63/2 (SEM-1) CHM 103

2021

(held in 2022)

CHEMISTRY

(Theory Paper)

Paper Code : CHM-103

(Inorganic Chemistry – I)

Full Marks – 80

Time – Three hours

The figures in the margin indicate full marks
for the questions.

1. Answer the following questions :   4×5=20

   (a) Compare the bonding in O_2^{2-}, O_2^- and O_2. Discuss briefly Lewis structures, molecular orbital structures, bond lengths and bond strengths.   4

   (b) Explain the geometry of CO_2 molecule with the help of MO theory.   4

[Turn over

(c) Based on the MO theory of NH_3, find the average NH bond order in NH_3 by calculating the net number of bonds and dividing by the number of NH groups. 4

(d) (i) Which hydrogen bond would you expect to be stronger, $S-H\cdots O$ or $O-H\cdots S$? Why ? 2

(ii) Describe the expected physical properties of water in the absence of Hydrogen bonding. 2.

(e) Explain the geometry of BeH_2 with the help of Walsh Diagram. 4

2. Answer any *four* of the following questions : 5×4=20

(a) Based on the analysis of Mandelung constant alone, predict which polymorph in ZnS should be more stable. Assume that the Zn-S distances in the polymorps are identical. 2+3=5

(b) Obtain the formula (MX_n or M_nX) for the following structures derived from the hole filling in close packed arrays with 5

(i) Half the octahedral holes filled

(ii) 1/4th of the tetrahedral holes filled

(iii) 1/3th of the octahedral holes filled.

(c) Explain polymorphism of a metals. Give suitable examples. 4+1=5

(d) Distinguish between substitutional solid solution and interstitial solid solution. What are the criteria for the formation of a substitutional solid solutions ? 2+3=5

(e) What is zintl phase ? Draw the position of alloys and zintl phase in a Ketelaar triangle. 5

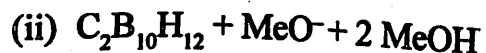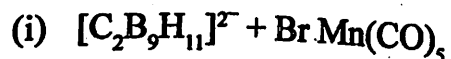3. Answer any *six* of the following questions : 5×6=30

(a) Write a note on structure, synthesis and applications of zeolite. 5

(b) Discuss the structures of silicates. 5

(c) What structures do you predict for the compound $GeC_2B_9H_{11}$ land SB_9H_{12} ? 5

(d) Complete the following reactions : $2\frac{1}{2}\times 2=5$

(i) $[C_2B_9H_{11}]^{2-} + Br\,Mn(CO)_5$

(ii) $C_2B_{10}H_{12} + MeO^- + 2\,MeOH$

(e) Write the energy level diagram for one B-H-B bridge in diborane.
5

(f) Draw the shape of a molecular orbital for the formation of 3C-2e. B-B-B bond.
5

(g) Draw the structure of dicarba-closo-dodecabo-rane. Give one method for synthesis of carborane.
$2\frac{1}{2}+\frac{1}{2}=5$

4. Answer any *one* of the following questions :

$5\times 1=5$

(a) What is super acid and how do you measure the acidity of such a solution ?
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 any *one* of the following questions :

$5\times 1=5$

(a) Show how electrochemical potential is influenced by pH.
5

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