



SPRING MID SEMESTER EXAMINATION-2019

2nd Semester B.Tech & B.Tech Dual Degree

CHEMISTRY CH-1007 (For 2018 Admitted Batch)

Full Marks: 20

Time: 1.5 Hours

Answer any **Four** questions including Question No. 1 which is compulsory. The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

- 1 **Answer all questions** 1×5
 - (a) What will be the Gibbs free energy change (ΔG) of a reaction at room temperature if the pressure of the system changes from 5 to 2 atm?
 - (b) Comment on the final entropy change of a following representative reaction:
Liquid + liquid = liquid + solid
 - (c) Why the rate of a reaction is increased by two times with every 10° rise in temperature?
 - (d) Calculate the equilibrium constant for the following reaction at 400°C
 $2\text{NOCl}_{(g)} \rightleftharpoons 2\text{NO}_{(g)} + \text{Cl}_{2(g)}$
The standard enthalpy and entropy of the reactions are 80 KJ/mol and 120 J/mol, respectively.
 - (e) Prove that $\Delta H_p = q$.
- 2
 - (a) In a container, 2 l of H_2 gas and 4 moles of N_2 gas was mixed with 4 g O_2 gas. Assuming no reaction occurred among them, calculate the entropy change of this mixture at NTP. 2.5
 - (b) 2.5

$$\begin{array}{l} \text{(i)} \quad \text{Cl}_{2(g)} \xrightleftharpoons[K_2]{K_1} 2\text{Cl (fast)} \\ \text{(ii)} \quad \text{Cl}_{(g)} + \text{CO}_{(g)} \xrightleftharpoons[K_4]{K_3} \text{COCl}_{(g)} \text{ (fast)} \\ \text{(iii)} \quad \text{Cl}_{2(g)} + \text{COCl}_{(g)} \xrightarrow{K_5} \text{COCl}_{2(g)} \text{ (slow)} \end{array}$$

Prove that, $\frac{d[\text{COCl}_2]}{dt} = k[\text{CO}][\text{Cl}_2]^{3/2}$ where k is overall rate constant.
- 3
 - (a) What is chemical potential? Show that $d\mu_B = -\left(\frac{n_A}{n_B}\right)d\mu_A$ 2.5
 - (b) For a consecutive reaction, $A \longrightarrow B \longrightarrow C$, with rate constants k_1 and k_2 respectively (each steps followed 1st order) deduce the concentration of 'B' at any time 't' using central idea of steady state approximation. 2.5
- 4
 - (a) The rate constant of the decomposition of N_2O_5 is 3.46×10^{-5} at 25°C and 4.87×10^{-3} at 65°C . Calculate the energy of activation of the reaction if $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$. 2.5
 - (b) What is time-lag theory? In which condition, a uni-molecular reaction will follow second-order kinetics? 2.5
- 5
 - (a) Discuss the feasibility of the following reaction:
 $\text{C(S)} + \text{H}_2\text{O (g)} \longrightarrow \text{CO(g)} + \text{H}_2 \text{ (g)}$
at 100°C and 1000°C . Given that $\Delta H = +31400 \text{ cal}$ and $\Delta S = +32 \text{ cal/K}$ 2.5
 - (b) How will you account the entropy change for any reversible and irreversible process? 2.5
- 6
 - (a) The vapor pressure of water at 95°C is 634 mm of Hg. Calculate the vapor pressure at 150°C if the heat of vaporization is 41.72 KJ/mole . 2.5
 - (b) Prove that, 2.5

$$\left[\frac{\partial(\Delta G/T)}{\partial T} \right]_P = -\frac{\Delta H}{T^2}$$

terms and symbols are as usual.
