

※ 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 points):

1. 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 G1 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 G2 phase, the spindle forms and each chromosome aligns independently for separation

2. 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.

3. 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.

4. 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.

5. In an equilibrium biochemical reaction of $A+B \leftrightarrow C+D$, $dG = -10 \text{ kJ/mole}$ 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

6. Which of the following can classified as a dehydration reaction?

- A) phosphodiester bond formation in RNA
- B) phosphodiester bond formation in rRNA
- C) peptide bond formation
- D) phosphodiester bond formation in mRNA
- E) all of the choices are correct

7. Which of the following is **NOT** a technique that can be used to study protein-protein interactions?

- A) 2-D gel electrophoresis
- B) protein microarrays
- C) immunoaffinity chromatography
- D) phage display
- E) yeast two-hybrid analysis

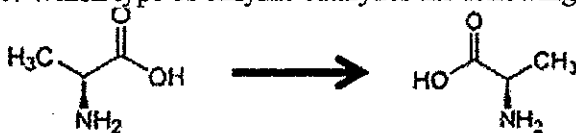
8. The $pK_1(\alpha\text{-COOH})$, $pK_2(\alpha\text{-NH}_3^+)$, and $pK_R(\text{side chain})$ of Glu are 2.10, 9.47, 4.07, respectively. What is the PI of Glu?

- A) 5.21
- B) 5.79
- C) 3.09
- D) 6.77
- E) 6.17

9. Which of the following pairs of sugars are epimers of each other?

- A) D-ribose and D-ribulose
- B) D-sorbose and D-fructose
- C) D-fructose and L-fructose
- D) D-arabinose and D-ribose
- E) None of above

10. Which type of enzyme catalyzes the following reactions?



- A) isomerase
- B) lyase
- C) oxidoreductase
- D) Ligase
- E) polymerase

11. Which of the following compound is the first compound generated by CAM plants after CO₂ fixation

- A. 3-phosphoglycerate
- B. phosphoenolpyruvate
- C. malate
- D. ribulose-1,5-bisphosphate
- E. oxaloacetate

12. Which element is important for oxygen evolving in photosynthesis?

- A. Ca
- B. Fe
- C. Zn
- D. Mn
- E. Cu

13. Which statement about nitrogen fixation is wrong?

- A. uses ferredoxin as electron donor
- B. is a hydrogen generated reaction
- C. sensitive to oxygen
- D. fixes atmospheric nitrogen into nitrate
- E. is a high energy-consuming process

14. Which enzyme in photosynthesis is not regulated by light?

- A. rubisco
- B. fructose-1,6-bisphosphatase
- C. sedoheptulose-1,7-bisphosphatase
- D. aldolase
- E. ribulose-5-phosphate kinase

15. Which enzyme is the marker enzyme of microbodies?

- A. malate synthase
- B. isocitrate lyase
- C. peroxidase
- D. catalase
- E. superoxide dismutase

II. Extended Matching Questions (20 points)

1. Match the enzyme(s) involved in the biosynthesis of plant hormone:

- | | |
|--------------------------------|--|
| A). ACC oxidase | H). Rubisco |
| B). Zeatin isomerase | I). α -amylase |
| C). GA 20-oxidase | J). Isopentenyl transferase (ipt) gene |
| D). Tryptophan synthases | K). 9-cis-epoxycarotenoid dioxygenase (NCED) |
| E). β -galactosidase | L). <i>iaaH</i> and <i>iaaM</i> synthase genes |
| F). Salicylate hydroxylase | M). GA 3-oxidase |
| G). zeaxanthin epoxidase (ZEP) | N). ACC synthase |

Q1. Enzymes involved in auxin biosynthesis (2 points)

Q2. Enzymes involved in cytokinin biosynthesis. (2 points)

Q3. Enzymes involved in gibberellin (GA) biosynthesis. (2 points)

Q4. Enzymes involved in abscisic acid (ABA) biosynthesis. (2 points)

Q5. Enzymes involved in ethylene biosynthesis. (2 points)

2. A). Methyl jasmonate
B). Salicylic acid
C). Strigolactone
D). Gibberellin (GA)
E). Kinetin-Cytokinin

Q1. Hormone discovered from herring sperm DNA (1 point)

Q2. Hormone discovered from *Striga*. (1 point)

Q3. Hormone discovered from Jasmine. (1 point)

Q4. Hormone discovered from Willow. (1 point)

Q5. Hormone discovered from rice. (1 point)

3. A). DELLA
 B). CTR
 C). Aux/IAA
 D). PP2C phosphatase
 E). JAZ

Q1. Repressor protein is degraded by 26 proteasome during Auxin signaling (1 point)

Q2. Repressor protein is inactivated during abscisic acid (ABA) signaling (1 point)

Q3. Repressor protein is degraded by 26 proteasome during Gibberellin (GA) signaling (1 point)

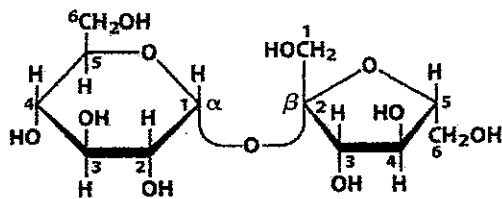
Q4. Repressor protein is inactivated during ethylene signaling (1 point)

Q5. Repressor protein is degraded by 26 proteasome during jasmonic acid (JA) signaling (1 point)

III. Applying what you known (20 points):

1. Describe three functions of triacylglycerols in mammals and one function in higher plants (10 points).

2. In the following structure:



- (a) How many of the monosaccharide units are glucose and how many are fructose? (b) What is the linkage between the two monosaccharide units? (c) Is this a reducing sugar? Explain (10 points).