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 109 學年度碩士班考試入學試題

系所班組別：生命科學院
丁組(醫學生物科技學程)

科 目 代 碼 ：0701

考 試 科 目 ：生物化學

－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. 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 109 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、乙組、丁組

考試科目（代碼）：生物化學(0401、0501、0701)

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 transmembrane proteins, which amino acid is preferred at the membrane-water interface?
   (A)W,
   (B) E,
   (C) K,
   (D) L,
   (E) A.

2. Which transport system does not require energy input to transport substrates?
   (A)Ca^{+2}-ATPase,
   (B) bacteriorhodopsin
   (C) ABC transporters,
   (D)potassium channel,
   (E) sodium pump.

3. Which of the following statement about the asymmetric structures of biological membranes is FALSE?
   (A) Membrane proteins display transverse and lateral asymmetry,
   (B) The lipids of the membrane exhibit lateral heterogeneity and transverse asymmetry,
   (C) The lipid composition is different from organelles to organelles,
   (D) The asymmetric membrane structures are maintained by transporters,
   (E) Acidic phospholipids are enriched in the outer leaflet.

4. Which amino acids are negatively-charged at neutral pH?
   (A)A, C,
   (B) D, E,
   (C) L, I,
   (D) K, R,
   (E) N, Q.

5. The rate-limiting step in glycogen catabolism is catalyzed by glycogen phosphorylase, which is activated by _____ ?
   (A) ATP,
   (B) ADP,
   (C) glucose-6-phosphate,
   (D) phosphorylation,
   (E) acetylation.

6. The biosynthesis of _____ is connected to purine biosynthesis by common intermediates?
   (A) Pro,
   (B) Tyr,
   (C) His,
   (D) Phe,
   (E) Lys.

7. HMG-CoA reductase is the key regulatory site in cholesterol synthesis. Which of the following statement about the regulatory mechanisms of HMG-CoA reductase is TRUE?
   (A) Phosphorylation by cAMP-dependent kinase activates HMG-CoA reductase,
   (B) A high AMP:ATP ratio leads to activation of HMG-CoA reductase,
   (C) High cholesterol level increases the half-life of HMG-CoA reductase,
   (D) High cholesterol level increases HMG-CoA reductase gene expression,
   (E) HMG-CoA reductase phosphatase can activate HMG-CoA reductase.

8. What is the net ATP yield from the complete oxidation of one myristate to CO_2 and H_2O?
   (A) 106,
   (B) 94,
   (C) 92,
   (D) 108,
   (E) 120.

9. How does fructose-2,6-bisphosphate regulate gluconeogenesis?
   (A) It inhibits phosphofructokinase to stimulate gluconeogenesis,
   (B) It inhibits fructose-1,6-bisphosphatase to reduce gluconeogenesis,
   (C) It activates Pyruvate kinase to reduce gluconeogenesis,
   (D) It activates phosphofructokinase to stimulate gluconeogenesis,
   (E) It activates pyruvate carboxylase to stimulate gluconeogenesis.

10. Acetate units for fatty acid synthesis are activated by formation of _____ .
   (A)Malonyl-CoA,
   (B) Acetyl-CoA,
   (C) Butyryl-CoA,
   (D) Malonyl-CoA and Acetyl-CoA,
   (E) Acetyl-CoA and Butyryl-CoA.

11. Which of the following statement about the mitochondrial electron transport chain is TRUE?
   (A) Complex I transfers electrons from $FADH_2$ to ubiquinone,
   (B) The Q cycle mediated by Complex II reduces cytochrome c,
   (C) A single catalytic cycle of Complex III transports four protons from the intermembrane space to the matrix,
   (D) Complex IV uses electrons from cytochrome c to reduce O_2 to H_2O,
   (E) Electrons move from more positive to more negative reduction potentials.

12. In the TCA cycle (also known as the Krebs cycle), which enzyme catalyzes the formation of GTP?
   (A) succinyl-CoA synthetase,
   (B) nucleoside diphosphate kinase,
   (C) succinate dehydrogenase,
   (D)alpha-ketoglutarate dehydrogenase,
   (E) malate dehydrogenase.

13. Glucose-6-phosphate dehydrogenase is the rate-determining enzyme of the pentose phosphate pathway. How is this enzyme regulated?
(A)Activated by NADPH,
(B) Activated by fatty acyl CoA,
(C) Activated by $NADP^+$,
(D) Activated by ribose,
(E) Activated by ADP.

14. Fatty acids are activated for β-oxidation by the hydrolysis of _____.
(A) UTP to UMP,
(B) UTP to UDP,
(C) CTP to CMP,
(D) ATP to AMP,
(E) ATP to ADP.

15. Which of the following cofactor is used to transfer one-carbon units such as methyl, formyl, and methenyl groups?
(A) Biotin,
(B) Thiamine pyrophosphate,
(C) Lipoamide,
(D) FAD,
(E) Tetrahydrofolate.

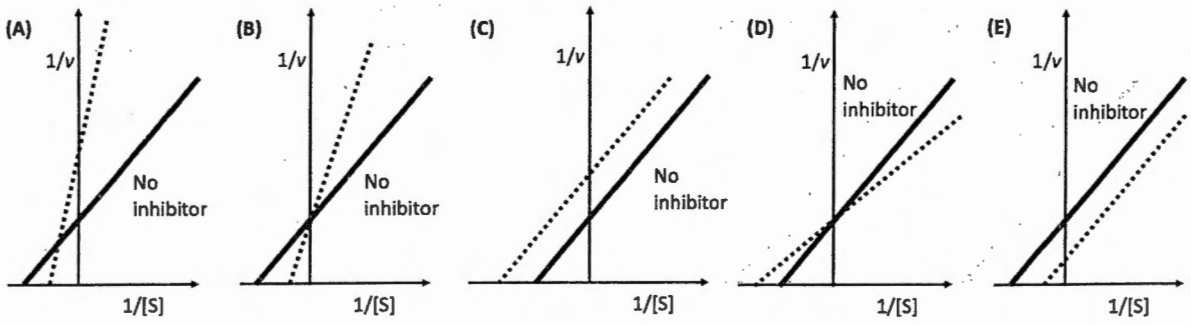
16. Which of the following sugar is a ketose?
(A)ribose,
(B) maltose,
(C) glucose,
(D) galactose,
(E) fructose.

17. The role of cytochrome b_6f complex in the photosystem is analogous to the role of mitochondrial _____.
(A) complex I,
(B) complex II,
(C) complex III,
(D) complex IV,
(E) complex V.

18. Which of the following cofactor requires a shuttle system in order to pass electrons to the electron transport chain?
(A)NADH produced in the citric acid cycle,
(B) NADH produced during glycolysis,
(C) QH_2 produced during fatty acid oxidation,
(D) NADH produced during fatty acid oxidation,
(E) all.

19. _____ is the common intermediate to synthesize aromatic amino acids and cellular compounds containing benzene rings.
(A) Chorismate,
(B) Pristanic acid,
(C) Arachidonic acid,
(D) Squalene,
(E) Ornithine.

20. The Lineweaver-Burk plot of an enzyme without inhibitor is shown. Which dash line can represent the kinetics of this enzyme in the presence of a competitive inhibitor?



國立清華大學 109 學年度碩士班考試入學試題

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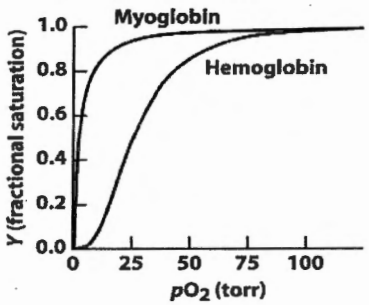
Part 2 問答題 (共六十分。請在【答案卷】務必依序作答)

1. If an enzyme-catalyzed reaction has a velocity of 2 mM/min and a V_{max} of 10 mM/min when the substrate concentration is 0.5 mM, what is the K_M? (10%)

2. Given the following plot of oxygen binding versus pressure of O_2 for myoglobin and hemoglobin at pH 7.2, (1) draw a curve that shows what happens when the pH is increased to about 7.6 and (2) draw a curve that shows what happens when the pH is decreased to about 6.8. (3) What is the pH value at which hemoglobin has higher affinity of O_2? Please provide the explanation from the curves. (10%)



3. β -oxidation: (1) Please plot the 4 steps of β -oxidation reaction and label the enzyme and the involved energy molecules of each step (10%). (2) Please determine the number of ATP equivalents if we complete β -oxidation of a palmitic acid (C18:0) to CO_2 and H_2O. By the calculation, how many kJ can be generated by 1g palmitic acid if the molecular weight of β -linolenic acid is 256 Da? (Assume for the calculation that NADPH is worth 3.5 ATPs, NADH is 2.5 ATPs, $FADH_2$ is 1.5 ATPs and one Acetyl-CoA produces 10 ATPs and the hydrolytic energy of ATP is 31 kJ/mol) (10%).

4. How many NADH, FADH2 and GTP can be generated for one molecule of acetyl-CoA passing through TCA cycle? How many ATP can be produced if these NADH, FADH2 and GTP passing through electric transfer system? (10%)

5. What is the start building block of cholesterol? What is the control enzyme for cholesterol biosynthesis? What is the major transporter of cholesterol in circulation system? How the cells manipulate the oversupply of cholesterol? (10%)