

I. 單選題：每一子題 1 分 (共 75 分, 75%)

- 1) Cholesterol enters cells via
 - A) pinocytosis.
 - B) phagocytosis.
 - C) receptor-mediated endocytosis.
 - D) osmosis.
 - E) exocytosis.

- 2) All of the following statements are true *except*:
 - A) All cells come from a preexisting cell.
 - B) Mitosis produces new nuclei with exactly the same chromosomal endowment as the parent nucleus.
 - C) The mitotic spindles in prokaryotic cells are composed of microtubules.
 - D) Mitosis may occur without cytokinesis.
 - E) Mitosis and cytokinesis are required for asexual reproduction.

- 3) Pyruvate is formed
 - A) on the inner mitochondrial membrane.
 - B) in the nucleus.
 - C) on the outer mitochondrial membrane.
 - D) in the mitochondrial matrix.
 - E) in the cytosol.

- 4) The enzyme glycogen phosphorylase is directly activated by
 - A) cyclic AMP.
 - B) GTP.
 - C) IP_3 .
 - D) protein kinases.
 - E) calcium ions.

- 5) Of the following, which is the most important role of exocytosis?
 - A) to pump protons
 - B) to create new cells
 - C) to move away from danger
 - D) to incorporate nutrients
 - E) to release substances from the cell

- 6) During meiosis, tetrads align along the metaphase plate during
 - A) prometaphase.
 - B) metaphase.
 - C) megaphase.
 - D) metaphase II.
 - E) metaphase I.

- 7) What is the expected phenotypic ratio of a cross between two orange-eyed MendAliens?
- A) 3 black-eyed:1 orange-eyed
 - B) 1 black-eyed:1 orange-eyed
 - C) 1 black-eyed:3 orange-eyed
 - D) 0 black-eyed:1 orange-eyed
 - E) 1 black-eyed:0 orange-eyed
- 8) Crossing over usually contributes to genetic variation by exchanging chromosomal segments between
- A) sister chromatids of a chromosome.
 - B) chromatids of nonhomologues.
 - C) nonhomologous loci of the genome.
 - D) autosomes and sex chromosomes.
 - E) nonsister chromatids of homologues.
- 9) In some organisms, mitosis occurs without cytokinesis occurring. This will result in
- A) destruction of chromosomes.
 - B) cells that are unusually small.
 - C) cell cycles lacking an S phase.
 - D) cells with more than one nucleus.
 - E) cells lacking nuclei.
- 10) A color-blind woman mates with a man who is not color-blind. All of the sons and none of the daughters are color-blind. What is the best explanation of this result?
- A) The gene for color vision is completely dominant to the gene for sex determination.
 - B) The gene for color vision is codominant with the gene for sex determination.
 - C) The gene for color vision is incompletely dominant to the gene for sex determination.
 - D) The gene for color vision is linked to the Y chromosome.
 - E) The gene for color vision is linked to the X chromosome.
- 11) Which of the following factors would tend to increase membrane fluidity?
- A) a relatively high protein content in the membrane
 - B) a greater proportion of relatively large glycolipids compared to lipids having smaller molecular weights
 - C) a high membrane potential
 - D) a lower temperature
 - E) a greater proportion of unsaturated phospholipids
- 12) What enzyme catalyzes the unwinding of a DNA double helix?
- A) DNA polymerase
 - B) primase
 - C) ligase
 - D) helicase
 - E) single-stranded binding protein

- 13) All of the events listed below occur in the energy-capturing light reactions of photosynthesis *except*
- A) oxygen is produced.
 - B) light is absorbed and funneled to reaction-center chlorophyll *a*.
 - C) ADP is phosphorylated to yield ATP.
 - D) NADP⁺ is reduced to NADPH.
 - E) carbon dioxide is incorporated into PGA.
- 14) Beadle and Tatum worked with
- A) monkeys.
 - B) zebrafish.
 - C) fruit flies.
 - D) bread mold.
 - E) guinea pigs.
- 15) The *lac* operon governs the expression of genes concerned with
- A) lactose utilization.
 - B) prophage integration.
 - C) lactate production.
 - D) provirus integration.
 - E) lactose production.
- 16) RNA polymerase binds to the
- A) activator.
 - B) operon.
 - C) enhancer.
 - D) promoter.
 - E) silencer.
- 17) Gel electrophoresis separates DNA molecules on the basis of
- A) the nucleotide sequence of their sticky ends.
 - B) their lengths.
 - C) their nucleotide sequences.
 - D) the amount of adenine they contain relative to the amount of guanine they contain.
 - E) the amount of adenine they contain relative to the amount of thymine they contain.
- 18) Which of the following is a true distinction between fermentation and cellular respiration?
- A) Only respiration oxidizes glucose.
 - B) NADH is oxidized by the electron transport chain only in respiration.
 - C) Substrate-level phosphorylation is unique to fermentation.
 - D) NAD⁺ functions as an oxidizing agent only in respiration.
 - E) Fermentation, but not respiration, is an example of a catabolic pathway.
- 19) *Bicoid* protein is produced by
- A) nurse cells.
 - B) the egg.
 - C) the acrosome.
 - D) a sperm cell.
 - E) the embryo.
- 20) Mendel's law of segregation was nearly impossible for most biologists to understand until there was a general understanding of
- A) mitosis.
 - B) epistasis.
 - C) meiosis.
 - D) pleiotropy.
 - E) dominance.
- 21) In a cell in which $2n = 6$, the independent assortment of chromosomes during meiosis can by itself give rise to _____ genetically different gametes.
- A) two
 - B) four
 - C) six
 - D) eight
 - E) ten

- 22) What is macroevolution?
- A) a uniform change in the rate and pattern of evolution
 - B) population-level changes in gene frequencies
 - C) it is a synonym for "stabilizing selection"
 - D) evolution as it occurs on a large scale
 - E) change on the subspecies level
- 23) Which of these events occurred during the Cenozoic?
- A) origin of eukaryotes
 - B) origin of prokaryotes
 - C) beginning of the accumulation of atmospheric oxygen
 - D) colonization of land by plants
 - E) first humans
- 24) Organisms classified as _____ are responsible for red tides and toxins that are deadly to fishes and humans.
- A) red algae
 - B) brown algae
 - C) dinoflagellates
 - D) chlorophytes
 - E) charophyceans
- 25) In ferns, the _____ stage is _____ on the _____ stage.
- A) gametophyte ... dependent ... gametophyte
 - B) sporophyte ... dependent ... protonema
 - C) gametophyte ... not dependent ... sporophyte
 - D) sporophyte ... dependent ... gametophyte
 - E) gametophyte ... dependent ... protonema
- 26) In pines a pollen cone contains
- A) archegonia.
 - B) microsporangia.
 - C) integuments.
 - D) ovules.
 - E) megasporangia.
- 27) Mollusks differ from nematodes in that mollusks have _____, which nematodes lack.
- A) three germ layers
 - B) a body cavity enclosed by mesoderm
 - C) true tissues
 - D) a body cavity formed from cell masses
 - E) bilateral symmetry

- 28) Which of these features is a characteristic of grasshoppers?
A) book lungs
B) an exoskeleton
C) a gastrovascular cavity
D) a closed circulatory system
E) nephridia
- 29) Which of these primates is a prosimian?
A) chimpanzee B) lemur C) spider monkey D) baboon E) gorilla
- 30) _____ provide cells for primary growth.
A) Xylem
B) Apical meristems
C) Vascular cambium
D) Cork cambium
E) Lateral meristems
- 31) The transport of phloem sap is called
A) transpiration.
B) transformation.
C) transmogrification.
D) translocation.
E) transduction.
- 32) _____ includes the incorporation of nitrogen into the body of a plant.
A) Ammonification
B) Nitrogen fixation
C) Assimilation
D) Nitrification
E) Denitrification
- 33) In the following list, which term is *least* related to the others?
A) X inactivation
B) fragile X syndrome
C) Mary Lyon
D) tortoiseshell coat pattern in cats
E) Barr body
- 34) A eukaryotic cell lacking telomerase would
A) be unable to identify and correct mismatched nucleotides in its daughter DNA strands.
B) be unable to take up DNA from the surrounding solution.
C) incorporate one extraneous nucleotide for each Okazaki fragment added.
D) have a greater potential to become cancerous.
E) experience a gradual reduction of chromosome length with each replication cycle.

- 35) A plant with a critical minimum day length of 14 hours and flowers in summer is a
- A) long-day plant.
 - B) neutral-day plant.
 - C) short-day plant.
 - D) neutral-night plant.
 - E) short-night plant.
- 36) Which of these hormones triggers the secretion of gastric juice?
- A) carboxypeptidase
 - B) gastrin
 - C) CCK
 - D) pepsin
 - E) secretin
- 37) In the capillaries of the head, oxygen released from hemoglobin first diffuses into the
- A) pulmonary veins.
 - B) alveoli.
 - C) blood plasma.
 - D) pulmonary arteries.
 - E) interstitial fluid.
- 38) Which of the following is true of translation in both prokaryotes and eukaryotes?
- A) Translation occurs simultaneously with transcription.
 - B) The codon UUU codes for phenylalanine.
 - C) The product of transcription is directly translated.
 - D) The signal-recognition particle (SRP) binds to the first 20 amino acids of certain polypeptides.
 - E) Ribosomes are affected by streptomycin.
- 39) Which of these cells secretes antibodies?
- A) macrophages
 - B) bacterial cells
 - C) cytotoxic T cells
 - D) plasma cells
 - E) helper T cells
- 40) Which of these is *not* a component of the filtrate that moves from the glomerulus to Bowman's capsule?
- A) urea
 - B) glucose
 - C) sodium chloride
 - D) water
 - E) blood cells

- 41) Which hormone is responsible for shaping the development of the female reproductive system and for secondary female sex characteristics such as broad hips?
A) progesterone B) thymosin C) estrogen D) inhibin E) testosterone
- 42) In frogs, the blastopore develops into the
A) anus. B) digestive tract. C) archenteron. D) mouth. E) brain.
- 43) At rest, there is a higher concentration of _____ outside the neuron membrane than inside the neuron membrane.
A) sulfate
B) amino acids
C) phosphate ions
D) potassium ions
E) sodium ions
- 44) Biomes are
A) recognized on the basis of the dominant animal life.
B) limited to aquatic regions.
C) unaffected by climatic factors.
D) a major type of ecosystem.
E) all of the populations of a particular species.
- 45) The function of the waggle dance in bees is to
A) attract mates.
B) indicate only the distance to food.
C) attract mates and indicate the direction and distance to food.
D) indicate only the direction to food.
E) indicate both the direction and the distance to a food source.
- 46) A survivorship curve that involves producing large numbers of offspring, each with a very low probability of surviving to adulthood, is typical of
A) elephants. B) whales. C) humans. D) cats. E) oysters.
- 47) On Earth, most organic molecules are produced by
A) photosynthesis.
B) glycolysis.
C) hydrolysis.
D) photorespiration.
E) cellular respiration.

- 48) Which of the following pairs is mismatched?
- A) nucleus—DNA replication
 - B) nucleolus—ribosomal RNA
 - C) lysosome—protein synthesis
 - D) cytoskeleton—microtubules
 - E) cell membrane—lipid bilayer
- 49) Which of the following statements is a correct distinction between cyclic and noncyclic photophosphorylation?
- A) Only cyclic photophosphorylation can operate in the absence of photosystem II.
 - B) In addition to ATP, cyclic photophosphorylation also produces O₂ and NADPH.
 - C) Chemiosmosis is unique to noncyclic photophosphorylation.
 - D) Only noncyclic photophosphorylation produces ATP.
 - E) Only cyclic photophosphorylation utilizes light at 700 nm.
- 50) Horizontal transmission of a plant viral disease could be caused by
- A) the movement of viral particles through plasmodesmata.
 - B) insects as vectors carrying virus particles between plants.
 - C) the inheritance of an infection from a parent plant.
 - D) the transmission of proviruses via cell division.
 - E) the spread of an infection by vegetative (asexual) propagation.
- 51) The functioning of enhancers is an example of
- A) the stimulation of translation by initiation factors.
 - B) post-translational control that activates certain proteins.
 - C) a eukaryotic equivalent of prokaryotic promoter functioning.
 - D) transcriptional control of gene expression.
 - E) a post-transcriptional mechanism for editing mRNA.
- 52) DNA technology has many medical applications. Which of the following is *not yet* done routinely?
- A) genetic testing for carriers of harmful alleles.
 - B) production of hormones for treating diabetes and dwarfism
 - C) introduction of genetically engineered genes into human gametes
 - D) prenatal identification of genetic disease genes
 - E) production of viral subunits for vaccines
- 53) The common house fly belongs to all of the following taxa. Assuming you had access to textbooks or other scientific literature, knowing which of the following should provide you with the greatest amount of detailed information about this organism?
- A) phylum Arthropoda
 - B) family Muscidae
 - C) genus *Musca*
 - D) class Hexapoda
 - E) order Diptera

- 54) In which class did jaws first occur?
- A) Placodermi
 - B) Ostracodermi
 - C) Chondrichthyes
 - D) Osteichthyes
 - E) Agnatha
- 55) Which of the following statements about demonstrating the pathogenicity of a particular bacterial species is *not* true?
- A) The same bacteria must be present in each diseased host investigated.
 - B) The bacteria isolated from a diseased host must be grown in pure culture.
 - C) The bacteria must be capable of inducing the disease when transferred to an experimental host.
 - D) The bacteria must be identified in the artificially infected experimental host after the disease develops.
 - E) The bacteria isolated from the experimental host must be capable of reinducing the disease when returned to the original host.
- 56) Which of the following characteristics supports molecular evidence for combining the dinoflagellates, apicomplexans, and ciliates in the monophyletic clade Alveolata?
- A) All possess mitochondria.
 - B) Their flagella or cilia are organized with the 9 + 2 microtubular ultrastructure.
 - C) All are pathogenic.
 - D) All are found exclusively in freshwater or marine habitats.
 - E) The three groups have small membrane-bound alveoli under their cell surfaces.
- 57) In which plant cell or tissue would the pressure component of water potential most often be negative?
- A) root epidermis
 - B) stem xylem
 - C) leaf mesophyll cell
 - D) root cortex cell
 - E) stem phloem
- 58) The bulk of a plant's dry weight is derived from
- A) CO₂.
 - B) the uptake of organic nutrients from the soil.
 - C) the hydrogen from H₂O.
 - D) the oxygen from H₂O.
 - E) soil minerals.
- 59) The following cellular structures are all found in cells of angiosperm or gymnosperm gametophytes *except*
- A) endomembrane system.
 - B) haploid nuclei.
 - C) chloroplasts.
 - D) mitochondria.
 - E) cell walls.

- 60) What accounts for the extremely fast growth of a fungal mycelium?
- A) a dikaryotic condition that supplies greater amounts of proteins and nutrients
 - B) a rapid distribution of synthesized proteins by cytoplasmic streaming
 - C) a long tubular body shape
 - D) their lack of motility that requires rapid spread of hyphae
 - E) the readily available nutrients from their predatory mode of nutrition
- 61) Which of the following is *not* consistent with distinguishing an animal from other life forms?
- A) impulse conduction and movement
 - B) multicellular, autotrophic, eukaryote
 - C) regulatory genes called *Hox* genes
 - D) sexual reproduction
 - E) structural proteins such as collagen
- 62) Plant hormones can have different effects at different concentrations. This is why
- A) plant genes recognize pathogen genes.
 - B) some plants are long-day plants and others are short-day plants.
 - C) they really don't fit the definition of "hormone."
 - D) auxin can stimulate cell elongation in apical meristems, yet will inhibit the growth of axillary buds.
 - E) signal-transduction pathways in plants are different from those in animals.
- 63) Meiosis occurs within all of the following flower parts *except* the
- A) ovule.
 - B) style.
 - C) ovary.
 - D) megasporangium.
 - E) anther.
- 64) The sinoatrial node in humans
- A) delays transmission in the cardiac conduction system after the pacemaker has fired.
 - B) monitors blood pressure in the aorta.
 - C) is the valve between the left atrium and the left ventricle.
 - D) is found in the lymphatic system.
 - E) is the heart's pacemaker.
- 65) An animal's inputs of energy and materials would exceed its outputs
- A) if it is growing and increasing its biomass.
 - B) if it is actively foraging for food.
 - C) if the animal is an endotherm, which must always take in more energy because of its high metabolic rate.
 - D) if it is hibernating.
 - E) never—homeostasis makes these energy and material budgets always balance.

- 66) Two plant species live in the same biome but on different continents. Although these two are not at all closely related, they may appear quite similar as a result of
- A) introgression.
 - B) allopatric speciation.
 - C) convergent evolution.
 - D) parallel evolution.
 - E) gene flow.
- 67) An example of antagonistic hormones controlling homeostasis is
- A) insulin and glucagon in glucose metabolism.
 - B) epinephrine and norepinephrine in "fight-or-flight" responses.
 - C) progesterins and estrogens in sexual differentiation.
 - D) thyroxine and parathyroid hormone in calcium balance.
 - E) oxytocin and prolactin in milk production.
- 68) All of the following characteristics are typical of an *r*-selected population *except*
- A) it occurs in open habitats.
 - B) it occurs in variable environments.
 - C) a high intrinsic rate of growth.
 - D) extensive parental care of offspring.
 - E) onset of reproduction at an early age.
- 69) During convergent extension
- A) the cells of a tissue layer reorganize forming a narrowed elongated sheet.
 - B) the dorsal-ventral axis is established.
 - C) the cells of the neural folds adhere to one another to complete the neural tube.
 - D) cell adhesion molecules are expressed, causing the eight blastomeres to adhere tightly to one another.
 - E) cells on the opposite side of the embryo follow converging developmental pathways leading to bilateral symmetry.
- 70) The sum total of an organism's interaction with the biotic and abiotic resources of its environment is called its
- A) microclimax.
 - B) logistic growth.
 - C) ecological niche.
 - D) habitat.
 - E) biotic potential.
- 71) One level of the biodiversity crisis is the potential loss of ecosystems. The most likely serious consequence of a loss in ecosystem diversity would be the
- A) loss of ecosystem services on which humans depend.
 - B) increase in the dominance of edge-adapted species.
 - C) increase in global warming and thinning of the ozone layer.
 - D) loss of species for "bioprospecting."
 - E) loss of a source of genetic diversity to preserve endangered species.

- 72) Which of the following is *least* related to the others?
- A) cognitive maps
 - B) territory
 - C) ritual
 - D) agonistic behavior
 - E) dominance hierarchy
- 73) Receptor sites for neurotransmitters are located on the
- A) membranes of synaptic vesicles.
 - B) tips of axons.
 - C) postsynaptic membrane.
 - D) presynaptic membrane.
 - E) axon membranes in the regions of the nodes of Ranvier.
- 74) All of the following describe possible results of competition between two species *except*
- A) warning coloration.
 - B) reduction in the populations of both species.
 - C) resource partitioning.
 - D) competitive exclusion.
 - E) reduction in the population of one species.
- 75) Which of these ecosystems has the highest primary productivity per square meter?
- A) savanna
 - B) open ocean
 - C) temperate forest
 - D) tropical rain forest
 - E) boreal forest

II. 解釋名詞：每一子題 2 分 (共 10 分, 10%)

- A. Evolutionary adaptation
- B. Phylogeny
- C. Habituation
- D. Codominance
- E. Signal-recognition particle

III. 問答題 (共 15 分, 15%)

- A. Discuss factors affecting the biodiversity of communities. (7 分)
- B. Describe the hormonal control of calcium homeostasis in mammals. (8 分)

國立中山大學九十四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】

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1. Biological control systems depend on mechanisms involving negative and positive feedbacks, give examples of each and describe their actions. (10%)
2. Describe the role of calcium ions in skeletal muscle contractions. (10%)
3. a. Define "apoptosis" (5%)
b. Describe its physiological significance. (5%)
4. a. Using a flow diagram to describe the pathways of the systemic and pulmonary circulation. (10%)
b. Indicate the relative concentrations of O₂ and CO₂ in the blood vessels. (10%)
5. a. Explain how action potentials are generated along an axon. (10%)
b. Why conduction velocity of an action potential in a myelinated axon (or axons with large diameters) is faster than that in unmyelinated one (or axons with small diameters)? (10%)
6. John has hypertension and his doctor prescribed thiazide diuretics (drugs that influence Na ion transport at distal tubules of the kidney)
 - a. Explain why this treatment might be effective. (10%)
 - b. Describe how these drugs act. (10%)
7. Contrast (compare) the morphology and physiologic functions of the rod and cone cells in the retina. (10%)

國立中山大學九十四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 1 頁 第 1 頁

Answer the following questions:

1. Why are women more susceptible than men to autoimmunity? (20 %)
2. Draw a diagram depicting the three complement activation pathways in detail. (20 %)
3. Describe the methods employed by helminthes in order to evade the host immune response in detail. (20 %)
4. γ -interferon has many effects on cells, one of which is to increase the number of class I MHC molecules on the cell surface. γ -interferon prepared by recombinant DNA technology is currently being tested clinically for the treatment of some viral infections and cancers. Considering the multiple activities of γ -interferon, how might it aid in the immune response against these abnormal cells? (20 %)
5. Explain the following terms: (20 %)
 - (1) Antigenic shift
 - (2) Kabat-Wu plot
 - (3) Double-negative cells
 - (4) Prausnitz-Kustner reaction
 - (5) Periarteriolar lymphoid sheath

一. 單選題 (每題一分, 共 75 題)

1. To position a gene in an expression vector downstream from a promoter (i.e., perform directional cloning), it is best to:
 - a. use the largest plasmid available.
 - b. treat the gene with DNase I.
 - c. restrict both the gene and the plasmid with one restriction endonuclease and then screen all colonies for those that express the gene.
 - d. restrict each end of the DNA fragment (gene) with a different restriction endonuclease and do likewise for the plasmid.

2. A method used to insert or transform cells with a plasmid is to:
 - a. add the DNA to bacterial cells that have been lightly treated with lysozyme to produce "holes" in the cell wall.
 - b. add the DNA to a heated suspension of cells at 42° C.
 - c. treat the bacteria with Ca^{2+} , add the DNA, and briefly heat to 42° C.
 - d. incubate the DNA with the cells overnight at 4° C.

3. In the Southern hybridization procedure, the gel after electrophoresis is treated with NaOH and then neutralized before blotting. What is the primary function of the alkaline treatment?
 - a. It neutralizes any acid soluble impurities in the gel.
 - b. It cleaves the DNA into smaller fragments to permit greater efficiency of transfer.
 - c. It inactivates any restriction endonucleases that may be in the gel.
 - d. It denatures the duplex DNA to single-stranded DNA (ssDNA).

4. Hybride proteins or fusion proteins are produced by:
 - a. incubation of two proteins with a protease.
 - b. expression of genes coding for multiple proteins.
 - c. translation of mRNAs without removing exons.
 - d. translation of recombinant sequences from expression vectors carrying cDNA inserts cloned directly into the coding sequence of a vector-born protein-coding gene.

5. Reporter genes such as those for green fluorescent protein (GFP) are found on many commercial plasmids. These genes are useful to determine:
 - a. if the plasmid is in the host.
 - b. if a gene is present in a library.
 - c. if a foreign protein is being expressed on a vector.
 - d. the relative strength of a promoter sequence.

6. All of the following are properties of a coenzyme EXCEPT:
 - a. They are usually actively involved in the catalytic reaction of the enzyme.
 - b. They tend to be stable to heat.
 - c. They can serve as intermediate carriers of functional groups.
 - d. They are protein components.

7. The free energy of activation, ΔG^\ddagger , is defined as:
- The average free energy of the product formed.
 - The rate of a chemical reaction in relationship to the concentration of reactant molecules.
 - The energy required to raise the average energy of one mole of reactant to the transition state energy.
 - The amount of energy released by a spontaneous reaction.
8. All of the following are true statements about the transition state of a reaction EXCEPT:
- The transition state is not an appropriate indication of the rate of a reaction.
 - The transition state is located at the height of a free energy diagram.
 - The energy required to raise the average energy of one mole of reactant to the transition state is the free energy of activation.
 - Reaching the transition state indicates that there is a high probability that the reaction will occur.
9. All of the following statements are true about the relationships between $[S]$, K_m and V_{max} EXCEPT:
- As the $[S]$ is increased, v approaches the limiting value, V_{max} .
 - $K_m = V_{max}/2$.
 - The rate of the reaction, v , follows a first order rate equation $v = K'[A]$ and $K' = V_{max}/K_m$.
 - The rate of product formed, v , is at V_{max} when $[S] \gg K_m$.
10. Which of the following statements is NOT characteristic of k_{cat}/K_m ?
- It corresponds to a second-order rate constant.
 - It provides an excellent parameter for comparison of the catalytic efficiency of enzymes.
 - It reflects the property of the enzyme when substrate concentration is at saturation.
 - The upper limit for the k_{cat}/K_m value is fixed by the diffusion-controlled limit for reactions, which is $10^9 \text{ M}^{-1} \text{ s}^{-1}$.
11. Most covalent catalysis is carried out by enzymes using a:
- ping-pong kinetic mechanism.
 - sequential bisubstrate kinetic mechanism.
 - random bisubstrate kinetic mechanism.
 - simple unimolecular kinetic mechanism.
12. Metal ion catalysis include all EXCEPT:
- metal ion requirement to maintain the stable, native state of the enzyme.
 - metal binding weakly, perhaps only during the catalytic cycle.
 - electrophilic catalysis, stabilizing the increased electron density or negative charge that can develop during a reaction.
 - all are true.

13. Organic fluorophosphates are _____ inhibitors of serine proteases such as chymotrypsin, etc.
- competitive
 - uncompetitive
 - noncompetitive
 - irreversible
14. In the chymotrypsin reaction mechanism there is a low-barrier hydrogen bond (LBHB) formed between:
- Asp¹⁰² and Ser¹⁹⁵.
 - Asp¹⁰² and His⁵⁷.
 - His⁵⁷ and Ser¹⁹⁵.
 - Ser¹⁹⁵ and carbonyl oxygen in the peptide bond.
15. The initial bond formation in the covalent intermediate in the chymotrypsin catalyzed reaction is between:
- serine and the carbonyl carbon in the peptide backbone.
 - serine and the nitrogen in the peptide backbone.
 - histidine and the carbonyl carbon in the peptide backbone.
 - histidine and the nitrogen in the peptide backbone.
16. Regulation of metabolism by regulation of the gene encoding a particular enzyme is called _____ when there is activation of the enzyme synthesis and _____ when there is a shutdown of the enzyme synthesis.
- intra-steric; covalent modification
 - covalent modification; repression
 - induction; repression
 - induction; allosteric control
17. Isozymes are enzymes with _____, and various isozymes differ in terms of their _____ for substrates and sensitivity to _____.
- totally different structures but the same function; specificity; inhibitors
 - catalytically distinct subunits; specificity; modification
 - slightly different subunits; specificity; inhibitors
 - slightly different subunits; affinity; inhibitors
18. The T form (tense or taut form) of deoxyhemoglobin differs from oxyhemoglobin (the R form or relaxed form) by all EXCEPT:
- covalent linkages between subunits.
 - specific intrachain hydrogen bonds.
 - between β -subunit salt links (ion-pair bonds).
 - between α -subunits salt links (ion-pair bonds).

19. Fetal hemoglobin (Hb F) has an intrinsically greater affinity for O₂ than adult hemoglobin (Hb A) because:
- Hb F has a diminished capacity to bind BPG compared to Hb A.
 - Hb A has a greater affinity for oxygen than does Hb F.
 - BPG binds Hb F with greater affinity than it binds Hb A.
 - The pH of fetal blood is less than the pH of maternal blood.
20. The cause of cell sickling in sickle cell anemia is:
- interaction of oxy-Hb S with the cell membrane.
 - precipitation of deoxy-Hb S into long, chain-like fibers.
 - formation of oxy-Hb S complexes and subsequent cell disruption.
 - precipitation of Hb S - Hb A hybrid molecules.
21. Amphibolic pathways can be:
- found in animals living in both land and water.
 - carried out both in water and organic solvents.
 - found on both sides of the mitochondrial membrane.
 - both anabolic and catabolic in nature.
22. In phototrophs, _____ and _____ are the two energy-rich primary products from the transformation of _____ energy into chemical energy.
- ATP; NAD⁺; cellular
 - NADPH; ATP; light
 - NADH; NADPH; light
 - ATP; NADH; light
23. Most biotin-dependent carboxylations use _____ as the carboxylating agent and transfer the carboxyl group to a substrate _____.
- bicarbonate; hydroxyl group
 - hydroxyl groups; carbanion
 - carboxyl group; carbonium ion
 - bicarbonate; carbanion
24. Pyruvate + CoA + NAD⁺ → _____ + CO₂ + _____
- oxaloacetate; ATP
 - malonyl CoA; NADH + H⁺
 - methylmalonyl CoA; biotin
 - acetyl CoA; NADH + H⁺
25. What are the principal minerals in the human body?
- iron and chloride
 - sodium and potassium
 - calcium and sodium
 - calcium and phosphorus

26. All are important reasons to phosphorylate glucose in the first step of glycolysis EXCEPT:
- the large positive free energy is important in getting the pathway started.
 - glucose-6-phosphate has a negative charge preventing transport out of the cell.
 - the concentration of free glucose in the cell is low favoring influx of glucose.
 - phosphorylation keeps the glucose in the cell.
27. Glucokinase has a K_m value of 10.0 mM, whereas hexokinase has a K_m value of 0.1 mM that is consistent with:
- glucokinase acting on glucose at low concentrations.
 - glucokinase acting on glucose only at high glucose concentrations.
 - glucokinase phosphorylation of most of the glucose at low glucose levels.
 - hexokinase acting on glucose only at high levels of glucose.
28. All are characteristics of Type 1 diabetes mellitus EXCEPT:
- low levels of glucokinase.
 - glucokinase is induced.
 - insufficient insulin is produced.
 - production of little liver glycogen.
29. All are allosteric regulators of phosphofructokinase-1 EXCEPT:
- glucose-6-phosphate by inhibition.
 - ATP by inhibition.
 - AMP by stimulation.
 - citrate by inhibition.
30. The reaction mechanism for glyceraldehyde-3-phosphate dehydrogenase involves _____ attack by a cysteine -SH group on the _____ carbon of the substrate to form a _____.
- electrophilic; carbonyl; ester
 - electrophilic; acidic; ester
 - nucleophilic; amino; ester
 - nucleophilic; carbonyl; hemithioacetal
31. The pyruvate dehydrogenase complex contains three multimeric enzymes (E_{TA} , E_{PDH} , and E_{DL}). All are properties of E_{PDH} EXCEPT:
- It uses thiamin pyrophosphate as a catalytic coenzyme.
 - It oxidatively decarboxylates pyruvate.
 - It binds NAD^+ in its active site.
 - It transfers an acetyl group to lipoamide of E_{TA} .

32. Fluoroacetate inhibits the TCA cycle. Although it does not inhibit citrate synthase, the product inhibits:
- aconitase.
 - isocitrate dehydrogenase.
 - α -ketoglutarate dehydrogenase.
 - succinate dehydrogenase.
33. The succinate dehydrogenase catalyzed reaction involves dehydrogenation _____ to a carbonyl group and is _____ to yield a _____ double bond.
- β,β ; electrophilic; *trans*
 - α,β ; electrophilic; *cis*
 - α,β ; stereospecific; *trans*
 - β,γ ; stereospecific; *cis*
34. The reaction $\text{CO}_2 + \text{PEP} + \text{GDP} \rightleftharpoons \text{OAA} + \text{GTP}$ is catalyzed by:
- PEP carboxylase.
 - PEP carboxykinase.
 - malic enzyme.
 - pyruvate carboxylase.
35. The isocitrate lyase catalyzed reaction cleaves isocitrate into:
- glyoxylate and fumarate.
 - succinate and acetyl-CoA.
 - malate and acetyl-CoA.
 - succinate and glyoxylate.
36. Redox couples with a large _____ reduction potential have a strong tendency to undergo _____ so NADH is a strong _____ agent.
- positive; reduction; oxidizing
 - negative; oxidation; reducing
 - negative; reduction; oxidizing
 - positive; oxidation; reducing
37. In the first phase of the Q cycle, UQH₂ transfers one electron to _____ and then to _____, releasing _____ H⁺ to the intermembrane space leaving _____ that transfers a second electron to _____.
- cyt *c*; Rieske protein; one; UQ; cyt *b_H*
 - cyt *b_L*; cyt *b_H*; two; UQ; cyt *c₁*
 - cyt *c₁*; Rieske protein; one; UQ[•]; cyt *b_H*
 - Rieske protein; cyt *c₁*; two; UQ[•]; cyt *b_L*
38. What molecule is the electron donor to complex III?
- cytochrome *c*
 - UQH₂
 - NADH
 - H₂O

39. In ATP synthase, it is proposed that ___-subunits form a rotor that turns with respect to ___-subunits and the ___-subunit is anchored to the rotor.
- α ; β ; γ
 - c; β ; α
 - c; γ ; β
 - c; α ; γ
40. P/O ratio is defined as:
- P_i uptake per oxygen atom by mitochondria.
 - molecules of phosphate released from ATP per oxygen utilized by muscle tissue.
 - ratio of atoms of phosphorous to oxygen in phosphate (P_i).
 - molecules of ATP formed per two electrons flowing through electron transport chain.
41. Chloroplast _____ give rise to _____ vesicles which occur in stacks called _____ joined by lamellae that run through the _____.
- thylakoid; stroma; grana; lamellae
 - lamellae; thylakoid; grana; stroma
 - lamellae; grana; stroma; thylakoid
 - grana; stroma; thylakoid; lamellae
42. Carotenoids have primary roles in photosynthesis as:
- accessory light-harvesting and photooxidation.
 - accessory light-harvesting and photoprotection from reactive oxygen species.
 - resonance transfer pigments and photooxidation.
 - resonance transfer and photodiffusion protection.
43. ___ and ___ are produced in the light reactions of photosynthesis and are used to convert ___ to ___.
- ATP; NADPH; carbon dioxide; sugar
 - Water; ATP; NADPH; carbon dioxide
 - ATP; $NADP^+$; carbon dioxide; sugar
 - Molecular oxygen; ATP; NADPH; sugar
44. The reaction, Ribulose-5-phosphate + ATP \rightarrow Ribulose-1,5-bisphosphate + ADP, is catalyzed by:
- phosphopentose isomerase.
 - phosphoribulose kinase.
 - ribulose bisphosphate carboxylase.
 - phosphopentose epimerase.
45. How is photorespiration avoided in C-4 plants?
- decrease the concentration of phosphoglycolate.
 - carry carbon dioxide towards an oxygen rich area of the plant.
 - increase the concentration of ribulose-1,5-bisphosphate.
 - transport of carbon dioxide from the mesophyll cells to the bundle sheath cells.

46. Glucose monitoring devices use the reaction, $\text{Glucose} + \text{O}_2 + \text{H}_2\text{O} \rightarrow \text{gluconate} + 2 \text{_____}$, which is catalyzed by the enzyme _____.
- H_2O ; glucose hydrolase
 - H_2O ; glucose oxidase
 - H_2O_2 ; peroxidase
 - H_2O_2 ; glucose oxidase
47. Pyruvate carboxylase consumes a(n) _____ to drive a carboxylation so that _____ could use the energy from decarboxylation to facilitate formation of PEP.
- NADH; pyruvate dehydrogenase
 - NADH; lactate dehydrogenase
 - ATP; pyruvate kinase
 - ATP; PEP carboxykinase
48. Cellular levels of fructose-2,6-bisphosphate (F-2,6-BP) are controlled by the tandem enzyme _____ and _____.
- fructokinase; F-2,6-BPase
 - F-2,6-BPase; PFK-2
 - PFK-2; PFK-1
 - PFK-1; F-2,6-BPase
49. Insulin in the bloodstream is a response to increased blood glucose, and:
- stimulates gluconeogenesis.
 - inhibits glycolysis.
 - stimulates glycogen synthesis in muscle and liver.
 - stimulates glycogen breakdown in liver.
50. Among the many physiological changes elicited by epinephrine, the initiation of the adenylyl cyclase cascade includes all EXCEPT:
- activation of glycogenolysis in liver.
 - inhibition of glycogen synthase.
 - stimulation of glycolysis by 2000 fold.
 - all are true
51. Bile salts are important in the initial digestion of triacylglycerols in the intestine because they:
- are coenzymes for pancreatic lipase.
 - convert the inactive lipase into the active form.
 - emulsify the triacylglycerol globules to produce greater surface area which will increase the activity of the lipase.
 - activate the cleavage at the C-2 position.
52. The first three reactions of β -oxidation of saturated fatty acids are analogous to which sequence of metabolic reactions already discussed?
- succinate \rightarrow fumarate \rightarrow malate \rightarrow oxaloacetate
 - isocitrate \rightarrow α -ketoglutarate \rightarrow succinate \rightarrow fumarate
 - oxaloacetate \rightarrow citrate \rightarrow isocitrate \rightarrow α -ketoglutarate
 - phosphoenolpyruvate \rightarrow pyruvate \rightarrow acetyl-CoA \rightarrow citrate

53. For the complete oxidation of a saturated fatty acid with 16 carbons, how many times must the β -oxidation cycle be repeated?
- 4
 - 7
 - 8
 - 6
54. During β -oxidation of certain unsaturated fatty acids, *cis*- Δ^3 -fatty acyl-CoAs are formed that must be converted to _____-fatty acyl-CoAs by the enzyme _____.
- cis*- Δ^2 ; acyl-CoA dehydrogenase
 - trans*- Δ^2 ; acyl-CoA dehydrogenase
 - trans*- Δ^2 ; enoyl-CoA dehydrogenase
 - trans*- Δ^3 ; enoyl-CoA dehydrogenase
55. In ketone body biosynthesis, the HMG-CoA lyase is mechanistically the reverse of the first half of the reaction catalyzed by:
- aconitase.
 - β -hydroxybutyrate dehydrogenase.
 - citrate synthase.
 - pyruvate dehydrogenase.
56. What type of linkage occurs between ACP and the intermediates in fatty acid biosynthesis?
- an ester
 - a thioester
 - an amide
 - an ether
57. Phosphorylation of regulatory sites on acetyl-CoA carboxylase _____ the affinity for citrate and _____ the affinity for fatty acyl-CoAs requiring _____ levels of fatty acyl-CoAs for inhibition.
- increases; decreases; low
 - decreases; increases; high
 - decreases; increases; low
 - increases; decreases; high
58. Both glycerol and dihydroxyacetone phosphate can serve as precursors for phosphatidic acid. Which enzyme is NOT USED to catalyze reactions in the synthesis of phosphatidic acid from these two precursors?
- glycerol kinase
 - triose phosphate isomerase
 - acyldihydroxyacetone-P reductase
 - glycerol-3-phosphate acyltransferase

59. A lipid that does NOT have a sphingosine backbone is:
- ganglioside GM₁.
 - sphingomyelin.
 - phosphatidylinositol.
 - ceramide.
60. _____ hydrolyzes _____ from chylomicrons and VLDLs to convert VLDLs into _____.
- Pancreatic lipase; triacylglycerols; HDLs
 - Lipoprotein lipase; cholesterol esters; LDLs
 - Lipoprotein lipase; triacylglycerols; LDLs
 - Triacylglycerol lipase; triacylglycerols; IDLs
61. Nitrite reductase requires _____ electrons to reduce NO₂⁻ to NH₄⁺ and the electrons are provided in higher plants through photosynthesis as reduced _____.
- 2; plastoquinone
 - 4; heme
 - 5; heme
 - 6; ferredoxin
62. What reaction does glutamate dehydrogenase (GDH) catalyze?
- The reductive amination of α -ketoglutarate to yield glutamate.
 - Phosphorylation of carbamate to yield carbamoyl-phosphate.
 - The amidation of the γ -carboxyl group of glutamate to form glutamine.
 - The deadenylation of glutamine synthetase.
63. Glutamine synthetase (GS) belongs to what class of enzymes?
- isomerases
 - oxidoreductase
 - ligase
 - lyase
64. Bacterial glutamine synthetase (GS) monomers are inactive because they must be:
- phosphorylated for activity.
 - activated by binding glutamine.
 - stacked for interface active site development.
 - combined for allosteric regulation.
65. In the process of amino acid biosynthesis, how are glutamic acid, glutamine, proline, and arginine all related?
- They are all derived from α -KG.
 - They are all derivatives of acetyl CoA.
 - They are all derivatives of pyruvate.
 - They are all derived from aspartate.

66. What is the limiting substance in the biosynthesis of purines?
- ribose-5-phosphate
 - 5-phosphoribosyl- β amine
 - formylglycinamide ribonucleotide
 - 5-phosphoribosyl- α -pyrophosphate (PRPP)
67. The reaction, base + PRPP \rightarrow nucleoside-5-phosphate + PP_i is catalyzed by the enzyme:
- nucleotide diphosphate kinase.
 - phosphoribosyltransferase.
 - ribose-5-phosphate pyrophosphokinase.
 - adenylate kinase.
68. Which of the following is an advantage of metabolic channeling?
- It allows the product of one reaction to be available for a reaction later in another pathway.
 - It allows the dilution of substrates.
 - It allows a more diverse interaction of substrates, intermediates, and enzymes.
 - It does not allow for substrate dilution into the milieu and for the accumulation of intermediates.
69. Unlike hydrogen, which is often abstracted from substrates as H⁺, electronegative _____ cannot be readily eliminated as _____, thus enzyme inhibitors can be fashioned in which _____ replaces H at positions where catalysis involves H-removal as H⁺.
- sodium; Na⁺; Na
 - potassium; K⁺; K
 - deuterium; D⁺; D
 - fluorine; F⁺; F
70. Thymidylate synthase synthesizes dTMP from _____ by _____ utilizing the coenzyme _____.
- dCTP; carboxylation; biotin
 - dUMP; methylation; THF
 - dCMP; methylation; THF
 - dGMP; phosphorylation; ATP
71. In photoautotrophs, _____ are fed into catabolism to generate the metabolic intermediates needed to supply _____.
- lipids; photorespiration
 - proteins; photorespiration
 - carbohydrates; anabolism
 - carbohydrates; NADPH

72. Regulatory enzymes, such as _____, in energy-producing pathways show greater activity at _____ energy charge.
- TPI; high
 - acetyl-CoA carboxylase; low
 - pyruvate kinase; high
 - PFK-1; low
73. Heart muscle differs from skeletal muscle in the following ways EXCEPT:
- heart is completely aerobic.
 - heart prefers fatty acids as fuel.
 - heart has more phosphocreatine than skeletal muscle.
 - heart has limited quantities of glycogen.
74. All are uses of glucose-6-phosphate in liver EXCEPT:
- catabolized to acetyl-CoA for fatty acid biosynthesis.
 - generate NADPH and pentoses.
 - released as glucose to blood stream.
 - all are true.
75. In addition to carbohydrate and lipid energy metabolism, the liver serves other purposes EXCEPT:
- producing insulin to regulate metabolism.
 - converting amino acids into metabolic fuel.
 - ketone body production.
 - detoxification of poisons and drugs.

二. 問答題 (共 25 分)

1. Assuming DNA replication proceeds at a rate of 750 base pairs per second, calculate how long it will take to replicate the entire *E. coli* genome. Under optimal conditions, *E. coli* cells divide every 20 minutes. What is the minimal number of replication forks per *E. coli* chromosome in order to sustain such a rate of cell division? (10 分)
2. DNA repair includes more than 10 different mechanisms in the following categories. Please describe the followings as detail as possible. (15 分)
- Direct reversal of damage;
 - Excision repair;
 - Mismatch repair;
 - SOS repair;
 - Double-stranded break repair

國立中山大學九十四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 5 頁 第 1 頁

1. 請自下列 1-20 題各題選出單一正確的答案。每題 3 分。
 1. A major difference between prokaryotic and eukaryotic DNA replication is
 - A. the absence of a nucleus in prokaryotes
 - B. no requirement for topoisomerases activity in prokaryotes
 - C. completely different proteins/enzymes in eukaryotes
 - D. multiple origins in eukaryotes
 2. During initiation of eukaryotic protein synthesis
 - A. the correct AUG is selected by Shine-Dalgarno interactions
 - B. initiation factors recognized and bind to the 5' cap of the mRNA
 - C. RNA helicases hydrolyze GTP to remove secondary structure between the cap and the AUG codon
 - D. eIF-1 is required to exchange GTP for GDP
 3. The first research team to propose the idea that the expression of a gene can be controlled by the product of another gene was
 - A. Watson and Crick
 - B. Morgan and Sutton
 - C. Wilkins and Franklin
 - D. Jacob and Monod
 4. On the ribosome, mRNA binds _____; the catalytic reaction of peptidyl transferase occurs _____.
 - A. to the large subunit; on the small subunit.
 - B. to the small subunit; on the large subunit.
 - C. between the subunits; on the large subunit.
 - D. between the subunits; on the small subunit.
 5. The role of a helicase is
 - A. hydrolysis of phosphodiester bonds
 - B. formation of phosphodiester bonds
 - C. breaking hydrogen bonds
 - D. the same as a topoisomerase

國立中山大學九十四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 5 頁 第 2 頁

6. The most simple type of repair for cyclobutane pyrimidine dimers which are caused by UV of sunlight is
 - A. double-strand break repair.
 - B. excision repair.
 - C. photoreactivation.
 - D. damage bypass.
7. No normal tRNA molecule has an anticodon complementary to any of the stop codons UAG, UAA, or UGA, which is why these codons are recognized as stop signals.
 - A. true
 - B. false
8. Which of the following statement is correct?
 - A. DNA pol I of *E. coli* is the major replicative polymerase in this organism – it is the enzyme that synthesizes the majority of the new DNA during DNA replication.
 - B. The "reverse" in the name reverse transcriptase refers to the fact that this enzyme moves in a 3'→5' direction.
 - C. cDNA refers to cloned DNA.
 - D. Telomerase is a reverse transcriptase.
9. Ribosome is the site for protein synthesis in cells. Which of the following regarding composition of the ribosome is correct?
 - A. Almost 50% protein and 50% RNA.
 - B. Almost 80% protein and 20% RNA.
 - C. Almost 20% protein and 80% RNA.
 - D. Almost 60% protein and 40% RNA.
10. Suppressor mutations change a nucleotide in the _____ of a tRNA molecule?
 - A. Acceptor stem
 - B. D loop
 - C. anticodon
 - D. T ψ C loop

國立中山大學九十四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 5 頁 第 3 頁

11. Nonhomologous end joining (NHEJ) is a mechanism for DNA repair involved in which type of repair system?
- A. Mismatch repair
 - B. Photoreactivation
 - C. Translesion DNA synthesis
 - D. Double-strand break repair
12. The spliceosome:
- A. is a large RNA complex made up exclusively of small nuclear RNAs.
 - B. recognizes the boundaries between exons and introns.
 - C. is located in the cytosol of eukaryotic cells.
 - D. all of the above.
13. What is the target molecule of *in situ* hybridization?
- A. double-stranded DNA
 - B. single-stranded DNA
 - C. RNA
 - D. Protein
14. Trans-splicing is the same mechanism as alternative splicing, both occur in eukaryotes.
- A. true B. false.
15. and 16.
- An undergraduate team had just cloned a new gene, gene Mobo, in mouse. They want to search for a homologous gene in humans. A probe was designed based on the mouse Mobo sequence and was used in Southern blot analysis of human genomic DNA. The hybridization conditions most likely to identify the human homologue would include:
15. A salt concentration that was relatively

國立中山大學九十四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 5 頁 第 4 頁

- A. high B. moderate C. low D. same
16. A temperature that was relatively
- A. high B. moderate C. low D. same
17. Homologous recombination is essential to and occurs in all organisms. Which of the following cellular process(es) may involve homologous recombination?
- A. DNA replication
B. meiosis
C. DNA repair
D. All of the above
18. The junction between the two helical portions of tRNA is stabilized by many non-standard base-base interactions between nucleotides in the
- A. anticodon and CCA ends.
B. helical stems the D and anticodon stems
C. anticodon loop and acceptor stem
D. loops of the T ψ C and D.
19. The exision repair of UV-induced DNA damage is defective in individuals suffering from
- A. hereditary nonpolyposis colon cancer.
B. Crohn's disease.
C. classical xeroderma pigmentosum.
D. xeroderma pigmentosum variant.
20. The consensus sequences , 5' splice site GU and 3' splice site AG, can be found at the boundary between introns and exons in all eukaryotic coding genes and allow the cell to identify and remove introns.
- A. true B. false

國立中山大學九十四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 5 頁 第 5 頁

II. 問答題 (21-24): 每題 10 分

21. DNA replication is an essential process for cell. Draw a DNA replication fork. Label the 5' and 3' ends of each strand. Identify the leading and lagging strand, Okazaki fragments, and clear show each of the proteins listed below. Give a brief description of each of the listed proteins for its role at the fork.

SSB

Helicase

DNA polymerase I

DNA polymerase III

Primase

22. Design an experiment to separate a mix of DNA, RNA, and protein.

23. Covalent modifications play important roles in regulating chromatin dynamics and gene expression. Name the known modifications and give one biological example for each to explain their function in chromatin.

24. Define telomere and telomerase and discuss their roles in cells.

Plant Physiology

1. Term explanation. 40%
 - (1) Apoplast
 - (2) De-differentiation
 - (3) Phytochrome
 - (4) Photorespiration
 - (5) Acid growth
 - (6) Guard cells
 - (7) Senescence
 - (8) Secondary metabolites
2. Describe the advantages of C_4 plants. 20%
3. Describe the model for the redistribution of auxin during gravitropism in maize roots. 20%
4. Describe the known factors involved in photochrome-regulated gene expression. 20%

國立中山大學九十四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. In a Gram stain, one step could be omitted and still allow differentiation between gram-positive and gram-negative cells. What is that one step? Why? (5 points)
2. Two types of cells have been distinguished: prokaryotic and eukaryotic. How do these cells differ from each other? (15 points)
3. Draw a typical bacterial growth curve. Label the X- and Y-axis. Name and define each of the four phases. (10 points)
4. Bioremediation of an oil spill site can be done by adding nitrogen salts and phosphorus salts to the oil polluted soil. Explain why and how this works? (5 points)
5. Differentiate between a genomic library and a cDNA library. (10 points)
6. Differentiate between cellular and plasmodial slime molds. (10 points)
7. Draw a brief picture and describe the life cycle of a + strand RNA virus. (15 points)
8. Define the following terms (5 points each)
 - (1) Pasteurization
 - (2) Ti plasmid
 - (3) Nosocomial infection
 - (4) Biochemical oxygen demand
 - (5) Chemoautotroph
 - (6) Endotoxin

I. 解釋名詞：每一子題 5 分（共 40 分, 40%）

1. Carrying capacity
2. CAM photosynthesis
3. Batesian mimicry
4. Autotrophy
5. Self-thinning
6. Realized niche
7. Character displacement
8. Climax community

II. 問答題，每一子題 15 分（共 60 分, 60%）

9. What are semelparity and iteroparity, and what conditions favor each one?
10. Discuss the factors which may have contributed to the evolution of sociality.
11. Discuss the mechanisms of succession.
12. Discuss the possible causes of different tree species number found in eastern Asia, eastern North America, and Europe.

國立中山大學九十四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 1 頁 第 1 頁

問答題：每題 20 分

- 1、請依據現今已知的證據所建構的演化樹，討論維管束植物中非種子植物的分類（系統）。
- 2、請依據現今已知的證據所建構的演化樹，討論被子植物的分類（系統）。
- 3、請敘述台灣裸子植物的分類，並列舉其中任何五種植物的學名。
- 4、請敘述台灣植被的垂直分佈。
- 5、請說明並討論下列三名詞：Systematics, Taxonomy, 和 Classification。

國立中山大學九十四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

- Distinguish SD from SE. (10%)
- White blood cells (10^3 cell/mm^3) of six matched patients of diabetes and hepatitis were shown below. Are the means different between two groups? (20%)

pairs	1	2	3	4	5	6
diabetes	14	11	9.2	7	3	5.3
hepatitis	15	10	7.5	4.2	2	3

- Three methods were compared for the teaching of biostatistics in a college. One student was selected from each department, and their test scores were obtained. Is the effect of method significant? (25%)

	Department		
	Biology	Agriculture	Medicine
Method A	60	50	70
B	90	85	90
C	70	80	80

- Draw a scatter diagram of the age and weight of rats given below. Find out the correlation coefficient and test the significance of the coefficient between the two. (25%)

Rat	1	2	3	4	5
Age (weeks)	10	20	22	30	32
Weight	200	260	270	300	320

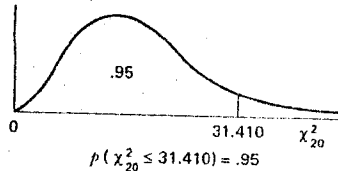
- A new medicine, compared with current method, to prevent acute myocardial infarction was administrated to patients, and the results are shown below. Is the new medicine more effective comparing with the current one? (20%)

Medicine	Effective		Not effective	
	New	Current	New	Current
New	2		5	
Current		2		4

TABLE IV Critical Values of F^1
Values of $F_{0.05}$

Degrees of freedom for denominator	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	3.01	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	2.53	2.46	2.39	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.	$\chi^2_{.005}$	$\chi^2_{.025}$	$\chi^2_{.05}$	$\chi^2_{.90}$	$\chi^2_{.95}$	$\chi^2_{.975}$	$\chi^2_{.99}$	$\chi^2_{.995}$
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	14.684	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	18.549	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	65.647	69.126	107.565	113.145	118.136	124.116	128.299
100	67.328	74.222	77.929	118.498	124.342	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	1.886	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	1.476	2.015	2.571	3.365
6	1.440	1.943	2.447	3.143
7	1.415	1.895	2.365	2.998
8	1.397	1.860	2.306	2.896
9	1.383	1.833	2.262	2.821
10	1.372	1.812	2.228	2.764
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

國立中山大學九十四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】

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1. Distinguish morphologically and ecologically among hagfishes, lampreys, and eels, and discuss the phylogenetic relationships among them. (15%)
2. Give one animal from Taiwan of the following mammalian families: Felidae, Ursidae, Mustelidae, and Viverridae, and discuss their distribution and conservation status. (15%)
3. The reproduction system of amphibians are said to be variable. What features do caecilians, salamanders and frogs all share in common? How do they differ? (15%)
4. Give examples of a. introduced b. new reptiles species from Taiwan recently described in scientific literature. (10%)
5. Compare the circulatory systems among major groups of vertebrates. (15%)
6. What are the morphological differences among storks, bitterns, herons, and cranes. (10%)
7. Explain the following terms: holotype, syntype, type series, paratype, and neotype. (10%)
8. Discuss the phylogenetic relationships among urochordates, hemichordates, cephalochordates, vertebrates, echinoderms, and mollusks. (10%)

國立中山大學九十四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】

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昆蟲學考題

名詞解釋與比較 (25%)

1. Diptera vs Hymenoptera
2. polymorphism vs polyphenism
3. prothoracic glands vs corpora allata
4. ectoparasitoids vs endoparasitoids
5. mayfly vs stonefly

英譯中 (10%)

Male and female conspecific insects often communicate with chemical sex pheromones. Mate location and courtship may involve chemicals in two stages, with sex attraction pheromones acting at distance, followed by close-up courtship pheromones employed prior to mating.

中譯英 (10%)

昆蟲對於以下的生態系功能扮演著重要的角色：養份的循環、植物的繁殖(包含授粉與種子的散播)、植物群落的維持、以及動物群落的維持。

問答題 (共 55%)

1. 請簡述脫皮(moulting)的過程與激素調控。(15%)
2. 請解釋何為精子競爭(sperm competition)並舉一實例說明之。(10%)
3. 請設計一個實驗比較同一種昆蟲在兩整不同植物上的取食與發育表現。請指出所有可能會利用到的硬體、軟體與統計方式 (30%)