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( CBCS )

( 6th Semester )

**CHEMISTRY**

NINTH PAPER

**( Inorganic Chemistry—III )**

*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. Which one of the following compounds is not an organometallic compound?

(a)  $(C_2H_5)_4Pb$  ( )

(b)  $CH_3COONa$  ( )

(c)  $Fe(C_5H_5)_2$  ( )

(d)  $Mg(CH_3)_2$  ( )

2. From which one of the following molecular orbitals CO donates an electron pair in the formation of OC—M coordinate bond in metal carbonyls?

- (a) Pi bonding MO ( )
- (b) Pi antibonding MO ( )
- (c) Sigma bonding MO ( )
- (d) Sigma antibonding MO ( )

3. The metal ion present in deoxyhemoglobin is

- (a) high spin (Fe(II)) ( )
- (b) low spin (Fe(II)) ( )
- (c) high spin (Fe(III)) ( )
- (d) low spin (Fe(III)) ( )

4. In carboxypeptidase, the ligands of  $Zn^{2+}$  ion are

- (a) three N atoms of the three imidazole rings of histidine groups ( )
- (b) two N atoms of two imidazoles of histidine group and a glutamic acid ( )
- (c) one N atom of imidazole of histidine group and two glutamic acids ( )
- (d) two N atoms of two imidazoles of histidine group and two glutamic acid residues ( )

5. In lanthanides, the last electron enters

(a)  $np$  subshell ( )

(b)  $(n-1)d$  subshell ( )

(c)  $(n-1)f$  subshell ( )

(d)  $(n-2)f$  subshell ( )

6. Which one of the following ions is colourless?

(a)  $\text{Lu}^{3+}$  ( )

(b)  $\text{Pr}^{3+}$  ( )

(c)  $\text{Dy}^{3+}$  ( )

(d)  $\text{Sm}^{3+}$  ( )

7. The magnetic permeability of paramagnetic substance is

(a) equal to zero ( )

(b) slightly less than 1 ( )

(c) equal to 1 ( )

(d) slightly greater than 1 ( )

8. The number of unpaired electrons present in a  $d^7$ , low spin octahedral complex is

(a) 0 ( )

(b) 1 ( )

(c) 2 ( )

(d) 3 ( )

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 ANSWER )

( Marks : 15 )

Answer the following questions :

3×5=15

UNIT—I

1. Explain how back bonding stabilizes the  $\pi$ -acid complexes.

**OR**

2. Explain how CO behaves as a  $\pi$ -acid ligand.

UNIT—II

3. What are the biological processes where  $\text{Ca}^{2+}$  ion plays an important role?

**OR**

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

UNIT—III

5. How does the lanthanide contraction affect the atomic size of heavier transition elements?

**OR**

6. Explain why the magnetic moments of lanthanides cannot be obtained from the spin-only formula.

UNIT—IV

7. Explain the following terms :

(a) Magnetic induction

(b) Bohr magneton

(c) Neel temperature

**OR**

8. What are the important properties of paramagnetic substances?

UNIT—V

9. Differentiate between Rayleigh scattering and Raman scattering.

**OR**

10. Write at least three similarities of Raman spectroscopy and infrared spectroscopy.

**( SECTION : C—DESCRIPTIVE )**

( Marks : 50 )

Answer the following questions :

10×5=50

UNIT—I

1. (a) How will you prepare the following compounds? 3  
(i)  $\text{Fe}(\text{CO})_5$   
(ii)  $\text{RMgX}$   
(iii)  $\text{Fe}_2(\text{CO})_9$
- (b) Write the uses of alkyl-boron in organic synthesis. 3
- (c) Discuss the different types of bonds found in metal carbonyls. 4

**OR**

2. (a) How will you prepare  $\text{Sn}(\text{CH}_3)_4$ ? Also explain how organotin compounds are used as stabilizers of PVC. 1+2=3
- (b) Explain the hybridization and structure of  $\text{Co}_2(\text{CO})_8$  in the solid state. 3
- (c) Citing a suitable example, discuss the bonding in metal-alkene complex. 4

UNIT—II

3. (a) Write one method of preparation of  $(\text{NPCl}_2)_3$  and explain its structure. 1+2=3
- (b) Explain the functioning of carbonic anhydrase. 3
- (c) Discuss the cooperativity effect in hemoglobin. 4

**OR**

4. (a) Draw the structure of heme group present in myoglobin and write a brief note on the structure of myoglobin. 3
- (b) Write a short note on the role of sodium and potassium ions in biological systems. 3
- (c) What are silicones? Discuss the method of preparation of a cross-linked silicone. 1+3=4

UNIT—III

5. (a) Give reasons why the separation of lanthanides is difficult. 3
- (b) Make a comparison of the oxidation states of lanthanides and actinides. 3
- (c) What is lanthanide contraction? What are its causes? 1+3=4

**OR**

6. (a) Write the valence shell electronic configurations of lanthanum, gadolinium and lutetium. 3
- (b) Compare the complexation tendency of lanthanides and actinides. 3
- (c) Discuss how lanthanide ions are separated by ion-exchange method. 4

UNIT—IV

7. (a) Explain the shortcomings of Curie law and advantages of Curie-Weiss law. 3
- (b) Compare the magnetic properties of  $\text{Ni}^{2+}$  ions in tetrahedral and square planar complexes. 3
- (c) Draw plots of inverse of molar susceptibility versus temperature for paramagnetic, ferromagnetic and antiferromagnetic substances and explain the difference. 3+1=4

**OR**

- 8.** (a) Discuss the origin of the spin magnetic moment. 3  
(b) Write a short note on ferromagnetism. 3  
(c) Explain the magnetic properties of the following complex ions : 4  
(i)  $[\text{Co}(\text{CN})_6]^{3-}$   
(ii)  $[\text{FeF}_6]^{4-}$

UNIT—V

- 9.** (a) Differentiate between Stokes' lines and anti-Stokes' lines. Which one is having greater intensity and why? 3  
(b) What are the fundamental vibrations of  $\text{CO}_2$  molecule? Indicate whether they are IR and Raman active or not. 3  
(c) Give reasons why the N-H stretching frequencies of ammine complexes are lower than those of the free  $\text{NH}_3$  molecule. 4

**OR**

- 10.** (a) What are the factors on which the intensity of a Raman peak depends? 4  
(b) Arrange the given species in the increasing order of their Fe-X stretching frequency and give reasons to support your answer : 3  
(i)  $[\text{FeCl}_4]^-$   
(ii)  $[\text{FeBr}_4]^-$   
(iii)  $[\text{FeBr}_4]^{2-}$   
(c) What is the mutual exclusion principle? Explain how it can be used for the structural elucidation of  $\text{N}_2\text{O}$  molecule. 1+2=3

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