

PRACTICE EXAM 14: 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. Which of the following processes is shared by all organisms — from bacteria to plants to humans?

- A. Producing food through chlorophyll-based photosynthesis
- B. Moving from one location to another to find new food
- C. Producing offspring exclusively through internal fertilization
- D. Performing cellular respiration to release energy from nutrients

2. The smallest living unit capable of carrying out all the functions of life independently is

- A. a single cell
- B. a single molecule
- C. a single organ
- D. a single tissue

3. Which of the following organelles is sometimes called the "powerhouse" of the cell because it produces ATP?

- A. the ribosome
- B. the mitochondrion
- C. the nucleus
- D. the lysosome

4. Which of the following best describes the role of the cell membrane in a living cell?

- A. It produces the cell's energy through chemical reactions
- B. It stores all of the cell's genetic information securely
- C. It regulates the movement of materials into and out of the cell
- D. It assembles amino acids into long protein chains in the cell

5. The diffusion of water across a selectively permeable membrane is called

- A. osmosis
- B. respiration
- C. transpiration
- D. condensation

6. An enzyme that normally functions at a pH of 7 is placed in a solution with a pH of 2. The most likely result is that

- A. the enzyme will continue to function as effectively as before
- B. the enzyme will function twice as quickly as it did before
- C. the enzyme will reproduce more rapidly under the new conditions
- D. the enzyme will lose its three-dimensional shape and function

7. In a plant, the products of photosynthesis are

- A. carbon dioxide and water vapor released into the air
- B. glucose and oxygen produced from carbon dioxide and water
- C. nitrogen and phosphorus absorbed from the soil daily
- D. ATP and amino acids manufactured in the chloroplast

8. During cellular respiration in human cells, glucose is broken down in the presence of

- A. oxygen, producing carbon dioxide, water, and ATP
- B. nitrogen, producing amino acids, water, and ATP
- C. carbon dioxide, producing glucose, oxygen, and ATP
- D. sunlight, producing glucose, oxygen, and ATP

9. A nucleotide of DNA consists of

- A. a fatty acid, a glycerol, and an amino acid
- B. an amino acid, a peptide bond, and a side chain

- C. a sugar (deoxyribose), a phosphate, and a nitrogenous base
- D. a glucose, a phosphate, and a fatty acid linked together

10. Before a cell divides, the entire DNA content must be

- A. translated into protein and stored in the nucleus
- B. destroyed by enzymes in the surrounding cytoplasm
- C. transferred to a daughter cell without any change
- D. duplicated (replicated) so each daughter cell receives a complete copy

11. The site of protein synthesis in the cell is the

- A. nucleus
- B. ribosome
- C. lysosome
- D. vacuole

12. A mutation that changes the sequence of bases in a gene may affect

- A. the type or sequence of amino acids in the protein produced by that gene
- B. only the genes located on the same chromosome as the mutation
- C. only the cell membrane of the organism in which the mutation occurs
- D. only the carbohydrate molecules within the affected cells

13. In a multicellular organism, mitosis is responsible for

- A. producing gametes for sexual reproduction
- B. introducing genetic variation into a population
- C. growth, tissue repair, and the replacement of body cells
- D. reducing the chromosome number in offspring cells

14. In humans, the chromosome number in a sperm or egg cell is

- A. 92 chromosomes
- B. 46 chromosomes
- C. 12 chromosomes
- D. 23 chromosomes

15. A trait controlled by an autosomal dominant allele is most likely to

- A. appear only in individuals who are homozygous for the recessive allele
- B. appear in every generation when at least one parent carries the dominant allele
- C. skip generations frequently and appear only in males in a family
- D. be expressed only when both parents have the trait themselves

16. In humans, a person who is heterozygous for sickle cell trait (AS) has both normal hemoglobin (A) and sickle hemoglobin (S) in their red blood cells. This is an example of

- A. codominance, in which both alleles are fully expressed
- B. incomplete dominance, in which the heterozygote is intermediate
- C. simple Mendelian dominance with one allele masking the other
- D. polygenic inheritance involving many different genes at once

17. In pea plants, yellow seeds (Y) are dominant to green seeds (y). A cross between two yellow-seeded plants produces approximately 75% yellow-seeded offspring and 25% green-seeded offspring. The genotypes of the parents are most likely

- A. $YY \times YY$
- B. $Yy \times yy$
- C. $YY \times yy$
- D. $Yy \times Yy$

18. Down syndrome is most commonly caused by

- A. a single mutation in a gene that controls human growth
- B. a sex-linked recessive allele on the X chromosome
- C. an extra copy of chromosome 21 (trisomy 21)
- D. environmental exposure to chemicals during pregnancy

19. A father who has color blindness (an X-linked recessive disorder) marries a woman who is homozygous normal. Their daughters will most likely

- A. all be carriers but not color blind themselves

- B. all be color blind themselves at birth
- C. all be color blind only if they marry an affected man
- D. have a 50% chance of being color blind themselves

20. Gregor Mendel is often called the father of genetics because he

- A. discovered the structure of the DNA double helix
- B. established the principles of inheritance using pea plant experiments
- C. sequenced the entire genome of the garden pea
- D. developed the technique of recombinant DNA technology

21. Darwin proposed that one major mechanism of evolutionary change is

- A. acquired characteristics passing from parent to offspring directly
- B. the body's strong determination to improve itself over generations
- C. environmental conditions directly changing the DNA of organisms
- D. natural selection acting on inherited variations within a population

22. The forelimbs of a whale, a bat, and a horse all share the same basic bone arrangement, despite serving different functions. These structures are best described as

- A. analogous structures with no shared ancestry
- B. vestigial structures that no longer serve any purpose
- C. homologous structures inherited from a common ancestor

D. coincidental similarities that arose independently in each species

23. The development of two new species from one ancestral species when populations are physically separated by a geographic barrier is called

A. allopatric speciation

B. convergent evolution

C. coevolution between species

D. competitive exclusion

24. In a population of beetles, those with longer antennae are better able to detect predators and avoid being eaten. Over time, the average antenna length in the population is most likely to

A. decrease, since shorter antennae require less energy to grow

B. increase, since longer-antennae beetles survive and reproduce more

C. remain unchanged, since antenna length is determined by environment

D. fluctuate randomly, since natural selection is unpredictable

25. A population is defined as

A. all the organisms of all species living in a given area at one time

B. all the producers in a particular ecosystem at one time

C. the living and nonliving things together in a particular area

D. all the members of a single species living in a given area at one time

26. As a population approaches the carrying capacity of its environment, the rate of population growth typically

- A. slows down and eventually levels off
- B. accelerates and continues at a faster rate
- C. drops immediately to zero with no further growth
- D. doubles within each successive year of growth

27. Producers in a food chain obtain their energy from

- A. consuming dead plant and animal material in the soil
- B. eating primary consumers found in the food chain
- C. capturing the sun's energy through photosynthesis
- D. absorbing chemical energy directly from the soil

28. In the food chain: algae → water flea → small fish → larger fish → osprey, the small fish is considered a

- A. producer at the base of the food chain
- B. secondary consumer that feeds on a primary consumer
- C. quaternary consumer at the top of the chain
- D. decomposer that breaks down organic material

29. Decomposers play an essential role in ecosystems by

- A. producing oxygen for other organisms to use in respiration
- B. consuming all of the producers at the base of the food chain
- C. competing with primary producers for sunlight in habitats
- D. breaking down dead organisms and recycling nutrients back into the ecosystem

30. Most of the oxygen in Earth's atmosphere was originally produced by

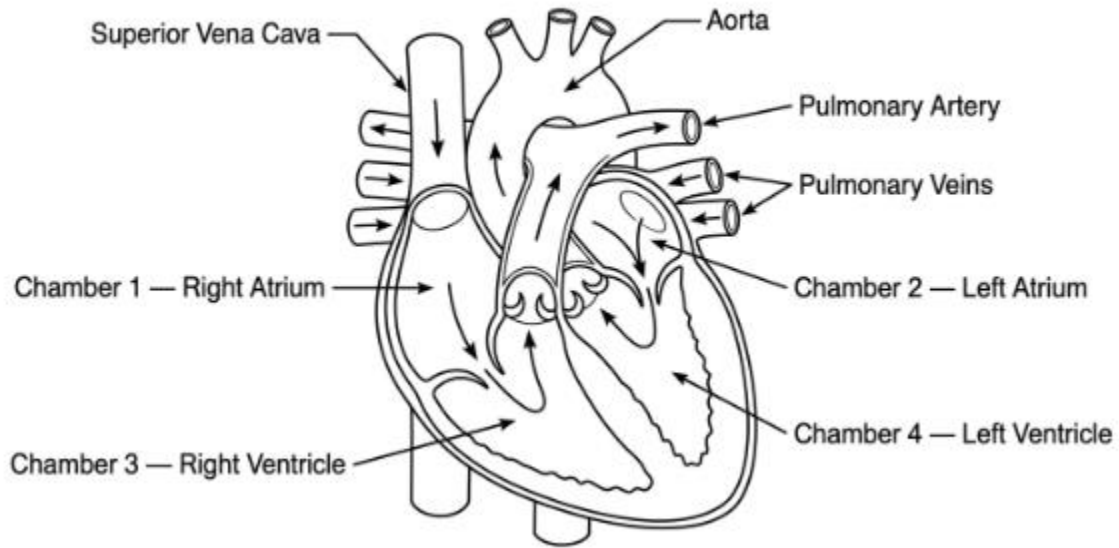
- A. photosynthetic organisms such as cyanobacteria and plants
- B. the breakdown of water molecules during volcanic eruptions
- C. cellular respiration carried out by early animal life
- D. the chemical reaction of nitrogen with sunlight in the atmosphere

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 labeled diagram of the human heart.

Cross-Section of the Human Heart



Based on the diagram, oxygenated blood returning from the lungs first enters which chamber?

- A. Chamber 1, the upper-right chamber
- B. Chamber 2, the upper-left chamber
- C. Chamber 3, the lower-right chamber
- D. Chamber 4, the lower-left chamber

32. Referring to the same diagram, the chamber with the thickest muscular wall is

- A. Chamber 1, since it receives blood from the entire body
- B. Chamber 2, since it receives blood from the lungs
- C. Chamber 3, since it pumps blood to the lungs nearby
- D. Chamber 4, since it pumps blood to the entire body

33. Referring to the same diagram, the chamber that pumps blood through the pulmonary artery to the lungs is

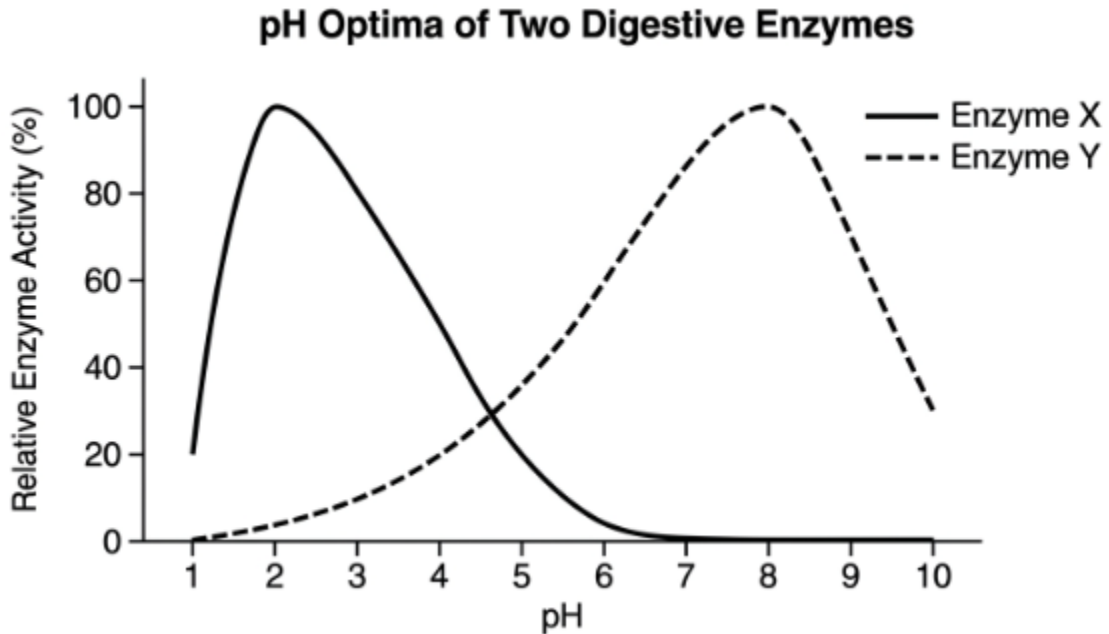
- A. Chamber 3
- B. Chamber 4
- C. Chamber 1
- D. Chamber 2

34. Referring to the same diagram, the function of the heart valves (drawn but not labeled) is to

- A. produce the electrical signals that maintain a regular heartbeat
- B. exchange oxygen and carbon dioxide with the surrounding lung tissue
- C. prevent the backflow of blood between the heart's chambers
- D. filter pathogens out of the blood as it passes through the heart

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

35. A student investigates how pH affects the activity of two different digestive enzymes (Enzyme X and Enzyme Y).



Based on the graph, Enzyme X is most likely found in the

- A. small intestine, where the environment is slightly basic
- B. mouth, where the pH is approximately neutral
- C. large intestine, where the pH is slightly acidic
- D. stomach, where the environment is highly acidic

36. Based on the same graph, the optimum pH for Enzyme Y is approximately

- A. 2, an acidic pH
- B. 8, a slightly basic pH
- C. 5, a slightly acidic pH
- D. 10, a strongly basic pH

37. Based on the same graph, the two enzymes function in different parts of the digestive system primarily because

- A. each enzyme has a specific pH range at which it works best
- B. each enzyme requires different types of food to function properly
- C. one enzyme is much larger than the other in molecular size
- D. the two enzymes are produced by entirely different organisms

Base your answers to questions 38-40 on the data table below and on your knowledge of biology.

38. A scientist tracks two competing populations of yeast (Population A and Population B) grown together over 10 days.

Day	Population A (cells/mL)	Population B (cells/mL)
0	50	50
2	120	100
4	280	180
6	500	200
8	750	150
10	950	80

Based on the data, which conclusion is best supported?

- A. The two populations are not competing with each other in any way
- B. Population B grows faster than Population A throughout the experiment
- C. Population A outcompetes Population B over the course of the experiment

D. Both populations follow the same exponential growth pattern over time

39. Based on the same data, if Population A were removed from the container on Day 6, Population B would most likely

A. continue declining at the same rate as observed in the data

B. recover and increase as competition for resources is reduced

C. immediately reach the same population size as Population A

D. evolve into a brand new yeast species within the next two days

40. Based on the same data, the relationship between Population A and Population B is best described as

A. mutualism, in which both populations benefit equally over time

B. predation, in which one population directly consumes the other

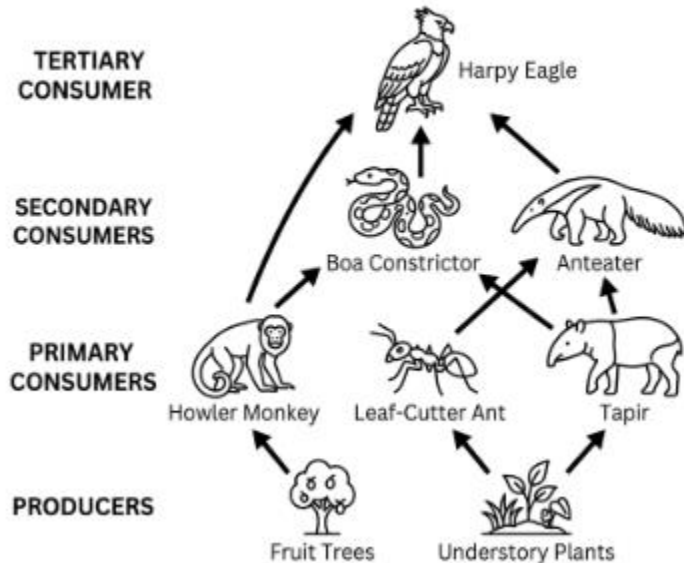
C. commensalism, with one population benefiting and the other unaffected

D. interspecific competition, with two species competing for shared resources

Base your answers to questions 41-43 on the diagram below and on your knowledge of biology.

41. A student examines a food web for a tropical rainforest ecosystem.

Tropical Rainforest Food Web



Based on the food web, the Howler Monkey serves as

- A. a primary consumer that is also a food source for the Harpy Eagle and the Boa Constrictor
- B. a producer at the base of the rainforest food web ecosystem
- C. a decomposer that breaks down dead leaves on the forest floor
- D. a top predator that has no natural predators in this ecosystem

42. Based on the same food web, if a disease eliminated all of the Leaf-Cutter Ants, the most directly affected population would be the

- A. Boa Constrictor, since it preys on the ants and their colonies
- B. Harpy Eagle, since it occasionally hunts ant colonies for food
- C. Anteater, since its primary food source is the Leaf-Cutter Ant
- D. Howler Monkey, since it competes with the ants for fruit

43. Based on the same food web, the Harpy Eagle feeds at how many different trophic levels?

- A. one trophic level only, since it sits at the top of the web
- B. two different trophic levels (primary and secondary consumers)
- C. three different trophic levels (primary, secondary, and tertiary consumers)
- D. four different trophic levels including the producers and decomposers

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

Answer all questions in this part.

44. A scientific theory is supported by

- A. a single experiment that gave a clear result one time
- B. the personal opinion of a single famous scientist
- C. only experiments conducted in one location on Earth
- D. extensive evidence from many independent investigations

45. In an experiment to test whether the brightness of light affects the growth of mold on bread, the dependent variable would be

- A. the amount of mold that grows on each bread slice
- B. the brightness of the light used in the experiment
- C. the type of bread used in the experiment

D. the temperature of the room during the experiment

46. In the same experiment, all bread slices should be the same size and stored at the same temperature so that

A. the experiment is completed more quickly than usual

B. the bread slices appear identical to the observer

C. any differences in mold growth can be attributed to light alone

D. the mold can grow more rapidly under the test conditions

47. A student wants to test a food sample for the presence of starch. The most appropriate indicator is

A. Benedict's solution, which turns orange-red when heated

B. Lugol's iodine, which turns blue-black in the presence of starch

C. bromothymol blue, which turns yellow in acidic conditions

D. litmus paper, which changes color depending on pH

48. In plants, sugars produced by photosynthesis are transported throughout the plant by

A. xylem, which carries water from the roots to the leaves

B. epidermis, the outermost layer of the leaves

C. phloem, which carries sugars to all parts of the plant

D. cuticle, the waxy covering on the upper surface of leaves

49. All of the body cells of a single human being have the same DNA. The reason that nerve cells and skin cells look and function differently is that

- A. different genes are expressed in each type of specialized cell
- B. nerve cells lost certain genes during embryonic development
- C. skin cells have additional chromosomes added during development
- D. each cell type contains a completely different version of the genome

50. Scientists insert the gene for human insulin into bacteria, which then produce human insulin that is used to treat diabetes. This is an example of

- A. natural selection occurring in a laboratory setting
- B. selective breeding of bacterial strains over time
- C. cellular respiration applied to medical problems
- D. genetic engineering using recombinant DNA technology

51. The circulatory system in the human body is responsible for

- A. breaking down food into smaller absorbable nutrients
- B. transporting nutrients, oxygen, hormones, and wastes throughout the body
- C. detecting changes in the environment and processing the information
- D. supporting the body's weight and allowing movement of body parts

52. The primary function of the small intestine is

- A. storing food until it can be digested in other parts of the body
- B. producing bile that breaks down dietary fats and lipids
- C. breaking down food using strong stomach acid for digestion
- D. completing chemical digestion and absorbing most nutrients

53. When blood glucose levels rise after a meal, the pancreas releases insulin. Insulin causes body cells to absorb glucose, which lowers the blood glucose level. The decrease in blood glucose in turn reduces insulin release. This process is an example of

- A. negative feedback maintaining homeostasis
- B. positive feedback that amplifies the original change
- C. random hormonal release unrelated to glucose levels
- D. competition between glucose and other sugars in the blood

54. The basic structural and functional unit of the nervous system is the

- A. synapse between two adjacent cells
- B. spinal cord segment within the vertebral column
- C. brain hemisphere on either side of the head
- D. neuron, also called a nerve cell

55. The function of B lymphocytes in the immune system is to

- A. directly engulf and digest invading pathogens

- B. produce antibodies that bind to specific antigens
- C. transport oxygen to body tissues through the bloodstream
- D. form blood clots at sites of injury or active infection

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

Answer all questions in this part.

56. A flu vaccine typically contains

- A. live, fully infectious flu viruses that cause mild illness
- B. memory cells already programmed to fight the flu virus
- C. weakened or inactivated flu viruses or viral proteins
- D. antibiotics that destroy the flu virus inside the body

57. Untreated HIV infection eventually leads to AIDS because the virus

- A. progressively destroys helper T cells, weakening immune defenses
- B. directly destroys all red blood cells in the body permanently
- C. damages the kidneys, preventing waste removal from the body
- D. blocks the production of insulin by the pancreas over time

58. A tapeworm living inside the intestine of a dog represents an example of

- A. mutualism between two cooperating species in the gut
- B. commensalism with no effect on the host animal at all
- C. parasitism, in which the tapeworm benefits and the dog is harmed
- D. competition for nutrients between two free-living species

59. The first organisms to colonize a newly formed volcanic island, where there is no soil at all, are most likely to be

- A. large mammals seeking new territory and abundant food
- B. flowering shrubs that require deep, nutrient-rich soil to grow
- C. amphibians that need both water and land to complete their life cycles
- D. lichens and mosses, which can survive on bare rock and help form soil

60. Ecosystems with greater biodiversity tend to be

- A. unstable and more vulnerable to environmental change
- B. less productive than ecosystems with very few species
- C. more resilient to disturbances and more stable over time
- D. less suitable for human exploration and outdoor visitation

61. Fertilizer runoff from farms entering a lake can cause an algal bloom. When the algae die, the lake's fish populations often die because

- A. the algae release toxic chemicals that directly poison the fish

- B. the fertilizer immediately raises the water temperature too high
- C. decomposing algae deplete the oxygen dissolved in the water
- D. the fertilizer reacts with water to form a strong acid solution

62. Polar bears are considered vulnerable to climate change primarily because

- A. they are unable to swim long distances in open water
- B. they are heavily hunted by humans in their native range
- C. warmer temperatures cause their fur to fall out gradually
- D. melting sea ice is reducing their hunting grounds for seals

63. One method used to control the population of an invasive insect is to introduce a natural predator from the insect's original habitat. This approach is known as

- A. biological control
- B. genetic modification of the insect populations
- C. chemical pesticide application in the affected region
- D. selective breeding of the targeted insect species

64. Damage to the ozone layer in the upper atmosphere increases the risk of

- A. excessive carbon dioxide buildup at the Earth's surface
- B. higher rates of skin cancer due to increased UV radiation
- C. lower oxygen levels in the breathing zone of the atmosphere

D. acid rain falling on forests and surface waters worldwide

65. The carrying capacity of an environment refers to

A. the total number of all species combined in an ecosystem

B. the highest population a species ever reached in history

C. the maximum population size of a species that an environment can sustainably support

D. the minimum number of individuals needed for a population to survive in an area

66. Sustainable forestry practices typically include

A. cutting only a portion of the trees and allowing the forest to regenerate

B. removing all trees from an area to maximize lumber yield

C. burning the forest to clear land for housing developments

D. replacing native trees with non-native ornamental species

67. Solar power is considered a renewable energy source because

A. it produces no waste or environmental impact whatsoever

B. it can be stored indefinitely without any loss of energy

C. sunlight is continuously replenished and will not run out on human timescales

D. solar panels themselves never need replacement or repair

68. The transfer of pollen from the anther of one flower to the stigma of another flower is called

- A. fertilization
- B. pollination
- C. germination
- D. transpiration

69. Which of the following organisms is best known for reproducing asexually through a process called budding?

- A. hydra, a small freshwater animal
- B. salmon, a migratory fish species
- C. human, a placental mammal
- D. fern, a vascular non-flowering plant

70. Which of the following organisms is a prokaryote?

- A. an oak tree growing in a forest
- B. a frog living in a freshwater pond
- C. a bacterium living in soil
- D. a mushroom growing on a log

71. Mushrooms and molds belong to which kingdom?

- A. Animalia
- B. Plantae
- C. Protista
- D. Fungi

72. Amoebas, paramecia, and certain algae are all examples of

- A. fungi, since they all decompose dead organic matter
- B. protists, a kingdom of mostly single-celled eukaryotes
- C. bacteria, which are tiny prokaryotic cells
- D. plants, which all carry out photosynthesis like green leaves

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

Answer all questions in this part.

73. On a compound light microscope, the part that holds the slide in place on the stage is called the

- A. objective lens
- B. eyepiece
- C. stage clip
- D. coarse adjustment knob

74. A student views a specimen using an eyepiece with a magnification of $10\times$ and an objective lens with a magnification of $4\times$. The total magnification is

- A. $40\times$
- B. $14\times$
- C. $4\times$
- D. $400\times$

75. During a dissection in biology class, the safest tool to use for cutting tissue is

- A. a pair of household scissors brought from home
- B. a sharp scalpel held away from the body
- C. a kitchen knife found at home in the drawer
- D. a pair of scissors with broken or rusted blades

76. In the Beaks of Finches simulation, students "starve" out tools that picked up too few seeds. This step represents

- A. the random extinction of a species from natural causes
- B. the random migration of finches to other islands
- C. the evolution of a brand new finch species in one round
- D. the death of less-adapted individuals through natural selection

77. In the Relationships and Biodiversity laboratory, students compare a target species to candidate species using gel electrophoresis. Gel electrophoresis separates DNA fragments by

- A. their size, with smaller fragments traveling farther through the gel
- B. their color, since each fragment is uniquely colored before loading
- C. their temperature, as warmer fragments move more quickly in the gel
- D. the time at which they were placed into the gel by the student

78. In the Diffusion Through a Membrane laboratory, a student finds that iodine has entered the dialysis tubing but starch has not exited the tubing. This best demonstrates that

- A. the dialysis tubing is impermeable to all molecules during the experiment
- B. the dialysis tubing functions as a selectively permeable membrane
- C. all molecules cross the membrane at exactly the same rate
- D. starch molecules and iodine molecules are identical in structure

79. In the Making Connections laboratory, students often investigate the effect of exercise on a measurable physiological response, such as pulse rate or muscle fatigue. A valid hypothesis for this lab would be

- A. Exercise is fun and good for you in many different ways
- B. Healthy people exercise more than unhealthy people typically do
- C. If a person exercises, then their pulse rate will increase due to increased oxygen demand
- D. Some kinds of exercise are better than others at burning calories

80. When preparing a wet-mount slide of plant cells, a student should

- A. heat the slide gently over a flame to dry the specimen first

- B. apply a thick layer of stain over the specimen for better visibility
- C. cut the specimen as thick as possible to see more cell layers
- D. place a thin specimen on the slide, add a drop of water, and lower the coverslip at an angle

81. A student tests an unknown solution with Benedict's solution and heats the mixture. The mixture turns orange-red. This result indicates the presence of

- A. glucose or another reducing sugar in the solution
- B. starch as a complex carbohydrate in the solution
- C. lipids or fats as macromolecules in the solution
- D. proteins or amino acids in the solution

82. When a student switches from low power to high power on a microscope, the field of view becomes darker. To improve visibility, the student should

- A. lower the stage further away from the objective lens
- B. increase the amount of light using the diaphragm or light source
- C. clean the eyepiece thoroughly with a paper towel
- D. turn the coarse adjustment knob until the specimen disappears

83. A student finds that one of her data points appears to be significantly different from the others in her experiment. The most appropriate action is to

- A. discard the outlier immediately without further consideration
- B. modify the data point so it matches the surrounding values

- C. record the data point but try to determine why it differs and consider repeating the trial
- D. report the outlier as the most accurate measurement in the experiment

84. A complete experimental conclusion should include

- A. only data values that support the original hypothesis
- B. an apology for any mistakes made during the experiment
- C. a promise that the results will never need to be repeated
- D. a statement of whether the data supported the hypothesis and possible sources of error

85. When working with a heated liquid in a test tube during a biology lab, the safest practice is to

- A. point the open end of the test tube away from yourself and others
- B. seal the test tube tightly with a rubber stopper before heating it
- C. hold the test tube horizontally directly over the open flame
- D. heat the test tube while pointing it toward your face for observation

EXPLAINED ANSWER KEY – PRACTICE EXAM 14

1. D — Cellular respiration is the universal process by which all living organisms convert nutrients into usable energy (ATP). Photosynthesis is limited to autotrophs, locomotion to certain animals, and internal fertilization to specific groups, but every organism extracts energy from nutrients through some form of cellular respiration or fermentation.

2. A — A cell is the smallest unit of life capable of carrying out all the basic life processes independently. Molecules are not alive, while tissues and organs are higher-level groupings of cells that exist only in multicellular organisms.

- 3. B** — Mitochondria produce most of the cell's ATP through aerobic respiration on their folded inner membrane, earning them the nickname "powerhouse of the cell." Ribosomes synthesize proteins, the nucleus stores DNA, and lysosomes digest cellular waste.
- 4. C** — The plasma membrane is selectively permeable, regulating which substances enter and leave the cell through diffusion, osmosis, active transport, and other mechanisms. It does not produce energy, store genetic information, or assemble proteins itself.
- 5. A** — Osmosis is specifically the diffusion of water across a selectively permeable membrane from regions of higher water concentration to lower water concentration. Respiration releases energy, transpiration is water loss from plants, and condensation is a phase change.
- 6. D** — Each enzyme has a narrow pH range in which its three-dimensional shape, especially at the active site, is preserved. A pH far from the optimum disrupts the hydrogen and ionic bonds that maintain that shape, causing denaturation and loss of activity.
- 7. B** — Photosynthesis combines CO_2 and water using light energy to produce glucose and release oxygen ($6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$). CO_2 and water are the raw materials, while glucose and oxygen are the products.
- 8. A** — Aerobic cellular respiration uses oxygen to break down glucose, producing carbon dioxide, water, and ATP ($\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{ATP}$). This is the central energy-releasing reaction in human cells.
- 9. C** — A DNA nucleotide is built from three components: a deoxyribose sugar, a phosphate group, and one of four nitrogenous bases (A, T, G, or C). Linked together, these nucleotides form the long strands of the DNA molecule.
- 10. D** — Before mitosis, DNA must be replicated so each daughter cell receives a complete and identical copy of the genome. Without this duplication, dividing cells would receive incomplete genetic information and could not function normally.
- 11. B** — Ribosomes are the molecular machines that translate mRNA into polypeptide chains by linking amino acids together in the order specified by the genetic code. They can be free in the cytoplasm or attached to the rough endoplasmic reticulum.
- 12. A** — A mutation that alters the DNA base sequence can change the codons read during translation, which in turn changes which amino acids are added to the protein and in what order. Even a single amino acid change can alter protein folding, function, or both.
- 13. C** — Mitosis produces two genetically identical diploid daughter cells from one parent cell, supporting growth of multicellular organisms, repair of damaged tissue, and continuous replacement of skin, blood, and intestinal cells. Meiosis, not mitosis, produces gametes and reduces chromosome number.
- 14. D** — Human gametes (sperm and egg) are haploid and contain 23 chromosomes — half the diploid number of 46 found in body cells. Fertilization then restores the diploid number when two gametes fuse.

- 15. B** — An autosomal dominant allele produces its phenotype whenever at least one copy is present, so affected individuals can pass the trait directly to their children. As a result, the trait typically appears in every generation rather than skipping generations as recessive traits often do.
- 16. A** — Codominance is the inheritance pattern in which both alleles in a heterozygote are fully and equally expressed, neither blending nor masking each other. In sickle cell trait (AS), the person produces both normal hemoglobin (A) and sickle hemoglobin (S) simultaneously.
- 17. D** — A 3:1 ratio of dominant to recessive offspring is the classic Mendelian outcome of a monohybrid cross between two heterozygotes. The cross $Yy \times Yy$ produces $\frac{1}{4}$ YY, $\frac{1}{2}$ Yy, and $\frac{1}{4}$ yy — three yellow-seeded plants to every one green-seeded plant.
- 18. C** — Down syndrome results from trisomy 21, the presence of an extra (third) copy of chromosome 21, most often caused by nondisjunction during meiosis. The extra chromosome alters typical development and produces the characteristic features of the syndrome.
- 19. A** — Because color blindness is X-linked recessive, an affected father passes his X^c only to his daughters; his sons inherit his Y chromosome. With a homozygous normal mother ($X^H X^H$), every daughter receives X^H from the mother and X^c from the father, making all daughters heterozygous carriers but phenotypically normal.
- 20. B** — Mendel's careful breeding experiments with pea plants in the 1860s established the laws of segregation and independent assortment, founding the modern science of genetics. His work predates the discovery of DNA structure, genome sequencing, and recombinant DNA technology.
- 21. D** — Darwin proposed that within every population there are heritable differences among individuals, and those whose traits make them better suited to the environment survive and reproduce more. Over generations, this natural selection of favorable variations drives evolutionary change.
- 22. C** — Homologous structures share the same underlying anatomical plan because they were inherited from a common ancestor, even when their current functions differ. The forelimb bones of whales, bats, and horses follow the same vertebrate pattern despite serving for swimming, flying, and running.
- 23. A** — Allopatric speciation occurs when a physical (geographic) barrier divides a population, blocking gene flow and allowing the isolated groups to accumulate distinct genetic differences over time. Eventually the populations become reproductively isolated and form separate species.
- 24. B** — Longer-antennae beetles avoid predators more successfully and therefore live to reproduce more often, passing alleles for longer antennae to the next generation. Over many generations, this differential reproductive success shifts the population's average antenna length upward.
- 25. D** — In ecology, a population is defined as all the members of a single species occupying a particular area at a particular time. Communities include multiple species, and ecosystems include both biotic and abiotic components.

- 26. A** — As a population approaches carrying capacity, limiting factors such as food, space, and waste accumulation reduce birth rates and increase death rates. Growth slows and the population levels off, producing the characteristic S-shaped (logistic) growth curve.
- 27. C** — Producers are autotrophs that capture solar energy directly through photosynthesis and convert it into the chemical energy stored in glucose. This captured energy is the original source for nearly every trophic level above them.
- 28. B** — Primary consumers (such as the water flea) eat producers, and secondary consumers eat the primary consumers — placing the small fish, which feeds on water fleas, in the secondary consumer position. Tertiary and quaternary consumers occupy higher levels farther up the chain.
- 29. D** — Decomposers (mainly bacteria and fungi) break down dead plants, animals, and waste, releasing carbon, nitrogen, and other nutrients back into the soil and air. Without this recycling step, nutrients would remain locked in dead material and ecosystem productivity would collapse.
- 30. A** — The atmospheric oxygen we breathe was originally produced by photosynthetic organisms — first by cyanobacteria more than two billion years ago and later by algae and land plants. Their splitting of water during photosynthesis released the oxygen that accumulated in the atmosphere.
- 31. B** — Pulmonary veins return oxygenated blood from the lungs and deliver it to the left atrium (Chamber 2), which then pumps it into the left ventricle. The right atrium (Chamber 1), in contrast, receives deoxygenated blood from the body.
- 32. D** — The left ventricle (Chamber 4) must generate enough force to drive blood throughout the entire systemic circulation, so its wall is the thickest and most muscular of the four chambers. The right ventricle, which pumps only to the nearby lungs, has a noticeably thinner wall.
- 33. A** — The right ventricle (Chamber 3) pumps deoxygenated blood out through the pulmonary artery to the lungs, where gas exchange occurs. It is the only ventricle that sends blood to the lungs rather than to the body.
- 34. C** — The atrioventricular and semilunar valves open in one direction only, allowing blood to flow forward through the heart while preventing it from leaking back into the chamber that just contracted. Without these one-way valves, the heart could not move blood efficiently in a single direction.
- 35. D** — Enzyme X reaches peak activity at pH 2, the highly acidic environment characteristic of the stomach, where HCl creates conditions ideal for pepsin and other gastric enzymes. The other listed locations have higher pH values that fall outside Enzyme X's effective range.
- 36. B** — Enzyme Y's activity curve peaks at pH 8, indicating that this slightly basic pH is its optimum. Such a pH is characteristic of the small intestine, where pancreatic and intestinal enzymes work best.
- 37. A** — Different enzymes have evolved different optimal pH values that match the chemical environment of the regions of the digestive tract where they work. Pairing each enzyme with the appropriate pH region maximizes catalytic efficiency along the entire digestive pathway.

- 38. C** — Population A grows steadily over the ten days while Population B rises briefly and then crashes — a classic outcome of interspecific competition in which one competitor outperforms the other for shared resources. The data show one species (A) dominating while the other (B) is suppressed.
- 39. B** — Without competition from Population A, Population B would gain access to the resources A had been monopolizing and would be expected to rebound and grow. Subordinate competitors often recover rapidly when the dominant competitor is removed.
- 40. D** — Two species competing for the same limited resources in the same environment fits the definition of interspecific competition, with one species (A) outcompeting the other (B) over time. The data show no evidence of mutualism, predation, or commensalism.
- 41. A** — The Howler Monkey feeds on Fruit Trees, making it a primary consumer (herbivore), and it is itself preyed upon by both the Boa Constrictor and the Harpy Eagle. Many species occupy this dual role, serving as both predator of lower levels and prey for higher ones.
- 42. C** — The Anteater's only food source in this web is the Leaf-Cutter Ant, so eliminating the ant population would cut off the Anteater's direct food supply almost completely. Other organisms in the web depend less directly on the ants.
- 43. B** — The Harpy Eagle feeds on the Howler Monkey (a primary consumer) and on the Boa Constrictor and Anteater (both secondary consumers). Eating from two distinct trophic levels — primary and secondary consumers — gives a count of two.
- 44. D** — A scientific theory is a well-supported explanation drawn from many independent lines of evidence, repeated experiments, and confirmation by multiple researchers. A single experiment, a personal opinion, or a single location of study cannot, on its own, establish a theory.
- 45. A** — The dependent variable is the response that is measured to detect any effect of the independent variable. Here the experimenter changes light brightness and observes the resulting amount of mold growth.
- 46. C** — Keeping bread size, temperature, and other conditions constant ensures that any observed difference in mold growth can be attributed only to the variable being tested (light brightness). Failing to control these factors would confound the results.
- 47. B** — Lugol's iodine is the standard biology-lab indicator for starch: in the presence of starch, it changes from amber to a deep blue-black color. Benedict's solution detects reducing sugars, bromothymol blue indicates pH/CO₂, and litmus paper tests acidity or alkalinity.
- 48. C** — Phloem is the vascular tissue that transports the sugars (mainly sucrose) produced in photosynthetic leaves to the rest of the plant, including roots, stems, fruits, and growing tissues. Xylem moves water and minerals upward, and the epidermis and cuticle serve protective roles.

- 49. A** — Every body cell in an individual contains the same genome, but each cell type transcribes (expresses) only a subset of those genes — turning specific genes on or off. This differential gene expression produces the unique proteins and structures that make a nerve cell different from a skin cell.
- 50. D** — Inserting a human gene (insulin) into a bacterial cell using recombinant DNA techniques and then harvesting the protein from the modified bacteria is the textbook example of genetic engineering. This technology has produced safe, abundant human insulin for diabetic patients since the early 1980s.
- 51. B** — The circulatory system uses the heart and blood vessels to deliver oxygen, nutrients, and hormones to body cells and to carry away carbon dioxide and metabolic wastes. The other listed functions belong to the digestive, nervous, and skeletal systems, respectively.
- 52. D** — The small intestine is where most chemical digestion is completed — by enzymes from the pancreas and the intestinal wall and by bile from the liver — and where the resulting nutrients are absorbed through villi into the bloodstream. The stomach, large intestine, and liver play supporting roles but not this central one.
- 53. A** — Negative feedback occurs when the output of a process inhibits the process itself, returning a regulated variable toward its set point. The insulin–glucose loop is a classic example: rising glucose triggers insulin release, glucose drops, and insulin release is then reduced, keeping blood sugar within homeostatic limits.
- 54. D** — The neuron (nerve cell) is the structural and functional unit of the nervous system, specialized to receive, integrate, and transmit electrochemical signals through dendrites, cell body, and axon. Synapses, spinal cord segments, and brain hemispheres are higher-level organizations of these cells.
- 55. B** — B lymphocytes (B cells) are the antibody-producing cells of the adaptive immune system; once activated by exposure to an antigen, they differentiate into plasma cells that secrete antibodies binding specifically to that antigen. This precise targeting is the basis of long-term, antigen-specific immunity.
- 56. C** — Most vaccines, including many flu vaccines, contain weakened (attenuated), inactivated (killed), or fragmented viral material that displays the viral antigens to the immune system without causing disease. Exposure trains the immune system to mount a fast, specific response if the real virus appears later.
- 57. A** — HIV specifically infects and destroys helper T (CD4⁺) cells, which coordinate both antibody-mediated and cell-mediated immune responses. As these cells are progressively lost, the immune system becomes increasingly unable to control opportunistic infections and certain cancers — the defining features of AIDS.
- 58. C** — Parasitism is a long-term symbiotic relationship in which one organism (the parasite) benefits while the other (the host) is harmed. A tapeworm absorbs nutrients from the dog's intestine at the dog's expense, fitting this definition precisely.
- 59. D** — Primary succession begins on bare rock with no soil; the first colonizers must tolerate harsh conditions and contribute to soil formation. Lichens and mosses are the textbook pioneer species, slowly breaking down rock and adding organic matter so that later species can establish themselves.

- 60. C** — Greater biodiversity means more species and more functional roles within an ecosystem, which buffers the community against disturbances such as disease, climate variation, and species loss. As a result, biodiverse ecosystems tend to be more stable and resilient over time.
- 61. C** — Excess nutrients fuel a rapid algal bloom; when the algae die, populations of decomposer bacteria consume the dissolved oxygen as they break the algae down. The resulting hypoxia (low oxygen) suffocates fish, which is the central problem in cultural eutrophication.
- 62. D** — Polar bears hunt seals primarily from the surface of Arctic sea ice; as warming temperatures shrink and thin the ice, polar bears have less platform from which to hunt. Reduced hunting success leads to declining body condition, reproduction, and survival.
- 63. A** — Biological control uses living organisms — typically a natural predator, parasite, or pathogen — to manage a pest population rather than relying on chemicals or genetic modification. When effective, it provides long-term pest suppression with limited environmental damage.
- 64. B** — Stratospheric ozone absorbs much of the sun's ultraviolet-B radiation; when the ozone layer is depleted, more UV reaches the surface and increases human exposure. Long-term increased UV exposure raises rates of skin cancer, cataracts, and damage to plants and aquatic ecosystems.
- 65. C** — Carrying capacity (K) is the maximum population size that a given environment can sustainably support over time, given available resources such as food, water, and habitat space. Populations tend to oscillate around or level off at this value, not exceed it for long.
- 66. A** — Sustainable forestry harvests only a portion of the trees in any one cycle, leaving enough mature trees to provide seeds, habitat, and shade so the forest can regenerate. Clear-cutting all trees or burning the forest removes this regenerative capacity.
- 67. C** — Solar power is classified as renewable because sunlight is continuously and reliably replenished by the sun on any human timescale. It is not fully impact-free or maintenance-free, but it is not subject to depletion the way fossil fuels are.
- 68. B** — Pollination is specifically the transfer of pollen from the male anther of one flower to the female stigma of another (or sometimes the same) flower. Fertilization happens later when sperm reach the egg in the ovule, and germination is the sprouting of a seed.
- 69. A** — Hydras are small freshwater cnidarians that classically reproduce asexually by budding: a small outgrowth (bud) develops on the parent's body, grows into a miniature hydra, and detaches as a genetically identical clone. The other listed organisms reproduce sexually as their primary or exclusive mode.
- 70. C** — Bacteria are prokaryotes — they lack a membrane-bound nucleus and most other membrane-bound organelles. Oak trees, frogs, and mushrooms are eukaryotes whose cells contain nuclei and complex organelles.

71. D — Mushrooms and molds are members of Kingdom Fungi: they are eukaryotic, have cell walls made of chitin, and absorb nutrients from their environment by secreting digestive enzymes. They are not plants (no photosynthesis), animals, or protists.

72. B — Amoebas, paramecia, and many algae are eukaryotic, mostly single-celled organisms that do not fit cleanly into the plant, animal, or fungus kingdoms, and are therefore classified as protists. The protist kingdom is famously diverse and serves as a catch-all for eukaryotes outside the other major groups.

73. C — Stage clips are small metal arms on either side of the microscope stage that hold the glass slide firmly in place so it does not shift during viewing. The objective lens, eyepiece, and adjustment knobs each serve different optical or focusing functions.

74. A — Total magnification of a compound light microscope equals the eyepiece magnification multiplied by the objective magnification: $10 \times 4 = 40\times$. This is the formula students apply to every magnification calculation in the lab.

75. B — A sharp scalpel makes a clean, controlled cut with minimal force and is the standard dissection tool; it should be held with the blade pointing away from the body to prevent slips. Household scissors, kitchen knives, and broken-bladed scissors are unsafe and not approved for laboratory dissection.

76. D — Tools that gathered too few seeds represent individuals whose beak variation gave them low fitness in the simulated environment; removing them from the next round models the death of less-adapted finches. This differential survival, repeated each generation, is the core mechanism of natural selection.

77. A — In gel electrophoresis, an electric field drives negatively charged DNA fragments through a porous gel; smaller fragments encounter less resistance and migrate farther from the wells than larger ones. The resulting size-based band pattern is the basis of DNA fingerprinting and many diagnostic tests.

78. B — The dialysis tubing acts like a real cell membrane: it allows small molecules such as iodine to pass through its pores while blocking larger molecules such as starch. This size-based discrimination is the defining feature of a selectively permeable membrane.

79. C — A valid scientific hypothesis follows an "if-then-because" structure that identifies the independent variable (exercise), predicts the dependent variable (increased pulse rate), and offers a reasoned mechanism (increased oxygen demand). The other options are opinions, generalizations, or value judgments rather than testable hypotheses.

80. D — A proper wet mount requires a thin specimen, a small drop of water, and a coverslip lowered at an angle to push air ahead of it and prevent trapped bubbles. Heating, thick specimens, or overstaining can ruin the slide or damage the cells before observation.

81. A — Benedict's solution detects reducing sugars (including glucose, fructose, maltose, and lactose); when heated with such sugars, it changes from clear blue to green, yellow, or orange-red, depending on the sugar's concentration. The orange-red endpoint indicates a relatively high level of reducing sugar.

82. B — Higher-power objectives admit less light through their narrower apertures, so the field of view appears dimmer. Opening the diaphragm or increasing the light source compensates for this, restoring brightness without affecting focus or magnification.

83. C — Scientific integrity requires recording all data, including outliers, exactly as observed. Investigating possible causes — instrument error, technique problem, or true biological variation — and repeating the trial if possible strengthens the experiment's reliability without compromising honesty.

84. D — A thorough conclusion explicitly evaluates whether the data support the hypothesis and also discusses possible sources of error and suggestions for improving the experiment. This reflective practice gives readers the context they need to judge and build on the results.

85. A — Heated liquids in a test tube can boil violently and spray outward, so the open end of the tube must always be pointed away from yourself and from any other person. Sealing the tube, holding it horizontally over the flame, or pointing it toward yourself creates serious risks of injury.