B.Sc.(Honours)Examination, 2018

Semester-I (CBCS)
Chemistry (Honours)
Core Course: CC-1
(Inorganic Chemistry)

Time: Three Hours **Full Marks: 40**

Questions are of value as indicated in the margin.
Answer ***any four*** questions.

1. Attempt ***any four***: 4x2.5
   a) Estimate the proton affinity of water using Born-Haber Cycle.
   b) Calculate the limiting radius ratio of a tetrahedral lattice.
   c) Write a short note on Born-Landé equation.
   d) Evaluate the forbidden energy gap of an intrinsic semiconductor.
   e) Explain the maleability and ductility of metals using the concept of slip system.

2. Attempt ***any four***: 4x2.5
   a) Write the probable electron dot structures for $S\overline{C}N$ and select the most suitable one using Pauling's electroneutrality rules. What do you mean by thiocyanate and isothiocyanate ions?
   b) Draw the reasonable structures of ClF_3. Could you choose the most stable one using VSEPR theory? Justify your answer.
   c) State and explain Bent's rules.
   d) Find the probability of finding the particle in one dimension box of length L in the region between $\frac{L}{4}$ and $\frac{3L}{4}$ for quantum number $n = 1$.
   e) Differentiate between sigma and pi bonds.

3. Attempt ***any four***: 4x2.5
   a) Compare and explain the trends of variation of size in a group for representative and transition elements.
   b) Lithium is referred as super alkali metal. Justify.
   c) How and why does the electronegativity of an atom depend on its involved hybrid orbitals?
   d) Compare the electronegativity and electron affinity of fluorine and chlorine with suitable explanation.
   e) Explain the trend of variation of ionization energy of second period elements.

4. Attempt ***any four***: 4x2.5
   a) Write down the simplest valence bond wave function (unnormalized and without spin part) for the HF molecule in the following cases:
      i) HF is purely covalent
      ii) HF is purely ionic
      iii) HF is 80% covalent and 20% ionic.
   b) Using the principle of LCAO, obtain the normalized wave functions for the BMO and ABMO of H_2^+ ion.
   c) Construct the wave functions for the sp hybridized orbitals.
   d) The energy necessary to dissociate one oxygen atom from different dioxygen species are reported as (in KJ mol^{-1}): 623, 494, 351 and 205. Correlate these terms with the species O_2^{2-}, O_2^-, O_2 and O_2^+. Explain in the light of MOT.
   e) Potassium dichromate oxidizes ferrous iron in dilute HCl medium. Balance the reaction by ion-electron method. What happens if dilute acid is not added?

P.T.O.

5. Attempt ***any four***: 4x2.5
   a) What is inert pair effect? Explain the effect.
   b) What is lanthanide contraction? Explain the cause(s) and effect.
   c) Predict the shape of the following molecules according to the VSEPR theory and indicate the stereochemically active ion pair, if any,
      (i) XeO_2F_2 (ii) NH_3
   d) What do you mean by penetration power and shielding effect of electron? How do they affect the orbital energy?
   e) Describe Hund's 1st and 2nd rules. Give ground state term of np^2 configuration. What is Landé interval rule?
   f) What is Hydrogen bonding? Ice contains extensive hydrogen bonding: Justify the statement.

6. Attempt ***any four***: 4x2.5
   a) Outline the main ideas underlying the wave mechanical theory of atom. Write down Schrödinger's time independent wave equation and define the terms involved.
   b) What do you mean by radial and angular part of a wave function? How do they depend on the different quantum number?
   c) Give the number of radial and angular nodes along with their topologies for orbitals with principal quantum number, $n = 3$.
   d) What are spin angular momentum, spin quantum number and auxiliary spin quantum number?
   e) Does wave mechanics offer any guideline for the assignment of quantum numbers to the electron? What are Pauli's exclusion principle and its implication? What is Bohr-Bury scheme?

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