

一. 單選題 (60%) ※注意：請於試卷「選擇題作答區」依題號作答。※

1. Chiasmata are what we see under a microscope that let us know which of the following is occurring?  
(A) Asexual reproduction      (B) Meiosis II      (C) Anaphase II      (D) Crossing over  
(E) Separation of homologs
2. When a disease is said to have a multifactorial basis, it means that  
(A) both genetic and environmental factors contribute to the disease.  
(B) it is caused by a gene with a large number of alleles.  
(C) it affects a large number of people.  
(D) it has many different symptoms.  
(E) it tends to skip a generation.
3. Map units on a linkage map cannot be relied upon to calculate physical distances on a chromosome for which of the following reasons?  
(A) The relationship between recombination frequency and map units is different in every individual.  
(B) Physical distances between genes change during the course of the cell cycle.  
(C) The frequency of crossing over varies along the length of the chromosome.  
(D) The gene order on the chromosomes is slightly different in every individual.  
(E) Linkage map distances are identical between males and females.
4. The enzyme telomerase solves the problem of replication at the ends of linear chromosomes by which method?  
(A) adding a single 5' cap structure that resists degradation by nucleases  
(B) causing specific double strand DNA breaks that result in blunt ends on both strands  
(C) causing linear ends of the newly replicated DNA to circularize  
(D) adding numerous GC pairs which resist hydrolysis and maintain chromosome integrity  
(E) adding numerous short DNA sequences such as TTAGGG, which form a hairpin turn
5. Which of the following is true for both prokaryotic and eukaryotic gene expression?  
(A) After transcription, a 3' poly-A tail and a 5' cap are added to mRNA.  
(B) RNA polymerase binds to the promoter region to begin transcription.  
(C) Translation of mRNA can begin before transcription is complete.  
(D) mRNA is synthesized in the 3' → 5' direction.  
(E) The mRNA transcript is the exact complement of the gene from which it was copied.
6. A principal problem with inserting an unmodified mammalian gene into a bacterial plasmid, and then getting that gene expressed in bacteria, is that  
(A) prokaryotes use a different genetic code from that of eukaryotes.  
(B) bacteria translate polycistronic messages only.  
(C) bacteria cannot remove eukaryotic introns.  
(D) bacterial RNA polymerase cannot make RNA complementary to mammalian DNA.  
(E) bacterial DNA is not found in a membrane-bounded nucleus and is therefore incompatible with mammalian DNA.
7. What is proteomics?  
(A) the linkage of each gene to a particular protein  
(B) the study of the full protein set encoded by a genome  
(C) the totality of the functional possibilities of a single protein  
(D) the study of how amino acids are ordered in a protein  
(E) the study of how a single gene activates many proteins
8. Natural selection is based on all of the following except  
(A) genetic variation exists within populations.  
(B) the best-adapted individuals tend to leave the most offspring.  
(C) individuals who survive longer tend to leave more offspring than those who die young.  
(D) populations tend to produce more individuals than the environment can support.  
(E) individuals adapt to their environments and, thereby, evolve.

見背面

9. What was the species concept most used by Linnaeus?  
(A) biological (B) ecological (C) phylogenetic (D) morphological (E) all of the above
10. Which of the following pairs are the best examples of homologous structures?  
(A) bat wing and human hand  
(B) owl wing and hornet wing  
(C) porcupine quill and cactus spine  
(D) bat forelimb and bird wing  
(E) Australian mole and North American mole
11. Which statement about the genomes of prokaryotes is *correct*?  
(A) Prokaryotic genomes are diploid throughout most of the cell cycle.  
(B) Prokaryotic chromosomes are sometimes called plasmids.  
(C) Prokaryotic cells have multiple chromosomes, "packed" with a relatively large amount of protein.  
(D) The prokaryotic chromosome is not contained within a nucleus but, rather, is found at the nucleoid region.  
(E) Prokaryotic genomes are composed of linear DNA (that is, DNA existing in the form of a line with two ends).
12. The following are common to both charophytes and land plants *except*  
(A) sporopollenin. (B) lignin. (C) chlorophyll *a*. (D) cellulose. (E) chlorophyll *b*.
13. Which of the following is an ongoing trend in the evolution of land plants?  
(A) decrease in the size of the leaf  
(B) increasing reliance on water to bring sperm and egg together  
(C) elimination of sperm cells or sperm nuclei  
(D) replacement of roots by rhizoids  
(E) reduction of the gametophyte phase of the life cycle
14. What is the primary role of a mushroom's underground mycelium?  
(A) absorbing nutrients (B) anchoring (C) sexual reproduction (D) asexual reproduction  
(E) protection
15. To recycle nutrients, the minimum an ecosystem must have is  
(A) producers.  
(B) producers and decomposers.  
(C) producers, primary consumers, and decomposers.  
(D) producers, primary consumers, secondary consumers, and decomposers.  
(E) producers, primary consumers, secondary consumers, top carnivores, and decomposers.
16. 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) prime habitat. (C) ecological niche. (D) resource partition.  
(E) home base.
17. The Allee effect is used to describe a population that  
(A) has become so small that it will have difficulty surviving and reproducing.  
(B) has become so large it will have difficulty surviving and reproducing.  
(C) approaches carrying capacity.  
(D) exceeds carrying capacity.  
(E) is in crash decline.
18. Probably the most important factor(s) affecting the distribution of biomes is (are)  
(A) wind and ocean water current patterns.  
(B) species diversity.  
(C) proximity to large bodies of water.  
(D) climate.  
(E) day length and rainfall.

19. Which of the following statements is (are) *true* of fixed action patterns?
- (A) They are highly stereotyped, instinctive behaviors.
  - (B) They are triggered by sign stimuli in the environment and, once begun, are continued to completion.
  - (C) An inappropriate stimulus can sometimes trigger them.
  - (D) A and B only
  - (E) A, B, and C
20. The perceived pitch of a sound depends on
- (A) vibrations of the tympanic membrane being transmitted through the incus.
  - (B) vibrations of the oval window creating wave formation in the fluid of the vestibular canal.
  - (C) the region of the basilar membrane where the signal originated.
  - (D) A and C only
  - (E) A, B, and C
21. After the depolarization phase of an action potential, the resting potential is restored by
- (A) the opening of sodium activation gates.
  - (B) the opening of voltage-gated potassium channels and the closing of sodium activation gates.
  - (C) a decrease in the membrane's permeability to potassium and chloride ions.
  - (D) a brief inhibition of the sodium-potassium pump.
  - (E) the opening of more voltage-gated sodium channels.
22. The migratory neural crest cells
- (A) form most of the central nervous system.
  - (B) serve as precursor cells for the notochord.
  - (C) form the spinal cord in the frog.
  - (D) form neural and non-neural structures in the periphery.
  - (E) form the lining of the lungs and of the digestive tract.
23. The primary function of the corpus luteum is to
- (A) nourish and protect the egg cell.
  - (B) produce prolactin in the alveoli.
  - (C) maintain progesterone and estrogen synthesis after ovulation has occurred.
  - (D) stimulate the development of the mammary glands.
  - (E) support pregnancy in the second and third trimesters.
24. What do nitric oxide and epinephrine have in common?
- (A) They both function as neurotransmitters.
  - (B) They both function as hormones.
  - (C) They are both involved in the "fight-or-flight" response.
  - (D) They bind the same receptors.
  - (E) Only A and B are correct.
25. Which feature of osmoregulation is found in both marine and freshwater bony fish?
- (A) gain of water through food
  - (B) gain of salt through the gills
  - (C) loss of salt in the urine
  - (D) no drinking of water
  - (E) loss of water through the gills
26. Clonal selection implies that
- (A) brothers and sisters have similar immune responses.
  - (B) only certain cells can produce interferon.
  - (C) a B cell has multiple types of antigen receptors.
  - (D) the body selects which antigens it will respond to.
  - (E) antigens increase mitosis in specific lymphocytes.

27. Why is the velocity of blood flow the lowest in capillaries?
- (A) The capillary walls are not thin enough to allow oxygen to exchange with the cells.
  - (B) Capillaries are far from the heart, and blood flow slows as distance from the heart increases.
  - (C) The diastolic blood pressure is too low to deliver blood to the capillaries at a high flow rate.
  - (D) The total surface area of the capillaries is larger than the total surface area of the arterioles.
  - (E) The systemic capillaries are supplied by the left ventricle, which has a lower cardiac output than the right ventricle.
28. In which blood vessel is glucose concentration likely to vary the *most*?
- (A) abdominal artery
  - (B) hepatic portal vessel
  - (C) pulmonary veins
  - (D) coronary arteries
  - (E) hepatic vein, which drains the liver
29. Stratified cuboidal epithelium is composed of
- (A) several layers of box-like cells.
  - (B) a hierarchical arrangement of flat cells.
  - (C) a tight layer of square cells attached to a basement membrane.
  - (D) an irregularly arranged layer of pillar-like cells.
  - (E) a layer of ciliated, mucus-secreting cells.
30. Which characteristic is shared by both cnidarians and flatworms?
- (A) dorsoventrally flattened bodies
  - (B) flame bulbs
  - (C) a digestive system with a single opening
  - (D) radial symmetry
  - (E) both A and D

※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 (30%)

1. Apoplast
2. Plasmolysis
3. Complete flowers
4. Phototropism
5. Auxin
6. Coenzyme
7. Competitive exclusion
8. Saltatory conduction
9. Speciation
10. Founder effect

三、請簡述 induced pluripotent stem cells (iPSCs) 技術的發展過程，並說明此技術的應用價值。(10%)