Practice Exam 35: Earth and Space Sciences Regents Simulation (50 Questions)

1. What is the difference between Earth's rotation and Earth's revolution?

A. Rotation is Earth's yearly orbit around the Sun, while revolution is Earth's daily spin on its own axis

B. Rotation and revolution both describe Earth's once-a-year journey around the Sun along its elliptical orbit

C. Rotation is the slow wobble of Earth's axis over thousands of years, while revolution is its daily east-to-west spin

D. Rotation is Earth's daily spin on its axis, while revolution is Earth's yearly orbit around the Sun

2. Polaris, the North Star, appears to stay nearly fixed in the sky throughout the night while other stars circle around it. Why does Polaris appear almost motionless?

A. Polaris lies almost directly above Earth's North Pole, nearly in line with Earth's axis of rotation

B. Polaris is by far the brightest star in the entire sky, so its light overpowers the motion of all the others

C. Polaris is the closest star to Earth, so its great nearness prevents it from appearing to move at all

D. Polaris orbits the Earth once each day at exactly the same rate that the Earth spins beneath it

3. All four of the giant outer planets — Jupiter, Saturn, Uranus, and Neptune — share which characteristic that the inner rocky planets lack?

A. They each have a solid rocky surface on which a spacecraft could safely land and roll across the ground

B. They each orbit closer to the Sun than the inner planets do and complete their orbits more quickly

C. They are much larger and more massive, composed largely of gases, and surrounded by ring systems

D. They are each smaller and denser than every one of the inner terrestrial planets in the entire solar system

4. Why are the inner planets rocky while the outer planets are made largely of gas and ice?

A. The outer planets formed first and used up all of the available rock, leaving only gas for the inner planets

B. Near the young Sun it was too hot for ices to remain solid, so only rock and metal collected there, while ices survived farther out

C. The Sun's gravity pulled all of the heavy rock outward to the distant planets and left only light gas near the center

D. The inner and outer planets formed from two completely separate clouds of material that never once mixed together

5. An observer in the Northern Hemisphere notices that the illuminated portion of the Moon is growing larger each night and the right side is lit. What is the Moon doing?

A. It is waning, moving from full toward new, with the illuminated portion shrinking a little more each night

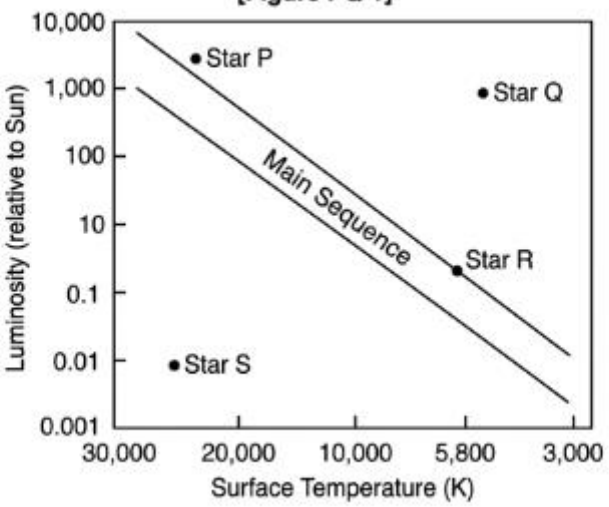
B. It is staying in the same phase, since the Moon's appearance does not change from one night to the next

C. It is undergoing a lunar eclipse, with Earth's shadow gradually covering more of the Moon each night

D. It is waxing, moving from new toward full, with the illuminated portion growing a little larger each night

6. On the Hertzsprung-Russell diagram below, four stars are plotted and labeled. Which labeled star is a main sequence star most similar to our Sun?

[Figure PQ-1]



A. Star P, located at the upper-left, which is far hotter and far more luminous than the Sun

B. Star Q, located at the upper-right, which is cool yet very luminous, indicating a giant star

C. Star R, located in the middle of the main sequence, with a temperature and luminosity close to the Sun's

D. Star S, located at the lower-left, which is hot but very dim, indicating a small white dwarf

7. When astronomers observe a galaxy that is one billion light-years away, they are seeing it as it appeared one billion years ago. Why is this true?

A. Light travels at a finite speed, so the light leaving that galaxy took one billion years to reach Earth

B. The galaxy physically existed only one billion years ago and has since disappeared completely from space

C. Telescopes can be set to look into the past, displaying galaxies exactly as they were at any chosen earlier time

D. Light from distant galaxies speeds up over time, arriving long before it was actually emitted by the galaxy

8. A solar eclipse occurs at new moon and a lunar eclipse at full moon, yet eclipses do not happen every month. Why not?

A. The Moon's orbit is so large that it takes several months for the Moon to return to the new or the full phase

B. The Moon's orbit is tilted relative to Earth's orbit, so the three bodies usually do not line up exactly

C. Eclipses can occur only during the summer months, when the Sun and the Moon are closest together in the sky

D. Earth's shadow is far too small to ever reach the Moon except during a few rare months of the year

9. Among the planets, which one travels around the Sun at the fastest orbital speed, and why?

A. Neptune, because being the most distant planet it must rush around its enormous orbit to keep pace with the others

B. Saturn, because its large ring system catches the solar wind and pushes the planet rapidly forward along its orbit

C. Mercury, the planet closest to the Sun, because the Sun's gravity is strongest there and pulls it around fastest

D. Earth, because it is the only planet whose orbital speed has ever actually been measured by scientists on the ground

10. The light from a certain star is shifted toward the blue end of the spectrum compared with its expected wavelengths. What does this blueshift indicate?

A. The star is moving toward Earth, which compresses its light waves to shorter, bluer wavelengths

B. The star is moving away from Earth, which stretches its light waves to longer, redder wavelengths

C. The star is extremely hot, which is the only possible reason a star's light could ever appear bluish in color

D. The star is completely stationary relative to Earth and is simply made of unusually blue-colored glowing gas

11. Astronauts aboard a spacecraft orbiting Earth appear to float weightlessly. What is the best explanation for this apparent weightlessness?

A. There is no gravity at all in space, so nothing aboard the orbiting spacecraft has any weight whatsoever

B. The spacecraft travels so fast that its great speed completely cancels out the entire force of Earth's gravity

C. The spacecraft is so far from Earth that the planet's gravity can no longer reach it or its crew at all

D. The spacecraft and the astronauts are continuously falling toward Earth together while moving forward, so they fall around it

12. A rock is dark, very fine-grained, and has small holes scattered throughout where gas bubbles were once trapped. It formed from lava that cooled quickly at the surface. What type of rock is this?

A. An extrusive igneous rock, formed when gas-rich lava cooled rapidly at Earth's surface, trapping bubbles as holes

B. A chemical sedimentary rock, formed when minerals dissolved in water slowly crystallized out over long periods

C. A foliated metamorphic rock, formed when an existing rock was squeezed and heated deep within Earth's crust

D. A clastic sedimentary rock, formed when fragments of older rock were compacted and cemented together over time

13. As deeply buried granite is slowly uplifted and the overlying rock is removed by erosion, the granite expands slightly and sheets of rock peel away from its surface. This type of physical weathering is called:

A. Frost wedging, in which water freezes inside cracks in the rock and expands, prying the separate pieces apart

B. Oxidation, in which iron-bearing minerals react with oxygen and water to form a soft reddish-brown surface crust

C. Exfoliation, in which the release of pressure allows the rock to expand and shed curved sheets from its surface

D. Abrasion, in which particles carried by wind or water repeatedly strike the rock and grind away at its surface

14. For a substance to be classified as a mineral, which set of conditions must it meet?

A. It must be naturally occurring, inorganic, solid, with a definite chemical composition and an orderly crystal structure

B. It must be a liquid at room temperature, formed by living organisms, and able to flow freely under any pressure

C. It must be made entirely of a single chemical element and must never form natural crystals of any kind at all

D. It must be a manufactured material produced in a laboratory and must have no consistent chemical composition

15. A river carries material in several ways. Tiny clay particles that remain mixed throughout the moving water without settling make up which part of the river's load?

A. The bed load, consisting of larger particles that roll, slide, and bounce along the bottom of the channel

B. The suspended load, consisting of fine particles held up within the moving water and carried along with it

C. The dissolved load, consisting of minerals that have completely dissolved and are invisible within the water

D. The traction load, consisting only of the very largest boulders that are pushed slowly along the river bed

16. Which natural feature serves as the recharge area for an aquifer, the place where surface water enters and refills the groundwater supply?

A. A layer of solid impermeable shale lying directly above the aquifer that seals it off completely from the surface

B. The deep, dense bedrock far below the aquifer, where water rises upward against gravity to refill the rock layers

C. A paved parking lot covering the land above the aquifer, which directs rainfall efficiently down into the rock below

D. A permeable surface area, such as exposed sand or fractured rock, where rain and surface water soak down into the aquifer

17. The Hawaiian Islands form a chain in which the islands grow progressively older toward the northwest, far from any plate boundary. What best explains the formation of this island chain?

A. A divergent plate boundary runs directly beneath the islands, creating new land at the southeastern end of the chain

B. The islands were pushed up one after another as two continental plates collided directly beneath the open ocean

C. A stationary hot spot in the mantle melts through the moving Pacific Plate, building new islands as the plate drifts over it

D. Each island was formed by a separate large meteorite impact that struck the ocean floor in a straight line over time

18. How does oceanic crust differ from continental crust?

A. Oceanic crust is thinner, denser, and made largely of basalt, while continental crust is thicker, less dense, and richer in granite

B. Oceanic crust is thicker and less dense than continental crust, which is why the oceans sit higher than the continents do

C. Oceanic crust and continental crust are completely identical in thickness, density, and composition everywhere on Earth

D. Oceanic crust is made of light granite, while continental crust is made of dense basalt that sinks down into the mantle

19. Along a winding river, where is sediment most likely to be deposited rather than eroded?

A. Along the steep outer bank of each bend, where the water moves fastest and carries the greatest amount of energy

B. Along the gentle inner bank of each bend, where the water slows down and drops the sediment it was carrying

C. Only in the deepest, fastest part of the channel at the very center of the river, regardless of any of the bends

D. Uniformly along both banks of the river at once, since rivers always erode and deposit equally at every single point

20. A mineral can scratch fluorite (hardness 4) but is itself scratched by orthoclase feldspar (hardness 6). What is the most reasonable estimate of this mineral's hardness on the Mohs scale?

A. A hardness of about 2, since it is clearly one of the very softest minerals found anywhere on the entire Mohs scale

B. A hardness of about 8, since it is clearly one of the very hardest minerals found anywhere on the entire Mohs scale

C. A hardness of about 5, since it is harder than fluorite at a hardness of 4 but softer than orthoclase at a hardness of 6

D. A hardness of about 10, which is equal to diamond, the single hardest known mineral on the entire Mohs scale

21. Magma that is rich in silica tends to be thick and sticky, trapping gases until they are released suddenly. What kind of volcanic eruption does this type of magma most often produce?

A. A gentle, quiet eruption in which runny lava flows slowly and steadily down the sides of the volcano for many years

B. No eruption at all, because silica-rich magma is far too thick to ever rise upward toward the surface of the volcano

C. An eruption that produces only gas and steam, with no lava, ash, or solid material ever reaching the surface at all

D. A violent, explosive eruption, because the trapped gases in the thick magma are released suddenly with great force

22. Which sequence correctly lists the major layers of Earth's interior in order from the surface to the center?

A. Mantle, crust, outer core, and inner core, beginning at the surface and moving downward toward the very center

B. Crust, mantle, outer core, and inner core, beginning at the surface and moving downward toward the very center

C. Crust, outer core, mantle, and inner core, beginning at the surface and moving downward toward the very center

D. Inner core, outer core, mantle, and crust, beginning at the surface and moving downward toward the very center

23. Of all the fresh water on Earth, the largest share is stored in which form?

A. Frozen in glaciers and polar ice caps, which hold the great majority of Earth's fresh water as solid ice

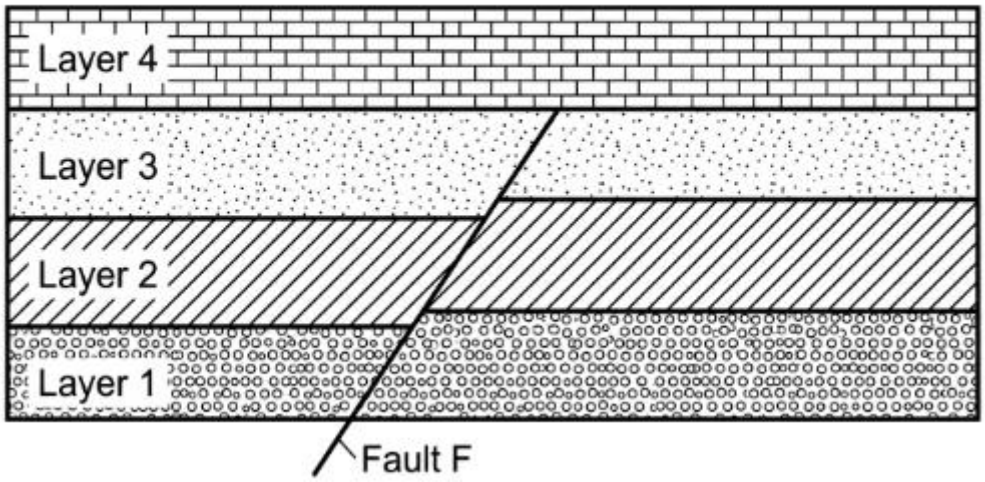
B. Flowing in the world's rivers and streams, which together hold most of the planet's available fresh water

C. Floating as water vapor in the atmosphere, which stores far more fresh water than any other reservoir on Earth

D. Held within the bodies of living plants and animals, which together contain the bulk of Earth's fresh water

24. The geologic cross-section below shows several rock layers and a fault. Which event happened most recently?

Figure PQ-2



A. The deposition of Layer 1, the bottom layer, which was the very last event to occur in this entire sequence

B. The movement along Fault F, which must have occurred after Layer 4 was deposited across the top of the section

C. The deposition of Layer 4, the top layer, since it lies unbroken across the fault and was therefore deposited after the faulting

D. The deposition of Layer 2, which occurred after all of the other layers were laid down and after the faulting event

25. Which type of organism is most likely to be preserved as a fossil?

A. A soft-bodied jellyfish living in the open ocean, which has no hard parts of any kind to leave behind in the rock

B. A clam with a hard calcium carbonate shell living on a shallow sea floor that is quickly buried by sediment

C. A small bird that dies high in a dry mountain forest, where its body is left exposed to the weather and scavengers

D. A worm living in loose dry sand on a windswept beach, where the shifting sand prevents any burial from lasting

26. A rock sample is found to contain equal amounts of a radioactive parent isotope and its stable daughter product. If the half-life of the parent is 700 million years, how old is the rock?

A. About 2,100 million years, because equal amounts of parent and daughter means that three half-lives have passed

B. About 1,400 million years, because equal amounts of parent and daughter means that two half-lives have passed

C. The age cannot be determined, because equal amounts of parent and daughter reveal nothing about the elapsed time

D. About 700 million years, because equal amounts of parent and daughter means that exactly one half-life has passed

27. The Precambrian represents what portion of Earth's total history, and what characterized most of it?

A. Roughly the first 88 percent of Earth's history, during which life consisted mainly of simple single-celled organisms

B. The most recent 10 percent of Earth's history, during which large mammals and flowering plants flourished widely

C. A brief interval of only a few million years near the very end of Earth's history, just before humans first appeared

D. Exactly the middle third of Earth's history, during which the dinosaurs rose up to dominate the land completely

28. A worldwide layer of the rare metal iridium is used by geologists as a time marker in rocks around the globe. Why can a single thin layer like this be used to match rocks on different continents to the same moment in time?

A. Iridium forms slowly and steadily everywhere on Earth, so the thickness of its layer records many millions of years of time

B. Iridium is radioactive and decays so quickly that the layer can directly reveal its own exact age within just a few minutes

C. The iridium was spread worldwide almost instantly by a single global event, so the layer marks the same moment everywhere

D. Iridium is found in only one single location on Earth, which makes it useful for precisely identifying that one place

29. Fossils have been found that show features intermediate between an older group of organisms and a younger group, such as a fish-like animal with limb-like fins. What do such fossils provide evidence of?

A. That the older and the younger groups of organisms were actually the very same single species the entire time

B. That major groups of organisms are connected by gradual change, with later groups descending from earlier ones over time

C. That fossils form completely at random and reveal nothing reliable about the history or the relationships of life

D. That the two groups of organisms appeared suddenly and separately, with no connection between them at all

30. According to the principle of lateral continuity, sedimentary layers originally extend outward in all directions until they thin out or reach the edge of the basin. How does this principle help geologists?

A. It allows geologists to conclude that rock layers now separated by a canyon were once connected as a single continuous layer

B. It proves that every sedimentary layer found anywhere on Earth is exactly the same age regardless of where it is located

C. It shows that sedimentary layers were originally deposited in steeply tilted positions rather than in horizontal ones

D. It allows geologists to read the exact age of any rock layer directly in years from how far that layer extends sideways

31. The largest mass extinction in Earth's history, in which an estimated 90 percent of marine species died out, occurred at the end of which era?

A. The end of the Cenozoic Era, an extinction that is still ongoing today and has not actually finished occurring yet

B. The end of the Mesozoic Era, the very same event that famously brought about the extinction of all the dinosaurs

C. The very end of the Precambrian, before any complex multicellular animals had yet evolved within the oceans at all

D. The end of the Paleozoic Era, in the great Permian extinction that wiped out most marine species of that time

32. Nuclear power plants generate large amounts of electricity. Which statement accurately describes a feature of nuclear energy?

A. Nuclear plants release large amounts of carbon dioxide during normal operation, making them a major source of greenhouse gas

B. Nuclear energy is a renewable resource, because the uranium fuel that it uses is continuously replaced by natural processes

C. Nuclear plants produce electricity with very low carbon dioxide emissions but generate radioactive waste that must be safely stored

D. Nuclear plants produce no waste of any kind and pose absolutely no risks at all, making them a completely flawless energy source

33. A city installs rooftop gardens and permeable pavement that allows rainwater to soak into the ground rather than rushing into storm drains. What is one environmental benefit of this "green infrastructure"?

A. It guarantees that the city will never again experience any rainfall, since the gardens absorb all of the incoming storms entirely

B. It reduces stormwater runoff and flooding while allowing more rainwater to recharge the local groundwater supply

C. It permanently raises the city's temperature, since the dark gardens and pavement absorb far more heat than before

D. It eliminates the need for the city to treat any of its wastewater, since the gardens completely purify all of it on their own

34. A fishing fleet catches a popular species faster than the fish can reproduce for many years in a row. What is the most likely long-term result for that fishery?

A. The fish population will grow steadily larger each year, because heavy fishing always stimulates faster reproduction in the fish

B. The fish population will remain perfectly stable forever, since fishing has no real effect on the overall size of the population

C. The fish will simply migrate to a brand-new ocean and then return fully restored once the fishing fleet has departed the area

D. The fish population will decline and may collapse, because the fish are being removed faster than they can be replaced

35. A toxic chemical released into a lake is absorbed by tiny organisms, which are eaten by small fish, which are then eaten by larger fish, so that the chemical becomes most concentrated in the largest predator fish at the top. This process is called:

A. Biomagnification, in which a toxic substance becomes increasingly concentrated at each higher level of a food chain

B. Photosynthesis, in which producers use sunlight to convert carbon dioxide and water into stored chemical energy

C. Eutrophication, in which excess nutrients trigger an overgrowth of algae that then depletes the oxygen from the water

D. Condensation, in which water vapor in the cooling air changes back into many tiny droplets of liquid water

36. Which energy source is both renewable and produces almost no greenhouse gas emissions while generating electricity?

A. Coal, which is burned in large quantities and is steadily replaced deep underground by ongoing natural processes

B. Natural gas, which burns more cleanly than coal does and is continuously replenished within just a few short years

C. Oil, a liquid fossil fuel that releases only water vapor and produces no carbon dioxide at all when it is burned

D. Wind, which is naturally replenished by the atmosphere and generates electricity without burning any fuel at all

37. The maximum number of individuals of a species that an environment can support over the long term, given its available resources, is called the environment's:

A. Biodiversity, a measure of the total variety of different species that are living within a particular ecosystem

B. Carrying capacity, the largest population of a species that the available resources of an environment can sustain

C. Food web, the network of feeding relationships that connect the many different organisms living within an ecosystem

D. Trophic level, the position that a particular organism occupies within the feeding levels of an ecosystem's food chain

38. In some irrigated farming regions, salts gradually build up in the soil until crops can no longer grow well. What practice most directly causes this buildup of salts in the soil?

A. Planting a wide variety of different crops together in the same field at the same time throughout the growing season

B. Allowing fields to lie completely bare and unplanted for several years in a row in between the growing seasons

C. Adding large amounts of organic compost and mulch to the surface of the soil before every single planting season

D. Repeatedly irrigating with water that evaporates and leaves its dissolved salts behind in the soil over time

39. Satellites that orbit Earth and collect images and data about the land, oceans, and atmosphere are valuable tools for environmental science mainly because they:

A. Can physically remove pollution from the oceans and the atmosphere as they pass overhead during each of their orbits

B. Replace the need for any ground-based measurements at all, since a satellite can directly sample the soil and water from orbit

C. Provide a broad, repeated, global view that lets scientists track large-scale changes such as deforestation and ice loss over time

D. Are able to prevent natural disasters such as hurricanes and earthquakes simply by carefully observing them from far above

40. Which of the following is the most sustainable way for a community to manage its organic food and yard waste?

A. Composting the organic waste so that it breaks down into nutrient-rich material that can then be returned to the soil

B. Sending all of the organic waste to a distant landfill, where it is sealed away permanently far beneath the ground

C. Burning all of the organic waste in open fires, which releases its stored nutrients harmlessly into the open air above

D. Dumping all of the organic waste directly into the nearest river so that the moving water carries it far away downstream

41. Relative humidity is best defined as:

A. The total mass of all the water vapor contained within a fixed large volume of the atmosphere at a given moment in time

B. The amount of water vapor present in the air compared with the maximum amount the air could hold at that temperature, expressed as a percentage

C. The temperature to which the air must be cooled before the water vapor within it first begins to condense into liquid

D. The total amount of rain, snow, and other precipitation that falls on a particular region over the course of a full year

42. On a clear, cloudless night, the temperature near the ground often drops much lower than it does on a cloudy night. Why do clouds keep nighttime temperatures warmer?

A. Clouds generate their own heat through chemical reactions, directly warming the air near the ground throughout the night

B. Clouds block the cold air from outer space from sinking down and chilling the surface during the dark nighttime hours

C. Clouds absorb heat radiated from the ground and radiate part of it back downward, slowing the loss of heat to space

D. Clouds reflect the warm light of the Moon back down onto the surface, which keeps the ground warm all through the night

43. Meteorologists use Doppler radar as an important tool in forecasting severe weather. What does Doppler radar primarily detect?

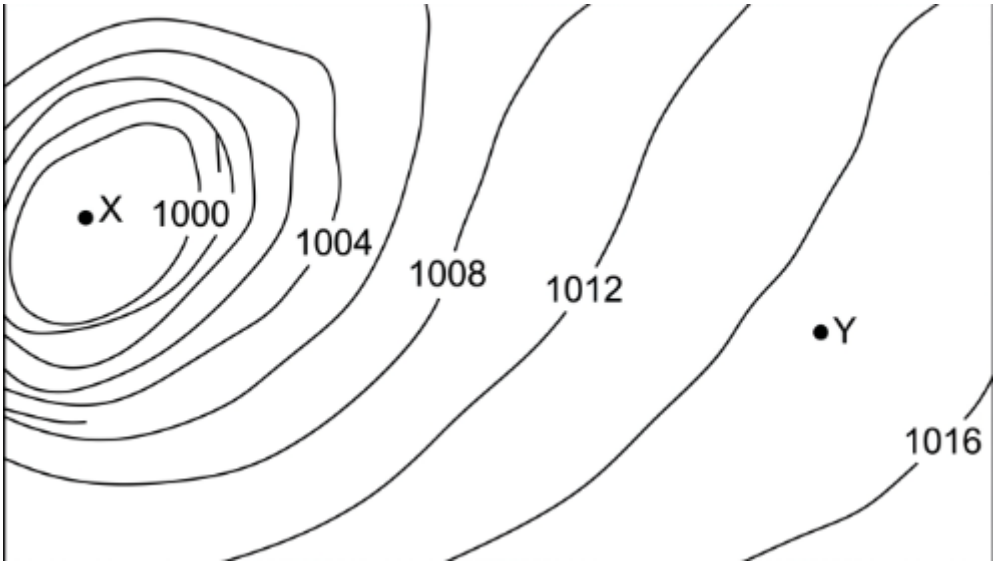
A. The exact surface temperature of the ground over a wide region by sensing the heat that it gives off into the air

B. The total amount of sunlight that is reaching the surface through the cloud cover at any given moment in time

C. The long-term average climate conditions of a region measured continuously over many decades of careful observation

D. The location, movement, and intensity of precipitation, including the rotation within storms that can produce tornadoes

44. The weather map below shows isobars labeled with pressure values and two locations, X and Y. At which location are the winds stronger, and why?



A. At Y, because the widely spaced isobars there show a very steep pressure gradient that produces strong winds

B. At X, because the closely spaced isobars there show a steep pressure gradient that produces stronger winds

C. The winds are exactly equal at both X and Y, since the spacing of the isobars has no relationship to wind speed at all

D. At Y, because winds are always strongest wherever the single highest air pressure value is printed on the map

45. Near the equator lies a belt of generally weak, calm winds where warm air rises, producing frequent thunderstorms. What is this low-latitude zone called?

A. The doldrums, a belt of low pressure and rising air near the equator known for calm winds and frequent storms

B. The horse latitudes, a belt of strong steady winds near the poles known for clear skies and very dry conditions

C. The jet stream, a narrow river of fast-moving air found high in the atmosphere at the middle latitudes only

D. The polar front, the boundary at high latitudes where cold polar air meets the warmer air of the middle latitudes

46. Many of the world's great deserts, such as the Sahara, are located near 30 degrees latitude. What atmospheric condition near this latitude helps create these dry desert belts?

A. Constant rising moist air that releases heavy rainfall, leaving the surrounding land parched and dry by comparison

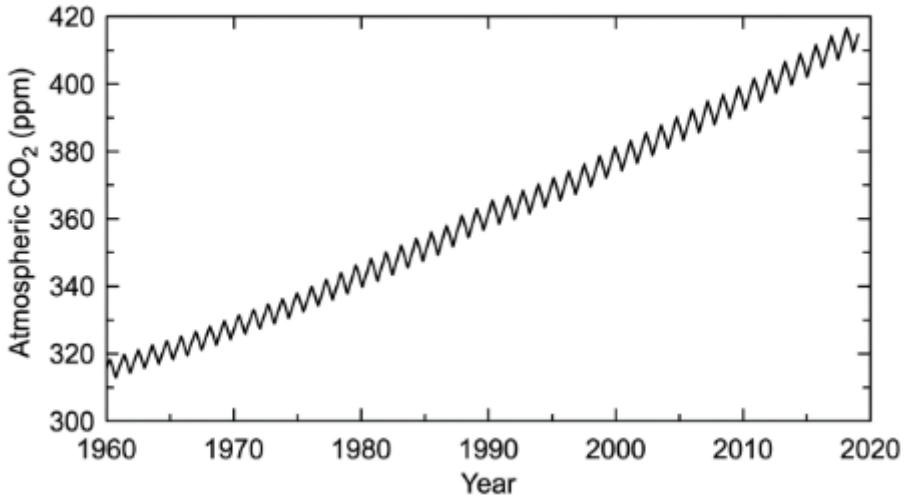
B. Powerful jet stream winds at the surface that blow all of the rain clouds away from these latitudes all year round

C. Sinking dry air associated with the subtropical high-pressure belts, which suppresses cloud formation and rainfall

D. Cold ocean currents that completely surround every single desert and freeze all of the moisture out of the passing air

47. The graph below shows measured atmospheric carbon dioxide concentration from 1960 to 2020. Which statement best describes the trend shown?

Figure PQ-4



A. Atmospheric carbon dioxide has decreased steadily and substantially over the entire period shown on the graph

B. Atmospheric carbon dioxide has increased steadily over the period, rising from about 315 ppm to about 415 ppm

C. Atmospheric carbon dioxide has remained completely constant, showing no overall change at all across the six decades

D. Atmospheric carbon dioxide rose sharply until 1990 and has fallen steadily back to its 1960 level ever since then

48. Most of the water vapor that enters Earth's atmosphere comes from which source?

A. The freezing of liquid water into solid ice at the surface of the polar regions during the long, cold winters

B. The breakdown of rocks by chemical weathering, which slowly releases the water molecules locked inside minerals

C. The respiration of land animals, which exhale large quantities of water vapor with each and every single breath

D. The evaporation of water from the surface of the oceans, which cover most of the planet and supply most of its water vapor

49. Which sequence best represents the general order of steps in the engineering design process?

A. Build the final product, identify the problem, then test the product, and only afterward define the criteria it must meet

B. Test the solution, define the problem, then build a prototype, and finally decide whether a problem exists at all

C. Define the problem, brainstorm and design solutions, build and test a prototype, then evaluate and improve the design

D. Evaluate the design, mass-produce it immediately, then define the problem, and finally brainstorm possible solutions

50. What is the main difference between the goals of science and the goals of engineering?

A. Science aims to build useful products and structures, while engineering aims only to ask questions about the natural world

B. Science aims to understand and explain the natural world, while engineering aims to design solutions to practical problems

C. Science and engineering have exactly the same goal, since both of them simply involve performing controlled experiments

D. Science aims to make money from new inventions, while engineering aims to publish papers about the natural world

ANSWERS KEY WITH EXPLANATIONS

1. D — Rotation is Earth's daily spin on its own axis, which produces day and night, while revolution is Earth's yearly orbit around the Sun, which produces the year. Keeping these two motions distinct is fundamental to understanding both the day-night cycle and the seasons.
2. A — Polaris appears nearly motionless because it sits almost directly above Earth's North Pole, close to the line of Earth's rotational axis, so the sky seems to turn around it. Its position, not its brightness or nearness, is what makes it the steady reference point of the northern sky.
3. C — The four giant outer planets are much larger and more massive than the inner planets, are composed largely of gases, and are encircled by ring systems. These shared gas-giant traits set them apart from the small, dense, rocky terrestrial planets.
4. B — Near the young Sun, temperatures were too high for ices to remain solid, so only rock and metal collected to form the inner planets, while ices survived in the colder outer regions to build the gas giants. This temperature gradient explains the rocky-inner, gas-outer pattern.
5. D — A Moon whose lit portion grows larger each night, with the right side illuminated, is waxing, moving from new toward full. The increasing illumination is the defining feature of the waxing phases in the Northern Hemisphere.
6. C — Star R lies in the middle of the main sequence at roughly the Sun's temperature and luminosity, making it the star most like our Sun. The Sun is an average main sequence star, so the central main-sequence position is the match.
7. A — Because light travels at a finite speed, light from a galaxy one billion light-years away took one billion years to reach Earth, so we see it as it was then. This light-travel time means looking far into space is the same as looking back in time.
8. B — Eclipses do not occur every month because the Moon's orbit is tilted relative to Earth's orbit, so the Sun, Earth, and Moon usually fail to line up exactly at new and full phases. Only when the bodies align at the orbital crossing points can an eclipse happen.
9. C — Mercury, the planet closest to the Sun, moves fastest in its orbit because the Sun's gravity is strongest there, requiring greater speed to maintain the orbit. Orbital speed increases with closeness to the Sun, which is why the innermost planet is the quickest.
10. A — A blueshift means a star's light waves are compressed to shorter wavelengths, which by the Doppler effect indicates the star is moving toward Earth. Motion toward an observer shortens the observed wavelengths, producing the shift toward blue.
11. D — Astronauts float because they and their spacecraft are continuously falling toward Earth while also moving forward fast enough to keep missing it, a state of free fall called orbit. Gravity is still strong at orbital altitude; the apparent weightlessness comes from falling together, not from gravity's absence.

12. A — A dark, fine-grained rock with gas-bubble holes that cooled quickly at the surface is an extrusive igneous rock, formed as gas-rich lava solidified rapidly. The small crystals and trapped vesicles are signatures of fast surface cooling.
13. C — Exfoliation is physical weathering in which the release of pressure as overlying rock is removed lets buried granite expand and shed curved sheets. Recognizing this pressure-release process explains the rounded, peeling outcrops seen on exposed granite.
14. A — A mineral must be naturally occurring, inorganic, solid, with a definite chemical composition and an orderly crystal structure. All five conditions together define a mineral and distinguish it from manmade or organic materials.
15. B — Fine clay particles held up within the moving water and carried without settling make up the suspended load. This is distinct from the bed load rolling along the bottom and the dissolved load carried in solution.
16. D — An aquifer is recharged through a permeable surface area, such as exposed sand or fractured rock, where rain and surface water can soak downward into it. Protecting these permeable recharge zones is essential to keeping groundwater supplies replenished.
17. C — The age progression of the Hawaiian Islands away from any boundary is explained by a stationary mantle hot spot that melts through the moving Pacific Plate, building new islands as the plate drifts over it. The chain records the plate's motion across a fixed heat source.
18. A — Oceanic crust is thinner, denser, and made largely of basalt, while continental crust is thicker, less dense, and richer in granite. These differences in density and composition explain why oceanic crust subducts beneath continental crust at convergent boundaries.
19. B — Sediment is deposited along the gentle inner bank of a river bend, where the water slows and drops its load, while the faster outer bank is eroded. This pattern of inner-bank deposition and outer-bank erosion is what causes meanders to shift over time.
20. C — A mineral that scratches fluorite (4) but is scratched by orthoclase (6) must fall between them, giving a hardness of about 5 on the Mohs scale. Using known reference minerals to bracket an unknown is the standard way to estimate hardness.
21. D — Silica-rich magma is thick and traps gases until they are released suddenly, producing violent, explosive eruptions. The high viscosity prevents gases from escaping gently, so pressure builds until it is released with great force.
22. B — From the surface inward, Earth's layers are crust, mantle, outer core, and inner core. Knowing this order is the basis for interpreting how seismic waves and heat move through the planet's interior.
23. A — The largest share of Earth's fresh water is frozen in glaciers and polar ice caps, which hold far more than rivers, the atmosphere, or living things. This means most fresh water is locked away as ice rather than readily available as liquid.
24. C — Layer 4 is the most recent event because it lies unbroken across the fault, meaning it was deposited after the faulting that offset the layers below. A layer that covers a fault without being broken must be younger than that fault.
25. B — A clam with a hard calcium carbonate shell that is quickly buried by sediment is most likely to be preserved, because hard parts and rapid burial protect remains from decay and scavengers. Hard parts plus quick burial are the key conditions for fossilization.
26. D — Equal amounts of parent and daughter mean half the parent has decayed, which corresponds to exactly one half-life, or 700 million years. The first half-life is reached when the parent has dropped to half its original amount.

27. A — The Precambrian spans roughly the first 88 percent of Earth's history, a vast interval during which life was mainly simple single-celled organisms. This shows how brief the time of complex, multicellular life has been by comparison.
28. C — A worldwide iridium layer works as a time marker because it was spread globally almost instantly by a single event, so it represents the same moment everywhere it is found. A rapidly deposited global layer is ideal for correlating rocks across continents.
29. B — Fossils with features intermediate between older and younger groups provide evidence that major groups are connected by gradual change, with later organisms descending from earlier ones. Such transitional forms document the continuity of evolutionary descent.
30. A — Lateral continuity lets geologists conclude that rock layers now separated by a canyon were once a single continuous layer before erosion cut through them. This principle allows matching of layers across gaps eroded into the landscape.
31. D — The greatest mass extinction, killing about 90 percent of marine species, occurred at the end of the Paleozoic Era in the Permian extinction. Recognizing this as the largest such event distinguishes it from the later dinosaur extinction that closed the Mesozoic.
32. C — Nuclear plants generate electricity with very low carbon dioxide emissions but produce radioactive waste that must be carefully stored for long periods. This trade-off of low emissions against the waste-management challenge is the defining feature of nuclear power.
33. B — Green infrastructure such as rooftop gardens and permeable pavement reduces stormwater runoff and flooding while letting more rainwater soak in to recharge groundwater. By mimicking natural infiltration, it manages stormwater more sustainably than hard drainage alone.
34. D — Catching fish faster than they can reproduce for years leads the population to decline and possibly collapse, because removals outpace replacement. This overfishing dynamic is why harvest must stay within a population's reproductive capacity.
35. A — The increasing concentration of a toxin at each higher level of a food chain is biomagnification, which leaves top predators with the highest doses. This process explains why large predators are most at risk from persistent pollutants.
36. D — Wind is both renewable, since the atmosphere continuously replenishes it, and nearly emission-free, since it generates electricity without burning fuel. These two qualities together set it apart from the fossil fuels listed.
37. B — Carrying capacity is the largest population of a species that an environment's resources can sustain over the long term. This concept explains why populations cannot grow without limit when resources are finite.
38. D — Repeated irrigation with water that evaporates and leaves dissolved salts behind causes salinization, the gradual buildup of salts that harms crops. Understanding this process guides irrigation practices that avoid degrading the soil.
39. C — Satellites are valuable because they provide a broad, repeated, global view that lets scientists track large-scale changes such as deforestation and ice loss over time. This wide, consistent monitoring is something ground measurements alone cannot match.
40. A — Composting organic food and yard waste is most sustainable because it breaks the material down into nutrient-rich matter that can be returned to enrich the soil. Composting recycles nutrients naturally instead of burying or burning them.
41. B — Relative humidity is the amount of water vapor in the air compared with the maximum the air could hold at that temperature, expressed as a percentage. This ratio, rather than a total mass or a temperature, is what the term specifically describes.

42. C — Clouds keep nights warmer because they absorb heat radiated from the ground and re-radiate part of it back downward, slowing the surface's heat loss to space. On clear nights this blanket is absent, so the ground cools more sharply.
43. D — Doppler radar primarily detects the location, movement, and intensity of precipitation, including rotation within storms that can spawn tornadoes. This ability to sense storm motion makes it a key tool for severe-weather warnings.
44. B — Winds are stronger at X because the closely spaced isobars there indicate a steep pressure gradient, which drives faster air movement. Tightly packed isobars always signal stronger winds than widely spaced ones.
45. A — The calm, rising-air, storm-prone belt near the equator is the doldrums, a zone of low pressure where converging trade winds force air upward. This rising moist air produces the frequent thunderstorms characteristic of the equatorial belt.
46. C — Deserts cluster near 30 degrees latitude because of sinking dry air in the subtropical high-pressure belts, which suppresses cloud formation and rainfall. This descending air, part of the global circulation, creates the persistent dryness of these regions.
47. B — The graph shows atmospheric carbon dioxide rising steadily from about 315 ppm in 1960 to about 415 ppm in 2020, with small seasonal zigzags on an overall upward trend. This clear long-term increase is central evidence of human influence on the atmosphere.
48. D — Most atmospheric water vapor comes from the evaporation of ocean water, since oceans cover most of the planet and supply the bulk of the moisture. This makes the oceans the primary source feeding the water cycle and weather.
49. C — The engineering design process generally proceeds by defining the problem, brainstorming and designing solutions, building and testing a prototype, then evaluating and improving the design. This ordered, iterative cycle is how engineers develop and refine workable solutions.
50. B — Science aims to understand and explain the natural world, while engineering aims to design solutions to practical problems. Distinguishing the pursuit of knowledge from the creation of solutions clarifies the complementary roles of the two fields.