# PRACTICE EXAM 7: LIVING ENVIRONMENT REGENTS SIMULATION

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

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

Answer all questions in this part.

1. The smallest unit that can carry out all the basic processes of life is best described as

A. a tissue made up of many cooperating cells

B. a cell with its own membrane and contents

C. an organ system carrying out specific tasks

D. an organism interacting with its environment

2. A type of transport that requires the cell to use energy from ATP is

A. simple diffusion across a thin membrane

B. osmosis of water through a membrane

C. facilitated diffusion through a protein channel

D. active transport against a concentration gradient

3. An enzyme that breaks down a specific substrate molecule is best compared to

A. a lock that fits only one specific key shape

B. a battery that can power many different devices

C. a key that fits into many different door locks

D. a hammer used for many different building tasks

4. The organelle responsible for packaging and shipping proteins out of the cell is the

A. nucleus, which contains the cell's DNA

B. mitochondrion, which produces ATP energy

C. Golgi apparatus, which sorts and ships proteins

D. ribosome, which assembles new proteins

5. The end products of aerobic cellular respiration include ATP and

A. glucose and chlorophyll for energy capture

B. carbon dioxide and water as waste products

C. amino acids and proteins for cell building

D. nitrogen gas and oxygen released into air

6. During photosynthesis, the source of the oxygen released into the atmosphere is

A. water molecules split during the light reactions

B. carbon dioxide molecules absorbed from the air

C. glucose molecules made during the dark reactions

D. ATP molecules consumed in the chloroplasts

7. The two strands of a DNA double helix are described as antiparallel and complementary because

A. both strands run in the same direction with matching bases

B. they curve in opposite directions but contain identical bases

C. they twist around each other randomly with no fixed pattern

D. they run in opposite directions with paired complementary bases

8. In a cell, the molecule that carries the genetic message from the nucleus to the ribosome is

A. tRNA, which carries amino acids to the ribosome

B. DNA, which remains permanently in the nucleus

C. mRNA, which is transcribed from the DNA template

D. ATP, which provides energy for protein synthesis

9. In humans, the sex of an offspring is determined by the

A. sex chromosome carried by the sperm cell

B. amount of male hormone in the mother

C. amount of female hormone in the father

D. position of the embryo in the uterus

10. A child has blue eyes (a recessive trait), but neither of the child's parents has blue eyes. The most likely explanation is that

A. one of the parents is homozygous dominant

B. both parents are heterozygous carriers of the recessive allele

C. the child inherited the trait from environmental exposure

D. only the mother carried the recessive allele in her sex cells

11. A mutation that results in a change to a single nitrogen base in a gene is called a

A. chromosomal mutation affecting whole chromosomes

B. translocation moving genes between chromosomes

C. point mutation altering one base in the DNA

D. duplication of a section of a chromosome's DNA

12. Compared with mitosis, meiosis produces daughter cells that are

A. larger and have more cytoplasm than the parent cell

B. genetically identical to the parent cell in every way

C. specialized into multiple different tissue types instantly

D. haploid and genetically different from the parent cell

13. According to the modern theory of evolution, the raw material for natural selection is provided by

A. genetic variation arising from mutation and recombination

B. acquired characteristics gained during the lifetime

C. the deliberate choices of individual organisms each generation

D. environmental conditions altering DNA directly

14. Two species that share a more recent common ancestor would be expected to have

A. completely identical DNA sequences across all genes

B. fewer body structures in common than distantly related species

C. more similar DNA sequences than two distantly related species

D. no fossil record showing any shared ancestral forms

15. The total mass of all living organisms in an ecosystem is referred to as the

A. carrying capacity of the ecosystem

B. biomass of the living organisms

C. limiting factors affecting the population

D. biodiversity of the ecosystem

16. In a food chain that begins with sunlight, energy is first captured by

A. herbivores feeding on plants and small animals

B. decomposers breaking down dead organic matter

C. carnivores feeding on the herbivores in the chain

D. producers performing photosynthesis using sunlight

17. Cleaner fish remove parasites from larger fish while gaining food in the process. The relationship between cleaner fish and larger fish is best classified as

A. parasitism, in which one species harms the other for nutrients

B. commensalism, in which only one species benefits from contact

C. mutualism, in which both species benefit from the interaction

D. competition, in which both species seek the same resource

18. A limiting factor in a desert ecosystem that most directly restricts plant growth is

A. the availability of water during the growing season

B. excessive precipitation in the form of rain and snow

C. abundant nutrients in the rich desert soil

D. low temperatures throughout the entire year

19. A population of deer in a forest grows rapidly at first but then levels off when food becomes scarce. The leveling off indicates that the population has reached the

A. limiting factor of the population's reproductive rate

B. carrying capacity of the surrounding environment

C. minimum number of individuals needed to survive

D. early phase of exponential population growth

20. Water vapor returns to the atmosphere from the leaves of plants by the process of

A. condensation forming dew drops on leaves

B. respiration consuming oxygen and glucose

C. evaporation from the soil's outer surface

D. transpiration through openings on leaf surfaces

21. Bacteria and fungi play an essential role in ecosystems by

A. decomposing dead matter and recycling nutrients

B. providing the main food source for top predators

C. capturing sunlight to produce sugars for plants

D. preventing all changes in ecosystem conditions

22. When a person's body temperature begins to drop below normal, the body may respond by

A. dilating blood vessels in the skin to release heat

B. increasing sweat production to cool the body

C. shivering to generate heat through muscle contraction

D. slowing the heart rate to conserve all energy

23. The chemical breakdown of proteins begins in the

A. mouth, where saliva moistens the food

B. stomach, where acid and pepsin work together

C. small intestine, where bile is secreted

D. esophagus, where food is transported downward

24. The right side of the heart pumps blood to the

A. brain to deliver oxygen-rich blood

B. kidneys to filter wastes from the blood

C. liver to detoxify the blood completely

D. lungs to pick up oxygen for the body

25. Gas exchange in the lungs depends on a large surface area provided by

A. millions of tiny air sacs called alveoli

B. the trachea, the main airway to the lungs

C. the bronchi branching from the main airway

D. mucus secreted along the respiratory pathway

26. The kidneys remove nitrogenous wastes from the blood by producing

A. carbon dioxide gas to be exhaled by the lungs

B. bile that flows into the small intestine for digestion

C. urine that is stored in the urinary bladder

D. sweat that evaporates from the surface of the skin

27. The part of the brain that controls basic involuntary functions such as breathing and heart rate is the

A. cerebrum, responsible for conscious thought

B. cerebellum, which controls voluntary movement

C. spinal cord, the major pathway for nerve signals

D. brainstem, which controls vital involuntary functions

28. The hormone adrenaline (epinephrine) is released in response to stress and prepares the body for

A. a long period of restful sleep and deep recovery

B. a "fight or flight" response with increased heart rate

C. slower digestion of a recently eaten meal

D. lower blood pressure to conserve circulating energy

29. The immune response triggered when a person is exposed to a pathogen for the second time is

A. faster and stronger because of memory cells produced earlier

B. weaker and slower than the first exposure response

C. identical to the response after the first exposure

D. completely independent of memory cells in the body

30. Sperm and egg cells are different from typical body cells because they each contain

A. twice as many chromosomes as body cells contain

B. the same number of chromosomes as body cells contain

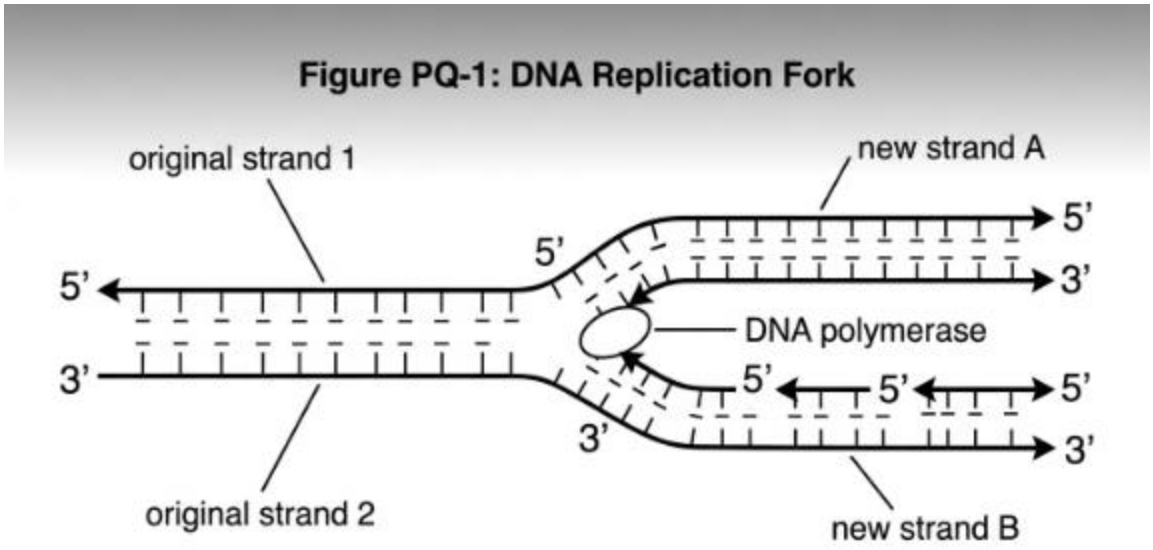
C. half the number of chromosomes found in body cells

D. only one chromosome regardless of species or origin

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

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

31. A student examines a diagram of DNA replication.




The diagram shows DNA replication, a process that produces

A. one new DNA molecule different from the original molecule

B. two identical DNA molecules from one original double helix

C. four new DNA molecules from one original double helix

D. one strand of DNA and one strand of mRNA together

32. Referring to the same diagram, the enzyme labeled DNA polymerase functions to

A. break the bonds connecting the two original strands of DNA

B. convert the original DNA into mRNA for transcription

C. transport finished DNA molecules out of the nucleus

D. add new nucleotides to each growing complementary strand

33. Referring to the same diagram, the base-pairing rules ensure that the new strands have a sequence

A. randomly different from the original strands shown

B. identical to the original strands without any pairing

C. complementary to the original strand they are copied from

D. matching that of an RNA strand rather than DNA

34. Referring to the same diagram, accurate DNA replication is essential because errors in the process can lead to

A. mutations that may affect the function of the resulting protein

B. an immediate change in the cell membrane's structure

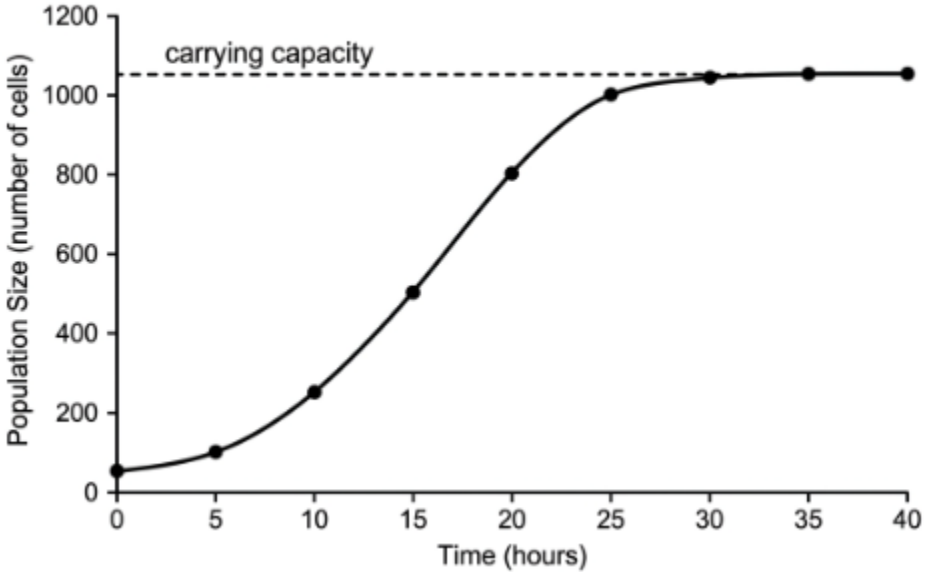
C. complete loss of all chromosomes from the daughter cells

D. permanent conversion of DNA into ribosomes inside the cell

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

35. A student plots the growth of a yeast population in a closed container over time.

**Figure PQ-2: Yeast Population Growth Over Time**




Based on the graph, the population shows the most rapid growth between approximately

A. 0 hours and 5 hours on the graph

B. 25 hours and 35 hours on the graph

C. 35 hours and 40 hours on the graph

D. 10 hours and 20 hours on the graph

36. Based on the same graph, the population size levels off after about 25 hours because

A. the yeast cells stop dividing after exactly one day

B. limiting factors such as food and space slow further growth

C. additional nutrients are added at this time point

D. all of the yeast cells suddenly die from old age

37. Based on the same graph, the dashed line drawn at approximately 1050 cells represents

A. the carrying capacity of the yeast environment

B. the maximum reproductive rate of the yeast culture

C. the smallest number of cells that can survive together

D. the original starting population at time zero

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

38. A Punnett square shows a cross between a man with blood type A (genotype I^A i) and a woman with blood type B (genotype I^B i).

Blood Type Cross: $I^Ai \times I^Bi$.

| | $I^A$ | i |
|---|---|---|
| $I^B$ | $I^AI^B$ (blood type AB) | $I^Bi$ (blood type B) |
| i | $I^Ai$ (blood type A) | ii (blood type O) |

$I^A$ = type A allele; $I^B$ = type B allele; i = type O allele.
$I^A$ and $I^B$ are codominant; i is recessive.

Based on the Punnett square, the possible blood types of the offspring are

A. type A and type AB only

B. only type A and type B

C. type A, type B, type AB, and type O

D. only type AB and type O

39. Based on the same Punnett square, the percentage of offspring expected to have blood type AB is

A. 50% of the offspring

B. 25% of the offspring

C. 75% of the offspring

D. 100% of the offspring

40. Based on the same Punnett square, blood type AB results from a relationship between the I^A and I^B alleles known as

A. complete dominance of one allele over the other

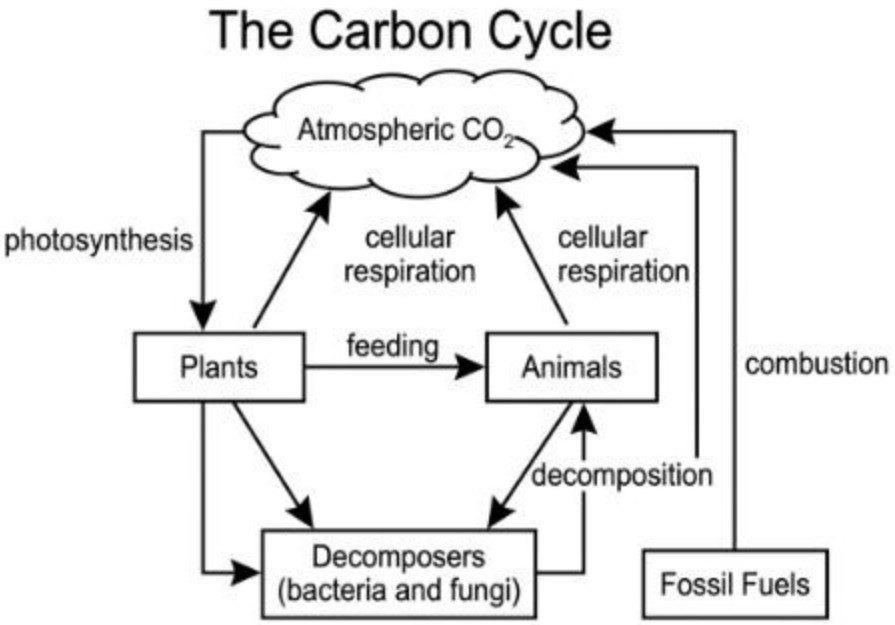
B. sex-linked inheritance on the X chromosome only

C. incomplete dominance producing a blended phenotype

D. codominance of two alleles expressed together

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

41. A student examines a diagram of the carbon cycle.



Based on the diagram, the process that removes carbon dioxide from the atmosphere is

A. cellular respiration carried out by all living organisms

B. combustion of fossil fuels by human industries

C. photosynthesis carried out by plants and algae

D. decomposition of dead matter by bacteria and fungi

42. Based on the same diagram, the human activity shown that adds significant amounts of carbon dioxide to the atmosphere is

A. burning fossil fuels for energy and transportation

B. respiration by living animals throughout the world

C. the decomposition of dead leaves and other matter

D. eating plants and animals as part of the food web

43. Based on the same diagram, if the world's plants were dramatically reduced, the most direct effect on the carbon cycle would be

A. a complete halt to all decomposition activity globally

B. a rise in atmospheric carbon dioxide from reduced photosynthesis

C. an immediate end to all cellular respiration in animals

D. a sharp decrease in the carbon dioxide level in the atmosphere

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

Answer all questions in this part.

44. A student wishes to test whether music tempo affects plant growth. The student plays fast music to one group of plants and no music to another group of plants. In this experiment, the no-music group serves as the

A. independent variable being changed in the test

B. dependent variable being measured by the student

C. experimental group receiving the test treatment

D. control group used for comparison

45. A student examines a data table showing how the rate of photosynthesis changes with light intensity. The most appropriate type of graph to display this relationship is

A. a bar graph comparing two unrelated categories

B. a circle graph showing only percentages of a whole

C. a line graph showing a continuous trend

D. a flowchart of the steps of photosynthesis

46. The number of chromosomes is reduced from diploid to haploid during

A. meiosis I, the first division of meiosis

B. meiosis II, the second division of meiosis

C. mitosis, the division of body cells only

D. fertilization, when sperm joins the egg

47. In a species of fly, red eyes are dominant over white eyes. A red-eyed fly is crossed with a white-eyed fly and produces offspring that are 50% red-eyed and 50% white-eyed. The red-eyed parent must be

A. homozygous dominant for the red allele

B. homozygous recessive for the white allele

C. unable to produce any offspring at all

D. heterozygous with one of each allele

48. Restriction enzymes are used in DNA technology to

A. produce ATP from breakdown of nucleotides

B. cut DNA at specific recognition sequences

C. fold DNA into chromosomes inside the nucleus

D. translate mRNA codons into amino acid chains

49. The Galápagos finches studied by Charles Darwin show that

A. similar species can develop different beak shapes adapted to different food sources

B. all species on a single island remain identical to one another forever

C. natural selection is unable to act on isolated island populations

D. acquired characteristics from feeding behavior are easily inherited

50. A keystone species is one that

A. is the most numerous species in any given ecosystem at all times

B. competes most successfully with other species in the area

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

D. produces the most biomass at the base of every food chain

51. In a typical food chain, the organisms with the smallest total amount of available energy are

A. the producers at the bottom of the food chain

B. the primary consumers eating the producers directly

C. the decomposers that recycle dead material in soil

D. the top consumers at the end of the food chain

52. The biome found near the equator with very high rainfall and the greatest diversity of plant and animal life is the

A. temperate grassland of dry interior regions

B. tropical rainforest of warm equatorial regions

C. taiga of cold northern coniferous forests

D. polar tundra with permafrost and short summers

53. A freshwater lake is divided into the littoral zone near the shore and the open-water zone away from the shore. Most photosynthesis in the open-water zone occurs

A. near the water surface where light penetrates the most

B. on the lake bottom where light is completely unavailable

C. deep within the lake's sediment layers near the bottom

D. only at night when the water temperatures are cooler

54. The release of chlorofluorocarbons (CFCs) into the atmosphere has been linked to

A. increased global biodiversity in the tropical zones

B. the formation of acid rain over forested regions

C. nitrogen pollution of freshwater lakes and streams

D. depletion of the ozone layer in the stratosphere

55. The most effective long-term strategy for protecting an endangered species in the wild is to

A. capture all remaining individuals for permanent zoo housing

B. release predators of the species into the surrounding area

C. preserve and restore the species' natural habitat

D. hunt other species that compete with it for resources

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

Answer all questions in this part.

56. A cell that is actively dividing rapidly would be expected to contain a large number of

A. ribosomes assembling protein chains constantly

B. mitochondria producing ATP for cell division

C. lysosomes digesting waste materials within the cell

D. chloroplasts performing photosynthesis steadily

57. Two pea plants heterozygous for both seed color and seed shape are crossed. According to the laws of independent assortment, the offspring will show

A. four different phenotypes in a 9:3:3:1 ratio

B. only one phenotype combining the two dominant traits

C. only two phenotypes in a 1:1 ratio of dominant traits

D. eight different phenotypes equally distributed among offspring

58. A trait that is determined by genes carried on the X chromosome and that occurs more often in males than in females is best described as

A. an autosomal dominant trait without linkage

B. an autosomal recessive trait without linkage

C. a sex-linked recessive trait on the X chromosome

D. a polygenic trait controlled by many genes

59. After the genetic code in a gene is transcribed into an mRNA strand, the mRNA travels to a ribosome where it directs the assembly of a protein. The overall flow of information just described is

A. protein → mRNA → DNA in the cytoplasm

B. mRNA → DNA → protein in the nucleus

C. protein → DNA → mRNA in the cytoplasm

D. DNA → mRNA → protein at the ribosome

60. Evidence that all living organisms share a common ancestor includes the fact that nearly all organisms

A. have the same number of chromosomes in every cell

B. use the same genetic code based on the same nitrogen bases

C. produce exactly the same proteins as one another

D. live in the same kinds of habitats throughout the world

61. Animals that live in cold climates often have small ears and short tails relative to their body size. This pattern is best understood as

A. a behavioral adaptation learned during the animal's life

B. evidence that cold environments are slowly warming

C. a structural adaptation that reduces heat loss

D. a sign of poor nutrition during early development

62. A small island has a population of rabbits that increases rapidly until food becomes scarce, after which the population falls sharply. This pattern is best described as

A. a population overshoot followed by a decline

B. a steady population at the carrying capacity for many years

C. random fluctuations unrelated to any environmental change

D. a gradual extinction following human hunting pressure

63. A toxic substance such as mercury that enters an ecosystem at low levels can become increasingly concentrated in the bodies of organisms at higher trophic levels. This process is called

A. nitrogen fixation by symbiotic bacteria in plant roots

B. cellular respiration that breaks down stored substances

C. eutrophication of nutrient-poor lakes and ponds

D. biomagnification along the food chain

64. When blood calcium levels fall below normal, the parathyroid glands release parathyroid hormone, which causes calcium to be released from bones. This is an example of

A. positive feedback amplifying an initial change

B. negative feedback restoring homeostatic balance

C. an immune response to a foreign pathogen

D. a reflex action mediated by the spinal cord

65. A newborn baby inherits some short-term immunity from its mother. This type of immunity is called

A. passive immunity, with antibodies received from another source

B. active immunity, with the body producing its own antibodies

C. genetic immunity, encoded directly in the DNA from birth

D. acquired immunity, learned by exposure to many pathogens

66. After fertilization, the zygote undergoes repeated cell divisions by mitosis to form

A. a haploid gamete with half the number of chromosomes

B. an unfertilized egg ready for another sperm cell

C. a single specialized cell that cannot divide further

D. a multicellular embryo with many identical cells

67. In flowering plants, the male reproductive cells are produced inside

A. the stigma at the top of the female part of the flower

B. the ovary at the base of the female part of the flower

C. pollen grains formed on the anther of the stamen

D. the petals that surround the flower's reproductive parts

68. The skin acts as the body's first line of defense by

A. producing antibodies against foreign pathogens

B. providing a physical barrier against invading microbes

C. absorbing all toxins from the bloodstream directly

D. circulating oxygen to deeper body tissues

69. Although every cell in a multicellular organism contains the same DNA, different cells perform different functions because

A. different genes are expressed in different cell types

B. each cell type contains a different DNA sequence

C. only certain cells contain any DNA at all

D. cells in different tissues lose chromosomes over time

70. Stem cells are valuable in biomedical research because they have the ability to

A. produce ATP at much higher rates than other cells

B. capture sunlight and perform photosynthesis directly

C. differentiate into many different specialized cell types

D. survive without oxygen for indefinite periods of time

71. The process by which scientists determine the order of nitrogen bases in a DNA sample is called

A. gel electrophoresis, which separates DNA fragments by size

B. polymerase chain reaction, which copies many DNA pieces

C. restriction digestion, which cuts DNA into smaller fragments

D. DNA sequencing, which reads the base order in a strand

72. A scientist produces an exact genetic copy of a single organism using a body cell from that organism. This procedure is best described as

A. genetic engineering using recombinant DNA techniques

B. cloning to produce a genetically identical organism

C. selective breeding to combine the best traits from each parent

D. natural selection acting on inherited variation in a population

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

Answer all questions in this part.

73. In the Beaks of Finches laboratory, students use different "beak" tools to pick up small "seeds." This activity is designed to simulate the concept of

A. natural selection acting on a population's variation

B. cellular respiration occurring inside body cells

C. photosynthesis in chloroplasts capturing sunlight

D. the structure of the cell membrane controlling transport

74. In the Diffusion Through a Membrane laboratory, the cell membrane is modeled by

A. a layer of paraffin wax surrounding the experimental setup

B. a glass tube open at both ends to the environment

C. a piece of selectively permeable dialysis tubing

D. a sheet of aluminum foil covering the apparatus

75. To calculate the total magnification of a specimen viewed through a compound microscope, the magnification of the eyepiece should be

A. divided by the magnification of the objective lens

B. subtracted from the magnification of the objective lens

C. added to the magnification of the objective lens

D. multiplied by the magnification of the objective lens

76. A student spills a small amount of an unknown chemical on the lab bench. The first action the student should take is to

A. wipe the spill quickly with a paper towel and continue working

B. notify the teacher immediately about the spill and the chemical

C. add water to the spill to dilute it before cleanup begins

D. cover the spill with a textbook to keep it contained

77. In the Relationships and Biodiversity laboratory, students may use indicator solutions to detect

A. the presence of carbon dioxide in plant cells

B. the wavelength of light absorbed by chlorophyll

C. the presence of specific molecules like starch or proteins

D. the rate of heart contraction in animal subjects

78. In the Making Connections laboratory, students often graph their data to better see relationships. When data are plotted, the variable along the horizontal x-axis is usually the

A. independent variable that the experimenter controls

B. dependent variable that responds to the change

C. random variable that has no effect on the results

D. controlled variable that is kept constant throughout

79. In the Beaks of Finches laboratory, students that fail to gather enough "seeds" in a round are considered to have

A. successfully reproduced within the population

B. won the competition for resources that round

C. moved to a different habitat with more food available

D. failed to survive the round and not reproduced

80. In the Diffusion Through a Membrane laboratory, the chemical used to test for the presence of starch is

A. Benedict's solution, which detects glucose by changing color

B. iodine solution, which turns blue-black in the presence of starch

C. methylene blue, which stains cell structures purple

D. phenolphthalein, which detects changes in solution pH

81. A student observes a paramecium through a compound microscope. The most appropriate unit for measuring the length of this microscopic organism is

A. micrometers (μm) for the microscopic specimen

B. kilometers (km) for the microscopic specimen

C. meters (m) for the microscopic specimen

D. milliliters (mL) for the microscopic specimen

82. In the Making Connections laboratory, students measure the time it takes to develop muscle fatigue while squeezing a clothespin repeatedly. This procedure is designed to investigate

A. the rate at which bacteria reproduce in a culture

B. the absorption of nutrients in the small intestine

C. how exercise affects skeletal muscle performance

D. the effect of light on the rate of photosynthesis

83. The four required New York State Living Environment laboratory investigations include all of the following EXCEPT

A. the Relationships and Biodiversity laboratory

B. the Diffusion Through a Membrane laboratory

C. the Making Connections laboratory on exercise

D. the Frog Dissection and Anatomy laboratory

84. The instrument used to measure the volume of a liquid most accurately in a biology laboratory is

A. a triple-beam balance with three sliding masses

B. a graduated cylinder with marked volume lines

C. a metric ruler marked in centimeters and millimeters

D. a thermometer that measures temperature in Celsius

85. After completing an experiment, a student should base any conclusion drawn from the experiment on

A. the data and observations collected during the experiment

B. the original hypothesis regardless of any results

C. the conclusions reached by other students at the same time

D. opinions held about the topic before the experiment began

# ANSWER KEY WITH EXPLANATIONS – Practice Exam 7

**1. B** — A cell is the smallest unit that can carry out all life functions including metabolism, response to stimuli, reproduction, and homeostasis. Tissues, organs, and organisms are all built from cells, but individual cells alone are capable of independent life activities. This principle is the foundation of the cell theory.

**2. D** — Active transport moves substances against their concentration gradient (from low to high concentration), which requires energy supplied by ATP. Diffusion, osmosis, and facilitated diffusion all move substances down their gradients and require no energy input. ATP-powered transport allows cells to accumulate needed nutrients and expel wastes.

**3. A** — Enzymes are highly specific because the substrate must fit precisely into the enzyme's active site, just like a key fits one specific lock. This "lock and key" model explains why each enzyme typically catalyzes only one type of reaction. Specificity ensures controlled, organized metabolism rather than chaotic chemical reactions.

**4. C** — The Golgi apparatus receives proteins from the rough ER, modifies them, sorts them, and packages them into vesicles for delivery inside or outside the cell. The nucleus stores DNA, mitochondria produce ATP, and ribosomes build proteins — only the Golgi packages and ships them.

**5. B** — Aerobic respiration follows the equation glucose + oxygen → carbon dioxide + water + ATP. Carbon dioxide is released as a gaseous waste, and water is produced when oxygen accepts electrons at the end of the electron transport chain. ATP is the useful energy product captured for cellular work.

**6. A** — The oxygen released during photosynthesis comes from water molecules split during the light reactions, not from carbon dioxide. This was confirmed by isotope-labeling experiments showing that oxygen atoms in $O_2$ trace back to $H_2O$. Water splitting also provides electrons used to reduce $NADP^+$ and produce ATP.

**7. D** — In a DNA double helix, one strand runs 5'-to-3' while the other runs 3'-to-5' (antiparallel orientation), and the bases pair specifically (A with T, G with C) across the strands. This complementary, antiparallel structure allows accurate replication because each strand serves as a template for a new partner strand.

**8. C** — Messenger RNA is transcribed from a DNA template in the nucleus and then travels through nuclear pores to ribosomes in the cytoplasm, where it directs protein synthesis. DNA itself stays in the nucleus, tRNA carries amino acids, and ATP supplies energy — only mRNA carries the gene's coded message to the ribosome.

**9. A** — Females are XX and produce only X-bearing eggs, while males are XY and produce both X-bearing and Y-bearing sperm in equal numbers. The chromosome carried by the fertilizing sperm therefore determines whether the offspring is XX (female) or XY (male). The mother's hormones and uterine position do not control sex.

**10. B** — When two unaffected parents have a child with a recessive trait, both parents must carry one copy of the recessive allele while expressing the dominant phenotype — they are heterozygous carriers. Their child inherited one recessive allele from each parent, producing the homozygous recessive genotype required for the blue-eye phenotype.

**11. C** — A point mutation is a change in a single nitrogen base of DNA, which may substitute, insert, or delete one base. Chromosomal mutations affect entire chromosomes, while translocations and duplications affect larger DNA regions. Single-base changes can still significantly alter the resulting protein if they shift the reading frame or hit a key codon.

**12. D** — Meiosis produces four haploid daughter cells, each with half the chromosome number of the parent cell and genetically different due to crossing over and independent assortment. Mitosis, in contrast, produces two diploid, genetically identical daughter cells. This chromosomal reduction is essential for sexual reproduction.

**13. A** — Natural selection acts on heritable variation that already exists in a population, and that variation arises mainly from random mutation and the recombination of alleles during sexual reproduction. Without this raw genetic variation, selection would have nothing to act on, and populations could not evolve over time.

**14. C** — Species that share a more recent common ancestor have had less time to accumulate genetic differences, so their DNA sequences are more similar. Comparative DNA analysis is now one of the strongest tools for determining evolutionary relationships and constructing phylogenetic trees among modern species.

**15. B** — Biomass refers to the total dry mass of all living organisms in an ecosystem at a given trophic level or in the system as a whole. Carrying capacity is the maximum sustainable population, biodiversity is species variety, and limiting factors restrict growth — none describe total living mass.

**16. D** — Producers (mainly plants, algae, and some bacteria) capture sunlight through photosynthesis and convert it into chemical energy stored in glucose. This energy is then passed up the food chain to consumers and decomposers. Without producers, no other trophic level could exist.

**17. C** — In mutualism, both partners benefit from the relationship. Cleaner fish gain food by eating parasites, while larger fish are freed from harmful parasites and gain a health benefit. The mutual advantage is the defining feature distinguishing mutualism from parasitism or commensalism.

**18. A** — In a desert, water is the most severely limited resource and the primary factor restricting plant growth. Desert soils are often nutrient-poor, and high temperatures and drought further reduce available moisture. Plants that survive in deserts show many adaptations for water conservation.

**19. B** — Carrying capacity is the maximum population size that the environment can sustain over time given available resources. When food, water, space, or other limiting factors become scarce, population growth slows and stabilizes at carrying capacity. This concept explains the S-shaped logistic growth curve.

**20. D** — Transpiration is the loss of water vapor from a plant's leaves through small openings called stomata. This process is crucial in the water cycle, helping return water to the atmosphere and also driving the upward transport of water from roots through the plant.

**21. A** — Decomposers — primarily bacteria and fungi — break down dead organisms and waste products, releasing nutrients back into the soil and water where producers can reuse them. Without decomposers, essential nutrients would remain locked in dead matter and ecosystems would collapse.

**22. C** — Shivering involves rapid muscle contractions that generate heat as a byproduct, helping raise body temperature back toward normal. Dilating skin vessels and sweating both release heat, while a slower heart rate does not generate heat. Shivering is a key negative-feedback response to cold.

**23. B** — Protein digestion begins in the stomach, where hydrochloric acid creates an acidic environment and activates pepsin, the enzyme that begins breaking proteins into smaller peptides. The mouth digests carbohydrates with amylase, and protein digestion continues in the small intestine with pancreatic enzymes.

**24. D** — The right ventricle pumps oxygen-poor blood through the pulmonary artery to the lungs, where it picks up oxygen and releases carbon dioxide. The oxygenated blood then returns to the left side of the heart, which pumps it out to the body. This is known as the pulmonary circuit.

**25. A** — Alveoli are tiny grape-like air sacs that provide an enormous surface area for the diffusion of oxygen into the blood and carbon dioxide out of the blood. Their thin walls (one cell thick) and rich capillary network make gas exchange highly efficient. Diseases that damage alveoli severely impair breathing.

**26. C** — The kidneys filter waste products, especially urea, from the blood and excrete them in urine, which is stored in the urinary bladder until elimination. Bile is produced by the liver, carbon dioxide is removed by the lungs, and sweat removes only minor amounts of waste — the kidneys are the main waste-filtering organ.

**27. D** — The brainstem (including the medulla and pons) controls involuntary vital functions such as breathing, heart rate, and blood pressure. The cerebrum handles conscious thought, the cerebellum coordinates movement, and the spinal cord transmits signals — only the brainstem directs basic survival functions.

**28. B** — Adrenaline triggers the "fight or flight" response, which increases heart rate, breathing rate, and blood flow to muscles, preparing the body to respond rapidly to a perceived threat. It also raises blood glucose by promoting glycogen breakdown, providing fuel for sudden action.

**29. A** — On a second exposure to the same pathogen, memory B and T cells produced during the first exposure recognize the antigen immediately and trigger a rapid, large antibody response. This stronger secondary response often prevents illness entirely and is the principle behind vaccination.

**30. C** — Sperm and egg cells are gametes produced by meiosis and contain only half the chromosome number (haploid, 23 in humans) of body cells (diploid, 46). At fertilization, the haploid gametes combine to restore the diploid chromosome number in the zygote.

**31. B** — DNA replication is semi-conservative: each original strand serves as a template, producing two daughter DNA molecules that each contain one original and one new strand. The two resulting molecules are identical to the original. This precise copying ensures genetic information is faithfully passed to new cells.

**32. D** — DNA polymerase reads each template strand and adds the appropriate complementary nucleotides one at a time, building the new strand in the 5'-to-3' direction. The enzyme also proofreads its work, removing incorrectly paired bases to maintain replication accuracy.

**33. C** — Because A pairs with T and G pairs with C, each new strand assembles in an order that is complementary to (not identical to) its template. The result is two complete DNA molecules, each with one original and one new strand, both carrying the same genetic information.

**34. A** — A replication error that is not corrected leaves a permanent mutation in the daughter DNA. If the change affects the coding sequence of a gene, the resulting protein may be misfolded or non-functional. Most mutations are neutral or harmful, though rare beneficial mutations provide raw material for evolution.

**35. D** — Between 10 and 20 hours the population rises from about 250 to 800 cells, the steepest portion of the S-curve. This is the exponential growth phase, during which resources are abundant and limiting factors have not yet slowed reproduction.

**36. B** — Once nutrients become limited and waste products accumulate in the closed container, fewer yeast cells can survive or reproduce, so the population plateaus. This represents the logistic growth pattern, in which growth slows as a population approaches the environment's carrying capacity.

**37. A** — Carrying capacity is the maximum population size that the environment can support given available resources. The dashed line at 1050 cells marks this upper limit, and the curve levels off there because births and deaths roughly balance. Populations rarely exceed carrying capacity for long.

**38. C** — Crossing I^A i × I^B i produces four genotype combinations: I^A I^B (AB), I^A i (A), I^B i (B), and ii (O). All four blood types therefore appear among the offspring because of the three-allele system in ABO inheritance. This is a classic example of multiple alleles affecting a single trait.

**39. B** — Only one of the four cells in the Punnett square (I^A I^B, top-left) produces blood type AB, giving a 1 in 4 chance. With each cell representing 25% probability, the expected proportion of AB offspring is 25%. The remaining 75% are distributed equally among types A, B, and O.

**40. D** — Codominance occurs when both alleles in a heterozygote are fully and equally expressed in the phenotype. In blood type AB, both the I^A allele (which makes the A antigen) and the I^B allele (which makes the B antigen) are expressed, producing red blood cells with both antigens on their surface.

**41. C** — Photosynthesis is the only process in the diagram that removes $CO_2$ from the atmosphere, converting it into glucose using sunlight energy. The other processes shown — respiration, decomposition, and combustion — all release $CO_2$ back into the atmosphere. Plants therefore serve as a major carbon sink.

**42. A** — Combustion of fossil fuels is the major human activity adding $CO_2$ to the atmosphere because it releases carbon that was locked underground for millions of years. Animal respiration and decomposition are natural processes that have always cycled carbon; the rapid release from burning fuels disrupts the balance.

**43. B** — Plants are the main sink for atmospheric $CO_2$ through photosynthesis. A dramatic loss of plant life would greatly reduce $CO_2$ uptake while respiration and decomposition continue releasing $CO_2$, causing atmospheric concentrations to rise. This is why deforestation is a major climate concern.

**44. D** — A control group does not receive the experimental treatment and provides a baseline for comparison with the treated group. Without a control (no music), differences in plant growth could not be attributed specifically to the music tempo, since other factors might also affect growth.

**45. C** — A line graph is best for displaying continuous data showing how one variable changes in response to another. Since light intensity is a continuous variable and photosynthesis rate is measured continuously, the relationship between them is most clearly shown as a line graph with a smooth trend.

**46. A** — Meiosis I separates homologous chromosome pairs, reducing the chromosome number from diploid (2n) to haploid (n). Meiosis II then separates the sister chromatids, producing four haploid daughter cells. The reduction to haploid status occurs specifically during meiosis I.

**47. D** — A 50:50 ratio of red-eyed to white-eyed offspring from a red × white cross is the result of a heterozygous (Rr) red-eyed parent and a homozygous recessive (rr) white-eyed parent — a classic test cross. A homozygous dominant (RR) parent would yield 100% red-eyed offspring instead.

**48. B** — Restriction enzymes recognize specific short DNA sequences and cut the DNA at those sites, producing precisely defined fragments. This ability to cut DNA at predictable locations is fundamental to recombinant DNA technology, gene cloning, and DNA fingerprinting.

**49. A** — Darwin observed that Galápagos finches descended from a common ancestor had evolved different beak shapes adapted to their specific food sources on different islands — seeds, insects, or fruit. This adaptive radiation provided strong support for evolution by natural selection.

**50. C** — A keystone species exerts an effect on its ecosystem far greater than would be expected from its population size or biomass. Sea otters, wolves, and certain starfish are classic examples — their removal can cause dramatic ecosystem changes through cascading effects on other species.

**51. D** — Because only about 10% of energy transfers between trophic levels, the cumulative losses leave top consumers with the smallest share of the original solar energy captured by producers. This is why top predator populations are typically small and food chains rarely have more than four or five levels.

**52. B** — Tropical rainforests near the equator receive year-round warmth and abundant rainfall, supporting the highest plant productivity and species diversity of any terrestrial biome. Although they cover only about 6% of Earth's land, they contain more than half of all known plant and animal species.

**53. A** — Light is required for photosynthesis, and it penetrates only the upper layer (photic zone) of a lake. Most photosynthetic plankton (phytoplankton) therefore live near the surface where sunlight is available. Deeper waters are too dark for photosynthesis to occur.

**54. D** — CFCs released into the atmosphere rise to the stratosphere, where ultraviolet radiation breaks them apart and frees chlorine atoms that destroy ozone molecules. The resulting thinning of the ozone layer allows more UV radiation to reach Earth's surface, increasing risks of skin cancer and ecosystem damage.

**55. C** — Habitat preservation and restoration is the most effective long-term conservation strategy because most species are endangered primarily due to habitat loss. Protecting wild populations in their natural settings preserves genetic diversity, ecosystem services, and species interactions that captivity cannot replicate.

**56. B** — Cell division requires large amounts of ATP for chromosome movement, spindle formation, and cytokinesis. Rapidly dividing cells therefore contain many mitochondria to meet this energy demand. Ribosomes, lysosomes, and chloroplasts serve different functions unrelated to powering mitosis directly.

**57. A** — A dihybrid cross between two double heterozygotes (RrYy × RrYy) for traits showing independent assortment produces a 9:3:3:1 phenotypic ratio in the offspring. This classic Mendelian ratio reflects the independent inheritance of two unlinked genes, each segregating in a 3:1 pattern.

**58. C** — Genes on the X chromosome are sex-linked. Males (XY) have only one X chromosome, so a single recessive X-linked allele will be expressed in the phenotype. Females (XX) typically need two recessive alleles to express the trait, which is rarer — explaining the higher male prevalence.

**59. D** — The "central dogma" of molecular biology states that genetic information flows from DNA → mRNA (transcription) → protein (translation). DNA serves as the master template, mRNA carries the message, and protein is the functional product synthesized at the ribosome.

**60. B** — Nearly all living organisms — from bacteria to humans — use the same four DNA bases (A, T, G, C) and the same triplet code to specify amino acids. This universality of the genetic code is one of the strongest pieces of evidence that all life on Earth shares a single common ancestor.

**61. C** — Smaller surface-area-to-volume ratios reduce heat loss from the body. Small ears and short tails minimize exposed surface, which is a structural adaptation favored by natural selection in cold environments. This pattern is described by Allen's rule among warm-blooded animals.

**62. A** — When a population grows beyond what its environment can sustain, food and other resources become depleted, causing mortality to spike sharply. This overshoot-and-decline pattern is common in populations whose growth temporarily exceeds the carrying capacity of their habitat.

**63. D** — Biomagnification is the increasing concentration of persistent toxins in organisms at successively higher trophic levels. Mercury and DDT are classic examples: small amounts in producers become highly concentrated in top predators that consume large numbers of contaminated organisms over their lifetimes.

**64. B** — Parathyroid hormone release in response to low blood calcium is a corrective negative feedback response that restores normal calcium levels. Negative feedback opposes the initial change, helping maintain homeostasis. Positive feedback, in contrast, amplifies the initial change.

**65. A** — Passive immunity involves antibodies received from another source rather than produced by the individual's own immune system. Maternal antibodies cross the placenta and are also delivered in breast milk, providing short-term protection to a newborn whose immune system has not yet matured.

**66. D** — A zygote undergoes mitosis to produce many genetically identical cells that form the early embryo. These cells later differentiate into specialized tissues. Mitosis preserves the diploid chromosome number, ensuring every body cell of the embryo carries the same genetic information as the original zygote.

**67. C** — Pollen grains contain the male gametes (sperm cells) of flowering plants and develop on the anther, the pollen-producing structure at the top of the stamen. The stigma, ovary, and petals are parts of the female reproductive structure or the flower's protective covering.

**68. B** — Intact skin acts as a physical barrier that blocks most microorganisms from entering the body — the first line of defense in the innate immune system. Skin secretions are also slightly acidic, further inhibiting microbial growth. Internal immune responses come into play only when this barrier is breached.

**69. A** — All cells in a multicellular organism share the same DNA, but each cell type expresses only a subset of those genes. Differential gene expression — turning specific genes on or off — is what makes a muscle cell function differently from a nerve cell despite their identical genomes.

**70. C** — Stem cells are undifferentiated cells with the capacity to develop into many different specialized cell types. This potential makes them valuable for regenerative medicine, where they may be used to repair or replace damaged tissues such as nerve, heart muscle, or pancreatic cells.

**71. D** — DNA sequencing determines the exact order of the four nitrogen bases (A, T, G, C) in a DNA sample. Gel electrophoresis sorts DNA fragments by size, PCR copies DNA segments, and restriction digestion cuts DNA — only sequencing reads the actual base order.

**72. B** — Cloning produces a genetically identical organism from a single cell of an existing organism, typically by transferring its nucleus into an enucleated egg. Dolly the sheep was the first famous mammal cloned in this way. The resulting individual carries the same genome as the original.

**73. A** — In the Beaks of Finches simulation, different "beaks" represent inherited variations in a trait, and the most successful "feeders" survive and reproduce. This models how natural selection acts on heritable variation, favoring individuals best suited to their environment.

**74. C** — The dialysis tubing used in this lab is selectively permeable: small molecules like water and glucose can pass through its pores, while larger molecules like starch cannot. This mimics the behavior of a real cell membrane, which controls what enters and exits the cell.

**75. D** — Total magnification equals the magnification of the eyepiece (usually 10×) multiplied by the magnification of the objective lens (e.g., 4×, 10×, 40×, 100×). For example, a 10× eyepiece combined with a 40× objective produces a total magnification of 400×.

**76. B** — Notifying the teacher immediately is the correct first step because the chemical may be hazardous and require special cleanup procedures. The teacher can identify the substance and direct an appropriate response. Wiping, adding water, or covering the spill could cause harm or worsen the situation.

**77. C** — In the Relationships and Biodiversity lab, indicator solutions such as iodine (for starch) and Benedict's reagent (for glucose) detect the presence of specific molecules in plant samples. These tests help determine biochemical similarities among species and infer evolutionary relationships.

**78. A** — By scientific convention, the independent variable (the one the experimenter changes) is plotted on the x-axis, and the dependent variable (the response being measured) is plotted on the y-axis. This makes it easy to read off how the dependent variable changes as the independent variable changes.

**79. D** — In the Beaks of Finches simulation, students who fail to collect enough "seeds" to "survive" are removed from the next round and do not "reproduce." This models the differential reproductive success that drives natural selection — less successful variants leave fewer offspring.

**80. B** — Iodine solution is the standard indicator for starch. In contact with starch, iodine forms a deep blue-black color due to a structural complex with starch's helical chains. Benedict's solution detects sugars, methylene blue stains cells, and phenolphthalein tests pH — only iodine detects starch.

**81. A** — Paramecia are about 50–300 micrometers long, so micrometers (μm) are the appropriate unit for measuring microscopic specimens. Larger units like meters or kilometers vastly exceed the size of the organism, and milliliters measure volume rather than length.

**82. C** — The Making Connections lab investigates how exercise affects muscle performance. Repeatedly squeezing a clothespin causes the small hand muscles to fatigue, allowing students to measure how factors such as rest periods or fitness level influence muscle endurance.

**83. D** — The four required New York State Living Environment labs are Relationships and Biodiversity, Diffusion Through a Membrane, Making Connections, and Beaks of Finches. Frog Dissection is not one of the four required investigations under current state standards.

**84. B** — A graduated cylinder is designed specifically for accurate volume measurement, with marked lines indicating volume to within fractions of a milliliter. A balance measures mass, a ruler measures length, and a thermometer measures temperature — none measure liquid volume accurately.

**85. A** — Scientific conclusions must be based on the actual data and observations collected, not on prior beliefs, hypotheses, or peer opinions. Even if the data contradict the original hypothesis, the conclusion must follow the evidence. This principle is fundamental to the integrity of the scientific method.