

國立清華大學 107 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、丁組

考試科目（代碼）：生物學(0402、0702)

Part I 單選題 (每題二分，共一百分，答錯不倒扣。)

共 10 頁，第 1 頁 *請在【答案卡】作答

1. The atomic number of nitrogen is 7. Nitrogen-15 has a greater mass number than nitrogen-14 because the atomic nucleus of nitrogen-15 contains _____.
A) 7 neutrons
B) 8 neutrons
C) 8 protons
D) 15 protons
2. In a single molecule of water, two hydrogen atoms are bonded to a single oxygen atom by _____.
A) hydrogen bonds
B) nonpolar covalent bonds
C) polar covalent bonds
D) ionic bonds
3. Differences among organisms are caused by differences in the _____.
A) elemental composition from organism to organism
B) types and relative amounts of organic molecules synthesized by each organism
C) sizes of the organic molecules in each organism
D) types of inorganic compounds present in each organism
4. How many molecules of water are used to completely hydrolyze a polymer that is 11 monomers long?
A) 12 B) 11 C) 10 D) 9
5. The advantage of light microscopy over electron microscopy is that _____.
A) light microscopy provides for higher magnification than electron microscopy
B) light microscopy provides for higher resolving power than electron microscopy
C) light microscopy allows one to view dynamic processes in living cells
D) light microscopy provides higher contrast than electron microscopy

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共 10 頁，第 2 頁 *請在【答案卡】作答

6. Some regions of the plasma membrane, called *lipid rafts*, have a higher concentration of cholesterol molecules. At higher temperatures, these regions _____.
A) are more fluid than the surrounding membrane
B) are less fluid than the surrounding membrane
C) detach from the plasma membrane and clog arteries
D) have higher rates of lateral diffusion of lipids and proteins into and out of these regions
7. Which of the following is an example of potential rather than kinetic energy?
A) water rushing over Niagara Falls
B) light flashes emitted by a firefly
C) a molecule of glucose
D) a crawling beetle foraging for food
8. When electrons move closer to a more electronegative atom, what happens? The more electronegative atom is _____.
A) reduced, and energy is released
B) reduced, and energy is consumed
C) oxidized, and energy is consumed
D) oxidized, and energy is released
9. In autotrophic bacteria, where is chlorophyll located?
A) in chloroplast membranes
B) in the ribosomes
C) in the nucleoid
D) in the infolded plasma membrane
10. Which of the following statements about quorum sensing is FALSE? Quorum sensing _____.
A) is cell-cell communication in eukaryotes
B) is species specific
C) may result in biofilm formation
D) is particularly well studied because of its medical importance

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共 10 頁，第 3 頁

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11. In eukaryotic cells, chromosomes are composed of _____.
A) DNA and RNA B) DNA only
C) DNA and proteins D) DNA and phospholipids
12. Quaking aspen 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
13. What was the most significant conclusion that Gregor Mendel drew from his experiments with pea plants?
A) There is considerable genetic variation in garden peas.
B) Traits are inherited in discrete units and are not the results of "blending."
C) Recessive genes occur more frequently in the F₁ generation than do dominant ones.
D) Genes are composed of DNA.
14. Males are more often affected by sex-linked traits than females because _____.
A) male hormones such as testosterone often alter the effects of mutations on the X chromosome
B) female hormones such as estrogen often compensate for the effects of mutations on the X chromosome
C) X chromosomes in males generally have more mutations than X chromosomes in females
D) males are hemizygous for the X chromosome
15. In trying to determine whether DNA or protein is the genetic material, Hershey and Chase made use of which of the following facts?
A) DNA contains sulfur, whereas protein does not.
B) DNA contains phosphorus, whereas protein does not.
C) DNA contains nitrogen, whereas protein does not.
D) DNA contains purines, whereas protein includes pyrimidines.

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共 10 頁，第 4 頁 *請在【答案卡】作答

16. Which of the following is directly related to a single amino acid?
- A) the base sequence of the tRNA
 - B) the amino acetyl tRNA synthase
 - C) the three-base sequence of mRNA
 - D) the complementarity of DNA and RNA
17. Which of the following, when taken up by a cell, binds to a repressor so that the repressor no longer binds to the operator?
- A) inducer B) promoter
 - C) repressor D) corepressor
18. In many ways, the regulation of the genes of a particular group of viruses will be similar to the regulation of the host genes. Therefore, which of the following would you expect of the genes of a bacteriophage?
- A) regulation via acetylation of histones
 - B) positive control mechanisms rather than negative
 - C) control of more than one gene in an operon
 - D) reliance on transcription activators
19. To introduce a particular piece of DNA into an animal cell, such as that of a mouse, you would most likely be successful with which of the following methods?
- A) electroporation followed by recombination
 - B) introducing a plasmid into the cell
 - C) infecting the mouse cell with a Ti plasmid
 - D) transcription and translation
20. Bioinformatics can be used to scan for short sequences that specify known mRNAs, called ____.
- A) expressed sequence tags
 - B) multigene families
 - C) proteomes
 - D) short tandem repeats

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共 10 頁，第 5 頁 *請在【答案卡】作答

21. During a study session about evolution, one of your fellow students remarks, "The giraffe stretched its neck while reaching for higher leaves; its offspring inherited longer necks as a result." Which statement is most likely to be helpful in correcting this student's misconception?
- A) Characteristics acquired during an organism's life are generally not passed on through genes.
 - B) Spontaneous mutations can result in the appearance of new traits.
 - C) Only favorable adaptations have survival value.
 - D) Disuse of an organ may lead to its eventual disappearance.
22. Genetic variation ____.
- A) is created by the direct action of natural selection
 - B) arises in response to changes in the environment
 - C) must be present in a population before natural selection can act upon the population
 - D) tends to be reduced by when diploid organisms produce gametes
23. Which of the various species concepts distinguishes two species based on the degree of genetic exchange between their gene pools?
- A) phylogenetic B) ecological C) biological D) morphological
24. What is true of the fossil record of mammalian origins?
- A) It shows that mammals and birds evolved from the same kind of dinosaur.
 - B) It includes transitional forms with progressively specialized teeth.
 - C) It indicates that mammals and dinosaurs did not overlap in geologic time.
 - D) It includes a series that shows the gradual change of scales into fur.
25. The various taxonomic levels (for example, phyla, genera, classes) of the hierarchical classification system differ from each other on the basis of ____.
- A) how widely the organisms assigned to each are distributed throughout the environment
 - B) their inclusiveness
 - C) the relative genome sizes of the organisms assigned to each
 - D) morphological characters that are applicable to all organisms

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共 10 頁，第 6 頁 *請在【答案卡】作答

26. If the experimental population of *E. coli* lacks an F factor or F plasmid, and if bacteriophages are excluded from the bacterial cultures, then beneficial mutations might be transmitted horizontally to other *E. coli* cells via _____.
A) sex pili
B) transduction
C) conjugation
D) transformation
27. According to the endosymbiotic theory, why was it adaptive for the larger (host) cell to keep the engulfed cell alive, rather than digesting it as food?
A) The engulfed cell provided the host cell with adenosine triphosphate (ATP).
B) The engulfed cell provided the host cell with carbon dioxide.
C) The engulfed cell allowed the host cell to metabolize glucose.
D) The host cell was able to survive anaerobic conditions with the engulfed cell alive.
28. According to the fossil record, plants colonized terrestrial habitats _____.
A) in conjunction with insects that pollinated them
B) in conjunction with fungi that helped provide them with nutrients from the soil
C) to escape abundant herbivores in the oceans
D) only about 150 million years ago
29. Which of these is a major trend in land plant evolution?
A) the trend toward smaller size
B) the trend toward a gametophyte-dominated life cycle
C) the trend toward a sporophyte-dominated life cycle
D) the trend toward larger gametophytes
30. Some fungal species can kill herbivores while feeding off of sugars from its plant host. What type of relationship does this fungus have with its host?
A) parasitic B) mutualistic
C) commensal D) predatory

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共 10 頁，第 7 頁 *請在【答案卡】作答

31. 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) β -catenin genes
 - D) genes involved in eye-lens synthesis
32. One should expect to find cilia associated with the feeding apparatus of ____.
- A) annelids
 - B) coral animals
 - C) tapeworms
 - D) sponges
33. 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
34. Which part of a plant absorbs most of the water and minerals taken up from the soil?
- A) root cap B) root hairs
 - C) the thick parts of the roots near the base of the stem
 - D) storage roots
35. Given that early land plants most likely share a common ancestor with green algae, the earliest land plants were most likely ____.
- A) nonvascular plants that grew leafless, photosynthetic shoots
 - B) species that did not exhibit alternation of generations
 - C) vascular plants with well-defined root systems
 - D) plants with well-developed leaves

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共 10 頁，第 8 頁 *請在【答案卡】作答

36. What soil composition would be best for availability of nutrients, water, and root development?
- A) equal amounts of sand, clay, and humus
 - B) higher proportion of humus, lower amounts of clay and sand
 - C) higher proportion of clay, lower amounts of humus and sand
 - D) higher proportion of sand, lower amount of humus and clay
37. During the alternation of generations in plants, ____.
- A) meiosis produces gametes
 - B) mitosis produces gametes
 - C) fertilization produces spores
 - D) fertilization produces gametes
38. The detector of light during de-etiolation (greening) of a tomato plant is (are) ____.
- A) carotenoids
 - B) xanthophylls
 - C) phytochrome
 - D) auxin
39. 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
40. What is the importance of consuming an adequate amount of proteins in the diet?
- A) They are most commonly used to meet energy demands of cells.
 - B) Proteins serve a variety of functions, and the body does not store excess quantities of protein.
 - C) They are used as cofactors for metabolic reactions and are required in minute quantities.
 - D) Proteins are necessary to produce urea and other important metabolites.

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共 10 頁，第 9 頁 *請在【答案卡】作答

41. The circulatory systems of bony fishes, rays, and sharks are most similar to _____.
A) those of birds, with a four-chambered heart
B) the portal systems of mammals, where two capillary beds occur sequentially, without passage of blood through a pumping chamber
C) those of sponges, where gas exchange in all cells occurs directly with the external environment
D) those of humans, where there are four pumping chambers to drive blood flow
42. The cells and signaling molecules involved in the initial stages of the inflammatory response are _____.
A) phagocytes and chemokines B) dendritic cells and interferons
C) mast cells and histamines D) lymphocytes and interferons
43. Sharks live in seawater. Their tissues are isotonic to seawater, but their concentrations of sodium ions, potassium ions, and chloride ions in cells and extracellular fluids are similar to those of freshwater fishes. How is that possible?
A) Urea and trimethylamine oxide contribute to intra- and extracellular osmolarity in shark tissues.
B) Metabolic intermediates of sharks tie up intracellular chloride and potassium ions.
C) Their blood is hypotonic to their tissues.
D) They excrete large quantities of electrolytes.
44. You are dissecting a fish in your biology laboratory section. Your teaching assistant points out a long oval structure and tells you it is an endocrine gland. Which of the following would you then know is a true statement about this structure?
A) It secretes a product that is released through a series of ducts.
B) The gland's product will only interact with receptors on the cell membrane.
C) The gland's product is lipid soluble.
D) The gland produces and secretes its product into the blood.

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45. What makes sexually reproduced offspring genetically different from their parents?
- A) genetic recombination during meiosis
 - B) genetic recombination during mitosis
 - C) crossing over during mitosis
 - D) Sexual reproduction does not produce genetically different offspring.
46. 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
47. Most of the neurons in the human brain are ____.
- A) sensory neurons B) motor neurons
 - C) interneurons D) peripheral neurons
48. In the human knee-jerk reflex of a seated individual, as the calf is raised from a vertical position to a horizontal position, the muscles of the quadriceps (on the front of the thighs) and the muscles of the hamstring (on the back side of the thighs) are ____.
- A) both excited and contracting
 - B) both inhibited and relaxed
 - C) excited and inhibited, respectively
 - D) inhibited and excited, respectively
49. Artificial electrical stimulation of a human's capsaicin-sensitive neurons would likely produce the sensation of ____.
- A) cold temperature B) hot temperature C) tactile stimulus D) deep pressure
50. What type of signal is brief and can work among obstructions at night?
- A) olfactory B) visual C) auditory D) magnetic