Q.P. Code : 61901

First Semester M.Sc. Degree Examination, January/February 2020

(CBCS – New Scheme – Freshers)

Chemistry

INORGANIC CHEMISTRY – I

Time : 3 Hours]   [Max. Marks : 70

Instructions to Candidates : Answer Q. No. 1 and any FIVE of the remaining.

1.   Answer any **TEN** of the following :   (10 × 2 = 20)

   (a)   What are agnostic and synergic bondings? Give an example for each.

   (b)   Based on electronegativity, arrange the following bonds in order of decreasing polarity : N-O, N-N, N-P and C-N. Justify your answer.

   (c)   The lattice energies for MgI_2, $MgBr_2$, $MgCl_2$ and MgF_2 are – 2327, -2440, -2526 and -2957 kJ/mol, respectively. Account for this observation.

   (d)   Outline the auto dissociation reaction of BrF_3. How do SbF_5 and KF act in BrF_3.

   (e)   Give the meaning of the terms cotton effect and ORD.

   (f)   Draw the structures and mention the composition of benitoite and beryl.

   (g)   How are S_4N_4 and S_2N_2 obtained? Draw their structures.

   (h)   Give the preparation and structure of $[Fe(C_2B_9H_{11})_2]^{2-}$.

   (i)   Why do Mg, Al and Hg are found as carbonate, oxide and sulfide, respectively in nature?

   (j)   Calculate the electron counts and name the skeletal structures of the metal clusters : $Rh_6(CO)_{16}$ and $O_5C(CO)_{15}$.

   (k)   Write the spin and parity of ^7Li and ^{17}O nuclides using shell model of the nucleus.

   (l)   How many α-particles and β^- particles are emitted in the decay of ^{238}U to ^{206}Pb?

2. (a) Identify the number of lone-pair of electrons present in the following :

   ClF_3, ICl_4^- and I_3^-; predict their structures using VSEPR theory.

   (b) The radii of Ag^+ and Cl^- ions are 126 and 181 pm respectively. Use the Kapustinskii's equation to calculate the lattice energy of AgCl.

   (c) Construct MO energy level diagram for NO molecule. Based on the bond order of NO, NO^+ and NO^-, explain their bond length and magnetic properties. $(3 + 3 + 4)$

3. (a) On the basis of HSAB principle, predict which species would be more stable and justify your choice :

   (i) $Fe(CO)_5$ or $Fe(NH_3)_5$,

   (ii) HgF_2 or HgI_2

   (iii) $[COF_6]^{3-}$ or $[COI_6]^{3-}$.

   (b) Outline the chemical reactions in which HNO_3, $HClO_4$, $H_2S_2O_7$ behave in sulfuric acid.

   (c) Write briefly on MCD and its applications. $(3 + 3 + 4)$

4. (a) Draw the topological structure and give the Styx codes of B_5H_9 and B_2H_6.

   (b) Write briefly on the structure and uses of ZSM-5.

   (c) Discuss the synthesis, structure and bonding in borazine. $(3 + 3 + 4)$

5. (a) Explain the salient features of liquid drop model.

   (b) Predict the possible mode of decay of the nuclides : $^{13}_7N$, $^{14}_6C$ and $^{131}_{53}I$.

   (c) Discuss the exceptional stability of $^{12}_6C$ and $^{16}_8O$ nuclides. $(3 + 3 + 4)$

6. (a) Explain Fajan's rules. Based on it explain why $AlCl_3$ shows higher melting point than $AlBr_3$ and AlI_3.

   (b) Explain the crystal structures of CsCl and TiO_2.

   (c) Discuss briefly on the applications of heteropoly acids of tungsten and molybdenum. $(4 + 3 + 3)$

7. (a) Write a note on theory of α-decay.

   (b) List the factors favouring in the formation of M-M bond. Give the structures of $Fe_2(CO)_9$ and $Ir_4(CO)_{12}$.

   (c) Explain the utility of N_2O_4 in inorganic synthesis. $(3 + 4 + 3)$

8. (a) Derive Born-Lande equation of an ionic solid.

   (b) Calculate the limiting radius ratio of an ionic solid with tetrahedral geometry.

   (c) Write notes on Auger effect. $(4 + 3 + 3)$