PRACTICE EXAM 60: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. A scientist explains that observations of the cosmic microwave background, distant galaxy redshifts, and the abundance of light elements together support a particular model of the universe's origin. Which of the following models do these observations support?

A. A steady-state model in which the universe has always existed in its current form and has never changed in any measurable way, with no beginning of any kind at any point in the past

B. A geocentric model in which the Earth lies at the exact center of a small, fixed universe of stars and planets, with no expansion, evolution, or change of any kind over any span of time

C. A cyclic-collision model in which the universe is created by repeated collisions between two galaxies in empty space, with no relationship to any expansion, redshift, or background radiation

D. A Big Bang model in which the universe began in a hot, dense state and has been expanding and cooling for billions of years, leaving behind background radiation, redshifts, and light elements

2. A scientist describes a star that has run out of hydrogen in its core and has begun fusing helium into heavier elements. Which of the following best describes the next stage of this star's life, assuming it is similar in mass to the Sun?

A. The star will expand into a red giant, eventually shed its outer layers as a planetary nebula, and leave behind a dense, slowly cooling white dwarf as its final state

B. The star will instantly collapse into a black hole, with no further stages of evolution or change in its structure over any span of time, regardless of the actual mass of the star at the time

C. The star will return to its original main-sequence stage, with no further changes in its structure for trillions of years, regardless of the actual mass of the star at the time of the change

D. The star will explode immediately as a supernova, scattering all of its material into space and leaving behind a small neutron star at its core, regardless of the actual mass of the star at the time

3. A scientist uses a telescope to observe a star and finds that the star's light is shifted toward shorter, bluer wavelengths. Which of the following best describes what this blueshift tells the scientist about the star?

A. The star is at exactly the same distance from Earth as it has always been, with no measurable motion in any direction, since blueshift indicates that a star is permanently fixed in its current position

B. The star is moving toward Earth, since a blueshift in a star's spectrum indicates that the source of light is moving toward the observer rather than away from the observer

C. The star is moving away from Earth, since a blueshift in a star's spectrum indicates that the source of light is moving away from the observer rather than toward the observer at any time

D. The star is rotating extremely rapidly on its axis, with no measurable motion toward or away from Earth, since blueshift always indicates that a star is spinning faster than every other star around it

4. A planet's orbital period is 64 years. Using Kepler's Third Law ($T^2 = a^3$ in solar units), what is its approximate average distance from the Sun?

A. About 8 AU, because 64 squared is 4,096, and the square root of 4,096 is 64 divided by some small constant, regardless of the actual cube-root relationship of the period to the distance

B. About 64 AU, because the orbital period in years is always equal to the average distance from the Sun in AU, regardless of the actual relationship between the period and the distance from the Sun

C. About 16 AU, because 64 squared is 4,096, and the cube root of 4,096 is 16 AU

D. About 4 AU, because the average distance from the Sun is always equal to the square root of the orbital period in years, regardless of the actual length of the orbit being analyzed

5. During the December solstice, the Northern Hemisphere experiences its shortest day of the year. Which of the following best describes the position of Earth's axis relative to the Sun on this day?

A. The Northern Hemisphere is tilted away from the Sun, so it receives less direct sunlight and shorter daylight hours, while the Southern Hemisphere is tilted toward the Sun and receives more direct light

B. The Northern Hemisphere is tilted directly toward the Sun, so it receives more direct sunlight and longer daylight hours, while the Southern Hemisphere is tilted away from the Sun and receives less direct light

C. The Earth's axis stands perfectly vertical with no tilt at all, so the Sun's rays strike the equator most directly and day length is equal everywhere on the surface of the Earth at any given time

D. The Earth's axis flips between two extreme tilts during the December solstice, with no relationship to the actual fixed orientation of the axis throughout the year that the Earth orbits the Sun

6. A new moon, when the side of the Moon facing Earth is dark and the Moon is nearly invisible in the sky, is followed about a week later by which Moon phase?

A. A full moon, when the entire side of the Moon facing Earth is brightly lit throughout the entire night for many hours after sunset across the western horizon to the eastern horizon

B. A last quarter, when exactly the left half of the Moon's visible disk is illuminated in the early morning sky just before sunrise above the eastern horizon for several hours before sunrise

C. A waning gibbous, when more than half of the Moon is lit on the left side and the bright portion is gradually shrinking each night after the most recent full moon stage in the cycle

D. A first quarter, when exactly the right half of the Moon's visible disk is illuminated in the early evening sky just after sunset

7. A scientist explains that solar flares are sudden bursts of radiation and energetic particles released from the Sun's surface, often associated with regions of strong magnetic activity. Which of the following best describes a major effect that powerful solar flares can have on Earth?

A. Solar flares can cause Earth's average annual temperature to rise sharply within a few hours, which is the only measurable effect that any solar flare has ever had on Earth in recorded history

B. Solar flares can permanently and instantly reverse the rotation of the Earth on its axis, which is the only measurable effect that any solar flare has ever had on Earth in recorded history at any time

C. Solar flares can disrupt radio communications, damage satellites, and disturb electrical grids, especially when accompanied by coronal mass ejections that send charged particles toward Earth

D. Solar flares have no measurable effect on the Earth in any way at any time, since the Sun is too far away from Earth for any solar event to have any measurable effect on the planet in any way

8. During a total lunar eclipse, the Moon often appears dim and reddish even though it is in Earth's shadow. Which of the following best explains why the eclipsed Moon does not appear completely dark?

A. The Sun produces a special kind of red light during every lunar eclipse, which is the only reason the eclipsed Moon often appears reddish rather than completely dark to observers on the Earth

B. Some sunlight is bent and filtered by Earth's atmosphere, so longer (red) wavelengths reach the Moon and give it a reddish glow even when it is in Earth's shadow during a total lunar eclipse

C. The Moon's surface naturally glows reddish during every lunar eclipse, which is the only reason the eclipsed Moon often appears reddish rather than completely dark to observers on Earth at any time

D. Mars happens to align directly behind the Moon during every lunar eclipse, lending its reddish color to the Moon for the duration of the entire eclipse event, regardless of any other astronomical bodies

9. Spring tides have the largest tidal range during a lunar month and occur when the Sun, Earth, and Moon are nearly in a straight line. Which of the following best describes the Moon phases during which spring tides occur?

A. The new moon and the full moon, because in both phases the Sun, Earth, and Moon are aligned in a nearly straight line, so the Sun's and Moon's gravitational pulls combine to produce the largest tidal range

B. The first quarter and last quarter, because in both phases the Sun and Moon pull on Earth's water at right angles to each other, so their gravitational pulls combine to produce the largest tidal range

C. Only during eclipses, because tides are largest only when the shadow of the Earth or of the Moon falls directly across the surface of the other, regardless of the relative positions of the Sun, Earth, and Moon

D. Only during the spring season, because tides are largest only when the season of spring coincides with certain lunar phases, regardless of the actual relative positions of the Sun, the Earth, and the Moon at any time

10. Mercury, Venus, Earth, and Mars are all classified as terrestrial planets. Which of the following best describes the properties shared by these four planets?

A. They are all very large gas giants with deep, thick atmospheres of hydrogen and helium, surrounded by many large moons and broad ring systems with no measurable solid surface anywhere on their planetary bodies

B. They are all very small, ice-covered worlds composed almost entirely of frozen water, with no measurable solid surface anywhere on their planetary bodies and no relationship at all to any rocky planetary composition

C. They all have brand-new, very hot, freshly-formed surfaces that have only just begun to cool, with no measurable craters anywhere on their planetary bodies and no relationship at all to any rocky planetary composition

D. They are all relatively small, dense, rocky worlds with solid surfaces, thin or no atmospheres compared with the gas giants, and a relatively small number of moons

11. A scientist explains that the Sun appears to move across the sky each day from east to west, but this apparent motion is not actually due to the Sun moving relative to Earth. Which of the following best describes the cause of this apparent motion?

A. The Sun actually does move around the Earth from east to west each day, which is the only reason the Sun appears to move across the sky from east to west each day from the perspective of any observer on the Earth

B. The Earth orbits the Sun once each day, which is the only reason the Sun appears to move across the sky from east to west each day from the perspective of any observer on the Earth at any time

C. Earth rotates on its axis from west to east, which causes the Sun (and other celestial objects) to appear to rise in the east and set in the west each day

D. The Moon orbits the Earth from west to east each day, which is the only reason the Sun appears to move across the sky from east to west each day from the perspective of any observer on the Earth at any time

12. A geologist examines a thick sequence of sedimentary rock layers that has remained undisturbed since deposition and identifies a particular layer as the youngest in the sequence. According to the principle of superposition, where in the sequence is this youngest layer located?

A. At the very top of the sequence, since the youngest layer in any undisturbed sequence of sedimentary rocks lies above all of the older layers below it by the principle of superposition over deposition

B. At the very bottom of the sequence, since the youngest layer in any undisturbed sequence of sedimentary rocks lies below all of the older layers above it by the principle of superposition over deposition

C. Exactly in the middle of the sequence, since deposition always begins at the middle of any sedimentary sequence and then builds outward in both directions over time, regardless of any other features

D. The youngest layer cannot be identified from position alone, since the layers in any undisturbed sedimentary sequence are always randomly ordered with no relationship between position and age at all

13. A geologist studies a sequence of sedimentary rocks and notices that one particular fossil species appears suddenly at one level, persists for several layers, and then disappears from the rock record. According to the principle of faunal succession, what does this pattern allow the geologist to do?

A. Use the species to determine the exact age of every layer in the sequence in years, since the appearance of any species in any layer always allows the exact numerical age of that layer to be calculated

B. Use the species to determine the exact composition of every layer in the sequence in minerals, since the appearance of any species in any layer always allows the exact mineral content of that layer to be calculated

C. Use the species to determine the exact temperature of every layer in the sequence in degrees Celsius, since the appearance of any species in any layer always allows the exact temperature of that layer to be calculated

D. Use the species as an index fossil to correlate layers of similar age in different regions, since organisms appear and disappear in a definite, predictable order in the rock record

14. A radioactive isotope has a half-life of 4,000 years. A sample now contains one-quarter of the original amount of this isotope. About how much time has passed since the sample formed?

A. About 4,000 years, because only one half-life is needed to reduce the original amount of a radioactive isotope to one-quarter of the value it had when it formed, regardless of any other factors at all

B. About 8,000 years, because two half-lives are needed to reduce the isotope to one-quarter of its original amount

C. About 2,000 years, because only half of one full half-life is needed to reduce the original amount of a radioactive isotope to one-quarter of the value it had when it formed, regardless of any other factors at all

D. About 16,000 years, because four full half-lives are always needed to reduce the original amount of a radioactive isotope to one-quarter of the value it had when it formed, regardless of any other factors at all

15. A scientist describes a particular layer of rock as containing many fossils of extinct corals, ammonites, and other marine organisms. Which of the following best describes the most likely past environment of this rock layer?

A. A dry, windswept desert, where wind-blown sand was piled into large dunes that were later buried, compacted, and cemented into a thick sedimentary rock layer with many extinct fossil corals and other marine organisms

B. A high mountain peak well above the tree line, where bare rock was exposed to constant freezing and thawing and was later buried and cemented into a thick sedimentary rock layer with many extinct fossil corals and marine organisms

C. A warm, shallow sea where marine organisms lived, died, and accumulated their shells and other hard parts on the ocean floor, where they were later buried and preserved as fossils within sedimentary rock

D. A swift, rocky mountain stream that tumbled and rounded large pebbles as they rushed downhill, which were later buried and cemented into a thick sedimentary rock layer with many extinct fossil corals and other marine organisms

16. Geologists divide Earth's 4.6-billion-year history into a sequence of eons, eras, periods, and epochs of varying lengths. Which of the following best describes the major reason that the boundaries between these divisions are placed where they are?

A. The boundaries mark major changes in Earth's life, climate, or geology preserved in the rock record, such as mass extinctions, major climate shifts, and significant changes in dominant life forms

B. The boundaries are placed at completely arbitrary numerical points so that every single division ends up containing exactly the same length of time, with no relationship at all to any events recorded in the rocks

C. The boundaries are placed wherever paleontologists happen to be working at the moment, so they reflect modern research locations more than past events, with no relationship at all to any events recorded in the rocks

D. The boundaries simply repeat the divisions of the modern calendar year on a much longer time scale, with no relationship at all to Earth's history, regardless of the actual rock or fossil record

17. A scientist explains that ice cores from Greenland and Antarctica preserve a long record of Earth's past climate. Which of the following best describes how ice cores provide this information?

A. Ice cores contain detailed written records left by ancient civilizations that wrote on layers of ice, which is the only way that ice cores provide information about past climate in any region of the Earth at any time

B. Ice cores contain fossils of ancient land animals such as dinosaurs, which is the only way that ice cores provide information about past climate in any region of the Earth at any time in geologic history

C. Ice cores contain the actual liquid water from Earth's past oceans, which can be measured directly, and which is the only way that ice cores provide information about past climate in any region of the Earth at any time

D. Ice cores contain trapped bubbles of ancient air and isotopic variations in the ice itself, both of which can be used to reconstruct the composition of the past atmosphere and past temperatures over time

18. A scientist explains that during Earth's history, organisms have evolved, diversified, and gone extinct in response to changing environmental conditions. Which of the following best describes the role of mass extinctions in this process?

A. Mass extinctions have had no role at all in the evolution of life on Earth, since the species lost during any mass extinction always reappear identically a short time after the end of the event in question

B. Mass extinctions remove many species from the world, often opening ecological niches that surviving species can later fill through diversification and the evolution of new species into the empty roles

C. Mass extinctions always result in the immediate extinction of every species on Earth, with no surviving organisms or relationships to any species that later evolves on Earth, regardless of the actual cause of the extinction

D. Mass extinctions always last for billions of years and result in no change in any species on Earth, with no relationship to the evolution or diversification of any species on Earth, regardless of the actual cause of the extinction

19. A scientist explains that the lithosphere is broken into rigid plates that move slowly across Earth's surface. The boundaries between these plates can be divergent, convergent, or transform. Which of the following best describes a convergent plate boundary?

A. A boundary where two plates pull apart and rising magma fills the gap to form new oceanic crust, often producing a long mid-ocean ridge that runs along the seafloor between the two plates

B. A boundary where two plates slide horizontally past one another, often producing frequent earthquakes but no volcanoes and no creation or destruction of any tectonic plate material at all

C. A boundary where two plates move toward each other, often resulting in one plate descending beneath the other in a subduction zone, or in the collision of continental crust to form mountain belts

D. A boundary where a single plate slowly rotates in place on Earth's surface, with no relationship at all to any other plate or to the movement of any other plate across Earth's surface at any time at all

20. A scientist describes a particular igneous rock as having a fine-grained texture with very small crystals that are barely visible without magnification. Which of the following best describes how this rock most likely formed?

A. The rock formed when lava cooled rapidly at or near Earth's surface, leaving little time for crystals to grow large, producing a fine-grained extrusive igneous rock such as basalt

B. The rock formed when magma cooled extremely slowly deep underground over millions of years, producing very large interlocking crystals that are easily visible without any kind of magnification at all

C. The rock formed when sediment was deposited and cemented at the surface over a relatively short period of time, producing a fine-grained sedimentary rock that closely resembles a fine-grained extrusive igneous rock

D. The rock formed when an existing rock was heated and squeezed deep underground over millions of years, producing a foliated metamorphic rock that closely resembles a fine-grained extrusive igneous rock

21. A geologist examines a sedimentary rock that contains rounded pebbles of many different minerals cemented together by finer material. Which of the following best describes this kind of rock?

A. A conglomerate, a sedimentary rock formed when rounded gravel was deposited, buried, and cemented together over time, often in environments where moving water transported and rounded the pebbles

B. A granite, an intrusive igneous rock formed deep underground from slowly cooling magma, which always contains randomly oriented large interlocking crystals rather than rounded pebbles of mixed minerals

C. A basalt, an extrusive igneous rock formed when lava cooled rapidly at or near the surface, which always contains glassy or fine-grained mineral textures rather than rounded pebbles of mixed minerals

D. A schist, a metamorphic rock formed when an existing rock was heated and squeezed by intense pressure deep underground, which always contains wavy parallel bands rather than rounded pebbles of mixed minerals

22. A scientist explains that a mineral's properties, such as hardness, color, streak, luster, cleavage, and crystal shape, are determined by its chemical composition and the arrangement of its atoms. Which of the following best describes what a mineral is?

A. Any solid object found in nature, regardless of its composition or internal structure, including manufactured objects, plant fragments, animal remains, and any other solid materials found anywhere on Earth at any time

B. A liquid found in nature that is composed of a specific chemical formula and a regular internal arrangement of molecules, regardless of whether or not the liquid is ever solid at any temperature found on Earth

C. Any organic substance produced by a living organism that has a specific chemical formula and a regular internal structure, regardless of whether or not the substance forms part of the body of the living organism

D. A naturally occurring, inorganic solid with a specific chemical composition and a regular internal arrangement of atoms (a crystal structure)

23. A river flows down a steep mountain and then enters a flat plain, where it slows abruptly. Which of the following best describes the most likely fate of the sediment carried by this river as it slows on the plain?

A. The river will continue to carry all of its sediment at the same speed across the plain, with no change in the amount or size of the sediment carried by the river over any distance, regardless of any other factors at all

B. The river will deposit its largest, heaviest particles first as it slows, while continuing to carry finer particles farther downstream, gradually depositing sand, gravel, and silt across the plain as it slows down

C. The river will lose all of its sediment immediately at the boundary between the mountain and the plain, with no further transport of any sediment across the plain by the river over any distance, regardless of any other factors

D. The river will reverse its flow and carry its sediment back upstream into the mountains, with no further transport of any sediment across the plain by the river over any distance, regardless of any other factors at all

24. A community draws water from a well that taps into a confined aquifer beneath an impermeable clay layer. Which of the following best describes one important benefit of drawing water from a confined aquifer rather than from nearby surface water?

A. The clay layer above the confined aquifer helps protect the groundwater from surface pollution and contamination, making the water generally cleaner than surface water from nearby rivers and lakes

B. The water in a confined aquifer is always saltier than any surface water in the region, which is the main reason that the community chooses to draw its drinking water from the confined aquifer at any time

C. The water in a confined aquifer is always warmer than any surface water in the region, which is the main reason that the community chooses to draw its drinking water from the confined aquifer at any time

D. The water in a confined aquifer is always more polluted than any surface water in the region, which is the main reason that the community chooses to draw its drinking water from the confined aquifer at any time

25. A scientist explains that wind blowing across Earth's surface carries loose sand and silt and can deposit these particles in dunes and other landforms over many years. Which of the following best describes one important characteristic of windblown sand dunes?

A. Sand dunes always have an unsorted mix of rock and sediment of all sizes, ranging from boulders to clay, which is the main feature that distinguishes them from all other landforms in any environment on Earth

B. Sand dunes always contain a thick mix of marine fossils, including corals, shells, and ammonites, which is the main feature that distinguishes them from all other landforms in any environment on Earth

C. Sand dunes are well-sorted accumulations of similar-sized sand grains, often showing distinctive cross-bedding patterns, because wind sorts particles by size as it carries them across the surface of the land

D. Sand dunes always form only at the bottom of deep oceans, where they are deposited by slow ocean currents over many millions of years, regardless of any other factors involved in their formation at any time

26. A coastal city is gradually losing sand from its beaches each year due to longshore currents and wave action. Which of the following best describes one strategy the city might use to slow the loss of beach sand?

A. Removing all vegetation from the coastal dunes, since removing plant cover always permanently and instantly stabilizes the beach sand and prevents any further loss of sand from any region of the coastline at any time

B. Encouraging the building of new homes directly on the beach itself, since the construction of new beachfront homes always permanently and instantly stabilizes the beach sand and prevents any further loss of sand

C. Setting fire to the beach during storms, since burning the beach has been shown to permanently and instantly stabilize the beach sand and prevent any further loss of sand from any region of the coastline at any time

D. Building structures such as groins or jetties to trap sand, or periodically replenishing the beach with sand from another source, both of which can help offset the natural loss of sand to longshore currents

27. A scientist explains that the carbon cycle moves carbon between the atmosphere, oceans, land, and living things. Which of the following best describes one major natural process that removes carbon dioxide from the atmosphere?

A. Combustion, in which fuels such as wood, coal, and oil are burned and stored carbon is released into the atmosphere as carbon dioxide, with no relationship at all to the removal of any carbon dioxide from the atmosphere

B. Respiration, in which living organisms break down sugars for energy and release carbon dioxide back into the surrounding air, with no relationship at all to the removal of any carbon dioxide from the atmosphere

C. Photosynthesis, in which green plants and other photosynthetic organisms take in carbon dioxide and use sunlight to build sugars, storing the carbon in their tissues and removing carbon dioxide from the atmosphere

D. Volcanic eruption, in which gases trapped deep within the Earth are released into the atmosphere as molten rock reaches the surface, with no relationship at all to the removal of any carbon dioxide from the atmosphere

28. A scientist describes a particular ecosystem as having very high biodiversity, with many different species of plants and animals living together and interacting with one another. Which of the following best describes one important benefit of high biodiversity in an ecosystem?

A. High biodiversity always permanently reduces the productivity of the ecosystem, since a more diverse community of species always produces less biomass per year than a single dominant species would produce on its own

B. High biodiversity supports ecosystem stability and resilience, since different species can play different roles, and the loss of one species is more likely to be partially offset by other species in a diverse community

C. High biodiversity always permanently destabilizes the ecosystem, since a more diverse community of species always introduces too much competition and reduces the long-term ability of the ecosystem to persist

D. High biodiversity always permanently and instantly halts the natural functioning of the ecosystem, since the presence of so many species always makes natural ecological processes impossible to occur at all

29. A scientist explains that ocean currents transport heat across the globe and influence regional climates. Which of the following best describes how warm ocean currents typically affect the climate of nearby land?

A. Warm ocean currents always make the climate of every nearby region uniformly hot, regardless of latitude or any other factor, since warm water always equally heats every nearby region of the world at any time

B. Warm ocean currents have no measurable effect on the climate of any nearby land, since the temperature and salinity of seawater never have any measurable influence on the temperature of the air above the land

C. Warm ocean currents always make the climate of every nearby region uniformly cold, regardless of latitude or any other factor, since warm water always equally cools every nearby region of the world at any time

D. Warm ocean currents can warm nearby coastal land by carrying heat from the tropics toward higher latitudes, often resulting in milder winters than at other locations at the same latitude

30. A weather forecaster explains that a region of low atmospheric pressure typically brings cloudy, rainy weather. Which of the following best explains this connection between low pressure and cloudy weather?

A. In a low-pressure system, air rises, cools, and condenses its water vapor into cloud droplets, often producing widespread clouds and precipitation across the affected region

B. In a low-pressure system, air sinks, warms, and dries, suppressing the formation of clouds and discouraging precipitation, which is the main reason that low pressure is associated with cloudy and rainy weather

C. In a low-pressure system, the Sun produces more energy than usual, which heats the air above the region and causes widespread clouds and precipitation, regardless of any other factors in the atmosphere at all

D. In a low-pressure system, the Moon's gravitational pull is stronger than usual, which lifts the air above the region and causes widespread clouds and precipitation, regardless of any other factors in the atmosphere at all

31. A meteorologist explains that the difference between weather and climate is fundamentally one of time scale. Which of the following best describes this distinction?

A. Weather refers to the long-term average of atmospheric conditions over many years, while climate refers to the short-term, day-to-day conditions of the atmosphere at one specific location at one specific time

B. Weather refers only to temperature, while climate refers only to precipitation, with no relationship at all between the two concepts and no overlap in the kinds of conditions described by each of them at any time

C. Weather and climate mean exactly the same thing, with no real distinction between the two concepts and no difference in the time scale used to describe atmospheric conditions in any region of the world at any time

D. Weather refers to short-term, day-to-day atmospheric conditions at a location, while climate refers to the long-term average of those conditions over many years

32. A scientist explains that the greenhouse effect is responsible for keeping Earth's surface warm enough to support liquid water and life. Which of the following best describes how the natural greenhouse effect works?

A. Greenhouse gases in the atmosphere reflect all of the incoming sunlight back into space before it can reach the surface of the Earth, which is the main reason the surface is warm enough to support liquid water and life

B. Greenhouse gases in the atmosphere block all of the heat radiated by the Earth's surface from leaving the atmosphere, with no role at all played by infrared radiation re-emitted by the atmosphere back toward the surface

C. Greenhouse gases in the atmosphere absorb infrared radiation emitted by Earth's surface and re-emit some of it back downward, warming the lower atmosphere and the surface

D. Greenhouse gases in the atmosphere generate their own heat through chemical reactions in the atmosphere, with no relationship at all to any radiation absorbed or emitted by the atmosphere or the surface

33. A meteorologist explains that strong thunderstorms can produce a wide range of dangerous weather conditions. Which of the following best describes a hazard commonly associated with severe thunderstorms?

A. Lightning, large hail, damaging straight-line winds, and the possibility of tornado formation, all of which can occur during severe thunderstorms

B. Snowstorms, blizzards, and ice storms, which are the most common weather hazards associated with severe thunderstorms during the summer months in the United States and around the world, regardless of any other factors at all

C. Sandstorms, dust storms, and droughts, which are the most common weather hazards associated with severe thunderstorms during the summer months in the United States and around the world, regardless of any other factors

D. Tides, ocean currents, and rising sea levels, which are the most common weather hazards associated with severe thunderstorms during the summer months in the United States and around the world, regardless of any other factors

34. A scientist explains that hurricanes and other tropical cyclones can cause widespread damage when they make landfall. Which of the following best describes the major hazards that affect coastal areas during a hurricane landfall?

A. Strong gravitational pulls from the Moon, which always become much stronger during hurricane landfalls and which always permanently and instantly raise the local sea level by many meters during the landfall of any hurricane

B. Powerful magnetic disturbances from the storm itself, which always become much stronger during hurricane landfalls and which always permanently and instantly disrupt the magnetic field of the Earth during landfall

C. Heavy radioactive fallout from the storm itself, which always become much stronger during hurricane landfalls and which always permanently and instantly contaminates the affected region during the landfall of any hurricane

D. Strong winds, torrential rainfall, storm surge that floods coastal areas, and the potential for spawning tornadoes, all of which can cause severe damage during a hurricane landfall

35. A scientist explains that ocean acidification is one important consequence of rising carbon dioxide levels in the atmosphere. Which of the following best describes how ocean acidification occurs and what effect it has on marine organisms?

A. The oceans become saltier as carbon dioxide dissolves into seawater, which is the only reason that any marine organisms are affected by rising carbon dioxide levels in the atmosphere over any period of time at all

B. The oceans absorb carbon dioxide from the atmosphere, which lowers the pH of seawater, making it more difficult for corals, shellfish, and some plankton to build calcium carbonate skeletons or shells

C. The oceans become warmer as carbon dioxide dissolves into seawater, which is the only reason that any marine organisms are affected by rising carbon dioxide levels in the atmosphere over any period of time at all

D. The oceans become fresher as carbon dioxide dissolves into seawater, which is the only reason that any marine organisms are affected by rising carbon dioxide levels in the atmosphere over any period of time at all

36. A scientist explains that climate change is supported by many independent lines of scientific evidence collected over many decades. Which of the following best describes one such line of evidence?

A. Long-term temperature records, melting of glaciers and polar ice, and rising global sea levels, all of which show consistent trends linked to a warming planet over many decades of careful observation

B. A single day of unusually warm weather in one city during one summer, which by itself is enough to definitively prove that the entire global climate is warming, regardless of any other long-term data trends at all

C. A single day of unusually cold weather in one city during one winter, which by itself is enough to definitively prove that the entire global climate is cooling, regardless of any other long-term data trends at all

D. A single hurricane making landfall in one region during one season, which by itself is enough to definitively prove that the entire global climate is warming, regardless of any other long-term data trends at all

37. A community is considering several different sources of electricity for its new neighborhood. Which of the following options would have the lowest direct greenhouse gas emissions over its operational lifetime?

A. A new coal-fired power plant that burns large quantities of coal to generate electricity, releasing significant carbon dioxide and other air pollutants into the atmosphere during operation, regardless of any other factors at all

B. A new natural gas power plant that burns large quantities of natural gas to generate electricity, releasing significant carbon dioxide and methane into the atmosphere during operation, regardless of any other factors at all

C. A new wind farm that uses turbines to convert energy from moving air into electricity, with little or no direct greenhouse gas emissions during operation

D. A new oil-fired power plant that burns large quantities of oil to generate electricity, releasing significant carbon dioxide and other air pollutants into the atmosphere during operation, regardless of any other factors at all

38. A region's forests are being cleared and converted to farmland and urban development. Which of the following best describes one direct environmental consequence of this large-scale deforestation?

A. The region's average rainfall doubles every year, since clearing forests always permanently and instantly doubles the precipitation in every region of the world that experiences any kind of deforestation at any time at all

B. The region's natural ecosystems immediately become healthier and more diverse, since clearing forests always permanently and instantly improves the biodiversity of every region of the world that experiences any kind of deforestation

C. The region's air becomes immediately and permanently clean of all pollutants, since clearing forests always permanently and instantly removes all of the air pollutants in every region of the world that experiences any kind of deforestation

D. The region loses habitat for forest species, loses carbon storage in the trees and soil, and may experience increased erosion and runoff, all of which can degrade ecosystems and water quality

39. A national policy requires that all new household appliances meet strict energy-efficiency standards. Which of the following best describes the most direct environmental benefit of this kind of policy?

A. Energy-efficient appliances always permanently and instantly reverse all of the climate change that has already occurred over recent centuries, with no further effort of any kind needed in any other sector of the economy at any time

B. Energy-efficient appliances reduce the total amount of energy needed to provide the same service, lowering demand for fossil fuels and reducing the greenhouse gas emissions associated with generating that energy

C. Energy-efficient appliances always permanently and instantly eliminate all of the world's environmental problems forever, with no further action of any kind needed in any other sector of the global economy at any time

D. Energy-efficient appliances always have no measurable effect on the environment, since improvements in efficiency are never able to reduce energy demand or emissions from any sector of the economy at all in any country

40. A community is debating whether to allow construction of a new chemical plant on land near a sensitive river ecosystem. Which of the following best describes one example of how a cost-benefit analysis might inform this decision?

A. The community would only consider the financial profits to the company that owns the plant and would ignore all other costs and benefits, including any environmental, social, or health-related effects on the surrounding region

B. The community would only consider the personal opinions of the company's chief executive officer and would ignore all other costs and benefits, including any environmental, social, or health-related effects on the region

C. The community would weigh the benefits of the plant, such as jobs and economic activity, against the costs, such as potential pollution, ecosystem damage, and effects on human health, before making a decision

D. The community would only consider the personal opinions of the plant's potential employees and would ignore all other costs and benefits, including any environmental, social, or health-related effects on the surrounding region

41. A coastal community is preparing for the impacts of climate change by elevating roads, restoring coastal wetlands, and strengthening flood barriers. Which of the following best describes this combination of actions?

A. Mitigation, since the community is reducing the greenhouse gas emissions that are the underlying cause of climate change by elevating its physical infrastructure, restoring its wetlands, and strengthening its flood barriers

B. Restoration, since the community is rebuilding ecosystems that have already been damaged or destroyed by previous human activity in the region, with no relationship to any future climate impacts on the coastline

C. Adaptation, since the community is adjusting its infrastructure and ecosystems to better cope with climate impacts that are already starting to occur in the region

D. Acidification, since the community is taking steps to lower the rising acidity of the nearby ocean by removing carbon dioxide from the seawater near its shoreline, with no relationship to any other climate impacts on the coastline

42. A scientist explains that some species of plants and animals have already begun shifting their ranges toward higher latitudes or higher elevations as the climate has warmed. Which of the following best describes one important consequence of these range shifts?

A. Species may encounter new competitors, predators, and habitat conditions, and some species may be unable to shift quickly enough to keep up with the changing climate, increasing the risk of decline

B. Species always become permanently and instantly extinct as soon as they begin to shift their ranges, with no relationship at all to any other factor involved in the survival of any species in any region of the world at any time

C. Species always become permanently and instantly more abundant in their new ranges, with no relationship at all to any other factor involved in the survival of any species in any region of the world at any time

D. Species always develop permanently and instantly new beneficial mutations as soon as they begin to shift their ranges, with no relationship at all to any other factor involved in the survival of any species in any region of the world

43. A scientist explains that the human population has more than doubled in the past several decades and now exceeds 8 billion people. Which of the following best describes one important environmental consequence of this population growth?

A. The natural ecosystems of the world have all become permanently and instantly healthier, since population growth always permanently and instantly improves the health of every natural ecosystem in every region of the world

B. The Earth's natural resources have all become permanently and instantly unlimited, since population growth always permanently and instantly increases the supply of every natural resource in every region of the world

C. The atmosphere has become permanently and instantly free of all pollutants, since population growth always permanently and instantly removes every air pollutant from every region of the world over time

D. Increased demand for food, water, energy, and land has placed greater pressure on natural ecosystems and resources, making sustainable management of these resources increasingly important over time

44. A scientist explains that water sustainability is an important goal in many regions of the world. Which of the following best describes the meaning of water sustainability?

A. Water sustainability is achieved only when a region completely eliminates all human water use, since any human use at all of water is always considered unsustainable in nature, regardless of any other factors involved at all in the use

B. Water sustainability is achieved when water is used in a way that allows the supply to meet present needs while still being available to meet the needs of future generations

C. Water sustainability is achieved only when a region uses every last drop of available water within the same year that it falls as precipitation, leaving none behind for future use, regardless of any other factors involved at all

D. Water sustainability is achieved only when a region completely replaces all of its freshwater supply with ocean water, since seawater is always considered more sustainable than any other water source, regardless of any other factors

45. A national government has set targets for reducing its country's greenhouse gas emissions over the next several decades. Which of the following best describes one important reason for setting such targets?

A. Reducing greenhouse gas emissions can lower the future severity of climate change and the risks of damaging impacts on ecosystems, infrastructure, and human well-being

B. Reducing greenhouse gas emissions always permanently and instantly reverses all of the climate change that has already occurred over recent centuries, with no further effort of any kind needed in any other sector of the global economy at all

C. Reducing greenhouse gas emissions has no measurable effect on the climate in any way, since the atmosphere is so vast that human emissions cannot possibly have any effect on it at all, regardless of any other factors involved at all

D. Reducing greenhouse gas emissions is purely a matter of personal taste and offers no real environmental benefit, since climate change is entirely natural and unaffected by human emissions, regardless of any other factors involved at all

46. A scientist explains that a healthy environment provides many services that support human well-being, including clean air, clean water, fertile soils, and pollination of crops. Which of the following best describes how these services are sometimes summarized?

A. Cultural amenities, the recreational, spiritual, and aesthetic benefits that people gain from spending time in nature, with no relationship to any of the physical processes that support clean air, water, soil, or pollination

B. Industrial outputs, the goods and services that are manufactured in factories and sold for profit, with no relationship to any of the natural processes that support clean air, water, soil, or pollination at any time at all

C. Mineral resources, the metals and other materials that are extracted from the ground for use in industry, with no relationship to any of the natural processes that support clean air, water, soil, or pollination at any time at all

D. Ecosystem services, the benefits that people receive from natural ecosystems, including provisioning services, regulating services, supporting services, and cultural services

47. A community wants to reduce the amount of solid waste sent to its landfill. Which of the following best describes one effective set of actions, at the individual or household level, to achieve this goal?

A. Burning all household waste in an open pile in the backyard, which has been shown to be the cleanest and most environmentally friendly way to handle the waste from any household ever, regardless of any other factors at all

B. Storing all household waste indefinitely in the attic or basement, with no recycling, composting, or disposal at all, which has been shown to be the safest way to handle waste from any household, regardless of any other factors at all

C. Reducing, reusing, and recycling materials whenever possible, and composting food scraps and yard waste, all of which divert materials away from landfills and return them to use or to the soil

D. Discarding all paper, glass, metal, food scraps, and yard waste directly into ordinary household trash without sorting any of them for recycling, composting, or repair at any point, which has been shown to be the most environmentally friendly practice

48. An engineering team has been asked to design a new flood-control levee for a town along a river. Before they begin sketching solutions, the team meets with local officials and gathers data on past river flows, the height and width of the river channel, the cost the town can afford, and the materials available locally. Which step of the engineering design process is the team performing in this meeting?

A. Defining the problem, since gathering information about the situation and identifying the criteria and constraints the solution must address is a key part of the early problem-definition phase

B. Building the final product, since gathering information about a problem is the same step as delivering a fully completed levee to the town that will eventually use it for many years without any further changes at all

C. Releasing the prototype, since gathering information about a problem is the same step as installing a small early test version of a levee along the river for an extended period of time, regardless of any other factors at all

D. Brainstorming solutions, since gathering information about a problem is the same step as generating a wide range of possible designs from which the team will later choose, regardless of any other factors involved in the design

49. An engineering team has built and tested a small-scale physical model of a new wind turbine. The model has revealed that one design choice produces excessive vibration. Which of the following best describes the team's most appropriate next action?

A. Conceal the vibration problem from the public and proceed to build the full-sized version of the wind turbine using the original plans, since revealing flaws found in any physical model is never an acceptable practice, regardless of any other factors at all

B. Abandon the entire project immediately, since the discovery of any unanticipated weakness in any physical model always proves that the underlying design can never be made to work safely under any conditions whatsoever, regardless of any other factors at all

C. Build the full-sized version of the wind turbine using the original plans without any further changes and then evaluate its safety only after the turbine has been opened to use, regardless of any other factors at all

D. Use the information from the test to modify the design, addressing the vibration problem, and then test the modified design again to see whether the change has been effective

50. Engineers often consider the environmental and social impacts of their designs in addition to the technical performance and cost. Which of the following best describes one reason that engineers might consider these broader impacts?

A. Engineers always ignore the environmental and social impacts of their designs, since these impacts have no relationship to the success of any engineering project in any region of the world at any time, regardless of any other factors at all

B. Engineering designs affect the people and ecosystems around them, so considering environmental and social impacts helps ensure that designs are safe, sustainable, equitable, and aligned with the values of the communities they serve

C. Engineers always consider only the financial profits of their designs and ignore all other impacts, since financial profit is always the only important factor in any engineering decision, regardless of any other factors at all

D. Engineering designs are always built in completely isolated environments with no people or ecosystems nearby, so considering environmental and social impacts is never necessary in any engineering project, regardless of any other factors at all

Practice Exam 60: Answer Key with Explanations

1. D — The Big Bang model describes a universe that began in a hot, dense state and has been expanding and cooling for billions of years, leaving behind background radiation, redshifts, and light elements. All three observations converge on this conclusion. It is the foundation of modern cosmology.
2. A — A Sun-like star that has begun fusing helium will expand into a red giant, eventually shed its outer layers as a planetary nebula, and leave behind a dense, slowly cooling white dwarf as its final state. Mass determines this gentle endpoint. More massive stars instead end in supernovae.
3. B — A blueshift in a star's spectrum indicates the source is moving toward Earth, since light waves are compressed when the source approaches. Redshift indicates the opposite motion. Doppler shifts reveal radial motion of celestial objects.
4. C — Kepler's Third Law gives $T^2 = a^3$, so with T = 64, T^2 equals 4,096 and a is the cube root of 4,096, exactly 16 AU. The square of the period sets the cube of the distance. This relationship applies to any object orbiting the Sun.
5. A — On the December solstice the Northern Hemisphere is tilted away from the Sun, so it receives less direct sunlight and shorter days, while the Southern Hemisphere is tilted toward the Sun. The orientation of the tilt, not its size, drives seasonal differences. This solstice marks the start of Southern Hemisphere summer.
6. D — A new moon is followed about a week later by the first quarter, with the right half of the visible disk illuminated. The lunar cycle proceeds new → first quarter → full → last quarter → new. Seven days after new moon places the Moon at first quarter.
7. C — Powerful solar flares, especially when accompanied by coronal mass ejections, can disrupt radio communications, damage satellites, and disturb electrical grids. The charged particles interact with Earth's magnetic field and upper atmosphere. Space weather monitoring exists to anticipate these effects.
8. B — During a lunar eclipse, sunlight is bent and filtered by Earth's atmosphere, so longer red wavelengths reach the Moon and give it a reddish glow. The Moon is lit by all of Earth's sunrises and sunsets at once. This is why the eclipsed Moon often looks coppery red.
9. A — Spring tides occur at the new moon and full moon, because in both phases the Sun, Earth, and Moon are aligned in a nearly straight line and their gravitational pulls combine to produce the largest tidal range. Alignment governs tidal strength. At the quarter phases, the pulls partly cancel.
10. D — The terrestrial planets are all relatively small, dense, rocky worlds with solid surfaces, thin or no atmospheres compared with the gas giants, and a relatively small number of moons. The frost line during solar system formation set this compositional divide. Mercury, Venus, Earth, and Mars share these features.
11. C — Earth rotates on its axis from west to east, which causes the Sun and other celestial objects to appear to rise in the east and set in the west each day. The Sun's apparent motion reflects Earth's spin. This rotation defines the solar day.
12. A — By the principle of superposition, the youngest layer in an undisturbed sedimentary sequence lies at the very top, above all older layers below. Layers accumulate from the bottom upward over time. This rule is the foundation of relative dating in horizontal strata.
13. D — Faunal succession lets a geologist use a species as an index fossil to correlate layers of similar age in different regions, since organisms appear and disappear in a definite, predictable order in the rock record. Brief existence pins the age precisely. Wide distribution allows correlation across regions.

14. B — One-quarter remaining means two half-lives have passed, since 1 → 1/2 → 1/4. Two half-lives × 4,000 years equals 8,000 years. Counting halvings is the key to radiometric age problems.
15. C — A rock layer containing extinct corals, ammonites, and other marine organisms most likely formed in a warm, shallow sea where these organisms lived, died, and were buried and preserved as fossils. The fossils reveal the depositional environment. Such conditions favor preservation of carbonate shells.
16. A — Boundaries on the geologic time scale mark major changes in Earth's life, climate, or geology preserved in the rock record, such as mass extinctions and significant shifts in dominant life forms. The divisions are tied to real events, not arbitrary numbers. This makes the time scale a record of Earth's history.
17. D — Ice cores preserve trapped bubbles of ancient air and isotopic variations in the ice itself, both of which can be used to reconstruct the composition of the past atmosphere and past temperatures. The bubbles sample the air as it was when each layer formed. Together they yield hundreds of thousands of years of climate history.
18. B — Mass extinctions remove many species from the world, often opening ecological niches that surviving species later fill through diversification and the evolution of new species into the empty roles. Major extinctions have repeatedly reshaped life on Earth. The aftermath of the end-Cretaceous event illustrates this pattern.
19. C — A convergent plate boundary is one where two plates move toward each other, often resulting in one plate descending beneath the other in a subduction zone, or in the collision of continental crust to form mountain belts. The Andes and Himalayas are examples. Convergence builds the world's tallest mountains.
20. A — A fine-grained extrusive igneous rock such as basalt forms when lava cools rapidly at or near Earth's surface, leaving little time for crystals to grow large. Rapid cooling limits crystal size. Slow, deep cooling, by contrast, yields coarse-grained rocks like granite.
21. A — A conglomerate is a sedimentary rock formed when rounded gravel was deposited, buried, and cemented together over time, often in environments where moving water transported and rounded the pebbles. The rounded shapes record transport before deposition. Cementation, not crystallization, binds the grains.
22. D — A mineral is a naturally occurring, inorganic solid with a specific chemical composition and a regular internal arrangement of atoms forming a crystal structure. These features distinguish minerals from rocks, organic substances, and manufactured materials. They are the building blocks of rocks.
23. B — A river slowing on a flat plain deposits its largest, heaviest particles first while continuing to carry finer particles farther downstream, gradually depositing sand, gravel, and silt across the plain. Slower water carries less. This sorts grain sizes from coarser upstream to finer downstream.
24. A — The impermeable clay layer above a confined aquifer helps protect the groundwater from surface pollution, making it generally cleaner than nearby surface water from rivers and lakes. The confining layer blocks downward percolation of pollutants. This is a major advantage of confined aquifers as drinking water sources.
25. C — Sand dunes are well-sorted accumulations of similar-sized sand grains, often showing distinctive cross-bedding, because wind sorts particles by size as it carries them across the land. Wind transport efficiently separates grains by size. Cross-bedding records the changing direction of windblown dune migration.

26. D — Building groins or jetties traps sand, and periodically replenishing the beach with sand from another source helps offset the natural loss of sand to longshore currents. Both approaches are widely used in coastal management. They address the actual transport processes at work.
27. C — Photosynthesis removes carbon dioxide from the atmosphere as green plants and other photosynthetic organisms take it in and use sunlight to build sugars, storing the carbon in their tissues. This is the main natural pathway that draws down atmospheric carbon. Respiration, combustion, and volcanism all release it instead.
28. B — High biodiversity supports ecosystem stability and resilience, since different species play different roles and the loss of one species is more likely to be partially offset by other species in a diverse community. Functional redundancy buffers ecosystems against disturbance. This is why biodiversity loss threatens many services people depend on.
29. D — Warm ocean currents can warm nearby coastal land by carrying heat from the tropics toward higher latitudes, often resulting in milder winters than at other locations at the same latitude. The North Atlantic Current warming western Europe is a familiar example. Cold currents, by contrast, cool nearby coasts.
30. A — In a low-pressure system, air rises, cools, and condenses its water vapor into cloud droplets, often producing widespread clouds and precipitation. Rising air drives the storms associated with low pressure. High-pressure systems, by contrast, bring fair weather.
31. D — Weather refers to short-term, day-to-day atmospheric conditions at a location, while climate refers to the long-term average of those conditions over many years. The two differ in time scale, not in what they measure. Distinguishing them is essential for interpreting climate trends.
32. C — The natural greenhouse effect works because greenhouse gases in the atmosphere absorb infrared radiation emitted by Earth's surface and re-emit some of it back downward, warming the lower atmosphere and the surface. They act on outgoing heat rather than reflecting incoming sunlight. This warming makes Earth habitable.
33. A — Severe thunderstorms commonly produce lightning, large hail, damaging straight-line winds, and the possibility of tornadoes. All four hazards can occur in a single storm. These are the defining dangers of severe convection.
34. D — Hurricane landfalls bring strong winds, torrential rainfall, storm surge that floods coastal areas, and the potential for spawning tornadoes, all of which can cause severe damage. The combination of wind and water makes hurricanes especially destructive. Storm surge causes much of the loss of life and property.
35. B — The oceans absorb carbon dioxide from the atmosphere, which lowers the pH of seawater, making it more difficult for corals, shellfish, and some plankton to build calcium carbonate skeletons or shells. Lower pH reduces available carbonate. This threat ripples through marine food webs.
36. A — Long-term temperature records, melting of glaciers and polar ice, and rising global sea levels all show consistent trends linked to a warming planet over many decades. The agreement across independent measurements is what makes the conclusion robust. Single events do not establish climate trends.
37. C — A wind farm uses turbines to convert energy from moving air into electricity, with little or no direct greenhouse gas emissions during operation. No fuel is burned to generate the power. This makes wind the lowest-emission choice among the options.
38. D — Large-scale deforestation causes loss of habitat for forest species, loss of carbon storage in trees and soil, and may increase erosion and runoff, all of which can degrade ecosystems and water

quality. Forests provide many services that are lost when cleared. Their removal also adds CO_2 to the atmosphere.

39. B — Energy-efficient appliances reduce the energy needed to provide the same service, lowering demand for fossil fuels and reducing greenhouse gas emissions from energy generation. Less demand means less fuel burned. Efficiency standards are among the most cost-effective climate strategies.
40. C — In a cost-benefit analysis, the community weighs benefits such as jobs and economic activity against costs such as pollution, ecosystem damage, and health effects before making a decision. Considering both sides leads to better-informed choices. Including environmental and social costs is essential.
41. C — Elevating roads, restoring coastal wetlands, and strengthening flood barriers is adaptation, because the community is adjusting its infrastructure and ecosystems to cope with climate impacts already occurring. Adaptation manages effects, while mitigation cuts the emissions causing them. Coping with unavoidable impacts is the defining feature of adaptation.
42. A — As species shift their ranges, they may encounter new competitors, predators, and habitat conditions, and some may be unable to shift quickly enough to keep pace with the changing climate, increasing decline risk. Range shifts are a documented response to warming. They affect biodiversity worldwide.
43. D — Rapid population growth has increased demand for food, water, energy, and land, placing greater pressure on natural ecosystems and resources and making sustainable management increasingly important. More people require more of everything. This drives many environmental challenges.
44. B — Water sustainability means using water so that supply meets present needs while remaining available for future generations. Matching withdrawals to natural replenishment is central to this balance. Neither total use nor total abstention defines sustainability.
45. A — Reducing greenhouse gas emissions can lower the future severity of climate change and the risks of damaging impacts on ecosystems, infrastructure, and human well-being. Cuts now shape the climate decades from now. Action does not reverse past warming but limits future harm.
46. D — Benefits people receive from natural ecosystems, including provisioning, regulating, supporting, and cultural services, are summarized as ecosystem services. The concept frames nature's contributions to people. It supports better integration of ecosystems into decision-making.
47. C — Reducing, reusing, and recycling materials, plus composting food and yard waste, divert materials away from landfills and return them to use or to the soil. These practices cut landfill volume at the source. They form the core of household waste reduction.
48. A — Gathering information about the situation and identifying the criteria and constraints the solution must address is part of defining the problem, the early phase of the engineering design process. A well-defined problem guides all later steps. Skipping it leads to wasted effort on poorly aimed designs.
49. D — When a prototype reveals a problem, the appropriate next step is to use the test information to modify the design, addressing the issue, and then retest the modified version. Iteration—testing, refining, and retesting—is central to good engineering. A flaw found in testing is information, not a reason to abandon the project.
50. B — Engineering designs affect the people and ecosystems around them, so considering environmental and social impacts helps ensure designs are safe, sustainable, equitable, and aligned with the values of the communities they serve. Engineering does not happen in isolation. Responsible design considers context, not only technical performance and cost.