

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 111 學年度碩士班考試入學試題


系所班組別：生命科學院

丙組(計算生物與人工智慧組)

科目代碼：0603

考試科目：物理化學

—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. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，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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系所班組別：生命科學院丙組

考試科目（代碼）：物理化學(0603)

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*請在【答案卷】作答

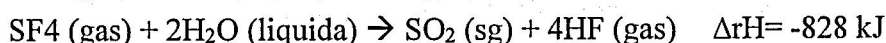
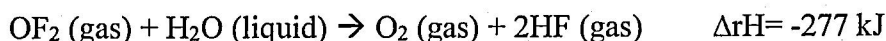
1. (5%) Body temperature measurement using a medical thermometer relies on the zeroth law of thermodynamics. Describe how the zeroth law is applied to thermometers?

2. (5%) How much expansion work is done on the system when exactly 1 mol of solid ammonium chloride, NH_4Cl , decomposes completely to yield gaseous ammonia, NH_3 , and hydrogen chloride, HCl , at a temperature of 1280 K. Treat the expansion as irreversible and the gases formed as perfect.

- A. -21.3 kJ
B. -39.1 kJ
C. -47.3 kJ
D. -52.8 kJ

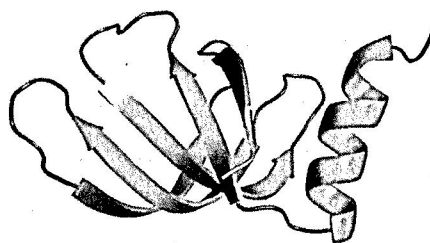
3. (5%) $2 S (gas) + 2 OF_2 (gas) \rightarrow SO_2 (gas) + SF_4 (gas)$

Calculate the change in enthalpy for the above reaction, given that:

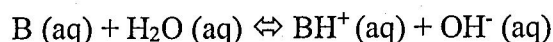


4. (15%) There are four levels of protein structure.

(1) Describe the primary, secondary and tertiary structure of a protein. (2) Name two secondary structures that you notice in the figure, and explain how they form from atomic-level view.



5. (10%) A sample of B is dissolved in water to produce 100.0 ml of 0.10 M solution. The pH of the solution is 8.0. Calculate the equilibrium constant, K_b , for this reaction:



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6. (15%) Please explain what helix dipole is and how helix dipole is formed.
7. (10%) What is the gross selection rule for Raman Spectroscopy?
8. (10%) According to Boltzmann distribution law, please explain how to calculate the ratio of molecules in the upper energy states to those in the lower energy states.
9. (15%) The diffusion coefficient for glucose ($C_6H_{12}O_6$) in water is $7.5 \times 10^{-10} \text{ m}^2 \text{ s}^{-1}$ at 27°C . The water viscosity at the temperature is $9 \times 10^{-4} \text{ kg m}^{-1} \text{ s}^{-1}$. Please use Stokes-Einstein equation to estimate the solute radius of glucose by using the Boltzmann's constant is $1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$. If the density of glucose is 1.6 g cm^{-3} , please estimate the molar mass of glucose by its size and compare to the true molar mass.
- Stokes-Einstein equation
- $$D = \frac{k_B T}{6\pi\mu R_0}$$
- D – diffusion coefficient
 μ – solvent viscosity
 R_0 – solute radius
 k_B – Boltzmann's constant
 T – temperature (K)
10. (10%) Please write down the Nernst equation and explain how to use the equation to determine the potential across cell membrane, particularly for a charged molecule.