CLEP Biology
Practice Test

Time—90 Minutes
110 Questions

For each question below, choose the best answer from the choices given.

1. Two organisms that are classified in the same family would not necessarily be classified in the same

(A) kingdom
(B) order
(C) phylum
(D) class
(E) genus

2. Plasma B cells are essential in the human immune response because of their ability to

(A) produce antibodies that can clump bacteria or viruses together so that macrophages can ingest them
(B) attach directly to infected cells and puncture them with enzymes
(C) cause antigen molecules, such as toxins, to settle out of the blood plasma
(D) engulf pathogens that they encounter in the bloodstream
(E) clot open wounds so that bacteria cannot invade the body

3. The first vertebrates to live on land were the amphibians, characterized by their ability to

(A) lay eggs and by their rough, scaly skin
(B) breathe through moist skin and walk on four limbs
(C) lay hard-shelled eggs on land
(D) run quickly on land using muscular limbs
(E) develop mammary glands for milk production

4. Fossils of an ancient reptile called *Lystrosaurus* have been found in Africa, India, and Antarctica. Which of the following best explains this distribution?

(A) They were able to move between continents before the oceans filled.
(B) The movement of India due to continental drift carried them from place to place.
(C) These land areas were once next to each other and have since drifted apart.
(D) They were able to migrate over frozen seas during Ice Ages.
(E) Changes in climate forced them to migrate from place to place.

5. Gregor Mendel identified "factors" that could be passed down from parents to offspring and that resulted in the expression of certain characteristics. Today, we call Mendel's "factors"

(A) linked genes
(B) alleles
(C) genotypes
(D) phenotypes
(E) homologous chromosomes

6. A decrease in the amount of carbon dioxide present in the air surrounding most plants would most likely result in

(A) the death of the plants
(B) an increase in the production of sugars through photosynthesis
(C) a decrease in the output of the Calvin cycle
(D) the breakdown of chlorophyll molecules in the mesophyll layer
(E) more nitrogen released into the air from the soil

7. Fertilization of a human ovum normally occurs in the

(A) vagina
(B) ovary
(C) uterus
(D) seminiferous tubule
(E) oviduct

8. A DNA strand has a base sequence of CGTAGT. The mRNA strand transcribed from this DNA is

(A) ACUACG
(B) CGTAGT
(C) GCAUCA
(D) GACUAC
(E) UACGUA

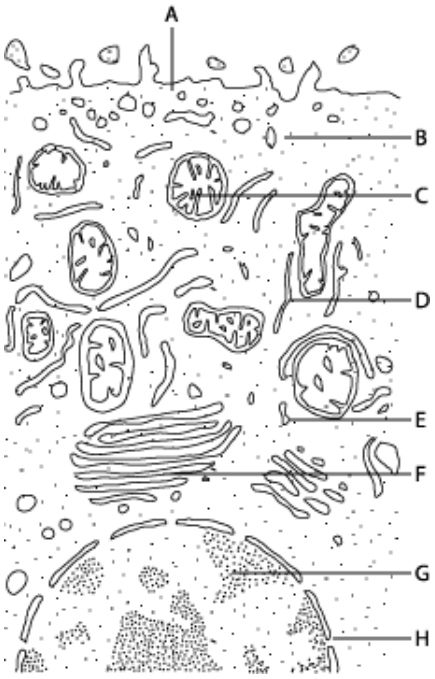
9. Diabetics may have sugar in their urine because

(A) the proximal tubules of their nephrons cannot reabsorb sugar efficiently
(B) they do not produce enough insulin to absorb sugar from the bloodstream
(C) of deamination of proteins in their cells
(D) poor filtration at the Bowman's capsules of their nephrons
(E) they eat large amounts of sugar

10. Damage to the cells lining the large intestine would likely result in

(A) diarrhea
(B) decreased absorption of sugars and lipids
(C) decreased filtration of proteins and amino acids from the bloodstream
(D) heartburn
(E) gallstones

11.



The area of this cell in which a chemiosmotic hydrogen-ion gradient is used to produce ATP is represented by the letter

(A) A
(B) C
(C) F
(D) G
(E) H

12. The following data is collected from placing three lizards of different species in separate closed tanks to measure their production of carbon dioxide over the course of 30 minutes.

Species	Weight in grams	CO_2 production (mL)
1	12	0.072
2	8	0.048
3	24	0.144

Which of the following conclusions can be accurately drawn from this data?

(A) Lizards with smaller bodies consumed less oxygen per gram of body weight than lizards with larger bodies.
(B) Each species of lizard has a unique rate of respiration.
(C) Lizards in warmer climates produce more carbon dioxide than lizards in colder climates.
(D) The 24-gram lizard consumes oxygen at a rate double that of the 12-gram lizard.
(E) The amount of carbon dioxide produced per gram of body weight for each species is the same.

13. Experiments involving the reduction of the blue dye DPIP, which loses its blue color and becomes clear as it absorbs electrons, have shown that the dye shows the greatest loss of color when in the presence of chloroplasts

(A) under bright, white light
(B) in a dark box
(C) that have been boiled before exposure to light
(D) exposed only to green light
(E) in a sugar solution

14. In humans, carbon dioxide in the bloodstream is mainly transported from cells to lungs

(A) as bicarbonate ion
(B) as carbon dioxide gas bubbles within red blood cells
(C) attached to hemoglobin
(D) as carbonic acid
(E) as carbon dioxide gas bubbles within the plasma

15. A newly discovered organism has ribosomes that can be inhibited by the antibiotic streptomycin as well as free-floating DNA not enclosed within a nuclear membrane. This organism is most likely a(n)

(A) virus
(B) plant
(C) fungus
(D) protist
(E) bacterium

16. In or around the cells of flowering plants, one would expect to find all of the following EXCEPT

(A) cell walls
(B) mitochondria
(C) centrioles
(D) large, central vacuoles
(E) chloroplasts

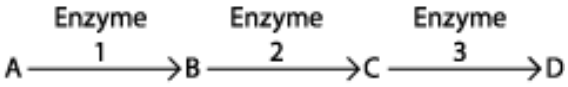
17. The best current evidence that modern-day birds evolved from certain lineages of dinosaurs or other reptiles may be supplied by the fact that

(A) some dinosaurs, like birds, could fly
(B) transitional fossils such as *Archaeopteryx* have been discovered
(C) birds and reptiles both exhibit some parental care for their young
(D) no birds have ever been found living during the same time period as dinosaurs
(E) modern-day crocodiles are genetically similar to certain lineages of modern-day birds

18. Malfunctioning sodium-potassium pumps along a neuron's axon would likely result in

(A) an increased frequency of action potentials
(B) a reversal in the movement of chloride ions across the axon membrane
(C) action potentials that move from axon to dendrite
(D) a rapid decrease in the ability of the axon to conduct an action potential
(E) the use of neurotransmitters to move the action potential down the axon

19.

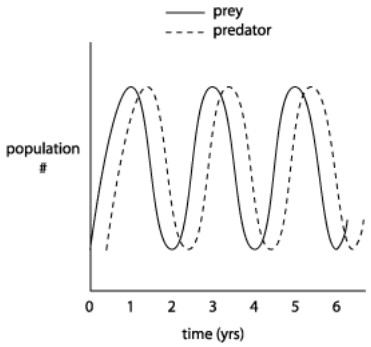


Which of the following conditions could result in a *decreased* production of Substance C?

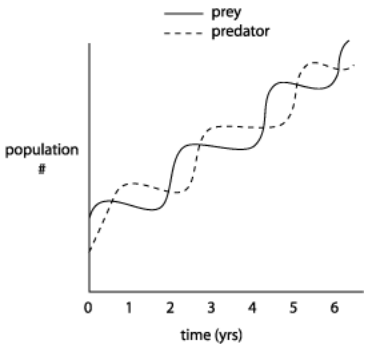
(A) Addition of Substance B
(B) Boiling Enzyme 1
(C) Mixing Enzyme 1 with Enzyme 2
(D) Addition of Enzyme 2
(E) Removal of Substance D

20. Which graph shows the likely relationship between a predator species and its prey over a six-year cycle?

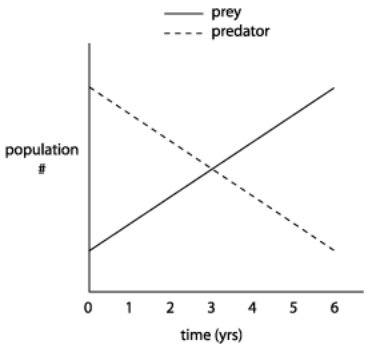
(A)



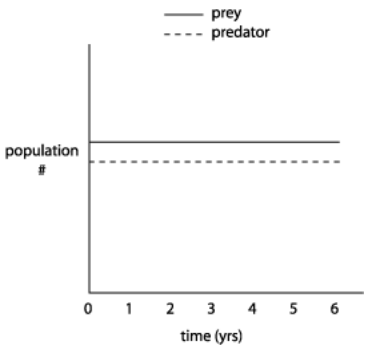
(B)



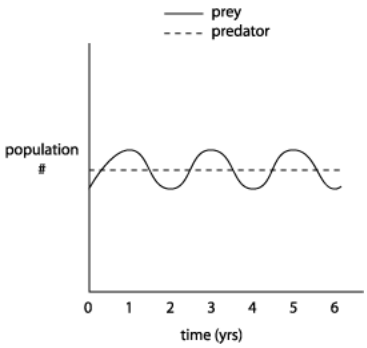
(C)



(D)



(E)



21. Which of the following hormones is correctly linked to its function in mammals?

(A) Prolactin.. regulates calcium in the blood-stream
(B) Follicle simulating hormone.. regulates sperm production
(C) Gonadotropin-releasing hormone.. causes release of thyroxine
(D) Aldosterone.. production of secondary sex characteristics
(E) Insulin.. increases blood glucose levels

22. The process of breaking food particles down into the macromolecules that make them up is called

(A) ingestion
(B) cellular respiration
(C) absorption
(D) dehydration synthesis
(E) digestion

23. In a plant cell, the reactions of photosynthesis take place within the

(A) mitochondria
(B) chloroplast
(C) cytoplasm
(D) nucleus
(E) plasma membrane

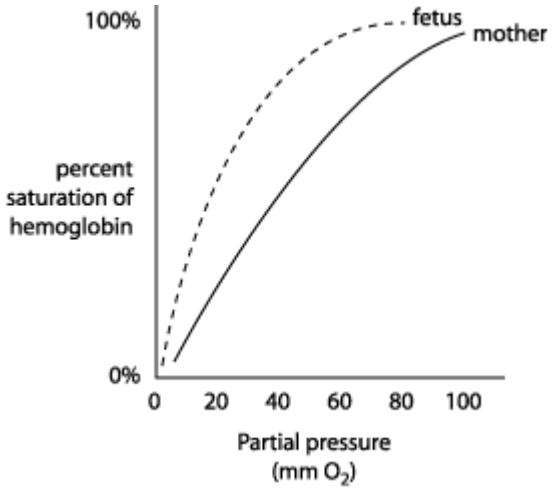
24. Mosses cannot grow very tall due to their lack of

(A) specialized vascular tissues
(B) a dominant gametophyte generation
(C) chlorophyll
(D) airborne spores
(E) bark

25. Two plants (A and B) of different species are growing together in the same pot. When plant A is removed and grown in a separate pot, it rapidly grows much taller than it had been before, while plant B dies. Which term describes the type of relationship that plants A and B most likely had?

(A) Mutualism
(B) Commensalism
(C) Competition
(D) Parasitism
(E) Polymorphism

26. The oxygen dissociation curve of human fetal hemoglobin differs significantly from that of the mother, as shown below. What characteristic of fetal hemoglobin might account for the fact that fetal hemoglobin is able to pick up oxygen from the mother's blood at a significant distance from the mother's lungs?



(A) The hemoglobin of the fetus cannot bind oxygen as strongly as the hemoglobin of the mother.
(B) Fetal hemoglobin binds oxygen at lower partial pressures and becomes fully saturated at lower partial pressures.
(C) Fetal hemoglobin has iron unlike maternal hemoglobin.
(D) Fetal hemoglobin needs higher partial pressures of oxygen than maternal hemoglobin in order to become fully saturated with oxygen.
(E) There is more hemoglobin packed into the red blood cells of fetuses than into the red blood cells of adults.

27. Red plants (R) are dominant to green plants (r). Crossing homozygous red plants with homozygous green plants would result in which of the following phenotype/genotype combinations?

(A) RR.. red
(B) Rr.. red
(C) rr.. green
(D) rr.. red
(E) Rr.. red with green patches

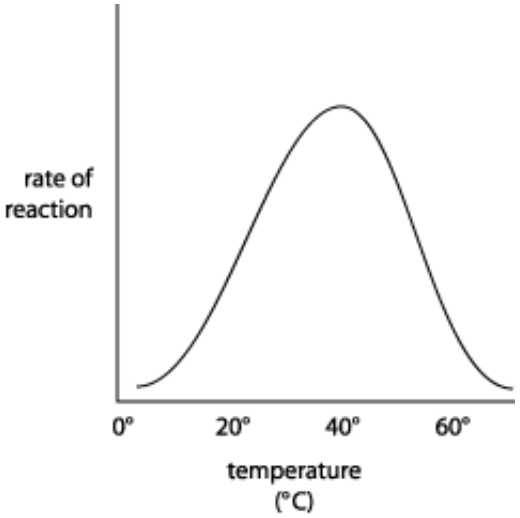
28. Proteins that bind to the surfaces of pathogens and help to destroy the pathogens are known as

(A) antibodies
(B) antigens
(C) histamine
(D) macrophages
(E) hormones

29. Mammals share all of the following characteristics with other vertebrates EXCEPT

(A) lungs
(B) egg-laying ability
(C) vertebrae
(D) endothermy
(E) mammary glands

30. The graph below shows the effectiveness of an enzyme at various temperatures ranging from 0 degrees Celsius to 60 degrees Celsius. What is the best explanation for the behavior of this enzyme at temperatures higher than approximately 40 degrees Celsius?



(A) The heat has caused the enzyme and substrate molecules to move more slowly.
(B) The enzyme cannot get any more oxygen at warmer temperatures and dies.
(C) The enzyme becomes denatured and loses its 3-D structure.
(D) The enzyme becomes more active due to the increased availability of substrate molecules at higher temperatures.
(E) A second enzyme had destroyed the active sites on the enzyme being examined.

31. Oils, fats, and waxes are included among which of the following classes of organic compounds?

(A) Steroids
(B) Proteins
(C) Lipids
(D) Carbohydrates
(E) Fatty acids

32. Which of the following eukaryotic organelles is correctly linked to its function?

(A) Golgi apparatus.. packaging products for export out of the cell
(B) ribosomes.. RNA synthesis
(C) lysosomes.. protein synthesis
(D) mitochondrion.. site of photosynthesis
(E) nucleus.. mitotic spindle production

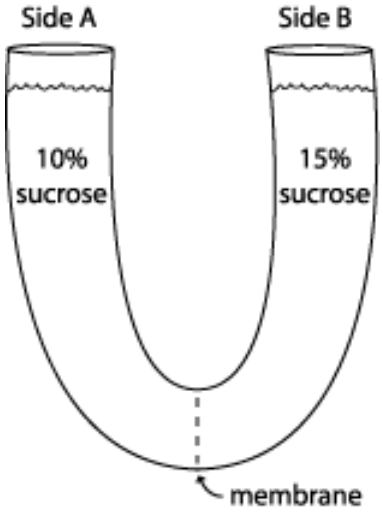
33. Which of the following statements correctly explains the flow of energy through a food web?

(A) There is more and more energy available as one moves up the food web in order to supply the larger organisms with the energy they need.
(B) Organisms of the third trophic level use three times the amount of energy that organisms of the second trophic level use.
(C) Radiant energy from the sun is shared equally at all trophic levels of the food web.
(D) Energy is recycled through an ecosystem much as carbon and nitrogen are.
(E) There is a step-like decline of available energy from one trophic level to the next as organisms use energy for activities such as growth and reproduction.

34. An animal cell is placed in a solution containing a solute concentration greater than that of the cell's cytoplasm. The cell membrane is permeable to water but not to the solutes. What is likely to happen to the cell?

(A) The cell will swell due to active transport of water.
(B) The cell will shrivel due to active transport of water.
(C) The cell will shrivel due to osmosis.
(D) The cell will swell due to osmosis.
(E) No change will occur in the size of the cell.

35. The two sides of the U-tube shown below are separated by a semi-permeable membrane that allows water but not sucrose to pass through it. Side A is filled with a 10% sucrose solution, and Side B is filled with a 15% sucrose solution. After the system reaches equilibrium, which of the following will have occurred?



(A) The water level of Side A will be higher than Side B.
(B) The water level of Side B will be higher than Side A.
(C) The concentration of sucrose on Side A will be higher than on Side B.
(D) The concentration of sucrose on Side B will be higher than it started out.
(E) There will be no change in water levels on either side.

36. Organisms in which of the following kingdoms are prokaryotic?

(A) Animalia
(B) Plantae
(C) Fungi
(D) Protista
(E) Monera

37. Small populations of organisms living in areas with plentiful resources usually

(A) maintain a fairly constant population number over time
(B) reach their carrying capacity after one or two generations
(C) undergo exponential growth
(D) experience a population crash
(E) have few offspring at each reproduction and invest a great deal of energy into parental care of offspring

38. All of the following statements concerning mutations are true EXCEPT

(A) Changes in the environment can suddenly lead to certain allelic variants becoming favorable.
(B) Point mutations may alter a single amino acid in a protein, resulting in either non-functional or more efficient proteins.
(C) Mutant alleles may increase in frequency in a population if they are linked to some beneficial allele.
(D) Mutations in all body cells can be passed onto offspring.
(E) Gene translocations can move certain alleles closer to promoter regions and result in increased transcription.

39. Traits within a population that vary from individual to individual in a noncontinuous manner (i.e. two or more forms of a particular trait exist but intermediate forms do not exist) are known as

(A) ecotypes
(B) polymorphisms
(C) clines
(D) recombinants
(E) gene amplifications

40. The neurons of the sympathetic branch of the autonomic nervous system would be most likely to result in which of the following actions?

(A) Digestion of food
(B) Rapid heartbeat
(C) Constriction of the pupils of the eye
(D) Decreased rate of breathing
(E) Activation of the vagus nerve

41. All of the following nitrogenous bases make up RNA molecules EXCEPT

(A) adenine
(B) cytosine
(C) thymine
(D) guanine
(E) uracil

42. Proteins such as hemoglobin that are comprised of multiple units, or chains, of amino acids exhibit what type of structure?

(A) Primary
(B) Secondary
(C) Tertiary
(D) Quaternary
(E) Trimeric

43. The electron carrier in photosynthesis responsible for ferrying electrons from the chloroplast membrane into the stroma of the chloroplast is

(A) NADPH
(B) NADH
(C) ATP
(D) $FADH_2$
(E) $C_6H_{12}O_6$

44. Significant overlap in the sequence of amino acids of the same protein involved in cell division from two different species indicates that

(A) other proteins compared between the two species are unlikely to be similar
(B) the proteins have a common evolutionary origin
(C) the DNA coding for the two proteins will be identical when introns are removed
(D) the two proteins would have identical tertiary structures
(E) the two species do not share a recent common ancestor

45. In order to splice a foreign gene into a bacterial plasmid in the laboratory to create a recombinant plasmid, one would use

(A) reverse transcriptase
(B) DNA polymerase
(C) catalase
(D) polymerase chain reaction (PCR)
(E) restriction enzymes

46. The process by which large fats are broken down into smaller "droplets" of fat for easier chemical digestion within the small intestine is called

(A) lipation
(B) emulsification
(C) hydrolysis
(D) dehydration synthesis
(E) cleavage

47. Which of the following is NOT a function of mitosis?

(A) Multiplication of somatic cells
(B) Growth
(C) Production of gametes
(D) Repair of wounds
(E) Replacement of lost or damaged cells

48. Which of the following sequences best describes the flow of information that takes place when a eukaryotic gene directs the synthesis of a protein?

(A) RNA → DNA → RNA → protein
(B) DNA → mRNA → protein
(C) protein → RNA → DNA
(D) DNA → amino acid → RNA → protein
(E) DNA → protein

49. Experiments by Thomas Hunt Morgan with the eye coloration of fruit flies demonstrated that

(A) mutations in DNA can knock out the function of certain genes
(B) one gene carries the code for a single protein
(C) the genes for certain traits are carried on the X-chromosome
(D) eye coloration genes are found on the same chromosome as genes for wing shape and length
(E) only male fruit flies express recessive white eye coloration, while both males and females express the dominant red eye coloration

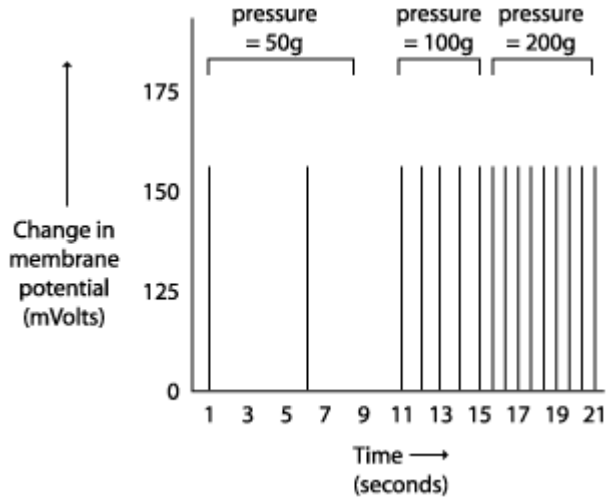
50. A lack of which of the following substances would likely lead to dizziness, fatigue, and confusion due to red blood cells being less able to carry oxygen?

(A) Calcium
(B) Vitamin D
(C) Zinc
(D) Magnesium
(E) Iron

51. The toad *Bufo marinus* generally lies in wait for prey such as cockroaches to wander past. As the cockroach enters the toad's field of view, the toad strikes with its sticky tongue. Yet, the cockroach begins its escape from the toad even before the tongue has left the toad's mouth, even though it may still be caught. Attacks generally occur at night and the tongue makes no detectable sound at all. Cockroaches have also seen climbing on the backs of sedentary toads.

These observations suggest that
(A) cockroaches are repelled by the odor of a toad
(B) cockroaches begin to flee at the sight of a toad
(C) cockroaches can detect slight changes in wind direction
(D) toads produce a high frequency sound detectable by the cockroach at the time of attack
(E) the cockroach is responding to a previously misdirected attack

52. The data below show the response of a neuron on the skin surface to repeated stimulation with varying degrees of pressure.



Which of the following conclusions concerning the pressure-sensitive neurons of the skin can be drawn from this data?

(A) The neurons fatigue quickly after repeated stimulation.
(B) There is a prolonged period of repolarization that leaves the neurons refractory for as long as one second after each firing.
(C) Increasing pressure results in an increase in amplitude of the action potential.
(D) The neurons signal increased pressure by increasing the frequency of signals sent per unit time.
(E) The neurons fire only after a certain pressure threshold is reached.

53. In contrast to spermatogenesis, oogenesis

(A) produces one functional haploid cell for every diploid cell that begins the process
(B) is started by the hormones FSH and LH
(C) takes place in the fallopian tubes
(D) produces gametes
(E) features equal divisions of cytoplasm and organelles into daughter cells

54. The white blood cells responsible for attacking specific pathogens with antibodies are a type of

(A) erythrocyte
(B) lymphocyte
(C) neutrophil
(D) macrophage
(E) platelet

55. Guard cells are kidney-shaped cells surrounding the stomata on the underside of leaves. These cells change their shape according to the amount of water that exists within them. The more water within, the more swollen the guard cells are and the stomata open. When water is sparse the guard cells shrivel and close the stomata. Recent evidence suggests that there are blue-light receptors on the plasma membrane surface of guard cells that are coupled to potassium (K^+) ion channels. K^+ ions are normally found in high concentration outside guard cell membranes when the channels are closed. What mechanism may account for the fact that guard cells are usually open during the day and closed at night?

(A) Photosynthesis uses K^+ ions; therefore, lower concentrations of potassium within the leaf drive the movement of K^+ into the leaf through the guard cells.
(B) The presence of sunlight drives K^+ into guard cells, while driving water out of the guard cells and opening the stomata.
(C) There is more water in the air during daylight hours than during nighttime hours.
(D) K^+ ions enter the cell through active transport only when enough water is present.
(E) The presence of sunlight opens the K^+ ion channels, driving potassium inside, and causing water to follow by osmosis, swelling the guard cells.

56. Pollen grains are produced by meiosis on which of the following parts of a flowering plant?

(A) Sepal
(B) Style
(C) Stigma
(D) Anther
(E) Filament

57. Lichens are hardy organisms that can be found growing on rocks or trees in relatively unpolluted environments. They are often the first colonizers of landscapes that have been destroyed by fire or other natural disasters. Lichens are made up of two symbiotic organisms. They are

(A) a fungus and an algae
(B) a fungus and a bacterium
(C) a bacterium and an algae
(D) two different species of algae
(E) two different species of fungus

58. Organisms that display radial symmetry as adults, possess stinging cells, and tentacles would be found in the animal phylum

(A) *Porifera*
(B) *Cnidaria*
(C) *Platyhelminthes*
(D) *Aschelminthes*
(E) *Annelida*

59. The soil of tropical rainforests is extremely nutrient-poor with little nitrogen. Despite this, the rainforests of the world are home to 75% of the world's species, including huge numbers of plants and trees. What may account for this apparent contradiction?

(A) Frequent volcanic eruptions enrich the soil with nutrients.
(B) There are so many organisms living and dying in the rainforests at any one time that a great deal of organic matter continuously exists to be cycled through the soil.
(C) Nitrogen compounds necessary for growth can be synthesized from scratch, without nitrogen from the atmosphere, by bacteria living in the soil.
(D) The soil is able to hold a great deal of water which cycles back into forest vegetation.
(E) The soil is nitrogen-poor because many of the rainforest plants are able to use nitrogen directly from the air, so that it does not have to be converted into nitrates by soil bacteria.

60. Natural disasters that wipe out large portions of a population, resulting in the formation of a new population that possesses only a small proportion of the original population's genetic diversity, cause what is known as

(A) a founder effect
(B) a bottleneck effect
(C) gene flow
(D) allopolyploidy
(E) speciation

61. If the frequency of a dominant *allele* for a particular trait goes up in a population, what would be expected to happen to the frequency of *individuals* who are *recessive* for that trait in this population?

(A) It would decrease regardless of what type of trait was coded for by this allele.
(B) It would increase regardless of what type of trait was coded for by this allele.
(C) It would remain the same
(D) It would increase only if the dominant condition were harmful.
(E) The frequency of recessive individuals would not be affected by changes in the frequency of dominant alleles.

62. Ammonia and other nitrogen-containing organic matter is generally decomposed and converted into nitrogen gas by reactions within the cells of

(A) denitrifying bacteria
(B) nitrifying bacteria
(C) nitrogen-fixing bacteria
(D) photosynthetic bacteria
(E) green plants and algae

63. In response to attack by a pathogen or allergen, basophils and mast cells around the body release large amounts of which of the following substances, which is responsible for dilating walls of blood vessels and making capillaries leaky?

(A) Interleukins
(B) Antibodies
(C) Lysozyme
(D) Acetylcholine
(E) Histamine

64. Stacks of grana can be found in this organelle for the purpose of providing increased surface area for chemical reactions.

(A) Chloroplast
(B) Mitochondria
(C) Nucleus
(D) Ribosome
(E) Endoplasmic reticulum

65. Two subunits built from proteins and rRNA.

(A) Chloroplast
(B) Mitochondria
(C) Nucleus
(D) Ribosome
(E) Endoplasmic reticulum

66. The site of protein synthesis in eukaryotic cells.

(A) Chloroplast
(B) Mitochondria
(C) Nucleus
(D) Ribosome
(E) Endoplasmic reticulum

67. Inner membrane made of convoluted cristae, where ETC proteins can be found.

(A) Chloroplast
(B) Mitochondria
(C) Nucleus
(D) Ribosome
(E) Endoplasmic reticulum

68. Enzymes that copy DNA can make mistakes and end up copying certain regions toward the tips of chromosomes multiple times, resulting in areas that can cause various genetic illnesses.

(A) Epistasis
(B) Epigenesis
(C) Genomic imprinting
(D) Triplet repeat extension
(E) Mitochondrial inheritance

69. A second set of alleles determines whether or not a first set of alleles will be expressed.

(A) Epistasis
(B) Epigenesis
(C) Genomic imprinting
(D) Triplet repeat extension
(E) Mitochondrial inheritance

70. Genes passed down through the egg from mother to offspring, and never passed down from fathers to offspring.

(A) Epistasis
(B) Epigenesis
(C) Genomic imprinting
(D) Triplet repeat extension
(E) Mitochondrial inheritance

71. A genetic inheritance pattern that results from the fact that certain alleles seem to be coded differently according to which parent that come from.

(A) Epistasis
(B) Epigenesis
(C) Genomic imprinting
(D) Triplet repeat extension
(E) Mitochondrial inheritance

72. The driest of all biomes, with little rain and limited vegetation.

(A) Taiga
(B) Temperate deciduous forest
(C) Tundra
(D) Chaparral
(E) Desert

73. Characterized by an abundance of fire-resistant plants, this biome is found in coastal areas that experience long, hot summers and short, rainy winters.

(A) Taiga
(B) Temperate deciduous forest
(C) Tundra
(D) Chaparral
(E) Desert

74. Known as the "frozen desert," this biome experiences long, harsh winters and darkness for up to 10 months of the year.

(A) Taiga
(B) Temperate deciduous forest
(C) Tundra
(D) Chaparral
(E) Desert

75. B.F. Skinner used his famous "Skinner boxes" to investigate this type of animal behavior involving a reward as reinforcement for an action.

(A) Fixed action pattern
(B) Imprinting
(C) Habituation
(D) Associative learning
(E) Operant conditioning

76. When you first tap on the lab dish holding a *C. elegans* worm, it will rapidly recoil from the tapping and swim backward to escape. Gradually, with continued tapping, it backs up less and less and finally stops backing up altogether.

(A) Fixed action pattern
(B) Imprinting
(C) Habituation
(D) Associative learning
(E) Operant conditioning

77. A dog, presented with a ringing bell upon eating, soon begins to salivate in the presence of the ringing bell alone and no food.

(A) Fixed action pattern
(B) Imprinting
(C) Habituation
(D) Associative learning
(E) Operant conditioning

78. A selective breeding process through which humans are able to pick organisms with particular traits and breed them to produce lines of offspring expressing those traits.

(A) Artificial selection
(B) Natural selection
(C) Sexual selection
(D) Habitat selection
(E) Mass extinction

79. Female peacocks are drawn to male peacocks by the relative attractiveness and size of their tail and tail feathers.

(A) Artificial selection
(B) Natural selection
(C) Sexual selection
(D) Habitat selection
(E) Mass extinction

80. Can create many new, available niches for the rapid growth and adaptive radiation of existing species.

(A) Artificial selection
(B) Natural selection
(C) Sexual selection
(D) Habitat selection
(E) Mass extinction

Questions 81-83

Three students added equal volumes of pond water to each of four beakers (1-4) and placed each beaker in a different constant temperature bath: 5°C, 15°C, 25°C, and 35°C respectively. The students then added 6 water fleas, *Daphnia pulex*, to each of the four beakers and recorded the initial time. After one hour, students removed 3 *Daphnia* from each beaker and looked at them under a light microscope (their transparent bodies can be easily seen under a light microscope). Their heart rates were recorded below (beats per minute).

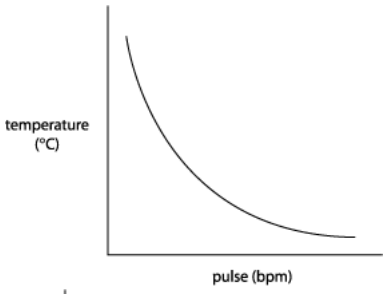
Beaker	Temperature	PULSE (per min)
1	5°C	41
2	15°C	119
3	25°C	202
4	35°C	281

81. The independent variable in this experiment is the

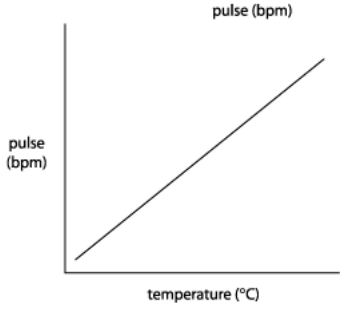
(A) amount of light
(B) number of water fleas
(C) pH of the water
(D) temperature of the water
(E) average heart rate (pulse)

82. If a graph were constructed using the data given in the table, it would most closely resemble which of the following graphs?

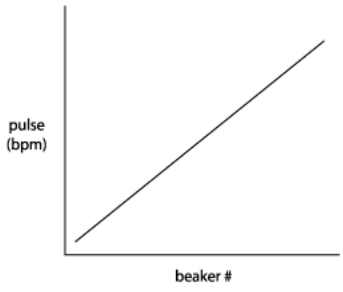
(A)



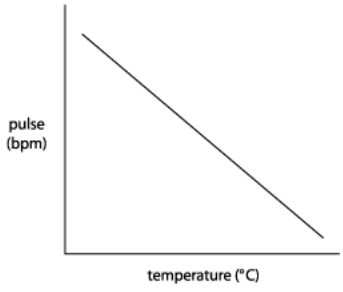
(B)



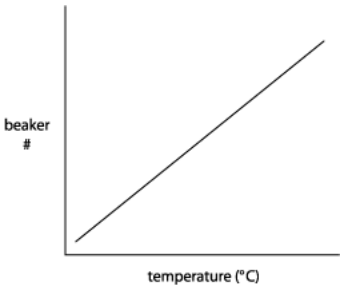
(C)



(D)



(E)

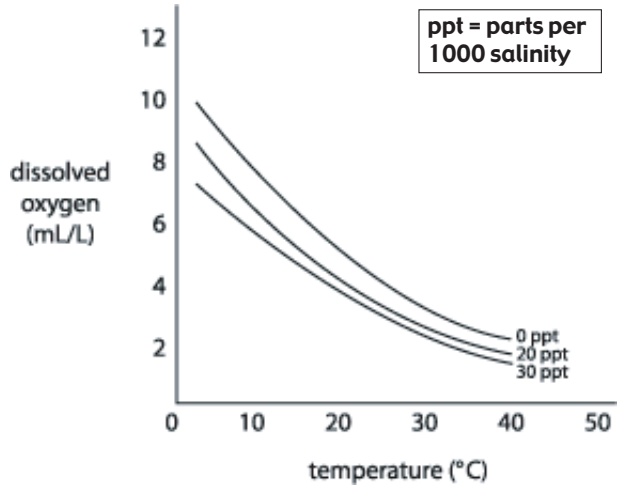


83. The data in this experiment give support to which of the following conclusions?

(A) At 45°C, the heart rate of the *Daphnia* would be around 320 beats per minute
(B) *Daphnia* swim more slowly at high temperatures
(C) Metabolic rate in *Daphnia* is directly proportional to water temperature
(D) Heart rate in *Daphnia* is inversely proportional to water temperature
(E) Between 0°C and 5°C, the heart rate of *Daphnia* remains constant

Questions 84-87

In an aquatic environment, oxygen concentration depends on chemical and physical factors and is greatly affected by many biological processes. There is much less dissolved oxygen (DO) in aquatic environments than in dry air. In most aquatic environments, there are only 5 to 10 mL of dissolved oxygen in a liter of water. Chemical and physical factors, such as salinity, pH, and especially temperature, can affect the DO concentration and distribution. An experiment was done to study the effect of different salinity levels on DO in water of varying temperatures. The results are below. Salinity is expressed in parts per thousand (ppt) and is the content of dissolved salt in water.



84. According to the data shown, a reasonable conclusion to form from the results of this experiment is that

(A) higher temperatures result in greater dissolved oxygen in water
(B) the greater the salinity, the lower the dissolved oxygen
(C) salinity is not related to dissolved oxygen levels
(D) the temperature of the water is more important than the salinity in determining dissolved oxygen levels
(E) as salinity increases, dissolved oxygen levels increase

85. The term "Dissolved Oxygen" refers to the oxygen that is dissolved in which of the following substances before it can be used by aquatic plants and animals?

(A) water
(B) ammonia
(C) salt
(D) blood
(E) carbon dioxide

86. The results of the experiment suggest that at salinities of greater than 30 ppt, it is likely that

(A) dissolved oxygen levels would increase
(B) water temperature would increase
(C) aquatic organisms would begin to die
(D) there would be no change in dissolved oxygen
(E) the amount of dissolved oxygen would decrease

87. The oxygen that is dissolved in the water is used by aquatic organisms for

(A) photosynthesis
(B) cellular respiration
(C) digestion
(D) dehydration synthesis
(E) chemosynthesis

Questions 88-91

Twenty-five ficus plants were placed in each of four closed containers and then exposed to light of specific colors as shown in the data table. All other environmental conditions were held constant for a period of 3 days. At the beginning of the investigation, the quantity of CO_2 present in each closed container was 220 cubic centimeters. The data table shows the amount of CO_2 remaining in each container at the end of 3 days.

Container	Color of light	CO_2 (cm^3)
1	blue	75
2	red	50
3	green	200
4	orange	150

88. The color of light that seems best for photosynthesis in ficus plants is

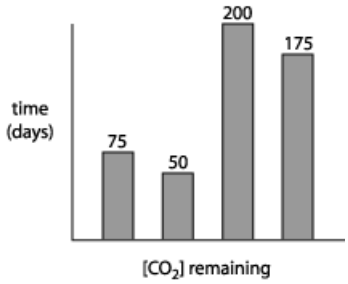
(A) blue
(B) red
(C) green
(D) orange
(E) All colors tested were equivalent.

89. The one color of light missing from the experimental data that would provide a suitable control group is

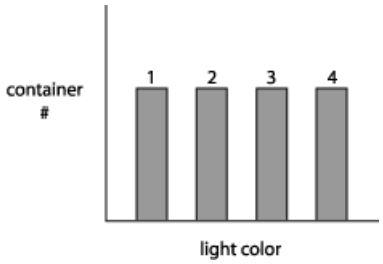
(A) orange
(B) indigo
(C) violet
(D) white
(E) yellow

90. A graph plotted of the experimental results would most closely resemble which of the following?

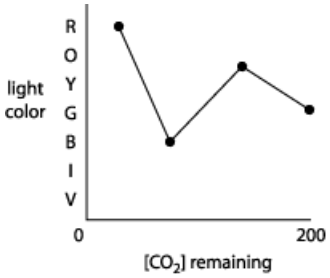
(A)



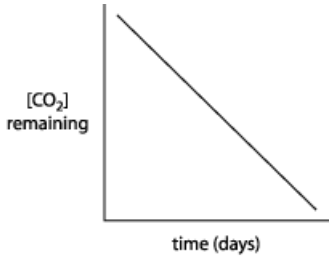
(B)



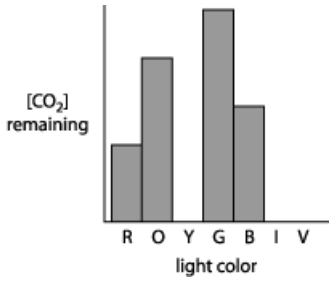
(C)



(D)



(E)

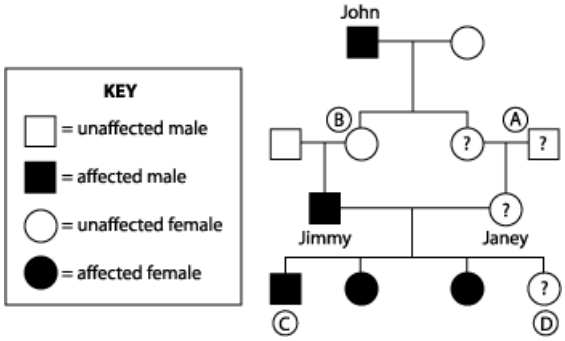


91. Which of the following is best explanation for the fact that 200 cm^3 of CO_2 remained in the green light group after three days?

(A) The plants absorbed a green light for photosynthesis.
(B) The plants reflected the green light and did not use it for photosynthesis.
(C) Carbon dioxide is produced as a waste product of photosynthesis.
(D) The green light was converted into other wavelengths as it was absorbed.
(E) Carbon dioxide built up as a by-product of cell respiration.

Questions 92-96

Duchenne muscular dystrophy (DMD) is a sex-linked recessive disorder that results in a degenerative disease of the muscles of the body. As muscles gradually deteriorate, patients lose the ability to control the muscles and eventually die as breathing muscles are rendered useless. An extended family was studied over several generations and the incidence of DMD was followed as indicated in the pedigree below.



92. Using the lower case letter *d* as the recessive allele for DMD, what is the genotype of the individual labeled "C" in the pedigree?

(A) X^dX^d
(B) XY
(C) XX
(D) X^dX
(E) X^dY

93. According to the pedigree, one can conclude that

(A) Janey is at least a carrier of DMD
(B) Janey has DMD
(C) Janey does not carry any copies of the DMD allele
(D) individual "D" will have two copies of the DMD allele
(E) individual "D" will not carry any copies of the DMD allele

94. If Janey were homozygous recessive for DMD, what are the chances that she and Jimmy would have another child who has the disease?

(A) 0%
(B) 25%
(C) 50%
(D) 75%
(E) 100%

95. Males are more likely to express the DMD allele than females because

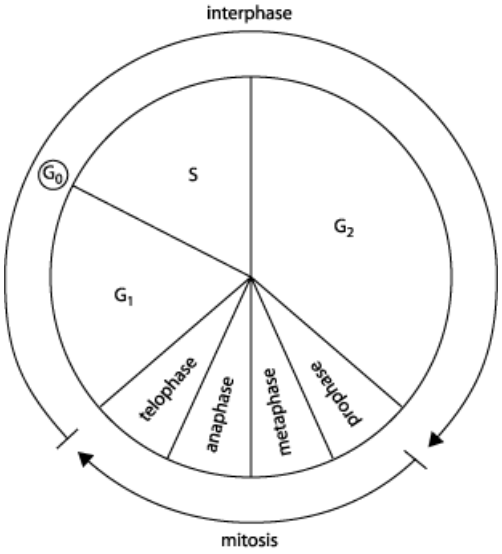
(A) muscles are generally larger and stronger in males than in females
(B) males have two X chromosomes and can get twice as many DMD alleles
(C) males have only one X chromosome and if passed even one DMD allele, they will express it
(D) sex-linked traits are not expressed in females
(E) the DMD allele is carried on the Y chromosome

96. How many generations of family are represented on the pedigree shown?

(A) 3
(B) 4
(C) 5
(D) 6
(E) 12

Questions 97-100

A diagram of the cell cycle of the eukaryotic species *C. elegans* is shown below.



97. During "S" phase of the cell cycle, *C. elegans* cells are

(A) growing larger
(B) dividing into two new cells
(C) in a period of dormancy
(D) copying DNA and organelles
(E) synthesizing large amounts of ATP

98. During which of the following phases does the nuclear membrane of the cell start to break apart so that chromosomes will be able to move to opposite sides of the dividing cell?

(A) Interphase
(B) Prophase
(C) Metaphase
(D) Anaphase
(E) Telophase

99. At the very end of mitosis, two daughter cells will be created by a process that pinches one cell in two. This process of pinching is called

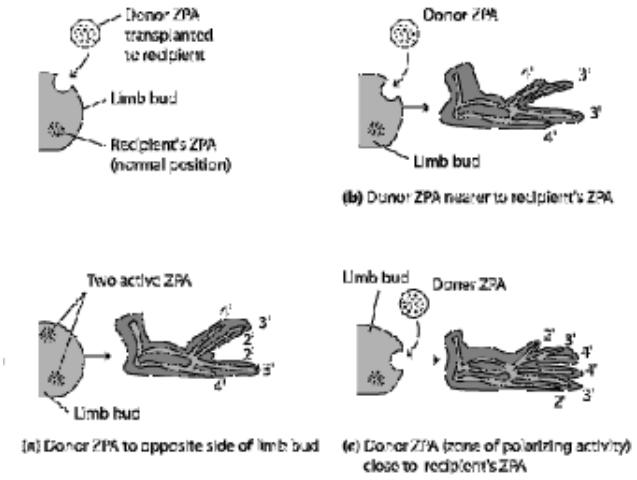
(A) cytokinesis
(B) cytolysis
(C) cytosolic pinching
(D) endocytosis
(E) exocytosis

100. During all the following phases of the cell cycle, *C. elegans* will have its DNA in a replicated state, EXCEPT

(A) G_1
(B) S
(C) G_2
(D) M
(E) all of interphase

Questions 101-104

Chickens have three digits on each limb and the development of these digits is controlled by a region of cells called ZPA (zone of proliferating activity) cells. The digits are normally labeled 2', 3' and 4' to show that, over the course of evolution, chickens have lost digits 1' and 5' that mammals and most reptiles have retained. Below is a three-part experiment performed on chicken embryos, where some ZPA cells are transplanted from a donor embryo into the limb bud that is pictured. The limb bud is the limb of the developing chick before any differentiation of digits has taken place. Depending upon where the ZPA cells are transplanted, different results occur.



101. Although the developing embryo normally has only one active area of ZPA ("recipient's ZPA normal position"), when a second active area of ZPA is present as seen in experiment (a), what is the result?

(A) Development proceeds as it normally does into three distinct digits
(B) Two identical, mirror-image sets of digits develop from the limb bud
(C) The ZPAs cancel each other out and no digits develop
(D) Digits are oriented with the shortest digits closest to the ZPAs
(E) The digits developing on the side of the original ZPA will be functional, while the digits developing from the transplanted ZPA will not.

102. This experiment demonstrates that

(A) ZPA regions have no effect on limb development
(B) implanting a second ZPA region will cause shorter digits, such as the 2' digit, to disappear
(C) the chicken embryo has mechanisms in place to turn off duplicate ZPA regions
(D) the ZPA regions work by secreting neurotransmitters to control limb development
(E) ZPA regions have to capacity to induce development of digits on limb buds

103. It is thought that the ZPA cells control the length of different digits by secreting hormone-like chemicals that build up in the limb bud tissues. What result in the experiment most clearly suggests that this is the case?

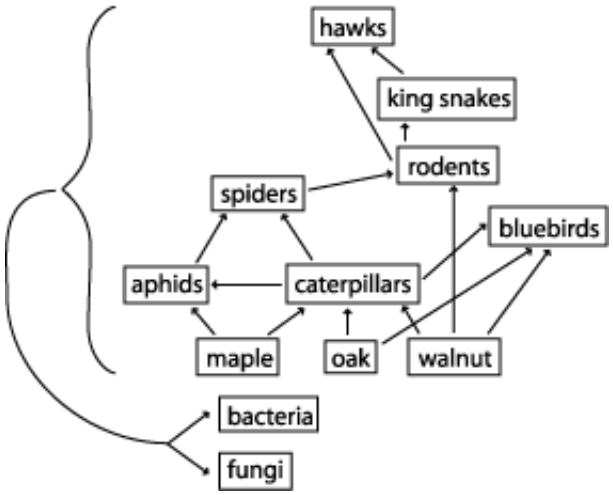
(A) The longest digits develop in areas closest to the ZPAs, while digits furthest from the ZPAs are shortest.
(B) Mirror image sets of digits developed in experiment (a) when ZPAs were placed in regions opposite one another.
(C) The sets of three digits in experiment (c) were opposite in orientation to the sets that developed in experiment (a).
(D) Digits 4' and 3' are consistently longer than digit 2'.
(E) Digit 2' does not develop in experiment (b).

104. The bones of the limb are derived from which of the following embryonic germ layers?

(A) Ectoderm
(B) Mesoderm
(C) Endoderm
(D) Notochord
(E) Neural crest

Questions 105-110

The following diagram shows a food web within a temperate deciduous forest of the Northeastern United States.



105. The maples, oaks, and walnut trees would be considered

(A) primary producers
(B) secondary producers
(C) primary consumers
(D) decomposers
(E) detritus

106. The top-level consumers in the ecosystem shown are the

(A) bacteria and fungi
(B) hawks
(C) spiders
(D) king snakes
(E) caterpillars

107. An increase in the population of rodent-eating birds would result most immediately in a(n)

(A) increase in the bluebird population
(B) decrease in the hawk population
(C) increase in the spider population
(D) crash of the entire food web
(E) increase in the bacteria and fungi populations

108. Bacteria and fungi are considered decomposers because they

(A) are autotrophic
(B) are heterotrophic
(C) are at the bottom of the food web
(D) eat the remains of dead organisms
(E) are mainly microscopic

109. Why would a crash in the caterpillar population not affect the spider population very much?

(A) Spiders feed on the rodents and do not depend on the caterpillars
(B) The spiders are not an essential part of the food web
(C) The spiders could get nourishment by feeding off of the aphids
(D) The spiders can leave the ecosystem and move to another one
(E) Spiders can last for long periods of time without food

110. A temperate deciduous forest is characterized by

(A) having all four seasons – fall, winter, summer, and spring
(B) long, dark, winters and short, hot, rainy summers
(C) frequent fires during long, dry summers
(D) permafrost all year around
(E) pine trees and alpine vegetation