

2018
CHEMISTRY
CHM 103
INORGANIC CHEMISTRY

Full Marks : 80

Time: 3 Hours

The figures in the margin indicates full marks for the questions

1. Answer the following questions:

- (a) Draw a molecular orbital energy-level diagram for the gaseous heteronuclear diatomic molecule boron nitride, BN. How does it differ from C_2 ? 2
- (b) What are the expected changes in bond order and bond distance that accompany in the following ionization processes? 1X3=3
- (i) $O_2 \rightarrow O_2^+ + e$ (ii) $N_2 + e \rightarrow N_2^-$ (iii) $NO \rightarrow NO^+ + e$
- (c) Using orbital potential energies, show that group orbital 4 is more likely to interact strongly with 2Pz orbital than group orbital 2 of carbon in case of CO_2 molecule. 2
- (d) Prepare a molecular orbital diagram for the azide ion N_3^- . 3
- (e) When an He atom absorbs a photon to form the excited configuration $1s^1 2s^1$, a weak bond forms with another He atom to give the diatomic molecule $HeHe$. Give a molecular orbital description of the bonding in this species. 5

C_{2v}	E	C_2	$3\sigma_{xz}$	σ_{yz}	
A_1	1	1	1	1	z
A_2	1	1	-1	-1	
B_1	1	-1	1	-1	x
B_2	1	-1	-1	1	y

- (f) Sketch the molecular orbital diagram for BeH_2 molecule. 5
 (g) Explain the effect of weak forces on the melting point and boiling point of compounds. 5

2. Answer the following questions:

- (a) (i) The Zinc blende structure is cubic. The unit cell may be described as a face centered sulphide ion sublattice with zinc ions in the centers of alternating mini cubes made by partitioning the main cube into eight equal parts, (A) How many nearest neighbors does each Zn^{2+} have? (B) How many nearest neighbors does each S^{2-} have? (C) What angle is made by the lines connecting any Zn^{2+} to any two of its nearest neighbors? (D) What minimum r_+/r_- ratio is needed to avoid anion-anion pairs are assumed to touch? 1+2+2=5

(ii) Explain the radius ratio rules. 5

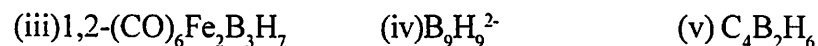
- (b) Calculate the lattice energy of NaCl ($r_+=116$ pm, $r_-=167$ pm, $M=1.74756$, $\rho=30$ pm and $\frac{e^2}{4\pi\epsilon_0} = 2.307 \times 10^{-28}\text{Jm}$) using Born Mayer equation. 5

- (c) Explain the consequence of lattice energy on (i) thermal stabilities of ionic solids (ii) the stabilities of oxidation states (iii) solubility of inorganic solids. 3+3+4=10

3. Answer the following questions: (any four) 4X5=20

- (a) Discuss the preparation of closo-1,2- $\text{B}_{10}\text{C}_2\text{H}_{12}$. Discuss the salient features of its synthesis. How can you isomerizes it to 1,7- $\text{B}_{10}\text{C}_2\text{H}_{12}$ and 1, 12- $\text{B}_{10}\text{C}_2\text{H}_{12}$? Draw the structure. 5

- (b) Draw the structures of the following: 1X5=5



- (c) How does the stability order differ from that for the polyhedral borane anions $\text{B}_n\text{H}_n^{2-}$? 5

- (d) Give a brief account of zeolites and their uses. 5

- (e) What is the shape of white phosphorous? Write short note on aluminosilicates. 2+3=5

4. Answer the following questions: (any one) 5

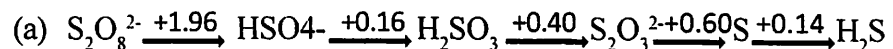
- (a) Explain what is super acid and super base. 5

- (b) State whether the formation of NH_3BF_3 is exothermic or endothermic. 5

	F	C	Drago-Wayland parameter
BF_3	20.2	3.31	
NH_3	2.78	7.08	

- (c) Explain the relevance of acidity and basicity in catalysis. 5

5. Answer the following questions: (any one) 5



Using the following Latimer diagram construct a Frost diagram and calculate the standard potential for the $\text{HSO}_4^-/\text{S}_8(\text{s})$ couple. 5

- (b) The standard potentials for the complex Fe^{2+}/Fe and $\text{Fe}^{3+}/\text{Fe}^{2+}$ are -0.41V and +0.77V respectively. Should we expect Fe^{2+} to disproportionate in aqueous solution? 5
