

2022

(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. What is the missing reactant in the unbalanced reaction given below?



- (a) RMgX ()
(b) MgR₂ ()
(c) Mg R ()
(d) RX ()

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) -bonding MO ()
(b) -antibonding MO ()
(c) -bonding MO ()
(d) -antibonding MO ()

3. The molar mass of myoglobin is about
- (a) 64500 ()
 - (b) 45000 ()
 - (c) 24500 ()
 - (d) 17000 ()
4. The coordination number of iron in deoxyhaemoglobin is
- (a) 4 ()
 - (b) 5 ()
 - (c) 6 ()
 - (d) 7 ()
5. In lanthanides, the last electron enters
- (a) valence shell ()
 - (b) penultimate shell ()
 - (c) anti-penultimate shell ()
 - (d) either penultimate or anti-penultimate shell ()
6. Which one of the following ions is expected to be diamagnetic?
- (a) La^3 ()
 - (b) Ce^3 ()
 - (c) Pr^3 ()
 - (d) Nd^3 ()
7. The magnetic susceptibility of diamagnetic substance is
- (a) zero ()
 - (b) small and positive ()
 - (c) large and positive ()
 - (d) small and negative ()

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

(a) a high-spin d^7 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 of H_2O molecule is

(a) 3 ()

(b) 4 ()

(c) 5 ()

(d) 6 ()

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

(a) $[FeCl_4]$ ()

(b) $[FeBr_4]$ ()

(c) $[FeCl_4]^2$ ()

(d) $[FeBr_4]^2$ ()

(SECTION : B—SHORT ANSWER)

(Marks : 15)

Answer the following questions :

3×5=15

UNIT—I

1. Give one method of preparation of Grignard reagent and also write two uses of this reagent in organic synthesis.

OR

2. Write a brief account of non-classically bonded organometallic compounds.

UNIT—II

3. Write a short note on coordination polymers.

OR

4. Briefly explain the pH dependence of haemoglobin-oxygen binding.

UNIT—III

5. Give reasons why the magnetic moments of lanthanides cannot be obtained from the spin-only formula.

OR

6. Write a short note on the colour of tripositive (M^3) actinide ions.

UNIT—IV

7. What are the important properties of paramagnetic substances?

OR

8. Explain the following terms :

(a) Magnetic induction

(b) Bohr magneton

(c) Curie temperature

UNIT—V

9. What do you understand by Raman shifts?

OR

10. Differentiate between Stokes lines and anti-Stokes lines.

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

UNIT—I

1. (a) Explain how synergic bonding stabilizes the metal carbonyls. 3
(b) Compare the hybridization and structure of $\text{Co}_2(\text{CO})_8$ in the solid-state and solution. 3
(c) Discuss the different types of bonds found in metal carbonyls. 4

OR

2. (a) How will you prepare the following compounds? 1+1=2
(i) $\text{Ni}(\text{CO})_4$
(ii) MgR_2
(b) Citing suitable example, discuss the bonding in metal-alkene complex. 4
(c) How will you obtain $\text{Fe}_2(\text{CO})_9$? Discuss its bonding and structure. 1+3=4

UNIT—II

3. (a) What is inorganic rubber? Write one method of its preparation and also explain the structure of $(\text{NPCl}_2)_3$. 1+1+2=4
(b) Write the important properties and applications of silicones. 3
(c) Explain how oxyhaemoglobin passes on its oxygen to myoglobin. 3

OR

4. (a) Discuss in detail the method of preparation of a cyclic tetramer silicone. 4
(b) Explain the functioning of carbonic anhydrase. 3
(c) Write a brief note on the roles of Mg and Ca in biological systems. 3

UNIT—III

5. (a) What is lanthanide contraction? What are its causes? 1+3=4
(b) Make a comparison of the oxidation states of lanthanides and actinides. 3
(c) What are inner transition elements? Why are they so called? 1+2=3

OR

6. (a) Explain how the lanthanide contraction affects the atomic size of transition elements. 3
(b) Discuss the tendency of complex formation of lanthanides. 3
(c) Discuss how lanthanide ions are separated by ion-exchange method. 4

UNIT—IV

7. (a) How was the Curie's law corrected in Curie-Weiss law and why? 3
(b) Discuss the origin of spin-magnetic moment. 3
(c) Compare the magnetic properties of $[\text{Fe}(\text{CN})_6]^{2-}$ and $[\text{FeF}_6]^{2-}$ ions. 4

OR

8. (a) What is meant by magnetic susceptibility? Explain the temperature dependence of the magnetic susceptibilities of paramagnetic and antiferromagnetic substances. 1+3=4
(b) Write a short note on ferromagnetism. 3
(c) Compare the magnetic properties of Ni^{2+} ion in tetrahedral and square planar complexes. 3

UNIT—V

9. (a) What are the fundamental vibrations of CO_2 molecule? Indicate whether they are IR or Raman active. 3
- (b) What are the factors on which the intensity of a Raman-peak depends? 3
- (c) What is mutual exclusion principle? Explain how it can be used for the structural elucidation of N_2O molecule. 1+3=4

OR

10. (a) Give at least three differences of Raman spectroscopy and infrared spectroscopy. 3
- (b) Give reasons why the N-H stretching frequencies of ammine complexes are lower than those of the free NH_3 molecule. 3
- (c) Give reasons for the difference in the observed Ni-X stretching frequencies of the given species : 4

<i>Complex</i>	(MX)
<i>trans</i> - $[\text{Pd}(\text{NH}_3)_2\text{Cl}_2]$	333
<i>cis</i> - $[\text{Pd}(\text{NH}_3)_2\text{Cl}_2]$	327, 306
<i>trans</i> - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$	365
<i>cis</i> - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$	330, 323

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