

國立成功大學

111學年度碩士班招生考試試題

編 號： 63

系 所： 熱帶植物與微生物科學研究所

科 目： 生物化學

日 期： 0220

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備 註： 不可使用計算機

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※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

**I. Select the best answer (60%) (每題 3 分)**

1. Aside from maintaining the integrity of its hereditary material, the most important general metabolic concern of a cell is:

- A) keeping its glucose levels high.
- B) maintaining a constant supply and concentration of ATP.
- C) preserving its ability to carry out oxidative phosphorylation.
- D) protecting its enzymes from rapid degradation.
- E) running all its major metabolic pathways at maximum efficiency.

2. A function of the glyoxylate cycle, in conjunction with the citric acid cycle, is to accomplish the:

- A) complete oxidation of acetyl-CoA to CO<sub>2</sub> plus reduced coenzymes.
- B) net conversion of lipid to carbohydrate.
- C) net synthesis of four-carbon dicarboxylic acids from acetyl-CoA.
- D) net synthesis of long-chain fatty acids from citric acid cycle intermediates.
- E) Both B and C are correct

3. The conversion of 1 mol of pyruvate to 3 mol of CO<sub>2</sub> via pyruvate dehydrogenase and the citric acid cycle also yields \_\_\_\_\_ mol of NADH, \_\_\_\_\_ mol of FADH<sub>2</sub>, and \_\_\_\_\_ mol of ATP (or GTP).

- A) 2; 2; 2
- B) 3; 1; 1
- C) 3; 2; 0
- D) 4; 1; 1
- E) 4; 2; 1

4. The conversion of palmitoyl-CoA (16:0) to myristoyl-CoA (14:0) and 1 mol of acetyl-CoA by the  $\beta$ -oxidation pathway results in the net formation of:

- A) 1 FADH<sub>2</sub> and 1 NADH.
- B) 1 FADH<sub>2</sub> and 1 NADPH.
- C) 1 FADH<sub>2</sub>, 1 NADH, and 1 ATP.
- D) 2 FADH<sub>2</sub> and 2 NADH.
- E) 2 FADH<sub>2</sub>, 2 NADH, and 1 ATP.

5. If an aerobic organism (for example, the bacterium *E. coli*) were fed each of the following four compounds as a source of energy, the energy yield per mole from these molecules would be in the order:

- A) alanine > glucose > palmitate (16:0).
- B) glucose > alanine > palmitate.
- C) glucose > palmitate > alanine.
- D) palmitate > alanine > glucose.
- E) palmitate > glucose > alanine.

6. In amino acid catabolism, the first reaction for many amino acids is a(n):

- A) decarboxylation requiring thiamine pyrophosphate (TPP).
  - B) hydroxylation requiring NADPH and O<sub>2</sub>.
  - C) oxidative deamination requiring NAD<sup>+</sup>.
  - D) reduction requiring pyridoxal phosphate (PLP).
  - E) transamination requiring pyridoxal phosphate (PLP).
7. Serine or cysteine may enter the citric acid cycle as acetyl-CoA after conversion to:
- A) oxaloacetate.
  - B) propionate.
  - C) pyruvate.
  - D) succinate.
  - E) succinyl-CoA.
8. Which one of the following statements about photophosphorylation is *false*?
- A) It can be uncoupled from electron flow by agents that dissipate the proton gradient.
  - B) The difference in pH between the luminal and stromal side of the thylakoid membrane is 3 pH units.
  - C) The luminal side of the thylakoid membrane has a higher pH than the stromal side.
  - D) The number of ATPs formed per oxygen molecule is about three.
  - E) The reaction centers, electron carriers, and ATP-forming enzymes are located in the thylakoid membrane.
9. The relative concentrations of ATP and ADP control the cellular rates of:
- A) glycolysis.
  - B) oxidative phosphorylation.
  - C) pyruvate oxidation.
  - D) the citric acid cycle.
  - E) all of the above.
10. In the carbon assimilation ("dark") reactions of photosynthesis, the biosynthesis of 1 mol of hexose from 6 mol of carbon dioxide requires:
- A) 12 mol of NADPH and 12 mol of ATP.
  - B) 12 mol of NADPH and 18 mol of ATP.
  - C) 18 mol of NADPH and 12 mol of ATP.
  - D) 18 mol of NADPH and 18 mol of ATP.
  - E) no NADPH and 12 mol of ATP.
11. The precursors for sucrose biosynthesis are:
- A) glucose and fructose.
  - B) UDP-glucose and fructose 6-phosphate.
  - C) UDP-fructose and glucose 6-phosphate.
  - D) UDP-glucose and fructose.
  - E) UDP-glucose and UDP-fructose.
12. Which of these compounds is *not* synthesized by a pathway that includes isoprene precursors?

- A) Natural rubber
  - B) Plastoquinone
  - C) Vitamin A
  - D) Vitamin B<sub>12</sub>
  - E) Vitamin K
13. Which of the following statements about the fixation of atmospheric nitrogen (N<sub>2</sub>) into NH<sub>3</sub> by living cells is *false*?
- A) It involves the transfer of 8 electrons per mol of N<sub>2</sub>.
  - B) It occurs in certain microorganisms, but not in humans.
  - C) It requires a source of electrons, normally ferredoxin.
  - D) It requires one ATP per mol of N<sub>2</sub> fixed.
  - E) It requires two key protein components, each containing iron.
14. The ABC excinuclease is essential in:
- A) base-excision repair.
  - B) methyl-directed repair.
  - C) mismatch repair.
  - D) nucleotide-excision repair.
  - E) SOS repair.
15. Which one of the following statements about mRNA stability is true?
- A) Degradation always proceeds in the 5' to 3' direction.
  - B) Degradation of mRNA by polynucleotide phosphorylase yields 5'-nucleoside monophosphates.
  - C) In general, bacterial mRNAs have longer half-lives than do eukaryotic mRNAs.
  - D) Rates of mRNA degradation are always at least ten-fold slower than rates of mRNA synthesis.
  - E) Secondary structure in mRNA (hairpins, for example) slows the rate of degradation.
16. Which statement about the cell cycle in eukaryotes is true?
- A) In S phase, the cells contain two copies of each chromosome, the normal diploid state of a cell
  - B) During G<sub>1</sub> phase, the DNA is replicated and form chromatin structures.
  - C) During cytokinesis, chromatids have been separated into two cells and the nuclear envelope reforms
  - D) During G<sub>2</sub> phase, the spindle forms and each chromosome aligns independently for separation
17. Amino acids are ampholytes because they can function as either a(n):
- A) neutral molecule or an ion.
  - B) polar or a nonpolar molecule.
  - C) standard or a nonstandard monomer in proteins.
  - D) acid or a base.
  - E) transparent or a light-absorbing compound.
18. There is reciprocal regulation of glycolytic and gluconeogenic reactions interconverting fructose-6-phosphate and fructose-1,6-bisphosphate. Which one of the following statements about this regulation is *not* correct?

- A) Fructose-2,6-bisphosphate activates phosphofructokinase-1.  
B) Fructose-2,6-bisphosphate inhibits fructose-1,6-bisphosphatase.  
C) The fructose-1,6-bisphosphatase reaction is exergonic.  
D) The phosphofructokinase-1 reaction is endergonic.  
E) This regulation allows control of the direction of net metabolite flow through the pathway.
19. The major component of cell membrane is the phospholipids bilayer. Therefore, the fluidity of cell membrane could be generally increased by:  
A) a decrease in temperature.  
B) an increase in fatty acyl chain length.  
C) an increase in the number of double bonds in fatty acids.  
D) an increase in the percentage of phosphatidyl ethanolamine  
E) the binding of water to the fatty acyl side chains.
20. In an equilibrium biochemical reaction of  $A+B \rightleftharpoons C+D$ ,  $dG = -10 \text{ kJ/mole}$  What will the final content in the reaction? A)  $A+B > C+D$  B)  $C+D > A+B$  C) only contain C and D D) only contain A and B

II.

Applying what you know 40%

1. Which enzyme is the first enzyme to fix atmospheric  $\text{CO}_2$  in C3 plants and C4 plants, respectively? (6%)
2. Please describe why light is essential for the dark reaction (Calvin cycle) of photosynthesis? (8%)
3. Please describe the similarities and differences between oxidative phosphorylation and photophosphorylation? (16%)
4. Describe three functions of triacylglycerols in mammals and one function in higher plants (10%)