

科目：分子生物學

(全一頁)

※以中文或英文作答均可，評分基準相同。

- 一、MicroRNA (miRNA) is a type of non-coding RNA that regulates gene expression at the post-transcriptional level. Please describe the biogenesis of miRNA and how it regulates gene expression. (25 分)
- 二、Phosphorylation of the C-terminal domain (CTD) of RNA polymerase II plays a crucial role in the transcription process. Please explain the roles of RNA polymerase II through phosphorylation at different stages of the transcription process. (25 分)
- 三、The CRISPR/Cas9 system is an important genome-editing technology developed in recent years. During this process, the system utilizes double-strand break (DSB) DNA repair pathways. Please explain the principles and mechanisms of the DNA repair pathways involved. (25 分)
- 四、Histone modification is one of the epigenetic mechanisms in transcription regulation. Please list five types of histone post-translational modifications and explain how these modifications regulate transcription. (25 分)

(試題隨試卷繳回)

教育部 113 年公費留學考試試題 143

科目：細胞生物學

(全一頁)

※以中文或英文作答均可，評分基準相同。

1. Please describe the morphology (5%) and three functions (15%) of rough endoplasmic reticulum (rER) in a mammalian cell.
2. Please describe the major types of cytoskeletons and their functions. (30%)
3. What are the structural features of integrins (10%), and how is integrin activity regulated? (10%)
4. Neutrophil extravasation from the bloodstream into inflamed tissue is a crucial process in innate immunity. Please describe the cascade of neutrophil extravasation (10%) and explain the roles of cell adhesion molecules involved in this process. (20%)

(試題隨試卷繳回)

教育部 113 年公費留學考試試題 144

科目：遺傳學(包含基因工程)

(全一頁)

- 一、(總分 25 分)某些植物細胞在進行減數分裂或有絲分裂的時候會出差錯。(一)請說明什麼是 nondisjunction 及其對植物基因體的影響。(10 分)(二)Nondisjunction 可能會對植物帶來什麼樣的影響?(15 分)
- 二、(總分 25 分)請說明什麼是鋅指蛋白 (zinc finger protein, ZFP)? (10 分) 請舉一例說明如何運用此項技術進行農植物 (如水稻、菸草、小麥、大豆、玉米) 品種改良。(15 分)
- 三、如果你要利用新興基因編輯技術進行農植物品種改良，你會選擇利用 CRISPR/Cas9 或者 ZFP 基因編輯技術？請說明。(25 分)
- 四、(總分 25 分)即時定量聚合酶連鎖反應 (Quantitative real-time PCR) 是常用的實驗技術。(一)請說明即時定量聚合酶連鎖反應 (Quantitative real-time PCR) 原理。(10 分)(二)請說明什麼是 lnc RNA。(5 分)(三)請說明是否可以利用 QRT-PCR 技術來鑑定 lnc RNA 的表達量?(10 分)

(試題隨試卷繳回)

科目：生態與演化生物學

(全一頁)

※以中文或英文作答均可，評分基準相同。

1. How can the population size of an organism be regulated by the density and non-density-dependent factors and their interactions? (20 points)
2. Tropicalization is rapidly impacting subtropical regions such as Taiwan. Please discuss how tropicalization would alter the community assemblage and interactions between different species. (20 points)
3. Allo-parapatric speciation (two lineages were isolated in the early stage of their divergence, but with gene flow in secondary contact in the later stage) had been suggested as a powerful driver of speciation. Please discuss how the alternation of allopatry and parapatry could facilitate the genesis of biodiversity. (20 points)
4. Anthropogenic changes have disturbed the natural habitat in various ways. Please discuss how human-driven environmental changes could affect the sexual selection and mating patterns of animals, which could lead to their extinction. (20 points)
5. Hybridization is usually considered to impact hybrids' fitness negatively. However, hybridization might positively affect a population's fitness through introgression. Please discuss how it could happen. (20 points)

(試題隨試卷繳回)

科目：保育生物學

(全二頁，第一頁)

※請以中文作答。如使用專有名詞，請保留英文原文。

一、(總分 20 分)生物保育學者面對保育政策決定時，曾經出現兩種觀點：

“Experience-based”與“Evidence-based”，請說明：

(一) 何謂“Experience-based Conservation”？(5 分)

(二) 何謂“Evidence-based Conservation”？(5 分)

(三) 保育學界對於這兩種觀點的評論為何？(10 分)

二、近幾十年的保育生物學的研究發展中，親緣地理學 (Phylogeography)、生物地理學 (Biogeography) 作為生物保育相關研究的基礎，主要是基於「考量生物演化歷程作為保育策略擬定之依據」，相關論述包括 Ryder (1986) 提出 Evolutionary Significant Unit (ESU)、Moritz (1994) 提出 Management Unit (MU)、Dodson 等人 (1998) 則相應提出 Operational Conservation Unit (OCU)。請分別說明 ESU、MU、OCU 的學理基礎，並說明三者間之關聯性、及其於保育生物學之應用。(30 分)

三、(總分 20 分)

(一) 請問，何謂“Post-glacial colonization”？(7 分)

(二) 在英國生物保育個案中，希望針對已經於 1851 年滅絕之橙灰蝶 (*Lycaena dispar*) 進行物種復育 (Species Reintroduction)，而橙灰蝶在歐洲的分布主要有三個亞種：*Lycaena dispar dispar* (曾分布於英國，現已滅絕)、*Lycaena dispar batavus* (分布於荷蘭)、*Lycaena dispar rutilus* (廣泛分布於中歐與南歐)，由於荷蘭的亞種與英國的亞種在形態與生活史都較相近，因此，英國從荷蘭引進 *Lycaena dispar batavus* 進行復育數次，但是於溫室繁殖後野放均未能於野外順利存活而告失敗，廿年前對於歐洲的橙灰蝶進行冰河時期之遷殖研究 (Lai & Pullin, 2004) 發現歐洲中部與北部的橙灰蝶族群是各自源於東南歐族群。請問，從上述之研究資料，對於英國橙灰蝶的物種復育計畫，若要再次啟動，您的建議為何？請說明您所依據之保育生物學相關論點。(13 分)

(接下頁)

科目：保育生物學

(全二頁，第二頁)

四、在有限經費下生物保育策略是否成功，對於 natural population decline 的評估是至關重要。假設，同一保育類物種的兩個自然棲地與該物種族群遺傳多樣性的資訊如下：A 棲地的面積是 B 棲地面積的 4 倍，而 B 棲地族群之遺傳多樣性是 A 棲地族群的 2 倍，兩地區的族群數量，於調查期間推估為相近，而棲地族群歷史則付之闕如。請問，如果只能在兩個棲地中選擇一個棲地進行規劃為保留區 (reserve area)，您會如何選擇？請說明相關之保育遺傳學學理基礎。(20 分)

五、「從生物演化歷史的角度，哺乳動物得以興盛發展的機緣在於白堊紀—第三紀滅絕事件 (Cretaceous-Tertiary extinction)，發生於 6600 萬年前的一次大規模物種滅絕事件。幾乎所有的非鳥恐龍、滄龍科、蛇頸龍目、翼龍目、菊石亞綱以及多種植物都在這次事件中集體滅絕。鳥類與哺乳類則存活下來並輻射演化成為新生代的優勢動物。倘若有激進的恐龍愛好者搭乘時光機器，回到 6600 萬年前，以當代對於瀕危物種積極保育的觀點，積極保育如今本應滅絕的非鳥恐龍等物種，因而造成鳥類與哺乳動物的發展受到阻礙而無法演化出如今豐富的多樣性，甚至造成人類因而未能演化出現。如此看來，對於瀕危物種的保育行動難道不是阻礙生物物種隨自然環境變動應有之演化歷程的行為嗎？」

對於上述有關保育瀕危物種的思想實驗論述，您的回應為何？請闡述您的觀點，以及相關之科學或哲學的論述基礎。(10 分)

(試題隨試卷繳回)

教育部 113 年公費留學考試試題 147

科目：免疫學

(全二頁，第一頁)

※以中文或英文作答均可，評分基準相同。

- 一、(總分 20 分) The significance of hypoxia in the tumor microenvironment has a profound impact on tumor progression and therapy resistance. (1) Explain how hypoxic conditions within the TME affect cellular metabolism, angiogenesis, and the immune response. (10 分) (2) Discuss how these effects contribute to challenges in cancer treatment, particularly in terms of resistance to chemotherapy and immunotherapy. (10 分)
- 二、(總分 20 分) Natural killer (NK) cells play a crucial role in tumor surveillance and elimination. (1) How do NK cells recognize and destroy malignant cells, and what mechanisms do tumors use to evade NK cell-mediated cytotoxicity? (10 分) (2) Discuss the balance between activating and inhibitory signals that regulate NK cell activity in the context of cancer. (10 分)
- 三、(總分 20 分) Indirect antigen presentation significantly contributes to tolerance induction in transplantation. (1) What strategies are being explored to modulate the indirect pathway of allorecognition to promote transplant tolerance? (10 分) (2) Analyze how targeting this pathway could potentially improve long-term graft survival and reduce the need for immunosuppressive therapy. (10 分)
- 四、(總分 20 分) Th17 cells are known to play a significant role in host defense against extracellular pathogens. (1) What cytokines and signaling pathways are involved in the differentiation of naive CD4⁺ T cells into Th17 cells? (10 分) (2) Discuss the role of transcription factors such as ROR γ t and STAT3 in the development and function of Th17 cells. (10 分)

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科目：免疫學

(全二頁，第二頁)

五、(總分 20 分) Recent studies have identified the role of pattern recognition receptors (PRRs) in the innate immune response to infection. (1) How does PRR recognition of pathogen-associated molecular patterns (PAMPs) influence the progression and resolution of infections? (10 分) (2) Provide examples of how pathogens evade PRR detection and discuss the implications for disease severity and host defense. (10 分)

(試題隨試卷繳回)