


注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生命科學院 丙組

考試科目(代碼)：物理化學(0603)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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共 2 頁，第 1 頁 *請在【答案卷】作答

1. Enthalpy H of a system is defined as $H = U + pV$ where U , p and V are the internal energy, pressure and volume of the system, respectively. (a) How does the change of enthalpy ΔH depend on the change of internal energy ΔU and volume ΔV at constant pressure p ? (b) ΔU equals sum of the work w done by the system and the heat q transferred to it ($\Delta U = w + q$). Please show that why at constant pressure the change of enthalpy ΔH of a system simply equals the heat transferred to it? (c) Why is enthalpy more useful than internal energy in measuring heat transferred to the system in most biological processes? (15%)
2. The second law of thermodynamics states that the entropy (a measure of randomness) of an isolated system tends to increase. However, life develops by organizing molecules into a more ordered form. Does this imply that the second law breaks in living organisms? Please explain your answer. (10%)
3. The phenomenon of osmosis is the passage of a pure solvent into a solution separated from it by a semipermeable membrane. Based on this phenomenon, explain why do we need to use the solution that contains similar concentrations of salt to the blood when performing intravenous feeding (靜脈給養). (10%)
4. Ultracentrifugation can separate particles with different properties. What are these properties? (9%)
5. Why can X-ray, but not light microscopy, determine protein structures at Angstrom resolution? (9%)
6. Please explain how fluorescence occurs. (9%)
7. Please explain Beer Lambert law. (8%)

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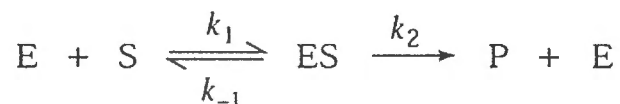
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共 2 頁，第 2 頁 *請在【答案卷】作答

8. We prepare a solution containing 1 mM DNA duplex (D). When we heat the solution to 50 °C, 0.5 mM single strand DNA (F and B) is detected in solution. Please calculate the binding constant K_D and free energy ΔG under the condition. (10%)



9. The rate constants for an enzyme reaction gave the following result:
 $k_1 = 5 \times 10^8 \text{ M}^{-1} \text{ sec}^{-1}$, $k_{-1} = 2 \times 10^3 \text{ sec}^{-1}$, $k_2 = 3 \times 10^3 \text{ sec}^{-1}$
- (a) Please write down Michaelis-Menton equation. (5%)
- (b) What are the values of K_M and K_{cat} ? (5%)
- (c) If the kinetic measurement was under the condition of 5 μM enzyme concentration. What would be the value of V_{max} ? (5%)



10. If there is a protein X with 125 amino acids. The diffusion coefficient D of protein X has been determined as $1.5 \times 10^{-10} \text{ m}^2 \text{ s}^{-1}$. Under the same condition, please calculate the diffusion coefficient D of protein Y that contains 1000 amino acids. If we assume that the shapes of the two conformations are near spheres, please estimate by looking at hydrodynamic radius r from Stokes-Einstein equation: (5%)

$$D = \frac{kT}{6\pi\eta r}$$