PRACTICE EXAM 61: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. A scientist describes the universe as expanding, with galaxies moving farther apart from one another over time. Which of the following best describes what is actually expanding in this picture of the universe?

A. The galaxies themselves are physically growing in size, while the space between them remains exactly the same throughout the entire history of the universe, regardless of any other factors at all

B. The Sun and the planets of our solar system are physically growing in size, while the space between galaxies remains exactly the same throughout the entire history of the universe, regardless of any other factors

C. Space itself is stretching between distant galaxies, carrying them farther apart over time, even though the galaxies themselves are not flying apart through any pre-existing space

D. The empty space between atoms inside ordinary matter is rapidly expanding, while the space between galaxies remains exactly the same throughout the entire history of the universe, regardless of any other factors

2. A scientist describes a brand-new star that has just begun nuclear fusion in its core. Which of the following best describes what is taking place inside the core of this newly formed star?

A. The new star is splitting heavy elements such as uranium into lighter ones, releasing energy through the same kind of fission reactions used in nuclear power plants on Earth, with no fusion of any kind at any time

B. The new star is fusing hydrogen nuclei into helium under crushing heat and pressure, releasing energy and providing the outward pressure that balances the inward pull of gravity

C. The new star is undergoing slow chemical burning of methane and other gases, releasing energy through the same kind of combustion reactions that occur in a household furnace, with no nuclear fusion at any time

D. The new star is gradually cooling and contracting under its own gravity, with no measurable release of energy from its core at any time during its earliest stage of life, regardless of any other factors at all

3. A scientist explains that the Sun is currently about halfway through its life as a main-sequence star. Which of the following best describes what will happen to the Sun about five billion years from now, when its hydrogen fuel begins to run out?

A. The Sun 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 Sun at the time it occurs

B. The Sun 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 Sun at the time of the explosion

C. The Sun will continue to fuse hydrogen at the same rate forever, with no further changes in its structure for trillions of years, regardless of the actual mass of the Sun at the time of the hydrogen exhaustion

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

4. A planet orbits the Sun at an average distance of 36 AU. Using Kepler's Third Law ($T^2 = a^3$ in solar units), what is the planet's approximate orbital period?

A. About 216 years, because 36 cubed is 46,656, and the square root of 46,656 is 216 years

B. About 36 years, because the orbital period in years is always equal to the average distance from the Sun in AU, regardless of the actual length of the orbit being analyzed or any other factors at all

C. About 6 years, because the orbital period in years is always equal to the square root of the average distance from the Sun in AU, regardless of the actual length of the orbit being analyzed or any other factors at all

D. About 1,296 years, because the orbital period in years is always equal to the average distance from the Sun in AU squared, regardless of the actual length of the orbit being analyzed or any other factors at all

5. A scientist explains that Earth's orbit around the Sun takes approximately 365.25 days. Which of the following best describes the consequence of this orbital period for the calendar system that humans use?

A. The calendar year is exactly 365 days long every year, with no relationship at all to the actual orbital period of the Earth around the Sun, regardless of any other factors involved in setting up a working calendar

B. A leap day is added to the calendar approximately every four years to compensate for the extra quarter-day in each orbital year, so that the calendar stays aligned with the actual position of Earth in its orbit

C. The calendar year is exactly 366 days long every year, with no relationship at all to the actual orbital period of the Earth around the Sun, regardless of any other factors involved in setting up a working calendar

D. The Earth completes exactly two full orbits around the Sun during each calendar year, with no leap days needed at any time during any calendar year, regardless of any other factors involved in setting up a working calendar

6. A scientist looking at the sky just after sunset sees a thin sliver of the Moon lit on its right side along the western horizon. About one week later, which Moon phase will be visible?

A. A new moon, when the side of the Moon facing the Earth is dark, so the Moon cannot easily be seen in the sky at any time of day or night, regardless of any other factors at all in the lunar cycle of any month

B. A full moon, when the entire side of the Moon facing the Earth is brightly lit throughout the entire night for many hours after sunset, regardless of any other factors at all in the lunar cycle of any month

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

D. A last quarter, when exactly the left half of the Moon's visible disk is illuminated in the early morning sky just before sunrise, regardless of any other factors at all in the lunar cycle of any month

7. During a total solar eclipse, the Moon completely covers the Sun's bright disk and casts a small shadow on Earth's surface. Which of the following best explains why total solar eclipses are visible from only a narrow path on Earth?

A. The Sun deliberately blocks its own light from reaching most of Earth's surface during eclipses, casting a narrow shadow only along the path of totality and leaving the rest of Earth in normal sunlight at all times

B. The Earth's atmosphere blocks the Moon's shadow from reaching most regions of Earth's surface, leaving only a narrow strip where the shadow can be observed during any total solar eclipse at any time of year

C. The Moon's orbit is tilted relative to Earth's orbit, which is the only reason that total solar eclipses are visible from only a narrow path on Earth, regardless of any other factor in the geometry of the eclipse at all

D. The Moon is much smaller than the Earth and casts only a small umbral shadow, so only the narrow region directly under this small shadow experiences totality during any solar eclipse

8. A coastal town has two high tides and two low tides each day. Which of the following best explains why most coastlines experience two high tides each day?

A. The Moon's gravitational pull raises bulges of ocean water on both the near and far sides of Earth, and the rotation of Earth causes a given coastline to pass through both bulges over the course of about one day

B. The Sun's gravitational pull alone raises bulges of ocean water on both the near and far sides of Earth, with no role at all played by the Moon, regardless of any other factor in the geometry of the Sun, Earth, and Moon at all

C. The Earth's rotation alone causes ocean water to pile up on both the near and far sides of the planet, with no role at all played by the Moon's gravity, regardless of any other factor in the geometry of the Sun, Earth, and Moon

D. The Moon's gravitational pull raises a single bulge of ocean water on the near side of Earth only, and the rotation of Earth causes a given coastline to pass through this single bulge twice each day, regardless of geometry

9. A scientist explains that the Sun is just one of many billions of stars in the Milky Way galaxy, and that the Milky Way is one of many billions of galaxies in the observable universe. Which of the following best describes the kind of galaxy that the Milky Way is?

A. A globular cluster galaxy, a tightly packed roughly spherical group of stars that are gravitationally bound together with no real spiral or barred structure at all, regardless of any other features of the galaxy itself at all

B. An elliptical galaxy, a smooth, featureless egg-shaped collection of stars with no spiral arms and no central bar, regardless of any other features of the galaxy itself at all, including its stellar population and its central structure

C. A spiral galaxy with a barred central region and several large spiral arms extending outward, with the Sun located in one of the smaller arms about two-thirds of the way out from the galactic center

D. An irregular galaxy, a galaxy with no distinct shape and no spiral arms or central bar, regardless of any other features of the galaxy itself at all, including its stellar population and its central structure

10. Mars has the highest mountain and the deepest canyon in the solar system, and its surface shows many features that suggest liquid water once flowed there. Which of the following best describes the current surface conditions on Mars?

A. Mars currently has open oceans of liquid water across its entire surface, with no real difference from Earth in terms of liquid water at the surface, regardless of any other features of the planet's atmosphere or interior at all

B. Mars has a thin atmosphere, an extremely cold and dry surface, and only small amounts of water ice in its polar caps and underground, with no large bodies of liquid water on its present surface

C. Mars has an extremely thick atmosphere of hydrogen and helium, with no real solid surface anywhere on the planet, regardless of any features of the planet's interior or any features observed from orbit by spacecraft at any time

D. Mars has a surface composed entirely of liquid water and salt that completely covers the planet, with no real solid surface anywhere on Mars, regardless of any features of the planet's interior or any features observed from orbit

11. A scientist explains that the Sun produces energy through nuclear fusion in its core. Which of the following best describes what happens to mass during this fusion process?

A. The mass of the products is exactly equal to the mass of the reactants, with no measurable change in mass at any time during nuclear fusion in the Sun's core, regardless of any other factors at all in the fusion reaction

B. The mass of the products is much greater than the mass of the reactants, with new mass being created by the fusion process in the Sun's core, regardless of any other factors at all in the fusion reaction at any time

C. A small amount of mass is converted into energy, which is released as light and heat, in accordance with Einstein's mass-energy equivalence relationship between the products and the reactants of the fusion

D. The mass of the reactants is completely destroyed during nuclear fusion, with no energy released and no products of any kind formed at any time during the fusion in the Sun's core, regardless of any other factors at all

12. Geologists determine the relative ages of rock layers by applying several principles. Which of the following correctly describes the principle of original horizontality?

A. Sedimentary layers are originally deposited in flat, horizontal sheets, and any folding, tilting, or other disturbance must have occurred after the layers were originally deposited and lithified

B. Sedimentary layers are originally deposited at the same angle as the surrounding bedrock, regardless of whether the bedrock is flat, tilted, or folded, so the original orientation of any layer cannot be determined from the layer alone

C. Sedimentary layers are originally deposited in vertical sheets that stand on edge, and any horizontal layering must have occurred after the layers were originally deposited and lithified, regardless of any other factors at all

D. Sedimentary layers are originally deposited in random orientations that have no relationship to gravity, water depth, or any other physical conditions at the time of deposition, regardless of any other factors at all

13. A scientist explains that the principle of cross-cutting relationships allows geologists to determine the relative ages of features that intersect one another. Which of the following best describes this principle?

A. Any feature that cuts across other features must always be the same age as the features that it cuts across, with no relationship between the ages of the cutting feature and the features being cut, regardless of any other factors

B. Any feature that cuts across other features must be older than the features it cuts across, since the cutting feature must always exist long before any features that it eventually cuts across can possibly form, regardless of factors

C. Any feature that cuts across other features must be much younger than the features it cuts across, by exactly the amount of time it took for the cutting feature to migrate across the rock layers from one side to the other, regardless of factors

D. Any feature that cuts across other features must be younger than the features it cuts across, since the features being cut must have existed before the cutting feature could break across them

14. A radioactive isotope has a half-life of 600 years. A sample now contains one-eighth of the original amount of this isotope. About how much time has passed since the sample formed?

A. About 600 years, because reducing the isotope to one-eighth requires only one half-life of decay, regardless of any other factors at all involved in the decay of the radioactive isotope over any period of time

B. About 1,800 years, because three half-lives are needed to reduce the isotope to one-eighth of its original amount

C. About 4,800 years, because eight half-lives are needed to reduce the isotope to one-eighth of its original amount, regardless of any other factors at all involved in the decay of the radioactive isotope over any period of time

D. About 1,200 years, because reducing the isotope to one-eighth requires only two half-lives of decay, regardless of any other factors at all involved in the decay of the radioactive isotope over any period of time

15. A scientist describes a layer of rock that contains fossilized leaves, tree trunks, and the bones of land animals, with no marine fossils anywhere in the layer. Which of the following best describes the most likely environment in which this rock layer formed?

A. A terrestrial environment such as a forested floodplain, where land plants and land animals lived, died, and were buried in sediments deposited by rivers, with no contribution from marine organisms at any time at all

B. A deep ocean basin, where only the very finest clay particles slowly settled to the bottom over many millions of years, with no contribution from any land plants or any land animals at any time at all

C. A high mountain summit, where bare rock was exposed to constant freezing and thawing for many millions of years, with no contribution from any land plants or any land animals at any time at all

D. A coral reef in a warm, shallow tropical sea, where many marine organisms lived and died, with no contribution from any land plants or any land animals at any time at all, regardless of any other factors at all

16. Wegener's hypothesis of continental drift was supported by several lines of evidence, including the fit of continental coastlines, the distribution of certain fossils, matching rock formations across oceans, and ancient climate indicators. Which of the following best describes how all of these lines of evidence together support the idea that the continents were once joined?

A. Each individual line of evidence is sufficient on its own to support the idea that the continents were once joined, with no need to combine multiple lines of evidence to draw a meaningful conclusion about the past of the Earth

B. Each line of evidence has no relationship to continental drift, since all of these features can be fully explained by other geologic processes that have nothing to do with the movement of continents over geologic time

C. Each line of evidence individually fits a picture in which the continents were once joined into a single landmass, and the combined weight of these independent lines of evidence makes the hypothesis far more convincing

D. Each line of evidence individually contradicts the idea that the continents were once joined, since all of these features can only be fully explained by continents that have always been in their present positions, regardless of any other factors at all

17. A scientist explains that the boundary between the Cretaceous and Paleogene periods is marked by a sharp change in the fossil record and a worldwide layer of rock that is rich in iridium. Which of the following best describes the most widely accepted explanation for this boundary?

A. The boundary marks the slow extinction of dinosaurs and other species over many millions of years due to gradual climate change, with no role at all played by any external event such as an asteroid impact at any time

B. The boundary marks no real event in Earth's history, since the change in the fossil record and the iridium-rich layer can be fully explained by ordinary geologic processes that have nothing to do with extinction or any external event

C. The boundary marks a major mass extinction event, including the extinction of the non-avian dinosaurs, that was likely caused by the impact of a large asteroid combined with major volcanic activity around the same time

D. A large asteroid impact at the end of the Cretaceous Period rapidly altered global conditions, contributing to a mass extinction that included the extinction of the non-avian dinosaurs and many other groups of organisms

18. A scientist explains that geologists divide Earth's history into time intervals based on changes recorded in the rocks. Which of the following best describes how the boundaries between these intervals are typically chosen?

A. Boundaries are chosen at completely arbitrary numerical points so that every interval ends up containing exactly the same length of time, with no relationship at all to any events recorded in the rocks or any other features of any kind

B. Boundaries are chosen at points where the rock record shows significant changes, such as the first or last appearance of important fossil groups, major shifts in climate, or major changes in the dominant kinds of organisms

C. Boundaries are chosen at points where the modern calendar happens to mark major holidays, with no relationship at all to any events recorded in the rocks or any other features of the planet's geologic history at any time at all

D. Boundaries are chosen wherever paleontologists happen to be working at the moment, so the boundaries reflect modern research locations more than past events, with no relationship at all to events in Earth's history at any time at all

19. A scientist explains that Earth's interior is divided into several layers, including the inner core, the outer core, the mantle, and the crust. Which of the following best describes the inner core of the Earth?

A. The inner core is a solid sphere of iron and nickel at the very center of the Earth, kept solid by the immense pressure at the center even though its temperature is extremely high

B. The inner core is a thick layer of molten rock that surrounds the outer core, where convection currents drive the motion of the tectonic plates above, with no relationship to the magnetic field of the Earth at any time at all

C. The inner core is a layer of liquid iron and nickel between the outer core and the mantle, where the motion of liquid metal generates the magnetic field of the Earth, with no relationship to any other feature of the Earth's interior at all

D. The inner core is a thin shell of solid rock at the surface of the Earth, which contains all of the rocks and minerals familiar at the surface, with no relationship to any other feature of the Earth's interior at any time at all

20. A scientist explains that some of the largest mountain ranges on Earth, such as the Himalayas, have formed where two continental plates collided. Which of the following best describes the process by which the Himalayas formed?

A. The Himalayas formed at a divergent boundary, where two continental plates pulled apart and rising magma formed a long ridge between them, regardless of any other features of the two continental plates at all

B. The Himalayas formed at a transform boundary, where two continental plates slid horizontally past one another along a fault, producing only earthquakes and no mountain building of any kind at any time at all

C. The Indian Plate collided with the Eurasian Plate, and the buoyant continental crust on both plates was crumpled and thickened upward to produce the Himalayas

D. The Himalayas formed at a subduction zone, where one oceanic plate descended beneath another oceanic plate, with no continental collision involved in the formation of the mountain range at any time at all

21. A geologist examines a rock made of large, rounded, well-cemented quartz grains and identifies it as a sandstone. Which of the following best describes the process by which sandstone forms?

A. Sand grains are deposited, buried, compacted, and cemented over time to form a clastic sedimentary rock, with the grains often rounded and sorted by their transport through water or wind before they are deposited

B. Sand grains are heated and squeezed deep underground until they recrystallize into a metamorphic rock with wavy parallel bands of aligned minerals, regardless of any other features of the original sand or any other factors at all

C. Sand grains are completely melted into magma deep underground and then re-solidified into an intrusive igneous rock with large interlocking crystals of quartz, feldspar, and mica, regardless of any other features of the rock at all

D. Sand grains are completely melted into lava at the surface and then quickly re-solidified into an extrusive igneous rock with a fine-grained or glassy texture, regardless of any other features of the rock at any time at all

22. A scientist describes a sample of igneous rock as having very large crystals of feldspar surrounded by a fine-grained matrix of smaller crystals. Which of the following best describes how this two-step texture, called porphyritic texture, likely formed?

A. The rock formed by the slow weathering of an older rock over millions of years, which produced both large crystals and a fine-grained matrix at the same time, with no relationship to magma or lava or any cooling at any time at all

B. The rock formed in a single stage of very slow cooling deep underground over millions of years, which produced both the large crystals and the fine-grained matrix at the same time, with no other stages involved at all

C. The magma cooled in two stages: slow cooling deep underground grew the large crystals, and then more rapid cooling, often after eruption to the surface, produced the fine-grained matrix around them

D. The rock formed in a single stage of very rapid cooling at the surface, which produced both the large crystals and the fine-grained matrix at the same time, regardless of any other factors at all involved in the rock at any time

23. A scientist explains that minerals are identified by physical properties such as hardness, color, streak, luster, cleavage, and density. Which of the following best describes the streak of a mineral?

A. Streak is the way that a mineral's surface reflects light, used to describe the appearance of the mineral with terms such as metallic, glassy, pearly, or dull, regardless of any other features of the mineral at any time at all

B. Streak is the color of the powdered form of a mineral, observed by rubbing the mineral across an unglazed porcelain tile, often more diagnostic than the color of the mineral's surface

C. Streak is the tendency of a mineral to break along smooth, flat planes determined by the orderly arrangement of its atoms, regardless of any other features of the mineral at any time at all in the natural environment

D. Streak is a measure of how strongly a mineral resists being scratched by another material whose hardness is already known, regardless of any other features of the mineral at any time at all in the natural environment

24. A scientist examines a sample of soil and identifies its horizons from the surface downward. Which of the following best describes the typical sequence of soil horizons from the surface to the underlying bedrock in a mature soil profile?

A. From the surface downward, the typical sequence is: bedrock, weathered rock, mineral-rich subsoil, and topsoil rich in organic matter at the bottom of the profile, regardless of any other features of the soil at any time at all

B. From the surface downward, the typical sequence is: bedrock, topsoil rich in organic matter, weathered rock, and mineral-rich subsoil in the middle of the profile, regardless of any other features of the soil at any time at all

C. From the surface downward, the typical sequence is: mineral-rich subsoil, weathered rock, topsoil rich in organic matter, and bedrock at the very top of the profile, regardless of any other features of the soil at any time at all

D. From the surface downward, the typical sequence is: topsoil rich in organic matter, mineral-rich subsoil, partially weathered rock, and finally solid bedrock at the deepest level

25. A scientist describes a river that drops most of its sediment where it enters a calm lake, building up a fan-shaped deposit over many years. Which of the following best describes how this fan-shaped deposit, called a delta, is structured as new sediment is added?

A. New sediment is added in a single thin layer that is deposited only when the river floods, with no real structure to the deposit and no relationship to the size of the particles carried by the river at any time at any time at all

B. New sediment is added in a single thick layer that is deposited only at the very edge of the delta, with no real structure to the deposit and no relationship to the size of the particles carried by the river at any time at any time at all

C. New sediment is added in layers that build outward into the lake, with coarser sediment usually nearer the river mouth and finer sediment carried farther into the lake before settling out from the water

D. New sediment is moved back upstream against the flow of the river and deposited in the mountains rather than at the lake, with no real structure to the deposit at the mouth of the river at any time at any time at all

26. A scientist explains that the water cycle is powered primarily by energy from the Sun. Which of the following best describes the role of solar energy in driving the water cycle?

A. Solar energy drives evaporation from oceans, lakes, and other surfaces, lifts water vapor into the atmosphere, and powers the atmospheric circulation that carries water vapor over the land and back to the oceans again

B. Solar energy has no real role in driving the water cycle, since the movement of water between the atmosphere, oceans, and land is completely independent of any solar radiation reaching the surface of the Earth at any time at all

C. Solar energy alone freezes water directly from oceans and other surfaces into ice in the atmosphere, with no liquid water phase at all involved in any stage of the water cycle on Earth at any time at all, regardless of any other factors

D. Solar energy alone heats water deep within the Earth and brings it to the surface as hot springs, with no other role for solar energy at any other stage of the water cycle on Earth at any time at all, regardless of any other factors

27. A scientist explains that the carbon cycle moves carbon among the atmosphere, oceans, land, and living things. Which of the following best describes one major reservoir of carbon on Earth?

A. The atmosphere is by far the largest carbon reservoir on Earth, holding far more carbon than the oceans, rocks, soils, and living organisms combined together at any time at all, regardless of any other factors at all

B. The Sun is one of the largest reservoirs of carbon for the Earth's carbon cycle, with most carbon on Earth originating from the Sun and gradually flowing into the Earth's atmosphere over many billions of years

C. Living organisms are by far the largest carbon reservoir on Earth, holding far more carbon than the oceans, rocks, soils, and the atmosphere combined together at any time at all, regardless of any other factors at all

D. Earth's rocks, especially carbonate rocks such as limestone, contain a very large amount of carbon, while the oceans and the atmosphere are smaller but still important reservoirs in the global carbon cycle

28. A scientist examines a region's bedrock and finds layers of porous, well-connected sandstone overlain by a thick layer of impermeable clay. Which of the following best describes this geologic situation in terms of groundwater?

A. The sandstone has no real role as an aquifer in this region, since the impermeable clay above the sandstone always permanently and instantly removes any water from the sandstone below at any time at all in any region of the world

B. The sandstone can act as a confined aquifer, with the impermeable clay layer above trapping water under pressure within the sandstone, and a well drilled into the sandstone may produce water that rises in the well casing

C. The sandstone has no real role as an aquifer in this region, since well-connected porous rocks always permanently and instantly drain dry without holding any water at any time at all in any region of the world, regardless of any other factors

D. The sandstone has no real role as an aquifer in this region, since the impermeable clay above always permanently and instantly converts the sandstone into a metamorphic rock at any time at all in any region of the world

29. A scientist examines an oceanic island that is the result of a hotspot beneath the ocean floor. Which of the following best describes the origin of such islands?

A. A rising plume of hot mantle material melts through the moving oceanic plate from below, producing a chain of volcanic islands as the plate slides over the hotspot, with the youngest island located directly above the hotspot

B. The Sun's gravitational pull on the ocean floor directly causes the formation of oceanic islands at hotspots, with no role at all played by any rising plume of hot mantle material at any time at any region of the world at all

C. The Moon's gravitational pull on the ocean floor directly causes the formation of oceanic islands at hotspots, with no role at all played by any rising plume of hot mantle material at any time at any region of the world at all

D. The Earth's magnetic field deflects the ocean floor at certain locations, producing volcanic islands at hotspots, with no role at all played by any rising plume of hot mantle material at any time at any region of the world at all

30. A scientist explains that the global climate system includes the atmosphere, the oceans, the cryosphere (snow and ice), the land, and the biosphere. Which of the following best describes how these components interact within the climate system?

A. The components of the climate system are completely independent of one another and never exchange any energy or material in any way at any time, with no relationship to any climate of any region of the world at any time at all

B. The components of the climate system continuously exchange energy and material with one another through processes such as evaporation, ocean currents, ice melt, and biological activity, all of which influence regional and global climates

C. The components of the climate system exchange energy and material only at the equator, with no exchange at any other latitude or region of the world at any time at all, regardless of any other factors at all in the climate system

D. The components of the climate system exchange energy and material only at the poles, with no exchange at any other latitude or region of the world at any time at all, regardless of any other factors at all in the climate system

31. A scientist explains that a sea breeze develops along a coastline during a sunny day, with cooler air from over the ocean flowing inland to replace rising warm air over the land. Which of the following best describes the cause of this sea breeze?

A. The Moon's gravitational pull on the ocean directly causes the sea breeze to develop along the coastline, with no relationship to any temperature difference between the land and the ocean at any time of day at all

B. The land heats more quickly than the ocean during the day, so warm air rises over the land and cooler ocean air flows in to replace it, producing the sea breeze that flows from the ocean toward the land during sunny days

C. The Sun's gravitational pull on the land directly causes the sea breeze to develop along the coastline, with no relationship to any temperature difference between the land and the ocean at any time of day at all

D. The ocean heats more quickly than the land during the day, so warm air rises over the ocean and cooler air from the land flows in to replace it, producing the sea breeze that flows from the land toward the ocean during sunny days

32. A scientist explains that hurricanes form only over warm tropical oceans and not over cold polar waters. Which of the following best explains why warm ocean water is essential for hurricane formation?

A. Warm ocean water deflects the Coriolis effect and allows the hurricane to organize and rotate, with no relationship to any heat or moisture being supplied to the storm from the ocean at any time at all in any region of the world at all

B. Warm ocean water repels the Earth's magnetic field at certain regions of the world and allows the hurricane to organize and rotate, with no relationship to any heat or moisture being supplied to the storm at any time at all in any region

C. Warm ocean water permanently and instantly stops the Earth's rotation in regions where hurricanes form, with no relationship to any heat or moisture being supplied to the storm at any time at all in any region of the world at all

D. Warm ocean water provides the heat and moisture that power a hurricane, fueling rising humid air and intense convection within the storm and allowing it to grow and intensify

33. A scientist examines a weather map and identifies a cold front advancing toward a warm, humid region. Which of the following sequences of weather is most typical as the cold front passes?

A. Several days of unchanging dense fog that simply sits over the same area, with no precipitation and no change in temperature of any kind for the entire period that the front sits over the region, regardless of any other factors at all

B. Completely clear skies and a sharp rise in temperature throughout the entire passage of the front, with no clouds or precipitation developing at any point during the day or evening hours, regardless of any other factors at all

C. A narrow band of heavy showers and thunderstorms, followed by clearing skies and a sharp drop in temperature behind the front

D. A long period of light, steady rain or drizzle that lasts many hours, followed by gradually warming temperatures and increasing humidity once the front has finally passed across the region, regardless of any other factors at all

34. A scientist explains that the natural greenhouse effect is essential for life on Earth, but that human activities have been strengthening this effect over the past century. Which of the following best describes the main human activity responsible for strengthening the greenhouse effect?

A. The burning of fossil fuels such as coal, oil, and natural gas, which releases large amounts of carbon dioxide and other greenhouse gases into the atmosphere over time

B. The hunting and fishing of wild animals, which has been shown to be the single largest source of greenhouse gas emissions in the modern world, regardless of any other factors at all in the climate system at any time at all

C. The cultivation of crops in fields, which has been shown to be the single largest source of greenhouse gas emissions in the modern world, regardless of any other factors at all in the climate system at any time at all

D. The construction of new roads and houses, which has been shown to be the single largest source of greenhouse gas emissions in the modern world, regardless of any other factors at all in the climate system at any time at all

35. A scientist explains that the difference between weather and climate is fundamentally one of time scale. Which of the following best illustrates this distinction with an example?

A. A blizzard in Buffalo on a particular January day is an example of climate, while the long-term pattern of cold, snowy winters and warm, humid summers in Buffalo is an example of weather, regardless of any other factors at all

B. A blizzard in Buffalo on a particular January day and the long-term pattern of cold, snowy winters and warm, humid summers in Buffalo are both examples of weather, with no real distinction between the two ideas at all

C. A blizzard in Buffalo on a particular January day and the long-term pattern of cold, snowy winters and warm, humid summers in Buffalo are both examples of climate, with no real distinction between the two ideas at all

D. A blizzard in Buffalo on a particular January day is an example of weather, while the long-term pattern of cold, snowy winters and warm, humid summers in Buffalo is an example of climate

36. A scientist explains that climate scientists use a wide variety of tools to study past climate, including ice cores, ocean sediments, tree rings, and corals. Which of the following best describes one important advantage of using multiple lines of evidence to study past climate?

A. Using only one line of evidence is always much more accurate than using multiple lines of evidence together, which is the main reason that modern climate science always relies on a single line of evidence at a time, regardless of any other factors at all

B. Combining multiple lines of evidence allows scientists to cross-check their results, develop a more complete picture of past climates, and identify changes that are consistent across many independent records

C. Using multiple lines of evidence together always increases the chance of producing a poor reconstruction of past climates, since any disagreement between lines of evidence always reduces the reliability of the resulting climate record at any time at all

D. Using multiple lines of evidence together has no real benefit over using a single line of evidence, since climate scientists are never able to combine information from many different sources into a single climate reconstruction at any time at all

37. A scientist explains that switching from coal-fired power plants to wind and solar farms is one important way to address climate change. Which of the following best describes the main environmental benefit of this kind of transition?

A. The transition reduces emissions of carbon dioxide and other air pollutants from electricity generation, lowering the contribution of the electricity sector to climate change and improving air quality

B. The transition has no measurable effect on the environment in any way, since coal-fired power plants and wind and solar farms have exactly the same emissions and the same environmental impacts at any time at all

C. The transition 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 any time at all

D. The transition always increases the emissions of carbon dioxide and other air pollutants from electricity generation, since adding new wind and solar farms always raises the total emissions of any region that adopts them, regardless of any other factors

38. A community wants to reduce the amount of solid waste it sends to landfills each year. Which of the following best describes a hierarchy of actions, listed from most to least preferred from an environmental perspective?

A. Disposing of waste in a landfill, incinerating waste, recycling materials, reusing items, and reducing the generation of waste in the first place, with no relationship to any environmental preference at all in any region of the world at all

B. Incinerating waste, disposing of waste in a landfill, reducing the generation of waste in the first place, reusing items, and recycling materials, with no relationship to any environmental preference at all in any region of the world at all

C. Reducing the generation of waste in the first place, reusing items, recycling materials, and finally disposing of any remaining waste safely, which together form the "reduce, reuse, recycle" hierarchy commonly used in waste management

D. Recycling materials, reducing the generation of waste in the first place, reusing items, incinerating waste, and finally disposing of waste in a landfill, with no relationship to any environmental preference at all in any region of the world at all

39. A scientist explains that ocean ecosystems provide many important services to people, including food, climate regulation, and coastal protection. Which of the following best describes one major threat to ocean ecosystems that is linked to climate change?

A. Cooler ocean temperatures, reduced ocean acidification, and lower sea levels, which are the main projected consequences of climate change for ocean ecosystems around the world over the next several decades, regardless of any other factors at all

B. Lower sea levels, reduced storm intensity, and slower ice melt, which are the main projected consequences of climate change for ocean ecosystems around the world over the next several decades, regardless of any other factors at all

C. Increased ocean salinity, reduced wave action, and lower sea levels, which are the main projected consequences of climate change for ocean ecosystems around the world over the next several decades, regardless of any other factors at all

D. Warmer ocean temperatures, ocean acidification, rising sea levels, and more intense storms, all of which threaten coral reefs, fisheries, and coastal communities in many regions of the world

40. A scientist explains that human activities, including industrial agriculture, urban expansion, and pollution, have contributed to a global decline in biodiversity. Which of the following best describes one important benefit of conserving biodiversity?

A. Conserving biodiversity always permanently destabilizes ecosystems, since a more diverse community of species always introduces too much competition and reduces the long-term ability of the ecosystem to persist, regardless of any other factors at all

B. Conserving biodiversity supports the functioning of ecosystems and the services they provide, including pollination, decomposition, water purification, and climate regulation, all of which benefit human well-being

C. Conserving biodiversity has no measurable effect on the long-term health of any ecosystem, since native species play no role at all in maintaining the natural functioning of any ecosystem anywhere in the world at any time at all

D. Conserving 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, regardless of any other factors at all

41. A scientist explains that the carbon dioxide concentration in the atmosphere has increased significantly over the past century, mainly due to human activities. Which of the following best describes one important consequence of this increase for Earth's climate?

A. The additional carbon dioxide strengthens the greenhouse effect, contributing to the long-term warming of Earth's surface and atmosphere observed over the past century and projected to continue in the coming decades

B. The additional carbon dioxide weakens the greenhouse effect, contributing to the long-term cooling of Earth's surface and atmosphere observed over the past century, regardless of any other factors at all in the climate system at any time at all

C. The additional carbon dioxide has no measurable effect on Earth's climate, since the atmosphere is so vast that human emissions cannot possibly have any effect on the climate of the planet at any time at all, regardless of any other factors at all

D. The additional carbon dioxide permanently and instantly reverses the rotation of the Earth on its axis, which is the only measurable effect that any rise in carbon dioxide has ever had on the climate of the Earth in any region of the world at all

42. A coastal community is considering ways to protect itself from a projected rise in sea level over the coming decades. Which of the following best describes one example of a nature-based adaptation strategy?

A. Filling in the community's natural wetlands to create more space for buildings and parking lots, regardless of any consequences for natural flood protection or coastal habitats in the area at any time at all, regardless of any other factors at all

B. Removing all of the natural vegetation from the community's beaches and dunes, regardless of any consequences for natural flood protection or coastal habitats in the area at any time at all, regardless of any other factors at all

C. Building a tall, solid concrete sea wall directly along the entire coastline of the community, with no consideration at all of any natural ecosystems or any habitat for wildlife in the area at any time at all, regardless of any other factors at all

D. Restoring coastal wetlands, mangroves, and oyster reefs to absorb wave energy and reduce flooding, while also providing habitat for many species that depend on these natural coastal ecosystems

43. A scientist explains that some natural resources, such as fossil fuels and many minerals, are nonrenewable on human timescales. Which of the following best describes one important consequence of relying on nonrenewable resources?

A. The supply of nonrenewable resources will continue to grow each year, since population growth always permanently and instantly increases the supply of every nonrenewable resource in every region of the world at any time at all

B. The supply of nonrenewable resources is never affected by human activity in any way, since the amount of every nonrenewable resource is always perfectly matched to the demand from the people, agriculture, and industry that depend on the resource

C. As nonrenewable resources are extracted and used, the available supply gradually decreases, which can lead to higher costs, increased extraction in environmentally sensitive areas, and growing pressure to develop alternatives

D. The supply of nonrenewable resources permanently and instantly doubles every year, since population growth always permanently and instantly doubles the supply of every nonrenewable resource in every region of the world at any time at all

44. A scientist explains that one important benefit of investing in renewable energy is that renewable energy sources do not produce significant air pollution during operation. Which of the following best describes one specific air pollution benefit of switching from fossil fuels to renewable energy sources?

A. Switching from fossil fuels to renewable energy sources always permanently and instantly removes every air pollutant from every region of the world, with no further effort of any kind needed in any other sector of the global economy at any time

B. Switching from fossil fuels to renewable energy sources reduces emissions of sulfur dioxide, nitrogen oxides, and particulate matter, which improves air quality and reduces respiratory illnesses, acid rain, and other environmental damage

C. Switching from fossil fuels to renewable energy sources 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 any time at all

D. Switching from fossil fuels to renewable energy sources always increases the emissions of sulfur dioxide, nitrogen oxides, and particulate matter, since adding new renewable energy always raises the total emissions of any region that adopts them, regardless of any other factors at all

45. A scientist explains that the carrying capacity of an environment is the maximum population of a particular species that the environment can support indefinitely. Which of the following best describes one important consequence when a population exceeds its environment's carrying capacity?

A. The population may experience a decline as resources such as food, water, and space become limited, and ecological problems such as competition, starvation, or disease can reduce the population back toward sustainable levels

B. The population always permanently and instantly doubles in size as soon as it exceeds the carrying capacity, since exceeding the carrying capacity always permanently and instantly improves the resources of any environment at any time

C. The population always permanently and instantly stabilizes at exactly the carrying capacity as soon as it exceeds the carrying capacity, since the carrying capacity always permanently and instantly adjusts to match any population size at any time

D. The population always permanently and instantly increases the carrying capacity of the environment to match its new size, since populations always permanently and instantly improve the resources of every environment they live in at any time

46. A scientist explains that effective management of natural resources often requires international cooperation, especially for resources that cross national borders or that affect the global atmosphere or oceans. Which of the following best describes one example of an environmental issue that benefits from international cooperation?

A. The depletion of a single drinking water reservoir in a small inland city, since the management of a single local reservoir always requires the participation of many countries in international cooperation at any time at all in any region of the world

B. The disposal of household trash from a single neighborhood, since the management of a single neighborhood's trash always requires the participation of many countries in international cooperation at any time at all in any region of the world

C. The maintenance of a single small park within a single city block, since the management of a single small park always requires the participation of many countries in international cooperation at any time at all in any region of the world

D. The protection of the ozone layer, which involves chemicals that can travel through the entire atmosphere and which has been successfully addressed by international agreements such as the Montreal Protocol

47. A community installs LED streetlights, improves the energy efficiency of its public buildings, and provides incentives for residents to install heat pumps and solar panels. Which of the following best describes the overall environmental strategy represented by these actions?

A. Climate 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 other climate impacts in the region at any time at all

B. Climate 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 at any time at all

C. Climate mitigation, since the community is reducing the greenhouse gas emissions that contribute to climate change by lowering its energy use and shifting toward cleaner sources of energy

D. Climate adaptation, since the community is adjusting its infrastructure to better cope with climate impacts that are already starting to occur in the region, with no relationship to any other climate impacts in the region at any time at all

48. An engineering team has been asked to design a new water purification system for a remote village. Before sketching solutions, the team gathers detailed information about the community's current water sources, the budget the community can afford, the materials available locally, the skills of local technicians, and any government regulations that apply. Which step of the engineering design process is the team performing in this activity?

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

B. Testing the design, since gathering information about a problem is the same step as evaluating the performance of a finished design under real conditions over a period of time before it is finalized, regardless of any other factors at all

C. Building a prototype, since gathering information about a problem is the same step as constructing an early working model of the design that the team plans to test in a real environment later on, regardless of any other factors at all

D. Releasing the final product, since gathering information about a problem is the same step as delivering a fully completed water system to the community that will eventually use it for many years, regardless of any other factors at all

49. An engineering team has tested a small-scale physical model of a new bridge and has identified one specific weakness in the design. Which of the following best describes the team's most appropriate next action in the engineering design process?

A. Conceal the weakness in the design from the public and proceed to build the full-sized version of the bridge 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. Use the information from the test to modify the design, addressing the weakness, and then test the modified design again to see whether the change has been effective

C. 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, regardless of any other factors at all

D. Open the full-sized version of the bridge to traffic without making any changes, since the first version of any design is always the final version, regardless of the actual results of any physical test of the design at any time at all

50. Engineers and scientists often work together to address complex environmental problems. Which of the following best describes one important way that science and engineering complement each other in such projects?

A. Science and engineering are completely independent of each other and never share any information or methods in any environmental project, with no relationship between the two fields in any way at any time at all in any project at all

B. Science and engineering have exactly the same goal of designing new products, with no real distinction between the two fields in terms of methods, questions, or the final products they produce in any environmental project at all

C. Science provides understanding of natural systems and processes, while engineering applies that understanding to design solutions to problems, and each field contributes knowledge and tools that support the other field's work

D. Science and engineering have exactly the same goal of explaining nature, with no real distinction between the two fields in terms of methods, questions, or the final products they produce in any environmental project at any time at all

Practice Exam 61: Answer Key with Explanations

1. C — In an expanding universe, space itself stretches between distant galaxies, carrying them farther apart over time, rather than galaxies flying outward through a pre-existing space. The galaxies themselves remain bound by gravity. This stretching of space is the key insight of Big Bang cosmology.
2. B — A newly formed star fuses hydrogen nuclei into helium under crushing heat and pressure, releasing energy and providing the outward pressure that balances gravity. This hydrostatic equilibrium defines the main sequence. Fusion ignition marks the true birth of a star.
3. D — When the Sun's hydrogen runs out, it will expand into a red giant, eventually shed its outer layers as a planetary nebula, and leave behind a slowly cooling white dwarf. Mass determines this gentle endpoint. More massive stars instead end in supernovae.
4. A — Kepler's Third Law gives $T^2 = a^3$, so with a = 36, a^3 equals 46,656 and T is the square root of 46,656, exactly 216 years. The cube of the distance sets the square of the period. This relationship applies to any object orbiting the Sun.
5. B — Because Earth's orbital period is about 365.25 days, a leap day is added approximately every four years to compensate for the extra quarter-day in each orbital year and keep the calendar aligned with Earth's position in its orbit. Without leap years, seasons would slowly drift across the calendar. This is why February 29 exists.
6. C — A thin waxing crescent visible just after sunset will grow into a first quarter Moon about a week later, with exactly the right half of the visible disk illuminated. "Waxing" means the lit fraction is increasing. The next stage will be waxing gibbous.
7. D — The Moon is much smaller than Earth and casts only a small umbral shadow, so only the narrow region directly under that shadow experiences totality. Outside the umbra observers see only a partial eclipse. Shadow geometry sets the narrow totality path.
8. A — The Moon's gravitational pull raises bulges of ocean water on both the near and far sides of Earth, and Earth's rotation carries a given coastline through both bulges over about one day. The near bulge faces the Moon, and the far bulge results from inertia. This produces two highs and two lows daily.
9. C — The Milky Way is a barred spiral galaxy with several large spiral arms, and the Sun lies in one of the smaller arms about two-thirds of the way out from the galactic center. Its structure includes a central bar and a disk of stars. This places our solar system in a relatively quiet outer region.
10. B — Mars has a thin atmosphere, an extremely cold and dry surface, and only small amounts of water ice in its polar caps and underground, with no large bodies of liquid water on its present surface. Past liquid water shaped many surface features. Today's conditions are too cold and low-pressure for liquid water to persist.
11. C — During fusion in the Sun's core, a small amount of mass is converted into energy in accordance with Einstein's mass-energy equivalence, $E = mc^2$. The lost mass appears as the light and heat the Sun radiates. This is the energy source for stars.
12. A — The principle of original horizontality states that sedimentary layers are originally deposited in flat, horizontal sheets, so any folding or tilting must have occurred after deposition and lithification. The original flat layering is the starting assumption. Deformation records crustal movement after the layers formed.
13. D — Cross-cutting relationships state that any feature cutting across other features must be younger than the features it cuts across, since the older features had to exist before they could be

cut. The disrupting feature always postdates what it disrupts. This is a foundational principle of relative dating.

14. B — One-eighth remaining means three half-lives have passed, since $1 \rightarrow 1/2 \rightarrow 1/4 \rightarrow 1/8$. Three half-lives × 600 years equals 1,800 years. Counting halvings is the key to radiometric age problems.
15. A — A rock layer containing fossilized leaves, tree trunks, and land animal bones, with no marine fossils, most likely formed in a terrestrial environment such as a forested floodplain. River-deposited sediments preserved the remains. The absence of marine fossils rules out an ocean setting.
16. C — Each line of evidence individually fits a picture in which the continents were once joined, and the combined weight of these independent lines makes the hypothesis far more convincing. Convergent evidence strengthens scientific conclusions. This is why Wegener assembled multiple types of evidence for drift.
17. D — A large asteroid impact at the end of the Cretaceous Period rapidly altered global conditions, contributing to a mass extinction that included the non-avian dinosaurs. The iridium-rich worldwide layer is direct evidence. Climate disruption from the impact drove the extinctions.
18. B — Boundaries on the geologic time scale are chosen where the rock record shows significant changes, such as the first or last appearance of important fossil groups, major climate shifts, or major changes in dominant organisms. The divisions are tied to real events. This makes the time scale a record of Earth's history.
19. A — The inner core is a solid sphere of iron and nickel at the very center of the Earth, kept solid by the immense pressure even though its temperature is extremely high. Pressure raises iron's melting point enough to keep it solid at the center. Seismic-wave behavior revealed this two-part core structure.
20. C — The Himalayas formed when the Indian Plate collided with the Eurasian Plate, and the buoyant continental crust on both plates was crumpled and thickened upward. Both plates are too buoyant to subduct easily. Continental collision builds the world's tallest mountains.
21. A — Sandstone forms when sand grains are deposited, buried, compacted, and cemented over time to form a clastic sedimentary rock, with the grains often rounded and sorted by their transport through water or wind. Cementation binds the grains. The texture records both transport and burial history.
22. C — A porphyritic texture forms in two stages: slow cooling deep underground grows large crystals, and then more rapid cooling, often after eruption to the surface, produces the fine-grained matrix around them. The two crystal sizes track the two cooling rates. This is common in volcanic rocks with deep-magma histories.
23. B — Streak is the color of the powdered form of a mineral, observed by rubbing the mineral across an unglazed porcelain tile, and is often more diagnostic than surface color. Crushing eliminates oxidation and impurity effects on the surface. This makes streak a reliable diagnostic property.
24. D — A mature soil profile, from the surface downward, typically consists of topsoil rich in organic matter, mineral-rich subsoil, partially weathered rock, and finally solid bedrock at the deepest level. Soils develop from the bedrock upward over time. This sequence reflects increasing weathering and organic input toward the surface.
25. C — A delta grows outward into the lake in layers, with coarser sediment usually nearer the river mouth and finer sediment carried farther in before settling. The river drops larger particles first as it slows. Continued sediment supply extends the delta over time.

26. A — Solar energy drives evaporation from oceans and other surfaces, lifts water vapor into the atmosphere, and powers the atmospheric circulation that distributes water across the globe. Without solar energy, the water cycle would shut down. Sunlight is the engine of the hydrologic cycle.
27. D — Earth's rocks, especially carbonate rocks such as limestone, contain a very large amount of carbon, while the oceans and the atmosphere are smaller but still important reservoirs in the global carbon cycle. Most carbon is locked in rocks over long timescales. The ocean and atmosphere exchange carbon on much shorter timescales.
28. B — Porous sandstone overlain by impermeable clay can act as a confined aquifer, with the clay trapping water under pressure within the sandstone. A well drilled through the clay may produce water that rises in the casing on its own. Such artesian conditions are common in confined aquifer systems.
29. A — A rising plume of hot mantle material melts through the moving oceanic plate from below at a hotspot, producing a chain of volcanic islands as the plate slides over it, with the youngest island located directly above the hotspot. The Hawaiian Islands are a classic example. The age of the islands increases with distance from the active hotspot.
30. C — The components of the climate system continuously exchange energy and material through processes such as evaporation, ocean currents, ice melt, and biological activity, all of which influence regional and global climates. The system is tightly coupled. Changes in one component ripple through the others.
31. B — Land heats more quickly than the ocean during the day, so warm air rises over the land and cooler ocean air flows in to replace it, producing a sea breeze. The land-sea temperature difference drives the circulation. The breeze reverses at night as the land cools faster than the ocean.
32. D — Warm ocean water provides the heat and moisture that power a hurricane, fueling rising humid air and intense convection within the storm and allowing it to grow. Without that energy supply, hurricanes weaken. This is why they form over warm tropical seas and decay over cold water or land.
33. C — A fast cold front lifts warm, humid air steeply, producing a narrow band of heavy showers and thunderstorms, followed by clearing skies and a sharp drop in temperature behind the front. The steep frontal slope drives vigorous uplift. This abrupt change is characteristic of cold front passage.
34. A — The main human activity strengthening the greenhouse effect is the burning of fossil fuels such as coal, oil, and natural gas, which releases large amounts of carbon dioxide and other greenhouse gases. This adds long-buried carbon to the atmosphere. Cutting these emissions is central to climate action.
35. D — A blizzard in Buffalo on a particular January day is an example of weather, while the long-term pattern of cold, snowy winters and warm, humid summers in Buffalo is an example of climate. The two differ in time scale, not in what they measure. Distinguishing them is essential for interpreting climate trends.
36. B — Combining multiple lines of evidence lets scientists cross-check results, build a more complete picture of past climates, and identify changes that are consistent across many independent records. Each line fills different gaps and supports the others. Convergent evidence strengthens scientific conclusions.
37. A — Switching from coal to wind and solar reduces emissions of carbon dioxide and other air pollutants from electricity generation, lowering the sector's contribution to climate change and improving air quality. No fuel is burned in operation. This is a key strategy for cutting emissions.

38. C — The "reduce, reuse, recycle" hierarchy lists actions from most to least preferred: reducing waste generation first, then reusing items, then recycling materials, and finally disposing of remaining waste safely. Earlier steps avoid both raw-material use and disposal impacts. This hierarchy guides sustainable waste management.
39. D — Climate change threatens ocean ecosystems through warmer temperatures, ocean acidification, rising sea levels, and more intense storms, all of which endanger coral reefs, fisheries, and coastal communities. These threats often act together. They are central concerns for marine conservation.
40. B — Conserving biodiversity supports ecosystem functioning and the services ecosystems provide, including pollination, decomposition, water purification, and climate regulation, all of which benefit human well-being. Diverse communities are more resilient and productive. Protecting biodiversity protects services people depend on.
41. A — Additional carbon dioxide strengthens the greenhouse effect, contributing to the long-term warming of Earth's surface and atmosphere observed over the past century and projected to continue. More CO_2 traps more outgoing infrared radiation. This is the central mechanism of human-caused climate change.
42. D — Restoring coastal wetlands, mangroves, and oyster reefs to absorb wave energy and reduce flooding, while also providing habitat, is a nature-based adaptation strategy. These ecosystems work with natural processes rather than against them. They often complement built defenses such as seawalls.
43. C — As nonrenewable resources are extracted and used, the available supply gradually decreases, which can lead to higher costs, increased extraction in environmentally sensitive areas, and growing pressure to develop alternatives. Finite supply is the defining feature of nonrenewables. This drives transitions toward renewable sources.
44. B — Switching from fossil fuels to renewables reduces emissions of sulfur dioxide, nitrogen oxides, and particulate matter, improving air quality and lowering rates of respiratory illness, acid rain, and other environmental damage. The benefits include both climate and direct health gains. Clean air is a major co-benefit of clean energy.
45. A — When a population exceeds carrying capacity, it may decline as resources such as food, water, and space become limited, and competition, starvation, or disease can reduce the population back toward sustainable levels. Carrying capacity sets a ceiling. Populations above it cannot be maintained long-term.
46. D — Protection of the ozone layer is an environmental issue that benefits from international cooperation, since ozone-depleting chemicals travel through the entire atmosphere and have been successfully addressed by international agreements such as the Montreal Protocol. Shared atmosphere requires shared action. The ozone layer is now slowly recovering.
47. C — Installing LED streetlights, improving building efficiency, and supporting heat pumps and solar panels is climate mitigation, because the community is reducing the greenhouse gas emissions that contribute to climate change. Mitigation targets the underlying cause, while adaptation copes with impacts. Cutting emissions at the source is the defining feature of mitigation.
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. B — When testing reveals a weakness, the appropriate next step is to use the information from the test to modify the design, addressing the weakness, 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. C — Science provides understanding of natural systems and processes, while engineering applies that understanding to design solutions to problems, and each field contributes knowledge and tools that support the other. Scientific findings enable new technologies, and engineering tools enable new science. The two advance together.