



The 58th Annual Merck State Science Day Competition May 20, 2008

Biology

Directions:

PLEASE DO NOT OPEN THE EXAM BOOKLET UNTIL DIRECTED.

Be sure to fill in your name on the answer sheet both by printing it in the correct space, and by filling in the corresponding letter in the provided spaces.

Use a #2 pencil only.

Carefully erase any errors, and do not make any extraneous marks on the answer sheet. Do NOT use *White-Out* on any portion of the answer sheet.

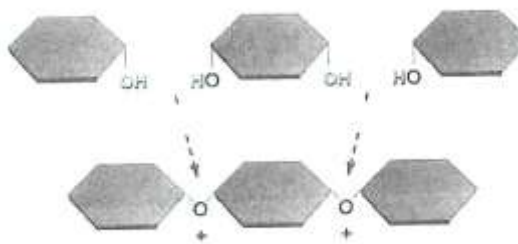
The test has **100 items** that will be scored. You have **90** minutes in which to answer all the questions.

There is only one correct answer per question. Do not spend too much time on any one question. Do the items you find easier first, and then go back to those you find more difficult or time consuming during the time you have remaining. Your individual score will be computed on the basis of the number of correctly answered items. (There is no penalty for guessing.)

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.

- 1) Which of the following statements is NOT true?
 - A) Biodiversity is the result of evolution
 - B) The characteristics of any living organism are under the control of chemical pathways
 - C) The diversity of living organisms makes life unpredictable, even using scientific methods
 - D) All organisms are alike in that their structure and organization arise from matter and energy
 - E) The behavior of individual organisms is dependent upon their evolutionary history
- 2) The figure below illustrates a ____ reaction that produces two ____ and a ____.



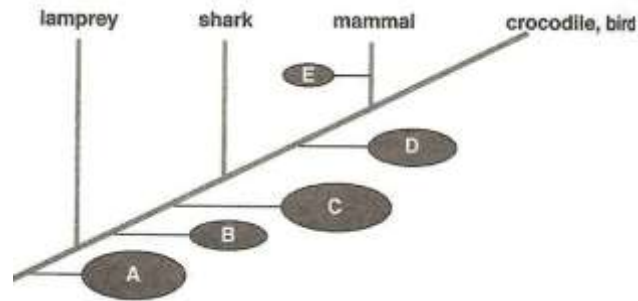
- A) condensation; hydroxyls; polymer
 - B) condensation; water molecules; polymer
 - C) hydrolysis; water molecules; monomer
 - D) hydrolysis; water molecule; polymer
 - E) condensation; peptide bonds; polymer
- 3) A biologist who says that the human body might be getting its power from 'bacteria' is referring to
 - A) some cells that utilize bacteria to produce energy
 - B) bacteria in our intestinal tract that digest food to supply us with energy
 - C) the *E. coli* throughout the human body that produce ATP
 - D) the mitochondria in our cells that may have originated as endosymbiotic bacteria
 - E) photoautotrophic bacteria that, like plants, can produce carbohydrates from sunlight and carbon dioxide
- 4) Which of the following statements is true?
 - A) The movement of solvent occurs from a hypotonic solution to an isotonic solution
 - B) The net movement from an isotonic to a hypotonic solution involve the movement of solute molecules only
 - C) The concentration of a solute is greater in an isotonic solution than is a hypertonic solution
 - D) The concentration of the solvent is greater in hypertonic solution than in an isotonic solution
 - E) Osmosis involves only hypertonic solutions
- 5) A high concentration of H^+ in the thylakoid compartment provides energy for the ____ by _____.
 - A) reduction of $NADP^+$; and electron transfer chain
 - B) production of sugars; the light-independent reactions
 - C) production of O_2 ; photolysis
 - D) production of ATP; ATP-synthetase
 - E) electron transport chain; photophosphorylation

- 6) Which of the following is NOT produced in the light-independent reaction?
- phosphoglyceric acid (PGA)
 - phosphoglyceraldehyde (PGAL)
 - ribulose biphosphate (RuBP)
 - ADP
 - NADPH
- 7) During the Krebs cycle, which of the following does NOT occur?
- substrate-level phosphorylation occurs
 - oxaloacetate is regenerated
 - electrons and H^+ are transferred to coenzymes NAD^+ and FAD
 - coenzyme A is used to produce acetyl-CoA
 - none: all of these occur in the Krebs cycle
- 8) The two meiotic phases that are most important in providing for genetic variability among the offspring are:
- prophase I and metaphase I
 - prophase I and metaphase II
 - prophase II and anaphase I
 - prophase I and anaphase II
 - metaphase I and anaphase II
- 9) In cocker spaniels, black coat color (B) is dominant over red (b), and solid color (S) is dominant over spotted (s). If a red, solid male is crossed with a black, solid female to produce a red, spotted puppy, the genotypes of the parents (with male genotype first) will be;
- BbSs (x) BbSs
 - bbSs (x) BbSs
 - bbss (x) BbSs
 - bbSs (x) Bbss
 - BBss (x) Bbss
- 10) In radishes, red and white are the pure-breeding colors and long and round are the pure-breeding shapes, while the hybrids are purple and oval. The cross of a red oval with a purple oval will produce all EXCEPT which of the following phenotypes?
- white and long
 - purple and oval
 - red and oval
 - purple and long
 - red and long
- 11) Nondisjunction involving the X chromosomes may occur during oogenesis and produce two kinds of eggs. If normal sperm fertilize these two types, which of the following pairs of genotypes are possible?
- XX and XY
 - XYY and XO
 - XXY and XO
 - Xyy and YO
 - none of these are possible combinations
- 12) If a mixture of bacteriophages, some labeled with radioactive sulfur and others labeled with radioactive phosphorus, is placed in a bacterial culture, the bacteria will eventually contain
- radioactive sulfur
 - radioactive phosphorus
 - both radioactive sulfur and phosphorus
 - neither radioactive sulfur nor radioactive phosphorus
 - complete viruses with radioactive sulfur coats

- 13) Crick and Brenner discovered that the presence of three extra nucleotides inserted in the middle of a gene caused far fewer problems than if only one or two extra nucleotides were inserted. They interpreted this result to mean that;
- A) the wobble effect accounts for the unpredictability in codon-anticodon pairing at the third base
 - B) there had been significant experimental error in their electrophoresis studies
 - C) the longer the sequence of nucleotides that is added to a gene, the more chemically stable the resulting DNA is
 - D) the genetic code consists of nonoverlapping triplets of nucleotide bases
 - E) all of these are valid interpretations of their experiments
- 14) Acetylation makes genes accessible to transcription by
- A) increasing the pH of the cell
 - B) making histones loosen their grip on the DNA molecule
 - C) modifying the nucleotides of the promoter region of the DNA molecule
 - D) enhancing the activity of RNA polymerase
 - E) enhancing the development of a DNA-RNA hybrid
- 15) All of the following are true concerning plasmids EXCEPT that they
- A) are self-reproducing circular molecules of DNA
 - B) are sites for inserting genes for amplification
 - C) may be transferred between different strains of bacteria
 - D) may confer the ability to donate genetic material when bacteria conjugate
 - E) are usually essential in bacteria
- 16) Which statement about the geologic time scale is incorrect?
- A) Mammals originated early in the Mesozoic era
 - B) Adaptive radiation of flowering plants, insects, and birds took place during the Mesozoic era
 - C) Mass extinction of the dinosaurs occurred at the K-T boundary about 65 million years ago
 - D) Reptiles originated during the Paleozoic era
 - E) Eukaryotes originated during the Proterozoic eon
- 17) Genetic equilibrium and allele frequencies are maintained by all EXCEPT which one of the following?
- A) development of isolating mechanisms
 - B) large populations interbreeding freely
 - C) differential survival and reproduction
 - D) random mating
 - E) absence of mutation
- 18) According to the Hardy-Weinberg principle, if the frequency of a recessive allele is 30%, the frequency of the heterozygous carrier would be;
- A) 42 %
 - B) 70 %
 - C) 9 %
 - D) 40 %
 - E) not enough information is given to predict the % for the heterozygote condition
- 19) The Hb^S allele (sickle cell) occurs at a higher frequency in Africa than it does in the United States because
- A) it is a dominant allele in Africa and a recessive allele in the United States
 - B) genetic recombination occurs at different rates in different human populations
 - C) the African population is descended from a small group of individuals who possessed the allele at a high frequency
 - D) natural selection favors heterozygotes in Africa but favors homozygous normal individuals in the United States
 - E) malarial infection is not a major health problem in Africa but is in the United States

- 20) Although there are as many starlings (a bird) in North America as there are in Europe, genetic variability in the North American population is reduced relative to that in Europe due to;
- A) there are more environments in Europe
 - B) there is more gene flow in Europe
 - C) the North America population is derived from a small founder population
 - D) the Europe population went through a major bottleneck recently
 - E) there is less habitat fragmentation in Europe

- 21) The derived trait represented by label “B” is;



- A) lungs
 - B) hair
 - C) a notochord
 - D) jaws
 - E) paired appnedages
- 22) The accumulation of free oxygen in the atmosphere;
- A) was a result of the accumulation of a by-product of a type of chemosynthesis
 - B) was a result of a the accumulation of a by-product of a type of photosynthesis
 - C) occurred approximately 3.2 billion years ago
 - D) was a result of the biochemical pathways of the methanogens
 - E) was a result of a biochemical pathway of the first eukaryotes 1.2 billion years ago
- 23) Contemporary hypotheses concerned with the origin of life focus on which of the following characteristics of living systems?
- A) energy conversion and biosynthesis
 - B) self-replication and energy conversion
 - C) plasma membranes and self-replication
 - D) growth and development
 - E) adaptation and energy conversion
- 24) All of the following are protists that are parasites of humans EXCEPT;
- A) *Trypanosoma*
 - B) *Trichomonas*
 - C) *Entamoeba*
 - D) *Euglena*
 - E) *Plasmodium*
- 25) Of the following, which is characterized by complex structural morphology, sporophyte-dominant structures, and an abundance of fucoxanthin?
- A) Phaeophyta
 - B) Rhodophyta
 - C) Chlorophyta
 - D) Bryophyta
 - E) Chrysophyta

- 26) Which organism is incorrectly paired with its description?
- A) cercozoans -- amoebas with threadlike pseudopodia
 - B) euglenids -- protists that store paramylon
 - C) forams -- ciliated algae with numerous micronuclei
 - D) apicomplexans -- parasites with intricate life cycles
 - E) diplomonads -- protists with modified mitochondria
- 27) Which of the following reproductive structures is *incorrectly* matched with the group in which it is found?
- A) zygospore: zygomycetes
 - B) ascus: sac fungi
 - C) conidia: club fungi
 - D) basidiospores: mushrooms
 - E) spores: deuteromycetes
- 28) The adaptive advantage associated with the filamentous nature of fungal mycelia is primarily related to;
- A) the ability to form haustoria and parasitize other organisms
 - B) avoiding sexual reproduction until the environment is favorable for survival
 - C) the potential to inhabit almost all terrestrial habitats
 - D) the increased probability of contact between different mating types
 - E) an extensive surface area well suited for absorptive nutrition
- 29) Which of the following statements concerning animal development is FALSE?
- A) The development of a coelom was necessary before organisms could develop a large size
 - B) Segmentation allows increasing specialization of body parts
 - C) The development of a complete digestive tract allows the specialization of regions to carry out a variety of functions
 - D) Organisms with radial symmetry developed into the deuterostomes and protostomes
 - E) none of these: all statements are correct concerning animal development
- 30) The figure labeled 'B' shows a cross section through a ____ and a vascular bundle.



- A) monocot stem
 - B) eudicot stem
 - C) monocot root
 - D) dicot root
 - E) none of the above
- 31) Which of the following statements is *false*?
- A) Some perennial plants may consist of primary growth only
 - B) Cork cambium and vascular cambium are cells that form lateral meristems
 - C) Nonwoody plants are herbaceous
 - D) Phloem is formed on the inside of vascular cambium, whereas xylem is formed on the outside
 - E) Sapwood surrounds heartwood

- 32) Abscisic acid is a hormone that helps a water-stressed plant conserve water by all of the following means EXCEPT;
- causing the decrease of carbon dioxide in the guard cells
 - influencing the movement of water out of the guard cells
 - causing the guard cells to become hypotonic in relation to their neighboring cells
 - influencing the flow of potassium and therefore water out of the guard cells
 - opening membrane calcium gates of the guard cells, allowing calcium to flow into the cells, which causes the potassium gates to open
- 33) The polar transport of auxin in a seedling;
- occurs in parenchyma cells
 - uses passive membrane transporters to move auxin in and out of cells
 - uses membrane pumps to move hydrogen ions out of the cytoplasm into the primary cell wall
 - activates enzymes that loosen crosslinks between cellulose microfibrils
 - all of the these are correct
- 34) Which of the following is the correct order of floral organs from the outside to the inside of a complete flower?
- sepals - petals - stamens - carpels
 - male gametophyte - female gametophyte - sepals - petals
 - spores - gametes- zygote - embryo
 - sepals - stamens - petals - carpels
 - petals - sepals - stamens - carpels
- 35) The signal for flowering could be released earlier than normal in a long-day plant experimentally exposed to flashes of;
- far-red light during the night
 - red light during the night
 - red light followed by far-red light during the night
 - far-red light during the day
 - red light during the day
- 36) The following events occur when a mammalian immune system first encounters a pathogen. Place them in correct sequence, and then choose the answer that indicates that sequence.
- Pathogen is destroyed
 - Lymphocytes secrete antibodies
 - Antigenic determinants from pathogen bind to antigen receptors on lymphocytes
 - Lymphocytes specific to antigenic determinates from pathogen become numerous
 - Only memory cells remain
- I, III, II, IV, V
 - III, II, I, V, IV
 - II, I, IV, III, V
 - IV, II, III, I, V
 - III, IV, II, I, V

- 37) Refer to the following data:

	Case 1	Case 2	Case 3
Mother	Rh ⁻	Rh ⁻	Rh ⁺
Fetus	Rh ⁺	Rh ⁻	Rh ⁻

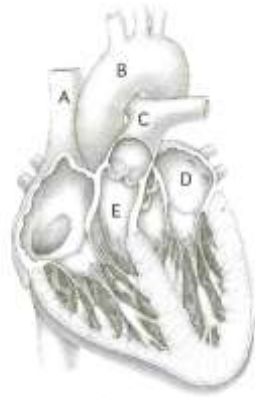
Which of the above cases may cause a potentially dangerous situation for the fetus?

- case 1 only
- case 3 only
- cases 1 and 2 only
- cases 1, 2, and 3
- Not even information is given to determine the correct answer

- 38) A marine sea star was mistakenly placed in freshwater and it died. What is the most likely explanation for its death?
- A) The sea star was stressed and required more time to adapt to new conditions
 - B) The sea star is hypertonic to the freshwater, and it could not osmoregulate
 - C) The osmoregulatory system of the sea star could not handle the change in ionic content of the freshwater
 - D) The contractile vacuoles used to regulate water content ruptured in the freshwater
 - E) The water was not a factor; the sea star simply died
- 39) Select the pair in which the nitrogenous waste is *incorrectly* matched with the benefit of its excretion.
- A) urea - low toxicity relative to ammonia
 - B) uric acid - can be stored as a precipitate
 - C) ammonia - very soluble in water
 - D) uric acid - minimal loss of water when excreted
 - E) urea - highly insoluble in water
- 40) An example of antagonistic hormones controlling dynamic equilibrium is;
- A) thyroxine and parathyroid hormone in calcium balance
 - B) insulin and glucagon in glucose metabolism
 - C) progesterone and estrogen in mammalian reproductive cycle
 - D) epinephrine and norepinephrine in the sympathetic nervous system
 - E) oxytocin and prolactin in milk production
- 41) Which of the following statements about hormones is *correct*?
- A) Steroid and peptide hormones produce different effects but use the same biochemical pathways
 - B) Steroid and peptide hormones produce the same effects but differ in the chemical pathways that produce the effects
 - C) Steroid hormones affect the synthesis of proteins, whereas peptide hormones affect the activity of proteins already present in the cell
 - D) Steroid hormones affect the activity of certain proteins within the cell, whereas peptide hormones directly affect the processing of mRNA
 - E) Steroid hormones affect the synthesis of proteins to be exported from the cell, whereas peptide hormones affect the synthesis of proteins that remain in the cell
- 42) In vertebrate animals, spermatogenesis and oogenesis differ, in that;
- A) oogenesis begins at the onset of sexual maturity
 - B) oogenesis produces four haploid cells, whereas spermatogenesis produces only one functional spermatozoan
 - C) spermatogenesis occurs before birth
 - D) spermatogenesis is not complete until after fertilization occurs
 - E) oogenesis produces one functional ovum, whereas spermatogenesis produces four functional spermatozoa
- 43) What happens if the hormone progesterone is not secreted in a human female?
- A) Secondary sex characteristics do not develop
 - B) The pituitary is stimulated to secrete gonadotropins
 - C) Uterine contractions begin stimulating childbirth
 - D) Enlargement of arteries supplying blood to the endometrium and growth of endometrial glands are inhibited
 - E) The ovary begins to form the corpus luteum

- 44) All of the following statements about transmission along neurons are correct EXCEPT?
- A) The rate of transmission of a nerve impulse is directly related to the diameter of the axon
 - B) The intensity of a stimulus is related to the frequency of the action potential
 - C) The resting potential is maintained by differential ion permeabilities and the sodium-potassium pump
 - D) Once initiated, local depolarizations stimulate a propagation of serial action potentials down the axon
 - E) A stimulus that affects the membrane's permeability to ions can either depolarize or hyperpolarize the membrane
- 45) For the events below, which of the following is the correct sequence as it relates to a human being able to hear sound?
1. reception
 2. transmission
 3. transduction
 4. perception
 5. amplification
- A) 1, 2, 3, 4, 5
 - B) 1, 5, 2, 3, 4
 - C) 1, 3, 5, 2, 4
 - D) 2, 3, 5, 1, 4
 - E) 2, 1, 5, 3, 4
- 46) Sea anemones have a(n) ___ that causes them to extend into a feeding position when longitudinal cells ___ and radial cells ___.
- A) hydrostatic skeleton; contract; relax
 - B) endoskeleton; contract; relax
 - C) exoskeleton; contract; relax
 - D) hydrostatic skeleton; relax; contract
 - E) exoskeleton; relax; contract
- 47) When calcium levels decline, the ___ secrete(s) ___, which ___ osteoclast activity.
- A) parathyroid; calcitonin; enhances
 - B) parathyroid; calcitonin; suppresses
 - C) thyroid; calcitonin; enhances
 - D) thyroid; PTH suppresses
 - E) parathyroid; PTH; enhances
- 48) Which of the following statements is true?
- A) Arteries carry only oxygenated blood
 - B) The systemic circuit leaves the heart from the left ventricle
 - C) Blood passes through only one capillary bed from the right ventricle back to the right atrium
 - D) Platelets survive a longer time than erythrocytes
 - E) the heart is considered a double pump in the fishes and amphibians

49) "D" shows the entry of the ___ into the ____.



- A) superior vena cava; left atrium
 - B) inferior vena cava; right atrium
 - C) pulmonary arteries; left atrium
 - D) pulmonary veins; left atrium
 - E) pulmonary veins; right atrium
- 50) Which of the following statements is NOT true of the lymph vascular system? The lymph vascular system;
- A) transports lipids absorbed from the small intestine to the bloodstream
 - B) recovers and transports interstitial fluid back to the bloodstream
 - C) absorbs glucose from the small intestine and transports it to the skeletal muscles
 - D) serves the body's system of defenses against bacteria and other infectious agents
 - E) consists of capillaries and of vessels that are similar to veins
- 51) Which of the following groups of animals has a digestive system most unlike the others?
- A) cnidarians
 - B) annelids
 - C) echinoderms
 - D) mollusks
 - E) arthropods
- 52) Concerning the role of the pancreas in digestion;
- A) no digestion occurs in the pancreas
 - B) endocrine cells secrete bicarbonate, which helps neutralize highly acidic chyme
 - C) endocrine cells release enzymes that break down carbohydrates, fats, proteins, and nucleic acids in the duodenum
 - D) exocrine tissue produces insulin and glucagon, which help regulate the blood sugar levels
 - E) all of these are roles carried out by the pancreas
- 53) Which of the following does NOT act to maintain the osmotic gradient necessary for the concentration of urine in mammals?
- A) countercurrent flow at the loop of Henle
 - B) decreased hypothalamic signals leading to a decrease in ADH production
 - C) impermeability of the descending limb of the loop of Henle to Na^+ , Cl^- , and other solutes
 - D) impermeability of the ascending limb of the loop of Henle to water
 - E) all of the above do act to maintain the osmotic gradient
- 54) Homeotic genes;
- A) cause lethal mutations
 - B) are found only in fruit flies, where they are responsible for odd placement of appendages
 - C) produce "fate maps"
 - D) form as blocks of genes in cells randomly distributed throughout the body
 - E) interact with control elements to map out the overall body plan

- 55) If you discovered a bacterial cell that contained no restriction enzymes, which of the following would you expect to happen?
- The cell would be unable to replicate its DNA
 - The cell would not replicate its plasmids
 - The cell would be easily infected and lysed by bacteriophages
 - The cell would form an endospore and lie dormant
 - Both A and D would occur
- 56) A graduate student has cloned a gene that she believes is important in conferring resistance to insects in a certain plant. She now wants to determine where in the genome that gene is physically located. She would most likely use which of the following techniques?
- in situ* hybridization
 - in vivo* mutagenesis
 - RFLP analysis
 - DNA microarray assays
 - use of antisense nucleic acids
- 57) ~~Which of the following sequences in double-stranded DNA is most likely to be recognized as a cutting site for a restriction enzyme?~~ **ELIMINATED**
- | | |
|-----------------|-----------------|
| A) AAGG
TTCC | D) ACCA
TGGT |
| B) AGTC
TCAG | E) AAAA
TTTT |
| C) AACC
CCAA | |
- 58) Expression of a cloned eukaryotic gene in a prokaryotic cell involves many difficulties. The use of mRNA and reverse transcriptase is part of a strategy to solve the problem of;
- post-transcriptional processing
 - post-translational processing
 - nucleic acid hybridization
 - restriction fragment ligation
 - polymerase chain reaction
- 59) A portion of the genetic code is UUU = phenylalanine, GCC = alanine, AAA = lysine, and CCC = proline. Assume the correct code places the amino acids phenylalanine, alanine, and lysine in a polypeptide chain (in that order). Which of the following would substitute proline for alanine?
- AAA-CGG-TTA
 - AAT-CGG-TTT
 - AAA-CCG-TTT
 - AAA-GGG-TTT
 - AAA-CCC-TTT
- 60) For a repressible operon to be transcribed, which of the following must be *true*?
- A corepressor must be present
 - RNA polymerase must bind to the promoter and the repressor must be inactive
 - RNA polymerase and the active repressor must be present
 - RNA polymerase cannot be present and the repressor must be inactive
 - RNA polymerase must not occupy the promoter and the repressor must be inactive
- 61) Which of the following represents an order of increasingly higher levels of organization?
- 30-nanometer chromatin fiber, nucleosome, looped domain
 - nucleosome, looped domain, 30-nanometer chromatin fiber
 - looped domain, nucleosome, 30-nanometer chromatin fiber
 - looped domain, 30-nanometer chromatin fiber, nucleosome
 - nucleosome, 30-nanometer chromatin fiber, looped domain

- 62) Which is the least accurate statement about the evolution of prokaryotes and the changing environment of Earth?
- A) Prokaryotes have interacted with the environment for more than 3.5 billion years
 - B) Although prokaryotes have a diverse morphology, they basically have the same metabolic pathways and products
 - C) Oxygen-producing photosynthesis favored the evolution of cells capable of performing aerobic respiration
 - D) Cyanobacteria evolved before aerobically respiring bacteria
 - E) Bacteria are among several kinds of organisms that recycle chemical elements in the ecosystem
- 63) In a practice known as *crop rotation*, farmers alternate a crop of legumes (e.g. beans) with a crop of nonlegumes (e.g. corn). What is the benefit of this practice?
- A) *Rhizobium* lives in the root nodules of the legumes, fixes nitrogen, and excess products of this process can fertilize the soil
 - B) This prevents the farmer from being personally exposed to the same crop pathogens year after year
 - C) This keeps the plants from becoming pesticide resistant
 - D) This keeps nematodes that damage the nonlegumes from becoming pest resistant
 - E) This is an economical practice to meet supply and demand
- 64) In a hypothetical situation, a bacterium lives on the surface of a leaf, where it obtains nutrition from the leaf's nonliving, waxy covering, and where it inhibits the growth of other microbes that damage the plant. If, and only if, this bacterium accidentally gains access to the inside of a leaf, it causes a fatal disease in the plant. Once the plant dies, the increased number of bacteria that underwent binary fission decompose the plant. What is the correct sequence of ecological roles played by the bacterium in this situation?
1. saprobe
 2. mutualist
 3. commensal
 4. parasite
 5. primary producer
- A) 1, 4, 2 B) 2, 3, 4 C) 1, 2, 5 D) 2, 4, 1 E) 2, 4, 2
- 65) An example of bioremediation is;
- A) the use of antibiotics produced by cultured prokaryotes
 - B) the genetic engineering of bacteria to produce human proteins and useful chemical products
 - C) the use of prokaryotes to treat sewage or clean up oil spills
 - D) the introduction of parasitic bacteria to kill other bacteria
 - E) all of the above
- 66) Some green algae exhibit alternation of generations. All land plants exhibit alternation of generations. No charophyceans exhibit alternation of generations. Keeping in mind the recent evidence from molecular systematics, the correct interpretation of these observations is that;
- A) charophyceans are not related to either green algae or land plants
 - B) plants evolved alternation of generations independently of green algae
 - C) alternation of generations cannot be beneficial to charophyceans
 - D) land plants evolved directly from green algae that perform alternation of generations
 - E) both A and D are likely interpretations

- 67) Which trait(s) is (are) shared by most modern gymnosperms and angiosperms?
1. wind can serve as a pollinating agent
 2. vessel elements
 3. microscopic gametophytes
 4. sterile sporophylls, modified to attract pollinators
 5. endosperm
- A) 1 only
 B) 1 and 3
 C) 1, 2, and 3
 D) 1, 3, and 5
 E) 2, 4, and 5
- 68) Agricultural modifications of plants have progressed to the point that the number of cultivated plant species probably would not survive in the wild. Why is this so?
- A) Environmental conditions have changed since the plants evolved
 B) Seeds can be obtained only from seed banks in agricultural countries
 C) Cultivated plants are more vulnerable to human-caused pollution and disasters
 D) Special conditions not found in nature are needed for their growth and reproduction
 E) Their seeds cannot be dispersed without agricultural machinery
- 69) In fungi, karyogamy does not immediately follow plasmogamy, which
- A) creates dikaryotic cells
 B) is strong support for the claim that fungi are not truly eukaryotic
 C) means that sexual reproduction can occur in specialized structures
 D) results in more genetic variation during sexual reproduction
 E) allows fungi to reproduce asexually most of the time
- 70) How are the vascular plants that are involved in mycorrhizae and the algae that are involved in lichens alike?
- A) They contain endosymbiotic fungi
 B) They are digested by fungal exoenzymes while still alive
 C) They are in intimate associations with chytrids
 D) They secrete acids that keep the fungal partner (mycobiont) from growing too quickly
 E) They provide organic nutrients to the fungal partners (mycobionts)
- 71) *A researcher compared the nucleotide sequences of a homologous gene from five different species of mammals. The sequence homology between each species' version of the gene and the human gene are presented as a percentage of similarity.*

<u>Species</u>	<u>Percentage</u>
Chimpanzee	99.7
Orangutan	98.6
Baboon	97.2
Rhesus monkey	96.9
Rabbit	93.7

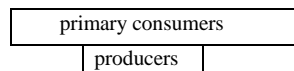
What is the most probable explanation for the inclusion of the rabbits in this research?

- A) Their short generation time provides a ready source of DNA
 B) They possess all of the shared derived characters as do the other species listed
 C) They are the closest known relatives of the rhesus monkey
 D) They are being used as the outgroup
 E) They are the most recent common ancestor of the Primates

- 72) The recent estimate that HIV-1 M first jumped from chimpanzees to humans in the 1930s is based on;
- A) the first clinical evidence of AIDS recorded in local village records in Africa
 - B) a molecular clock that plotted changes in sequences of an HIV gene sampled from patients over the past 20 years and then projected backward to an estimated origin
 - C) a comparison of homologous genes in HIV found in chimpanzees and in humans
 - D) the recent discovery of HIV in a blood sample saved from that time period
 - E) a parsimonious explanation of the evolutionary relationships among the various strains of the virus found in humans
- 73) Plant species A has a diploid number of 12. Plant species B has a diploid number of 16. A new species C, arises as an allopolyploid from hybridization of A and B. The diploid number of C would probably be;
- A) 12 B) 14 C) 16 D) 28 E) 56
- 74) In an experiment studying photosynthesis performed during the day, you provide a plant with radioactive carbon (^{14}C) dioxide as a metabolic tracer. The ^{14}C is incorporated first into OAA (oxaloacetic acid). The plant is best described as a:
- A) C-4 plant
 - B) C-3 plant
 - C) CAM plant
 - D) carnivorous plant
 - E) chemoautotroph
- 75) Of the following, a receptor protein in a membrane that recognizes a chemical signal is most similar to;
- A) genes making up a chromosome
 - B) an enzyme with an optimum pH and temperature for activity
 - C) a specific catalytic site of an enzyme binding to a substrate
 - D) DNA encoding a message into RNA
 - E) a particular metabolic pathway operating within a specific organelle
- 76) Cellular respiration;
- A) is the reverse of the process of photosynthesis
 - B) involves the physical exchange of gases
 - C) is a mechanism of tapping the energy found in the bonds between atoms in organic compounds
 - D) can occur only if there is a supply of glucose available
 - E) occurs only in heterotrophs
- 77) High altitude acclimatization results in all of the following EXCEPT;
- A) increased production of erythropoietin
 - B) increased blood-cell production
 - C) decreased workload for the heart
 - D) an increase in blood viscosity
 - E) increased O_2 concentration in the blood
- 78) Type II survivorship curves:
- A) are characteristic of humans and elephants
 - B) indicate a fairly constant rate of death at all ages
 - C) indicate a high mortality rate in the very young
 - D) are characteristic of species in which most individuals live a relatively long life and die of old age
 - E) are typical of species with high biotic potentials

- 79) Many introduced species have deleterious effects on communities and ecosystems because;
- A) coevolved parasites and competitors are absent
 - B) the introduced species are generally long-lived
 - C) predators prefer the introduced species, and the local prey therefore exponentially grow to drastically exceed their carrying capacity
 - D) the communities from where they came from collapse because most of these are keystone species
 - E) all of these are probable explanations
- 80) Which of the following is mismatched?
- A) oligotrophic lake; high productivity
 - B) cool water; high gas content
 - C) eutrophic lake; pollution
 - D) eutrophic lake; succession
 - E) eutrophic lake; oxygen depletion
- 81) Which of the following is (are) fixed action patterns(s)?
- A) A baby garter snake captures and eats a slug
 - B) A human infant mimics facial expressions of a nearby adult
 - C) A European cuckoo hatchling pushes the host bird's egg out of the nest
 - D) a male fruit fly waves his wings at a female fruit fly during courtship
 - E) All of these are examples of FAPs
- 82) When researchers attempt to answer the question of why various animals exist in such a diversity of social units from solitary to complex societies, they use;
- A) genetic analysis
 - B) habitat data
 - C) cost-benefit analysis
 - D) environmental studies
 - E) time-density studies
- 83) The most outcries concerning the possible disappearance of the tropical rain forests within a human lifetime comes from groups in ___ countries, which use ___ of the world's resources.
- A) developing; the least
 - B) developing; the most
 - C) highly developed; the least
 - D) highly developed; the most
 - E) the poorest; most
- 84) All of the following are true regarding the state of the coral reefs EXCEPT that they;
- A) develop in warm, clear waters near coasts or volcanic islands
 - B) are found between 25 degrees north and south
 - C) contain the remains of hard corals and the mineral-hardened cells walls of red algae
 - D) are very resistant to increase in temperature and siltation from erosion due to development and agriculture along the coastlines
 - E) are increasing in number as 'endangered ecosystems' due to the increase in the occurrence of bleaching
- 85) In order to maintain the largest sustainable fish harvest, fishing efforts should;
- A) harvest only postreproductive fish
 - B) maintain the population close to its carrying capacity
 - C) reduce the population to a very low number to take advantage of exponential growth
 - D) be prohibited
 - E) maintain the population density close to $1/2 K$

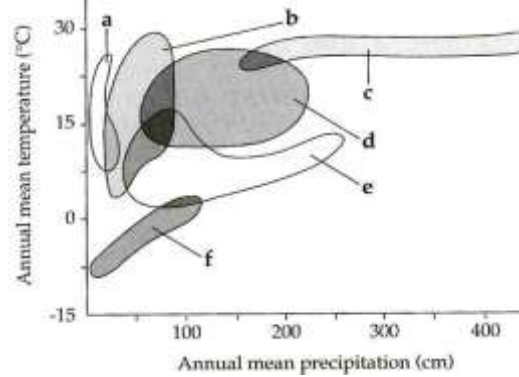
- 86) The symptoms of a certain inherited disorder in humans include respiratory problems and, in males, sterility. Which of the following is a reasonable hypothesis for the molecular basis of this disorder?
- A) a defective enzyme in the mitochondria
 - B) defective actin molecules in cellular microfilaments
 - C) defective dynein molecules in cilia and flagella
 - D) abnormal hydrolytic enzymes in the lysosomes
 - E) a defective enzyme in the mast cells
- 87) If a genetic researcher were to look at a sequence of an entire chromosome, how could she identify which segments might contain a gene?
- A) She could identify large protein-coding regions (open reading frames)
 - B) She could look for a match with an expressed sequence tag (EST)
 - C) She could look for consensus regulatory sequences that could initiate transcription
 - D) All of these strategies could be used to identify possible genes
 - E) It is impossible to predict genes from sequence data alone
- 88) For the biomass pyramid shown below, choose the correct statement:



- A) This may be typical of an aquatic ecosystem where the autotrophs reproduce quickly, but are also consumed at a rapid rate
 - B) Biomass decreases with higher trophic levels
 - C) This biomass pyramid is consistent with an algal bloom
 - D) This may be typical of a tropical rain forest where there is rapid growth of the autotrophs and rapid recycling of the nutrients
 - E) This biomass pyramid is not possible
- 89) In the acronym, H.I.P.P.O., coined by E.O. Wilson regarding the primary reasons for the loss of biodiversity, which of the following is INCORRECT?
- A) H - habitat destruction
 - B) I - introduced species
 - C) P - pollution
 - D) P - population
 - E) O - organic farming
- 90) 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) 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
 - B) planting a nontransgenic plant border around crop fields to reduce crop-to-weed transfer
 - C) breeding male sterility into transgenic plants so that they have no pollen to be transferred to nearby weeds
 - D) engineering the gene of interest into chloroplast DNA, which is inherited from the maternal plant and is not transferred by pollen
 - E) all of these would reduce the risk of crop-to-weed transgene escape
- 91) A secondary immune response is usually more rapid and greater in effect than a primary immune response due to;
- A) histamines and prostaglandins cause rapid vasodilation
 - B) the second response is an active immunity, whereas the primary response is a passive immunity
 - C) memory cells respond to the pathogen and quickly clone more effector cells
 - D) chemokines cause the rapid accumulation of phagocytic cells
 - E) helper T cells are available to activate other blood cells

- 92) What do the invertebrate statocysts, the lateral line of fish, and the cochlea of a human ear all have in common?
- A) They are used to sense sound or pressure waves
 - B) They are organs of equilibrium
 - C) They use hair cells as mechanoreceptors
 - D) They use granules to stimulate their receptor cells
 - E) They use a second-messenger pathway of signal transduction

- 93) Using the climograph below: which of the following is NOT correctly matched?



- A) a - arctic and alpine tundra
 - B) b - grassland
 - C) c - tropical rain forest
 - D) d - temperate deciduous forest
 - E) All are correctly matched
- 94) Which of the following interspecific interactions is NOT an example of a +/- interaction?
- A) ectoparasite and host
 - B) herbivore and plant
 - C) pathogen and host
 - D) honeybee and flower
 - E) carnivore and prey
- 95) The greenhouse effect:
- A) could change global climate and lead to flooding of coastal areas
 - B) could result in more C-4 plants in plant communities that were previously dominated by C-3 plants
 - C) causes an increase in temperature when CO₂ absorbs more sunlight entering the atmosphere
 - D) could increase precipitation in central continental areas
 - E) all of the above are possible consequences of the greenhouse effect
- 96) With limited resources, conservation biologists need to prioritize their efforts. Of the following choices, which should receive the greatest conservation attention in order to sustain biodiversity?
- A) the norther spotted owl
 - B) a commercially important species
 - C) declining keystone species in a community
 - D) endangered and threatened vertebrate species
 - E) all declining species

- 97) Which of the following combinations of phylum and characteristics is INCORRECT?
- A) Echinodermata - radial symmetry, endoskeleton, water vascular system
 - B) Annelida - segmentation, closed circulatory system, hydrostatic skeleton
 - C) Nematoda - gastrovascular cavity, tough cuticle, hermaphroditic
 - D) Rotifera - parthenogenesis, crown of cilia, microscopic animals
 - E) Nemertea - proboscis worm, complete digestive tract, closed circulatory system
- 98) Why is the diversity of life now organized into three Domains?
- A) The origin of life involved three distinct stages - protobiont, prokaryote, and eukaryote - and each domain represents one of these stages
 - B) Molecular evidence indicates that the protists really include three separate lineages
 - C) The eukaryotes are more alike than are the prokaryotes and thus belong to one large group
 - D) The domains Bacteria and Archaea reflect the early evolutionary divergence of these two lineages, and they differ from eukaryotes
 - E) The division into plants, animals, and bacteria is more intuitive and accessible to the majority of scientists
- 99) Which of the following enzymes or proteins is paired INCORRECTLY with the function?
- A) Helicase - unwind and separate parental double helix
 - B) Telomerase - add telomere repetitions to the ends of chromosomes
 - C) Single-strand binding protein - hold strands of unwound DNA apart and straight
 - D) Nuclease - excise (cut out) damaged or mismatched pairs of DNA
 - E) Primase - form DNA primer to initiate replication
- 100) This restriction fragment contains a gene whose recessive allele is lethal. The normal allele has restriction sites for the restriction enzyme *PSTI* at sites I and II. The recessive allele lacks restriction site I. An individual who had a sister with the lethal trait is being tested to determine if she is a carrier for that allele. Indicate which of these band patterns would be produced on a gel if she is a carrier (heterozygous).



- A)

Diagram A shows a gel with four bands. From left to right, the bands are: a short band, a medium band, a long band, and a very long band. The gel is labeled with a minus sign (-) on the left and a plus sign (+) on the right.
- B)

Diagram B shows a gel with six bands. From left to right, the bands are: a short band, a medium band, a long band, a very long band, a medium band, and a short band. The gel is labeled with a minus sign (-) on the left and a plus sign (+) on the right.
- C)

Diagram C shows a gel with three bands. From left to right, the bands are: a short band, a long band, and a very long band. The gel is labeled with a minus sign (-) on the left and a plus sign (+) on the right.
- D)

Diagram D shows a gel with five bands. From left to right, the bands are: a short band, a medium band, a long band, a very long band, and a short band. The gel is labeled with a minus sign (-) on the left and a plus sign (+) on the right.
- E)

Diagram E shows a gel with two bands. From left to right, the bands are: a short band and a very long band. The gel is labeled with a minus sign (-) on the left and a plus sign (+) on the right.

The End