

國立清華大學命題紙

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

科目 生物化學 科目代碼 0802 共 2 頁第 1 頁 \*請在【答案卷卡】內作答

1. Biological membranes (25%)

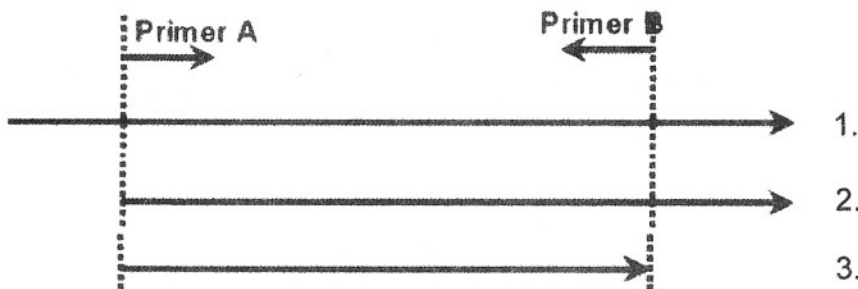
- (a) The fundamental component of a biological cell membrane is the lipid bilayer. Schematically describe the structure of lipid bilayers. (3%)
- (b) Please describe the mechanisms of passive membrane transport and active membrane transport. (8%)
- (c) Describe how the following bio-molecules are transported across the cell membrane:  $K^+$ , ATP, and protein. (12%)
- (d) What is an enzyme? Can enzyme work in membrane transport? How? (2%)

2. TCA cycles (25%)

- (a) The TCA cycle produces energy currency and reducing powers, write down the overall reaction (5%).
- (b) Write down the steps that lead to the formation of products appearing in the final stoichiometric equation. You only need to write down the reactants and key products of each step, no structural formulas are needed. (15%).
- (c) Calculate how many moles of ATP (and equivalent) can be obtained from TCA cycle (from 1 mole of glucose) if all the reducing powers are coupled to electron transport chain and oxidative phosphorylation. (5 %).

3. PCR (25%)

- (a) A PCR experiment starts with  $2.5 \times 10^{-10}$  mol of duplex DNA. At the end of four cycles, how much of each of the following products will be produced? (6%)



- (b) What are the three basic steps in a single PCR cycle? Which step is typically performed at the highest temperature? (8 %)
- (c) Fatty acids can spontaneously form various organized structures in aqueous solution. Name four different types of structures, and for each type provide a diagram to show the organization of the fatty acids in relationship to each other and to solvent. (8 %)
- (d) Which ion is the trigger for all muscle contraction? (note: write the chemical symbol in ionic form) (3%)

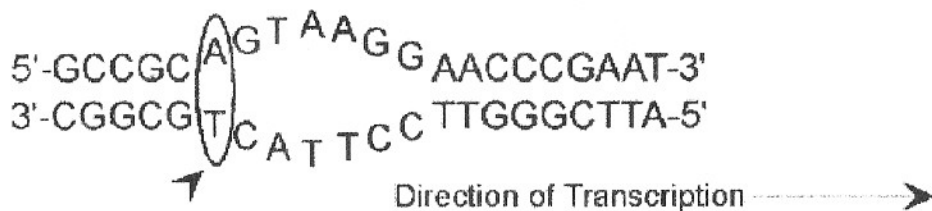
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4. Deoxyribonucleic acid is the basic hereditary material in all cells and contains all the information necessary to make proteins. DNA is a polymer. The monomer units of a DNA are nucleotides, and the polymer is known as a polynucleotide.

- What are three basic components of nucleotides? Please draw the structure of a nucleotide monomer in detail. (5%)
- Explain how those nucleotides form polynucleotide and also specify its polarity. (5%)
- For DNA, there are four different nitrogenous bases, adenine (A), guanine (G), cytosine (C), thymine (T), respectively. Based on their molecular structures, explain Watson-Crick base pairing (5%)
- The following diagram shows a segment of double-stranded prokaryotic DNA that has melted because gene transcription is about to begin. Transcription begins at the base-pair that is circled and proceeds to the right. What is the sequence of the first 12 nucleotides of the RNA transcript? (Do not draw the nucleotide structure here, but just give the order of nucleotides using the appropriate capital letter for each nucleotide). Label the 5' and 3' ends. (5%)



Base-pair at which transcription begins

- In a DNA sequence, the base pair where RNA polymerase starts synthesis of a RNA is given the number +1. Explain how RNA polymerase transcribes different genes by recognizing distinct sequences and how to verify this mechanism. (5%)