

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：分析與環境科學研究所

科目代碼：2904

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. 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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1~25 題為選擇題（每題 2 分）

1. The function of DNA topoisomerases is:

- (A) forming cruciform DNA,
- (B) packaging DNA into nucleosomes,
- (C) breaking DNA, winding them tighter or looser, and rejoining the ends,
- (D) unwinding G:C rich areas in DNA,
- (E) promoting DNA hybridization.

2. Which stage of cellular respiration produces the most ATP?

- (A) fermentation,
- (B) citric acid cycle,
- (C) glycolysis,
- (D) mitochondrial electron transport,
- (E) oxidative phosphorylation.

3. Secondary and higher orders of structure are determined by all EXCEPT:

- (A) hydrogen bonds,
- (B) ionic bonds,
- (C) van der Waals forces,
- (D) hydrophobic interactions,
- (E) peptide bonds.

4. Protein isolation and purification include all of the techniques EXCEPT:

- (A) gas-liquid chromatography,
- (B) solubility,
- (C) electrophoresis,
- (D) ion exchange chromatography,
- (E) affinity chromatography.

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5. \_\_\_\_\_ is specific in hydrolyzing only peptide bonds in which the carboxyl function is contributed by an arginine or a lysine residue.

- (A) CNBr,
- (B) carboxypeptidase,
- (C) trypsin,
- (D) chymotrypsin,
- (E) none of the above.

6. The peptide backbone of a protein consists of the repeated sequence:

- (A) -N-CO-C $\alpha$ -,
- (B) -C $\alpha$ -N-CO-,
- (C) -N-C $\alpha$ -CO-,
- (D) -CO-C $\alpha$ -N-,
- (E) none of the above.

7. Edman degradation will:

- (A) cleave the protein into a multitude of smaller peptides,
- (B) determine the C-terminal amino acid by using a carboxypeptidase,
- (C) compare overlapping sets of peptide fragments,
- (D) determine the N-terminal amino acid,
- (E) generate two different, but overlapping sets of peptide fragments.

8. In cellulose the glucose units are linked by

- (A)  $\alpha$  (1 $\rightarrow$ 4)
- (B)  $\beta$  (1 $\rightarrow$ 4)
- (C)  $\alpha$  (1 $\rightarrow$ 6)
- (D)  $\beta$  (1 $\rightarrow$ 6)
- (E)  $\alpha$  (1 $\rightarrow$ 3) glycosidic bonds.

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9. NADPH generally can be obtained from

- (A) fatty acid oxidation,
- (B) citric acid cycle,
- (C) pentose phosphate pathway,
- (D) glycolysis,
- (E) oxidative phosphorylation.

10. Cytochrome c oxidase is NOT inhibited by

- (A) carbon monoxide,
- (B) sulfide,
- (C) azide,
- (D) cyanide,
- (E) rotenone.

11. What is the overall net charge on the peptide Arg-Gly-Ser-Lys-Glu-Asp at pH 7.0?

- (A) +3;
- (B) +1;
- (C) -2;
- (D) -3;
- (E) 0



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12. A Ramachandran plot shows

- (A) the amino acid residues which have the greatest degree of rotational freedom.
- (B) the sterically allowed rotational angles between R groups and  $\alpha$ -carbons in a peptide.
- (C) the sterically allowed rotational angles between  $C_\alpha$  and the amide nitrogen ( $C_\alpha$ -N) as well as between  $C_\alpha$  and the amide carbonyl carbon ( $C_\alpha$ -CO).
- (D) the amino acid residues that form  $\alpha$ -helix,  $\beta$ -sheet, etc.
- (E) the sterically allowed rotational angles about the amide nitrogen (NH) and CO.

13. Which amino acid acts as a helix breaker due to its unique structure?

- (A) Arginine
- (B) Tyrosine
- (C) Histidine
- (D) Serine
- (E) Proline

14. Biological molecules denaturation will occur in all EXCEPT:

- (A) addition of strong acid or base
- (B) change in ionic strength
- (C) refrigeration
- (D) dramatic increase in temperature
- (E) none, all will denature biological macromolecules.

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15. Ribose is mainly produced by

- (A) Protein metabolism
- (B) Pentose phosphate pathway
- (C) Citric acid pathway
- (D) Oxidative phosphorylation
- (E) Glycolysis pathway

16. To synthesis one molecule of palmitate from acetyl-CoA and malonyl-CoA, how many electrons are involved?

- (A) 12
- (B) 16
- (C) 28
- (D) 32
- (E) 18

17. The driving force(s) for fatty acid biosynthesis from acetyl-CoA

- (A) ATP, carboxylation, decarboxylation
- (B) ATP, carboxylation, decarboxylation, NADH
- (C) ATP, NADPH, decarboxylation
- (D) ATP, NADH, carboxylation
- (E) ATP, carboxylation, decarboxylation, NADPH

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18. The driving force(s) for cholesterol biosynthesis from acetyl-CoA
- (A) ATP, NADH, carboxylation
  - (B) ATP, carboxylation, decarboxylation
  - (C) ATP, NADPH, decarboxylation
  - (D) ATP, NADH, carboxylation, decarboxylation, pyrophosphate hydrolysis
  - (E) ATP, NADPH, carboxylation, decarboxylation, pyrophosphate hydrolysis
19. The driving force(s) for inosine monophosphate biosynthesis from ribose5-P
- (A) ATP, NADPH, carboxylation, decarboxylation, pyrophosphate hydrolysis
  - (B) ATP, carboxylation, pyrophosphate hydrolysis
  - (C) ATP, NADPH, carboxylation, pyrophosphate hydrolysis
  - (D) ATP, NADPH, decarboxylation, pyrophosphate hydrolysis
  - (E) ATP, carboxylation, decarboxylation
20. Based on the chemical formulae of various membrane phospholipids. Which statement about charge character is true?
- (A) PC, PE negative, PS, PI neutral in charge
  - (B) PC, PE neutral, PS, PI negative in charge
  - (C) PC, PE positive, PS, PI neutral in charge
  - (D) PC positive, PE negative, PS, PI neutral in charge
  - (E) None of above

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21. About transaldolase and transketolase

- (A) Both transfer 1-carbon unit
- (B) Both transfer 2-carbon unit
- (C) Both transfer 4-carbon unit
- (D) Transaldolase transfer 2-carbon, transketolase transfer 3-carbon.
- (E) Transaldolase transfer 3-carbon, transketolase transfer 2-carbon.

22. Glycolysis is enhanced by

- (A) Fructose-1,6-bisphosphate
- (B) Glucose-1-phosphate
- (C) Fructose-2,6-bisphosphate
- (D) Glucose-6-phosphate and Fructose-1,6-bisphosphate
- (E) Fructose-1,6-bisphosphate and Fructose-2,6-bisphosphate

23. Which of the following chemicals is a substrate for the only membrane-bound enzyme complex in TCA cycle?

- (A) succinate,
- (B) malate,
- (C) citrate,
- (D) pyruvate,
- (E)  $\alpha$ -ketoglutarate.

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24. Succinyl-CoA of TCA cycle provides most of the carbon atoms in the biosynthesis of

- (A) fatty acids,
- (B) steroids,
- (C) porphyrins,
- (D) lysine,
- (E) cysteine.

25. The first reaction of glycolysis pathway is catalyzed by

- (A) hexokinase,
- (B) pyruvate kinase,
- (C) phosphoglucosomerase,
- (D) phosphofructokinase,
- (E) aldolase.

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26~30 題為簡答題 (每題 10 分)

26. What are allosteric control points in glycolysis? Please list the key involved enzymes.
27. 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?
28. What is the salvage pathway of purine? What reactions (substrates & products) are involved? What is the key enzyme in response to this process? What disease is caused by the deficient of this key enzyme? What is the outcome of the disease?
29. How the proton gradient formation in inter-membrane space of mitochondria? and how the gradient links to ATP formation?
30. The overall reaction of the pyruvate dehydrogenase can convert the acetyl group of pyruvate to CoASH. Which cofactors are involved in this reaction?