

[4]

- d) Explain with reason
- Effect of temperature on the value of viscosity coefficient of a gas.
 - Effect of temperature on the mean free path of a gas molecule.

5. Answer **any one** questions 5

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

Ex/SC/CHEM/UG/CORE/TH/01/2023

B. SC. CHEMISTRY EXAMINATION, 2023

(1st Year, 1st Semester)

CHEMISTRY (CORE)

PAPER: CORE/CHEM/TH/01

Time : Two Hours

Full Marks : 40

(20 marks for each unit)

Use a separate answer script for each unit.

UNIT - 1011 - I

- Assign the correct values for the quantum numbers n , l and m_l for $2p_z$ and $3d_{z^2}$ orbitals. 1
 - Write down the electron configuration of ${}_{22}\text{Ti}^{3+}$ ion and determine its ground state term symbol. 1
 - Calculate the wavelength of a 10g ball travelling at a velocity of 500 km/h. What would be the likelihood demonstrate the wave properties of the ball with the help of existing instruments. 2
 - What are the limitations Bohr's atomic model? How did Sommerfeld modify the Bohr's model to explain the fine structure of the atom?
 - Explain the meaning of the terms : "*eigenfunction*" and "*eigenvalue*"
 - Sketch the
 - radial wave function and
 - radial probability functions of 2s and 2p orbitals for the hydrogen atom. 1+1

[Turn over

[2]

2. Answer **any five** questions ? 2 × 5

- a) Explain in the light of relativistic effect why silver (Ag) is colourless but gold (Au) is yellow in colour.
- b) Write down the differences between electronegativity and electron affinity.
- 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 in going 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 and gold (Au) behaves like halogen gases. Explain why?
- f) Write short note on (**any one**)
 - i) Lanthanide contraction
 - ii) General periodic trend of Z_{eff}

[3]

UNIT - 1011 - P

3. a) Find the units (with reason) of 'a' and 'b' in $(P+n^2a / V^2) (V-nb) = nRT$. 2
 - b) Fill up the following blanks using symbols of unit.
 - i) $N_A \times e = \underline{\hspace{2cm}}$,
 - ii) $A.S^{-1} = \underline{\hspace{2cm}}$,
 - iii) $N = \underline{\hspace{2cm}}$,
 - iv) $J = \underline{\hspace{2cm}}$,
 - c) Give the values up to correct significant digits
 - i) $1.0567 + 0.004321 = \underline{\hspace{2cm}}$,
 - ii) $5.32 \times 0.00006 = \underline{\hspace{2cm}}$,
4. Answer **any two** of the following questions 2 × 5
- 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 with meaning of the symbols used. Draw and explain the distribution curves for a gas at different temperatures.
 - c) What collision frequency (Z_{AA}) of gas molecules? Derive the expression for collision frequency (Z_{AA}),

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