

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 110 學年度碩士班考試入學試題

系所班組別：生命科學院

甲組(生物與醫學科學組)

科目代碼：0402

考試科目：生物學

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記  由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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系所班組別：生命科學院甲組、丁組

考試科目（代碼）：生物學(0402、0702)

共 7 頁，第 1 頁 *請在【答案卡】作答

一、單選題(每題 2 分，共 50 分)

1. Which of the following is **NOT** part of the endomembrane system?
(A) Lysosome
(B) Endoplasmic reticulum
(C) Golgi apparatus
(D) Mitochondria
2. In a natural community, the primary consumer is?
(A) Carnivores
(B) Herbivores
(C) Detritivores
(D) Decomposers
3. Which of the following statement about enzyme is **NOT TRUE**?
(A) All enzymes are proteins
(B) The active site is the region where the substrate binds
(C) Each enzyme has an optimal temperature and pH in which it can function
(D) Optimal conditions usually favor the most stable and active conformation for the enzyme molecule
4. What is the central role of helper T cells?
(A) Helper T cells are the only immune cell type that can produce immunological memory
(B) Activated helper T cells release perforin that make pores in the target cell's membrane and enzymes promoting apoptosis leading to cell death
(C) Helper T cells can be activated through innate immune response by antigen-presenting cells such as macrophages and dendritic cells, setting stage for the adaptive immune response
(D) Activated helper T cells can produce antibodies
5. Which of the following statements about excretory system is **NOT TRUE**?
(A) Nephron is the functional unit of kidney
(B) The nephron consists of a single long tubule and a ball of capillaries called glomerulus. Filtration occurs as blood pressure forces fluid from the blood in the glomerulus into the lumen of Bowman's capsule
(C) Filtration of small molecules passes through three regions of the nephron: the proximal tubule, the loop of Henle, and the distal tubule, which are all permeable to salt but not to water
(D) The controlled movement of ions (such as H^+ , NH_4^+ , HCO_3^-) in the proximal and distal tubules keep the constant pH in the body fluid

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共 7 頁，第 2 頁 *請在【答案卡】作答

6. About digestion, which of the following statement is **TRUE**?
- (A) Protein digestion occurs only in the stomach
 - (B) Most digestion occurs in the duodenum, where acid chyme from the stomach mixes with digestive enzymes from the pancreas, liver, gallbladder, and the small intestine itself
 - (C) Polysaccharides digestion starts from small intestine with enzymes from pancreas
 - (D) Bile is made in the pancreas and stored in the gallbladder
7. Which of the following statement is **TRUE** about respiration?
- (A) Alveoli is the place where gas exchange occurs
 - (B) In the capillaries of alveoli, CO₂ diffuses into the blood and O₂ diffuses into the air
 - (C) During inhalation, lung volume increases as the rib muscle contracts and diaphragm relaxes
 - (D) The breathing control center is located in the hypothalamus
8. Thomas Hunt Morgan's choice of *Drosophila melanogaster* (fruit fly) has been proven to be useful even today. Which of the following is the most important character that makes fly one of the most useful and powerful model organisms in research?
- (A) They have compound eyes
 - (B) They have large and transparent embryos that can be easily studied
 - (C) They have genome that is more than 90% similar to the human beings
 - (D) They have short life cycle with large number of offspring
9. Which of the following is the most important factor that determine the resolution of a light microscope?
- (A) Magnification
 - (B) The wavelength of light
 - (C) Contrast
 - (D) Price
10. Which of the following statement about anaerobic and aerobic respirations is **NOT TRUE**?
- (A) Both use glycolysis
 - (B) Both use NAD⁺ as electron carrier
 - (C) Both use oxygen as final electron acceptor
 - (D) Aerobic respiration produces about 30-32 ATP, whereas anaerobic respiration produces 2 ATP

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共 7 頁，第 3 頁 *請在【答案卡】作答

11. About genetic mutation, which of the following statement is **TRUE**?
- (A) Silent mutations usually do not have observable effects on phenotypes because they are in-frame mutations
 - (B) Missense mutations change a codon into a stop codon leading to a truncated protein
 - (C) Nonsense mutation is a point mutation in which a single nucleotide change resulted in a change in an amino acid
 - (D) Insertions and deletions are additions or losses of nucleotides in a gene that usually alter the reading frame producing frame-shifted mutations
12. Lipid-soluble signaling molecules, such as aldosterone, can diffuse across the cell membranes but affect only target cells because?
- (A) Only target cells have responsive DNA segments
 - (B) Intracellular receptors are present only in target cells
 - (C) Only target cells have enzymes that convert aldosterone to active form
 - (D) Aldosterone-responsive genes are only present in the target cells
13. The upper forelimbs of humans and bats have fairly similar skeletal structures, whereas the corresponding bones in whales have very different shapes and proportions. However, genetic data suggest that all three kinds of organisms diverged from a common ancestor at about the same time. Which of the following is the most likely explanation for these data?
- (A) Forelimb evolution was adaptive in people and bats, but not in whales
 - (B) Whales are not properly classified as mammals
 - (C) Genes mutate faster in whales than in humans or bats
 - (D) Natural selection in an aquatic environment resulted in significant changes to whale forelimb anatomy
14. Which of the following is the correct description of the tropical rain forest?
- (A) Long summers and mild winters
 - (B) Low temperature, rain uniform during the year
 - (C) Warm temperatures and continual rains allow plant growth year-round
 - (D) Low rainfall and dry weather
15. Chemoautotrophs?
- (A) Use inorganic compound (such as methane) as energy source and CO_2 as a carbon source
 - (B) Use light as energy source and organic compound as a carbon source
 - (C) Use organic compound as energy source and organic compound as a carbon source
 - (D) Use light as energy source and CO_2 as a carbon source

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共 7 頁，第 4 頁 *請在【答案卡】作答

16. Which of the following is a density-independent factor in a population?
(A) Food
(B) Weather
(C) Habitat
(D) Carrying capacity
17. Gymnosperms?
(A) Ovary becomes the fruit after fertilization
(B) Undergo double fertilization
(C) Do not have vascular tissues
(D) Bear seeds on exposed surfaces of spore-bearing structures
18. Which of the following tools of DNA technology is incorrectly paired with its use?
(A) DNA polymerase—polymerase chain reaction to amplify specific DNA fragments
(B) Electrophoresis—separation of DNA fragments by size
(C) DNA ligase—cutting DNA to create DNA segments with specific ends
(D) Reverse transcriptase—use mRNA to synthesize DNA
19. The most direct ancestors of land plants were probably
(A) Kelp (brown alga) that formed large beds near the shorelines
(B) Green algae
(C) Photosynthesizing prokaryotes (cyanobacteria)
(D) Liverworts and mosses
20. In addition to seeds, which of the following characteristics is unique to the seed-producing plants?
(A) Sporopollenin (a component of spore outer walls)
(B) Lignin present in cell walls
(C) Megaphylls
(D) Pollen
21. Much of the animal diversity is a result of the evolution of novel ways to
(A) Reproduce
(B) Arrange cells into tissues
(C) Sense, feed, and move
(D) Form an embryo and establish a basic body plan
22. Vertebrates and tunicates share?
(A) A notochord and a dorsal, hollow nerve cord
(B) The formation of structures from the neural crest
(C) A high degree of cephalization
(D) Jaws adapted for feeding

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共 7 頁，第 5 頁 *請在【答案卡】作答

23. One important difference between the anatomy of roots and the anatomy of leaves is that?

- (A) Only leaves have phloem and only roots have xylem
- (B) Root cells have cell walls and leaf cells do not
- (C) Vascular tissue is found in roots but is absent from leaves
- (D) A waxy cuticle covers leaves but is absent from roots

24. Darwin and Wallace's theory of evolution by natural selection was revolutionary because it

- (A) Was the first theory to refute the ideas of special creation
- (B) Dismissed the idea that species are constant and emphasized the importance of variation and change in populations
- (C) Proved that individuals acclimated to their environment over time
- (D) Was the first time a biologist had proposed that species changed through time

25. Which statement about variation is **TRUE**?

- (A) All phenotypic variation is the result of genotypic variation
- (B) All genetic variation produces phenotypic variation
- (C) All new alleles are the result of nucleotide variability
- (D) All nucleotide variability results in neutral variation

二、多選題(每題 5 分，共 50 分；答對一個選項得 1 分，答錯一個選項扣 1 分；未作答，不給分亦不扣分)

26. Which of the following two main solutes contribute to the osmolarity of the interstitial fluid in the kidney?

- (A) NH_4^+
- (B) HCO_3^-
- (C) Urea
- (D) KCl
- (E) NaCl

27. Which of the following hormones are secreted from the anterior pituitary gland?

- (A) Anti-diuretic hormone
- (B) Thyroid stimulating hormone
- (C) Thyrotropin-releasing hormone
- (D) prolactin
- (E) Oxytocin

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共 7 頁，第 6 頁 *請在【答案卡】作答

28. What are the main functions of the antibody in the immune system?
- (A) Induction of inflammatory response
 - (B) Neutralization of viral toxicity
 - (C) Binding to antigen on the surface of bacteria to promote phagocytosis
 - (D) Activation of the complement system
 - (E) Activation of phagocytotic cells, including neutrophils and macrophages
29. Which of the following organelles or structures are observed in both plant cells and animal cells?
- (A) Plasmodesmata
 - (B) Central vacuole
 - (C) Ribosomes
 - (D) Chloroplast
 - (E) Mitochondria
30. About mitosis and meiosis, which of the following statements are TRUE?
- (A) Mitosis conserves the number of chromosome sets, producing cells that are genetically identical to the parent cell
 - (B) Meiosis is a special type of mitosis producing reproductive cells that occurs only in animal cells
 - (C) Meiosis reduces the number of chromosomes sets from two (diploid) to one (haploid)
 - (D) Meiosis produces cells that differ genetically from each other and from the parental cell
 - (E) Synapsis and crossing over occur in both mitosis and meiosis
31. In yeast signal transduction, a yeast cell releases a mating factor which
- (A) diffuses through the membranes to opposite type of cells, causing them to produce factors that initiate long-distance migrations
 - (B) binds to receptors on the membranes of opposite type of yeast cells
 - (C) passes through the membranes of opposite cell type, binds to DNA, and initiates transcription
 - (D) acts back on the same cell type that secreted the mating factor, changing its cell division
 - (E) Changes the shape of the opposite type of yeast cells
32. In eukaryotic cells, chromosomes are composed of
- (A) DNA
 - (B) RNA
 - (C) Phospholipid
 - (D) Ribosome
 - (E) Protein

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33. Viruses?

- (A) Make their own ATP, proteins, and nucleic acids
- (B) Have RNA rather than DNA
- (C) Use the host cell to copy themselves and make viral proteins
- (D) That infect bacteria called phage
- (E) Enveloped viruses have a phospholipid membrane outside their capsid, whereas nonenveloped viruses do not have a phospholipid membrane

34. Which of the following statements is a correct distinction between autotrophs and heterotrophs?

- (A) Cellular respiration is unique to heterotrophs
- (B) Only heterotrophs have mitochondria
- (C) Autotrophs, but not heterotrophs, can nourish themselves beginning with CO₂ and other nutrients that are inorganic
- (D) The most common way that autotrophs make their own food is converting inorganic molecules into usable components by sunlight through photosynthesis
- (E) Only heterotrophs require oxygen

35. Which of the following scientists were responsible for the following discovery?

- (A) Erwin Chargaff discovered that in DNA from any species, the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine
- (B) Alfred Hershey and Martha Chase discovered that RNA can be converted to DNA by reverse transcription
- (C) James Watson and Francis Crick discovered that DNA is a double helix in structure
- (D) Oswald Avery, Maclyn McCarty, and Colin MacLeod discovered that DNA is genetic material
- (E) Matthew Meselson and Franklin Stahl discovered that DNA replication is semi-conservative