

PRACTICE EXAM 6: LIVING ENVIRONMENT REGENTS SIMULATION

Time Allowed: 3 hours | Total Points: 85 | Passing: 65 scaled | Mastery: 85 scaled

PART A — CORE CONTENT MULTIPLE CHOICE (30 Questions, 30 Points)

Answer all questions in this part.

1. The maintenance of a stable internal environment despite changes in the surroundings is known as
 - A. metabolism, the sum of all chemical reactions
 - B. reproduction, the production of new organisms
 - C. growth, the increase in cell number and size
 - D. homeostasis, the regulation of internal conditions

2. A scientist examining cells under a microscope notes that one cell has a cell wall, chloroplasts, and a large central vacuole. The cell most likely came from
 - A. an animal lining a section of digestive tract
 - B. a green leaf of a flowering plant species
 - C. a fungus growing on decaying wood material
 - D. a single-celled bacterium living in pond water

3. The folded inner membranes of a mitochondrion increase the surface area available for
 - A. the synthesis of new proteins from amino acids

- B. the storage of genetic information as DNA
 - C. the chemical reactions that release energy from glucose
 - D. the absorption of carbon dioxide for photosynthesis
4. A red blood cell placed in pure distilled water will most likely
- A. swell and possibly burst as water enters by osmosis
 - B. shrink and shrivel as water exits the cell rapidly
 - C. remain unchanged because the membrane blocks water
 - D. divide into two new daughter cells by mitosis
5. A graph shows the rate of an enzyme-catalyzed reaction peaks at body temperature (37°C) and then drops sharply at higher temperatures. The drop is best explained by
- A. the substrate breaking apart at the higher temperatures
 - B. the enzyme becoming more active as temperature rises
 - C. the enzyme's shape changing so it can no longer bind substrate
 - D. the product inhibiting the reaction at the higher temperatures
6. Which of the following best describes the role of ATP in living organisms?
- A. ATP stores the long-term genetic information for cells
 - B. ATP serves as the immediate energy source for cellular work
 - C. ATP is the primary structural component of cell membranes
 - D. ATP catalyzes nearly all biochemical reactions in the body
7. During aerobic cellular respiration, the gas taken in by the cell and the gas released as waste are, respectively,

- A. carbon dioxide taken in and oxygen released as waste
- B. nitrogen gas taken in and carbon dioxide released as waste
- C. oxygen taken in and only water vapor released as waste
- D. oxygen taken in and carbon dioxide released as waste

8. In the chloroplasts of a leaf, the green pigment that captures light energy is

- A. chlorophyll, located in the thylakoid membranes
- B. hemoglobin, located in the stroma of the chloroplast
- C. cellulose, located along the outer cell wall
- D. melanin, located in the cytoplasm of leaf cells

9. In a DNA molecule, the nitrogen bases pair such that adenine always bonds with

- A. cytosine, a pyrimidine with three rings in its structure
- B. thymine, the complementary pyrimidine base in DNA
- C. uracil, which replaces thymine only inside DNA molecules
- D. guanine, the other purine base found in DNA strands

10. The process of using the information in an mRNA strand to assemble a chain of amino acids is called

- A. replication, occurring before each cell division begins
- B. transcription, occurring inside the nucleus of the cell
- C. translation, occurring at ribosomes in the cytoplasm
- D. mutation, occurring randomly in many genes over time

11. A pea plant heterozygous for purple flowers (Pp) is crossed with another pea plant heterozygous for purple flowers (Pp). The expected ratio of purple to white flowers in the offspring is

- A. 1 purple to 1 white in the offspring
- B. 3 purple to 1 white in the offspring
- C. 1 purple to 3 white in the offspring
- D. 9 purple to 7 white in the offspring

12. In four o'clock flowers, a cross between a red-flowered plant and a white-flowered plant produces only pink-flowered offspring. This pattern of inheritance is called

- A. complete dominance of the red allele over white
- B. multiple alleles controlling one inherited trait
- C. sex-linked inheritance on the X chromosome
- D. incomplete dominance of the flower color alleles

13. A change in the DNA sequence of a body cell of an adult organism would most likely

- A. not be passed on to any of the organism's offspring
- B. be passed to every one of the organism's offspring
- C. cause all of the organism's gametes to mutate as well
- D. be corrected automatically before the next cell division

14. A single bacterium divides to produce two genetically identical daughter cells. This form of reproduction is

- A. sexual reproduction involving two different parents
- B. fertilization between two specialized sex cells
- C. asexual reproduction by binary fission
- D. metamorphosis through several distinct life stages

15. Embryos of fish, birds, and humans look remarkably similar during their early stages of development. This similarity is best explained by

- A. all three groups currently living in similar environments
- B. all three groups consuming similar food types as adults
- C. similar diseases that affect all three groups in early development
- D. shared common ancestry among all vertebrate animals

16. A population of bacteria is exposed to an antibiotic, and most bacteria die but a few survive and reproduce. Over time, the population becomes resistant to the antibiotic. This is best described as

- A. natural selection acting on existing genetic variation
- B. genetic engineering performed by laboratory scientists
- C. acquired traits passed from parent to offspring directly
- D. bacteria deliberately choosing to develop resistance

17. Two populations of squirrels become separated by a deep canyon and over many generations evolve into distinct species that can no longer interbreed. This process is best described as

- A. convergent evolution of two unrelated species
- B. geographic isolation leading to speciation
- C. artificial selection by human breeders
- D. genetic drift within a single population

18. The role a species plays in its ecosystem — including what it eats, where it lives, and how it interacts with other species — is called the species'

- A. biome with a defined set of climate conditions
- B. habitat where the species lives day to day
- C. ecological niche within the ecosystem

D. carrying capacity of the surrounding area

19. A tapeworm lives inside the intestine of a dog, absorbing nutrients from the dog's digested food and weakening the dog over time. This relationship is best described as

- A. parasitism, in which one species harms the other
- B. mutualism, in which both species clearly benefit
- C. commensalism, in which neither species is affected
- D. predation, in which the prey is killed quickly

20. As energy moves from one trophic level to the next in a food chain, approximately

- A. all of the energy is transferred to the next level
- B. half of the energy is transferred to the next level
- C. one-quarter of the energy is transferred to the next level
- D. one-tenth of the energy is transferred to the next level

21. The processes of photosynthesis and cellular respiration together help recycle which of the following through ecosystems?

- A. only solid mineral nutrients drawn from the soil
- B. only liquid water passing through plant tissues
- C. carbon and oxygen between organisms and the air
- D. only nitrogen passed from soil bacteria to plants

22. After a forest fire destroys most vegetation in an area, grasses appear first, then shrubs, and eventually mature trees grow back. This sequence of changes is called

- A. secondary succession in a disturbed ecosystem

- B. primary succession on entirely new bare rock
- C. random colonization by unrelated species
- D. complete ecosystem collapse with no recovery

23. When a person becomes too warm during exercise, blood vessels in the skin widen and sweat glands release sweat. The combined effect of these responses is to

- A. raise the body temperature back up to normal levels
- B. cool the body by increasing heat loss to the surroundings
- C. conserve heat by reducing blood flow to the skin
- D. produce more energy from the food being digested

24. The chambers of the human heart that pump blood out to the body and lungs are the

- A. right and left atria, which receive the returning blood
- B. aorta and pulmonary artery, which receive pumped blood
- C. capillaries and venules, which return blood to the heart
- D. right and left ventricles, which pump blood from the heart

25. Carbon dioxide is removed from the blood and exhaled out of the body primarily in the

- A. nasal cavity, where air is filtered and warmed first
- B. alveoli of the lungs, where gas exchange occurs
- C. bronchi, which conduct air to deeper structures
- D. trachea, the main air passage to the lungs

26. The bacterium that causes strep throat reproduces inside the throat tissue. To classify this organism, scientists would describe it as

- A. an immune cell defending the throat region
- B. a healthy member of the body's normal flora
- C. a beneficial decomposer of throat cell tissue
- D. a pathogen capable of causing infectious disease

27. Vaccines protect against disease primarily by

- A. stimulating the immune system to produce specific antibodies
- B. directly killing the pathogens already present in the body
- C. providing nutrients to support natural healing in the body
- D. lowering the body's overall temperature to slow infections

28. A coral reef contains thousands of species of fish, invertebrates, plants, and microorganisms. This high level of biodiversity makes the ecosystem

- A. less able to recover from minor environmental changes
- B. completely immune to natural disturbances over time
- C. more stable and better able to respond to disturbances
- D. dependent on only a few keystone species for survival

29. A government agency proposes to set aside a large area of forest as a protected wildlife reserve. The most likely positive impact of this decision is

- A. an increase in air pollution near nearby urban centers
- B. a loss of habitat for many of the native species
- C. a complete halt to evolutionary changes over time
- D. preservation of habitat and biodiversity in the area

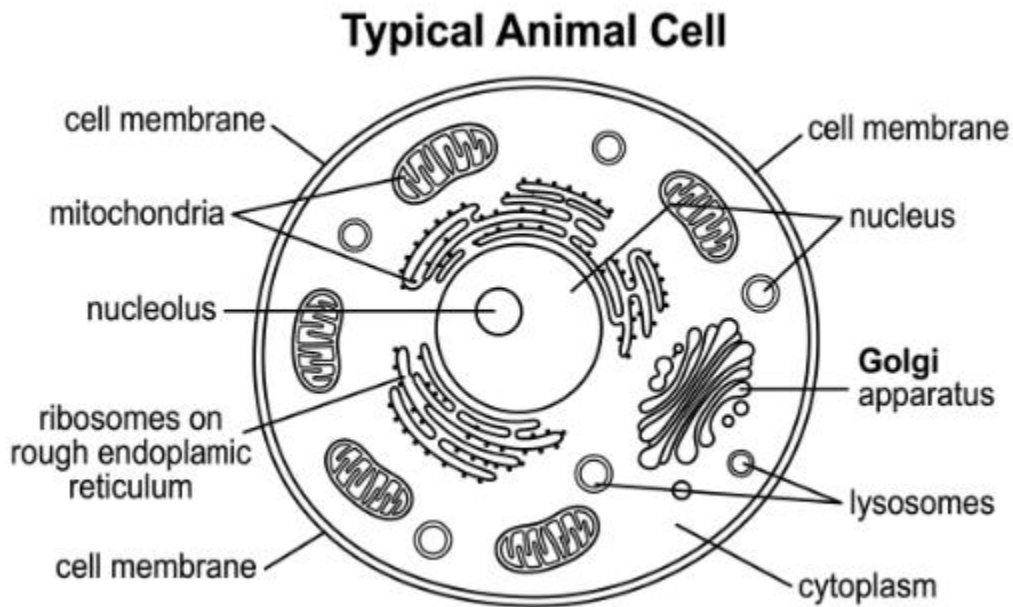
30. Burning fossil fuels releases carbon dioxide, a greenhouse gas that

- A. blocks all sunlight from reaching Earth's surface
- B. traps heat in the atmosphere and warms the planet
- C. cools the planet by reflecting heat back into space
- D. produces an ozone layer that protects from UV rays

PART B-1 — DATA-BASED MULTIPLE CHOICE (13 Questions, 13 Points)

Answer all questions in this part. Base your answers to questions 31–34 on the diagram below and on your knowledge of biology.

31. A student examines a diagram of an animal cell cross-section.



In the diagram, the structure where genetic information is stored is the

- A. nucleus, shown as the large central sphere
- B. ribosome, shown attached to the membrane network
- C. mitochondrion, shown with the folded internal membranes
- D. Golgi apparatus, shown as a stack of flattened sacs

32. Referring to the same diagram, the structure where most of the cell's energy is released from food molecules is the

- A. nucleus, which stores the cell's DNA molecules
- B. ribosome, where proteins are assembled together
- C. Golgi apparatus, which packages cellular proteins
- D. mitochondrion, where cellular respiration occurs

33. Referring to the same diagram, the membrane network with attached ribosomes is the site where

- A. cellular waste is broken down by acidic enzymes
- B. the cell's genetic information is being duplicated
- C. proteins are synthesized and modified for use
- D. carbohydrates are stored for later energy needs

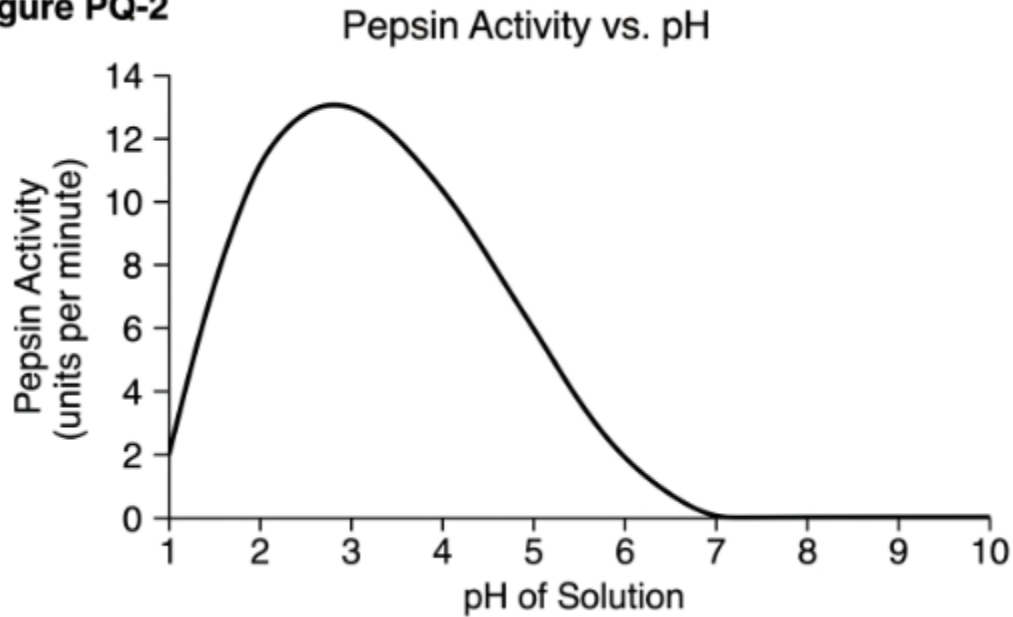
34. Referring to the same diagram, the structure missing from this animal cell but present in plant cells would be

- A. ribosomes that assemble all protein chains
- B. chloroplasts that perform photosynthesis
- C. mitochondria that release stored chemical energy
- D. lysosomes that digest cellular waste materials

Base your answers to questions 35–37 on the graph below and on your knowledge of biology.

35. A student measures the activity of the enzyme pepsin (a stomach enzyme) at different pH levels.

Figure PQ-2



Based on the graph, pepsin shows its highest activity at approximately

- A. pH 5 on the graph
- B. pH 7 on the graph
- C. pH 9 on the graph
- D. pH 2 on the graph

36. Based on the same graph, pepsin would be most effective in which of the following environments in the human body?

- A. the stomach, where the contents are highly acidic
- B. the mouth, where the saliva is nearly neutral in pH
- C. the small intestine, where the contents are basic
- D. the bloodstream, which is held near pH 7.4

37. Based on the same graph, the most likely explanation for the very low activity of pepsin at pH 9 is that

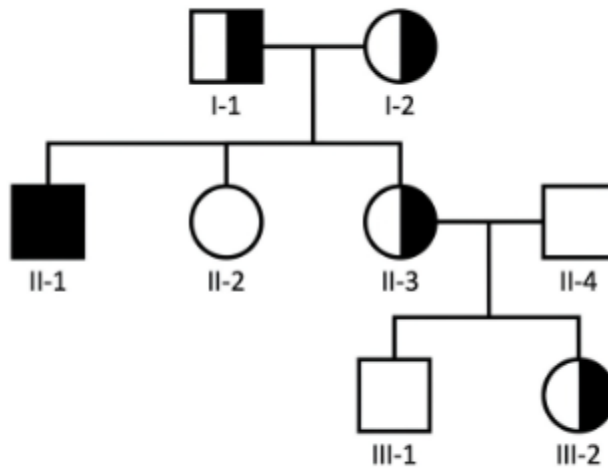
- A. pepsin requires a higher temperature to function at all

- B. the enzyme's shape is altered, preventing substrate binding
- C. the substrate of pepsin breaks down at the higher pH levels
- D. pepsin is converted into a different enzyme at higher pH

Base your answers to questions 38–40 on the pedigree below and on your knowledge of biology.

38. A pedigree shows the inheritance of cystic fibrosis, an autosomal recessive disorder, in a family.

Pedigree of Cystic Fibrosis in a Family



Filled = affected with cystic fibrosis; Half-filled = unaffected carrier;
Unfilled = unaffected non-carrier; Square = male; Circle = female.

Based on the pedigree, the genotype of the affected male individual II-1 is

- A. homozygous dominant for the normal allele
- B. heterozygous with one of each allele
- C. homozygous recessive for the disease allele
- D. carrying only one copy of the disease allele

39. Based on the same pedigree, individuals I-1 and I-2 must both have the genotype

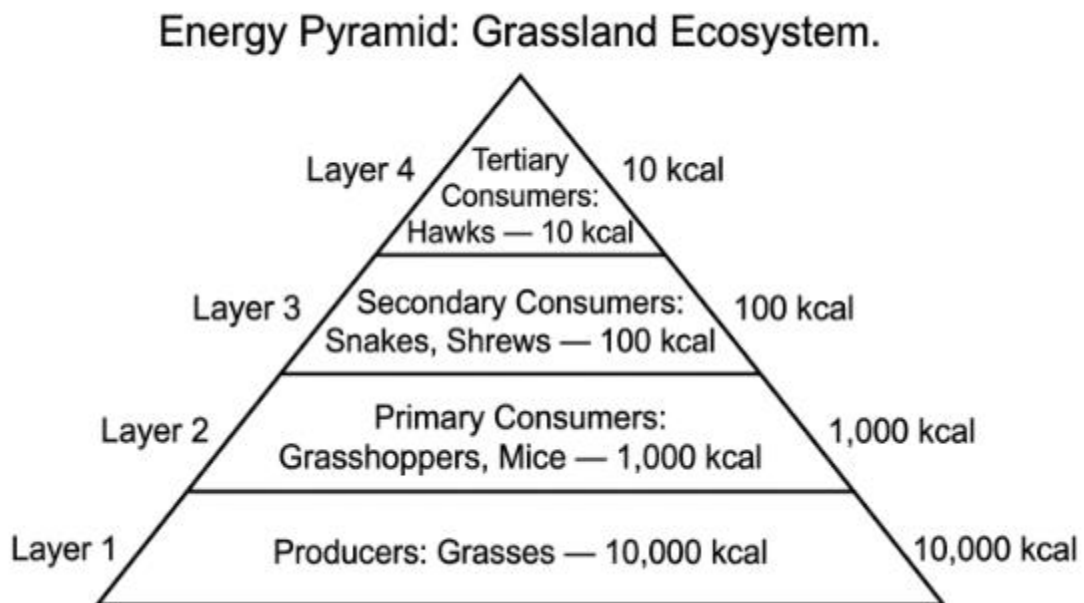
- A. heterozygous, with one normal and one disease allele
- B. homozygous dominant, with two normal alleles each
- C. homozygous recessive, with two disease alleles each
- D. carriers of only the dominant allele on the Y chromosome

40. Based on the same pedigree, the most likely explanation for individual II-1 having cystic fibrosis while his parents do not is that

- A. both parents were carriers and passed on the recessive allele
- B. a new dominant mutation occurred only in individual II-1
- C. the disease was acquired from the environment after birth
- D. only the father carried the disease allele on his Y chromosome

Base your answers to questions 41–43 on the energy pyramid below and on your knowledge of biology.

41. A student examines an energy pyramid for a grassland ecosystem.



Based on the energy pyramid, the organisms that contain the largest amount of available energy are the

- A. tertiary consumers found at the top of the pyramid
- B. producers found at the base of the pyramid
- C. secondary consumers in the middle of the pyramid
- D. primary consumers just above the producer layer

42. Based on the same energy pyramid, the approximate percentage of energy transferred from the grasses to the grasshoppers and mice is

- A. 90% of the available energy transfers
- B. 50% of the available energy transfers
- C. 10% of the available energy transfers
- D. 1% of the available energy transfers

43. Based on the same energy pyramid, if the grasses were removed from the ecosystem, the most immediate consequence would be

- A. a decrease in the available energy for all consumer levels
- B. an increase in the number of hawks at the top level
- C. a rise in the total energy available in the ecosystem
- D. no significant change to any of the levels shown above

PART B-2 — MIXED FORMAT (12 Questions, 12 Points)

Answer all questions in this part.

44. A scientist designs an experiment to test whether a new fertilizer makes tomato plants grow taller. In this experiment, the dependent variable is

- A. the amount of fertilizer applied to each plant
- B. the type of soil used in each tomato pot
- C. the species of plant being tested in the experiment
- D. the height of the tomato plants after several weeks

45. A scientist proposes that adding a certain mineral to ocean water will increase the rate of algal growth. Before this proposal is widely accepted, it must be supported by

- A. the personal opinion of well-respected scientists in the field
- B. agreement from a small number of close associates
- C. repeated experimental data and peer-reviewed publication
- D. the marketing efforts of the company selling the mineral

46. During mitosis, the result is two daughter cells that are

- A. genetically identical to the original parent cell
- B. genetically different and contain half the DNA
- C. always larger in size than the original parent cell
- D. specialized to perform only one specific function

47. Nondisjunction during meiosis can result in offspring with an abnormal chromosome number, such as

- A. an extra strand of mitochondrial RNA in the cell
- B. three copies of chromosome 21, causing Down syndrome
- C. extra chloroplasts in the plant cells of the offspring
- D. duplicated mitochondria in every body cell of the offspring

48. A DNA sample is found to be 22% adenine. According to Chargaff's rules, the percentage of guanine in the same sample is

- A. 22% of the bases are guanine
- B. 56% of the bases are guanine
- C. 78% of the bases are guanine
- D. 28% of the bases are guanine

49. Recombinant DNA technology allows scientists to

- A. combine genes from different organisms into one DNA molecule
- B. eliminate all genetic disorders from the human population
- C. produce an organism without any genetic material at all
- D. reverse the direction of evolution in modern species

50. The hormone insulin is produced by the

- A. liver, where it is also broken down later for use
- B. thyroid gland, located in the front of the neck region
- C. pancreas, which releases it when blood sugar rises
- D. adrenal glands, located on top of each kidney organ

51. A reflex such as pulling one's hand away from a hot stove involves a fast pathway through the

- A. cerebrum, the largest part of the human brain
- B. endocrine system, using slow hormonal signals
- C. circulatory system, traveling through the bloodstream
- D. spinal cord, without waiting for full brain processing

52. Plants in a tropical rainforest must compete most directly for

- A. sunlight, which is limited under the dense forest canopy
- B. soil minerals, which are extremely abundant in the topsoil
- C. oxygen, which is plentiful at all elevations of the forest
- D. carbon dioxide, which is largely absent from the local air

53. Earth's tundra biome is characterized by

- A. dense forests of broadleaf evergreen trees year-round
- B. cold temperatures, permafrost, and low-growing plants
- C. high rainfall and a wide variety of large tree species
- D. hot temperatures and large herds of grazing animals

54. The introduction of a non-native species into an ecosystem often

- A. has no effect on the existing native species at all
- B. always increases the biodiversity of the area permanently
- C. disrupts the ecosystem by outcompeting native species
- D. quickly leads to the extinction of the introduced species

55. Cutting down large areas of forest for agriculture or development is referred to as

- A. deforestation, which reduces habitat and biodiversity
- B. eutrophication, which adds nutrients to water systems
- C. desertification, which converts farmland into desert
- D. afforestation, which plants new trees in open land

PART C — EXTENDED CONSTRUCTED RESPONSE (17 Questions, 17 Points)

Answer all questions in this part.

56. The cell cycle phase during which DNA is replicated in preparation for cell division is

- A. mitosis, when the nucleus divides into two parts
- B. cytokinesis, when the cytoplasm splits in two
- C. G1 phase, when the cell first begins to grow
- D. S phase, when DNA synthesis occurs in the nucleus

57. In humans, sperm and egg cells are produced by meiosis and each contains

- A. 46 chromosomes, the same as in a body cell
- B. 92 chromosomes, twice the body cell number
- C. 23 chromosomes, half the body cell number
- D. only one single chromosome per gamete cell

58. A gene that codes for the same protein in many different species — such as one involved in basic cellular respiration — is best described as

- A. a unique gene found only in one species today
- B. a highly conserved gene shared by many species
- C. a gene that mutates rapidly between generations
- D. a gene that produces a different protein in each species

59. A small island population of finches is reduced to just a few individuals after a hurricane. Over time, the surviving population shows reduced genetic diversity. This change in allele frequencies is best described as

- A. natural selection by environmental pressure
- B. directional selection toward one extreme trait
- C. gene flow between two different populations
- D. genetic drift caused by the bottleneck event

60. Two unrelated species — such as a dolphin and a shark — have streamlined body shapes that allow rapid swimming. This similarity is the result of

- A. convergent evolution producing similar traits in unrelated species
- B. divergent evolution producing different traits in related species
- C. coevolution between predator and prey populations
- D. genetic drift within a single ancestral species

61. The use of selective breeding to produce dogs with specific traits, such as breeds adapted for herding or hunting, is an example of

- A. natural selection acting in the wild populations
- B. artificial selection guided by human choices
- C. coevolution between dogs and their environments
- D. random mutation producing all observed traits

62. A coyote eats both rabbits (herbivores) and ground squirrels (also herbivores). In this food web, the coyote is best classified as

- A. a producer making its own food from sunlight
- B. a primary consumer eating only producers
- C. a secondary consumer that eats herbivores
- D. a decomposer breaking down dead organic matter

63. Nitrogen fixation, the conversion of atmospheric nitrogen gas into compounds usable by plants, is most often performed by

- A. autotrophic photosynthetic algae in surface waters
- B. predatory mammals consuming nitrogen-rich prey items
- C. fungi growing on decaying organic material in soil
- D. specialized bacteria living in soil and plant root nodules

64. The human liver performs many functions in maintaining homeostasis, including

- A. removing toxins from the blood and storing glucose as glycogen
- B. pumping blood out to all parts of the body's tissues
- C. producing all hormones that regulate the menstrual cycle
- D. directly absorbing oxygen from the alveoli of the lungs

65. When a person climbs to a high altitude where less oxygen is available, the body responds over several weeks by

- A. decreasing the number of red blood cells in circulation
- B. permanently lowering the resting heart rate at rest
- C. increasing the number of red blood cells to carry more oxygen
- D. reducing the rate of breathing at rest gradually over time

66. Hormones are transported throughout the body by the

- A. lymphatic system, draining excess fluid from tissues
- B. circulatory system, carrying them in the bloodstream
- C. nervous system, traveling along the nerve fibers
- D. digestive system, moving through the intestinal tract

67. The villi of the small intestine increase the surface area available for

- A. absorption of nutrients into the bloodstream
- B. mechanical digestion of larger food particles
- C. storage of partially digested food for later use
- D. production of bile for the digestion of fats

68. The two main systems involved in the rapid coordination and control of body activities are the

- A. respiratory and digestive systems of the body
- B. circulatory and lymphatic systems of the body
- C. immune and excretory systems of the body
- D. nervous and endocrine systems of the body

69. In humans, the diaphragm is a dome-shaped muscle that, when it contracts,

- A. closes off the airway to prevent the swallowing of food
- B. compresses the heart in order to pump blood through it
- C. flattens downward, drawing air into the lungs
- D. moves food along the digestive tract through peristalsis

70. White blood cells help protect the body against infection by

- A. carrying oxygen from the lungs to the body cells
- B. attacking pathogens and producing protective antibodies
- C. clotting blood at the site of a deep open cut
- D. transporting hormones throughout the entire bloodstream

71. The release of the hormone glucagon by the pancreas when blood glucose levels fall is an example of

- A. negative feedback maintaining a stable internal environment
- B. positive feedback amplifying a small change in blood sugar
- C. a sensory response to changes in light intensity
- D. an immune reaction to a foreign substance in the blood

72. In a pregnant woman, the umbilical cord connects the fetus to the placenta. The cord serves to

- A. anchor the fetus to the uterine wall lining
- B. provide a passageway for the developing nervous system
- C. produce the hormones needed for pregnancy maintenance
- D. carry nutrients, oxygen, and wastes between fetus and placenta

PART D — LABORATORY PRACTICAL (13 Questions, 13 Points)

Answer all questions in this part.

73. In the Relationships and Biodiversity laboratory, a botanist is asked to determine whether a newly discovered plant called *Botana curus* is closely related to a known plant species. One of the tests used is

- A. measuring how rapidly the new plant grows in a greenhouse
- B. counting the number of leaves on the new plant each week
- C. comparing plant pigments using paper chromatography
- D. observing the new plant's reproductive habits over time

74. In gel electrophoresis, the molecules being separated move through the gel because

- A. they are physically pushed by the laboratory technician's hand

- B. they are pulled by an electric field through the porous gel
- C. they swim through the gel under their own metabolic power
- D. they are carried by water currents flowing through the gel

75. A student measures the mass of a small mouse on a triple-beam balance. The most appropriate unit for recording this measurement is

- A. milliliters of the total mass
- B. degrees Celsius of the mass
- C. centimeters of length per unit mass
- D. grams of mass on the balance

76. When focusing a compound light microscope on a specimen, the student should always begin with

- A. the low-power objective lens engaged in place
- B. the high-power objective lens engaged in place
- C. the oil-immersion objective lens engaged in place
- D. no objective lens engaged in place at all

77. In the Beaks of Finches laboratory, students who successfully collect enough "seeds" to "survive" are allowed to "reproduce" by

- A. exchanging their tools with another surviving student
- B. adding two new tools of their own choosing
- C. providing another student with the same tool they used
- D. removing one tool from the simulation entirely

78. In the Making Connections laboratory, students compare the pulse rate at rest with the pulse rate after exercise. The variable being changed by the student in this experiment is

- A. the pulse rate measured before and after the exercise
- B. the level of physical activity performed by the student
- C. the type of measuring device used to count the pulse
- D. the room temperature where the experiment takes place

79. In the Diffusion Through a Membrane laboratory, glucose indicator (Benedict's solution) is used to detect the presence of glucose. After the dialysis tubing containing starch and glucose is placed in water and tested, glucose is found in the water outside the tubing. This indicates that

- A. starch molecules diffused out through the tubing into the water
- B. water molecules diffused into the tubing very rapidly
- C. the dialysis tubing is fully impermeable to all molecules
- D. glucose molecules diffused out through the tubing into the water

80. A scientist creates a hypothesis stating "If the amount of light increases, then the rate of photosynthesis will increase." The independent variable in this hypothesis is

- A. the type of plant species used in the experiment
- B. the rate of photosynthesis measured by the scientist
- C. the amount of light provided to each plant
- D. the time of day at which the experiment is run

81. In a controlled experiment, the group that does not receive the experimental treatment serves as the

- A. control group used for comparison with the experimental group
- B. independent group whose results determine the conclusion
- C. dependent group whose results are not measured at all
- D. random group selected to participate in no testing

82. In a biology laboratory, before beginning any experiment involving chemicals, students should always

- A. taste a small sample of each chemical to identify them
- B. put on safety goggles to protect their eyes from spills
- C. remove their lab coats so they can move more freely
- D. mix unknown chemicals to see what reactions occur

83. When using a dropper to add a liquid to a slide on a microscope, the student should hold the dropper

- A. so that it touches the slide surface directly
- B. completely upside down with the tip pointing up
- C. inside the test tube containing the liquid sample
- D. just above the slide without touching the surface

84. In the Beaks of Finches laboratory, when the type of "seed" available is changed in the middle of the simulation, students who were most successful before may now perform poorly. This step models how

- A. all species can adapt instantly to any environmental change
- B. environmental changes have no effect on populations
- C. environmental changes can alter which traits are favored
- D. populations remain genetically identical over generations

85. The required New York State Living Environment laboratory that has students compare amino acid sequences and DNA samples to determine evolutionary relationships is

- A. the Making Connections laboratory on muscle fatigue
- B. the Relationships and Biodiversity laboratory
- C. the Diffusion Through a Membrane laboratory
- D. the Beaks of Finches simulation laboratory

ANSWER KEY WITH EXPLANATIONS

1. D — Homeostasis is the maintenance of a stable internal environment despite external changes. Metabolism refers to chemical reactions, reproduction to producing offspring, and growth to increase in size — none of these describe stability of internal conditions. Homeostatic regulation is essential for survival because cells function only within narrow ranges of temperature, pH, and chemistry.
2. B — Cell walls, chloroplasts, and large central vacuoles are characteristic of plant cells. Animal cells lack all three structures. Fungi have cell walls but no chloroplasts, and bacteria lack the membrane-bound organelles described.
3. C — The folded inner membrane (cristae) of a mitochondrion increases the surface area available for the chemical reactions of aerobic cellular respiration, which release energy from glucose. Greater surface area means more space for the enzymes and electron transport chain components that produce ATP.
4. A — In distilled water, the inside of the red blood cell has a higher solute concentration than the surrounding water, so water moves into the cell by osmosis. Red blood cells lack cell walls, so excess water causes them to swell and burst (hemolyze).
5. C — Enzymes are proteins whose function depends on their three-dimensional shape. At excessively high temperatures, the bonds maintaining shape break, causing denaturation. Once the active site changes shape, the enzyme can no longer bind its substrate, and the reaction rate drops sharply.
6. B — ATP (adenosine triphosphate) is the immediate energy currency of cells, releasing energy when its terminal phosphate bond is broken. DNA stores genetic information, lipids form membranes, and enzymes catalyze reactions — ATP's specific role is providing usable energy for cellular work.
7. D — Aerobic cellular respiration follows the equation: $\text{glucose} + \text{oxygen} \rightarrow \text{carbon dioxide} + \text{water} + \text{ATP}$. Cells take in oxygen to serve as the final electron acceptor and release carbon dioxide as a waste product of glucose breakdown.
8. A — Chlorophyll is the green pigment that absorbs light energy for photosynthesis, located in the thylakoid membranes inside chloroplasts. Hemoglobin transports oxygen in blood, cellulose is structural, and melanin provides pigmentation in animals — none capture light for photosynthesis.

9. B — In DNA, adenine (A) pairs with thymine (T) and cytosine (C) pairs with guanine (G). These specific base-pairing rules, called Chargaff's rules, are maintained by hydrogen bonds and the geometric fit between purines and pyrimidines.

10. C — Translation is the process of using mRNA codons to assemble amino acids into a protein at ribosomes in the cytoplasm. Transcription (in the nucleus) makes the mRNA, replication copies DNA, and mutation changes DNA sequences — only translation produces proteins.

11. B — A Pp × Pp cross produces offspring in a 1 PP : 2 Pp : 1 pp ratio, giving 3 purple (with at least one P allele) to 1 white (pp). This classic Mendelian 3:1 phenotypic ratio applies whenever two heterozygotes are crossed.

12. D — Incomplete dominance occurs when neither allele is fully dominant, producing an intermediate phenotype in heterozygotes. In four o'clocks, red × white yields pink because both alleles partially express, blending the phenotype.

13. A — Mutations in body (somatic) cells affect only the individual and cannot be passed to offspring because they are not present in the gametes. Only mutations in egg or sperm cells (gametic mutations) can be inherited by the next generation.

14. C — Binary fission is a form of asexual reproduction in which a bacterium divides into two genetically identical daughter cells. Because there is only one parent and no mixing of genetic material, the offspring are clones of the parent.

15. D — The similarity of vertebrate embryos during early development is strong evidence of common ancestry. Shared developmental patterns reflect inherited genetic programs from a common ancestor that have been conserved despite later divergence among species.

16. A — Natural selection acted on existing variation in the bacterial population: a few bacteria already carried resistance genes by chance, survived the antibiotic, and passed those genes to offspring. The bacteria did not "decide" to become resistant; they simply outreproduced the susceptible ones.

17. B — Geographic isolation occurs when a physical barrier separates populations, preventing gene flow. Over many generations, different selection pressures and genetic drift cause the populations to diverge until they can no longer interbreed, completing speciation.

18. C — A species' ecological niche is its complete role in the ecosystem — what it eats, where it lives, when it is active, and how it interacts with other organisms. The habitat is just the physical location, while a niche is the broader functional role.

19. A — Parasitism is a symbiotic relationship where one organism (the parasite) benefits at the expense of the other (the host). The tapeworm gains nutrients while harming the dog, fitting the definition of parasitism exactly.

20. D — The "10% rule" in ecology states that approximately 10% of energy at one trophic level is transferred to the next. The rest is lost as heat during metabolism, used for life processes, or not consumed at all.

21. C — Photosynthesis takes in carbon dioxide and releases oxygen, while cellular respiration does the reverse. Together these processes cycle carbon and oxygen between living organisms and the atmosphere, maintaining atmospheric balance.

22. A — Secondary succession follows a disturbance (like fire) that leaves the soil intact. Pioneer species like grasses arrive first, followed by shrubs and eventually trees as the community develops. Primary succession requires starting with bare rock and forming new soil.

23. B — Vasodilation in the skin and sweating both increase heat loss to the environment, cooling the body. This negative feedback response counteracts the rise in body temperature caused by exercise, maintaining homeostatic temperature regulation.

24. D — The right and left ventricles are the heart's pumping chambers: the right ventricle pumps blood to the lungs through the pulmonary artery, and the left ventricle pumps blood to the body through the aorta. The atria receive blood; they do not pump it out of the heart.

25. B — Gas exchange in the lungs occurs at the alveoli, where oxygen diffuses from air into blood and carbon dioxide diffuses from blood into air for exhalation. The trachea and bronchi only conduct air; they are not gas exchange surfaces.

26. D — A pathogen is any disease-causing microorganism. The strep bacterium invades throat tissue, causes inflammation, and produces illness — fitting the definition of a pathogen. Normal flora and decomposers do not cause disease.

27. A — Vaccines contain weakened or inactive pathogens (or pieces of them) that trigger the immune system to produce specific antibodies and memory cells without causing disease. If the real pathogen later enters the body, the immune system can respond rapidly.

28. C — Biodiversity provides genetic variation that allows ecosystems to absorb disturbances and recover. If one species is lost, others may fill similar roles. Low-biodiversity ecosystems are far more vulnerable to collapse from any single disturbance.

29. D — Setting aside protected land preserves habitat, which directly supports the species living there and the genetic diversity within them. Habitat protection is one of the most effective tools for maintaining biodiversity.

30. B — Carbon dioxide is a greenhouse gas that absorbs infrared radiation (heat) and re-emits it, trapping heat in the lower atmosphere. Increasing CO₂ levels enhance this greenhouse effect, contributing to global warming and climate change.

31. A — The nucleus, shown as the large central sphere in the diagram, stores the cell's DNA inside its nuclear membrane. Ribosomes assemble proteins, mitochondria release energy, and the Golgi apparatus packages proteins — none store genetic information.

32. D — Mitochondria are the sites of aerobic cellular respiration, where most ATP is produced from glucose. The folded inner membrane visible in the diagram contains the electron transport chain components that capture energy from glucose breakdown.

33. C — Rough endoplasmic reticulum is studded with ribosomes that synthesize proteins. Many of these proteins are then modified within the ER before being sent on to the Golgi apparatus. This network is essential for producing membrane and secreted proteins.

34. B — Chloroplasts perform photosynthesis and are found only in plant cells (and some protists), not in animal cells. Animal cells contain ribosomes, mitochondria, and lysosomes, but lack the chloroplasts needed to capture light energy.

35. D — The graph shows the peak of pepsin activity at approximately pH 2, where activity reaches about 12 units per minute. Pepsin's optimum pH reflects its function in the acidic environment of the stomach.

36. A — Since pepsin is most active at pH 2 (highly acidic), it functions best in the stomach, where gastric acid maintains a pH near 1.5–2. The mouth, small intestine, and bloodstream are all closer to neutral, where pepsin shows very low activity.

37. B — At pH 9, the basic environment disrupts the bonds maintaining pepsin's three-dimensional shape, causing denaturation. The active site no longer fits the substrate, so the reaction rate drops to essentially zero, as shown on the graph.

38. C — Cystic fibrosis is autosomal recessive, so affected individuals must carry two copies of the disease allele (homozygous recessive). The fully filled symbol indicates II-1 is affected, meaning he must have inherited the recessive allele from both parents.

39. A — Since both parents (I-1 and I-2) are unaffected carriers (half-filled), they must each have one normal allele and one disease allele, making them heterozygous. Only this genotype combination can produce an affected (homozygous recessive) child while leaving the parents healthy.

40. A — When two heterozygous carriers reproduce, each child has a 25% chance of inheriting the recessive allele from both parents and being affected. Individual II-1 inherited one recessive allele from each carrier parent, producing his homozygous recessive genotype.

41. B — Producers at the base of every energy pyramid contain the most available energy because they capture sunlight directly through photosynthesis. Each successive trophic level retains only about 10% of the energy from the level below it.

42. C — The pyramid shows 10,000 kcal at the producer level and 1,000 kcal at the primary consumer level. This $1,000/10,000 = 10\%$ transfer reflects the standard ecological rule that only about 10% of energy passes to the next trophic level.

43. A — Removing producers eliminates the energy base of the entire ecosystem. Without grasses, primary consumers starve, and the loss cascades upward through every higher trophic level, reducing the energy available to all consumers.

44. D — The dependent variable is what the experimenter measures in response to the treatment — here, plant height. The amount of fertilizer is the independent variable (what is changed), while soil type and plant species are controlled (kept constant).

45. C — Scientific claims gain acceptance through repeated experiments showing the same results and through peer review, which checks methods and conclusions. Personal opinion, marketing, or agreement among friends is not scientific evidence.

46. A — Mitosis produces two genetically identical daughter cells with the same chromosome number as the parent cell. This is the basis for growth, repair, and asexual reproduction. Genetic variation comes from meiosis and sexual reproduction, not mitosis.

47. B — Nondisjunction is the failure of chromosomes to separate properly during meiosis, producing gametes with extra or missing chromosomes. Trisomy 21 (three copies of chromosome 21) causes Down syndrome and is the classic example studied in biology classes.

48. D — By Chargaff's rules, A pairs with T (each 22%) and G pairs with C (equal amounts). If $A + T = 44\%$, then $G + C = 56\%$, and since $G = C$, each must be 28%. This base-pairing arithmetic is a common Regents test item.

49. A — Recombinant DNA technology combines DNA from two different organisms — often using restriction enzymes and DNA ligase — to create a new DNA molecule. This technique allows production of insulin, growth hormones, and many other useful proteins.

50. C — The pancreas releases insulin from its beta cells in response to elevated blood glucose levels after a meal. Insulin signals body cells to take up glucose, lowering blood sugar back to normal as part of homeostatic regulation.

51. D — Reflexes use a fast pathway through the spinal cord, bypassing the brain to enable rapid responses to dangerous stimuli. The sensory neuron signals the spinal cord, which directly activates a motor neuron, producing the protective movement.

52. A — In tropical rainforests, the dense upper canopy blocks most sunlight from reaching lower layers, making light the most limiting resource for plant growth. Water, warmth, and CO₂ are abundant, but sunlight competition shapes rainforest plant structure.

53. B — The tundra biome is defined by extremely cold temperatures, a permanently frozen subsoil (permafrost), a short growing season, and low-growing vegetation such as mosses, lichens, and small shrubs. Trees cannot establish in these conditions.

54. C — Non-native (invasive) species often lack natural predators and outcompete native species for food, space, or other resources. This frequently reduces native biodiversity and disrupts ecosystem function. Examples include zebra mussels and Asian carp.

55. A — Deforestation is the removal of forest cover for human use. It destroys habitat, reduces biodiversity, releases stored carbon, and contributes to soil erosion and climate change. Afforestation is the opposite — planting new trees.

56. D — DNA replication occurs during the S (synthesis) phase of interphase, before mitosis begins. By the time the cell enters mitosis, each chromosome has already been duplicated and consists of two sister chromatids attached at the centromere.

57. C — Human body (somatic) cells are diploid with 46 chromosomes (23 pairs). Meiosis halves this number, producing haploid gametes with 23 chromosomes each. Fertilization restores the diploid number when egg and sperm fuse.

58. B — Highly conserved genes are those that have changed very little across evolutionary time and are shared by many species. These genes typically code for essential proteins, so mutations are usually harmful and removed by natural selection.

59. D — A bottleneck event — like a hurricane reducing the population to very few individuals — causes genetic drift, where random chance determines which alleles survive. The result is reduced genetic diversity that may persist for many generations.

60. A — Convergent evolution occurs when unrelated species develop similar traits because they face similar selection pressures. Dolphins (mammals) and sharks (fish) both evolved streamlined shapes independently because of similar aquatic environments.

61. B — Artificial selection is the deliberate selection of organisms with desired traits for breeding by humans. Different dog breeds were produced this way over centuries by humans choosing which animals would reproduce based on size, behavior, and appearance.

62. C — Secondary consumers eat primary consumers (herbivores). Since the coyote eats rabbits and ground squirrels, both of which eat plants, the coyote occupies the secondary consumer trophic level in this food web.

63. D — Nitrogen-fixing bacteria, especially those living in legume root nodules (such as *Rhizobium*), convert atmospheric N_2 gas into ammonia and nitrate compounds that plants can absorb. This process is essential to the global nitrogen cycle and to plant nutrition.

64. A — The liver performs many homeostatic functions, including detoxifying chemicals, breaking down drugs, regulating blood glucose by storing glycogen, and producing bile. Its position in the bloodstream between the digestive system and general circulation supports these roles.

65. C — At high altitude, the kidneys release more erythropoietin (EPO), stimulating bone marrow to produce more red blood cells. More red blood cells increase the blood's oxygen-carrying capacity, partially compensating for the reduced oxygen in the air.

66. B — Hormones are secreted by endocrine glands directly into the bloodstream, which carries them throughout the body to target tissues. This makes hormonal communication slower than nervous signals but capable of long-lasting and widespread effects.

67. A — Villi are tiny finger-like projections lining the small intestine, dramatically increasing the surface area for absorbing digested nutrients into the bloodstream. Combined with microvilli on each cell surface, they make absorption highly efficient.

68. D — The nervous system uses fast electrical signals, while the endocrine system uses slower hormonal signals. Together, these two systems coordinate and control nearly all body activities, working in close cooperation to maintain homeostasis.

69. C — The diaphragm is the primary muscle of breathing. When it contracts, it flattens downward, expanding the chest cavity and lowering pressure in the lungs so that air flows in. When it relaxes, it returns to its dome shape, pushing air out.

70. B — White blood cells (leukocytes) include phagocytes that engulf pathogens and lymphocytes that produce antibodies. Red blood cells carry oxygen, platelets help clot blood, and hormone transport is a function of the bloodstream itself, not white blood cells.

71. A — When blood glucose falls, the pancreas releases glucagon, which signals the liver to break down glycogen and release glucose, raising blood sugar back to normal. This corrective response is a classic example of negative feedback maintaining homeostasis.

72. D — The umbilical cord contains arteries and a vein that connect the fetus to the placenta. Through this connection, oxygen and nutrients flow from mother to fetus, and carbon dioxide and other wastes flow from fetus to mother for elimination.

73. C — Paper chromatography in the Relationships and Biodiversity lab separates plant pigments based on their solubility and molecular size. Species with closely related pigment compositions are more likely to share a recent common ancestor.

74. B — Gel electrophoresis applies an electric field across the gel. Because DNA is negatively charged, fragments migrate toward the positive electrode. Smaller fragments move through the gel pores faster and travel farther than larger fragments.

75. D — Mass is measured in grams using a triple-beam balance. Milliliters measure volume, degrees Celsius measure temperature, and centimeters measure length — none are appropriate for mass measurements in the laboratory.

76. A — Always begin microscope viewing with the low-power objective lens, which has the widest field of view, making it easier to locate the specimen and protect the slide and lens. Higher-power lenses come close to the slide and risk damage if used first.

77. C — In the Beaks of Finches lab, surviving students "reproduce" by passing their tool (representing their beak trait) to another student in the next round. This simulates the inheritance of advantageous traits from successful parents to offspring.

78. B — The independent variable is what the experimenter changes — here, the level of physical activity. The pulse rate is the dependent variable being measured, while the device used and room temperature are controlled to prevent confounding effects.

79. D — Glucose molecules are small enough to pass through the pores in the dialysis tubing, while starch molecules are too large. Detecting glucose in the water outside shows that glucose diffused outward through the membrane down its concentration gradient.

80. C — The independent variable is what the experimenter changes to test its effect. Here, the amount of light is being changed to see how it affects the dependent variable (rate of photosynthesis). Plant species and time of day would be controlled.

81. A — A control group does not receive the experimental treatment and provides a baseline for comparison with the experimental group. Without a control, the experimenter cannot tell whether observed changes were caused by the treatment or other factors.

82. B — Safety goggles must be worn whenever chemicals are used in the laboratory to protect eyes from splashes, spills, and fumes. Tasting chemicals and mixing unknowns are dangerous; removing protective clothing reduces safety rather than increasing it.

83. D — A dropper should be held just above the slide without making contact, to prevent contamination of the dropper and to allow a controlled drop. Touching the slide can transfer material or damage the dropper tip.

84. C — Changing the food source in the Beaks of Finches lab models how environmental changes alter which traits are favored. A beak (or tool) well-suited to one food may be poorly suited to another, illustrating natural selection in a shifting environment.

85. B — The Relationships and Biodiversity lab compares amino acid sequences, DNA, and physical characteristics of organisms to determine evolutionary relationships. This is one of the four required New York State Living Environment lab investigations.