

一、單選題 (80%) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. Bacteria perform each of the following ecological roles. Which role typically does *not* involve a symbiosis?
 - A) skin commensalist
 - B) decomposer
 - C) aggregates with methane-consuming archaea
 - D) gut mutualist
 - E) pathogen
2. Which functional groups can act as acids?
 - A) amino and sulfhydryl
 - B) carbonyl and carboxyl
 - C) carboxyl and phosphate
 - D) hydroxyl and aldehyde
 - E) ketone and amino
3. The tertiary structure of a protein is the
 - A) bonding together of several polypeptide chains by weak bonds.
 - B) order in which amino acids are joined in a polypeptide chain.
 - C) unique three-dimensional shape of the fully folded polypeptide.
 - D) organization of a polypeptide chain into an α helix or β pleated sheet.
 - E) overall protein structure resulting from the aggregation of two or more polypeptide subunits.
4. The evolution of eukaryotic cells most likely involved
 - A) endosymbiosis of an aerobic bacterium in a larger host cell—the endosymbiont evolved into mitochondria.
 - B) anaerobic archaea taking up residence inside a larger bacterial host cell to escape toxic oxygen—the anaerobic bacterium evolved into chloroplasts.
 - C) an endosymbiotic fungal cell evolved into the nucleus.
 - D) acquisition of an endomembrane system, and subsequent evolution of mitochondria from a portion of the Golgi.
5. Which of the following membrane activities require energy from ATP hydrolysis?
 - A) facilitated diffusion of chloride ions across the membrane through a chloride channel
 - B) movement of water into a cell
 - C) Na^+ ions moving out of a mammalian cell bathed in physiological saline
 - D) movement of glucose molecules into a bacterial cell from a medium containing a higher concentration of glucose than inside the cell
 - E) movement of carbon dioxide out of a paramecium
6. Some of the drugs used to treat HIV patients are competitive inhibitors of the HIV reverse transcriptase enzyme. Unfortunately, the high mutation rate of HIV means that the virus rapidly acquires mutations with amino acid changes that make them resistant to these competitive inhibitors. Where in the reverse transcriptase enzyme would such amino acid changes most likely occur in drug-resistant viruses?
 - A) in or near the active site
 - B) at an allosteric site

見背面

- C) at a cofactor binding site
D) in regions of the protein that determine packaging into the virus capsid
E) such mutations could occur anywhere with equal probability
7. In liver cells, the inner mitochondrial membranes are about five times the area of the outer mitochondrial membranes. What purpose must this serve?
A) It allows for an increased rate of glycolysis.
B) It allows for an increased rate of the citric acid cycle.
C) It increases the surface for oxidative phosphorylation.
D) It increases the surface for substrate-level phosphorylation.
E) It allows the liver cell to have fewer mitochondria.
8. In the thylakoid membranes, what is the main role of the antenna pigment molecules?
A) split water and release oxygen to the reaction-center chlorophyll
B) harvest photons and transfer light energy to the reaction-center chlorophyll
C) synthesize ATP from ADP and P_i
D) transfer electrons to ferredoxin and then NADPH
E) concentrate photons within the stroma
9. Which of the following describes the events of apoptosis?
A) The cell dies, it is lysed, its organelles are phagocytized, and its contents are recycled.
B) Its DNA and organelles become fragmented, it dies, and it is phagocytized.
C) The cell dies and the presence of its fragmented contents stimulates nearby cells to divide.
D) Its DNA and organelles are fragmented, the cell shrinks and forms blebs, and the cell self-digests.
E) Its nucleus and organelles are lysed, then the cell enlarges and bursts.
10. Taxol is an anticancer drug extracted from the Pacific yew tree. In animal cells, Taxol disrupts microtubule formation by binding to microtubules and accelerating their assembly from the protein precursor, tubulin. Surprisingly, this stops mitosis. Specifically, Taxol must affect
A) the formation of the mitotic spindle.
B) anaphase.
C) formation of the centrioles.
D) chromatid assembly.
E) the S phase of the cell cycle.
11. If the bacterium *Staphylococcus aureus* experiences a cost for maintaining one or more antibiotic-resistance genes, then what should happen in environments from which antibiotics are missing?
A) These genes should continue to be maintained in case the antibiotics ever appear.
B) These bacteria should be outcompeted and replaced by bacteria that have lost these genes.
C) The bacteria should try to make the cost worthwhile by locating, and migrating to, microenvironments where traces of antibiotics are present.
D) The bacteria should start making and secreting their own antibiotics.
12. Beetle pollinators of a particular plant are attracted to its flowers' bright orange color. The beetles not only pollinate the flowers, but they mate while inside of the flowers. A mutant version of the plant with red flowers becomes more common with the passage of time. A particular variant of the beetle prefers the red flowers to the orange flowers. Over time, these two beetle variants diverge from each other to such an

- extent that interbreeding is no longer possible. What kind of speciation has occurred in this example, and what has driven it?
- A) allopatric speciation; ecological isolation
 - B) sympatric speciation; habitat differentiation
 - C) allopatric speciation; behavioral isolation
 - D) sympatric speciation; sexual selection
 - E) sympatric speciation; allopolyploidy
13. An organism has a relatively large number of *Hox* genes in its genome. Which of the following is true of this organism?
- A) These genes are fundamental, and are expressed in all cells of the organism.
 - B) The organism must have multiple paired appendages along the length of its body.
 - C) The organism has the genetic potential to have a relatively complex anatomy.
 - D) Most of its *Hox* genes owe their existence to gene fusion events.
 - E) Its *Hox* genes cooperate to bring about sexual maturity at the proper stage of development.
14. If natural selection in a particular environment favored genetic systems that permitted the production of daughter "cells" that were genetically dissimilar from the mother "cells," then one should expect selection for which of the following?
- I. polynucleotide polymerase with low mismatch error rates
 - II. polynucleotide polymerases without proofreading capability
 - III. batteries of efficient polynucleotide repair enzymes
 - IV. polynucleotide polymerases with proofreading capability
 - V. polynucleotide polymerases with high mismatch error rates
- A) I only
 - B) I and IV
 - C) I, III, and IV
 - D) II and V
 - E) II, III and V
15. Prokaryotic ribosomes differ from those present in eukaryotic cytosol. Because of this, which of the following is correct?
- A) Some antibiotics can block protein synthesis in bacteria without effects in the eukaryotic host.
 - B) Eukaryotes did not evolve from prokaryotes.
 - C) Translation can occur at the same time as transcription in eukaryotes but not in prokaryotes.
 - D) Some antibiotics can block the synthesis of peptidoglycan in the walls of bacteria.
 - E) Prokaryotes are able to use a much greater variety of molecules as food sources than can eukaryotes.
16. On a field trip, a student in a marine biology class collects an organism that has differentiated organs, cell walls of cellulose, and chloroplasts with chlorophyll *a*. Based on this description, the organism could be a brown alga, a red alga, a green alga, a charophyte recently washed into the ocean from a freshwater or brackish water source, or a land plant washed into the ocean. The presence of which of the following features would definitively identify this organism as a land plant?
- A) alternation of generations
 - B) sporopollenin
 - C) rings of cellulose-synthesizing complexes

- D) flagellated sperm
E) embryos
17. The seeds of orchids are among the smallest known, with virtually no endosperm and with miniscule seed leaves. Consequently, what should one expect to be true of such seeds?
A) They require extensive periods of dormancy during which the embryo develops.
B) They are surrounded by brightly colored, sweet fruit.
C) They germinate very soon after being released from the ovary.
D) The developing embryo within is dependent upon the gametophyte for nutrition.
E) The sporophytes that produce such seeds are wind-pollinated.
18. Angiosperms are the most successful terrestrial plants. Which of the following features is unique to them and helps account for their success?
A) wind pollination
B) dominant gametophytes
C) fruits enclosing seeds
D) embryos enclosed within seed coats
E) sperm cells without flagella
19. Given the differences between angiosperms and gymnosperms in the development of the integument(s), which of these statements is the most logical consequence?
A) The seed coats of angiosperms should be relatively thicker than those of gymnosperms.
B) It should be much more difficult for pollen tubes to enter angiosperm ovules than for them to enter gymnosperm ovules.
C) The female gametophytes of angiosperms should not be as well protected from environmental stress as should those of gymnosperms.
D) As a direct consequence of such differences, angiosperms should have fruit.
E) Angiosperm seeds should be more susceptible to desiccation.
20. A botanist discovers a new species of plant in a tropical rain forest. After observing its anatomy and life cycle, he notes the following characteristics: flagellated sperm, xylem with tracheids, separate gametophyte and sporophyte generations with the sporophyte dominant, and no seeds. This plant is probably most closely related to
A) mosses.
B) charophytes.
C) ferns.
D) gymnosperms.
E) flowering plants.
21. A specific gene is known to code for three different but related proteins. This could be due to which of the following?
A) premature mRNA degradation
B) alternative RNA splicing
C) use of different enhancers
D) protein degradation
E) differential transport

22. What is the function of reverse transcriptase in retroviruses?
- A) It converts host cell RNA into viral DNA.
 - B) It hydrolyzes the host cell's DNA.
 - C) It uses viral RNA as a template for making complementary RNA strands.
 - D) It translates viral RNA into proteins.
 - E) It uses viral RNA as a template for DNA synthesis.

23. Neurotransmitters are released from axon terminals via
- A) osmosis.
 - B) active transport.
 - C) diffusion.
 - D) transcytosis.
 - E) exocytosis.

24. The following is a map of four genes on a chromosome:



Between which two genes would you expect the highest frequency of recombination?

- A) A and W
 - B) W and E
 - C) E and G
 - D) A and E
 - E) A and G
25. Genomic imprinting, DNA methylation, and histone acetylation are all examples of
- A) genetic mutation.
 - B) chromosomal rearrangements.
 - C) karyotypes.
 - D) epigenetic phenomena.
 - E) translocation.
26. Which area of the brain is most intimately associated with the unconscious control of respiration and circulation?
- A) thalamus
 - B) cerebellum
 - C) medulla
 - D) corpus callosum
 - E) Cerebrum
27. In correct chronological order, the three phases of the ovarian cycle are
- A) menstrual → ovulation → luteal
 - B) follicular → luteal → secretory
 - C) menstrual → proliferative → secretory
 - D) follicular → ovulation → luteal
 - E) proliferative → luteal → ovulation
28. The secretion of hormone A causes a change in the amount of protein X in an organism. If this mechanism works by positive feedback, which of the following statements represents that fact?
- A) An increase in A produces an increase in X.
 - B) An increase in X produces a decrease in A.
 - C) A decrease in A produces an increase in X.
 - D) A and B are correct.
 - E) B and C are correct.
29. Which part of the vertebrate nervous system is most involved in preparation for the fight-or-flight

見背面

- response?
- A) sympathetic B) somatic C) central
D) visceral E) parasympathetic
30. RNA polymerase moves in which direction along the DNA?
- A) 3' → 5' along the template strand
B) 3' → 5' along the coding (sense) strand
C) 5' → 3' along the template strand
D) 3' → 5' along the coding strand
E) 5' → 3' along the double-stranded DNA
31. Which of the following statements is true?
- A) The closer two genes are on a chromosome, the lower the probability that a crossover will occur between them.
B) The observed frequency of recombination of two genes that are far apart from each other has a maximum value of 100%.
C) All of the traits that Mendel studied (seed color, pod shape, flower color, and others) are due to genes linked on the same chromosome.
D) Linked genes are found on different chromosomes.
E) Crossing over occurs during prophase II of meiosis.
32. In frog embryos, the blastopore becomes the
- A) anus. B) ears. C) eyes.
D) nose. E) mouth.
33. The phenomenon in which RNA molecules in a cell are destroyed if they have a sequence complementary to an introduced double-stranded RNA is called
- A) RNA interference.
B) RNA obstruction.
C) RNA blocking.
D) RNA targeting.
E) RNA disposal.
34. Pepsin is a digestive enzyme that
- A) is manufactured by the pancreas.
B) helps stabilize fat-water emulsions.
C) splits maltose into monosaccharides.
D) begins the hydrolysis of proteins in the stomach.
E) is denatured and rendered inactive in solutions with low pH.
35. The absorption of fats differs from that of carbohydrates in that the
- A) processing of fats does not require any digestive enzymes, whereas the processing of carbohydrates does.
B) fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.
C) carbohydrates need to be emulsified before they can be digested, whereas fats do not.
D) most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood.
E) fats, but not carbohydrates, are digested by bacteria before absorption.

36. A portal system is
- A) an area connecting arterioles to venules.
 - B) a series of vessels that returns blood to the heart in an animal with an open circulatory system.
 - C) a space within or between organs where blood is allowed to pool.
 - D) a slightly muscular vessel that has minimal pumping action in an organism with no heart.
 - E) a vessel or vessels connecting two capillary beds.
37. The receptors on T cells and B cells bind to
- A) antibodies.
 - B) antigens.
 - C) natural killer cells.
 - D) double-stranded RNA.
 - E) immunoglobulins.
38. The fluid with the highest osmolarity is
- A) distilled water.
 - B) plasma in birds.
 - C) plasma in mammals.
 - D) seawater in a tidal pool.
 - E) estuarine water.
39. Within a normally functioning kidney, blood can be found in
- A) the vasa recta.
 - B) Bowman's capsule.
 - C) the loop of Henle.
 - D) the proximal tubule.
 - E) the collecting duct.
40. Endocrine structures derived from nervous tissue include the
- A) thymus and the thyroid.
 - B) ovaries and the testes.
 - C) liver and the pancreas.
 - D) anterior pituitary gland and the adrenal cortex.
 - E) posterior pituitary gland and the adrenal medulla.

二、解釋名詞 (20%)

1. Photoautotrophs
2. Endocytosis
3. Cadherins
4. Actinomorphic flower
5. Legume
6. Prion
7. Codon
8. Countercurrent exchange
9. Innate immunity
10. Parthenogenesis

試題隨卷繳回