

(4)

(d) Explain with reason :

- (i) Effect of temperature on the value of viscosity coefficient of a gas.
- (ii) Effect of temperature on the mean free path of a gas molecule.

3. Answer *any one* question : 5

- (a) What is Boyle temperature? From van der Waals equation for real gases derive Boyle temperature.
- (b) State 'Law of corresponding states' after deriving the reduced equation of state for a van der Waals gas.
- (c) What are the origins of intermolecular forces? Explain why ammonia gas can be liquefied easily compared to nitrogen gas.

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Ex/SC/CHEM/UG/CORE/TH/01/2025(OLD)

BACHELOR OF SCIENCE EXAMINATION, 2025

(1st Year, 1st Semester)

CHEMISTRY (CORE)

PAPER : CORE/CHEM/TH/01

Time : 2 Hours

Full Marks : 40

Use a separate answer script for each Unit.

UNIT—1011-I

Answer *all the* questions :

1. (a) What are the limitations of Bohr's atomic model. How Sommerfeld modified the Bohr's model to explain the fine structure of the atom? 1+2
- (b) Assign the correct values for the quantum numbers n , l and m_l for $2p_z$ and $3dz^2$ orbitals. 1
- (c) Write down the electron configuration of ${}_{22}\text{Ti}^{3+}$ ion and determine its ground state term symbol. 1
- (d) Write down time-independent Schrödinger wave equation explaining the meaning of each term. What do you mean by 'eigenfunctions' and 'eigenvalues'? 3

(2)

- (e) Sketch the (i) radial wave functions and (ii) radial probability functions of 2s and 2p orbitals for the hydrogen atom. 1+1

2. Answer any **five** questions: 2×5=10

- (a) Write down the differences between electronegativity and electron affinity. Illustrate your answer with suitable example.
- (b) Explain in the light of relativistic effect why silver (Ag) is colourless but gold (Au) is yellow in color?
- (c) First ionization energy (IE_1) of B is 801 kJ/mol, Al is 582 kJ/mol, Ga is 578 kJ/mol and In is 558 kJ/mol. Explain the anomaly in IE_1 trend ongoing from Al to Ga.
- (d) Calculate the electronegativity of hydrogen (in Pauling scale) from the following data.
 $E_{H-H} = 458$ kJ/mol, $E_{F-F} = 155$ kJ/mol, $E_{H-F} = 565$ kJ/mol, Pauling electronegativity of fluorine = 4.0.
- (e) Mercury (Hg) behaves like noble gas, while gold (Au) behaves like halogen gases. Explain.
- (f) Write short note on Lanthanide contraction.

(3)

UNIT—1011 P

1. (a) Find the units (with reason) of a and b in $(P + n^2 a / V^2) (V - nb) = nRT$.

- (b) Fill up the following blanks using symbols of unit.

(i) $N_A \times e =$ _____, (ii) $A \cdot S^{-1} =$ _____,

(iii) $N =$ _____, (iv) $J =$ _____.

- (c) Give the values up to correct significant digits.

(i) $1.0567 + 0.004321 =$ _____

(ii) $5.32 \times 0.00006 =$ _____ 2+2+1

2. Answer any **two** of the following questions 5×2=10

- (a) Calculate translational kinetic energy of a gas molecule using kinetic gas equation. Show that $C_{p,m} / C_{v,m} = 1.083$ for CH_4 (assuming it behaves ideally).
- (b) Write down the Maxwell-Boltzmann velocity distribution equation. Draw and explain the distribution curves for same gas at different temperatures.
- (c) What is collision frequency for (Z_{AA}) of gas molecules? Derive the expression for collision frequency (Z_{AA}).