Part I 單選題，每題兩分，請於試卷內之「選擇題作答區」依序作答。

1. The BLOSUM scoring matrix gives a measure of how conservative a mutation is. The matrix is often used to perform sequence alignment of homologous proteins. For substitutions of glutamic acid (E), which of the following orderings correctly places the amino acids from most conservative to least conservative?
   a. K, L, A, C, D, S
   b. D, S, K, A, C, L
   c. L, C, A, K, S, D
   d. A, C, D, K, L, S

2. The least restricted ϕ and ψ angles are found in polypeptides in which class of secondary structure?
   a. right-handed α helix
   b. β sheet
   c. left-handed α helix
   d. loop

3. In most carbohydrate monomers, the ratio of carbon:hydrogen:oxygen is
   a. 1:2:2
   b. 2:2:1
   c. 1:2:1
   d. 1:1:2
   e. 6:2:6

4. Which of the following is not a stabilizing force for the structure and stability of double-stranded nucleic acids?
   a. base stacking
   b. hydrogen bonding
   c. disulfide bonds
   d. electrostatic forces

5. Which equation defines a system at equilibrium?
   a. $\Delta G > 0$
   b. $\Delta G^\circ = \Delta G$
   c. $\Delta G = 0$
   d. $\Delta G^\circ = 0$
   e. $\Delta G = RT \ln$ ([products]/[reactants])

6. Which of the following statements about ATP is NOT true?
   a. It is used for short-term energy in the cell.
   b. It has two phosphoanhydride bonds.
   c. The reason for the large $-\Delta G^\circ$ values of hydrolysis reactions is due to stabilization of products.
   d. ATP is usually complexed with Mn2+.
   e. ATP is a kinetically stable molecule.

7. Which of the listed amino acids is classified as a basic amino acid?
   a. leucine
   b. phenylalanine
   c. aspartate
   d. asparagine
   e. lysine

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8. All of the information necessary for folding the peptide chain into its "native" structure is contained in the ____ of the peptide.
   a. amino acid sequence
   b. amino acid composition
   c. configuration
   d. amino acid side chain charges
   e. all are true

9. Membranes with unsaturated fatty acids in their components are more flexible and fluid because:
   a. Unsaturated fatty acids pack closely together to form ordered arrays.
   b. Unsaturated fatty acids bend at the double bond preventing close packing.
   c. Saturated fatty acids have a "kink" that produces more fluid aggregates.
   d. Unsaturated fatty acids have cis double bonds that prevent formation of the "kink."
   e. All of the above are correct.

10. In passive diffusion, the transported species moves across the membrane in the ____ favored direction ____.
   a. kinetically; using a transport protein
   b. kinetically; without a specific transport system/molecule
   c. thermodynamically; using a transport protein
   d. thermodynamically; without a specific transport system/molecule
   e. none of the above.

Part II 問答題，分數標示於各題，**請於試卷內之「非選擇題作答區」標明題號依序作答。**

11. Interactions between biomolecules are essential to the biochemical reactions in the living organisms. Common interactions include protein-ligand, DNA-protein, protein-protein, enzyme-substrate. Please answer the following questions. You may need to discuss each different biomolecule complexes for each questions. **(10 points)**
    a. How these different biomolecule complexes recognize to each other using forces/bonds?
    b. How to study these interactions by different experiments?
    c. What are their physiological roles? (name a few examples for each complex)

12. Solubility of hormones can be related to the cellular localization of their receptors, namely membrane-bound receptor or nuclear receptor. Please use two hormones, insulin (water-soluble) and estrogen (more hydrophobic) to discuss this issue. **(10 points)**

13. Please compare the chemical/structural properties of DNA and RNA. These differences are highly related to their physiological roles, please discuss this. Also please describe the latest advancement of DNA or RNA research fields **(10 points).**

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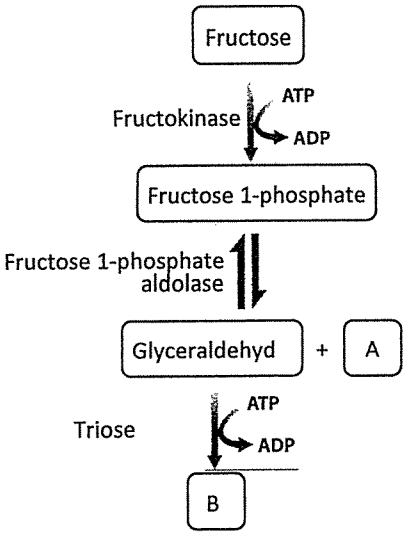
14. High fructose corn syrup (HFCS) has been used as a replacement for sucrose in the food industry. HFCS is produced by milling corn to produce corn starch, then processing that starch to yield corn syrup, which is almost entirely glucose, and then adding enzymes that change some of the glucose into fructose. **(total 12 points)**

(1) **(2 points)** How do glucose molecules join together to form starch?

(2) **(2 points)** Is fructose classified as a ketose or an aldose? Why? Please draw the open-chain form of fructose and explain.

(3) **(2 points)** Health concerns have been raised about HFCS. A molecule of glucose has the same caloric value as a molecule of fructose. However, fructose is almost exclusively metabolized in the liver by the following reactions to enter glycolysis. What are the compound A and B in the following reactions?



(4) **(6 points)** In the liver, fructose bypasses the two highly regulated steps of glycolysis, raising questions about its individual role in obesity and metabolic syndrome. What are the enzymes that catalyze these two regulatory steps which fructose bypasses? Which enzyme is the most important control element in glycolysis and how is it regulated in liver?

15. Glucose is an important energy source in virtually all life forms. A typical human adult uses about 160 g of glucose per day. **(total 12 points)**

(1) **(3 points)** In addition to circulating glucose (blood glucose), what is the available reserve of glucose in human body? How dose it supply glucose?

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(2) **(3 points)** After the reserve has been depleted during starvation, how would the body obtain more glucose?

(3) **(6 points)** When muscle proteins are catabolized in skeletal muscle during a fast, what are the fates of these amino acids?

16. The Nobel Prize in Chemistry 1997 was divided, one half jointly to Paul Boyer and John Walker for their elucidation of the enzymatic mechanism underlying the synthesis of adenosine triphosphate. **(total 12 points)**

(1) **(4 points)** Describe two major functions of adenosine triphosphate in cell metabolism.

(2) **(4 points)** Describe the binding-change mechanism they proposed.

(3) **(4 points)** If you isolate mitochondria and place them in buffer with a low pH, would they begin to manufacture adenosine triphosphate? Please explain the basis for your answer.

17. Some researchers have proposed that photosystem II (PSII) is the most important enzyme system in the history of life. Do you agree with them? Please explain the basis for your answer. **(4 points)**

18. Please draw the pyrimidine ring structure and indicate the metabolic origin of the atoms in the ring. **(4 points)**

19. (6 points) How might increased synthesis of aspartate and glutamate affect energy production in a cell? How would the cell respond to such effect?

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