國立中山大學生物科學系101學年下學期
博士班資格考試(筆試)

科目：生物化學

1. Membrane proteins, secreted proteins or lysosomal proteins share the first few steps of a pathway that begins in the ER. (1) Describe the targeting system for protein translocation into the ER lumen. (2) Most of these proteins undergo further modifications in the ER lumen. Describe the possible posttranslational protein modifications in the ER lumen. (3) Glycosylation of proteins plays a key role in protein targeting. Describe the best understood sorting process of hydrolases destined for lysosomes. (25%)

2. (1) The chemiosomotic model proposed by Peter Mitchell is the paradigm for the mechanism for ATP synthesis. Describe the mechanism and the key experiments that support the mechanism. (2) The binding-change model for ATP synthase describes the mechanism for ATP synthesis. Describe the rotational catalysis mechanism proposed by Paul Boyer and the key experiments that support the mechanism. (30%)

3. In aerobic organisms, the citric acid cycle is an amphibolic pathway. The cycle serves in both catabolic and anabolic processes, it is a nearly universal central catabolic pathway for oxidative breakdown of carbohydrates, fatty acids and amino acids and it provides precursors for many biosynthetic pathways. Describe the roles of the citric acid cycle in catabolism and anabolism based on what you have learned. (20%)

4. Tertiary structure of a protein is the complete three-dimensional structure of a polypeptide chain. Globular proteins have more complicated tertiary structures, often with several types of secondary structure in the same polypeptide chain. Describe the secondary structure and the tertiary structure of proteins and how these structures are stabilized. (25%)

國立中山大學生物科學系101學年下學期
博士班資格考試(筆試)

科目：生態學

1. Please discuss in details the relationships and interactions between plants and animals from the concepts of evolution and ecology. (50 points)
2. Please discus the relationship between species richness and altitude. (50 points)

國立中山大學生物科學系 101 學年下學期
博士班資格考試(筆試)

科目：動物生理學

答題規定：請由下列題目中，一～三題中選兩題，四～六題中選兩題，總共四題。答題超過四題者，以最低四題計算為所得總分。

1. 胰島為體內重要的消化與內分泌激素的器官。請問:
   A. 胰島內的α與β細胞分別主要分泌何種激素 ? (5 %)
   B. 博士班資格考前，學生喝了一杯高蛋白的無糖營養補充包。請問喝完此飲品後，身體的血糖如何變化? 請詳細描述此狀況下血糖的調控機制(答案請包含激素名稱、激素作用的目標組織、血糖與蛋白質含量的變化等)。(20 %)

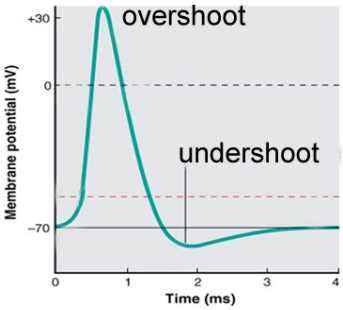
2. 自主神經系統包含著交感與副交感神經系統,這兩部分的神經系統對於心跳節律扮演著重要的調控作用。正常情況之下，成人心跳每分鐘約 72 次，但若將調控心臟的自主神經系統移除，心跳會增加到每分鐘 100 次。請問:
   A. 此心跳變化的現象代表著在正常情況下，哪一部分的自主神經系統(交感或副交感)對於心跳較有顯著的調控作用並請敘明理由? (5 %)。
   B. 請詳細說明交感神經系統調控心跳的機制。答案請包含神經傳遞物質、接受器種類、胞內訊息傳遞路徑、離子孔道通透性變化以及心跳的變化。(20 %)

3. 呼吸的主要功能在於進行體內與外界的氣體交換。請問:
   A. 哺乳類主要負責吸氣的肌肉為何? 而調控此肌肉的運動神經元為於哪裡? (5 %)
   B. 呼吸是一連串節律性的動作，請詳細說明呼吸節律的產生是藉由何種機制。(20 %)

4. *Describes* the underlying molecular *mechanisms involved* in the pathogenesis of *Alzheimer's* disease. Current treatments only help with the symptoms of the disease. There are no available treatments that stop or reverse the progression of the disease. However, enormous researches have resulted in more than 1000 clinical trials worldwide, and approximately a quarter of these compounds are in Phase III trials. Discuss the research directions for curing Alzheimer's disease. (25 %)

5. The receptors responsible for odorant discrimination were first cloned in 1991 by Linda Buck and Richard Axel, both awarded 2004 Nobel Prize in Physiology or Medicine. Even though mammals have only 100s of functional odorant receptors (ORs), they can discriminate a much higher number (several thousands) of odorants. Describe the underlying mechanisms involved in olfactory sensation. (25 %)

6. Illustration right depicts the ups and downs of an action potential. The protein structures of ion channels are responsible for rapid initiation and termination of an action potential, typically within a short time frame of 1~3 minisecond. Discuss the ionic mechanism in overshoot and undershoot phase of an action potential and how ion channels contribute in the rapid time frame. (25 %)



國立中山大學生物科學系 101 學年下學期
博士班資格考試(筆試)

科目：細胞分子生物學

1. 配合題: 請將下列人物及他們在在分子生物學留名的實驗結果做配合。(5%)

A. Maurice Wilkins and Rosalind Franklin
B. James Watson and Francis Crick
C. Stanley Miller
D. Jacob and Monod
E. Howard Temin

a. resolve a double-helical model for the structure of deoxyribonucleic acid
b. discovered the first ribozyme and show life may have originated in an RNA world
c. proposed the regulation of the *lac* operon model to explain gene regulation
d. discover the retroviruses' replication involved in reverse transcriptase
e. discover the DNA polymerase for DNA replication
f. decipher the structure of transfer RNA
g. generate X-ray diffraction photograph of DNA

2. 名詞解釋 (12%)
a. spliceosome
b. pseudogene
c. RNA editing
d. reassociation kinetics
e. Bacterial Artificial Chromosomes (BACs)
f. Short tandem repeats (STRs)

3. (任選 2 題) 試以細胞分子生物學角度說明下列人類遺傳性疾病之致病機轉。(6%)
a. Hemophilia b. Huntington disease c. Sickle-cell anemia d. Cystic fibrosis

4. (任選 2 題) 下列人物及實驗結果在分子生物學留名。試說明他們是如何進行實驗的? (8%)
a. In 1928, Frederick Griffith's experiment to identify transforming factor.
b. In 1944, Avery's transformation experiment
c. In 1952, the Hershey-Chase "radio-labelled phage" experiment to prove DNA carries genetic materials.
d. Meselson-stahl experiment to prove DNA replication is semiconservative.

5. 直線型 DNA 複製後染色體會兩端會變得愈來愈短，試問在生殖細胞或幹細胞中如何解決此困境? (hint: DNA 尾端序列 及 telomerase 如何作用之分子機轉以防止 DNA 在複製後的變短) (5%)

6. 試說明 真核生物中 gene regulation 為何比原核生物複雜? (hint:真核生物中 gene regulation 可發生在哪些步驟，而那些步驟是不同(或不存在)於原核生物的。) (7%)

7. (任選 1 題) DNA damage is unavoidable and arises in many ways. Fortunately, DNA repair system has been shown important to maintain the DNA integrity in the cells. Please answer one question related to DNA repair pathways. (7%)

(A) Two types of repair mechanism involve in double-strand DNA breaks, they are homologous recombination (HR) and nonhomologous end-joining (NHEJ). Please describe those two mechanisms and the consequence by using these different repair pathways.

(B) Please compare two DNA repair mechanisms of NER (Nucleotide excision repair) with BER (base excision repair)?

8. Fixatives such as formaldehyde are routinely used in certain types of electron microscopy and light microscopy. However, fixatives may introduce complications in analysis of the resulting images. What problems may result from using fixatives? (7 points)

9. How do animal cells maintain membrane fluidity, and hence membrane function, in response to decreased temperature? What experimental evidence supports the fluid mosaic model of biomembranes? (7 points)

10. There are several enzymes involved in cholesterol biosynthetic pathway. Which of these is subject to feedback regulation? How does this enzyme sense cholesterol levels? (7 points)

11. How can a uniporter, GLUT2, be sufficient to support the entry of glucose from intestinal epithelial cells into the bloodstream? (7 points)

12. Propose a rationale for why the coupling of the import of amino acids or sugars into cells is typically to Na^+ ion import. (8 points)

13. What is the function of the malate–aspartate shuttle? (7 points)

14. What is the role of quinone in generating the charge separation needed to remove electrons from H_2O for use in electron transport? (7 points)

國立中山大學生物科學系 101 學年下學期
博士班資格考試(筆試)

科目：微生物免疫學

1. Mycorrhiza is a fungus growing in symbiosis with plant roots. There are 2 types of these fungi: endomycorrhiza and ectomycorrhiza. Explain the difference between these two types of mycorrhiza, and explain why mycorrhiza is beneficial to plant growth? (10%)

2. Penicillin is known to be most effective against Gram-positive bacteria that are actively growing during the log phase. Why? Explain why stationary phase cells are not sensitive to penicillin? (10%)

3. Compare and contrast “fermentation” and “aerobic respiration”. (10%)

4. List the procedures of doing a Gram staining. (20%)

5. 請分別說明抗原呈獻(antigen presentation)細胞如何分別呈獻內源性抗原(endogenous antigen)及外源性抗原(exogenous antigen)，並分別說明負責呈現抗原之蛋白及被其呈獻之抗原之分子特性及呈獻機制。(15 分)

6. 請以感冒病毒之感染為例，說明黏膜系統之免疫反應清除病毒之分子機轉。(15 分)

7.解釋名詞: (每小題 2 分)

(1). Immune Tolerance
(2). Allergen
(3). Delayed type hypersensitivity
(4). Autoimmunity
(5). Antibody mediated cytotoxicity
(6). Pattern recognition receptors
(7). Immunoglobulin diversity
(8). T cell receptor
(9). Clonal selection
(10). Anergy

國立中山大學生物科學系 101 學年下學期
博士班資格考試(筆試)

科目：演化生物學

一.

Using sequences below and Kimura-2-Parameters substitute model and indels were treated as 5th state to answer the following questions:(50%)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
S1	A	T	T	G	T	T	A	T	C	G	C	A	G	C	G	C
S2	G	G	G	A	G	T	A	T	C	T	A	G	A	C	T	T
S3	A	T	A	G	T	T	G	T	C	T	C	G	G	C	T	C
S4	A	A	T	G	T	T	G	T	C	G	C	A	G	C	G	C
S5	G	G	G	-	T	A	A	C	T	G	-	T	A	A	T	T

1. Draw UPGMA phylogenetic tree step by step
2. Draw Neighbor-Joining tree step by step
3. Draw network tree based on MP method step by step

二.請問基因的表現量、行為、適應、族群分化、與物種形成之間的關聯為何？(25%)

三.分類群取樣的綿密程度如何影響系統發育(phylogenetic)與演化生態研究的精確性? (25%)