M.Sc. CHEMISTRY
SECOND SEMESTER
INORGANIC CHEMISTRY-II
MSC – 202
[USE OMR FOR OBJECTIVE PART]

SET A

Duration: 3 hrs.

Full Marks: 70

(**Objective**)

Time: 30 min.

Marks: 20

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

1. Which of the following statement is true about magnetic field intensity:
    a. Magnetic field intensity is the number of lines of force crossing per unit volume
    b. Magnetic field intensity is the number of lines of force crossing per unit area
    c. Magnetic field intensity is the magnetic induction force acting on a unit magnetic pole
    d. Magnetic field intensity is the magnetic moment per unit volume

2. The experimental magnetic moment of $K_3[Fe(CN)_6]$ is 2.3BM and is attributed to the:
    a. Spin only value of a low spin Fe
    b. Spin only value of a high spin Fe
    c. Low spin with orbital contribution
    d. High spin with orbital contribution

3. Which one of the following shows ∂-bond
    a. $[Cu(CH_3COO)_2]_2 2H_2O$
    b. MnO_2
    c. $[Cu(OH)_6]^{2+}$
    d. $K_3[Cu(CN)_6]$

4. Which one of the following is the example of antiferromagnetism:
    a. MnO
    b. MnO_2
    c. CrO_2
    d. Both (a) and (b)

5. What will be the consequence of heating a ferromagnetic substance, above its curie temperature?
    a. Ferromagnetic domain becomes perfectly arranged
    b. Ferromagnetic domain are not influenced
    c. Ferromagnetic domain becomes perfectly diamagnetic
    d. Ferromagnetic domain becomes perfectly paramagnetic

6. Ground term for d^8 (in octahedral ligand field) is:
    a. T_{2g}
    b. A_{2g}
    c. T_{1g}
    d. A_2

7. Which of the following transition will require lowest energy for the electronic transition of $[CoCl_4]^{2-}$?
    a. T_{1g} to T_{2g}
    b. T_1 to A_2
    c. A_2 to T_2
    d. None of the above

[1]

8. For a Nickel (II) complex three bands are observed at energies of 8000, 13200, and 22800 cm^{-1}. What is the value of Δ_0?
   a. 8000 cm^{-1} b. 13200 cm^{-1}
   c. 22800 cm^{-1} d. None of the above

9. In the Tanabe Sugano diagram of d^3 case, two curved lines are observed. Which are those two?
   a. A_{2g} and T_{2g} b. A_{2g} and T_{1g}
   c. T_{1g} and T_{2g} d. T_{1g} (F) and T_{1g} (P)

10. How Laporte selection rule is relaxed?
    a. by spin orbit coupling   b. by vibronic coupling
    c. Both (a) and (b)   d. This rule cannot be relaxed in any condition

11. The electrode potential depends on the pH because:
    a. Many redox reactions in aqueous reaction involve transfer of H$^+$ b. Redox reactions in aqueous reaction involve transfer of electrons
    c. Both (a) and (b)   d. None of the above

12. Which of the following statement is correct:
    a. Cu(I) is not stable in aqueous solution because it can undergo disproportionation   b. Cu(I) is stable in aqueous solution because it can undergo disproportionation
    c. Both (a) and (b)   d. None of the above

13. In Pourbaix diagram a horizontal line separates species related by:
    a. Proton transfer only   b. Electron transfer only
    c. Both proton and electron transfer only   d. None of the above

14. Elements obtained by the chemical oxidation include:
    a. Heavier halogens   b. Sulphur
    c. Noble metals   d. All of the above

15. In oxidation of Fe^{2+} by permanganate ions (MnO$_4^-$) in acid solution the number of electron involved in balanced equation:
    a. +6   b. +5
    c. +4   d. +3

16. The ligand that support quadruple bonds are
    a. pi-donor but not pi acceptor   b. sigma-donor but not sigma acceptor
    c. sigma acceptor but not pi donor   d. none of the above

17. Polyoxometallate anion can be prepared by carefully adjusting
    a. pH and concentration   b. pressure
    c. temperature   d. none of the above

18. Charge-transfer spectra originates from a redistribution of electronic density
     a. within a molecule
     b. within and outside the molecule
     c. only in the exterior
     d. none of the above

19. The characteristics of a mixed valence complex is that the ion strongly absorbs in the
     a. mid infrared region
     b. near infrared region
     c. far infrared region
     d. none of the above

20. The Uranyl ion is strongly fluorescent with strong emission between 500-550 nm due to
     a. excitation with UV radiation
     b. excitation with IR radiation
   c. excitation with gamma radiation
     d. none of the above

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Descriptive

Time : 2 hrs. 30 mins.   Marks : 50

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

1. a. A compound of metal ion M^{x+} (Z=24) has a spin magnetic moment of $\sqrt{15}$ BM. Identify the name of the metal and calculate the number of unpaired electron.   2+3+2+3 =10

   b. State Laporte and Spin selection rule for electronic transition of metal complexes.

   c. Define disproportionation reaction with example.

   d. Why there is strong similarities between the chemical properties of the early d-block Organometallic compounds and those of the f-block elements

2. a. Define the term magnetic susceptibility?   1+2+3+4 =10

   b. Why magnetic susceptibility for diamagnetic substance is negative?

   c. Write two advantage and disadvantage of Faraday's method?

   d. Calculate the magnetic moment of the following compound;
      (i) $[Fe(H_2O)_5(NO)]^{2+}$ (ii) $[Cr(H_2O)_6]^{3+}$
      (iii) $VOSO_4$ (iv) $K_4[Mn(CN)_6]$

3. a. Classify the following configurations as A, E or T in complexes having octahedral symmetry. Some of these configurations represent excited states.   2+6+2 =10

[3]

(i) $t_{2g}^4 e_g^2$ (ii) t_{2g}^6

(iii) $t_{2g}^3 e_g^3$ (iv) t_{2g}^5
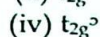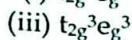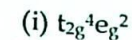
  b. Draw all Orgel's diagrams.

  c. What are the differences between Orgel and Tanabe-Sugano Diagram?

4. a. Explain a Pourbaix diagram for some important naturally occurring aqua species of iron.   5+5=10

   b. What is called chemical oxidation? Discuss Claus process with chemical reaction.

5. a. Account for the electronic spectra of early actinoids.   2+2+3+3

   b. Explain the reasons for the uniformity across f-block elements.   =10

   c. What is Creutz-Taube ion metal complex? How was the complex isolated?

   d. What is Ruthenium Red? What are its applications?

6. Answer the following: 3+2+3+2

  a. Write a short note on: =10

    (i) Temperature Independent Paramagnetism and

    (ii) Diamagnetic Correction.

  b. Show that Mn(VI) is unstable with respect to disproportionation into Mn(VII) and Mn(II) in acidic aqueous solution.

  c. Write the key points for construction of Latimer diagram and show the Latimer diagram for Chlorine in acid solution.

7. a. Define the term spin cross over?   1.5+1.5+3

   b. In octahedral geometry, which one of the following electronic configuration will have orbital contribution to the magnetic moment: +4=10

    (i) d^2 and

    (ii) d^7: Explain it in terms of octahedral arrangement and ground state term.

  c. Write the chemical reaction involved in oxidation by atmospheric oxidation.

  d. Draw Tanabe Sugano diagrams for d^2 and d^3 electronic configuration.

8. a. How many transitions do you expect for $[V(H_2O)_6]^{3+}$ in electronic spectra? Specify those transitions.   3+5+3

   b. What is 'Lanthanide contraction? What are its causes and impact on solubilities of their ions?   =10

   c. Enumerate the effects of Lanthanide contraction on the d-block elements

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