

國立臺灣海洋大學 106學年度研究所碩士班招生考試試題

考試科目：生物化學

系所名稱：食品科學系碩士班生技組、食品科學系碩士班食科組

1. 答案以橫式由左至右書寫。2. 請依題號順序作答。

I. Multiple choices: (單選, 2 points for each)

1. All of the following functions of an enzyme are true **EXCEPT**:
 - a. Enzymes mediate the rates of cellular reaction in proportion to cellular requirements.
 - b. An increased activity of an enzyme increases the amount of energy produced.
 - c. Enzymes are sensitive to temperature, pH, and concentration changes.
 - d. Enzymes help to catalyze virtually every metabolic reaction.
 - e. Enzymes are used as a catalyst to increase reaction rates many orders of magnitude.
2. The amino acid with a side-chain pKa near neutrality and which therefore plays an important role as proton donor and acceptor in many enzyme catalyzed reactions is:
 - a. serine.
 - b. methionine.
 - c. proline.
 - d. histidine.
 - e. cysteine.
3. Which of the following is **NOT** a commonly used technique for protein isolation and purification?
 - a. electrophoresis.
 - b. ion exchange chromatography.
 - c. affinity chromatography.
 - d. solubility ("salting in" and "salting out").
 - e. gas-liquid chromatography.
4. Which of the following represents an example of a proteoglycan?
 - a. attachment of a small antigenic determinant to a membrane bound protein of a cell
 - b. attachment of a Gal- β (1,3)-GalNAc disaccharide to the fish antifreeze protein
 - c. attachment of several molecules of heparin to the peptide antithrombin III
 - d. attachment of a small oligosaccharide to an immunoglobulin
 - e. none of the above
5. Dietary essential fatty acids for humans include
 - a. linoleic and γ -linolenic acids.
 - b. palmitic and oleic acids.
 - c. γ -linolenic and oleic acids.
 - d. oleic and linoleic acids.
 - e. all are true.

6. Hydropathy plots for transport proteins are utilized to reveal:

- a. stretches of amino acid residues that make up hydrophobic regions, which may be directly associated with the lipid bilayer.
- b. amino acid residues which are hyper-reactive due to their location.
- c. amino acid residues which may be highly modified.
- d. amino acid residues which may be directly involved in facilitated transport.
- e. whether there is interaction between N-terminal and C-terminal amino acids.

7. All are necessary for restriction endonuclease mapping of DNA molecules **EXCEPT**:

- a. Hydrolysis with two or more endonucleases.
- b. Knowing where each endonuclease hydrolyzes.
- c. Electrophoresis of fragments.
- d. Determining the 5'- and/or 3'-ends of the molecule.
- e. All are true.

8. All are true for DNA polymerase **EXCEPT**:

- a. generates dsDNA from ssDNA.
- b. copies the sequence of nucleotides of one strand in a complementary fashion.
- c. synthesizes new strands by adding successive nucleotides in the 5'→3' direction.
- d. requires a primer with a free 5'-OH end, but the 3'-end may be phosphorylated.
- e. copies the sequence of nucleotides of one strand to form a new second strand.

9. For an enzyme-catalyzed reaction, the initial velocity was determined at two different concentrations of the substrate. Which of the following would be closest to the value of K_m ?

[S] (mM)	V_o (mM/min)
1.0	2.0
4.0	2.8

- a. 1.7 mM
- b. 0.6 mM
- c. 2.7 mM
- d. 0.17 mM
- e. 5.7 mM

10. Since both glycolysis and gluconeogenesis are spontaneous pathways, which of the following explains how this is **True**?

- a. glycolysis uses 10 enzyme catalyzed steps while gluconeogenesis uses 11
- b. glycolysis is catabolic while gluconeogenesis is anabolic
- c. the three irreversible steps of glycolysis have alternate routes for gluconeogenesis

- d. glycolysis is oxidative while gluconeogenesis is reductive
- e. glycolysis converts glucose to pyruvate while gluconeogenesis converts pyruvate to glucose

11. In alcohol fermentation from glucose, the two oxidation-reduction reactions are catalyzed by:

- a. glyceraldehyde-3-phosphate dehydrogenase and lactate dehydrogenase
- b. glyceraldehyde-3-phosphate dehydrogenase and pyruvate decarboxylase
- c. glyceraldehyde-3-phosphate dehydrogenase and alcohol dehydrogenase
- d. lactate dehydrogenase and pyruvate decarboxylase
- e. alcohol dehydrogenase and pyruvate decarboxylase

12. ATP made in glycolysis and the TCA cycle is the result of ____ phosphorylation, and NADH-dependent ATP synthesis is the result of ____ phosphorylation.

- a. substrate-level; oxidative
- b. substrate-level; electron
- c. oxidative; electron
- d. oxidative; substrate-level
- e. proton-gradient; oxidative

13. Which of the following **Correctly** describes the sequence of events for the conversion of a fatty acid to CO₂?

- a. TCA cycle, activation to acyl CoA, carnitine shuttle, β -oxidation
- b. TCA cycle, activation to acyl CoA, β -oxidation, carnitine shuttle
- c. carnitine shuttle, activation to acyl CoA, β -oxidation, TCA cycle
- d. activation to acyl CoA, β -oxidation, carnitine shuttle, TCA cycle
- e. activation to acyl CoA, carnitine shuttle, β -oxidation, TCA cycle

14. All occur during DNA replication in E. coli EXCEPT:

- a. helicase unwinds dsDNA at the replication fork.
- b. primase (DnaG) binds to a GC rich region of dsDNA in oriC.
- c. DNA polymerase I hydrolyzes RNA from the 5' ends of Okazaki fragments.
- d. DNA ligase catalyzes the formation of phosphoester bonds on the lagging strand.
- e. all are true.

15. The appropriate sequence for ubiquitination of proteins to be degraded is:

- A. multiple ubiquitinations may occur on a protein substrate,
- B. ubiquitin-protein ligase (E3) transfers ubiquitin to free amino groups on the protein,

- C. E3 selects a protein for degradation by the nature of the N-terminal amino acid,
- D. ubiquitin-carrier protein (E2) picks up ubiquitin,
- E. ubiquitin-activating enzyme (E1) attaches via ATP-dependent formation of thioester bond to C-termini of ubiquitin,

- a. C, E, D, B, A
- b. E, D, A, B, C
- c. D, E, C, A, B
- d. E, D, C, B, A
- e. A, C, B, D, E

II. Fill in questions: (填空, 2 points for each) 10分

1. Glutamic acid has pKa values of 2.2, 4.3 and 9.7. The isoelectric point of glutamic acid is ____.
2. Biochemists define the group transfer potential as the ____ that occurs upon hydrolysis (i.e., transfer of the particular group to water).
3. A common reaction of two cysteine residues in proteins results in the formation of ____.
4. ____ are attached to hnRNAs and mRNAs after transcription has been completed and is essential for efficient translation and stability of the mRNAs.
5. The correct sequence of procedures in the Southern blotting (hybridization) technique is ____.
 - a. hybridization with radioactive probe.
 - b. agarose gel electrophoresis and visualize bands.
 - c. transfer (blot) to nitrocellulose filter.
 - d. digest DNA with restriction nucleases.
 - e. expose filter to X-ray film, develop and observe.

III. Please briefly translate the following short paper and give your comments. (翻譯及讀後心得, 10 points)

Free fatty acids (FFAs) are important substrates for mitochondrial oxidative metabolism and ATP synthesis but also cause serious stress to various tissues, contributing to the development of metabolic diseases. CD36 is a major mediator of cellular FFA uptake. Inside the cell, saturated FFAs are able to induce the production of cytosolic and mitochondrial reactive oxygen species (ROS), which can be prevented by co-exposure to unsaturated FFAs. There are close connections between oxidative stress and organellar Ca^{2+} homeostasis. Highly oxidative conditions induced by palmitate trigger aberrant endoplasmic reticulum (ER) Ca^{2+} release and thereby deplete ER Ca^{2+} stores. The resulting ER Ca^{2+} deficiency impairs chaperones of the protein folding machinery, leading to the accumulation of misfolded proteins. This ER stress may further aggravate oxidative stress by augmenting ER ROS production. Secondary to ER Ca^{2+} release, cytosolic and mitochondrial matrix Ca^{2+} concentrations can also be altered. In addition, plasmalemmal ion channels operated by ER Ca^{2+} depletion mediate persistent Ca^{2+} influx, further impairing cytosolic and mitochondrial Ca^{2+} homeostasis. Mitochondrial Ca^{2+} overload causes superoxide production and functional impairment, culminating in apoptosis. This vicious cycle of lipotoxicity occurs in multiple tissues, resulting in β -cell failure and insulin resistance in target tissues, and further aggravates diabetic complications.

IV. Choice questions (Please choose ONE appropriate answer, 2 points for each) (20.5)

1. Transamination of pyruvate with glutamate as amino donor gives:
 - A. aspartate
 - B. alanine
 - C. serine
 - D. cysteine
 - E. valine
2. Glutamate synthase (GOGAT) catalyzes the reaction _____ + _____ + _____ \rightarrow 2 glutamate + NADP⁺
 - A. glutamate; α -ketoglutarate; NADH
 - B. glutamyl-phosphate; glutamine; NADPH
 - C. N-acetylglutamate; α -ketoglutarate; NADH
 - D. α -ketoglutarate; NADPH; glutamine
 - E. none are true
3. Usually the quickest method of influencing an enzymatic activity is by:
 - A. enzyme induction
 - B. enzyme destruction
 - C. allosteric regulation
 - D. activation of a zymogen
 - E. covalent modification
4. Which of the following set of pathways is similar between plants and animals?
 - I. electron transport and the dark reactions of photosynthesis
 - II. electron transport and the light reactions of photosynthesis
 - III. the Hatch-Slack pathway (C-4) and pyruvate carboxylase
 - A. I only
 - B. II only
 - C. III only
 - D. I, II
 - E. II, III
5. All are important reasons to phosphorylate glucose in the first step of glycolysis EXCEPT:
 - A. the large positive free energy is important in getting the pathway started.
 - B. glucose-6-phosphate has a negative charge preventing transport out of the cell.
 - C. the concentration of free glucose in the cell is lowered favoring influx of glucose.
 - D. phosphorylation keeps the glucose in the cell.
 - E. regulatory control can be imposed only at a reaction not at equilibrium.

6. All of the following are characteristic of the coupling between glycolysis and the citric acid cycle EXCEPT:
- glycolysis feeds acetyl-CoA, via pyruvate, to the citric acid cycle.
 - citrate inhibits glucokinase to regulate glycolysis.
 - citrate builds up when citric acid cycle reaches saturation.
 - citric acid cycle directs electrons into electron transport chain for the purpose of ATP production.
 - ATP production via citric acid cycle, electron transport, and oxidative phosphorylation inhibits glycolysis.
7. Many of the enzymes of the Calvin cycle are also involved in _____ and _____; however, the glyceraldehyde-3-phosphate dehydrogenase of the Calvin cycle is specific for _____.
- fatty acid synthesis, gluconeogenesis; NADPH
 - citric acid cycle; pentose phosphate pathway; NADH
 - glycolysis; β -oxidation; FADH_2
 - glycolysis; pentose phosphate pathway; NADPH
 - none of the above
8. In the Cori cycle, the liver _____ because it has a typically high _____.
- shares the load of exercising muscle; acetate level
 - converts lactate to lactose; galactose
 - shares the load of exercising muscle; NAD^+/NADH ratio
 - burns fat; ATP
 - converts glucose to lactate; NAD^+/NADH ratio
9. When acetyl-CoA levels exceed the _____ supply, allosteric activation of _____ by _____ raises the oxaloacetate (OAA) levels for condensation with acetyl-CoA to form _____.
- Acetyl-CoA; pyruvate carboxylase; citrate; acetyl-CoA
 - citrate; citrate synthase; acetyl-CoA; citrate
 - OAA; citrate synthase; acetyl-CoA; isocitrate
 - malate; malate dehydrogenase; ATP; citrate
 - OAA; pyruvate carboxylase; acetyl-CoA; citrate
10. The correct sequence for the hormone-activated enzymatic cascade that leads to activation of glycogen phosphorylase is:
- Phosphorylation to active phosphorylase kinase
 - Activation of G-protein

- c. Activation of adenylyl cyclase to produce cAMP
- d. Phosphorylation of glycogen phosphorylase
- e. cAMP activation of protein kinase A (PKA)

- A. b, c, e, a, d
- B. b, d, e, a, c
- C. c, b, a, d, e
- D. c, b, e, a, d
- E. a, b, c, d, e

V. Question

1. What is reciprocal regulation of gluconeogenesis and glycolysis? (10 points)
2. Please explain the connecting links between the urea cycle and the TCA cycle. (5 points)

VI. Paper reading

1. 以下摘要請翻譯中文 (10 points)

A fermented milk beverage containing *Lactobacillus paracasei* 01 at 3×10^8 CFU/mL was made from skim milk powder, glucose, sucrose and isomaltooligosaccharide. Results indicated that *L. paracasei* 01 fermented milk beverage could reduce macromolecule permeability caused by dextran sodium sulfate-induced damage. Besides, 50 mL/L fermented milk beverage with live *L. paracasei* 01 in the cell medium could increase intestinal epithelial cell Caco-2 growth, decrease lipopolysaccharide/tumor necrosis factor- α (TNF- α)/interferon- γ (IFN- γ)-induced Caco-2 cell death and chemokine CCL-20 production. The protecting mechanisms involve promoting intestinal epithelial cell growth and intestinal epithelial integrity to strengthen the intestinal barrier against chemical and inflammatory stimuli-induced damage. Inhibition of inflammatory cytokines and chemokine such as IFN- γ , TNF- α and CCL-20 also contributes to the beneficial effects of this product on epithelial function.

2. 請依據上題摘要內容制定標題 (中文或英文皆可, 20字以內) (5 points)