

# 中原大學 100 學年度 碩士班 入學考試

3 月 19 日 10:30~12:00 生物科技學系

誠實是我們珍視的美德，  
我們喜愛「拒絕作弊，堅守正直」的你！

科目：生物化學

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可使用計算機，惟僅限不具可程式及多重記憶者

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## 1. About Proteins: basic concepts

- A. Catalysis is a characteristic of life. Most of enzymes in cells are proteins. Which type of macromolecules other than proteins can also work like an enzyme? (1 points)
- B. Proteins can be synthesized in the cytosol or endoplasmic reticulum (ER). Which is the organelle that conducts proteins synthesis? (1 points)
- C. The process that do not change the primary structure of proteins but can cause the lost of function of proteins is called? (1 points)
- D. What is the technique that can use the charge of proteins to separate each other and can determine the purity of a protein? (1 points)
- E. A nonapeptide was determined to have the following amino acid composition: (Arg)<sub>2</sub>, (Gly)<sub>2</sub>, (Phe)<sub>2</sub>, Glu, Leu, Met. The native peptide was incubated with 1-fluoro-2,4-dinitrobenzene (FDNB) and then hydrolyzed; 2, 4-dinitrophenylglutamate was identified by HPLC. When the native peptide was exposed to cyanogen bromide (CNBr cleavage point: Met), an octapeptide and free glycine were recovered. Incubation of the native peptide with trypsin (cleavage point: Lys or Arg) gave a pentapeptide, a tripeptide, and free Arg. 2,4-Dinitrophenyl-glutamate was recovered from the pentapeptide, and 2,4-dinitrophenylphenylalanine was recovered from the tripeptide. Digestion with the enzyme pepsin (cleavage point: Phe) produced a dipeptide, a tripeptide, and a tetrapeptide. The tetrapeptide was composed of (Arg) 2, Phe, and Gly. Please derive the native sequence and explain your rationales. (5 points)

## 2. About Proteins: Medicine and Applications

- A. Find the Match: Please match the diseases list in the left with the causing misfolding proteins list in the right (5 points)
- |                          |                                      |
|--------------------------|--------------------------------------|
| (a) Alzheimer disease    | (1) huntingtin                       |
| (b) Cystic fibrosis      | (2) CFTR (a Cl <sup>-</sup> channel) |
| (c) Huntington's disease | (3) $\alpha$ -synuclein              |
| (d) Parkinson's disease  | (4) APP and Tau protein              |
| (e) BSE and CJD          | (5) prion                            |
- B. Please describe the difference between monoclonal antibody and polyclonal antibodies. (2 points)
- C. Please indicate the major difference between the ELISA and Western blot assay for protein detection. And, is it possible that a protein can be detected with Western blot but not be detected by ELISA with the same antibodies? Please give a brief explanation for your answer. (3 points)

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### 3. Carbohydrates can act as information molecules

- Please indicate one way in which the body marks “old” proteins for destruction and replacement. You should give your answer about the working mechanism. (2 points)
- Why the gastric ulcers people of blood type O are several folds higher than in those of type A or B? (2 points)
- What is lipopolysaccharide ? Please also indicate which bacteria type will carry it and which syndrome is caused by it? (2 points)
- Can you give an explanation about the difference on carbohydrates between **glycoproteins** and **proteoglycans** ? (2 points)
- What is the difference between the N-linked and O-linked glycoproteins? (2 points)

### 4. lipids, membrane and signal transduction

- Please design an experiment that can distinguish the increasing of cytosolic  $\text{Ca}^{2+}$  concentrations of cells is come **from cytosol or extracellular**  $\text{Ca}^{2+}$  sources? (2 points)
- Phospholipase C can activate the protein kinase C by increasing the cytosolic  $\text{Ca}^{2+}$  and to response the action of hormone. Please indicate the signal transduction process: from Phospholipase C to protein kinase C by  $\text{Ca}^{2+}$ . (3 points)
- Match the compounds on the left with the important roles they play listed on the right. (Answers are used only once.) (2 points)

(a) prostaglandins	(1) blood clotting
(b) sphingolipids	(2) necessary for sight
(c) thromboxanes	(3) mediates pain and inflammation
(d) vitamin A	(4) important component of myelin membranes
- Please design an experiment that can demonstrate the membrane fluid mosaic model. (3 points)

**5. Translation.** Please compare and contrast the initiation stage of translation between prokaryotes and eukaryotes. (10 points)

**6. Gene expression regulation.** Using the following metabolic pathway to answer the questions that follow it. (8 points)



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If enzyme *a* is inducible and is not being synthesized at present, a (1) \_\_\_\_\_ protein must be bound tightly to the (2) \_\_\_\_\_ site. When the inducer is present, it will bind to the (3) \_\_\_\_\_ so that (4) \_\_\_\_\_ can occur.

7. Genetic code. The following is a code for a strand of DNA. (12 points)

DNA	3' A T A T	T T T			
	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19				
mRNA			C G U		U G A
tRNA				U G G	
Amino acid		Met	_____	_____	_____

ATAT= promoter sequence

- A. Using the genetic code provided in the following, fill in the blanks to complete the segment of DNA shown.
- B. Fill in the blanks to complete the segment of amino acids coded for by this strand of DNA.
- C. Write the code for the complementary strand of DNA completed in part (A).
- D. What would be the effect if C was substituted for T at base 10?
- E. What would be the effect if C was inserted between base 9 and 10?
- F. How would UV radiation affect this strand of DNA?

		Second letter of codon							
		U		C		A		G	
		U	C	U	C	U	A	U	G
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	
	UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys	
U	UUA	Leu	UCA	Ser	UAA	Stop	UGA	Stop	
	UUG	Leu	UCG	Ser	UAG	Stop	UGG	Trp	
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	
	CUC	Leu	CCC	Pro	CAC	His	CGC	Arg	
C	CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg	
	CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg	
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	
	AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser	
A	AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg	
	AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg	
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	
	GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly	
G	GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly	
	GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly	

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## 8. About Citric Acid Cycle

- A. Individuals with a thiamine-deficient diet have relatively high levels of pyruvate in their blood. Please explain this in the aspect of biochemistry. (2 points)
- B. What electron acceptors play a role in the citric acid cycle? (4 points)
- C. Would you expect the citric acid cycle to be more or less active when a cell has a high ATP/ADP ratio and a high NADH/NAD<sup>+</sup> ratio? Give the reason for your answer. (4 points)

**9. About Carbohydrate Metabolism.** What are four possible metabolic fates of glucose-6-phosphate? (8 points)

## 10. About Lipid Metabolism.

- A. In  $\beta$ -oxidation, how many carbons at a time are cleaved from acyl-CoA, starting at the carboxyl end. (2 points)
- B. Under what conditions are ketone bodies produced? (4 points)
- C. Why are linoleate and linolenate considered essential fatty acids? What step in production of polyunsaturated fatty acids are mammals unable to perform? (4 points)
- D. Which enzyme does the statins lower plasma cholesterol level by? (2 points)