

※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. Briefly describe the five major events in metastasis. (10%)
  2. Specify how cells exit Telophase phase to G<sub>1/0</sub> phase. (7%)
  3. Address how cells establish a front to rear polarity for cell migration. (8%)
  4. The polymerase chain reaction (PCR) is a widely used technique that allows investigators to amplify DNA segments.
    - a. What are required in a PCR reaction? (4%)
    - b. Please write three steps of PCR. (3%)
    - c. How to prevent the sample evaporation during PCR? (2%)
    - d. We would like to PCR the human Interferon- $\beta$  promoter spanning from position -16 to -211 containing the TATA box, which sequences as the following:  

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CTGAAACTTTAA-200AAAACATTAGAAAACCTCACAGTTTGTAATCTTTTTCCCTATTATATATATCATAAGA-150
TAGGAGCTTAAATAAGAGTTTATAAACT-110ACTAAAATGTAAATGACATAGGAAAAGTAAAGGGAGA
AGTGAAAGTGGGAAATTCCT-50CTGAATAGAGAGAGGACCATCTCATATAAATAGGCCA
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- Please write out the sequences of two primers (20 nucleotides from 5' to 3' for each primer) and what kind of DNA is required for a template? (4%)
5. The underlined sequences above indicate the transcription factor NF- $\kappa$ B binding site. NF- $\kappa$ B can respond to many signals to be activated and induce gene expression.
    - a. Please describe the canonical pathway of NF- $\kappa$ B activation. (4%)
    - b. We would like to investigate NF- $\kappa$ B-mediated induction of human Interferon- $\beta$  gene by using functional Luciferase reporter assay and biochemical gel shift and ChIP (Chromatin Immunoprecipitation) assays. Please briefly describe these three assays. (8%)
  6. Describe a) the reactions catalyzed by the aminoacyl-tRNA synthetase needed in protein synthesis (6%), and b) the process of forming the 80S translation initiation complex in eukaryotic cells. (6%)
  7. Compared to RNA polymerase, DNA polymerase has a much lower error rate for nucleotide incorporation. What structural difference between these two polymerases accounts for this? (3%)

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8. Describe how the loading of the replicative helicase MCM onto DNA and its subsequent activation ensures that only one functional replisome is built at any replication origin. Furthermore, describe how the MCM loading and activation are coordinated with the cell cycle in eukaryotes in a manner such that DNA replication can only occur in the S phase. (10%)
9. Glutathione is synthesized by glutamate cysteine ligase and glutathione synthetase sequentially from the amino acids L-cysteine, L-glutamic acid, and glycine. Please describe the function of glutathione in animal cells. (6%)
10. The levels of proteins within cells are determined not only by rates of synthesis, but also by rates of degradation. What are the major pathways mediating protein degradation in eukaryotic cells? (6%)
11. Nitric oxide ( $\cdot\text{NO}$ ) is a free radical mediator of cell signaling and inflammation. Please explain how nitric oxide transduces the signal within cells. (6%)
12. Please describe the roles of endocytosis and endosome trafficking in receptor signal transduction. (7%)

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