

M.Sc. CHEMISTRY
Third Semester
INORGANIC CHEMISTRY-III
(MSC - 12)

Duration: 3Hrs.

Full Marks: 70

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins.

Marks: 50

Answer any five of the following questions:

1. Define labile and inert complexes and give one example for each. Explain A and D mechanism of substitution for octahedral complexes. Illustrate the factors on which acid hydrolysis of metal complexes depends. (3+4+3=10)
2. Explain the mechanism of trans effect. What do you mean by reorganisation energy in case of outer sphere electron transfer reactions? Explain the background of dividing cations and anions into hard and soft acids and bases. Explain the HSAB principle in terms of HOMO-LUMO concept. (2+3+2+3=10)
3. Between $B(CH_3)_3$ and $B(OCH_3)_3$ which one is called organometallic and why? Draw the structure of $Al_2(CH_3)_6$. What product is obtained when $Al_2(CH_3)_6$ reacts with BF_3 . What is redistribution reaction? Give example. Comment on the redox properties of main group organometallic compounds. (2+2+1+1+1+3=10)
4. Give examples of oxidative addition and insertion reaction for the synthesis of organometallic complexes. Explain the bonding of alkene transition metal complex. (2+3=5)
Explain – “ $Mn(CO)_5$ can't be isolated but $(CO)_5Mn-Mn(CO)_5$ is quite stable”. (2)
With example distinguish between carbynes and carbides. (3)

5. Write reactions to show the synthesis of nickelocene. Write the IUPAC name and structure of Wilkinson's catalyst. What type of reaction does it catalyse?

(3+1+1=5)

Write a short note on Ziegler-Natta catalysis.

(3)

Give one example of an organometallic reagent used as reducing agent.

(2)

6. With diagram explain the hexagonal and cubic close packing. Explain with diagram the cesium-chloride structure for solid. What is the F centre in an imperfect crystal? Illustrate the thermodynamic reasons behind crystal defects.

(3+3+1+3=10)

7. Mention the biological roles played by Ni^{2+} , Cr^{3+} , K^+ and Mn^{2+} . Draw the active centre structure of Plastocyanine and Cytochrome c. Explain the mechanism of co-operativity effect of haemoglobin towards O_2 binding. Give example of two reactions catalysed by vitamin B12.

(2+3+3+2=10)

8. Draw structure of one synthetic O_2 carrier. What is the difference between ferredoxin and HiPIP? Draw the schematic diagram of the enzyme nitrogenase. Explain the active centre structure of hemocyanine. What are the basic differences between PSI and PSII?

(2+2+2+2+2=10)

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Duration: 20 minutes

Marks – 20

(PART A- Objective Type)

I. Choose the correct answer:

1×20=20

- Which is of the following labile?
(a) $\text{Mg}(\text{H}_2\text{O})_6^{2+}$ (b) $\text{Cr}(\text{H}_2\text{O})_6^{3+}$
(c) $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ (d) $\text{Co}(\text{H}_2\text{O})_6^{3+}$
- The correct increasing order of trans effect is—
(a) $\text{Cl}^- < \text{Br}^- < \text{I}^- < \text{CN}^-$ (b) $\text{Cl}^- > \text{Br}^- > \text{I}^- > \text{CN}^-$
(c) $\text{I}^- < \text{Br}^- < \text{Cl}^- < \text{CN}^-$ (d) $\text{CN}^- < \text{Cl}^- < \text{Br}^- < \text{I}^-$
- Consider the following reaction. If the first step formation constant is 10^{-3} and subsequent step formation constants increase by 10 times to that of previous step then the overall formation constant of the reaction is—
 $\text{M}^{n+} + 6\text{L} = [\text{ML}_6]^{n+}$
(a) 10^{-6} (b) 10^{-3} (c) 10 (d) 0
- Which of the following pair of complexes is likely to follow electron transfer reaction by inner sphere mechanism—
(a) $[\text{Fe}^{2+}(\text{CN})_6]^{4-} / [\text{Ir}^{4+}(\text{CN})_6]^{2-}$
(b) $[\text{Fe}^{2+}(\text{CN})_6]^{4-} / [\text{Fe}^{3+}(\text{CN})_6]^{3-}$
(c) $[\text{Cr}^{2+}(\text{H}_2\text{O})_6]^{2+} / [\text{Co}^{3+}\text{Cl}(\text{NH}_3)_5]^{2+}$
(d) All the above
- Consider the following Lewis acids—
 $\text{Li}^+, \text{K}^+, \text{Cu}^+, \text{Ag}^+$
Which of the following statement is correct?
(a) Li^+, K^+ are soft while Cu^+, Ag^+ are hard.
(b) Cu^+, Ag^+ are soft while Li^+, K^+ are hard.
(c) Li^+, Ag^+ are soft while Cu^+, K^+ are hard.
(d) Ag^+, K^+ are soft while Li^+, Cu^+ are hard.
- Ethylenediaminetetraacetate (EDTA) acts as hexadentate ligand in aqueous medium—
(a) when the medium is basic (b) when the medium is acidic
(c) when the medium is neutral (d) in all the above three cases

7. Which of the following carbonyl does not exist?
 (a) $\text{Fe}(\text{CO})_4\text{PPh}_3$ (b) $\text{Mn}_2(\text{CO})_{10}$
 (c) $\text{Mn}(\text{CO})_5$ (d) $\text{Co}_2(\text{CO})_8$
8. In metal carbonyls, CO binds to metal through C due to the fact that—
 (a) dipole moment of CO is directed towards C.
 (b) metal-C bonds are more stronger than metal-O bonds.
 (c) metal-C interaction releases more energy.
 (d) now O atom is free to form H bonding with solvent.
9. The number of bridging carbonyls present in $\text{Co}_4(\text{CO})_{12}$ is—
 (a) 3 (b) 4 (c) 2 (d) 0
10. The IUPAC name of Zeise's salt is—
 (a) trichloroethylenepalatinatate(IV) (b) trichloroethylenepalatinatate(II)
 (c) tetrachloroethylenepalatinatate(II) (d) tetrachloroethylenepalatinatate(IV)
11. Complete the following reaction—
 $\text{NiCl}_2 + 2\text{CH}_2=\text{CHCH}_2\text{MgCl} \longrightarrow \underline{\hspace{2cm}} + 2\text{MgCl}_2$
12. Consider the metal alkene complex of the type $(\text{L}_3)\text{Pb}(\text{H}_2\text{C}=\text{CH}_2)$. For which ligand L you expect H atoms to deviate maximum from planarity?
 (a) Cl^- (b) CN^- (c) PPh_3 (d) PMe_3
13. Wilkinson's catalyst is used for—
 (a) Hydroformylation reactions (b) Polymerisation reactions
 (c) Hydrogenation reactions (d) All the above
14. NiO crystal on analysis found to show Schottky defect with the incorporation of Ni^{3+} and another metal ion which is likely to be—
 (a) Cr^{3+} (b) Co^{3+} (c) Fe^{3+} (d) Ca^{2+}
15. Which of the metal ion is not found in biological systems—
 (a) Cr^{3+} (b) Al^{3+} (c) Au^{3+} (d) Ni^{2+}
16. In the active centre of rubredoxin the iron is coordinated to—
 (a) Four cysteine (b) Four cystine
 (c) Four methionine (d) Four histidine
17. The plot of per cent saturation of haemoglobin versus O_2 partial pressure is—
 (a) Parabolic (b) Hyperbolic
 (c) Sigmoidal (d) Depends on the source of haemoglobin
18. In case of cytochrome Cyt_{550} , 550 means—
 (a) molecular weight of the cytochrome.
 (b) wavelength at which the cytochrome absorbs.
 (c) number of electrons transferred per second.
 (d) it is 550th cytochrome discovered.

19. Unusual P clusters are involved in—

- (a) PSI and PSII
- (b) Respiratory chain
- (c) N_2 fixation
- (d) Synthesis of ATP

20. Which of the following vitamin is mainly found in animal liver?

- (a) C
- (b) D
- (c) B_{12}
- (d) E
