Biochemistry 2006B 學號：_____ 姓名：_____ 代號：_____

答案直接寫在考卷上，可寫在背面，有問題可加註說明，注意不能加紙。(每題 5%, 第 16~18 題 10%)。

1. 請至少寫出三個理由，說明地球上最早存在的核酸應該是 RNA 而非 DNA。

2. 酵素的活性區大多是一個凹陷的口袋，請問在演化過程中，這種口袋可能是如何形成的？

3. 已知某酵素的 K_m 為 5 μM，則當我們要分析此酵素活性時，都給予 50 μM 的基質濃度。請以動力學的角度，說明此一設計。

4. 下面 peptide 以 trypsin 作用後會得到什麼產物？

   Val-Trp-Glu-Arg-Ala-Ala-Lys-His

5. 如何計算一個酵素的 turn over number (t.o.n.)？

6. 我們可以用很多種方法去描述酵素的催化行為 (例如 K_m, V_{max}, k_3, k_{cat} 等)，請問用何種方法最為適當？也請說明為何。

7. 某氧化還原酵素製品含有 10 μg 蛋白質，活性分析 (總反應體積 0.5 mL) 是測量 NADH 轉換成 NAD^+ 的速率，測得 10 min 內可生成 48 μmole 的 NAD^+。請問此酵素製品之比活性若干？

8. Cysteine protease 也是一蛋白脢家族，其活性區以 Cys 為催化中心，請畫出其共通催化機制。

9. 請回答以下有關 chymotrypsin 的問題：
   a) 爲何剛轉譯出來的時候沒有活性。
   b) 其催化機制分成兩個步驟，請說明。

10. 若用定點突變對 chymotrypsin 分子上的胺基酸做改變如下，請預測對酵素活性的影響程度：
    a) 活性區上的 Ser 改成 Thr
    b) 活性區上的 His 改成 Pro
    c) 活性區上的 Asp 改成 Glu。

11. 外加的磷酸基團，造成蛋白質構形的改變，也因此會改變酵素活性。請至少舉出兩種方法，可以在蛋白質分子加上磷酸。

12. 請簡要描述凝血機制是如何進行的，並強調說明『蛋白脢』在整個凝血反應的角色。

13. 鋅離子對 carboxypeptidase A 很重要，請寫出鋅離子對此酵素在構造或活性上的貢獻。

14. 請畫出酵素動力學中 mix type inhibition 的雙倒數圖形。

15. 我們的身體對血中葡萄糖的濃度很敏感，可以在數分鐘之內快速調節其濃度。請問細胞是如何達到這個任務？

16. 若某酵素的動力學作圖得到 S 型曲線，請預測這個酵素的構造、催化機制或任何功能性質。請至少做三種預測或說明。

17. 精要解釋以下名詞：
    a) Enzyme-linked receptor
    b) Second messenger
    c) Aspartyl protease
    d) Inten
    e) Abzyme

18. 請說明以下物質對 glycogen phosphorylase 活性的影響：
    a) ATP
    b) AMP
    c) cAMP
    d) Glucose
    e) Caffeine

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Please write directly on this sheet. Use the reverse side if necessary. No extra pages. You can express you opinion about the questions. (1~15, 5% each; 16~18, 10% each)

1. It is believed that the first nucleic acid in the Earth is RNA, not DNA. Please give at least three possible explanations.

2. The active site of an enzyme is generally shaped like a deep pocket. Please describe how the pocket was formed during the evolution of this enzyme.

3. If the K_m of an enzyme is 5 μM. When we are analyzing the activity of this enzyme, the concentration of the substrate is set to 50 μM. Please explain this designing in terms of enzyme kinetics.

4. What would be the product(s) of the following peptide after being treated with trypsin?

   Val-Trp-Glu-Arg-Ala-Ala-Lys-His

5. How to calculate the turn over number (t.o.n) of an enzyme?

6. There are several ways to describe the catalytic behavior of an enzyme (e.g. K_m, V_{max}, k_3, k_{cat} etc.) Which is the best choice for this purpose? Please explain why.

7. An oxidation-reduction enzyme preparation contains 10 μg protein. The enzyme activity assay measures the production of NADH from NAD^+ in a total reaction mixture of 0.5 mL. If you find that 48 μmole of NAD^+ is produce in 10 min in the mixture. Please calculate the specific activity of this enzyme preparation.

8. The active site of **cysteine** proteases contains an active Cys residue. Please draw the chemical structure and the possible catalytic mechanism for its active site.

9. Answer following questions about chymotrypsin:
   a) Why the complete protein right after its translation is inactive?
   b) There are two sequential steps in its catalytic reaction, please describe these steps.

10. If the amino acids on the active site of chymotrypsin are changed by site-directed mutagenesis as the following strategies, please predict the effect in each case:
    a) Active site Ser is changed to Thr
    b) Active site His is changed to Pro
    c) Active site Asp is changed to Glu

11. The addition of phosphoryl group to a protein should change its conformation, as well as the activity of an enzyme. Please describe at least two methods by which the protein can adopt a phosphoryl group.

12. Describe the molecular mechanism of blood clotting. Please specify how the proteases are involved.

13. Zinc ion plays important roles in carboxypeptidase A. Please describe its contributions to the conformation and the activity of the enzyme.

14. Draw the double-reciprocal plot for the mix-type inhibition in enzyme kinetics.

15. Blood sugar concentration is controlled in a very sensitive mode, which could be changed in a few minutes. Please describe how cells achieve this function?

16. Predict the structure, catalytic mechanism, or possible function of an enzyme, if the Michaelis-Menten plot of this enzyme has a sigmoidal shape. Please give at least three predictions.

17. Explain the following terms:
    a) Enzyme-linked receptor
    b) Second messenger
    c) Aspartyl protease
    d) Inten
    e) Abzyme

18. Describe how the following substances affect the activity of glycogen phosphorylase:
    a) ATP
    b) AMP
    c) cAMP
    d) Glucose
    e) Caffeine