

國立中山大學九十三年學年度碩士班招生考試試題

科目：普通生物學 生科所(甲、乙、丙組)

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一、單選題：(請注意答案卷有一定的格式，選擇「最恰當」的一個答案，填寫在答案卷「所指定的位置」中，只有在指定位置中的答案才予以計分，50%)

1. The naturalist who synthesized a concept of natural selection independently of Darwin was
(A) Charles Lyell. (B) Gregor Mendel. (C) Alfred Wallace. (D) John Henslow.
(E) Thomas Malthus.
2. Of the following anatomical structures, which is homologous to the wing of a bat? The (A) dorsal fin of a shark (B) tail of a kangaroo (C) wing of a fly (D) tail fin of a fish (E) arm of a human
3. Which of the following is the unit of evolution? In other words, which of the following can evolve in the Darwinian sense? (A) gene (B) chromosome (C) individual (D) population (E) species
4. In a population that is in Hardy-Weinberg equilibrium, the frequency of the allele a is 0.3. What is the percentage of the population that is heterozygous for this allele? (A) 3 (B) 9 (C) 21 (D) 30 (E) 42
5. The biological species concept is inadequate for grouping (A) plants. (B) parasites. (C) asexual organisms. (D) endemic populations. (E) sympatric populations.
6. According to the concept of punctuated equilibrium, the "sudden" appearance of a new species in the fossil record means that (A) the species is now extinct. (B) speciation occurred instantaneously. (C) speciation occurred in one generation. (D) speciation occurred over many thousands of years. (E) the species will consequently have a relatively short existence, compared to other species.
7. Which of the following terms best describes the process in which organisms reach sexual maturity while retaining some juvenile characteristics? (A) homeotic gene expression (B) allometric growth (C) cladogenesis (D) paedomorphosis (E) sexual selection
8. If the half-life of carbon-14 is about 5,730 years, then a fossil that has one-eighth the normal proportion of carbon-14 to carbon-12 is probably _____ years old. (A) 1,400 (B) 2,800 (C) 11,200 (D) 16,800 (E) 22,400
9. The correct sequence from the most to the least comprehensive of the taxonomic levels listed here is (A) family, phylum, class, kingdom, order, species, and genus. (B) kingdom, phylum, class, order, family, genus, and species. (C) kingdom, phylum, order, class, family, genus, and species. (D) phylum, kingdom, order, class, species, family, and genus. (E) phylum, family, class, order, kingdom, genus, and species.
10. Which technique provides the most important information for determining whether a particular character is a shared derived character or a shared primitive character? (A) a molecular clock (B) outgroup comparison (C) radiometric dating (D) amino acid sequencing (E) radioactive labeling
11. The first genetic material was most likely a(n) (A) DNA polymer. (B) DNA oligonucleotide. (C) RNA polymer. (D) protein. (E) protein enzyme.
12. The antibiotics known as penicillins inhibit the ability of certain bacteria to (A) form spores. (B) perform respiration. (C) replicate DNA. (D) synthesize proteins. (E) synthesize cell walls.
13. Protists are ecologically important in all of the following ecosystems except (A) freshwater systems. (B) marine phytoplankton. (C) antarctic dry valleys. (D) parasitic ones. (E) pathogenic systems.

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14. The most recent common ancestors of all land plants were most likely similar to modern-day members of which group? (A) Cyanobacteria (B) Rhodophyta (red algae) (C) Charophyceae (D) Phaeophyta (brown algae) (E) Chrysophyta (golden algae)
15. Plant spores give rise directly to (A) sporophytes. (B) gametes. (C) gametophytes. (D) zygotes. (E) seeds.
16. The sori of ferns are analogous to which structures? (A) spores of bryophytes (B) capsules of moss sporophytes (C) gametangia of hornwort gametophytes (D) protonemata of moss gametophytes (E) strobili of horsetail sporophytes
17. Which of the following terms is equivalent to fertilization? (A) spore dispersal (B) fruit formation (C) pollination (D) fusion of gametes (E) meiosis
18. Which function is, at least partly, performed by cells that are no longer alive? (A) stomatal opening and closing in angiosperms (B) water transport in angiosperms (C) water transport in gymnosperms (D) structural support in gymnosperms (E) transport of sugars in gymnosperms
19. Pistils and stamens are (A) sporophyte plants in their own right. (B) gametophyte plants in their own right. (C) gametes. (D) spores. (E) modified sporophylls.
20. Which part of the female gametophyte contributes to the formation of endosperm upon successful fertilization? (A) egg (B) synergids (C) antipodal cells (D) polar nuclei (E) sperm
21. Which of the following do all fungi have in common? (A) meiosis in basidia (B) coenocytic hyphae (C) sexual life cycle (D) absorption of nutrients (E) symbioses with algae
22. What do fungi and arthropods have in common? (A) Both groups are commonly coenocytic. (B) The haploid state is dominant in both groups. (C) Both groups are predominantly saprobic in nutrition. (D) Both groups use chitin for the construction of protective coats. (E) Both groups have cell walls.
23. The sporangia of bread molds are (A) asexual structures that produce haploid spores. (B) asexual structures that produce diploid spores. (C) sexual structures that produce haploid spores. (D) sexual structures that produce diploid spores. (E) vegetative structures with no role in reproduction.
24. Mushrooms and toadstools are classified as (A) basidiomycetes. (B) ascomycetes. (C) deuteromycetes. (D) zygomycetes. (E) chytridiomycetes.
25. Lichens are symbiotic associations of fungi and (A) mosses. (B) cyanobacteria. (C) green algae. (D) Both A and B are correct. (E) Both B and C are correct.
26. Microfilaments participate in the formation of (A) flagella. (B) mitotic spindles. (C) basal bodies. (D) cell cleavage furrows. (E) cilia
27. Of the following, which is the most important role of exocytosis? (A) to pump protons (B) to move away from danger (C) to incorporate nutrients (D) to create new cells (E) to release substances from the cell
28. Muscle cells in oxygen deprivation convert pyruvate to _____ and in this step gain _____. (A) alcohol; ATP (B) alcohol; CO₂ (C) lactate; ATP (D) lactate; NAD⁺ (E) ATP; NAD⁺
29. Proteins that are involved in the regulation of the cell cycle, and that show fluctuations in concentration during the cell cycle, are called (A) kinetochores. (B) centrioles. (C) cyclins. (D) proton pumps. (E) ATPases.

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30. A 9 purple to 7 white phenotype in sweet peas in the F₂ generation most likely is due to
(A) pleiotropy. (B) trisomy 21. (C) crossing over. (D) epistasis. (E) linkage.
31. What is the primer that is required to initiate the synthesis of a new DNA strand? (A) RNA
(B) protein (C) ligase (D) DNA (E) primase
32. What is one function of a signal peptide? (A) to signal the initiation of transcription (B) to
terminate translation of the messenger RNA (C) to direct an mRNA molecule into the cisternal
space of ER (D) to bind RNA polymerase to DNA and initiate transcription (E) to attach
ribosomes synthesizing secretory proteins to the ER
33. What is the function of the operator locus of an inducible operon? (A) producing repressor
molecules (B) producing messenger RNA (C) binding steroid hormones (D) identifying the
substrate lactose (E) permitting transcription
34. If a cell were unable to produce histone proteins, which of the following would be expected?
(A) An increase in the amount of "satellite" DNA produced during centrifugation. (B) The
amplification of other protein genes would compensate for the lack of histones. (C) Spindle
fibers would not form during prophase. (D) Chromosomes would not form during prophase.
(E) Pseudogenes would be transcribed to compensate for the decreased protein in the cell.
35. Why is it difficult to get bacteria to express genes directly from eukaryotic DNA? (A) Eukaryotic
genes do not contain enhancer sequences. (B) Eukaryotic genes may contain transposons.
(C) Eukaryotic genes are not transcribed in a single transcript. (D) Eukaryotic genes contain
introns. (E) Eukaryotic genes lack controlling regions.
36. One striking difference between development in plants and development in animals is the
importance of cell _____ in animal embryos. (A) division (B) differentiation (C) growth
(D) death (E) movement
37. The primary ecological role of prokaryotes is (A) metabolizing materials in extreme environments.
(B) to show that a diverse group of organisms can be remarkably similar in many ways.
(C) parasitizing eukaryotes, thus causing diseases. (D) to show that cells can exist without cell
walls. (E) the decomposition of organic matter.
38. Eukaryotic organisms are responsible for all of the following human diseases EXCEPT
(A) giardiasis. (B) malaria. (C) syphilis. (D) African sleeping sickness. (E) tuberculosis.
39. Which of the following is NOT generally an animal characteristic? (A) nervous and muscle tissue
(B) multicellularity (C) autotrophic nutrition (D) unique types of intercellular junctions such as
tight and gap (E) sexual reproduction
40. A lophophore is used by bryozoans, phoronids, and brachiopods (A) as a larval stage. (B) for
feeding. (C) for locomotion. (D) as a skeletal system. (E) for sensory reception.
41. Which is NOT characteristic of all mammals? (A) have a diaphragm to assist in ventilating the
lungs (B) give birth to live young (viviparous) (C) have hair during at least some period of their
life (D) a four-chambered heart that prevents mixing of oxygenated and deoxygenated blood
(E) have glands to produce milk to nourish their offspring
42. The body's automatic tendency to maintain a constant internal environment is termed (A) static
equilibrium. (B) negative feedback. (C) homeostasis. (D) physiologic control. (E) organ
system function.

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43. What are essential amino acids? (A) those amino acids that are generally more abundant in vegetables than in meat (B) one class of vitamins that is indispensable for neurological development (C) molecules that can't be synthesized by most animals (D) the only amino acids found in human proteins (E) those that are absent in fruits and vegetables
44. Which of the following features do all gas exchange systems have in common? (A) They are enclosed within ribs. (B) They are found only in animals. (C) They are exposed to air. (D) The exchange surfaces are moist. (E) They are maintained at a constant temperature.
45. The MHC (major histocompatibility complex) is important in (A) distinguishing self from nonself. (B) identifying bacterial pathogens. (C) recognizing parasitic pathogens. (D) identifying abnormal cells. (E) Both A and D are correct.
46. All of the following are functions of the mammalian kidney EXCEPT (A) water retention. (B) production of urea as a waste product of protein catabolism. (C) regulation of salt balance in the blood. (D) filtration of blood. (E) excretion of nitrogenous waste.
47. Hormones are able to control homeostasis because (A) they are present at low concentrations. (B) they are subject to negative feedback. (C) they are steroids. (D) they may be found in the lymphatic system. (E) they are not produced by exocrine glands.
48. Which of the following is a form of asexual reproduction? (A) protogyny (B) anadromesis (C) hermaphroditism (D) parthenogenesis (E) protandry
49. The cortical reaction functions directly in the (A) production of a fast block to polyspermy. (B) generation of a nerve-like impulse by the egg cell. (C) formation of a fertilization membrane. (D) the fusion of egg and sperm nuclei. (E) release of hydrolytic enzymes from the sperm cell.
50. Which part of the vertebrate nervous system is most involved in preparation for "fight or flight"? (A) central (B) visceral (C) somatic (D) sympathetic (E) parasympathetic

二、問答題：(請依先後次序回答於答案卷上，50%)

1. Describe the composition, structure, and function of the extracellular matrix (ECM) of animal cells. (10 points)
2. Explain the following biological terms: (A) scolex (B) intracellular receptor (C) circadian rhythm (D) chromosome walking (E) epitope (15 points)
3. Discuss the possible role of plant hormones in apical dominance. (5 points)
4. Draw a cross section figure of a typical dicot root and label the internal structures. (10 points)
5. Describe the logistic model of population growth. (10 points)

單選題 (40 分)

1. In order to display cooperative kinetics, an enzyme must have all these characteristics, except:
 - (1) Multiple subunits
 - (2) A value for the Michaelis constant, K_m
 - (3) Allosteric sites that affect the substrate binding to the active site
 - (4) Ability to display a V_{max}

2. Enzyme inhibition has proven to be useful in the treatment of the following diseases, except:
 - (1) AIDS
 - (2) Lactose intolerance
 - (3) Virus infection
 - (4) Gout

3. The Michaelis-Menten constant has all of the following characteristics, except:
 - (1) It is similar to the affinity constant between the enzyme and substrate
 - (2) The dimension for the Michaelis-Menten constant is concentration, such as molarity
 - (3) The Michaelis-Menten constant determines the V_{max}
 - (4) It is the substrate concentration necessary to reach 0.5 V_{max}

4. Two-dimensional electrophoresis usually exploits these two different properties of proteins:
 - (1) Molecular weight and shape
 - (2) Molecular weight and net charge
 - (3) Molecular weight and pH
 - (4) Shape and net charge

5. The following amino acid causes a kink or bend in the α -helix.
 - (1) Ala
 - (2) Glu
 - (3) Lys
 - (4) Pro

6. Under normal circumstances:
 - (1) Adult hemoglobin binds to O_2 more tightly than myoglobin binds
 - (2) Fetal hemoglobin binds to O_2 more tightly than adult hemoglobin
 - (3) Adult hemoglobin binds to O_2 more tightly than either fetal

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科目：生物化學 【生物科學系碩士班 甲、乙組】

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- hemoglobin or myoglobin binds
- (4) Myoglobin has the lowest affinity for O_2 of the three
7. Which of these hormones causes elevation of the level of glucose in human blood?
- (1) Insulin (2) Glucagon
(3) Glucagon and epinephrine (4) Insulin and glucagons
8. The following reactions are all common part of some hormone processes.
- A: Binding of the hormone to a receptor
B: Synthesis of cyclic AMP
C: Phosphorylation of the target enzyme
D: Release of a G-protein from the interior cell membrane
E: Activation of a protein kinase
- A typical path of reactions would follow this sequence:
- (1) A → B → D → C → E
(2) A → D → B → C → E
(3) A → D → B → E → C
(4) A → B → D → E → C
9. The following dietary modifications are all potential ways of treating phenylketonuria (PKU).
- A: Limit phenylalanine
B: Omit phenylalanine
C: Omit phenyl-ketones, such as phenylpyruvate
D: Supplement tyrosine
- The following combination is the proper therapy for PKU:
- (1) Only A is necessary (2) Only B is necessary
(3) A and D are necessary (4) B and D are necessary
10. Humans produce these as the major nitrogen waste products.
- (1) Ammonia (2) Urea
(3) Uric acid (4) Both Urea and Uric acid
11. The following two amino acids are key to the transfers of amino groups during breakdown and synthesis of amino acids.
- (1) Glu and Asp (2) Glu and Arg

(3) Glu and Gln

(4) Asp and Gln

12. The following enzyme type is likely to have a large $-\Delta G^\circ$:

(1) Dehydrogenase

(2) Isomerase

(3) Kinase

(4) Phosphatase

13. All the following types of high-energy phosphate bonds are found in the intermediate compounds of glycolysis, except:

(1) Pyrophosphate bonds

(2) Mixed acid anhydrides

(3) Thioesters

(4) Enolphosphates

14. Linolenic acid is designated an "omega-three" ($\omega 3$) fatty acid. What does $\omega 3$ mean?

(1) It has a double bond between carbon 3 and 4

(2) It has a double bond between carbon 15 and 16

(3) It has three double bonds

(4) It has three carboxyl groups

15. What statement is incorrect about the triacylglycerols stored in adipocytes?

(1) Their fatty acid components are transported to the adipocytes primarily in lipoproteins

(2) They are synthesized in these cells from three fatty acids and glycerol

(3) They are stored as anhydrous droplets in the cytoplasm

(4) They store more metabolic energy per gram than does glycogen

16. The pentose phosphate pathway is especially important in human red blood cells (RBC) for all of these reasons, except:

(1) The NADPH product is especially important in maintaining a supply of reduced glutathione in the RBC

(2) Human RBC's need the pentose pathway as a source of deoxyribose to make DNA

(3) The pathway allows oxidative reactions that would not otherwise occur in RBC

(4) Human RBC's do not have mitochondria to allow utilization of molecular oxygen

17. The Cori cycle involves the following:
- (1) Conversion of lactate produced in the liver by regeneration of glucose in muscle
 - (2) Conversion of pyruvate produced in the muscle by regeneration of glucose in the liver
 - (3) Conversion of lactate produced in the muscle by regeneration of glucose in the liver
 - (4) The Cori cycle involves a different pathway from any of these
18. The enzyme glucose-6-phosphatase is only in cells which have this function or ability:
- (1) Ability to utilize glucose anaerobically
 - (2) Ability to replenish the levels of glucose in the blood
 - (3) Glycogen storage
 - (4) Glucose-6-phosphatase activity is found almost all types of cells
19. The process called substrate cycling is used to describe this process:
- (1) Freely reversible reactions
 - (2) Recycling of vitamins as catalysts in metabolism
 - (3) Situations where there are two different enzymes used to reverse a specific step in a metabolic pathway
 - (4) Metabolic pathways which run in cycles and regenerate the initial molecule
20. Branched polymers like glycogen are better for energy storage than linear molecules for all of these reasons, except:
- (1) Branched polymers are more accessible to enzymes since they bond more water
 - (2) All of the reducing ends of the branched polymers are available to release glucose
 - (3) All of the nonreducing ends of the branched polymer are available to release glucose
 - (4) Glycogen is more compact and stores more glucose molecules in a given volume

解釋名詞 (24 分)

1. Abzyme
2. Western blotting
3. Adenylate energy charge
4. DNA supercoiling
5. Fluorescence photobleaching recovery
6. Proteasome

問答題 (36 分)

1. Each type of protein molecule in its natural environment folds into a unique three-dimensional structure. Discuss the most important determinant in protein structure.
2. Draw a graph for each of the following kinetic situations.
 - (1) A plot of V_o versus $[E]$.
 - (2) A plot of V_o versus $[S]$ for an enzyme that obeys the Michaelis-Menten equation.
 - (3) A plot of V_o versus $[S]$ for an enzyme that obeys the Michaelis-Menten equation in the presence and absence of competitive inhibitor.
 - (4) A plot of V_o versus $[S]$ for an allosteric enzyme.
 - (5) A plot of V_o versus $[S]$ for an allosteric enzyme in the presence and absence of activator.
3. The uncoupling agent 2,4-dinitrophenol acts by making the inner mitochondrial membrane "leaky." Protons can readily diffuse through such a leaky membrane. Explain how this disrupts oxidative phosphorylation.
4. List strategies that are used by organisms to help facilitate, control, and coordinate the metabolic reactions that occur within them.

I. 選擇題：請自下列選擇題(1-15)各題選出單一最正確的答案。每題三分。45%

1. In the transcription control model of Jacob and Monod, a repressor protein binds
 - A. an enhancer
 - B. an operator
 - C. an AUG sequence
 - D. a ribosome-binding site
 - E. a TATA box
2. Which of the following is most likely to lead to a loss-of-function of a gene?
 - A. A change from T to C in the promoter region
 - B. A missense mutation in the open reading frame
 - C. A frameshift mutation in the coding region
 - D. A sequence change in the 3' untranslated region
 - E. A change from a TAA codon to a TAG codon in the coding region
3. Which of the following characteristics are the principles of separation of proteins in denaturing condition during two-dimensional (2-D) gel electrophoresis experiment?

First dimension	Second dimension
A. Hydrophobicity	Subunit molecular weight
B. Density	Charge
C. Subunit molecular weight	Density
D. Amino acid composition	Charge
E. Isoelectric point (pI)	Subunit molecular weight
4. The ribosome is involved in all of the following except
 - A. aminoacylation of tRNA
 - B. binding of aminoacyl tRNA to mRNA
 - C. peptide bond formation
 - D. binding of mRNA at an initiation codon
 - E. binding of protein factors during elongation
5. RNA molecules having catalytic activity are termed
 - A. ribonucleotides
 - B. ribonucleases
 - C. mRNAs
 - D. ribozymes
 - E. ribosomes
6. When *E. coli* are released from catabolite repression by transfer to low-glucose medium, which of the following sequential events occurs?
 - A. cAMP levels rise, cAMP binds to CAP, cAMP-CAP complex binds to a site on DNA and activates transcription.
 - B. cAMP levels fall, cAMP is removed from CAP, cAMP-CAP complex binds to a site on DNA and represses transcription.
 - C. cAMP levels rise, cAMP binds to CAP, cAMP-CAP complex binds to a site on DNA and represses transcription.
 - D. cAMP levels rise, cAMP binds to CAP, cAMP-CAP complex is removed from a site on DNA and activates transcription.
 - E. cAMP levels fall, cAMP is removed from CAP, cAMP-CAP complex binds to a site on DNA and activates transcription.

7. An *E. coli* mutant strain lacking DNA polymerase I would be deficient in
 - A. methylation
 - B. degradation
 - C. splicing
 - D. transcription
 - E. repair
8. "Leucine zippers" are important in cellular regulation because they are
 - A. at the catalytic site of many kinases
 - B. a structural motif in many DNA-binding proteins
 - C. characteristic of palindromic stretches of unique-sequence DNA
 - D. restricted to the cytoplasmic domain of growth-factor receptors
 - E. structures with high redox potential
9. A solution contains DNA polymerase I, Mg^{2+} salt of dTTP, dGTP, dATP, and dCTP, and an appropriate buffer. Which of the following DNA molecules would serve as a template for DNA synthesis when added to this solution?
 - A. A single-stranded closed circle
 - B. A single-stranded closed circle base-paired to a shorter linear strand with a 3'-terminal hydroxyl
 - C. A single-stranded closed circle base-paired to a shorter linear strand with a 3'-terminal phosphate
 - D. A double-stranded closed circle
 - E. A blunt-ended, double-stranded molecule with a 3'-terminal hydroxyl at each end
10. Which of the following is the most likely mechanism for the origin of multigene family?
 - A. Horizontal gene transfer
 - B. Viral infection
 - C. Endosymbiosis
 - D. Gene duplication
 - E. Convergent evolution of dissimilar genes
11. What type of linkage is created in the 5' capping process?
 - A. 5'-3'
 - B. 3'-5'
 - C. 5'-5'
 - D. 3'-3'
 - E. 5'-2'
12. What is the sequence recognized by poly(A) polymerase
 - A. TATAAA
 - B. TATTAT
 - C. CAA
 - D. CCCGAA
 - E. AAUAAA
13. Which of the following is not involved in the splicing reaction?
 - A. 5' splice site
 - B. Hairpin loops
 - C. 3' splice site
 - D. Branch A point
14. What links codons and anti-codons together during translation?
 - A. DNA ligase
 - B. Single-strand binding proteins
 - C. Complementary base-pairing
 - D. GTP
 - E. Ribosome
15. The overall rate of protein synthesis is determined by the rate of
 - A. Initiation
 - B. elongation
 - C. termination
 - D. translocation

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分子生物學【生物科學系一甲、乙組選考】

科目：

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II. 解釋下列名詞(16-20): 每題四分。20%

- 16. isoschizomers
- 17. Shine-Dargano sequence
- 18. RNA editing
- 19. microRNAs
- 20. chromatin remodeling

III. 問答題(21-23): 35%

- 21. A powerful and sensitive molecular biology method called the yeast two-hybrid system has been used in studying molecular cell biology of various biological fields. How does a yeast two hybrid system work and what is it used for? (15%)
- 22. List the steps you would need to perform if you wanted to do a Northern blot of a human gene, GSK, to see the status of the gene in mouse. You do not to write the details but make sure you list the common steps in all Northern blots. Also, describe the probe you would use. (10%)
- 23. Read the following paragraph carefully and make comments on this paragraph: (10%)
"Geneticists have long focused on just the small part of DNA that contains blueprints for proteins. The remainder-in humans, 98 percent of the DNA-was often dismissed as junk. But the discovery of many hidden genes that working through RNA, rather than protein, has overturned that assumption. These RNA-only genes tend to be short and difficult to identify. But some of them play major roles in the health and development of plants and animals."

By W. Wayt Gibbs, The Unseen Genome, Scientific American 2003 November.

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科目：動物生理學 (選考) 【生物科學系碩士班 甲組】

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1. Describe the roles of Renin-Angiotensin system in blood pressure control. (15%)
2. Phototransduction is a process that a photon of light captured by a molecule of visual pigment present in the rod cells which results in the generation of an electrical response in the photoreceptor cell. Please describe the signaling mechanisms used in phototransduction. (10%)
3. Explain the roles of insulin on glucose metabolism in muscle, brain and liver. (15%)
4. The Nobel Prize in Chemistry for 2003 is shared between two scientists, Peter Agre and Roderick MacKinnon, who have made fundamental discoveries concerning how water and ions move through cell membranes. What do you know about their works? (15%)
5. The method routinely used in measuring systolic and diastolic pressure is the "Auscultatory Method" (聽診器法). Describe the measuring protocols and the mechanisms therein. (10%)
6. Describe the neuronal mechanism of the "Flexor reflex". (10%)
7. Point 10 structural or functional differences between sympathetic and parasympathetic nervous system. (15%)
8. Describe the chemical control of respiration. (10%)

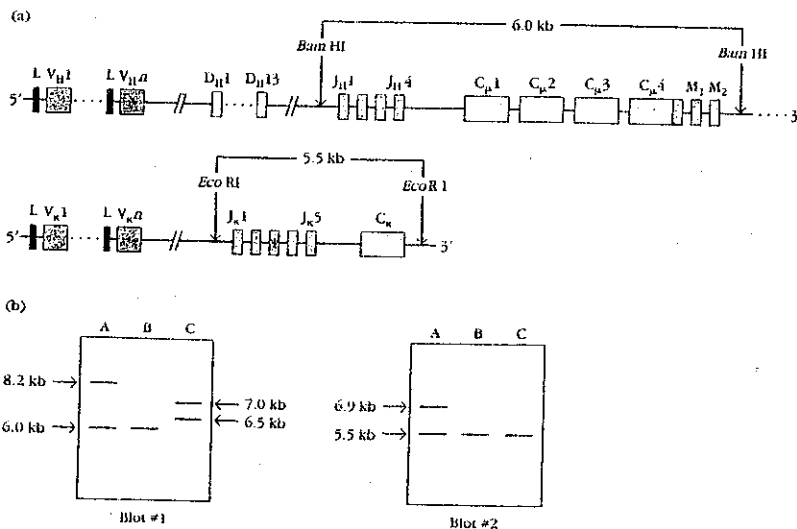
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科目：免疫學 (選考) 【生物科學系碩士班 甲組】

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一、問答題：共 75 分

1. What is DNA vaccine? How it works in inducing immune response against invading antigen? (20%)
2. Please describe the strategy that S. Hedrick and M. Davis used to clone T-cell receptor gene. (10%)
3. DNA was isolated from three sources: Liver cell, pre-B lymphoma cells, and IgM-secreting myeloma cells. Each DNA was digested separately with the restriction enzymes *Bam*HI and *Eco*RI, which cleave germ-line heavy-chain and kappa light-chain DNA, respectively, as indicated in part (a) of the diagram illustrated below. The digested samples were analyzed by Southern blot analysis using a radiolabeled $C_{\mu}1$ probe with the *Bam*HI digests (blot #1) and a radiolabeled C_{κ} probe with the *Eco*RI digests (blot #2). The blot patterns are illustrated in part (b) of the diagram. Based on this information, please indicate the cells from which each DNA sample(designated A, B, or C) was isolated and explain your assignments. (20%)



4. Please describe the biological consequences of complement activation. (10%)
5. Please describe how antigen induces humoral immune response. In your answer please indicate the in vivo site(s) where the humoral immune response is induced. (15%)

二、解釋名詞：每題 5 分，共 25 分

1. Carrier effect 2. affinity maturation 3. ELISA
4. Immunotoxin 5. opsonization

國立中山大學九十三年學年度碩士班招生考試試題

科目：植物生理學 (選考) 【生物科學系碩士班 乙組】

共 / 頁 第 / 頁

Plant Physiology

Questions: 100%

1. Describe the apoplast and symplast pathways for water uptake by the root.
2. Describe the Z scheme of photosynthesis.
3. Describe the C_4 photosynthetic pathway.
4. Describe the molecular model for the induction of α -amylase synthesis in barley aleurone layers by gibberellin.
5. Describe the model of ethylene signaling in *Arabidopsis*.

國立中山大學九十三年度碩士班招生考試試題

科目：微生物學 (選考) 【生物科學系碩士班 乙組】

共 / 頁 第 / 頁

Short questions (10 points each)

1. Why is it necessary to flame the mouth of a test tube before and after performing an inoculation?
2. Differentiate "Selective medium" with "Differential medium".
3. Differentiate "Phototroph" with "Prototroph".
4. Describe the principles of the "MR-VP test".
5. Briefly describe the procedures of performing a Gram staining.
6. Two types of prokaryotic cells have been distinguished: bacteria and archaea. How do these cells differ from each others? How are they similar?
7. *Clostridium* and *Streptococcus* are both catalase-negative. *Streptococcus* grows by fermentation. Why is *Clostridium* killed by oxygen, whereas *Streptococcus* is not?
8. Replication of the *Escherichia coli* chromosomes takes 40-45 minutes, but the organism has a generation time of 20 minutes. How does the cell have time to make complete chromosomes for each daughter cell?
9. Why might the influenza vaccine be less effective than other vaccines?
10. Define the term "bioremediation". Why is bioremediation a more attractive method of cleaning up oil spill than conventional methods?

國立中山大學九十三年度碩士班招生考試試題

科目：生物統計學 【生物科學系碩士班】【丙組選考】

共 2 頁 第 1 頁

Write down hypothesis for each test. (25% each)

1. The tibia lengths (mm) of three species of beetles were measured as below:

Species A: 2, 3, 3, 4, 5, 6, 6

Species B: 4, 4, 5, 6, 8, 9

Species C: 5, 7, 7, 8, 9

Are the tibia lengths of the three the same? $\alpha = 0.05$

2. The visits of butterflies on different flowers were recorded.

Butterfly	Flowers			
	<i>Tricyrtis</i> sp.	<i>Senecio</i> sp.	<i>Bredia</i> sp.	<i>Chrysanthemum</i> sp.
<i>Hebomoia</i> sp.	57	42	33	18
<i>Catopsilla</i> sp.	12	12	10	45

Is there any evidence that the two butterflies show different preference of visits on different flowers? $\alpha = 0.01$

3. The probabilities are 0.4, 0.3 and 0.1 that a lizard will prey on a millipede, a centipede, or both. Find the probabilities that

- (a) the lizard will prey on either millipede or on a centipede;
- (b) the lizard that is preying on a millipede will also prey on a centipede;

4. The diameters (mm) of left ventricle of 10 AMI patients were determined;

38, 40, 40, 45, 47, 47, 48, 49, 51, 52

- a. Calculate the mean diameter with 95% confidence interval
- b. Based on the confidence interval, is there any evidence that the mean diameter of the AMI patients is larger than 45 mm?

國立中山大學九十三年度碩士班招生考試試題

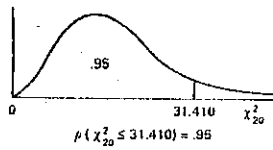
科目：生物統計學 【生物科學系碩士班】【丙組選考】

共 2 頁 第 2 頁

TABLE IV Critical Values of F^1
Values of $F_{\alpha, \beta, \gamma}$

	Degrees of freedom for numerator																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251	252	253	254
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.00	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.55	2.46	2.40	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.20	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

TABLE F Percentiles of the Chi-Square Distribution



d.f.	$\chi^2_{.995}$	$\chi^2_{.99}$	$\chi^2_{.95}$	$\chi^2_{.90}$	$\chi^2_{.85}$	$\chi^2_{.80}$	$\chi^2_{.75}$	$\chi^2_{.70}$	$\chi^2_{.65}$
1	.0000393	.000982	.00393	2.706	3.841	5.024	6.635	7.879	
2	.0100	.0506	.103	4.605	5.991	7.378	9.210	10.597	
3	.0717	.216	.352	6.251	7.815	9.348	11.345	12.838	
4	.207	.484	.711	7.779	9.488	11.143	13.277	14.860	
5	.412	.831	1.145	9.236	11.070	12.832	15.086	16.750	
6	.676	1.237	1.635	10.645	12.592	14.449	16.812	18.548	
7	.989	1.690	2.167	12.017	14.067	16.013	18.475	20.278	
8	1.344	2.180	2.733	13.362	15.507	17.535	20.090	21.955	
9	1.735	2.700	3.325	14.681	16.919	19.023	21.666	23.589	
10	2.156	3.247	3.940	15.987	18.307	20.483	23.209	25.188	
11	2.603	3.816	4.575	17.275	19.675	21.920	24.725	26.757	
12	3.074	4.404	5.226	18.519	21.026	23.336	26.217	28.300	
13	3.565	5.009	5.892	19.812	22.362	24.736	27.688	29.819	
14	4.075	5.629	6.571	21.064	23.685	26.119	29.141	31.319	
15	4.601	6.262	7.261	22.307	24.996	27.488	30.578	32.801	
16	5.142	6.908	7.962	23.542	26.296	28.845	32.000	34.267	
17	5.697	7.564	8.672	24.769	27.587	30.191	33.409	35.718	
18	6.265	8.231	9.390	25.989	28.869	31.526	34.805	37.156	
19	6.844	8.907	10.117	27.204	30.144	32.852	36.191	38.582	
20	7.434	9.591	10.851	28.412	31.410	34.170	37.566	39.997	
21	8.034	10.283	11.591	29.615	32.671	35.479	38.932	41.401	
22	8.643	10.982	12.338	30.813	33.924	36.781	40.289	42.796	
23	9.260	11.688	13.091	32.007	35.172	38.076	41.638	44.181	
24	9.886	12.401	13.848	33.196	36.415	39.364	42.980	45.558	
25	10.520	13.120	14.611	34.382	37.652	40.646	44.314	46.928	
26	11.160	13.844	15.379	35.563	38.885	41.923	45.642	48.290	
27	11.808	14.573	16.151	36.741	40.113	43.194	46.963	49.645	
28	12.461	15.308	16.928	37.916	41.337	44.461	48.278	50.993	
29	13.121	16.047	17.708	39.087	42.557	45.722	49.588	52.336	
30	13.787	16.791	18.493	40.256	43.773	46.979	50.892	53.672	
35	17.192	20.569	22.465	46.059	49.802	53.203	57.342	60.275	
40	20.707	24.433	26.509	51.805	55.758	59.342	63.691	66.766	
45	24.311	28.366	30.612	57.505	61.656	65.410	69.957	73.166	
50	27.991	32.357	34.764	63.167	67.505	71.420	76.154	79.490	
60	35.535	40.482	43.188	74.397	79.082	83.298	88.379	91.952	
70	43.275	48.758	51.739	85.527	90.531	95.023	100.425	104.215	
80	51.172	57.153	60.391	96.578	101.879	106.629	112.329	116.321	
90	59.196	65.617	69.126	107.565	113.145	118.136	124.116	128.299	
100	67.328	74.222	77.929	118.498	124.312	129.561	135.807	140.169	

TABLE II Critical Values of t

d.f.	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$
1	3.078	6.314	12.706	31.821
2	1.888	2.920	4.303	6.965
3	1.638	2.353	3.182	4.541
4	1.533	2.132	2.776	3.747
5	1.478	2.015	2.571	3.385
6	1.440	1.943	2.447	3.143
7	1.415	1.895	2.365	2.998
8	1.397	1.860	2.308	2.898
9	1.383	1.833	2.262	2.821
10	1.372	1.812	2.228	2.784
11	1.363	1.796	2.201	2.718
12	1.356	1.782	2.179	2.681
13	1.350	1.771	2.160	2.650
14	1.345	1.761	2.145	2.624
15	1.341	1.753	2.131	2.602
16	1.337	1.746	2.120	2.583
17	1.333	1.740	2.110	2.567
18	1.330	1.734	2.101	2.552
19	1.328	1.729	2.093	2.539
20	1.325	1.725	2.086	2.528
21	1.323	1.721	2.080	2.518
22	1.321	1.717	2.074	2.508
23	1.319	1.714	2.069	2.500
24	1.318	1.711	2.064	2.492
25	1.316	1.708	2.060	2.485
26	1.315	1.706	2.056	2.479
27	1.314	1.703	2.052	2.473
28	1.313	1.701	2.048	2.467
29	1.311	1.699	2.045	2.462
inf.	1.282	1.645	1.960	2.326

I. 解釋名詞：每一子題 5 分（共 40 分, 40%）

1. optimal foraging theory
2. principle of allocation
3. Lincoln-Peterson Index
4. hyperosmotic aquatic organisms
5. greenhouse effect
6. biome
7. evapotranspiration
8. predator satiation

II. 問答題，每一子題 15 分（共 60 分, 60%）

9. What are the relationships among body size, metabolic rate and temperature regulation? How do some organisms avoid extreme ambient temperature?
10. What kinds of factors influence individuals within populations lead to different distribution patterns? Discuss your answers for plants and animals both from small and large scales.
11. Give any experimental example to describe mutualistic advantages.
12. How to describe (or measure) species diversity?

解釋名詞（每題 5 分）

1. Character state
2. Homoplasy
3. Spike inflorescence
4. Allopolypoidy
5. Sympetalous
6. Multiple fruit
7. Cladistics
8. Introgressive hybridization

問答題（任選三題作答，每題 20 分）

9. 請說明如何區別禾本科、莎草科及燈心草科。
10. 請敘述台灣植物的海拔垂直分布。
11. 有八科植物的科名具有兩種合法的拉丁名（其中一種不以-aceae 結尾），請列出其中任何四科的中名及其兩種合法的拉丁名的任何一種，並用檢索表的方法來區分此四科植物。
12. 請任意選用一個例子來說明分子系統分類學的數據如何改變或證實原有依據其他資料（如形態、解剖、染色體、生態....）所建立的分類系統（從門至種下階層的任一層次皆可）。