

國 立 清 華 大 學 命 題 紙

97 學年度\_\_\_\_工學院生物工程學程碩士班\_\_\_\_系(所)\_\_\_\_\_組碩士班入學考試

科目\_\_生物化學\_\_ 科目代碼\_\_0802\_\_共\_\_3\_\_頁第\_\_1\_\_頁 \*請在【答案卷卡】內作答

1. Explain the difference of feedback inhibition and feedback repression in the metabolic regulation of microbial cells. (10%)
2. Compare the gene expression and protein synthesis mechanisms of prokaryotic and eukaryotic cells. (10%)
3. DNA/RNA (20%)
  - (a) Schematically illustrate the molecular structure of a single-stranded polynucleotide (including the nucleotides). Draw the structures of nucleotides including the bonds connecting the nucleotides, but the structures of bases are not needed. (5%)
  - (b) What is the precursor of DNA synthesis? Schematically illustrate how DNA is synthesized from its precursor and the DNA template. (4%)
  - (c) What is the precursor of RNA synthesis? Schematically illustrate how RNA is synthesized from its precursor and the DNA template. (4%)
  - (d) What is the precursor of protein synthesis? Schematically illustrate in brief how a polypeptide is synthesized from its precursor and the RNA template. (5%)
  - (e) What are the major forces that stabilize the DNA and protein structures? (2%)
4. Recombinant DNA technology (20%)
  - (a) What are the two major classes of enzymes that are commonly used to “cut and past” DNA for the creation of recombinant DNA molecules? Indicate their names and featured functions. (4%).
  - (b) Plasmid is the most commonly used vector for molecular cloning. Write down 4 features why plasmid is so common (8%).
  - (c) After the construction of a recombinant DNA molecule, typically one needs to transform the DNA into bacterial cells and select and screen for the recombinants. Describe how the selection and screening are performed. (8%)

國立清華大學 命題紙

97 學年度 工學院生物工程學程碩士班 系(所) 組碩士班入學考試

科目 生物化學 科目代碼 0802 共 3 頁第 2 頁 \*請在【答案卷卡】內作答

5. For each of the following sentences, fill in the blanks with the best word or phrase selected from the list below. Not all words or phrases will be used; each word or phrase should be used only once. (15%)

a) Eucaryotic cells are bigger and more elaborate than procaryotic cells. By definition, all eucaryotic cells have a \_\_\_\_\_, usually the most prominent organelle in the eucaryotic cell. Another organelle found in essentially all eucaryotic cells is the \_\_\_\_\_, which generates the chemical energy for the cell. If we were to strip away the plasma membrane from a eucaryotic cell and remove all of its membrane-enclosed organelles, we would be left with the \_\_\_\_\_, which contains many long, fine filaments of protein that are responsible for cell shape and structure and thereby form the cell's \_\_\_\_\_.

b) The specialized functions of different cellular membranes are largely determined by the \_\_\_\_\_ they contain. Membrane lipids are \_\_\_\_\_ molecules, composed of a hydrophilic portion and a hydrophobic portion. All cell membranes have the same lipid bilayer structure, with the \_\_\_\_\_ of the phospholipids facing into the interior of the membrane and the \_\_\_\_\_ on the outside. The most common lipids in most cell membranes are the \_\_\_\_\_. The head group of a glycolipid is composed of \_\_\_\_\_.

c) The  $\alpha$  helices and  $\beta$  sheets are examples of protein \_\_\_\_\_ structure. A protein such as hemoglobin, which is composed of more than one protein subunit, has \_\_\_\_\_ structure. A protein's amino acid sequence is known as its \_\_\_\_\_ structure. A protein \_\_\_\_\_ is the modular unit from which many larger single-chain proteins are constructed. The three-dimensional conformation of a protein is its \_\_\_\_\_ structure.

<i>allosteric</i>	<i>ligand</i>	<i>secondary</i>
<i>domain</i>	<i>primary</i>	<i>subunit</i>
<i>helix</i>	<i>quaternary</i>	<i>tertiary</i>
<i>active</i>	<i>carrier proteins</i>	<i>ion channels</i>
<i>amino acid</i>	<i>hydrophilic</i>	<i>noncovalent</i>
<i>amphipathic</i>	<i>hydrophobic</i>	<i>passive</i>
<i>phosphatidylserine</i>	<i>antiport</i>	<i>coupled</i>
<i>membrane potential</i>	<i>ATP hydrolysis</i>	<i>electrochemical</i>
<i>symport</i>	<i>concentration</i>	<i>light-driven</i>
<i>cholesterol</i>	<i>lipid bilayer</i>	<i>phospholipids</i>
<i>fatty acid tails</i>	<i>lipid monolayer</i>	<i>proteins</i>
<i>glycolipids</i>	<i>lipids</i>	<i>sterols</i>
<i>hydrophilic head groups</i>	<i>phosphatidylcholine</i>	<i>sugars</i>
<i>uniport chloroplast</i>	<i>cytosol</i>	<i>nucleus</i>
<i>chromosome</i>	<i>endoplasmic reticulum</i>	<i>ribosomes</i>
<i>cytoskeleton</i>	<i>mitochondrion</i>	

國立清華大學 命題紙

97 學年度 工學院生物工程學程碩士班 系(所) \_\_\_\_\_ 組碩士班入學考試

科目 生物化學 科目代碼 0802 共 3 頁第 3 頁 \*請在【答案卷卡】內作答

6. Which of the following statement(s) are FALSE? (2%) Why? (3%)

- (a) Proteoglycans can act as filters to regulate which molecules pass through the extracellular medium.
- (b) The negative charge associated with proteoglycans attracts cations, which cause water to be sucked into the extracellular matrix.
- (c) Proteoglycans are a major component of compact connective tissues, but relatively unimportant in watery tissues such as the jellylike substance in the interior of the eye.
- (d) Proteoglycans help tissues resist mechanical compression.
- (e) Glycosaminoglycans are components of proteoglycan.

7. Do you agree or disagree with the following statement? Explain your answer. (10%)

Like many other extracellular proteins, newly synthesized collagen molecules undergo post-translational processing inside the cell to convert them into their mature form, and are then secreted and self-assemble into fibrils in the extracellular space.

8. Match the chemical groups shown in the first list with their names selected from the second list. (5%)

List 1	Answer	List 2	
A. -OH		1. Amino	6. Methyl
B. -C = O		2. Aldehyde	7. Amido
C. -COOH		3. Phosphate	8. Ester
D. -CH <sub>3</sub>		4. Carboxyl	9. Hydroxyl
E. -NH <sub>2</sub>		5. Carbonyl (ketone)	10. glycerol

9. The following figure is regarding isoelectric focusing. Please explain the phrase "isoelectric point" and the application of isoelectric focusing. (5%)

