M.Sc. CHEMISTRY
SECOND SEMESTER
INORGANIC CHEMISTRY II
MSC – 202

SET A

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs.

Full Marks: 70

(Objective)

Time: 30 min.

Marks: 20

Choose the correct answer from the following:

$1\times20=20$

1. Ground state term for Ni2+ ion is
   - a. 3F2
   - b. 3F4
   - c. 5E
   - d. 3T2

2. Spin selection rule says that
   - a. There must be change in spin multiplicity during an electronic transition
   - b. $\Delta S = 0$
   - c. There must be no change in spin multiplicity during an electronic transition
   - d. Both b and c

3. Spectroscopic term symbol is result of
   - a. Spin-spin electronic interaction
   - b. Orbital-orbital electronic interactions
   - c. Spin-orbital electronic interactions
   - d. All of the above

4. The ground state for $[Cr(CN)_6]^{4-}$ is
   - a. ^3E_g
   - b. ^5E_g
   - c. $^3T_{1g}$
   - d. None of the above

5. The sum of the oxidation state and coordination number of the complex $[Co(en)_3]^{3+}$ is
   - a. 9
   - b. 6
   - c. 4
   - d. 7

6. In an optimum temperature, Chlorine reacts with dilute alkalis by
   - a. oxidizing some atoms only
   - b. reducing some atoms only
   - c. neutralizing some ions
   - d. oxidizing and reducing some atoms

7. Chlorate ion is the
   - a. oxidizing agents
   - b. reducing agents
   - c. bleaching agent
   - d. none of above

8. The specific Redox reaction of chlorine is known as
   - a. disproportionation
   - b. oxidation
   - c. reduction
   - d. redox chlorination

9. The ratio of Intensity of magnetism to the magnetization force is known as
   a. Flux density
   b. Magnetic susceptibility
   c. Relative permeability
   d. None of them

10. The relative permeability is less than unity in case of
    a. Fe, Ni
    b. Ferrites
    c. Cu, Ag
    d. Li, Mg

11. At Neel temperature
    a. Permeability is minimum
    b. Susceptibility is minimum
    c. Permeability is maximum
    d. Susceptibility is maximum

12. Which of the following solids is used as a standard calibrant for the measurement of magnetic susceptibility
    a. $Hg[Co(NCS)_4]$
    b. $Hg[Ni(NCS)_4]$
    c. $Hg[Co(CNS)_4]$
    d. $Hg[Ni(CNS)_4]$

13. The ligands 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

14. Peroxy metallate anion can be prepared by carefully adjusting
    a. Pressure
    b. pH and concentration
    c. Temperature
    d. None of the above

15. Charge-transfer originates from a redistribution of
    a. Electric Charge density within the molecule
    b. Electronic charge density within and outside the molecule
    c. Only in the exterior
    d. None of the above

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

17. Blood red color of Sm^{2+} ion is due to
    a. f-f transition
    b. d-f transition
    c. Charge-transfer transition
    d. d-d transition

18. Correct statement about actinides is/are
    a. 5f electrons are less loosely bound than 4f electrons
    b. Transuranium species are artificial
    c. Actinides are radioactive
    d. All of the above

19. Hf (Z=72) and Zr (Z=40) have similar ionic and atomic radii due to
    a. Diagonal relationship
    b. Similar chemical properties
    c. Lanthanoid contraction
    d. Same group

20. Which of the following is not a lanthanide?
    a. Er
    b. Pu
    c. Tm
    d. Tb

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$\boxed{\textbf{Descriptive}}$

Time : 2 hrs. 30 mins.   Marks : 50

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

1. a. What are the selection rules for electronic transitions of metal complexes and how intensity of colour of the complexes governed by these rules.   2+2+2+2+2=10

    b. Write a balanced equation for the oxidation of Fe^{2+} by permanganate ions (MnO_4^-) in acid solution.

    c. Explain the structure of uranyl fluoride (UO_2F_2).

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

    e. Define the term orbital contribution with one example?

2. a. Draw Tanabe Sugano Diagram for d^8 ion in octahedral field. What are the differences of Orgel and Tanabe Sugano Diagram.   6+2+2=10

    b. Calculate the cell potential produced by a fuel cell in which the overall reaction:
        $$2H_2 (g) + O_2 (g) \rightarrow 2H_2O(l)$$
        with H_2 and O_2 each at 1bar and 25°C.

    c. Write a balanced equation for the oxidation of iodide ion (I^-) by dichromate ion ($Cr_2O_7^{2-}$) in acid solution.

3. a. Discuss the effect of temperature on paramagnetic substance.   3+4+3=10

    b. What is Tungsten Bronze? Outline the properties of Sodium Tungsten Bronze.

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

4. a. Draw Orgel diagram for those d-electron configurations which have F ground term for free ion.   2+2+4+2=10

    b. Explain with chemical reaction of oxidation by atmospheric oxidation.

    c. What is Quadruple bond? Name the first compound to be synthesised containing Quadruple bond.

5. a. Why orbital magnetic moment is quenched in most of the first transition series complex?   2+3+2+3 =10

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

    c. Write down the steps involved in the separation of actinide ions using ion-exchange technique.

    d. Write two consequences of decrease in basicity of lanthanide ions due to lanthanide contraction.

6. a. How does the f-f transition band of lanthanides vary from d-d transition bands of transition metals? Explain.   3+2+3+2 =10

    b. Why Sm^{2+} ion exhibit intense blood red color?

    c. Write two advantages of Gouy method and Faraday method to measure magnetic susceptibility.

    d. Define the term spin cross over by taking one example d^6-octahedral complex.

7. a. How does hypochlorous acid undergoes disproportionation reaction? Explain with chemical reaction.   2+4+3+ 1=10

    b. What are dinitrogen complexes? How pentamine (dinitrogen)Ruthenium (II) could be synthesised?

    c. How would you account for the magnetic moment listed against each of the following complexes:
        (i) $Na_4[Co(NO_2)_6]$
        (ii) $[Co(biguanide)_2]$
        (iii) $[Ni(NH_3)_6]SO_4$

    d. Draw the Hysteresis loop for a magnetic substance.

8. a. Why does f-orbital have poor shielding effect?   2+2+2+2 +2=10

    b. Calculate the magnetic moment of Gd^{3+} ion in Bohr Magneton.

    c. How Laporte selection rule is relaxed?

    d. Explain why $[Mn(H_2O)_6]^{2+}$ complex is very light pink in color?

    e. Two half cell reactions of an electrochemical cell are given below:
        $MnO_4^-(aq) + 8H^+ (aq) + 5e^- \rightarrow Mn^{2+} (aq) + 4H_2O (l)$ $E° = + 1.51$ V
        $Sn^{2+} (aq) \rightarrow 4Sn^{4+} (aq) + 2e^-$ $E° = +0.15$V
        Construct the redox equation from the two half cell reactions and predict if this reaction favors formation of reactants or product shown in the equation.

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