

Bachelor of Science (B.Sc.) Semester—I (C.B.S.) Examination

(New & Old)

CHEMISTRY (Physical Chemistry)

Compulsory Paper—2

(New Course)

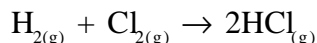
Time : Three Hours]

[Maximum Marks : 50

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

(2) Write chemical equations and draw diagrams wherever necessary.

1. (A) State and explain Hess's law of constant heat summation. Calculate the enthalpy change of the following reaction :



Given that the bond dissociation energies of H – H, Cl – Cl and H – Cl are 437.0 kJ mol⁻¹, 244.0 kJ mol⁻¹ and 433.0 kJ mol⁻¹ respectively. 5

- (B) Derive an expression for w, q, ΔE and ΔH for expansion of gases under isothermal reversible process. 5

OR

- (C) Distinguish between reversible and irreversible processes. 2½

- (D) Explain with examples :

(i) Intensive and

(ii) Extensive properties. 2½

- (E) Show that in Joule-Thomson experiment the enthalpy remains constant under adiabatic expansion of a real gases. 2½

- (F) The enthalpy change (ΔH) for the reaction, N_{2(g)} + 3H_{2(g)} → 2NH_{3(g)} is -92.38 kJ at 298 K. What is ΔE at 298 K ? 2½

2. (A) Discuss Maxwell-Boltzmann distribution of molecular velocities. Explain graphically, how the velocities change with temperature. 5

- (B) Describe critical phenomenon in the light of Andrew's experiment on CO₂ gas. The van der Waal's constants of a gas are a = 0.751 atm.dm⁶ mol⁻² and b = 0.0226 dm³ mol⁻¹. Calculate its critical volume, critical pressure and critical temperature.

(R = 0.0821 atm.dm³ K⁻¹ mol⁻¹) 5**OR**

- (C) Calculate the temperature at which the root mean square velocity of nitrogen molecule will be 1000 ms⁻¹. (R = 8.314 JK⁻¹mol⁻¹) 2½

- (D) Define :

(i) Mean free path

(ii) Collision diameter

(iii) Collision number. 2½

- (E) Explain the deviation of real gases on the basis of van der Waal's equation. 2½

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

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

5

(B) Describe how relative surface tension of liquid is determined by drop-number method. The number of drops of water and ethanol counted at 298 K are 400 and 952 respectively. Calculate the surface tension of ethanol given that density of ethanol is $0.7895 \times 10^3 \text{ kgm}^{-3}$ and that of water is $0.9980 \times 10^3 \text{ kg m}^{-3}$. (Surface tension of water is $72.0 \times 10^{-3} \text{ Nm}^{-1}$ at 298 K).

5

OR

(C) Discuss :

(i) Dipole-dipole and

(ii) Ion-dipole interaction in liquids.

2½

(D) Write a note on seven segment cell.

2½

(E) How is relative viscosity of liquid determined by Ostwald's viscometer ?

2½

(F) Calculate the refractive index of acetic acid at 298 K at which its density is $1.046 \times 10^3 \text{ kg m}^{-3}$. The molar refraction of acetic acid at this temperature is $13.021 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$.

2½

4. (A) What do you understand by adsorption isotherm ? Explain Freundlich adsorption isotherm. How can it be verified ?

5

(B) Describe the kinetics of enzyme-catalysed reactions as proposed by Michaelis and Menten.

5

OR

(C) Discuss the assumptions of Langmuir adsorption isotherms.

2½

(D) What are the factors affecting adsorption of gases by solids ?

2½

(E) Describe any five applications of adsorption.

2½

(F) Explain with examples homogeneous and heterogeneous catalysis.

2½

5. Attempt any **TEN** questions of the following :

(i) Define state functions.

(ii) Give two statements of first law of thermodynamics.

(iii) Define inversion temperature.

(iv) State Avogadro's law.

(v) What is meant by an Ideal gas ?

(vi) Define Boyle temperature.

(vii) Give any two uses of liquid crystal.

(viii) What is intrinsic viscosity ?

(ix) What is parachor ?

(x) Why powdered charcoal is better adsorbent than a lump of charcoal of the same mass ?

(xi) Define autocatalysis.

(xii) What are promoters ?

1×10=10

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

(2) Draw diagrams wherever necessary.

1. (A) State postulates of kinetic theory of gases. From kinetic gas equation deduce Avogadro's law. 5
- (B) State van der Waal's equation for 1 mole of gas. How does it explain deviation of real gases from ideal behaviour ? 5

OR

- (C) Explain the terms RMS velocity and average velocity. How are these velocity interrelated ? 2½
- (D) Discuss graphically Maxwell-Boltzman distribution of molecular velocities. 2½
- (E) Explain the term pressure correction in van der Waal's equation. 2½
- (F) The critical constants for a gas are $T_c = 647 \text{ K}$, $P_c = 218 \text{ atm}$ and $V_c = 0.057 \text{ lit}^6 \text{ mol}^{-1}$. Calculate the van der Waal's constants a and b. 2½
2. (A) Define :
- Unit cell
 - Space lattice
 - Crystal planes
 - Miller indices and
 - Centre of symmetry. 5
- (B) Derive Bragg's equation $n\lambda = 2d \sin \theta$. A beam of x-rays of wavelength 0.071 nm is diffracted by (1 1 0) plane of NaCl crystal having edge length of 0.28 nm. Find the glancing angle for the second order diffraction. 5

OR

- (C) What is law of symmetry ? Explain symmetry elements in crystals. 2½
- (D) Why is Bragg's x-ray diffraction method unable to show that KCl has FCC crystal structure like NaCl ? 2½
- (E) What does the symbol d_{hkl} stands for ? Determine the interplanar spacing between plane of a (2 1 2) cubic lattice of length 6.0 Å. 2½
- (F) Identify the crystal systems having the following parameters of unit cell :
- $\alpha = \beta = \gamma = 90^\circ$ and $a \neq b \neq c$, and
 - $\alpha = \beta = 90^\circ \neq \gamma$ and $a = b = c$. 2½
3. (A) What are intermolecular forces ? Discuss the following intermolecular forces in liquids :
- Dipole-dipole interactions
 - Ion-dipole interactions
 - Dipole-Induced dipole interactions. 5
- (B) How is relative viscosity of a liquid determined by Ostwald's viscometer ? The viscosity of olive oil at 298 K is 0.084 Ns m^{-1} and its density is $1.1 \times 10^3 \text{ kg m}^{-3}$. How long will it take to pass through a viscometer, if water under the same conditions takes 30 seconds ?
(Viscosity of water = $0.00101 \text{ Ns m}^{-2}$ and density of water = $0.9980 \times 10^3 \text{ kg m}^{-3}$). 5

OR

- (C) What are liquid crystals ? Discuss the Nematic and Smectic liquid crystals. 2½
- (D) Discuss the atomic and structural parachors. 2½
- (E) Write a note on seven segment cell. 2½
- (F) The refractive index of carbon tetra chloride for D-line of Sodium has found to be 1.4573. Calculate its molar refraction if density is $1.595 \times 10^{-3} \text{ kg m}^{-3}$. 2½
4. (A) Write assumptions of Langmuir adsorption isotherm. Derive langmuir adsorption equation. 5
- (B) Write general characteristics of catalyst. Discuss homogeneous and heterogeneous catalysis with examples. 5
- OR**
- (C) How surface area of adsorbent can be determined by BET equation ? 2½
- (D) Differentiate between physiosorption and chemisorption. 2½
- (E) What is positive catalysis and negative catalysis ? 2½
- (F) Write a note on Enzyme Catalysis. 2½
5. Attempt any **TEN** questions of the following :
- (i) What is Boyle temperature ?
- (ii) What is mean free path ?
- (iii) Define collision number.
- (iv) Find Miller indices of crystal planes having intercepts of ∞ , $-3b$ and $2c$. Where a, b and c are unit cell dimensions.
- (v) What are Bravais lattices ?
- (vi) Show 110 and 111 planes in a simple cubic unit cell.
- (vii) Define surface tension of a liquid.
- (viii) What is thermography ?
- (ix) What is the effect of temperature on viscosity of a liquid ?
- (x) What are adsorbates and adsorbents ?
- (xi) What are autocatalytic reactions ?
- (xii) Give any one application of adsorption. 1×10=10