PRACTICE EXAM 5: 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 is a fundamental life process performed by all living organisms?

A. Active hunting for prey using complex behavior

B. Construction of permanent shelters for protection

C. Maintenance of stable internal conditions through homeostasis

D. Sexual reproduction involving two parents of opposite sex

2. The cell membrane is composed primarily of

A. a double layer of phospholipid molecules with embedded proteins

B. a single layer of carbohydrates attached to ribosomes

C. a rigid wall of cellulose fibers found in animal cells

D. a continuous sheet of DNA wrapping around the cell

3. Water is essential for living organisms because it

A. provides energy when broken down during cellular respiration

B. stores genetic information that codes for proteins

C. carries oxygen directly to the body's tissues during exercise

D. acts as a solvent in which many substances dissolve

4. The network of membranes inside a cell that helps transport newly made proteins is called the

A. nuclear envelope surrounding the genetic material

B. endoplasmic reticulum located near the nucleus

C. cell membrane forming the cell's outer boundary

D. Golgi apparatus that packages cellular materials

5. The movement of molecules from an area of high concentration to an area of low concentration without using cellular energy is called

A. diffusion across the cell membrane

B. active transport requiring ATP energy

C. endocytosis bringing materials into the cell

D. exocytosis releasing materials from the cell

6. In a typical animal cell, the organelle in which glucose is broken down to release ATP energy is the

A. ribosome assembling protein chains

B. lysosome digesting unwanted materials

C. mitochondrion releasing energy from food

D. centriole assisting in cell division

7. When ADP combines with a phosphate group to form ATP, energy is

A. released from ATP to power cellular activities

B. stored in the new bond between ADP and the phosphate

C. converted into heat with no use to the cell

D. permanently lost from the cellular energy supply

8. Which of the following describes a structural feature unique to DNA?

A. The presence of the nitrogen base uracil instead of thymine

B. A single-stranded form located only in the cytoplasm

C. A structure that is too small to encode genetic information

D. A double helix of two complementary strands of nucleotides

9. In a eukaryotic cell, the process of transcription — making mRNA from a DNA template — occurs in the

A. cytoplasm at the surface of ribosomes

B. mitochondrion where ATP is produced

C. nucleus where DNA is stored

D. cell membrane bordering the cell

10. Most enzymes in the human body function best at a particular pH because pH affects the

A. three-dimensional shape of the enzyme's active site

B. number of substrate molecules available for the reaction

C. concentration of ATP used to power the reaction

D. temperature of the cellular environment around the enzyme

11. A point mutation that changes a single base in a gene's coding sequence may

A. always cause the cell to die immediately

B. produce a protein with altered structure or function

C. transfer to other species through casual contact

D. only affect organisms in the next generation

12. A genetically identical copy of an organism produced from a single body cell is best described as

A. a hybrid produced by crossing two species

B. a mutation caused by environmental damage

C. a recombinant organism produced by gene splicing

D. a clone produced from the cell's nucleus

13. In a sexually reproducing population, new combinations of alleles in offspring result mainly from

A. meiosis and the random fertilization of gametes

B. binary fission in the parents' body cells

C. the use of enzymes that copy DNA without errors

D. the death of older, less fit individuals each generation

14. In humans, gametes (sperm and egg cells) are produced by

A. mitosis in skin and muscle cells of the body

B. binary fission in cells of the reproductive system

C. meiosis in cells of the ovaries and testes

D. budding from existing reproductive tissues

15. In Mendel's experiments, the offspring of a tall pea plant and a short pea plant were all tall. This pattern is best explained by

A. the tall trait being dominant and the short trait being recessive

B. the short trait being inherited only by the next generation

C. all pea plants becoming tall after environmental change

D. the tall plants always producing tall offspring without crossing

16. The basic mechanism of natural selection requires that there is

A. an absence of variation in any trait of the population

B. heritable variation combined with differential survival and reproduction

C. equal reproductive success for every member of the species

D. the deliberate action of humans selecting which animals breed

17. Scientists can estimate the age of fossils embedded in rock layers by

A. counting growth rings within the fossilized bones

B. measuring the height of the rock above sea level

C. analyzing the colors visible in the surrounding rock

D. comparing the rock layers and using radioactive dating

18. The early embryos of fish, chickens, and humans look remarkably similar. This similarity is evidence that these species

A. develop into identical adult organisms over time

B. have all evolved very rapidly from one parent species

C. share a common ancestor far back in evolutionary history

D. were all created in their current forms recently

19. Over millions of years, hummingbirds evolved long, thin beaks while certain flowers evolved long, tubular shapes that match those beaks. This is an example of

A. coevolution between two species adapting to each other

B. convergent evolution producing identical structures

C. competitive exclusion where one species displaces another

D. genetic drift in two unrelated populations of species

20. When a species can no longer produce offspring and dies out completely, the species is said to be

A. dormant until conditions change for the better

B. extinct, with no living members remaining

C. endangered, with a few members left in the wild

D. invasive, having entered a new habitat unchecked

21. All the living and nonliving components of an environment, considered together, are referred to as

A. a population of one species in the area

B. a community of multiple interacting species

C. a niche occupied by a particular species

D. an ecosystem including living and non-living parts

22. In a savanna ecosystem, a zebra that feeds only on grasses is best classified as

A. a producer at the base of the food web

B. a carnivore that hunts other animals

C. an herbivore that eats only plant material

D. a decomposer breaking down dead matter

23. Which of the following is a biotic factor that affects a population of deer in a forest?

A. The wolves that prey on the deer

B. The temperature during the winter months

C. The amount of rainfall the forest receives

D. The mineral content of the forest soil

24. A factor that prevents a population from continuing to grow once it reaches a certain size is called

A. an abiotic factor with no impact on growth

B. a limiting factor in the environment

C. a producer at the base of the food chain

D. a positive feedback that boosts growth

25. In the carbon and nitrogen cycles, decomposers play an essential role because they

A. fix atmospheric nitrogen into ammonia for plants

B. release oxygen into the atmosphere by photosynthesis

C. produce all the carbon dioxide in the atmosphere alone

D. break down dead organisms and return nutrients to the soil

26. A bird that migrates south every fall to find food and warmer weather is demonstrating

A. a behavioral adaptation passed down through generations

B. a structural adaptation involving body shape change

C. a learned response taught by humans to wild animals

D. a physiological reaction to the cooling of its blood

27. A species whose population has dropped to such a low level that extinction is a serious threat is best described as

A. an extinct species with no surviving members

B. an endangered species near possible extinction

C. an invasive species expanding without limit

D. a keystone species holding the ecosystem together

28. A single species whose presence has a disproportionately large effect on the structure of an entire ecosystem is called

A. a producer at the base of the food chain

B. a top predator at the highest trophic level

C. a keystone species critical to ecosystem stability

D. a decomposer recycling nutrients into the soil

29. The most significant cause of species extinction worldwide today is

A. natural predation by other animals

B. competition for food among species

C. the introduction of new useful technology

D. habitat destruction from human activities

30. A fishing community decides to harvest only enough fish each year that the fish population can replace through reproduction. This practice is best described as

A. sustainable harvesting that preserves the population

B. overharvesting that depletes the population quickly

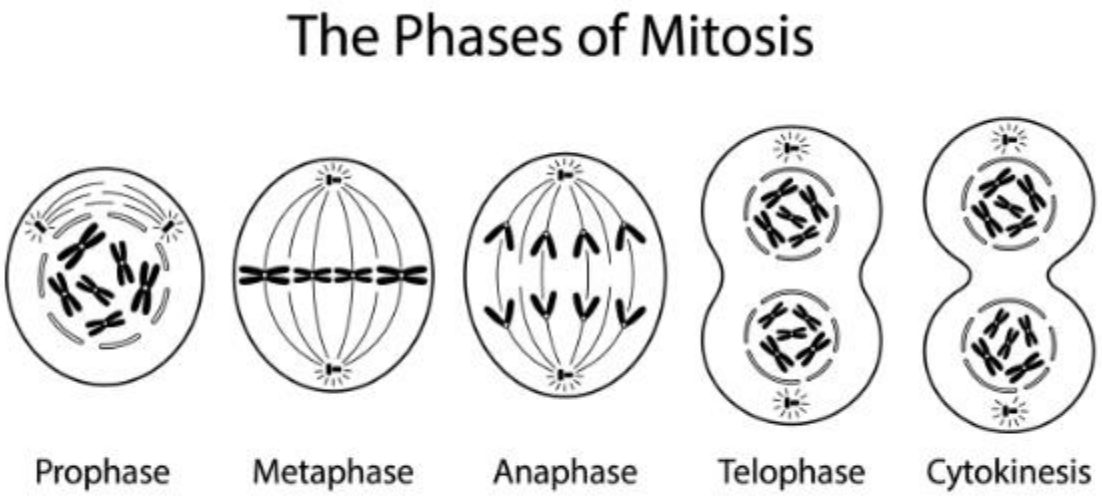
C. selective breeding to improve the fish species

D. introduction of an invasive species into the waters

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

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

31. A student examines a diagram of the phases of mitosis in a body cell.



In the diagram, the phase characterized by chromosomes aligning along the center of the cell is

A. Prophase, when chromosomes first condense and become visible

B. Metaphase, when chromosomes align at the cell's equator

C. Anaphase, when sister chromatids pull apart toward the poles

D. Telophase, when two new nuclear envelopes form

32. Referring to the same diagram, during anaphase the sister chromatids of each chromosome

A. pair up with their homologous chromosomes for crossing over

B. duplicate themselves to produce additional copies

C. condense further to become tightly packed structures

D. separate and move toward opposite poles of the cell

33. Referring to the same diagram, the end result of the complete mitosis process shown is

A. two daughter cells genetically identical to the parent cell

B. four daughter cells each containing half the parent's chromosomes

C. one large daughter cell containing twice the original DNA

D. no daughter cells produced from the original parent cell

34. Referring to the same diagram, if a parent cell containing 46 chromosomes undergoes mitosis as shown, each daughter cell will contain

A. 23 chromosomes per daughter cell

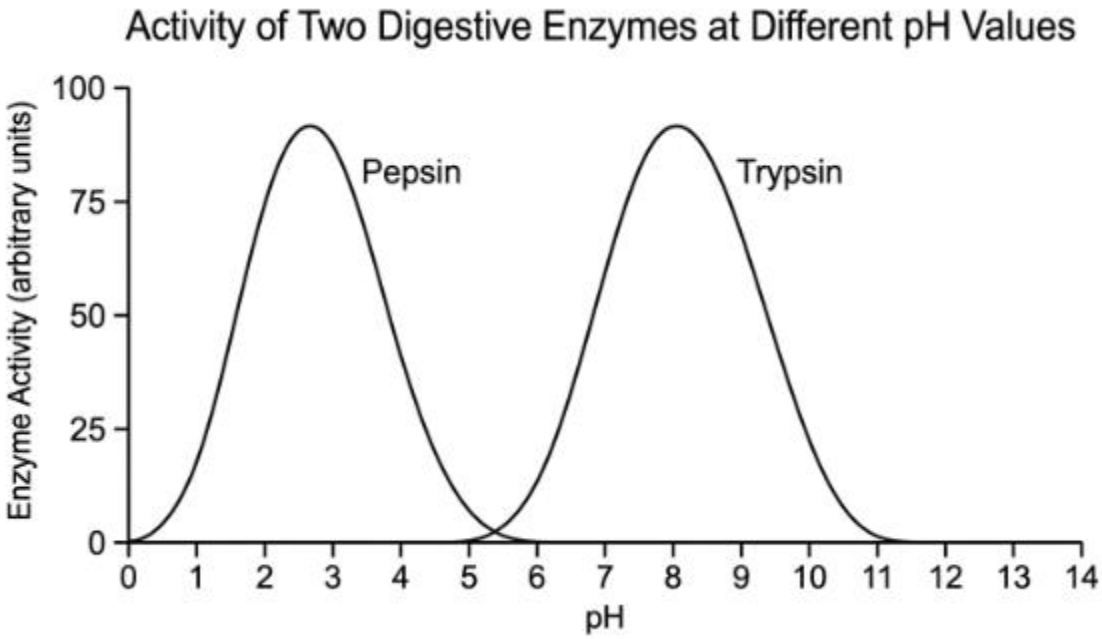
B. 92 chromosomes per daughter cell

C. 46 chromosomes per daughter cell

D. 138 chromosomes per daughter cell

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

35. A student examines a graph showing the activity of two digestive enzymes at different pH values.



Based on the graph, at pH 7 the activity of pepsin is approximately

A. 90 units, near its peak activity level

B. 0 units, with virtually no activity

C. 50 units, at moderate activity level

D. 100 units, above its peak activity level

36. Based on the same graph, trypsin works best in conditions found in the

A. mouth, where saliva has near-neutral pH

B. stomach, where strong acid produces low pH

C. bloodstream, where pH is closely controlled at 7.4

D. small intestine, where conditions are slightly basic

37. Based on the same graph, the change in enzyme activity at different pH values occurs primarily because pH affects the

A. three-dimensional shape of the enzyme's active site

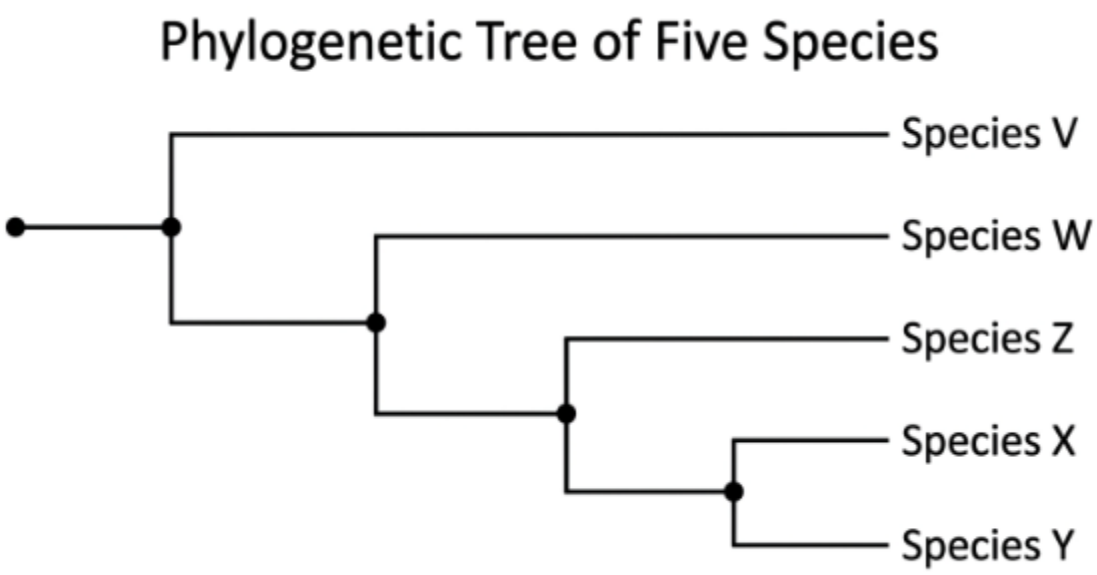
B. number of substrate molecules present in the solution

C. temperature of the surrounding cellular environment

D. concentration of ATP available to power the reaction

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

38. A student examines a phylogenetic tree showing the evolutionary relationships among five species.



[Figure PQ-3: Clean black-line phylogenetic tree diagram on white background.]

Based on the phylogenetic tree shown, the species most closely related to Species X is

A. Species V, which branched off the earliest

B. Species W, which branched off second

C. Species Y, which shares the most recent ancestor with X

D. Species Z, which branched off just before X and Y

39. Based on the same phylogenetic tree, Species V and Species X share a common ancestor that

A. lived more recently than the ancestor of X and Y

B. is the same as the ancestor shared by W and Z only

C. lived after the ancestor of Z and the other species

D. is the most distant ancestor of all the species shown

40. Based on the same phylogenetic tree, which two species are MOST distantly related?

A. Species X and Species Y, which share a recent ancestor

B. Species V and Species Y, which share only the oldest ancestor

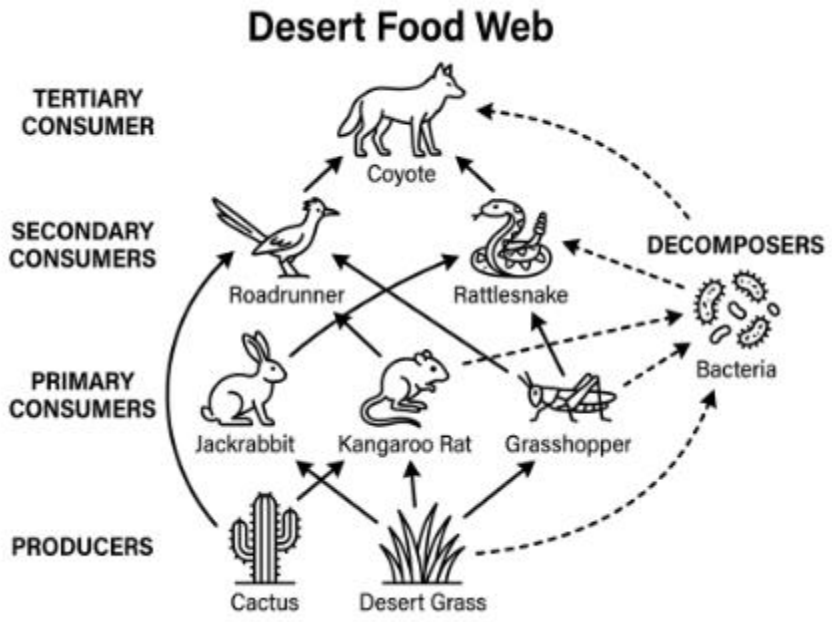
C. Species W and Species Z, which share a middle-aged ancestor

D. Species V and Species W, which both branched off early

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

41. A student examines a food web of a desert ecosystem.

Figure PQ-4



Based on the desert food web shown, which organism is a producer?

A. The jackrabbit that feeds on desert grass

B. The coyote that hunts other desert animals

C. The cactus that performs photosynthesis

D. The rattlesnake that preys on rodents

42. Based on the same food web, which organism occupies the highest trophic level?

A. The coyote, which is a tertiary consumer

B. The cactus, which is a producer

C. The grasshopper, which eats only plants

D. The bacteria, which break down dead matter

43. Based on the same food web, if a severe drought killed most of the desert grass, the populations most directly affected first would be

A. only the coyote and rattlesnake populations at the top

B. the bacterial decomposers found throughout the soil

C. the cactus plants that require water to survive

D. the jackrabbit, kangaroo rat, and grasshopper populations

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

Answer all questions in this part.

44. A student designs an experiment to determine how the amount of fertilizer affects bean plant growth. The amount of fertilizer applied to each plant is the

A. dependent variable, the one being measured

B. independent variable, the one being manipulated

C. control group used for direct comparison

D. constant held the same in every group

45. Which of the following statements is best written as a scientific hypothesis?

A. The bean plants will grow much better than expected.

B. Fertilizer is a substance that helps plants grow.

C. If bean plants receive more fertilizer, then they will grow taller.

D. I think that this experiment might produce interesting results.

46. To estimate the number of dandelion plants in a large field, ecologists count the plants in several smaller square-meter sections randomly chosen throughout the field. This sampling method is known as

A. quadrat sampling, used to estimate population size

B. mark-and-recapture sampling for mobile animals

C. dichotomous sampling using identification keys

D. total population sampling by counting every plant

47. On a properly labeled scientific graph, the dependent variable is plotted on the

A. x-axis along the horizontal direction

B. y-axis along the vertical direction

C. diagonal line across the entire graph

D. corner where two axes meet at zero

48. A mutation that changes a single base in a gene may ultimately affect the organism's trait because

A. the mutation directly changes the organism's physical appearance immediately

B. genes function independently from proteins in determining traits

C. all mutations are passed to every offspring of the organism

D. genes code for proteins that control the expression of traits

49. Genetic engineering allows scientists to insert a gene from one species into the DNA of another species. The organism that results from this process is called

A. a transgenic organism with DNA from two species

B. a cloned organism identical to its original parent organism

C. a hybrid organism produced through interbreeding of species

D. an extinct organism with no living relatives left

50. A flu vaccine often contains weakened or killed flu virus particles. These particles work by

A. directly destroying any flu virus already in the body

B. providing the body with extra red blood cells to fight infection

C. stimulating the immune system to produce antibodies and memory cells

D. permanently raising the body temperature above normal levels

51. When a person walks from a warm room into a cold outdoor environment, the body responds by shivering and constricting skin blood vessels. These responses are examples of

A. positive feedback amplifying the temperature change

B. learned behaviors taught during early childhood

C. permanent adaptations to changes in the environment

D. negative feedback maintaining stable body temperature

52. During childbirth, contractions of the uterus stimulate the release of a hormone (oxytocin) that increases the strength and frequency of contractions. This is an example of

A. negative feedback that opposes the original change

B. positive feedback that amplifies the original change

C. balanced feedback that holds conditions constant

D. random feedback unrelated to the original event

53. A population of mice grows rapidly when introduced to a new habitat with abundant food and no predators. The growth pattern that best describes this is

A. exponential growth limited only by available resources

B. linear growth at a steady, fixed rate per year

C. zero growth as the population stays at a constant size

D. negative growth as the population steadily decreases

54. The process by which water is released from the leaves of plants into the atmosphere is called

A. precipitation falling from clouds to earth

B. condensation forming clouds in the sky

C. transpiration through stomata on leaves

D. evaporation directly from the soil's surface

55. As average global temperatures rise, scientists predict that polar ice will continue to melt. The most direct effect of this melting on coastal ecosystems will be

A. an immediate increase in ocean salinity worldwide

B. a rise in sea levels flooding coastal habitats

C. a permanent freezing of all freshwater rivers

D. a sharp decrease in the world's deserts

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

Answer all questions in this part.

56. In the overall process of aerobic cellular respiration, glucose and oxygen are combined to produce

A. starch, lipids, and protein molecules

B. amino acids and nucleic acid building blocks

C. light energy that can be used by other cells

D. carbon dioxide, water, and ATP energy

57. In a plant cell, the light-dependent reactions of photosynthesis occur in the

A. thylakoid membranes located inside the chloroplast

B. cytoplasm surrounding all cellular organelles

C. mitochondrial matrix that produces ATP energy

D. nuclear envelope surrounding the genetic material

58. When yeast cells convert sugar into alcohol and carbon dioxide in the absence of oxygen, the cells are carrying out

A. aerobic respiration with full energy yield

B. photosynthesis producing glucose and oxygen

C. anaerobic fermentation producing less ATP

D. protein synthesis at the cellular ribosomes

59. All the cells in your body contain the same DNA. The reason a liver cell and a skin cell perform different functions is that each cell

A. lost different genes during the embryonic developmental stage

B. expresses a different combination of genes from its DNA

C. inherited DNA from two completely different parent organisms

D. uses an entirely different genetic code than other cells

60. Cystic fibrosis is caused by a recessive allele on a non-sex chromosome. A child affected with cystic fibrosis must have inherited

A. one normal allele and one cystic fibrosis allele

B. only one cystic fibrosis allele from a single carrier parent

C. cystic fibrosis alleles only from the mother's side

D. two cystic fibrosis alleles, one from each carrier parent

61. A population of squirrels becomes divided when a river forms through their forest habitat. Over many generations, the two separated groups evolve into different species. This process is an example of

A. geographic isolation leading to speciation

B. coevolution between two competing species

C. artificial selection by human intervention

D. mass extinction following an environmental disaster

62. In a population of beetles, individuals with green coloration blend with the leaves and avoid predators. Over many generations, the percentage of green beetles in the population increases. This change is the result of

A. genetic engineering performed by predators

B. random changes occurring without selection

C. natural selection favoring camouflaged individuals

D. inheritance of acquired green coloration traits

63. After a volcano erupts and covers a region with new lava rock, the gradual establishment of pioneer species and later communities on the bare rock is called

A. secondary succession on previously disturbed land

B. primary succession on newly exposed surfaces

C. ecological collapse of all existing communities

D. evolutionary radiation of unrelated species

64. A tapeworm lives inside the intestine of a deer, absorbing nutrients from the deer's digested food and harming the deer. This relationship is best described as

A. mutualism, in which both species benefit

B. commensalism, in which only one species benefits

C. predation, in which one species kills and eats the other

D. parasitism, in which one species benefits at the host's expense

65. When blood glucose levels fall too low, the pancreas releases the hormone glucagon, which causes the liver to release stored glucose. This is best described as

A. a negative feedback mechanism that maintains homeostasis

B. a positive feedback loop that worsens the problem

C. an unrelated response not connected to glucose

D. an acquired behavior learned over time

66. Blood returning from the body's tissues enters the heart through which chamber first?

A. The left atrium receiving blood from the lungs

B. The left ventricle pumping blood to the body

C. The right atrium receiving blood from the body

D. The right ventricle pumping blood to the lungs

67. The liver supports digestion by producing

A. insulin that regulates the body's blood glucose

B. bile that helps emulsify fats for digestion

C. saliva that begins the digestion of starches

D. gastric acid that breaks down proteins fully

68. After blood is filtered in the kidneys, the resulting fluid containing wastes is collected and stored in the

A. liver, which removes many toxins from the blood

B. lungs, which release carbon dioxide as waste

C. small intestine, which absorbs nutrients into the blood

D. bladder, where urine is stored before excretion

69. In a female human, the hormone that primarily regulates the development of the uterine lining each month is

A. testosterone produced mainly by the testes

B. insulin produced by the pancreas after eating

C. estrogen produced mainly by the ovaries

D. adrenaline produced in response to sudden stress

70. During pregnancy, the umbilical cord serves to

A. transport nutrients and oxygen between mother and fetus

B. produce the hormones that maintain the pregnancy

C. cushion the fetus from physical injury and damage

D. provide a passage for the fetus during delivery

71. In a healthy immune response, a child exposed to chicken pox once typically does not develop the same disease again because the body has produced

A. extra red blood cells specifically targeting that virus

B. memory cells that recognize the virus very quickly

C. permanent inflammation throughout the body's tissues

D. enzymes that destroy the cell wall of the virus

72. An invasive species can disrupt an ecosystem because it often

A. quickly evolves to look identical to native species

B. provides nutrients that all native species need

C. lacks predators and parasites that limited it before

D. has fewer offspring than the native species

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

Answer all questions in this part.

73. In the Diffusion Through a Membrane laboratory, a student places red onion cells in salt water and observes them under a microscope. The cells appear to shrink. This occurs because

A. salt molecules moved into the cells through active transport

B. water entered the cells and made them swell up

C. the salt water dissolved the cell walls of the onion

D. water left the cells by osmosis into the salt solution

74. A compound light microscope has a 10x eyepiece and three objective lenses: 4x, 10x, and 40x. The lowest total magnification a student can use with this microscope is

A. 4x total magnification

B. 40x total magnification

C. 14x total magnification

D. 400x total magnification

75. In the Beaks of Finches laboratory, after one round of feeding, the students with the smallest number of seeds "die" and are removed from the population. This step is meant to model

A. natural selection eliminating poorly adapted individuals

B. genetic mutation creating new beak shapes randomly

C. migration of birds to new island habitats

D. random sampling errors in the data collection

76. In the Relationships and Biodiversity laboratory, students perform several tests on plant samples to determine which species is most closely related to a hypothetical valuable species. The MOST reliable evidence comes from

A. observing the physical color of the plant leaves

B. comparing the heights of the different plant species

C. comparing the DNA base sequences of the samples

D. measuring the weight of each plant species sample

77. In the Making Connections laboratory, students measure pulse rate before and after squeezing a clothespin many times. The data typically show that pulse rate

A. decreases sharply during the exercise period

B. increases during exercise and returns to resting rate

C. stays exactly the same throughout the entire experiment

D. only changes after the student has rested for a long time

78. In a paper chromatography experiment, a pigment travels 4 cm up the paper while the solvent travels 8 cm. The Rf value (ratio of pigment distance to solvent distance) for this pigment is

A. 4.0 as a calculated Rf value

B. 8.0 as a calculated Rf value

C. 2.0 as a calculated Rf value

D. 0.5 as a calculated Rf value

79. Before beginning any laboratory activity that involves chemicals, the FIRST safety step a student should take is to

A. wash hands thoroughly with antibacterial soap

B. read the textbook chapter about the lab content

C. put on safety goggles to protect the eyes

D. turn on the overhead lights in the laboratory

80. A student measures the volume of liquid in a graduated cylinder. The most appropriate unit for this measurement is

A. centimeters of cubic length

B. milliliters of liquid volume

C. grams of mass per second

D. degrees Celsius of temperature

81. A student creates a line graph showing how the number of insects in a forest changed over 12 months. The graph shows a sharp drop in numbers from December to February. The most reasonable explanation is that

A. all insects migrated to warmer forests during the season

B. a sudden disease killed every insect in the forest at once

C. the insects had consumed all available food in the forest

D. cold winter temperatures killed or inactivated many insects

82. To estimate the population of clovers in a large lawn, a student places a 1-meter square frame randomly on the lawn and counts the clovers inside it. The student repeats this in 10 different spots and calculates the average. This method is called

A. quadrat sampling to estimate plant populations

B. mark-and-recapture sampling for mobile animals

C. total population census of every clover plant

D. exponential growth measurement of a population

83. A student watches a frog jump from one lily pad to another. The student then says, "The frog jumped because it saw a fly." This statement is

A. an observation based on direct sensory evidence

B. a measurement made with proper instruments

C. an inference based on the student's interpretation

D. a hypothesis tested in a controlled experiment

84. In an experiment testing the effect of light color on plant growth, all plants are given the same amount of water, the same temperature, and the same soil. The water, temperature, and soil are best described as

A. independent variables being changed by the experimenter

B. controlled variables held constant in all groups

C. dependent variables being measured during the experiment

D. control groups used as a comparison standard

85. Which of the following is NOT one of the four required New York State Living Environment laboratory investigations?

A. The Relationships and Biodiversity laboratory

B. The Making Connections laboratory

C. The Diffusion Through a Membrane laboratory

D. The Genetic Engineering of Bacteria laboratory

Practice Exam *5* – Answer Key and Explanations

1. C — All living organisms must maintain stable internal conditions to function, a process called homeostasis. Movement, shelter-building, and sexual reproduction are not universal — many organisms are sessile, lack shelters, or reproduce asexually only.

2. A — The cell membrane is a phospholipid bilayer with embedded proteins that handle transport, signaling, and recognition functions. This fluid mosaic structure is what allows selective permeability across the membrane.

3. D — Water dissolves many ionic and polar substances, allowing nutrients, gases, and wastes to be transported throughout organisms. This solvent role is why water is often called the "universal solvent" and is essential for biochemistry inside cells.

4. B — The endoplasmic reticulum is a network of membranes that transports newly synthesized proteins (especially those made on attached ribosomes of the rough ER) toward the Golgi apparatus. The Golgi then packages those proteins, but the ER is the transport network itself.

5. A — Diffusion is the passive movement of molecules down a concentration gradient, from higher to lower concentration, without expending cellular energy. Active transport, endocytosis, and exocytosis all require ATP and either move materials against a gradient or transport them in bulk.

6. C — Mitochondria are the sites of aerobic cellular respiration, where glucose is fully broken down to release energy stored in ATP. The Krebs cycle and electron transport chain take place inside the mitochondrion, making it the cell's main power plant.

7. B — Forming ATP from ADP and phosphate is an energy-requiring (endergonic) process; the energy is stored in the new phosphate bond. The cell later releases this stored energy by breaking that bond, converting ATP back into ADP plus phosphate.

8. D — DNA is uniquely structured as a double helix of two complementary, antiparallel nucleotide strands held together by hydrogen-bonded base pairs. RNA, by contrast, is typically single-stranded and uses uracil in place of thymine.

9. C — Transcription requires access to the DNA template, which is housed in the nucleus of eukaryotic cells. The mRNA produced then exits the nucleus through nuclear pores to reach ribosomes in the cytoplasm for translation.

10. A — Enzyme function depends on the precise three-dimensional shape of the active site. Extreme pH disrupts the hydrogen bonds and ionic interactions that maintain this shape, denaturing the enzyme and stopping the reaction.

11. B — A point mutation that changes a codon can change the amino acid inserted into the protein, altering its folding and function. The effect can range from harmless to severe depending on which amino acid is changed and where in the protein.

12. D — A clone is a genetically identical copy of an organism produced from a single cell's nucleus, as in the famous case of Dolly the sheep. Hybrids and recombinant organisms involve genetic combinations from two sources, and mutations are random genetic changes.

13. A — Meiosis produces gametes with new allele combinations through independent assortment and crossing over, and random fertilization further shuffles those alleles. Together these processes generate the genetic variation that characterizes sexual reproduction.

14. C — Gametes form through meiosis in the gonads — ovaries in females and testes in males. Meiosis reduces the chromosome number from diploid to haploid so that fertilization restores the species' normal chromosome count.

15. A — When all F1 offspring of a tall × short cross are tall, the tall allele must mask the short allele in heterozygotes. This is the definition of complete dominance, with tall being dominant and short being recessive.

16. B — Natural selection requires three conditions: heritable variation among individuals, differential survival or reproduction based on that variation, and inheritance of the favored traits by offspring. Together these conditions cause allele frequencies to shift over generations.

17. D — Geologists use the relative positions of rock layers (stratigraphy) along with radioactive dating of isotopes such as carbon-14 or uranium-238 to determine fossil ages. These methods provide both relative and absolute age estimates.

18. C — Vertebrate embryos share features such as pharyngeal arches and a notochord because they inherited these from a common ancestor. The similarities decrease as development proceeds and species-specific traits emerge, illustrating descent with modification.

19. A — Coevolution occurs when two species act as reciprocal selective pressures on each other, each driving adaptive change in the other. Hummingbird beaks and matching tubular flowers are a classic example, as are predator-prey and host-parasite pairs.

20. B — Extinction is the complete and permanent loss of a species, with no surviving members anywhere. Endangered species still have living individuals, while dormancy is a temporary inactive state, and invasive species are spreading rapidly.

21. D — An ecosystem includes both the biotic (living) community and the abiotic (non-living) environment, considered together as an interacting unit. Populations and communities describe only living components, while a niche is a species' role.

22. C — Herbivores are consumers that eat only plant material; the zebra eating grasses fits this definition exactly. Producers make their own food, carnivores eat other animals, and decomposers break down dead organic matter.

23. A — Biotic factors are the living components of an environment — other organisms that affect a population. Wolves preying on deer are living predators, while temperature, rainfall, and soil minerals are non-living (abiotic) factors.

24. B — A limiting factor is anything that restricts population growth — food, water, space, predation, or disease. As a population grows, limiting factors become more pressing and eventually bring growth to a halt at the carrying capacity.

25. D — Decomposers (bacteria and fungi) break down dead organisms and waste products, returning carbon, nitrogen, and other nutrients to the soil and atmosphere. Without this recycling, essential nutrients would be locked up in dead matter and unavailable to producers.

26. A — Migration is an inherited behavioral response that allows organisms to escape unfavorable conditions and find resources elsewhere. Like all behavioral adaptations, it has a genetic basis and is passed from generation to generation.

27. B — An endangered species has experienced a severe population decline that places it at high risk of extinction without conservation intervention. Extinct species have no surviving members, while keystone and invasive species describe ecological roles rather than population status.

28. C — A keystone species exerts influence on its ecosystem far out of proportion to its abundance, such that its removal causes major changes. Sea otters, beavers, and certain top predators are classic examples of this category.

29. D — Habitat destruction — through deforestation, urbanization, and agricultural expansion — is the leading driver of biodiversity loss worldwide. When habitats disappear, species that depend on them cannot survive, especially specialists with narrow requirements.

30. A — Sustainable harvesting balances the rate of removal with the rate of population renewal, allowing the resource to persist indefinitely. This approach contrasts with overharvesting, which removes individuals faster than they can be replaced and leads to population collapse.

PART B-1 — DATA-BASED MULTIPLE CHOICE (Questions 31–43)

31. B — Metaphase is defined by the alignment of duplicated chromosomes along the cell's equator (the metaphase plate), each attached to spindle fibers from both poles. This precise alignment ensures equal separation of chromatids during anaphase.

32. D — Anaphase begins when the centromeres divide and the sister chromatids are pulled apart by shortening spindle fibers, moving toward opposite poles. This separation is what ultimately delivers one complete set of chromosomes to each daughter cell.

33. A — Mitosis produces two daughter cells that are genetically identical to the parent cell and to each other, each containing the full diploid chromosome number. This is the basis for growth, repair, and asexual reproduction in eukaryotes.

34. C — Mitosis is an equational division — daughter cells receive the same chromosome number as the parent. A parent cell with 46 chromosomes therefore produces daughter cells with 46 chromosomes each, preserving the diploid number.

35. B — At pH 7, the pepsin curve has dropped essentially to zero because pepsin's active site is denatured outside the acidic range. Pepsin functions best at very low pH (around pH 2), consistent with its role in the acidic stomach.

36. D — Trypsin's activity peaks near pH 8 according to the graph, matching the slightly basic environment of the small intestine. Pancreatic bicarbonate neutralizes stomach acid as chyme enters the duodenum, creating the conditions trypsin needs.

37. A — pH alters the charge on amino acid side chains in the enzyme's active site, disrupting the hydrogen bonds and ionic interactions that hold the site in its functional shape. Outside the optimal pH range, the enzyme denatures and loses activity.

38. C — In a phylogenetic tree, the most closely related species are those that share the most recent common ancestor. Since X and Y branch from the same most recent node, they are each other's closest relatives.

39. D — Species V branches off first, at the deepest node in the tree, so V's common ancestor with X is the most ancient ancestor on the diagram. That same ancestor is the common ancestor of all five species shown.

40. B — The most distantly related species are those whose only shared ancestor lies at the oldest node. Since V branches off first, V and Y meet only at that deepest ancestor, making them the most distantly related pair shown on the diagram.

41. C — Producers synthesize their own food through photosynthesis using sunlight, water, and carbon dioxide. The cactus is a green plant performing photosynthesis, placing it at the base of the desert food web.

42. A — The coyote sits at the top of the food web, preying on both primary consumers (jackrabbits) and secondary consumers (rattlesnakes). This makes it a tertiary consumer occupying the highest trophic level shown.

43. D — Jackrabbits, kangaroo rats, and grasshoppers all feed directly on desert grass and would lose their primary food source first. Higher-level consumers would feel the effect later as the herbivore base collapsed.

PART B-2 — MIXED FORMAT (Questions 44–55)

44. B — The independent variable is the factor the experimenter intentionally changes to test its effect. Since the student is varying the amount of fertilizer to see how it affects growth, fertilizer is the independent variable.

45. C — A scientific hypothesis is a testable, falsifiable prediction, typically expressed in "if-then" form linking an independent variable to an expected outcome. The other statements are opinions or general claims, not testable predictions.

46. A — Quadrat sampling uses small, defined-area frames (quadrats) placed randomly across a larger area to estimate population density. Counts within several quadrats are averaged and extrapolated to the full habitat, providing a practical estimate for sessile or stationary organisms.

47. B — By convention, the dependent variable (what is measured in response) is plotted on the vertical y-axis, while the independent variable (what is manipulated) goes on the horizontal x-axis. This standard layout allows graphs to be read consistently across all sciences.

48. D — Genes encode the instructions for making proteins, and proteins carry out the cellular and structural functions that produce visible traits. A mutation that alters a gene's sequence can alter the protein it codes for, which can then alter the trait.

49. A — A transgenic organism contains DNA from a different species inserted into its genome through genetic engineering. Examples include bacteria engineered to make human insulin and crops modified for pest resistance or improved nutrition.

50. C — Vaccines expose the immune system to weakened, killed, or fragmented pathogens, triggering the production of antibodies and memory B cells specific to that pathogen. On future exposure, memory cells respond rapidly to prevent illness.

51. D — Shivering generates heat and vasoconstriction reduces heat loss, both opposing the drop in body temperature and restoring it to normal. This opposition to a change is the defining feature of negative feedback, the dominant mechanism for maintaining homeostasis.

52. B — Positive feedback amplifies a change, intensifying the original signal rather than reversing it. In childbirth, contractions release oxytocin, which causes stronger contractions, releasing more oxytocin — a self-reinforcing loop that drives delivery to completion.

53. A — Exponential (J-shaped) growth occurs when a population reproduces unchecked in a resource-rich environment without significant predation, disease, or competition. Growth accelerates rapidly until limiting factors reduce it toward the carrying capacity.

54. C — Transpiration is the loss of water vapor from a plant's leaves through stomata, the small pores on the leaf surface. This process pulls water and dissolved minerals upward through the xylem and accounts for much of the water moving through the plant.

55. B — As polar ice melts, it adds water to the oceans, causing sea levels to rise. Rising seas inundate low-lying coastal habitats such as marshes, mangroves, and beaches, displacing the species and human communities that depend on them.

PART C – EXTENDED CONSTRUCTED RESPONSE (Questions 56–72)

56. D — Aerobic cellular respiration combines glucose with oxygen and produces carbon dioxide, water, and approximately 36–38 ATP per glucose molecule. The ATP captures the released energy in a form the cell can use to power its activities.

57. A — The light-dependent reactions of photosynthesis occur in the thylakoid membranes inside the chloroplast, where chlorophyll absorbs light and water is split to release oxygen. The light-independent (Calvin cycle) reactions then occur in the surrounding stroma.

58. C — In the absence of oxygen, yeast carry out fermentation, breaking down glucose only to ethanol and carbon dioxide and producing just 2 ATP per glucose. This is far less energy than aerobic respiration's 36–38 ATP, but it allows life to continue without oxygen.

59. B — Although every body cell contains the same DNA, different cell types switch different combinations of genes on and off — a process called differential gene expression. A liver cell expresses liver-specific proteins while a skin cell expresses skin-specific proteins, despite their identical genomes.

60. D — Cystic fibrosis is autosomal recessive, so an affected person must be homozygous recessive (two copies of the recessive allele). Each carrier parent (heterozygous) contributes one recessive allele, giving the child the two recessive copies needed for the disorder to appear.

61. A — Geographic isolation occurs when a physical barrier, such as a new river, separates a population into two groups that can no longer interbreed. Over generations, the separated populations accumulate different genetic changes and may eventually become distinct species — the process of allopatric speciation.

62. C — Natural selection favors traits that improve survival and reproduction in a given environment. Green beetles that blend with leaves avoid predation more successfully, reproduce more, and pass green-coloration alleles to the next generation, shifting the population's color over time.

63. B — Primary succession begins on newly exposed surfaces with no preexisting soil, such as cooled lava rock or bare ground left by glaciers. Pioneer species like lichens slowly break down rock to build soil, allowing later species to colonize.

64. D — Parasitism is a symbiotic relationship in which one organism (the parasite) benefits at the expense of the other (the host). The tapeworm gains nutrients while the deer is harmed through nutrient loss, fitting parasitism's definition exactly.

65. A — Glucagon raises low blood glucose back toward the normal range, opposing the original change. This opposition is the hallmark of negative feedback, the mechanism that maintains homeostasis for nearly every regulated variable in the body.

66. C — Deoxygenated blood from the body returns through the superior and inferior venae cavae into the right atrium, the first chamber it enters. From there it passes into the right ventricle, which pumps it to the lungs for gas exchange.

67. B — The liver produces bile, which is stored in the gallbladder and released into the small intestine to emulsify fats. Emulsification breaks large fat droplets into smaller ones, dramatically increasing surface area for lipase to act on.

68. D — Urine produced in the kidneys travels down the ureters and is stored in the urinary bladder until it is expelled through the urethra. The bladder is therefore the storage organ in the urinary system.

69. C — Estrogen, produced primarily by the ovaries, drives the proliferation of the uterine lining (endometrium) during the first half of the menstrual cycle. Progesterone then maintains the thickened lining in the second half if implantation is to occur.

70. A — The umbilical cord contains blood vessels that connect the fetus to the placenta, where exchange of nutrients, oxygen, and wastes occurs with the mother's blood supply. The cord is the lifeline that supports fetal growth throughout pregnancy.

71. B — On first exposure to a pathogen, the immune system produces antibodies and memory B and T cells specific to that pathogen. Memory cells persist for years and mount a rapid, strong response on second exposure, often preventing illness entirely — the basis of long-term immunity.

72. C — Invasive species typically lack the predators, parasites, and pathogens that controlled their populations in their native range. Freed from these natural regulators, they can grow rapidly and outcompete or displace native species.

PART D – LABORATORY PRACTICAL (Questions 73–85)

73. D — Salt water is hypertonic to onion cell cytoplasm, so water moves out of the cells by osmosis from higher water concentration inside to lower water concentration outside. This water loss causes the cells to shrink — a phenomenon called plasmolysis in plant cells.

74. B — Total magnification equals eyepiece magnification multiplied by objective magnification. With a 10x eyepiece and the lowest objective (4x), total magnification is $10 \times 4 = 40$x.

75. A — Removing the least successful "finches" from the next round models differential survival — the core mechanism of natural selection. Over rounds, beak types that gather food efficiently increase in frequency, just as adaptive traits do in real populations.

76. C — DNA base sequences are the most reliable evidence of evolutionary relatedness because they directly reflect inherited genetic information. Physical traits like color, height, and weight can converge through unrelated environmental pressures and are less precise indicators of common ancestry.

77. B — During exercise, working muscles demand more oxygen, so the heart rate rises to deliver oxygenated blood faster. When activity stops, demand falls and the heart rate gradually returns to its resting value — illustrating the cardiovascular system's response to changing energy needs.

78. D — Rf (retention factor) = distance traveled by the pigment ÷ distance traveled by the solvent = 4 cm ÷ 8 cm = 0.5. Rf values are always between 0 and 1 and serve as identifying "fingerprints" for individual pigments.

79. C — Eye protection is the first safety measure put on before any lab activity involving chemicals, because chemical splashes can cause serious eye injury. Goggles should be worn for the entire procedure and removed only after cleanup is complete.

80. B — Liquid volume in a graduated cylinder is measured in milliliters (mL) or liters (L), the standard metric units for volume. The other choices mix units of length, mass, time, or temperature, which do not measure volume.

81. D — Many insect species die back or enter dormancy (diapause) during cold winter months because low temperatures slow metabolism and limit feeding. The sharp December–February drop on the graph fits this expected seasonal pattern in temperate forests.

82. A — Placing a fixed-area frame (quadrat) at random locations and averaging the counts is the standard ecological technique for estimating populations of plants and other stationary organisms. The averaged count is then scaled up to the area of the full habitat.

83. C — An inference is an explanation or conclusion drawn from an observation, going beyond what is directly seen. Watching the frog jump is observation; claiming the frog jumped because it saw a fly adds an interpreted cause not directly observed.

84. B — Controlled variables are factors held constant across all groups so that any differences in outcome can be attributed to the manipulated variable. Keeping water, temperature, and soil identical isolates the effect of light color, the independent variable.

85. D — The four required New York State Living Environment laboratory investigations are Relationships and Biodiversity, Making Connections, Beaks of Finches, and Diffusion Through a Membrane. Genetic Engineering of Bacteria is not on this required list.