國立成功大學 106 學年度碩士班招生考試試題

系　　所：分子醫學研究所

考試科目：分子生物學

考試日期：0214，節次：3

※ 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。

問答題 (70%)

1. Please describe central dogma of molecular biology (5%).

2. Please compare translation mechanism of eukaryotic cells to that of prokaryotic cells (5%).

3. Please describe types and functions of proteins (10%).

4. Please describe oncogene definition (2%) and how to identify a gene as an oncogene (8%).

5. Please describe how the cells communicate with each other at molecular level (10%).

6. Describe the gene control region of a typical eukaryotic gene, and briefly describe the events associated with **transcription initiation** of a specific gene around the gene control region (15%).

7. Human genome can be damaged by different kinds of radiation, including UV, gamma and x-rays. Please describe different types of DNA damage caused **by radiation** and choose **two** types of DNA damage caused by **radiation** to describe the repair processes in human cells(**must** include non-homologous end-joining repair, but **not** homologous recombination repair) (15%)

簡答題 (30%)

8. Polymerase chain reaction (PCR) is a technique to amplify a specific DNA region. A PCR basically requires DNA polymerase, two primes, ___①__, buffer solution, magnesium. Typically, PCR consists of a series of 20–40 repeated temperature cycles, with each cycle commonly consisting three steps. The first step is denaturation in which the reaction is heated to 94-98°C for 20-30 seconds. It causes DNA melting of the DNA template by disrupting the ___②__ between complementary bases, yielding single-stranded DNA molecules. The second step is annealing during which the temperature is decreased to 50-65°C for 20-40 seconds. This temperature has to be low enough to allow for hybridization of the primer to the template strand, but high enough to get specific hybridization. The last step is extension (elongation). The reaction temperature is determined by the ___③____. At this step, the DNA polymerase synthesizes a new DNA strand ___④___to the DNA template strand by adding nuclear tide to extend a new strand from the annealing primer.

A) Fill blanks ① ② ③ and ④. (4%)

B) What determines the extension time? (3%)

C) Draw pictures to show the first 3 cycles of a PCR.(4%)

D) Design 20 bp primers to amplify the following region, and indicate the 3' and the 5' ends of the primers. (4%)

5'-atgaccatgattacgccaagcttgcatgcctgcaggtcgactctagaggatccccgggtaccgagctcgaattcactggccgtcgttttacaacgtcgtgactgggaaaacc
ctggcgttacccaacttaatcgccttgcagcacatccccctttcgccagctggcgtaatagcgaagaggcccgcaccgatcgcccttcccaacagttgcgcagcctgaatggc
gaatggcgcctgatgcggtattttctccttacgcatctgtgcggtatttcacaccgcatatggtgcactctcagtacaatctgctctgatgccgcatag-3'

9. Polyacrylamide gel electrophoresis (PAGE), is a technique commonly used in molecular biology to separate biological macromolecules, usually proteins or ___①__, according to their electrophoretic mobility. The mobility is determined by the length, conformation and charge of the molecules. To separate protein samples, sodium dodecyl sulfate (SDS) which is an anionic detergent, is applied to the samples to __②__ the proteins and to add a __③__ charge to them. This procedure is called SDS-PAGE. In most proteins, the binding of SDS to the protein chains adds an even distribution of charge per unit mass, thereby resulting in a separation by approximate size during electrophoresis.

A) Fill the blanks ① ② and ③. (3%)

B) In the process of SDS-PAGE, does the protein sample run from the positive electrode to the negative electrode, or from the negative to the positive? Why? (3%)

C) Explain the reason why a reducing agent (generally mercaptoethanol) is added to the sample buffer for SDS-PAGE. (3%)

D) An SDS-PAGE experiment carried out with 4% of acrylamide in the upper gel, and 12% of it in the lower gel. Describe the function of the upper gel and the lower gel. (3%)

E) How is the molecular weight of a protein determined from a SDS-PAGE result? (3%).