高雄醫學大學 114 學年度學生轉系考試【普通生物學】試題

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二、考生應在答案卡上規定範圍內作答，且不得書寫任何與答案無關之文字、符號，違者該科不予計分。

三、答案卡每人各一張，不得要求增補；試題與答案卡必須繳回，不得攜出試場。

選擇題 50 題 (每題 2 分，共 100 分)

1. Which of the following describes the difference between two isotopes of the same element?
   (A) They have a different atomic number.
   (B) They have one more proton.
   (C) They have one more electron.
   (D) They have a different number of neutrons.

2. The property of water that allows hydrogen bonds to form between water molecules is primarily due to:
   (A) water's overall nonpolar nature.
   (B) the equal sharing of electrons between oxygen and hydrogen.
   (C) the polar covalent bonds between oxygen and hydrogen atoms.
   (D) water being a good solvent for hydrophobic substances.

3. If the pH of a solution decreases from 7 to 4, it means the concentration of hydrogen ions (H^+) has:
   (A) decreased by a factor of 3.
   (B) decreased by a factor of 1000.
   (C) increased by a factor of 3.
   (D) increased by a factor of 1000.

4. Which of the following is defined as the study of carbon compounds?
   (A) Biochemistry
   (B) Organic chemistry
   (C) Physical chemistry
   (D) Inorganic chemistry

5. A single polypeptide chain can have all of the following levels of structure EXCEPT:
   (A) Primary structure (B) Secondary structure (C) Tertiary structure (D) Quaternary structure

6. Which of the following is present in a prokaryotic cell?
   (A) Mitochondrion (B) Ribosome (C) Nuclear envelope (D) Chloroplast

7. For a resting neuron, which of the following is true regarding ion distribution and membrane potential?
   (A) The concentration of Na^+ is higher inside the cell, and the membrane potential is positive.
   (B) The concentration of K^+ is higher outside the cell, and the membrane potential is positive.
   (C) The concentration of Na^+ is higher outside the cell, and the inside is negatively charged relative to the outside.
   (D) The concentration of K^+ is higher outside the cell, and the inside is positively charged relative to the outside.

8. Which of the following classes of large biological molecules does NOT consist of polymers?
   (A) Carbohydrates (B) Proteins (C) Lipids (D) Nucleic acids

9. Which of the following processes involves the net movement of water across a selectively permeable membrane?
   (A) Active transport (B) Facilitated diffusion (C) Osmosis (D) Cotransport

10. To study the process of protein translation from mRNA, which cellular component would be most enriched in the final pellet after cell fractionation?
    (A) Nuclei (B) Mitochondria
    (C) Pieces of plasma membranes (D) Ribosomes

11. Consider a metabolic pathway where compound X is converted to Y, and Y is converted to Z. If the enzyme converting X to Y is inhibited by the accumulation of Z, this is an example of:
    (A) Allosteric activation. (B) Competitive inhibition.
    (C) Noncompetitive inhibition. (D) Feedback inhibition.

12. An enzyme is added to a solution where its substrate and product are in equilibrium. What will occur?
    (A) Additional substrate will be formed.
    (B) The reaction will change from endergonic to exergonic.
    (C) The free energy of the system will change.
    (D) Nothing; the reaction will stay at equilibrium.

13. What percentage of the human genome codes for proteins or gives rise to rRNAs or tRNAs?
    (A) 1.5% (B) 5% (C) 20% (D) 75%

14. The immediate energy source that directly drives ATP synthesis by ATP synthase during oxidative phosphorylation is the:
    (A) oxidation of glucose and other organic compounds.
    (B) flow of electrons down the electron transport chain.
    (C) H+ concentration gradient across the membrane holding ATP synthase.
    (D) transfer of phosphate to ADP.

15. How do transposons and retrotransposons differ in their movement mechanisms within the genome?
    (A) Transposons move via an RNA intermediate, while retrotransposons move via a DNA intermediate.
    (B) Transposons are less prevalent and move via an RNA intermediate, while retrotransposons are more prevalent and move via a DNA intermediate.
    (C) Transposons move via a DNA intermediate, while retrotransposons are more prevalent and move via an RNA intermediate.
    (D) Both transposons and retrotransposons move via a DNA intermediate, but only retrotransposons create new copies.

16. Which mechanism of evolution consistently causes adaptive evolution?
    (A) Genetic drift (B) Gene flow (C) Natural selection (D) Mutation

17. Which of the following is the primary role of the Calvin cycle in photosynthesis?
    (A) To produce ATP and NADPH.
    (B) To capture light energy.
    (C) To split water and release oxygen.
    (D) To use chemical energy (ATP and NADPH) to reduce CO_2 to sugar.

18. A water-soluble hormone typically acts on a target cell by:
    (A) binding to a receptor inside the cell to alter gene expression.
    (B) binding to a cell-surface receptor to trigger an intracellular signal transduction pathway.
    (C) diffusing across the plasma membrane to directly activate enzymes.
    (D) being converted into a lipid-soluble form before entering the cell.

19. Different species of fruit flies that live in the same parts of the Hawaiian Islands have distinct, elaborate courtship rituals. What type of reproductive isolation does this represent?
(A) Habitat isolation (B) Temporal isolation (C) Behavioral isolation (D) Gametic isolation

20. Genes A, B, and C are located on the same chromosome. Testcrosses show that the recombination frequency between A and B is 28% and that between A and C is 12%. Which of the following statements about the order of these genes on the chromosome is most likely correct?
(A) The order is A-B-C. (B) The order is A-C-B.
(C) The order is B-A-C. (D) The order cannot be determined from this data alone.

21. If a diploid cell in the G1 phase of the cell cycle has a DNA content of 'x', what would be the DNA content of the same cell at metaphase of meiosis I?
(A) 0.25x (B) 0.5x (C) x (D) 2x

22. The relatively short interval of time (535–525 million years ago) during which large forms of many present-day animal phyla first appear in the fossil record is known as what?
(A) The Permian extinction (B) The Cambrian explosion
(C) The Mesozoic era (D) The colonization of land

23. How might an error during meiosis lead to polyploidy in plants?
(A) Failure of homologous chromosomes to separate during meiosis I, leading to diploid gametes.
(B) Random assortment of chromosomes during metaphase I, resulting in gametes with extra chromosomes.
(C) Crossing over between non-sister chromatids, creating recombinant chromosomes.
(D) Nondisjunction in mitosis during gamete formation in the diploid organism.

24. A population has an allele 'a' with a frequency of 0.45. If the population is in Hardy-Weinberg equilibrium, what is the expected frequency of the homozygous dominant genotype (AA)?
(A) 0.2025 (B) 0.3025 (C) 0.4950 (D) 0.5500

25. According to the principle of maximum parsimony, when considering multiple phylogenetic hypotheses, which explanation should systematists investigate first?
(A) The most complex explanation consistent with all known facts.
(B) The explanation that incorporates the most recently discovered genetic mutations.
(C) The simplest explanation that is consistent with the facts.
(D) The explanation that best aligns with previously established taxonomic classifications.

26. Two organisms, with genotypes BbDD and BBDd, are mated. Assuming independent assortment of the B/b and D/d genes, what is the probability of obtaining an offspring with the genotype BbDd?
(A) 1/16 (B) 1/8 (C) 1/4 (D) 1/2

27. Which of the following characteristics, structures, or processes is common to both bacteria and viruses?
(A) Metabolism (B) Ribosomes
(C) Genetic material composed of nucleic acid (D) Cell division

28. Which type of sensory receptor detects physical deformation in the body's environment associated with pressure, touch, stretch, motion, or sound?
(A) Chemoreceptor (B) Electromagnetic receptor
(C) Nociceptor (D) Mechanoreceptor

29. Which of the following describes the ploidy and state of a fungal cell in the heterokaryotic stage?
    (A) Haploid (n), with a single nucleus.
    (B) Diploid (2n), formed after karyogamy.
    (C) Dikaryotic (n + n), containing haploid nuclei from two parents.
    (D) Polyploid, with multiple sets of chromosomes from a single parent.

30. Imagine you want to study a human crystallin protein. To obtain a sufficient amount of this protein, you decide to clone its gene. Assuming you know the gene sequence, which approach would allow you to produce the protein in a suitable system like bacteria?
    (A) Isolate lens cells, extract genomic DNA, and insert the entire gene directly into a bacterial expression vector.
    (B) Isolate lens cells, extract mRNA, use reverse transcriptase to make cDNA, and insert the cDNA into a bacterial expression vector.
    (C) Directly synthesize the protein from its known amino acid sequence using a chemical synthesizer.
    (D) Use PCR to amplify the gene from a brain cell and insert it into a eukaryotic yeast expression vector.

31. Which statement accurately distinguishes Ulva from Caulerpa regarding their multicellular organization?
    (A) Ulva is a colonial protist, while Caulerpa is a true multicellular alga with specialized tissues.
    (B) Ulva forms true multicellular bodies through cell division and differentiation, whereas Caulerpa achieves large size via repeated nuclear division without cytoplasmic division, making it not truly multicellular.
    (C) Caulerpa exhibits alternation of generations, while Ulva only has a single-celled haploid stage.
    (D) Both are truly multicellular, but Ulva has a simpler organizational plan compared to Caulerpa's complex thallus.

32. All chordates, at some point during their life cycle, are characterized by which of the following derived traits?
    (A) Notochord, dorsal hollow nerve cord, pharyngeal slits or clefts, and muscular post-anal tail.
    (B) Jaws, mineralized skeleton, lungs, and four limbs.
    (C) Vertebrae, cranium, a two-chambered heart, and paired fins.
    (D) Hair, mammary glands, endothermy, and a highly developed brain.

33. Put the following milestones in animal evolution in order from oldest to most recent: (a) origin of mammals, (b) earliest evidence of terrestrial arthropods, (c) Ediacaran fauna, (d) extinction of large, nonflying dinosaurs.
    (A) c, b, a, d (B) a, b, c, d (C) d, c, b, a (D) c, a, b, d

34. The ability of the mammalian kidney to produce urine that is much more concentrated than blood is primarily due to:
    (A) The active transport of water in the collecting duct.
    (B) The presence of a short loop of Henle in cortical nephrons.
    (C) The establishment and maintenance of a steep osmolarity gradient in the renal medulla by the loops of Henle of juxtamedullary nephrons.
    (D) The selective reabsorption of all solutes, including urea, in the proximal tubule.

35. What are the four main stages of food processing in animals, in order?
    (A) Digestion, ingestion, absorption, elimination
    (B) Ingestion, digestion, absorption, elimination
    (C) Ingestion, absorption, digestion, elimination
    (D) Digestion, absorption, ingestion, elimination

36. Given that sponges lack true tissues and organs, how do they accomplish vital functions such as gas exchange, nutrient transport, and waste disposal?
    (A) They possess a gastrovascular cavity that handles all internal transport.
    (B) Through specialized, but rudimentary, circulatory and excretory systems.
    (C) By simple diffusion across the surfaces of their cells, which are in direct contact with the water environment.
    (D) They rely on symbiotic bacteria to perform these functions for them.

37. In a closed circulatory system, where does chemical exchange occur between the blood and interstitial fluid?
    (A) Arteries (B) Veins (C) Capillaries (D) Ventricles

38. If a plant detects increased levels of light reflected from the leaves of encroaching neighbors, it typically responds with stem elongation, production of erect leaves, and reduced lateral branching. How do these responses help the plant compete?
    (A) They allow the plant to store more water in its stems.
    (B) They enhance the plant's ability to produce defensive chemicals.
    (C) They enable the plant to grow taller and capture more light, reducing shading from competitors.
    (D) They promote earlier flowering and seed production.

39. Which type of immunity is active immediately upon exposure to a pathogen and is the same whether or not the pathogen has been encountered previously?
    (A) Adaptive immunity (B) Acquired immunity
    (C) Innate immunity (D) Humoral immunity

40. If a complete ring of bark is removed from around a tree trunk (a technique called girdling), the tree will die, but typically slowly (in weeks) rather than quickly (in days). Which of the following best explains this observed timeframe?
    (A) Girdling only disrupts the xylem, and the tree's roots can store enough water to survive for a few days.
    (B) Girdling severs the phloem, cutting off sugar transport to the roots, which leads to root starvation and eventual death, a process that takes weeks.
    (C) Girdling directly kills all the living cells in the trunk, but the leaves can continue photosynthesis until stored carbohydrates are depleted.
    (D) The tree can regenerate the phloem within days, thus preventing rapid death, but the energy cost is high.

41. Which type of plant supplements its mineral nutrition by digesting animals?
    (A) Epiphytes (B) Parasitic plants
    (C) Carnivorous plants (D) Nitrogen-fixing plants

42. In mammalian circulation, oxygen-rich blood returns from the lungs to the heart via the:
    (A) Pulmonary arteries (B) Aorta (C) Venae cavae (D) Pulmonary veins

43. A plant has a double mutation: ctr (constitutive triple response, meaning it always shows the triple response regardless of ethylene) and ein (ethylene insensitive, meaning it cannot respond to ethylene). What would be its triple-response phenotype?
    (A) It would display a normal triple response, as the mutations compensate for each other.
    (B) It would not display the triple response, as the ein mutation makes it insensitive to ethylene.
    (C) It would constitutively display the triple response, because the ctr mutation is dominant.
    (D) Its phenotype would be intermediate between a wild-type plant and a ctr mutant.

44. If a human female begins taking estradiol and progesterone immediately after the start of a new menstrual cycle, how will ovulation be affected?
    (A) Ovulation will be stimulated early in the cycle.
    (B) Ovulation will be delayed or inhibited.
    (C) Ovulation will occur normally, but fertilization will be prevented.
    (D) Ovulation will become irregular, but not necessarily inhibited.

45. Which of the following is a direct consequence of biological magnification?
    (A) Ecosystems with higher primary productivity support larger populations of herbivores.
    (B) Toxic chemicals, such as PCBs, become more concentrated in organisms at higher trophic levels.
    (C) The total biomass decreases as you move up trophic levels in an ecosystem.
    (D) Species with narrow habitat requirements are more vulnerable to extinction.

46. Ruminant animals, such as cows, have specialized digestive systems that allow them to obtain significant nutrients from cellulose-rich plant material. Which of the following best describes the key adaptation responsible for this ability?
    (A) They have an extended small intestine for increased absorption surface area.
    (B) Their stomach has four chambers, with mutualistic microorganisms digesting cellulose in the rumen and reticulum.
    (C) They produce unique enzymes in their abomasum that directly break down cellulose.
    (D) They re-ingest their feces to re-process undigested plant matter, similar to coprophagous animals.

47. Which of the following is a less toxic nitrogenous waste product that mammals and most adult amphibians convert ammonia into, requiring a moderate amount of water for excretion?
    (A) Ammonia (B) Urea (C) Uric acid (D) Creatinine

48. During the rising phase of an action potential, what is the primary event that causes the rapid depolarization of the neuron's membrane?
    (A) Outflow of potassium ions (K^+)
    (B) Inflow of chloride ions (Cl^-)
    (C) Rapid opening of voltage-gated sodium channels (Na^+) allowing Na^+ to diffuse into the cell
    (D) Active transport of sodium and potassium ions by the Na^+/K^+ pump

49. The production of offspring without the fusion of gametes is known as:
    (A) Sexual reproduction (B) Parthenogenesis
    (C) Hermaphroditism (D) Asexual reproduction

50. What is the process by which an encounter with an antigen selects which lymphocyte will divide to produce a clonal population of thousands of cells specific for a particular epitope?
    (A) Immunological memory (B) Antigen presentation
    (C) Clonal selection (D) Self-tolerance