22

M.Sc. CHEMISTRY
First Semester
INORGANIC CHEMISTRY-I
(MSC - 102)

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. What is meant by Temperature Independent Paramagnetism? What is meant by hysteresis? Draw and explain the qualitative molecular orbital treatment of octahedral complex. (3+3+4=10)
2. What is meant by spin orbital coupling? Explain the mechanism of ligand substitution in square planar complexes. Explain the Trans effect with suitable example (3+3+4=10)
3. (a) What are the major regions of the atmosphere? Mention their temperature range and chemical composition.
   (b) What is chemical oxygen demand and biological oxygen demand? Explain.
   (c) Explain what do you mean by green house effect? What type of gases will act as green house gas? Discuss the effect of CO_2 gas towards global warming. (2+3+5=10)
4. (a) Illustrate and explain hydrologic cycle. (2+3+5=10)
   (b) Explain acid-base and ion-exchange reactions in the soil.
   (c) Illustrate what is meant by photochemical smog? Explain how PAN is formed during this process.

5. (a) What do you mean by Walsh diagram? Explain with one example. (3)

(b) On the basis of Molecular orbital theory show the orbital overlap for CO and NO molecules. (2+2=4)

(c) Answer the following: (3)

i) If the extra bond energy Δ ($Kjmol^{-1}$) for C-H bond is 24.3, then what is the electronegativity difference between C and H atom?

ii) Why dipole moment of BF_3 is zero?

iii) Write the statement of bent rules.

6. (a) What is the spetrochemical series, and what is its importance? (3)

(b) Describe and explain Jahn-Teller effect in octahedral complexes of Cr^{+2} and Cu^{+2}. (3)

(c) Calculate spin-only magnetic moment for a d^8 ion in octahedral, square planner and tetrahedral ligand field. (2)

(d) Calculate in its Δ_0, the difference in crystal field stabilization energy between complexes d^6 octahedral and d^6 tetrahedral assuming that ligands are strong field ligand. (2)

7. (a) Calculate the microstates for p^4 and p^5 electronic arrangement. (2)

(b) What are the rules for determination of ground state term symbol for carbon and nitrogen atom? (3)

(c) How Orgel combined energy level diagram for d1 electronic arrangement? Explain in details. (3)

(d) Show that the transforming spectroscopic terms(S, P, D, F, G) into Mulliken symbols. (2)

8. (a) What do you mean by STYX number? Mention the STYX number for B_2H_6 and B_5H_{11}. (2×5=10)

(b) Explain the molecular structure of diborane.

(c) What are the different types of interhalogens? Show the structural formation of two interhalogen compounds.

(d) What are pseudohalides and pseudohalogen? Explain.

(e) Draw the different types of silicates structure.

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Duration: 20 minutes **Marks – 20**

PART-A (Objective)

Time: 20 mins **Total Marks: 20**

I. Choose the correct option: **1×20=20**

1. According to the MO theory for octahedral complexes which of the following metal d-orbital has an overlap with the ligand orbital:
   i) t_{2g} ii) t_{iu} iii) a_{1g} iv) e_g*

2. Trans effect is shown by the following complex:
   i) $[Co(NH_3)_6]Cl_3$ ii) $[Ni(Cl)_4]^{2-}$
   iii) $[Pt(NH_3)_2Cl_2]$ iv) $[Pt(Cl)_3NO_2]$

3. Temperature Independent Paramagetism is shown ions or compounds which are:
   i) Paramagnetic ii) Ferromagnetic
   iii) Diamagnetic iv) Antiferromagnetic

4. Spin orbital complexes are usually shown by
   i) Fe^{3+} complexes ii) Al^{3+} complexes
   iii) Ru^{2+} complexes iv) Ni^{2+} complexes

5. In Adjusted Crystal field theory there is……..between the ligand orbitals and metal d-orbitals.
   i) Complete overlap ii) No overlap
   iii) Moderate overlap iv) None of the above

6. Which of the following gas is an air pollutant?
   i) SO_2 ii) NO_2 iii) CO iv) All of these

7. Percentage of fresh water available for terrestrial life out of total Earth's water is about:
   i) 1.0 ii) 5.0 iii) 7.0 iv) 9.0

8. Which of the following gases will contribute towards green house effect?
   i) CH_4 ii) H_2O iii) O_3 iv) All of these

9. For a homonuclear diatomic molecule the bonding molecular orbital is:
   i) σ_g of lowest energy ii) σ_u of second lowest energy
   iii) π_g of lowest energy iv) π_u of lowest energy

10. The bond order and magnetic behavior of He_2^{+2} are respectively:
    i) Zero and para magnetic
    ii) Two and diamagnetic
    iii) Three and diamagnetic
    iv) One and diamagnetic

11. The number of hydroxyl (OH) groups present in phosphorus acid is:
    i) 1 ii) 2 iii) 3 iv) 4

12. The species which has a square planner structure is:
    i) BF_4^- ii) $FeCl_4^-$ iii) SF_4 iv) XeF_4

13. The shape of ICl_4^- is:
    i) Octahedral
    ii) See-saw
    iii) Square planner
    iv) None of the above

14. White phosphorus P_4 belongs to the:
    i) Closo system
    ii) Nido system
    iii) Arachno system
    iv) Hypo system

15. The general formulae of silicate ion present in cyclic silicate is:
    i) SiO_4^{-4} ii) $Si_2O_5^{-2}$ iii) SiO_7^{-6} iv) $(SiO_3)_n^{2n}$

16. The number of oxygen atom involved in sharing of $(Si_3O_9)^{-6}$ is:
    i) 2 ii) 3 iii) 6 iv) 4

17. The crystal field stabilization energy will be highest for:
    i) $[Mn(H_2O)_6]^{+2}$
    ii) $[Co(NH_3)_6]^{+3}$
    iii) $[Co(F)_6]^{-3}$
    iv) None of the above

18. The species containing paired electron in antibonding molecular orbital is:
    i) C_2
    ii) N_2
    iii) O_2
    iv) Both C_2 and N_2

19. The structure of $N(CH_3)_3$ and $N(SiH_3)_3$ are respectively:
    i) Pyramidal and trigonal planner
    ii) Trigonal planner and Pyramidal
    iii) Both pyramidal
    iv) None of these

20. The magnetic moment of Fe^{+2} in low spin octahedral complex is:
    i) 0
    ii) 1.41
    iii) 1.71
    iv) None of the above

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