(c) The free energy change accompanying a reaction are found to be –75.8 kJ at 25°C and –76 kJ at 35°C. Calculate the enthalpy change of the reaction at 30°C. (4)

7. (a) Deduce the expression for Helmholtz function with temperature and volume. (6)

(b) Deduce the expression for relationship of Joule Thomson coefficient with enthalpy, temperature and pressure. (6)

(c) Calculate the enthalpy of formation of methane (given that the enthalpy of combustion of methane, graphite and hydrogen are 890.2 kJ mol^{-1}, 393.4 kJ mol^{-1} and 285.7 kJ mol^{-1} respectively. (3)

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May 2026

B.Sc. (CHEMISTRY) II SEMESTER

Physical Chemistry–II (BCHT–MI–204)

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) Discuss the characteristics of Isothermal irreversible free expansion. (1.5)

(b) Define residual entropy. (1.5)

(c) Describe Henry's Laws and what are its applications? (1.5)

(d) Among P, V, T variable, identify dependent and independent variable and justify the answer. (1.5)

(e) Calculate the work done and change in internal energy when 1 mole of water at 100°C is converted into steam at 1 atm pressure (Heat of Vaporization of water = 9720 cal/mol). (1.5)

(f) Under what condition, an extensive property may become intensive property. Explain with one suitable example. (1.5)

(g) What are the standard state conditions? Which form of carbon is assigned a value of zero for molar enthalpy in standard state and why? (1.5)

(h) A reversible reaction is spontaneous in the forward direction as well as the backward direction. Explain with one suitable example. (1.5)

(i) State the Law of mass action. (1.5)

(j) What are the isotonic solutions? How are their molar concentrations related to each other? (1.5)

PART–B

2. (a) What do you mean by molal elevation constant of a solvent? How is it related to the latent heat of vaporization? (4)

(b) Derive van't Hoff reaction isotherm and drive the expression for relationship of equilibrium constant and reaction quotient. (6)

(c) Calculate the molar elevation constant of water, its latent heat of vaporization is 540 cal per gram. (5)

3. (a) Appy Le-Chatelier principle to predict suitable conditions for getting maximum yield of the product in the following reaction: (6)

(i) Manufacture of hydrogen by Bosch process.

(ii) Manufacture of ammonia by Haber's process.

(b) The latent heat of fusion of water is 1436.3 cal per mol. Calculate the molal freezing point depression constant of water. (4)

(c) Calculate the entropy of mixing when 15 g of benzene is mixed with 15 g of cyclohexane. (5)

4. (a) Calculate the boiling point of a solution containing 0.4650 g of camphor (Mol. Wt. 152) dissolved in 31.4 g of acetone (b.p. = 56.30°C), if the molecular elevation of per 100 g of acetone is 17.2°C. (5)

(b) The standard free energy change of reaction at 298 K was 28.5 kJ. Calculate the equilibrium constant K_p. (4)

(c) Derive Claussius-Clapeyron equation for liquid-vapour equilibrium. Show its integrated form. (6)

5. (a) Discuss the application of Le-Chatelier principle (i) Melting of Ice and (ii) Vaporization of water. (6)

(b) Heat of combustion of benzene in a bomb calorimeter was found to be 3263.9 kJ mol^{-1} at 25°C. Calculate the heat of combustion of benzene at constant pressure. (4)

(c) Derive the relationship between elevation in boiling point and osmotic pressure. (5)

6. (a) Derive the relationship between depression in freezing point and lowering of vapour pressure. (5)

(b) Derive the expression of Gibbs-Helmholtz equation. (6)