

# 國立屏東教育大學 103 學年度研究所碩士班入學考試

## 生物化學 試題

(應用化學系碩士班)

※請注意：1.本試題共四頁。

2.答案須寫在答案卷上，否則不予計分。

### 一、單選題 (每題 2 分，共 30 分)

1. For amino acids with neutral R groups, at any pH below the pI of the amino acid, the population of amino acids in solution will have:  
(A) a net negative charge.  
(B) a net positive charge.  
(C) no charged groups.  
(D) no net charge.  
(E) positive and negative charges in equal concentration.
2. Which of the following is correct with respect to the amino acid composition of proteins?  
(A) Larger proteins have a more uniform distribution of amino acids than smaller proteins.  
(B) Proteins contain at least one each of the 20 different standard amino acids.  
(C) Proteins with different functions usually differ significantly in their amino acid composition.  
(D) Proteins with the same molecular weight have the same amino acid composition.  
(E) The average molecular weight of an amino acid in a protein increases with the size of the protein.
3. Even when a gene is available and its sequence of nucleotides is known, chemical studies of the protein are still required to determine:  
(A) molecular weight of the protein.  
(B) the amino-terminal amino acid.  
(C) the location of disulfide bonds.  
(D) the number of amino acids in the protein.  
(E) whether the protein has the amino acid methionine in its sequence.
4. A *true* statement about hydrophobic interactions is that they:  
(A) are the driving force in the formation of micelles of amphipathic compounds in water.  
(B) do not contribute to the structure of water-soluble proteins.  
(C) have bonding energies of approximately 20–40 Kjoule per mole.  
(D) involve the ability of water to denature proteins.  
(E) primarily involve the effect of polar solutes on the entropy of aqueous systems.

5. Phosphoric acid is tribasic, with  $pK_a$ 's of 2.14, 6.86, and 12.4. The ionic form that predominates at pH 3.2 is:
- (A)  $H_3PO_4$ .
  - (B)  $H_2PO_4^-$ .
  - (C)  $HPO_4^{2-}$ .
  - (D)  $PO_4^{3-}$ .
  - (E) none of the above.
6. The most important contribution to the stability of a protein's conformation appears to be the:
- (A) entropy increase from the decrease in ordered water molecules forming a solvent shell around it.
  - (B) maximum entropy increase from ionic interactions between the ionized amino acids in a protein.
  - (C) sum of free energies of formation of many weak interactions among the hundreds of amino acids in a protein.
  - (D) sum of free energies of formation of many weak interactions between its polar amino acids and surrounding water.
  - (E) stabilizing effect of hydrogen bonding between the carbonyl group of one peptide bond and the amino group of another.
7. Which statement about intrinsically disordered proteins is *true*?
- (A) They contain small hydrophobic cores.
  - (B) They represent misfolded conformations of cellular proteins.
  - (C) They have no stable three-dimensional structure and therefore have no cellular function.
  - (D) They are responsible for proteostasis.
  - (E) They can interact with multiple protein-binding partners and are central to protein interaction networks.
8. Thr and/or Leu residues tend to disrupt an  $\alpha$  helix when they occur next to each other in a protein because:
- (A) an amino acids like Thr is highly hydrophobic.
  - (B) covalent interactions may occur between the Thr side chains.
  - (C) electrostatic repulsion occurs between the Thr side chains.
  - (D) steric hindrance occurs between the bulky Thr side chains.
  - (E) the R group of Thr can form a hydrogen bond.
9. An  $\alpha$  helix would be destabilized most by:
- (A) an electric dipole spanning several peptide bonds throughout the  $\alpha$  helix.
  - (B) interactions between neighboring Asp and Arg residues.
  - (C) interactions between two adjacent hydrophobic Val residues.
  - (D) the presence of an Arg residue near the carboxyl terminus of the  $\alpha$  helix.
  - (E) the presence of two Lys residues near the amino terminus of the  $\alpha$  helix.

10. A sequence of amino acids in a certain protein is found to be -Ser-Gly-Pro-Gly-. The sequence is most probably part of a(n):
- (A) antiparallel  $\beta$  sheet.
  - (B) parallel  $\beta$  sheet.
  - (C)  $\alpha$  helix.
  - (D)  $\alpha$  sheet.
  - (E)  $\beta$  turn.
11. Which of the following is *not* correct concerning 2,3-bisphosphoglycerate (BPG)?
- (A) It binds at a distance from the heme groups of hemoglobin.
  - (B) It binds with lower affinity to fetal hemoglobin than to adult hemoglobin.
  - (C) It increases the affinity of hemoglobin for oxygen.
  - (D) It is an allosteric modulator.
  - (E) It is normally found associated with the hemoglobin extracted from red blood cells.
12. Carbon monoxide (CO) is toxic to humans because:
- (A) it binds to myoglobin and causes it to denature.
  - (B) it is rapidly converted to toxic  $\text{CO}_2$ .
  - (C) it binds to the globin portion of hemoglobin and prevents the binding of  $\text{O}_2$ .
  - (D) it binds to the Fe in hemoglobin and prevents the binding of  $\text{O}_2$ .
  - (E) it binds to the heme portion of hemoglobin and causes heme to unbind from hemoglobin.
13. The steady state assumption, as applied to enzyme kinetics, implies:
- (A)  $K_m = K_s$ .
  - (B) the enzyme is regulated.
  - (C) the ES complex is formed and broken down at equivalent rates.
  - (D) the  $K_m$  is equivalent to the cellular substrate concentration.
  - (E) the maximum velocity occurs when the enzyme is saturated.
14. The following data were obtained in a study of an enzyme known to follow Michaelis-Menten kinetics:

$V_0$ ( $\mu\text{mol}/\text{min}$ )	Substrate added ( $\text{mmol}/\text{L}$ )
217	0.8
325	2
433	4
488	6
647	1,000

The  $K_m$  for this enzyme is approximately:

- (A) 1 mM.
- (B) 1000 mM.
- (C) 2 mM.
- (D) 4 mM.
- (E) 6 mM.

15. Following complete hydrolysis of a sample of glycogen and a sample of cellulose, which of the following must be *true*?
- (A) The glycogen sample is more soluble than the cellulose sample.
  - (B) The cellulose sample is more soluble than the glycogen sample.
  - (C) Both samples consist of a mixture of  $\alpha$ -D-glucose and  $\beta$ -D-glucose.
  - (D) The glycogen sample has a higher ratio of  $\alpha$ -D-glucose than the cellulose sample.
  - (E) The cellulose sample contains only  $\beta$ -D-glucose.

## 二、問答題 (共 70 分)

- (一) Why do smaller molecules elute after large molecules when a mixture of proteins is passed through a size-exclusion (gel filtration) column? (15%)
- (二) Explain how each of the following is used in cloning in a plasmid:  
(a) antibiotic-resistance genes; (b) origin of replication; (c) polylinker region. (15%)
- (三) What are Southern blot, Northern blot and Western blot? What can they tell you from each experimental data? (20%)
- (四) In measuring long-term glucose levels in the bloodstream, glycosylated hemoglobin must be separated from unmodified hemoglobin to determine the percentage of glycosylated hemoglobin. Suggest a simple chromatographic method by which this separation can be performed. (5%)
- (五) Describe the dependence of the melting point of a fatty acid upon (a) chain length and (b) unsaturation; (c) explain these dependencies in molecular terms. (5%)
- (六) Reagents A and B both react covalently with primary amino groups such as those of phosphatidylethanolamine. Reagent A permeates erythrocytes, but reagent B is impermeant. Both A and B are available in radioisotopically labeled form. Describe a simple experiment by which you might determine whether the phosphatidylethanolamine of erythrocyte membranes is located in the outside face of the lipid bilayer, the inside face, or in both. (10%)