

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 equation and draw diagrams wherever necessary.

1. (A) Derive an expression for the work of expansion,

$$W_{\max} = - 2.303 nRT \log \frac{P_1}{P_2}$$

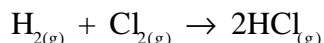
Calculate the work performed when 10.5×10^{-3} kg of Oxygen expands isothermally and reversibly from 10 dm^3 to 21 dm^3 at 300 K . 5

(B) Explain :—

(i) Average bond energy and

(ii) Bond dissociation energy.

Calculate the enthalpy change of the following reaction :



Given that the bond dissociation energies of H–H, Cl–Cl and H–Cl are $437.0 \text{ kJ mol}^{-1}$, $244.0 \text{ kJ mol}^{-1}$ and $433.0 \text{ kJ mol}^{-1}$ respectively. 5

OR

(C) What are extensive and intensive properties ? Give two examples of each of them. 2½

(D) Define the following terms :—

(i) Reversible and Irreversible Processes.

(ii) State function and Path function. 2½

(E) Define :—

(i) Joule-Thomson coefficient and

(ii) Inversion temperature. 2½

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

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

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

The van der Waal's constants for hydrogen chloride gas are $a = 3.67 \text{ dm}^6 \text{ atm mol}^{-2}$ and $b = 0.0408 \text{ dm}^3 \text{ mol}^{-1}$. Calculate its critical temperature and critical pressure of the gas. ($R = 0.0821 \text{ dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$) 5

OR

(C) Calculate average velocity and most probable velocity of sulphur dioxide molecule at 700 K . Given that root mean square velocity of sulphur dioxide molecule is 522.3 ms^{-1} . 2½

- (D) Define the terms :—
- Mean free path and
 - Collision diameter. 2½
- (E) What is an ideal gas ? Discuss the deviation of real gases from ideal behaviour. 2½
- (F) Derive reduced equation of state. 2½
3. (A) What are liquid crystals ? Explain the structural difference between solid, liquid and liquid crystal. Discuss the structure of nematic liquid crystal. 5
- (B) Explain 'coefficient of viscosity'. What is the effect of temperature on viscosity of a liquid ? How is relative viscosity of a liquid determined by Ostwald Viscometer ? 5
- OR**
- (C) Discuss the following intermolecular forces in liquids :
- Dipole-induced dipole interaction and
 - London-forces. 2½
- (D) Write short note on Thermography. 2½
- (E) How is surface tension of liquid determined by drop number method ? 2½
- (F) Define refractive index. The refractive index of liquid benzene at 298 K is 1.5000 and its density is $0.87 \times 10^3 \text{ kg m}^{-3}$. Find the molar refraction of liquid Benzene at 298 K. 2½
4. (A) What is adsorption ? What are the factors affecting adsorption of gases by solids ? Write the differences between physical adsorption and chemical adsorption. 5
- (B) Explain with examples homogeneous and heterogeneous catalysis. What is the catalytic promoter ? Explain with suitable examples. 5
- OR**
- (C) Explain Freundlich adsorption isotherm. How can it be verified ? 2½
- (D) How BET equation can be used in the determination of surface area of the adsorption ? 2½
- (E) What are the important applications of adsorption ? 2½
- (F) Explain enzyme catalysed reactions. 2½
5. Attempt any **TEN** questions of the following :—
- Define cyclic process.
 - Give two statements of first law of thermodynamics.
 - Define standard states.
 - State Graham's law of diffusion.
 - Define Boyle temperature.
 - Write van der Waal's equation for n moles.
 - Give any two applications of liquid crystal.
 - Define parachor value.
 - What is reduced viscosity ?
 - Write Michaelis-Menten equation.
 - Define autocatalysis.
 - What are inhibitors ? 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) Define the terms :—

- (i) Root mean square velocity
- (ii) Most probable velocity and
- (iii) Average velocity.

Calculate the root mean square velocity of Nitrogen molecule at NTP. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

5

(B) Derive expression for critical constants in terms of van der Waals' constants.

5

OR

(C) Write any five postulates of kinetic theory of gases.

2½

(D) With graph, explain the effect of temperature on distribution of molecular velocities.

2½

(E) Discuss the deviation of real gases from ideal behaviour.

2½

(F) Explain Compressibility Factor and Boyle temperature.

2½

2. (A) Explain elements of symmetry. A crystal face cuts the axes at $\frac{1}{3}a$, $\frac{3}{4}b$ and $\frac{1}{2}c$. Find its miller indices.

5

(B) What are Bravais lattices ? Sketch and discuss three types of Bravais lattices of cubic system.

5

OR

(C) Explain the law of rationality of indices.

2½

(D) The diffraction of X-rays of wavelength $3.0 \times 10^{-10} \text{ m}$ gives a first order reflection at $27^\circ 8'$. What is the distance between lattice planes ?

2½

(E) Draw neat diagram of unit cell of :

- (i) NaCl and (ii) CsCl crystals.

2½

(F) Describe Laue's method for determination of crystal structure.

2½

3. (A) What are liquid crystals ? Discuss the structure of nematic and cholesteric liquid crystals. 5
- (B) Explain 'refractive index' of a medium. How is it determined by Abbe's refractometer ? The molar refraction of acetic acid is $13.021 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$ at 298 K. Calculate the refractive index of acetic acid if its density is $1.046 \times 10^3 \text{ kg m}^{-3}$. 5

OR

- (C) What are intermolecular forces ? Discuss ion-dipole interaction in liquids. 2½
- (D) Write a short note on Thermography. 2½
- (E) Define the term surface tension. How is surface tension of liquid determined by drop number method ? 2½
- (F) The viscosity of olive oil at 293 K is $0.084 \text{ Nm}^{-2} \text{ s}$ 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 condition takes 30 seconds ?
(Viscosity of water = $1.01 \times 10^{-3} \text{ Nm}^{-2} \text{ s}$ and Density of water = $0.998 \times 10^3 \text{ kg m}^{-3}$). 2½
4. (A) Give the assumptions and derive an expression for Langmuir Adsorption Isotherm. 5
- (B) Write any five characteristics of catalysed reactions. Explain with example homogeneous and heterogeneous catalysis. 5

OR

- (C) How BET equation can be used in the determination of surface area of the adsorbent ? 2½
- (D) Explain auto catalysis with examples. 2½
- (E) What are the important applications of adsorption ? 2½
- (F) What is catalytic promoter ? Explain with suitable example. 2½
5. Attempt any **TEN** questions of the following :—
- (i) Define collision diameter.
 - (ii) Write van der Waal's equation of state for x moles of real gases.
 - (iii) What is meant by an ideal gas ?
 - (iv) Define space lattice.
 - (v) State law of constancy of interfacial angles.
 - (vi) Identify the crystal structure with the dimensions of unit cell :
 $a \neq b \neq c, \alpha = \beta = \gamma = 90^\circ$.
 - (vii) Define parachor value.
 - (viii) Give any two applications of crystal crystal.
 - (ix) What is reduced viscosity ?
 - (x) Define the term physical adsorption.
 - (xi) What are inhibitors ?
 - (xii) What is the effect of pressure on adsorption of gases by solids. 1×10=10