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 112 學年度碩士班考試入學試題

系所班組別：生命科學暨醫學院
　　　　　　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

ー作答注意事項ー

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。

系所班組別：生命科學暨醫學院丙組

考試科目（代碼）：物理化學(0603)

1. (10%) Draw the atomic structure of the tripeptide Gln-Arg-Trp as it would appear in solution at pH 7, and label the $C\alpha$ atoms.

2. (12%) Describe what are the primary, secondary, tertiary and quaternary structures of a protein?

3. (5%) Tris, *Tris*(hydroxymethyl)aminomethane, is a commonly used buffering solution. It's molecular weight is *121.136 g/mol*. Please describe how to make 1 L of 0.5 M Tris buffer at pH 8 in detail.

4. (9%) List and describe briefly three different non-covalent interactions thought to be involved in stabilizing protein folding.

5. (15%) Following the question 4, when the second law of thermodynamics of the protein "system" suggests the biological molecule should be unfolded, why proteins are still folded in solution. List at least two arguments as to why proteins are folded in nature.

6. (10%) What is the relationship between the absorbance spectrum of a compound and its electronic structure?

7. (15%) A redox reaction is expressed by the two half-reactions (the corresponding electrochemical potential is provided):

$Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$

$Cu^{2+} + 2e^- \rightarrow Cu$　　　　$E = + 0.34V$

$Zn \rightarrow Zn^{2+} + 2e^-$　　　　$E = + 0.76 V$

For the full reaction, please calculate the combined standard electrochemical potential (E) and the free energy (ΔG) derived from the electrochemical potential. If we have Cu^{2+} concentration 10 times higher than Zn^{2+} concentration, please explain how to calculate the corresponding free energy (ΔG) of the full reaction.

8. (12%) Please write down Michaelis-Menten equation and explain the physical meaning for the involved parameters, V_{max}, [S], K_M. To have a data analysis by linear regression, we will convert Michaelis-Menten equation to a Lineweaver-Buck plot. Please explain how to use Lineweaver-Buck plot to obtain K_M and V_{max}.

9. (12%) A kinetic analysis of a reaction obtained from the Michaelis-Menten mechanism is shown in the following figure. The enzyme concentration used in the analysis is 1 nM. Please estimate the values of V_{max}, K_M and k_{cat}.