PRACTICE EXAM 11: LIVING ENVIRONMENT REGENTS SIMULATION

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

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

Answer all questions in this part.

1. The cell theory states that

A. all cells are identical in structure and function

B. only animal cells are considered true living cells

C. all living things are composed of one or more cells

D. cells can spontaneously arise from non-living matter

2. Which sequence shows the correct order of biological organization from smallest to largest?

A. organ → tissue → cell → organ system

B. cell → tissue → organ → organ system

C. tissue → organ system → cell → organ

D. organ system → organ → cell → tissue

3. The molecule that serves as the main energy storage compound in animal cells is

A. starch

B. cellulose

C. lipid

D. glycogen

4. The plasma membrane of a cell is best described as

A. a flexible barrier composed primarily of a phospholipid bilayer

B. a rigid structure made entirely of carbohydrate molecules

C. an impermeable layer that blocks all substances from entering

D. a single layer of protein molecules with embedded sugar units

5. Which of the following processes does NOT require the cell to expend energy?

A. Active transport of ions against a concentration gradient

B. Diffusion of gases across the cell membrane

C. Endocytosis of large food particles into the cell

D. Exocytosis of waste materials out of the cell

6. An enzyme that functions in the human stomach would be most active at

A. a temperature near freezing

B. a neutral pH near 7

C. a low pH near 2

D. a high pH near 10

7. The light-dependent reactions of photosynthesis occur in the

A. thylakoid membranes of the chloroplast

B. stroma of the chloroplast

C. inner membrane of the mitochondrion

D. cytoplasm of the surrounding leaf cell

8. Anaerobic respiration in yeast cells results in the production of

A. lactic acid and ATP

B. carbon dioxide and water

C. glucose and oxygen

D. carbon dioxide and alcohol

9. During DNA replication, the two strands of the original DNA molecule

A. join together to form a single new chromosome

B. break apart and are completely destroyed

C. separate, and each serves as a template for a new complementary strand

D. exchange large pieces with each other before duplication begins

10. The process of transcription produces

A. a copy of DNA from an RNA template

B. proteins from amino acids on a ribosome

C. messenger RNA from a DNA template

D. duplicated chromosomes for cell division

11. During the process of translation, amino acids are joined together to form

A. polypeptide chains that fold into proteins

B. messenger RNA strands carrying genetic codes

C. DNA molecules that store genetic information

D. lipid molecules used to build cell membranes

12. A mutation that adds a single base to a DNA sequence is most accurately called

A. a substitution mutation that changes one base

B. an insertion mutation that shifts the reading frame

C. a deletion mutation that removes a base entirely

D. a chromosomal mutation affecting many genes at once

13. In a multicellular organism, mitosis is essential for

A. producing gametes for sexual reproduction

B. introducing genetic variation into the population

C. reducing the chromosome number in offspring cells

D. growth, repair, and replacement of body cells

14. The process of meiosis is necessary because it

A. produces cells with identical genetic material to the parent

B. occurs in all body cells throughout an organism's lifetime

C. reduces the chromosome number by half to produce gametes

D. allows organisms to reproduce without a partner organism

15. In humans, the blood types A and B are codominant, while O is recessive. A person with genotype I^A I^B would have

A. blood type AB, expressing both A and B antigens

B. blood type A, expressing only A antigens

C. blood type O, expressing no antigens at all

D. blood type B, expressing only B antigens

16. A trait that appears more frequently in males than in females is most likely

A. controlled by a dominant allele on the Y chromosome

B. influenced primarily by environmental factors during development

C. controlled by codominant alleles on an autosome

D. controlled by a recessive allele on the X chromosome

17. A mutation that occurs in a body cell of a mature human will

A. always be passed on to all offspring through reproduction

B. affect only the individual in whom the mutation occurred

C. be eliminated immediately by enzymes that detect DNA changes

D. always produce a noticeable change in physical appearance

18. Charles Darwin proposed that organisms with traits best suited to their environment will

A. produce offspring with completely new traits not present in parents

B. die out quickly and be replaced by more primitive ancestral forms

C. tend to survive longer and produce more offspring than those without such traits

D. develop new structures during their lifetimes through repeated use

19. The similar bone structure of a whale flipper, a bat wing, and a human arm provides evidence that these species

A. evolved from a common vertebrate ancestor

B. live in similar physical environments today

C. developed these structures independently for different functions

D. have identical DNA sequences throughout their genomes

20. Which of the following is required for natural selection to occur in a population?

A. The species must reproduce sexually with two parents

B. The environment must remain perfectly stable for many generations

C. The population must avoid all mutations during reproduction

D. There must be heritable variation among individuals in the population

21. A community in an ecosystem consists of

A. all the producers and decomposers in a specific area

B. all the populations of different species living together in an area

C. the physical environment including soil, water, and climate

D. a single population of organisms occupying a specific habitat

22. The arrows in a food chain represent the direction of

A. energy flow from one organism to another

B. movement of organisms in search of food

C. the loss of carbon dioxide to the atmosphere

D. genetic information transferred between species

23. In a food chain consisting of grass → cricket → frog → snake → hawk, the frog is classified as

A. a producer

B. a primary consumer

C. a secondary consumer

D. a quaternary consumer

24. If all decomposers were suddenly removed from an ecosystem, the most immediate ecological effect would be

A. a rapid increase in the producer population in the area

B. a complete and immediate loss of all herbivore species

C. immediate climate change at the global ecosystem level

D. an accumulation of dead organic material and limited nutrient recycling

25. Nitrogen-fixing bacteria found in the root nodules of legume plants convert

A. ammonia into nitrate that can be used by plants

B. nitrate into nitrogen gas that returns to the atmosphere

C. organic nitrogen into carbon dioxide and water vapor

D. atmospheric nitrogen gas into ammonia that plants can use

26. The maintenance of a stable internal body temperature in mammals despite changes in the external environment is an example of

A. homeostasis maintained through negative feedback

B. positive feedback amplifying environmental changes

C. genetic variation appearing within the population

D. random fluctuation without regulation by the body

27. Compared to the nervous system, the endocrine system typically produces responses that are

A. faster and shorter in duration

B. instant but limited to small body regions

C. slower but longer lasting in their effects

D. independent of any chemical messengers

28. During an allergic reaction, the body's immune system reacts to a harmless substance as if it were a

A. naturally occurring hormone in the bloodstream

B. nutrient required for normal body function

C. waste product that needs to be excreted

D. dangerous pathogen requiring immediate defense

29. A vaccine works by

A. providing antibiotics that destroy invading pathogens directly

B. stimulating the immune system to produce memory cells against a specific pathogen

C. killing all bacteria present in the body at the time of injection

D. genetically modifying the patient's cells to resist all future infections

30. Which of the following is a noncellular infectious agent?

A. a virus

B. a bacterium

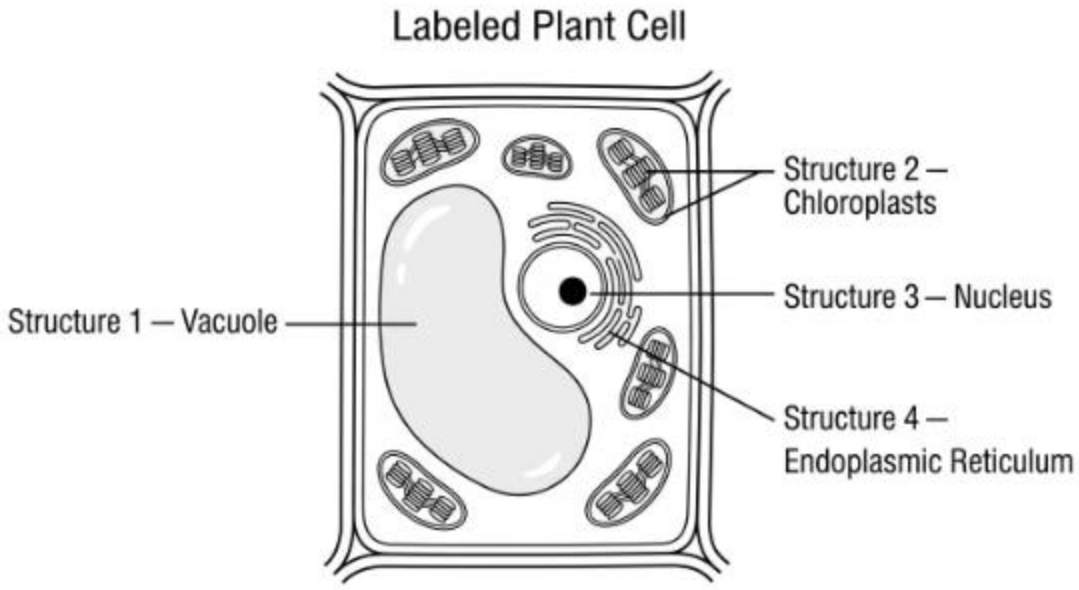
C. a protozoan

D. a fungus

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 plant cell with four structures identified.



Based on the diagram, which structure stores water and helps maintain turgor pressure in the cell?

A. Structure 4 — the folded membranes near the nucleus

B. Structure 2 — the organelles containing internal stacks

C. Structure 1 — the large central organelle filled with fluid

D. Structure 3 — the small round organelle with a dense spot

32. Referring to the same diagram, which structure carries out photosynthesis?

A. Structure 2 — the organelles containing internal stacks

B. Structure 4 — the folded membranes near the nucleus

C. Structure 1 — the large central organelle filled with fluid

D. Structure 3 — the small round organelle with a dense spot

33. Referring to the same diagram, which structure controls cell activities and contains the cell's DNA?

A. Structure 1 — the large central organelle filled with fluid

B. Structure 3 — the small round organelle with a dense spot

C. Structure 2 — the organelles containing internal stacks

D. Structure 4 — the folded membranes near the nucleus

34. Referring to the same diagram, the presence of Structure 2 indicates that this cell is most likely

A. a unicellular bacterium that lacks membrane-bound organelles

B. a plant cell that is capable of carrying out photosynthesis

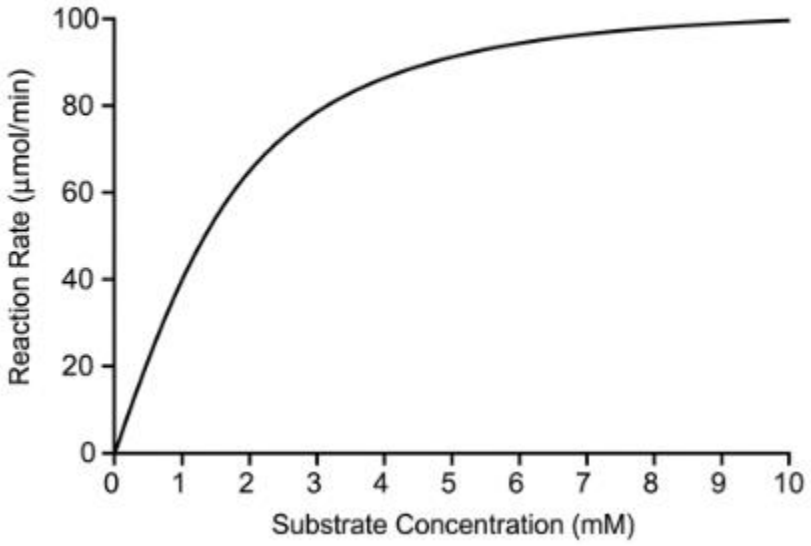
C. an animal cell that consumes other organisms for food

D. a fungal cell that decomposes dead organic matter

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

35. A scientist measures the rate of an enzyme-catalyzed reaction at various substrate concentrations while keeping enzyme concentration constant.

Figure PQ-2 Effect of Substrate Concentration on Enzyme Reaction Rate.



Based on the graph, the reaction rate levels off at high substrate concentrations because

A. the enzyme has been used up and broken down by the substrate

B. higher substrate concentrations inhibit enzyme function entirely

C. all of the enzyme's active sites are occupied (saturated) with substrate

D. the temperature of the reaction has decreased significantly over time

36. Based on the same graph, doubling the substrate concentration from 5 mM to 10 mM produces

A. only a small increase in reaction rate because the enzyme is nearly saturated

B. exactly twice the original reaction rate because the relationship is linear

C. a sharp decline in reaction rate due to substrate inhibition

D. no change because enzymes do not respond to substrate concentration

37. Based on the same graph, the most effective way to further increase the reaction rate at 10 mM substrate would be to

A. add more inhibitor molecules to slow the reaction down

B. add more enzyme so that additional active sites become available

C. lower the temperature to half its original value

D. remove all of the substrate currently in the reaction mixture

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

38. A student measures the rate of oxygen production (mL/hr) in an aquatic plant exposed to different light intensities.

Light Intensity (lux)	Oxygen Production (mL/hr)
0	0
500	4
1,000	8
2,000	16
4,000	24
6,000	28
8,000	29
10,000	29

Based on the data, the most likely explanation for the leveling off of oxygen production above 6,000 lux is that

A. the plant has run out of oxygen molecules to release

B. light intensity becomes toxic to the plant above this level

C. the plant has reached its maximum lifespan during testing

D. some other factor (such as CO_2 availability) has become limiting

39. Based on the same data, the relationship between light intensity and oxygen production from 0 to 4,000 lux is best described as

A. directly proportional, with oxygen production increasing approximately linearly with light

B. inversely proportional, with oxygen production decreasing as light intensity increases

C. completely random, with no clear relationship between the two variables

D. exponential, with oxygen production doubling for each small increase in light

40. Based on the same data, the increase in oxygen production from 1,000 lux to 2,000 lux is approximately

A. 1 mL/hr

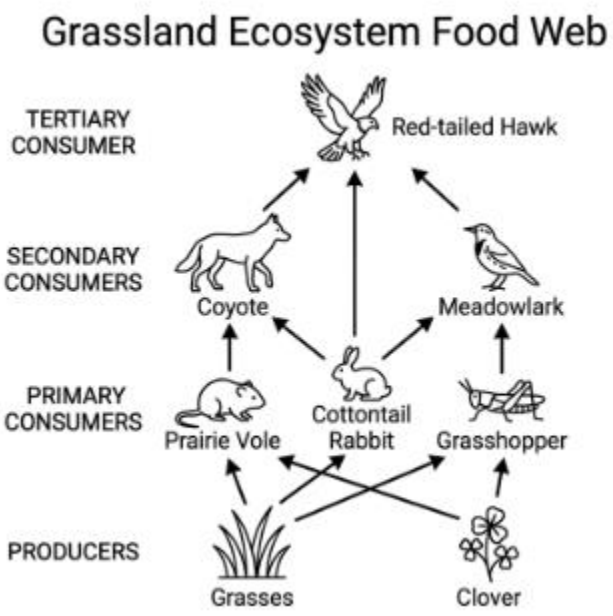
B. 4 mL/hr

C. 8 mL/hr

D. 16 mL/hr

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

41. A student examines a food web for a grassland ecosystem.



Based on the food web, which organism is classified as both a primary consumer and a food source for a tertiary consumer?

A. Coyote, which feeds on multiple prey species across the web

B. Meadowlark, which feeds on grasshoppers as its only food

C. Prairie Vole, which feeds on grasses and is eaten by the hawk

D. Red-tailed Hawk, which sits at the top of the food web

42. Based on the same food web, removing all the Grasshoppers from the ecosystem would most directly affect the

A. Clover, which would no longer be eaten by any organism in the web

B. Coyote, which depends on grasshoppers as its main food source

C. Cottontail Rabbit, which competes with grasshoppers for prey

D. Meadowlark, which feeds primarily on grasshoppers in this web

43. Based on the same food web, the Coyote and the Red-tailed Hawk share which two prey species?

A. Prairie Vole and Cottontail Rabbit

B. Grasshopper and Meadowlark

C. Grasses and Clover

D. Grasses and Grasshopper

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

Answer all questions in this part.

44. A student investigates whether the temperature of water affects the speed at which sugar dissolves. In this experiment, the independent variable is

A. the amount of sugar that dissolves over the trial period

B. the type of sugar used in the experiment

C. the temperature of the water in each trial

D. the size of the container holding the water

45. In the same experiment, which factor should be kept constant in all trials to ensure a valid result?

A. The temperature of the water at the start of each trial

B. The amount of sugar added and the volume of water used

C. The total time required for the dissolving to complete

D. The order in which the temperature trials are conducted

46. When a student displays the results of an experiment in a graph, the independent variable is conventionally plotted on the

A. y-axis as a continuous variable that depends on others

B. y-axis as the response being measured in the experiment

C. x-axis as the variable measured at the end of each trial

D. x-axis as the variable that the experimenter changes deliberately

47. A pedigree chart is a tool used by geneticists to

A. trace the inheritance of a particular trait through several generations of a family

B. measure the rate of mutation in a population over a single generation

C. predict the extinction of a species based on its evolutionary history

D. determine the exact location of a gene on a chromosome

48. Scientists use restriction enzymes in genetic engineering primarily to

A. join two strands of DNA back together after replication is complete

B. cut DNA at specific base sequences so that genes can be isolated

C. translate messenger RNA into protein chains on the ribosome

D. duplicate entire chromosomes during normal cell division

49. The relative age of fossils can be determined by examining

A. the chemical composition of preserved soft tissue samples

B. the temperature at which the fossil was originally formed

C. the average size of the organism compared to modern species

D. the layer (stratum) of rock in which the fossil was found

50. A polar bear's thick layer of fat (blubber) is an example of

A. a behavioral adaptation for finding food in the Arctic

B. a structural adaptation for surviving cold temperatures

C. a physiological adaptation that controls reproduction

D. a learned response to seasonal changes in the environment

51. Blood returning to the heart from the body's tissues first enters which chamber?

A. the right atrium

B. the left atrium

C. the right ventricle

D. the left ventricle

52. The kidneys help maintain homeostasis by removing

A. excess oxygen and carbon dioxide from the blood

B. solid waste products from the digestive tract

C. urea, excess water, and dissolved salts from the blood

D. red blood cells that have reached the end of their lifespan

53. A neuron is a specialized cell that

A. produces antibodies against invading pathogens in the body

B. transmits electrochemical signals throughout the body

C. contracts and relaxes to produce movement of body parts

D. carries oxygen and carbon dioxide between lungs and tissues

54. Most chemical digestion and nutrient absorption in humans occurs in the

A. esophagus

B. stomach

C. large intestine

D. small intestine

55. The hormone glucagon, produced by the pancreas, helps maintain blood sugar levels by

A. signaling the liver to release stored glucose into the bloodstream

B. causing body cells to absorb glucose more rapidly from the blood

C. converting glucose into protein for muscle development purposes

D. removing all glucose from the bloodstream during periods of stress

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

Answer all questions in this part.

56. A reflex pathway involving the spinal cord typically follows the sequence

A. effector → motor neuron → spinal cord → sensory neuron → receptor

B. motor neuron → receptor → spinal cord → sensory neuron → effector

C. receptor → sensory neuron → spinal cord → motor neuron → effector

D. spinal cord → receptor → motor neuron → effector → sensory neuron

57. In the human female reproductive system, fertilization typically occurs in the

A. uterus where the embryo will develop after implantation

B. fallopian tube as the egg travels toward the uterus

C. vagina at the entrance to the reproductive tract

D. ovary at the moment the egg is first released

58. After fertilization, the zygote undergoes a series of rapid cell divisions through the process of

A. meiosis to reduce the chromosome number further

B. binary fission to produce two identical bacterial cells

C. budding to produce a small clone of the parent organism

D. mitosis to produce many genetically identical cells

59. An antigen is best described as

A. a substance that triggers an immune response in the body

B. a chemical produced by white blood cells to neutralize disease

C. a type of antibiotic medication taken to fight infections

D. an enzyme that breaks down food in the digestive tract

60. The human immunodeficiency virus (HIV) weakens the immune system primarily by

A. infecting and destroying red blood cells that transport oxygen

B. infecting and destroying certain types of white blood cells (helper T cells)

C. damaging the lungs and reducing the body's overall oxygen supply

D. preventing the production of digestive enzymes in the body

61. Down syndrome is caused by

A. a single point mutation in a gene that codes for hemoglobin

B. a deletion of a portion of chromosome 7 during meiosis

C. an environmental toxin that damages DNA during pregnancy

D. the presence of an extra copy of chromosome 21 (trisomy 21)

62. Stem cells differ from most other body cells because they

A. contain only half the normal number of chromosomes

B. lack a nucleus and genetic material entirely within them

C. can divide and develop into many different specialized cell types

D. are found exclusively in the bloodstream of mature adults

63. Selective breeding has been used by humans for thousands of years to

A. increase the frequency of desirable traits in domesticated species

B. introduce entirely new genes into a species from outside sources

C. eliminate all genetic variation within a species permanently

D. prevent reproduction between members of closely related species

64. Inserting a gene for pest resistance from a bacterium into a corn plant is an example of

A. natural selection occurring in a controlled laboratory setting

B. genetic engineering using recombinant DNA technology

C. cloning to produce identical copies of an existing plant

D. selective breeding between two related plant species

65. Increased levels of greenhouse gases (such as CO_2 and methane) in the atmosphere contribute to global warming by

A. blocking incoming sunlight from reaching the Earth's surface

B. cooling the upper atmosphere through chemical reactions

C. converting oxygen into nitrogen at higher altitudes

D. trapping heat that would otherwise escape into space

66. The ozone layer in the upper atmosphere protects living organisms by

A. blocking visible light from reaching the planet's surface

B. providing oxygen for organisms to breathe at high altitudes

C. absorbing harmful ultraviolet radiation from the sun

D. preventing carbon dioxide from entering the atmosphere

67. Acid rain is most directly caused by

A. the release of sulfur and nitrogen oxides from burning fossil fuels

B. the natural decomposition of dead plants in tropical rainforests

C. the evaporation of water from polluted ocean surfaces

D. the breakdown of pesticides used on agricultural fields

68. One important reason to preserve biodiversity in natural ecosystems is that

A. all species eventually become harmful if their numbers grow too large

B. greater biodiversity contributes to ecosystem stability and resilience

C. each ecosystem can function with only one species at each trophic level

D. preserved species can be sold for high prices in international markets

69. Bacteria that consume oil spills as a food source represent an example of

A. invasive species that disrupt natural ecosystems significantly

B. natural selection occurring within a single generation in bacteria

C. bioremediation, using living organisms to clean up environmental pollutants

D. genetic engineering performed by humans to create new species

70. In a typical energy pyramid, the amount of energy available decreases at each successive trophic level because

A. organisms at higher levels reproduce more slowly than those at lower levels

B. the total mass of organisms increases at each successive level

C. all the energy is recycled and returned to the producers immediately

D. energy is lost as heat through metabolism at each level

71. In a population of deer living on an island, the population grows rapidly at first and then levels off. This pattern is best explained by

A. the population reaching the carrying capacity of the environment

B. all deer suddenly becoming infertile at the same time

C. random changes in the genetic makeup of the population

D. a sudden decrease in the number of predators on the island

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

A. a hurricane that destroys habitat regardless of population size

B. a cold winter that affects all individuals equally

C. a volcanic eruption that buries an entire region of habitat

D. an infectious disease that spreads more easily in larger populations

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

Answer all questions in this part.

73. In the Diffusion Through a Membrane laboratory, students determine that starch molecules do not pass through the dialysis tubing while glucose molecules do. This difference is best explained by

A. the chemical reaction between starch and iodine inside the tubing

B. the relative size of the molecules compared to the pores of the tubing

C. the electrical charge of each molecule in the surrounding solution

D. the temperature of the water in the beaker during the experiment

74. In the same laboratory, the presence of glucose in the water outside the dialysis tubing can be confirmed using

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

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

C. bromothymol blue, which changes color when glucose is present

D. litmus paper, which detects glucose by changing color rapidly

75. In the Beaks of Finches laboratory, the seeds remaining at the end of each round represent

A. mutations that occurred during the simulation rounds

B. offspring produced through asexual reproduction of finches

C. dead finches that were unable to compete for food resources

D. the food resources still available for the next generation of finches

76. When viewing a thick specimen under a compound light microscope, a student can focus on different layers within the specimen by adjusting the

A. eyepiece magnification to vary how deep the lens reaches

B. fine adjustment knob to move slightly above or below a layer

C. light intensity to penetrate the various layers of the specimen

D. position of the slide horizontally on the stage of the microscope

77. When a student switches from a low-power objective to a high-power objective on a microscope, the field of view will

A. become brighter while showing a larger area of the specimen

B. remain identical in both size and brightness for direct comparison

C. become smaller and the specimen will appear larger

D. show only the right half of the original field of view at all times

78. Lugol's iodine solution is used in biology laboratories to test for the presence of

A. starch, which causes the iodine to turn blue-black in color

B. carbon dioxide, which produces a yellow color change with the iodine

C. proteins, which produce a green color change with the iodine

D. lipids, which dissolve the iodine into a clear solution rapidly

79. In the Relationships and Biodiversity laboratory, students compare a target species (Botana curus) to three other candidate plants. Structural similarities such as leaf shape and stem appearance provide

A. definitive proof that two species share an exact recent common ancestor

B. one line of evidence that may suggest a possible evolutionary relationship

C. evidence that two species occupy the same geographic region today

D. proof that two species can interbreed to produce fertile offspring

80. In the Making Connections laboratory, students measure pulse rate before exercise, during exercise, and during recovery to investigate the relationship between

A. age and the maximum heart rate during physical exertion

B. body weight and the rate at which oxygen is consumed

C. blood type and the speed of recovery after physical activity

D. physical activity and the body's circulatory response

81. If a chemical is splashed into a student's eye during a biology laboratory, the first action should be to

A. cover the affected eye with a clean cloth and wait for help

B. continue the experiment and consult the teacher at the end

C. flush the eye thoroughly with water at the eyewash station

D. apply over-the-counter eye drops to relieve the immediate discomfort

82. When a student needs to transfer a small, accurate volume of liquid from one container to another, the most appropriate piece of equipment is

A. a graduated pipette or dropper marked with volume measurements

B. a large open beaker without any volume markings

C. an empty flat petri dish placed on the lab bench

D. a sealed test tube without any measurement markings

83. To ensure long-term accuracy and cleanliness of microscope lenses, a student should

A. wipe lenses with a coarse paper towel after every single use

B. clean lenses gently using only lens paper or a soft cloth

C. spray lenses with water before each use to keep them clear

D. rub lenses vigorously with a finger to remove any fingerprints

84. In a biology laboratory, a student needs to determine whether an unknown sample is a living organism. Which of the following observations would provide the strongest evidence that the sample is alive?

A. the sample is colored and has an irregular outer shape

B. the sample shows the same temperature as the surrounding environment

C. the sample does not change in size over a one-hour observation period

D. the sample shows growth, response to stimuli, and the ability to reproduce

85. A student completes an experiment and finds that her results do NOT support the original hypothesis. The most appropriate next step is to

A. discard the data and start the entire experiment over from scratch

B. modify the data so that it appears to support the original hypothesis

C. report the actual results honestly and consider revising the hypothesis based on the evidence

D. publish only the data points that match the hypothesis as originally written

EXPLAINED ANSWER KEY – PRACTICE EXAM 11

1. C — The cell theory has three core principles: all living things are composed of one or more cells, the cell is the basic unit of structure and function, and all cells come from pre-existing cells. The other options contradict this theory, since cells vary widely in structure, plant and other cells are equally valid, and spontaneous generation has been disproven.

2. B — Biological organization progresses from cell (the basic unit) to tissue (group of similar cells) to organ (group of tissues working together) to organ system (group of organs performing a major function). This bottom-up sequence is foundational to understanding multicellular structure in plants and animals.

3. D — Glycogen is a highly branched polysaccharide stored primarily in the liver and skeletal muscle of animals, serving as the body's main reserve of glucose. Starch is the plant equivalent, cellulose is a structural carbohydrate in plants, and lipids store energy long-term but are not the primary short-term carbohydrate reserve.

4. A — The plasma membrane is a fluid phospholipid bilayer with embedded proteins, often described by the fluid mosaic model. Its flexible, selectively permeable nature allows it to regulate what enters and leaves the cell while still maintaining cell integrity.

5. B — Diffusion of gases (such as O_2 and CO_2) across the membrane moves substances down their concentration gradient and requires no ATP, making it a form of passive transport. Active transport, endocytosis, and exocytosis all require energy because they either move substances against gradients or involve membrane reshaping.

6. C — Pepsin and other gastric enzymes operate in the highly acidic environment of the stomach, with optimal activity near pH 2 due to the hydrochloric acid secreted by parietal cells. This adaptation allows protein digestion to proceed efficiently in the harsh stomach environment.

7. A — The light-dependent reactions take place in the thylakoid membranes of chloroplasts, where chlorophyll captures light energy to produce ATP and NADPH and to split water into oxygen. The Calvin cycle (light-independent reactions) takes place in the stroma surrounding the thylakoids.

8. D — Yeast undergo alcoholic fermentation under anaerobic conditions, converting glucose into ethanol (alcohol) and carbon dioxide while producing a small amount of ATP. This process is the basis of bread rising and the production of beer and wine.

9. C — DNA replication is semiconservative: the double helix unwinds, the two parental strands separate, and each serves as a template for the synthesis of a new complementary strand. The result is two identical daughter molecules, each containing one original and one newly synthesized strand.

10. C — Transcription is the process by which RNA polymerase reads a DNA template and synthesizes a complementary messenger RNA molecule. This mRNA then carries the genetic instructions out of the nucleus to the ribosomes, where translation produces a protein.

11. A — During translation, ribosomes read mRNA codons and link amino acids together via peptide bonds to form polypeptide chains, which then fold into functional proteins. tRNA molecules deliver the correct amino acids based on codon-anticodon pairing.

12. B — An insertion mutation adds one or more base pairs into a DNA sequence, and adding a single base shifts the reading frame of every codon downstream (a frameshift). This frameshift typically produces a drastically altered, often nonfunctional protein.

13. D — In multicellular organisms, mitosis produces genetically identical diploid cells required for growth (adding new cells), repair (replacing damaged tissue), and routine replacement of worn-out cells such as skin and intestinal lining. Gamete production and chromosome reduction require meiosis instead.

14. C — Meiosis halves the chromosome number, producing haploid gametes from diploid parent cells. This reduction is essential because fertilization will rejoin two haploid gametes to restore the species' normal diploid chromosome number — without meiosis, chromosome counts would double every generation.

15. A — In the ABO blood system, the I^A and I^B alleles are codominant, so an individual with genotype I^A I^B expresses both A and B antigens on the surface of red blood cells, producing blood type AB. Type O appears only when both alleles are the recessive i allele.

16. D — X-linked recessive traits appear more often in males because males (XY) have only one X chromosome, so a single recessive allele on that X is sufficient to express the trait. Females (XX) typically need two copies of the recessive allele, which is statistically far less likely.

17. B — A mutation in a body (somatic) cell is not passed to offspring because gametes are produced from germ-line cells, not somatic cells. As a result, somatic mutations affect only the individual in whom they occur and may contribute to conditions such as cancer in that person.

18. C — Darwin's theory of natural selection holds that individuals whose traits are best suited to their environment are more likely to survive long enough to reproduce, so those favorable heritable traits become more common over generations. This differential survival and reproduction is the engine of adaptive evolutionary change.

19. A — Homologous structures — like the forelimb bones of whales, bats, and humans — share the same underlying skeletal plan despite serving different functions. This common architecture is best explained by descent with modification from a shared vertebrate ancestor whose forelimb pattern was inherited and modified in each lineage.

20. D — Natural selection cannot occur without heritable variation, because selection acts on differences among individuals that are passed to offspring. Without inherited variation, all individuals would have equal reproductive success and no evolutionary change could accumulate over generations.

21. B — A community is defined as all the populations of different species that live and interact in a given area. A population is a single species, an ecosystem adds the abiotic environment, and producers/decomposers alone do not constitute the full community.

22. A — Arrows in a food chain or food web point from prey to predator, showing the direction in which energy and nutrients flow as one organism is consumed by another. They do not represent physical movement of organisms, gas exchange, or genetic transfer.

23. C — In the chain grass → cricket → frog → snake → hawk, grass is the producer, the cricket is the primary consumer (eats producers), and the frog is the secondary consumer (eats primary consumers). The snake is a tertiary consumer and the hawk is quaternary.

24. D — Decomposers (bacteria and fungi) break down dead organisms and waste, returning carbon, nitrogen, and other nutrients to the soil and atmosphere. Without them, dead material would accumulate and essential nutrients would be locked away, halting their recycling through the ecosystem.

25. D — Nitrogen-fixing bacteria in the root nodules of legumes convert atmospheric N_2 gas — which most organisms cannot use — into ammonia (NH_3), a form plants can readily incorporate into amino acids and nucleic acids. This step is the entry point for nitrogen into the biological nitrogen cycle.

26. A — Maintaining a stable internal temperature in the face of environmental fluctuation is a classic example of homeostasis achieved through negative feedback: when temperature deviates from the set point, the body activates responses (sweating, shivering, vasodilation/constriction) that return it toward normal.

27. C — Endocrine signals are chemical messengers (hormones) carried through the bloodstream, so they act more slowly than nerve impulses but produce effects that can last minutes, hours, or even longer.

Nervous signals are nearly instantaneous but very brief, while hormonal effects on growth, metabolism, and reproduction are sustained.

28. D — In an allergic reaction, the immune system mistakenly identifies a harmless substance (such as pollen or peanut protein) as a dangerous pathogen and mounts an inflammatory response. This overreaction produces the familiar symptoms of allergy and, in severe cases, anaphylaxis.

29. B — Vaccines introduce weakened, killed, or fragmented pathogens (or their antigens) into the body, stimulating the adaptive immune system to produce antibodies and long-lived memory cells against that specific pathogen. On future exposure, these memory cells trigger a rapid, robust response that often prevents illness.

30. A — Viruses are noncellular infectious agents consisting essentially of nucleic acid wrapped in a protein coat (capsid), with some also surrounded by a lipid envelope. Bacteria, protozoa, and fungi are all cellular organisms, which is why antibiotics that target cellular processes are ineffective against viruses.

31. C — Structure 1 (the large central organelle filled with fluid) is the central vacuole, which in plant cells stores water and dissolved substances and exerts turgor pressure against the cell wall to keep the cell firm. Loss of vacuolar water is what causes plants to wilt.

32. A — Structure 2 (the oval organelles containing internal stacks of discs called thylakoids/grana) represents chloroplasts, the site of photosynthesis in plant cells. Chlorophyll within the thylakoid membranes captures light energy used to convert CO_2 and water into glucose.

33. B — Structure 3 (the small round organelle with a dense spot — the nucleolus — inside) is the nucleus, which contains the cell's DNA and serves as the control center for cellular activities by regulating gene expression and directing protein synthesis.

34. B — Chloroplasts (Structure 2) are present only in photosynthetic plant cells (and certain algae and protists). Their presence, together with the rectangular shape implied by a cell wall, identifies this cell as a plant cell rather than an animal, bacterial, or fungal cell.

35. C — At high substrate concentrations every enzyme active site is occupied and the enzymes work as fast as they can; adding more substrate cannot speed up the reaction further. This saturation produces the characteristic plateau (V_max) seen at the right side of the graph.

36. A — At 5 mM the curve is already very close to V_max, so doubling substrate to 10 mM yields only a small additional rise in reaction rate. This is exactly what saturation kinetics predicts — large changes in substrate produce diminishing returns once the enzyme is nearly saturated.

37. B — Once enzymes are saturated, the limiting factor is the number of active sites available, not substrate availability. Adding more enzyme provides additional active sites, raising the maximum possible reaction rate; adding more substrate at this point would have little effect.

38. D — At low light intensities, light is the limiting factor and oxygen production rises with light. Above 6,000 lux the curve plateaus because another factor — typically carbon dioxide concentration or temperature — has become the new limiting factor for photosynthesis.

39. A — Between 0 and 4,000 lux the data points fall along an approximately straight line: 0 → 4 → 8 → 16 → 24 mL/hr. This direct, roughly linear relationship between light intensity and oxygen production is characteristic of the light-limited region of photosynthesis.

40. C — Oxygen production at 1,000 lux is 8 mL/hr, and at 2,000 lux is 16 mL/hr, giving an increase of $16 - 8 = 8$ mL/hr. This calculation also confirms the proportional relationship in the lower light range of the data.

41. C — The Prairie Vole feeds on grasses (making it a primary consumer) and is preyed upon by the Red-tailed Hawk (a tertiary consumer). This dual role illustrates how energy moves through multiple trophic levels in a food web.

42. D — The Meadowlark's only food source in this web is the Grasshopper, so removing all grasshoppers would most directly cause the meadowlark population to decline. The coyote does not feed on grasshoppers, and clover is also eaten by other organisms.

43. A — The Coyote feeds on Prairie Vole and Cottontail Rabbit, and the Red-tailed Hawk also feeds on those same two prey species (plus the Meadowlark). Sharing prey species places coyote and hawk in direct competition for these two consumers.

44. C — The independent variable is the factor the experimenter intentionally changes, which in this case is water temperature. The amount of sugar dissolved is the dependent variable (measured outcome), and the sugar type and container size should be held constant.

45. B — To isolate the effect of temperature, all other variables must be held constant. Keeping both the mass of sugar added and the volume of water identical across trials ensures that any difference in dissolving rate can be attributed solely to temperature.

46. D — By scientific convention, the independent variable — the one the experimenter deliberately manipulates — is placed on the horizontal x-axis, and the dependent variable (the response) is placed on the vertical y-axis. This consistent layout makes graphs easier to read and compare.

47. A — A pedigree chart uses standardized symbols to record the appearance of a trait across multiple generations of a family, helping geneticists determine inheritance patterns (dominant, recessive, sex-linked, etc.) and predict probabilities for future offspring. It does not measure mutation rate or gene locations directly.

48. B — Restriction enzymes are bacterial proteins that recognize and cut DNA at specific base sequences (recognition sites). This precise cutting allows researchers to remove particular genes or DNA fragments and recombine them with other DNA molecules — a foundational tool of recombinant DNA technology.

49. D — By the principle of superposition, in undisturbed sedimentary rock layers the lower strata are older than the upper ones. The layer in which a fossil is found therefore provides a relative age estimate compared with fossils in other layers above or below it.

50. B — Blubber is a physical, anatomical feature of the polar bear's body — a thick layer of insulating fat — making it a structural adaptation. It is not learned, not a behavior, and not a physiological regulatory response.

51. A — Deoxygenated blood returning from the body through the superior and inferior vena cava enters the right atrium first. From there it is pumped into the right ventricle and onward to the lungs, eventually returning oxygenated to the left atrium and then the left ventricle.

52. C — The kidneys filter blood in the nephrons and remove metabolic wastes such as urea, along with excess water and dissolved salts (electrolytes), which are excreted as urine. This filtration maintains the proper composition of body fluids and supports overall homeostasis.

53. B — Neurons are specialized for rapid communication: they generate and transmit electrochemical signals (action potentials) along their axons and release neurotransmitters at synapses to convey information to other neurons, muscles, or glands. Their structure with dendrites and axons supports this signaling role.

54. D — The small intestine is the principal site of both chemical digestion (carried out by enzymes from the pancreas and intestinal wall together with bile from the liver) and absorption of nutrients into the bloodstream through villi and microvilli. The large intestine mainly absorbs water and forms feces.

55. A — When blood glucose drops, the pancreas releases glucagon, which signals the liver to break down glycogen and release glucose into the bloodstream. This action raises blood glucose back toward the normal range and works in opposition to insulin in maintaining glucose homeostasis.

56. C — A reflex arc follows the sequence: receptor detects the stimulus → sensory neuron carries the signal to the spinal cord → interneurons relay to motor neuron → motor neuron carries the response to the effector (muscle or gland). This pathway bypasses the brain, allowing very rapid protective responses.

57. B — Fertilization normally takes place in the fallopian tube (oviduct) when sperm meet the egg shortly after ovulation. The resulting zygote then travels down the tube and implants in the uterus, where embryonic development continues.

58. D — After fertilization, the diploid zygote divides repeatedly by mitosis, producing many genetically identical daughter cells that organize into the embryo. Meiosis only occurs in the formation of gametes, not in embryonic development.

59. A — An antigen is any molecule (often a protein or polysaccharide on the surface of a pathogen) that the immune system recognizes as foreign and that triggers an immune response, including antibody production. Antibodies are produced *in response to* antigens, not the antigens themselves.

60. B — HIV specifically infects and destroys helper T cells ($CD4^+$ T lymphocytes), which coordinate both the antibody-mediated and cell-mediated immune responses. As these cells are depleted, the immune system becomes increasingly unable to defend the body against opportunistic infections and certain cancers.

61. D — Down syndrome results from trisomy 21 — the presence of three copies of chromosome 21 instead of the normal two — usually caused by nondisjunction during meiosis. The extra chromosome alters development and produces the characteristic physical and cognitive features of the condition.

62. C — Stem cells are unspecialized cells capable of both self-renewal and differentiation into many specialized cell types. This dual property makes them essential for embryonic development and for tissue repair throughout life, and gives them tremendous potential in regenerative medicine.

63. A — In selective breeding, humans choose individuals with desirable traits and breed them together so that those traits become more common in future generations. This artificial selection has produced modern crops, livestock breeds, and dog breeds, but works only with variation already present in the species.

64. B — Moving a gene from one species (a bacterium) into another (corn) creates a recombinant DNA molecule and is a defining example of genetic engineering. The resulting genetically modified organism (GMO) expresses the new trait — in this case, pest resistance — that it could not have acquired through conventional breeding.

65. D — Greenhouse gases such as CO_2 and methane absorb infrared radiation emitted by Earth's surface and re-radiate some of it back downward, trapping heat in the lower atmosphere. Increased concentrations of these gases enhance this greenhouse effect and cause global average temperatures to rise.

66. C — The ozone (O_3) layer in the stratosphere absorbs most of the sun's harmful ultraviolet-B and UV-C radiation, preventing it from reaching the Earth's surface. This protection reduces rates of skin cancer, cataracts, and damage to plant and aquatic ecosystems.

67. A — Burning fossil fuels releases sulfur dioxide (SO_2) and nitrogen oxides (NO_x) into the atmosphere, where they react with water vapor to form sulfuric and nitric acids that fall as acid rain. Acid rain damages forests, acidifies lakes, and corrodes buildings and statues.

68. B — Biodiverse ecosystems contain a wider variety of species and genetic resources, which makes them more resilient to disturbances such as disease outbreaks, climate variation, and habitat change. Loss of biodiversity weakens these stabilizing relationships and increases the risk of ecosystem collapse.

69. C — Bioremediation uses living organisms — most commonly bacteria or fungi — to break down or remove environmental pollutants such as oil, heavy metals, or industrial chemicals. Oil-eating bacteria deployed after spills are a well-known practical application of this approach.

70. D — At each trophic transfer, only about 10% of the energy is incorporated into the next level's biomass; the rest is lost mainly as heat during cellular respiration and metabolism, with some lost in undigested material. This continual heat loss is why food chains rarely exceed four or five levels.

71. A — Populations introduced to a new environment typically grow rapidly at first (J-shaped curve) and then level off as resources such as food, water, or space become limited. The maximum population that the environment can sustain over time is called the carrying capacity (K).

72. D — Density-dependent factors have effects that intensify as population density increases. Infectious diseases spread more readily when individuals are crowded, making disease a classic density-dependent limit on population growth. Hurricanes and volcanic eruptions, by contrast, act regardless of population density.

73. B — Dialysis tubing has pores of a fixed size: small molecules such as water, iodine, and glucose can pass through, but starch molecules are too large to fit. This size-based selectivity is exactly how cell membranes also restrict the passage of certain molecules.

74. A — Benedict's solution is a chemical indicator for reducing sugars (including glucose); when heated in the presence of glucose, it changes from blue to green, yellow, or orange-red depending on sugar concentration. Detecting glucose in the beaker water confirms that glucose diffused out of the dialysis tubing.

75. D — In the Beaks of Finches simulation, seeds left at the end of a round are the food still available, which then "feeds" the next generation of finches. Finches whose beak tools collected enough food survive and reproduce, modeling how natural selection acts on inherited variation.

76. B — When the specimen has measurable thickness, slowly turning the fine adjustment knob raises or lowers the objective in tiny increments, bringing different depths within the specimen into focus. This technique, called optical sectioning, allows the observer to scan through layers without damaging the slide.

77. C — Increasing magnification reduces the field of view because the same physical area is now spread across the entire field. As a result, the specimen appears larger but less of it is visible at once, and the image is generally dimmer.

78. A — Lugol's iodine solution reacts with starch to produce a characteristic dark blue-black color, while leaving other macromolecules unaffected. This makes it a standard test for the presence of starch in foods or in cells.

79. B — Structural similarities (such as leaf shape or stem appearance) are a useful but not definitive form of evidence for evolutionary relatedness, because similar structures can also arise from convergent evolution. Confident conclusions require combining structural data with biochemical and genetic evidence.

80. D — The Making Connections laboratory uses pulse rate measurements before, during, and after exercise to investigate how the circulatory system responds to increased physical activity and oxygen demand. The experiment illustrates homeostatic regulation of heart rate during stress and recovery.

81. C — A chemical eye splash demands immediate, prolonged flushing with water at the eyewash station — typically for at least 15 minutes — to dilute and remove the chemical and minimize tissue damage. Any delay or use of cloths, drops, or covers risks worsening the injury.

82. A — Graduated pipettes and droppers are designed to deliver small volumes of liquid with accuracy and control, with markings that indicate precise volumes. Beakers, petri dishes, and unmarked test tubes lack the calibration and precision needed for transferring small accurate amounts.

83. B — Microscope lenses are delicate optical surfaces that must be cleaned only with lens paper or a soft, lint-free cloth, often with a small amount of specialized lens cleaner. Paper towels, fingers, or water can leave residues, scratch coatings, and degrade image quality over time.

84. D — The characteristics of life include growth, response to stimuli (irritability), and the ability to reproduce, among others. Demonstrating several of these characteristics together provides the strongest evidence that a sample is a living organism rather than non-living matter.

85. C — Scientific integrity requires that data be reported honestly, even when they contradict the original hypothesis. Unexpected results are not failures but new information; a researcher should consider revising the hypothesis or designing a follow-up experiment to investigate the unexpected outcome further.