

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 1 頁

選擇題 (共 50 題)

2 pts. each

1

1. Which of the following is specifically a part or a function of the central nervous system?
 - a. sensory receptors
 - b. integration
 - c. sensory input
 - d. motor output
 - e. effectors
2. Which of the following statements about the response of arteriolar smooth muscle to changing oxygen partial pressures is true?
 - a. Both systemic and pulmonary arterioles respond to a decrease in P_{O_2} by constricting.
 - b. Both systemic and pulmonary arterioles respond to a decrease in P_{O_2} by dilating.
 - c. Systemic arterioles respond to a decrease in P_{O_2} by dilating but pulmonary arterioles constrict in response to decreased P_{O_2} .
 - d. Systemic arterioles respond to a decrease in P_{O_2} by constricting but pulmonary arterioles dilate in response to decreased P_{O_2} .
 - e. None of the choices are true.
3. An organism has a haploid chromosome number $n = 4$. How many tetrads will form during meiosis?
 - a. 2
 - b. 3
 - c. 4
 - d. 8
 - e. 16
4. Which of the following statements regarding control of body movement is correct?
 - a. The skeletal muscles of the body are represented in the primary motor cortex proportionately to their size.
 - b. The cerebellum is important for the initiation of body movement.
 - c. The basal ganglia form part of the corticospinal pathways.
 - d. The basal ganglia receive input from dopaminergic neurons of the substantia nigra.
 - e. None of the choices are correct.
5. A scientist clones a regulatory gene that is involved in controlling the expression of other genes, and discovers that the regulatory gene encodes a histone deacetylase enzyme. It is likely that this enzyme regulates gene expression by _____.
 - a. causing tighter packing of the chromatin at the target gene, thereby inhibiting transcription
 - b. causing looser packing of the chromatin at the target gene, thereby inhibiting transcription

國立中山大學96學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共9頁第2頁

2

- c. causing tighter packing of the chromatin at the target gene, thereby enhancing transcription
 - d. causing looser packing of the chromatin at the target gene, thereby enhancing transcription
 - e. causing tighter packing of the chromatin at the target gene, thereby inhibiting translation
6. Proper functioning of the human kidney requires considerable active transport of sodium in the kidney tubules. If these active transport mechanisms were to stop completely, how would urine production be affected?
- a. No urine would be produced.
 - b. A less-than-normal volume of hypoosmotic urine would be produced.
 - c. A greater-than-normal volume of isoosmotic urine would be produced.
 - d. A greater-than-normal volume of hyperosmotic urine would be produced.
 - e. A less-than-normal volume of isoosmotic urine would be produced.
7. Most aquatic animals excrete ammonia, while land animals excrete urea or uric acid. What is the most likely explanation for this difference?
- a. They have different diets.
 - b. Land animals can get the energy needed to make urea or uric acid.
 - c. Fish need to get rid of ammonia, but land animals need it to live.
 - d. Land animals cannot afford the energy needed to make ammonia.
 - e. Ammonia is very toxic, and it takes lots of water to dilute it.
8. Which one of the following statements about hormones or the endocrine system is **false**?
- a. Hormones are secreted into the blood.
 - b. Hormones result in long-lasting responses, compared with nervous system responses.
 - c. Endocrine organs are sometimes derived from nervous tissue.
 - d. Hormones are distributed only to specific cells having the appropriate membrane receptors.
 - e. Endocrine organs and the nervous system sometimes produce similar substances.
9. Because the genetic composition of the fetus is not identical to that of the mother, it is somewhat surprising that the fetus is not rejected as a foreign body. It appears that this is because _____.
- a. the embryo does not express paternal antigens on its cells until after birth
 - b. the embryo produces signal molecules that turn off the mother's immune system for the nine months of pregnancy
 - c. special maternal immune cells produce antigenic modifier proteins (AMPs), which mask the foreign antigens
 - d. a protective layer, the trophoblast, surrounds the embryo and prevents direct contact with maternal tissue
 - e. successful pregnancies occur only when the mother and father are genetically similar, and the paternal antigens are not recognized as dissimilar
10. Action potentials are normally carried in one direction from the axon hillock to the axon terminals. By using an electronic probe, you experimentally depolarize the middle of the axon to threshold. What do you expect?
- a. No action potential will be initiated.
 - b. An action potential will be initiated and proceed in the normal direction toward the axon terminal.
 - c. Two action potentials will be initiated, one going toward the axon terminal and one going back toward the hillock.

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 3 頁

3

- d. An action potential will be initiated and proceed back toward the axon hillock.
e. An action potential will be initiated, but it will die out before it reaches the axon terminal.
11. A man who can roll his tongue and a woman who cannot roll her tongue have a son who can roll his tongue (R = can roll tongue; r = can't roll tongue). The son is curious about whether his father is homozygous or heterozygous for the tongue-rolling trait. Which of the following facts would allow him to know?
- His father's mother cannot roll her tongue.
 - His paternal grandfather and his paternal grandmother can both roll their tongues.
 - The son's sister is a tongue roller.
 - The son's own daughter cannot roll her tongue.
 - The son submits his own blood sample to a local genotyping lab, and they establish that he is heterozygous for the trait.
12. Given the steps shown below, which of the following is the correct sequence for transmission at a chemical synapse?
- Neurotransmitter binds with receptors associated with the postsynaptic membrane.
 - Ca^{2+} ions rush into neuron's cytoplasm.
 - Action potential depolarizes the synaptic terminal membrane.
 - Ligand-gated ion channels open.
 - Synaptic vesicles release neurotransmitter into the synaptic cleft.
- 1, 2, 3, 4, 5
 - 2, 3, 5, 4, 1
 - 3, 2, 5, 1, 4
 - 4, 3, 1, 2, 5
 - 5, 1, 2, 4, 3
13. A nerve poison that blocked acetylcholine receptors on the dendrites would ____.
- prevent receipt of a signal that crossed the synaptic gap
 - inhibit the regeneration of acetylcholine for use by the synaptic terminals
 - cause continued stimulation of the synaptic membrane
 - inactivate acetylcholinesterase
 - do all of the above
14. Alex becomes so dehydrated while playing tennis that his blood pressure starts to drop. His ____ detects the drop in pressure and sends signals via ____ to speed up the heart to compensate.
- hypothalamus ... parasympathetic neurons
 - cerebellum ... sympathetic neurons
 - cerebellum ... parasympathetic neurons
 - medulla oblongata ... parasympathetic neurons
 - medulla oblongata ... sympathetic neurons
15. At very low concentrations, epinephrine causes an artery to vasodilate. At higher concentrations epinephrine causes the same artery to constrict. How can these different effects be explained?
- There is one type of epinephrine receptor that uses two second messenger systems.
 - There are two types of epinephrine receptors with different affinities for epinephrine that use

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 4 頁

4

- two different second messenger systems.
- c. There are two types of receptors for epinephrine that use the same second messenger system.
 - d. At higher concentrations epinephrine can pass through the plasma membrane and directly stimulate contraction within the cell.
16. An electroencephalogram
- a. is a record of action potentials in the brain.
 - b. records the potential difference between two points on the scalp's surface.
 - c. is a pattern of complex waves with amplitudes similar to those of action potentials.
 - d. is both is a record of action potentials in the brain and records the potential difference between two points on the scalp's surface.
 - e. is both records the potential difference between two points on the scalp's surface and is both is a record of action potentials in the brain and records the potential difference between two points on the scalp's surface.
17. The blood-brain barrier
- a. is formed by cells lining tiny blood vessels in the brain.
 - b. is present in all parts of the brain.
 - c. prevents entry of all lipid-insoluble molecules into the brain.
 - d. Both is formed by cells lining tiny blood vessels in the brain and prevents entry of all lipid-insoluble molecules into the brain are correct.
 - e. All of the choices are correct.
18. One reason you can distinguish between a needle prick on the foot and an ice cube on the wrist is that
- a. the ice cube stimulates a different class of receptors than the needle prick, even though both signals go to exactly the same location in the brain.
 - b. the nerve impulse from the needle prick is inherently different from the impulse generated by the ice cube.
 - c. the region of the brain to which one receptor pathway leads is different from the region to which the other pathway leads.
 - d. the needle prick generates a stronger action potential in any one neuron than an ice cube does.
 - e. None of the choices are correct.
19. Which of the following *best* explains how the phenomenon of "tolerance" develops with use of psychoactive drugs over time?
- a. Psychoactive drugs can alter blood flow to the brain.
 - b. Psychoactive drugs often produce euphoria.
 - c. Psychoactive drugs can cross the blood-brain barrier.
 - d. Psychoactive drugs can inhibit production of endogenous neurotransmitters.
 - e. Psychoactive drugs can up-regulate receptors for endogenous neurotransmitters.
20. John is a sprinter who specializes in quick and powerful bursts of speed followed by periods of rest. Jim is a marathon runner who specializes in long, steady runs. Compared to Jim, John is likely to have
- a. legs with a smaller diameter.

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 5 頁

5

- b. legs with a larger diameter.
 - c. hypertrophy of type I muscle fibers.
 - d. legs with a larger diameter and hypertrophy of type I muscle fibers.
 - e. legs with a smaller diameter and hypertrophy of type I muscle fibers.
21. Comparing excitation-contraction coupling in cardiac muscle with that in skeletal muscle:
- a. Extracellular calcium plays a major role in cardiac but not skeletal muscle.
 - b. The stimulus for calcium release from the sarcoplasmic reticulum is the same in both muscles.
 - c. Troponin sites are always saturated immediately after calcium release in both muscles.
 - d. There is no net change in total intracellular calcium concentration in either muscle.
 - e. Both extracellular calcium plays a major role in cardiac but not skeletal muscle and the stimulus for calcium release from the sarcoplasmic reticulum is the same in both muscles are correct.
22. If the arterial blood pressure in the brain is suddenly decreased, the flow through arterioles in the brain will immediately fall and then return to near their original levels due to flow autoregulation.
- a. This statement is false. The arterioles of the brain do not exhibit flow autoregulation to any significant extent.
 - b. This statement is false. The flow of blood will only rise.
 - c. This statement is false. The flow of blood will only fall.
 - d. This statement is false. The flow of blood will not change.
 - e. This statement is true.
23. During heavy exercise, all of the following increase except
- a. minute ventilation.
 - b. oxygen extraction by muscles.
 - c. oxygen delivery to muscles.
 - d. arterial P_{CO_2} .
 - e. body heat production.
24. Gene A is normally found on chromosome number 15 in humans. If amniocentesis reveals fetal cells containing gene A on chromosome 17, but not on 15, the best explanation would be that _____.
- a. crossing over occurred during synapsis of meiosis I in one parent's gametes
 - b. base substitution occurred either during gametogenesis or in the mitotic divisions following fertilization
 - c. an inversion of gene A occurred on chromosome 15
 - d. translocation occurred
 - e. at least one parent probably had a genetic syndrome
25. After spending several days at a high altitude, where oxygen pressure is low, a person will begin to produce more red blood cells, which enhances the ability of his/her blood to carry oxygen to the tissues. Which of the following control mechanisms best describes this response?
- a. developmental acclimatization

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 6 頁

6

- b. positive feedback
 - c. physiological acclimatization
 - d. feedforward regulation
 - e. None of the choices are correct.
26. Which of the following levels of organization is arranged in the correct sequence from most to least inclusive?
- a. community, ecosystem, individual, population
 - b. ecosystem, community, population, individual
 - c. population, ecosystem, individual, community
 - d. individual, population, community, ecosystem
 - e. individual, community, population, ecosystem
27. Which of the following is true about imprinting?
- a. It may be triggered by visual or chemical stimuli.
 - b. It happens to many adult animals, but not to their young.
 - c. It is a type of learning that does not involve innate behavior.
 - d. It occurs only in birds.
 - e. It causes behaviors that last for only a short time (the critical period).
28. Which of the following aspects of an organism's life is least relevant to its life history?
- a. number of offspring per reproductive bout
 - b. age at which it first reproduces
 - c. frequency of reproduction
 - d. frequency of dispersal
 - e. all of the above
29. The sum total of an organism's interaction with the biotic and abiotic resources of its environment is called its
- a. habitat.
 - b. logistic growth.
 - c. biotic potential.
 - d. microclimax.
 - e. ecological niche.
30. Which of these ecosystems has the highest net primary productivity per square meter?
- a. savanna
 - b. open ocean
 - c. boreal forest
 - d. tropical rain forest
 - e. temperate forest
31. Which of the following terms includes all of the others?
- a. species diversity
 - b. biodiversity
 - c. genetic diversity
 - d. ecosystem diversity
 - e. species richness

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 7 頁

7

32. A person working with plants may remove apical dominance by doing which of the following?
- pruning
 - deep watering of the roots
 - fertilizing
 - transplanting
 - feeding the plants nutrients
33. Active transport involves all of the following except the
- slow movement through the lipid bilayer of a membrane.
 - pumping of solutes across the membrane.
 - hydrolysis of ATP.
 - transport of solute against a concentration gradient.
 - a specific transport protein in the membrane.
34. In the nutrition of a plant, which element is classified as a macronutrient?
- zinc
 - chlorine
 - calcium
 - molybdenum
 - manganese
35. Which of the following is the correct sequence during alternation of generations in a flowering plant?
- sporophyte-meiosis-gametophyte-gametes-fertilization-diploid zygote
 - sporophyte-mitosis-gametophyte-meiosis-sporophyte
 - haploid gametophyte-gametes-meiosis-fertilization-diploid sporophyte
 - sporophyte-spores-meiosis-gametophyte-gametes
 - haploid sporophyte-spores-fertilization-diploid gametophyte
36. Plants growing in a partially dark environment will grow toward light in a response called phototropism. Choose the incorrect statement regarding phototropism.
- It is caused by a chemical signal.
 - One chemical involved is auxin.
 - Auxin causes a growth increase on one side of the stem.
 - Auxin causes a decrease in growth on the side of the stem exposed to light.
 - Removing the apical meristem prevents phototropism.
37. In what way were conditions on Earth more than 2 billion years ago different from those on Earth today?
- The early Earth had water vapor in its atmosphere.
 - The early Earth was intensely bombarded by large space debris.
 - The early Earth had an oxidizing atmosphere.
 - Less ultraviolet radiation penetrated the early atmosphere.
 - The early atmosphere had significant quantities of ozone.
38. Which of the following is the most common compound in the cell walls of gram-positive bacteria?
- cellulose
 - lipopolysaccharide
 - lignin
 - peptidoglycan

國立中山大學96學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共9頁第8頁

8

- e. protein
39. Protists are alike in that all are
- a. multicellular.
 - b. photosynthetic.
 - c. marine.
 - d. nonparasitic.
 - e. eukaryotic.
40. Bryophytes have all of the following characteristics except
- a. multicellularity.
 - b. specialized cells and tissues.
 - c. lignified vascular tissue.
 - d. walled spores in sporangia.
 - e. a reduced, dependent sporophyte.
41. All of the following cellular structures are found in cells of angiosperm and gymnosperm gametophytes except
- a. haploid nuclei.
 - b. mitochondria.
 - c. cell walls.
 - d. chloroplasts.
 - e. peroxisomes.
42. The gray-black filamentous mycelium growing on bread is most likely what kind of organism?
- a. chytrid
 - b. ascomycete
 - c. basidiomycete
 - d. deuteromycete
 - e. zygomycete
43. You are trying to identify an organism. It is an animal, but it does not have nerve or muscle tissue. It is neither diploblastic nor triploblastic. It is probably a
- a. flatworm.
 - b. jelly.
 - c. comb jelly.
 - d. sponge.
 - e. nematode.
44. The possession of two pairs of antennae is a characteristic of
- a. spiders.
 - b. insects.
 - c. centipedes.
 - d. millipedes.
 - e. crustaceans.
45. What is the single unique characteristic that distinguishes extant birds from other extant animals?
- a. a hinged jaw
 - b. feathers

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【生科系碩士班】

共 9 頁 第 9 頁

9

- c. an amniotic egg
 - d. flight
 - e. a gizzard
46. All of the following are criteria for maintaining Hardy-Weinberg equilibrium involving two alleles except
- a. the frequency of all genotypes must be equal.
 - b. there should be no natural selection.
 - c. matings must be random.
 - d. populations must be large.
 - e. gene flow from other populations must be zero.
47. Which of the following is not considered an intrinsic isolating mechanism?
- a. sterile offspring
 - b. ecological isolation
 - c. geographic isolation
 - d. gametic incompatibility
 - e. timing of courtship display
48. Which of the following types of molecules are the major structural components of the cell membrane?
- a. phospholipids and cellulose
 - b. nucleic acids and proteins
 - c. phospholipids and proteins
 - d. proteins and cellulose
 - e. glycoproteins and cholesterol
49. What is the term for metabolic pathways that release stored energy by breaking down complex molecules?
- a. anabolic pathways
 - b. catabolic pathways
 - c. fermentation pathways
 - d. thermodynamic pathways
 - e. bioenergetic pathways
50. The centromere is a region in which
- a. chromatids are attached to one another.
 - b. metaphase chromosomes become aligned.
 - c. chromosomes are grouped during telophase.
 - d. the nucleus is located prior to mitosis.
 - e. new spindle microtubules form.

國立中山大學 96 學年度碩士班招生考試試題

科目：生物化學【生科系碩士班甲、乙組】

共 2 頁 第 1 頁

1. In respect to the following Noble Laureates' developments, discoveries or studies, describe the application or impact on the research and knowledge of biochemistry. (40%)

(1) A.Z. Fire and C.C. Mello for the discovery of RNA interference-gene silencing by double-stranded RNA. -- *2006 Nobel Price in Physiology & Medicine*

(2) A. Ciechanover, A. Hershko, and I. Rose for the discovery of ubiquitin-mediated protein degradation. -- *2004 Nobel Price in Chemistry*

(3) J.B. Fenn and K. Tanaka for the development of soft desorption ionization methods for mass spectrometric analyses of biological macromolecules; and K. Wüthrich for the development of nuclear magnetic resonance spectroscopy for determining the three-dimensional structure of biological macromolecules in solution. -- *2002 Nobel Price in Chemistry*

(4) K.B. Mullis for the invention of the polymerase chain reaction (PCR) method and Michael Smith for the fundamental contributions to the establishment of oligonucleotide-based, site-directed mutagenesis and its development for protein studies. -- *1993 Nobel Price in Chemistry*

(5) S. Altman and T.R. Cech for the discovery of catalytic properties of RNA. -- *1989 Nobel Price in Chemistry*

(6) F. Sanger for the work on the structure of proteins, especially that of insulin. -- *1958 Nobel Price in Chemistry*

(7) G. Blobel for the discovery that proteins have intrinsic signals that govern their transport and localization in the cell. -- *1999 Nobel Price in Physiology & Medicine*

(8) A.G. Gilman and M. Rodbell for the discovery of G-proteins and the role of these proteins in signal transduction in cells. -- *1994 Nobel Price in Physiology & Medicine*

(9) E.H. Fischer and E.G. Krebs for the discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism. -- *1992 Nobel Price in Physiology & Medicine*

(10) N.K. Jerne, G.J.F. Kohler and C. Milstein for the theories concerning the specificity in development and control of the immune system and the discovery of the principle for production of monoclonal antibodies. -- *1984 Nobel Price in Physiology & Medicine*

國立中山大學 96 學年度碩士班招生考試試題

科目：生物化學【生科系碩士班甲、乙組】

共 2 頁 第 2 頁

2. Describe the theory and application of the following methods or tools in biochemical research. (40%)

- (1) Edman degradation
- (2) Gel filtration chromatography
- (3) Affinity chromatography
- (4) SDS-Polyacrylamide gel electrophoresis (SDS-PAGE)
- (5) Two-dimensional electrophoresis
- (6) Western blotting
- (7) Ultrafiltration
- (8) Pulse-Chase labeling

3. An organism at work uses ATP continuously, but ATP is a renewable resource that can be regenerated by phosphorylation of ADP. The energy required to phosphorylate ADP comes from catabolism in the cell. (10%)

- (1) Discuss the metabolic roles of ATP.
- (2) The formation of ATP by phosphoryl transfer from a substrate is referred to as substrate-level phosphorylation, to distinguish this mechanism from respiration-linked phosphorylation (oxidative phosphorylation). Give examples to and illustrate the two mechanisms respectively.

4. Many drugs are designed to inhibit the activity of specific enzymes. Describe the molecular bases for the action or the target enzyme of the following drugs. (10%)

- (1) Aspirin
- (2) Mevinolin (Lovastatin)
- (3) Allopurinol
- (4) Amethopterin (Methotrexate)
- (5) Sulfonamides

國立中山大學 96 學年度碩士班招生考試試題

科目：分子生物學【生科系碩士班甲、乙組選考】

共 6 頁 第 1 頁

I. 選擇題：請自下列 1~20 題選擇題各選出一正確答案。每題 3 分。

1. Which of the following would you use to clone intact DNA pieces of a certain organism that are 10^6 base pairs long?

- A. An *E. coli* plasmid
- B. Bacteriophage
- C. Polymerase chain reaction
- D. Yeast artificial chromosomes
- E. Restriction endonuclease digestion

2. Telomere is a special and essential structure found in eukaryotes with linear chromosomes. What is the function of the telomere?

- A. To allow cells to divide.
- B. To induce cells to "age."
- C. To allow complete replication of an entire chromosome.
- D. To ensure segregation of sister chromatids during mitosis.
- E. To bind to Autonomous Replicating Sequences on chromosomes.

3. Eukaryotic DNA polymerase ϵ is active in nondividing as well as dividing cells. This suggests that it

- A. is the polymerase for leading-strand replication.
- B. is the polymerase for lagging-strand replication.
- C. fills in the gaps between Okazaki fragments.
- D. functions primarily in repair of DNA damage.
- E. functions primarily in DNA recombination.

4. Which of the following statements regarding tRNAs is false?

- A. tRNAs are approximately 70–90 nucleotides long and form a cloverleaf structure.
- B. All tRNAs have a CCA sequence at their 3' terminus.
- C. tRNAs differ in sequence only at the anticodon.
- D. There are several modified bases present in mature tRNAs.
- E. tRNA genes are transcribed by RNA polymerase III in eukaryotic cells.

5. DNA can be introduced into mammalian cells by

- A. microinjection into the nucleus of a cell.
- B. fusion of DNA-containing liposomes with cells.
- C. electroporation of DNA into cells.
- D. calcium-phosphate-mediated method
- E. All of the above

國立中山大學 96 學年度碩士班招生考試試題

科目：分子生物學【生科系碩士班甲、乙組選考】

共 6 頁 第 2 頁

6. Which of the following would be used to express a human protein in *E. coli*?
- A. An expression plasmid containing T7 promoter.
 - B. An expression plasmid containing cDNA made from the mRNA for the protein.
 - C. The human gene for that protein inserted into *E. coli* by a bacteriophage expression vector.
 - D. A yeast artificial chromosome containing the human gene for the protein.
 - E. An expression plasmid containing an *Eco* RI-cut piece of the gene for that protein.
7. Proteins are important molecules and their turnover mirrored the needs of the cells. The half-lives of proteins in the cell vary widely, usually ranging from
- A. milliseconds to seconds.
 - B. minutes to days.
 - C. hours to days.
 - D. days to weeks.
 - E. weeks to years.
8. The *trp* operon in *E. coli* is partly regulated by transcriptional attenuation, in which a stalled ribosome leads to premature transcriptional termination. This type of regulation does *not* occur in eukaryotic cells because
- A. eukaryotic cells do not contain tryptophan.
 - B. in eukaryotic cells, transcription and translation are separated both physically and temporally.
 - C. premature transcriptional termination does not occur in eukaryotic cells.
 - D. only activators regulate the process of transcription in eukaryotic cells.
 - E. eukaryotic cells have to make this essential amino acid.
9. The human genome contains only 20,000 to 25,000 actual gene sequences, yet the human genome can produce up to 30,000 gene products. Which of the following processes accounts for this difference?
- A. Alternative splicing
 - B. Spacer Sequences
 - C. Satellite DNA
 - D. Short Interspersed Elements (SINEs)
 - E. RNA editing

國立中山大學 96 學年度碩士班招生考試試題

科目：分子生物學【生科系碩士班甲、乙組選考】

共 6 頁 第 3 頁

10. Estimates of mutation rates for a variety of genes indicate that the frequency of errors during replication is much lower than would be predicted on the basis of complementary base pairing. Which of the following mechanisms accounts for the higher degree of fidelity?

- A. Conformational changes in DNA polymerase.
- B. 3' to 5' exonuclease activity of DNA polymerase.
- C. Requirement of a primer for DNA synthesis by DNA polymerase.
- D. Correct base-pairing between the incoming dNTP and the template.
- E. All of the above

11. Mutations can be introduced into selected target genes of living cells by

- A. hybridization with antisense nucleic acid sequences.
- B. homologous recombination with an altered cloned gene.
- C. polymerase chain reaction.
- D. ultraviolet laser irradiation.
- E. RNA interference.

12. Introns were discovered when mRNA for adenovirus protein expressed in mammalian cells was hybridized to single-stranded virus DNA coding for that mRNA. When the complexes were observed under the electron microscope,

- A. a completely double-stranded hybrid was seen.
- B. a partial hybrid with loops of mRNA extending from the hybrid regions was seen.
- C. a partial hybrid with loops of DNA extending from the hybrid regions was seen.
- D. no hybrid formed, because the introns had been removed.
- E. double-stranded virus DNA was formed by re-annealing of single-stranded virus DNA.

13. Which of the following both stabilizes and increases the efficiency of translation of an mRNA?

- A. Editing
- B. Splicing
- C. 7-methylguanosine cap addition
- D. Addition of the CCA sequence to the 3' end
- E. Addition of poly(A) signal sequence

14. A dominant inhibitory mutant is typically one that
- A. produces a protein that interferes with the function of the protein produced by the normal gene.
 - B. deletes the normal gene.
 - C. blocks transcription of the normal gene.
 - D. blocks translation of the normal mRNA.
 - E. shuts off expression of related genes.
15. Which of the following correctly outlines the process of RNA interference beginning with a double-stranded RNA molecule?
- A. Unwinding of siRNA; cleavage by Dicer; association with RISC; pairing with target mRNA; mRNA cleavage
 - B. Reverse transcription of RNA to cDNA; addition of oligonucleotide linkers containing restriction endonuclease cleavage sites; cDNA ligation to appropriate vector; introduction of recombinant molecule into *E. coli*
 - C. Cleavage by Dicer; association with RISC; unwinding of siRNA; pairing with target mRNA; mRNA cleavage
 - D. Reverse transcription of RNA to cDNA; double-stranded DNA heated to separate strands; cooling to allow primers to bind to each strand of DNA; synthesis of new DNA molecules by Taq polymerase
 - E. Specific cleavage of RNA; by exonuclease digestion
16. Group of genes arose by successive duplication is called a gene family which is
- A. a set of related genes that perform identical functions.
 - B. a set of related but slightly different genes present in multiple copies in one individual.
 - C. a family of individuals with the same gene.
 - D. a set of slightly different genes present as one copy each in a set of individuals.
 - E. a family of individuals in which each has a slightly different sequence of the same gene.
17. Which of the following experimental approaches is least likely to be used in identifying transcription factor binding sites?
- A. Electrophoretic mobility shift assay
 - B. Chromatin-immunoprecipitation-on-chip
 - C. DNA footprinting
 - D. Chromatin immunoprecipitation
 - E. Northern blot

18. Which of the following statements is false about integrase, the enzyme that catalyzes the integration of bacteriophage DNA into the *E. coli* genome?

- A. It is encoded by the bacterial genome.
- B. It is necessary for the process of lysogeny.
- C. It is necessary for excision of the phage DNA from the bacterial genome.
- D. It possesses both nuclease and ligase activities.
- E. It helps establishment of bacteriophage latency.

19. The human genes that convey a susceptibility to hereditary nonpolyposis colorectal cancer are genes coding proteins involved in the DNA repair mechanism called

- A. base excision repair.
- B. nucleotide excision repair.
- C. mismatch repair.
- D. photoreactivation.
- E. All of the above.

20. The primary function of rRNAs in the ribosome is

- A. to serve as a scaffold for the ribosomal proteins.
- B. to catalyze peptide bond formation.
- C. to assist in the proper folding of ribosomal proteins.
- D. to assist in the proper positioning of tRNAs along the mRNA template.
- E. to help modification of tRNA molecules.

II. 問答題 (第 21 題至 24 題；每題 10 分)

21. Suppose you are studying a mammalian transcription factor that has three distinct domains: a DNA-binding domain, a dimerization domain, and a transactivation domain. You know from biochemical studies that the transcription factor forms homodimers. You want to know what will happen if you introduce a mutant version of the gene that lacks the DNA-binding domain into wild-type cells, so you generate the deletion *in vitro*, clone it into a high-copy expression vector, and transfect it into wild-type cells. How to make this mutant version of the gene?

22. The following paragraphs are excerpted from a paper by W. Wayt Gibbs published in *Scientific American* v289, Nov 2003. Give your major conclusion of the following paragraphs.

"The extent of this unseen genome is not yet clear, but at least two layers of information exist outside the traditionally recognized genes. One layer is woven throughout the vast "noncoding" sequences of DNA that interrupt and separate genes. Though long ago written off as irrelevant because they yield no proteins, many of these sections have been preserved mostly intact through millions of years of evolution. That suggests they do something indispensable. And indeed a large number are transcribed into varieties of RNA that perform a much wider range of functions than biologists had imagined possible. Some scientists now suspect that much of what makes one person, and one species, different from the next are variations in the gems hidden within our "junk" DNA.

Above and beyond the DNA sequence there is another, much more malleable, layer of information in the chromosomes. "Epigenetic" marks, embedded in a mélange of proteins and chemicals that surround, support and stick to DNA, operate through cryptic codes and mysterious machinery. Unlike genes, epigenetic marks are routinely laid down, erased and rewritten on the fly. So whereas mutations last a lifetime, epigenetic mistakes-implicated in a growing list of birth defects, cancers and other diseases-may be reversible with drugs. In fact, doctors are already testing such experimental treatments on leukemia patients."

23. UV irradiation often induces DNA damage in the form of pyrimidine dimers. Briefly describe the two mechanisms that cells have developed to repair this damage and which mechanism is lacking in humans?

24. One of important regulation processes in higher eukaryotes is alternative pre-mRNA splicing. Alternative splicing plays a major role in sex determination in *Drosophila*, antibody response in humans and other tissue or developmental stage specific processes. Describe different types, i.e. various ways for making the products, of alternative splicing.

國立中山大學96學年度碩士班招生考試試題

科目：動物生理學【生科系碩士班甲組選考】

共3頁第1頁

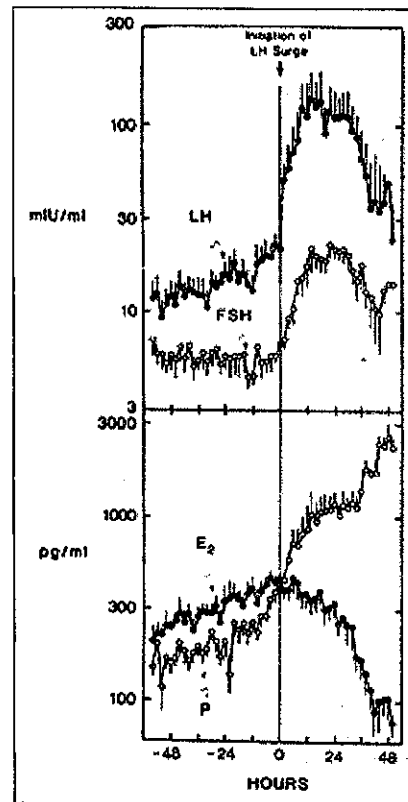


Figure 1

1. The above figure (Figure 1) shows changes in gonadotropins and ovarian steroids at midcycle of menstruation in a young woman (22 years old). just prior to ovulation. Abbreviations: LH, luteinizing hormone; FSH, Follicle stimulating hormone; E₂, estrogen; P, progesterone (From Hoff JD, Quigley ME, Yen SCC. Hormonal dynamics at midcycle: A re-evaluation. J Clin Endocrinol Metab. 57:792, 1983.

Q1-1: List factors that initiated the triggering of LH surge.(5%)

Q1-2: Indicate the point on the time scale representing the beginning of ovulation. (5%)

Q1-3: Describe briefly the rule of hypothalamus on regulating hormonal changes shown in this figure. (5%)

Q1-4: Describe major functions of each hormone shown in this figure. (5%)

國立中山大學 96 學年度碩士班招生考試試題

科目：動物生理學【生科系碩士班甲組選考】

共 3 頁 第 2 頁

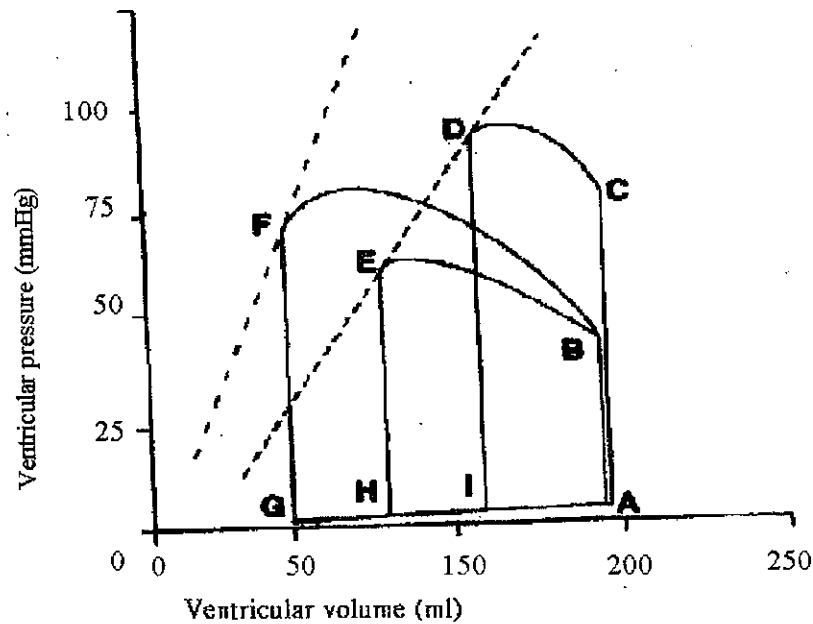


Figure 2

2. The above figure (Figure 2) describes the ventricular pressure-volume (PV) relationships of the heart. Loop ABEH represents a normal PV loop.

- Q21: How loop ABEH can be corresponded to a normal cardiac cycle? (5%)
- Q22: What are the points in loop ABEH represent valve closure and/or opening during a cardiac cycle? (5%)
- Q23: Explain possible effects of after load on the PV diagram, which one among the three diagrams in figure 2 (loop ABEH, loop ACFG, and loop ACDEI) is most closely describing the effects of an increased afterload ? (5%)
- Q24: List two factors that may contribute to contractility increments of the heart. Indicate in Figure 2 the diagram most closely describe the effect of increased contractility. (5%)

國立中山大學 96 學年度碩士班招生考試試題

科目：動物生理學【生科系碩士班甲組選考】

共 3 頁 第 3 頁

3. Draw an oxygen-hemoglobin dissociation curve of a normal human blood and answer the following questions:

Q31: describe the structure of the hemoglobin. (5%)

Q32: explain why the shapes of the curve are affected by oxygen partial pressure of the blood. (5%)

Q33: contrast the curves in carbon monoxide (CO) poisoned subjects with that of normal subjects. (5%)

Q34: List factors that may shift the position and shapes of the curve. (5%)

4. Contrast both the anatomy and physiological functions of pyramidal and extra-pyramidal motor pathways of mammals. (10%)

5. List the functions of the lung in mammals. (15%)

6. List and give a brief description on each of the three basic renal processes that lead to the formation of urine. (15%)

國立中山大學 96 學年度碩士班招生考試試題

科目：免疫學【生科系碩士班甲組選考】

共 / 頁 第 / 頁

Answer the following questions as better as you can:

1. Describe the events that occur during the process of B-cell development. (25%)
2. Compare the advantages as well as disadvantages of using attenuated and inactivated vaccines against human diseases? Give examples of diseases for each type of vaccines. (25%)
3. Describe the major steps of treatment for a B-cell lymphoma patient with mouse monoclonal antibody specific for idiotypic determinants on the cancer cells. What steps should be taken to make this therapeutic monoclonal anti-idiotypic antibody most suitable for use in a patient? Is such an antibody generally useful for other patients? Why? (40%)
4. What are the four major categories of tumor antigens recognized by T cells? (10%)

國立中山大學 96 學年度碩士班招生考試試題

科目：微生物學【生科系碩士班乙組選考】

共 / 頁 第 / 頁

★ 請務必依題號依序作答

1. If the Gram-iodine step was omitted from a Gram staining procedures, what will happen to a Gram-positive cell? Why? What will happen to a Gram-negative cell? Why? (10 points)
2. Two types of prokaryotic cells have been distinguished: bacteria and archaea. How do these cells differ from each other? How are they similar? (15 points)
3. Replication of the *Escherichia coli* chromosome takes about 40-45 minutes, but this organism has a generation time of only 26 minutes. How does the cell have time to make complete chromosomes for each daughter cell? (10 points)
4. Compare the two types of human herpes simplex virus (HSV) according to the types of diseases they cause, body areas affected, and complications. (10 point)
5. Why a bacterial endospore so resistant to environmental stresses? How do you perform a staining to make an endospore visible under a light microscope? (10 points)
6. Draw a brief picture and describe the life cycle of a - strand RNA virus. (15 points)
7. Define and describe the following terms (5 points each)
 - (1) Photoautotrophs
 - (2) 16S RNA
 - (3) Facultative anaerobes
 - (4) Prion
 - (5) Bioremediation
 - (6) LD₅₀

國立中山大學 96 學年度碩士班招生考試試題

科目：植物生理學【生科系碩士班乙組選考】

共 / 頁 第 / 頁

植物生理學

1. Term explanation : 40%

- (1) Apoplast pathway (2) Crassulacean acid metabolism (CAM) plant
(3) T-DNA (4) gravitropism (5) ABA (6) phytochrome
(7) secondary metabolites (8) photorespiration

2. Describe the molecular mechanism of GA(or IAA) action : 15%

3. Describe the advantages of C4 plant in terms of photosynthesis : 15%

4. Describe how blue light affect stomatal opening : 15%

5. Describe the Z scheme of photosynthesis : 15%

國立中山大學 96 學年度碩士班招生考試試題

科目：生態學【生科系碩士班丙組】

共 | 頁 第 | 頁

2007

生態學 (生物科學系) (丙組必考)

問答題 (共六題 100 分)

1. How and why do age structures differ between animal and plant populations? (15 分)
2. Explain the meaning of natality, fecundity, and rate of increase. How are they related? (15 分)
3. What is a life table? Construct one life table with information of a hypothetical species or a species that you are familiar with. (20 分)
4. What are the differences between the integrated hypothesis of community structure and the individualistic hypothesis of community structure, and discuss the current view on these two hypotheses. (20 分)
5. What are dominant species and keystone species? How are they different? How do they affect species diversity of a community? (15 分)
6. Describe the possible interspecific interactions in a community, and the individual effects on the interacting species. (15 分)

國立中山大學 96 學年度碩士班招生考試試題

科目：植物分類學【生科系碩士班丙組選考】

共 | 頁第 | 頁

2007

植物分類學 (生物科學系) (丙組選考)

問答題 (共六題 100 分)

1. How a phylogenetic tree was constructed? (20 分)
2. How fern and fern allies at the order rank or above are classified? (20 分)
3. Discuss the phytogeographical affinity of Taiwan flora? (15 分)
4. What are "basal" flowering plants? How are they in common? (15 分)
5. What is a conifer? List five conifer species native or cultivated in Taiwan. If possible, list their Latin names. (15 分)
6. How do the Core Caryophyllales (Centrospermae) differ from other Eudicots? (15 分)

國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【生科系碩士班丙組選考】

共 2 頁 第 1 頁

1. The weight (kg) of two groups of animals were recorded as follows:

Experiment: 3, 4, 4, 5, 7

Control: 4, 6, 8, 9

- Calculate the 95% confidence interval for mean weight of each of the group.
- Are the variances the same?
- Are the means the same? (25%)

2. The habitat preferences between sexes of a hummingbird were compared. The number of birds found in each habitat of different sexes was determined.

Sex	Habitat		
	1	2	3
Male	40	30	5
Female	10	10	35

- What is the probability that a hummingbird would be located in habitat 1?
- What is the probability that a hummingbird would be located in habitat 2, given that it is a male?
- What is the probability that a hummingbird is a male and found in habitat 3?
- Is there any evidence that the different sexes would prefer different habitats? (25%)

3. The effect of temperature and humidity on the growth (cm) of a plant was tested using the following data.

Temperature	Relative humidity	
	90%	60%
High	4, 4, 5	3, 4, 2
Low	3, 3, 4	2, 3, 3

- Determine whether the effect of interaction is significant using the ANOVA table.
- Can we conclude that the temperature or the humidity has a significant effect on the growth of the plant. (25%)

4. The distance traveled and energy used were determined for an experiment animal.

Distance (m)	1	2	3	4
Energy (kcal)	20	26	30	50

- Determine the Pearson correlation coefficient. What does it mean?
- Is it a significant correlation? (25%)

國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【生科系碩士班丙組選考】

共 2 頁 第 2 頁

Degrees of Freedom	Area in One Tail				
	0.005	0.01	0.025	0.05	0.10
1	63.657	31.821	12.706	6.314	3.078
2	9.925	6.965	4.303	2.920	1.886
3	5.841	4.541	3.182	2.353	1.638
4	4.604	3.747	2.776	2.132	1.533
5	4.032	3.365	2.571	2.015	1.476
6	3.707	3.143	2.447	1.943	1.440
7	3.499	2.998	2.365	1.895	1.415
8	3.355	2.896	2.306	1.860	1.397
9	3.250	2.821	2.262	1.833	1.383
10	3.169	2.764	2.228	1.812	1.372
11	3.106	2.718	2.201	1.796	1.363
12	3.055	2.681	2.179	1.782	1.356
13	3.012	2.650	2.160	1.771	1.350
14	2.977	2.624	2.145	1.761	1.345
15	2.947	2.602	2.131	1.753	1.341

Degrees of Freedom	Area to the Right of the Critical Value									
	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	—	—	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.071	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188

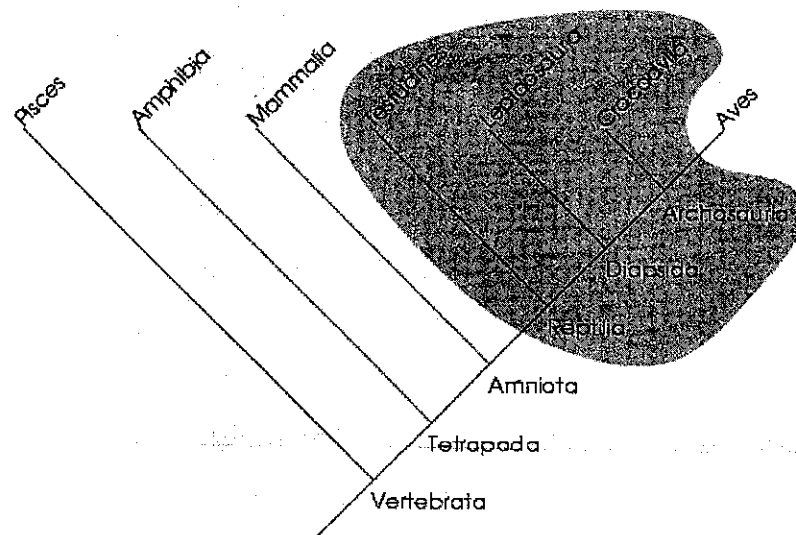
Denominator degrees of freedom (df_2)	Numerator degrees of freedom (df_1)						
	1	2	3	4	5	6	7
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77
2	18.513	19.000	19.164	19.247	19.296	19.330	19.353
3	10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870
8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066
16	4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767
19	4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435
20	4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876
22	4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638
23	4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226
25	4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047

國立中山大學 96 學年度碩士班招生考試試題

科目：脊椎動物學【生科系碩士班丙組選考】

共 / 頁 第 / 頁

1. Explain in detail at least four of the diagnostic characters that separate Aves and Amphibia each from the rest of the vertebrates. (20%)
2. Distinguish among typological, individualistic and biological species concepts. (10%)
3. According to the following cladogram, which group of taxa would be treated as a monophyletic, paraphyletic, and polyphyletic group?
Write one derived character that would separate each taxon from the ancestral taxon in the shaded area. (20%)



4. List two freshwater species of fishes of Taiwan that would descend into the ocean to reproduce. Describe the migration pattern of one of these fishes. (20%)
5. Differentiate between digitgrade and plantigrade. Give one animal as an example of each. (10%)
6. Describe the following locomotion modes in snakes. a. rectilinear mode b. curvilinear mode c. sidewinding mode d. concertina mode. (20%)

國立中山大學 96 學年度碩士班招生考試試題

科目：昆蟲學【生科系碩士班丙組選考】

共 / 頁 第 / 頁

昆蟲學考題

一、名詞解釋 (共 15 分) (請注意：解釋就是要詮釋這個名詞的涵意與代表議題的背景，不是翻譯)

1. Sexual selection
2. Phylogeny
3. Population genetics
4. Speciation
5. Reproductive isolation

二、語言能力 (共 30 分)

1. 英譯中 (15%)

The relationships of insects to other animal groups remain unclear. Although more traditionally grouped with millipedes and centipedes, evidence has emerged favouring closer evolutionary ties with the crustaceans. In the Pancrustacea theory, insects, together with among others Malacostraca, make up a monophyletic group (sharing a common ancestor).

2. 中譯英 (請注意中文標點符號、斷句、同一文意的主詞與主被動式與英文不盡相同) (15%)

昆蟲是六隻腳的節肢動物，六隻腳的節肢動物就是昆蟲。但是科學家找到了例外，並非六隻腳的節肢動物都是昆蟲。因為六腳節肢動物的出現，可能共發生了兩次！節肢動物是地球上分佈最廣、數量最多、多樣性最高的一門動物，所有動物物種中，有八成就是節肢動物。而昆蟲綱（六足綱）又是節肢動物門裡，物種數量最多的一綱。這去科學家爭論的是，究竟昆蟲和多足綱的蜈蚣等的親緣關係較近，還是和甲殼綱的蝦子、螃蟹等關係較近。現在科學家一般相信昆蟲的祖先長得像蝦子，所有的六足綱節肢動物都來自於一個共同祖先。

三、問答題 (共 55 分)

1. 請舉三例說明台灣地區具有昆蟲標本典藏的機構之名稱、所在地、主要收藏內容以及研究人員之研究方向。僅有教學標本之單位請勿列入考量。(15%)

2. 請敘述台灣植被類型的海拔梯度分區，以及各區昆蟲相的特色 (包含形態、多樣性、親緣生物地理、生理適應等特色)。(請忽略台灣南北端的植群壓縮現象)。(25%)

3. 請由「蝴蝶」、「蝗蟲」或「鍬形蟲」中擇一，分別畫出以下結構的示意圖：頭部 (側方、背面或腹面觀)、翅脈 (前翅或後翅)、以及前足。請儘可能精細地標示出各分節構造，標示構造時以英文或中文書寫皆可。(15%)