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(CBCS)

(6th Semester)

CHEMISTRY

NINTH PAPER

(Inorganic Chemistry—III)

Full Marks : 75

Time : 3 hours

(PART : A—OBJECTIVE)

(Marks : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(Marks : 10)

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

1×10=10

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

(a) CH_3MgBr ()

(b) $\text{Al}(\text{OCH}_3)_3$ ()

(c) $(\text{C}_2\text{H}_5)_4\text{Pb}$ ()

(d) $(\text{CH}_3)_2\text{SnCl}_2$ ()

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

(a) sp^3d ()

(b) sp^3 ()

(c) sp^2 ()

(d) sp ()

3. In deoxyhemoglobin, iron is present as

(a) both Fe^{2+} and Fe^{3+} ()

(b) Fe^{3+} ()

(c) Fe^0 ()

(d) Fe^{2+} ()

4. Inorganic rubber is

(a) polyphosphonitrilic chloride ()

(b) silicone rubber ()

(c) natural rubber ()

(d) polyurethane ()

5. In inner-transition elements, the differentiating electron enters

- (a) valence shell ()
- (b) penultimate shell ()
- (c) antipenultimate shell ()
- (d) All of the above ()

6. Which of the following pairs of ion will not be expected to show same colour?

- (a) Ce^{3+} and Yb^{3+} ()
- (b) Pm^{3+} and Tm^{3+} ()
- (c) Sm^{3+} and Dy^{3+} ()
- (d) Eu^{3+} and Tb^{3+} ()

7. The relative magnetic permeability of diamagnetic substance is

- (a) slightly less than 1 ()
- (b) equal to 0 ()
- (c) equal to 1 ()
- (d) slightly larger than 1 ()

8. The paramagnetism in substances is

- (a) independent of both temperature and strength of magnetic field applied ()
- (b) dependent of both temperature and strength of magnetic field applied ()
- (c) dependent on the strength of magnetic field applied but not on temperature ()
- (d) dependent on temperature but not on the strength of magnetic field applied ()

9. The number of normal modes of vibration for SO_2 molecule is

- (a) 3 ()
- (b) 4 ()
- (c) 5 ()
- (d) 6 ()

10. Which one of the following is correct with respect to the M-X stretching frequencies of bridging (ν_b) and terminal (ν_t) M-X bonds in the bridging metal-halogen compounds?

- (a) ν_b are generally lower than ν_t ()
- (b) ν_b are generally higher than ν_t ()
- (c) ν_b are generally equal to ν_t ()
- (d) ν_b may be lower or higher than ν_t ()

SECTION—B

(Marks : 15)

Answer the following questions :

3×5=15

1. Write a brief note on non-classically bonded organometallic compounds.

OR

2. What are metallic carbonyls? Why is the metallic atom present in low oxidation state in metallic carbonyls?

3. Draw the structure of heme group and explain how it is coordinated with the polypeptide chain in hemoglobin.

OR

4. What are condensation polymers? Give examples.

5. Point out at least three similarities of lanthanides and actinides.

OR

6. Give reasons why separation of lanthanides is difficult.

7. How do you deduce magnetic moment from magnetic susceptibility?

OR

8. Write the properties of ferromagnetic substances.

9. What do you understand by Raman shifts?

OR

10. Point out three similarities and three dissimilarities between Raman spectroscopy and Infrared spectroscopy.

(PART : B—DESCRIPTIVE)

(Marks : 50)

The figures in the margin indicate full marks for the questions

1. (a) Give one method of preparation and two applications of Grignard reagent in the preparations of alcohols. 3
- (b) Explain the hybridization of the central atom and structure of $\text{Ni}(\text{CO})_4$. 3
- (c) Discuss Dewar-Chatt-Duncanson model of metal-alkene bonding. 4

OR

2. (a) Discuss briefly the applications of alkyl and aryl borons in organic synthesis. 3
- (b) Explain different types of bonds found in mononuclear metallic carbonyls. 3
- (c) How will you prepare $\text{Fe}_2(\text{CO})_9$? Draw its structure and explain how the bridging carbonyl groups are bonded to iron atoms. 1+1+2=4
3. (a) Discuss the mechanism for the hydrolysis of peptide bond by carboxypeptidase. 3
- (b) Briefly explain the functioning and importance of Na⁺ - K⁺ pump. 3
- (c) Explain the cooperativity effect in hemoglobin. 4

OR

4. (a) Point out at least six properties of inorganic polymers. 3
- (b) Discuss the structure of $(\text{NPCl}_2)_3$. 3
- (c) What are silicones? Discuss the method of preparation of a linear (tetramer) silicone. 1+3=4

5. (a) Write a brief note on the colour of M^{3+} actinide ions. 3
- (b) Compare the tendency of complex formation in lanthanides and actinides. 3
- (c) What is lanthanide contraction? Write three of its direct consequences. 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 different oxidation states shown by lanthanides and actinides. 3
- (c) Describe the separation of lanthanides by ion exchange method. 4
7. (a) Discuss the origin of spin magnetic moment. 3
- (b) Explain why $[Mn(CN)_6]^{4-}$ has a magnetic moment of $1.73 \mu_B$ whereas $[Mn(H_2O)_6]^{2+}$ has a value of $5.9 \mu_B$. 3
- (c) What is magnetic susceptibility? Draw plots of susceptibility versus temperature for paramagnetic and ferromagnetic substances and explain why they are different. 1+3=4

OR

8. (a) Write a short note on antiferromagnetism. 3
- (b) Explain the magnetic behaviours of the following compounds : 1½+1½=3
- (i) $K_3[Co(CN)_6]$
- (ii) $K_3[FeF_6]$
- (c) What is Curie law? Draw plots of inverse of molar susceptibility versus temperature for paramagnetic and antiferromagnetic substances and explain the differences. 1+3=4

9. (a) Explain in brief about Rayleigh and Raman scatterings using suitable energy diagrams. 3
- (b) Give reasons why the NH_3 stretching frequencies of ammine complexes are lower than those of the free NH_3 molecule. 3
- (c) Explain the differences of Fe-Cl symmetric stretching vibrational frequencies in the IR spectra of the following complex ions : 4

Complexes	(Fe Cl) (in cm^{-1})
$[\text{FeCl}_4]$	330
$[\text{FeBr}_4]$	200
$[\text{FeCl}_4]^2$	266
$[\text{FeBr}_4]^2$	162

OR

10. (a) What are the factors on which the intensity of a Raman peak depends? 3
- (b) Discuss different vibrational modes of a CO_2 molecule and explain how IR and Raman spectra are used for its structural elucidation. 3
- (c) The IR spectra for *trans*- and *cis*-isomers of $[\text{Pd}(\text{NH}_3)_2\text{Cl}_2]$ and $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$, show the following M-X vibrational frequencies. Comment on the observed IR bands : 4

Complexes	(M-X) (in cm^{-1})
<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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