Item Position	Rationales	
1	Option B is correct	Section X has the steepest slope, showing a rapid change in the average number of rings on trilobite tails, which was likely caused by a rapidly changing environment.
	Option A is incorrect	Section W has a more gradual slope than Section X, showing a slower rate of change in the average number of rings on trilobite tails, which suggests that there was little change to the environment.
	Option C is incorrect	Section Y has a more gradual slope than Section X, showing a slower rate of change in the average number of rings on trilobite tails, which suggests that there was little change to the environment.
	Option D is incorrect	Section Z has the most gradual slope of all the sections of the graph, showing the slowest rate of change in the average number of rings on trilobite tails and suggesting a stable environment, not a rapidly changing one.

Item Position	Rationales	
2	Option B is correct	Structure W in the diagram is made of multiple genes, so it is a chromosome. Structure Z in the diagram is made of many base pairs, so it is a gene.
	Option A is incorrect	"Structure W in the diagram is made of multiple genes, so it is a chromosome, not a gene. Structure Z in the diagram is made of many base pairs, so it is a gene, not a chromosome.
	Option C is incorrect	The diagram does not show any amino acids. Structure W and Structure Z are both nucleic acids.
	Option D is incorrect	The diagram does not show any amino acids. Structure W and Structure Z are both nucleic acids.

Item Position	Rationales	
3	Option D is correct	Both theories suggest that complex eukaryotic cells evolved from simpler prokaryotic cells.
	Option A is incorrect	Neither theory addresses the relative complexity of organelles.
	Option B is incorrect	Only the endosymbiotic theory suggests that cells joined together; furthermore, cells would have become more complex by joining with other cells.
	Option C is incorrect	Neither theory discusses a timeline.

Item Position	Rationales	
4	Part A	
	Option B is correct	The biodiversity of frog species increases the likelihood that the ecosystem will have alternative resources available when conditions change.
	Option A is incorrect	Diverse ecosystems are more resilient in the face of change, not less resilient.
	Option C is incorrect	Ecosystem biodiversity does not reduce the adaptability of individual organisms.
	Option D is incorrect	Ecosystem biodiversity does not directly affect the resilience of individual organisms.
	Part B	
	Option A is correct	Species biodiversity increases the likelihood that many species can fill similar roles in an ecosystem.
	Option B is incorrect	Species biodiversity reduces the likelihood that the loss of a single species would devastate an ecosystem.
	Option C is incorrect	Adaptation does not increase the likelihood that change will cause multiple extinctions in an ecosystem.
	Option D is incorrect	Competition among native species increases the likelihood that all resources will be in use, which makes it more difficult for invasive organisms to become established.

Item Position	Rationales	
5	Option B is correct	When a splinter enters the body, the integumentary system alerts the body first, and then the immune system sends white blood cells to the injured area.
	Option A is incorrect	The skin (part of the integumentary system) must first alert the body before the immune system can react.
	Option C is incorrect	The immune system does not release water into an injured area of the body.
	Option D is incorrect	The increase in temperature is a result of the circulatory system, not the immune system.

Item Position	Rationales	
6	Option C is correct	The ribosome holds the mRNA molecule, allowing the tRNA molecules to bring the amino acids that will form a polypeptide or protein in the process of protein synthesis.
	Option A is incorrect	This is not an image of the endoplasmic reticulum; RNA is created in the nucleus from DNA through the process of transcription.
	Option B is incorrect	This is not an image of the endoplasmic reticulum; translation occurs when mRNA copies of a section of DNA are translated to a polypeptide or protein as tRNA molecules carry the amino acids to the ribosome.
	Option D is incorrect	This is the reverse of the correct answer; the ribosome holds the mRNA molecule, allowing the tRNA molecules to bring the amino acids that will form a polypeptide or protein in the process of protein synthesis.

Item Position	Rationales	
7	Option B is correct	The coastal populations have a light coat color, and the inland population has a dark coat color; analyzing the frequencies of the *Agouti* and *Mc1r* genes in these populations could help determine whether natural selection has led to certain genes becoming predominant in certain populations.
	Option A is incorrect	The coastal populations have the same phenotype, but they have mutations in different genes.
	Option C is incorrect	The populations all have the *Agouti* and *Mc1r* genes.
	Option D is incorrect	The populations all have the *Agouti* and *Mc1r* genes; mutations in these genes result in different coat colors in the populations.

Item Position	Rationales	
8	Option D is correct	Enzymes are proteins that catalyze reactions, and the primary function of DNA, which is a nucleic acid, is to store and carry genetic material.
	Option A is incorrect	Lipids do not carry genetic material; carbohydrates provide energy but do not catalyze reactions.
	Option B is incorrect	Carbohydrates do not carry genetic information; nucleic acids are not responsible for catalyzing reactions.
	Option C is incorrect	Nucleic acids, not proteins, carry genetic material; proteins, not lipids, catalyze reactions.

Item Position	Rationales	
9	2 pts	The student's response states that Student B is correct because eukaryotic organisms have DNA stored within a nucleus, while prokaryotic organisms do not.
	1 pt	The student answers half of the questions correctly. Student B is correct. OR Eukaryotic organisms have a nucleus. OR Prokaryotic and eukaryotic organisms can both have cell walls. OR Prokaryotic and eukaryotic organisms both have cytoplasm and ribosomes.
	0 pt	The response is incorrect or irrelevant.

Item Position	Rationales	
10	Option D is correct	The destruction of bacteria in the soil would affect the uptake of nitrogen by plants more than the other changes would because bacteria fix nitrogen in the soil into a form that can be taken up by plants.
	Option A is incorrect	A period of seasonal rainfall would not affect the uptake of nitrogen by plants as much as the destruction of bacteria in the soil would.
	Option B is incorrect	A decrease in the burning of fossil fuels would be unlikely to affect the uptake of nitrogen by plants.
	Option C is incorrect	An increase in herbivore populations would be unlikely to affect the uptake of nitrogen by plants.

Item Position	Rationales	
11	Option A is correct	Hares whose fur color changed color as the seasons changed survived and were able to pass their traits to offspring.
	Option B is incorrect	Hares change their fur color as camouflage, not to attract mates.
	Option C is incorrect	Natural selection is not the cause of mutations.
	Option D is incorrect	While some animals have fur that changes color for various reasons throughout their lives, the hare's fur changes in response to seasonal changes and helps provide the hares with camouflage.

Item Position	Rationales	
12	Option C is correct	The length of daylight stimulates the plant to produce the hormones needed for flowering to occur.
	Option A is incorrect	The pigment in flowers helps attract pollinators and does not initiate blooming.
	Option B is incorrect	Water enters the plant through the root structure and travels to other parts of the plant through the xylem.
	Option D is incorrect	Although warmer temperatures contribute to flowering and increased transpiration rates, water travels through the xylem, not the phloem.

Item Position	Rationales	
13	2 pts	Apoptosis is a normal cellular process that **destroys** cells. A cell may enter apoptosis **at the end of its lifespan**. Without apoptosis, the cell may **become cancerous**.
	1 pt	The student answers half of the questions correctly.
	0 pt	The response is incorrect or irrelevant.

Item Position	Rationales	
14	Option A is correct	Process 1 is crossing-over, Process 2 is independent assortment, and Process 3 is fertilization.
	Option B is incorrect	Independent assortment, not crossing-over, results in the production of haploid cells.
	Option C is incorrect	Crossing-over does not produce diploid cells that are used for sexual reproduction.
	Option D is incorrect	Independent assortment does not produce diploid cells that are used for sexual reproduction.

Item Position	Rationales	
15	Option C is correct	Emissions of greenhouse gases such as carbon dioxide are increasing, which risks exacerbating ocean acidification and disrupting the nitrogen cycle, likely making it more difficult for many marine organisms to survive.
	Option A is incorrect	Emissions of greenhouse gases such as carbon dioxide are increasing, and the resulting decrease in nitrite availability will harm, not help, marine organisms.
	Option B is incorrect	Emissions of greenhouse gases such as carbon dioxide are increasing, which makes the oceans more acidic, likely disrupting the nitrogen cycle and making it more difficult for many marine organisms to survive.
	Option D is incorrect	Oceans are becoming more acidic; this will likely disrupt the nitrogen cycle and reduce the availability of nitrite for many marine organisms, making it more difficult for these organisms to survive.

Item Position	Rationales	
16	Option D is correct	Large particles and macromolecules are carried into cells via endocytosis.
	Option A is incorrect	Only water moves by osmosis.
	Option B is incorrect	Large particles and macromolecules are too large to move into cells by facilitated diffusion.
	Option C is incorrect	Large particles and macromolecules do not react chemically to make holes in cell membranes; if they were to do so, the cell would die.

Item Position	Rationales	
17	Option B is correct	Chloroplasts convert water and carbon dioxide into glucose that can be used by mitochondria.
	Option A is incorrect	Chloroplasts do not convert glucose into ATP.
	Option C is incorrect	Mitochondria do not absorb carbon dioxide.
	Option D is incorrect	Mitochondria do not take in water and carbon dioxide that are used for photosynthesis.

Item Position	Rationales	
18	Option D is correct	Bacteria are one of the main food sources in this food web, so harm to bacteria would cause the other organisms to lose a main food supply.
	Option A is incorrect	Texas cave shrimp are a secondary consumer, so harm to this population would cause less instability in the ecosystem than harming the bacteria would.
	Option B is incorrect	*Seborgias* are a consumer, so harm to this population would cause less instability in the ecosystem than harming the bacteria would.
	Option C is incorrect	Texas blind salamanders are top consumers in this food web, so harm to this population would cause less instability in the ecosystem than harming the bacteria would.

Item Position	Rationales	
19	Part A	
	Option C is correct	The horned cattle will appear occasionally one generation after another.
	Option A is incorrect	The cattle will be mostly hornless with some appearances of horned cattle.
	Option B is incorrect	The next generation of cattle will still be mostly hornless.
	Option D is incorrect	There is no specific pattern for the appearance of horned cattle based on generations.
	Part B	
	Option A is correct	The hornless cattle still carry the recessive allele for horns, and these alleles can be passed on to future generations.
	Option B is incorrect	The hornless allele is dominant, but the horned trait will appear when an offspring receives a recessive allele from each parent.
	Option C is incorrect	The recessive allele does not become dominant, which means that this statement is false.
	Option D is incorrect	The appearance of dominant and recessive alleles does not follow a periodic pattern.

Item Position	Rationales	
20	Option C is correct	The rate of reproductive success varies based on temperature.
	Option A is incorrect	The data do not suggest an impact on egg size.
	Option B is incorrect	The data do not suggest an influence on the gender of the offspring.
	Option D is incorrect	The data do not suggest an influence on nutrient availability.

Item Position	Rationales	
21	Option A is correct	Viruses take over the activities of the cell, resulting in the cell making products that are needed by the virus.
	Option B is incorrect	Viruses do not give the cell energy.
	Option C is incorrect	Viruses do not release antibiotics.
	Option D is incorrect	Some viruses alter cellular DNA, but they do not prevent the DNA from being copied; the copying of cellular DNA would also copy the viral DNA.

Item Position	Rationales	
22	Option C is correct	The complementary DNA strand runs from 3’ to 5’ and contains the correct complementary base pairs.
	Option A is incorrect	This is not the complementary DNA strand, as the complementary DNA strand would run from 3’ to 5’.
	Option B is incorrect	This is not the complementary DNA strand, as the complementary DNA strand would run from 3’ to 5’.
	Option D is incorrect	This is not the complementary DNA strand, as the base pairs are incorrect.

Item Position	Rationales	
23	Option A is correct	Hormone production is influenced by the nervous system.
	Option D is correct	Hormones are transported to parts of the body by the circulatory system.
	Option B is incorrect	Hormones do not cause infections.
	Option C is incorrect	The digestive system helps convert ingested materials into forms that can be used by the body.
	Option E is incorrect	Hormone production is unrelated to the absorption of oxygen, which involves the respiratory and circulatory systems.

Item Position	Rationales	
24	2 pts	The genetic diversity of wild tiger populations is **decreasing**, because the gene flow is **decreasing** due to isolation from habitat loss.
	1 pt	The student answers half of the questions correctly.
	0 pt	The response is incorrect or irrelevant.

Item Position	Rationales	
25	Option A is correct	An ecosystem becomes less diverse when extinction occurs, which decreases ecosystem stability by removing predators and food sources from the ecosystem.
	Option B is incorrect	When extinction occurs, ecosystem biodiversity decreases, which decreases its stability; lower biodiversity can lead to instability and ecosystem collapse.
	Option C is incorrect	An extinction would result in a loss of some organisms in an ecosystem, which would decrease biodiversity and therefore ecosystem stability.
	Option D is incorrect	An extinction would cause a decrease in ecosystem stability. The removal of a species from an ecosystem lowers biodiversity, decreasing ecosystem stability.

Item Position	Rationales	
26	Option D is correct	Molecules 3 and 4 are moving from an area of lower concentration to an area of higher concentration, which indicates active transport.
	Option A is incorrect	Molecule 2 is moving from an area of higher concentration to an area of lower concentration, which indicates passive transport.
	Option B is incorrect	Molecules 1 and 2 are moving by passive transport, from an area of higher concentration to an area of lower concentration.
	Option C is incorrect	Molecule 1 is moving from an area of higher concentration to an area of lower concentration, which indicates passive transport.

Item Position	Rationales	
27	Option B is correct	The probability is 50% because Parent 1 (*aa*) does not carry the allele and Parent 2 (*Aa*) is a carrier; Child 1 has a 50% chance of inheriting the dominant allele from Parent 2 and therefore having Marfan syndrome.
	Option A is incorrect	A 25% probability would occur if the syndrome were an autosomal recessive disorder and if each parent were a carrier (*Aa*).
	Option C is incorrect	A 75% probability would occur if each parent were a carrier (*Aa*).
	Option D is incorrect	A 100% probability would occur only if at least one parent were homozygous dominant (*AA*).

Item Position	Rationales	
28	2 pts	The student's response states that the tuna is most closely related to the gray whale because the only difference in the amino acid sequence provided is at amino acid 12.
	1 pt	The student answers half of the questions correctly. The tuna is most closely related to the gray whale (with no evidence provided.)
	0 pt	The response is incorrect or irrelevant.

Item Position	Rationales	
29	Option C is correct	An enzyme has an optimal pH range; the shift in pH from the stomach to the intestine would cause lipase to become less effective.
	Option A is incorrect	Enzymes are reused if they are not denatured.
	Option B is incorrect	Enzymes lower the activation energy of chemical reactions. They do not acquire energy.
	Option D is incorrect	A change in shape to an enzyme would indicate denaturation, which causes an enzyme to become less effective at catalyzing a chemical reaction.

Item Position	Rationales	
30	Option B is correct	Biomagnification describes the higher concentration of a toxic product in organisms higher up in a food chain due to the consumption of organisms that contain the toxic product.
	Option A is incorrect	Biogeography is a branch of biology that studies the geographical distribution of organisms.
	Option C is incorrect	Biomass is organic material from organisms.
	Option D is incorrect	Biotic factors are living organisms that make up an ecosystem.

Item Position	Rationales	
31	Option D is correct	Because the genes for glycolysis enzymes are active, these genes can be transcribed and translated.
	Option A is incorrect	Genes for glucagon production are not active in muscle cells, so muscle cells would not produce glucagon.
	Option B is incorrect	Immature red blood cells express hemoglobin.
	Option C is incorrect	The genes for muscle proteins are not expressed in blood cells.

Item Position	Rationales	
32	1 pt	The student selects Location 1 and Location 6.
	0 pt	The response is incorrect.

Item Position	Rationales	
33	Option A is correct	Xylem moves water up through the tree, allowing the water to be used in cellular processes.
	Option B is incorrect	Water is absorbed by the roots, not the leaves.
	Option C is incorrect	While phloem does transport nutrients down to the roots, water is moved from the roots upwards through the tree by the xylem.
	Option D is incorrect	Water is not collected and absorbed by flowers and is not directly converted into bark tissue.

Item Position	Rationales	
34	Option B is correct	A substitution mutation occurs when one base is replaced by a different base in a DNA sequence and the length of the DNA sequence is unchanged.
	Option A is incorrect	A deletion mutation occurs when a base is removed from a DNA sequence and not replaced, resulting in a shorter DNA sequence.
	Option C is incorrect	An insertion mutation occurs when a new base is added to a DNA sequence but no bases are removed, resulting in a longer DNA sequence.
	Option D is incorrect	A translocation occurs when an entire section of a chromosome breaks off and is reattached to a different chromosome.

Item Position	Rationales	
35	Option A is correct	Mutualism describes this symbiotic relationship because both the fungus and the plant benefit from the relationship.
	Option B is incorrect	Commensalism describes a relationship in which one organism is benefited while the other organism is neither benefited nor harmed.
	Option C is incorrect	Parasitism describes a relationship in which one organism benefits from harming another organism.
	Option D is incorrect	Predation describes a relationship in which one organism consumes another organism (the prey).

Item Position	Rationales	
36	Option C is correct	UCU codes for serine (Ser), UGU codes for cysteine (Cys), and CGA codes for arginine (Arg).
	Option A is incorrect	Threonine (Thr) is coded by ACU, ACC, ACA, and ACG; asparagine (Asn) is coded by AAU and AAC; and glutamic acid (Glu) is coded by GAA and GAG.
	Option B is incorrect	Cysteine (Cys) is coded by UGU and UGC; phenylalanine (Phe) is coded by UUU and UUC; and leucine (Leu) is coded by CUU, CUC, CUA, CUG, UUA, and UUG.
	Option D is incorrect	Serine (Ser) is coded by UCU, UCC, UCA, UCG, AGU, and AGC; tryptophan (Trp) is coded by UGG; and aspartic acid (Asp) is coded by GAU and GAC.

<table>
<tr><th>Item Position</th><th colspan="4">Rationales</th></tr>
<tr><td rowspan="4">37</td><td rowspan="3">2 pts</td><td colspan="3">Properties of Viruses</td></tr>
<tr><td>Reproduction</td><td>Size</td><td>Genetic Material</td></tr>
<tr><td>Is dependent on a <u>host cell</u></td><td>Is <u>smaller than</u> human cells</td><td>Uses <u>DNA or RNA</u></td></tr>
<tr><td>1 pt</td><td colspan="3">The student answers half of the questions correctly.</td></tr>
<tr><td>0 pt</td><td colspan="3">The response is incorrect or irrelevant.</td></tr>
</table>

Item Position	Rationales	
38	Option A is correct	In enzymatic reactions, substrates are changed, and enzymes are unchanged and reused.
	Option B is incorrect	Enzymes are reused in chemical reactions.
	Option C is incorrect	Enzymes detach from substrates once the reaction is completed.
	Option D is incorrect	Substrates, not the enzyme, become the product.

Item Position	Rationales	
39	Option C is correct	Brightly colored feathers help male peacocks attract a mate.
	Option A is incorrect	Brightly colored feathers do not help male peacocks resist diseases.
	Option B is incorrect	Brightly colored feathers do not help male peacocks avoid competition.
	Option D is incorrect	Brightly colored feathers do not help male peacocks move more easily.

Item Position	Rationales	
40	Option B is correct	Both Fact 1 and Fact 3 describe predator-prey relationships.
	Option A is incorrect	Fact 2 would better describe a commensal relationship, because the raccoons benefit from plants while the plants are neither harmed nor benefited by this relationship.
	Option C is incorrect	Fact 2 would better describe a commensal relationship, and Fact 4 describes a scavenging behavior.
	Option D is incorrect	Fact 4 describes a scavenging behavior, not a predator-prey relationship.

Item Position	Rationales	
41	1 pt	The student selects the second cell from the left and the cell farthest to the right because they both show unequal separation of homologous chromosome pairs.
	0 pt	The response is incorrect or irrelevant.

Item Position	Rationales	
42	Option A is correct	The root tip is the area with the highest growth rate in an onion.
	Option B is incorrect	Photosynthesis takes place in leaves.
	Option C is incorrect	Water is absorbed throughout the root cells.
	Option D is incorrect	Sexual reproduction takes place in the flowers of onion plants.

Item Position	Rationales	
43	Option A is correct	*RrTt* and *RrTt* would result from crossing-over between *RRTT* and *rrtt* chromosomes.
	Option B is incorrect	The recessive *r* allele would not disappear due to crossing-over, and *RRTT* would indicate the lack of crossing-over.
	Option C is incorrect	Both dominant *R* and *T* alleles would still be present after crossing-over.
	Option D is incorrect	Crossing-over cannot convert an *R* allele into an *r* allele or a *t* allele into a *T* allele.

Item Position	Rationales	
44	Option C is correct	Both carbohydrates and lipids provide energy for organisms.
	Option A is incorrect	Proteins change shape to function properly.
	Option B is incorrect	Lipids act as insulation, but carbohydrates do not.
	Option D is incorrect	Nucleic acids encode genetic information.

Item Position	Rationales	
45	Option D is correct	The area where the limb was removed is an area where active growing is occurring and thus has high rates of mitosis and division.
	Option A is incorrect	Meiosis is used to generate new sex cells and would not be used to regrow the tail, and the rate of mitosis would increase in the tail.
	Option B is incorrect	The rate of cell division would not decrease in other body cells, and the rate of meiosis would not be affected.
	Option C is incorrect	Organisms grow mainly through cell division, not by increasing the size of cells.