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並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生命科學院 甲組

考試科目(代碼)：生物學(0402)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
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共 8 頁，第 1 頁 *請在【答案卡】作答

單選題 (每題二分，共一百分，答錯不倒扣。)

- Which of the following types of cells utilize deoxyribonucleic acid (DNA) as their genetic material but do not have their DNA encased within a nuclear envelope?
A) animal
B) plant
C) archaean
D) fungi
- Which of the following statements is TRUE?
A) Carbon, hydrogen, oxygen, and calcium are the most abundant elements of living matter.
B) Some naturally occurring elements are toxic to organisms.
C) All life requires the same essential elements.
D) A patient suffering from a goiter should not consume seafood.
- Which of the following can be attributed to water's high specific heat?
A) Oil and water do not mix well.
B) A lake heats up more slowly than the air around it.
C) Ice floats on water.
D) Sugar dissolves in hot tea faster than in iced tea.
- A carbon atom has 6 electrons however, its valency is 4. This is because the carbon atom _____.
A) donates its 2 electrons to another atom
B) shares its 2 electrons and bonds with another atom
C) has 4 electrons in its first shell and 2 in the second shell
D) has only 2 electrons in its first shell and 4 in the second shell
- You would like to lose weight. Which of the following should be your preferred food group?
A) Lactose and glucose
B) Sucrose and starch
C) Starch and fructose
D) Cellulose and fructose
- Which of the following would be the most appropriate method to observe the movements of condensed chromosomes during cell division?
A) a hand lens (magnifying glass)
B) standard light microscopy
C) scanning electron microscopy
D) transmission electron microscopy
- Which of the following would likely diffuse through the lipid bilayer of a plasma membrane most rapidly?
A) sucrose B) an amino acid
C) O₂ D) Na⁺

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8. A decrease in entropy is associated with which type of reaction?
A) dehydration
B) catabolic
C) depolymerization
D) hydrolysis
9. Which of the following statements about NAD^+ is true?
A) NAD^+ is reduced to NADH during glycolysis, pyruvate oxidation, and the citric acid cycle.
B) NAD^+ has more chemical energy than NADH .
C) NAD^+ can donate electrons for use in oxidative phosphorylation.
D) In the absence of NAD^+ , glycolysis can still function.
10. Under what conditions do photosynthesis and cellular respiration occur in plants?
A) Photosynthesis and cellular respiration occur only in the light.
B) Photosynthesis occurs only in the light, and cellular respiration occurs only in the dark.
C) Photosynthesis occurs only in the light, and cellular respiration occurs in both the dark and the light.
D) Photosynthesis and cellular respiration occur in both the dark and the light.
11. Which observation suggested to Sutherland the involvement of a second messenger in epinephrine's effect on liver cells?
A) Receptor studies indicated that epinephrine was a ligand.
B) Glycogen breakdown was observed only when epinephrine was administered to intact cells.
C) Glycogen breakdown was observed when epinephrine and glycogen phosphorylase were combined in a cell-free system.
D) Epinephrine was known to have different effects on many types of cells.
12. Metaphase is characterized by _____.
A) alignment of chromosomes on the equator of the cell
B) separation of the centromeres
C) cytokinesis
D) separation of sister chromatids
13. Quaking aspen trees can send out underground stems for asexual reproduction. Sexual reproduction is not as common, but when it does happen, the haploid gametes have 19 chromosomes. How many chromosomes are in the cells of the underground stems?
A) 9
B) 10
C) 19
D) 38

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14. Skin color in a certain species of fish is inherited by a single gene with four different alleles. How many different types of gametes would be possible in this organism?
A) 2
B) 4
C) 8
D) 16
15. Cinnabar eye color 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 F1 males will have cinnabar eyes?
A) 0%
B) 25%
C) 50%
D) 100%
16. Thymine makes up 28% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be guanine?
A) 8%
B) 16%
C) 22%
D) 72%
17. Which of the following molecular structures contain codons?
A) a protein
B) mRNA
C) tRNA
D) rRNA
18. According to the lac operon model proposed by Jacob and Monod, what is predicted to occur if the operator is removed from the operon?
A) The lac operon would be transcribed continuously.
B) Only lacZ would be transcribed.
C) Only lacY would be transcribed.
D) Galactosidase permease would be produced, but would be incapable of transporting lactose.
19. Which of the following events or characteristics accounts for someone who has had regular herpesvirus-mediated cold sores or genital sore flare-ups?
A) reinfection by a closely related herpesvirus of a different strain
B) reinfection by the same herpesvirus strain
C) copies of the herpesvirus genome permanently maintained in host nuclei
D) copies of the herpesvirus genome permanently maintained in host cell cytoplasm

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20. Select the appropriate condition to determine if the plasmid has entered the E. coli bacterial cell.
- A) nutrient broth to which no antibiotic has been added
 - B) water to which ampicillin has been added
 - C) nutrient broth to which ampicillin has been added
 - D) nutrient broth to which other resistant bacteria have been added
21. After finding a new medicinal plant, a pharmaceutical company decides to determine if the plant has genes similar to those of other known medicinal plants. What would annotation of the genome of this plant allow the company to determine?
- A) what proteins are produced by the plant
 - B) what mRNA transcripts are produced by the plant
 - C) identify genes and determine their functions
 - D) identify the location of mRNA within the plant cells
22. For which one of the following observations were both Lamarck's hypothesis and Darwin's hypothesis in complete agreement?
- A) Use and disuse of organs determines their size in progeny.
 - B) Gradual evolutionary change explains why organisms are well-suited to their environments.
 - C) Acquired characteristics are inherited.
 - D) More complex species are descended from less complex species.
23. Which statement about variation is true?
- A) All phenotypic variation is the result of genotypic variation.
 - B) All genetic variation produces phenotypic variation.
 - C) All nucleotide variability results in neutral variation.
 - D) All new alleles are the result of nucleotide variability.
24. Which of the following statements describes mechanical isolation prezygotic barrier?
- A) two species live in different habitats
 - B) two species mate at different times
 - C) two species share courtship activities
 - D) two snails have shells that spiral in different directions
25. In 2013, researchers constructed a vesicle with replicated RNA. Why was this significant evidence for abiotic origin of life?
- A) RNA molecules could pass on information to their "daughters."
 - B) RNA molecules were not able to replicate.
 - C) RNA would be used up by protocells.
 - D) RNA is a stable repository.

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26. Carolus Linnaeus believed that species remained fixed in the form in which they had been created. Linnaeus would have been uncomfortable with _____.
- A) a hierarchical classification scheme
 - B) taxonomy
 - C) phylogenies
 - D) nested, increasingly inclusive categories of organisms
27. Jams, jellies, preserves, honey, and other foods with high sugar content hardly ever become contaminated by bacteria, even when the food containers are left open at room temperature. This is because bacteria that encounter such an environment _____.
- A) undergo death as a result of water loss from the cell
 - B) are unable to metabolize the glucose or fructose, and thus starve to death
 - C) are obligate anaerobes
 - D) are unable to swim through these thick and viscous materials
28. All protists are _____.
- A) unicellular
 - B) eukaryotic
 - C) symbionts
 - D) mixotrophic
29. The most direct ancestors of land plants were probably _____.
- A) kelp (brown alga) that formed large beds near the shorelines
 - B) green algae
 - C) photosynthesizing prokaryotes (cyanobacteria)
 - D) liverworts and mosses
30. In seed plants, which of the following is part of a pollen grain and has a function most like that of the seed coat?
- A) sporophyll
 - B) sporopollenin
 - C) stigma
 - D) sporangium
31. A fungal spore germinates, giving rise to a mycelium that grows outward into the soil surrounding the site where the spore originally landed. Which of the following accounts for the fungal movement, as described here?
- A) karyogamy
 - B) mycelial flagella
 - C) breezes distributing spores
 - D) cytoplasmic streaming in hyphae
32. Which of the following is (are) unique to animals?
- A) the structural carbohydrate, chitin
 - B) nervous system signal conduction and muscular movement
 - C) heterotrophy
 - D) flagellated gametes

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*請在【答案卡】作答

33. Which of the following is most likely to be aquatic?
A) filter feeder
B) mass feeder
C) deposit feeder
D) fluid feeder
34. Which of the following is a characteristic of all chordates at some point during their life cycle?
A) jaws
B) post-anal tail
C) four-chambered heart
D) vertebrae
35. Strawberries have modified horizontal shoots growing along the surface, which are referred to as _____.
A) rhizomes
B) tubers
C) stolons
D) rhizoids
36. Why do most angiosperms have alternate phyllotaxy, with leaf emergence at an angle of 137.5° compared to leaves above and below?
A) to allow maximum exposure to light
B) to promote a leaf area index above 8
C) to reduce shading of lower leaves
D) to allow maximum exposure to light and to reduce shading of lower leaves
37. The highest amount of oxygen will be found in soils containing large amounts of _____.
A) clay
B) sand
C) gravel
D) silt
38. A summer occupation in the Corn Belt states is de-tasseling the corn: removing unwanted male flowers so that female flowers on the same plant are pollinated by the desired pollen for the hybrid corn. What does this tell you about corn? The flowers are _____.
A) perfect and the plant is dioecious
B) perfect and the plant is monoecious
C) imperfect and the plant is dioecious
D) imperfect and the plant is monoecious
39. Plant hormones _____.
A) in plant cells naturally exist in very large amounts
B) change their shape in response to stimulus
C) are unable to move from one cell to another
D) affect only cells with the appropriate receptor

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40. Penguins, seals, and tuna have body forms that permit rapid swimming, because _____.
- A) all share a recent common ancestor
 - B) all of their bodies have been compressed since birth by intensive underwater pressures
 - C) the shape is a convergent evolutionary solution, which reduces drag while swimming
 - D) this is the only shape that will allow them to maintain a constant body temperature in water
41. Which of the following is a difference between vitamins and minerals?
- A) Vitamins are involved in regulating enzyme activity, but minerals are not.
 - B) Vitamins are organic molecules, but minerals are inorganic molecules.
 - C) Minerals are obtained by an animal through dietary sources, but vitamins are made by the animal.
 - D) Vitamins and minerals are only obtained by digesting plants.
42. In which of the following organisms does blood flow from the pulmocutaneous circulation to the heart before circulating through the rest of the body?
- A) annelids
 - B) fishes
 - C) frogs
 - D) insects
43. The cells and signaling molecules involved in the initial stages of the inflammatory response are _____.
- A) phagocytes and cytokines
 - B) dendritic cells and interferons
 - C) mast cells and histamines
 - D) lymphocytes and interferons
44. Single-celled Paramecium live in pond water (a hypotonic environment relative to the cytosol). They have a structural feature, a contractile vacuole, which enables them to osmoregulate. If sucrose or saline was added to the pond water in different concentrations (in millimolars, mM), under which conditions would you expect the contractile vacuole to be most active?
- A) 0.0 mM sucrose
 - B) 0.05 mM saline
 - C) 0.08 mM sucrose
 - D) 1.0 mM saline
45. What is the only type of chemical signal that does not alter the physiology of the animal producing that signal?
- A) neural
 - B) paracrine
 - C) neuroendocrine
 - D) pheromones

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46. Which of the following organisms reproduces by fission?
A) lamprey
B) bluefin tuna
C) whiptail lizards
D) stony corals
47. Contact of a sea urchin egg with signal molecules on sperm causes the egg to undergo a brief _____.
A) mitosis
B) membrane depolarization
C) vitellogenesis
D) acrosomal reaction
48. If you experimentally increase the concentration of Na^+ outside a cell while maintaining other ion concentrations as they were, what would happen to the cell's membrane potential?
A) The membrane potential would become more negative.
B) The membrane potential would become more positive.
C) The membrane potential would be unaffected.
D) The answer depends on the thermodynamic potential.
49. Preparation for the fight-or-flight response includes activation of the _____ nervous system
A) sympathetic
B) somatic
C) central
D) parasympathetic
50. A given photon of light may trigger an action potential with thousands of times more energy because the signal strength is amplified by _____.
A) the receptor
B) ion channels
C) a signal transduction pathway
D) triggering several receptors at once