

2024

(CBCS)

(6th Semester)

**CHEMISTRY**

## NINTH PAPER

**( Inorganic Chemistry—I )**

Full Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks for the questions***( SECTION : A—OBJECTIVE )**

( Marks : 10 )

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. The hybridization of carbon in the bridging carbonyl group is

(a)  $sp$  ( )(b)  $sp^2$  ( )(c)  $dsp^2$  ( )(d)  $sp^3$  ( )

2. What is the missing reactant in the reaction given below?



(a)  $\text{RMgX}$  ( )

(b)  $\text{MgR}_2$  ( )

(c)  $\text{Mg} + \text{R}$  ( )

(d)  $\text{RX}$  ( )

3. The coordination number of iron in oxymyoglobin is

(a) 4 ( )

(b) 5 ( )

(c) 6 ( )

(d) 7 ( )

4. How is the zinc ion coordinated with the apoenzyme of the carbonic anhydrase?

(a) Three imidazole nitrogens of three histidine groups ( )

(b) Two imidazole nitrogens of two histidine groups and glutamic acid ( )

(c) One imidazole nitrogen of histidine group and two glutamic acids ( )

(d) Two imidazole nitrogens of two histidine groups and two glutamic acids ( )

5. The electronic configuration of gadolinium is

(a)  $[\text{Xe}]4f^7 5d^2 6s^1$  ( )

(b)  $[\text{Xe}]4f^8 5d^0 6s^2$  ( )

(c)  $[\text{Xe}]4f^6 5d^2 6s^2$  ( )

(d)  $[\text{Xe}]4f^7 5d^1 6s^2$  ( )

6. The +4 oxidation state is exhibited by which elements among the actinides?

(a) The first 8 elements (Ac to Cm) ( )

(b) The first 5 elements (Th to Pu) ( )

(c) The last 4 elements (Pa to Pu) ( )

(d) All actinide elements ( )

7. The magnetic susceptibility of antiferromagnetic substance is

(a) small and negative ( )

(b) large and positive ( )

(c) small and positive ( )

(d) zero ( )

8. Which one of the following ions will have the highest number of unpaired electrons in an octahedral complex?

(a) a high-spin  $d^5$  ion ( )

(b) a low-spin  $d^5$  ion ( )

(c) a high-spin  $d^6$  ion ( )

(d) a low-spin  $d^4$  ion ( )

9. The number of normal modes of vibration for  $\text{SO}_2$  molecule is

(a) 2 ( )

(b) 3 ( )

(c) 4 ( )

(d) 5 ( )

10. Which one of the following is expected to show the lowest M-X stretching frequency?

(a)  $[\text{AlF}_4]^-$  ( )

(b)  $[\text{AlCl}_4]^-$  ( )

(c)  $[\text{GaCl}_4]^-$  ( )

(d)  $[\text{GaBr}_4]^-$  ( )

**( SECTION : B—SHORT ANSWERS )**

( Marks : 15 )

Answer the following :

3×5=15

**UNIT—I**

1. What are  $\pi$ -acid ligands? Explain how CO acts as a  $\pi$ -acid ligand.

**OR**

2. What are the characteristics of ionic organometallic compounds?

**UNIT—II**

3. Point out the basic differences between inorganic polymers and organic polymers.

**OR**

4. What are condensation polymers and addition polymers? Give examples.

**UNIT—III**

5. Give reasons, why the separation of lanthanides is difficult.

**OR**

6. Explain how the lanthanide contraction affects the atomic size of transition elements.

**UNIT—IV**

7. Compare the magnetic properties of  $\text{Ni}^{2+}$  ion in tetrahedral and square planar complexes.

**OR**

8. Discuss the origin of the spin magnetic moment.

UNIT—V

9. Give at least three differences of Raman spectroscopy and Infrared spectroscopy.

OR

10. Differentiate between Rayleigh scattering and Raman scattering.

( SECTION : C—DESCRIPTIVE )

( Marks : 50 )

Answer the following :

10×5=50

UNIT—I

1. (a) Discuss how carbonyl to metal coordinate bond is formed in metallic carbonyls. 3
- (b) How will you prepare the following compounds? 1×3=3
- (i)  $\text{Ni}(\text{CO})_4$
- (ii)  $\text{BR}_3$
- (iii)  $\text{Co}_2(\text{CO})_8$
- (c) What is meant by  $\pi$ -metal alkene complexes? Citing suitable example, explain the bonding in the metal-alkene complex. 1+3=4

OR

2. (a) Explain how back bonding stabilized the metal carbonyls. 3
- (b) Give one method of preparation of Grignard reagent and also write two uses of this reagent in the preparation of alcohol. 1+2=3
- (c) How will you obtain  $\text{Fe}_2(\text{CO})_9$ ? Discuss its bonding and structure. 1+3=4

## UNIT—II

3. (a) Write one method of preparation of  $(\text{NPCl}_2)_3$  and explain its structure. 1+2=3  
(b) What are the roles of sodium and potassium ions in biological systems? 3  
(c) Draw the structure of the heme group present in hemoglobin and discuss the cooperativity effect in hemoglobin. 1+3=4

**OR**

4. (a) Discuss the functioning of carboxypeptidase. 3  
(b) Explain how oxyhemoglobin passes on its oxygen to myoglobin. 3  
(c) What are silicones? Discuss the method of preparation of a linear tetramer silicone. 1+3=4

## UNIT—III

5. (a) Why do lanthanides show lower oxidation number than actinides? 3  
(b) Comment on the colour of tripositive ( $\text{M}^{3+}$ ) actinide ions. 3  
(c) What is lanthanide contraction? What are its causes? 1+3=4

**OR**

6. (a) Give reasons why the magnetic moments of lanthanides cannot be obtained from the spin-only formula. 3  
(b) Compare the complexation tendency of lanthanides and actinides. 3  
(c) Discuss how lanthanides are separated by ion exchange method. 4

## UNIT—IV

7. (a) What are the important properties of paramagnetic substances? 3  
(b) Explain the following terms : 1×3=3  
    (i) Magnetic induction  
    (ii) Bohr magneton  
    (iii) Curie temperature

- (c) What is meant by magnetic susceptibility? Explain the temperature dependence of the magnetic susceptibilities of paramagnetic and antiferromagnetic substances. 1+3=

OR

8. (a) Write a short note on ferromagnetism. 3  
 (b) How was the Curie's law corrected in Curie-Weiss law and why? 3  
 (c) Under strong field ligands, Co(III) forms diamagnetic complexes wherein weak field ligands it forms paramagnetic complexes. Explain. 4

### UNIT—V

9. (a) Differentiate between Stokes' lines and anti-Stokes' lines. Which one has greater intensity and why? 3  
 (b) Give reasons why the N-H stretching frequencies of ammine complexes are lower than those of the free  $\text{NH}_3$  molecule. 3  
 (c) Give reasons for the difference in the observed Ni-X stretching frequencies of the given species : 4

NiCl <sub>2</sub> 521	Ni(PPh <sub>3</sub> ) <sub>2</sub> Cl <sub>2</sub> 341	<i>trans</i> -Ni(py) <sub>4</sub> Cl <sub>2</sub> 207
NiBr <sub>2</sub> 414	Ni(PPh <sub>3</sub> ) <sub>2</sub> Br <sub>2</sub> 265	<i>trans</i> -Ni(py) <sub>4</sub> Br <sub>2</sub> 140

OR

10. (a) What are the fundamental vibrations of  $\text{CO}_2$  molecules? Indicate whether they are IR and Raman active or not. 3  
 (b) Arrange the given species in the increasing order of their Fe-X stretching frequency and give reasons to support your answer : 3  
 $[\text{FeCl}_4]^-$ ,  $[\text{FeBr}_4]^-$  and  $[\text{FeBr}_4]^{2-}$   
 (c) What is mutual exclusion principle? Explain how it can be used for the structural elucidation of  $\text{N}_2\text{O}$  molecules. 1+3=4

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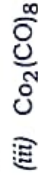
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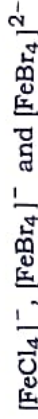
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