

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

Duration: 3 Hrs.

Marks: 70

Part : A (Objective) = 20

Part : B (Descriptive) = 50

[ PART-B : Descriptive ]

Duration: 2 Hrs. 40 Mins.

Marks: 50

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

1. a. Calculate the bond order for  $\text{NO}^+$  ions on the basis of molecular orbital theory (MOT). 2+3+5  
=10  
b. Calculate the formal charge for ozone ( $\text{O}_3$ ) and  $\text{NO}_2$  molecule.  
c. Discuss acidity of diboranes. Give the following reactions of diborane
  - i. Diborane and ammonia treated at high temperature in 1:2 ratio
  - ii. Hydrolysis of diborane in presence of conc. alkali solution
  - iii. Combustion of diborane.
  
2. a. Explain the Jahn -Teller Effect 5x2=  
10  
b. The aqueous solution of  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  shows the following transitions at 8,500; 13,800 and 25, 300  $\text{cm}^{-1}$ . Make assignment of the bands and calculate the value of  $\Delta_0$  and B.
  
3. a. Explain the spin state cross over phenomena in certain complexes. 5x2=  
10  
b. Explain the Selection rules for electronic spectra. Metal complexes shows d-d transition despite being Laporte forbidden. How?
  
4. a. Explain the bonding in  $\text{ML}_6$  octahedral complex (with only sigma bonding ligands) by MO theory. 7+3=  
10  
b. How does quenching of orbital magnetic moment take place in complexes?

5. a. Write a short note on phosphazene. Discuss the structure of hexachlorocyclotriphosphazene. 3+2=5  
b. Define electronegativity. How electronegativity value can be determined using Pauling Scale? 5
6. a. Define pseudohalides and give two dissimilarities between halogens and pseudohalogens. 3  
b. In the following molecules, give the hybridization and geometry of Xe atom: 2  
i.  $\text{XeO}_2\text{F}_2$  ii.  $\text{XeO}_2\text{F}_4$   
c. Discuss the structure of silicates. 5
7. a. Describe citing one example how Walsh's diagram approach relates molecular shape to the occupation of molecular orbitals. 5+5=10  
b. Why nitrogen molecule is diamagnetic in nature but oxygen molecule is paramagnetic in nature. Explain on the basis of molecular orbital theory.
8. a. Write short notes on: 5x2=10  
i. Dissolved oxygen (DO)  
ii. Biological oxygen Demand(BOD)  
b. Explain the mechanism of photochemical smog.

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[ PART-A : Objective ]

Choose the correct answer from the following :

1×20=20

- The Microstate for  $d^2$  configuration with  $M_L = -4$  and  $M_S = 0$  will be
  - $(2^+, 2^-)$
  - $(-2^+, -2^-)$
  - $(2^+, 2^+)$
  - $(-2^-, -2^-)$
- The Ground Term for  $d^5$  configuration will be
  - $^5D$
  - $^1S$
  - $^4F$
  - $^6S$
- The  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$  complex shows the transition at 17,400; 24,600; and 37,800  $\text{cm}^{-1}$ .  
The value of  $\Delta_o$  is
  - 17,400  $\text{cm}^{-1}$
  - 24,600  $\text{cm}^{-1}$
  - 37,800  $\text{cm}^{-1}$
  - 17,400 nm
- The calculated spin only Magnetic Moment of  $\text{Fe}^{3+}$  will be
  - 2.83
  - 3.87
  - 4.90
  - 5.92
- The origin of paramagnetism is
  - Field induced electron circulation.
  - Angular momentum of electron.
  - Spin-alignment from dipole-dipole interaction.
  - Spin pairing from dipole-dipole interaction.
- The maximum degeneracy for  $t_{2g}^2$  configuration is -
  - 15
  - 25
  - 35
  - 45

7. The distortion (elongation) along only one  $C_4$  axis in octahedral is called -
- Rhombic distortion
  - Tetragonal distortion
  - Trigonal distortion
  - Pyramidal distortion
8. A complex which absorbed in the Red region of the spectrum appears
- Red in colour
  - Yellow in colour
  - Orange in colour
  - Blue -Green in colour
9. In chain silicates the number of bridging O atoms are-
- 1
  - 2
  - 3
  - 4
10. All of the following are bases except
- $NH_3$
  - $N_3H$
  - $N_2H_4$
  - $NH_2OH$
11. In  $B_2H_6$
- The B-H bonds are ionic
  - There is a direct B-B bond
  - It is isostructural with  $C_2H_6$
  - Boron atoms are linked through H bridges
12. The oxoacid of phosphorus having P atoms in +4, +3 and +4 oxidation states
- $H_5P_3O_{10}$
  - $H_5P_3O_7$
  - $H_5P_3O_8$
  - $H_5P_3O_9$
13. The correct sequence in which bond order decreases in  $O_2, O_2^+, O_2^-, O_2^{2-}$
- $O_2 > O_2^+ > O_2^- > O_2^{2-}$
  - $O_2 > O_2^+ > O_2^{2-} > O_2^-$
  - $O_2^+ > O_2 > O_2^- > O_2^{2-}$
  - $O_2 > O_2^- > O_2^+ > O_2^{2-}$
14. In which one of the following pairs molecules/ions have similar shape?
- $CO_2$  and  $H_2O$
  - $BF_3$  and t-butyl carbonium ion
  - $CCl_4$  and  $PtCl_4$
  - $NH_3$  and  $BF_3$
15. In which compound are the bond most polar?
- $H_2O$
  - $CO_2$
  - $CCl_4$
  - $ClF$
16. Where is an electron added during the change of  $NO^+$  to  $NO$ ?
- $\sigma$ -orbital
  - $\pi$ -orbital
  - $\sigma^*$ -orbital
  - $\pi^*$ -orbital
17. The shape of  $BrF_3$  is
- T-Shaped
  - Trigonal planar
  - Trigonal pyramidal
  - Trigonal bipyramidal
18. The number of electron in the  $\sigma_{2p}$  molecular orbital in  $N_2^+$
- 0
  - 1
  - 2
  - 3
19. Ozone layer of stratosphere requires protection from indiscriminate use of
- Pesticides
  - Balloons
  - Atomic explosions
  - Aerosols and high flying jets
20. Photochemical smog is formed in
- Summer during morning time
  - Summer during day time
  - Winter during morning time
  - Winter during day time