PRACTICE EXAM 41: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. A lunar eclipse occurs when the Moon passes through Earth's shadow and darkens. For a lunar eclipse to happen, how must the Sun, Earth, and Moon be arranged?

A. The Earth must be positioned directly between the Sun and the Moon so that Earth's shadow falls across the Moon

B. The Moon must be positioned directly between the Sun and the Earth so that the Moon's shadow falls across the Earth

C. The Sun must be positioned directly between the Earth and the Moon so that the Sun's light is blocked from the Earth

D. The three bodies must form a perfect right angle, with the Moon off to one side well away from the Earth's shadow

2. The four inner planets are small and rocky, while the four outer planets are large and made mostly of gas. How do the densities of the inner planets generally compare with those of the outer planets?

A. The inner and outer planets all have exactly the same density, since every planet in the solar system is made of identical material

B. The inner rocky planets are generally much denser than the outer gas planets, because rock and metal are denser than gas

C. The outer gas planets are far denser than the inner rocky planets, because their enormous size makes them extremely heavy and dense

D. Density has no meaning for planets, so it is impossible to compare the inner and outer planets in terms of how dense they are

3. Astronomers observe that some stars glow with a reddish light while others glow blue-white. What does the color of a star reveal about it?

A. The color reveals the exact distance of the star from Earth, with red stars always being the closest and blue stars the farthest

B. The color reveals the chemical that the star is named after, but it provides no information about the star's physical properties

C. The color reveals how old the entire universe is, since every star formed at a different known moment in the past based on its color

D. The color reveals the star's surface temperature, with blue-white stars being hotter and reddish stars being cooler

4. A satellite stays in a stable circular orbit around the Earth rather than flying off into space or falling straight down. What combination of factors keeps the satellite in orbit?

A. The satellite is held up by a steady upward push of air pressure from the atmosphere, which exactly balances its tendency to fall

B. The satellite is completely free of all forces in orbit, so it simply drifts in a straight line without anything acting upon it at all

C. The satellite's forward motion combines with Earth's gravity pulling it inward, so it continually falls around the curve of the Earth

D. The satellite is pushed outward by the Earth's magnetic field, which throws it away from the planet at exactly the right speed

5. The Sun produces an enormous amount of energy in its core that streams outward as light and heat. What process generates the Sun's energy?

A. Nuclear fusion, in which hydrogen nuclei join together to form helium, releasing tremendous energy in the process

B. The burning of wood and coal, exactly like an ordinary fire on Earth, which slowly consumes the Sun's solid fuel supply

C. The friction of the Sun spinning rapidly on its axis, which heats the surface through the rubbing of its outer layers

D. Nuclear fission, in which very large, heavy atoms are split apart into smaller pieces, which is the Sun's only energy source

6. As a comet approaches the Sun, it develops a long, glowing tail. In which direction does a comet's tail generally point?

A. The tail always points in the exact direction the comet is traveling, streaming out ahead of the comet like a searchlight beam

B. The tail always points straight down toward the nearest planet, pulled into position by that planet's powerful gravity

C. The tail always points back toward the comet's starting place far out in the solar system, no matter where the comet is

D. The tail generally points away from the Sun, because the solar wind and radiation push the comet's gas and dust outward

7. Over the course of a night, the stars appear to move slowly across the sky from east to west, just as the Sun does during the day. What actually causes this apparent motion of the stars?

A. The stars themselves are physically racing across the sky from east to west at enormous speeds throughout the entire night

B. The Earth rotates on its axis from west to east, which makes the stars appear to drift in the opposite direction across the sky

C. The stars are dragged across the sky by the gravity of the Moon, which pulls them along its own path each and every night

D. The entire sky is a solid dome that physically spins around the motionless Earth once during each twenty-four hour period

8. The Big Bang theory describes the origin and expansion of the universe. According to this theory, what was the universe like at its very beginning?

A. The universe has always existed at exactly its present enormous size and has never changed in any way throughout all of time

B. The universe began as a cold, empty, and unchanging void that has slowly been filling up with new matter ever since its start

C. The universe began extremely hot and dense, concentrated in an exceedingly small region, and has been expanding ever since

D. The universe began as a single solid planet that gradually shattered into all of the stars and galaxies that are seen today

9. Most coastal locations experience two high tides and two low tides each day. What is the primary cause of these ocean tides on Earth?

A. The gravitational pull of the Moon, which raises bulges of ocean water on the sides of Earth facing toward and away from it

B. The heat of the Sun, which boils the ocean water upward at high tide and then allows it to cool back down at low tide

C. Strong winds blowing across the ocean surface, which physically pile the water up against the shore twice every single day

D. The daily melting and refreezing of the polar ice caps, which adds and removes ocean water on a regular daily schedule

10. Venus is the hottest planet in the solar system, with surface temperatures hot enough to melt lead, even though Mercury is closer to the Sun. What is the main reason Venus is so extremely hot?

A. Venus is actually far closer to the Sun than Mercury is, which is the simple reason that it ends up being the hotter of the two

B. Venus generates its own intense internal heat through constant volcanic eruptions covering every part of its entire surface

C. Venus spins so rapidly on its axis that the friction of its rotation heats the whole planet to its extremely high temperatures

D. Venus has a thick atmosphere rich in carbon dioxide that traps heat through a runaway greenhouse effect, keeping it extremely hot

11. Galaxies come in several different shapes. A galaxy with a flat, rotating disk and graceful curved arms winding outward from a central bulge is classified as which type?

A. An elliptical galaxy, which has a smooth, rounded, football-like shape and contains mostly older stars with little gas or dust

B. An irregular galaxy, which has no definite or organized shape and often appears chaotic and lumpy with no clear structure at all

C. A spiral galaxy, which has a flat, rotating disk with curved arms winding outward from a bright central bulge of stars

D. A dwarf galaxy, a classification based only on a galaxy's small size that describes nothing at all about its overall shape

12. In a sequence of undisturbed sedimentary layers, a geologist labels the bottom layer 1 and the top layer 5. Which layer was deposited most recently?

A. Layer 1, the bottom layer, because the deepest layers in any sequence are always the youngest ones that formed most recently

B. Layer 5, the top layer, because in an undisturbed sequence each layer is deposited on top of the older layers beneath it

C. Layer 3, the middle layer, because deposition always begins in the exact center of a sequence and then builds outward

D. All five layers were deposited at the very same instant, so there is no single layer that can be called the most recent one

13. Carbon-14 dating is useful for finding the age of materials up to roughly 50,000 years old but cannot date dinosaur bones that are tens of millions of years old. Why does carbon-14 dating fail for such ancient remains?

A. After many half-lives, so little carbon-14 remains in extremely old material that there is too little left to measure accurately

B. Carbon-14 only forms in objects that are younger than 50,000 years, so older objects never contained any carbon-14 to begin with

C. Carbon-14 decays more and more slowly as time passes, so in very old objects it stops decaying entirely and freezes in place

D. Dinosaur bones repel carbon-14 atoms completely, which is the specific reason that this one method cannot be used to date them

14. Fossils are found almost exclusively in sedimentary rock and very rarely in igneous rock. What best explains why fossils are typically preserved in sedimentary rock but not in igneous rock?

A. Sedimentary rock is far older than igneous rock, so only sedimentary rock existed back when living organisms were being fossilized

B. Igneous rock forms only deep underground where no living organisms have ever existed, so there is nothing there to be fossilized

C. Sedimentary rock forms from sediment that gently buries organisms, while igneous rock forms from molten material that destroys remains

D. Fossils form equally well in both rock types, but geologists have simply never thought to look for any fossils inside igneous rock

15. A radioactive isotope has a half-life of 700 million years. A rock contains an amount of this isotope equal to one-quarter of its original amount. Approximately how old is the rock?

A. About 350 million years, found by taking half of the isotope's 700-million-year half-life one single time

B. About 700 million years, since one-quarter remaining corresponds to exactly one half-life of the isotope passing

C. About 2.8 billion years, since reaching one-quarter of the original amount requires a total of four full half-lives to pass

D. About 1.4 billion years, since one-quarter remaining corresponds to two half-lives, and two times 700 million is 1.4 billion

16. A sedimentary rock layer contains fragments of granite embedded within it. According to the principle of inclusions, what can be concluded about the granite fragments?

A. The granite fragments are younger than the sedimentary layer, since the fragments must have formed after the layer was deposited

B. The granite fragments are older than the sedimentary layer, since the granite had to already exist to be included within the layer

C. The granite fragments and the sedimentary layer are exactly the same age, since inclusions always form at the same instant as their host

D. The age of the granite fragments cannot be determined at all, since fragments embedded in a rock carry no information about age

17. Geologists find a worldwide thin layer of clay rich in the rare element iridium at the exact boundary marking the extinction of the dinosaurs. Iridium is rare in Earth's crust but common in asteroids. What conclusion does this evidence support?

A. A large asteroid impact likely contributed to the mass extinction, spreading iridium-rich material around the globe in a thin layer

B. The dinosaurs themselves were made of iridium, which is why a layer of the element appears exactly where their fossils end in the record

C. Iridium is produced naturally by living dinosaurs, so the layer simply marks the last place that any dinosaurs were ever alive on Earth

D. The iridium layer formed long after the dinosaurs and has no connection at all to the timing of their extinction in the rock record

18. Which of the following lists the three most recent geologic eras in the correct order, from oldest to most recent?

A. Cenozoic, then Mesozoic, then Paleozoic, moving in order from the most recent era backward to the oldest of the three

B. Mesozoic, then Paleozoic, then Cenozoic, with the age of dinosaurs coming before the age of early fish and trilobites

C. Paleozoic, then Mesozoic, then Cenozoic, moving in order from the oldest of the three eras forward to the most recent one

D. Cenozoic, then Paleozoic, then Mesozoic, placing the present era first and the age of the dinosaurs last in the sequence

19. Scientists drill deep into ancient glaciers and ice sheets to extract long cylinders of ice containing trapped air bubbles. How do these ice cores help scientists study Earth's past?

A. The ice cores contain tiny fossils of ancient fish that swam in the glaciers, which reveal what animals lived in each past time period

B. The trapped air bubbles preserve samples of the ancient atmosphere, allowing scientists to study past climate and gas concentrations

C. The ice cores generate a faint electrical signal that scientists measure to read the exact temperature of the planet millions of years ago

D. The ice cores contain written records left by ancient civilizations, which directly describe the weather conditions of the distant past

20. High, wispy, feathery clouds made of ice crystals form at very high altitudes and often signal that a change in weather may be approaching. What type of cloud are these?

A. Cumulus clouds, the puffy, white, cotton-like clouds with flat bottoms that usually indicate fair weather on a pleasant day

B. Stratus clouds, the low, flat, gray clouds that spread across the sky in a featureless sheet and often bring drizzle or light rain

C. Nimbostratus clouds, the thick, dark, low layers of cloud that produce steady, continuous rain or snow over a wide area

D. Cirrus clouds, the high, thin, wispy clouds made of ice crystals that often appear ahead of an approaching weather change

21. Warm air rises near the equator, moves toward the poles high in the atmosphere, cools and sinks, then returns toward the equator near the surface. This large-scale circulation of rising and sinking air is an example of:

A. Convection, the transfer of heat by the movement of a fluid such as air, in which warm fluid rises and cool fluid sinks

B. Conduction, the transfer of heat by direct contact between two touching objects without any movement of material at all

C. Radiation, the transfer of heat by electromagnetic waves that can travel through the empty vacuum of space without any medium

D. Precipitation, the falling of water from clouds to the ground in the form of rain, snow, sleet, or hail under the force of gravity

22. A fast-moving cold front pushes into a region of warm, moist air. What weather does the passage of a cold front most commonly produce?

A. A long, slow period of light, steady drizzle lasting for several days, followed by a very gradual and gentle warming of the air

B. Completely clear, calm, and unchanging skies, since a cold front has no measurable effect on the weather at the surface below it

C. A narrow band of heavy showers or thunderstorms as the warm air is forced upward quickly, often followed by cooler, clearer air

D. A steady rise in temperature and humidity over many hours, with hazy skies and absolutely no precipitation of any kind at all

23. A meteorologist uses a particular instrument to measure atmospheric pressure, and a falling reading often signals that stormy weather may be approaching. What is this instrument called?

A. A thermometer, the instrument used to measure the temperature of the air, the water, or another substance being studied

B. A barometer, the instrument used to measure atmospheric pressure, whose falling readings often warn of approaching storms

C. A hygrometer, the instrument used to measure the amount of water vapor, or humidity, present in the surrounding air

D. An anemometer, the instrument used to measure the speed of the wind as it blows past the spinning cups of the device

24. During the water cycle, plants take up water through their roots and release much of it as water vapor through tiny openings in their leaves. What is this release of water vapor from plant leaves called?

A. Precipitation, the process by which water falls from clouds back to the surface of the Earth as rain, snow, sleet, or hail

B. Condensation, the process by which water vapor in the cooling atmosphere changes back into tiny droplets of liquid water

C. Infiltration, the process by which water at the surface soaks downward into the soil and the spaces within the rock below

D. Transpiration, the release of water vapor into the air through tiny openings in the leaves of plants during the water cycle

25. At night along a coastline, the land cools faster than the nearby ocean, and a breeze blows from the land out toward the sea. Why does this land breeze blow from the land toward the water at night?

A. The land cools faster than the water at night, so the air over the warmer water rises and cooler air flows out from over the land

B. The water cools far faster than the land at night, so the wind is forced to blow inland from the much colder ocean surface

C. The Moon directly pulls the night air from the land out toward the sea, regardless of the temperatures of the land or the water

D. The land and the sea remain at precisely the same temperature all night, so the direction of the breeze is completely random

26. As global temperatures rise, scientists observe that average sea levels around the world are also rising. Which two effects of warming are the main contributors to this rise in sea level?

A. The freezing of additional ocean water into new ice and the sinking of the ocean floor, which together raise the global sea level

B. The melting of land-based ice such as glaciers and the thermal expansion of seawater as it warms, both of which add to sea level

C. An increase in the total amount of rainfall over land and a decrease in evaporation, which together cause the oceans to overflow

D. The growth of coral reefs and the buildup of sediment on the seafloor, which physically push the surface of the ocean upward

27. In the middle latitudes of North America, the prevailing winds generally blow from the west. How do these prevailing westerly winds affect the weather of the region?

A. They prevent any weather systems from ever moving, holding the same weather conditions fixed in place over the region permanently

B. They cause all weather systems to travel from east to west, the opposite of the direction in which the prevailing winds blow

C. They have no effect at all on the movement of weather systems, which drift in completely random directions across the continent

D. They generally carry weather systems from west to east across the region, which is why storms tend to approach from the west

28. Many of the world's large deserts are located in bands where air that rose near the equator sinks back toward the surface. Why does this sinking air create dry desert conditions?

A. The sinking air is extremely cold, which causes all of its moisture to fall out immediately as heavy snow before reaching the ground

B. The sinking air carries enormous amounts of moisture downward, which should make these regions among the wettest places on Earth

C. As the air sinks it warms and its capacity to hold moisture increases, so clouds and precipitation rarely form and the region stays dry

D. The sinking air spins so rapidly that it flings all of the available water far away from the region, leaving the desert completely dry

29. Two cities are located at the same latitude, but one sits high in the mountains and the other at sea level. The mountain city is consistently much colder. Which factor best explains the temperature difference?

A. Elevation, because air temperature generally decreases with increasing altitude, so higher locations tend to be colder than lower ones

B. Longitude, because cities located farther to the east are always colder than cities located to the west at the same latitude

C. The time of day, because mountain cities experience daytime while sea-level cities at the same latitude experience nighttime

D. Ocean depth, because the depth of the nearest ocean directly sets the air temperature of any city located at the same latitude

30. Deep beneath a mountain range, intense heat and pressure change existing rock into a new rock with bands of aligned minerals, without ever melting it. What type of rock forms through this process of heat and pressure?

A. An igneous rock, which forms only when molten magma or lava cools and hardens into solid rock either underground or at the surface

B. A metamorphic rock, which forms when existing rock is changed by intense heat and pressure without melting completely into magma

C. A sedimentary rock, which forms when loose particles of weathered rock are deposited in layers and then compacted and cemented

D. A pure mineral crystal, which forms only by precipitating directly out of a water solution and never from any pre-existing rock

31. A mineral can scratch fluorite (hardness 4) but is itself scratched by quartz (hardness 7). According to the Mohs hardness scale, what must be true about this mineral's hardness?

A. The mineral must have a hardness of exactly 7, the same as quartz, since any mineral that can be scratched by quartz equals it

B. The mineral must have a hardness of less than 4, since being able to scratch fluorite means the mineral is softer than fluorite

C. The mineral's hardness must fall between 4 and 7, since it is harder than fluorite but softer than quartz on the Mohs scale

D. The mineral's hardness cannot be estimated at all, since scratch tests reveal nothing useful about where a mineral falls on the scale

32. Along the San Andreas Fault in California, two tectonic plates slide horizontally past one another, frequently producing earthquakes. What type of plate boundary is this?

A. A divergent boundary, where two plates pull apart from each other and new crust forms in the gap that opens between them

B. A convergent boundary, where two plates move directly toward each other and one plate is forced down beneath the other plate

C. A hot spot, a place far from any plate boundary where a plume of hot mantle material rises and forms volcanoes at the surface

D. A transform boundary, where two plates slide horizontally past each other, building up stress that is released as earthquakes

33. In a cold mountain climate, water repeatedly seeps into cracks in rocks, freezes and expands overnight, then thaws during the day, gradually breaking the rock into pieces. What type of weathering is this?

A. Mechanical weathering, the physical breaking apart of rock into smaller pieces without changing the rock's chemical composition

B. Chemical weathering, the breakdown of rock through chemical reactions that change the minerals into entirely new substances

C. Deposition, the process by which sediment that has been carried away by water, wind, or ice is finally dropped in a new location

D. Cementation, the process by which dissolved minerals glue loose sediment grains together to form a solid sedimentary rock

34. Earth's rigid outer plates ride slowly on a layer of the upper mantle that behaves like a soft, slowly flowing solid. What is this partially soft layer of the upper mantle on which the plates move called?

A. The crust, the thin, brittle, outermost solid layer of the Earth on which the continents and oceans and all living things rest

B. The inner core, the solid, intensely hot sphere of iron and nickel located at the very center of the Earth beneath everything else

C. The asthenosphere, the soft, slowly flowing layer of the upper mantle on which Earth's rigid tectonic plates slowly move

D. The outer core, the layer of liquid iron and nickel whose churning motion is responsible for generating Earth's magnetic field

35. A geologist examines two stream pebbles: one is jagged and angular, while the other is smooth and well-rounded. What does the smooth, rounded shape of the second pebble most likely indicate?

A. The rounded pebble formed very recently, while the angular pebble is millions of years older than the smooth one beside it

B. The rounded pebble has been transported a long distance, with its edges worn smooth by abrasion during the journey downstream

C. The rounded pebble is made of a completely different mineral that naturally forms only in perfectly smooth, rounded shapes

D. The rounded pebble was never moved at all and formed exactly where it was found, while the angular pebble traveled far downstream

36. Beneath the surface, there is a level below which all the openings and spaces in the soil and rock are completely filled with water. What is this underground boundary called?

A. The aquifer, the body of permeable rock or sediment that is capable of storing and transmitting usable amounts of groundwater

B. The runoff line, the surface boundary above which rainwater flows across the land and below which it soaks into the ground instead

C. The bedrock layer, the solid, unbroken rock that lies beneath the looser soil and sediment at the very bottom of the ground

D. The water table, the underground level below which all of the spaces in the soil and rock are completely filled with water

37. The rock cycle describes how the three major rock types can change from one form into another over time. According to the rock cycle, can a metamorphic rock ever become a sedimentary rock?

A. Yes, a metamorphic rock can be weathered and eroded into sediment, which can then be deposited and cemented into sedimentary rock

B. No, once a rock becomes metamorphic it is permanently locked in that form and can never change into any other type of rock again

C. No, a metamorphic rock can only ever melt into magma and then cool back into the very same metamorphic rock it was before

D. Yes, but only if the metamorphic rock is first launched into outer space, where the conditions needed for the change can occur

38. A geologist finds an igneous rock with large, easily visible mineral crystals. What does this large crystal size indicate about how the rock formed?

A. The rock cooled extremely quickly at the surface from erupted lava, which is what allowed its large crystals to form so rapidly

B. The rock never cooled at all and is still partly molten, which is the only condition under which large crystals are able to grow

C. The rock cooled slowly deep underground, which gave the mineral crystals a long time to grow into large, visible grains

D. The crystal size of an igneous rock is completely random and reveals nothing whatsoever about the conditions in which it formed

39. A wide, fan-shaped deposit of sediment builds up where a fast mountain stream suddenly slows down as it reaches a flat valley floor. This landform, built by deposition where the stream loses energy, is called:

A. A moraine, the ridge of mixed rock and soil that is pushed up and left behind at the leading edge of a slowly moving glacier

B. A sand dune, the mound of loose sand that is piled up and slowly moved across the land by the wind in a dry desert region

C. A sinkhole, the surface depression that forms when the roof of an underground limestone cavern collapses into the empty space

D. An alluvial fan, the fan-shaped deposit of sediment that forms where a fast stream slows and drops its load on a flat valley floor

40. Carbon moves continually among the atmosphere, living things, the oceans, and rocks in the carbon cycle. Which process removes carbon dioxide from the atmosphere and stores its carbon in living plant tissue?

A. Combustion, the burning of fuels such as wood, coal, and oil, which releases stored carbon back into the air as carbon dioxide

B. Photosynthesis, in which plants take in carbon dioxide from the air and use it to build the sugars and tissues of their bodies

C. Respiration, in which living organisms break down sugars for energy and release carbon dioxide back into the surrounding air

D. Erosion, in which wind and water wear away rock and soil and carry the loosened particles away to be deposited elsewhere

41. In regions with volcanic activity, power plants tap the natural heat of the Earth's interior to produce steam that spins turbines and generates electricity. This renewable energy source is known as:

A. Geothermal energy, the heat drawn from within the Earth's interior, which is used to produce steam to generate electricity

B. Nuclear energy, the energy released by splitting the nuclei of heavy atoms such as uranium inside a controlled reactor core

C. Fossil fuel energy, the energy released by burning coal, oil, or natural gas formed from the remains of ancient organisms

D. Hydroelectric energy, the energy generated by the force of falling or flowing water as it spins the turbines of a dam

42. Fertilizer runoff from farms washes into a lake, causing a rapid overgrowth of algae. When the algae die and decay, oxygen in the water is used up and fish die. What is this process called?

A. Desalination, the removal of dissolved salts from seawater or other salty water to produce fresh water that is safe for drinking

B. Condensation, the change of water vapor in the cooling atmosphere back into tiny droplets of liquid water that form the clouds

C. Sedimentation, the settling and accumulation of solid particles at the bottom of a body of still or slowly moving water over time

D. Eutrophication, the over-enrichment of water with nutrients that triggers algae overgrowth, oxygen depletion, and the death of fish

43. On a steep hillside farm, a farmer plows and plants across the slope, following the natural contour lines of the hill rather than running rows straight up and down. How does this practice of contour plowing help the land?

A. It causes rainwater to rush straight down the slope much faster, which carries away far more soil and speeds up erosion on the hill

B. It bakes and hardens the soil into a solid crust, which permanently prevents any crops or other plants from growing on the hillside

C. It slows the flow of water down the slope, reducing soil erosion by allowing more water to soak in rather than running off rapidly

D. It has no effect at all on erosion, since the direction in which a farmer plows a hillside cannot influence how water moves across it

44. A non-native plant is introduced to a new region where it has no natural predators or diseases. It spreads rapidly and crowds out the native plants. What is such an introduced organism called?

A. A keystone species, an organism that has an unusually large and essential effect on the structure of its natural ecosystem

B. An invasive species, a non-native organism that spreads rapidly in a new environment and harms the native species there

C. An endangered species, a native organism whose population has dropped so low that it is at serious risk of becoming extinct

D. A decomposer, an organism such as a fungus or bacterium that breaks down dead material and returns its nutrients to the soil

45. As the climate warms, bright, reflective ice and snow melt, exposing darker ocean and land underneath. The darker surfaces absorb more sunlight, which causes even more warming and more melting. This self-reinforcing cycle is an example of:

A. A positive feedback loop, in which an initial change triggers effects that amplify the original change and push it even further

B. A negative feedback loop, in which an initial change triggers effects that oppose and cancel out the original change completely

C. A steady state, in which all of the parts of a system remain perfectly balanced and unchanging no matter what disturbs them

D. Conduction, the transfer of heat from one object to another through direct physical contact between the two touching surfaces

46. In many large cities, sunlight reacts with pollutants released by vehicle exhaust to form a brownish haze that irritates the lungs and reduces visibility. What is this type of air pollution commonly called?

A. Acid rain, the precipitation that becomes acidic when sulfur and nitrogen compounds from burning fuels dissolve into the water

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

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

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

47. Topsoil, the fertile upper layer of soil where most plant roots grow, forms extremely slowly but can be lost rapidly through erosion. Why is the loss of topsoil a serious concern for human agriculture?

A. Topsoil reforms within just a few days after it is lost, so its loss is only a very brief and minor inconvenience for farmers

B. Topsoil is completely useless for growing crops, so losing it actually improves farmland and increases agricultural production

C. Topsoil contains no nutrients of any kind, so whether it is present or lost has no effect on how well crops are able to grow

D. Topsoil takes a very long time to form but erodes quickly, so its loss reduces the land's fertility and ability to grow crops

48. An individual wants to reduce the amount of carbon dioxide their daily activities add to the atmosphere. Which of the following choices would most directly reduce a person's carbon footprint?

A. Driving alone for every trip, even very short ones, instead of walking, biking, or sharing rides with other people going the same way

B. Using energy-efficient appliances and reducing electricity use, since much electricity is generated by burning carbon-emitting fossil fuels

C. Leaving lights, heating, and electronic devices running at all times, even in empty rooms, to avoid the effort of switching them off

D. Buying many single-use disposable products, since manufacturing and discarding these items has no effect on carbon emissions at all

49. At the start of an engineering project to design a new bridge, the team lists the requirements the bridge must meet and the limits it must work within, such as budget and available materials. The requirements a successful solution must meet are known as the project's:

A. Criteria, the requirements or goals that a successful design solution must satisfy in order to be considered successful

B. Constraints, the limitations or restrictions, such as cost, time, or materials, within which the design solution must be developed

C. Prototypes, the early working models of a design that are built specifically so the team can test how well the design performs

D. Variables, the factors in an experiment that are deliberately changed, measured, or held constant to test their effects on results

50. During a field study, a student writes down: "The rock layer is reddish-brown and about 2 meters thick." This statement is best described as:

A. An inference, because it is a conclusion the student has drawn about how the rock layer most likely formed in the distant past

B. A prediction, because it states what the student expects will happen to the rock layer at some specific point in the future

C. An observation, because it records information about the rock layer gathered directly through the senses and measurement

D. A hypothesis, because it offers a testable proposed explanation for why the rock layer appears the way that it currently does

Practice Exam 41: Answer Key with Explanations

1. A — A lunar eclipse requires Earth to lie directly between the Sun and the Moon so that Earth's shadow falls across the Moon. Because the Moon must be on the far side of Earth from the Sun, lunar eclipses occur only at the full moon phase.
2. B — The inner rocky planets are generally much denser than the outer gas giants because rock and metal pack more mass into a given volume than gas does. This density difference reflects how the materials sorted by location when the solar system formed.
3. D — A star's color reveals its surface temperature, with blue-white stars being hotter and reddish stars cooler. This temperature-color relationship lets astronomers gauge a star's heat just from the light it emits.
4. C — A satellite stays in orbit because its forward motion combines with Earth's gravity pulling it inward, so it continually falls around the planet's curve. This balance of inertia and gravity is what produces a stable orbit rather than a crash or an escape.
5. A — The Sun's energy comes from nuclear fusion, in which hydrogen nuclei join to form helium and release tremendous energy. This fusion in the core is the power source that makes the Sun shine and warms the solar system.

6. D — A comet's tail generally points away from the Sun because the solar wind and radiation push its released gas and dust outward. As a result the tail streams away from the Sun regardless of the comet's direction of travel.
7. B — The apparent east-to-west drift of the stars is caused by Earth rotating on its axis from west to east. Because we move with the rotating Earth, the sky appears to turn in the opposite direction over the night.
8. C — The Big Bang theory holds that the universe began extremely hot and dense in an exceedingly small region and has been expanding ever since. The ongoing expansion observed today is consistent with this hot, dense origin.
9. A — Ocean tides are caused mainly by the Moon's gravitational pull, which raises water bulges on the sides of Earth facing toward and away from it. As Earth rotates through these bulges, coastal locations pass through two high and two low tides daily.
10. D — Venus is the hottest planet because its thick carbon-dioxide atmosphere traps heat in a runaway greenhouse effect. This heat trapping makes Venus hotter than Mercury even though Mercury orbits closer to the Sun.
11. C — A galaxy with a flat, rotating disk and curved arms winding from a central bulge is a spiral galaxy. Our own Milky Way is a spiral, with active star formation concentrated in its arms.
12. B — By the law of superposition, each undisturbed layer is deposited on top of older layers, so the topmost layer 5 was deposited most recently. The youngest material sits highest in an undisturbed sequence.
13. A — Carbon-14 dating fails for very old remains because after many half-lives so little carbon-14 is left that it cannot be measured accurately. Its short half-life limits the method to materials up to roughly 50,000 years old.
14. C — Fossils form in sedimentary rock because sediment gently buries organisms and preserves their remains, while igneous rock forms from molten material that destroys any remains. This is why nearly all fossils occur in sedimentary layers.
15. D — One-quarter remaining means two halvings have occurred ($1 \rightarrow 1/2 \rightarrow 1/4$), so two half-lives have passed. Two times the 700-million-year half-life gives an age of about 1.4 billion years.
16. B — By the principle of inclusions, fragments contained within a rock must be older than the rock that surrounds them. The granite had to already exist before it could be broken up and included in the sedimentary layer.
17. A — A worldwide iridium-rich layer at the dinosaur extinction boundary supports the idea that a large asteroid impact contributed to the mass extinction. Iridium's abundance in asteroids but rarity in the crust links the layer to extraterrestrial impact debris.
18. C — The correct oldest-to-most-recent order of the three most recent eras is Paleozoic, then Mesozoic, then Cenozoic. This sequence runs from the age of early fish and trilobites, through the age of dinosaurs, to the age of mammals.
19. B — Ice cores help reconstruct the past because their trapped air bubbles preserve samples of the ancient atmosphere. Analyzing these bubbles lets scientists study past climate conditions and greenhouse gas concentrations.
20. D — High, thin, wispy clouds made of ice crystals are cirrus clouds, which often appear ahead of an approaching weather change. Their high altitude and feathery look distinguish them from low, puffy, or layered cloud types.
21. A — The large-scale rising of warm air and sinking of cool air is convection, the transfer of heat by the movement of a fluid. This circulation of air drives the global wind belts and redistributes heat around the planet.

22. C — A fast-moving cold front forces warm air upward quickly, commonly producing a narrow band of heavy showers or thunderstorms followed by cooler, clearer air. The steep lifting of the warm air is what makes cold-front weather brief but intense.
23. B — A barometer measures atmospheric pressure, and a falling reading often warns that stormy weather is approaching. Tracking pressure changes is a key tool for short-term weather forecasting.
24. D — The release of water vapor from plant leaves through tiny openings is transpiration. This process returns water from plants to the atmosphere and is an important part of the water cycle.
25. A — At night the land cools faster than the water, so air over the warmer water rises and cooler air flows out from over the land, creating a land breeze. This is the reverse of the daytime sea breeze and again results from land-water temperature differences.
26. B — Sea level rises mainly from the melting of land-based ice such as glaciers and the thermal expansion of seawater as it warms. Both add volume to the oceans as global temperatures climb.
27. D — Prevailing westerlies generally carry weather systems from west to east across the mid-latitudes. This is why, in much of North America, storms typically approach from the west.
28. C — Sinking air warms, and as it warms its capacity to hold moisture increases, so clouds and precipitation rarely form. These bands of descending dry air are why many of the world's great deserts occur where they do.
29. A — The mountain city is colder because air temperature generally decreases with increasing elevation. At the same latitude, the higher location is cooler simply due to its greater altitude.
30. B — Rock changed by intense heat and pressure into banded rock without melting is metamorphic rock. The alignment of minerals into bands records the directed pressure that reshaped the original rock.
31. C — Since the mineral scratches fluorite (4) but is scratched by quartz (7), its hardness must fall between 4 and 7 on the Mohs scale. A mineral can scratch anything softer than itself and is scratched by anything harder.
32. D — Two plates sliding horizontally past each other, as at the San Andreas Fault, define a transform boundary. The stress that builds as the plates grind past one another is released in earthquakes.
33. A — Water freezing and thawing in cracks to break rock apart is mechanical (physical) weathering, since it changes the rock's size but not its chemical makeup. This frost wedging is common in cold climates with repeated freeze-thaw cycles.
34. C — The soft, slowly flowing layer of the upper mantle on which the rigid plates ride is the asthenosphere. Its ability to flow allows the tectonic plates above it to move over geologic time.
35. B — A smooth, well-rounded pebble most likely traveled a long distance, with its edges worn down by abrasion during transport. Rounding is therefore a clue to how far and how long sediment has been carried.
36. D — The underground level below which all pore spaces are completely filled with water is the water table. It marks the top of the saturated zone that supplies water to wells.
37. A — Yes—a metamorphic rock can be weathered and eroded into sediment that is later deposited and cemented into sedimentary rock. The rock cycle allows any rock type to be transformed into another over time.
38. C — Large, visible crystals indicate that the igneous rock cooled slowly deep underground, giving crystals time to grow. Rapid cooling at the surface, by contrast, produces fine-grained or glassy textures.

39. D — A fan-shaped sediment deposit formed where a fast stream slows on a flat valley floor is an alluvial fan. It builds up because the stream drops its load as it loses the energy needed to carry sediment.
40. B — Photosynthesis removes carbon dioxide from the atmosphere and stores its carbon in plant tissues as the plant builds sugars. This uptake is the main pathway by which carbon moves from the air into living things.
41. A — Tapping the Earth's internal heat to make steam and generate electricity is geothermal energy. Because that heat is continually supplied from within the Earth, geothermal is classified as a renewable source.
42. D — Nutrient runoff triggering algae overgrowth, oxygen depletion, and fish death is eutrophication. The decay of the algae consumes the dissolved oxygen that fish and other aquatic life need to survive.
43. C — Contour plowing follows the slope's contour lines, which slows water moving downhill and lets more soak in, reducing erosion. Slowing runoff is what keeps the soil from being washed off the hillside.
44. B — A non-native organism that spreads rapidly and harms native species is an invasive species. The lack of natural predators or diseases in the new region lets it outcompete and crowd out native organisms.
45. A — Melting ice exposing darker surfaces that absorb more heat and drive further melting is a positive feedback loop, in which a change amplifies itself. This self-reinforcing cycle accelerates warming once it begins.
46. C — The brownish haze formed when sunlight reacts with vehicle-exhaust pollutants is photochemical smog. It irritates the lungs and reduces visibility, making it a major urban air-quality concern.
47. D — Topsoil forms very slowly but erodes quickly, so its loss reduces the land's fertility and ability to grow crops. Because it cannot be replaced on a human timescale, conserving topsoil is vital for agriculture.
48. B — Using energy-efficient appliances and cutting electricity use most directly lowers a carbon footprint because much electricity comes from burning carbon-emitting fossil fuels. Reducing that demand reduces the associated carbon dioxide emissions.
49. A — The requirements a successful design must satisfy are its criteria, while the limits it must work within are constraints. Defining clear criteria sets the goals the finished bridge design must meet.
50. C — Recording the color and measured thickness of a rock layer is an observation, since it is information gathered directly through the senses and measurement. It states what is seen rather than drawing a conclusion or proposing an explanation.