

**Multiple Choice**

Identify the letter of the choice that best completes the statement or answers the question and place your selection ON THE ANSWER SHEET.

- Carbon-14 is often used for carbon dating, where scientists measure the rate of carbon-14 decay to determine the age of items. It contains six protons and eight neutrons. During the process of carbon-14 decay, one of its eight neutrons becomes a proton and an electron is emitted. Which of the following is the BEST explanation of what has occurred?
  - An ionic bond has formed.
  - The resulting atom is still carbon-14
  - The resulting atom still has an unstable nucleus
  - The resulting atom is now a different element because the number of protons has changed.
- The numbers listed represent the first, second, and third energy levels, respectively. On the basis, which of the following is an unstable or reactive atom?
  - 2
  - 2,8,8
  - 2,8
  - 2,8,1
- A pharmaceutical company hires a chemist to analyze the purity of the water being used in its drug preparations. If the water is pure, the chemist would expect to find
  - only  $H^+$  ions and  $OH^-$  ions
  - $H_2O$  molecules and  $H^+$  ions.
  - $H_2O$  molecules and  $OH^-$  ions.
  - Only molecules of  $H_2O$ .
  - $H_2O$  molecules,  $H^+$  ions, and  $OH^-$  ions.
- Which of the following best describes the relationship between the atoms described below?
 

Atom 1	Atom 2
${}^1_1H$	${}^3_1H$

  - They are polymers
  - They are isotopes
  - They each contain 1 neutron
  - They contain 1 and 3 protons, respectively
  - They are isomers
- What do the four elements most abundant in life? carbon, oxygen, hydrogen, and nitrogen? have in common?
  - They are elements produced only by living cells.
  - Each element exists in only one isotopic form
  - They are equal in electronegativity
  - They all have the same number of valence electrons
  - They all have unpaired electrons in their valence shells
- Which is the best description of a carbonyl group?
  - a carbon joined to two hydrogens by single covalent bonds
  - an oxygen joined to a carbon by a single covalent bond
  - a nitrogen and two hydrogens joined to a carbon by covalent bonds
  - a sulfur and a hydrogen joined to a carbon by covalent bonds
  - a carbon atom joined to an oxygen by a double covalent bond

7. A chemist wishes to make an organic molecule less acidic. Which of the following functional groups should be added to the molecule in order to do so?
- A) phosphate
  - B) carboxyl
  - C) hydroxyl
  - D) sulfahydryl
  - E) amino
8. Select which reactions will usually be irreversible regarding chemical equilibrium in living systems.
- A) complete glucose decomposition
  - B)  $\text{H}_2\text{O} + \text{CO}_2$  to make  $\text{H}_2\text{CO}_3$
  - C)  $\text{ADP} + \text{Pi}$  to make  $\text{ATP}$
  - D) glucose molecules joined to make glycogen
9. The R group or side chain of the amino acid serine is  $\text{CH}_2\text{-OH}$ . The R group or side chain of the amino acid alanine is  $-\text{CH}_3$ . Where would you expect to find these amino acids in a globular protein in aqueous solution?
- A) Both serine and alanine would be in the interior of the globular protein
  - B) Serine would be in the interior, and alanine would be on the exterior of the globular protein
  - C) Alanine would be in the interior, and serine would be on the exterior of the globular protein
  - D) Both serine and alanine would be in the interior and on the exterior of the globular protein
  - E) Both serine and alanine would be on the exterior of the globular protein
10. Which type of interaction stabilizes the alpha ( $\alpha$ ) helix and the beta ( $\beta$ ) pleated sheet structures of proteins?
- A) hydrophobic interactions
  - B) nonpolar covalent bonds
  - C) ionic bonds
  - D) peptide bonds
  - E) hydrogen bonds
11. In the fractionation of homogenized cells using centrifugation, the primary factor that determines whether a specific cellular component ends up in the supernatant or the pellet is
- A) the percentage of carbohydrates in the component
  - B) the relative solubility of the component
  - C) the presence or absence of lipids in the component
  - D) the size and weight of the component
  - E) the number of enzymes in the fraction
12. Which of the following is mismatched?
- A) mesoderm-notochord
  - B) endoderm-lungs
  - C) ectoderm-liver
  - D) mesoderm-somites
  - E) ectoderm-eye

13. All of the following structures and proteins are directly associated with movement in cells or by cells *except*
- A) dynein
  - B) actin
  - C) cilia
  - D) centrosomes
  - E) flagella
14. Plasmodesmata in plant cells are *most* similar in function to which of the following structures in animal cells?
- A) tight junctions
  - B) desmosomes
  - C) gap junctions
  - D) peroxisomes
  - E) extracellular matrix
15. Which of the following *correctly* lists the order in which cellular components will be found in the pellet when homogenized cells are treated with increasingly rapid spins in a centrifuge?
- A) vacuoles, ribosomes, nucleus
  - B) ribosomes, nucleus, mitochondria
  - C) nucleus, ribosomes, chloroplasts
  - D) chloroplasts, ribosomes, vacuoles
  - E) nucleus, mitochondria, ribosomes
16. Cells can increase the number or size of some organelles in response to new demands. The amount of one organelle often is increased dramatically in the livers of alcoholics. Based on what you know of organelle function, this organelle is the
- A) ribosome
  - B) golgi apparatus
  - C) mitochondria
  - D) smooth endoplasmic reticulum
  - E) nucleus
17. A person with cystic fibrosis has
- A) an abnormal chloride channel protein
  - B) cysts in the lungs
  - C) an abnormal sodium channel protein
  - D) no sodium channel protein
  - E) no chloride channel protein
18. Which type of proteins are involved in nutrient transport and why?
- A) integral proteins because they span the membrane, thereby being able to carry nutrients across the membrane
  - B) integral proteins because they are smaller and can travel across the membrane, thereby carrying nutrients across the membrane
  - C) peripheral proteins because they are smaller and can travel across the membrane, thereby carrying nutrients across the membrane
  - D) peripheral proteins because they span the membrane, thereby being able to carry nutrients across the membrane
  - E) both integral and peripheral proteins because they can both span the membrane, thereby being able to carry nutrients across the membrane

19. An animal cell lacking oligosaccharides on the external surface of its plasma membrane would likely be impaired in which function?
- A) cell-cell recognition
  - B) establishing the diffusion barrier to charged molecules
  - C) attaching to the cytoskeleton
  - D) transporting ions against an electrochemical gradient
  - E) maintaining fluidity of the phospholipid bilayer
20. A child is hospitalized for a series of chronic bacterial infections and dies despite heroic efforts. At autopsy, the physicians are startled to see that the child's white blood cells are loaded with vacuoles containing intact bacteria. Which of the following explanations could account for this finding? A defect in the
- A) rough endoplasmic reticulum prevented the synthesis of the antibodies (defensive proteins) that would have inactivated the bacteria
  - B) Golgi apparatus prevented the cells from processing and excreting the bacteria
  - C) lysosomes of the white blood cells prevented the cells from destroying engulfed bacteria
  - D) cell walls of the white blood cells permitted bacteria to enter the cells
  - E) surface receptors of the white blood cells permitted bacteria to enter the cells
21. What is the cause of familial hypercholesterolemia?
- A) poor attachment of the cholesterol to the extracellular matrix of cells
  - B) inhibition of the cholesterol active transport system in red blood cells
  - C) defective LDL receptors on the cell membranes
  - D) a general lack of glycolipids in the blood cell membranes
  - E) a poorly formed lipid bilayer that cannot incorporate cholesterol into cell membranes
22. The addition of the competitive inhibitor slows down a particular reaction. How could you overcome the effects of the inhibitor and increase the rate of the reaction?
- A) lower the temperature of the reaction
  - B) add more substrate
  - C) allow the reaction to reach equilibrium
  - D) add a coenzyme
  - E) add more inhibitor
23. Many different things can alter enzyme activity. Which of the following underlie all types of enzyme regulation?
- A) changes in the activation energy of the reaction
  - B) changes in the active site of the enzyme
  - C) changes in the free energy of the reaction
  - D) A and B only
  - E) A, B, and C
24. Consider the following: Succinate dehydrogenase catalyzes the conversion of succinate to fumarate. The reaction is inhibited by malonic acid, which resembles succinate but cannot be acted upon by succinate dehydrogenase. Increasing the ratio of succinate to malonic acid reduces the inhibitory effect of malonic acid. Which of the following is correct?
- A) Malonic acid is the product, and fumarate is a competitive inhibitor
  - B) Succinate dehydrogenase is the enzyme, and malonic acid is the substrate
  - C) Succinate is the substrate, and fumarate is the product
  - D) Fumarate is the product, and malonic acid is a noncompetitive inhibitor
  - E) Succinate dehydrogenase is the enzyme, and fumarate is the substrate

25. Which of the following is/are true of oxidation and reduction?
- A) A molecule which has gained an electron has been reduced
  - B) If one molecule is oxidized, another must be reduced
  - C) Oxygen is required for all oxidation reactions
  - D) Both A and B are true
  - E) A, B, and C are true
26. What molecule is common to both C<sub>3</sub> photosynthesis and the process of glycolysis?
- A) fructose
  - B) NADPH
  - C) G3P
  - D) Pyruvate
  - E) Acetyl CoA
27. Where does fermentation occur within a cell undergoing anaerobic metabolism of glucose?
- A) mitochondrial matrix
  - B) fluid portion of the cytoplasm
  - C) stroma of chloroplast
  - D) surface of cell membrane
  - E) nucleus
28. How do fatigued human muscle cells repay an "oxygen debt"?
- A) The cells decrease CO<sub>2</sub> production
  - B) Cells produce more oxygen
  - C) Lactic acid is converted back into pyruvic acid by the cells
  - D) The cells convert glucose into pyruvic acid
  - E) The tired cells increase production of ATP
29. Cellular respiration harvests the most chemical energy from which of the following?
- A) generating carbon dioxide and oxygen in the electron transport chain
  - B) chemiosmotic phosphorylation
  - C) converting oxygen to ATP
  - D) transferring electrons from organic molecules to pyruvate
  - E) substrate-level phosphorylation
30. The direct energy source that drives ATP synthesis during respiratory oxidative phosphorylation is
- A) the thermodynamically favorable transfer of phosphate from glycolysis and the citric acid cycle intermediate molecules of ADP.
  - B) the final transfer of electrons to oxygen.
  - C) the difference in H<sup>+</sup> concentrations on opposite sides of the inner mitochondrial membrane.
  - D) the thermodynamically favorable flow of electrons from NADH to the mitochondrial electron transport carriers.
  - E) oxidation of glucose to CO<sub>2</sub> and water.
31. If the S phase was eliminated from the cell cycle, the daughter cells would
- A) be genetically identical to the parental cell
  - B) be genetically identical
  - C) have half the genetic material found in the parental cell
  - D) synthesize the missing genetic material on their own
  - E) None of the choices are correct

32. As a patch of scraped skin heals, the cells fill in the injured area but do not grow beyond that. This is an example of
- A) growth factor inhibition
  - B) anchorage-dependent inhibition
  - C) density-independent inhibition
  - D) density-dependent inhibition
  - E) anchorage independence
33. Suppose a slide containing 100 cells is made from a random sample of cells growing in a petri plate. The average time for a complete cell cycle to occur in the petri plate is 24 hours. Ten cells on the slide are in prophase, three are in metaphase, six in anaphase, eight in telophase, and 73 are in interphase. How many hours, on average, does a cell in the petri plate spend in interphase?
- A) 24 hours
  - B) 73 hours
  - C) 6.5 hours
  - D) 17.5 hours
  - E) One cannot tell from the information given
34. Movement of the chromosomes during anaphase would be *most* affected by a drug that
- A) increases cyclin concentrations
  - B) prevents attachment of the microtubules to the kinetochore
  - C) reduces cyclin concentrations
  - D) prevents elongation of microtubules
  - E) prevents shortening of microtubules
35. Proteins that are involved in the regulation of the cell cycle, and that show fluctuations in concentration during the cell cycle, are called
- A) kinetochores
  - B) centrioles
  - C) cyclins
  - D) proton pumps
  - E) ATPases
36. In Griffith's experiments, what happened when heat-killed S-strain *pneumococcus* were injected into a mouse along with live R-strain *pneumococcus*?
- A) DNA from the live R-strain was taken up by the heat-killed S-strain, converting them to R-strain and killing the mouse
  - B) RNA from the heat-killed S-strain was translated into proteins that killed the mouse
  - C) Proteins released from the heat-killed S-strain killed the mouse
  - D) DNA from the heat-killed S-strain was taken up by the live R-strain, converting them to S-strain and killing the mouse
  - E) Nothing
37. The DNA of a certain organism has guanine as 30% of its bases. What percentage of its bases would be adenine?
- A) 0%                      B) 30%                      C) 10%                      D) 40%                      E) 20%
38. Which of the following is *least* related to the others on the list?
- A) DNA polymerase
  - B) Okazaki fragments
  - C) telomerase
  - D) semiconservative model
  - E) replication fork

39. If the presynaptic membrane of a motor neuron suddenly became permeable to calcium ion,
- no neurotransmitter would be released
  - the neuron would fatigue
  - the neuron would not be able to stimulate the muscle
  - the motor end plate would be stimulated
  - the motor end plate would be inhibited
40. A lack of intrinsic factor, leading to a deficiency of vitamin B12 and large pale cells called macrocytes, is characteristic of:
- pernicious anemia
  - aplastic anemia
  - polycythemia
  - sickle-cell anemia
  - none of the above
41. Which sequence is correct for the following events?
- fibrinogen --> fibrin
  - clot retraction
  - formation of thromboplastin
  - prothrombin --> thrombin
- 4, 3, 1, 2
  - 3, 2, 1, 4
  - 3, 4, 1, 2
  - 1, 2, 3, 4
  - 4, 1, 2, 3
42. When can erythroblastosis fetalis not possibly happen in the child of an Rh negative mother?
- if the child is Rh+
  - if the child is type O positive
  - if the father is Rh+
  - if the father is Rh-
43. Theoretically, if a muscle were stretched to the point where thick and thin filaments no longer overlapped:
- maximum force production would result since the muscle has a maximum range of travel.
  - no muscle tension could be generated.
  - cross bridge attachment would be optimum because of all the free binding sites on actin.
  - ATP consumption would increase since the sarcomere is "trying" to contract
44. Fenestrated capillaries:
- do not occur in the glomerular capillaries of the kidneys
  - are not common in endocrine organs and in areas where capillary absorption is an important function
  - are not more permeable than continuous capillaries
  - are not found in the brain
45. Place the following in correct sequence from the formation of a drop of urine to its elimination from the body.
- major calyx
  - minor calyx
  - nephron
  - urethra
  - ureter
  - collecting duct
- 2, 1, 3, 6, 5, 4
  - 3, 1, 2, 6, 5, 4
  - 6, 3, 2, 1, 5, 4
  - 3, 6, 2, 1, 5, 4

46. Hydrochloric acid is secreted by which of the secretory cells of the stomach?
- A) parietal cells
  - B) serous cells
  - C) chief cells
  - D) mucous neck cells
47. A fluid secreted into the small intestine during digestion that contains cholesterol, emulsification agents, and phospholipids is;
- A) intestinal juice
  - B) bile
  - C) gastric juice
  - D) pancreatic juice
  - E) amylase
48. With the Bohr effect, more oxygen is released because:
- A) a decrease in pH (acidosis) weakens the hemoglobin-oxygen bond
  - B) an increase in pH (alkalosis) strengthens the hemoglobin-oxygen bond
  - C) a decrease in pH (acidosis) strengthens the hemoglobin-oxygen bond
  - D) an increase in pH (alkalosis) weakens the hemoglobin-oxygen bond
  - E) a change in pH does not affect the strength of the hemoglobin-oxygen bond
49. Carbon dioxide is more soluble in water than oxygen is. To get the same amount of oxygen to dissolve in plasma as carbon dioxide, you would have to;
- A) increase the temperature of the plasma
  - B) decrease the partial pressure of oxygen
  - C) decrease the alveolar ventilation rate
  - D) increase the partial pressure of oxygen
  - E) increase the rate of plasma flow through the lungs
50. During a primary humoral response to antigens all of the following occur *except*;
- A) neutrophils invade the surrounding areas, releasing chemotactic substances
  - B) the first immunoglobulins to appear in circulation are of the IgM type
  - C) B cells may differentiate into plasma cells immediately
  - D) B cells may undergo several rounds of mitosis before producing plasma cells and memory cells
  - E) antibody levels do not peak until 1 to 2 weeks following the initial exposure
51. Complement proteins and antibodies coat a microorganism and roughen its surface, enabling macrophages and neutrophils to phagocytize the organism. This phenomenon is termed;
- A) agglutination
  - B) opsonization
  - C) chemotaxis
  - D) diapedesis
  - E) neutralization
52. Which of the following is the first threat of life from a massive third-degree burn?
- A) infection
  - B) dehydration
  - C) loss of immune function
  - D) unbearable pain
  - E) necrotic tissue



53. A puppy is born with a malformed right leg. A veterinarian studies the animal and determines that all of the correct type of cells are present, but the leg simply took on the wrong shape. This is most likely a result of;
- histogenesis
  - fertilization
  - cell differentiation
  - morphogenesis
  - blastulation
54. Arrange the following stages of fertilization and early development into a proper sequence.
- onset of new DNA synthesis
  - cortical reaction
  - first cell division
  - acrosomal reaction; plasma membrane depolarization
  - fusion of egg and sperm nuclei complete
- III, V, I, IV, II
  - V, I, IV, II, III
  - I, III, II, IV, V
  - V, III, I, II, IV
  - IV, II, V, I, III
55. You observe an embryo with meroblastic cleavage, extraembryonic membranes, and a primitive streak. How would you identify this organism, based on the information given?
- insect
  - fish
  - amphibian
  - bird
  - sea urchin
56. All of the following make it difficult to construct acceptable classification schemes *except*:
- deciding where to impose artificial cutoffs in the midst of a naturally continuous series of organisms
  - convergent evolution
  - differences in rates of evolution for different characters
  - persistence of conservative characters
  - the large number of species that must be accommodated
57. The taxonomy of the fungi is based on;
- life history
  - mode of nutrition
  - sexual reproductive structures
  - complexity of vegetative structures
  - type of cell wall
58. Newly started rice paddies produce poor crops until they have established a flourishing population of cyanobacteria. This is most likely due to:
- the rice needs nitrogen fixed by the cyanobacteria
  - the rice cannot compete with weeds, which are poisoned by toxins produced by the cyanobacteria
  - the cyanobacteria use up surplus nutrients from sewage in the rice paddies
  - the cyanobacteria provide plasmids carrying genes that increase fertility
  - cyanobacteria form a protective coating on the rice plants
59. An advance shown by gymnosperms that was not found in previous groups of plants was;
- growth exceeding a few meters high due to the evolution of vascular tissue
  - dominance of the sporophyte over the gametophyte generation
  - protection of the gametophyte within the sporophyte body
  - presence of large leaves
  - production of reproductive structures at tips of the plant

60. One method that the bryophytes have adapted to life on land is by;
- reproducing vegetatively
  - using alternation of generations
  - having dependent sporophytes
  - holding water near their bodies
  - producing seeds
61. The Chlorophyta are believed to share a common ancestor with plants because;
- they are the only multicellular algal protists
  - they do not have flagellated gametes
  - they are the only protists whose plastids evolved from cyanobacteria
  - their chloroplasts are similar in ultrastructure and pigment composition to those of plants
  - they are the only algae that exhibit alternation of generations
62. Which of the following chordate characteristic contributes least to its efficiency of locomotion?
- myotomes
  - pharyngeal gill slits
  - notochord
  - post-anal tail
  - streamlined body shape
63. The evolutionary importance of a coelom is that it:
- permitted animals to have a circulatory system and other internal organs that move
  - permitted animals to move onto land with an internal storage place for extra body fluid
  - provided the possibility of evolving a hard, protective exoskeleton
  - allowed organisms to have excretory systems
  - paved the way for evolution of locomotory appendages
64. Which of the following combinations of phylum and characteristics is *incorrect*?
- Nemertea – proboscis worm, complete digestion
  - Rotifera – parthenogenesis, crown of cilia, microscopic animals
  - Nematoda – gastrovascular cavity, tough cuticle, bilateral symmetry
  - Annelida – segmentation, closed circulatory system, hydrostatic skeleton
  - Echinodermata – radial symmetry, endoskeleton, water vascular system
65. In accordance with the model of mosaic evolution,
- biogeography explains the adaptive radiation of many groups
  - erect posture preceded the enlargement of the brain in human evolution
  - modern humans evolved in parallel in different parts of the world, laying the groundwork for geographic differences more than a million years ago
  - modern humans first evolved in Africa and later dispersed to other regions
  - the rapid expansion of *H. sapiens* may be tied to the evolution of human cognition, including symbolic thought, language, and complex tool making
66. Which of the following is not in the same lineage as the others?
- lizards
  - birds
  - dinosaurs
  - crocodilians
  - pterosaurs
67. Which of the following is incorrectly paired with its function?
- ray initials – form radial xylem and phloem rays
  - lenticels – gas exchange in woody stems
  - root hairs – absorption of water and dissolved minerals
  - root cap – protects root as it pushes through soil
  - procambium – meristematic tissue that forms protective layer of cork

68. Compared with a eutrophic lake; an oligotrophic lake contains a greater concentration of;
- A) organic matter
  - B) plants
  - C) bacteria
  - D) mineral nutrients
  - E) oxygen
69. Which of the following is a likely result of deforestation?
- A) The amount of CO<sub>2</sub> removed from the atmosphere is reduced
  - B) Wind blows soil away because its plant cover has been removed
  - C) Water washes off the land more rapidly, causing floods
  - D) Water rushes soil into rivers and streams, causing them to silt up
  - E) All of the above
70. The demographic transition in a country is correlated with:
- A) education of women
  - B) improvements in agricultural production
  - C) the industrial revolution
  - D) improved hygiene and nutrition
  - E) improved medical care
71. Some grassland and conifer forest preserves have effective fire prevention programs. What is the most likely result of such programs?
- A) an increase in species diversity because fires are prevented
  - B) a change in community composition because fires are natural disturbances that maintain the community structure
  - C) the preservation of endangered species in the area
  - D) no change in the species composition of the preserved community
  - E) succession to a deciduous forest
72. With limited resources, conservation biologists need to prioritize their efforts. Of the following choices, which should receive the greatest conservation attention in order to preserve biodiversity?
- A) the northern spotted owl
  - B) declining keystone species in a community
  - C) a commercially important species
  - D) endangered and threatened vertebrate species
  - E) all declining species
73. Which of the following is a technique being developed to reduce the threat of introduced genes for herbicide or insect resistance escaping to closely related weed species?
- A) planting a nontransgenic plant border around crop fields to reduce crop-to-weed gene transfer
  - B) breeding male sterility into transgenic plants so that they have no pollen to be transferred to nearby weeds
  - C) engineering the gene of interest into chloroplast DNA, which is inherited from the maternal plant and is not transferred by pollen
  - D) engineering crops, such as soybeans, that have no weedy relatives nearby, or introducing genes for beneficial crop traits that would actually reduce the fitness of hybrid weeds
  - E) all of the above would reduce the risk of crop-to-weed transgene escape

74. What mechanism explains the movement of sucrose from source to sink?
- A) evaporation of water and active transport of sucrose from the sink
  - B) osmotic movement of water into the sucrose-loaded sieve-tube members creating a higher pressure in the source than in the sink
  - C) tension created by the differences in pressure in the source and sink
  - D) active transport of sucrose through the sieve-tube cells driven by proton pumps
  - E) the hydrolysis of starch to sucrose in the mesophyll cells that raises their water potential and drives the bulk flow of sap to the sink
75. The primitive atmosphere of Earth may have favored the synthesis of organic molecules because it;
- A) was highly oxidative
  - B) had a great deal of methane and organic fuels
  - C) had plenty of water vapor, carbon, oxygen, and nitrogen, providing the C, H, O and N needed for organic molecules
  - D) consisted almost entirely of hydrogen gas
  - E) was reducing and had energy sources in the form of lightening and UV radiation
76. Why is the diversity of life now organized into three domains?
- A) Molecular evidence indicates that the protists really include three separate lineages
  - B) The domains Bacteria and Archaea reflect the early evolutionary divergence of these two lineages, and they differ from eukaryotes
  - C) The eukaryotes are more alike than are the prokaryotes and thus belong in one large group
  - D) The division into plants, animals, and bacteria is more intuitive and accessible to most people
  - E) The origin of life involved three distinct stages – protobiont, prokaryote, and eukaryote – and each domain represents one of those stages
77. A comparative study of which of the following would provide the best data on the early evolution of fungi and plants?
- A) mitochondrial DNA
  - B) DNA from a chloroplast
  - C) the amino acid sequence of chlorophyll
  - D) DNA from ribosomal RNA
  - E) the morphology of present-day specimens
78. According to the top-down (trophic cascade) model of community control, which trophic level would you decrease if you wanted to increase the vegetation level in a community?
- A) nutrients
  - B) vegetation
  - C) secondary consumers (carnivores)
  - D) tertiary consumers
  - E) omnivores
79. Two allopatric species of Galapagos finches have beaks of similar size. There is significant difference in beak size when the two species occur on the same island. This is an example of;
- A) character displacement
  - B) competitive exclusion
  - C) trophic cascade
  - D) coevolution
  - E) commensalism

80. A plant may withstand salt stress by;
- releasing abscisic acid that closes stomata to salt accumulation
  - the production of organic solutes that lower the water potential of root cells
  - wilting, which reduces water and salt uptake by reducing transpiration
  - producing canavanine that reduces the toxic effect of sodium ions
  - releasing ethylene that leads to apoptosis of damaged cells
81. A biologist is studying the evolution of four similar species of birds. Which approach would allow her to choose the best phylogenetic tree from all possible phylogenies?
- draw the simplest cladogram and choose that one
  - from a comparison of nucleotide sequences, determine the number of evolutionary events required for each tree and choose the most parsimonious tree
  - compare the entire genomes of each species; the two most similar genomes are the two species that are most closely related
  - determine which species can interbreed; those that can evolved from a common ancestor most recently
  - choose the tree that has the most evolutionary changes required as the most probable explanation for why these similar birds have evolved into four distinct species
82. A mutation that renders the regulator gene of a repressible operon inactive in an *E. coli* cell would result in;
- complete inhibition of transcription of the structural genes
  - irreversible binding of the repressor to the operator
  - inactivation of RNA polymerase
  - continuous transcription of the structural gene controlled by that regulator
  - Both A and B are correct
83. Which of the following is true of gene regulation in both prokaryotes and eukaryotes?
- Nucleosomes regulate gene expression by preventing transcriptional factors from associating with DNA
  - Heterochromatin remains coiled, thus preventing its transcription
  - DNA binding proteins interact with other proteins and environmental factors to control gene expression
  - 10 – 25% of the cell's DNA forms 'satellite' DNA, thus limiting the amount of DNA available for transcription
  - Noncoding sequences are transcribed into RNA from the DNA, thus slowing down the rate at which the genes are transcribed
84. Which of the following is the most logical sequence of the steps shown below for splicing foreign DNA into a plasmid and inserting the plasmid into a bacterium?
- transform *E. coli* cells
  - cleave by endonuclease
  - extract plasmid DNA from bacterial cells
  - join plasmid DNA with foreign DNA by hydrogen bonds
  - seal with DNA ligase
- I, II, IV, III, V
  - II, III, V, IV, I
  - III, II, IV, V, I
  - III, IV, V, I, II
  - IV, V, I, II, III

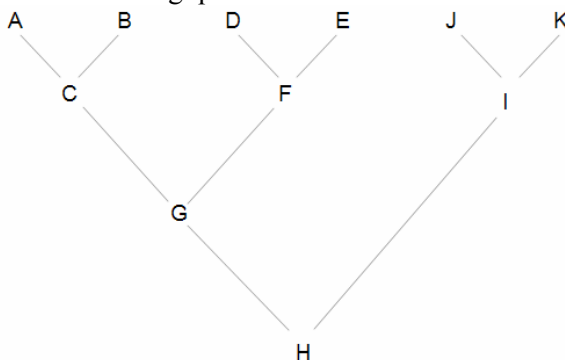
85. In cucumbers, warty (W) is dominant over dull (w), and green (G) is dominant over orange (g). A cucumber plant that is homozygous for wartiness and green color is crossed with one that is homozygous for dullness and orange color. The F<sub>1</sub> are then crossed to produce an F<sub>2</sub> generation. If a total of 144 offspring are produced, which of the following is the closest to the number of dull green cucumbers expected?  
A) 3                      B) 10                      C) 28                      D) 80                      E) 161
86. In humans, hemophilia is a sex-linked recessive trait. If a man and a woman produce a son that is affected with hemophilia, which of the following is definitely true?  
A) The mother carries an allele for hemophilia  
B) The father carries an allele for hemophilia  
C) The father is affected with hemophilia  
D) Neither parent carries an allele for hemophilia  
E) The boy's paternal grandfather is a hemophiliac
87. A goat can be made to produce milk containing the same polymers present in the silk production by spiders when particular genes from a spider are inserted into the goat's genome. Which of the following reasons describes why this is possible?  
A) Goats and spiders share a common ancestor and thus produce similar protein excretions  
B) The opposite is true, too – when genes from a goat are inserted into a spider's genome, the spider produces goats' milk instead of silk  
C) The proteins in goats' milk and spiders' silk have the same amino acid sequence  
D) The process of transcription and translation in the cells of the spiders and goats are fundamentally similar  
E) The processes of transcription and translation in the cells of spiders and goats produce exactly the same proteins
88. Which of the following is an important difference between the light-dependent and the light-independent reactions of photosynthesis?  
A) The light-dependent reactions occur only during the day; the light-independent reactions occur only during the night  
B) The light-dependent reactions occur in the cytoplasm; the light-independent reactions occur in chloroplasts  
C) The light –dependent reactions utilize CO<sub>2</sub> and H<sub>2</sub>O; the light-independent reactions produce CO<sub>2</sub> and H<sub>2</sub>O  
D) The light-dependent reactions depend on the presence of both photosystems I and II; the light-independent reactions require only photosystem I  
E) The light-dependent reactions produce ATP and NADPH; the light-independent reactions use energy stored in ATP and NADPH
89. Chemosynthetic bacteria may use which element as a hydrogen donor instead of water?  
A) potassium dihydrogen phosphate  
B) sulfur  
C) hydrogen chloride  
D) hydrogen sulfate  
E) hydrogen peroxide
90. Why are C<sub>4</sub> plants able to photosynthesize with no apparent photorespiration?  
A) They do not carry out the Calvin cycle  
B) They use a more efficient enzyme to initially fix CO<sub>2</sub>  
C) They are adapted to cold, wet climates  
D) They conserve water more efficiently  
E) They exclude oxygen from their tissues

91. You place a growing seedling in an east-facing window. On which side of the plant will auxin accumulate?
- A) North side
  - B) South side
  - C) East side
  - D) West side
  - E) Equally distributed on all sides of the plant
92. Which statement describing plant structure is true?
- A) Sclerenchyma cells provide support for the plant body
  - B) Collenchyma cells form the outer cell layer of the plant
  - C) Wood is formed from old epidermal cells
  - D) Stomates are pores in the roots that allow nutrients to enter
  - E) Parenchyma cells have thicker cell walls than other plant cells
93. Ethidium bromide is used in electrophoresis of DNA fragments because;
- A) It makes the fragments visible under UV light
  - B) It makes the DNA fragments more mobile in the gel
  - C) It increases the conductivity of electricity through the gel
  - D) It helps determine the size of the fragmentsIt maintains a stable pH
  - E) It maintains a stable pH
94. The Hardy-Weinberg equilibrium principle assumes all of the following statements EXCEPT?
- A) The proportion of alleles in a population tends to remain stable
  - B) The frequencies of dominant and recessive alleles for a given trait in a gene pool of a large population can be determined mathematically
  - C) Genotype frequencies in a large population are unaffected by Mendelian segregation and recombination of alleles
  - D) For a given trait the frequency of dominant alleles is greater than that of recessive alleles
  - E) For a given trait the frequency of dominant alleles is greater than that of recessive alleles
95. Tobacco mosaic virus has RNA rather than DNA as its genetic material. If the RNA genome from a tobacco mosaic virus is mixed with proteins from a human rhinovirus, the result is a mixed virus. If that virus could infect a cell and reproduce, what would you expect the resulting viruses to be like?
- A) A hybrid including genetic material from tobacco mosaic virus and proteins from the rhinovirus
  - B) A hybrid including proteins from tobacco mosaic virus and genetic material from the rhinovirus
  - C) Rhinovirus only
  - D) Tobacco mosaic virus only
  - E) No viruses would result because no viral DNA was present
96. Which of the following would most likely increase competition among members of a vole population in a given area?
- A) An increase in the number of hawk predators
  - B) An increase in the reproductive rate of voles
  - C) An increase in temperature
  - D) An increase in the food supply
  - E) An epidemic of rabies within the vole population

97. In an experiment, a plant is grown at a particular level of light and in a certain concentration of CO<sub>2</sub>. With CO<sub>2</sub> constant and light intensity gradually increasing to a preset level, oxygen production increases up to a point and then levels off. If light is increased beyond the preset level, no further increase in oxygen production is noted. In a second experiment, the same increasing regiment of light is used, but a higher level of CO<sub>2</sub> is supplied. O<sub>2</sub> production in the second experiment continues to increase beyond the point where it leveled off in the first experiment. From these observations, one might conclude;
- Light is the only limiting factor
  - CO<sub>2</sub> concentration is the only limiting factor
  - Both light and CO<sub>2</sub> concentration are limiting factors throughout the time course of the reaction
  - Light is limiting up to a point and then CO<sub>2</sub> becomes a limiting factor
  - Neither light nor CO<sub>2</sub> concentration are limiting
98. The most phytoplankton in a lake would be found in which zone?
- Littoral zone
  - Benthic zone
  - Limnetic zone
  - Oligotrophic zone
  - Profundal zone
99. The biodiversity of a given region is an outcome of;
- climate and topography
  - possibilities for dispersal
  - evolutionary history
  - both A and B
  - A, B, and C are correct
100. An investigator found 150 different diatom species in one mile of a stream. None of the species comprised more than 5% of the total population. In a second observation twenty-five miles downstream, there were only 20 different diatom species, with 2 species representing 80% of the total population. What is the best explanation of these two observations?
- There must have been significant errors with the sampling methods
  - The stream velocity changed
  - The stream is bigger at mile 25
  - The nature of the stream bottom changed
  - Organic wastes high in nitrates and phosphates entered the stream somewhere between the two sampling stations
101. In a population of 15 **AA**, 25 **Aa**, and 10 **aa** individuals, the frequency of the **a** allele is;
- 0.10
  - 0.35
  - 0.45
  - 0.50
  - 0.55
102. When an ant in a colony dies, the live ants will throw the dead ant out of the anthill. If a live ant from the colony, Ant X, is sprayed with a chemical characteristic of dead ants, the live ants will repeatedly throw Ant X out of the anthill, until the chemical on Ant X wears off. What is the best behavioral explanation of the ant colony?
- The chemical acts as a sign stimulus for a fixed action pattern
  - The ants are exhibiting a negative taxis triggered by the chemical
  - The ants exhibit a learned behavior
  - The other ants can learn only through trial and error
  - The live ants continue the behavior until they have been habituated



103. Use the cladogram below to answer the following question.



Which group represents a monophyletic taxon?

- A) H, I, J, and K  
B) A, B, D and E  
C) D, E, F, and G  
D) A and B  
E) A, B, C, D, E, F, and G
104. In the lysogenic pathway of the lambda bacteriophage;  
A) bacterial DNA becomes incorporated in viral DNA  
B) viral DNA becomes incorporated in bacterial DNA  
C) viral DNA produces bacterial RNA  
D) the viral DNA causes the bacteria to produce enzymes that split the bacteria apart  
E) the lambda bacteriophage DNA is destroyed by the restriction enzymes in the bacteria
105. A plant that has chlorosis of the leaves is most likely to be deficient in;  
A) iron      B) phosphorous    C) magnesium    D) nitrogen      E) potassium
106. When the earth's crustal plates collided some 240 million years ago, there was a dramatic increase in land area. What event correlated with this?  
A) the rise of the amphibians  
B) the extinction of many species of fish  
C) adaptive radiation of living organisms onto the edge of the land  
D) extinction of the dinosaurs  
E) all of the above
107. Producing a vaccine against the tsetse fly-borne trypanosomes is very difficult because;  
A) tsetse flies are hard to grow in captivity  
B) trypanosomes each have over a thousand genes for antigens but express only one at a time  
C) the disease is only expressed in humans and experimental subjects are hard to get  
D) the trypanosome does not cause an antibody response  
E) none of the above: the vaccine is easy and inexpensive to produce
108. Which of the following is a desirable characteristic for a cloning plasmid?  
A) a site at which replication can be initiated  
B) one or more unique restriction endonuclease sites  
C) one of more antibiotic-resistance or drug resistance genes  
D) a highly active promoter  
E) all of the above

- 109.** Which of the following is true about developing cDNA?
- A)** mature mRNA directs the formation of the DNA
  - B)** mature mRNA does not contain introns
  - C)** DNA taken from the nucleus is used to produce the cDNA
  - D)** Both A and B are true
  - E)** A, B, and C are true
- 110.** A scientist observes the height of a certain species of yarrow plants decreases as the altitude on a mountainside increases. She gathers seeds from samples at various altitudes, plants them in a uniform environment and measures the height of the new plants. All of her experimental yarrows grow to approximately the same height. From this she concludes that;
- A)** height is not a quantitative trait
  - B)** the cline she observed was due to genetic variations
  - C)** the differences in the parent plants' heights were due to directional selection
  - D)** the height variation she initially observed was an example of nongenetic environmental influence
  - E)** stabilizing selection was responsible for height differences in the parent plants

**Continue on to the next page**

**Read the following selection and answer questions 111-115 on the answer sheet.**

**Air Pollution**

Air pollution and air quality were not considered a global concern until the second half of the twentieth century. The topic was traditionally a problem only for heavily industrialized areas. The effects of air pollution and poor air quality manifest far downwind from the sources of the pollution. The cumulative effects of air pollution are historically linked to our dependence on the combustion of fossil fuels to satisfy domestic, industrial and automotive energy demands. Developed nations have implemented costly technologies and pollution regulations to decrease the units of air pollution emitted. However, problems still exist in these nations because of their large populations. Developing nations typically do not have adequate pollution regulations and cannot afford to implement the costly technology to minimize air pollutants. Air pollution and air quality problems extend far beyond urban and industrialized areas.

- 111.** Air pollution contributes to the following environmental problems:
- A) acid rain
  - B) ozone depletion
  - C) global warming
  - D) all of the above
  - E) none of the above
- 112.** Sulfur emissions from coal-fired power plants are one of the sources of air pollution and poor air quality because it
- I. Contributes to the acid rain problem
  - II. Damages the lungs of living organisms
  - III. Smells like rotten eggs
- A) I & II
  - B) I & III
  - C) II & III
  - D) I, II & III
- 113.** The human effect of poor air quality are being seen through an increase in everything but
- A) Asthma and emphysema
  - B) Birth defects and cancer
  - C) Allergies and diabetes
  - D) Bronchitis and pneumonia
- 114.** Which of the following do air pollutants affect the least?
- A) the hydrologic cycle
  - B) the biochemical cycles
  - C) the biosphere
  - D) the atmosphere
  - E) the rock cycle
- 115.** Particulate matter degrades air quality. Which of the following does not contribute to the release of particulates into the air?
- A) Revegetation
  - B) Deforestation
  - C) Urban sprawl
  - D) Volcanic eruptions
  - E) Automobile exhaust

**Read the following selection and answer questions 116-120 on the answer sheet.**

**Water Pollution**

The majority of the water on this planet is located in the oceans or is frozen. The amount of water on which all plants, animals and people sustain themselves, totals less than one percent. As the human population increases so does their need for water. Presently the majority of the drinking water consumed comes from surface water or groundwater. Restoring polluted surface water and/or groundwater is a time consuming and expensive process. Presently, the primary water pollution problem in the world is the lack of clean, disease-free drinking water. In the United States it is sediment pollution.

116. What tests would you perform on a water sample to help determine if the water sample is disease free?
- A) Nitrogen and phosphorus
  - B) Pesticides and fertilizers
  - C) Heavy metals and sediment
  - D) Fecal coliform and cryptosporidium
  - E) Dissolved oxygen and biological oxygen demand
117. Following a heavy rainfall, a sample of water is taken from a shallow lake. Successive pH readings over several months show the average pH of all the rainfall measurements is 5.0. You should
- A) not worry, it is normal
  - B) test the water for sulfates
  - C) test the water for phosphates
  - D) look at the aquatic insects along the shore
118. If a water body has a mat of green algae growing over its surface it is termed eutrophic. Eutrophication can be caused naturally or by man. If the algae mat gets too thick the water body will
- A) Have a high dissolved oxygen and low biological oxygen demand
  - B) Have a low dissolved oxygen and a high biological oxygen demand
  - C) Have a low dissolved oxygen and a low biological oxygen demand
  - D) Have a high dissolved oxygen and a high biological oxygen demand
119. An increase in sediment in surface water can be caused by
- A) Cultivating crop land
  - B) Construction of buildings
  - C) Grazing or Feeding lots
  - D) All of the above
  - E) None of the above
120. **Eliminated** ~~Aquifers are underground zones from which groundwater can be extracted. Groundwater flows very slowly and if polluted is extremely difficult to remediate. Aquifers are not presently~~
- ~~A) being contaminated by underground storage tanks~~
  - ~~B) being stressed because of an increase in usage~~
  - ~~C) drying up because of lack of recharge~~
  - ~~D) an issue of environmental concern~~
  - ~~E) experiencing salt water intrusion~~

**The End**

MULTIPLE CHOICE

- 1. D
- 2. D
- 3. E
- 4. B
- 5. E
- 6. E
- 7. E
- 8. A
- 9. C
- 10. E
- 11. D
- 12. C
- 13. D
- 14. C
- 15. E
- 16. D
- 17. A
- 18. A
- 19. A
- 20. C
- 21. C
- 22. B
- 23. D
- 24. C
- 25. D
- 26. C
- 27. B
- 28. C
- 29. B
- 30. C
- 31. C
- 32. D
- 33. D
- 34. E
- 35. C
- 36. D
- 37. E
- 38. C
- 39. D
- 40. A

- 41. C
- 42. D
- 43. B
- 44. D
- 45. D
- 46. A
- 47. B
- 48. A
- 49. D
- 50. A
- 51. B
- 52. B
- 53. D
- 54. E
- 55. D
- 56. D
- 57. C
- 58. A
- 59. C
- 60. D
- 61. D
- 62. B
- 63. A
- 64. C
- 65. B
- 66. A
- 67. E
- 68. E
- 69. E
- 70. A
- 71. B
- 72. B
- 73. E
- 74. B
- 75. E
- 76. B
- 77. D
- 78. D
- 79. A
- 80. B

- 81. B
- 82. D
- 83. C
- 84. C
- 85. C
- 86. A
- 87. D
- 88. E
- 89. D
- 90. B
- 91. D
- 92. A
- 93. A
- 94. D
- 95. D
- 96. B
- 97. C
- .98 C
- 99. E
- 100. E
- 101. C
- 102. A
- 103. A
- 104. B
- 105. C
- 106. C
- 107. B
- 108. E
- 109. D
- 110. D
- 111. A
- 112. D
- 113. B
- 114. E
- 115. A
- 116. D
- 117. A
- 118. B
- 119. D
- 120. C