

國立成功大學

113學年度碩士班招生考試試題

編 號：57

系 所：生命科學系

科 目：分子生物學

日 期：0202

節 次：第 3 節

備 註：不可使用計算機

※ 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。

1. Answer briefly the following questions:

- Q1. What is the function of DNA helicases in DNA replication? (4 points)
 Q2. What does “complementary” mean in DNA sequences? (4 points)
 Q3. What is the main difference between animal and plant cytokinesis? (4 points)
 Q4. What is the function of snoRNAs and where is their main cellular localization? (4 points)
 Q5. Who won the Nobel Prize in Physiology or Medicine last year (2023) and what was their achievement? (4 points)

2. You perform the PCR experiment to amplify the specific target DNA fragment.

Q1. Explain the principle of PCR using the following terms: template, primer(s), single strand. (4 points)

You set the reaction temperature as follows:

	95°C	30 sec	
(1) →	95°C	30 sec	}
	52°C	30 sec	
(2) →	72°C	2 min	
	72°C	30 sec	
			x 30 cycles

- Q2. Why is the step (1) necessary for the PCR reaction? Briefly explain. (4 points)
 Q3. After the step (2), what is the state of the fragments. Briefly draw it. (4 points)
 Q4. In gel electrophoresis of the PCR product, you detected multiple bands including your target DNA fragment band. If you are trying to detect a single band by changing the reaction temperature, which step in the above setting should be changed and how? (4 points)

3. Answer the following questions:

- Q1. Given the following genotypes for two parents, $AaBBCc \times AabbCc$, assume that all traits exhibit simple dominance and independent assortment. What proportion of the progeny of this cross will be expected to phenotypically resemble the first parent with the genotype $AaBBCc$? (3 points)
 Q2. Which of the following is a major difference between prokaryotic cells and eukaryotic cells? (3 points)
 A) Prokaryotic cells have cell walls, while eukaryotic cells do not.
 B) Eukaryotic cells have flagella, while prokaryotic cells do not.
 C) Eukaryotic cells have membrane-bound organelles, while prokaryotic cells do not.
 D) Prokaryotic cells are generally larger than eukaryotic cells.
 Q3. Which of the following facts did Hershey and Chase make use of in trying to determine whether DNA or protein is the genetic material? (3 points)
 A) DNA contains sulfur, whereas protein does not.
 B) DNA contains phosphorus, whereas protein does not.
 C) DNA contains nitrogen, whereas protein does not.

D) DNA contains purines, whereas protein includes pyrimidines.

Q4. The beginning of anaphase is indicated by which of the following processes? (3 points)

- A) Loss of kinetochores from the chromatids.
- B) Attachment of sister chromatids to each other by cohesin.
- C) Disappearance of the nuclear membrane.
- D) Enzymatic cleavage of cohesin.

Q5. In a diploid cell with 5 chromosome pairs, how many sister chromatids will be found in a nucleus at prophase of mitosis? (2 points)

4. Consider a bacterial promoter with -35 and -10 elements. What assay is best to show that RNA polymerase binds at regions centered on the -35 and -10 positions upstream of the start site of transcription? (10points)
5. Explain the basis of interaction between small nuclear ribonuclear proteins (snRNPs) and the pre-mRNA splicing substrate. (10points)
6. You are screening *E. coli* for **suppressor** mutations for a mutant of your gene of interest. The mutation that currently causes the protein encoded by your gene to not be expressed is a **nonsense** mutation. One suppressor mutation is located in the gene encoding a less common tRNA^{Leu}. Why is it more likely that a less common tRNA^{Leu} carries a suppressor mutation than a very commonly used tRNA^{Leu}? (10points)
7. In the laboratory, you want to purify a protein that is normally toxic in *E. coli* cells. Your advisor suggests cloning the gene encoding your protein into an expression vector that uses the *araBAD* promoter. Why is it ideal to use the *araBAD* promoter for expression of your gene of interest in *E. coli* cells? (10points)
8. Explain why *E. coli lacZ* is often used as a reporter gene in *S. cerevisiae* cells but not in *E. coli* cells. (10points)