

I. 單選題 (每題 2 分，共 60 分) (請依題號順序於選擇題作答區內作答)

1. A process common to all living organisms, aerobic and anaerobic, is  
A. glycolysis                      B. fermentation                      C. the Krebs cycle  
D. electron transport chain reactions                      E. pyruvate oxidation
2. Chemiosmotic generation of ATP is driven by  
A. phosphate transfer through the plasma membrane  
B. sodium, potassium pump  
C. a difference in  $H^+$  concentration on the two sides of the mitochondrial membrane  
D. osmosis of macromolecules  
E. large quantities of ADP
3. As electrons are passed through the system of electron carriers associated with photosystem II, they lose energy. What happens to this energy?  
A. It excites electrons of the reaction center of photosystem I.  
B. It is lost as heat.  
C. It is used to establish and maintain a proton gradient.  
D. It is used to phosphorylate  $NAD^+$  to NADPH, the molecule that accepts electrons from.
4. Based on what you know about the structure and function of the antenna complex, irradiating (照射) a leaf with which of the following light types would result in the release of the greatest quantities of oxygen?  
A. red and orange light                      B. green and blue light  
C. violet and red light                      D. red and blue light
5. What evidence do paleobotanists (古生物學者) look for that indicates (顯示) the movement of plants from water to land?  
A. waxy cuticle to decrease evaporation from leaves  
B. loss of structures that produce spores  
C. sporopollenin to inhibit evaporation from leaves  
D. remnants of chloroplasts from photosynthesizing cells
6. Which of the following is a correct element of alternation of generations?  
A. The sporophyte is haploid and produces gametes.  
B. The sporophyte is diploid and produces spores.  
C. The gametophyte is haploid and produces spores.  
D. The gametophyte is diploid and produces gametes.  
E. Two spores unite to form a zygote.
7. The most important ion in controlling the movement of water into and out of the guard cells is  
A. sodium                      B. hydrogen                      C. carbon                      D. nitrogen                      E. potassium
8. Which of these actions describes secondary growth?  
A. growth in height                      B. development of leaves and flowers  
C. growth of herbaceous tissue                      D. development of wood and bark  
E. development of fruit
9. If you examined a cross section of a woody stem under the microscope and located the vascular cambium, everything inside (towards the center of the stem) of the vascular cambium ring would be  
A. xylem (primary and secondary)                      B. xylem (only primary)  
C. phloem (primary and secondary)                      D. phloem (only secondary)  
E. xylem and phloem since vascular cambium is only one cell in thickness
10. Compared to plants from other environments, the cells of many desert plants contain high concentrations of solutes. This helps them survive in their arid surroundings because the high solute concentrations create relatively \_\_\_\_\_, which help reduce water loss.  
A. low solute potentials                      B. high pressure potentials  
C. low pressure potentials                      D. high solute potentials

11. The data indicate that plants from shady habitats do not respond to far-red light by growing taller. Which of the following would be a logical hypothesis for why these plants do not respond to far-red light?
  - A. The shade plants do not have phototropin.
  - B. The shade plants do not have protein kinases.
  - C. The shade plants do not have cryptochromes.
  - D. The shade plants do not have phytochrome.
  - E. All of these are reasonable hypotheses.
12. Microspore mother cells produce microspores that develop into
  - A. egg cells
  - B. pollen grains
  - C. synergids
  - D. endosperm
  - E. runners
13. 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.
14. In an ecosystem, which statement reflects the relationship with energy and nutrients?
  - A. Energy cycles and nutrients also cycle in a balanced ecosystem
  - B. Energy flows and nutrients cycle in an ecosystem.
  - C. Energy cycles and nutrients flow in an ecosystem.
  - D. Energy flows and nutrients flow through an ecosystem.
  - E. In an unbalanced ecosystem, nutrients are stored in energy cycles.
15. If two species are close competitors, and one species is experimentally removed from the community, the remaining species would be expected to \_\_\_\_\_.
  - A. eventually become competitively superior to the other species
  - B. change its fundamental niche
  - C. decline (降低) in abundance
  - D. become the target of specialized parasites
  - E. expand its realized niche
16. The five islands in the following diagram formed at about the same time near a particular mainland, which island with the greatest number of species?
 

The diagram shows a vertical bracket on the left labeled 'Mainland'. To the right of the mainland are five rectangular boxes representing islands. Island A is the closest to the mainland. Island E is slightly further. Island D is further still. Island B is further. Island C is the furthest from the mainland.

17. According to the fluid mosaic model of cell membranes, which of the following is a true statement about membrane phospholipids?
  - A. They can move laterally along the plane of the membrane.
  - B. They occur in a lipid bilayer, with membrane proteins restricted to the surface of the membrane.
  - C. They frequently flip-flop from one side of the membrane to the other.
  - D. They have hydrophilic tails in the interior of the membrane.
18. Researchers tried to explain how vesicular transport occurs in cells by attempting to assemble the transport components. They set up microtubular tracks along which vesicles could be transported, and they added vesicles and ATP. Yet, when they put everything together, there was no movement or transport of vesicles. What were they missing?
  - A. an axon
  - B. endoplasmic reticulum
  - C. motor proteins
  - D. contractile microfilaments

19. A salmon goes back to its home stream to spawn by using  
 A. habituation.      B. imprinting.      C. social learning.      D. kinesis.
20. A mutation that disrupts the ability of an animal cell to add polysaccharide modifications to proteins would most likely cause defects in its  
 A. nuclear pores and secretory vesicles.      B. nuclear matrix and extracellular matrix.  
 C. mitochondria and Golgi apparatus.      D. Golgi apparatus and extracellular matrix.
21. At puberty, an adolescent female body changes in both structure and function of several organ systems, primarily under the influence of changing concentrations of estrogens and other steroid hormones. How can one hormone, such as estrogen, mediate so many effects?  
 A. Estrogen is produced in very large concentration and therefore diffuses widely.  
 B. Estrogen binds to different receptors on the surface of many kinds of cells, each of which have different responses to its binding.  
 C. Estrogen binds to specific receptors inside many kinds of cells, each of which have different responses to its binding.  
 D. The subcomponents of estrogen, when metabolized, can influence cell response.
22. The cyclin component of MPF is destroyed toward the end of which phase in a cell cycle?  
 A. G<sub>0</sub>      B. G<sub>1</sub>      C. S      D. G<sub>2</sub>      E. M
23. Cinnabar eyes is a sex-linked recessive characteristic in fruit flies. If a female having cinnabar eyes is crossed with a wild-type male, what percentage of the F<sub>1</sub> males will have cinnabar eyes?  
 A. 0%      B. 25%      C. 50%      D. 75%      E. 100%
24. Suppose you are provided with an actively dividing culture of *E. coli* bacteria to which radioactive thymine has been added. What would happen if a cell replicates once in the presence of this radioactive base?  
 A. One of the daughter cells, but not the other, would have radioactive DNA.  
 B. Neither of the two daughter cells would be radioactive.  
 C. All four bases of the DNA would be radioactive.  
 D. Radioactive thymine would pair with nonradioactive guanine.  
 E. DNA in both daughter cells would be radioactive.
25. At a specific area of a chromosome, the sequence of nucleotides below is present where the chain opens to form a replication fork:  
 3' CCTAGGCTGCAATCC 5'  
 An RNA primer is formed starting at the underlined T (T) of the template. Which of the following represents the primer sequence?  
 A. 5' GCCTAGG 3'      B. 3' GCCTAGG 5'  
 C. 5' ACGTTAGG 3'      D. 5' ACGUAGG 3'  
 E. 5' GCCUAGG 3'
26. How many of the following are characteristics of arthropods?  
 1. protostome development      4. three embryonic germ layers  
 2. bilateral symmetry      5. a closed circulatory system  
 3. a pseudocoelom  
 A. one      B. two      C. three      D. four      E. five
27. In a population that is in Hardy-Weinberg equilibrium for two alleles, C and c, 16% of the population show a recessive trait. Assuming C is dominant to c, what percent show the dominant trait?  
 A. 36%      B. 48%      C. 60%      D. 84%      E. 96%
28. When several EPSPs arrive at the axon hillock from different dendritic locations, depolarizing the postsynaptic cell to threshold for an action potential, this is an example of  
 A. temporal summation.      B. spatial summation.  
 C. tetanus.      D. the refractory state.

29. Stomach cells are moderately well adapted to the acidity and protein-digesting activities in the stomach by having
- a sufficient colony of *H. pylori*.
  - a thick, mucous secretion and active mitosis of epithelial cells.
  - a high level of secretion by chief cells.
  - secretions enter the stomach from the pancreas.
30. After the depolarization phase of an action potential, the resting potential of a neuron is restored by
- the opening of sodium activation gates.
  - the opening of voltage-gated potassium channels and the closing of sodium channels.
  - a decrease in the membrane's permeability to potassium and chloride ions.
  - a brief inhibition of the sodium-potassium pump.
  - the opening of more voltage-gated sodium channels.

**II. 簡答題 (共 40 分) (請標明題號，於非選擇題作答區內作答)**

- What is the most abundant protein, which has both carboxylation and oxidation activity, in the world? **(in English) (3 分)**
- Name two plants which have no photorespiration. **(in Chinese or English) (4 分)**
- Plant cells A and B are adjacent to each other. The solute potential ( $\psi_s$ ) of cell A is  $-0.65$  MPa, and its pressure potential ( $\psi_p$ ) is  $+0.15$  MPa. The solute potential ( $\psi_s$ ) of cell B is  $-0.75$  MPa, and its pressure potential ( $\psi_p$ ) is  $+0.35$  MPa. In which direction will net water movement occur, A to B or B to A, Why? **(in Chinese or English) (5 分)**
- Scientists study Biology using the methods of science. What are the "scientific methods"? **(in Chinese or English) (6 分)**
- Draw a model of a eukaryotic gene undergoing transcription. Label enhancers, promoter-proximal elements, the promoter, regulatory transcription factors, basal (general) transcription factors, and RNA polymerase. **(in English) (6 分)**
- What is the endomembrane system? **(in Chinese or English) (5 分)**
- What are aquaporins? Why are aquaporins important in kidney cells? Which hormone can increase the number of aquaporins in the membrane of kidney cells? **(in Chinese or English) (6 分)**
- Why is the lungs of birds considered much more efficient than that of human and other mammals? **(in Chinese or English) (5 分)**