


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 丁組

考試科目(代碼)：生物化學(0701)

### —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。

國立清華大學 108 學年度碩士班考試入學試題

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考試科目（代碼）：生物化學(0401、0501、0701)

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Part 1 單選題 (每題二分，共四十分，答錯不倒扣。請在【答案卡】作答)

1. In a \_\_\_\_\_, the carbohydrate is responsible for most of the mass; in a \_\_\_\_\_, the protein is responsible for most of the mass.  
(A) glycoprotein; proteoglycan  
(B) proteoglycan; glycoprotein  
(C) *N*-linked glycoprotein; *O*-linked glycoprotein  
(D) *O*-linked glycoprotein; *N*-linked glycoprotein  
(E) *N*-linked proteoglycan; *O*-linked glycoprotein proteoglycan
2. Which of the following must be true if the steady state assumption is to be used?  
(A)  $[E]_T = [ES]$ ,  
(B)  $(k_2 - k_{-1}) / k_1 = 1$ ,  
(C)  $k_1[E][S] = k_2[ES]$ ,  
(D)  $k_1[E][S] = k_2[ES] - k_{-1}[ES]$ ,  
(E)  $d[ES] / dt = 0$ .
3. What amino acid performs the nucleophilic attack during the chymotrypsin mechanism?  
(A) Ser,  
(B) His,  
(C) Lys,  
(D) Cys,  
(E) Thr.
4. The ability for an enzyme to change its shape upon substrate binding represents the concept of \_\_\_\_\_.  
(A) lock and key,  
(B) induced fit,  
(C) proximity and orientation effects,  
(D) covalent catalysis,  
(E) none of the above.

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\*請在【答案卡】作答

5. How does CO<sub>2</sub> affect hemoglobin-oxygen binding?
- (A) CO<sub>2</sub> binds directly to the oxygen binding site, displacing oxygen and thus promoting the deoxy state,
  - (B) CO<sub>2</sub> displaces BPG, thus promoting the oxy state,
  - (C) CO<sub>2</sub> is converted to bicarbonate and H<sup>+</sup> which promotes the oxy state,
  - (D) CO<sub>2</sub> is converted to bicarbonate and H<sup>+</sup> which promotes the deoxy state,
  - (E) None of the above.
6. Which complex reduces molecular oxygen?
- (A) Complex I,
  - (B) Complex II,
  - (C) Complex III,
  - (D) UQH/UQH<sub>2</sub> pool,
  - (E) Complex IV.
7. Electrostatic interactions among amino acid residues on proteins may be damped out by high concentrations of:
- (A) Water,
  - (B) Organic solvents,
  - (C) Salts,
  - (D) Heat,
  - (E) All of the above.
8. Nearly all of the calcium ions in muscle are sequestered inside vesicles called:
- (A) Mitochondria,
  - (B) Sarcoplasmic reticulum,
  - (C) Endoplasmic reticulum,
  - (D) Golgi,
  - (E) Secretory vesicles.

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\*請在【答案卡】作答

9. The most significant factor in contributing protein folding between tightly packed amino acid side chains in the interior of the protein is:

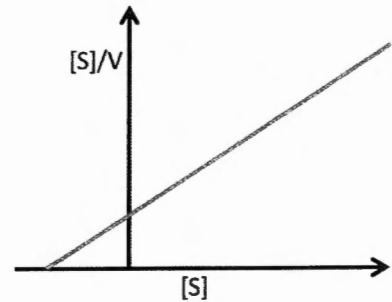
- (A) Hydrogen bonds,
- (B) Electrostatic interactions,
- (C) Covalent ester bonds,
- (D) Van der Waals interactions,
- (E) All are true.

10. If an enzyme has a  $V_{max}$  of 15 mM/min, what is the velocity if the substrate is present at  $1/5$  of the  $K_m$ ?

- (A) 12 mM/min,
- (B) 6 mM/min,
- (C) 3 mM/min,
- (D) 2.5 mM/min,
- (E) cannot be determined from given information.

11. Which transport process is best characterized by the Hanes Woolf plot as shown at right? ( $[S]$  is the solute concentration.  $V$  is the transport rate.)

- (A) Passive diffusion,
- (B) Active transport,
- (C) Facilitated diffusion,
- (D) Active transport and facilitated diffusion,
- (E) All of the above.



12. Which of the following residue prefers to be at the membrane-water interface?

- (A) Gly,
- (B) Trp,
- (C) Leu,
- (D) Arg,
- (E) Gln.

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\*請在【答案卡】作答

13. Which of the following transport process requires energy input?
- (A) Facilitated diffusion,
  - (B) Passive diffusion,
  - (C) Secondary active transport,
  - (D) All of the above,
  - (E) None of the above.
14. Which of the following does not reduce Cu(II) to Cu(I), but does react with Cu(II) to produce reddish  $\text{Cu}_2\text{O}$  after invertase treatment?
- (A) Sucrose,
  - (B) Glucosamine,
  - (C) Maltose,
  - (D) Hyaluronic acid,
  - (E) Chitin.
15. Which of the following statement about biological membranes is TRUE?
- (A) Plasma membranes are asymmetric. The outer leaflet is enriched in phosphatidylserine, whereas the inner leaflet is enriched in phosphatidylcholine.
  - (B) Membrane asymmetry is maintained predominantly by scramblase.
  - (C) Cerebrosides are mostly found in the inner leaflet of plasma membranes.
  - (D) Membrane curvature is controlled by cytoskeleton reorganization, and does not affected by changes in lipid composition.
  - (E) Phospholipids with unsaturated fatty acyl chains increase membrane fluidity.

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\*請在【答案卡】作答

16. During the amino acid synthesis, Methionine is derived from which metabolic progenitor?
- (A)  $\alpha$ -ketoglutarate,
  - (B) Aspartate,
  - (C) Pyruvate,
  - (D) 3-phosphoglycerate,
  - (E) Phosphoenolpyruvate.
17. Urea contains one carbon, two nitrogens, one oxygen and 4 hydrogens. Where are the sources of the carbons and nitrogens?
- (A) carbamoyl phosphate and ornithine,
  - (B) bicarbonate and aspartate,
  - (C) carbamoyl phosphate and bicarbonate and ornithine,
  - (D) aspartate,
  - (E) None of the above.
18. What form of tetrahydrofolate (THF) is used for methionine biosynthesis?
- (A)  $N^5$ -methyl-THF,
  - (B)  $N^5 N^{10}$ -methylene-THF,
  - (C)  $N^{10}$ -formyl-THF,
  - (D)  $N^5$ -formyl-THF,
  - (E)  $N^5 N^{10}$ -methenyl-THF.
19. What is the active form of methionine and acts as an intracellular methyl group donor?
- (A) S-adenosylhomocysteine,
  - (B) homocysteine,
  - (C) S-adenosylmethionine,
  - (D) 5-methylthioadenosine,
  - (E) None of the above.

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\*請在【答案卡】作答

20. Which amino acid is the “pure” ketogenic amino acid?

- (A) tyrosine,
- (B) leucine,
- (C) histidine,
- (D) isoleucine,
- (E) cysteine.

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考試科目（代碼）：生物化學(0401、0501、0701)

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\*請在【答案卷】作答

Part 2 問答題 (共六十分。請在【答案卷】務必依序作答)

1. (A) What is the pI for the following peptide: Ala-Glu-Val-Asp-Lys-Leu? (6%)

(B) What is the C-terminal amino acid in this peptide? (3%)

Name	pK		
	pK	pK	pK
	$\alpha$ -COOH	NH <sub>3</sub>	R-group
Alanine	2.35	9.87	
Arginine	2.18	9.09	13.2
Asparagine	2.18	9.09	13.2
Aspartic Acid	1.88	9.60	3.65
Cysteine	1.71	10.78	8.33
Glutamic Acid	2.19	9.67	4.25
Glutamine	2.17	9.13	
Glycine	2.34	9.60	
Histidine	1.78	8.97	5.97
Isoleucine	2.32	9.76	
Leucine	2.36	9.60	
Lysine	2.20	8.90	10.28
Methionine	2.28	9.21	
Phenylalanine	2.58	9.24	
Proline	1.99	10.60	
Serine	2.21	9.15	
Threonine	2.15	9.12	
Tryptophan	2.38	9.39	
Tyrosine	2.20	9.11	10.07
Valine	2.29	9.74	

2. If an enzyme-catalyzed reaction with a  $K_M$  of 3.5 mM has a velocity of 5 mM/min at a substrate concentration of 0.5 mM, what is the  $V_{max}$ ? (6 %)



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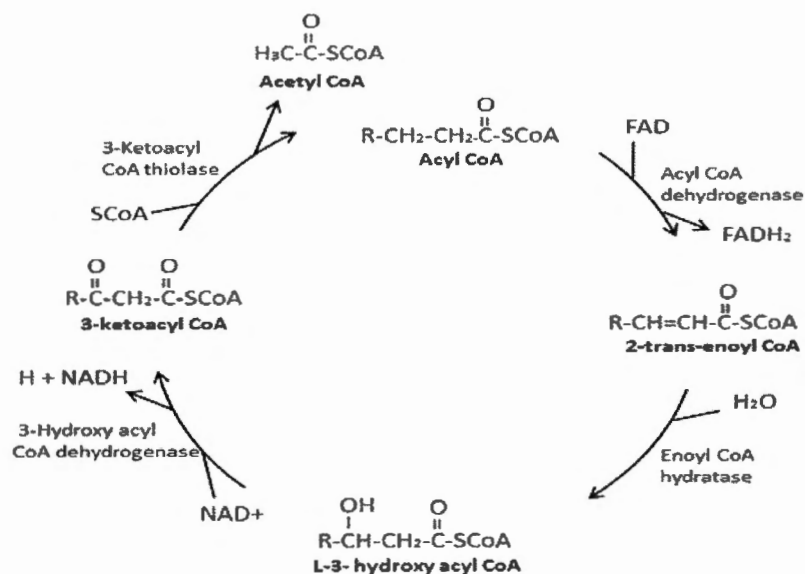
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\*請在【答案卷】作答

3. This is a cycle of the  $\beta$ -oxidation of saturation fatty acid. Please calculate how many ATP can be generated in a complete oxidation of Myristic-CoA (C14:0-CoA) (if you consider one NADH produces 2.5 ATP, one FADH<sub>2</sub> produces 1.5 ATP and one Acetyl-CoA produces 10 ATP)? (10%)



4. Please explain the mechanism of how F<sub>1</sub>F<sub>0</sub>-ATPase produces ATP in mitochondria. You need include the teams of proton gradient, c subunit of F<sub>0</sub>, and  $\alpha$  and  $\beta$  subunits of F<sub>1</sub>. (5%)
5. Please draw a potential energy diagram for the exothermic reaction A  $\rightarrow$  B and explain why the enzyme-catalyzed reaction is faster than the uncatalyzed reaction. (10%)
6. Please explain why the transmembrane domains of integral membrane proteins mostly have a high secondary structure content. (5%)

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7. What is the key enzyme for the biosynthesis of deoxyribonucleotides? How the catalytic activity of the enzyme is turned on and off in response to need for dNTPs? In general, this reaction involved oxidation-reduction cycle through two redox-regulatory enzymes which deliver reducing equivalents. Please write down the names of these two enzymes? (10 %)
8. How does the completion of human genome project contribute to current human proteomic studies? (5 %)