

※ 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。

一、選擇題，每題 5 分，共 20 分。

1. The pH of a solution made by mixing 200 ml of 0.100 M ammonium with 100 ml of 0.10 M HCl is:
pH (a) 11.1 (b) 10.3 (c) 9.4 (d) 5.5

2. All are true about hydrophobic interactions EXCEPT:
 - (a) Hydrophobic interactions result from the strong tendency of water to exclude nonpolar groups or molecules.
 - (b) The preferential interactions between water molecules “exclude” hydrophobic substances from aqueous solution and drive nonpolar molecules to cluster together.
 - (c) Hydrophobic interaction result in nonpolar regions of biological molecules being buried in the molecule’s interior to exclude them from the aqueous environment.
 - (d) Hydrophobic interactions result from hydrogen bonds between water molecules and the hydrophobic molecules.

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

4. $pH = pK_a$ when:
 - (a) $[A^-] = [HA]$
 - (b) $[A^-]/[HA] = 0$
 - (c) $\log([A^-]/[HA]) = 1$
 - (d) $[A^-] \gg [HA]$
 - (e) $\log([HA]/[A^-]) = 1$

(背後仍有題目，請繼續作答)

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二、是非題。若是，請填寫“T”，若非，請填寫“F”，每題 3 分，共 30 分。

1. The transport of HCO_3^- across the plasma membrane of a red blood cell requires Na^+ ions.
2. The K_m and V_{\max} of an enzyme are both independent of enzyme concentration.
3. Allosteric enzymes are very common in nature. The models used to explain their S-shaped v_0 vs. $[S]$ curves are called the “sequential” or “concerted” models.
4. The best protein purification technique is isoelectric focusing.
5. In a protein purification table, each step in the purification should show an increase in enzyme specific activity.
6. The Sanger method of identifying the N-terminal amino acid would work if the ether extraction step was done using 1 M NaOH instead of 1 M HCl.
7. Dr. Levinthal showed through calculations that proteins fold in a random manner.
8. An enzyme catalyzed reaction is assayed at 10 μM S. If the enzyme is re-assayed at 20 μM S, the recorded initial velocity will be twice as great.
9. One way for human to adapt to high altitude, in order to deliver more oxygen to his (her) tissues, is to decrease the concentration of BPG in one's red blood cells.
10. Proline will not react with Sanger's reagent.

三、填入適當答案 (7 分)

Fill in the blanks with the one-letter code of each amino acid that answers the question. A question may have more than one correct answer. No partial credit for each question.

- (a) Side chain has an asymmetric carbon in it: _____
- (b) Hydrophobic side chain consisting of 3 reduced carbons: _____
- (c) Amide in the side chain: _____
- (d) Sulfur atom in the side chain: _____
- (e) Side chain absorbs ultraviolet light: _____
- (f) Side chain is a H-bond donor at pH 12.5: _____
- (g) Amino acid does not exist in L or D form: _____

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四、回答下列問題 (33 分)

1. Write a brief definition of these terms: (4 pts)

- Primary structure
- Secondary structure
- Tertiary structure
- Quaternary structure

2. What is the structural effect of Proline in an alpha helix? (3 pts)

3. The coat for Tobacco Mosaic Virus (TMV) is made up of 2000 identical subunits of a 158 amino acid protein. Why does this structural arrangement lead to an economy of genetic material? The answer should look something like “The TMV genetic material is this way instead of that way.” Make a calculation to support your statement. (5 pts)

4. You are purifying a 40 kDa protein. In a previous experiment it was bound to a cation exchange resin and eluted between 300 and 350 mM NaCl. You have at your disposal a cation exchange column, an anion exchange column, and two gel filtration (= size exclusion) columns filled with beads with size cutoffs at 20 and 60 kDa, respectively. How would you use one of these to lower the salt concentration of your protein solution? (5 pts)

5. HEPES is a commonly used ‘Good’ buffer with a pKa of 7.5. It is fully protonated as a powder, and makes an acidic solution if not titrated with OH⁻. What pH results from the addition of 25 mmoles of NaOH to a 2.0 liter solution of 25 mM HEPES? (5 pts)

6. What pH results from adding 7 g KOH (MW = 56 g/mol) to 4 liters of 25 mM HCl? [Note: log5 = 0.7]
SHOW YOUR CALCULATIONS AND REASONING FOR FULL CREDIT. (5 pts)

7. Name three classes of enzymes and describe what they do. (6 pts)

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五、連連看 Connect with lines the columns (left) to their sorting capabilities (right) (10 分)

1. Ion Exchange Chromatography

a. Size: Small elutes first, large is retarded

b. Size: Large elutes first, small is retarded

2. Gel Filtration Chromatography

c. Partitioning Coefficient

d. pI

3. Affinity Chromatography

e. Charge

f. Molecular recognition

4. Reverse Phase Chromatography (HPLC)