

國立成功大學

113學年度碩士班招生考試試題

編 號：254

系 所：生理學研究所

科 目：細胞生物學

日 期：0202

節 次：第 2 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. Aberrant intracellular lipid accumulation is considered one of the leading causes of metabolic disorders. Within mammalian cells, the smooth endoplasmic reticulum (ER) and lipid droplets are the two major organelles responsible for lipid homeostasis. Please provide a comprehensive description of (1) the characteristics of the smooth ER and lipid droplets, and (2) the functions of the ER and lipid droplets in maintenance of intracellular lipid homeostasis. (12%)
2. Acquiring energy from food is crucial for sustaining life. At the cellular level, multiple organelles work in concert to convert nutrients into energy. Please (1) identify the organelles responsible for energy generation and (2) describe how these organelles produce ATP. (12%)
3. Cells have the ability to export intracellular substances into the circulation system via secretory pathways. Please identify and briefly describe the mechanisms involved in these secretory pathways (12%)
4. Continuing from the previous question, cells uptake extracellular substances through endocytosis. Please identify and describe the mechanisms involved in endocytic pathways. (10%)
5. 2022 marked the end of the COVID-19 pandemic. The development of mRNA vaccines stands as a significant milestone in easing pandemic restrictions. As a result, the scientists who pioneered the mRNA vaccine were awarded the 2023 Nobel Prize. Please describe (1) the concept behind designing a COVID-19 mRNA vaccine and (2) how the COVID-19 mRNA vaccine effectively functions in humans. (12%)
6. In eukaryotic cells, post-translational modification is crucial for the full functionality of a protein. Please (1) describe how proteins are synthesized and (2) illustrate one post-translational modification involved in determining the fate of a protein. (12%)
7. Professor Physiology's research interest lies in exploring the intracellular function of the 'NCKU' protein in response to extracellular stimuli. After years of dedicated work, Professor Physiology has formulated a hypothesis suggesting that extracellular stimuli may induce the subcellular redistribution of the 'NCKU' protein. Please answer the following questions.
 - (1) Scenario 1: You are requested to identify the subcellular localization of "NCKU" protein under extracellular stimuli by Prof. Physiology. Please describe the experimental design and explain the critical importance of these experiments. (10%)
 - (2) Scenario 2: Unfortunately, your preliminary results have indicated that the extracellular stimuli do not induce subcellular redistribution of the 'NCKU' protein. However, you have discovered a significant reduction in the expression level of the 'NCKU' protein. Please describe the experimental design aimed at evaluating whether the regulation of the 'NCKU' protein by extracellular stimuli occurs transcriptionally or translationally. (10%)
 - (3) Scenario 3: The 'NCKU' protein undergoes post-translational regulation by extracellular stimuli through the protein degradation pathway. Please illustrate the characteristics of the ubiquitin-proteasome pathway and the autophagy-lysosome pathway. (10%)