

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2025
(First Semester)

Branch - CHEMISTRY

THERMODYNAMICS, ELECTROCHEMISTRY AND PHASE EQUILIBRIUM

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Question No.	Question
1	How does the chemical potential of a substance change with temperature at constant pressure? (a). Increases (b). Decreases (c). Remains constant (d). Remains constant
2	What is the activity coefficient for an ideal solution? (a). Equal to zero (b). Less than one (c). Equal to one (d). Greater than one
3	How does the Gibbs free energy (G) change with increasing temperature at constant pressure for a system in equilibrium? (a). Increases (b). Decreases (c). Remains constant (d). Varies unpredictably
4	The Nernst Heat Theorem implies that the entropy of all perfect crystalline substances at absolute zero is: (a). Equal to the Boltzmann constant (b). Equal to a finite positive value (c). Exactly zero (d). Proportional to temperature
5	The term Λ_0 in the Debye-Huckel-Onsager equation represents: (a). The molar conductivity at any concentration (b). The limiting molar conductivity at infinite dilution (c). The molar conductivity at zero temperature (d). The conductivity of pure water
6	What is the EMF of a galvanic cell when the cell reaches equilibrium? (a). Positive (b). Negative (c). Zero (d). Cannot be determined
7	In the Butler-Volmer equation, the term j_0 represents: (a). Limiting current density (b). Maximum current density (c). Exchange current density (d). Minimum current density
8	What is the main disadvantage of nickel-cadmium batteries compared to other types of storage batteries? (a). Low energy density (b). High cost (c). Memory effect (d). Short lifespan
9	The eutectic point in a phase diagram is characterized by: (a). Maximum solubility of components in each other (b). The lowest temperature at which a liquid can exist (c). A single solid phase in equilibrium with a liquid phase (d). Complete immiscibility of components
10	Which of the following regions in a ternary phase diagram represents a single-phase region? (a). Inside the triangle (b). Along the tie lines (c). Within the three-phase region (d). Corners of the triangle

Cont...

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks (5 × 7 = 35)

Question No.	Question
11.a.	Utilize the mean activity of the electrolyte using freezing point method.
	(OR)
11.b.	Develop the activity coefficient using EMF measurements.
12.a.	Simplify thermodynamic derivation of the equilibrium constant and its significance.
	(OR)
12.b.	Analyse the exceptions to the Third Law of Thermodynamics.
13.a.	Applying the conductometric titrations of strong and weak electrolytes.
	(OR)
13.b.	Utilizing the determination and applications of EMF Measurements.
14.a.	Appraise the structure of electrical double layer model.
	(OR)
14.b.	Evaluate the operation of a lead-acid battery.
15.a.	Predict the Gibbs Phase Rule.
	(OR)
15.b.	Construct the phase diagram of the one component system in water.

SECTION - C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks (3 × 10 = 30)

Question No.	Question
16	Prove the Gibbs-Duhem equation and the variation of chemical potential with temperature.
17	Examine the Le Chatelier-Braun principle and its applications.
18	Simplify the Debye-Hückel-Onsager theory and its experimental verification.
19	Appraise the Butler-Volmer equation.
20	Determine the two components system of Fe-C in phase diagram.

Z-Z-Z

END