B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)

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Subject : Chemistry

Course : CC-VI

(Inorganic Chemistry-II)

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 from the following: 2×5=10

(a) Name the fissile nuclides which were used in the atom bomb dropped on Hiroshima and Nagasaki during World War-II.

(b) 'ZnO is white when cold but yellow when hot'— Explain.

(c) Define ionic potential and indicate its implication in chemistry.

(d) Calculate the formal charge on the constituent atoms in BF_3.

(e) 'Radioactive equilibrium is known though all nuclear reactions are irreversible'. — Explain.

(f) 'Water has higher boiling point than hydrogen fluoride though hydrogen bond strengths are in reverse order' — Account for the fact.

(g) 'He_2 molecule is unstable'— explain using Molecular Orbital theory.

(h) What are the *p*-type semiconductors? Give one example.

2. Answer *any two* questions from the following: 5×2=10

(a) State and explain Bent rule and apply the same to predict the most probable structure of OsF_4. 1+1+3

(b) What do you mean by radius ratio principle? What information can be obtained from it? Find out the limiting radius ratio for tetrahedral and cubic coordination. 1+1+(1·5+1·5)

(c) What is spallation reaction? Give example. How does it differ from nuclear fission reaction? 1+1+3

(d) Define dipole moment. Mention its unit. 'The more polar the bonds in a molecule, the more the value of its dipole moment'.— Comment. 1+1+3

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

(a) (i) The final product of ^{238}U is ^{206}Pb. A sample of pitchblende contains 0·0453 g of ^{206}Pb for each gram of ^{238}U present in it. Assuming that the mineral pitchblende formed at the time of formation of earth did not contain any ^{206}Pb, calculate the age of the earth. (Given, $t_{\frac{1}{2}}$ of $^{238}U = 4 \cdot 5 \times 10^9$ years).

(ii) Why is fusion of hydrogen into helium nuclide energetically favourable but not of rhodium into uranium nuclide?

(iii) How does the meson theory of exchange force explain the nuclear stability? 4+3+3

(b) (i) What do you mean by lattice energy of an ionic crystal? Calculate the lattice energy of NaCl using the following data:
Madelung Constant (A) = 1·748, Equilibrium ionic distance = 2·79 Å, Born Exponent = 8·0, Electronic charge = $4{\cdot}8\times10^{-10}$ esu.

(ii) Describe the shapes of ICl_4^+ and H_3O^+ on the basis of VSEPR theory.

(iii) 'NH_3, BCl_3, BrF_3 have comparable molecular formulae but their shapes are different.'— Explain. (1+3)+3+3

(c) (i) '$MgSO_4$ is water soluble, but $BaSO_4$ is not.' — Explain.

(ii) Predict the possible mode of decay of the following nuclides: $_{13}Al^{29}$ and $_{11}Na^{24}$

(iii) 'The thermal stability of isomorphous sulphates of Ca(II), Sr(II) and Ba(II) with respect to decomposition into metal oxide and SO_3 increases in the sequence :

$CaSO_4 < SrSO_4 < BaSO_4$'. — Explain. 3+4+3

(d) (i) What is meant by artificial transmutation? Give two examples.

(ii) Compare the geometry of NO_2 and NO_2^+ from VSEPR theory. Compare the bond angles of NO_2, NO_2^+, NO_2^-.

(iii) 'The bond length in N_2^+ is greater than that in N_2 while bond length in NO^+ is lesser than that of NO.' — Explain the observation using Molecular Orbital theory. 3+4+3