PRACTICE EXAM 16: LIVING ENVIRONMENT REGENTS SIMULATION

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

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

Answer all questions in this part.

1. Which of the following is the most fundamental characteristic of life?

A. The ability of an organism to maintain homeostasis through internal regulation

B. The ability to move from place to place searching for food and shelter

C. The ability to live for many years in the same physical environment

D. The ability to communicate using sounds and visual signals

2. The cell theory states that all of the following are true EXCEPT

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

B. cells are the basic unit of structure and function in living things

C. all cells come from pre-existing cells through cell division

D. cells arise spontaneously from non-living matter under certain conditions

3. Which structure controls the activities of a eukaryotic cell and contains its genetic material?

A. the mitochondrion

B. the nucleus

C. the ribosome

D. the cell wall

4. Animal cells differ from plant cells because animal cells lack

A. a nucleus and ribosomes

B. mitochondria and cell membranes

C. a cell wall and chloroplasts

D. lysosomes and Golgi bodies

5. A red blood cell placed in a solution containing a high concentration of salt will most likely

A. swell and burst because of water entering the cell

B. shrink as water leaves the cell by osmosis

C. remain unchanged because the cell membrane blocks salt water

D. divide rapidly to form many new red blood cells

6. Enzymes function as biological

A. catalysts that speed up chemical reactions without being consumed

B. nutrients that provide energy directly to cells

C. genetic materials that are inherited from parents

D. structural materials that make up the cell membrane

7. The oxygen released into the atmosphere by green plants comes from the splitting of

A. carbon dioxide molecules

B. glucose molecules

C. amino acid molecules

D. water molecules

8. During aerobic respiration, glucose is broken down to produce carbon dioxide, water, and

A. amino acids for protein synthesis

B. nitrogen for use in DNA synthesis

C. ATP for energy use in the cell

D. lipids for storage in fat tissue

9. In a normal human body cell, the chromosomes are arranged in

A. 46 individual chromosomes with no pairing pattern

B. 23 pairs of homologous chromosomes

C. one single long chromosome strand

D. 46 pairs of identical chromosomes

10. The structure of a DNA molecule is best described as a

A. double helix made of two strands twisted together

B. single straight chain of nucleotides

C. branched tree of connected molecules

D. circular ring of repeating units

11. During translation, amino acids are linked together to form a protein chain at the

A. nucleus of the cell

B. mitochondrion of the cell

C. ribosome of the cell

D. lysosome of the cell

12. A mutation in the DNA of an egg or sperm cell is significant because it

A. only affects the parent organism during its lifetime

B. can be passed to offspring in future generations

C. is corrected immediately by enzymes before it has any effect

D. cannot affect the offspring of the organism in any way

13. During which stage of mitosis do duplicated chromosomes line up along the center (equator) of the cell?

A. prophase, the first stage of division

B. anaphase, when chromosomes separate

C. telophase, near the end of cell division

D. metaphase, the middle stage of division

14. The process of meiosis is necessary for sexual reproduction because it

A. produces large numbers of identical body cells for growth

B. produces cells with twice the normal chromosome number

C. produces gametes with half the chromosome number of body cells

D. allows organisms to reproduce without a partner organism

15. Crossing over during meiosis contributes to genetic variation because it

A. produces gametes that are identical to the parent cell

B. duplicates the chromosome number in each gamete formed

C. exchanges segments between homologous chromosomes

D. removes all harmful mutations from the chromosomes

16. In a Punnett square showing a cross between two heterozygous parents (Bb × Bb), the expected ratio of dominant to recessive phenotypes in the offspring is

A. 1:1

B. 3:1

C. 1:2

D. 2:1

17. A mother who is a carrier for color blindness (X^C X^c) and a father with normal vision (X^C Y) have children. What percentage of their sons would be expected to be color blind?

A. 0%

B. 25%

C. 75%

D. 50%

18. When a red-flowered plant (RR) is crossed with a white-flowered plant (WW) and all of the offspring have pink flowers, this is an example of

A. incomplete dominance, in which the heterozygote shows an intermediate phenotype

B. codominance, in which both alleles are expressed independently and separately

C. simple dominance, in which one allele completely masks the other

D. sex-linked inheritance, in which the trait depends on chromosome sex

19. Antibiotic resistance in bacteria is best explained by

A. bacteria intentionally changing their genes in response to antibiotics

B. antibiotics directly causing beneficial mutations in bacterial DNA

C. selection of bacteria that already had random mutations conferring resistance

D. bacteria developing immunity through exposure to other resistant bacteria

20. Two species of birds in different parts of the world have similar wing structures but evolved from different ancestors. These similar structures are best described as

A. homologous structures inherited from a common ancestor

B. vestigial structures that no longer serve their original function

C. embryonic similarities that disappear in adulthood

D. analogous structures that evolved independently for similar functions

21. Reproductive isolation between two populations of the same species can lead to

A. immediate extinction of both populations

B. the formation of two new species over time

C. the merging of the two populations into one large population

D. the doubling of the chromosome number in both populations

22. The role that an organism plays in its environment, including its food sources, habitat, and interactions with other species, is called its

A. ecological niche

B. food chain position

C. environmental factor

D. abiotic interaction

23. Of the following, which trophic level typically contains the smallest amount of available energy?

A. producers at the base of the food chain

B. primary consumers (herbivores) in the middle

C. tertiary consumers at the top of the food chain

D. secondary consumers in the middle of the chain

24. What would most likely happen to an ecosystem if all the decomposers were removed?

A. plant populations would increase immediately

B. herbivore populations would grow rapidly

C. predator populations would dominate the ecosystem

D. dead organic matter would accumulate and nutrients would not be recycled

25. A relationship in which one species benefits at the expense of another species is called

A. mutualism, in which both species benefit

B. parasitism, in which the host species is harmed

C. commensalism, in which one species is unaffected

D. competition, in which both species are harmed

26. During photosynthesis, plants remove carbon dioxide from the atmosphere and incorporate the carbon into

A. glucose and other organic compounds

B. nitrogen-containing amino acids only

C. inorganic minerals stored in soil

D. methane gas released by the plants

27. Most plants obtain the nitrogen they need to make proteins from

A. atmospheric nitrogen gas absorbed by their leaves

B. carbon dioxide absorbed during photosynthesis

C. nitrate compounds dissolved in the soil

D. sunlight converted into nitrogen by chlorophyll

28. Which of the following processes returns water from the surface of the Earth to the atmosphere?

A. condensation forming clouds in cool air

B. precipitation falling as rain or snow

C. infiltration of water through soil layers

D. evaporation from oceans, lakes, and rivers

29. A population of organisms living in a stable environment with plenty of food and no predators would most likely show

A. exponential growth, producing a J-shaped curve

B. logarithmic growth, with growth slowing immediately

C. cyclical growth, oscillating with the seasons

D. linear growth, with the same number added each year

30. The maximum population size that an environment can support over a long period of time is called

A. the reproductive potential of a species

B. the carrying capacity of the environment

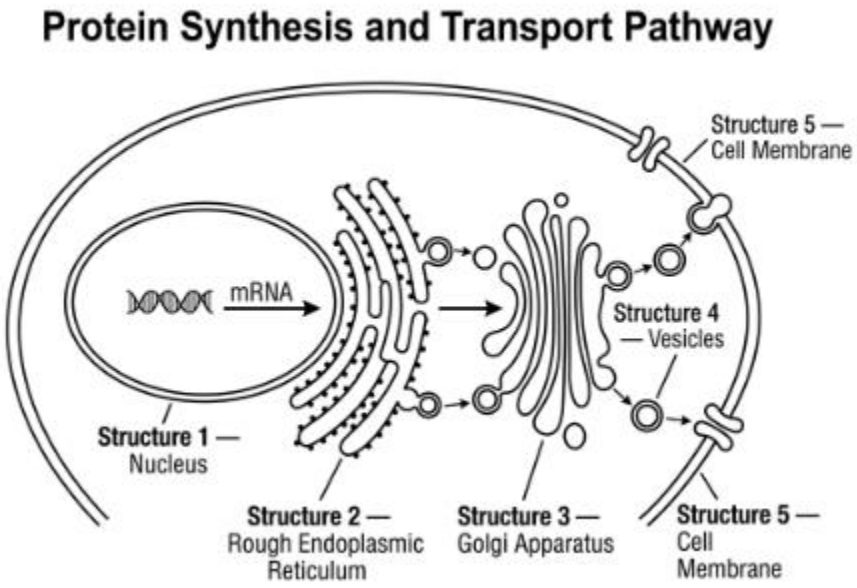
C. the geographic range of the species

D. the trophic level of the organism

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

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

31. A student examines a diagram showing the pathway of protein synthesis and transport in a eukaryotic cell.



Based on the diagram, which structure produces the mRNA that codes for proteins?

A. Structure 5, the cell membrane

B. Structure 3, the Golgi apparatus

C. Structure 2, the rough endoplasmic reticulum

D. Structure 1, the nucleus

32. Referring to the same diagram, the structure where proteins are first synthesized on attached ribosomes is

A. Structure 2, the rough endoplasmic reticulum

B. Structure 3, the Golgi apparatus

C. Structure 4, the transport vesicles

D. Structure 5, the cell membrane

33. Referring to the same diagram, the function of Structure 3 (the Golgi apparatus) in the pathway is to

A. produce mRNA from a DNA template inside the nucleus

B. modify, sort, and package proteins for transport

C. synthesize amino acids from inorganic precursors

D. break down old proteins for cellular recycling

34. Referring to the same diagram, Structures 4 (vesicles) and 5 (cell membrane) work together to

A. produce ATP through cellular respiration in the cell

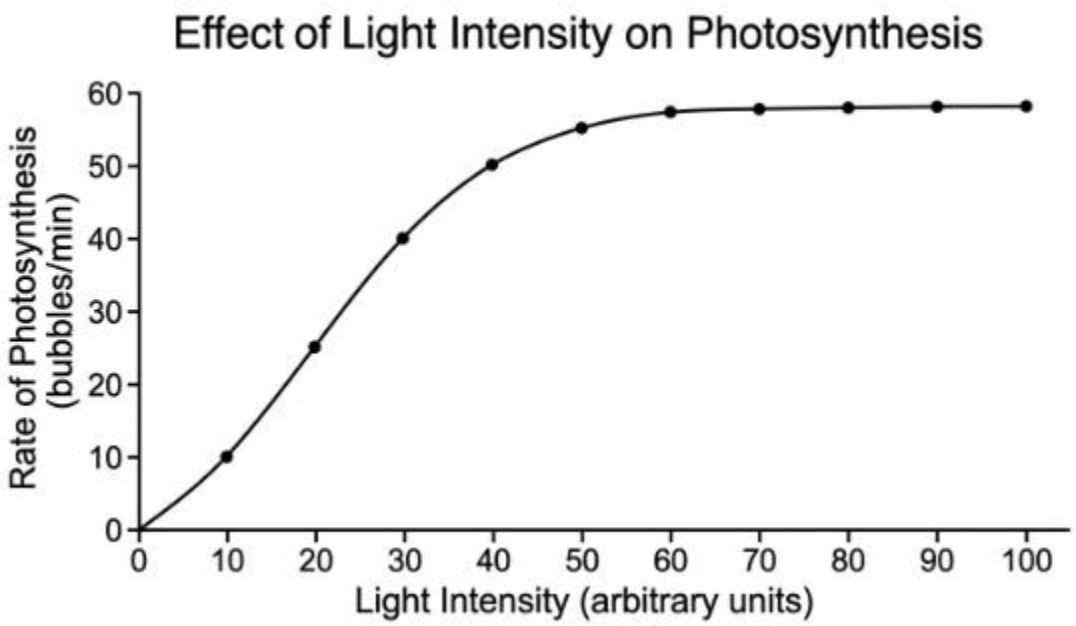
B. read the genetic code stored within the DNA

C. release finished proteins outside the cell through exocytosis

D. divide the cell into two daughter cells during mitosis

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

35. A student measures the rate of photosynthesis in an aquatic plant at different light intensities while keeping other factors constant.



Based on the graph, at very low light intensities (0 to 30 units), light intensity is

A. the limiting factor controlling the rate of photosynthesis

B. completely irrelevant to the rate of photosynthesis

C. inhibiting photosynthesis and slowing the reaction down

D. damaging the chlorophyll molecules in the plant cells

36. Based on the same graph, the leveling off of the photosynthesis rate at high light intensities (above 60 units) is best explained by

A. the chlorophyll being destroyed at higher light intensities

B. the plant entering a dormant phase at high light intensities

C. an increase in the rate of cellular respiration that offsets photosynthesis

D. another factor (such as CO_2 availability) becoming the new limiting factor

37. Based on the same graph, if the experimenter wanted to further increase the rate of photosynthesis above the plateau, the most effective action would be to

A. lower the temperature of the surrounding water significantly

B. reduce the light intensity to a lower value below 30 units

C. increase the carbon dioxide concentration in the water

D. remove all of the plant material from the experimental setup

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

38. A scientist compares the amino acid sequences of a particular protein in five different species and counts the number of differences from a reference species (Species A).

Species	Number of Amino Acid Differences from Species A
Species A	0
Species B	4
Species C	18
Species D	32
Species E	55

Based on the data, which species is most closely related to Species A?

A. Species C, with 18 differences from Species A

B. Species B, with 4 differences from Species A

C. Species D, with 32 differences from Species A

D. Species E, with 55 differences from Species A

39. Based on the same data, which species is most distantly related to Species A?

A. Species E, with 55 differences from Species A

B. Species D, with 32 differences from Species A

C. Species C, with 18 differences from Species A

D. Species B, with 4 differences from Species A

40. Based on the same data, the most reasonable conclusion is that

A. all five species shared a common ancestor only one generation ago

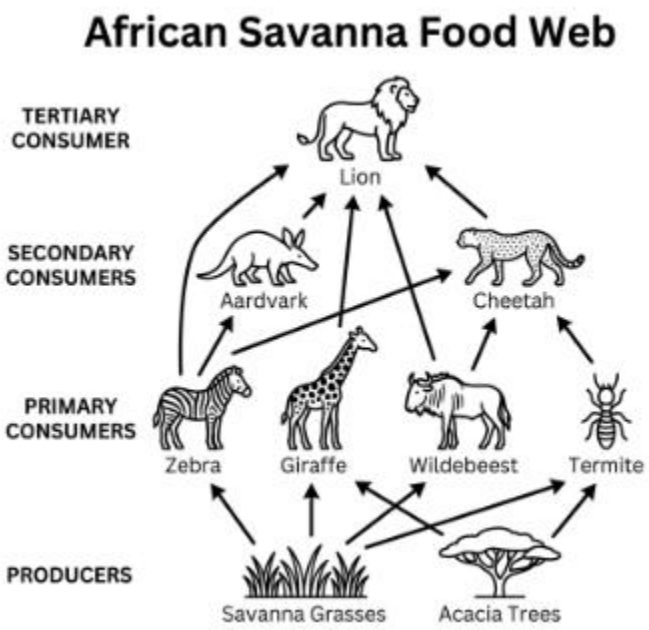
B. amino acid sequences are an unreliable measure of evolutionary relatedness

C. species with more amino acid differences live closer to Species A geographically

D. species with fewer amino acid differences shared a more recent common ancestor with Species A

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

41. A student examines a food web for an African savanna ecosystem.



Based on the food web, which organism is a primary consumer that feeds on more than one type of producer?

A. Lion, which feeds on multiple kinds of prey

B. Termite, which feeds on Savanna Grasses and Acacia Trees

C. Aardvark, which feeds on Termites only

D. Cheetah, which feeds on Zebra and Wildebeest

42. Based on the same food web, if a disease eliminated all the Termites from the savanna, the most directly affected population would be the

A. Lion, which depends on termites as its main food source

B. Cheetah, which feeds primarily on termites in this habitat

C. Aardvark, which depends on termites as its sole food source

D. Giraffe, which competes with termites for acacia leaves

43. Based on the same food web, the Lion can be considered a

A. producer at the base of the food web

B. primary consumer feeding directly on producers

C. tertiary consumer feeding at multiple trophic levels

D. decomposer breaking down dead organic matter

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

Answer all questions in this part.

44. A scientist wants to test how different concentrations of fertilizer affect the growth of tomato plants. The dependent variable in this experiment is

A. the concentration of fertilizer applied to each plant

B. the type of soil in which the tomato plants are grown

C. the species of tomato plant chosen for the experiment

D. the change in height of the plants over the testing period

45. In the same experiment, the control group should consist of plants that

A. receive the highest possible concentration of fertilizer

B. are grown under the same conditions but receive no fertilizer

C. are grown in completely different soil from all other plants

D. are watered only with bottled spring water during the experiment

46. A scientific hypothesis must be

A. testable through experimentation or observation

B. accepted as true by the majority of scientists

C. proven beyond any reasonable doubt before testing

D. impossible to disprove through any future experiment

47. A student wants to test an unknown solution for the presence of a reducing sugar such as glucose. The appropriate indicator to use is

A. Lugol's iodine, which turns blue-black with reducing sugars

B. bromothymol blue, which turns yellow with reducing sugars

C. Benedict's solution, which turns orange-red when heated with reducing sugars

D. litmus paper, which changes color in the presence of reducing sugars

48. A scientist uses a restriction enzyme to cut DNA at a specific sequence so that a particular gene can be isolated and studied. This procedure is most directly used in

A. cellular respiration in living cells

B. photosynthesis in green plant leaves

C. mitotic division in body cells

D. genetic engineering of organisms

49. A stem cell differs from most other body cells in that a stem cell can

A. survive longer than other body cells in tissues

B. divide and develop into many different specialized cell types

C. produce more ATP than any other type of cell in the body

D. live without any oxygen or nutrients from the body

50. All of the body cells of a human contain the same DNA. The reason that liver cells and muscle cells look and function very differently is that

A. different genes are expressed (turned on or off) in each cell type

B. each cell type contains a different set of chromosomes entirely

C. the DNA mutates differently in each cell during development

D. each cell type is descended from a different fertilized egg

51. In humans, the breathing rate increases during exercise because

A. the heart stops pumping for short periods between breaths

B. the brain shuts down all unnecessary body functions during activity

C. the lungs become smaller and need more frequent inflation

D. exercising muscles need more oxygen and produce more CO_2, signaling faster breathing

52. The structure that prevents blood from flowing backward through the heart is the

A. atrium that receives blood from the body and lungs

B. ventricle that pumps blood from the heart outward

C. valve located between heart chambers

D. coronary artery surrounding the heart muscle

53. The function of villi in the small intestine is to

A. produce digestive enzymes for breaking down food

B. increase surface area for the absorption of nutrients

C. break down food using strong muscular contractions

D. transport bile from the liver to the digestive tract

54. Sweat glands in the human skin help maintain homeostasis by

A. releasing water and dissolved salts to cool the body

B. producing red blood cells to carry oxygen through the body

C. producing antibodies to fight off infections in tissues

D. storing fat for use during periods of food scarcity

55. In a reflex action such as pulling a hand away from a hot object, the response is initiated by

A. the cerebellum at the back of the brain

B. the pituitary gland at the base of the brain

C. the hypothalamus in the center of the brain

D. the spinal cord acting as a coordinator

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

Answer all questions in this part.

56. In a person with Type 1 diabetes, the body is unable to produce enough

A. glucagon, the hormone that lowers blood glucose

B. adrenaline, the hormone for fight or flight responses

C. insulin, the hormone that regulates blood glucose levels

D. thyroxine, the hormone that controls metabolism

57. When a pathogen first enters the body, the immune system responds by

A. producing antibodies that recognize and bind to specific antigens

B. immediately replacing all of the body's white blood cells with new ones

C. preventing the pathogen from entering the body in the first place

D. generating new chromosomes to fight the pathogen directly

58. A vaccine for a specific bacterial disease typically contains

A. live, actively reproducing bacteria that cause the disease

B. weakened, killed, or fragmented bacteria that cannot cause the disease

C. antibiotics that destroy the bacteria once introduced into the body

D. ready-made antibodies that immediately neutralize the disease

59. An allergic reaction to pollen occurs because the immune system

A. correctly identifies pollen as a dangerous bacterial pathogen

B. fails to recognize the pollen at all and lets it pass freely

C. produces too few antibodies to neutralize the pollen

D. mistakenly responds to a harmless substance as if it were a threat

60. In the human female reproductive system, the corpus luteum is involved in

A. the digestion of food during pregnancy in the digestive tract

B. the filtering of blood and waste products through the kidneys

C. the production of hormones that maintain the uterine lining

D. the release of carbon dioxide from the embryo to the mother

61. During early human development, a fertilized egg divides repeatedly to form an embryo. These cell divisions are accomplished through

A. mitosis, producing genetically identical cells

B. meiosis, producing gametes with halved chromosomes

C. binary fission, splitting cells unequally each time

D. budding, with new cells forming as outgrowths

62. Sexual reproduction generally provides greater evolutionary advantage than asexual reproduction in changing environments because sexual reproduction

A. produces many more offspring per reproductive event

B. produces offspring with greater genetic variation

C. requires far less energy from the parent organisms

D. allows the species to ignore environmental changes

63. After a forest is destroyed by wildfire, the first plants to grow back in the burned area are typically

A. mature deciduous trees with deep root systems

B. flowering shrubs requiring rich nutrient soil

C. evergreen trees with needle-like leaves

D. fast-growing grasses and small weedy plants

64. An ecosystem with high biodiversity is more likely to

A. collapse when an environmental disturbance occurs

B. support only a few specialized species of organisms

C. resist disturbances and recover more quickly from them

D. require fewer resources to maintain over time

65. The pesticide DDT became concentrated in birds at the top of food chains, causing eggshells to thin and bird populations to decline. This is an example of

A. biomagnification through the food chain

B. eutrophication of aquatic ecosystems by nutrients

C. the greenhouse effect in the atmosphere

D. ozone depletion in the stratosphere

66. Burning fossil fuels contributes to climate change primarily by

A. depleting the ozone layer in the upper atmosphere

B. increasing the concentration of carbon dioxide in the atmosphere

C. directly heating the Earth's surface through combustion

D. reducing the amount of oxygen available for breathing

67. The introduction of an invasive plant species into a wetland often leads to

A. an immediate increase in biodiversity of the wetland

B. a decline in native plant species that compete for the same resources

C. an improvement in water quality due to the new plant

D. an instant restoration of the wetland to its original state

68. Establishing a wildlife corridor connecting two protected forest areas is most likely to

A. cause the forest areas to become much smaller in size

B. reduce the populations of species in both forest areas

C. allow animals to move between the areas, increasing genetic diversity

D. permanently separate the two populations from each other

69. Which of the following best illustrates a sustainable agricultural practice?

A. rotating different crops in a field each year to maintain soil nutrients

B. growing the same crop in the same field year after year continuously

C. applying maximum amounts of synthetic fertilizers every growing season

D. converting more wetlands and forests into farmland each year

70. Wind power is considered a renewable energy source because

A. wind is continuously generated by the heating of the Earth by the sun

B. wind turbines can be operated without any maintenance for many decades

C. wind power generates no environmental impact whatsoever

D. wind is the most abundant resource on the Earth's surface today

71. The thick, fleshy stems of cacti are an adaptation that helps these plants

A. attract pollinators visiting from neighboring oases nearby

B. store water for use during prolonged dry periods

C. capture more sunlight in the harsh desert environment

D. absorb additional carbon dioxide from the surrounding air

72. Oxygen is transported from the lungs to body cells by

A. white blood cells circulating in the bloodstream

B. platelets dispersed throughout the blood plasma

C. hemoglobin molecules inside red blood cells

D. plasma protein molecules dissolved in blood

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

Answer all questions in this part.

73. In the Diffusion Through a Membrane laboratory, a student finds that after 30 minutes the dialysis bag contents have turned blue-black, but the surrounding water has not. The best explanation for this observation is that

A. iodine molecules diffused through the membrane and reacted with starch inside the bag

B. starch molecules diffused out of the bag and reacted with iodine in the water

C. glucose molecules in the bag changed color when exposed to water

D. water molecules in the bag combined with starch to form a new substance

74. When viewing a specimen under a compound light microscope, the student adjusts focus using the

A. eyepiece magnification adjustment knob

B. light intensity control dial only

C. nosepiece holding the objective lenses

D. coarse adjustment knob for low power and fine adjustment knob for high power

75. During a laboratory activity involving heating, a student's hair is hanging down loosely. The teacher should advise the student to

A. continue working but remain extra cautious around the flame

B. tie back long hair before working near any open flame

C. wet the hair so it cannot catch on fire during the lab

D. cut the hair shorter before beginning the laboratory exercise

76. In the Beaks of Finches simulation, the seeds remaining at the end of each round represent

A. the food still available to support finches in the next generation

B. the offspring produced by surviving finches in the simulation

C. dead finches that could not compete for resources during the round

D. random mutations that occurred during the simulation rounds

77. In the Relationships and Biodiversity laboratory, students compare a target species (Botana curus) to several candidate species using multiple lines of evidence. The strongest evidence for relatedness comes from

A. similar appearance of the plants in their natural habitat

B. similar geographic locations where the plants are found

C. similar DNA base sequences in homologous genes

D. similar weather conditions where the plants are found

78. In the Making Connections laboratory, students measure pulse rate before and after exercise. The use of class data rather than individual data improves the experiment because

A. class data are always more interesting to graph than individual data

B. class data eliminate the need for any controlled variables in the experiment

C. class data save the teacher time when grading the assignments

D. larger sample sizes reduce the influence of random individual variation

79. When preparing a wet-mount slide, lowering the coverslip onto the specimen at an angle helps to

A. stain the specimen with iodine for better visibility

B. minimize the formation of air bubbles under the coverslip

C. cause the specimen to lay flat against the slide

D. allow excess water to be absorbed by the specimen

80. When graphing experimental data, a line graph is most appropriate when

A. both the independent and dependent variables are continuous numerical data

B. both variables are categorical (groups or labels rather than numbers)

C. only counts of items in different categories need to be shown

D. only one data value has been collected during the experiment

81. A dichotomous key allows students to identify an unknown organism by

A. measuring the genetic similarity of the organism to known species

B. randomly guessing which species the unknown organism might be

C. comparing the organism to photographs of all known species

D. following a series of paired contrasting statements that narrow down the identification

82. A student conducts an experiment and finds that the data clearly do NOT support the original hypothesis. The most scientifically appropriate response is to

A. modify the data so that it matches the original hypothesis

B. omit the data that conflicts with the original hypothesis

C. report the data honestly and consider revising the hypothesis

D. discard the entire experiment and pretend it never happened

83. A student repeats an experiment several times and obtains slightly different results each time. The best way to handle these results is to

A. report only the result that matches the original hypothesis exactly

B. calculate an average of the results to reduce the effect of random variation

C. report only the single most extreme result that was obtained

D. discard the experiment because reliable results were not obtained

84. In a biology laboratory, the mass of a small sample is most appropriately measured in

A. grams using an electronic balance

B. liters using a graduated cylinder

C. centimeters using a metric ruler

D. degrees Celsius using a thermometer

85. A student writes a complete conclusion for a science experiment. A well-written conclusion should include

A. only the data values that supported the original hypothesis

B. a single sentence stating whether the hypothesis was correct

C. an apology if the data did not support the hypothesis

D. an interpretation of the data and discussion of possible sources of error

EXPLAINED ANSWER KEY – PRACTICE EXAM 16

1. A — Homeostasis — the ability to maintain a stable internal environment through continuous adjustment — is universal to all living organisms and is one of the defining characteristics of life. Movement, longevity, and complex communication apply only to certain groups, not to all living things.

2. D — The three core principles of the cell theory state that all living things are made of cells, that cells are the basic unit of structure and function, and that all cells come from pre-existing cells. The idea that cells can arise spontaneously from non-living matter is the discredited theory of spontaneous generation, which the cell theory explicitly rejects.

3. B — The nucleus contains the cell's DNA and serves as the control center that directs cellular activities through gene expression. Mitochondria produce ATP, ribosomes assemble proteins, and cell walls (found in plants and some other groups) provide structural support but do not house genetic material.

4. C — Animal cells share most organelles with plant cells but lack a rigid cell wall and lack chloroplasts because animals cannot perform photosynthesis. Both cell types contain a nucleus, ribosomes, mitochondria, lysosomes, and a plasma membrane.

5. B — A salt solution is hypertonic relative to the cell's cytoplasm, so water flows out of the red blood cell by osmosis, causing it to shrink (a process called crenation). Cells do not swell, divide, or remain unchanged when placed in hypertonic surroundings.

6. A — Enzymes are biological catalysts that lower the activation energy required for specific chemical reactions, allowing them to proceed at body temperature. They are not consumed in the reaction and can be reused many times.

7. D — During the light-dependent reactions of photosynthesis, water molecules (H_2O) are split — a process called photolysis — releasing electrons, hydrogen ions, and oxygen gas. The oxygen we breathe therefore originates from water, not from carbon dioxide.

8. C — Aerobic respiration breaks glucose down using oxygen to produce carbon dioxide, water, and ATP, the cell's main energy-carrying molecule. The overall reaction is $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ ATP.

9. B — Normal human body (somatic) cells are diploid and contain 46 chromosomes arranged as 23 homologous pairs — 22 autosome pairs plus one sex chromosome pair. One chromosome of each pair is inherited from each parent.

10. A — The DNA molecule is a double helix: two complementary nucleotide strands wound around each other, with the sugar-phosphate backbones on the outside and base pairs on the inside. This structure was first described by Watson and Crick in 1953.

11. C — Translation occurs at the ribosome, where mRNA codons are read and amino acids are linked together by peptide bonds to form a polypeptide chain. Ribosomes can be free in the cytoplasm or attached to the rough endoplasmic reticulum.

12. B — Mutations in gametes (egg or sperm cells) are heritable because they become part of the fertilized zygote and are copied into every cell of the resulting offspring. Mutations in body (somatic) cells, in contrast, affect only the individual in whom they occur.

13. D — Metaphase is the middle stage of mitosis, during which condensed chromosomes line up along the metaphase plate at the equator of the cell. This precise alignment ensures that each daughter cell will receive exactly one copy of every chromosome in anaphase.

14. C — Meiosis is a reduction division that halves the chromosome number, producing haploid gametes from diploid parent cells. Fertilization then combines two haploid gametes to restore the species' normal diploid chromosome number.

15. C — Crossing over occurs in prophase I of meiosis when homologous chromosomes pair up and exchange segments at sites called chiasmata. This swapping shuffles parental alleles onto new chromosome combinations, producing genetically varied gametes.

16. B — A monohybrid cross between two heterozygotes (Bb × Bb) yields a 1 BB : 2 Bb : 1 bb genotype ratio, which translates to a 3:1 phenotypic ratio of dominant to recessive. This Mendelian 3:1 ratio is one of the most reproducible patterns in genetics.

17. D — Sons inherit their single X chromosome from the mother and the Y from the father. Because the mother is X^C X^c, half her X chromosomes carry the color-blind allele, giving each son a 50% chance of being color blind.

18. A — Incomplete dominance produces a heterozygous phenotype intermediate between the two homozygous phenotypes — red × white yielding pink in snapdragons. Codominance, by contrast, would produce flowers with separate red and white patches rather than a blended pink.

19. C — Within any large bacterial population, a few individuals already carry random mutations that confer antibiotic resistance. When antibiotics are applied, susceptible bacteria die while resistant individuals survive and reproduce, increasing the frequency of resistance alleles — a textbook example of natural selection.

20. D — Wings that evolved independently in different ancestral lineages but serve a similar function are analogous structures, an example of convergent evolution. Homologous structures, by contrast, share a common ancestral origin even when their functions differ.

21. B — When two populations of the same species become reproductively isolated and can no longer interbreed, gene flow stops between them; over generations they accumulate distinct genetic differences and become two separate species. This is the central pathway of speciation.

22. A — An organism's ecological niche encompasses its complete role in the ecosystem — including its habitat, food sources, behaviors, and interactions with other species. Niche is more comprehensive than habitat, which describes only the physical place where the organism lives.

23. C — Because roughly 90% of energy is lost as heat at each trophic transfer, only about 10% reaches the next level. Tertiary consumers at the top of the chain therefore receive the smallest share of the original energy captured by producers.

24. D — Decomposers break down dead organisms and waste material, releasing nutrients such as carbon and nitrogen back into the environment for reuse by producers. Without decomposition, nutrients would remain locked in dead matter and ecosystem productivity would collapse.

25. B — Parasitism is a symbiotic relationship in which one organism (the parasite) benefits at the expense of another (the host), which is harmed but usually not killed outright. Examples include tapeworms, ticks, and parasitic plants such as dodder.

26. A — In photosynthesis, plants fix atmospheric CO_2 into glucose and use that glucose as the starting material for building all of the organic compounds — carbohydrates, lipids, proteins, and nucleic acids — they need. Inorganic minerals and methane are not photosynthetic products.

27. C — Plants absorb nitrogen from the soil mainly as dissolved nitrate (NO_3^-) or ammonium (NH_4^+) ions, which they incorporate into amino acids and nucleic acids. They cannot use atmospheric N_2 directly, since they lack the enzymes to break its strong triple bond.

28. D — Evaporation transfers liquid water from oceans, lakes, rivers, and soils into the atmosphere as water vapor; together with plant transpiration, it is the main pathway for water entering the atmosphere. Condensation, precipitation, and infiltration all move water in the opposite direction.

29. A — With unlimited resources and no environmental pressures, a population grows at an accelerating rate as more individuals reproduce, producing a J-shaped exponential growth curve. This pattern is only seen temporarily in nature because environmental limits eventually slow growth.

30. B — Carrying capacity (K) is defined as the maximum population size that a given environment can sustainably support over time, given available resources such as food, water, and habitat. Populations tend to level off near this value as density-dependent factors take effect.

31. D — The nucleus (Structure 1) is the site of transcription, where RNA polymerase reads the DNA template and produces mRNA. The mRNA then leaves the nucleus through nuclear pores to direct protein synthesis in the cytoplasm.

32. A — The rough endoplasmic reticulum (Structure 2) is studded with ribosomes that synthesize proteins destined for secretion, the cell membrane, or other organelles. As the ribosomes assemble the polypeptide chains, the proteins thread into the lumen of the rough ER for further processing.

33. B — The Golgi apparatus (Structure 3) modifies, sorts, and packages proteins received from the rough ER, often attaching sugar groups or other markers that direct each protein to its proper destination. The finished proteins are then enclosed in vesicles for transport.

34. C — Transport vesicles (Structure 4) carry finished proteins to the cell membrane (Structure 5), where they fuse with the membrane and release their contents to the cell's exterior. This process is called exocytosis and is how cells secrete hormones, enzymes, and other proteins.

35. A — At low light intensities, the graph rises steeply, indicating that adding light directly increases the rate of photosynthesis — the defining sign of a limiting factor. Light is therefore the bottleneck controlling the reaction rate in this region of the curve.

36. D — Once light is no longer limiting, some other resource — usually CO_2 concentration, but possibly temperature or chlorophyll quantity — becomes the new limiting factor and caps the rate. This is why the curve plateaus even though light is still increasing.

37. C — Above the plateau, light is in excess and a different factor limits the reaction. Increasing CO_2 availability supplies the Calvin cycle with more substrate, allowing photosynthesis to proceed faster.

38. B — The smaller the number of amino acid differences in a homologous protein, the more recently two species diverged from a common ancestor. Species B, with only 4 differences, must be the closest relative of Species A among those listed.

39. A — Conversely, the largest number of amino acid differences indicates the longest period of independent evolution since the last common ancestor. Species E, with 55 differences, is therefore the most distantly related to Species A.

40. D — Molecular clock reasoning holds that fewer differences in homologous proteins reflect a more recent common ancestor, because mutations accumulate roughly with time. This principle is one of the strongest tools modern biology has for inferring phylogenetic relationships.

41. B — In this web, the Termite is shown receiving arrows from both Savanna Grasses and Acacia Trees, marking it as a primary consumer that feeds on two distinct producers. The Zebra, Giraffe, and Wildebeest each consume only one producer.

42. C — The Aardvark's only food source in the web is the Termite, so eliminating termites would directly cut off the Aardvark's primary food supply. The Lion and Cheetah do not feed on termites, and the Giraffe eats acacia leaves rather than termites.

43. C — The Lion preys on Zebra, Wildebeest, and Giraffe (all primary consumers) as well as on the Cheetah (a secondary consumer), placing it at the top of the web while drawing energy from multiple trophic levels. This dietary breadth is typical of apex predators.

44. D — The dependent variable is the outcome the experimenter measures to detect any effect of the independent variable. Plant height is what is measured in response to changes in fertilizer concentration, making it the dependent variable.

45. B — A proper control group differs from the experimental groups only in the variable being tested. Plants given no fertilizer but kept under otherwise identical conditions serve as the baseline against which fertilized plants can be compared.

46. A — A hallmark of any scientific hypothesis is that it must be testable — its predictions must be capable of being verified or refuted through observation or experiment. Hypotheses are not required to be already accepted, proven, or unfalsifiable; in fact, scientific claims that cannot in principle be tested fall outside science.

47. C — Benedict's solution is the standard biology-lab reagent for detecting reducing sugars such as glucose; when heated with a reducing sugar, it changes from clear blue to green, yellow, or orange-red. Lugol's iodine tests for starch, bromothymol blue tests pH/CO_2, and litmus paper tests acidity.

48. D — Restriction enzymes cut DNA at specific recognition sequences, allowing scientists to isolate, splice, and transfer particular genes. This precise cutting and pasting of DNA is a foundational technique of genetic engineering (recombinant DNA technology).

49. B — Stem cells are unspecialized cells with the unique ability to divide indefinitely and to differentiate into many different specialized cell types. This makes them invaluable for embryonic development and for potential therapies aimed at repairing or replacing damaged tissues.

50. A — Every cell in the body contains the same complete genome, but each cell type expresses (transcribes) only a particular subset of those genes. This differential gene expression produces the distinct proteins and structures that give a liver cell and a muscle cell their different appearances and functions.

51. D — Working muscles consume more oxygen and produce more carbon dioxide than resting tissues; chemoreceptors detect the rising CO_2 and falling oxygen and trigger the respiratory center to increase the rate and depth of breathing. This negative feedback loop keeps blood gases within homeostatic limits.

52. C — Heart valves — the atrioventricular and semilunar valves — open in only one direction, ensuring blood flows forward through the heart and preventing it from leaking back into the chamber that just contracted. Without these valves, the heart could not move blood efficiently.

53. B — Villi are tiny finger-like projections lining the inner wall of the small intestine, with even smaller microvilli on each villus, which together greatly increase the surface area available for nutrient absorption. This expanded surface is what makes nutrient uptake in the small intestine so efficient.

54. A — Sweat consists mainly of water with dissolved salts; as it evaporates from the skin, it carries heat away from the body, helping to lower body temperature toward the homeostatic set point. This is the body's main cooling mechanism during exertion or heat exposure.

55. D — A reflex arc is processed at the spinal cord, where a sensory neuron synapses (often through an interneuron) with a motor neuron, generating a rapid response without waiting for signals to reach the brain. This shortcut explains why the hand pulls back before the person consciously feels pain.

56. C — Type 1 diabetes results from autoimmune destruction of pancreatic beta cells, leaving the body unable to produce enough insulin to regulate blood glucose. People with Type 1 diabetes therefore require external insulin to control their blood sugar.

57. A — In the adaptive immune response, B lymphocytes recognize specific antigens on a pathogen and produce antibodies that bind to those antigens, marking the pathogen for destruction. This antigen-specific recognition is the basis of immunity and vaccination.

58. B — Most vaccines contain weakened (attenuated), inactivated (killed), or fragmented pathogens or pathogen antigens; they cannot cause the disease but still expose the immune system to the relevant antigens. Exposure trains the body to mount a rapid response if the real pathogen appears later.

59. D — In an allergic reaction, the immune system mistakenly identifies a harmless substance such as pollen as a threat and launches an inflammatory response (often involving IgE antibodies and histamine release). The symptoms — sneezing, itching, congestion — are caused by the immune overreaction itself, not by the pollen.

60. C — After ovulation, the ruptured follicle becomes the corpus luteum, which produces progesterone (and some estrogen) that maintain the thickened uterine lining and prepare the uterus for possible pregnancy. If pregnancy does not occur, the corpus luteum degenerates and hormone levels fall, triggering menstruation.

61. A — Once a zygote forms at fertilization, it divides repeatedly by mitosis to build a multicellular embryo of genetically identical cells. Meiosis, binary fission, and budding are not used to build the human embryo.

62. B — Sexual reproduction shuffles parental alleles through meiosis (crossing over and independent assortment) and fertilization, producing genetically varied offspring. This variation increases the chance that at least some offspring will have favorable traits when environments change, providing a long-term evolutionary advantage.

63. D — After a wildfire destroys vegetation but leaves the soil intact, secondary succession begins with fast-growing pioneer species — grasses and weedy plants — that can quickly colonize disturbed ground. Larger shrubs and trees follow only after these early species improve the conditions.

64. C — Greater biodiversity means more species and more functional roles in an ecosystem, which buffers the community against disturbances and speeds recovery when disturbance occurs. Biodiverse ecosystems are therefore more resilient and stable over time.

65. A — Biomagnification is the increase in concentration of a persistent pollutant at each higher trophic level, because predators accumulate the pollutant from many contaminated prey. The DDT–thinning of bird eggshells in raptors such as bald eagles is the textbook case of this phenomenon.

66. B — Burning fossil fuels releases large amounts of CO_2 into the atmosphere, increasing greenhouse gas concentrations and enhancing the greenhouse effect. The accumulated CO_2 traps more outgoing infrared radiation, warming the lower atmosphere.

67. B — Invasive plants typically lack the natural enemies that controlled them in their original range, so they can outcompete native species for sunlight, water, and nutrients. This competitive displacement causes native plant populations to decline and reduces overall biodiversity.

68. C — Wildlife corridors physically link otherwise isolated habitat patches, allowing animals to disperse between them, find mates, and exchange genes. This movement maintains genetic diversity within populations and reduces the risk of inbreeding and local extinction.

69. A — Crop rotation alternates plants with different nutrient requirements and disease susceptibilities, helping to restore soil fertility, reduce pest buildup, and minimize the need for synthetic inputs. It is a long-standing sustainable practice, unlike monoculture, heavy fertilization, or habitat conversion.

70. A — Wind is generated by uneven solar heating of the Earth's atmosphere and surface, which produces pressure gradients and air movement; because the sun will continue to drive this process for billions of years, wind is classified as renewable. It is not impact-free or maintenance-free, but it does not deplete.

71. B — Cacti store water in their thick, fleshy stems, allowing them to survive long droughts in arid environments. Their reduced leaves (often modified into spines) further minimize water loss while the stems carry out photosynthesis.

72. C — Red blood cells contain hemoglobin, an iron-rich protein that reversibly binds oxygen in the lungs and releases it in the tissues. Hemoglobin therefore serves as the body's main oxygen-transport molecule and gives blood its red color.

73. A — Iodine molecules are small enough to pass through the pores of the dialysis tubing into the bag, where they contact starch and produce the characteristic blue-black color. The reaction occurs inside the bag because starch is too large to leave through the membrane.

74. D — Standard microscope procedure uses the coarse adjustment knob at low power to bring the specimen into rough focus, then the fine adjustment knob (alone) at higher powers to sharpen the image. Using the coarse knob at high power risks crushing the slide or damaging the lens.

75. B — Loose hair near an open flame is a serious fire hazard and must be tied back before any heating procedure. Continuing to work or trying to wet or cut the hair on the spot does not provide reliable protection.

76. A — Seeds left at the end of a round represent the food still available to support the next generation of finches; finches whose tools were poor at picking up seeds "starve" and contribute fewer offspring. This setup models how the food supply drives natural selection on beak variation.

77. C — DNA base sequence comparisons provide the most direct and quantitative measure of evolutionary relatedness: closely related species share nearly identical sequences in homologous genes, while distantly related species accumulate more differences. Habitat, geography, and weather are far less reliable indicators of shared ancestry.

78. D — Using class-wide data dramatically increases the sample size, which averages out random individual variation and produces more reliable estimates of the true response. Larger samples make the underlying trend easier to detect and reduce the influence of outliers.

79. B — 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 circles that obscure the specimen under the microscope.

80. A — Line graphs are used to show how one continuous numerical variable changes in response to another, typically with the independent variable on the x-axis and the dependent variable on the y-axis. Categorical or count data are better displayed using bar graphs or pie charts.

81. D — A dichotomous key consists of a series of paired, contrasting statements; at each step the user selects the statement that best matches the unknown specimen and is directed to the next pair, eventually arriving at a species identification. This branching, paired structure is what makes the key "dichotomous."

82. C — Scientific integrity requires reporting data honestly, even when they conflict with the original hypothesis. Unexpected results are not failures but new information that may lead the researcher to revise the hypothesis or design a follow-up experiment.

83. B — Slight variation across replicate trials is normal and arises from countless small uncontrolled factors. Calculating an average (mean) reduces the influence of this random variation and gives a more reliable estimate of the true value being measured.

84. A — Mass is measured in grams (or kilograms) using a calibrated electronic balance or triple-beam balance. Graduated cylinders measure volume, rulers measure length, and thermometers measure temperature.

85. D — A thorough conclusion does more than state whether the hypothesis was supported: it interprets the data, identifies possible sources of error, and suggests how the experiment could be improved or extended. This reflective practice strengthens the scientific value of the report and guides future investigations.