REV-01
MSC/07/12

2025/12

SET A

M.Sc. CHEMISTRY
FIRST SEMESTER
INORGANIC CHEMISTRY I
MSC – 102

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs. **Full Marks: 70**

Objective

Time: 30 min. **Marks: 20**

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

1. Intermediates such as peroxides are not released during the conversion of
   a. H_2O_2 to H_2O b. O_2 to H_2O
   c. H_2 to H_2O d. O_3 to H_2O

2. Siderophores are small polydentate ligands that have high affinities for
   a. Zn(II) b. Fe(III)
   c. Cu(I) d. Mn(III)

3. Enzymes like *cytochrome-C oxidase* that catalyses the 4- electron reduction of O_2 to H_2O are called
   a. Proton pumps b. Electron pumps
   c. Salt pumps d. Photons pumps

4. Ionosphere have
   a. hydrophobic exterior that makes them suitable in lipids. b. hydrophilic exterior that makes them suitable in lipids.
   c. hydrophobic interior that makes them suitable in lipids. d. hydrophilic I interior that make the suitable in lipids.

5. Prokaryotes are
   a. bacteria and bacteria like organisms b. eukaryots
   c. enzymes d. germs

6. The operation of rotation by 120° about an axis is denoted as:
   a. C_2 b. C_3
   c. C_4 d. S_3

7. Which of the following statements regarding *classes* in a point group is true?
   a. All symmetry operations belonging to the same class are equivalent by conjugation. b. Each symmetry element defines a single class.
   c. The identity element belongs to multiple classes. d. Classes are always equal to the number of elements.

8. Which of the following molecules belongs to D∞h point group?
   a. CO_2 b. H_2O
   c. CH_4 d. NH_3

9. Which of the following is a reducible representation?
   a. a representation that can be broken down into smaller irreducible representations
   b. a representation that is already simplest
   c. a representation with only zeros
   d. a [1×1] identity matrix

10. The character of a symmetry operation in a matrix representation is:
   a. The trace of the inverse matrix
   b. The determinant of the matrix
   c. The sum of the diagonal elements of the matrix
   d. The inverse of the matrix

11. Excessive Na uptake results in ----------.
   a. Bloating
   b. Hypertension
   c. Anxiety
   d. Cholesterol

12. Vitamin B_{12} deficiency in human body leads to ----------.
   a. Anemia
   b. Anxiety
   c. Pernicious anemia
   d. Gall bladder stones

13. Hypogonadism is caused due to deficiency of ---------- in the body.
   a. Zinc
   b. Cobalt
   c. Copper
   d. Vitamin

14. The parasite that causes *Malaria* is ----------.
   a. *Pseudomonas*
   b. *Corona*
   c. *Plasmodium*
   d. *Ferritin*

15. Chelation therapy is used in the treatment of ----------.
   a. Thalassemia
   b. Cancer
   c. Pneumonia
   d. Fever

16. Non-bonding molecular orbital of an octahedral complex is
   a. e_g
   b. e_g^*
   c. t_{2g}
   d. t_{1u}

17. Which order is correct in terms of their magnetic moment?
   a. $O_2^{2-} < O_2 < O_2^-$
   b. $O_2^{2-} < O_2^- < O_2$
   c. $N_2^- < N_2^{2-} < N_2$
   d. $O_2^{2-} < N_2^{2-} < O_2^-$

18. LUMO for Li_2 molecule is
   a. $\sigma_g(2s)$
   b. $\sigma_u^*(2p)$
   c. $\sigma_g(2p)$
   d. $\sigma_u^*(2s)$

19. How many non-bonding molecular orbital is present in HF molecule?
   a. 1
   b. 2
   c. 3
   d. 4

20. How many ligand group orbitals (LGOs) are formed by the SALC method when constructing the molecular orbitals of an octahedral (ML_6) complex?
   a. 3
   b. 6
   c. 5
   d. 8

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Descriptive

Time : 2 hr 30 mins **Marks : 50**

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

1. **a.** Why is cobalt- based macrocyclic complex rather than Fe-based complex like haem, is well suited for radical based rearrangement? **3+3+2+2 =10**
   b. Explain with a diagram the symmetry elements present in the water (H_2O).
   c. Why is *cis*-platin more suitable than *trans*-platin in the treatment of cancer?
   d. Between CO and CO^+, which has a shorter bond length? Justify using bond order.

2. **a.** Four-electron reduction potential for O_2 is +0.82 V at pH 7. *Cytochrome-C*, electron donor to *cytochrome-C oxidase*, has a reduction potential of +0.26 V, whereas organic substrates of fungal lacaces, often have value as high as +0.7V. What is the significance of these data in terms of energy conservation? **4+3+3 =10**
   b. Write notes on *Blue Copper Oxidases*.
   c. Explain why Ca^{2+} is more suitable to Mg^{2+} for fast signalling process in the cell?

3. **a.** State the Great Orthogonality Theorem (GOT) in the context of molecular symmetry. **3+4+3 =10**
   b. Explain reducible and irreducible representations in molecular symmetry. How can a reducible representation be reduced into irreducible representations?
   c. Explain the relationship between the order of a point group and the sum of squares of dimensions of all irreducible representations. Illustrate with an example.

4. **a.** Write the role of any three metalloenzymes containing Cu in human body. **3+3+3+ 1=10**
   b. What is Acrodermatitis enteropathica? Write its cause and effects.
   c. How *ferroquinone* used in the treatment of Malaria?

d. What is the cause of siderosis?

5. a. Determine the number of unpaired electrons in the following species using MOT: 2+5+3 =10

(i) N_2^- (ii) B_2 (iii) Ne_2^+

b. Draw the MO diagram of ML_6 using SALC.

c. Write key features of MOT.

6. a. What is *horseradish peroxidase* (*HRP*)? What are the functions of this enzyme? 2+3+5 =10

b. What are zinc fingers? Discuss their role in biological system.

c. Define *subgroup*. Explain why C_4v is a subgroup of D_4h.

7. a. Write the mechanism of treatment of gastric ulcer. 5+2+3 =10

b. Explain why Li_2 exists in the gas phase but Be_2 does not.

c. among the following pairs of atomic orbitals, which pairs give rise to zero overlap (assume z axis as molecular axis): $3P_z$ and $3dz^2$, $2p_z$ and $2p_x$, $3dx^2\text{-}y^2$ and $3p_z$, 2s and $2p_x$, 2s and $2p_z$, 1s and $3p_z$.

8. a. Describe the role of Na^+/K^+ pump in biological system. 2+2+3+ 3=10

b. What is a center of inversion (i) in molecular symmetry? Give an example.

c. (i) How rheumatoid arthritis is treated?

(ii) Which is the most abundant element in earth's crust. Write its role in plant and animal body.

d. (i)Draw MO diagram of O_2^{2-}.

(ii) Explain with example, what do you mean by orbital parity.

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