



M.Sc. CHEMISTRY
Third Semester
Physical Chemistry-III
(MSC - 13)

Duration: 3Hrs.

Full Marks: 70

Part-A (Objective) =20
Part-B (Descriptive)=50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins.

Marks: 50

1. Answer the following questions: (any five)

2×5=10

- What are fluorophores? Explain with examples.
- Write down the sequences of photophysical processes that can occur in an electronically excited molecule (unimolecular).
- Determine the point group of the following molecular and ionic species:
 ICl_4^- , BH_3 , CH_2Cl_2 , PtCl_4^{2-}
- What is meant by order of a group? What is the order of D_{3h} point group?
- What do you mean by Nerve Impulse? Explain.
- Discuss the forces that are involved in 3° structure of proteins.
- What are corrosion inhibitors? How it works to prevent corrosion in metals?

2. Answer the following questions: (any five)

3 ×5= 15

- Discuss the selection rules for nonradiative transitions. Figure out the allowed and forbidden transitions in radiationless transitions.
- Discuss the photophysical kinetics of unimolecular processes.
- Deduce a C_n matrix.
- How do you divide the group into a set of sub-groups? Illustrate by taking C_{4v} as an example.
- Write briefly about the 2° structure of protein.

- f) Explain the term overvoltage. Discuss the application of overvoltage in electro-deposition of metals in aqueous solution.
- g) What is dropping mercury electrode (DME)? What are the advantages of using DME in polarography?

3. Answer the following questions: (any five)

5 × 5 = 25

- a) What do you mean by delayed fluorescence? Discuss in detail the P-type delayed fluorescence.
- b) Discuss the principle of a photoelectrochemical cell with an example.
- c) Construct the C_{3v} character table by employing the properties of irreducible representations.
- d) How many vibrational modes are possible in H_2O ? Determine Γ_{vib} for H_2O with the help of internal coordinate method.
- e) Discuss in detail the Na^+/K^+ Transport process across biological membrane.
- f) What do you mean by concentration polarisation? Give the numerical expression for concentration polarisation. What is the significance of limiting diffusion current?
- g) What is the significance of half-wave potential? Derive the expression for polarographic wave.

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(The figures in the margin indicate full marks for the questions)

Duration: 20 minutes

Marks – 20

PART A- Objective Type

I. Select and Put '✓' mark on the appropriate answer: 1×20=20

1. The percentage transmission of a solution having absorbance 1.0 is:
(a) 1
(b) 10
(c) 50
(d) 99
2. Phosphorescence is represented by:
(a) $T_1 \rightarrow S_0 + h\nu$
(b) $T_1 \rightarrow S_0 + \Delta$
(c) $S_1 \rightarrow S_0 + h\nu$
(d) $S_1 \rightarrow T_1 + \Delta$
3. The conversion of excited singlet state, S_1 of a molecule to triplet state, T_1 is known as:
(a) fluorescence
(b) phosphorescence
(c) intersystem crossing
(d) internal conversion
4. The fluorescence yield, ϕ_f is defined as:
(a) $\frac{S_0 \rightarrow S_1}{S_0 \leftarrow S_1}$
(b) $\frac{S_1 \rightarrow S_0}{S_1 \leftarrow S_0}$
(c) $\frac{T_1 \rightarrow S_0}{S_1 \leftarrow S_0}$
(d) $\frac{S_0 \rightarrow T_1}{S_1 \leftarrow T_1}$

5. Which of the following molecule is nonfluorescent:
 (a) Acridine (b) Fluorescein (c) Azaphenanthrene (d) Aniline
6. The matrix which transforms $\begin{pmatrix} x \\ y \end{pmatrix}$ to $\begin{pmatrix} -x \\ -y \end{pmatrix}$ is:
 (a) $\begin{pmatrix} -1 & -1 \\ 0 & -1 \end{pmatrix}$
 (b) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$
 (c) $\begin{pmatrix} -1 \\ -1 \end{pmatrix}$
 (d) $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$
7. The symmetry group is C_2 for the molecule/ion:
 (a) H_2O (b) H_2O_2 (c) SO_2 (d) NO_2^-
8. The point group of NSF_3 is:
 (a) D_{3d} (b) C_{3h} (c) D_{3h} (d) C_{3v}
9. Symmetry operations of the four C_2 axes perpendicular to the principal axis belong to the same class in the point group(s):
 (a) D_4
 (b) D_{4h}
 (c) D_{4d}
 (d) D_{4h} and D_{4d}
10. The plane passes through a least number of atoms:
 (a) vertical
 (b) dihedral
 (c) molecular
 (d) horizontal
11. A bent, AB_2 molecule belongs to C_{2v} point group. The symmetry operations are: $E, C_2, \sigma_v, \sigma_v'$. The trace for the reducible representation, when symmetry operations of C_{2v} applied to AB_2 is:
 (a) 3 1 1 3
 (b) 2 1 1 2
 (c) 1 1 1 1
 (d) 4 1 1 4
12. In a biological process, the total entropy change, dS is:
 (a) $dS_i + dS_e = 0$
 (b) $dS_i + dS_e = 0$
 (c) $dS_i + dS_e = 0$
 (d) $dS_i + dS_e = 0$
13. Active transport is associated with:
 (a) Increase in free energy of the system
 (b) Decrease in free energy of the system
 (c) Increase in entropy of the system
 (d) There is no change in free energy

14. Two solutions are said to be isotonic if:
- (a) They have the same value of vapour pressure
 - (b) They have the same value of osmotic pressure
 - (c) They have the same value of surface tension
 - (d) They have the same value of viscosity coefficient
15. Which of the following amino acid is found in protein:
- (a) Adenine
 - (b) Alanine
 - (c) Creatine
 - (d) Adenosine
16. The energy for all forms of muscle contraction is provided by:
- (a) ATP
 - (b) ADP
 - (c) phosphocreatine
 - (d) oxidative phosphorylation
17. Concentration polarisation arises:
- (a) Electrolytic tranference
 - (b) Slow diffusion of ions
 - (c) Osmosis
 - (d) Quick migration of ions
18. In polarographic cell, the current density at which the rapid increase of potential takes place is known as:
- (a) Diffusion current density
 - (b) Limiting current density
 - (c) Drift current density
 - (d) Direct current density
19. The correct expression for diffusion current produced in polarographic cell is (Ilkovic equation):
- (a) $i_d = 607 nD^{1/2} m^{2/3} t^{1/6} c^*$
 - (b) $i_d = 607 nDm^2 t^{1/6} c^*$
 - (c) $i_d = 607 nD^{1/2} m t^{1/6} c^*$
 - (d) $i_d = 607 nD^{1/2} m^{2/3} t c^*$
20. Which statement is true about polarography?
- (a) The diffusion current is caused by solution stirring.
 - (b) The addition of supporting electrolytes is necessary for a migration current.
 - (c) The diffusion current is proportional to the square root of the concentration of the electroactive species.
 - (d) The magnitude of the diffusion current is proportional to concentration of electroactive species.