

94 學年度生命科學院甲組、乙組、結構生物學程甲組碩士班入學考試

科目生物化學 科目代碼 0801, 0901, 1101 共 4 頁第 1 頁 *請在試卷【答案卷】內作答

第一部份：選擇題 (30%) 每題一分，由(A)~(E)選擇，單選題，答錯不倒扣。必須寫在電腦閱卷卡

1. Which of the following molecules is directly involved in an enzymatic step which results in oxidation? (A) glyceraldehyde-3-phosphate (B) fructose-1,6-bisphosphate (C) glucose-6-phosphate (D) dihydroxyacetone phosphate (E) phosphoenolpyruvate.
2. Linoleic acid (1) has 16 carbons. (2) has 2 double bonds. (3) is an essential fatty acid. (4) has a double bond between carbon 12 and 13.
(A) 1, 2 and 3 are correct (B) 1, 3 and 4 are correct (C) 2, 3 and 4 are correct (D) only statement 3 is correct (E) all correct.
3. (1) acetyl CoA (2) thiamine pyrophosphate (3) NADH (4) insulin can cause an increase in the level of phosphorylation of pyruvate dehydrogenase complex.
(A) 1, 2 and 3 are correct (B) 1 and 3 are correct (C) 2 and 4 are correct (D) only statement 4 is correct (E) all incorrect.
4. A class of lipids that is not amphipathic molecules is: (A) cholesterol (B) phosphoglycerides (C) sphingolipids (D) triglyceride (E) glycolipids.
5. The pentose phosphate pathway serves as an important source of (1) NADPH (2) ATP (3) ribose-5-phosphate (4) glucose-6-phosphate
(A) 1, 2 and 3 are correct (B) 1 and 3 are correct (C) 2 and 4 are correct (D) only statement 3 is correct (E) all correct.
6. What is the pH of an aqueous solution that has a $[H^+]$ of $1.6 \times 10^{-4} M$? (A) 5.5 (B) 4.8 (C) 4.3 (D) 3.8 (E) 3.2.
7. Which of the following redox pair has the lowest standard reduction potential? (A) NADH/NAD⁺ (B) H₂O/O₂ (C) Fe⁺²/Fe⁺³ (D) FADH₂/FAD (E) lactate/pyruvate.
8. How many cysteine residues are involved in the complex of a Fe₂S₂ type iron-sulfur center? (A) 1 (B) 2 (C) 3 (D) 4 (E) 6.
9. The color of cytochrome proteins is (1) yellow (2) red (3) green (4) brown.
(A) 1 and 3 are correct (B) 2 and 4 are correct (C) 1 and 2 are correct (D) 3 and 4 are correct (E) all incorrect.
10. Under anaerobic conditions, working muscle carries out glycolysis resulting in ATP and lactic acid formation. The production of lactate is necessary due to limiting supplies of (A) NAD⁺ (B) NADH (C) ADP (D) ATP (E) glucose.
11. If carbon 1 is the carbonyl group of an aldohexose, which carbon determines if the sugar is a D- or L-stereoisomer? (A) 2 (B) 3 (C) 4 (D) 5 (E) 6.
12. Which subunit forms the H⁺ channel in F₀F₁-ATP synthase? (A) a (B) b (C) c (D) γ (E) β .
13. You find a lipid containing a fatty acyl chain and ceramide, so the lipid class that you assign this new lipid to is: (A) phosphoglycerides (B) sphingolipids (C) sterols (D) triacylglycerols (E) wax.
14. The number of chiral carbons in an aldopentose is: (A) 1 (B) 2 (C) 3 (D) 4 (E) 5.
15. Which enzyme is inhibited by glucose-6-phosphate? (A) glucokinase (B) hexokinase (C) phosphofructokinase (D) both A and B (E) both B and C.

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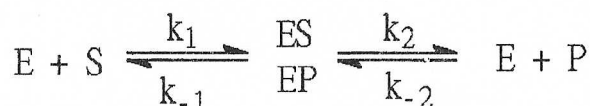
16. The cofactor that is required for the function of transketolase is (A) thiamine pyrophosphate (B) FAD (C) coenzyme A (D) biotin (E) lipoic acid.
17. The committed step in the citric acid cycle is catalyzed by (A) pyruvate dehydrogenase (B) α -ketoglutarate dehydrogenase (C) succinate dehydrogenase (D) citrate synthase (E) malate dehydrogenase.
18. All are true statements about ferredoxin EXCEPT: (A) an electron acceptor of photosystem I (B) a component of photosynthetic cyclic electron transport (C) contains Fe-S center (D) two-electron carrier (E) all are true.
19. Chlorophylls absorb light mainly at (1) 370 nm (2) 440 nm (3) 560 nm (4) 670 nm.
(A) 1 and 2 are correct (B) 2 and 3 are correct (C) 3 and 4 are correct (D) 1 and 3 are correct (E) 2 and 4 are correct.
20. Both cytochrome bc_1 complex of mitochondria and cytochrome b_6f complex (1) contain type c cytochrome (2) contain Fe-S center (3) accept electron from quinone (4) pump H^+ across membrane.
(A) 1, 2, and 3 are correct (B) 2, 3 and 4 are correct (C) 2 and 4 are correct (D) 2 and 3 are correct (E) all are true.
21. All are true statements about photorespiration EXCEPT: (A) ribulose-1,5-bisphosphate is lost from the Calvin cycle (B) O_2 is consumed and CO_2 is released (C) it involves chloroplast, peroxisome and mitochondria (D) all carbons leaving chloroplast are lost (E) ATP is expended.
22. Mobile carriers and channels can be distinguished based on their response to (A) pH (B) ionic strength (C) proton gradient (D) temperature (E) none of the above.
23. What cellular compartments become acidic during electron transport? (1) mitochondrial intermembrane space (2) mitochondrial matrix (3) chloroplast stroma (4) chloroplast lumen.
(A) 1 and 3 (B) 2 and 4 (C) 1 and 4 (D) 2 and 3 (E) none of the above.
24. Glycolysis, pyruvate oxidation and the citric acid cycle convert only a small portion of the energy of glucose to ATP. At this point, the majority of the usable energy is contained in (A) NADH and $FADH_2$ (B) pyruvate (C) acetyl-CoA (D) citrate (E) NAD^+ and FAD.
25. If the blood flowing to the heart muscle is interrupted during a heart attack, what would NOT happen to the heart muscle? (A) the production of lactic acid would increase (B) the use of glucose would decrease (C) the oxidative phosphorylation would slow down (D) NADH would accumulate in mitochondria (E) the production of water in mitochondria would be inhibited.
26. During photosynthesis, the conversion of light energy to chemical energy begins when an excited chlorophyll molecule (A) releases heat (B) undergoes oxidation (C) emits fluorescence (D) is transported across the thylakoid membrane (E) raises its temperature.
27. All are true statements about Na^+ , K^+ -pump EXCEPT: (A) it couples ATP hydrolysis to transport (B) it locates in the plasma membrane of cells (C) it pumps 3 Na^+ into and 2 K^+ out of the cell (D) it consists of large α subunits and smaller β subunit (E) it is inhibited by ouabain.
28. The enzyme that is under "dietary control" is (A) pyruvate kinase (B) phosphofructokinase (C) phosphoglycerate kinase (D) hexokinase (E) pyruvate dehydrogenase.
29. Which reaction(s) involve free radical reaction? (1) rhodopsin (2) lipoxygenase (3) rNADP reductase (4) coenzyme B_{12} (5) pyruvate decarboxylase. (A) (1) and (2) (B) (3) and (4) (C) (2) and (3) (D) only (1) (E) only (2).

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30. Prostaglandin family and derivatives can induce (1) smooth muscle contraction (2) smooth muscle relaxation (3) blood coagulation (4) anticoagulation (A) (1) and (2) (B) (3) and (4) (C) (2) and (3) (D) all of above (E) none of above.

第二部份：問答與計算 (70%)

1. What is transition state? Explain Pauling's transition state stabilization concept as applied to enzyme catalysis using thermodynamic box (cycle). (6%)



2. What is Haldane relationship? Give the expression and meaning of K_{eq} for the reversible enzyme reaction in terms of reaction rate constants and enzyme kinetic constants. (6%)

3. Describe substrate cycles in terms of ATP coupling coefficients and metabolic regulation. (6%)

4. Outline (words or symbols) the reaction cycle by which methionine is converted to S-adenosylmethionine (SAM), and methionine is regenerated by a pathway involving methyl transfer from N^5 -methyl-tetrahydrofolate. (6%)

5. Explain the effects of each of the following on the rates of glycolysis, gluconeogenesis and glycogen metabolism: (6%)

- Increasing the concentration of blood glucose
- Increasing the concentration of blood insulin
- Increasing the amount of blood glucagon

6. Describe how F_0F_1 -ATP synthase works as a rotary motor. (5%)

7. General knowledge (35%, 每題 5%)

- (1) You have heard of fatty liver. Although its cause is complicate, what goes wrong (in terms of biochemistry) for people with fatty liver? Have you ever heard of fatty brain or fatty kidney? Explain your answer. What is the biochemical basis? (5%)
- (2) Collagen is used extensively in commercial cosmetics. Manufacturers claimed that collagen has broad biochemical effects. How is collagen synthesized *in vivo*? What do you think about the usefulness of applying cosmetic collagen? (5%)
- (3) This is to test your laboratory experience. The centrifugal force is $\omega^2 r$. What is ω called? What is its unit? You performed an experiment at 50,000 RPM for one hour. Now if you change to 60,000 RPM, how long will it take? (5%)

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- (4) This is to test your laboratory experience. Under certain gel condition, the mobility of protein A (MW 5.0 KD) is 10.0 cm; protein B (MW 10.0 KD) is 7.5 cm. Assume a linear relationship, what is the molecular weight (in KD) if protein C has a mobility of 3.0 cm? Show your plot and calculation on answer sheet. Note $\sqrt{20} = 4.47$ and $\log 20 = 1.30$ (5%)
- (5) This is a simple general biochemistry. What causes UV-VIS absorption? Why glucose does not have UV-VIS spectrum? You can write quantum mechanical description. (5%)
- (6) This is a simple general biophysics. X-ray crystallography is one of the most powerful tools in studying the structure of macromolecules. Suppose the incident angle of x-ray is θ , the distance between adjacent lattice plane is d . Derive Bragg's law. (5%)
- (7) Based on your chemistry, draw the proton NMR spectrum of ethyl alcohol. (5%)