PRACTICE EXAM 47: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. Geologists describe the rock cycle as a continuous process in which all three major rock types can change into one another over time. Which of the following statements correctly describes part of the rock cycle?

A. Once an igneous rock has formed, it is permanently locked in that form and can never change into a sedimentary or metamorphic rock under any conditions

B. A metamorphic rock can melt into magma, cool to form an igneous rock, weather to produce sediment, and eventually form a new sedimentary rock

C. Each of the three rock types forms only once and then disappears from the Earth forever, so the rock cycle is not actually a cycle of any kind at all

D. Sedimentary rocks form only from other sedimentary rocks, igneous from other igneous, and metamorphic from other metamorphic, with no overlap at all

2. Earth's solid inner core is surrounded by the liquid outer core. Why is the inner core solid even though it is hotter than the surrounding liquid outer core?

A. The immense pressure at the very center of the Earth keeps the iron and nickel in the inner core solid despite its extreme temperature

B. The inner core is actually much colder than the outer core, which is the simple reason that its iron and nickel remain in the solid state

C. The inner core contains no metal at all and is made of solid rock, which is why it stays solid while the metal outer core remains liquid

D. The inner core is a completely hollow sphere with nothing inside it, so it is not truly solid and instead consists of empty space at the center

3. Geologists infer that Earth's tectonic plates move only a few centimeters per year, but over millions of years this slow motion has dramatically rearranged the continents. What does this fact illustrate about geologic processes?

A. That geologic processes act so quickly that the entire surface of the Earth is rebuilt from scratch every few thousand years without any interruption

B. That the movement of the continents has no real effect on the Earth's surface, since a few centimeters per year is far too small to add up to anything

C. That very slow processes acting over long spans of time can produce large, dramatic changes to the surface and structure of the entire planet

D. That the continents only began to move within the last few hundred years, which is why their slow current motion has had little time to do anything

4. A geologist finds a sample of pumice, a light-colored, glassy volcanic rock full of tiny holes that floats on water. What do the many holes in pumice indicate about how it formed?

A. The holes were drilled into the rock by burrowing animals, which is the only way that a volcanic rock can ever come to contain many small holes

B. The holes formed from raindrops striking the surface as the lava cooled, which is what created the small cavities throughout the pumice rock

C. The holes were carved by river water flowing through the solidified rock long after it had formed, which gives pumice its characteristic sponge-like look

D. The holes were left behind by gas bubbles escaping from the lava as it cooled rapidly at the surface, giving pumice its spongy, hole-filled texture

5. As warm magma rises from deeper layers, cooler material sinks down to replace it, and this cycle slowly transfers heat through the mantle over long periods. This pattern of rising and sinking material that moves heat through the mantle is an example of:

A. Conduction, the transfer of heat by direct contact between particles, which is how heat is supposed to travel through the slowly flowing mantle below

B. Convection, the transfer of heat by the movement of a fluid in which warmer material rises and cooler material sinks, slowly circulating through the layer

C. Radiation, the transfer of enegy by electromagnetic waves, which is the only process able to carry heat through any of the layers of the solid Earth

D. Combustion, the rapid burning of a fuel, which is the only way that the heat of the Earth's mantle is ever transferred from one location to another

6. A river deposits its sediment as the steeper mountain section transitions to a flatter plain. Why does the river drop its sediment when it leaves the mountains?

A. The river suddenly stops flowing the moment it leaves the mountains, which is why all of its sediment is dropped at the exact boundary between the two

B. The river always picks up new sediment when it reaches a flat plain, but it never deposits any sediment at the same place that it picks up the new material

C. The flatter slope reduces the river's speed and energy, so it can no longer carry as much sediment and deposits the heavier material it can no longer move

D. The river splits into countless tiny channels at the boundary, which is the only thing that makes the river drop any sediment after it leaves the mountains

7. A common rock-forming mineral is feldspar, which contains aluminum, silicon, and oxygen. Based on this composition, feldspar belongs to which group of minerals?

A. Silicate minerals, the most abundant group of minerals in Earth's crust, which are built around a structural unit of silicon combined with oxygen

B. Carbonate minerals, a group of minerals such as calcite that are built around a structural unit combining carbon with oxygen and forming limestone

C. Native element minerals, a group consisting of minerals such as gold and copper that occur in nature as a single pure element rather than as a compound

D. Sulfide minerals, a group of minerals such as pyrite that are built from a combination of one or more metallic elements together with the element sulfur

8. A surveyor notices that a section of a freshly built highway has cracked and shifted along a long, straight line, with one side raised slightly higher than the other. Which kind of underground structure most likely caused this surface offset?

A. An aquifer, a body of permeable rock or sediment that is able to store and transmit usable amounts of groundwater for human use through wells

B. A vesicle, one of the small holes left behind by escaping gas bubbles in a volcanic rock that has rapidly cooled and hardened from molten lava

C. A delta, the fan-shaped deposit of sediment that builds up where a river slows down and drops its load as it enters a calm lake or the open sea

D. A fault, a fracture in the rock along which blocks of crust have slipped past each other, which can offset features built across the surface above

9. When sediment carried by a river reaches the calm waters of a lake, the sediment is sorted by size, with the heaviest particles settling out first and the smallest particles settling last. What does the process of sorting sediment by size as it settles out of water produce?

A. A jumbled, unsorted mixture of every size of particle from boulders to clay, with all of the sizes mixed together throughout the entire deposit

B. A deposit in which the smallest particles, such as clay, settle to the bottom first and the largest particles, such as boulders, rest on top of them

C. A graded deposit in which the heaviest, largest particles settle to the bottom first and the smallest, lightest particles settle out on top of them later

D. A deposit of only one size of particle, since flowing water always sorts its load down to a single grain size before it ever drops any of the sediment

10. A homeowner sees a curtain of water flowing across a sloping yard during a heavy rainstorm. What is happening to this water that flows across the surface of the ground rather than soaking into the soil?

A. The water is becoming runoff, flowing across the surface of the land toward streams and rivers rather than soaking down into the ground

B. The water is undergoing condensation, changing from invisible water vapor in the atmosphere back into the tiny droplets of liquid water in the air

C. The water is being absorbed entirely by the air, since rainwater that does not soak into the ground is always taken up directly by the surrounding atmosphere

D. The water is freezing solid as soon as it touches the slope, regardless of the temperature, which is the only way water can ever flow across a yard

11. Galileo's discovery of moons orbiting Jupiter in the early 1600s helped overturn a long-held belief about the universe. What earlier belief did Galileo's discovery of Jupiter's moons help to disprove?

A. The belief that nothing in the universe orbits anything else, since the discovery of moons orbiting Jupiter showed that orbits can never exist anywhere

B. The belief that everything in the universe orbits the Earth at its center, since the moons orbiting Jupiter showed that not everything circles the Earth

C. The belief that the Earth orbits the Sun, since Galileo's observations were taken at the time as proof that the Earth stood still at the center instead

D. The belief that the planets are perfect spheres of light, since the moons orbiting Jupiter revealed that the planets are actually large solid worlds with their own moons

12. The Sun's gravitational influence stretches across the entire solar system, all the way out to the most distant comets. What keeps the planets, asteroids, and comets bound to the solar system rather than wandering off into deeper space?

A. The pull of the Earth's gravity, which extends across the entire solar system and is what truly keeps the other planets and small bodies in their places

B. A constant push from sunlight, which steadily shoves every object in the solar system inward toward the Sun and prevents them from drifting away

C. The strong magnetic field of the Sun, which is the only force capable of holding the planets, asteroids, and comets in their orbits across the system

D. The Sun's powerful gravity, which extends far across the solar system and holds the planets, asteroids, and distant comets in their orbits around it

13. A reddish star and a blue-white star are observed to be about the same distance from Earth, but their light tells astronomers about more than just their colors. Besides color, what other property is closely connected to a star's color?

A. Surface temperature, since blue-white stars have much higher surface temperatures than red stars, which are the coolest stars of the visible color range

B. Distance from Earth, since red stars are always closer to Earth than blue-white stars regardless of their other properties or surface temperatures

C. Age of the universe, since the color of a star is what tells astronomers exactly how old the entire universe was when that particular star formed

D. The number of planets around the star, since a star's color directly reveals the exact total of planets in orbit around it without any other measurement

14. Astronomers describe black holes as regions of space with gravity so strong that not even light can escape from within their boundaries. What is the most likely origin of a stellar-mass black hole?

A. The slow cooling of an average-sized star such as the Sun, which gradually fades into a black hole over the course of just a few billion years

B. The capture of a wandering planet by a powerful nearby star, which crushes the planet into a black hole during a single rapid collision in space

C. The collapse of the core of a very massive star at the end of its life, after a supernova explosion blows away the star's outer layers entirely

D. The deliberate construction of a black hole by an advanced civilization, which is the only known way that black holes are ever formed in the universe

15. Observations show that on every day of the year, the Sun rises and sets at slightly different times and the Sun's path across the sky changes slightly. What is the cause of these changes throughout the year?

A. Random changes in the Sun's behavior, which simply rises and sets at different times each day for no underlying reason that anyone could ever explain

B. The combination of Earth's orbit around the Sun and the tilt of Earth's axis, which together change the Sun's apparent path and the length of daylight

C. Changes in Earth's rotation rate, since the planet spins much faster during the summer months and much more slowly during the cold winter months

D. The Sun's own changing distance from the Milky Way's center, which is the actual cause of the daily and yearly changes seen in the sky on Earth

16. Astronomers searching for planets around other stars have now identified thousands of "exoplanets," some of which orbit at distances where liquid water might exist on their surfaces. What is the importance of finding exoplanets in this so-called "habitable zone"?

A. Such planets are the only objects in space whose discovery proves that no other planets exist outside our own solar system, ending the search for them

B. Such planets are immediately confirmed to support life identical to Earth's, with no further observation or investigation of any kind ever being required

C. Such planets are easier to see from Earth than other exoplanets are, which is the sole reason that astronomers focus on searching for them in space

D. Such planets are good places to search for conditions that might support life as we know it, since liquid water is considered important for life

17. A common misconception is that astronauts on the International Space Station are weightless because there is no gravity in space. What is the more accurate explanation for the apparent weightlessness of astronauts on the station?

A. The astronauts and the station are both in free fall around the Earth at the same rate, so the astronauts float relative to the station even though gravity acts on them

B. Earth's gravity does not extend up to the altitude of the International Space Station, which is why the astronauts on board are truly weightless in orbit

C. The astronauts are too small to be affected by gravity, while the larger station is held in orbit by gravity, which is what makes the astronauts float freely

D. The astronauts wear special weightless suits that cancel out the force of gravity, which is the only reason they appear to float around inside the station

18. Some recent space missions have been designed to grab small samples of an asteroid or comet and return them to Earth for study in laboratories. Why is bringing back samples valuable, when spacecraft can already photograph and analyze these bodies in space?

A. Because returned samples instantly tell scientists the exact age of the entire universe, which is something that no other type of mission can ever do at all

B. Because instruments on Earth are far weaker than those carried on spacecraft, so samples returned to Earth provide far less information than remote analysis

C. Because powerful laboratory instruments on Earth can perform more detailed analyses than spacecraft can, revealing details that remote observations may miss

D. Because samples returned to Earth allow scientists to physically rebuild the asteroid or comet inside the laboratory, restoring the original body in full

19. Many of Earth's natural satellites and planets show layered internal structures with denser materials concentrated toward their centers. What does this common layering pattern reveal about how such bodies formed?

A. That denser materials were added on top later, which is why the densest material in any planet or moon is always found right at the outermost surface

B. That every planet and moon was constructed by an outside intelligent being who deliberately placed each layer of material in a specific position within it

C. That layering is purely random, with the dense and light materials mixed together completely at random and no orderly pattern across these bodies at all

D. That while the body was molten or partially molten, denser materials sank toward the center and lighter ones rose to form a layered, differentiated structure

20. A particular galaxy has a smooth, rounded, football-like shape and contains mostly older, redder stars with very little gas and dust. Which type of galaxy is this most likely to be?

A. A spiral galaxy, which has a flat, rotating disk and curved arms winding outward from a bright central bulge of stars and contains much new star formation

B. An elliptical galaxy, which has a smooth, rounded, football-like shape and contains mostly older stars together with very little gas and dust between them

C. An irregular galaxy, which has no definite or organized shape and often appears chaotic and lumpy, containing many young stars and large clouds of new gas

D. A dwarf galaxy, a classification based only on the small size of a galaxy and describing nothing about its overall shape, age, color, or gas content at all

21. Hubble's observation that distant galaxies are moving away from us led to the conclusion that the universe is expanding. Why does the recession of galaxies imply that the universe must have been smaller and denser in the past?

A. Because galaxies move away faster the older they get, so even in the past they would have been moving apart at exactly the same speed they do today

B. Because galaxies moving apart prove that the universe is shrinking, so it must have been even larger and emptier in the past than it appears to be today

C. Because the galaxies are not actually moving, the past and the present of the universe must have looked exactly the same in size, density, and contents

D. Because if galaxies are moving apart now, then running the picture backward in time means they were once closer together, suggesting a denser past

22. Of the gases that make up Earth's atmosphere today, only a few are powerful greenhouse gases. Which of the following is a greenhouse gas that is naturally present in the atmosphere?

A. Water vapor, which is the most abundant greenhouse gas in the atmosphere and traps a large amount of the heat radiated by Earth's surface

B. Argon, an inert gas that makes up about one percent of the atmosphere and is famous for being the most powerful greenhouse gas on Earth today

C. Pure helium, the second most abundant gas in the universe, which makes up much of Earth's atmosphere and contributes to the natural greenhouse effect

D. Hydrogen, which makes up the vast majority of Earth's lower atmosphere and is the single largest greenhouse gas responsible for warming the planet

23. Higher altitudes in the troposphere are generally colder than locations at sea level. What does this observation reveal about how the troposphere is heated?

A. The troposphere is heated directly by the Sun's rays passing through it from above, which is why the highest altitudes in the troposphere are the hottest

B. The troposphere is heated mostly by the cold of space pressing down on it from above, which is why the lowest layers near the ground end up being the warmest

C. The troposphere is heated mainly from below by Earth's surface, which absorbs sunlight and warms the air above it, so air near the ground is warmer

D. The troposphere is heated by a steady release of underground heat from volcanoes alone, since the air receives no heat at all from sunlight or the surface

24. A cold air mass moving rapidly into a region pushes underneath a warmer air mass already in place, forcing the warm air sharply upward. What kind of front is this, and what weather often follows its passage?

A. A warm front, often followed by clearing skies and steadily falling temperatures over the next several days as the warm air retreats from the region

B. A cold front, often followed by a brief band of heavy showers or thunderstorms and a noticeable drop in temperature once the front has passed through

C. A stationary front, often followed by extremely calm conditions with no precipitation at all, since stationary fronts produce no weather of any kind

D. A sea-breeze front, often followed by frigid Arctic temperatures and several days of heavy snowfall well inland from the coast where it formed

25. During a major snowstorm, snow on the ground reflects much of the incoming sunlight back to space. What is the term for the fraction of incoming sunlight that a surface reflects, and why does it matter?

A. The lapse rate, which describes how quickly air temperature changes with altitude in the atmosphere and which directly determines how much snow a surface reflects

B. The dew point, which describes the temperature at which air becomes saturated with moisture and which determines how much sunlight any surface can reflect

C. The relative humidity, which describes how saturated the air is with water vapor at a given temperature and which controls how reflective any snow becomes

D. The albedo, which describes the fraction of incoming sunlight a surface reflects, with high-albedo surfaces like snow absorbing less heat and staying cooler

26. El Niño and La Niña events are large-scale changes in ocean temperatures in the tropical Pacific that can change weather patterns far around the globe. What do El Niño and La Niña best illustrate about Earth's systems?

A. That the ocean and the atmosphere are closely linked, so a change in one part of the ocean can influence weather patterns far away on land

B. That the ocean and the atmosphere are completely separate systems that never affect one another, so ocean changes cannot influence the weather at all

C. That only the atmosphere can change weather patterns, while the ocean has no effect on weather anywhere on Earth no matter what changes occur in it

D. That the ocean controls the weather only over its own surface and never has any effect at all on weather over the continents that border it on every side

27. Cars stuck in traffic in a large city release exhaust gases that include nitrogen oxides and volatile compounds. When sunlight acts on these pollutants, a brownish haze develops over the city. What kind of pollution is this?

A. Acid rain, the precipitation that forms when sulfur and nitrogen compounds from burning fuels dissolve into water in the atmosphere and fall back to the surface

B. The ozone hole, the seasonal thinning of the protective ozone layer high in the stratosphere over the polar regions, especially the continent of Antarctica

C. Photochemical smog, the brownish haze that forms when sunlight reacts with pollutants from vehicle exhaust over a large city on a hot, sunny day

D. The greenhouse effect, the natural warming process that occurs when atmospheric gases trap heat radiating from the surface of the Earth into space

28. Beginning in the late 19th century, scientists started to keep detailed records of average temperature, rainfall, and other climate variables at many locations. Why has this long-term, worldwide collection of climate data been important?

A. The records are valuable only as historical curiosities and reveal nothing useful about long-term trends in temperature, rainfall, or other variables

B. The long-term, worldwide records reveal trends and changes in climate over time, helping scientists detect and understand patterns such as global warming

C. The records have served only to predict tomorrow's weather and have no value at all for understanding climate change occurring across decades or centuries

D. The records permanently prevent any further changes in climate from occurring, simply by the act of recording the measurements and storing them carefully

29. Forecasters use models of how the atmosphere moves and changes to predict weather days in advance. Why are even short-term weather forecasts sometimes wrong?

A. Forecasters deliberately publish incorrect predictions on purpose, since their goal is never to actually inform the public about any of the weather to come

B. The atmosphere has stopped following the laws of physics altogether, so no possible model could ever produce a correct prediction of tomorrow's weather

C. The weather instruments used to gather data are completely broken, so all forecasts are made by guessing rather than by using any real measurements at all

D. The atmosphere is a complex system in which small errors in observation can grow over time, so even the best models cannot make perfect predictions

30. Many world climates can be summarized in terms of two main variables. Which two long-term variables are most commonly used to describe a region's climate?

A. Average temperature and average precipitation over many years, which together capture the overall heat and moisture conditions that define the climate

B. The number of sunny days per year and the number of cloudy days per year alone, which together fully define the climate type of any region on Earth

C. The maximum wind speed and the minimum wind speed ever recorded in the region, which together are the two key measurements that define any climate

D. The exact air pressure and the exact relative humidity at one randomly chosen single moment, which together fully reveal the long-term climate of a region

31. Even the rocks at the very deepest parts of the ocean are eventually weathered, eroded, and redeposited, given enough time. What does this fact reveal about Earth's surface?

A. That Earth's surface is permanently fixed and has remained completely unchanged ever since the planet first formed billions of years ago in space

B. That the rocks on the seafloor are made of a special unbreakable material that never weathers or erodes under any conditions or over any timescale

C. That Earth's surface is constantly being recycled over geologic time, with materials moving among the rock cycle, the water cycle, and the tectonic system

D. That the seafloor is the only part of Earth's surface where any change ever takes place, while the continents remain completely fixed and unchanging forever

32. Some city governments require new buildings to use energy-efficient lighting, insulation, and heating systems. How do these "green building" regulations benefit the environment?

A. By forcing power plants to generate far more electricity, since efficient buildings somehow require much greater amounts of power than older designs do

B. By preserving older, less efficient buildings unchanged, since modernizing buildings always increases energy use and pollution within a large city

C. They reduce the energy a building uses, which lowers the amount of fossil fuel burned to provide that energy and cuts the resulting emissions

D. By guaranteeing that absolutely no environmental change will ever occur, since regulations on buildings have no actual effect of any kind on the natural world

33. Coastal communities and engineers often respond to rising sea levels by building higher sea walls, restoring wetlands, or relocating buildings inland. What kind of response to climate change do these actions best represent?

A. Mitigation, the reduction of the causes of climate change by limiting emissions of greenhouse gases such as carbon dioxide and methane into the atmosphere

B. Reversal, a complete and permanent undoing of climate change that returns the global climate to exactly what it was many decades or even centuries ago

C. Denial, the refusal to acknowledge climate change as a real problem, which the construction of sea walls and relocation projects is intended to express

D. Adaptation, the adjustment of human practices and infrastructure to reduce harm from the effects of climate change that are already occurring

34. Smoke from forest fires, even those burning hundreds of kilometers away, can fill the skies of a distant city for days and harm the lungs of people there. What does this connection reveal about how the atmosphere works?

A. That the atmosphere is a single connected system, so pollutants released in one place can be transported by winds and affect air quality far away

B. That pollutants always stay exactly where they are first released and can never travel through the atmosphere from one region to a distant region

C. That the atmosphere has no influence on human health, since smoke and other pollutants released anywhere in the world cannot affect the people who breathe them

D. That city air can never be affected by pollution coming from outside the city, since the smoke from distant fires never crosses the borders of any major city

35. Genetic diversity within a single species describes the variety of traits found among its individuals. Why is high genetic diversity beneficial for a species over the long term?

A. It guarantees that the species will go extinct very quickly, which is the main reason that biologists usually try to reduce diversity within a single species

B. It has no effect on the species over the long term, since the traits of individuals have no connection to the survival of the species in changing environments

C. It increases the chance that some individuals will have traits suited to changing conditions, so the species is more likely to survive new challenges

D. It causes the species to remain exactly the same from generation to generation, which is what allows it to survive changes in its surrounding environment

36. A scientific study finds that average global ocean temperatures have risen by a small but measurable amount over the past few decades. Why are even small increases in average ocean temperature considered a serious concern?

A. Because small increases in ocean temperature have no effect on weather, ecosystems, or sea level, the concern is purely about how the numbers look on a graph

B. Because warmer oceans store more heat, fuel stronger storms, harm temperature-sensitive species, and cause water to expand, which raises sea level

C. Because warmer oceans completely stop evaporation and rainfall, the concern is that the entire water cycle would shut down, plunging the planet into drought

D. Because warmer oceans freeze faster than cool ones, the concern is that the increase will cause a sudden new ice age across the surface of the planet

37. Some agricultural practices, such as overusing irrigation in dry regions, can leave salts behind in the soil as water evaporates, eventually making the land unusable for crops. What is this damaging build-up of salt in the soil called?

A. Eutrophication, the over-enrichment of a body of water with nutrients that triggers a rapid overgrowth of algae and a subsequent depletion of oxygen

B. Deforestation, the widespread clearing of trees from a forest, which leaves the land bare and exposes the soil to erosion and other forms of degradation

C. Desertification, the gradual expansion of desert conditions into formerly productive land, often caused by overgrazing, deforestation, and a hotter climate

D. Salinization, the gradual build-up of salts in the soil, often caused by repeated irrigation in dry regions where evaporation leaves the salts behind

38. Even areas of cropland that look uniform from above are actually living ecosystems that depend on healthy soil to function. Why is maintaining healthy soil critical for the sustainable production of food?

A. Healthy soil holds water and nutrients and supports the plant roots and soil organisms that crops depend on, which is essential for long-term agriculture

B. Healthy soil has no real effect on crops, since plants are able to grow equally well in healthy soil or in sterile, lifeless soil that contains no nutrients

C. Healthy soil should be completely removed from farmland before planting, since rich soil interferes with the growth of nearly every kind of crop plant

D. Healthy soil produces toxins that kill crops, so farmers must work hard to keep their soil unhealthy in order to grow any food on it successfully

39. Tropical coral reefs support an extraordinary diversity of marine life within a very small area of the world's oceans. Which of the following is a major threat to coral reefs caused by human activity?

A. The deliberate planting of mangrove forests next to reefs, which is the largest single threat to coral reefs around the world today

B. The widespread placement of large artificial reefs by divers, which is the main reason that natural coral reefs have been declining in recent decades

C. Warming sea temperatures and ocean acidification, both linked to rising carbon dioxide, which stress corals and cause widespread coral bleaching

D. The reduction of fishing pressure in many countries, which is the main human action that is currently causing the destruction of the world's coral reefs

40. Some governments tax goods such as gasoline based partly on the pollution they create. How can such "pollution taxes" or "carbon taxes" help reduce environmental harm?

A. The taxes make polluting goods cheaper, encouraging people to use far more of them and thereby reducing the total amount of pollution they release

B. The taxes raise the price of polluting goods, which encourages people to use less of them or switch to cleaner alternatives, reducing pollution overall

C. The taxes have no effect on people's behavior, since adding a small extra cost to polluting goods cannot influence how much people buy or use of them

D. The taxes guarantee that polluters will be completely shut down within minutes of the taxes being introduced, which is the only way they reduce pollution

41. A scientist finds two fossils preserved in different rock layers at the same location, with one fossil far below the other in an undisturbed sequence. According to the principle of superposition, which of the two fossils is older?

A. The fossil in the lower layer is older, because in an undisturbed sequence the lower layers were deposited first, before the layers above them

B. The fossil in the upper layer is older, because in an undisturbed sequence the topmost layers were deposited before the lower layers beneath them

C. The two fossils must be exactly the same age, since fossils preserved in separate layers always formed at the same instant in geologic time

D. The relative ages of the fossils cannot be compared at all, since fossils in different layers carry no information about the order in which they formed

42. Some fossils consist of an organism's footprints, burrows, or droppings rather than its physical body. What general kind of fossil are these?

A. Index fossils, fossils from organisms that were widespread but lived only briefly and are most useful for matching and dating distant rock layers

B. Mold fossils, hollow impressions left in the rock when a buried organism's hard parts dissolve away completely and leave behind only their outer shape

C. Cast fossils, solid replicas formed when minerals fill the hollow mold left behind by a dissolved organism and harden into a copy of its original shape

D. Trace fossils, preserved records of an organism's activity, such as its footprints, burrows, or droppings, rather than the actual body of the organism

43. Fossils of identical extinct land plants are found in rock layers in South America, Africa, India, Australia, and Antarctica, all dating to the same time period. What does this distribution of fossils across separated continents most strongly support?

A. The idea that the continents have always been separated and that identical plants somehow happened to evolve independently on each of these continents

B. The idea that these continents were once joined into a single landmass, allowing the plants to grow across a continuous area that later split apart

C. The idea that ancient people deliberately carried these plants by ship from one continent to another, planting them at every location at the same time

D. The idea that these plant fossils were placed in each location by an external force, which is the only possible reason that identical fossils could appear

44. During the Cenozoic Era, several long ice ages occurred, during which thick ice sheets advanced across large portions of the continents and then later retreated. What is one important kind of evidence that geologists use to identify regions that were once covered by these ice sheets?

A. Tall mountain ranges with sharp, jagged peaks formed by tectonic uplift, which can be created only by glaciation and never by any other geologic process

B. Coral reef fossils preserved in tropical limestone, which are the most direct kind of evidence that a particular region was once covered by a thick ice sheet

C. U-shaped valleys, glacial scratches on bedrock, and deposits of unsorted rock and sediment, all of which are produced by the action of moving ice

D. Layers of fossil-rich shale containing the bones of large dinosaurs, which are the most direct evidence that a region was once buried under thick glacial ice

45. Throughout much of Earth's history, the magnetic field has reversed direction many times, so that the north and south magnetic poles have switched places. How does evidence of these magnetic reversals help support the theory of plate tectonics?

A. Magnetic patterns recorded in seafloor rocks form mirror-image stripes on either side of mid-ocean ridges, providing strong evidence of seafloor spreading

B. Magnetic reversals prove that the continents have always been in their present positions, since the magnetic field has changed direction repeatedly over time

C. Magnetic reversals show that Earth has no internal layers at all, which is why the theory of plate tectonics relies on them to explain the surface features

D. Magnetic reversals have no real connection to plate tectonics, and the records of reversed magnetism in seafloor rocks reveal nothing about plate motion

46. Volcanic eruptions on early Earth released gases such as water vapor, carbon dioxide, and nitrogen into the atmosphere. Why is this process, called outgassing, important in understanding the early development of Earth's atmosphere?

A. Outgassing only removed gases from the atmosphere and never added any, so it played no role at all in shaping the gas composition of the early Earth

B. Outgassing released only solid material onto the surface and never any gases, so the early atmosphere developed in some completely different way over time

C. Outgassing took place only within the last few thousand years, so it had no influence at all on the atmosphere during the long early history of the planet

D. Outgassing supplied many of the gases that built Earth's earliest atmosphere and that contributed to the formation of the oceans through condensation later

47. Some sequences of sedimentary rock contain very fine, alternating dark and light layers that may represent yearly cycles of deposition. How are these layered sequences useful in studying Earth's history?

A. Layered sequences allow scientists to use the layers as a calendar, since each pair of layers may represent one year and lets researchers count back through time

B. Layered sequences are useless for studying Earth's history, since the layers within them form at completely random intervals with no useful time pattern

C. Layered sequences exist only in modern rocks formed within the last hundred years, so they cannot reveal any information about Earth's deeper past at all

D. Layered sequences provide information only about the current weather at the site, and contain no clues at all about the conditions of past environments

48. A radioactive isotope has a half-life of 4 billion years. A meteorite contains one-eighth of the original amount of this isotope. About how old is the meteorite?

A. About 4 billion years old, since one-eighth of the isotope remaining corresponds to exactly one full half-life of the isotope having passed since formation

B. About 12 billion years old, since one-eighth remaining means three half-lives have passed, and three times 4 billion years equals 12 billion years

C. About 32 billion years old, since one-eighth of the isotope remaining corresponds to exactly eight full half-lives of the isotope having passed in total

D. About 8 billion years old, since one-eighth of the isotope remaining corresponds to exactly two full half-lives of the isotope having passed since formation

49. An engineering team has developed a new design for a wind turbine and wants to know whether it will perform better than existing designs. Before building a full-scale version, what is the best next step for the team to take?

A. Sell thousands of the proposed turbines to customers without any further testing, since the very first design is always guaranteed to be a successful product

B. Abandon the entire project permanently, since any design that has not yet been built at full scale can never be successfully completed under any conditions

C. Replace all existing turbines around the world with the untested new design, since deploying the new turbines widely is the fastest way to verify their success

D. Build and test a smaller-scale prototype or computer model first, then use the test results to improve the design before constructing the full-scale version

50. Scientists communicate the results of their work through articles, presentations, and shared data. Why is this open communication an important part of how science works?

A. Sharing results is important only as a courtesy and has no real influence on whether ideas in science can ever be accepted, challenged, or built upon

B. Sharing results allows the original scientist to keep all of the credit private, which is the only reason that scientific results are ever published or presented

C. Sharing results lets other scientists check, build on, and challenge findings, which helps science self-correct and develop more reliable understanding over time

D. Sharing results has no effect on the development of science, since each scientist always works in complete isolation and ignores the work of every other researcher

Practice Exam 47: Answer Key with Explanations

1. B — A metamorphic rock can melt into magma, cool to form igneous rock, weather to produce sediment, and eventually form sedimentary rock. This pathway shows how the rock cycle connects all three rock types through ongoing transformation.
2. A — The immense pressure at Earth's center keeps the iron and nickel in the inner core solid despite its extreme temperature. Pressure raises the melting point enough that the metal remains solid even hotter than the liquid outer core.
3. C — Very slow processes acting over long spans of time can produce large, dramatic changes to the planet's surface. A few centimeters per year of plate motion adds up to thousands of kilometers over hundreds of millions of years.
4. D — The many holes in pumice were left by gas bubbles escaping from lava as it cooled rapidly at the surface. This frothy, gas-rich texture is what makes pumice light enough to float on water.
5. B — Mantle material rising and sinking to move heat through the layer is convection, the transfer of heat by the movement of a fluid. This circulation in the mantle drives the slow motion of Earth's tectonic plates.
6. C — A flatter slope reduces the river's speed and energy, so it can no longer carry as much sediment and drops the heavier load. Loss of carrying capacity at the base of the mountains is what builds features like alluvial fans.
7. A — Feldspar, built from aluminum, silicon, and oxygen, belongs to the silicate minerals, the most abundant group in Earth's crust. Their shared silicon-oxygen structural unit defines the group.
8. D — A long, straight surface offset with one side raised above the other is the signature of a fault, where blocks of crust have slipped past each other. This movement displaces features built across the surface above.
9. C — When sediment settles out of slowing water, the heaviest, largest particles drop first and the smallest land on top, producing graded bedding. Difference in settling speed by size is what sorts the deposit.
10. A — Rainwater flowing across the surface toward streams and rivers instead of soaking in is runoff. It happens where the ground is saturated, sloped, or compacted enough that infiltration cannot keep up.
11. B — Galileo's discovery of moons orbiting Jupiter helped disprove the belief that everything orbits the Earth. Showing that some bodies orbit something other than Earth weakened the geocentric model.
12. D — The Sun's powerful gravity extends across the solar system and holds the planets, asteroids, and distant comets in their orbits. Its dominant mass anchors the gravitational structure that keeps these bodies bound.
13. A — A star's color is closely tied to its surface temperature: blue-white stars are hotter, while red stars are cooler. Temperature changes the wavelengths a star radiates most strongly, which sets its observed color.
14. C — A stellar-mass black hole most likely forms from the collapse of the core of a very massive star after a supernova blows away its outer layers. The core's gravity becomes strong enough that not even light can escape.
15. B — Earth's orbit around the Sun combined with the tilt of its axis changes the Sun's apparent path and the length of daylight throughout the year. These two effects, not the Sun's behavior, produce the seasonal variation in the sky.

16. D — Habitable-zone exoplanets are good targets in the search for conditions that might support life as we know it, since liquid water is considered important for life. Finding such planets focuses efforts on the most promising candidates.
17. A — Astronauts and the station are both in free fall around Earth at the same rate, so the astronauts float relative to the station even though gravity still acts on them. Their apparent weightlessness is a result of falling together, not the absence of gravity.
18. C — Returned samples can be analyzed with powerful laboratory instruments on Earth that are far more capable than those on spacecraft. This allows much more detailed measurements than remote sensing can provide.
19. D — Layering with denser materials at the center indicates that while a body was molten or partially molten, dense materials sank and lighter ones rose, producing a differentiated structure. This sorting by density is a hallmark of how planets and moons formed.
20. B — A smooth, rounded, football-shaped galaxy with mostly older stars and little gas and dust is an elliptical galaxy. Its lack of star-forming material is why few young stars are seen.
21. D — If galaxies are moving apart now, then running the picture backward in time means they were once closer together, implying a smaller, denser past. This logic supports the Big Bang origin of the universe.
22. A — Water vapor is the most abundant natural greenhouse gas in Earth's atmosphere and traps a large amount of the heat radiated by the surface. Its concentration varies but it contributes strongly to the natural greenhouse effect.
23. C — The troposphere is heated mainly from below by Earth's surface, which absorbs sunlight and warms the air above. Because the heat source is at the ground, temperature generally decreases with altitude in this layer.
24. B — A fast-moving cold front pushes under warmer air and forces it sharply upward, often producing a brief band of heavy showers or thunderstorms followed by a noticeable temperature drop. Steep lifting of the warm air is what makes cold-front weather intense but short-lived.
25. D — Albedo describes the fraction of incoming sunlight a surface reflects, with high-albedo surfaces like snow absorbing less heat and staying cooler. This reflectivity is important for Earth's energy balance.
26. A — El Niño and La Niña show that the ocean and atmosphere are closely linked, so changes in tropical Pacific ocean temperatures can shift weather patterns worldwide. This coupling demonstrates how Earth's systems interact.
27. C — A brownish haze formed when sunlight reacts with nitrogen oxides and volatile compounds from vehicle exhaust over a city is photochemical smog. Strong sunlight on hot days drives the reactions that produce it.
28. B — Long-term, worldwide climate records reveal trends and changes in climate over time, helping scientists detect and understand patterns such as global warming. Decades of consistent data make slow shifts visible.
29. D — The atmosphere is a complex system in which small errors in observation can grow over time, so even the best models cannot make perfect predictions. This sensitivity to initial conditions limits forecast accuracy.
30. A — A region's climate is most commonly described by average temperature and average precipitation over many years. Together these capture the long-term heat and moisture conditions that define a climate.

31. C — Even rocks on the deep seafloor being weathered, eroded, and redeposited shows that Earth's surface is constantly being recycled over geologic time. The rock cycle, water cycle, and tectonics together keep reshaping the planet.
32. C — Green building regulations reduce the energy a building uses, which lowers the fossil fuel burned to supply that energy and cuts emissions. Saving energy at the source is how efficiency standards benefit the environment.
33. D — Building sea walls, restoring wetlands, and relocating buildings inland are adjustments to reduce harm from changes that are already happening, which is adaptation. Mitigation, by contrast, targets the causes of climate change rather than its effects.
34. A — Smoke from distant fires reaching a faraway city shows that the atmosphere is a single connected system, so pollutants can be transported by winds and affect air quality far from their source. Air pollution does not respect political or geographic boundaries.
35. C — High genetic diversity increases the chance that some individuals will have traits suited to changing conditions, so the species is more likely to survive new challenges. Variation provides the raw material on which natural selection acts.
36. B — Even small ocean warming is serious because warmer oceans store more heat, fuel stronger storms, harm temperature-sensitive species, and cause water to expand, raising sea level. These compounding effects amplify the impact of a modest temperature rise.
37. D — The gradual build-up of salts in the soil from repeated irrigation in dry regions is salinization. As water evaporates it leaves dissolved salts behind, eventually making the land unsuitable for crops.
38. A — Healthy soil holds water and nutrients and supports the roots and soil organisms that crops depend on, which is essential for sustainable agriculture. Protecting soil structure and fertility keeps farmland productive over time.
39. C — Warming sea temperatures and ocean acidification, both linked to rising carbon dioxide, stress corals and cause widespread bleaching. These changes are among the greatest human-driven threats to reef ecosystems.
40. B — Pollution and carbon taxes raise the price of polluting goods, encouraging people to use less of them or switch to cleaner alternatives, which reduces overall pollution. Pricing in environmental costs shifts consumer and producer behavior.
41. A — By the principle of superposition, in an undisturbed sequence the lower layers were deposited first, so the fossil in the lower layer is older. The upper layer rests on older material beneath it.
42. D — Footprints, burrows, and droppings are trace fossils, preserved records of an organism's activity rather than its body. They reveal information about behavior that body fossils alone may not.
43. B — Identical fossils across now-separated southern continents support the idea that those landmasses were once joined, allowing the plants to grow across a continuous area before drift split them apart. This is a classic line of evidence for continental drift.
44. C — U-shaped valleys, glacial scratches on bedrock, and deposits of unsorted rock and sediment are produced by moving ice and mark regions once covered by glaciers. These features together fingerprint past glaciation.
45. A — Magnetic patterns recorded in seafloor rocks form mirror-image stripes on either side of mid-ocean ridges, providing strong evidence of seafloor spreading. The symmetry across ridges shows new crust is generated there and moves outward.

46. D — Volcanic outgassing supplied many of the gases that built Earth's earliest atmosphere and contributed to the formation of the oceans as water vapor later condensed. This process helped shape the planet's early atmosphere and hydrosphere.
47. C — Annual layers in sedimentary sequences can be counted like a calendar, since each pair of layers may represent one year of deposition. This counting lets researchers track time through the layered record.
48. B — One-eighth remaining means three halvings have occurred ($1 \rightarrow 1/2 \rightarrow 1/4 \rightarrow 1/8$), so three half-lives have passed. Three times 4 billion years gives about 12 billion years.
49. D — Before committing to a full-scale build, the team should build and test a smaller-scale prototype or computer model and use the results to refine the design. Iterating from small-scale tests is how the engineering design process reduces risk and improves performance.
50. C — Open sharing lets other scientists check, build on, and challenge findings, which helps science self-correct and develop more reliable understanding. This collective scrutiny is central to how knowledge is verified and advanced.