

Reg. No. :

Name :

First Semester M.Sc. Degree Examination, January 2026
Chemistry/Analytical Chemistry/Polymer Chemistry/Chemistry with
Specialisation in Drug Design and Development
CH 213/CL 213/PC 213/CHDD 513 : PHYSICAL CHEMISTRY — I
(2020 – 2024 Admission)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer any **two** questions from each unit.

- I. 1. Find the expression for the operator $\left(\frac{d}{dx} + x\right)^2$.
2. Calculate $[\hat{L}_z, \hat{L}_+]$.
3. Write down the recursion formula.
- II. 4. Give the Michaelis-Menten equation and explain the terms.
5. Mention the important factors which influence the adsorption of a gas on a solid surface.
6. What are the limitations of Langmuir's theory of unimolecular adsorption?
- III. 7. Calculate the free energy change (involving fugacities) accompanying the compression of 1 mole of a gas at 57°C from 25 to 200 atm. The fugacities of the gas at 57°C may be taken as 23 and 91 atm, respectively, at pressures 25 and 200 atm.
8. Give the Duhem-Margules equation, specifying the terms involved.
9. State Konowaloff's rule.
- IV. 10. Give the Brønsted-Bjerrum equation and explain the terms.
11. Explain steady-state approximation.
12. What is Taft equation?
- V. 13. Identify the symmetry elements present in the following and assign the point group.
- (a) CO_2 (b) BH_3
14. How do you define a class of elements?
15. What is the standard reduction formula for finite groups? Explain all the terms involved in it.

(10 × 2 = 20 Marks)

P.T.O.

SECTION – B

Answer **all** questions. **Each** question carries **5** marks.

16. Calculate the average potential and kinetic energies of a harmonic oscillator in the ground state. Compare the results obtained with the classical results.

OR

17. Calculate the probability that an electron in the state with $n=1$ will be found between $x=0.25 L$ and $x=0.75 L$ in a conjugated molecule of length L (with $x=0$ at the left-hand end of the molecule).

18. Discuss briefly BET adsorption isotherm.

OR

19. Derive an expression for Langmuir's adsorption isotherm. Show that at normal pressures, Langmuir adsorption isotherm becomes identical with Freundlich adsorption isotherm.

20. Express entropy change as function of

(a) T and V and (b) T and P

OR

21. Derive any four Maxwell's relations and give its significances.

22. Discuss the kinetics of reversible reactions.

OR

23. Explain the influence of solvent on the rates of ionic reactions.

24. Construct the character table for C_{2v} point group.

OR

25. Construct the group multiplication table for the symmetry operations of H_2O molecule.

(5 × 5 = 25 Marks)

SECTION – C

Answer any **three** questions. **Each** question carries **10** marks.

26. (a) Write a note on the experimental verification of de Broglie's equation.

(b) Explain Born interpretation of wave function.

27. Discuss briefly the different methods used for surface area determination.

28. (a) What is meant by chemical potential? Derive the Gibbs-Duhem equation.

(b) Derive an expression for the entropy of a mixture of ideal gases.

29. Write a note on various methods used to study fast reactions.

30. (a) Using similarity transformation show that the six elements of the C_{3v} point group can be divided into three classes.

(b) How many vibrational modes can occur in NH_3 molecule? Sketch all these nodes.

(3 × 10 = 30 Marks)