

編號： 219 系所：環境工程學系丙組

科目：普通化學

本試題是否可以使用計算機：可使用，不可使用（請命題老師勾選）

1. The following results are obtained for decomposition of R ($R \rightarrow P$) at 298 K. At 310 K, the rate constant for the decomposition is found to be twice the value at 298 K. Calculate the activation energy (E_a) and reaction order (n). (20%)

Conversion (X)	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05	0
Rate (M/min)	2.3	2.7	3.1	3.8	4.3	4.7	5.1	6.0	6.7	7.5	8.5

2. The following experimental data apply to an enzyme-catalyzed reaction (in terms of mechanism: $E + S \rightleftharpoons ES; ES \rightarrow E + Z$). Derive the rate equation and calculate the limiting rate. (20%)

[S] (M)	2.5×10^{-4}	5.0×10^{-3}
Rate (M/s)	2.3×10^{-4}	7.8×10^{-4}

3. Calculate the maximum entropy (ΔS) for mixing of two ideal gases at 350 K and determine their ΔG and ΔH . (10%)
4. One mole of supercooled water at 270 K freezes suddenly. Calculate the net entropy changes in the system and surroundings. Heat capacities (C_p) for water and ice are 76 and 38 J/Kmol, respectively. (20%)
5. Calculate the adiabatic flame temperature for CO burned with 20% excess air (20% oxygen and 80% nitrogen) at 300 K. (15%)
6. A heat engine that burns CO (with 20% excess air) in a room is to maintain the temperature of the room at 300 K when the external temperature is 280 K. Calculate the ratio of the heat delivered to the room to the heat produced by the heat engine. (15%)

	ΔH (kJ/mol)	ΔG (kJ/mol)	d (J/Kmol)	e ($J/K^2 \text{mol}$)	f (JK/mol)
O ₂	0	0	30	4.2×10^{-3}	-1.7×10^{-5}
CO	-110.5	-137.2	28	4.1×10^{-3}	-4.6×10^{-4}
CO ₂	-393.5	-394.4	44	8.8×10^{-3}	-8.6×10^{-5}

$$C_p = d + eT + fT^{-2} \quad \Delta H^T = \Delta H^\circ + \int C_p dT \quad \Delta G = \Delta H - T\Delta S$$

$$\Delta S = nC_v \ln(T_2/T_1) + nR \ln(V_2/V_1) \quad \text{Rate} = k[R]^n \quad k = A \exp(-E_a/RT)$$