maxwell's law of distribution of molecular velocities. 2½

(D) The most probable velocity of a gas at NTP is 570.4 ms^{-1}. Calculate its molecular weight. 2½

(E) Discuss the pressure correction applied by van der Waal to general gas equation. 2½

(F) Derive reduced equation of state. 2½

3. (A) What are liquid crystals ? Discuss structure and properties of nematic and cholesteric liquid crystals. 5

(B) How can surface tension of a liquid be determined by capillary rise method ? A glass capillary of diameter 0.10 cm is dipped in water. Calculate the height to which liquid will rise if density and surface tension of water are $0.9984 \times 10^3\ kg\ m^{-3}$ and $0.0727\ Nm^{-1}$ respectively.

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(E) State any five characteristics of catalyst. 2½

(F) Explain the role of molybdenum in the manufacture of ammonia in the Habber's process. 2½

5. Attempt any **ten** questions :

(i) Which of the following properties are intensive properties ?

Entropy, surface tension, chemical potential, specific heat, temperature.

(ii) If the gas is allowed to expand from higher pressure region to lower pressure region through the porous plug above the inversion temperature, what will be the value of Joule-Thomson coefficient ?

(iii) Define heat of reaction.

(iv) Give the relationship between average velocity and most probable velocity.

(v) What is meant by free path ?

(vi) Define Boyle temperature.

(vii) Define specific viscosity of solution.

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