

U.G. 3rd Semester Examination 2021

CHEMISTRY (Honours)

Paper Code : DC-6

[Inorganic Chemistry]

(CBCS)

Full Marks : 25

Time : Two Hours

I. Answer any *five* questions from the following:

1 × 5 = 5

(a) According to molecular orbital theory for atomic species C_2

- (i) Bond order is zero and it is paramagnetic
- (ii) Bond order is zero and it is diamagnetic
- (iii) Bond order is two and it is diamagnetic
- (iv) Bond order is two and it is paramagnetic

(b) The coordination number of Ba^{2+} ions in barium fluoride is 8. The coordination number of the fluoride ions is

- (i) 8
- (ii) 4
- (iii) 1
- (iv) 2

(c) How many α - and β - particles would be emitted during the disintegration of ^{232}Th to ^{208}Pb ?

- (i) 6α and 4β
- (ii) 4α and 8β
- (iii) 4α and 6β
- (iv) 8α and 6β

(d) The boiling points of noble gases are illustrative of the operation of forces of the type –

- (i) ion-dipole
- (ii) dipole-induced dipole
- (iii) ion-induced dipole
- (iv) London dispersion forces

(e) Which of the following sequences represent the correct increasing order of the polarizing power of the cations?

- (i) $\text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+$
- (ii) $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$
- (iii) $\text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+}$
- (iv) $\text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+}$

(f) Band theory predicts that magnesium is an insulator. However, in practice it acts as a conductor due to

- (i) presence of filled 3s- orbital
- (ii) Overlap of filled 2p- and filled 3s- orbital
- (iii) presence of unfilled 3p- orbital
- (iv) Overlap of filled 3s- and empty 3p orbital

(g) Elements of which of the following radioactive disintegration series do not occur in nature?

- (i) Thorium series or 4n series
- (ii) Neptunium series or (4n+1) series
- (iii) Uranium series or (4n-2) series
- (iv) Actinium series or (4n+3) series

(h) According to VSEPR theory, the shapes of $[\text{SFCl}_2]^+$ and $[\text{S}_2\text{O}_4]^{2-}$ should be

- (i) trigonal planar for $[\text{S}_2\text{O}_4]^{2-}$ and trigonal pyramidal for $[\text{SFCl}_2]^+$
- (ii) both trigonal planar
- (iii) trigonal pyramidal for $[\text{S}_2\text{O}_4]^{2-}$ and trigonal planar for $[\text{SFCl}_2]^+$
- (iv) both trigonal pyramidal

2. Answer any *four* questions: $2 \times 4 = 8$

- (a) Draw the schematic band models for insulator and intrinsic semiconductor.
- (b) What are extrinsic semiconductors? Give examples
- (c) A cancer patient undergoing radiotherapy is given a dose of $3.42 \mu\text{g}$ ^{60}Co . How much isotope will remain in his body after 30 years? The half-life of ^{60}Co is 5.27 years.
- (d) Do you expect the structures of PCl_3F_2 and PF_3Cl_2 to be different? If so why?
- (e) Differentiate between Schottky defect and Frenkel defect.
- (f) Based on MO theory explain the chemical reactivity of N_2 molecule.
- (g) What do you mean by nuclear spallation reaction? Give example.
- (h) Use Fajan's polarization rules to predict which is likely to be ionic or covalent: RbCl and CsCl

3. Answer any *two* questions: $6 \times 2 = 12$

- (a) (i) Calculate the limiting radius ratio value for coordination number 6 (octahedral geometry).
- (ii) Discuss the valence bond theory to explain the nature of metallic bond.
- (iii) ^9Be is stable but ^9B is not. Why? $2\frac{1}{2} + 2\frac{1}{2} = 1$
- (b) (i) What are the significant differences observed in neptunium disintegration series from other disintegration series?
- (ii) What information do we obtained from the plot of binding energy per nucleon vs. mass number?
- (iii) What thermodynamic considerations are involved in creation of stoichiometric defects?

 $2 + 2 + 2$

- (c) (i) Using Born – Haber Cycle, calculate the electron affinity of chlorine from the following data:

$$\text{Bond enthalpy of Cl}_2 = +240.0 \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of formation of NaCl (s)} = -440.0 \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of sublimation of Na (s)} = +110.0 \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of ionization of Na (g)} = +480.0 \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of lattice formation of NaCl (s)} = -810.0 \text{ kJ mol}^{-1}$$

- (ii) State Sody-Fajan group displacement law with suitable example.

- (iii) Write down the limitations of radius ratio concepts. 2 + 2 + 2

- (d) (i) On analysis, an ore of uranium shows the mass ratio for ^{233}U to $^{206}\text{Pb} = 6.08$. All ^{206}Pb are supposed to appear from the disintegration of ^{238}U . Find the age of the ore. (Given, $t_{1/2}$ for $^{238}\text{U} = 4.5 \times 10^9$ year, the next longest lived nuclide ^{234}U in the series shows $t_{1/2} = 2.5 \times 10^5$ year)

- (ii) Draw and explain the MO diagram for CO_2 molecule.

- (iii) What is the significance of Madelung constant? 2½ + 2½ + 1
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