

國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：生態學【生科系碩士班甲組】

題號：421002

※本科目依簡章規定「不可以」使用計算機(混合題)

共 3 頁第 1 頁

一、選擇題 (單選，共 30 分，每題 2 分)

1. Species that feed on more than one trophic level are called
  - A. tertiary consumers.
  - B. herbivores.
  - C. omnivores.
  - D. primary producers.
  - E. secondary consumers.
2. The Shannon index measures
  - A. interaction strength.
  - B. species richness.
  - C. species diversity.
  - D. the extent of trophic facilitation.
  - E. the size of a trophic cascade.
3. A group of interacting species that occur together at the same place and time is known as a(n)
  - A. community.
  - B. biome.
  - C. species network.
  - D. ecosystem.
  - E. interaction web.
4. Which of the following types of succession involves colonization of habitats devoid of life?
  - A. Primary
  - B. Secondary
  - C. Pristine
  - D. Facilitation
  - E. Abiotic
5. The final theoretical stage of succession is called the \_\_\_\_\_ stage.
  - A. omega
  - B. Ultimate
  - C. penultimate
  - D. climax
  - E. pioneer
6. Which of the following effects occurs during the alder stage of succession of Glacier Bay communities?
  - A. Increase in nitrogen levels
  - B. Increase in germination rates
  - C. Decrease in root competition
  - D. Increase in light competition
  - E. Decrease in growth rate
7. Which of the following processes or events is most responsible for current species losses in the Amazon?
  - A. Global climate change
  - B. Deforestation
  - C. Acid rain
  - D. Overexploitation
  - E. Invasive species
8. The scientist who conceptualized the Earth as divided into six biogeographic regions and is considered the father of biogeography is
  - A. Alexander von Humboldt.
  - B. Charles Darwin.
  - C. Robert MacArthur.
  - D. Edward O. Wilson.
  - E. Alfred Russel Wallace.
9. Currently in the United States, the major crop used to produce ethanol for fuel is
  - A. sugarcane.
  - B. corn.
  - C. soybeans.
  - D. peanuts.
  - E. alfalfa.

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10. The fate of algae of the genus *Caulerpa* in the Mediterranean best illustrates which of the following?
- A. Salinity can be an important abiotic condition preventing establishment.
  - B. pH can be an important abiotic condition preventing establishment.
  - C. Temperature can be an important abiotic condition preventing establishment.
  - D. Physiological constraints are not always a reliable mechanism for excluding potential invaders from a community.
  - E. Species interactions can be very important factors limiting establishment in a community.
11. Robert MacArthur showed that different species of warblers in New England forests
- A. cannot coexist indefinitely.
  - B. coexist because they utilize different types of trees.
  - C. coexist because they utilize different parts of the same trees.
  - D. coexist because they utilize the same trees at different times of the day.
  - E. coexist despite utilizing the exact same resources.
12. In Sousa's test of the intermediate disturbance hypothesis in intertidal communities, communities with high levels of disturbance were those
- A. in which the experimenter changed the temperature frequently.
  - B. in which the experimenter changed light levels frequently.
  - C. on large boulders.
  - D. on small boulders.
  - E. in which predators were most abundant.
13. In the studies by Hacker and Gaines in a New England salt marsh, the presence of *Juncus* \_\_\_\_\_ species diversity, especially in the \_\_\_\_\_ intertidal zone.
- A. increased; high
  - B. decreased; low
  - C. decreased; high
  - D. decreased; middle
  - E. increased; middle
14. The total amount of photosynthesis is referred to as
- A. net primary production (NPP).
  - B. carbon fixation production (CFP).
  - C. net photosynthetic production (NPP).
  - D. gross photosynthetic production (GPP).
  - E. gross primary production (GPP).
15. In which of the following biomes would you most likely see the greatest percentage of NPP devoted to roots?
- A. Pine savannas of Belize
  - B. Tundra of Alaska
  - C. Boreal forests of Russia
  - D. Tropical forest of Panama
  - E. Temperate forests of North America

## 二、簡答題(共 70 分，每題 7 分)

1. What is the formal definition of a community? Why is incorporating species interactions important to the definition? What kinds of characteristics of communities can be used as a guide to define a community in practical terms?
2. Describe the differences between primary and secondary succession and what they mean for colonizing species.
3. Describe the factors believed to have created biogeographic regions on land and in the oceans.

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4. Describe the interaction between figs and their pollinated wasps.
5. Compare and contrast the predators and parasites.
6. Describe the three generalized types of survivorship curves.
7. How to estimate population abundances and distributions?
8. What is ecological footprint? How to calculate it for a nation?
9. How ecological preferences of  $C_4$  and  $C_3$  plants differ?
10. Describe the vegetation zones along the altitude in Taiwan.

# 國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：生物化學【生科系碩士班乙組】

題號：421001

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁 第 1 頁

1. Protein structure can be described in terms of four levels of organization. (1) Describe each level of protein structure. (2) Describe how each level of protein structure is maintained. (20 分)
2. Two-dimensional gel electrophoresis is a separation technique which uses isoelectric focusing in one dimension and SDS-polyacrylamide gel electrophoresis (SDS-PAGE) in the second dimension. Describe how this technique is used in protein purification and characterization. (15 分)
3. Enzymes are remarkably biochemical catalysts. Describe three distinctive features which enzymes have in common. (15 分)
4. The Michaelis-Menten equation  $v = V_{\max}[S]/(K_m + [S])$  describes that the initial rate ( $v$ ) of an enzyme-catalyzed reaction is determined by two constants ( $V_{\max}$  and  $K_m$ ) and the initial concentration of substrate ( $[S]$ ). (20 分)
  - (1) What is the major assumption used in the derivation of the Michaelis-Menten equation?
  - (2) Describe the importance of  $V_{\max}$  and  $K_m$  in enzyme kinetics
  - (3) Describe how to determine the values of  $V_{\max}$  and  $K_m$  more accurately
  - (4) Can the Michaelis-Menten equation be applied to allosteric enzymes? Explain.
5. Each class of biomolecules has a variety of functions. Describe any two functions of (1) proteins, (2) carbohydrates, and (3) lipids with specific examples. (15 分)
6. Metabolism serves two different purposes: the generation of energy and the synthesis of biological molecules. To achieve these purposes, metabolism consists largely of two contrasting processes: catabolism and anabolism. Compare and contrast catabolism and anabolism. (15 分)

# 國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

題號：421003

※本科目依簡章規定「不可以」使用計算機(混合題)

共 6 頁第 1 頁

## 一、選擇題每題 1 分(25%) 單選

1. What word below refers to a pair of homologous chromosomes?  
A) chromophores B) bivalent C) birefringence D) bilateral E) nucleolus
2. What was the first treatment to be shown to be mutagenic?  
A) ultraviolet irradiation B) infrared irradiation C) X-rays D) microwaves E) radio waves
3. What is the name of chromosomes that have as many as 1024 times the number of DNA strands usually present?  
A) polymorphic chromosomes B) polytene chromosomes C) homologous chromosomes  
D) heterozygous chromosomes E) papillosomes
4. The building blocks of a nucleotide are \_\_\_\_\_.  
A) a pentose sugar and a phosphate group  
B) a pentose sugar and a nitrogenous base  
C) a phosphate group and a nitrogenous base  
D) a pentose sugar, a phosphate group and a nitrogenous base  
E) a pentose sugar, a phosphate group and an amino acid
5. You isolate DNA from a particular organism and analyze it. The amount of adenine was 6  $\mu$ moles and the A+T/G+C ratio is 4.0. How much thymine would be found in the sample?  
A) 6  $\mu$ moles B) 3  $\mu$ moles C) 1.5  $\mu$ moles D) 4  $\mu$ moles E) 12  $\mu$ moles
6. What gives a DNA molecule its negative charge?  
A) deoxyribose B) ribose C) phosphate groups D) chlorine ion E) adenine
7. What is one explanation for the wide discrepancies in genome sizes from species to species?  
A) More advanced organisms have more DNA.  
B) Genomes have an extremely variable number of repeated DNA sequences that do not code for proteins.  
C) Some organisms have multiple repeats of each gene.  
D) More advanced organisms have more genes.  
E) More advanced organisms have more centromeric DNA.
8. \_\_\_\_\_ is thought to be derived from a reverse transcriptase encoded by an ancient retrotransposon.  
A) Phosphatase B) Esterase C) Telomerase D) Protein kinase E) Phosphodiesterase
9. Why has the One Gene – One Polypeptide hypothesis had to be modified?  
A) It was totally wrong.  
B) Genes can be spliced differently to generate a variety of related polypeptides.  
C) Enzymes sometimes consist of more than one polypeptide, each of which is coded for by its own gene.  
D) Enzymes actually code for genes.  
E) Polypeptides code for genes.
10. The site on DNA to which RNA polymerases bind before initiating transcription is called the \_\_\_\_\_.  
A) terminator B) operator C) promoter D) enhancer E) silencer
11. Which eukaryotic RNA polymerase synthesizes the larger rRNAs, like 28S, 18S and 5.8S rRNAs?  
A) RNA polymerase I B) RNA polymerase II C) RNA polymerase III  
D) RNA polymerase IV E) RNA polymerase V

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12. What is responsible for synthesizing hnRNAs?  
A) RNA polymerase I                      B) RNA polymerase II                      C) RNA polymerase III  
D) reverse transcriptase                      E) general transcription factors
13. What molecule is TFIIH known to phosphorylate?  
A) a G protein                                  B) RNA polymerase II                      C) RNA polymerase IV  
D) peptidyltransferase                      E) DNA helicase
14. The 3' end of most eukaryotic mRNAs contains a \_\_\_\_\_, while the 5' end has a \_\_\_\_\_.  
A) poly(A) tail, methylated guanosine cap                      B) poly(U) tail, methylated guanosine cap  
C) methylated guanosine cap, poly(A) tail                      D) poly(A) tail, sulfonated guanosine cap  
E) methylated guanosine cap, poly(U) tail
15. The macromolecular complex that associates with each intron and splices it is called a(n) \_\_\_\_\_.  
A) splicer    B) acrosome    C) spliceosome    D) splicing body    E) splice engine
16. Why is it thought that RNAi may have evolved to protect the cell from viral infection and replication and/or the movement of transposons within the genome?  
A) Both processes involve RNA binding to DNAs.  
B) Both involve RNA binding to specific cellular proteins.  
C) Both processes typically involve the formation of double-stranded RNA intermediates.  
D) Both processes typically involve the formation of double-stranded DNA intermediates.  
E) Both processes typically involve the formation of single-stranded RNA intermediates.
17. What is the significance of the variability of the third nucleotide in a codon?  
A) Each tRNA can recognize and bind its own codon.  
B) Each tRNA can recognize and bind its own amino acid.  
C) The same tRNA can recognize more than one codon.  
D) The same tRNA can recognize more than one anticodon.  
E) The same anticodon can recognize more than one amino acid.
18. After an amino acid is adenylated in the first step of the activation of a tRNA, where is the adenylated amino acid found?  
A) bound to ATP                                  B) bound to the aminoacyl-tRNA synthetase  
C) bound to peptidyltransferase                      D) floating free in the nucleus  
E) floating free in the cytoplasm
19. Peptide bond formation is accomplished as the amine nitrogen of the aa-tRNA in the \_\_\_\_\_ carries out a \_\_\_\_\_ of the amino acid bound to the \_\_\_\_\_.  
A) A site, nucleophilic attack on the carbonyl carbon, tRNA of the P site  
B) P site, nucleophilic attack on the carbonyl carbon, tRNA of the A site  
C) A site, acidophilic attack on the carbonyl carbon, tRNA of the P site  
D) A site, electrophilic attack on the carbonyl carbon, tRNA of the P site  
E) P site, electrophilic attack on the carbonyl carbon, tRNA of the A site
20. The upstream activator sequences (UASs) of yeast are analogous to \_\_\_\_\_ in higher eukaryotes.  
A) promoters                      B) TATA boxes                      C) operators                      D) enhancers

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21. Because of the imprecision of molecular joining, recombination between LV and J regions shows considerable variation. This regulation is called DNA \_\_\_\_\_?  
A) transmutation B) rearrangement C) modification D) conjugation E) transduction
22. A DNA microarray (also called a DNA chip) can be used to \_\_\_\_\_.  
A) isolate genes from eukaryotic cell nuclei  
B) assay protein output from a genomic database  
C) mutate genes of interest  
D) trap genes that are both active and inactive  
E) scan a population of nucleic acids for abundance
23. *Proteomics* is the \_\_\_\_\_.  
A) harvesting of proteins from a cell to determine their economic value  
B) manipulation of amino acid sequences in proteins to alter their function  
C) process of defining the complete set of proteins encoded by a genome  
D) changing of the terminal sequences of proteins to alter their function  
E) rational design of drugs based on protein structure
24. The sequences 5'-GTCACGACTAGCCATCAGCCTG-3' contain a six-nucleotide inverted repeat, it is \_\_\_\_\_.  
A) GTCACG B) CACGAC C) CGACTA D) ACTAGC
25. Eukaryotic genomes have several features not found in prokaryotes, not including  
A) Gene density B) Introns C) Repetitive sequences D) Promoters

二、選擇題每題 1.5 分(15%) 單選

26. When a gene has been duplicated one or more times, what are the possible things that can happen to the duplicated gene?  
A) The duplicated gene can accumulate favorable mutations and acquire a new function.  
B) The duplicated gene can be lost during evolution through deletion.  
C) The duplicated gene can be rendered nonfunctional by unfavorable mutations.  
D) If there are two copies of the gene, both could undergo mutation so that each evolves a more specialized function than the original gene.  
E) All of these are correct.
27. A transposable element is a type of genetic parasite that can invade a host genome from the outside world, spread within the genome and be transmitted to offspring. Under what circumstances, would a transposable element not be able to accomplish this?  
A) if it has serious adverse effects on the ability of the host to survive and reproduce  
B) if it does not have serious adverse effects on the ability of the host to survive and reproduce  
C) if it speeds up the activity of amylase  
D) if it slows down the activity of triosephosphate isomerase  
E) if it increases the rate at which an organism can sense time
28. Which of the following is not a normal property of eukaryotic mRNAs?  
A) They contain a continuous nucleotide sequence encoding a specific polypeptide.  
B) They are found in the cytoplasm and inside the Golgi complex.  
C) They are attached to ribosomes when they are translated.  
D) Most have a significant noncoding segment that does not direct assembly of amino acids.  
E) Eukaryotic mRNAs have special modifications at their 5' and 3' termini.

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29. Before the genetic code was actually known, Francis Crick predicted that it was degenerate. What piece of evidence led him to make this prediction?
- A) All proteins looked the same.
  - B) All proteins were made of amino acids.
  - C) He noted that the base composition of the DNAs of various bacteria varied greatly while the amino acid composition of their proteins varied very little overall.
  - D) He noted that the base composition of the DNAs of various bacteria varied little while the amino acid composition of their proteins varied greatly overall.
  - E) The code was nonoverlapping.
30. Which of the following clusters of terms applies when addressing *enhancers* or *silencers* as elements associated with eukaryotic genetic regulation?
- A) *cis*-acting, fixed position, fixed orientation
  - B) *trans*-acting, fixed position, fixed orientation
  - C) *cis*-acting, variable orientation, variable position
  - D) *cis*-acting, variable position, fixed orientation
  - E) *trans*- and *cis*-acting, variable position
31. A major difference between the *E. coli lac* and *ara* operons is that \_\_\_\_\_.
- A) the substrate of the enzyme coded by *ara* is not the inducer
  - B) the *ara* regulator protein interacts with two regions of the operon
  - C) *ara* does not have a CAP-binding site
  - D) *ara* is expressed constitutively
  - E) *ara* does not have an operator site
32. Under strictly controlled conditions, a probe can be used that will hybridize only with its complementary sequence and not with other sequences that may vary by as little as one nucleotide. What are such probes called?
- A) generation-specific probes
  - B) short, variable repeats
  - C) VNTRs
  - D) microsatellites
  - E) allele-specific oligonucleotides (ASOs)
33. The human genome contains approximately 20,000 protein-coding genes, yet it has the capacity to produce several hundred thousand gene products. What can account for the vast difference in gene number and product number?
- A) Alternative splicing occurs.
  - B) There are more introns than exons.
  - C) There are more exons than introns.
  - D) Much of the DNA is in the form of trinucleotide repeats, thus allowing multiple start sites for different genes.
  - E) Every gene can be read in both directions, and each gene can have inversions and translocations.
34. Following are four processes common to most cloning experiments. (a) transforming bacteria, (b) plating bacteria on selective medium, (c) cutting DNA with restriction endonucleases, (d) ligating DNA fragments. Which order would be the most likely occur during a cloning experiment.
- A) abcd
  - B) cdba
  - C) acdb
  - D) cdab
35. Assume that a plasmid (circular) is 3200 base pairs in length and has restriction sites at the following locations: 400, 700, 1400, 2600. Give the expected sizes of the restriction fragments following complete digestion.
- A) 400, 800, 1000 (2 of these)
  - B) 300, 700, 2200
  - C) 700, 400, 1400, 2600
  - D) 300, 700, 1000, 1200



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## 三、解釋下列名詞 (10%)

1. Restriction fragment length polymorphisms (RFLP)
2. Fluorescent *in situ* hybridization (FISH)
3. chromatin immunoprecipitation (ChIP) assay
4. cDNA library
5. polymerase chain reaction (PCR)

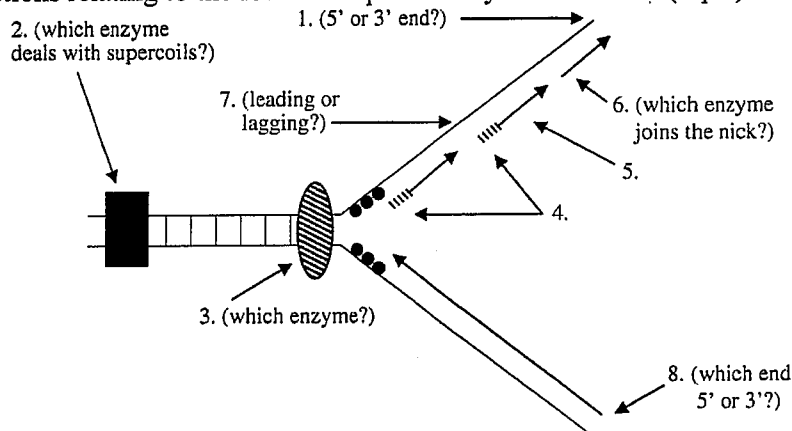
## 四、配合題 (6%): Match up the important persons and their significant discoveries

1. Avery
2. Watson and Crick
3. Frederick Griffith
4. Jacob and Monod
5. Howard Temin
6. Hershey and Chase

- a. generate X-ray diffraction photograph of DNA
- b. resolve a double-helical model for the structure of deoxyribonucleic acid
- c. prove DNA replication is semiconservative.
- d. proposed the regulation of the *lac* operon model to explain gene regulation
- e. discover the retroviruses' replication involved in reverse transcriptase
- f. discover the DNA polymerase for DNA replication
- g. transformation experiment
- h. identify transforming factor.
- i. "radio-labelled phage" experiment to prove DNA carries genetic materials.

## 五、問答題(44%)

1. Below is a diagram of DNA replication in *E. coli*. From specific points, arrows lead to numbers. Answer the questions relating to the locations specified by the numbers. (8 pts)



- (a) Which end (5' or 3') of the molecule is here?
  - (b) Which enzyme is probably functioning here to deal with supercoils in the DNA?
  - (c) Which enzyme is probably functioning here to unwind the DNA?
  - (d) Which nucleic acid is probably depicted here?
  - (e) What are these short DNA fragments usually called?
  - (f) Which enzyme functions here to couple these two newly synthesized fragments of DNA?
  - (g) Is this strand the leading or lagging strand?
  - (h) Which end (5' or 3') of the molecule is here?
2. List three major structural classifications of DNA-binding domains that are found in eukaryotic transcription factors. (3 pts)
  3. Name three consensus sequences or modular DNA sequences that exist upstream from the coding regions of some eukaryotic genes. (3 pts)

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4. Please describe the basic components of a cloning vector. (5pts)
5. Please describe how to use yeast two-hybrid system to identify protein-protein interaction? (hint: DNA binding domain (DBD), Activation domain (AD), reporter gene, such as *lacZ* or *Luciferase* gene) (5pts)
6. The following table lists several genotypes associated with the *lac* operon in *E. coli*. For each, indicate with a "+" or "-" whether active  $\beta$ -galactosidase would be expected to be produced at induced levels. (Assume that glucose is not present in the medium.) (5 pts)

Genotype	$\beta$ -galactosidase production	
	No Lactose	with Lactose
$I^+ O^+ Z^+$ (wild type)	--	+
a) $I^- O^+ Z^+$	---	---
b) $I^+ O^c Z^+$	---	---
c) $I^- O^+ Z^+ / F' I^+$	---	---
d) $I^- O^+ Z^+ / F' O^+$	---	---
e) $I^s O^+ Z^+$	---	---

$I^+$  = wild-type repressor

$I^-$  = mutant repressor (unable to bind to the operator)

$I^s$  = mutant repressor (insensitive to lactose)

$O^+$  = wild-type operator

$O^c$  = constitutive operator (insensitive to repressor)

7. What is the difference between telomerase in cancer cells and telomerase in normal somatic cells of an adult, and what is the significance of that difference? (5 pts)
8. What does the term "replication licensing" refer to in the process of eukaryotic DNA replication? (5 pts)
9. In what types of cells do the piRNAs act? Why is it important to suppress transposition events in the germline? (5 pts)

# 國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：普通生物學【生科系碩士班】

題號：421004

※本科目依簡章規定「不可以」使用計算機（問答申論題）

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問答題(每一題配分請見題目後方說明，建議同時使用圖表與文字表達你的觀點。任何的文字達皆應注意文字的順暢、邏輯的清晰、段落的安排，與書寫答案時排版的整齊)

1. 2014 年底爆發的禽流感造成相當大的經濟損害，防檢局與家衛所宣稱此次入侵台灣的四個病毒株都是候鳥同時帶到台灣，絕對不是由已經存在保毒於台灣禽場中的病毒株再度復發，或經由病毒重組而造成的疫情。此外，目前除了雞、鴨與鵝外，有留鳥與候鳥皆被檢測出不同的病毒株，且在東西部都有。家衛所所者宣稱東部的病毒株應該是候鳥帶過去的。然而有媒體與學者對以上見解表示不以為然。有人認為有些病毒株可能來自於業者偷打劣質減毒疫苗所形成的，也有人認為把責任都推給候鳥是想轉移禽場管理不當的焦點。如果現在政府有求於你，希望你幫忙解決病毒的來源究竟是由候鳥帶來？在禽場中保毒後再度復發？或兩者都有？然後究竟有沒有可能來自不當的減毒疫苗？請問你打算如何使用親緣關係理論(phylogenetic theory)來回應這個問題？(20 分)

2. 為了要瞭解台灣淺山溼地湖沼的物種多樣性，以及這些棲地被外來種入侵的程度，某老師的團隊把以下物種當成目標物種進行監測，如果你是某老師的研究助理，老師要求你選定北中南東 10 個地方，並設定預計誘捕與採集的生物，請問你想要選擇那些地方？每個地方可以監測什麼物種？是否會建議老師排除或加入那些物種？原因為何？請加上台灣地圖說明你的規畫(以下是老師原本設定的物種，此題 20 分)

- A. 泰國鱧
- B. 中國藍鵲
- C. 小花蔓澤蘭
- D. 福壽螺
- E. 香魚
- F. 美國螯蝦
- G. 布袋蓮

3. 台東池上鄉最近又要搶救金城武樹(是一株茄苳樹)，因為地方人士認為遊客一直去合照打卡有礙植物的復原。但也有人認為那個地方本來就不適合茄苳生長，倒了只是剛好而已。請你就你對茄苳這種樹的瞭解，以及對植物生理的知識，說明金城武樹有救嗎？為什麼？(20 分)

4. 有學者建議要在苗栗劃設石虎保護區，結果引起居民的不滿和抗議。主要是因為石虎的棲地與人類聚落及土地利用方式重疊，而且石虎長期被栽贓成偷吃雞的兇手。也有學者認為如果苗栗不要石虎保護區，石虎又一直被路殺，那就只好把石虎搬到翡翠水庫去復育。可是又有學者指出這樣還是會有問題。請你就族群遺傳學的觀點說明：棲地零碎化與路殺對石虎保育的衝擊是什麼？然後移地復育的必要性，以及會成功的前提為何？(20 分)

5. 自從多個颱風重創台灣之後，水利與工程單位就應所謂地方民意要求大肆整治溪流，使得台灣幾乎所有溪流都被水泥化，到中游都無法倖免。水利單位認為，唯有以水泥做成的護岸才能保持河道暢通，但保育單位認為，把所有的溪流水泥化不利生物多樣性。如果現在有機會給你兩年做個實驗，要向水利單位證實天然護岸或生態工法，相較於傳統混凝土護岸工法有利水土保持與生物多樣性，請問你認為應該要監測什麼樣的生物與非生物因子？而且因子的分析又為什麼能夠回應這個議題？(20 分)