PRACTICE EXAM 19: LIVING ENVIRONMENT REGENTS SIMULATION

Answer all questions in this part.

1. Which of the following is the smallest unit of life capable of carrying out all life processes on its own?

A. a single molecule of protein

B. a single chromosome inside a nucleus

C. a single cell of any organism

D. a single tissue of an organism

2. The discovery that all cells come from pre-existing cells contributed most directly to the development of:

A. the cell theory

B. the laws of motion

C. the theory of plate tectonics

D. the law of conservation of energy

3. A student observes a one-celled organism that moves using a long, whip-like flagellum and obtains food by ingesting smaller organisms. The single-celled organism is best described as:

A. an autotroph that performs photosynthesis only

B. a multicellular plant in its earliest growth stage

C. a multicellular animal in its embryonic stage

D. a heterotrophic protist that obtains food from its surroundings

4. Which of the following statements best describes the relationship between DNA, genes, and chromosomes?

A. chromosomes are made of glucose units that contain DNA fragments

B. a gene is a segment of DNA, and many genes together form a chromosome

C. DNA is a small subunit found only within the gene of a ribosome

D. chromosomes are tiny proteins found only within the cell membrane

5. Which of the following is the primary reason that the cell membrane is described as selectively permeable?

A. it allows every substance to cross at the same rate

B. it blocks all materials from entering or exiting the cell

C. it allows some substances to pass through while restricting others

D. it allows only sodium ions to pass through and nothing else

6. The organelle that packages and modifies proteins for secretion outside the cell is the:

A. Golgi apparatus

B. mitochondrion

C. lysosome

D. nucleolus

7. Which of the following processes does NOT require an input of energy from ATP?

A. the active transport of sodium ions out of a nerve cell

B. the contraction of muscle fibers during exercise

C. the assembly of amino acids into a protein on a ribosome

D. the diffusion of oxygen across the alveolar membrane

8. A scientist observes that an enzyme works best at a pH of 8.0. At a pH of 2.0, the same enzyme is completely inactive. The best explanation for this loss of activity is that:

A. the enzyme has been used up as a reactant in the reaction

B. the enzyme has been denatured by the strongly acidic conditions

C. the substrate molecules have changed into a different enzyme

D. the temperature of the solution has increased significantly

9. Which of the following sequences correctly traces the path of energy through most ecosystems?

A. Sun → producers → primary consumers → secondary consumers

B. producers → Sun → decomposers → consumers

C. consumers → producers → Sun → decomposers

D. decomposers → consumers → producers → Sun

10. Which of the following structures is responsible for protein synthesis in both prokaryotic and eukaryotic cells?

A. nucleus

B. mitochondrion

C. ribosome

D. chloroplast

11. The process by which water moves across a selectively permeable membrane from an area of higher water concentration to an area of lower water concentration is called:

A. active transport

B. exocytosis

C. phagocytosis

D. osmosis

12. Which of the following human body systems is primarily responsible for transporting oxygen, nutrients, and wastes throughout the body?

A. the digestive system

B. the circulatory system

C. the muscular system

D. the skeletal system

13. During aerobic respiration, the chemical energy in glucose is released and used to produce:

A. CO_2 only, with no other products

B. starch and cellulose for storage in cells

C. ATP, along with water and carbon dioxide

D. oxygen molecules to be exhaled by the lungs

14. Plants store the chemical energy produced during photosynthesis primarily in molecules of:

A. glucose, which can be polymerized into starch

B. ATP, which is exported to the atmosphere

C. water, which is then released through transpiration

D. carbon dioxide, which is stored in the leaves

15. A scientist examines the chromosome number of a normal human skin cell and a normal human sperm cell. Which of the following correctly compares the two?

A. both cells contain 23 chromosomes

B. both cells contain 46 chromosomes

C. the skin cell contains 23 and the sperm cell contains 46

D. the skin cell contains 46 and the sperm cell contains 23

16. Which of the following best explains why meiosis is essential for sexual reproduction?

A. it doubles the chromosome number of the parent cell

B. it produces gametes with half the chromosome number of the parent

C. it produces genetically identical cells for asexual reproduction

D. it eliminates all genetic variation from the offspring

17. The phenotypic ratio observed in the offspring of a Bb × Bb cross is most likely to be:

A. 1:1 dominant to recessive

B. 1:2:1 dominant to intermediate to recessive

C. 3:1 dominant to recessive

D. 9:3:3:1 across four classes

18. A genetic disorder is caused by a single base change in a gene that codes for a protein. This is best described as a:

A. point mutation

B. polyploidy event

C. chromosomal deletion

D. genetic translocation

19. Which of the following best describes the role of mRNA in the synthesis of proteins?

A. it directly assembles amino acids into peptide bonds

B. it stores the entire genetic code of the organism

C. it carries the genetic code from the nucleus to the ribosome

D. it provides the energy needed for translation to occur

20. Two organisms of different species that share many similar physical features most likely:

A. live on opposite sides of the world

B. share a relatively recent common ancestor

C. evolved completely independently of each other

D. are now genetically identical to one another

21. A population of bacteria is exposed repeatedly to a particular antibiotic. Over many generations, the population becomes increasingly resistant to that antibiotic. This change is best explained by:

A. each bacterium intentionally changing its DNA to resist the antibiotic

B. the antibiotic adding new resistance genes into every bacterium

C. random environmental shifts that altered the antibiotic's effect

D. natural selection acting on existing genetic variation in the population

22. Which of the following is the best example of an inherited behavioral trait?

A. the migration pattern of a particular species of bird

B. an individual learning to ride a bicycle as a child

C. a person memorizing a list of vocabulary words

D. an athlete improving by practicing daily

23. Which of the following provides evidence that whales evolved from land-dwelling ancestors?

A. whales live entirely in salt water as adults

B. whales swim using powerful tail fins called flukes

C. whales have small, internal pelvic and limb bones

D. whales communicate using complex sound patterns

24. A species of moth has both light-colored and dark-colored individuals. In a forest where tree trunks are darkened by soot, the dark-colored moths survive better than the light-colored ones. This is an example of:

A. genetic drift in a small population

B. natural selection favoring a particular trait

C. mutation rate increasing in a single generation

D. immigration of new individuals into the area

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

A. a powerful hurricane striking a coastal forest

B. a sudden flood washing through a riverside meadow

C. an unusually cold winter freezing most of a lake

D. competition between members of a population for limited food

26. Which of the following statements about a stable ecosystem is most accurate?

A. it contains a balance between producers, consumers, and decomposers

B. it contains only producers and consumers but no decomposers

C. it contains only one species of organism repeated many times

D. it has no recycling of matter between living and nonliving components

27. Mycorrhizal fungi grow on plant roots and help the plant absorb water and minerals while receiving sugars from the plant. This relationship best illustrates:

A. parasitism, in which the fungi harm the plant

B. predation, in which the fungi consume the plant

C. mutualism, in which both organisms benefit

D. competition, in which both compete for sunlight

28. A scientist studying an ecosystem identifies one organism's habitat, food source, daily activity patterns, and interactions with other species. Together, these features describe the organism's:

A. trophic level only

B. genetic makeup only

C. carrying capacity

D. ecological niche

29. Which of the following human activities is most likely to disrupt the carbon cycle by adding additional carbon to the atmosphere?

A. planting forests across previously cleared land

B. burning large quantities of coal and gasoline

C. installing wind turbines on coastal regions

D. recycling household paper and cardboard

30. Acid precipitation is most often caused by air pollutants that contain:

A. sulfur and nitrogen oxides released from burning fossil fuels

B. oxygen and water vapor released by green plants

C. methane gas released from agricultural livestock

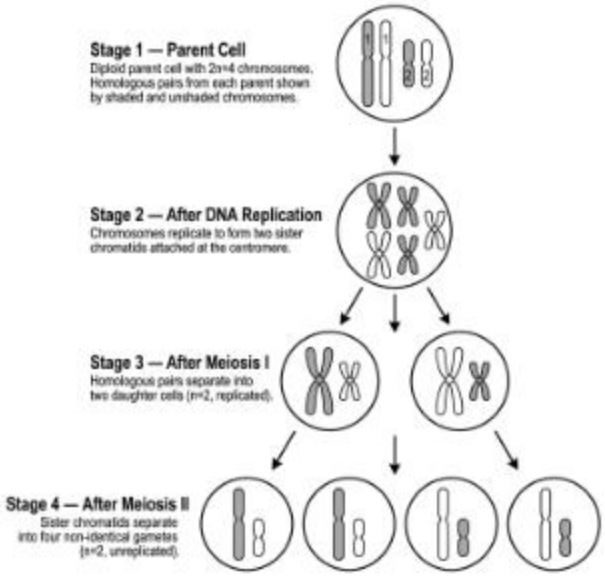
D. helium gas released by industrial processes

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 process of meiosis in a hypothetical organism that has a diploid chromosome number of 4 (2n = 4).

[Figure PQ-1: Diagram of meiosis in an organism with 2n = 4]



31. How many chromosomes are present in each cell at the end of Stage 4?

A. 1 chromosome

B. 4 chromosomes

C. 2 chromosomes

D. 8 chromosomes

32. The cells produced at the end of Stage 4 are best described as:

A. haploid gametes containing half the chromosome number of the parent cell

B. diploid body cells identical to the original parent cell

C. polyploid cells containing extra copies of every chromosome

D. prokaryotic cells lacking any membrane-bound organelles

33. Between Stage 1 and Stage 2, each chromosome has doubled into two attached sister chromatids. This change is the result of:

A. mitosis of the parent cell

B. translation of mRNA codons

C. fertilization by a sperm cell

D. DNA replication during interphase

34. Which step in the diagram most directly contributes to genetic variation in the gametes produced by meiosis?

A. the doubling of each chromosome before Stage 2

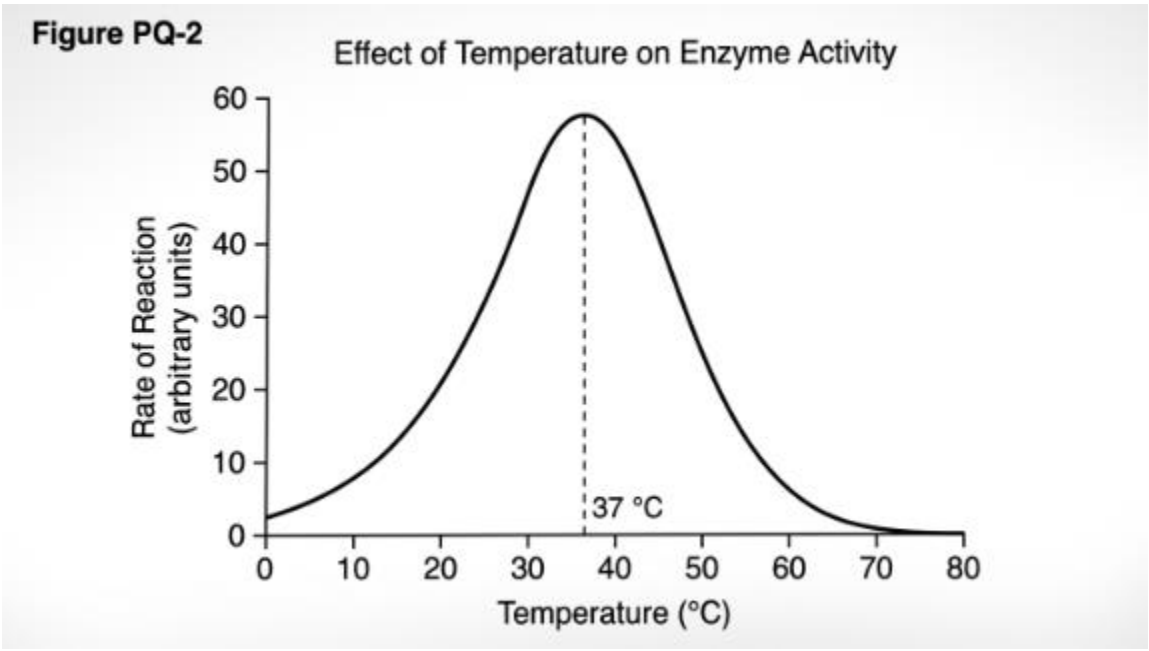
B. the separation of homologous pairs during Stage 3

C. the formation of a single cell at Stage 1

D. the absence of any chromosome movement at all

Base your answers to questions 35 through 37 on the graph below and on your knowledge of biology. The graph shows the rate of an enzyme-catalyzed reaction at different temperatures, with all other conditions held constant.

Figure PQ-2



35. At which temperature does this enzyme work at its highest rate?

A. 20 °C

B. 37 °C

C. 50 °C

D. 70 °C

36. The sharp decrease in reaction rate at temperatures above 50 °C is best explained by:

A. denaturation of the enzyme's three-dimensional shape at high temperatures

B. an increase in the number of enzyme molecules in the solution

C. a sudden drop in the available substrate for the reaction

D. the substrate becoming a stronger reactant at high temperatures

37. Which of the following best supports the conclusion that this enzyme came from an organism that lives in a warm-blooded mammal?

A. the enzyme works best at 0 °C, the freezing point of water

B. the enzyme works best at 100 °C, the boiling point of water

C. the enzyme works best at temperatures around 20 °C

D. the enzyme works best at approximately human body temperature of 37 °C

Base your answers to questions 38 through 40 on the data table below and on your knowledge of biology. The table shows the average growth of two crop plants when grown in soil treated with three different concentrations of an experimental fertilizer.

Figure PQ-3: Data table titled 'Average Plant Growth (cm) After 6 Weeks at Different Fertilizer Concentrations.'

Fertilizer Concentration (%)	Crop A Average Growth (cm)	Crop B Average Growth (cm)
0.0%	5.4 cm	5.1 cm
0.5%	12.6 cm	9.8 cm
1.0%	22.4 cm	14.7 cm
1.5%	28.7 cm	16.2 cm
2.0%	24.5 cm	14.1 cm
2.5%	16.3 cm	9.4 cm
3.0%	8.1 cm	5.6 cm

38. Based on the data, the fertilizer concentration that produces the greatest growth for Crop A is:

A. 0.0%

B. 1.0%

C. 1.5%

D. 3.0%

39. The decline in growth at fertilizer concentrations above 1.5% most likely indicates that:

A. higher concentrations of fertilizer have no effect on plant growth

B. excessive fertilizer can become harmful to plants at high concentrations

C. the plants have become genetically resistant to the fertilizer

D. the plants no longer require water or sunlight at higher concentrations

40. Which of the following is the most reasonable conclusion that can be drawn from the table?

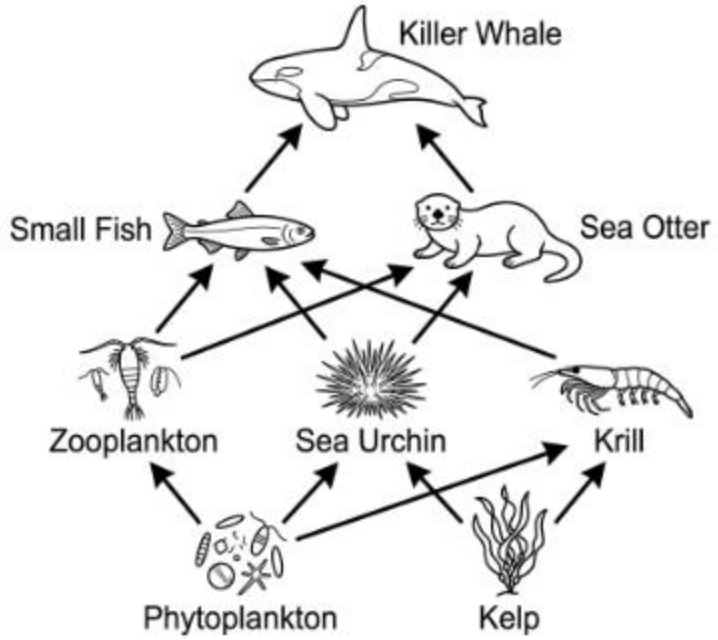
A. Crop A responds more strongly to fertilizer than Crop B across all tested concentrations

B. fertilizer has no effect on either crop at any tested concentration

C. Crop B grows taller than Crop A at every tested concentration

D. neither crop is able to grow without added fertilizer

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



41. Which organism in this food web obtains its energy directly from the kelp?

A. Killer Whale

B. Small Fish

C. Zooplankton

D. Sea Urchin

42. A sudden disease outbreak that drastically reduces the sea otter population would most likely cause the sea urchin population to:

A. increase due to reduced predation

B. decrease due to lack of food

C. remain unchanged because urchins don't interact with otters

D. become extinct within only a few weeks

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

A. zooplankton and krill

B. small fish and sea otter

C. phytoplankton and kelp

D. killer whale and sea urchin

PART B-2

Answer all questions in this part.

44. A student designs an experiment to test the effect of soil moisture on radish seed germination. To make the experiment a controlled investigation, the student must:

A. change the amount of light, temperature, and water all at once

B. change only the soil moisture and keep all other conditions constant

C. use a different type of seed in each test group

D. use only one radish seed for the entire experiment

45. Which of the following is the best example of a measurable observation?

A. the green plant looks really pretty today in the garden

B. the experiment was probably a great success this time

C. that animal seems very happy in its outdoor habitat

D. the plant grew 4.2 cm in seven days under bright light

46. Which of the following best describes the purpose of a peer review process in science?

A. to allow other scientists to check methods, data, and conclusions before publication

B. to ensure that only the original author can ever repeat the experiment

C. to guarantee that every published study reaches the same conclusion

D. to keep all experimental data permanently hidden from other researchers

47. The function of the human respiratory system is best described as:

A. breaking down food molecules into usable nutrients

B. circulating blood throughout the entire body

C. exchanging oxygen and carbon dioxide between the body and the environment

D. filtering metabolic wastes from the blood

48. Which of the following best describes the path of blood through the human heart?

A. left atrium → right atrium → left ventricle → right ventricle

B. right atrium → right ventricle → lungs → left atrium → left ventricle

C. right ventricle → right atrium → left ventricle → left atrium

D. left ventricle → left atrium → right ventricle → right atrium

49. A person infected with a bacterial pathogen may develop a fever. The fever is most directly part of the body's:

A. digestive response to the infection

B. circulatory response to high oxygen demand

C. reproductive response to environmental stress

D. nonspecific immune response that creates an unfavorable environment for the pathogen

50. Which of the following best describes the role of the central nervous system in a reflex action?

A. the spinal cord processes the signal and triggers a rapid motor response

B. the central nervous system plays no role in any reflex action

C. every reflex requires conscious decisions made in the cerebral cortex

D. the central nervous system can slow but never speed up a reflex

51. A person's pancreas releases insulin when blood glucose rises after a meal. The pancreas is best classified as part of the:

A. respiratory system

B. excretory system

C. endocrine system

D. skeletal system

52. Which of the following hormones is most directly involved in the regulation of blood glucose levels?

A. insulin from the pancreas

B. melatonin from the pineal gland

C. thyroxine from the thyroid gland

D. testosterone from the testes

53. The kidneys are essential for homeostasis primarily because they:

A. produce ATP for muscle contraction

B. synthesize digestive enzymes for the small intestine

C. filter wastes from blood and regulate water balance

D. release insulin in response to high blood glucose

54. Which of the following structures is most directly responsible for the absorption of nutrients in the human digestive system?

A. the stomach lining

B. the esophagus

C. the large intestine

D. the small intestine, especially the villi

55. Which of the following is the best example of a chemical change that occurs during human digestion?

A. food being chewed into smaller pieces by teeth

B. starches being broken down into glucose by amylase

C. food being pushed along the esophagus by peristalsis

D. water being absorbed from undigested matter in the large intestine

PART C

Answer all questions in this part.

56. During human fetal development, the placenta serves as the site where:

A. oxygen, nutrients, and wastes are exchanged between mother and fetus

B. all of the embryo's organs are built from maternal cells

C. fetal blood mixes directly and completely with maternal blood

D. the fetus eats solid food broken down by maternal enzymes

57. Which of the following best describes the role of the corpus luteum after ovulation?

A. it dissolves the egg before it can be fertilized

B. it prevents implantation in the uterine wall

C. it permanently halts the menstrual cycle

D. it produces hormones that prepare the uterus for possible pregnancy

58. A pedigree showing that a particular trait skips generations and appears more often in males is most consistent with:

A. an autosomal dominant pattern of inheritance

B. a mitochondrial pattern of inheritance

C. an X-linked recessive pattern of inheritance

D. a Y-linked codominant pattern

59. Which of the following best explains why identical twins are genetically alike?

A. they develop from a single zygote that splits early in development

B. they develop from two separate eggs fertilized by two separate sperm

C. they develop from one egg fertilized by two different sperm cells

D. their identical genes appear by random chance after birth

60. Which of the following best describes the process of speciation through reproductive isolation?

A. two populations of one species begin to interbreed more often

B. two populations of one species become unable to interbreed over time

C. one species rapidly fuses with another over a single generation

D. mutations stop occurring entirely in a small population

61. A volcanic eruption covers a region with fresh lava. Within decades, lichens, mosses, and small plants begin to colonize the cooled lava. This is an example of:

A. secondary succession on a disturbed forest floor

B. an immediate stable climax community

C. competitive exclusion between two species

D. primary succession on newly formed substrate

62. Which of the following is most likely to be a result of habitat fragmentation?

A. decreased gene flow between separated subpopulations

B. an immediate increase in biodiversity across the entire area

C. an unlimited supply of food for all remaining species

D. the elimination of all density-independent population factors

63. A keystone species is best described as a species that:

A. is the largest predator at the top of every food chain

B. lives entirely outside the food web of an ecosystem

C. has a disproportionately large effect on its ecosystem relative to its abundance

D. is always the most numerous species in its community

64. Which of the following human practices most directly increases the risk of soil erosion?

A. planting cover crops between growing seasons

B. clearing large forested areas for short-term agricultural use

C. terracing steep hillsides to slow water flow

D. rotating different crops to maintain soil structure

65. Which of the following is a major benefit of preserving large undisturbed tracts of land such as national parks?

A. providing space for unrestricted construction of homes

B. allowing the introduction of many non-native species

C. providing fertile new ground for agricultural monocultures

D. preserving habitat that supports natural biodiversity

66. Which of the following best describes how invasive species often disrupt native ecosystems?

A. they always become extinct shortly after arrival

B. they immediately form mutualisms with all native species

C. they may outcompete native species and reduce biodiversity

D. they only affect ecosystems in tropical climates

67. Which of the following is an example of bioremediation?

A. using bacteria to break down petroleum after an oil spill

B. transporting toxic waste to a sealed landfill far from cities

C. burning hazardous chemicals at very high temperatures

D. burying radioactive material under thick concrete walls

68. Which of the following is a direct biological consequence of the use of pesticides in agriculture?

A. an immediate elimination of all pest species worldwide

B. selection for pesticide-resistant individuals in target populations

C. an automatic increase in soil pH on treated fields

D. the production of more renewable energy on the farm

69. Coral reefs are extremely vulnerable to climate change because:

A. coral animals require temperatures higher than 50 °C to survive

B. coral animals can move easily to cooler waters when stressed

C. coral animals receive all of their energy by ingesting plankton in the dark

D. coral animals depend on symbiotic algae that are sensitive to small temperature increases

70. Reforestation projects can help slow climate change because trees:

A. release additional carbon dioxide into the atmosphere as they grow

B. absorb atmospheric carbon dioxide and store carbon in their tissues

C. release methane that quickly warms the troposphere

D. consume large amounts of oxygen but no carbon dioxide

71. Which of the following is an example of a renewable resource that produces no direct greenhouse gas emissions during use?

A. burning coal to produce electricity

B. extracting natural gas from underground deposits

C. generating electricity from sunlight using solar panels

D. refining petroleum to power vehicles

72. Which of the following best describes the role of decomposers in nutrient cycles?

A. they break down dead organisms and release nutrients back into the environment

B. they produce all of the new nitrogen and carbon used by living organisms

C. they consume only living plants and never any dead material

D. they store nutrients permanently inside their own bodies

PART D

Answer all questions in this part.

73. A student is performing the "Diffusion Through a Membrane" lab. After 20 minutes, the liquid surrounding the dialysis tubing has turned red-orange when tested with Benedict's solution and gently heated. This result indicates that:

A. starch has diffused out of the dialysis tubing into the surrounding water

B. iodine has destroyed the glucose inside the dialysis tubing

C. proteins have diffused through the tubing into the surrounding water

D. glucose has diffused out of the tubing into the surrounding water

74. In the "Beaks of Finches" lab, students use various household tools (such as tweezers, spoons, and pliers) to pick up seeds during timed feeding rounds. Across multiple rounds, students notice that the most successful "beaks" change as the type of food available changes. This result best illustrates that:

A. natural selection acts the same way on all beak shapes regardless of food type

B. environmental conditions help determine which traits are favored over time

C. genetic mutation alone determines which finches survive each generation

D. all tools become equally successful as long as students try harder

75. When using a compound light microscope, the diaphragm is used to control the:

A. magnification of the objective lens

B. distance between the slide and the objective lens

C. amount of light passing through the specimen

D. number of cells visible in the field of view

76. A microscope has an ocular lens of 10× and three objective lenses of 4×, 10×, and 40×. Under the low-power objective (4×), the total magnification of the specimen is:

A. 40×

B. 400×

C. 14×

D. 10×

77. In the "Making Connections" lab, students measure their pulse rates before and after physical activity. Which of the following best explains why pulse rate increases during exercise?

A. the heart slows down to conserve oxygen during exercise

B. cells need less oxygen during heavy physical exertion

C. the body's nervous system stops responding to muscle activity

D. working muscles require more oxygen and produce more carbon dioxide

78. A student preparing a wet-mount slide places a few drops of water on a slide, adds the specimen, and lowers a coverslip at an angle. Adding the coverslip at an angle is the best technique because it:

A. prevents the specimen from being lit during observation

B. allows the student to skip the focusing step entirely

C. helps avoid trapping air bubbles under the coverslip

D. permanently glues the coverslip to the slide for storage

79. In the "Relationships and Biodiversity" lab, students compare Botana curus to four related species using a combination of physical, biochemical, and DNA tests. Using multiple types of evidence is important because:

A. each test produces opposite results, so they must be averaged together

B. multiple lines of evidence provide a stronger conclusion than any single test

C. only DNA evidence is acceptable in modern biological research today

D. physical traits alone always provide all the evidence a scientist needs

80. A student is using a graduated cylinder to measure 25.0 mL of water for a lab. To obtain the most accurate measurement, the student should:

A. read the volume from above the cylinder while standing up

B. read the volume from below the cylinder while looking up

C. estimate the volume without bringing the eye to the cylinder

D. read the bottom of the meniscus while keeping the eye at the same level as the liquid

81. When dissecting biological specimens in lab, the most important safety precaution is to:

A. wear safety goggles and gloves and handle sharp instruments with care

B. work quickly to finish before any other group in the classroom

C. share sharp instruments with other groups to save time

D. eat snacks at the lab bench while working on the dissection

82. A student measures the same length of a leaf five times and records values of 6.2 cm, 6.1 cm, 6.3 cm, 6.2 cm, and 6.2 cm. The best way to report a single value for the leaf's length is to use:

A. only the highest value, since it is the most generous estimate

B. only the lowest value, since it is the most conservative estimate

C. the average (mean) of all five values

D. only the first value, since it was measured first

83. A scatter plot is the best type of graph to use when a scientist wants to:

A. compare the average heights of four different plant species

B. show the relationship between two continuous numerical variables, such as temperature and growth rate

C. display the percentage of students who prefer different lunch foods

D. show changes in a single value over very short, equal time intervals

84. During a laboratory investigation, a student notices that one of the recorded data points is far higher than all of the others and is most likely the result of a measurement error. The best practice is to:

A. delete the data point from the data set without making any notation

B. change the data point to match the average of the other measurements

C. ignore the data point entirely and never mention it again in the report

D. record the data point and clearly note the suspected error in the lab notebook

85. A student is asked to identify an unknown invertebrate in the laboratory. The most useful tool for systematically identifying the organism is:

A. a calibrated electronic balance on the lab bench

B. a stopwatch set to count the seconds during observation

C. a dichotomous key that uses paired contrasting statements

D. a clear plastic ruler with millimeter markings

EXPLAINED ANSWER KEY – PRACTICE EXAM 19

1. C — The cell is the smallest unit of life capable of carrying out all life processes — metabolism, growth, response, and reproduction — on its own. Molecules and chromosomes are components of cells, while tissues are organized groups of cells; none can perform all of life's functions independently.

2. A — The cell theory has three core principles: all living things are made of cells, cells are the basic unit of life, and all cells come from pre-existing cells. The third principle, established by Virchow in the 1850s, replaced the older idea of spontaneous generation.

3. D — A single-celled organism that moves with a flagellum and ingests other organisms is a heterotrophic protist (such as Euglena's predatory relatives or a flagellated protozoan). It cannot be a multicellular plant or animal embryo because it is unicellular, and a pure photosynthesizer would not actively ingest food.

4. B — A gene is a specific segment of DNA that codes for a particular trait, and many genes are linked together along a single DNA molecule to form a chromosome. This hierarchical relationship — nucleotide → gene → DNA molecule → chromosome — is foundational to molecular genetics.

5. C — A selectively permeable membrane allows certain substances to cross while restricting others based on size, charge, or solubility. This selectivity allows the cell to control its internal environment and is essential for homeostasis.

6. A — The Golgi apparatus receives proteins from the rough ER, modifies them (often by adding carbohydrate or lipid groups), and packages them into vesicles for delivery to their destinations, including secretion outside the cell. It functions much like a cellular post office.

7. D — Diffusion is a passive process driven by random molecular motion down a concentration gradient and does not require ATP. Active transport, muscle contraction, and protein synthesis all consume ATP to do cellular work.

8. B — Each enzyme has an optimal pH range; extreme deviations disrupt the hydrogen bonds and ionic interactions that maintain its three-dimensional shape. At pH 2.0, an enzyme optimized for pH 8.0 becomes denatured, its active site no longer fits the substrate, and catalytic activity stops.

9. A — Energy enters most ecosystems as sunlight captured by producers in photosynthesis, then flows through primary consumers (herbivores), secondary consumers (carnivores), and onward. About 90% of the energy is lost as heat at each transfer, so energy flow is one-directional rather than cyclical.

10. C — Ribosomes are the protein-building machinery found in every living cell, including prokaryotes (which lack a nucleus and most organelles). They read mRNA codons and link amino acids together into polypeptide chains, regardless of cell type.

11. D — Osmosis is the diffusion of water across a selectively permeable membrane from a region of higher water concentration (lower solute) to lower water concentration (higher solute). It is a passive process that requires no energy input from the cell.

12. B — The circulatory system transports oxygen, nutrients, hormones, and metabolic wastes throughout the body via the blood. Its central pump is the heart, and its network of arteries, veins, and capillaries reaches every tissue.

13. C — Aerobic respiration uses oxygen to fully break down glucose into carbon dioxide and water, capturing much of the released energy in ATP. The complete equation is $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + ATP$.

14. A — Photosynthesis produces glucose, which plants can use immediately for respiration or link together into long chains of starch for longer-term storage. ATP is used as immediate energy within cells, not as a storage molecule.

15. D — Human body (somatic) cells, such as skin cells, are diploid and contain 46 chromosomes, while gametes such as sperm and egg cells are haploid and contain 23. Fertilization restores the diploid number by combining a haploid sperm with a haploid egg.

16. B — Meiosis is a reduction division that halves the chromosome number, producing haploid gametes from diploid parent cells. Without this reduction, fertilization would double the chromosome number each generation, which would be unsustainable.

17. C — A Bb × Bb cross produces a 1 BB : 2 Bb : 1 bb genotype ratio, which corresponds to a 3:1 phenotypic ratio of dominant to recessive. This 3:1 ratio is one of the most reproducible patterns in genetics and was first described by Mendel.

18. A — A point mutation is a change involving a single base in the DNA sequence, such as a substitution, insertion, or deletion of one nucleotide. Sickle-cell anemia is a famous example, in which a single base change alters one amino acid in hemoglobin.

19. C — Messenger RNA (mRNA) is transcribed from a DNA template in the nucleus and then travels to the ribosome in the cytoplasm, where it serves as the template for translation. This carrier role allows the DNA to remain protected in the nucleus.

20. B — Strong physical similarity between species is most often the result of shared inheritance from a relatively recent common ancestor. Convergent evolution can produce similar features in unrelated lineages, but extensive similarity is generally evidence of common descent.

21. D — A few bacteria in the original population already carry random mutations conferring antibiotic resistance. The antibiotic kills susceptible cells while resistant ones survive and reproduce, increasing the frequency of resistance over generations — the textbook example of natural selection.

22. A — Migration patterns are innate, genetically programmed behaviors that occur even when birds have never witnessed the journey before, and they are passed from parents to offspring. Learning to ride a bicycle, memorizing vocabulary, and training are all acquired behaviors that cannot be inherited.

23. C — Modern whales retain small, internal pelvic and hindlimb bones that are nonfunctional for swimming but match the limb bones of land mammals. These vestigial structures provide strong evidence that whales descended from four-legged terrestrial ancestors.

24. B — In a darkened forest, dark moths blend in with soot-covered tree trunks while light moths are easily spotted by predators. Differential survival based on this heritable color trait is the essence of natural selection — the classic peppered moth case.

25. D — Density-dependent factors have stronger effects as population density increases. Competition for limited food intensifies as the population grows, whereas hurricanes, floods, and freezes are density-independent because they affect the population regardless of its size.

26. A — A stable ecosystem maintains roughly balanced populations of producers (capturing energy), consumers (using that energy), and decomposers (recycling nutrients). All three functional groups are necessary for sustained energy flow and nutrient cycling.

27. C — Mycorrhizal relationships benefit both partners: the fungus extends the plant's effective root system and supplies water and minerals, while the plant supplies the fungus with sugars from photosynthesis. This mutual benefit defines mutualism.

28. D — An organism's ecological niche includes its habitat, food sources, behavior, and interactions with other species — its full functional role in the ecosystem. Habitat alone describes only where it lives, while trophic level describes only its feeding position.

29. B — Burning coal, oil, and gasoline releases CO_2 that was locked in fossil fuels millions of years ago, adding carbon to the active atmospheric pool faster than natural processes can remove it. Reforestation, wind power, and recycling all reduce — not increase — atmospheric carbon.

30. A — Sulfur oxides (SO_2) and nitrogen oxides (NO_x) released by burning fossil fuels react with water vapor in the atmosphere to form sulfuric and nitric acids, which fall as acid precipitation. Acid rain lowers the pH of lakes and damages forests and limestone structures.

31. C — Starting with a parent cell containing 4 chromosomes ($2n = 4$), meiosis halves the chromosome number to produce four haploid cells, each containing 2 chromosomes ($n = 2$). The diagram shows exactly this $4 \rightarrow 2 \rightarrow 2$ reduction.

32. A — The four cells produced by meiosis are haploid gametes with half the parent's chromosome number, ready to participate in fertilization. Combining two haploid gametes restores the diploid chromosome number in the resulting zygote.

33. D — Before meiosis (or mitosis) begins, each chromosome is duplicated by DNA replication during the S phase of interphase. This produces two identical sister chromatids attached at the centromere, giving each chromosome its characteristic X-shape.

34. B — During meiosis I, homologous chromosome pairs separate independently — independent assortment — and crossing over may exchange segments between homologs. Both events shuffle parental alleles into new combinations and are the major sources of genetic variation in gametes.

35. B — The graph peaks at approximately 37 °C with a reaction rate near 58 units, which is the highest point on the bell-shaped curve. This is the enzyme's optimum temperature, where its active site is most precisely shaped to bind substrate.

36. A — Above the optimum, increasing temperature breaks the hydrogen bonds and other weak interactions that maintain the enzyme's three-dimensional shape, denaturing the protein. Once the active site is distorted, substrate can no longer bind and the reaction rate falls sharply.

37. D — Mammalian body temperature is approximately 37 °C, and enzymes from mammals are typically optimized for this temperature. An enzyme peaking at 37 °C is therefore most likely to have originated in a warm-blooded mammal.

38. C — Crop A's average growth peaks at 28.7 cm when the fertilizer concentration is 1.5%, the highest value in its column. Both lower and higher concentrations produce shorter plants, indicating that 1.5% is the optimum for this crop.

39. B — At fertilizer concentrations above 1.5%, growth decreases steadily for both crops, indicating that excess fertilizer becomes harmful. This pattern reflects the principle that nutrients are essential at moderate levels but toxic in excess — often by drawing water out of plant roots through osmotic stress.

40. A — At every tested concentration, Crop A's growth exceeds Crop B's, and Crop A also shows a much larger increase from baseline to peak (5.4 → 28.7 cm versus 5.1 → 16.2 cm). This pattern shows that Crop A responds more strongly to fertilizer than Crop B.

41. D — Sea urchins are kelp-eating herbivores; the diagram shows an arrow from Kelp directly to Sea Urchin, identifying urchins as the primary consumer of kelp. Zooplankton and small fish do not feed on kelp in this web.

42. A — Sea otters are the only predator of sea urchins in this food web. With reduced otter predation, urchin populations would expand rapidly — a real-world phenomenon that has produced "urchin barrens" along Pacific coasts when otter populations decline.

43. C — Producers carry out photosynthesis and form the base of the food web. Phytoplankton and kelp are the only photosynthetic organisms in this diagram; all others are consumers feeding directly or indirectly on them.

44. B — A controlled experiment isolates the effect of one factor (the independent variable) by holding all others constant. Changing only soil moisture while keeping seed type, light, and temperature the same allows any difference in germination to be attributed specifically to moisture.

45. D — A measurable observation is quantitative — it can be expressed with a number and units, such as 4.2 cm of growth in seven days. Statements about prettiness, success, or happiness are qualitative impressions, not measurements.

46. A — Peer review allows independent experts to scrutinize the methods, data, and reasoning of a study before publication. This quality-control process helps catch errors and ensures that scientific claims are subject to outside checking.

47. C — The respiratory system exchanges gases between the body and the environment, taking in oxygen for cellular respiration and expelling carbon dioxide produced as waste. This exchange occurs across the thin alveolar walls of the lungs.

48. B — Deoxygenated blood enters the right atrium, passes to the right ventricle, and is pumped to the lungs for gas exchange. The freshly oxygenated blood then returns to the left atrium, moves to the left ventricle, and is pumped out to the rest of the body.

49. D — Fever is part of the body's innate, nonspecific immune response. Mildly elevated body temperature slows pathogen replication and enhances the activity of immune cells, helping the body fight the infection.

50. A — In a reflex arc, sensory information reaches the spinal cord, which directly triggers a motor response without waiting for the signal to reach the brain. This shortcut produces a very rapid response, such as pulling a hand away from a hot surface.

51. C — The pancreas releases insulin and glucagon directly into the bloodstream, making it part of the endocrine system. (It also has an exocrine role in digestion, but blood-glucose regulation is its endocrine function.)

52. A — Insulin, produced by beta cells of the pancreas, lowers blood glucose by signaling cells to take up glucose and to store it as glycogen. Together with the opposing hormone glucagon, it forms the central feedback loop regulating blood sugar.

53. C — The kidneys continuously filter blood, removing metabolic wastes such as urea and excess water and salts to form urine. By regulating water and ion balance, they are central to homeostasis of body fluids.

54. D — The small intestine is the main site of nutrient absorption, and its inner surface is covered with villi and microvilli that dramatically increase surface area for uptake of sugars, amino acids, and other nutrients. The stomach mainly digests; the large intestine mainly absorbs water.

55. B — Chemical digestion changes the molecular structure of food. Amylase breaks the chemical bonds in starch, hydrolyzing it into glucose units — a true chemical change. Chewing, peristalsis, and water absorption are physical (mechanical) processes.

56. A — The placenta is a temporary organ that forms a close interface between maternal and fetal blood vessels without mixing the two circulations directly. Through it, oxygen and nutrients pass from mother to fetus and metabolic wastes move in the opposite direction.

57. D — After ovulation, the ruptured ovarian follicle becomes the corpus luteum, which secretes progesterone (and some estrogen) to maintain the thickened uterine lining and prepare the uterus for possible implantation. If pregnancy does not occur, the corpus luteum degenerates and menstruation follows.

58. C — X-linked recessive traits appear more often in males because males have only one X chromosome — a single recessive allele is enough to produce the phenotype — while females need two copies to be

affected. The trait often "skips" generations as carrier females (one recessive allele) pass it to affected sons.

59. A — Identical (monozygotic) twins arise when a single fertilized egg splits early in development into two embryos. Because both embryos developed from the same zygote, they share essentially identical genomes.

60. B — Speciation through reproductive isolation occurs when two populations of the same species can no longer interbreed and produce fertile offspring. Over time, genetic differences accumulate until the two populations become separate species.

61. D — Primary succession begins on newly formed or barren substrate where no soil exists, such as fresh lava or rock exposed by retreating glaciers. Pioneer species like lichens and mosses are the first to colonize and begin building soil for later plant communities.

62. A — Habitat fragmentation breaks continuous habitat into smaller, isolated patches that limit movement between populations. Reduced gene flow between subpopulations decreases genetic diversity and can lead to inbreeding and local extinctions.

63. C — A keystone species exerts an effect on its ecosystem far greater than its biomass or numbers would suggest. Removing a keystone species — such as sea otters in kelp forests — can trigger dramatic restructuring of the entire community.

64. B — Removing forest cover exposes soil to wind and rain, accelerating erosion and causing loss of topsoil, nutrients, and water-holding capacity. Cover crops, terracing, and crop rotation all reduce erosion rather than increase it.

65. D — National parks and large protected areas preserve intact habitat, which is the single greatest determinant of biodiversity. By safeguarding habitat from development, agriculture, and invasive species, they help maintain the natural diversity of life.

66. C — Invasive species often lack natural predators or competitors in their new range, so they can outcompete native species for food, space, and other resources. The resulting decline in native species lowers overall biodiversity, as seen with zebra mussels, kudzu, and many other invasions.

67. A — Bioremediation uses living organisms — typically bacteria or fungi — to break down environmental pollutants into less harmful substances. Microbes that metabolize hydrocarbons have been used to clean up oil spills, including the Exxon Valdez and Deepwater Horizon disasters.

68. B — Pesticide application acts as a selective pressure: susceptible individuals die while a few naturally resistant individuals survive and reproduce. Over generations, the resistant trait spreads through the population, making the pesticide less effective — a direct example of natural selection.

69. D — Reef-building corals live in symbiosis with photosynthetic algae called zooxanthellae, which provide most of the coral's energy. Small increases in water temperature stress these algae and cause corals to expel them, leading to coral bleaching and, if prolonged, death.

70. B — Trees absorb atmospheric CO_2 during photosynthesis and incorporate the carbon into wood, leaves, and roots, where it is stored for the life of the tree. Reforestation therefore acts as a "carbon sink," removing greenhouse gases from the atmosphere.

71. C — Solar panels convert sunlight directly into electricity through the photovoltaic effect, producing no direct CO_2 emissions or other greenhouse gases during use. Because the sun's energy supply is effectively limitless on human timescales, solar power is renewable.

72. A — Decomposers — primarily bacteria and fungi — break down dead organisms and waste material, releasing carbon, nitrogen, phosphorus, and other nutrients back into the soil and air. Without decomposers, nutrients would remain locked in dead matter and ecosystems would collapse.

73. D — Benedict's solution turns from blue to green, yellow, orange, or red-orange when heated in the presence of a reducing sugar such as glucose. The red-orange color in the surrounding water shows that glucose, small enough to cross the membrane, diffused out of the dialysis tubing.

74. B — As the type of food changed across rounds, different tools (representing different beak shapes) became most successful, mirroring how environmental change can shift which traits are favored in a population. This is the essence of how natural selection adapts populations to changing conditions.

75. C — The diaphragm is an adjustable opening below the stage that controls the amount of light passing through the specimen. Opening it lets more light reach the objective; closing it reduces brightness and can increase contrast.

76. A — Total magnification of a compound microscope equals the product of the ocular and objective lens magnifications: $10\times \times 4\times = 40\times$. This calculation is a standard Regents-level expectation for microscopy.

77. D — Exercising muscles consume more oxygen and produce more carbon dioxide than resting muscles. The cardiovascular and respiratory systems respond by increasing pulse and breathing rate to deliver more oxygen and remove more CO_2 — a homeostatic response controlled by the nervous and endocrine systems.

78. C — Lowering the coverslip onto the specimen at an angle pushes air ahead of it out of the liquid drop, minimizing trapped air bubbles. Air bubbles obstruct light and appear as dark-edged circles that obscure the specimen under the microscope.

79. B — Multiple independent lines of evidence — physical traits, biochemical similarities, and DNA sequence comparisons — produce a more robust conclusion than any single test alone. Convergent results from independent methods strengthen confidence in evolutionary relationships.

80. D — Liquids form a curved meniscus in narrow tubes due to surface tension. The standard procedure is to read the volume at the bottom of the meniscus with the eye at the same level as the liquid to avoid parallax error and obtain an accurate measurement.

81. A — Safety goggles and gloves protect the eyes and skin from splashes, sharp tissue, and preservative chemicals. Sharp instruments must always be handled carefully to prevent cuts to the user or to others nearby.

82. C — When repeated measurements show small variation around a true value, the arithmetic mean is the best single summary because it incorporates every data point and averages out random error. Selecting only the highest, lowest, or first value would discard most of the information collected.

83. B — Scatter plots are designed to display the relationship between two continuous numerical variables, with each data point plotted by its x- and y-values. They reveal correlations and trends that bar graphs or pie charts cannot show.

84. D — Honest scientific practice requires recording all observations, including suspected outliers, and clearly noting any concerns in the lab notebook. Silently deleting or altering data compromises the integrity of the experiment, even if the data point is later excluded with proper justification.

85. C — A dichotomous key consists of a series of paired contrasting statements; at each step the user selects the statement that best matches the specimen and is directed to the next pair, eventually arriving at an identification. Its branching, paired structure is the standard tool for identifying unknown organisms.