

請清楚標示題號並依序作答於試卷上

I. 單選題: (每題 2 分, 共 54 分) ※請作答於試卷內之「選擇題作答區」

1. A tree in your backyard is home to two woodpeckers, three squirrels, a colony of ants, a wasp's nest, and millions of bacteria. Together, all of these organisms represent a/an \_\_\_\_\_.  
A) species      B) population      C) community      D) ecosystem
2. you look into a microscope to see a prokaryotic cell. You will be looking for a cell that \_\_\_\_\_.  
A) has a nucleus      B) has a membrane      C) has many mitochondria      D) has several lysosomes
3. Which of the following statements about evolution is true?  
A) Individuals evolve within the span of their own lifetimes.  
B) Organisms evolve structures in response to needs.  
C) Evolution is intentional and purposeful.  
D) Evolution can result in adaptations.
4. The cells of a spider and a tiger are, on average, the same small size; a tiger just has more of them. What is the main advantage of small cell size?  
A) It takes less energy to make an organism out of small cells.  
B) Small cells require less oxygen than large cells do.  
C) Small cells can better take up sufficient nutrients and oxygen to provide for their need.  
D) A small cell has a less plasma membrane surface area than a large cell does.
5. Organisms belonging to the kingdom Plantae \_\_\_\_\_.  
A) are photosynthetic      B) obtain food by decomposing the dead organisms  
C) are unicellular and lack a nucleus      D) are multicellular and lack a nucleus
6. Red-green color blindness is a sex-linked recessive trait (i.e., the responsible gene is on the X chromosome). From a marriage between a woman heterozygous for color-blindness gene and a normal vision man, which of the following predictions for their children is correct?  
A) all the boys are color blind      B) half of the boys are color blind  
C) half of the girls have normal vision      D) all the girls are heterozygous carrier
7. Which of the following is not the regulatory mechanism of gene expression at the post-transcriptional level?  
A) alternative RNA splicing      B) protein degradation  
C) miRNA-mediated gene silencing      D) use of different repressors
8. A plasma cell produces thousands of antibodies per second for release into the body. What kind of organelles would you expect to be very prominent within the cell?  
A) nucleus      B) endoplasmic reticulum      C) lysosomes      D) microtubules
9. A drug that interferes with microtubule formation is likely to completely disrupt \_\_\_\_\_.  
A) the amoeboid movement of a cell.      B) the function of lysosomes  
C) contraction of muscle cells      D) the movements of sperm cells
10. Which of the following scenarios describes an example of epistasis?  
A) Albino corn snake result from animals having recessive genotypes for each of two genes.  
B) In many mammals one genotype (ee) prevents any fur color from developing.  
C) In fruit flies white eyes can be due alleles of a gene on the X chromosome or a combination of other genes.  
D) In cacti (仙人掌), there several genes control the type of spines.
11. If, on average, 48% of the loci in a species' gene pool are heterozygous, then the average homozygosity of the species should be \_\_\_\_\_.  
A) 24%      B) 48%      C) 26%      D) 52%
12. The Casparian strip of the endodermis stops water from the \_\_\_\_\_ before it reaches the stele.  
A) symplastic pathway only      B) transmembrane and symplastic pathways  
C) transmembrane pathway only      D) apoplastic pathway only

見背面

13. What is the function of reverse transcriptase in retroviruses?
- A) It uses viral RNA as a template for making complementary RNA strands.
  - B) It uses viral RNA as a template for DNA synthesis.
  - C) It uses host cell RNA as a template for viral DNA synthesis.
  - D) It translates viral RNA into capsid proteins.
14. Under what conditions do photosynthesis and cellular respiration occur in plants?
- A) Photosynthesis and cellular respiration occur only in the light.
  - B) Photosynthesis occurs only in the light, and cellular respiration occurs only in the dark.
  - C) Photosynthesis occurs only in the light, and cellular respiration occurs in both the dark and the light.
  - D) Photosynthesis and cellular respiration occur in both the light and the dark.
15. What would be the expected effect on C3 and C4 plants if the atmospheric CO<sub>2</sub> concentration was doubled?
- A) All plants would have faster growth rates.
  - B) C3 plants would have faster growth rates; C4 plants would be minimally affected.
  - C) C4 plants would have faster growth rates; C3 plants would be minimally affected.
  - D) C3 plants would have faster growth rates; C4 plants would have slower growth rates.
16. Aquaporins \_\_\_\_\_.
- A) allow water to cross the plasma membrane along its concentration gradient
  - B) allow water to cross the plasma membrane against its concentration gradient
  - C) allow for the active transport of water
  - D) are found in all cells
17. Which of the following are the male gametophytes in flowering plants?
- A) stamens      B) shoot parts bearing male flowers      C) pollen grains      D) anthers
18. Which of the following best describes double fertilization in flowering plants?
- A) Flowers must be pollinated twice to yield both fruits and seeds.
  - B) One sperm fertilizes the egg, and a second sperm fertilizes both polar nuclei.
  - C) The egg of the embryo sac is diploid.
  - D) Two sperms are needed to fertilize the egg.
19. The following steps occur during a plant's response to drought stress.
- I) ABA accumulates in the leaves      III) transpiration decreases
  - II) stomata close      IV) guard cell potassium channels open
- Which of the following places the steps in the correct sequence to represent the acquisition of drought tolerance in the plant?
- A) I, II, III, and IV      B) I, IV, II, and III      C) II, I, III, and IV      D) IV, I, II, and III
20. Which of the following events is most immediately associated with the absorption of energy by chlorophyll molecules of the reaction-center complex?
- A) ATP is synthesized from the energy absorbed.      B) A molecule of water is split.
  - C) An electron is excited.      D) NADP<sup>+</sup> is reduced to NADPH.
21. The genetic code is essentially the same for all organisms. From this, one can logically assume which of the following?
- A) A gene from an organism can theoretically be expressed by any other organism.
  - B) All organisms have experienced convergent evolution.
  - C) DNA was the first genetic material.
  - D) The same codons in different organisms translate into different amino acids.
22. *E. coli* cells grown on <sup>15</sup>N medium are transferred to <sup>14</sup>N medium and allowed to grow for two more generations (two rounds of DNA replication). DNA extracted from these cells is centrifuged. What density distribution of DNA would you expect in this experiment?
- A) one high-density and one low-density band      B) one intermediate-density band
  - C) one intermediate-density and one low-density band      D) one low-density band

23. Put the following steps of DNA replication in the proper order.
1. Single-stranded binding proteins attach to DNA strands.
  2. Hydrogen bonds between base pairs of antiparallel strands are broken.
  3. Primase binds to the site of origin.
  4. DNA polymerase binds to the template strand.
  5. An RNA primer is created.
- A) 2, 3, 5, 1, 4    B) 2, 1, 3, 5, 4    C) 3, 2, 1, 5, 4    D) 3, 1, 2, 5, 4
24. You want to engineer a eukaryotic gene into a bacterial colony and have it expressed. What must be included in addition to the coding exons of the gene?
- A) eukaryotic polymerases
  - B) a bacterial promoter sequence
  - C) a eukaryotic promoter sequence
  - D) bacterial ligases
25. In a species that alternates between sexual and asexual reproduction, under which of the following conditions is sexual reproduction more likely to occur than is asexual reproduction?
- A) when food is abundant
  - B) when conditions for survival are unfavorable
  - C) when a male and female mate for the first time
  - D) when finding a mate becomes more difficult
26. Injury to the hypothalamus would most likely disrupt \_\_\_\_\_.
- A) regulation of food appetite
  - B) speech
  - C) long-term memory
  - D) sorting of sensory information
27. When fat enters the duodenum, it stimulates release of \_\_\_\_\_.
- A) secretin
  - B) cholecystokinin
  - C) gastrin
  - D) ghrelin

## II. 解釋名詞 (每題 4 分，共 16 分)

1. endotherm
2. microRNAs
3. antigen presenting cells
4. mycorrhiza

## III. 簡答題 (每題 6 分，共 30 分)

1. Is respiratory control more sensitive to small changes in arterial  $PO_2$  or in arterial  $PCO_2$  in humans? Explain your answer.
2. What is clonal selection with regard to B cells? How does it occur?
3. Which of the following reactions differs from the others in terms of the cellular mechanism? (Select the best answer from the choices given, and explain your answer.)
  - A) Fast block to polyspermy
  - B) Acrosomal reaction
  - C) Cortical reaction
  - D) Release of neurotransmitters from axonal terminals
4. When a healthy young man stands up abruptly after lying down, the veins in the lower limbs become distended and accumulate blood. Which of the following statements about the physiological conditions of the man is true? (Select the best answer from the choices given, and explain your answer.)
  - A) The capillary filtration in his leg will increase.
  - B) His stroke volume will increase
  - C) His heart rate will decrease.
  - C) Afferent activities of arterial baroreceptors will increase.
5. In vertebrates, the binding of acetylcholine to the ligand-gated ion channels of a skeletal muscle, which are permeable to both  $Na^+$  and  $K^+$  ions, will cause \_\_\_ at the motor endplate of the muscle cell. (Select the best answer from the choices given, and explain your answer.)
  - A) repolarization only
  - B) no change in membrane potential
  - C) depolarization only
  - D) hyperpolarization only

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