MID SEMETER EXAMINATION, SPRING 2024
Subject: CHEMISTRY
Code:CH10001

B. Tech.
2nd Semester (2023AB & Back)
Spring 2024 (SAS)

Full Marks: 20   **Time: 90 minutes**

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. All
parts of a question should be answered at one place only.

		Marks	CO
1	**Answer the following Questions**		
a)	What would be the sign of the entropy change (ΔS) for the crystallization of salt from a solution and the dissolving of sugar in water? Provide justification for your answers in both scenarios.	1	1
b)	For the melting of sodium chloride, NaCl, $\Delta H_{fus} = +30.2$ kJ mol^{-1} and $\Delta S_{fus} = +28.1$ J K^{-1} mol^{-1}. Estimate the melting point of NaCl.	1	1
c)	Among the listed thermodynamic properties - work done on a system, heat absorbed, entropy, and enthalpy - which ones are classified as state functions and which ones are classified as path functions?	1	1
d)	For a reaction, rate constant $k_1 = 5.16 \times 10^{-4}$ sec^{-1} at 1085K and $k_2 = 3.76 \times 10^{-3}$ sec^{-1} at 1125K. Find the activation energy E_a	1	2
e)	For a consecutive reaction	1	2

$A \xrightarrow{k_1} B \xrightarrow{k_2} C$; $k_1 = 2k_2 = 0.1$ sec^{-1}. Find the time when intermediate will have the maximum concentration

		Marks	CO
Q.2		**Marks**	**CO**
a)	Derive van't Hoff isochore relation.	2.5	1
b)	For the following reaction	2.5	2

$2NO + O_2 \xrightarrow{k} 2NO_2$
the proposed reaction mechanism is;

$2NO \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_2$
.... (fast)

$N_2O_2 + O_2 \xrightarrow{k_3} 2NO_2$
.... (slow)

Assuming all the reactions are elementary, find the relation between overall rate constant k with k_1, k_2 and k_3.

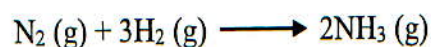|		Marks	CO
Q.3		**Marks**	**CO**
a)	2 mole of H_2 gas was mixed with 9 mole of Ar gas. Calculate $(\Delta S)_{mix}$ and $(\Delta G)_{mix}$ at 300K assuming ideal gas behavior.	2.5	1
b)	Prove that the entropy of mixing of two ideal gases is maximum when mole fractions of gas 1 and 2 are 0.5	2.5	1

		Marks	CO
Q.4		2.5	1
a)	For the following reaction		

$$N_2 (g) + 3H_2 (g) \longrightarrow 2NH_3 (g)$$

The free energy change at 25 ^{0}C and 35 ^{0}C are -3.98 and -3.37 kcal. Calculate the heat of the reaction at 35 ^{0}C

		Marks	CO
b)	For the following parallel reaction;	2.5	2
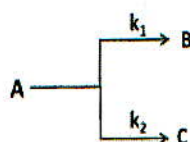
Find out the expression for k_1+k_2

		Marks	CO
Q.5		2.5	2
a)	The rate constant for the first order decomposition of a certain reaction is described by the equation		

$$Log\ k\ (s^{-1}) = 14.34 - \frac{1.25 \times 10^4\ K}{T}$$

a) Find E_a for the above reaction
b) At what temperature will its half-life period would be 256 min?

		Marks	CO
b)	Explain Lindemann's Time Lag theory of uni-molecular reactions. Suggest the condition at which a unimolecular reaction follows second-order kinetics.	2.5	2

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