2024/12

SET A

M.Sc. CHEMISTRY
FIRST SEMESTER
INORGANIC CHEMISTRY I
MSC – 102 [REPEAT]

[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. Which of the following have same bond order?
   a. O_2^-, N_2^+ and N_2^- b. O_2^+, O_2^- and N_2^-
   c. O_2^{2-}, N_2^{2-} and N_2 d. O_2^+, N_2^+ and N_2^-

2. Magnetic moment of N_2^{2-} is
   a. 2.82 BM b. 4.87 BM
   c. 1.73 BM d. 5.92 BM

3. Which of the following diatomic molecules would be stabilized by the removal of an electron?
   a. C_2 b. CO
   c. N_2 d. O_2

4. The bond energy of H_2 is 436 kJ mol^{-1}. Thus bond energy of H_2^+ is
   a. 436 kJ mol^{-1} b. 218 kJ mol^{-1}
   c. 512 kJ mol^{-1} d. 872 kJ mol^{-1}

5. Which one of the following is diamagnetic and has shortest bond length?
   a. C_2^{2-} b. N_2^{2-}
   c. O_2^{2-} d. O_2

6. What is the axis of symmetry (Cn) for the molecule CO_2?
   a. C_2 b. C_∞
   c. C_4 d. C_6

7. What is the matrix representation of an inversion (i) through the origin?
   a. [1 0 0; 0 1 0; 0 0 1] b. [-1 0 0; 0 -1 0; 0 0 -1]
   c. [0 1 0; 1 0 0; 0 0 1] d. [0 -1 0; 1 0 0; 0 0 1]

8. Which point group corresponds to a molecule with the following symmetry elements:E, C_4, C_2, $4S_4$, $4\sigma_d$?
   a. D_4 b. D_{4h}
   c. D_{4d} d. C_{4v}

9. What is the order of the C_{3v} point group?
   a. 4 b. 6
   c. 8 d. 12

10. The value of reducible representation of water molecule using 3-cartesian basis set
    a. (3,-1, 1, 1)
    b. (-3, -1, 1, -1)
    c. (-3, -1, 1, 3)
    d. (1, 1, 1, 1)

11. Archaea are group of organisms that are similar to but evolutionarily distinct from
    a. enzymes
    b. bacteria
    c. proteins
    d. lipids

12. Functions of lipids include
    a. destruction of energy
    b. storing of energy
    c. generation of energy
    d. generation of bacteria

13. The transport across membrane is achieved by proteins known as
    a. ion pumps and channels
    b. haemoglobin pump.
    c. magnesium pump
    d. calcium pump

14. Acid phosphatase contain a dinuclear metal site comprising
    a. Fe(III) in conjunction with Fe, Zn or Mn.
    b. Mg or Ca
    c. Na or K
    d. Cd or Hg

15. Calvin is a process that plants and algae use to turn
    a. CO_2 from air in to sugar
    b. SO_2 from air in to sugar.
    c. H_2 from air in to sugar
    d. N_2 from air in to sugar

16. Bipolar disease is treated by
    a. Li_2CO_4
    b. Li_3CO_3
    c. Li_2CO_3
    d. $LiCO_3$

17. Which of the following drugs are used for arthristis treatment?
    a. Solganol and ferroquine
    b. Auranofin and deferasirox
    c. Ferroquine and deferasirox
    d. Solganol and auranofin

18. Which of the following metal is present in the drug that isused to locate damaged tissue is
    a. Bi
    b. Gd
    c. Au
    d. Fe

19. Anti cancer drugs
    a. Prevents replication of DNA
    b. Binds with cytocin base
    c. Helps in healthy cell division
    d. All of the above

20. Which of the following statement is wrong about anti arthritis drug
    a. It works according to HSAB principle
    b. It binds with Cysteine protein
    c. Cures joint pain
    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.** What is the bond order and magnetic moment of O_2^- ion. **3+2+3+2=10**
   b. Draw the dihedral plane of symmetry for methane molecule.
   c. What are lipids? What are their functions?
   d. Give the name and structure of one anti-arthritis drug.

2. **a.** Draw molecular orbital diagramof CO and O_2 molecule. Calculate bond order for both and comment on their magnetic behaviour. **5+5=10**
   b. Draw molecular orbital diagramof HF and N_2 molecule. Compare bond order, bond strength and bond length of N_2, N_2^+ and N_2^-.

3. **a.** What is Na^+/ K^+ pump? What are it's role? **3+3+4=10**
   b. Why Ca^{2+} is more suitable to Mg^{2+} for fast signalling process in the cell?
   c. What do you understand by the term zinc transcription? What are transcript factors?

4. **a.** "Cadmium which is normally regarded as highly toxic is now recognized as being essential nutrient of certain organisms''- elucidate. **3+4+3=10**
   b. Give a plausible mechanism of the action of acotinise based on structural, kinetic and spectroscopic evidences.
   c. Why is cobalt based macrocyclic complex rather than iron complex like haem, is well suited for radical based rearrangement?

5. **a.** Define symmetry elements and symmetry operations with one example for each? **2×5=10**
   b. Find out the acceptable improper symmetry operation for S_4 improper axis of symmetry.
   c. Find out the matrix representation of following symmetry elements: (i) Identity and (ii) Inversion

d. Match the following columns:

Column I	Column II
C_{2v}	Tetrahedral geometry with $4C_3$-axes
D_{4h}	Linear molecule with infinite C_∞-axis
T_d	Octahedral geometry with $3C_4$-axes
O_h	Planar molecule with $2C_2$-axes and $2\sigma v$ planes
$C_{\infty v}$	Cubic geometry with $4C_3$-axes and $6\sigma_d$ planes

e. State the axis of symmetry for the following molecules:

(i) water and (ii) ammonia

6. a. What type of symmetry operation transforms the coordinates (x,y,z) to (-x, y, -z) with n=4 and $\theta = 90°$? **2×5=10**

b. Find out the class and order of D_{4h} point group.

c. State the Great Orthogonality Theorem.

d. The symmetry group is C_2 for a molecule (AX) which is having the following reducible representation:

AX	E	C_2	σv	σv/
A_1	1	1	1	1

Identify the irreducible representation which is orthogonal to A_1 among the following irreducible representation present in the molecule:

C_{2v}	E	C_2	σv	σv/
Γ_1	1	-1	1	1
Γ_2	1	-1	-1	1
Γ_3	1	1	1	-2
Γ_4	1	1	1	2

e. Prove that A_1 and A_2 represantation in C_{2v} point group are orthogonal to each other.

7. **a.** Give the pathway on how anti-cancer drugs work. Why trans platin is not an anti-cancer drug? **5+5 =10**

   b. What is iron overload? How to treat it? Write in detail.

8. **a.** What are the cause and consequences of malaria in human body? Give the name and structure of the organometallic drug to treat malaria. **4+3+3 =10**

   b. What is the cause of gastric ulcer and how to treat it.

   c. Draw molecular orbital diagram for SF_6 molecule.

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