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May 2026

B.SC. (CHEMISTRY) II SEMESTER

Physical Chemistry II (BCH–202)

Time : 3 Hours]

[Maximum Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any **four** questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Define inversion temperature. (1.5)

   (b) Explain intensive and extensive variables with an example. (1.5)

   (c) What is the value of C_p and C_v for a diatomic ideal gas? (1.5)

   (d) Define the van't Hoff factor. (1.5)

   (e) Define chemical potential. (1.5)

   (f) What are the characteristics of an ideal mixture? (1.5)

   (g) What are the criteria of thermodynamic equilibrium? (1.5)

(h) What is the reaction quotient (Q)? (1.5)

(i) Why does the freezing point decrease when a solute is added? (1.5)

(j) Explain Raoult's law. (1.5)

PART–B

2. (a) Discuss the Joule-Thomson effect and derive an expression for the Joule-Thomson coefficient. (10)

(b) 3 moles of an ideal gas expand reversibly and isothermally at 300 K from 10 L to 50 L. Calculate the work done, the change in heat, and the change in internal energy in joules. (5)

3. (a) What do you mean by residual entropy? A substance has 6 orientations at 0 K. Calculate its residual entropy. (5)

(b) Define Gibbs free energy (G) and Helmholtz energy (A) and explain their significance. 10 moles of an ideal gas undergo a reversible isothermal expansion from volume 20 L to 70 L at a temperature of 400 K. Calculate the entropy change for the process. (10)

4. (a) What do you mean by entropy of mixing? Calculate the Gibbs free energy of mixing when 10 moles of A gas and 5 moles of B gas are mixed at 300 K. Assume that both gases are ideal. (5)

(b) Derive the Gibbs-Duhem equation and discuss its significance in detail. (10)

5. (a) Explain the Le-Chatelier principle and discuss how a reaction at equilibrium responds to changes in temperature, concentration, pressure and addition of ideal gases with a suitable example. (10)

(b) Standard enthalpy change for a reaction is 50 KJ/mol. What happens to the equilibrium constant when the temperature increases from 500 K to 600 K? (5)

6. (a) State Henry's law and discuss its significance. Derive the general relation between solute amount and relative lowering in vapor pressure. (10)

(b) What do you mean by vapour pressure of liquid? Explain factors affecting of vapour pressure in detail. (5)

7. Explain the following: (15)

(i) Free expansion under isothermal process.

(ii) Osmotic pressure.

(ii) Degree of advancement of reaction.

(iv) Partial molar properties.

(v) Thermodynamic equation of state.