PRACTICE EXAM 18: LIVING ENVIRONMENT REGENTS SIMULATION

Answer all questions in this part.

1. A scientific theory differs from a scientific hypothesis primarily in that a theory:

A. has not yet been tested by any experiment

B. is a broad explanation supported by a large body of evidence

C. is always considered absolutely final and unchangeable

D. is based only on the personal opinion of one scientist

2. Which of the following biological molecules is the main source of immediate chemical energy used by living cells to power their activities?

A. ATP

B. DNA

C. starch

D. cellulose

3. All of the following are characteristics of living things EXCEPT the ability to:

A. grow and develop over a life span

B. reproduce and pass traits to offspring

C. maintain a stable internal environment

D. create new matter from nothing during growth

4. A unicellular organism that lacks a true membrane-bound nucleus is best classified as a:

A. plant cell

B. fungal cell

C. prokaryotic cell

D. eukaryotic animal cell

5. Which of the following is the primary function of the cell wall in a plant cell?

A. providing structural support and protection for the cell

B. controlling the activities of all the cell's organelles

C. producing ATP from glucose during respiration

D. storing the genetic material of the plant

6. A red blood cell placed in distilled water will most likely:

A. shrivel and become a crenated shape

B. remain exactly the same size and shape

C. swell and possibly burst due to osmotic water uptake

D. begin to perform photosynthesis and produce sugars

7. Which of the following best describes the function of the endoplasmic reticulum (ER) in a cell?

A. final breakdown of worn-out cellular components

B. synthesis and transport of proteins and lipids within the cell

C. capture of solar energy for the production of glucose

D. random storage of waste products before excretion

8. A scientist heats a solution containing an enzyme and its substrate to 90 °C. The reaction stops almost completely because the enzyme has been:

A. used up as a reactant in the chemical reaction

B. diluted by the high temperature of the solution

C. converted into a different type of substrate molecule

D. denatured, causing it to lose its functional three-dimensional shape

9. Active transport differs from passive transport in that active transport:

A. requires the cell to expend ATP energy

B. moves substances only down a concentration gradient

C. does not involve the cell membrane in any way

D. occurs only in deceased or inactive cells

10. The process by which white blood cells engulf and destroy bacteria is best described as:

A. osmosis

B. diffusion

C. phagocytosis

D. transcription

11. Which of the following is the correct word equation for aerobic cellular respiration?

A. carbon dioxide + water → glucose + oxygen

B. glucose + oxygen → carbon dioxide + water + ATP

C. ATP + oxygen → carbon dioxide + water + glucose

D. glucose + carbon dioxide → ATP + oxygen + water

12. Photosynthesis is best described as the process by which plants:

A. use ATP to break down glucose into smaller molecules

B. release oxygen by breaking down protein molecules

C. consume oxygen and release carbon dioxide into the air

D. convert solar energy into chemical energy stored in glucose

13. A nucleotide is the structural building block of:

A. nucleic acids such as DNA and RNA

B. carbohydrates such as starch and glycogen

C. lipids such as fats and oils

D. proteins such as hemoglobin and enzymes

14. During DNA replication, the two strands of the double helix:

A. swap positions with each other along the molecule

B. fuse permanently into one single strand of DNA

C. separate so that each strand serves as a template for a new strand

D. are broken into individual nucleotides that are randomly reassembled

15. The number of chromosomes in a normal human gamete is:

A. 46 chromosomes arranged as 23 pairs

B. 23 individual chromosomes

C. 92 chromosomes arranged as 46 pairs

D. 12 individual chromosomes

16. Which of the following statements about genes is most accurate?

A. Genes are short segments of protein found inside the nucleus

B. Genes are entirely contained within the mitochondria of every cell

C. Genes are made of lipids and are located in the cell membrane

D. Genes are specific segments of DNA that code for particular traits

17. A pea plant heterozygous for tall stem (Tt) is crossed with a plant homozygous recessive for short stem (tt). What percentage of the offspring is expected to be tall?

A. 50%

B. 25%

C. 75%

D. 100%

18. Which of the following is an example of asexual reproduction?

A. fertilization of an egg by a sperm cell

B. cross-pollination between two flowering plants

C. division of a hydra by budding into a new individual

D. mating of two organisms to produce a zygote

19. Which of the following structures is most closely associated with the inheritance of traits from one generation to the next?

A. cell membrane of a body cell

B. cytoplasm of the liver cell

C. mitochondrion of a muscle cell

D. chromosome of a gamete cell

20. A child inherits a recessive disorder from carrier parents. The most likely genotype of each parent is:

A. homozygous dominant for the disorder

B. heterozygous for the disorder

C. homozygous recessive for the disorder

D. completely free of the recessive allele

21. Genetic engineering of bacteria to produce human growth hormone involves:

A. inserting the human gene for growth hormone into a bacterial plasmid

B. removing all DNA from the bacterial cell before culturing

C. replacing the bacterial cell wall with a human cell membrane

D. mutating the bacterial DNA with random ultraviolet exposure

22. Which of the following best describes a mutation that occurs in a body (somatic) cell rather than in a gamete?

A. The mutation will appear in every cell of the offspring

B. The mutation will be present only in the gametes of the offspring

C. The mutation can affect only the individual in whom it arose, not future generations

D. The mutation will pass directly into the eggs and sperm of the individual

23. Two species of birds living in the same forest avoid competition by feeding at different times of day. This is an example of:

A. interbreeding between the two bird species

B. parasitism by one bird on the other species

C. mutualism between the two bird species

D. resource partitioning to reduce competition

24. Which of the following best describes the process of natural selection?

A. All members of a population are equally likely to survive and reproduce

B. Individuals with traits better suited to their environment tend to survive and reproduce more

C. Organisms can intentionally change their DNA to suit their environment

D. New species arise instantly when the environment changes suddenly

25. Which of the following is the most reliable source of evidence supporting the theory of evolution?

A. Comparing the DNA base sequences of different species

B. Counting the total number of individuals in each species today

C. Measuring the average daily temperature of each habitat

D. Recording the favorite food of each modern species

26. Vestigial structures, such as the pelvic bones in modern whales, provide evidence that:

A. modern whales were created independently of all other mammals

B. whales evolved by acquiring entirely new body structures over time

C. all vertebrates share an identical set of vestigial features

D. modern whales share common ancestry with land-dwelling vertebrates

27. The carrying capacity of an environment is best defined as:

A. the largest organism that the environment can ever produce

B. the maximum population size that the environment can sustainably support

C. the smallest area in which a single individual can live

D. the speed at which individuals migrate out of an area

28. Which of the following is a biotic factor in a pond ecosystem?

A. the average daily temperature of the pond water

B. the amount of sunlight penetrating the pond surface

C. the number of frogs living along the pond shoreline

D. the pH of the water in the pond

29. Which of the following best describes commensalism between two species?

A. one species benefits while the other is neither helped nor harmed

B. both species benefit equally from the relationship

C. one species benefits while the other is significantly harmed

D. both species are harmed equally by the relationship

30. In ecological terms, a community is best defined as:

A. one population of a single species in an area

B. all the abiotic factors found in a specific location

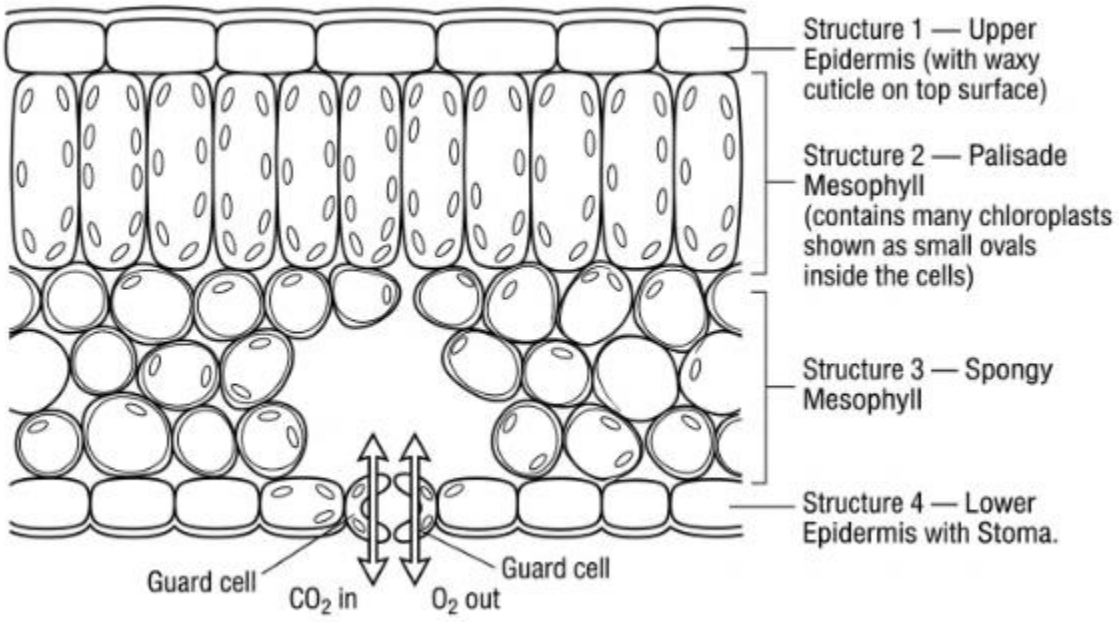
C. all the populations of different species living together in an area

D. all the ecosystems combined into a single biome

PART B-1

Answer all questions in this part.

Base your answers to questions 31 through 34 on the diagram below and on your knowledge of biology. The diagram represents the structure of a typical plant leaf as seen in cross-section.



31. Which structure in this leaf is the primary site of photosynthesis?

A. Structure 1, the upper epidermis

B. Structure 2, the palisade mesophyll

C. Structure 3, the spongy mesophyll

D. Structure 4, the lower epidermis

32. The waxy cuticle on the upper surface of Structure 1 helps the plant survive on land by:

A. allowing rapid diffusion of carbon dioxide into the leaf

B. dissolving minerals out of the surface of the leaf

C. capturing solar energy for use in photosynthesis

D. preventing excessive loss of water through the leaf surface

33. The opening between the two guard cells of Structure 4 allows the exchange of gases needed for photosynthesis. This opening is called a:

A. stoma

B. vein

C. vacuole

D. chloroplast

34. Which of the following best describes how the structure of the leaf is matched to its function in photosynthesis?

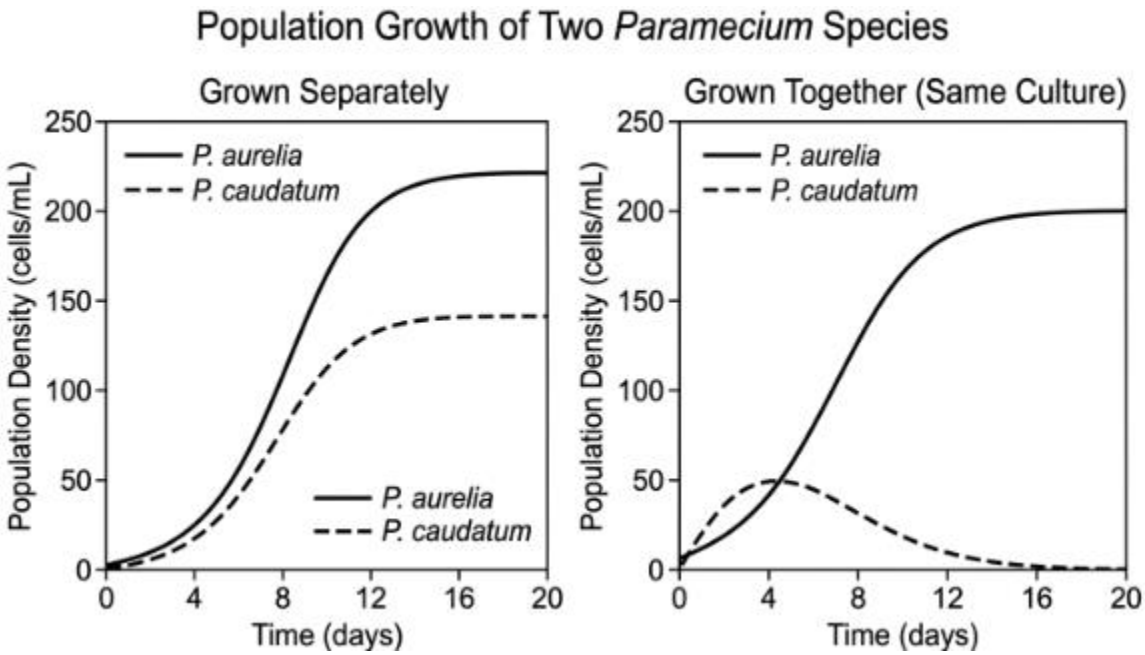
A. The waxy cuticle is the main site of glucose production in the leaf

B. The lower epidermis contains most of the chloroplasts in the leaf

C. Chloroplasts are concentrated in mesophyll cells where light most easily reaches them

D. Air spaces in the leaf prevent any gases from moving between cells

Base your answers to questions 35 through 37 on the graph below and on your knowledge of biology. The graph shows the population growth of two species of paramecium (Paramecium aurelia and Paramecium caudatum) when grown separately and when grown together in the same culture, with limited food.



35. When grown separately, both species show population curves that level off rather than continuing to rise. This leveling off is best explained by the fact that:

A. each species has reached the carrying capacity of its environment

B. both species have run out of all genetic variation in the population

C. both species have begun the process of speciation in the culture

D. both species have stopped reproducing entirely

36. When grown together, P. caudatum declines while P. aurelia continues to grow. This pattern most strongly supports the conclusion that:

A. the two species formed a mutualistic relationship in the culture

B. P. caudatum preyed on P. aurelia throughout the experiment

C. there was no interaction between the two species at all

D. P. aurelia outcompeted P. caudatum for the limited resources

37. The principle most directly illustrated by the right-hand graph is that:

A. two species can occupy identical niches indefinitely without consequence

B. two species competing for identical limited resources cannot coexist indefinitely

C. predation always favors the smaller of two competing species

D. genetic mutation alone determines the outcome of competition

Base your answers to questions 38 through 40 on the data table below and on your knowledge of biology. The table shows results from a controlled investigation of how soil pH affects the height of bean plants grown over 30 days. All plants received the same amount of water, light, and starting soil volume.

Figure PQ-3: Effect of Soil pH on Bean Plant Height After 30 Days

Soil pH	Average Plant Height (cm)	Number of Plants in Group
4.0	5.2	10
5.5	14.8	10
6.5	24.6	10
7.0	26.3	10
7.5	22.4	10
8.5	11.7	10
9.5	4.1	10

38. Based on the data, the soil pH that best supports the growth of bean plants under these conditions is approximately:

A. pH 4.0

B. pH 5.5

C. pH 7.0

D. pH 9.5

39. Why did the investigator use 10 plants at each pH level rather than only one plant per group?

A. to increase sample size and reduce the influence of random individual variation

B. to allow the plants to compete with one another for the same nutrients

C. to ensure that no two plants of the same height were ever measured

D. to guarantee that every plant in the group would grow to exactly the same height

40. Which of the following is the dependent variable in this investigation?

A. the type of bean seed planted in each pot

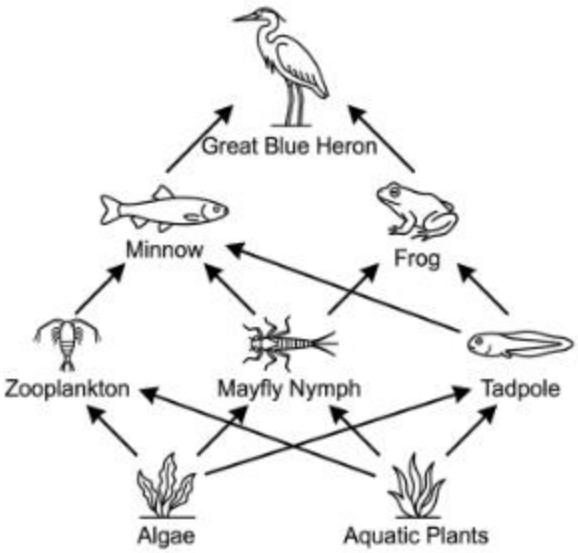
B. the amount of water given to each plant daily

C. the soil pH used in each experimental group

D. the average height of the plants after 30 days

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

[Figure PQ-4: Food web diagram for a freshwater pond ecosystem]



41. Which organism in this food web is best classified as a tertiary consumer?

A. Mayfly Nymph

B. Great Blue Heron

C. Tadpole

D. Algae

42. Which of the following correctly identifies the producers in this food web?

A. zooplankton and mayfly nymph

B. minnow and frog

C. algae and aquatic plants

D. great blue heron and tadpole

43. If a pollutant killed most of the algae in the pond, which population would most likely be directly affected first?

A. zooplankton and mayfly nymph populations

B. great blue heron population

C. aquatic plant population

D. frog population only

PART B-2

Answer all questions in this part.

44. A scientist designs an experiment to test the effect of caffeine on the heart rate of small water fleas (Daphnia). The control group in this experiment should be exposed to:

A. an unknown chemical not specified in the procedure

B. a higher concentration of caffeine than the experimental groups

C. a lower temperature than the experimental groups

D. pond water with no caffeine added at all

45. The development of an unintended mutation in a fish population would most likely:

A. always be harmful and quickly eliminated from the population

B. always be beneficial and rapidly spread through the population

C. produce variation upon which natural selection may act

D. completely replace the existing genetic code of the fish population

46. In humans, the small intestine is specialized for nutrient absorption because its inner wall contains:

A. tiny finger-like projections called villi that greatly increase surface area

B. thick layers of dense connective tissue that block absorption

C. specialized cells that secrete oxygen into the bloodstream

D. large muscle blocks that prevent food from moving through

47. Which of the following best explains why blood is considered a connective tissue?

A. it functions only as part of the digestive system

B. it consists of specialized cells suspended in a liquid extracellular matrix

C. it is composed entirely of nerve cells transmitting impulses

D. it forms the strong outer skeleton of the body's organs

48. Which of the following is a function of the human kidney?

A. producing red blood cells from amino acids

B. digesting food in the small intestine

C. breaking down toxins absorbed from the lungs

D. filtering wastes from the blood and producing urine

49. A person breathes more deeply and rapidly while exercising. This change is most likely controlled by:

A. nervous and chemical signals in response to rising CO_2 levels

B. a sudden decrease in body temperature of the muscles

C. the digestive system absorbing additional carbon dioxide

D. the kidneys releasing oxygen into the bloodstream

50. Which of the following best describes the role of memory cells in the immune system?

A. they directly digest pathogens with powerful enzymes

B. they store unused fats for emergencies during infection

C. they enable a faster and stronger response upon re-exposure to the same antigen

D. they transport oxygen throughout the body during illness

51. Vaccines work by causing the immune system to:

A. become permanently weakened against future infections

B. produce memory cells specific to a pathogen without causing the disease

C. attack and destroy all of the host's own body cells

D. eliminate the need for any future immune responses

52. A person with type 1 diabetes mellitus is unable to produce enough of the hormone:

A. estrogen

B. testosterone

C. adrenaline

D. insulin

53. Insulin lowers blood glucose levels primarily by:

A. converting glucose directly into amino acids in the blood

B. signaling body cells to take up glucose from the bloodstream

C. causing the kidneys to release glucose into the urine

D. preventing the digestion of carbohydrates in the stomach

54. Sweat glands in the skin help to maintain homeostasis by releasing water that:

A. evaporates from the skin and cools the body during overheating

B. immediately freezes on the skin during cold weather

C. provides additional calories for muscle activity

D. carries oxygen from the lungs to body tissues

55. Which of the following best describes the function of the central nervous system?

A. it is composed only of the spinal cord and its branching nerves

B. it secretes hormones into the bloodstream from the pancreas

C. it processes information and coordinates responses of the body

D. it is responsible for the digestion of all proteins in food

PART C

Answer all questions in this part.

56. Which of the following is the best example of a structural adaptation for survival in a cold climate?

A. a thin layer of skin that releases heat rapidly

B. a thick layer of insulating fur covering the body

C. a very long, narrow body with little surface area

D. dark-colored skin that absorbs maximum solar radiation

57. Camouflage coloring in many prey animals is an example of:

A. an adaptation that interferes with reproduction

B. a behavior that always attracts more predators

C. a trait that increases competition between species

D. an adaptation that increases the chances of survival

58. During human fetal development, the umbilical cord serves to:

A. connect the developing fetus to the mother's placenta for exchange of materials

B. provide additional air for the fetus to breathe inside the uterus

C. dissolve solid foods entering the fetus's digestive system

D. produce the hormones needed to begin labor and delivery

59. A woman who is a carrier of a recessive sex-linked disorder marries a man who does not carry the allele. What percentage of their sons would most likely be affected?

A. 0% of the sons

B. 25% of the sons

C. 50% of the sons

D. 100% of the sons

60. Which of the following best describes the events that occur during fertilization in humans?

A. one sperm cell fuses with several egg cells to produce one zygote

B. several sperm cells must fuse to produce a single zygote

C. an egg divides on its own to produce a complete embryo

D. a single sperm cell joins with a single egg cell to form a diploid zygote

61. Which of the following best illustrates the concept of biological diversity within an ecosystem?

A. a forest containing many species of trees, birds, and insects

B. a single field containing only one species of corn

C. a laboratory dish with one species of bacteria

D. a barren rocky island with no organisms at all

62. Loss of biodiversity in an ecosystem most often leads to:

A. greater stability when major environmental change occurs

B. reduced ability of the ecosystem to recover from disturbance

C. an immediate increase in available resources for all species

D. complete elimination of all decomposers from the ecosystem

63. Which of the following human activities most directly increases the concentration of carbon dioxide in the atmosphere?

A. planting large numbers of trees in deforested areas

B. installing solar panels on residential rooftops

C. switching from incandescent to LED lighting

D. burning fossil fuels for transportation and electricity

64. Which of the following is the most direct consequence of ozone layer depletion?

A. immediate cooling of the lower atmosphere worldwide

B. complete loss of all infrared radiation from the Sun

C. increased levels of harmful ultraviolet radiation reaching Earth's surface

D. an increase in the planet's overall gravity

65. Reforestation programs help reduce the effects of climate change because trees:

A. absorb carbon dioxide from the atmosphere during photosynthesis

B. release large amounts of nitrogen gas into the atmosphere

C. consume oxygen during photosynthesis and release glucose into the air

D. produce methane as a major waste product of growth

66. A bog containing very acidic, low-oxygen water gradually fills with sediment, becomes drier soil, and is colonized first by grasses and then by shrubs and trees over several centuries. This process is best described as:

A. primary succession on bare rock

B. secondary succession of a previously vegetated area

C. immediate climax community formation

D. complete loss of all living organisms from the area

67. Two organisms living in the same habitat that occupy slightly different niches are most likely to:

A. always compete to extinction within one generation

B. share identical food sources at the same time of day

C. become a single new species within only a few years

D. coexist by using different resources or feeding at different times

68. A population of insects becomes resistant to a pesticide that was once effective in killing them. The best explanation for this change is that:

A. each individual insect changed its DNA to resist the pesticide

B. the pesticide added new genes for resistance into all insects

C. resistant individuals already in the population survived and reproduced

D. the entire population learned how to detoxify the pesticide together

69. Which of the following statements about ecosystems is most accurate?

A. ecosystems consist only of biotic factors

B. ecosystems contain no flow of energy from one organism to another

C. matter is recycled within ecosystems, while energy continually flows through them

D. energy is recycled within ecosystems, while matter continually flows away

70. Which process is responsible for returning nitrogen from dead organisms to a form usable by plants?

A. decomposition by bacteria and fungi in the soil

B. exhalation of nitrogen gas by terrestrial mammals

C. evaporation of nitrogen from the surface of the ocean

D. solar radiation breaking down dead bodies in sunlight

71. Which of the following is an example of a renewable resource?

A. coal mined from underground deposits

B. crude oil extracted from offshore wells

C. natural gas drawn from shale formations

D. wind energy used to generate electricity

72. Sustainable agriculture practices help maintain ecosystems by:

A. relying entirely on a single crop year after year

B. rotating crops and using cover crops to maintain soil health

C. clearing as much new land as possible each year

D. eliminating all natural pollinators from farmland

PART D

Answer all questions in this part.

73. A student is performing the "Diffusion Through a Membrane" lab and observes that starch indicator (Lugol's iodine) inside dialysis tubing turns blue-black after the tubing is placed in a beaker of water containing iodine. The best explanation for this observation is that:

A. the starch molecules diffused out of the tubing into the surrounding water

B. the water molecules diffused into the iodine and broke it down chemically

C. the iodine molecules were small enough to diffuse through the tubing and react with the starch inside

D. the dialysis tubing actively transported the starch into the surrounding water

74. In the "Beaks of Finches" lab, students simulate natural selection by using various tools to pick up seeds during timed trials. The "finches" with the fewest seeds at the end of each round are removed from the next round to represent:

A. starvation and decreased reproductive success of poorly adapted individuals

B. random emigration of those individuals to a new island

C. an increase in the rate of mutation among slower individuals

D. an artificially induced infectious disease among the slowest birds

75. When focusing a specimen under a compound light microscope, the student should:

A. always use only the high-power objective from the start

B. begin focusing using the fine adjustment knob on high power immediately

C. avoid touching any focus knobs after the slide is placed on the stage

D. begin focusing using the low-power objective and the coarse adjustment knob

76. A microscope has an ocular (eyepiece) lens with a magnification of 10× and a high-power objective lens with a magnification of 40×. The total magnification under high power is:

A. 50×

B. 400×

C. 10×

D. 4×

77. In the "Making Connections" lab, students measure their pulse rate before, during, and after performing physical exercise. To make the comparison of class data more reliable, students should:

A. combine pulse rate data from many students and calculate the class average for each condition

B. report only the highest pulse rate measured in the class for each condition

C. use only data from one student in the entire class for the comparison

D. discard any student measurement that does not exactly match a partner's

78. Paper chromatography is used to separate the photosynthetic pigments of a spinach leaf. The student observes four distinct bands of color on the chromatography paper after running the experiment. These results best support the conclusion that:

A. spinach leaves contain only one type of pigment used for photosynthesis

B. all of the spinach pigment molecules have identical solubility in the solvent used

C. the spinach leaf contains multiple different pigments with different solubilities in the solvent

D. paper chromatography destroys all pigments in the leaf during the process

79. A student measures the volume of a small irregularly shaped pebble using a graduated cylinder filled with water. The best method to determine the pebble's volume is to:

A. estimate the pebble's volume by carefully measuring its outside dimensions with a ruler

B. weigh the pebble on a triple-beam balance and convert the mass to volume

C. record only the volume of water in the cylinder before adding the pebble

D. record the change in water level after submerging the pebble in the cylinder

80. When reporting laboratory results, a student should:

A. round all measured values to the nearest whole number for simplicity

B. include all observed measurements with appropriate units throughout the work

C. omit any data that conflicts with the student's original hypothesis

D. record only the calculated average and discard each original measurement

81. A student investigating the effect of light color on plant growth uses red light, blue light, green light, and a darkened cabinet (no light). Which group serves as the control in this experiment?

A. the plants grown in the darkened cabinet with no light

B. the plants exposed only to red light

C. the plants exposed only to green light

D. the plants exposed to all three light colors combined

82. When using a triple-beam balance to measure the mass of a small object, the student should first:

A. place the object on the pan, then read the balance immediately

B. set all of the riders to zero and confirm the balance reads exactly zero

C. blow lightly on the pan to make sure it is moving freely

D. zero the balance carefully with the object already placed on the pan

83. In the "Relationships and Biodiversity" lab, students compare Botana curus to other plants using paper chromatography of leaf pigments. Pigment bands that line up at the same position on the chromatography paper indicate that:

A. the two plants always belong to entirely different species

B. one plant must be a direct parent of the other plant

C. the two plants contain at least one pigment with similar chemical properties

D. the two plants live in geographically distant habitats

84. A student is asked to identify an unknown plant specimen using a dichotomous key. The key works by:

A. randomly listing all known species and letting the user pick one

B. presenting pairs of contrasting statements that lead the user toward an identification

C. asking the user to name the species based only on prior memory

D. providing a single statement that immediately gives the correct answer

85. A student uses a stopwatch to measure how long a snail takes to crawl across a 10-cm line. To improve the accuracy of the measurement, the student should:

A. perform several trials and calculate the average time taken

B. perform the experiment only once to save time

C. estimate the time mentally without using a stopwatch at all

D. record only the fastest trial and discard all other data

EXPLAINED ANSWER KEY – PRACTICE EXAM 18

1. B — A scientific theory is a comprehensive, well-substantiated explanation supported by a large body of experimental and observational evidence accumulated over many investigations. A hypothesis, in contrast, is a single tentative explanation awaiting testing; theories remain open to revision but are far better supported than hypotheses.

2. A — ATP (adenosine triphosphate) is the cell's primary energy currency: the energy released when its terminal phosphate bond is broken powers virtually every active cellular process. DNA stores genetic information, while starch and cellulose are long-term plant storage and structural carbohydrates rather than immediate energy carriers.

3. D — Living things take in and reorganize existing matter from their surroundings — they do not create new matter from nothing. Growth and metabolism follow the law of conservation of matter, with atoms simply being rearranged into living tissue.

4. C — Prokaryotic cells, such as bacteria and archaea, lack a true membrane-bound nucleus; their DNA floats freely in a region called the nucleoid. Plant, fungal, and animal cells are all eukaryotic and have a defined nuclear envelope.

5. A — The plant cell wall is a rigid layer made primarily of cellulose that surrounds the cell membrane and provides structural support, shape, and protection. It also helps the plant withstand the pressure of water taken in by the central vacuole.

6. C — Distilled water is hypotonic relative to a red blood cell, so water moves into the cell by osmosis. Because red blood cells lack a cell wall, the influx of water causes them to swell and may rupture them in a process called hemolysis.

7. B — The endoplasmic reticulum is a network of membranes that synthesizes and transports proteins (rough ER, studded with ribosomes) and lipids (smooth ER) within the cell. Materials made on the ER are typically packaged into vesicles for delivery to the Golgi apparatus.

8. D — High temperatures disrupt the hydrogen bonds and other weak interactions that hold an enzyme's three-dimensional shape together, causing denaturation. Once the active site loses its proper shape, the enzyme can no longer bind substrate and the reaction stops.

9. A — Active transport moves substances against their concentration gradient, which requires the cell to expend energy from ATP, often through pumps such as the sodium-potassium pump. Passive transport, in contrast, moves substances down a gradient without any energy input.

10. C — Phagocytosis is the process by which white blood cells (and other phagocytes) engulf bacteria, debris, or foreign particles by wrapping their membrane around them and forming an internal vesicle. The engulfed material is then broken down by enzymes inside lysosomes.

11. B — The summary equation for aerobic respiration is $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + ATP$. Glucose is oxidized using oxygen, producing carbon dioxide, water, and the ATP that cells use as energy.

12. D — Photosynthesis is the process by which plants and other autotrophs use light energy to convert CO_2 and H_2O into glucose (chemical energy) and release O_2. This transformation of solar energy into chemical energy is the energetic foundation of nearly all ecosystems.

13. A — Nucleotides — each consisting of a sugar, phosphate group, and nitrogenous base — are the monomer units of nucleic acids such as DNA and RNA. Carbohydrates, lipids, and proteins are built from different monomers (sugars, fatty acids/glycerol, and amino acids).

14. C — During replication, the two parental DNA strands unwind and separate, and each acts as a template for the synthesis of a new complementary strand by DNA polymerase. This semiconservative mechanism produces two daughter molecules, each containing one original and one new strand.

15. B — Human gametes (egg and sperm) are haploid and contain 23 chromosomes — exactly half the diploid number of 46. Fertilization restores the diploid number by combining the chromosomes from each parent.

16. D — A gene is a specific segment of DNA that codes for a particular protein (or functional RNA) and therefore for a particular trait. Genes are organized into chromosomes within the cell nucleus.

17. A — A Tt × tt test cross produces offspring with the genotypes Tt and tt in equal proportion, meaning 50% are tall (Tt) and 50% are short (tt). The recessive parent allows the heterozygote's hidden allele to be revealed in the offspring.

18. C — Budding in hydra is asexual reproduction: a new individual grows directly from the parent and is genetically identical to it, with no fusion of gametes. Fertilization, cross-pollination, and zygote formation by mating are all forms of sexual reproduction.

19. D — Inherited traits are determined by genes carried on chromosomes; each gamete carries one set of chromosomes that combines at fertilization with the partner's set. Cell membranes, cytoplasm, and mitochondrial activity do not by themselves transmit nuclear inheritance.

20. B — Carrier parents show no symptoms but each carry one copy of the recessive allele, so they must be heterozygous. A heterozygous × heterozygous cross produces a 25% chance per child of being homozygous recessive (affected).

21. A — Genetic engineering of bacteria to produce a human protein involves splicing the human gene into a bacterial plasmid (a small circular DNA molecule) using restriction enzymes and DNA ligase. The bacteria then transcribe and translate the inserted gene, producing the human protein.

22. C — Somatic (body cell) mutations affect only the cells descended from the mutated cell within that individual, since they are not passed into the gametes. Only mutations occurring in egg or sperm cells can be inherited by offspring.

23. D — Resource partitioning occurs when species with overlapping needs reduce competition by using slightly different resources or being active at different times. Feeding at different times of day is a classic temporal partitioning example that allows two species to share the same habitat.

24. B — Natural selection acts on heritable variation: individuals whose traits best suit the current environment tend to survive and reproduce, passing those traits to their offspring. Over generations, advantageous traits become more common in the population.

25. A — DNA sequence comparison provides direct molecular evidence of common ancestry: closely related species share nearly identical sequences in homologous genes, while more distantly related species accumulate more differences. This is among the most powerful tools modern biology has for testing evolutionary relationships.

26. D — Vestigial structures are reduced, nonfunctional remnants of features that were fully functional in ancestral species. The presence of small pelvic bones in modern whales is strong evidence that whales descended from four-legged land-dwelling ancestors.

27. B — Carrying capacity (K) is the maximum population size that an environment can sustainably support given the available resources such as food, water, and space. Populations tend to fluctuate around K as density-dependent factors regulate growth.

28. C — Biotic factors are the living components of an ecosystem; abiotic factors are nonliving. The frog population is a group of living organisms, while temperature, sunlight, and pH are physical and chemical (abiotic) factors.

29. A — In commensalism, one species benefits while the other is essentially unaffected — neither helped nor harmed in any significant way. A classic example is barnacles attached to a whale, where the barnacles gain transport and food access while the whale is largely unaffected.

30. C — A community in ecology is defined as all the populations of different species living and interacting in a given area. A population is a group of one species; an ecosystem also includes abiotic factors; a biome is a much larger regional category.

31. B — The palisade mesophyll is the layer just below the upper epidermis where most photosynthesis occurs because it contains the highest concentration of chloroplasts in the leaf. Its tall, tightly packed cells maximize light capture from the leaf's upper surface.

32. D — The waxy cuticle is a hydrophobic layer that coats the upper epidermis and reduces water loss through evaporation. This adaptation is essential for terrestrial plants, helping them retain moisture in dry air.

33. A — A stoma is the small opening in the lower epidermis between two guard cells through which gases enter and exit the leaf. Carbon dioxide diffuses in for photosynthesis while oxygen and water vapor diffuse out.

34. C — Chloroplasts are concentrated in the palisade and spongy mesophyll cells where light can most easily reach them after passing through the transparent epidermis. This placement maximizes photosynthetic efficiency by exposing chloroplasts to light while keeping them protected.

35. A — When a population reaches carrying capacity (K), birth and death rates balance, producing the characteristic plateau of a logistic (S-shaped) curve. Resource limitations such as food and space prevent further growth beyond this point.

36. D — When the two species are grown together with limited resources, *P. aurelia* drives *P. caudatum* nearly to extinction. This outcome is best explained by competitive exclusion: *P. aurelia* uses the shared resources more efficiently and outcompetes *P. caudatum*.

37. B — The right-hand graph illustrates the competitive exclusion principle (Gause's principle): two species competing for the same limited resources in the same niche cannot coexist indefinitely — one will eventually outcompete and eliminate the other. This principle was first demonstrated experimentally with these very paramecium species.

38. C — At pH 7.0, the average plant height of 26.3 cm is the largest value in the table, indicating optimal growth conditions for bean plants. Both more acidic and more alkaline soils produced shorter plants, showing that pH 7.0 is closest to the optimum.

39. A — Using 10 plants per treatment provides a sample large enough that random differences between individual plants average out. Larger samples produce more reliable mean values and reduce the chance that an unusual single plant will skew the results.

40. D — The dependent variable is the outcome that is measured to detect any effect of the independent variable. Soil pH (the independent variable) was manipulated; plant height after 30 days is what was measured in response.

41. B — A tertiary consumer feeds on secondary consumers. The Great Blue Heron at the top of the web eats Minnow and Frog (both secondary consumers), placing it at the third consumer level.

42. C — Producers carry out photosynthesis and form the base of the food web. The Algae and Aquatic Plants are the only photosynthetic organisms shown; all other organisms in the web are consumers.

43. A — Zooplankton and mayfly nymphs feed directly on algae, so a sudden loss of algae would immediately remove their primary food source. Heron, frog, and other higher consumers would be affected only after these primary consumers declined.

44. D — A proper control group is treated identically to the experimental groups except for the variable being tested. Daphnia in plain pond water (no caffeine) provide the baseline against which caffeine-exposed Daphnia can be compared.

45. C — Mutations introduce new heritable variation into a population, and that variation is the raw material on which natural selection acts. Whether a particular mutation is helpful, harmful, or neutral depends on the environment.

46. A — Villi (and their microvilli) are finger-like projections lining the inner surface of the small intestine that vastly increase the surface area available for nutrient absorption. This expanded surface allows efficient uptake of digested sugars, amino acids, and other nutrients into the blood.

47. B — Connective tissue is characterized by cells suspended in an extracellular matrix. In blood, that matrix is the liquid plasma, in which red blood cells, white blood cells, and platelets are suspended.

48. D — The kidneys filter the blood, removing metabolic wastes such as urea and excess water and salts, and produce urine. This filtration role is central to maintaining homeostasis of body fluid composition.

49. A — Rising CO_2 levels during exercise are detected by chemoreceptors that signal the medulla oblongata in the brainstem to increase breathing rate and depth. This negative-feedback response restores blood gas levels to homeostatic limits.

50. C — Memory B and T cells are generated during the first exposure to an antigen and persist in the body long-term. Upon re-exposure to the same antigen, they trigger a faster, stronger immune response, often preventing illness entirely.

51. B — Vaccines expose the immune system to weakened, inactivated, or fragmented antigens that cannot cause disease but still trigger production of antibodies and memory cells. This primes the immune system to mount a rapid response if the real pathogen is encountered later.

52. D — Type 1 diabetes is caused by autoimmune destruction of insulin-producing beta cells in the pancreas, leaving the body unable to make adequate insulin. Without insulin, body cells cannot take up glucose efficiently and blood glucose rises.

53. B — Insulin binds to receptors on body cells (especially muscle, liver, and adipose) and signals them to take up glucose from the blood and to store excess glucose as glycogen. The net effect is to lower blood glucose levels back toward homeostatic limits.

54. A — Sweat is mostly water with dissolved salts; as it evaporates from the skin, it carries heat away with it, cooling the body. This evaporative cooling is the body's main mechanism for releasing excess heat during exertion or in hot environments.

55. C — The central nervous system, composed of the brain and spinal cord, integrates sensory information and coordinates motor responses throughout the body. The peripheral nervous system carries signals to and from the CNS but does not perform the central processing.

56. B — A thick layer of insulating fur reduces heat loss to the environment by trapping a layer of warm air against the skin. This structural adaptation is common in mammals living in cold climates, such as polar bears and arctic foxes.

57. D — Camouflage allows prey to blend into their surroundings, making them harder for predators to detect. Better-camouflaged individuals are more likely to survive and reproduce, so this adaptation increases survival and is favored by natural selection.

58. A — The umbilical cord contains arteries and a vein that connect the fetus to the placenta, where exchange of oxygen, nutrients, and wastes occurs between fetal and maternal blood. The fetus does not breathe air, eat solid food, or initiate labor through the cord.

59. C — A carrier female (X^A X^a) crossed with an unaffected male (X^A Y) produces sons who receive their X from the mother. Half her X chromosomes carry the recessive allele, so 50% of sons would be affected.

60. D — In human fertilization, a single sperm cell fuses with a single egg cell to produce a diploid zygote containing 46 chromosomes — 23 from each parent. Only one sperm successfully fertilizes the egg, after which the egg blocks further sperm entry.

61. A — Biological diversity refers to the variety of species (and the variety of genes and ecosystems) in an area. A forest with many species of trees, birds, and insects exemplifies high biodiversity, in contrast to a monoculture or barren area.

62. B — Greater biodiversity provides functional redundancy and a wider range of responses to disturbance, so the loss of biodiversity reduces an ecosystem's resilience and slows recovery after disruption. Diverse ecosystems are typically more stable and more able to bounce back from change.

63. D — Burning fossil fuels (coal, oil, natural gas) releases large quantities of CO_2 into the atmosphere, raising greenhouse gas concentrations and driving climate change. Tree planting, solar panels, and LED lighting all reduce — not increase — atmospheric CO_2.

64. C — The stratospheric ozone layer absorbs much of the Sun's ultraviolet (UV) radiation. As ozone is depleted, more UV reaches Earth's surface, increasing risks of skin cancer, cataracts, and damage to ecosystems.

65. A — During photosynthesis, trees absorb CO_2 from the atmosphere and incorporate the carbon into plant tissues. Reforestation therefore removes a major greenhouse gas from the atmosphere, helping to mitigate climate change.

66. B — Secondary succession occurs when an already-vegetated area undergoes change after disturbance, with soil and some organisms remaining. A bog gradually drying and being colonized by grasses, shrubs, and trees over centuries is a classic example of secondary succession.

67. D — When species occupy slightly different niches — using different food sources, foraging at different times, or exploiting different habitat layers — competition is reduced and coexistence is possible. This niche differentiation is a key reason ecosystems can support many similar species.

68. C — A few insects in the original population already carried mutations that made them resistant to the pesticide. When the pesticide was applied, susceptible insects died while resistant individuals survived and reproduced, increasing the frequency of the resistance allele — a textbook example of natural selection.

69. C — In ecosystems, matter (such as carbon, nitrogen, and water) is recycled through biogeochemical cycles, while energy flows in one direction — entering primarily as sunlight and exiting as heat. Energy is therefore not recycled; new energy must continually enter the system.

70. A — Decomposer bacteria and fungi break down dead organisms and waste into simpler molecules, releasing nitrogen as ammonium (NH_4^+) into the soil. Other soil bacteria then convert it to nitrates (NO_3^-), which plants can absorb and use to build amino acids and nucleic acids.

71. D — Wind is generated by uneven solar heating of the atmosphere and surface; because solar input is effectively inexhaustible on human timescales, wind energy is classified as renewable. Coal, oil, and natural gas are all finite fossil resources that take millions of years to form.

72. B — Crop rotation and cover cropping maintain soil fertility, reduce pest buildup, and limit erosion, all of which protect long-term ecosystem health. Monoculture, land clearing, and removing pollinators all degrade ecosystems rather than sustain them.

73. C — Iodine molecules are small enough to diffuse through the pores of the dialysis tubing into the tubing's interior, where they encounter starch and produce the characteristic blue-black color. Starch is too large to cross the membrane, which is why the color change occurs only inside the tubing.

74. A — In this simulation, "finches" that gathered the fewest seeds represent individuals that obtained less food, suffered greater starvation, and produced fewer offspring. Removing them models reduced reproductive success — the selective pressure that drives natural selection.

75. D — Proper microscope technique requires beginning with the low-power objective and using the coarse adjustment knob to bring the specimen into rough focus. The fine adjustment knob is then used to sharpen the image, especially after switching to higher-power objectives.

76. B — Total magnification of a compound microscope is the product of the ocular and objective lens magnifications: 10× ocular × 40× objective = 400× total. This calculation is a standard piece of lab math expected on the Regents exam.

77. A — Averaging pulse rate data across many students smooths out random individual variation and produces a more reliable estimate of how exercise affects heart rate. Larger sample sizes give more statistical confidence and reduce the influence of outliers.

78. C — Different pigments travel different distances on chromatography paper because they differ in solubility in the solvent and in how strongly they adhere to the paper. Observing four distinct bands therefore indicates that the spinach leaf contains four different pigments with different chemical properties.

79. D — The water displacement method gives the volume of an irregularly shaped object directly: the volume of water displaced equals the volume of the submerged object. This is based on Archimedes' principle and is far more accurate than estimating from outside dimensions.

80. B — Honest, complete reporting requires including all measured values with their proper units throughout the lab notebook. Rounding, omitting conflicting data, or discarding individual measurements would compromise the integrity of the scientific record.

81. A — The plants grown in darkness experience no light at all, providing the baseline against which the effects of red, blue, and green light can be measured. A control group lacks the variable being tested, so the no-light group is the proper control here.

82. D — Standard procedure with a triple-beam balance is to zero the balance before placing any object on the pan, by moving all riders to zero and confirming that the pointer rests at the zero mark. The object is then placed on the pan and the mass is measured.

83. C — Pigment bands at the same position on a chromatogram have the same Rf value, indicating they share similar solubility and chemical properties. This suggests the two plants contain at least one pigment with similar structure, providing evidence of relatedness.

84. B — A dichotomous key consists of a series of paired, contrasting statements; at each step the user selects the statement that better matches the specimen, eventually arriving at an identification. This branching, paired structure is what makes the key "dichotomous."

85. A — Performing several trials and averaging the times reduces the influence of random error from individual measurements, such as small differences in reaction time when starting and stopping the stopwatch. Multiple trials produce a more reliable estimate of the true crawling time than any single measurement.