

說明：1. 請依序作答並標明題號

2. 計算題必須寫出計算過程，只寫答案不給分

3. $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$

1. If a first-order reaction is 20% complete in 20 minutes, how long will it take to be 90% complete? (10%)
2. The overall rate constant of a reaction is related to the rate constants of three elementary reactions as $k = k_1 \sqrt{k_2/k_3}$. How is the Arrhenius activation energy of the overall rate constant related to those of the elementary reactions? (10%)
3. It is often said that near room temperature, a chemical reaction rate doubles with every 10° rise in temperature. Calculate the activation energy of a reaction at 300°K that obeys this rule exactly. (10%)
4. Please state the First, Second, and Third laws of thermodynamics. (10%)
5. Calculate K (equilibrium constant) at 25°C for the reaction
$$\text{NO}_{(g)} + 1/2 \text{O}_{2(g)} = \text{NO}_{2(g)}$$
where $\Delta G^\circ = -8.33 \text{ kcal/mol}$. Which factor, enthalpy or entropy, makes K greater than unity and thereby provides the principal driving force for the reaction? (10%)
6. One mole of an ideal gas at 300°K expands isothermally and reversibly from 5 to 20 liters. Please calculate the work done and the heat absorbed by the gas. What is ΔE and ΔH for the process? (20%)
7. For the process $A \rightarrow B$, the value ΔG is 30 KJ at 25°C , and 30.02 KJ at 26°C . Estimate ΔS for the process. (10%)
8. Please answer the following questions: (20%)
 - (a) de Broglie wavelength
 - (b) time-independent Schrödinger equation
 - (c) Bohr correspondence principle
 - (d) Born-Oppenheimer approximation