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1 SEM PG (CBCS) CHM C 1

2024

(December)

CHEMISTRY

Paper : 101

(Core Course)

(Inorganic Chemistry-I)

Full Marks : 60

Time : Three hours

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

UNIT-I

(Marks : 25)

1. Answer **any three** of the following questions : 4×3=12

(a) Explain Bent's rule with example. Predict the structure of the following molecules according to the VSEPR theory : **(any two)** 2+2=4



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- (b) With the help of MO diagram of CO, explain why CO is bonded to metal through carbon end but not through the oxygen. Compare and contrast the magnetic nature of CO and NO. $2+2=4$
- (c) (i) Applying Wade's rules classify the following framework compounds as closo, nido and arachno.
 $C_2B_4H_8, B_5H_{11}, B_9C_2H_{11}, B_{10}H_{10}^{2-}$ 2
- (ii) What is meant by 'Closo-Boranes'? Give examples. Write a method of preparation of Closo-Borane. $1+1=2$
- (d) Describe the structure of S_4N_4 . 4
- (e) Using the example of $P_3N_3Cl_6$, discuss the structure and bonding in P-N compounds. 4
2. Using graphical representation, compare the variation in ionic radii of isolated M^{2+} ions in the 3d transition series with those of their high-spin and low-spin counterparts. Discuss the observed trends and behavior. 4

3. Answer **any three** of the following questions: $3 \times 3 = 9$

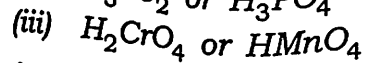
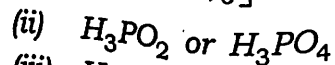
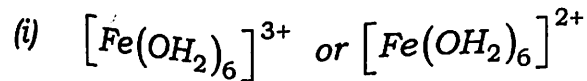
- (a) How does Ligand Field Theory (LFT), explain the ordering of ligands in the spectrochemical series and what factors influence a ligand's position within this series? $2+1=3$
- (b) What is nephelauxetic effect? How does it provide insights into the covalent character of metal-ligand bonds in coordination complexes? $1+2=3$
- (c) How does the electronic configuration of transition metal ions affect the stability of normal versus inverse spinel structures? Predict the spinel structure of $MgAl_2O_4$. $2+1=3$
- (d) What are spinels? On the basis of CFT, explain why Fe_3O_4 have inverse structure whereas Mn_3O_4 have normal spinel structure? $1+2=3$

UNIT-II

(Marks : 15)

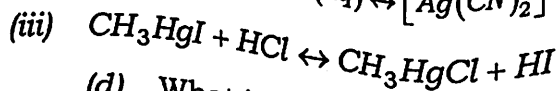
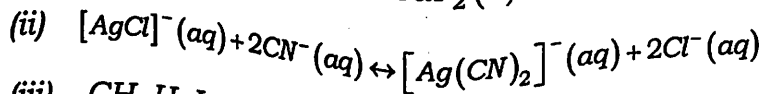
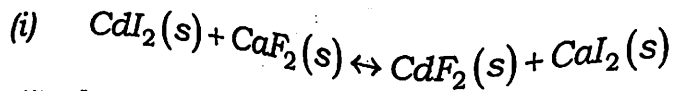
4. Answer **any three** questions from the following: 3×3=9

(a) Which of the following pairs is the stronger acid ? Give reason for your answer : 3



(b) Arrange the oxides : Al_2O_3 , B_2O_3 , CO_2 , Cl_2O_7 , SO_3 in order from most basic through amphoteric to most acidic. Give reason for your answer. 1.5+1.5=3

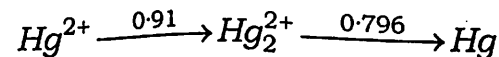
(c) Using hard-soft acid-base theory predict whether equilibrium constants for the following reactions should be greater or less than one. Give reason for your answer : 3



(d) What is super acid ? Give **two** examples of super acid. 1+2=3

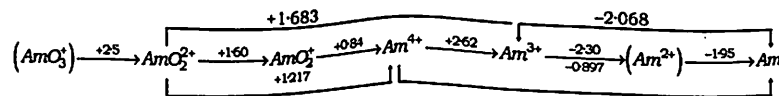
5. Answer **any two** of the following questions : 3×2=6

(a) What is Frost Diagram ? Draw a Frost diagram for mercury in acid solution from the given Latimer diagram. 1+2=3



(b) Discuss electrochemical series and its importance in electrochemistry. 3

(c) What is disproportionation reaction ? The Latimer diagram of Americium is given below. State which of the following species undergo disproportionation ? Give reason. 1+2=3



UNIT-III

(Marks : 20)

6. Answer the questions from the following :

(a) Briefly mention the biological roles of copper (Cu). What is the oxidation state of 'Cu' atom in deoxyhemocyanin and oxyhemocyanin ? Draw the bonding pattern of one O_2 molecule in one subunit of a Hemocyanin. 1+1+1=3

- (b) Although water has a great affinity for Fe(II), however, heme-containing cavities prevent it from binding with water, why? What structural changes occur when iron goes from deoxy to oxy form in hemoglobin (Hb)? 1+2=3

7. Answer **any three** questions from the following : 4×3=12

- (a) What are the sources of Rieske's iron-sulphur protein? Describe the structural features and biological functions of Rieske's Iron-Sulphur proteins. What do you mean by High Potential Iron-Sulphur Proteins (HiPIPs)? 1+2+1=4

- (b) "The function of both Hemoglobin (Hb) and Myoglobin (Mb) is to bind oxygen, but their physiological roles are quite different". Explain the physiological roles of Hb and Mb based on the above statement. 4

- (c) Mention the biological importance of 'Mo' metal. What do you mean by *in vivo* nitrogen fixation? What are the main components of 'Fe, Mo-containing' nitrogenase? 1+1+2=4

- (d) What are cytochromes and how do they classify? What is the active site structure of cytochrome C? Comment on its function as an electron transfer protein rather than an enzyme.

2+1+1=4

- (e) How does magnesium function within chlorophyll? Why is it essential for the absorption of light energy during photosynthesis? 2+2=4

8. With the help of a diagram, discuss the mechanism of Na⁺/K⁺ pump. 2

Or

What are crown ethers? Comment on the selectivity of these systems for alkali metals.

1+1=2