

PRACTICE EXAM 15: 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 best demonstrates the life process of growth?

- A. A rock breaking apart due to weathering over many years
- B. A puddle drying up under sunlight in the afternoon
- C. A young oak tree adding new layers of wood each year
- D. A river carving a deeper channel over many centuries

2. A group of similar cells working together to perform a specific function is called

- A. a tissue
- B. an organ
- C. an organ system
- D. an organism

3. Which organelle is responsible for breaking down worn-out cellular components and digesting cellular debris?

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

4. Which of the following organisms is composed of prokaryotic cells?

- A. an amoeba living in pond water
- B. a streptococcus bacterium
- C. a mushroom growing on a log
- D. a moss growing on a stone

5. The cell membrane is composed primarily of

- A. carbohydrates and water molecules
- B. nucleic acids and ribosomes only
- C. a phospholipid bilayer with embedded proteins
- D. cellulose fibers arranged in a thick mat

6. A molecule of carbon dioxide moves out of a body cell into the surrounding blood. This movement is best described as

- A. simple diffusion down a concentration gradient
- B. active transport requiring ATP energy
- C. endocytosis with the membrane folding inward
- D. exocytosis with the membrane releasing a vesicle

7. The "lock-and-key" model is used to describe how

- A. cells communicate with each other across long distances
- B. enzymes bind to their specific substrates at the active site
- C. DNA replicates during the cell cycle in dividing cells
- D. neurons transmit electrical signals across synapses

8. In a plant cell, photosynthesis takes place primarily in the

- A. nucleus
- B. ribosome
- C. mitochondrion
- D. chloroplast

9. Most ATP in a eukaryotic cell is produced in the

- A. mitochondria during aerobic respiration
- B. ribosomes during protein synthesis

- C. nucleus during gene expression
- D. cell membrane during active transport

10. The overall equation for photosynthesis can be summarized as

- A. glucose + oxygen \rightarrow carbon dioxide + water + ATP
- B. amino acids \rightarrow proteins + nucleic acids + ATP
- C. carbon dioxide + water \rightarrow glucose + oxygen
- D. nitrogen + water \rightarrow ammonia + oxygen

11. In humans, a normal body cell contains how many chromosomes?

- A. 23 chromosomes total
- B. 92 chromosomes arranged in groups of four
- C. 100 chromosomes including additional sex chromosomes
- D. 46 chromosomes arranged in 23 pairs

12. In an RNA molecule, which base replaces thymine that is found in DNA?

- A. adenine
- B. uracil
- C. cytosine
- D. guanine

13. A gene is best described as

- A. a segment of DNA that codes for a specific protein or trait
- B. a complete chromosome containing all of an organism's DNA
- C. a single nucleotide subunit in a DNA molecule
- D. an enzyme that catalyzes a specific cellular reaction

14. Which type of molecule carries genetic instructions from the nucleus to the ribosome?

- A. transfer RNA (tRNA)
- B. ribosomal RNA (rRNA)
- C. messenger RNA (mRNA)
- D. deoxyribonucleic acid (DNA)

15. The process of mitosis in a multicellular organism is essential for

- A. producing haploid gametes for sexual reproduction
- B. growth, repair, and replacement of body cells
- C. introducing new genetic variation in offspring
- D. shuffling alleles to maintain genetic diversity

16. At the end of meiosis, a single diploid parent cell with 8 chromosomes produces

- A. one diploid cell with 8 chromosomes
- B. two diploid cells with 8 chromosomes each
- C. two haploid cells with 4 chromosomes each
- D. four haploid cells with 4 chromosomes each

17. In pea plants, round seeds (R) are dominant to wrinkled seeds (r). If two heterozygous plants (Rr) are crossed, the probability that any one offspring will have wrinkled seeds is

- A. 25%
- B. 50%
- C. 75%
- D. 100%

18. Hemophilia is more common in males than in females because

- A. females produce hormones that prevent hemophilia from developing
- B. the hemophilia gene is located only on the Y chromosome
- C. males have only one X chromosome, so a single recessive allele produces the disorder
- D. hemophilia mutations occur more often in male reproductive cells

19. Sickle cell anemia is caused by

- A. an extra chromosome 21 inherited from a parent
- B. a deletion of an entire chromosome during gamete formation

- C. environmental damage to red blood cells in adulthood
- D. a point mutation in the gene that codes for hemoglobin

20. The transfer of a gene from one organism to another using laboratory techniques is called

- A. natural selection guided by environmental pressure
- B. genetic engineering or recombinant DNA technology
- C. selective breeding of organisms over many generations
- D. cellular respiration applied to industrial processes

21. The original source of new genetic variation in any population is

- A. selective breeding by human intervention
- B. learned behaviors passed from parents to offspring
- C. random mutations that occur in DNA
- D. consistent environmental conditions over many generations

22. According to the theory of natural selection, organisms with traits that increase their chances of survival and reproduction will

- A. pass those favorable traits on to more offspring than others in the population
- B. produce offspring that are exact clones of themselves through asexual means
- C. live forever and never face the threat of extinction in nature
- D. always change their own physical traits to match the environment

23. Which of the following provides the strongest direct evidence that two species share a recent common ancestor?

- A. they live in the same geographic region of the world
- B. they consume similar foods in their respective environments
- C. they have a similar overall body size and outward appearance
- D. they have very similar DNA base sequences in homologous genes

24. Two populations of squirrels become separated by the formation of a new mountain range. Over thousands of years, they accumulate so many genetic differences that they can no longer interbreed. This process is called

- A. coevolution between two different species
- B. allopatric speciation due to geographic isolation
- C. convergent evolution producing similar traits independently
- D. genetic drift acting equally on both populations

25. The webbed feet of a duck are best described as

- A. a structural adaptation that aids in swimming
- B. a behavioral adaptation learned during early life
- C. a physiological adaptation involving body chemistry
- D. a temporary adaptation that disappears in winter months

26. All the populations of plants, animals, and other organisms that live and interact in a forest make up

- A. a single biome
- B. a single population
- C. an ecological community
- D. an individual organism

27. In a typical food chain, the amount of energy available decreases at each successive trophic level mainly because

- A. organisms at higher levels have lower body temperatures
- B. predators consume too many prey at each level
- C. the sun stops providing energy at higher trophic levels
- D. most energy at each level is lost as heat during respiration

28. Bacteria and fungi that break down dead organisms and waste material are called

- A. autotrophs
- B. decomposers
- C. herbivores
- D. carnivores

29. In the water cycle, water vapor cools and forms clouds through the process of

- A. condensation
- B. precipitation

- C. transpiration
- D. infiltration

30. Carbon dioxide is released into the atmosphere by

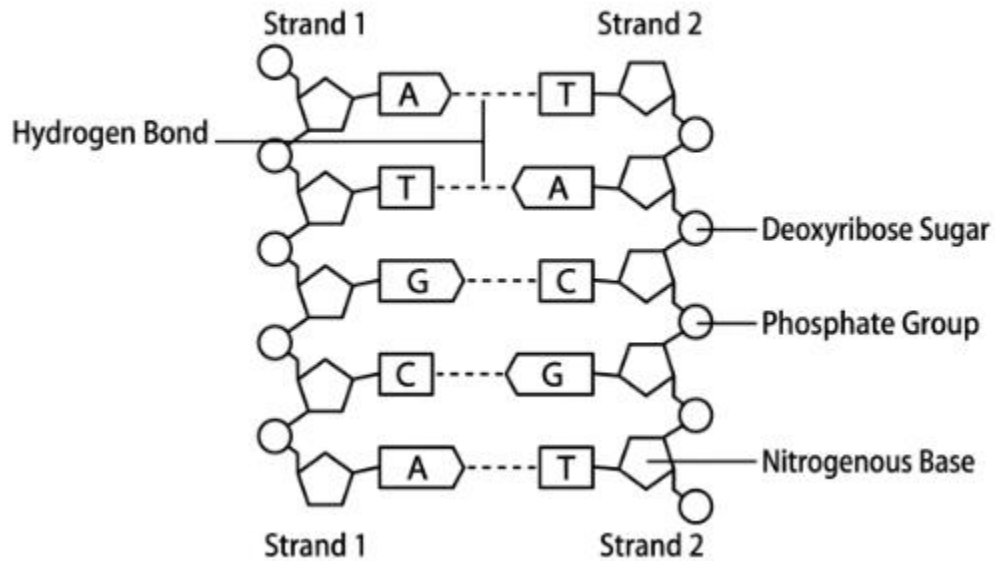
- A. only the photosynthesis of green plants
- B. only the decomposition of organic matter in soil
- C. cellular respiration, decomposition, and the combustion of fossil fuels
- D. the formation of new sedimentary rocks under pressure

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 a section of a DNA molecule.

Structure of a DNA Molecule



Based on the diagram, the two strands of DNA are held together by

- A. covalent bonds between adjacent sugar molecules in each strand
- B. ionic bonds between phosphate groups in different strands
- C. peptide bonds between the nitrogenous bases on opposite strands
- D. hydrogen bonds between complementary nitrogenous bases

32. Referring to the same diagram, the alternating sugar (deoxyribose) and phosphate units form the

- A. genetic code that determines amino acid sequences
- B. backbone of each DNA strand
- C. hydrogen bonds linking the two strands together
- D. site where transcription begins on the molecule

33. Referring to the same diagram, if the sequence of bases on Strand 1 (read from top to bottom) is A-T-G-C-A, then the sequence of complementary bases on Strand 2 must be

- A. T-A-C-G-T
- B. A-T-G-C-A
- C. U-A-C-G-U
- D. C-G-T-A-C

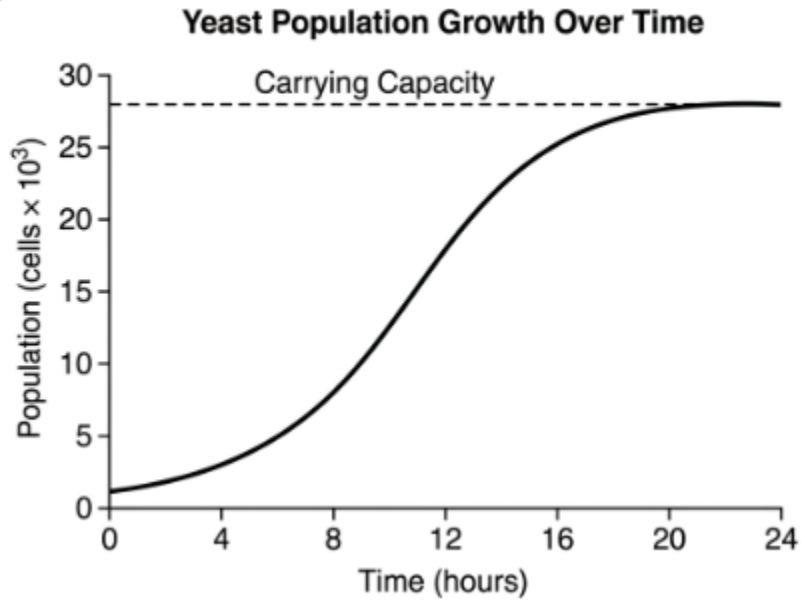
34. Referring to the same diagram, the smallest repeating subunit that makes up the entire DNA strand is called

- A. a chromosome containing all genetic information
- B. a gene that codes for a specific protein
- C. a nucleotide consisting of a sugar, phosphate, and base
- D. a codon consisting of three bases in sequence

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

35. A scientist measures the growth of a yeast population in a closed container over a 24-hour period.

Figure PQ-2



Based on the graph, the carrying capacity of this environment for yeast is approximately

- A. 28,000 cells
- B. 18,000 cells
- C. 12,000 cells
- D. 5,000 cells

36. Based on the same graph, the rapid increase in population between hours 8 and 12 is best described as

- A. an unlimited expansion in resource availability for the yeast
- B. a stable equilibrium between birth and death rates
- C. the start of a population crash due to environmental change
- D. exponential growth occurring under favorable conditions

37. Based on the same graph, the leveling off of the population after hour 16 is most likely caused by

- A. a permanent improvement in the surrounding environment
- B. limiting factors such as nutrient depletion or waste accumulation
- C. the migration of yeast cells out of the container completely
- D. a sudden mutation in all the yeast cells at the same time

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

38. A scientist crosses two pea plants and records the seed colors of the offspring.

Cross	Parent 1	Parent 2	Yellow Seed Offspring	Green Seed Offspring
1	Yellow	Yellow	76	24
2	Yellow	Green	50	50
3	Green	Green	0	100

Based on the data, the trait for yellow seed color is

- A. recessive to green seed color
- B. controlled only by environmental conditions
- C. dominant over green seed color
- D. linked to the sex chromosomes of the plant

39. Based on the data from Cross 1, the genotypes of the two yellow-seeded parents are most likely

- A. both homozygous dominant ($YY \times YY$)
- B. one homozygous dominant and one homozygous recessive ($YY \times yy$)
- C. both homozygous recessive ($yy \times yy$)
- D. both heterozygous ($Yy \times Yy$)

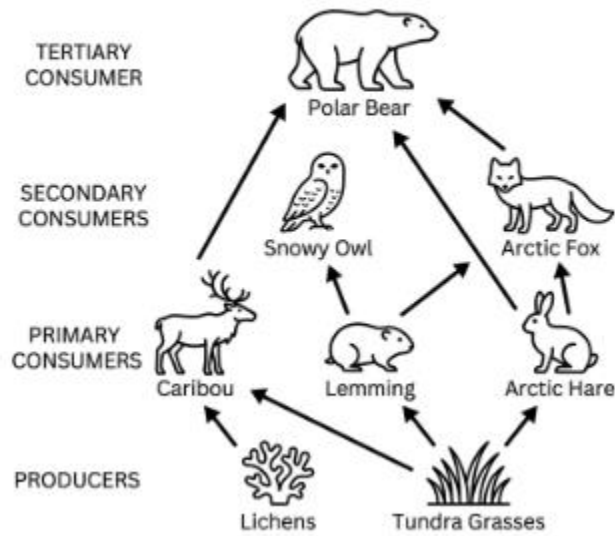
40. Based on the data from Cross 3, the parents must have the genotype

- A. one homozygous dominant and one heterozygous ($YY \times Yy$)
- B. both homozygous recessive ($yy \times yy$)
- C. both heterozygous ($Yy \times Yy$)
- D. one heterozygous and one homozygous recessive ($Yy \times yy$)

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 an Arctic tundra ecosystem.

Arctic Tundra Food Web



Based on the food web, which organism functions as a producer?

- A. Lichens, which carry out photosynthesis
- B. Caribou, which feed on tundra plants
- C. Snowy Owl, which feeds on lemmings
- D. Polar Bear, which is the top predator

42. Based on the same food web, if a disease eliminated all of the Lemmings, the most directly affected populations would be the

- A. Lichens and Tundra Grasses
- B. Caribou and Arctic Hare
- C. Snowy Owl and Arctic Fox
- D. Polar Bear only at the top of the food web

43. Based on the same food web, the Polar Bear can best be described as a

- A. producer and a primary consumer
- B. tertiary consumer feeding at multiple trophic levels
- C. decomposer recycling nutrients to the soil
- D. primary consumer feeding only on producers

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

Answer all questions in this part.

44. A scientist designs an experiment to test the effect of different fertilizers on the growth of tomato plants. The fertilizer type being tested is

- A. the dependent variable measured at the end of the experiment
- B. a controlled variable held constant in all trials
- C. a random factor that has no effect on the outcome
- D. the independent variable being deliberately changed

45. In the same experiment, all plants must be given the same amount of water and grown at the same temperature. These constant conditions are called

- A. controlled variables
- B. dependent variables

- C. independent variables
- D. random variables

46. After collecting data from an experiment, the next step in the scientific method is typically to

- A. immediately publish the results in a research journal
- B. analyze the data and form a conclusion based on the evidence
- C. discard any data that does not support the original hypothesis
- D. start an entirely new experiment with a different topic

47. Which of the following is the best example of a testable scientific hypothesis?

- A. Plants are beautiful and provide many benefits to humanity
- B. The teacher should give more time for students to complete labs
- C. If plants receive more sunlight, then they will grow taller because of increased photosynthesis
- D. Plants are very important to ecosystems all around the world

48. During cellular respiration, the energy released from glucose is used to produce

- A. ATP, the cell's main energy-carrying molecule
- B. additional glucose for long-term energy storage
- C. proteins that build cellular structures
- D. lipids for membrane construction in cells

49. The order of amino acids in a protein is ultimately determined by

- A. the location of the protein within the cell at synthesis
- B. the temperature at which the protein is being synthesized
- C. random selection of amino acids from the cytoplasm
- D. the sequence of bases in the DNA coding for that protein

50. A key difference between mitosis and meiosis is that meiosis

- A. occurs only in single-celled bacterial organisms
- B. produces gametes with half the chromosome number of the parent
- C. is responsible for the growth of body tissues in animals
- D. produces two genetically identical daughter cells from one parent

51. In humans, oxygen is delivered to body cells by

- A. white blood cells that engulf foreign particles
- B. platelets that form clots at injury sites
- C. red blood cells circulating through blood vessels
- D. plasma protein molecules dissolved in blood

52. In the human digestive system, the chemical digestion of proteins begins in the

- A. stomach, where pepsin and acid break down proteins
- B. mouth, where amylase begins protein digestion
- C. small intestine, where bile begins protein digestion
- D. large intestine, where bacteria begin protein digestion

53. The human immune system distinguishes the body's own cells from foreign pathogens by recognizing

- A. the temperature of cells throughout the body
- B. the color of cells found in different tissues
- C. the size of cells in different parts of the body
- D. specific molecules (antigens) on the surface of cells

54. The hormone insulin helps regulate blood glucose levels by

- A. stimulating the liver to release glucose stored as glycogen
- B. signaling body cells to absorb glucose from the bloodstream
- C. converting amino acids into glucose for energy use
- D. removing all glucose from the body through the kidneys

55. When a person becomes dehydrated, the body responds by reducing the amount of water lost in urine. This response is an example of

- A. positive feedback that amplifies the original change

- B. random fluctuation in body water content
- C. negative feedback that helps maintain homeostasis
- D. an unrelated mechanism unconnected to water balance

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

Answer all questions in this part.

56. In the human female reproductive system, the structure where fertilization usually occurs is the

- A. uterus, where the embryo will develop after fertilization
- B. cervix, the lower opening of the uterus
- C. vagina, the passage to the external environment
- D. fallopian tube (oviduct), located between the ovary and uterus

57. After fertilization, the resulting zygote begins to divide by

- A. mitosis to form a multicellular embryo
- B. meiosis to reduce its chromosome number
- C. budding to produce identical offspring clones
- D. fragmentation to split into many individuals

58. A reflex action, such as pulling a hand away from a hot surface, is controlled mainly by

- A. the cerebral cortex, the seat of conscious thought
- B. the spinal cord, which provides a rapid response pathway
- C. the pituitary gland, which releases hormones
- D. the kidney, which filters blood and removes wastes

59. In the human body, oxygen-poor blood from body tissues returns to the heart through blood vessels called

- A. arteries
- B. capillaries
- C. veins
- D. ventricles

60. In the lungs, gas exchange between the air and the bloodstream takes place across the walls of the

- A. trachea
- B. bronchi
- C. larynx
- D. alveoli

61. The kidneys help maintain homeostasis by

- A. filtering wastes such as urea from the blood
- B. producing red blood cells for oxygen transport

- C. secreting bile that aids in the digestion of fats
- D. storing glucose and releasing it during exercise

62. The pancreas produces both insulin and glucagon. Together, these hormones

- A. control the rate of breathing during physical activity
- B. regulate the level of glucose in the blood
- C. determine the rate of growth of body tissues
- D. signal the body to release adrenaline in emergencies

63. Honeybees collect nectar and pollen from flowers and, in the process, transfer pollen from flower to flower. This interaction is best classified as

- A. parasitism, with the bees harming the flowers
- B. commensalism, with the bees benefiting and flowers unaffected
- C. mutualism, since both bees and flowers benefit
- D. predation, with the bees consuming the flowers themselves

64. Which of the following is a density-dependent factor that can limit the size of a population?

- A. an infectious disease that spreads more rapidly in crowded conditions
- B. a severe drought that affects every individual regardless of population size
- C. a sudden volcanic eruption that destroys an entire habitat instantly
- D. an unusually cold winter that brings temperatures below normal

65. An invasive species introduced to a new ecosystem often grows rapidly because

- A. it requires far less food than any of the native species
- B. it brings new diseases that protect itself from harm
- C. it always evolves faster than the local native species
- D. it lacks natural predators and competitors in the new environment

66. Biodiversity in an ecosystem refers to

- A. the total mass of all living organisms in the ecosystem
- B. the variety of species and the genetic differences among them
- C. the number of food chains operating in the area at one time
- D. the amount of sunlight that reaches the surface each day

67. Which of the following human activities is most likely to reduce biodiversity in an ecosystem?

- A. replanting native trees in a deforested region
- B. establishing wildlife reserves and national parks
- C. clearing a tropical rainforest for cattle grazing
- D. cleaning up pollution from a contaminated lake

68. A pesticide that breaks down very slowly in the environment can become more concentrated in organisms at higher levels of a food chain. This phenomenon is called

- A. biomagnification
- B. eutrophication
- C. decomposition
- D. transpiration

69. The greenhouse effect is caused primarily by

- A. the destruction of the ozone layer in the upper atmosphere
- B. the depletion of fresh water sources around the world
- C. an increase in solar radiation reaching Earth's surface
- D. atmospheric gases such as CO₂ that trap heat near the surface

70. Which of the following is the best example of a sustainable practice?

- A. clear-cutting an entire forest for short-term lumber profit
- B. harvesting only mature trees while allowing the forest to regenerate
- C. draining wetlands to create more agricultural farmland
- D. converting natural prairie to intensive single-crop farming

71. In a Diffusion Through a Membrane laboratory, a student places a dialysis bag filled with starch and glucose into a beaker of water containing Lugol's iodine. After 30 minutes, the contents of the dialysis bag turn blue-black, indicating that

- A. iodine has diffused into the bag and reacted with the starch inside

- B. starch has diffused out of the bag and into the surrounding water
- C. glucose has reacted with the iodine to form a new compound
- D. water has moved out of the dialysis bag and into the beaker

72. In the same experiment described above, the water in the beaker is tested with Benedict's solution and the mixture is heated. A color change to orange-red indicates that

- A. starch has diffused into the surrounding water of the beaker
- B. glucose has diffused from the bag into the surrounding water
- C. iodine has destroyed all the molecules in the surrounding water
- D. carbon dioxide has been released by the dialysis bag itself

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

Answer all questions in this part.

73. In the Beaks of Finches simulation, students use different tools (such as forceps, chopsticks, and clothespins) to pick up seeds. This simulation models how

- A. genetic mutations occur randomly in a population
- B. environmental conditions directly change an animal's anatomy
- C. natural selection favors traits that improve survival
- D. organisms learn new feeding behaviors through practice

74. To begin focusing on a slide using a compound light microscope, a student should

- A. start with the highest power objective for the clearest image
- B. focus first using only the fine adjustment knob without coarse adjustment
- C. apply oil directly to the lens before any focusing attempts
- D. start with the lowest power objective and the coarse adjustment knob

75. A student views a specimen through a microscope with an eyepiece of $10\times$ and an objective lens of $40\times$. The total magnification of the specimen is

- A. $400\times$
- B. $50\times$
- C. $410\times$
- D. $4,000\times$

76. In the Relationships and Biodiversity laboratory, students compare a target species (*Botana curus*) with several candidate species. To strengthen their conclusions about evolutionary relatedness, students should

- A. rely on a single line of structural evidence alone
- B. use only biochemical comparisons without other tests
- C. ignore DNA evidence in favor of physical traits only
- D. use multiple lines of evidence including structural, biochemical, and DNA comparisons

77. A student adds Benedict's solution to an unknown sample and heats the mixture. The solution remains blue. This result indicates that

- A. starch is present in the unknown sample
- B. proteins are present in the unknown sample
- C. glucose or other reducing sugars are not present in the sample
- D. the sample is highly acidic in nature

78. During a laboratory activity, if a student accidentally spills a chemical on their skin, the first action they should take is to

- A. rinse the affected area thoroughly with water and notify the teacher
- B. cover the affected area with a paper towel and continue working
- C. wipe the chemical off with their shirt and finish the experiment
- D. ignore the spill until the laboratory period has ended

79. When preparing a wet-mount slide of plant cells, the purpose of adding a drop of water before placing the coverslip is to

- A. cause the cells to swell and burst for better observation
- B. spread the specimen evenly and prevent it from drying out
- C. stain the cells a different color for easier identification
- D. fix the cells permanently in place on the slide surface

80. In the Making Connections laboratory, students measure their pulse rate before and after exercise. A valid scientific question for this investigation would be

- A. Is it good for everyone to exercise regularly each day?
- B. Why do some people enjoy exercise more than other people?
- C. How does the intensity of exercise affect the increase in pulse rate?
- D. Should physical education classes be required in all schools?

81. In the Beaks of Finches simulation, tools that succeed in picking up many seeds represent finches that would

- A. die before reaching reproductive age in their habitat
- B. survive and produce more offspring than other finches
- C. migrate away from the food source to a new island
- D. develop new tools through their own conscious efforts

82. When constructing a graph from experimental data, the independent variable is typically placed on the

- A. y-axis at the top of the graph
- B. line of best fit drawn through data points
- C. legend showing what each line represents
- D. x-axis at the bottom of the graph

83. A dichotomous key used in a biology lab helps students to

- A. identify an unknown organism by following paired contrasting statements
- B. measure the genetic distance between two related species exactly
- C. predict the future evolution of a particular species over time
- D. determine the carrying capacity of an environment for a species

84. A student notices that one of her data values is much higher than all the others in her experiment. Before discarding it, she should

- A. immediately remove the value from the data set without any analysis
- B. modify the value so it matches the rest of her data
- C. assume the value is correct and use it as her main result
- D. consider whether the value is a real result or could be due to an error, and possibly repeat the trial

85. In a complete experimental conclusion, the student should include

- A. only the data values that confirmed the original hypothesis
- B. an apology if the data did not match the hypothesis
- C. a statement of whether the data supported the hypothesis and any possible sources of error
- D. a promise that the experiment will work the same way for everyone

EXPLAINED ANSWER KEY – PRACTICE EXAM 15

1. C — Growth is the life process by which a living organism increases in size by adding new cells or new mass to existing cells. The young oak tree gaining wood each year is biological growth; the other choices describe nonliving physical processes such as weathering, evaporation, and erosion.

2. A — A tissue is a group of similar cells that share structure and function and work together, such as muscle tissue or epithelial tissue. Organs are made of multiple tissues, organ systems are groups of organs, and organisms include all body systems together.

3. D — Lysosomes contain powerful digestive enzymes that break down worn-out organelles, foreign particles, and other cellular debris in a process called autophagy. This recycling role makes them essential for cellular maintenance and renewal.

4. B — Bacteria, including *Streptococcus*, are prokaryotes — they lack a membrane-bound nucleus and other membrane-bound organelles. Amoebas, mushrooms, and mosses are all eukaryotes whose cells have nuclei and complex internal organelles.

5. C — The cell membrane is built from a phospholipid bilayer in which proteins, cholesterol, and carbohydrates are embedded, an arrangement known as the fluid mosaic model. This structure allows the membrane to be both flexible and selectively permeable.

6. A — Movement of CO₂ from a cell (where it is concentrated) to the blood (where it is less concentrated) is passive movement down a concentration gradient, the definition of simple diffusion. No ATP or vesicle formation is required for this small, nonpolar molecule to cross the membrane.

7. B — The lock-and-key model describes how each enzyme's active site has a specific 3D shape that fits only its matching substrate, just as a particular key fits only one lock. This shape specificity is why each enzyme catalyzes only one reaction or class of reactions.

8. D — Chloroplasts contain chlorophyll, the green pigment that absorbs light energy, and are the site of both the light-dependent reactions and the Calvin cycle. The other listed organelles handle DNA storage, protein synthesis, and respiration, not photosynthesis.

9. A — Mitochondria are the main site of aerobic respiration, where the electron transport chain produces the bulk of cellular ATP. Their double membrane and folded cristae greatly increase the surface area available for these energy-yielding reactions.

10. C — Photosynthesis combines carbon dioxide and water in the presence of light energy to produce glucose and release oxygen: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$. The other listed equations describe respiration, protein synthesis, or nitrogen fixation, not photosynthesis.

11. D — Normal human body cells are diploid and contain 46 chromosomes arranged in 23 homologous pairs — 22 pairs of autosomes plus one pair of sex chromosomes. Gametes are haploid (23 chromosomes), while polyploid counts like 92 are abnormal.

12. B — RNA contains the base uracil (U) wherever DNA would have thymine (T), pairing with adenine in transcription and translation. Adenine, cytosine, and guanine occur in both DNA and RNA.

13. A — A gene is a specific segment of DNA that encodes the information for a particular protein (or a functional RNA), thereby influencing a trait. Chromosomes carry many genes; a single nucleotide is only a building block; enzymes are products of genes, not genes themselves.

- 14. C** — Messenger RNA (mRNA) is transcribed from a DNA template in the nucleus and carries that genetic information out to the ribosome, where it directs protein synthesis. tRNA delivers amino acids and rRNA is part of the ribosome itself.
- 15. B** — Mitosis produces two genetically identical diploid daughter cells from a parent cell, supporting growth of multicellular organisms, repair of damaged tissue, and routine replacement of worn-out cells. Gamete formation and genetic shuffling are functions of meiosis, not mitosis.
- 16. D** — Meiosis is a reduction division consisting of two sequential divisions; starting from one diploid cell with 8 chromosomes, it produces four haploid cells, each with 4 chromosomes. This halving is what allows fertilization to restore the species' diploid number.
- 17. A** — A monohybrid cross between two heterozygotes ($Rr \times Rr$) yields a 1 RR : 2 Rr : 1 rr genotype ratio, so 25% of offspring are homozygous recessive (rr) and show the wrinkled phenotype. The phenotypic ratio of 3 dominant : 1 recessive is the classic Mendelian outcome.
- 18. C** — Because the hemophilia allele is X-linked recessive and males (XY) have only one X chromosome, a single copy of the recessive allele on that X produces the disorder. Females (XX) need two copies for expression, which is far less likely.
- 19. D** — Sickle cell anemia arises from a single base substitution in the beta-globin gene, which changes one amino acid (glutamic acid to valine) in hemoglobin. This single point mutation alters hemoglobin's shape, causing red blood cells to sickle under low-oxygen conditions.
- 20. B** — Moving a gene from one organism into another with laboratory techniques such as restriction enzymes and plasmids is the defining feature of genetic engineering (recombinant DNA technology). Natural selection, selective breeding, and cellular respiration do not insert specific genes between species in this way.
- 21. C** — The ultimate source of all new genetic variation in a population is random mutation, which generates novel alleles in DNA. Without mutation, recombination and sexual reproduction would only reshuffle existing variation rather than create anything new.
- 22. A** — Natural selection acts when individuals with favorable inherited traits survive longer and reproduce more, passing those traits to a greater share of the next generation. Over many generations this differential reproductive success increases the frequency of advantageous alleles in the population.
- 23. D** — Closely related species share more recent common ancestors and therefore have more similar DNA sequences in their homologous genes. DNA sequence comparison is the most precise and quantitative form of evidence used in modern phylogenetics.
- 24. B** — When a physical barrier (such as a new mountain range) separates a population and stops gene flow, the two groups accumulate distinct genetic changes until they can no longer interbreed. This pattern — geographic isolation leading to reproductive isolation — defines allopatric speciation.

- 25. A** — Webbed feet are a permanent anatomical feature of the duck's body, making them a structural adaptation that increases surface area for paddling in water. They are inherited, not learned (behavioral), and persist year-round.
- 26. C** — A community in ecology is the set of all interacting populations of different species in a given area. Adding the abiotic environment to a community gives an ecosystem; a population is a single species; a biome is a much larger climatic region.
- 27. D** — At each trophic transfer, roughly 90% of the available energy is lost — mainly as heat released during cellular respiration, plus some lost in undigested material. As a result, only about 10% of energy is incorporated into the next level's biomass.
- 28. B** — Decomposers, principally bacteria and fungi, feed on dead organisms and waste material, returning carbon, nitrogen, and other nutrients to the environment. Without them, nutrients would remain locked in dead matter and ecosystems would collapse.
- 29. A** — Condensation is the phase change from gaseous water vapor to liquid water, which happens as warm, moist air rises and cools, forming cloud droplets. Precipitation, transpiration, and infiltration are different steps of the same water cycle.
- 30. C** — CO₂ is added to the atmosphere by cellular respiration in living organisms, by decomposition of dead material, and by human burning of fossil fuels for energy and transportation. Photosynthesis is a CO₂ sink, not a source.
- 31. D** — The two complementary DNA strands are held together by hydrogen bonds between paired nitrogenous bases — two bonds in A–T pairs and three in G–C pairs. These bonds are individually weak but collectively stable, allowing the strands to separate during replication.
- 32. B** — Alternating sugar (deoxyribose) and phosphate units, linked by strong covalent bonds, form the backbone of each DNA strand. The nitrogenous bases project inward from this backbone and pair across the helix to form the "rungs."
- 33. A** — Base pairing rules require A–T and G–C, so the complement of A-T-G-C-A on Strand 1 is T-A-C-G-T on Strand 2 (read in the antiparallel direction). U is found in RNA, not DNA, ruling out option C.
- 34. C** — The repeating building block of DNA is the nucleotide, made of one deoxyribose sugar, one phosphate group, and one of the four nitrogenous bases. Genes, codons, and chromosomes are higher-level structures built from many nucleotides.
- 35. A** — The graph levels off at approximately 28,000 cells (the y-axis is in thousands), and the horizontal dashed line is explicitly labeled "Carrying Capacity" at that value. Carrying capacity is the maximum population size the environment can support.
- 36. D** — Between hours 8 and 12 the population roughly doubles in a short interval — the signature of exponential growth when resources are still abundant. After this phase, limiting factors slow growth as the population nears carrying capacity.

- 37. B** — As the closed container's resources are used up and waste products accumulate, birth rates fall and death rates rise, slowing growth until the population plateaus. These density-dependent limits are what shape the upper portion of a logistic curve.
- 38. C** — In every cross involving a yellow parent (Crosses 1 and 2), yellow offspring outnumber or match green offspring, and green \times green (Cross 3) produces only green. This pattern fits a dominant–recessive model with yellow as the dominant trait and green as the recessive trait.
- 39. D** — Cross 1 produces a 3 yellow : 1 green ratio (76:24), which is the classic Mendelian outcome of two heterozygotes ($Yy \times Yy$). Homozygous combinations like $YY \times YY$ or $YY \times yy$ would not produce any green offspring.
- 40. B** — Because two green-seeded parents produce 100% green offspring, the green-seed trait must be recessive (yy) and both parents must be homozygous recessive ($yy \times yy$). Any yellow allele in either parent would produce some yellow offspring.
- 41. A** — Lichens (a symbiosis of fungus and photosynthetic alga or cyanobacterium) carry out photosynthesis and therefore function as producers in the tundra food web. Caribou, snowy owls, and polar bears are all consumers.
- 42. C** — Lemmings are the prey species for both the Snowy Owl and the Arctic Fox in this web, so eliminating them would immediately deprive both predators of a key food source. Producers and the caribou/hare populations would not be directly affected by the loss of lemmings.
- 43. B** — In this web the Polar Bear eats Caribou and Arctic Hare (primary consumers) and Arctic Fox (a secondary consumer), placing it at the top trophic level while drawing energy from multiple lower levels. This is the typical role of an apex predator with broad dietary breadth.
- 44. D** — The factor an experimenter deliberately changes between trials is, by definition, the independent variable — here, the type of fertilizer applied to each plant. The growth response that is then measured (such as height) is the dependent variable.
- 45. A** — Conditions that are deliberately held constant across all trials, such as water amount and temperature, are called controlled variables. Keeping them constant ensures that any observed difference can be attributed to the independent variable alone.
- 46. B** — After data collection, the scientific method calls for analyzing the data — looking for patterns, performing calculations, and graphing results — and forming a conclusion about whether the hypothesis is supported. Discarding inconvenient data or publishing without analysis violates scientific integrity.
- 47. C** — A testable hypothesis follows an if–then–because structure that identifies the independent and dependent variables and offers a reasoned mechanism. "If plants receive more sunlight, then they will grow taller because of increased photosynthesis" meets all three criteria; the other choices are opinions or generalities.

48. A — The energy released when glucose is broken down in cellular respiration is captured in the high-energy phosphate bonds of ATP. ATP then serves as the cell's main energy-carrying molecule, powering nearly all active cellular processes.

49. D — A protein's amino acid sequence is specified by the sequence of bases in the DNA gene that codes for it: triplet codons are transcribed to mRNA and then translated by ribosomes into amino acids. Cellular location, temperature, and randomness do not determine the amino acid order.

50. B — Meiosis is a reduction division that produces haploid gametes containing half the parent's chromosome number, allowing fertilization to restore the diploid number. Mitosis, in contrast, produces two genetically identical diploid cells for growth and repair.

51. C — Red blood cells (erythrocytes) contain hemoglobin, an iron-rich protein that binds oxygen in the lungs and releases it in the tissues, making them the body's specialized oxygen carriers. White blood cells, platelets, and plasma proteins serve immune, clotting, and transport roles other than oxygen delivery.

52. A — Protein digestion begins in the stomach, where hydrochloric acid denatures proteins and pepsin breaks peptide bonds to produce shorter polypeptides. The mouth handles starch (via amylase), and fat digestion centers in the small intestine with bile.

53. D — The immune system identifies cells using surface molecules called antigens; "self" antigens are tolerated, while "foreign" antigens on pathogens trigger an immune response. This recognition system is the basis of vaccination, transplant rejection, and autoimmune disease.

54. B — Insulin, released by the pancreas after a meal, binds receptors on body cells and signals them to take up glucose from the blood, lowering blood sugar. Glucagon performs the opposite function by signaling the liver to release stored glucose.

55. C — Reducing urinary water loss in response to dehydration is a classic negative feedback response: a deviation from the set point (body water level) triggers a corrective response (water conservation) that returns the body toward homeostasis. Positive feedback would amplify, not counteract, the change.

56. D — Fertilization in humans normally occurs in the fallopian tube (oviduct), where a sperm meets the egg shortly after ovulation. The resulting zygote then travels to the uterus, where implantation and embryonic development take place.

57. A — Once fertilization produces a diploid zygote, the cell divides repeatedly by mitosis to build a multicellular embryo of genetically identical cells. Meiosis, budding, and fragmentation do not occur in normal human embryonic development.

58. B — A reflex arc such as pulling away from a hot surface is processed at the spinal cord, allowing a rapid protective response without waiting for the signal to reach the brain. This shortcut explains why the hand jerks back before the person consciously feels pain.

- 59. C** — Veins carry oxygen-poor blood from body tissues back to the heart (with the exception of the pulmonary veins). Arteries carry blood away from the heart, capillaries handle exchange, and ventricles are heart chambers, not vessels.
- 60. D** — The alveoli are the tiny thin-walled air sacs at the ends of the bronchioles, where oxygen diffuses into the blood and carbon dioxide diffuses out. The trachea, bronchi, and larynx are conducting airways and do not perform gas exchange.
- 61. A** — The kidneys filter the blood in the nephrons and remove nitrogenous wastes such as urea, along with excess water and salts, which are excreted as urine. Red blood cell production occurs mainly in bone marrow, bile comes from the liver, and glycogen storage is largely a liver function.
- 62. B** — Insulin and glucagon are the principal pancreatic hormones that maintain blood glucose homeostasis: insulin lowers blood sugar after a meal, and glucagon raises it between meals. Their opposing actions keep glucose levels within a narrow range.
- 63. C** — In mutualism, both species benefit: bees obtain nectar and pollen as food, while the flowers achieve pollination and reproduction in return. This relationship is one of the most ecologically important mutualisms on the planet.
- 64. A** — Density-dependent factors exert stronger effects as population density increases; infectious diseases spread more readily among crowded individuals, fitting this definition. Droughts, eruptions, and severe winters act regardless of population density and are therefore density-independent.
- 65. D** — Invasive species in new ecosystems often grow unchecked because they have escaped the natural predators, parasites, and competitors that limited them in their native range. Released from these regulators, their populations can explode and outcompete native species.
- 66. B** — Biodiversity refers to the variety of living organisms at multiple levels — most often species diversity and the genetic diversity within and among those species. Total biomass, the number of food chains, and sunlight reaching the surface are different ecological measures.
- 67. C** — Clear-cutting a tropical rainforest for cattle grazing destroys habitat for thousands of species, many of them found nowhere else, and dramatically reduces biodiversity. Replanting, protected areas, and pollution cleanup all tend to increase or preserve biodiversity.
- 68. A** — Biomagnification occurs when a persistent pollutant becomes increasingly concentrated in the tissues of organisms at higher trophic levels, because predators consume many contaminated prey. Persistent pesticides such as DDT, and heavy metals such as mercury, are classic examples.
- 69. D** — Greenhouse gases such as carbon dioxide, methane, and water vapor absorb infrared radiation emitted from Earth's surface and re-radiate part of it back downward, trapping heat in the lower atmosphere. Increased concentrations of these gases enhance this natural greenhouse effect.

- 70. B** — Sustainable forestry harvests only mature trees in any one cycle and leaves enough trees to provide seeds, habitat, and shade for the forest to regenerate. Clear-cutting, draining wetlands, and converting prairie to monoculture all degrade ecosystems and are not sustainable.
- 71. A** — Iodine molecules are small enough to diffuse through the pores of the dialysis tubing into the bag, where they contact starch and produce the characteristic blue-black color. The reaction therefore reveals that iodine moved inward — starch itself is too large to leave the bag.
- 72. B** — Benedict's solution turns orange-red when heated with a reducing sugar such as glucose, so the color change in the beaker water indicates that glucose has diffused out of the bag. Starch cannot cross the dialysis tubing and would not produce this result.
- 73. C** — Different "beak" tools represent inherited variations in beak structure; tools that are best suited to picking up the available seeds collect more food, "survive," and reproduce in the next round. The simulation models natural selection acting on heritable variation.
- 74. D** — Standard microscope procedure begins at the lowest power objective, where the wide field of view makes the specimen easy to locate, and uses the coarse adjustment knob to bring it into rough focus. Coarse adjustment with high-power objectives risks damaging the slide or the lens.
- 75. A** — Total magnification of a compound light microscope equals eyepiece magnification times objective magnification: $10 \times 40 = 400\times$. This calculation gives the apparent size of the specimen relative to its actual size.
- 76. D** — Modern biology and taxonomy combine multiple independent lines of evidence — structural, biochemical, and DNA-based — because consistent results across different methods produce more reliable conclusions about relatedness. Relying on any one line of evidence alone risks being misled by convergent evolution or atypical traits.
- 77. C** — Benedict's solution turns orange-red, green, or yellow only when reducing sugars such as glucose are present; a solution that remains blue indicates that no reducing sugars are detectable in the sample. The test tells us nothing about proteins, starch, or pH directly.
- 78. A** — A chemical spill on the skin must be flushed immediately with large amounts of water to dilute and remove the chemical, then the teacher must be notified for further action. Delaying or wiping the chemical onto clothing risks burns and exposure for others.
- 79. B** — Adding a drop of water before lowering the coverslip spreads the specimen evenly across the slide, keeps the cells from drying out, and provides the medium through which the microscope light passes. Stains are added separately and are not the function of this water drop.
- 80. C** — A valid scientific question identifies a measurable independent variable (intensity of exercise) and a measurable dependent variable (increase in pulse rate). The other options are value judgments or opinion questions, which cannot be investigated through controlled experiments.

81. B — In the simulation, tools that capture many seeds represent finches that successfully obtain food, survive to reproduce, and contribute more offspring to the next generation. This greater reproductive success is the engine of natural selection.

82. D — By convention, the independent variable (the factor the experimenter changes) is plotted on the horizontal x-axis, and the dependent variable (the measured response) is plotted on the vertical y-axis. This consistent layout helps readers interpret graphs uniformly.

83. A — A dichotomous key consists of a sequence of paired contrasting statements; at each step the user selects the statement that best matches the unknown specimen and is directed onward, eventually arriving at a species identification. It does not measure genetic distance or predict evolution.

84. D — Outliers should not be discarded automatically; instead, the student should consider whether the value reflects a real biological result or could stem from procedural or measurement error, and should repeat the trial if possible to verify. This approach preserves data integrity and rules out random mistakes.

85. C — A thorough lab conclusion explicitly states whether the evidence supports or refutes the hypothesis and also discusses possible sources of error and limitations of the experiment. This reflective practice gives readers context to judge the results and design improved follow-up studies.