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····O or O–H····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**

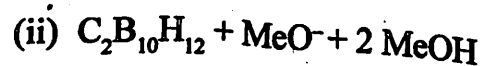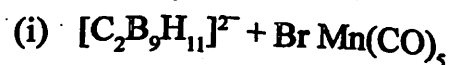3. Answer any *six* of the following questions :

                                  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-dodecaborane. 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