



‘সমানো মন্ত্র: সমিতি: সমানী’

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 2nd Semester Examination, 2022

CC4-CHEMISTRY

PHYSICAL CHEMISTRY

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.
All symbols are of usual significance.*

Answer any four questions from the following

10×4 = 40

1. (a) State and explain the first law of thermodynamics. 2½
- (b) Show that in a reversible adiabatic expansion $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$. Symbols carry their usual meaning. 2½
- (c) Adiabatic curves are steeper than the isothermal curves. Explain in detail. 2½
- (d) Six moles of an ideal gas expand isothermally and reversibly from a volume of 1 dm³ to a volume of 10 dm³ at 27° C. What is the maximum work done? 2½

2. (a) Prove thermodynamically that for any substance 3+1

$$C_P - C_V = \left[P + \left(\frac{\partial U}{\partial V} \right)_T \right] \left(\frac{\partial V}{\partial T} \right)_P$$

Simplify this equation for an ideal gas.

- (b) Calculate the free energy change in the freezing of 18 g of water at 263.15 K, given that the vapour pressure of water and ice at 263.15 K are 0.287 Pa and 0.260 Pa respectively. 3
- (c) What will happen if a gas that obeys the equation $P(\bar{V} - b) = RT$ undergoes 3

Joule-Thomson expansion, given $\mu_{J.T.} = \frac{1}{C_P} \left[T \left(\frac{\partial \bar{V}}{\partial T} \right)_P - \bar{V} \right]$.

3. (a) Show that $dG = -S dT + V dP$ and $dU = T dS - P dV$, symbols have their usual meaning. 4
- (b) Prove that Joule-Thomson expansion is an iso-enthalpic process. 3
- (c) Define thermodynamic functions. Discuss with suitable examples. 3

4. (a) Discuss the expression of Clausius inequality. 3
 (b) If ΔS is negative for a process, can this process be spontaneous? Explain clearly. 2
 (c) What is meant by equilibrium constant? What are its characteristics? $1\frac{1}{2}+1\frac{1}{2}$
 (d) Benzoic acid in benzene shows less osmotic pressure than expected — Explain. 2
5. (a) State Henry's law and explain it. Show that volume of a gas dissolved in a given volume of a solvent is independent of the pressures of the gas. $2\frac{1}{2}+2$
 (b) What is meant by ideal solution? Why does a solution deviate from ideal behaviour? 1+2
 (c) Explain the depression of freezing point with the help of vapour pressure-temperature curve. $2\frac{1}{2}$
6. (a) Derive the relation between K_c and K_x . 2
 (b) The value of equilibrium constant of a reaction is dependent on the stoichiometric equation by which it is expressed — Justify or criticize. 2
 (c) The value of ΔG° for the reaction $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons \text{NO}_2(\text{g})$ is 4.61 kJ. Calculate the value of K_p and K_c for this reaction. 3
 (d) Distinguish between ΔG and ΔG° . 2
 (e) Why NH_3 is preferably synthesized at low temperature and high pressure? 1

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