M.Sc. CHEMISTRY
FIRST SEMESTER
INORGANIC CHEMISTRY-I
MSC-103

(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. Which is the Term Symbol for state with angular momentum quantum number (L,S)=(3, 3/2)?
   a. ^{3}D b. ^{3}F c. ^{4}F d. ^{4}G

2. Identify the ground term from the set of Terms- ^{1}P, ^{3}P, ^{3}F, ^{1}G.
   a. ^{1}P b. ^{3}P c. ^{3}F d. ^{1}G

3. The colour of a complex in solution is blue, therefore it absorbs:
   a. Blue light b. Red light
   c. Green light d. Orange light

4. Which has the smallest CFSE amongst the following complex? $[Cr(H_20)_6]^{2+}$, $[Fe(H_20)_6]^{3+}$, $[Fe(CN)_6]^{3-}$, $[Ru(CN)_6]^{3-}$
   a. $[Cr(H_20)_6]^{2+}$ b. $[Fe(H_20)_6]^{3+}$
   c. $[Fe(CN)_6]^{3-}$ d. $[Ru(CN)_6]^{3-}$

5. The spin only magnetic moment for the complex $[Co(NH_3)_6]^{3+}$, $[Fe(H_20)_6]^{2+}$, $[Fe(CN)_6]^{3-}$, $[Cr(NH_3)_6]^{3+}$ are respectively:
   a. 0, 4.9, 1.73 , 3.87 B M b. 0, 4.9, 3.87, 1.73 BM
   c. 0, 1.73, 4.9, 3.87 B M d. 3.87, 0, 4.9, 1.73 B M

6. The structure of magnetite Fe_3O_4 is inverse spinel. Therefore the formula is:
   a. $(Fe^{2+})_T (Fe^{3+})_o O_4$ b. $(Fe^{3+})_T (Fe^{2+}, Fe^{3+})_o O_4$
   c. $(Fe^{3+})_T (Fe^{2+}, Fe^{2+})_o O_4$ d. $(Fe^{2+})_T (Fe^{2+}, Fe^{3+})_o O_4$

7. The pink colour of MnO_4^- solution is because of charge transfer from:
   a. d → d b. M → L
   c. L → M d. L → L

8. The observed magnetic moment of which of the two lanthanides does not agree to calculations based on J value?
   a. Ce^{3+} and Sm^{3+} b. Ce^{3+} and Lu^{3+}
   c. Sm^{3+} and Gd^{3+} d. Gd^{3+} and Lu^{3+}

9. Which of the following is wrong regarding the structure of diborane?
   a. Four terminal H atom and two bridging H atom.
   b. Terminal H atom and B lie in a plane.
   c. Four two centre bond, two three centre bond.
   d. B is sp^2 hybridised.

10. Boron compounds behaves as Lewis acid because of their:
    a. Acidic nature b. Electron deficiency
    c. Ionic property d. Smaller size

11. Structure of $XeOF_4$ is:
    a. Trigonal bipyramidal
    b. Tetrahedral
    c. Square pyramidal
    d. Square planar

12. Hypoxic water have DO:
    a. 5-7 mg/L
    b. 3-4 mg/L
    c. 10-12 mg/L
    d. 0.5-2 mg/L

13. Si-O bond in silica can be broken on treatment with:
    a. HCl b. HNO_3 c. BF_3 d. HF

14. Primary unit in cyclic silicate is:
    a. $(SiO_3)^{2-}$ b. $(SiO_2)_n$ c. $(Si_2O_7)^{6-}$ d. $(SiO_4)^{4-}$

15. Formula of inorganic benzene is:
    a. $(BN)_3$
    b. $B_3N_3H_3$
    c. $B_3N_3H_3Cl_3$
    d. $B_3N_3H_6$

16. Which of the following compound belong to allylide carbide category?
    a. Mg_2C_3 b. Al_4C_3 c. CaC_2 d. Be_2C

17. The shape of the molecule XeO_2F_2 is?
    a. Distorted octahedral
    b. Square planar
    c. Trigonal bipyramidal
    d. Tetrahedral

18. The number of lone pair of electron on the central atom in $[BrF_4]^-$, XeF_6?
    a. 2, 0 and 1
    b. 1,0 and 1
    c. 2, 1 and 1
    d. 2,1 and 0

19. The decreasing order of dipole moment of molecule is:
    a. $NF_3 > NH_3 > H_2O$
    b. $NH_3 > NF_3 > H_2O$
    c. $H_2O > NH_3 > NF_3$
    d. $NF_3 > H_2O > NH_3$

20. The total number of lone pair of electrons in I_3^-
    a. 0 b. 3 c. 6 d. 9

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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) Describe and explain the Jahn-Teller effect in Octahedral complexes. 5+5=10
   b) Discuss the bonding involved in the formation of diborane on the basis of MO approach.

2. Describe the Crystal field Theory as applied to Octahedral complexes and state the factors that determine the CFSE. What is the weakness of the theory? 10

3. A solution of $Ni(H_2O)_6^{2+}$ shows three transitions at 8500, 13,800 and 25, 300 cm^{-1}. Draw the Orgel diagram for Ni^{2+} ion and make assignments of the bands. Calculate the Δo, x and B parameters. If the free ion B value is 1030 cm^{-1}, what is your observation? 10

4. a) Explain what is quenching of orbital angular momentum. 5+5=10
   b) Explain spin state cross over in certain complexes.

5. a) Determine the skeletal structure of following carbonyl cluster: 3+2+3+2=10
      i. $C_2B_{10}H_{12}$ ii. $C_2B_4H_8$ iii. $C_2B_7H_{13}$
   b) Give two methods of preparation of borazine.
   c) What are metal carbides and give one methods of preparation of salt like carbides? How salt like carbides are classified, explain with examples?
   d) What are phosphazenes? Give one method of preparation of hexachlorocyclotriphosphazenes and also write its structure?

6. a) What are the harmful effects of smog? Discuss the mechanism of photochemistry of smog. 4+2+4=10
   b) What is chemical oxygen demand (COD) and threshold limiting value (TLV)?
   c) Discuss the chemical properties of soil.

7. a) State and explain bent rule 3+1+3+3=10
   b) Define electronegativity. How electronegativity value can be determined using the following scale?
      i) Pauling Scale ii) Mulliken Scale

8. a) Explain using Walsh diagram why the first excited state of BeH_2 is bent, whereas that of BH_2 is linear. 4+6=10
   b) Explain the molecular energy level for NO and CO molecule using Molecular Orbital Theory (MOT).

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