

※ 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。

簡答題與問答題 (100 分)

1. Other than being used in the research for detecting gene expression, PCR is also a very powerful technique used in many other fields such as medicine. Please describe all the usages of this technique. (5%)
2. What are the differences between si RNA and micro RNA? (5%)
3. What is “next generation sequencing”? (5%)
4. If you hybridized the labeled cDNA coding for A specific cytokine gene with the restriction enzyme-cut, denatured whole genome, multiple bands were detected after gel electrophoresis. Please describe all the possible reasons. (5%)
5. What techniques can you use to detect the function of a novel gene *in vivo*? (5%)
6. You suspect a novel gene is an oncogene, please describe the techniques you may use to prove it *in vitro* or *in vivo*. (5%)
7. Please describe the factors which may affect the fidelity of the PCR reaction. (5%)
8. Please describe the landscape of the human genome. (5%)
9. Please first design an eukaryotic conditional (or inducible) expression vector based on the regulatory control used in bacterial lactose operon, and then describe how to apply this vector for conditional (or inducible) gene expression in mammalian cells. (10%)
10. Please first design an eukaryotic bi-cistronic (or di-cistronic) expression vector that can be used for expressing two genes simultaneously (at the same time) from only one transcriptional unit, and then describe the biological functions of essential components involved in this bi-cistronic (or di-cistronic) expression system. (10%)
11. Please first design two eukaryotic miRNA inhibition vectors based on the miRNA absorbing sponge and CRISPR/Cas9-mediated genomic DNA editing techniques, and then compare the advantages and disadvantages between both systems. (10%)
12. Describe (1) locus control region (2) chromatin remodelling machine (3) nuclear matrix in transcription regulation in eucaryotes. (10%)
13. Describe the possible mechanisms of regulation of cyclin-dependent kinase in cell cycle progression in eucaryotes. (10%)
14. Explain the following terms: (a) miRNA (b) long non-coding RNA (c) shRNA (d) DICER (10%)