所別：生物醫學工程研究所碩士班 生醫材料與技術組(一般生)　科目：物理化學　共 2 頁　第 1 頁

本科考試可使用計算器，廠牌、功能不拘　＊請在試卷答案卷（卡）內作答

參考用

1. The Arrhenius equation is expressed by $k=Ae^{-Ea/RT}$
   (a) What is the physical meaning of E_a? **(5 pt)**
   (b) Explain the physical meaning of $e^{-Ea/RT}$ in the Arrhenius equation. **(5 pt)**

2. Brief describe the process of "Fluorescence", "Phosphorescence", "Internal conversion", "Vibrational relaxation" and "Intersystem crossing" with the help of Jablonski diagram. **(12 pt)**

3. (a) Please write down the three necessary and sufficient conditions for the validity of the Langmuir equation. **(9 pt)**
   (b) A gas A_2 adsorbs onto a surface M as represented by
   $$A_2(g) + 2M(surface) \leftrightarrow 2AM(surface)$$
   Assume that the adsorption process follows the Langmuir isotherm, i.e. $\theta = \frac{K^{1/2}[A]^{1/2}}{1+K^{1/2}[A]^{1/2}}$ where θ = fractional coverage and [A]= partial pressure of A_2, and $K=k_a/k_d$.
   Derive the above expression of Langmuir isotherm for the adsorption process. **(10 pt)**

4. Two moles of H_2 gas which is assumed as ideal gas were compressed isothermally at 300K from 1 bar to 5 bar against a constant pressure of 5 bar. Calculate: (Gas constant R=8.314 $J\cdot K^{-1}\cdot mol^{-1}$) **(15 pt)**
   (a) The work done by the system (W),
   (b) The heat absorbed by the system (q),
   (c) The change of the entropy ($\triangle S$),
   (d) The change of the Helmholtz energy ($\triangle A$),
   (e) The change of the Gibbs energy ($\triangle G$).

注意:背面有試題

參考用

5. For the reaction A+B→ X consider the following mechanism:

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} AB \qquad (1)$$

$$AB \xrightarrow{k_2} X \qquad (2)$$

Derive the rate law using the steady state approximation to eliminate the concentration of AB. **(7pt)**

6. Consider the equation for changes in Gibbs free energy in terms of the following cases of ΔH and ΔS:

   (a) Case 1: $\Delta H<0$ and $\Delta S<0$

   (b) Case 2: $\Delta >0$ and $\Delta S<0$

   (c) Case 3: $\Delta H<0$ and $\Delta S>0$

   (d) Case 1: $\Delta H>0$ and $\Delta S>0$

   For each case, indicate what conditions would lead to positive values of ΔG. Also, indicate the temperatures for which the process or reaction is spontaneous. **(12 pt)**

7. The rate constants for a reaction are determined experimentally. At 550°K, the rate constant is $3X10^{-6}$ $dm^3 \cdot mol^{-1} \cdot s^{-1}$ and at 800°K, the rate constant is $6X10^{-3}$ $dm^3 \cdot mol^{-1} \cdot s^{-1}$. Determine the activation energy of this reaction. (Gas constant R=8.314 $J \cdot K^{-1} \cdot mol^{-1}$) **(10 pt)**

8. Explain the following terms: **(15 pt)**
   (a) Hess's Law
   (b) Absorption and adsorption
   (c) Ideal solution
   (d) Pauli exclusion principle
   (e) Michaelis constant

注意：背面有試題