2023/01

**SET A**

# M.Sc. CHEMISTRY
## FIRST SEMESTER
## INORGANIC CHEMISTRY
## MSC – 101 [REPEAT]

[USE OMR SHEET FOR OBJECTIVE PART]

**Duration : 3 hrs.** **Full Marks : 70**

**( Objective )**

**Time: 30 min.** **Marks: 20**

***Choose the correct answer from the following:*** ***1X20=20***

1. The number of Molecular Orbital formed for Octahedral $ML_6$ Complexes ( sigma –bonding only ) is-
   a. 15 b. 12
   c. 6 d. 9

2. The order of variation of Lattice Enthalpy in terms of CFSE is
   a. CaO<TiO< VO <MnO b. CaO>TiO> VO >MnO
   c. CaO<TiO>VO >MnO d. CaO<TiO< VO >MnO

3. The electron pairing energy for the $Mn^{3+}$ ions is 28000 $cm^{-1}$, and the Δo value for $[Mn(H_2O)_6]^{3+}$ and $[Mn(CN)_6]^{3-}$ are 15,800 and 38500 $cm^{-1}$ respectively. The complexes respectively are-
   a. Both high spin b. Both low spin
   c. Low spin and high spin d. High and low spin

4. The Effective Atomic Number of the complex $[Pt(NH_3)_6]^{4+}$ is-
   a. 78 b. 36
   c. 54 d. 86

5. The free ion ground term for the $d^7$ – and $d^2$-configuration respectively are-
   a. $^3F$ and $^4F$ b. $^4F$ and $^3F$
   c. $^2D$ and $^4F$ d. $^5D$ and $^2D$

6. The value of Crystal Field Stabilization Energy Δo can be obtained from the first transition energy for the configuration of -
   a. $d^2$ and $d^3$ b. $d^3$ and $d^7$
   $d^3$ and $d^8$ $d^7$ and $d^8$

7. The number of different way two electron can be arranged in the set of three orbital of $t_{2g}$ is -
   a. 45 b. 30
   c. 25 d. 15

8. The colour of $[Fe(Phen)_3]^{2+}$ is because of -
   a. MLCT b. LMCT
   c. d-d transition d. None of the above.

9. Diborane consists of terminal B-H bonds which are
   a. 2c, 2e
   b. 3c, 2e
   c. 2c, 3e
   d. 3c, 3e

10. The F orbitals associated in the $BF_3$ molecule formation are
   a. 2s, 2p
   b. 2s, 3s
   c. 2s, 3p
   d. 2s, 2s

11. The low oxidation state of metal atoms is stabilized by
   a. Hydride ion
   b. Halide ion
   c. Carbonyl ion
   d. None of the above

12. High nuclearity carbonyl clusters contain
   a. Two metal atoms directly bonded to one another
   b. Five or more than five metal atoms directly bonded to one another
   c. Five or more than five halide ions directly bonded to one another
   d. None of the above

13. A fluxial molecule is one
   a. in which double bonds and single bonds keep changing places
   b. which is prepared by refluxing in concentrated nitric acid
   c. which contains only double bonds
   d. None of the above

14. Inert pair effect
   a. Decreases as we go down the group
   b. Increases as we go down the group
   c. Remains unchanged in a group
   d. None of the above

15. Mono positive lithium ion has high polarizing power due to its
   a. Large size and low charge density
   b. Small size and low charge density
   c. Small size and high charge density
   d. None of the above

16. Fluorine cannot form polyhalides because
   a. It is the most unreactive among the halides
   b. Of the absence of d-orbitals
   c. It reacts with water to form HF
   d. None of the above

17. Chemisrty of Francium is not well studied because
   a. It is the most unreactive of all alkali metals
   b. It is a noble gas
   c. It has very short half life period
   d. None of the above

18. Higher oxidation states of metals are stabilized in
   a. Halide type metal clusters
   b. Low nuclearity carbonyl clusters
   c. High nuclearity carbonyl clusters
   d. None of the above

19. Amongst of the species, the one having the highest bond strength is
   a. $O_2$
   b. $O_2^+$
   c. $O_2^{2+}$
   d. $O_2^{2-}$

20. In which set of diatomic molecules is the bond order three
   a. $NO^+$, $N_2$ and $CN^-$
   b. $N_2$,$O_2$ and CO
   c. NO, $N_2$ and $CN^-$
   d. CN, $N_2$ and CO

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# Descriptive

Time : 2 hrs. 30 mins. Marks : 50

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

1. a. Explain and draw the molecular orbital diagram of BF3 molecule. 5×2=10

   b. Explain the Orgel diagram for d8 –octahedral complex and suggests number spin allowed transition possible for [Ni(H2O)6}2+ ions.

2. a. Find the microstates and the Terms for $d^1$ configuration. 3
   b. What is Nephelauxetic series? 3
   c. What are Selection rules for electronic transition? How does it is relaxed? 4

3. What is Jahn-Teller effect? Explain its effect on high and low spin complexes of $d^1$ to $d^9$ complexes. How does it affect the structure and the spectra of transition metal complexes? 10

4. a. Solutions of $[Cr(H_2O)_6]^{3+}$ ions are pale blue-green but chromate ion $[CrO_4]^{2-}$ is an intense yellow. Characterize the origin of the transition and explain the relative intensity. 5+3+2 =10

   b. Complete and balance the following reaction

   (i) $Cr_2O_7^{2-} + SO_3^{2-} + H^+ \longrightarrow$

   (ii) $MnO_4^- + I^- + H_2O \longrightarrow$

   c. Arrange the following species on increasing order of bond length

   $O_2$, $O_2^+$, $O_2^-$, $O_2^{2-}$

5. Explain the splitting of d-orbital for octahedral and tetrahedral complexes in terms of Crystal Field Theory. What are the factors that determine the value of CFSE? 10

6. a. What are low and high nuclearity carbonyl clusters? Taking suitable examples, discuss in brief the structure and bonding in low nuclearity carbonyl clusters. 5×2=10

   b. Illustrate the terms "Chevrel phases' and "Zintal clusters".

c. Give a brief account of halide type metal Clusters.

7. a. What are boranes?How is diborane prepared ? Discuss the structure of diborane in terms of [3c-2e] bonding. **5×2=10**

   b. Explain why carbondioxide is a gas, while silicon dioxide is a solid?

   c. "Nitrogen cannot form pentachloride while phosphorus does"- explain.

8. a. Explain and draw the molecular orbital energy level diagram of CO and NO. **5×2=10**

   b. Write the enthalpy of formation deduced from the Born-Haber cycle and explain the cycle.

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