PRACTICE EXAM 49: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. Air masses are named by the temperature and moisture of the surface over which they form. An air mass that forms over a cold polar continent would most likely be described as:

A. Maritime tropical, since air masses that form over a cold polar continent take on the warm, humid conditions of a tropical ocean far away

B. Maritime polar, since an air mass that forms over a cold polar continent always absorbs huge amounts of moisture from the surrounding ocean below

C. Continental tropical, since cold polar land masses produce hot, dry air masses that closely resemble those formed over a desert near the equator

D. Continental polar, since an air mass that forms over a cold polar continent takes on the cold, dry conditions of the cold land it sits above

2. Most weather forecasts are based partly on observing how high- and low-pressure systems move across a region from day to day. Why is tracking the movement of high- and low-pressure systems useful for predicting weather?

A. Because high- and low-pressure systems never actually move from one place to another, watching them simply identifies where the weather is permanently fixed

B. Because high- and low-pressure systems bring characteristic weather, knowing where they are headed helps forecasters predict the conditions of areas they will reach

C. Because the movement of pressure systems is completely random and unrelated to the weather, forecasters track them only to gather data with no practical use at all

D. Because the movement of pressure systems is the only thing that determines the time of sunrise, watching them is essential only for predicting the next sunrise

3. A meteorologist describes air over a region as "unstable" and warns of possible thunderstorms later in the afternoon. What does "unstable" air mean in this context?

A. The air is warmer and more moist near the surface than it is higher up, so it is prone to rising rapidly, which can fuel the growth of storm clouds and thunderstorms

B. The air is so cold and dry that even small rises in temperature will cause large amounts of snow to fall from a completely clear sky during the afternoon hours

C. The air is layered into perfectly steady, motionless sheets that resist any movement at all, which is the only condition that ever produces afternoon thunderstorms

D. The air is composed mostly of pure helium, which is the only gas that can ever rise rapidly enough through the atmosphere to fuel the growth of strong thunderstorms

4. A hot, sunny region has nearly constant dry weather and very few clouds throughout the year. This kind of dry climate is best classified as:

A. A polar climate, where year-round freezing temperatures and ice and snow on the ground are the main defining features of the region's climate

B. A tropical rainforest climate, where steady high temperatures and heavy rainfall throughout the year produce dense vegetation and very humid conditions

C. An arid climate, where very low precipitation and dry conditions throughout the year are the defining features of the region's overall climate

D. A continental climate, where large temperature differences between summer and winter and moderate seasonal precipitation define the region's climate

5. During a long, cold night, the temperature of a metal flagpole drops steadily as it gives off energy in the form of invisible infrared waves. What process is the flagpole losing heat by?

A. Conduction, the transfer of heat by direct contact between particles, which is the only way the flagpole can ever lose heat to its surroundings overnight

B. Radiation, the transfer of energy by electromagnetic waves, which allows the flagpole to give off heat as infrared waves even when no air is touching it

C. Convection, the transfer of heat by the movement of a heated fluid, which is the main process by which a solid metal object loses heat during a cold night

D. Precipitation, the falling of water from clouds to the surface of the Earth as rain, snow, sleet, or hail, which is how solid objects steadily lose heat each night

6. The Sun does not heat Earth's surface evenly: the equator receives more direct sunlight than the poles do. How does this uneven heating of the surface affect Earth's atmosphere?

A. It drives the global circulation of air, since warm air rises near the equator and cooler air sinks at higher latitudes, producing large-scale wind patterns

B. It has no effect on the atmosphere, since the uneven heating of the surface cannot influence how air moves anywhere within the planet's atmosphere

C. It causes the atmosphere to disappear in the regions where heating is uneven, which is the only effect that the temperature difference can ever produce

D. It cools the equator and heats the poles, since uneven heating reverses the natural temperature pattern of the Earth's atmosphere over time

7. A weather observer notices that as a warm front passes over a location, the temperature gradually rises and the steady precipitation tapers off. Why does the temperature usually rise after a warm front passes?

A. The warm front pulls colder air down from the upper atmosphere, which is what causes the local temperature to rise gradually behind the front

B. The warm front instantly cools the area as it passes, which is the only way that a warm front can produce any change in surface temperature behind it

C. The warm front is followed by warmer air masses that move into the region, replacing the cooler air that was there before and raising the local temperature

D. The warm front has no effect on temperature at all, since the rise that is observed must come from some other source entirely unrelated to the front itself

8. A meteorologist warns of dangerous wind chill on a cold, windy day, even though the thermometer reads only a few degrees below freezing. What is wind chill?

A. The effect by which strong wind raises the actual temperature of the surrounding air, which somehow makes the cold conditions feel much warmer than they really are

B. A type of severe ice storm that only ever occurs on extremely calm days with no wind at all, which is exactly when wind chill warnings are issued by forecasters

C. The temperature inside a person's body during a strong wind, which is much lower than the air temperature and is reported as the wind chill in cold weather

D. The effect by which wind increases heat loss from exposed skin, making the air feel colder than the actual temperature would suggest and increasing the risk of frostbite

9. Tornadoes are most common in regions where cold, dry air from one direction meets warm, moist air from another, creating strong rotating thunderstorms. The wide region of the central United States where this kind of storm is especially common is sometimes called:

A. The Rain Shadow, a dry region on the downwind side of a tall mountain range where descending air has already lost most of its moisture climbing the windward side

B. Tornado Alley, the wide region of the central United States where cold dry air and warm moist air frequently meet, producing the conditions favorable for tornadoes

C. The Doldrums, the belt of calm, nearly windless air found near the equator where rising air produces very few surface winds and almost no severe weather

D. The Gulf Stream, a warm ocean current that flows northeast across the Atlantic Ocean and that has nothing to do with the formation of severe land-based storms

10. A meteorologist combines ground observations, satellite images, radar, and computer models to forecast the weather. Why is a forecast based on all of these sources together more reliable than one based on a single source?

A. Each source captures different parts of the atmosphere, so combining them gives a more complete picture and reduces the chance that any single error will lead to a wrong forecast

B. Using more than one source always makes a forecast less accurate, since the only reliable kind of forecast is one that uses just a single instrument or observation

C. Using many sources lets a forecaster fill in numbers by guessing, since combining many measurements is just a way of generating extra data without any analysis

D. The different sources all give exactly the same information, so combining them simply makes the forecast take longer to produce without adding any additional value

11. A community installs LED streetlights and uses motion sensors to dim them when no one is around. How does this kind of "smart lighting" benefit the environment?

A. By dramatically increasing total energy use, since each LED requires far more electricity than the older lights it replaces and motion sensors add even more demand

B. By cutting electricity use, which lowers the fossil fuels burned for power, reduces greenhouse gas emissions, and also reduces light pollution at night

C. By having no effect on energy use at all, since the type of streetlight chosen has no connection to how much electricity is generated by a city's power plants

D. By forcing power plants to burn more coal at night, since efficient lights must be balanced by extra fossil-fuel generation to keep the local power grid stable

12. Some communities reduce waste by composting food scraps and yard waste, turning them into a nutrient-rich material that improves soil. Why is composting considered an environmentally beneficial way to handle these wastes?

A. Composting releases huge amounts of toxic chemicals into the air, but it is still beneficial because it removes food scraps from people's homes for them

B. Composting keeps organic waste out of landfills, reduces methane emissions from buried waste, and recycles nutrients back into the soil for plants to use

C. Composting actually increases the amount of waste a community sends to landfills, since composted materials add new garbage that would not exist otherwise

D. Composting has no effect on landfill use, methane emissions, or soil quality, since organic waste behaves exactly the same in compost piles as in landfills

13. Some governments require new buildings to use energy-efficient appliances, insulation, and heating systems. How does this kind of regulation help reduce climate change?

A. By guaranteeing that every building will be torn down within a few years, since efficient buildings have an unusually short lifespan that limits their emissions

B. By forcing every household to use more electricity, since efficient buildings require constant heavy electricity use to keep their efficiency systems running properly

C. By making buildings far more expensive without any environmental benefit, since the type of insulation and appliances used has no real effect on emissions overall

D. By lowering the energy each building uses, which reduces the fossil fuels burned to supply that energy and cuts the resulting greenhouse gas emissions

14. A community holds an annual cleanup day during which volunteers remove trash from parks, streams, and shorelines. Besides simply making the area look cleaner, how does this kind of cleanup benefit the environment?

A. It removes plastic and other debris that can harm wildlife, contaminate water, and break down into smaller pieces that are even harder to remove from the environment later

B. It increases the total amount of pollution that enters local waterways, since collecting and disposing of trash always produces more pollution than leaving the trash on the ground

C. It permanently destroys all wildlife habitats in the area, since removing trash from a stream or park is the most effective way to harm the species that live there

D. It has no real effect on the environment beyond appearance, since trash left on the ground does not interact with the surrounding soil, water, or organisms in any way

15. A farm rotates its livestock between several pastures, allowing each pasture to rest and regrow between grazing periods. How does this practice, sometimes called rotational grazing, benefit the land?

A. By stripping each pasture completely bare of vegetation in a single grazing period, since rotating animals between fields is the most efficient way to destroy plant cover quickly

B. By forcing pastures to remain permanently overgrazed at all times, since the rotation of animals between fields makes recovery impossible no matter how much rest is given

C. By giving plants time to recover and roots time to grow deeper, which helps maintain soil health, reduces erosion, and supports more sustainable grazing over time

D. By having no measurable effect on the soil or vegetation, since the order in which animals graze a set of pastures cannot influence the long-term health of the land

16. A homeowner installs a low-flow showerhead and toilet to reduce water use, especially during a regional drought. Why is this kind of water conservation considered an environmentally responsible action?

A. Reducing water use forces local rivers and streams to flow far more strongly, since rivers somehow flow faster when nearby homes use less water during a drought

B. Reducing water use does not help during a drought, since the amount of water a single home uses cannot affect the larger supply of any region or community at all

C. Reducing water use forces nearby reservoirs to evaporate faster, which is the only way that conserving water at home can shorten the duration of any drought

D. Reducing water use lowers demand on local supplies, leaving more water for ecosystems and other users and lessening the strain on the region's water resources

17. A nature center starts a project to remove non-native invasive plants from a local forest and replant native species. How does this kind of restoration project benefit the ecosystem?

A. By replacing all native species with new invasive ones, since restoration projects are typically designed to introduce as many non-native plants as possible to a forest

B. By restoring habitat for native wildlife, increasing biodiversity, and reducing the spread of invasive species that can crowd out and outcompete native plants

C. By permanently destroying the entire ecosystem, since removing invasive plants and replanting native species is known to be harmful to local biodiversity over time

D. By having no effect on the forest at all, since the plant species present in an ecosystem have no influence on the wildlife or biodiversity that live within it

18. Researchers find that some chemicals dumped into a river decades ago still appear in the tissues of fish and birds in the area today. What does this persistence of pollutants in living organisms over many years reveal?

A. That some pollutants persist in the environment for long periods and can accumulate in food chains, continuing to affect organisms long after the original release

B. That all pollutants disappear from the environment within a few days after being released, which is why none of these pollutants would still be detectable today

C. That pollutants released into a river never enter the bodies of any organisms at all, so the chemicals found in the fish and birds must come from somewhere else

D. That pollutants released long ago are now safely removed from the environment, since the organisms eat them and then somehow destroy them permanently inside their bodies

19. A city expands rapidly, paving over wetlands and forests at the edge of town. Why does this kind of urban growth often cause environmental problems beyond the loss of habitat?

A. Because the paved area looks different from natural land, the new neighborhoods cause environmental problems purely because of the change in their appearance

B. Because urban expansion is always limited to a small area, the loss of wetlands and forests has no real effect on flooding, air quality, or local biodiversity at all

C. Because paving over wetlands and forests reduces the city's heat, lowers air pollution, and prevents flooding entirely, urban expansion is purely beneficial overall

D. Because paving reduces infiltration and removes vegetation, flooding, runoff pollution, and the urban heat island effect can all worsen as a city grows outward

20. Astronomers measure the brightness of a star both as it appears in our sky and as it would appear from a standard distance away. What is the brightness a star would appear to have at a standard distance called?

A. Surface temperature, the average temperature of the outer layers of a star, which is the only physical property that astronomers can measure for any star at all

B. Distance modulus, the difference between the value reported in nearby light-years and the value reported in faraway parsecs for any star in the night sky

C. Absolute brightness, the brightness a star would appear to have at a standard distance, which allows fair comparisons of true brightness among different stars

D. Apparent magnitude, the brightness a star appears to have in Earth's night sky, which is identical to the absolute brightness and depends on distance from Earth

21. A common belief is that all planets in the solar system orbit the Sun at the same speed. What does the evidence actually show about orbital speed?

A. Planets closer to the Sun orbit faster than planets farther away, since the Sun's gravity is stronger at closer distances and requires faster motion to balance it

B. Planets farther from the Sun orbit faster than planets closer in, since distant planets must move quickly to cover the larger distances around their wider orbits

C. Every planet in the solar system orbits the Sun at exactly the same speed, since the Sun's gravity affects every planet identically regardless of distance

D. Planets do not orbit the Sun at any particular speed, since their motion is completely random and depends on no physical factor whatsoever in the system

22. Astronomers describe the universe as having a structure on the largest scales, with galaxies grouped into clusters, and clusters grouped into still larger superclusters separated by mostly empty regions. What does this large-scale structure look like overall?

A. Galaxies are arranged in completely flat, evenly spaced grids that extend perfectly outward in every direction from one fixed center of the universe forever

B. Galaxies are arranged in perfect circles around a single point that lies at the center of the universe, just as planets orbit a star at the center of a solar system

C. Galaxies are scattered completely at random, with no clustering, no voids, and no large-scale patterns of any kind anywhere across the universe at all

D. Galaxies are organized into a web-like pattern of clusters, filaments, and walls separated by large, mostly empty regions called voids across vast distances

23. A small asteroid is detected on a path that will bring it close to Earth, but not directly toward it. Why is the study of such "near-Earth objects" considered an important area of modern astronomy?

A. Because near-Earth objects always pass at safe distances, studying them is done purely as a hobby and has no real connection to the safety of life on Earth

B. Because near-Earth objects are too small to ever cause any damage even if they did strike the planet, studying them serves no useful safety purpose at all

C. Because some near-Earth objects could one day strike Earth, tracking and studying them helps assess and prepare for any potential impact hazards in the future

D. Because near-Earth objects have already destroyed life on every other planet, studying them is the only way astronomers can prevent the same fate from happening here

24. Comets have long, glowing tails that can stretch for millions of kilometers. What causes a comet's tail to form as the comet approaches the Sun?

A. The friction of the comet's surface against the empty vacuum of space, which heats the comet enough to make it glow with the long bright tail seen from Earth

B. The Sun's heat and solar wind evaporate ice and dust from the comet, and radiation pressure and the solar wind push the released material into a long glowing tail

C. The comet's own internal nuclear fusion, which is the only source of energy capable of producing a glowing tail of gas and dust millions of kilometers long

D. The pull of the planets' gravity stretches the comet's body outward into a long tail of solid rock, which is why the tail glows so brightly across the entire sky

25. Astronomers think the Sun is roughly halfway through its expected lifetime as a stable, hydrogen-burning star. About how long is the Sun expected to live as a stable star before it changes dramatically?

A. About one hundred years, after which the Sun will completely burn out and disappear from the sky entirely, leaving the solar system in total darkness forever

B. About one million years, which is roughly the same as the entire history of human beings on Earth and which suggests the Sun is nearing the end of its life

C. About one billion years total, with the Sun having already used up nearly all of its hydrogen fuel only a few hundred million years after its initial formation

D. About ten billion years total, of which the Sun is roughly halfway through, so it has roughly another five billion years left as a stable, hydrogen-burning star

26. Spacecraft missions have discovered that Saturn's moon Titan has lakes and rivers of liquid methane and ethane on its surface, not liquid water. Why is this an interesting discovery for the study of conditions beyond Earth?

A. Because Titan's surface is identical to Earth's in every way, the discovery is interesting only because it shows that Titan is a perfect copy of our own planet in space

B. Because Titan provides a different kind of liquid-on-a-solid environment, it offers a place where scientists can study processes like rivers and lakes under non-Earth conditions

C. Because liquid methane and ethane behave exactly the same as liquid water in every way, the discovery is not really an interesting one from a scientific point of view

D. Because Titan has no surface features of any kind, the discovery is interesting only because no other moon in the entire solar system has any features for scientists to study

27. Astronomers detect distant galaxies in many forms of light, not just visible light. They use radio waves to study clouds of gas and X-rays to study very hot regions, among other examples. What does this show about how astronomers gather information about objects in space?

A. Different objects and processes give off different forms of electromagnetic radiation, so studying many forms reveals features that visible light alone would miss

B. Visible light is the only form of light that contains real information, so the use of radio and X-ray telescopes is purely a hobby with no scientific value at all

C. Radio waves and X-rays are not actually forms of light, so astronomers using these telescopes are gathering no real information about objects in space at all

D. Radio waves and X-rays come only from Earth and never from space, so telescopes designed for these wavelengths cannot reveal anything at all about distant objects

28. Telescopes have been placed on mountaintops, in deserts, in orbit above the atmosphere, and even on the far side of the Moon. What is one major reason astronomers choose remote or high-altitude sites for many telescopes?

A. Such sites provide the worst possible viewing conditions, which is the main reason that astronomers prefer them over any other location available for telescopes

B. Such sites are easy and inexpensive to reach, since remote mountaintops and orbital locations are typically among the most accessible places on Earth or above it

C. Such sites offer dark, dry, and stable air or no atmosphere at all, reducing blurring and absorption of light and providing clearer views of objects in space

D. Such sites are the only locations on or above the Earth where visible light is able to travel through space at all, which is why telescopes must be placed there

29. Our solar system formed about 4.6 billion years ago, but the universe is much older than that. Approximately how old is the universe based on current scientific evidence?

A. About 4.6 billion years old, which means that the solar system and the universe formed at exactly the same time in the same single event many years ago

B. About 1 million years old, which is older than the human species but still far younger than the dinosaurs that once lived across the surface of the Earth

C. About 6,000 years old, a figure that scientists have calculated directly from the measured rate at which the universe is currently expanding into open space

D. About 13.8 billion years old, a figure that is roughly three times the age of the Earth and that comes from observations of the universe's expansion

30. Some stars are observed to brighten and dim regularly over time. Astronomers use the patterns of these "variable stars" to gather information beyond simply how they look. What is one important use of variable stars in astronomy?

A. Variable stars cause the universe to expand and contract, and observing their brightness directly controls the rate at which the universe grows or shrinks each year

B. Some variable stars have a known true brightness, so comparing this to how bright they appear in our sky lets astronomers calculate the distance to those stars

C. Variable stars are completely identical to non-variable stars in every way, so observing their changing brightness reveals nothing useful about distances or properties

D. Variable stars are used only to set the time on Earth's clocks, since their brightness changes serve as the basis of our standard system of timekeeping each day

31. A radioactive isotope used in dating ancient rocks has a half-life of 1.4 billion years. A sample contains one-quarter of the original amount of this isotope. About how old is the sample?

A. About 1.4 billion years old, since one-quarter of the isotope remaining corresponds to a single half-life of the isotope having passed since the rock first formed

B. About 700 million years old, since one-quarter of the isotope remaining corresponds to only half of one half-life of the isotope having passed since formation

C. About 2.8 billion years old, since one-quarter remaining means two half-lives have passed, and two times 1.4 billion years equals 2.8 billion years

D. About 5.6 billion years old, since one-quarter of the isotope remaining corresponds to exactly four full half-lives of the isotope having passed since formation

32. Scientists use the principle that "the present is the key to the past" to interpret ancient rocks and landscapes. What does this principle mean?

A. That observations of present-day processes, such as deposition or erosion, can be used to understand how similar processes shaped rocks and landscapes in the past

B. That the present and the past are completely different, so observations of modern processes cannot reveal anything at all about how past landscapes formed

C. That the past can be reconstructed only by ignoring all modern observations, since past processes are so different from present ones that they share no similarities

D. That events of the past will repeat in exactly the same way in the future, which is the only useful meaning of the principle of "the present is the key to the past"

33. A geologist studying a remote outcrop finds that fossils of brachiopods occur consistently below fossils of more recent organisms in undisturbed layers. What does this consistent vertical pattern of fossils show?

A. That all fossils form at exactly the same time, regardless of their position within an undisturbed sequence of rock layers from anywhere across the world

B. That fossils in the lower layers are younger than fossils in the upper layers, since deeper layers always contain more recent organisms in the geologic record

C. That fossils are arranged randomly in rocks, so their position within an undisturbed sequence cannot be used to determine the relative ages of layers anywhere

D. That fossils in lower layers are older than fossils in upper layers, consistent with superposition, and that life has changed over time as life evolved

34. A geologist finds a fossil that is well-known to occur only in rocks from a single, narrow time period across the world. How could this fossil be useful in studying other rock layers?

A. Such a fossil could not be used to help date other rock layers, since its narrow time range and wide distribution make it useless for the relative dating of any rocks

B. Such a fossil could be used as an index fossil: finding it in another rock layer indicates that the layer formed during the same narrow time period across the world

C. Such a fossil could be used to determine the exact age of a rock in years, since the time range of an index fossil is always given as a single precise numerical age

D. Such a fossil could be used only to identify rocks that are very young, since fossils that exist for only a narrow span of time always belong to very recent layers

35. The most recent geologic period contains the rise of modern humans, the spread of agriculture, and the development of industrial society. This most recent geologic period is called the:

A. Quaternary, the most recent geologic period in which modern humans evolved and spread across the globe and during which several major ice ages have occurred

B. Jurassic, the geologic period during which the dinosaurs were the dominant land animals and the first birds and small early mammals appeared on Earth

C. Cambrian, the early geologic period at the start of the Paleozoic during which many complex marine animals with hard parts first appeared and diversified rapidly

D. Pennsylvanian, the middle geologic period of the Paleozoic Era during which thick coal-forming swamp forests covered large areas of the equatorial continents

36. A geologist proposes that a particular mountain range was once at the bottom of a shallow sea. What kind of evidence in the mountains' rocks would best support this idea?

A. The presence of dinosaur footprints, which can form only in dry desert environments where the soft sand is far away from any large body of water

B. The presence of large pieces of pumice and obsidian, which form only when surface lava cools so quickly that no crystals or sediment particles can ever form

C. The presence of large amounts of pure ice, which would be the only convincing evidence that the rocks of the mountain range had once been at the bottom of a shallow sea

D. The presence of marine fossils such as corals and shells in the rocks, which strongly suggests that the area was once underwater before being uplifted into mountains

37. Geologists have found that on a few continents, layers of glacial deposits dating to the same time are now located in tropical or subtropical regions. How does this distribution of ancient glacial deposits support the theory of continental drift?

A. It shows that the climate of these regions has always been frigid, with thick glaciers covering them even today, which has nothing to do with continental drift at all

B. It shows that these continents have always been in their present positions, since glaciers can form anywhere on Earth regardless of where the continents are located

C. It suggests that the continents were once located near the South Pole, where they were covered by glaciers, and have since drifted to their present warmer locations

D. It shows that ancient glacial deposits cannot be reliable evidence of past climates, since glaciers in tropical regions are common in the modern geologic record today

38. Although mass extinctions are catastrophic events, the long-term fossil record shows that life on Earth has repeatedly recovered and diversified afterwards. What does this pattern of recovery after extinctions illustrate?

A. That life on Earth always returns to exactly its pre-extinction state after every mass extinction, since the same species reappear unchanged in the fossil record

B. That life on Earth is resilient and adaptable over geologic time, with surviving groups evolving and diversifying to fill ecological roles left empty by the extinction

C. That mass extinctions have no real effect on life, since the exact same set of species lives across the planet both before and after every recorded mass extinction event

D. That life on Earth completely vanishes after every mass extinction, since no organisms have ever survived an extinction event during the long history of the planet

39. A geologist finds a metamorphic rock that contains visible bands of alternating light and dark minerals running through it. What name is given to this banded, layered texture in a metamorphic rock?

A. Foliation, the banded, layered texture seen in many metamorphic rocks whose minerals have been flattened and lined up by directed pressure during metamorphism

B. Cleavage, the tendency of a mineral to break along smooth, flat planes that are determined by the regular internal atomic structure of the individual mineral crystals

C. Vesicular texture, the holey or sponge-like texture of a volcanic rock that is full of small cavities that were left behind by gas bubbles escaping from the cooling lava

D. Clastic texture, the texture of a sedimentary rock that is made up of separate fragments and grains that have been cemented together into a solid rock over time

40. A geologist uses the rock cycle to explain how a single rock could, over millions of years, change into a different rock type more than once. Which of the following describes a possible rock-cycle pathway?

A. A sedimentary rock immediately becomes the same sedimentary rock again, since sedimentary rocks are unable to change into any other rock type under any conditions

B. An igneous rock is permanently locked in its original form and is unable to ever change into a sedimentary or metamorphic rock through any process at all

C. A metamorphic rock instantly becomes a sedimentary rock without going through any other steps, since metamorphic rocks always skip directly to sedimentary form

D. An igneous rock can weather into sediment, become a sedimentary rock, be buried and metamorphosed, then melt into magma and form a new igneous rock

41. A geologist finds a sequence of horizontal rock layers cut by a long fault, and a vertical igneous dike that crosses the fault. Using the principle of cross-cutting relationships, which event happened first?

A. The igneous dike was the earliest event, since dikes are always the oldest features in any outcrop regardless of what else is present, by the principle of cross-cutting relationships

B. The fault was the earliest event, since faults are always older than any other feature found nearby, by the principle of cross-cutting relationships and superposition

C. It is impossible to determine the order of any of these events, since cross-cutting relationships do not actually reveal the order in which geologic events happened

D. The horizontal rock layers were the earliest event, since the layers must have existed before they could be cut by the fault and by the later dike that cuts the fault

42. A geologist examining a region's bedrock finds large amounts of solid rock salt, which forms when a body of saltwater evaporates almost completely and leaves the salt behind. What does the presence of this rock salt indicate about the area's past?

A. The area once held a body of saltwater that gradually evaporated, leaving behind the dissolved salt as a thick layer of solid rock salt on the ancient surface

B. The area has always been covered by a thick layer of pure ice, since rock salt can form only when very thick glaciers slowly melt and refreeze repeatedly over time

C. The area was once filled with molten lava that cooled into solid rock salt, since rock salt is a typical product of volcanic eruptions across the surface of the Earth

D. The area was once at the bottom of a deep, freshwater lake, since freshwater lakes leave behind thick layers of rock salt when their water gradually evaporates away

43. A volcano builds a tall, steep-sided cone made up of alternating layers of hardened lava and explosively erupted ash and cinders. What type of volcano is this?

A. A shield volcano, a broad volcano with gentle slopes built up from many flows of thin, runny lava that spreads out over wide areas before it cools and hardens

B. A cinder cone volcano, a small steep-sided hill built entirely from loose rock fragments that are blasted into the air and pile up around the vent, with no lava layers

C. A composite volcano, a tall, steep-sided cone built from alternating layers of hardened lava and explosively erupted ash and cinders from many separate eruptions

D. A caldera, a large bowl-shaped depression that forms when the summit of a volcano collapses into the emptied magma chamber that previously lay just beneath it

44. A river meandering across a flat plain often forms a curved oxbow lake when one of its loops is cut off from the main channel. How does an oxbow lake form?

A. The river cuts a brand-new straight channel that begins in a separate location, leaving the older meander untouched, which mysteriously becomes an oxbow lake

B. Erosion and deposition gradually make a meander loop tighter until the river takes a more direct path, cutting off the loop and leaving behind an oxbow lake

C. The river suddenly reverses its flow direction, leaving a long, straight body of water behind as an oxbow lake without any erosion or deposition involved at all

D. The river permanently dries up across its entire length, leaving only the curve of the former meander filled with rainwater, which is what becomes an oxbow lake

45. A common claim is that all groundwater is found in large underground rivers or lakes. What is the more accurate description of where groundwater is stored?

A. Most groundwater is found in vast underground rivers that flow steadily through wide tunnels in the bedrock, which is the standard way underground water is stored

B. Most groundwater is found in large open underground lakes that fill enormous hidden cavities, which is the only place that groundwater is ever stored beneath the surface

C. Most groundwater is stored inside the bodies of underground animals that live deep beneath the surface, which is the most common storage location for water in the ground

D. Most groundwater is held in the small pore spaces between particles of soil and rock and in cracks within rock, with true underground rivers being relatively rare

46. The Mohs hardness scale uses ten common minerals as reference points, from talc at 1 to diamond at 10. Which of the following statements about the Mohs hardness scale is correct?

A. A mineral higher on the scale can scratch all the minerals with lower numbers, since hardness measures resistance to being scratched, and harder minerals scratch softer ones

B. A mineral higher on the scale is scratched easily by all of the minerals with lower numbers, since higher numbers on the Mohs scale always indicate softer minerals

C. The numbers on the Mohs scale measure the color of each reference mineral, and minerals higher on the scale always have darker colors than those with lower numbers

D. The Mohs scale is exactly linear, so a mineral with a hardness of 8 is exactly four times as hard as one with a hardness of 2, which is what the numbers directly express

47. A homeowner has a property bordered by a steep slope. After heavy rain saturates the soil and adds great weight to the slope, the saturated soil and loose rocks suddenly slide downhill. This sudden movement of material is best described as:

A. Erosion, the gradual wearing-away of rock and soil by wind, water, or ice, which always occurs slowly and gradually rather than as a sudden movement of material

B. Deposition, the dropping of sediment by water, wind, or ice when those agents lose energy and can no longer carry their load, which is not the process described here

C. A mass movement, a sudden downhill movement of soil, rock, and debris that is often triggered by heavy rain, an earthquake, or the steepening of a slope

D. Crystallization, the process by which atoms arrange themselves into an orderly repeating solid structure to form a mineral crystal, which is unrelated to slope failure

48. Some metamorphic rocks form deep underground from rocks that are buried as tectonic plates collide and crust is thickened. What does the formation of such metamorphic rocks reveal about the rock cycle?

A. That metamorphic rocks form only at the surface and never deep underground, since the heat and pressure required for metamorphism do not exist deep below the surface

B. That tectonic processes are part of the rock cycle, since plate collisions can bury rock deep enough that heat and pressure transform it into metamorphic rock

C. That the rock cycle has no real connection to plate tectonics, since the formation of metamorphic rocks is entirely unrelated to the motion of the tectonic plates

D. That metamorphic rocks form only from sediment freshly laid down at the surface, since metamorphic rocks can never form from any rock type other than sediment

49. An engineering team must design a bridge that meets safety codes, fits the available space, and stays within budget. Which of the following best describes how the team should approach competing requirements such as cost, strength, and weight?

A. Choose the cheapest design without considering safety, strength, or weight, since cost alone is the only requirement that any engineering team should ever consider at all

B. Refuse to make any choices at all, since competing requirements cannot be reconciled and the team should simply leave the bridge unbuilt rather than weigh trade-offs

C. Choose the heaviest design possible without any other thought, since the heavier a bridge is, the better it will perform across every other requirement the team faces

D. Weigh the trade-offs among cost, strength, and weight against the project's criteria and constraints, choosing the design that best balances the competing requirements

50. A student claims that a particular new water filter is the best available. To support this claim scientifically, the student should rely on:

A. Evidence from controlled tests comparing the new filter with other filters under the same conditions, since scientific claims must be supported by reproducible evidence

B. A strong personal opinion from a single trusted friend who has used the filter once, since one positive opinion is always enough to establish a scientific claim

C. The price of the new filter alone, since the most expensive product available on the market is always automatically the highest-quality option for any given task

D. The claim's appearance in a single short advertisement, since any product advertised on television must necessarily be the best of its kind on the market

Practice Exam 49: Answer Key with Explanations

1. D — An air mass that forms over a cold polar continent takes on the cold, dry conditions of the land beneath, making it continental polar. Air masses acquire the temperature and moisture of their source region.
2. B — High- and low-pressure systems bring characteristic weather, so knowing where they are headed helps forecasters predict conditions in areas they will reach. Tracking their motion projects today's weather patterns into tomorrow.
3. A — "Unstable" air is warmer and more moist near the surface than higher up, making it prone to rising rapidly, which can fuel storm cloud and thunderstorm growth. Strong vertical motion is what builds these afternoon storms.
4. C — A hot, dry region with very low precipitation and few clouds year-round has an arid climate. Long-term dryness is the defining feature of this climate type.
5. B — A flagpole giving off energy as invisible infrared waves loses heat by radiation, the transfer of energy by electromagnetic waves. This can occur even without contact between the pole and the surrounding air.
6. A — Uneven solar heating drives the global circulation of air, with warm air rising near the equator and cooler air sinking at higher latitudes. This pattern produces the large-scale wind belts of the atmosphere.
7. C — After a warm front passes, warmer air masses move in to replace the cooler air, which raises the local temperature. The change in air mass behind the front is what produces the warming.
8. D — Wind chill is the effect by which wind increases heat loss from exposed skin, making the air feel colder than the actual temperature. This greater heat loss raises the risk of frostbite even at moderate sub-freezing temperatures.
9. B — The wide region of the central United States where cold dry air and warm moist air frequently meet, producing conditions favorable for tornadoes, is Tornado Alley. The clash of contrasting air masses there fuels severe rotating thunderstorms.
10. A — Each data source captures different parts of the atmosphere, so combining them gives a more complete picture and reduces the chance that any single error misleads the forecast. Multiple, independent inputs improve overall accuracy.
11. C — Smart LED lighting with motion sensors cuts electricity use, which lowers the fossil fuels burned for power, reduces greenhouse gas emissions, and also reduces light pollution at night. Lower demand translates directly into smaller environmental impact.
12. B — Composting keeps organic waste out of landfills, reduces methane emissions from buried waste, and recycles nutrients back into the soil for plants. These combined benefits make composting an environmentally sound waste strategy.
13. D — Energy-efficient buildings lower the energy each building uses, which reduces the fossil fuels burned to supply that energy and cuts greenhouse gas emissions. Less demand for power means fewer climate-warming emissions.
14. A — Cleanups remove plastic and other debris that can harm wildlife, contaminate water, and break down into smaller pieces that are harder to remove later. Preventing this accumulation protects ecosystems beyond just improving appearance.
15. C — Rotational grazing gives plants time to recover and roots time to grow deeper, supporting soil health, reducing erosion, and making grazing more sustainable. Resting pastures between grazing periods prevents overuse.

16. D — Conserving water at home lowers demand on local supplies, leaving more water for ecosystems and other users and lessening strain on the region's resources. During a drought, reduced demand helps stretch the limited supply.
17. B — Restoration projects benefit ecosystems by restoring habitat for native wildlife, increasing biodiversity, and reducing the spread of invasive species that can crowd out natives. Replacing invasives with natives helps the ecosystem function as it did historically.
18. A — Some pollutants persist in the environment for long periods and can accumulate in food chains, continuing to affect organisms long after their original release. Biomagnification through food webs is why decades-old chemicals still show up in wildlife.
19. D — Paving over wetlands and forests reduces infiltration and removes vegetation, so flooding, runoff pollution, and the urban heat island effect can all worsen as a city grows. Loss of natural surfaces undermines the services those ecosystems provided.
20. C — The brightness a star would have at a standard distance is its absolute brightness, which allows fair comparisons of true brightness among different stars. Standardizing distance removes the dimming effect of varying distances from Earth.
21. A — Planets closer to the Sun orbit faster than those farther away, since the Sun's gravity is stronger at closer distances and faster motion is needed to balance it. This is reflected in shorter years for inner planets.
22. D — Galaxies are organized into a web-like pattern of clusters, filaments, and walls separated by large, mostly empty regions called voids. This cosmic web is the large-scale structure of the universe.
23. C — Because some near-Earth objects could one day strike Earth, tracking and studying them helps assess and prepare for any potential impact hazards. Knowing their orbits is essential to planning any planetary-defense response.
24. B — The Sun's heat and solar wind evaporate ice and dust from a comet, and radiation pressure and the solar wind push the released material into a long glowing tail. The tail therefore points away from the Sun regardless of the comet's direction of travel.
25. D — The Sun is expected to live about ten billion years total as a stable, hydrogen-burning star, of which it is roughly halfway through. That leaves another five billion years before it changes dramatically.
26. B — Titan provides a different kind of liquid-on-a-solid environment, offering a place to study processes like rivers and lakes under non-Earth conditions. This expands the range of settings in which planetary processes can be investigated.
27. A — Different objects and processes give off different forms of electromagnetic radiation, so studying many forms reveals features that visible light alone would miss. This is why astronomers build telescopes across the spectrum.
28. C — Remote and high-altitude sites offer dark, dry, and stable air—or no atmosphere at all in orbit—reducing blurring and absorption of light. These conditions provide much clearer views than typical low, urban sites.
29. D — Current evidence places the universe at about 13.8 billion years old, roughly three times the age of the Earth, and comes from observations of the universe's expansion. This far exceeds the 4.6-billion-year age of the solar system.
30. B — Some variable stars have a known true brightness, so comparing it with their apparent brightness lets astronomers calculate their distances. This makes such variables key "standard candles" for measuring cosmic distances.

31. C — One-quarter remaining means two halvings have occurred (1 → 1/2 → 1/4), so two half-lives have passed. Two times the 1.4-billion-year half-life gives about 2.8 billion years.
32. A — "The present is the key to the past" means observations of present-day processes, such as deposition or erosion, can be used to understand how similar processes shaped rocks and landscapes long ago. Modern processes thus serve as a guide to reading the rock record.
33. D — Brachiopod fossils below more recent fossils in undisturbed layers shows older fossils are in lower layers and younger ones above, consistent with superposition, and that life has changed over time. The vertical fossil order records evolutionary change in the rock record.
34. B — A fossil restricted to a narrow time interval but found across the world is an index fossil; finding it in another rock layer indicates that layer formed during the same narrow time period. Such fossils allow geologists to correlate distant rock units.
35. A — The most recent geologic period, in which modern humans evolved and spread and several major ice ages occurred, is the Quaternary. It is the youngest period of the Cenozoic Era.
36. D — Marine fossils such as corals and shells in the mountain rocks would strongly suggest the area was once underwater before being uplifted into mountains. Such fossils are direct evidence of an ancient sea.
37. C — Ancient glacial deposits in now-tropical regions suggest those continents were once located near the South Pole, where they were covered by glaciers, and have since drifted to warmer locations. This pattern supports continental drift as part of plate tectonics.
38. B — Repeated recovery and diversification after mass extinctions show that life on Earth is resilient and adaptable over geologic time, with survivors evolving to fill vacated ecological roles. The fossil record documents this rebound after each major crisis.
39. A — The banded, layered texture of a metamorphic rock whose minerals have been flattened and aligned by directed pressure is foliation. The alignment of minerals into bands records the directional stress during metamorphism.
40. D — A possible rock-cycle pathway is: an igneous rock weathers into sediment, becomes sedimentary rock, is buried and metamorphosed, then melts into magma and forms a new igneous rock. This chain shows how rocks can pass through all three types over geologic time.
41. D — By cross-cutting relationships, the horizontal rock layers came first because they had to already exist before being cut by the fault, which itself had to exist before being cut by the later dike. A feature that cuts another must be younger than what it cuts.
42. A — Thick layers of rock salt indicate the area once held a body of saltwater that gradually evaporated, leaving the dissolved salt behind as solid rock salt. Such evaporite deposits record ancient evaporating seas or saline lakes.
43. C — A tall, steep-sided cone built from alternating layers of hardened lava and explosively erupted ash and cinders is a composite volcano. This layered structure reflects the volcano's varied eruption styles.
44. B — Erosion and deposition gradually tighten a meander loop until the river takes a more direct path, cutting off the loop and leaving behind an oxbow lake. The abandoned bend becomes a curved standing body of water.
45. D — Most groundwater is held in the small pore spaces between particles of soil and rock and in cracks within rock, with true underground rivers being relatively rare. Aquifers store water in these pore spaces, not in vast underground lakes.
46. A — On the Mohs scale, a mineral with a higher number can scratch all minerals with lower numbers, since hardness measures resistance to being scratched and harder materials scratch softer ones. This ordering is the practical basis of scratch testing.

47. C — A sudden downhill movement of soil, rock, and debris—often triggered by heavy rain saturating a slope—is a mass movement. Saturated soil is heavier and weaker, which makes the slope prone to sudden failure.
48. B — Metamorphic rocks forming where plate collisions bury rock deep enough for heat and pressure to transform it show that tectonic processes are part of the rock cycle. Plate tectonics provides the burial and stress that drive metamorphism.
49. D — Competing requirements should be handled by weighing the trade-offs among cost, strength, and weight against the project's criteria and constraints, choosing the design that best balances them. Systematic comparison is how engineering reaches a workable compromise.
50. A — A scientific claim about which water filter is best should rest on evidence from controlled tests comparing it with others under the same conditions. Reproducible, controlled comparisons are what make a claim scientifically credible.