

系所組別：生命科學系

考試科目：普通生物學

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※ 考生請注意：本試題不可使用計算機

請勿在本試題紙上作答，否則不予計分

## Multiple-Choice Questions (2 points each)

1. Why isn't the mitochondrion classified as part of the endomembrane system?  
(A) It is a static structure. (B) Its structure is not derived from the ER or Golgi. (C) It has too many vesicles.  
(D) It is not involved in protein synthesis. (E) It is not attached to the outer nuclear envelope.
2. What types of proteins are not synthesized in the rough ER?  
(A) endoplasmic reticulum proteins (B) extracellular matrix proteins (C) secreted proteins (D) mitochondrial proteins (E) plasma membrane proteins
3. Which of the following would likely move through the lipid bilayer of a plasma membrane most rapidly?  
(A) CO<sub>2</sub> (B) an amino acid (C) glucose (D) K<sup>+</sup> (E) starch
4. An organism with a cell wall would most likely be unable to take in materials through  
(A) diffusion. (B) osmosis. (C) active transport. (D) phagocytosis. (E) facilitated diffusion.
5. Which of the following types of reactions would decrease the entropy within a cell?  
(A) anabolic reactions (B) hydrolysis (C) respiration (D) digestion (E) catabolic reactions
6. Which kind of metabolic poison would most directly interfere with glycolysis?  
(A) an agent that reacts with oxygen and depletes its concentration in the cell (B) an agent that binds to pyruvate and inactivates it (C) an agent that closely mimics the structure of glucose but is not metabolized (D) an agent that reacts with NADH and oxidizes it to NAD<sup>+</sup> (E) an agent that blocks the passage of electrons along the electron transport chain
7. The synthesis of ATP by oxidative phosphorylation, using the energy released by movement of protons across the membrane down their electrochemical gradient, is an example of  
(A) active transport. (B) an endergonic reaction coupled to an exergonic reaction. (C) a reaction with a positive  $\Delta G$ . (D) osmosis. (E) allosteric regulation.
8. Which of the following statements best describes the relationship between photosynthesis and respiration?  
(A) Respiration runs the biochemical pathways of photosynthesis in reverse. (B) Photosynthesis stores energy in complex organic molecules, whereas respiration releases it. (C) Photosynthesis occurs only in plants and respiration occurs only in animals. (D) ATP molecules are produced in photosynthesis and used up in respiration. (E) Respiration is anabolic and photosynthesis is catabolic.

9. In C3 photosynthesis, the reactions that require ATP take place in  
(A) the light reactions alone. (B) the Calvin cycle alone. (C) both the light reactions and the Calvin cycle. (D) neither the light reactions nor the Calvin cycle. (E) the chloroplast, but is not part of photosynthesis.
10. The toxin of *Vibrio cholerae* causes profuse diarrhea because it  
(A) modifies a G protein involved in regulating salt and water secretion. (B) decreases the cytosolic concentration of calcium ions. (C) binds with adenylyl cyclase and triggers the formation of cAMP. (D) signals IP3 to act as a second messenger for the release of calcium. (E) none of above.
11. Cyclin E forms a complex with Cdk 2 (cyclin-dependent kinase 2) which is important for the progression of the cell from G1 into the S phase of the cell cycle. Which of the following statements is correct?  
(A) The amount of free cyclin E is greatest during the S phase. (B) The amount of free Cdk 2 is greater during G1 compared to the S phase. (C) The amount of free cyclin E is highest during G1. (D) The amount of free Cdk 2 is greatest during G1. (E) The activity of the cyclin E/Cdk 2 complex is highest during G2.
12. If an organism is diploid and a certain gene found in the organism has 18 known alleles (variants), then any given organism of that species can/must have which of the following?  
(A) at most, 2 alleles for that gene (B) up to 18 chromosomes with that gene (C) up to 18 genes for that trait (D) a haploid number of 9 chromosomes (E) up to, but not more than, 18 different traits
13. How could you best predict the maximum number of alleles for a single gene?  
(A) Search the population for all phenotypic variants of this polypeptide. (B) Count the number of amino acids in the polypeptide. (C) Mate all known genotypes and collect all possible offspring different from the parents. (D) Measure the rate of new mutations in the species and estimate the number since it first evolved. (E) Count the number of DNA nucleotides that are in the code for the polypeptides.
14. If the environmental parameters, such as temperature, humidity, atmosphere, sunlight, and so on, are mostly Earthlike, which of the following do you expect of its types of leaves, stems, and flowers?  
(A) Such plants would have originated on Earth. (B) They share a common ancestor with those from Earth. (C) Such plants could be safely eaten by humans. (D) Their genotypes would be identical to Earth plants with the same traits. (E) Phenotypes would be selected for or against by these environmental factors.
15. 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 frequency of crossing over varies along the length of the chromosome. (B) The relationship between recombination frequency and map units is different in every individual. (C) Physical distances between genes change during the course of the cell cycle. (D) The gene order on the chromosomes is slightly different in every individual. (E) Linkage map distances are identical between males and females.

16. Which of the following would you expect of a eukaryote lacking telomerase?  
(A) a high probability of somatic cells becoming cancerous (B) production of Okazaki fragments (C) inability to repair thymine dimers (D) a reduction in chromosome length in gametes (E) high sensitivity to sunlight
17. 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 the different amino acids. (E) Different organisms have different numbers of different types of amino acids.
18. Alternative RNA splicing  
(A) is a mechanism for increasing the rate of transcription. (B) can allow the production of proteins of different sizes from a single mRNA. (C) can allow the production of similar proteins from different RNAs. (D) increases the rate of transcription. (E) is due to the presence or absence of particular snRNPs.
19. A mutation that inactivates the regulatory gene of a repressible operon in an *E. coli* cell would result in  
(A) continuous transcription of the structural gene controlled by that regulator. (B) complete inhibition of transcription of the structural gene controlled by that regulator. (C) irreversible binding of the repressor to the operator. (D) inactivation of RNA polymerase by alteration of its active site. (E) none of above.
20. The fact that plants can be cloned from somatic cells demonstrates that  
(A) differentiated cells retain all the genes of the zygote. (B) genes are lost during differentiation. (C) the differentiated state is normally very unstable. (D) differentiated cells contain masked mRNA. (E) differentiation does not occur in plants.
21. What is the function of reverse transcriptase in retroviruses?  
(A) It hydrolyzes the host cell's DNA. (B) It uses viral RNA as a template for DNA synthesis. (C) It converts host cell RNA into viral DNA. (D) It translates viral RNA into proteins. (E) It uses viral RNA as a template for making complementary RNA strands.
22. Antiviral drugs that have become useful are usually associated with which of the following properties?  
(A) ability to remove all viruses from the infected host (B) interference with viral replication (C) prevention of the host from becoming infected (D) removal of viral proteins (E) removal of viral mRNAs
23. A student wishes to clone a sequence of DNA of ~200 kb. Which vector would be appropriate?  
(A) a plasmid (B) a typical bacteriophage (C) a BAC (D) a plant virus (E) a large polypeptide

24. Scientists developed a set of guidelines to address the safety of DNA technology. Which of the following is one of the adopted safety measures?
- (A) Microorganisms used in recombinant DNA experiments are genetically crippled to ensure that they cannot survive outside (of the laboratory. (B) Genetically modified organisms are not allowed to be part of our food supply. (C) Transgenic plants are engineered so that the plant genes cannot hybridize. (D) Experiments involving HIV or other potentially dangerous viruses have been banned. (E) Recombinant plasmids cannot be replicated.
25. Why might the cricket genome have 11 times as many base pairs as that of *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 noncoding DNA. (E) Crickets must make many more proteins.
26. Which of these conditions should completely prevent the occurrence of natural selection in a population over time?
- (A) All variation between individuals is due only to environmental factors. (B) The environment is changing at a relatively slow rate. (C) The population size is large. (D) The population lives in a habitat where there are no competing species present. (E) none of above
27. In a Hardy-Weinberg population with two alleles, A and a, that are in equilibrium, the frequency of allele a is 0.1. What is the frequency of individuals with AA genotype?
- (A) 0.20 (B) 0.32 (C) 0.42 (D) 0.81 (E) 0.92.
28. A hybrid zone is properly defined as
- (A) an area where two closely related species' ranges overlap. (B) an area where mating occurs between members of two closely related species, producing viable offspring. (C) a zone that features a gradual change in species composition where two neighboring ecosystems border each other. (D) a zone that includes the intermediate portion of a cline. (E) none of above.
29. The best classification system is that which most closely
- (A) unites organisms that possess similar morphologies. (B) conforms to traditional, Linnaean taxonomic practices. (C) reflects evolutionary history. (D) reflects the basic separation of prokaryotes from eukaryotes. (E) none of above
30. If nothing is done to counter the reduction of intestinal bacteria, a hospital patient who is receiving broad-spectrum antibiotics is most likely to become
- (A) unable to fix carbon dioxide. (B) antibiotic resistant. (C) unable to fix nitrogen. (D) unable to synthesize peptidoglycan. (E) deficient in certain vitamins and nutrients.

31. In terms of alternation of generations, the internal parts of the pollen grains of seed-producing plants are most similar to a  
(A) moss sporophyte. (B) moss gametophyte bearing both male and female gametangia. (C) fern sporophyte. (D) hermaphroditic fern gametophyte. (E) fern gametophyte bearing only antheridia.
32. 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
33. Asexual reproduction in yeasts occurs by budding. Due to unequal cytokinesis, the "bud" cell receives less cytoplasm than the parent cell. Which of the following should be true of the smaller cell until it reaches the size of the larger cell?  
(A) It should produce fewer fermentation products per unit time. (B) It should produce ribosomal RNA at a slower rate. (C) It should be transcriptionally less active. (D) It should have reduced motility. (E) It should have a smaller nucleus.
34. Chemicals, secreted by soil fungi, that inhibit the growth of bacteria are known as  
(A) antibodies. (B) aflatoxins. (C) hallucinogens. (D) antigens. (E) antibiotics.
35. In individual insects of some species, whole chromosomes that carry larval genes are eliminated from the genomes of somatic cells at the time of metamorphosis. A consequence of this occurrence is that  
(A) we could not clone a larva from the somatic cells of such an adult insect. (B) such species must reproduce only asexually. (C) the descendants of these adults do not include a larval stage. (D) metamorphosis can no longer occur among the descendants of such adults. (E) none of above.
36. A researcher is trying to construct a molecular-based phylogeny of the entire animal kingdom. Assuming that none of the following genes is absolutely conserved, which of the following would be the best choice on which to base the phylogeny?  
(A) genes involved in chitin synthesis (B) collagen genes (C)  $\beta$ -catenin genes (D) genes involved in eye-lens synthesis (E) genes that cause radial body symmetry
37. Penguins, seals, and tuna have body forms that permit rapid swimming, because  
(A) all share a common ancestor at some point in the past. (B) all of their bodies have been compressed since birth by intensive underwater pressures. (C) flying, pregnancy, and gill-breathing all require similar adaptations in form. (D) the shape is a convergent evolutionary solution to the need to reduce drag while swimming. (E) none of above

38. Seasonal changes in snake activity are due to the fact that the snake  
(A) is less active in winter because the food supply is decreased. (B) is less active in winter because it does not need to avoid predators. (C) is more active in summer because that is the period for mating. (D) is more active in summer because it can gain body heat by conduction. (E) none of above.
39. Ingested dietary substances must cross cell membranes to be used by the body, a process known as  
(A) ingestion. (B) digestion. (C) hydrolysis. (D) absorption. (E) elimination.
40. For a nondiabetic person, the glucose concentration in this part of the vasculature varies more than in any other part.  
(A) abdominal artery (B) coronary arteries (C) pulmonary veins (D) hepatic portal vessel (E) jugular vein
41. A significant increase in the amount of interstitial fluid surrounding the capillary beds of a human's lungs will cause  
(A) an increase in the amount of carbon dioxide moving from the blood to the lungs. (B) an increase in the amount of oxygen moving from the lungs into the blood. (C) a decrease in the amount of oxygen moving from the lungs into the blood. (D) an increase of pressure that would cause the capillary beds to burst. (E) a decrease in the amount of work needed for effective ventilation of the lungs.
42. The cells and signaling molecules that initiate inflammatory responses are  
(A) the phagocytes and the lysozymes. (B) the phagocytes and the chemokines. (C) the dendritic cells and the interferons. (D) the mast cells and the histamines. (E) the lymphocytes and the interferons.
43. Histamines trigger dilation of nearby blood vessels as well as an increase in their permeability, producing  
(A) redness and heat only. (B) swelling only. (C) pain. (D) redness, heat, and swelling. (E) all of the signs of a major infection.
44. The advantage of excreting nitrogenous wastes as urea rather than as ammonia is that  
(A) urea can be exchanged for  $\text{Na}^+$ . (B) urea is less toxic than ammonia. (C) urea requires more water for excretion than ammonia. (D) urea does not affect the osmolar gradient. (E) less nitrogen is removed from the body.
45. Endocrine glands that are sources of steroid hormones  
(A) secrete the steroids through ducts into the blood. (B) store those hormones in membrane-bound vesicles. (C) have a very short latency between steroid synthesis and steroid release. (D) are all controlled by the autonomic nervous system. (E) operate independently of other hormonal cuing systems.

46. Analysis of a blood sample from a fasting individual who had not eaten for 24 hours would be expected to reveal high levels of  
(A) insulin. (B) glucagon. (C) secretin. (D) gastrin. (E) glucose.
47. Organisms with a reproductive pattern that produces shelled amniotic eggs generally  
(A) end up having a higher embryo mortality rate than do organisms with unprotected embryos. (B) invest most of their reproductive energy in the embryonic and early postnatal development of their offspring. (C) invest more energy in parenting than do placental animals. (D) produce more gametes than do those animals with external fertilization and development. (E) lower their embryo mortality rate to less than one in a thousand.
48. If an amphibian zygote is manipulated so that the first cleavage plane fails to divide the gray crescent, then  
(A) the daughter cell with the entire gray crescent will die. (B) both daughter cells will develop normally because amphibians are totipotent at this stage. (C) only the daughter cell with the gray crescent will develop normally. (D) both daughter cells will develop abnormally. (E) both daughter cells will die immediately.
49. In mammals, advanced cognition is usually correlated with a large and very convoluted neocortex, but birds are capable of sophisticated cognition because they have  
(A) a more advanced cerebellum. (B) a cerebellum with several flat layers. (C) a pallium with neurons clustered into nuclei. (D) microvilli to increase the brain's surface area. (E) none of above
50. The muscles of a recently deceased human can remain in a contracted state, termed rigor mortis, for several hours, due to the lack of  
(A) phosphorylated myosin. (B) ATP needed to break actin-myosin bonds. (C) calcium ions needed to bind to troponin. (D) oxygen supplies needed for myoglobin. (E) sodium ions needed to fire action potentials.