B.Sc. 3rd Semester (Honours) Examination, 2018 (CBCS)

Subject : Chemistry

(Inorganic Chemistry-II)

Paper : CC-6

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

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

(a) Give the example (one each) of molecules/species with sp^3d and d^3s hybridisation.

(b) All the P–Cl bonds in PCl_5 are not equivalent. — Explain.

(c) Describe modern concept of formal charge. Calculate the formal charge on phosphorus and hydrogen atoms in phosphonium ion.

(d) Explain : $SnCl_4$ is more covalent than $SnCl_2$.

(e) What are stoichiometric defects? — Give an example.

(f) Mention the nuclear reaction that ultimately led to the discovery of artificial radioactivity.

(g) What are mirror nuclei? — Give suitable examples.

(h) State the prime differences between nuclear reactor and atom bomb – though nuclear fission is the source of energy in both. Mention one method for enrichment of U-235 over U-238.

2. Answer *any two* questions: 5×2=10

(a) (i) What is hydrogen bond? What are the essential conditions for hydrogen bond formation?

(ii) H_2O has highest boiling point than HF though their hydrogen bond strength are in reverse order — explain. 3+2=5

(b) (i) What do you mean by dipole moment? NH_3 has a dipole moment of 1·49 unit against almost zero value of NF_3 — explain.

(ii) Using VSEPR theory draw the structure of ClF_3 and XeF_4. 3+2=5

(c) Draw the MO diagram for O_2^+, O_2^- and O_2^{2-} and give the order of stability as well as magnetic behaviour with appropriate reason. 3+2=5

(d) (i) What is Madelung's constant? What is its significance?

(ii) Explain why 'Sn' exhibits maximum number of stable isotopes. 3+2=5

3. Answer *any two* questions: 10×2=20

(a) (i) State the basis of 'radius ratio rule' for ionic compounds. What information can be obtained from it? Mention any two limitations of radius ratio rule.

(ii) Calculate the heat of formation (ΔH_f) of KF from its elements from the following data by the use of Born-Haber cycle.

Sublimation energy of K(s) = 87·8 kJ mol^{-1}

Dissociation energy of F_2(D) = 158·9 kJ mol^{-1}

Ionization energy of K(g)(I) = 414·2 kJ mol^{-1}

Electron affinity for F(g)(E) = –334·7 kJ mol^{-1}

Lattice energy of KF (U_0) = –807·5 kJ mol^{-1}

(iii) $AlCl_3$ anhydrous is covalent but $AlCl_3$. $6H_2O$ is ionic in nature — How would you account for this behaviour? (2+2+1)+3+2=10

(b) (i) Write about the band theory of metals.

(ii) What are semiconductors? Give an example of *n*-type semiconductor.

(iii) Illustrate 'instantaneous dipole induced dipole interactions. 4+3+3=10

(c) (i) Define the binding energy per nucleons of a nucleus in terms of mass number and atomic number. Discuss the characteristics of short range forces that is responsible for holding the nucleons together within the nucleus.

(ii) A old piece of wooden sample has disintegration rate 30% of an equal weight of a new piece of wood. Find the age of the wooden sample. (Given $t_{1/2}$ of ^{14}C = 5740 years).

(iii) Complete the following nuclear reactions:

(A) $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{144}_{55}Cs + {}^{90}_{37}Rb + \cdots$

(B) ${}^{1}_{0}n \rightarrow ? + {}^{0}_{-1}e + ?$ (3+2)+3+2=10

(d) (i) The Binding energy per nucleon for C-12 is 7·68 MeV and that for C-13 is 7·47 MeV respectively. Calculate the energy required to remove a neutron from C-13 nucleus.

(ii) Why oxygen nucleus does not undergo nuclear fission but uranium does so? — Justify the answer from binding energy curve.

(iii) Show use of a radioisotope in nuclear medicine.

(iv) Calculate the packing efficiency of fcc lattice. 3+3+2+2=10

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