

(一) Multiple Choice Questions: Choose the best answer for each question (2 points for each).

「選擇題作答區」依序作答

1. Which of these characteristics provides evidence of the common ancestry of all life?
 - A) ubiquitous use of catalysts by living systems
 - B) structure of the nucleus
 - C) structure of cilia
 - D) near universality of the genetic code
 - E) structure of chloroplasts

2. How does a scientific theory differ from a scientific hypothesis?
 - A) Theories are predicted from scientific hypotheses.
 - B) Confirmed theories become scientific laws; hypotheses become theories.
 - C) Hypotheses are usually an explanation for a more general phenomenon; theories typically address more specific issues.
 - D) Theories are proposed to test scientific hypotheses.
 - E) Theories are usually an explanation for a more general phenomenon; hypotheses typically address more specific issues.

3. The best experimental design _____.
 - A) includes a large sample size for each condition
 - B) includes a control
 - C) alters only one condition between the controls and the experimental condition
 - D) applies statistical hypothesis
 - E) includes a large sample size and a control, and alters only one condition between the controls and the experimental condition

4. Which of the followings are qualities of any good scientific hypothesis?
 - I. It is testable.
 - II. It is falsifiable.
 - III. It produces quantitative data.
 - IV. It produces results that can be replicated.
 - A) I only
 - B) II only
 - C) III only
 - D) I and II
 - E) III and IV

5. Which of the followings best describes the logic of scientific inquiry?
 - A) If I generate a testable hypothesis, tests and observations will support it.
 - B) If my prediction is correct, it will lead to a testable hypothesis.
 - C) If my observations are accurate, they will support my hypothesis.
 - D) If my hypothesis is correct, I can expect certain test results.
 - E) If my experiments are set up right, they will lead to a testable hypothesis.

見背面

6. The formulation of a model for a structure or for a process serves which of the following purposes?

- A) It asks a scientific question.
- B) It records observations.
- C) It functions as a testable hypothesis.
- D) It serves as a data point among results.
- E) It can be arrived at only after years of experimentation.

7. About 25 of the 92 natural elements are known to be essential to life. Which 4 of these 25 elements make up approximately 96% of living matter?

- A) carbon, sodium, hydrogen, nitrogen
- B) carbon, oxygen, phosphorus, hydrogen
- C) oxygen, hydrogen, calcium, nitrogen
- D) carbon, hydrogen, nitrogen, oxygen
- E) carbon, oxygen, nitrogen, calcium

8. Why is carbon so important in biology?

- A) It is a common element on Earth.
- B) It has very little electronegativity, making it a good electron donor.
- C) It bonds to only a few other elements.
- D) It can form a variety of carbon skeletons and host functional groups.
- E) It is the heart of biogeochemical cycle.

9. Which structure is common to plant and animal cells?

- A) chloroplast
- B) wall made of cellulose
- C) central vacuole
- D) mitochondrion
- E) centriole

10) For living organisms, which of the following is an important consequence of the first law of thermodynamics?

- A) The energy content of an organism is constant.
- B) The entropy of an organism decreases with time as the organism grows in complexity.
- C) Life does not obey the first law of thermodynamics.
- D) Organisms grow by converting energy into organic matter.
- E) The organism ultimately must obtain all of the necessary energy for life from its environment.

11. Which of the following statements is a logical consequence of the second law of thermodynamics?
- A) If the entropy of a system increases, there must be a corresponding decrease in the entropy of the universe.
 - B) If there is an increase in the energy of a system, there must be a corresponding decrease in the energy of the rest of the universe.
 - C) Every energy transfer requires activation energy from the environment.
 - D) Every chemical reaction must increase the total entropy of the universe.
 - E) Energy can be transferred or transformed, but it cannot be created or destroyed.
12. Which of the following is the greatest threat to biodiversity?
- A) overharvesting of commercially important species
 - B) introduced species that compete with native species
 - C) pollution of Earth's air, water, and soil
 - D) habitat alteration, fragmentation, and destruction
 - E) disruption of trophic relationships as more and more prey species become extinct
13. Mendel studies seven different traits in the garden pea. What genetic term is used to describe an observable trait, such as those studied by Mendel?
- A) genotype
 - B) appearance
 - C) haplotype
 - D) phenotype
 - E) category
14. Which of the following levels of ecological organization is arranged in the correct sequence from most to least inclusive?
- A) community, ecosystem, organism, population
 - B) population, ecosystem, organism, community
 - C) organism, population, community, ecosystem
 - D) ecosystem, community, population, organism
 - E) organism, community, population, ecosystem
15. Fertilization normally _____.
- A) reinstates diploidy
 - B) follows gastrulation
 - C) is required for parthenogenesis
 - D) merges two diploid cells into one haploid cell
 - E) precedes ovulation

16. Darwin and Wallace's theory of evolution by natural selection was revolutionary because it _____.
A) was the first theory to refute the ideas of special creation
B) proved that individuals acclimated to their environment over time
C) dismissed the idea that species are constant and emphasized the importance of variation and change in populations
D) was the first time a biologist had proposed that species changed through time
E) dismissed the idea that species are constant and de-emphasized the importance of variation in populations
17. Which of the following is the best modern definition of evolution?
A) inheritance of acquired characters
B) change by natural selection
C) survival of the fittest
D) descent with modification
E) change in the number of genes in a population over time
18. Which of the following evidence most strongly supports the common origin of all life on Earth? All organisms _____.
A) require energy
B) use essentially the same genetic code
C) reproduce
D) show heritable variation
E) evolve
19. Biological fitness is best defined as
A) A heritable trait that increases the match of an individual to its environment.
B) Variability in the population for a trait that increases survival.
C) Similar reproductive success among individuals in a population.
D) Competition among individuals for resources that allow them to have more offspring.
E) Relative the ability of an individual to produce offspring that survive and reproduce.
20. Over long periods of time, many cave-dwelling organisms have lost their eyes. Tapeworms have lost their digestive systems. Whales have lost their hind limbs. How can natural selection account for these losses?
A) The ancestors of these organisms experienced harmful mutations that forced them to lose these structures.
B) Natural selection cannot account for losses, but accounts only for new structures and functions.
C) Natural selection accounts for these losses by the principle of use and disuse.
D) Under particular circumstances that persisted for long periods, each of these structures presented greater costs than benefits.
E) Each of these structures presented less costs than benefits.

21. Why doesn't inbreeding depression, by itself, cause evolution?
- A) It increases homozygosity.
 - B) It decreases the population's average fitness.
 - C) It limits gene flow.
 - D) It does not change the population's allele frequencies.
 - E) It violates the Hardy-Weinberg assumptions.
22. As climate changes because of global warming, plant species' ranges in the northern hemisphere may move northward. The trees that are most likely to avoid extinction in such an environment are those that _____.
- A) have seeds that are easily dispersed by wind or animals
 - B) have thin seed coats
 - C) produce well-provisioned seeds
 - D) have seeds that become viable only after a forest fire
 - E) disperse many seeds in close proximity to the parent tree
23. In 1986, a nuclear power accident in Chernobyl, USSR (now Ukraine), led to high radiation levels surrounding the plant. The high levels of radiation caused elevated mutation rates in the surviving organisms, and evolutionary biologists have been studying rodent populations in the Chernobyl area ever since. Based on your understanding of evolutionary mechanisms, which of the following most likely occurred in the rodent populations following the accident?
- A) Mutation led to increased genetic variation.
 - B) Mutations caused major changes in rodent physiology over time.
 - C) Mutation caused genetic drift and decreased fitness.
 - D) Mutation caused the fixation of new alleles.
 - E) Mutation was not found..
24. Which of the following statements about species, as defined by the biological species concept, is (are) correct?
- I. Biological species are defined by reproductive isolation.
 - II. Biological species are the model used for grouping extinct forms of life.
 - III. All members of a species can potentially interbreed.
- A) I and II
 - B) I and III
 - C) II and III
 - D) I, II, and III
 - E) III only

25. Which of the following does not tend to promote speciation?
- A) the founder effect
 - B) natural selection
 - C) polyploidy
 - D) disruptive selection
 - E) gene flow
26. The probable sequence in which organisms evolved is?
- A) Prokaryotic bacteria --> eukaryotic algae --> cyanobacteria --> land plants
 - B) Eukaryotic bacteria --> cyanobacteria --> eukaryotic algae --> land plants
 - C) Cyanobacteria --> eukaryotic algae --> prokaryotic bacteria --> land plants
 - D) Prokaryotic bacteria --> cyanobacteria --> eukaryotic algae --> land plants
 - E) Cyanobacteria --> prokaryotic bacteria --> eukaryotic algae --> land plants
27. A biochemist was working with an enzyme known to be a SINGLE polypeptide chain. When the pH around the enzyme was lowered slightly, the enzyme's activity slowed. When the pH was returned to the original value, the enzyme resumed normal activity. Lowering the pH probably altered the enzyme's
- A) Primary structure
 - B) Tertiary structure
 - C) Quaternary structure
 - D) Peptide bonds
 - E) covalent bonds
28. The concentration of iodine ions in cells of seaweeds or kelps can be up to 30,000 times higher than in seawater. This is due to
- A) Diffusion
 - B) Facilitated diffusion
 - C) Active transport
 - D) Formation of vesicles
 - E) negative transport
29. If a normal body cell of a plant contains 5 picograms of DNA, then that cell at the end of prophase of mitosis contains
- A) 1.25 picograms
 - B) 2.5 picograms
 - C) 5 picograms
 - D) 10 picograms
 - E) 20 picograms

30. Cell division in eukaryotic and prokaryotic cells different in that
- A) Prokaryotic cytokinesis is an outward extension of a cell plate
 - B) Mitosis occurs only in eukaryotes
 - C) Meiosis occurs only in prokaryotes
 - D) Microtubules form only in prokaryotes
 - E) DNA duplication occurs only in eukaryotes
31. The order of phases in a typical cell cycle is
- A) G₁, G₂, S, nuclear division, cytokinesis
 - B) G₁, S, G₂, nuclear division, cytokinesis
 - C) S, G₁, G₂, nuclear division, cytokinesis
 - D) Cytokinesis, nuclear division, S, G₁, G₂
 - E) Cytokinesis, S, nuclear division, G₁, G₂
32. If a leaf is cut off of an African violet plant and placed in water, new roots form at the base of the petiole. The first root formed this way is
- A) A taproot
 - B) Adventitious
 - C) A radicle
 - D) A lateral root
 - E) A primary root
33. A root is not uniform along its length, but has distinct zones. Starting at tip, these zones are
- A) Apical meristem ---> root cap ---> zone of elongation ---> zone of maturation/root hairs
 - B) Root cap ---> zone of elongation ---> apical meristem ---> zone of maturation/root hairs
 - C) Root cap ---> apical meristem ---> zone of elongation ---> zone of maturation/root hairs
 - D) Root cap ---> apical meristem ---> zone of maturation/root hairs ---> zone of elongation
 - E) Apical meristem ---> zone of elongation ---> root cap ---> zone of maturation/root hairs
34. The downward direction of root growth in response to gravity would be most adversely affected by an inhibition of
- A) Protein synthesis
 - B) Lipid synthesis
 - C) Starch synthesis
 - D) Cellulose synthesis
 - E) DNA synthesis

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35. In humans, cartilage gives firm but flexible support, the comparable tissue in a plant would be
- A) Parenchyma
 - B) Sclerenchyma
 - C) Collenchyma
 - D) Phloem
 - E) Xylem
36. The major direct advantage to a plant of a mycorrhizal relationship is increased
- A) Sugar production
 - B) Carbon absorption
 - C) Nitrogen fixation
 - D) Phosphorus absorption
 - E) Food digestion
37. If a plant leaf is exposed to radioactively-labeled carbon dioxide, the radioactivity first appears in palisade and spongy mesophyll cells. The radioactivity would most likely move next to cells of the
- A) Midrib
 - B) Lateral veins
 - C) Minor veins
 - D) Midrib and lateral veins
 - E) Guard cells
38. Where would you expect to find stomata in the floating leaves of water lilies?
- A) Upper epidermis only.
 - B) Equally distributed in the upper and lower epidermis
 - C) Mainly in the lower epidermis with a few in the upper epidermis
 - D) Lower epidermis only
 - E) No stoma formed
39. In a plant, the least amount of resistance occurs as water moves between
- A) tracheids through pit-pairs
 - B) tracheids through plasmodesmata
 - C) vessel elements through pit-pairs
 - D) vessel elements through perforations
 - E) cells between membranes
40. Which of the following mature cells would be most active metabolically?
- A) Vessel element
 - B) Sclerid
 - C) Collenchyma
 - D) Parenchyma
 - E) Sieve tube member

41. Which of the following leaf adaptations would you NOT expect to find in desert plants?
- A) Hairy leaves
 - B) Thick cuticle
 - C) Stomata in epidermal crypt cavities
 - D) Thin palisade layer
 - E) Few intercellular spaces
42. As a new lateral root grows, it destroys tissues of the parent root in what order?
- A) Xylem, endodermis, pericycle, cortex, epidermis
 - B) Endodermis, cortex, epidermis
 - C) Cortex, endodermis, epidermis
 - D) Phloem, pericycle, endodermis, cortex, epidermis
 - E) Pericycle, phloem, cortex, endodermis, epidermis
43. True secondary growth occurs in
- A) All of ferns, gymnosperms, dicots, and monocots
 - B) Some of ferns, gymnosperms, dicots, and monocots
 - C) All gymnosperms, dicots, and monocots
 - D) All gymnosperms and some dicots
 - E) All green plants
44. In a tree whose sapwood functions for nine years, how many annual rings have been converted to heartwood in a trunk section that is thirty five years old?
- A) 9
 - B) 24
 - C) 34
 - D) 35
 - E) 44
45. Regarding ATP, all are true EXCEPT
- A) Each cell must make its own ATP
 - B) The reaction $ADP \rightarrow AMP + Pi$ is endergonic
 - C) ATP is highly reactive
 - D) ATP cannot be stored in a cell
 - E) ATP supplies the energy to drive most energy-requiring reactions in cells

(二) 問答題 (10%)

「非選擇題作答區」依序作答

- 1) Ethics and morality cannot be studied using the scientific method. Does that mean the science plays no role in those fields? Briefly explain your answer. (3%)
- 2) Is a carrot in the supermarket alive or not? List the characteristics of living things and design the related hypothesis-testing experiments for each. (7%)