

**B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)****412****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:  $2 \times 5 = 10$

- (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  $\text{BF}_3$ .
- (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) ‘ $\text{He}_2$  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:  $5 \times 2 = 10$

- (a) State and explain Bent rule and apply the same to predict the most probable structure of  $\text{OsF}_4$ .  $1+1+3$
- (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:  $10 \times 2 = 20$

- (a) (i) The final product of  $^{238}\text{U}$  is  $^{206}\text{Pb}$ . A sample of pitchblende contains 0.0453 g of  $^{206}\text{Pb}$  for each gram of  $^{238}\text{U}$  present in it. Assuming that the mineral pitchblende formed at the time of formation of earth did not contain any  $^{206}\text{Pb}$ , calculate the age of the earth. (Given,  $t_{\frac{1}{2}}$  of  $^{238}\text{U} = 4.5 \times 10^9$  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 =  $4.8 \times 10^{-10}$  esu.
- (ii) Describe the shapes of  $\text{ICl}_4^+$  and  $\text{H}_3\text{O}^+$  on the basis of VSEPR theory.
- (iii) 'NH<sub>3</sub>, BCl<sub>3</sub>, BrF<sub>3</sub> have comparable molecular formulae but their shapes are different.' — Explain. (1+3)+3+3
- (c) (i) 'MgSO<sub>4</sub> is water soluble, but BaSO<sub>4</sub> is not.' — Explain.
- (ii) Predict the possible mode of decay of the following nuclides:  $^{13}\text{Al}^{29}$  and  $^{11}\text{Na}^{24}$
- (iii) 'The thermal stability of isomorphous sulphates of Ca(II), Sr(II) and Ba(II) with respect to decomposition into metal oxide and SO<sub>3</sub> increases in the sequence :  
 $\text{CaSO}_4 < \text{SrSO}_4 < \text{BaSO}_4$ '. — Explain. 3+4+3
- (d) (i) What is meant by artificial transmutation? Give two examples.
- (ii) Compare the geometry of NO<sub>2</sub> and NO<sub>2</sub><sup>+</sup> from VSEPR theory. Compare the bond angles of NO<sub>2</sub>, NO<sub>2</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>.
- (iii) 'The bond length in N<sub>2</sub><sup>+</sup> is greater than that in N<sub>2</sub> while bond length in NO<sup>+</sup> is lesser than that of NO.' — Explain the observation using Molecular Orbital theory. 3+4+3
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