

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5709

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Unique Paper Code : 2174001001

Name of the Paper : GE : Atomic Structure and Chemical Bonding

Name of the Course : **B.Sc. (Hons.)**

Semester : II/IV/VI

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **All** questions carry equal marks.
3. Attempt any **Four** questions in all.
4. Use of scientific calculator is allowed.

1. (a) Write the time-independent Schrodinger wave equation for the hydrogen atom and explain the terms used in it.

(b) What is radial distribution probability. Draw the radial probability distribution curve of 3s, 3p, and 3d orbitals.

(c) Explain the following:

i) s-orbitals are spherical in shape.

ii) H_2 is known but He_2 is not. (5, 5, 5)

2. (a) Explain VSEPR theory and predict shape of ClF_3 , and SF_4 .

(b) i) Explain difference in bond angles between NH_3 and H_2O .

ii) Ionization energy of O is less than that of N. Explain.

(c) State Heisenberg Uncertainty principle. Determine the uncertainty in the position of an electron whose velocity is known to be within $1 \times 10^{-6} \text{ ms}^{-1}$. (Mass of electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$, $h = 6.626 \times 10^{-34} \text{ kgm}^2/\text{s}$). (5, 5, 5)

3. (a) Define Lattice energy. Calculate the enthalpy of formation (ΔH) for MgF_2 using the provided data:

Sublimation Enthalpy of Mg = 146.4 kJ/mol

Ionization Enthalpy of Mg to Mg^{2+} = 2184 kJ/mol

Dissociation Energy of F_2 = 158.9 kJ/mol

P.T.O.

Electron gain enthalpy of $F(g) = -334.7 \text{ kJ/mol}$

Lattice Energy of $MgF_2 = -2922.5 \text{ kJ/mol}$

(b) Arrange the following in terms of increasing order of their melting point and explain: $BeCl_2$, $MgCl_2$, $CaCl_2$, $SrCl_2$, $BaCl_2$

(c) i) Differentiate between Orbit and orbital.

ii) Differentiate between electronegativity and electron affinity. (5, 5, 5)

4. (a) Draw MO energy level diagram for CO and calculate its bond order.

(b) What are isoelectronic ions? Arrange the following ions in increasing order of their sizes: N^{3-} , F^- , O^{2-} , Mg^{2+} , Na^+ and Al^{3+} . Justify your answer.

(c) Define radial and angular node. How many radial and angular nodes are present in 2p and 3d. (5, 5, 5)

5. (a) Explain Fajan's rule. Give its application.

(b) What is de-Broglie equation. Calculate the wavelength of an electron travelling with the speed of 63 ms^{-1} . (Given mass of electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$).

(c) Write down the electronic configuration of N_2 , N_2^- and N_2^+ and arrange them in increasing order of bond length. (5, 5, 5)

6. Write Short notes on any three of the following:

(a) Bohr's model and its limitation

(b) Molecular Orbital Theory

(c) Quantum numbers

(d) Hybridization (5, 5, 5)