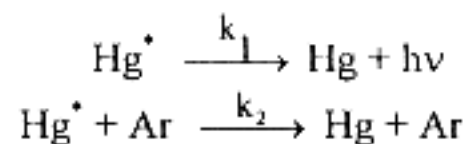


- 說明：
1. 請依序作答並標明題號
 2. 計算題必須寫出計算過程，只寫答案不給分
 3. $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$

1. Comparing two reactions with different activation energies, for which will the rate increase more rapidly with temperature? why? (5%)
2. If a first-order reaction is 20% complete in 20 minutes, how long will it take to be 90% complete? (6%)
3. 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%)

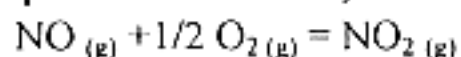
4. An electronically excited atom can either fluoresce or lose its energy by collision with some other molecules. For example,



These reactions are elementary processes. What is the rate law of each? What is the expression for the fraction of atoms lost by fluorescence at a given pressure of Ar? (14%)

5. Calculate ΔG° for each of the following transformations:
 - a. $\text{H}_2\text{O}(\ell, 100^\circ\text{C}) \rightleftharpoons \text{H}_2\text{O}(\text{g}, 100^\circ\text{C})$, the vapor pressure of H_2O at 100°C is 101.325 kPa (5%)
 - b. $\text{H}_2\text{O}(\ell, 25^\circ\text{C}) \rightleftharpoons \text{H}_2\text{O}(\text{g}, 25^\circ\text{C})$, the vapor pressure of H_2O at 25°C is 3.17 kPa (10%)

6. Calculate K (equilibrium constant) at 25°C for the reaction



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? (14%)

請接下一頁

(背面仍有題目,請繼續作答)

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. (6%)
8. For the process $A \rightarrow B$, the function $\Delta H = -50$ KJ and $\Delta S = -100$ JK⁻¹. At what temperature is A in equilibrium with B? (5%)
9. Give the ground-state electron configuration, bond order, and term state for H₂⁻ (6%)
10. Please answer the following questions: (12%)
- (a) de Broglie wavelength
 - (b) time-independent Schrödinger equation
 - (c) Bohr correspondence principle
 - (d) Born-Oppenheimer approximation
 - (e) Franck-Condon principle
 - (f) commute of two operators
11. Please describe hard-sphere potential and Lennard-Jones potential (7%)