

一、單選題 (每題 2 分) ※注意：請於試卷「選擇題作答區」依題號作答。※

1. The bonding of two amino acid molecules to form a larger molecule requires which of the following?  
(A) removal of a water molecule  
(B) addition of a water molecule  
(C) formation of an ionic bond  
(D) formation of a hydrogen bond  
(E) removal of an electron
2. Cell membranes are asymmetrical. Which of the following is a most likely explanation?  
(A) The cell membrane forms a border between one cell and another in tightly packed tissues such as epithelium.  
(B) Cell membranes communicate signals from one organism to another.  
(C) Cell membrane proteins are determined as the membrane is being packaged in the ER and Golgi.  
(D) The inner leaflet and outer leaflet of membrane are predetermined by genes.  
(E) Proteins can only span cell membranes if they are hydrophobic.
3. The primary role of oxygen in cellular respiration is to \_\_\_\_\_.  
(A) yield energy in the form of ATP as it is passed down the respiratory chain  
(B) act as an acceptor for electrons and hydrogen, forming water  
(C) combine with carbon, forming CO<sub>2</sub>  
(D) combine with lactate, forming pyruvate  
(E) catalyze the reactions of glycolysis
4. Carotenoids are often found in foods that are considered to have antioxidant properties in human nutrition. What related function do they have in plants?  
(A) They serve as accessory pigments.  
(B) They reflect orange light.  
(C) They cover the sensitive chromosomes of the plant.  
(D) They dissipate excessive light energy.  
(E) They take up toxins from the water.
5. Independent assortment of chromosomes is a result of \_\_\_\_\_.  
(A) the random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I  
(B) the random nature of the fertilization of ova by sperm  
(C) the random distribution of the sister chromatids to the two daughter cells during anaphase II  
(D) the relatively small degree of homology shared by the X and Y chromosomes  
(E) All of the above

6. Which of the following best describes siRNA?
- (A) a double-stranded RNA that is formed by cleavage of hairpin loops in a larger precursor
  - (B) a single-stranded RNA that can, where it has internal complementary base pairs, fold into cloverleaf patterns
  - (C) a short double-stranded RNA, one of whose strands can complement and inactivate a sequence of mRNA
  - (D) a portion of rRNA that allows it to bind to several ribosomal proteins in forming large or small subunits
  - (E) a molecule, known as Dicer, that can degrade other mRNA sequences
7. Why might the cricket genome have 11 times as many base pairs than that of fly, *Drosophila melanogaster*?
- (A) The two insect species evolved at very different geologic eras.
  - (B) Crickets have higher gene density.
  - (C) *Drosophila* are more complex organisms.
  - (D) Crickets must have more non-coding DNA.
  - (E) Crickets must make many more proteins.
8. Over time, the movement of people on Earth has steadily increased. This has altered the course of human evolution by increasing \_\_\_\_\_.
- (A) non-random mating
  - (B) geographic isolation
  - (C) genetic drift
  - (D) mutations
  - (E) gene flow
9. Which statement about bacterial cell walls is false?
- (A) Bacterial cell walls differ in molecular composition from plant cell walls.
  - (B) Cell walls prevent cells from dying in hypertonic conditions.
  - (C) Cell walls prevent cells from bursting in hypotonic environments.
  - (D) Cell walls provide the cell with a degree of physical protection from the environment.
  - (E) Bacterial cell walls are similar in function to the cell walls of many protists, fungi, and plants.
10. CO<sub>2</sub> enters the inner spaces of the leaf through the \_\_\_\_\_.
- (A) cuticle
  - (B) epidermal trichomes
  - (C) walls of guard cells
  - (D) phloem
  - (E) stoma
11. Where and by which process are sperm cells formed in plants?
- (A) meiosis in pollen grains
  - (B) meiosis in anthers
  - (C) mitosis in male gametophyte pollen tube
  - (D) mitosis in the micropyle
  - (E) mitosis in the embryo sac

12. Which of the following is true of bile salts?
- (A) They are enzymes.
  - (B) They are manufactured by the pancreas.
  - (C) They are normally an ingredient of gastric juice.
  - (D) They increase the efficiency of pepsin action.
  - (E) They emulsify fats in the duodenum.
13. Which of the following is a function of plasma proteins in humans?
- (A) maintenance of blood osmotic pressure
  - (B) transport of water-soluble lipids
  - (C) gas exchange
  - (D) aerobic metabolism
  - (E) oxygen transport
14. Clonal selection implies that \_\_\_\_\_.
- (A) brothers and sisters have similar immune responses
  - (B) antigens increase mitosis in specific lymphocytes
  - (C) only certain cells can produce interferon
  - (D) a B cell has multiple types of antigen receptors
  - (E) the body selects which antigens it will respond to
15. The body fluids of an osmoconformer would be \_\_\_\_\_ with its \_\_\_\_\_ environment.
- (A) hyperosmotic; freshwater
  - (B) isotonic; freshwater
  - (C) hyperosmotic; saltwater
  - (D) isoosmotic; saltwater
  - (E) hypoosmotic; saltwater
16. The divisions of the nervous system that have antagonistic actions, or opposing actions are \_\_\_\_\_.
- (A) motor and sensory
  - (B) central nervous system and peripheral nervous system
  - (C) presynaptic and postsynaptic
  - (D) forebrain and hindbrain
  - (E) sympathetic and parasympathetic
17. Cells move to new positions as an embryo establishes its three germ tissue layers during \_\_\_\_\_.
- (A) gastrulation
  - (B) cleavage
  - (C) fertilization
  - (D) induction
  - (E) differentiation

18. 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
19. A species of fish is found to require a certain water temperature, a particular oxygen content of the water, a particular depth, a rocky substrate on the bottom, and a variety of nutrients in the form of microscopic plants and animals to thrive. These requirements describe its \_\_\_\_\_.
- (A) dimensional profile
  - (B) resource partition
  - (C) prime habitat
  - (D) ecological niche
  - (E) home base
20. How is habitat fragmentation related to biodiversity loss?
- (A) Less carbon dioxide is absorbed by plants in fragmented habitats.
  - (B) In fragmented habitats, more soil erosion takes place.
  - (C) Populations of organisms in fragments are smaller and, thus, more susceptible to extinction.
  - (D) Animals are forced out of smaller habitat fragments.
  - (E) Fragments generate silt that negatively affect sensitive river and stream organisms.

※下列題目請標明題號，依序作答於試卷內「非選擇題作答區」。※

二、名詞解釋 (每題 4 分)

1. Fluid mosaic model
2. Genomic imprinting
3. Hardy-Weinberg equilibrium
4. Metagenomics
5. Nondisjunction
6. Restriction enzyme

三、簡答題 (每題 12 分)

1. 新冠肺炎 (COVID-19) 是一種由 RNA 病毒引起的感染性疾病，請說明患者由感染 RNA 病毒到呼吸道分泌液釋出大量病毒的過程，並說明你認為最可能開發藥物抑制病情發展的階段及理由。
2. 請由誘發因素、釋出的器官或細胞、作用的標的及調節的生理功能等，來說明抗利尿激素 (antidiuretic hormone, ADH) 與醛固酮 (aldosterone) 控制血壓的機制。
3. 請比較 C3、C4 與 CAM 植物進行固碳作用過程之差異。