

1. (5%) Proteins that bind specifically to DNA are of great biological importance because of their roles in replication or expression of genetic information. Of great interest is that those proteins bind to very specific sites on the double-stranded DNA, defined by specific sequences of the four nucleotides A, T, C, and G. How might a protein discriminate among different DNA base pairs? What is the most important interaction? Explain your reasons at an atomic level.
2. (10%) The data below show a purification for an enzyme. After Sephadex G-75, two peaks with enzyme activity were observed.

Table 1. Purification of two enzymes

	Volume (ml)	Total Protein (mg)	Total Activity (unit)
Crude enzyme	1050	615	1210
Ammonium sulfate precipitate	124	111	620
Phenyl Superose chromatography	62	8.8	219
DEAE-Sephadex chromatography	35	1.6	124
Metal-binding chromatography	12	0.4	300
Sephadex G-75 peak I (A)	8	0.16	240
Sephadex G-75 peak II (B)	10	0.15	120

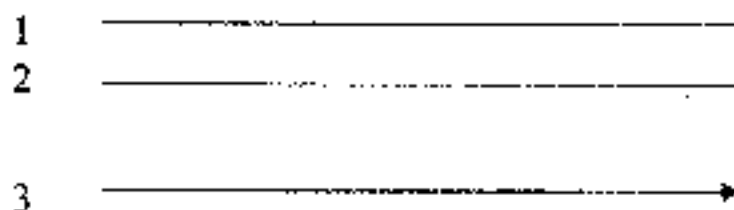
- a. What is the final purification fold after Sephadex G-75 chromatography as compared to the crude enzymes in the culture medium?
- b. What are the properties of these two enzymes based on the above isolation procedures? Compare these two enzymes in brief.
- c. The  $K_M$  values are 3.3 mg/ml and 1.2 mg/ml for enzyme A and enzyme B, respectively. Describe the physiological meaning.

八十五學年度 生命科學 系 所 分生組甲、乙、丙 組碩士班研究生入學考試  
 科目 生物化學 科號 0901 : 1301 1104 : 1201 1301 : 1404 共 3 頁 第 2 頁 \*請在試卷【答案卷】內作答

3. (10%) Answer the following questions on protein structures.
  - a. Proteins are made from 20 amino acids. Studies of naturally occurring amino acid substitutions may reveal the importance of individual residues. What will you predict if one tryptophan residue is replaced? Please draw the chemical structure and explain in brief.
  - b. Please give two factors that favors the oligomeric association of protein monomer. Explain in brief.
  - c. Please use thermodynamics to predict the single largest contribution onto the stability of a folded protein.
  
4. (10%) General concepts on chemical bonds. (1% each for questions 4a, 4b, and 4c)
  - a. The most likely C-C bond dissociation energy (in Kcal/mol) is  
(A) < 50 (B) 50-100 (C) 100-150 (D) >150
  - b. The most likely C-H bond dissociation energy (in Kcal/mol) is  
(A) < 50 (B) 50-100 (C) 100-150 (D) >150
  - c. The most likely hydrogen bond energy (in Kcal/mol) is  
(A) <10 (B) 20-30 (C) 30-40 (D) > 50
  - d. How to cleave a C-C bond in cellular metabolism? Please give an example to elucidate your explanation. (7%)
  
5. (10%) Briefly answer the following questions.
  - a. The structural diversity of proteins originates from the composition and sequence of twenty amino acids. The diversity of DNA originates from the base composition and sequence. What are the factors that contribute to the structural diversity for polysaccharides? (4%)
  - b. Carbohydrates are important fuel molecules. Do they have other biological functions? (3%)
  - c. What are the molecular mechanisms for the toxicity of penicillin and bacitracin against bacteria? Why are these antibiotics rather unharmed to human? (3%)
  
6. (20%) In most terrestrial vertebrates, excess  $\text{NH}_4^+$  resulted from amino acid degradation is converted into urea and then excreted.
  - a. Describe the biochemical reactions/pathways that synthesize 1 mole of urea from 2 moles of  $\text{NH}_4^+$  and 1 mole of  $\text{CO}_2$ .
  - b. What is the stoichiometry of the above reactions? (Hint: write a balanced equation and indicate how many  $\sim\text{P}$  are spent or generated.).

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 1104、1201  
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7. (5%) Line 1 and line 2 represent a double strand DNA, line 3 is a mRNA transcribed from the DNA, the arrow indicates the direction of transcription.



- a. Label the 5' and 3' ends of each line.
  - b. Which line is the template strand? The coding strand? The noncoding strand?
8. (30%) Distinguish between the following pairs of terms. [Hints: i. Give correct and complete spellings for each abbreviations. ii. Use definitions, structural formulas, brief descriptions, etc. to explain each terms. iii. Compare the similarities or differences between the pairs of terms, examples are usually helpful.]
- a. Configuration and conformation.
  - b. COSY and NOESY.
  - c. HTH-motif and leucine zipper.
  - d. snRNA and scRNA.
  - e. EDTA and EGTA.
  - f. Transition mutations and transversion mutations.