M.Sc. CHEMISTRY
THIRD SEMESTER
INORGANIC CHEMISTRY-III
MSC-302

(Use separate answer scripts for Objective & Descriptive)

Duration : 3 hrs.   Full Marks : 70

[PART-A : Objective]

Time : 20 min.   Marks : 20

Choose the correct answer from the following: *1×20=20*

1. Alkyl Boranes are:
   a. Monomeric and not hydrolysed by water.
   b. Polymeric and not hydrolysed by water.
   c. Monomeric and hydrolysed by water.
   d. Polymeric and hydrolysed by water.

2. Organo-mercuric compounds are:
   a. Photochemically and thermally unstable.
   b. Photochemically and thermally stable.
   c. Photochemically stable but thermally unstable.
   d. Photochemically unstable but thermally stable.

3. In the gas phase $Be(CH_3)_2$ is............... but in solid it is..............
   a. Monomeric, monomeric   b. Monomeric, polymeric
   c. Polymeric, monomeric   d. Polymeric, polymeric

4. $H_2Os_3(CO)_{10}$ follows 18-electron rule. The number of Os-Os bond is:
   a. One   b. Two   c. Three   d. Four

5. $Co(CO)_3$ is isolobal with:
   a. CH_2 b. $Ni(C_5H_5)$
   c. $Fe(CO)_3$ d. $Co(C_5H_5)$

6. Asymmetric Hydrogenation of alkenes contains ligands with ....chiral center and having ....symmetry.
   a. 1, C_2-axis   b. 2, C_2-axis
   c. 1, C_3-axis   d. 2, C_3-axis

7. Bonding in Ferrocene involves ....sigma, ...pi and ....delta number of bonds respectively.
   a. 2, 4 and 2   b. 2, 2 and 4
   c. 1, 4 and 2   d. 4, 2 and 1

8. Among the given pH values, the O_2 binding efficiency of hemoglobin is maximum at:
   a. 6.8   b. 7.0   c. 7.2   d. 7.4

9. In biological systems, the metal ions responsible for maintaining the concentration gradient (osmotic balance) in cells are:
   a. Zn^{2+} and Mg^{2+} b. Ca^{2+} and Mg^{2+}
   c. Na^+ and K^+ d. Cu^{2+} and Fe^{3+}

10. Which group is bound to the metal ion in coenzyme B_{12}?
    a. Cyanide
    b. Methyl
    c. Adenosyl
    d. Hydroxyl

11. Iron-sulphur clusters in biological systems are involved in:
    a. Proton transfer
    b. Electron transfer
    c. Group transfer
    d. Atom transfer

12. The packing fraction of a simple cubic lattice is close to:
    a. 0.76
    b. 0.52
    c. 0.94
    d. 0.45

13. The lattice parameter of an element stabilized in a fcc structure is 4.04 Å. What is the atomic radius of the element?
    a. 1.43 Å
    b. 5.72 Å
    c. 4.29 Å
    d. 2.86 Å

14. A compound of A and B atoms forms a cubic unit cell. A atoms are at the corners and body centre position and B atoms are at the face centre positions of the cube. The molecular formula of the compound is:
    a. AB
    b. AB_2
    c. A_3B_2
    d. A_2B_3

15. A true statement about base hydrolysis of $[Co(NH_3)_5Cl]^{2+}$:
    a. It is first order kinetics.
    b. The rate determining steps involves the dissociation of chloride in $[Co(NH_3)_4(NH_2)Cl]^+$
    c. The rate is independent of the concentration of the base.
    d. The rate determining steps involves the abstraction of proton from $[Co(NH_3)_5Cl]^{2+}$.

16. The reaction of $Ni(CO)_4$ with the ligand L (L=PMe_3) yields $Ni(CO)_3L$ .The reaction is:
    a. Associative
    b. Dissociative
    c. Interchange(Ia)
    d. Interchange(Id)

17. Aqueous Cr^{2+} effects one electron reduction of $[Co(NH_3)_5Cl]^{2+}$ giving compounds Y. Compound Y undergoes rapid hydrolysis. Y is:
    a. $[Co(NH_3)_5]^{2+}$
    b. $[Co(NH_3)_5(OH)]^+$
    c. $[Co(NH_3)_4(OH)_2]^{2+}$
    d. $[Cr(H_2O)_5Cl]^{2+}$

18. The mechanism of the reaction between $[Fe(CN)_6]^{4-}$ and $[Fe(bpy)_3]^{3+}$ is:
    a. Outer-sphere electron transfer.
    b. Inner-sphere electron transfer.
    c. Self-exchange reaction.
    d. Ligand exchange followed by electron transfer.

19. Number of rotational symmetry axes for triclinic crystal system is:
    a. 4
    b. 3
    c. 1
    d. 0

20. The value of d_{111} in cubic crystal is 325.6 pm. The value of d_{333} is:
    a. 325.6pm
    b. 976.8pm
    c. 108.5pm
    d. 625.6pm

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(**PART-B :Descriptive**)

Time: 2 hrs. 40min.   Marks: 50

[**Answer question no.1 & any four (4) from the rest**]

1. a) Discuss the toxicity of methyl mercury compounds.   4+4+2=10
   b) Discuss the role of zinc and manganese in human body.
   c) Write the difference between two electron transfer reactions.

2. a) Discuss the synthesis and applications of Polysiloxanes or silicones.   5+5=10
   b) Elaborate the structure of $(LiCH_3)_4$.

3. Explain the synthesis, reactivity and structure of Metal-Carbene   10
   complexes.

4. a) Explain the structure of Metal-Olefin complexes. What factors affect   5+5=10
      the π-back bonding in Metal-olefin complexes?
   b) Discuss the Monsanto Process of preparation of acetic acid.

5. Discuss the conformational changes in the *oxy* and *deoxy* forms of   3+2+1+4=10
   hemoglobin. What is the significance of the Bohr effect in hemoglobin?
   What are cytochromes? Discuss the structure of cytochrome c.

6. How is the corrin ring different from the porphyrin ring? What does the   2+1+5+2=10
   deficiency of vitamin B_{12} cause? How does nitrogenase enzyme fix
   atmospheric nitrogen? What are the photosystems present in the process
   of photosynthesis?

7. Calculate the packing efficiency in bcc and fcc lattices. What are the   5+5=10
   different types of stoichiometric defects in solids?

8. Explain the mechanism of Acid hydrolysis reaction and Base hydrolysis   5+5=10
   reaction.

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