

※ 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。

Part A (第一部份，簡答題)：共 40 分

Human DEFB4A encodes defensin, beta 4, an antibiotic peptide which is locally regulated by inflammation. The following is the full-length cDNA sequence for this protein.

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1  gtggctgaat tctaacctct gtaatgagca ttgcacccaa taccagttct gaactctacc
61  tggtgaccag ggaccaggac ctttataagg tggaaggctt gatgtcctcc ccagactcag
121 ctctctggtga agctcccagc catcagccat gagggctctg tatctctct tctcgttctc
181 cttcatattc ctgatgcctc ttccagggtg ttttggtggt ataggcgatc ctgttacctg
241 ccttaagagt ggagccatat gtcacccagt cttttgccct agaaggtata aacaaattgg
301 cacctgtggt ctccctggaa caaatgctg caaaaagcca tgaggaggcc aagaagctgc
361 tgtggctgat gcggattcag aaagggctcc ctcatcagag acgtgcgaca tgtaaaccaa
421 attaaactat ggtgtccaaa gatacgcaaa aaaaaaaaaa

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1. Please briefly define central dogma for genetic flow in molecular biology (10 %).
2. Please 1) name the process of converting mRNA into cDNA and 2) list 3 essential components required for synthesizing a eukaryotic RNA molecule *in vitro* (10 %).
3. Please define the initiation and termination codons in eukaryotes and calculate the number of amino acid encoded by DEFB4A based on the given sequence above (10 %).
4. In addition to the process of converting mRNA to cDNA, please list one additional example defying the central dogma for genetic flow (10 %).

Part B (第二部份，問答題)：共 30 分

5. Please read this article and answer to the questions from 1) to 8) listed below.

The organisms can be divided into (A) and (B) by the difference in structure of the cells (a). Based on the ribosomal RNA sequence (b), (A) is classified into (C) and (D). The origin of (B) is assumed by a theory named (E), which is hypothesized that (F) such as mitochondria and chloroplast in (B) are derived from (D).

Crude ribosome can be extracted by sucrose density gradient centrifugation (c). The cytoplasmic ribosome extracted with enough  $Mg^{2+}$  shows 70S (d) from (A) and 80S from (B). On the other hands, the (G)S ribosome is extracted from mitochondria, which is one piece of evidence to support (E).

- 1) Please describe a suitable term for blanks A-G. (7% in total, 1% per answer)
- 2) For the underline (a), please describe the difference between (A) and (B) cells in 3-4 lines. (4 %)
- 3) For underline (b), please describe the reason why ribosomal RNA sequence can be applied for classification of organisms in 3-4 lines. "Primer" and "protein coding gene" are essential word. (4 %)
- 4) For underline (c), please describe how to do it in 3-4 lines. "Swinging-bucket" and "top" are essential words. (3 %)

- 5) For underline (d), please describe the "S" in 1-2 lines. "Molecular weight" is essential word. (3 %)
- 6) The 70S and 80S ribosome can be separate into two subunits by removing  $Mg^{2+}$ . Please describe the sizes of subunits. (2 %)
- 7) Please describe function of ribosome in 3-4 lines. "rRNA" and "mRNA" are essential words (4 %)
- 8) Please describe 2 evidences to support (E) except described in above article. (3%)

Part C (第三部份，問答題): 共 30 分

6. The genome of cancer cells is generally hypomethylated (low in methylation). Where does DNA methylation generally occur in eukaryotic genome? What is the residue generally methylated? What is the outcome of this methylation in regulating gene transcription? Discuss the possible effect of hypomethylated genome on cancer cells (10 %).
7. Describe the characteristics of the promoter of eukaryotic RNA polymerase II-transcribed genes and how to identify the important transcription-control sequence upstream of a eukaryotic RNA polymerase II-transcribed gene (10 %).
8. Describe the characteristics of telomere in a eukaryotic chromosome. Explain **why** and **how** telomere is replicated differently as compared to the rest of the DNA in a eukaryotic cell (10 %).