REV-01
MSC/48/53

2022/07

M.Sc. CHEMISTRY
SECOND SEMESTER
INORGANIC CHEMISTRY II
MSC - 201

(Use Separate Answer Scripts for Objective & Descriptive)

Duration : 3 hrs. Full Marks : 70

(PART-A: Objective)

Time : 20 min. Marks : 20

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

1. The point group of the trigonalplanar molecule of formula $[ML_2L']$ and $[MLL'L'']$ is -
   a. C_{2v} and C_{2v} b. C_{2v} and C_s
   c. C_s and C_{2v} d. C_s and C_s

2. The Order of Tetrahedral (T_d) and Octahedral (O_h) point group is respectively-
   a. 24 and 24 b. 48 and 48
   c. 24 and 48 d. 48 and 24

3. The sum of the diagonal elements of the matrix of identity operation is
   a. 1 b. 2
   c. 3 d. 4

4. In a Cis-$[PtCl_2(PPh_3)_2]$ compound, the number of IR active stretching Pt—Cl and Pt –P vibrations respectively are -
   a. 2 and 2 b. 2 and 1
   c. 1 and 2 d. 1and 1

5. The Tetrahedral hybridization may be formed by hybridization of
   a. One s- and two p-orbitals b. One d- and two p- orbitals
   c. One s- and three d-orbitals d. One s- and one d- and two p-orbitals

6. The metal-dinitrogen bond is weaker as compared to metal-carbonyl bond because
   a. CO is a better sigma-donor and a better pi-acceptor.
   b. CO is better pi-donor and sigma acceptor.
   c. CO is a better pi –donor and pi-acceptor.
   d. None of the above.

7. The first well characterized example of a bent nitrosyl ligand was found in a derivative of of
   a. Zeises salt b Vaska's complex
   c. Zeigler Natta catalyst d None of the above.

8. Polyoxo metalletes can be prepared by carefully adjusting
   a. pH and concentration. b Pressure
   c. Temparature d None of the above.

9. High coordination number of lanthanides in a complex adopt such geometries that
   a. Neutralizes Inter ligand repulsion. b Maximizes inter ligand repulsion.
   c. Minimizes inter ligand repulsoin d None of the above.

10. Lanthanide shift reagents are paramagnetic compounds that have the ability to induce a
    a. Paramagnetic shift on the neighborhood nuclear spin on the molecular system.
    b. Diamagnetic shift on the neighborhood nuclear spin on the molecular system.
    c. Antiferromagnetic shift on the neighborhood nuclear spin on the molecular system,
    d. None of the above.

11. Creutz-Taube complex ion is represented as
    a. $[Ru(NH_3)]_2[C_4H_4N_2]$ b. $Ru(NH_3)_2$
    c. $(C_4H_4N_2)$ d. None of the above.

12. The value of 'X' in Na_XWO_3 is
    a. Greater than 1 b. Equal to zero
    c. Is equal or less than 1 d. None of the above.

13. The ammoniated Ruthenium oxy chloride is known as
    a. Ruthenium red. b. Ruthenium blue.
    c. Ruthenium bronze. d. None of the above.

14. Which of the following statement is correct
    a. If $\Delta_rG^0 < 0$, then the reaction is spontaneous
    b. If $\Delta_rG^0 = 0$, then reaction becomes equilibrium
    c. If Δ_rG^0 = -ve, then the reaction is spontaneous
    d. All of the above

15. Which of the following is wrong statement
    a. A redox reaction can be expressed as the difference of two reduction half reaction
    b. Oxidation does not take place by atmospheric oxidation
    c. The electrode potential depends on pH
    d. None of the above

16. Which of the following is correct statement of Latimer diagram
    a. It is known as a oxidation state potential diagram
    b. The most highly oxidized form of the element is on the right
    c. In species to the left the element is successively lower oxidation state
    d. None of the above

17. The standard cell potential can be used to determine
    a. The solubility product b. The rate constant
    c. Equilibrium constant d. All of the above

18. Which of the following compounds can be used as reference compound for magnetic susceptibility measurement using Faraday method?
    a. $NiCl_2.6H_2O$ b. $FeSO_4.(NH_4)_2SO_4.6H_2O$
    c. $HgCo(NCS)_4$ d. All of the above

19. In presence of magnetic field, a substance shows diamagnetism when
    a. Weight of the sample increases b. Weight of the sample decreases
    c. No change of weight d. Not related to weight change

20. Spin state crossover happens when
    a. Pairing energy is more than crystal field splitting energy
    b. Pairing energy is more than crystal field splitting energy
    c. Pairing energy is approximately same with crystal field splitting energy
    d. None of the above

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PART-B : Descriptive

Time : 2 hrs. 40 min. Marks : 50

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

1. a. Prove that the product of the matrices of C_2 X $\sigma(xz) = \sigma(yz)$. 2+4+2+2=10

   b. Account for the strong similarities between the chemical properties of the early d-block transition metallic compounds with those of the f-block elements.

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

   d. Write the advantages and disadvantages of Faraday's method of measurement of magnetic susceptibility.

2. Find the number of molecular vibrations of water molecule which are IR and Raman active from symmetry considerations. 10

3. a. Find the symmetry operations for the BF_3 molecule and systematically determine its point group. 7+3=10

   b. What is Mutual Exclusion principle for IR and Raman spectra?

4. a. What is quadrapole bond? Name the first chemical compound containing quadrapole bond to be synthesized. 3+4+3=10

   b. What are dinitrogen complexes ? How platinum (dinitrogen) ruthenium (II) could be synthesized?

   c. How was iridium compound with bent nitrosyl ligand formed?

5. a. What are Creutz-Taube ion metal complexes? How was the compound isolated? 3+4+3=10

   b. What is tungsten bronze? Outline the properties of sodium tungsten bronze.

   c. What is ruthenium red? What are its applications?

6. a. Use the following standard potentials to calculate the standard potential of copper –zinc cell **2+3+5 =10**

Cu^{2+} (aq) + 2e- ⟶ Cu (s), E^{o} (Cu^{2+}/Cu) = +0.34V

Zn^{2+} (aq) + 2e- ⟶ Zn(s), E^{o} (Zn^{2+}/Zn) = -0.76V

b. What are disproportionation and comproportionation reaction? Explain with examples.

c. Calculate magnetic moment of Sm and Eu? Why Sm and Eu shows higher magnetic moment than calculated one.

7. a. Show that Mn (VI) is unstable with respect to disproportionation into Mn(VII) and Mn (II) in acidic aqueous solution. **3+3+4 =10**

b. A part of the Latimer diagram of oxygen is

O_2 $\xrightarrow{+0.70}$ H_2O_2 $\xrightarrow{1.76}$ H_2O

Does hydrogen peroxide have a tendency to disproportionation in acid solution?

c. What are the main key points of Pourbaix diagram? Explain with diagram.

8. a. $[Ni(PPh_3)_2Cl_2]$ when crystallised from ethanol gives dark blue crystals with a magnetic moment of approximately 3.2 B.M. However, crystallisation from dichloromethane at low temperatures gives a red isomer, which is diamagnetic. Explain this. **5+5=10**

b. Which d electron configurations show orbital magnetic moment for octahedral and tetrahedral complexes and explain why?

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