

**B. Sc. MICROBIOLOGY  
FOURTH SEMESTER  
CHEMISTRY II  
BMB - 405**

( 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 number of moles of AgCl precipitated from one mole of the complex  $[\text{CoL}_6]\text{Cl}_3$  on treatment with  $\text{AgNO}_3$  solution is -  
a. One  
b. Two  
c. Three  
d. Six
2. If a ligand can bond to a metal atom through different atom present in the ligand, it is called  
a. Bidentate ligand  
b. Unidentate ligand  
c. Chelated ligand  
d. Ambidentate ligand
3. The number of Isomer possible for a complex type  $[\text{ML}_4\text{X}_2]$  Y is  
a. One  
b. Two  
c. Three  
d. Four
4. The Effective Atomic Number for the complex  $\text{K}_3[\text{Fe}(\text{CN})_6]$  is -  
a. 34  
b. 35  
c. 36  
d. 37
5. The  $\text{K}_3[\text{CoF}_6]$  is high spin  $d^6$  complex, its magnetic moment can be -  
a. 1.73 BM  
b. 2.83 BM  
c. 3.87 BM  
d. 4.90 BM
6. The Crystal Field Stabilization Energy for the complex  $\text{K}_4[\text{Fe}(\text{CN})_6]$  is -  
a.  $-2.4 \Delta_o + 3P$   
b.  $-1.2 \Delta_o + 2P$   
c.  $-0.4 \Delta_o + P$   
d.  $0.4 \Delta_o + P$
7. Which of the octahedral complex is likely to have Jahn-Teller effect (both)?  
a. High spin and low spin  $d^3$  ion  
b. High spin and low spin  $d^8$  ion  
c. High spin and low spin  $d^7$  ion  
d. High spin and low spin  $d^5$  ion
8. The bond order of  $\text{O}_2^{2+}$  ion is  
a. 1  
b. 3  
c. 3  
d. 1.5
9. The bond order of  $\text{N}_2$  molecule  
a. 3  
b. 2  
c. 1  
d. 4

10. The bond order of  $\text{H}_2\text{O}$  molecule
- |                |                  |
|----------------|------------------|
| a. $120^\circ$ | b. $104.5^\circ$ |
| c. $107^\circ$ | d. $180^\circ$   |
11. Which of the following is paramagnetic in nature
- |                 |                      |
|-----------------|----------------------|
| a. $\text{N}_2$ | b. $\text{O}_2$      |
| c. $\text{F}_2$ | d. None of the above |
12. The hybridization of  $\text{PCl}_5$  molecule is
- |              |                      |
|--------------|----------------------|
| a. $sp^3$    | b. $dsp^3$           |
| c. $d^2sp^2$ | d. None of the above |
13. Which of the following species has a trigonal planar shape?
- |                    |                    |
|--------------------|--------------------|
| a. $\text{NO}_3^-$ | b. $\text{CO}_2$   |
| c. $\text{N}_3$    | d. $\text{NO}_2^-$ |
14. Find the molecule with the least bond angle
- |                   |                         |
|-------------------|-------------------------|
| a. $\text{BeF}_2$ | b. $\text{CH}_4$        |
| c. $\text{NH}_3$  | d. $\text{H}_2\text{O}$ |
15. Vander walls force is
- |                              |                                |
|------------------------------|--------------------------------|
| a. Weaker than covalent bond | b. Stronger than covalent bond |
| c. Weaker than hydrogen bond | d. Both a and c                |
16. Which of the following/s is/are Vander walls force
- |                             |                     |
|-----------------------------|---------------------|
| a. Keesom interaction       | b. Debye forces     |
| c. London dispersion forces | d. All of the above |
17. In hydrogen bond, H is attached with
- |                                |                                |
|--------------------------------|--------------------------------|
| a. Highly electronegative atom | b. Highly electropositive atom |
| c. Both of the above           | d. None of the above           |
18. In general, variable valency is exhibited by
- |                      |                      |
|----------------------|----------------------|
| a. Gaseous elements  | b. Non-metals        |
| c. Transition metals | d. None of the above |
19. Colour of transition metals due to
- |  |                                |
|--|--------------------------------|
| a. Splitting of d orbitals in ligand field | b. Partially filled d orbitals |
| c. Both of the above                       | d. None of the above           |
20. Transition metals must possess..... For showing paramagnetism
- |                     |                       |
|---------------------|-----------------------|
| a. Paired electrons | b. Unpaired electrons |
| c. Zero electron    | d. None of the above  |

**( PART-B : Descriptive )**

Time : 2 hrs. 40 min.

Marks : 50

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

1. a. What are the postulates of Werner's theory? 3+3+4  
=10  
b. Draw the molecular orbital energy diagram for  $F_2$  molecule and calculate the bond order of  $F_2$  molecule.  
c. Write a note on different types of Vander walls interactions.
  
2. a. Write the IUPAC name of the following complexes- 3+3+4  
=10  
(i)  $[PtBr(NH_3)_3Cl(NO_2)]Cl$   
(ii)  $[Co(NH_3)_5ONO]Cl_2$   
(iii)  $[Cr(H_2O)_4Cl_2]Cl$   
b. Write the postulates VSEPR theory.  
c. Explain the trend of boiling points of  $H_2O$ ,  $H_2S$ ,  $H_2Se$  and  $H_2Te$ .
  
3. Explain the bonding in  $[FeF_6]^{3-}$  and  $[Fe(CN)_6]^{3-}$  ion using Valence Bond theory. Explain the hybridization used, magnetic property in each and the concept of outer orbital and inner orbital complexes. 10
  
4. a. Explain the splitting of d-orbital for octahedral and tetrahedral complexes on the basis of Crystal Field Theory. 5+5=10  
b. What are the factors that determine the Crystal Field Stabilization Energy?
  
5. a. Explain the molecular orbital energy level diagram for  $O_2$  and  $N_2$  molecule. 5+5=10  
b. Arrange the following species on increasing order of bond length, bond order, bond strength  
(i)  $O_2, O_2^+, O_2^{2-}, O_2^-$   
(ii)  $N_2^+, N_2, N_2^-$

1.

6. a. Explain the following molecule using hybridization 4+2+2+  
2=10  
(i)  $C_2H_4$  (ii)  $C_2H_2$
- b. Why  $He_2$  molecule does not exist?
- c. Define sigma bond ( $\sigma$ ) and pi ( $\pi$ ) bond.
- d. Define resonance. Draw the resonating structure of phenol.
7. a. What is Latimer diagram? What information we can get from Latimer diagram? 5+5=10
- b. Which elements in periodic table is known as inner transition elements. What are their features. What is the difference between transition elements and inner transition elements?
8. a. Explain the reason behind the following properties shown by transition elements: variable valency, colour, magnetism and catalytic property. 5+5=10
- b. What is the effect of different types of interaction on solubility.

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