

PRACTICE EXAM 45: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. One Earth year is defined as the time it takes for the Earth to complete one full trip around the Sun. What motion of the Earth determines the length of one year?

A. Earth's revolution, the complete orbit it makes around the Sun, which takes about 365 days and defines the length of one year

B. Earth's rotation, the single spin it makes on its own axis, which takes about 24 hours and determines the length of one full year

C. The Moon's orbit around the Earth, which takes about 27 days and is the actual motion that defines the length of one Earth year

D. The Sun's spin on its own axis, which takes about 25 days and is the motion that sets the length of one year here on the Earth

2. The highest high tides and lowest low tides, called spring tides, occur when the Sun, Earth, and Moon are aligned in a straight line. Why does this alignment produce especially large tides?

A. The alignment causes the Moon to physically touch the ocean surface, which is what pulls the water up into the unusually high spring tides

B. The alignment blocks the Sun's heat from the ocean, which cools the water until it contracts and produces the extreme spring tides

C. When the Sun and Moon are lined up, their gravitational pulls combine and add together, producing the especially large spring tides

D. The alignment stops the Earth from rotating for a short time, and this pause in the rotation is what causes the unusually large tides

3. Astronomers distinguish between a star's apparent brightness, how bright it looks from Earth, and its absolute brightness, how much light it truly gives off. Why can two stars that give off the same amount of light appear to have very different brightness in our sky?

A. The two stars must be made of completely different materials, which is the only thing that can ever make their apparent brightness differ

B. One of the two stars has stopped producing light altogether, even though both are described as giving off the same amount of light

C. Apparent and absolute brightness are exactly the same quantity, so two stars giving off the same light can never look different in brightness

D. The two stars are at different distances from Earth, and a star that is farther away appears dimmer even if it gives off the same light

4. The Moon travels around the Earth in a nearly circular orbit rather than flying off into space. What force keeps the Moon in orbit around the Earth?

A. The push of sunlight striking the Moon, which constantly shoves it toward the Earth and holds it in its orbit around our planet

B. The gravitational pull between the Earth and the Moon, which continually bends the Moon's motion into a curved orbit around the Earth

C. The magnetic attraction between the iron in the Moon and the iron in the Earth, which is the force that holds the Moon in its orbit

D. The pressure of the Earth's atmosphere reaching out into space, which presses against the Moon and keeps it from drifting away

5. After the Sun and planets formed from a collapsing cloud of gas and dust, some material was left over and never became part of a planet. Which of the following is made of this leftover material from the formation of the solar system?

A. The Sun itself, which is composed entirely of the small leftover scraps of material that failed to be gathered up into any of the planets

B. The Earth's Moon, which formed from leftover debris that was never part of the original cloud of gas and dust at all

C. Asteroids and comets, which are leftover rocky and icy bodies that never came together to form a planet during the system's formation

D. The continents on Earth, which drifted in from outside the solar system long after the Sun and the planets had already finished forming

6. During a full moon, the entire face of the Moon that we see appears brightly lit. Where is the Moon located relative to the Earth and Sun during a full moon?

A. The Moon is located directly between the Earth and the Sun, so the side facing us is in shadow and appears completely dark to observers

B. The Moon is located off to one side at a right angle to the Earth-Sun line, so we see exactly half of its lit face from our position

C. The Moon is located inside the Earth's shadow, which is what causes its entire near side to appear so brightly lit during a full moon

D. The Moon is located on the opposite side of the Earth from the Sun, so the Sun fully lights the side of the Moon that faces the Earth

7. Students sometimes assume a light-year is a measure of time because it contains the word "year." What does a light-year actually measure?

A. A light-year measures distance, specifically the distance that light travels in one year, which is about 9.5 trillion kilometers

B. A light-year measures time, specifically the amount of time it takes a beam of light to travel all the way around the entire Earth

C. A light-year measures the brightness of a star, with brighter stars having a larger number of light-years than dimmer stars do

D. A light-year measures the age of a star, telling astronomers exactly how many years have passed since that star first began to shine

8. Mars has a very thin atmosphere made mostly of carbon dioxide, far less dense than Earth's atmosphere. What is one consequence of Mars having such a thin atmosphere?

- A. The thin atmosphere traps so much heat that Mars is the hottest planet in the entire solar system despite its distance from the Sun
- B. The thin atmosphere provides plenty of oxygen, making it easy for astronauts to breathe on the surface of Mars without any equipment
- C. The thin atmosphere provides little insulation, so Mars has very large temperature swings and cannot hold much heat at its surface
- D. The thin atmosphere completely blocks all sunlight from reaching the surface, leaving Mars in total darkness at every hour of the day

9. On a very dark night, the Milky Way appears as a hazy band of light stretching across the sky. Why does our own galaxy appear to us as a band of light rather than a spiral shape?

- A. The Milky Way is actually shaped like a perfect sphere, which is why it appears as a simple round band of light when viewed from Earth
- B. We are located inside the flat disk of the Milky Way, so we see its many stars edge-on as a band stretching across our sky
- C. The band of light is not the Milky Way at all, but rather the combined glow of the planets of our own solar system seen from Earth
- D. The Milky Way spins so quickly that its spiral arms blur together into a single smooth band of light when seen from the Earth's surface

10. The Sun and the other stars in the night sky are fundamentally the same type of object. What is the Sun?

- A. A large planet, similar to Jupiter but much bigger, which produces its light by reflecting the light of even larger stars far beyond it
- B. A giant ball of burning wood and coal, much like an enormous campfire, that slowly consumes its solid fuel and gives off light and heat
- C. A cloud of glowing gas with no real structure, which is steadily fading away and will completely vanish within just a few more years
- D. A star, an enormous ball of hot gas that produces its own light and heat through nuclear fusion taking place deep within its core

11. When it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere at the same time. Why do the two hemispheres experience opposite seasons?

- A. Earth's axis is tilted, so when the Northern Hemisphere is tilted toward the Sun the Southern Hemisphere is tilted away, and vice versa
- B. The Northern and Southern Hemispheres are at completely different distances from the Sun, which is why their seasons are always opposite
- C. The Sun shines only on one hemisphere at a time and never on the other, which is the reason the two hemispheres have opposite seasons
- D. The two hemispheres rotate in opposite directions, and this difference in their spin is what causes them to have opposite seasons

12. An igneous rock is buried deep underground, where it is exposed to intense heat and pressure but does not melt. According to the rock cycle, what can happen to this igneous rock?

- A. Nothing can ever happen to it, since an igneous rock is permanently locked in its form and can never change into any other rock type
- B. It must immediately melt into magma, since any igneous rock that is buried underground always melts completely no matter the conditions
- C. It can become a metamorphic rock, since intense heat and pressure can change an existing rock into metamorphic rock without melting it
- D. It can only turn back into the exact same igneous rock it already was, since igneous rocks are unable to change into any other type

13. Scientists discovered that certain earthquake waves, called S-waves, do not pass through one of Earth's interior layers, while other waves do. This behavior of the S-waves provided evidence that one of Earth's layers is:

- A. Completely solid all the way through, since S-waves are only able to pass through layers of the Earth that are entirely liquid
- B. Liquid, since S-waves cannot travel through liquids, and their failure to pass through this layer revealed that the outer core is liquid

C. Made of pure gas, since S-waves pass easily through solids and liquids but are completely stopped by any layer made entirely of gas

D. Hollow and empty, since the only thing that could ever stop an S-wave from passing through a layer is a completely empty void inside it

14. When a large boulder is broken into many small pieces, the small pieces weather and break down chemically much faster than the original solid boulder did. Why does breaking rock into smaller pieces speed up chemical weathering?

A. Smaller pieces are made of softer minerals than the original boulder, which is the reason the small pieces weather so much faster

B. Smaller pieces are always located in warmer, wetter climates than large boulders, which is what causes them to weather more rapidly

C. Breaking a rock changes it into a completely different chemical substance, and this new substance simply weathers faster than the old one

D. Breaking the rock exposes much more total surface area to air and water, and chemical weathering acts on exposed surfaces

15. Many minerals form when a hot, mineral-rich liquid such as magma slowly cools, or when water carrying dissolved minerals evaporates. What is the general process by which atoms arrange into an orderly solid mineral called?

A. Erosion, the process by which loosened rock and mineral particles are picked up and carried away to a new location by wind, water, or ice

B. Compaction, the process by which the weight of overlying layers squeezes loose sediment particles tightly together into solid rock

C. Crystallization, the process by which atoms arrange themselves into an orderly, repeating solid structure to form a mineral crystal

D. Evaporation, the process by which liquid water at the surface changes into invisible water vapor and rises upward into the atmosphere

16. The deepest places in the ocean are long, narrow trenches where one tectonic plate bends and dives down beneath another plate. At which type of plate boundary do these deep ocean trenches form?

- A. A convergent boundary, where two plates collide and one is forced down beneath the other, forming a deep trench at the surface above
- B. A divergent boundary, where two plates pull apart from each other and new crust rises up to fill the widening gap between them
- C. A transform boundary, where two plates slide horizontally past each other without either one moving up or down relative to the other
- D. A hot spot, a location far from any plate boundary where a rising plume of hot mantle material melts through the plate above it

17. When a sediment-filled flow of water slows down and stops, the particles settle out in a graded pattern, with the largest at the bottom and the smallest at the top. Why do the largest, heaviest particles settle to the bottom first?

- A. The largest particles are actually the lightest, so they sink fastest, while the smallest particles are the heaviest and settle out last
- B. All of the particles settle at exactly the same rate regardless of size, so the graded pattern from large to small forms purely by chance
- C. The smallest particles always sink first because their tiny size lets them slip downward through the water faster than the large ones do
- D. The largest, heaviest particles sink faster through the water than the smaller, lighter ones, so they reach the bottom first

18. Despite supporting lush rainforest plant growth, the soils of many tropical rainforests are surprisingly low in nutrients. Why are these rainforest soils often nutrient-poor?

- A. Tropical rainforests receive no rainfall at all, so without water the soil is never able to develop any nutrients in the first place
- B. Heavy rainfall washes nutrients out of the soil, and most nutrients are quickly taken up by the dense plants rather than stored in the ground
- C. Tropical soils are made entirely of solid bedrock with no loose material, so there is simply no soil present to hold any nutrients at all
- D. The constant cold temperatures of the rainforest freeze the soil solid year-round, which permanently locks away all of its nutrients

19. Slate is a metamorphic rock that forms from the sedimentary rock shale, and marble forms from limestone. What does this relationship show about metamorphic rocks?

- A. Metamorphic rocks form only from igneous rocks such as granite and can never form from any sedimentary rock under any conditions
- B. Metamorphic rocks form directly from magma as it cools, which is why each one has a parent rock that was once completely molten
- C. Metamorphic rocks form from pre-existing rocks that are changed by heat and pressure, so each metamorphic rock has a parent rock
- D. Metamorphic rocks form only when loose sediment is compacted, so slate and marble are simply ordinary sedimentary rocks given new names

20. In dry desert regions with little plant cover, wind is an especially important agent of erosion. Why is wind a more effective agent of erosion in deserts than in well-vegetated regions?

- A. With little plant cover to hold the soil in place, loose, dry sediment is easily picked up and carried away by the wind in deserts
- B. Desert winds are the only winds on Earth strong enough to move any sediment at all, while winds elsewhere are always far too weak
- C. The plants in a vegetated region actually speed up wind erosion, so removing them, as in a desert, slows the erosion down considerably
- D. Wind can only erode land that is completely covered in thick vegetation, so deserts with bare ground experience almost no wind erosion

21. In regions underlain by limestone, groundwater dissolves the rock to form underground caverns. When the roof of such a cavern collapses, a bowl-shaped depression suddenly appears at the surface. What is this surface depression called?

- A. A delta, the fan-shaped deposit of sediment that builds up where a river slows down and drops its load as it enters a lake or the sea
- B. A moraine, the long ridge of mixed rock and soil that is bulldozed up and left behind at the edge of a slowly moving sheet of glacial ice

C. A meander, one of the looping bends that a slow-moving river develops as it winds back and forth across a wide, flat floodplain over time

D. A sinkhole, the bowl-shaped surface depression that forms when the roof of an underground cavern collapses into the empty space below

22. Most of the water vapor that enters Earth's atmosphere comes from one major source. From where does the largest amount of water evaporate into the atmosphere?

A. From the small ponds and puddles on land, which together provide nearly all of the water vapor that ever enters Earth's atmosphere

B. From the oceans, which cover most of Earth's surface and supply by far the largest amount of water vapor through evaporation

C. From the breath of animals and people, which is the single largest source of all the water vapor found in the Earth's atmosphere

D. From volcanoes, which release nearly all of the planet's atmospheric water vapor directly from deep inside the Earth's hot interior

23. On a cool morning, a thick, low-lying cloud forms right at ground level, reducing visibility for drivers. What is this ground-level cloud called?

A. A cirrus cloud, a high, thin, wispy cloud made of ice crystals that forms at very high altitudes far above the surface of the ground

B. A cumulonimbus cloud, the tall, towering storm cloud that produces thunderstorms, heavy rain, lightning, and sometimes even hail

C. Fog, a cloud that forms at or very near ground level when the air near the surface cools enough for its water vapor to condense

D. A contrail, the thin line of cloud that forms high in the sky behind a passing jet aircraft as the water vapor in its exhaust condenses

24. Air near the surface of the Earth tends to flow from areas of higher pressure toward areas of lower pressure. What is this horizontal movement of air from high to low pressure called?

- A. Precipitation, the falling of water from clouds to the surface of the Earth in the form of rain, snow, sleet, or hail under gravity
- B. Wind, the horizontal movement of air across the surface, which flows from regions of higher pressure toward regions of lower pressure
- C. Condensation, the process by which water vapor in the cooling air changes back into the tiny droplets of liquid water that form clouds
- D. Convection, the vertical transfer of heat that occurs as warm air rises upward and cooler, denser air sinks downward to replace it

25. Regions near the equator stay warm all year and experience little change between seasons, unlike regions at higher latitudes. Why do equatorial regions have such small seasonal temperature changes?

- A. Near the equator the Sun stays high in the sky and sunlight remains fairly direct all year, so the amount of heating changes little by season
- B. The equator is tilted far more sharply on its axis than the rest of the planet, which is what eliminates the seasons in that one region
- C. The equator receives no sunlight at all during any season, so its temperature simply stays the same cold value throughout the entire year
- D. The equator is much farther from the Sun than the poles are, and this great distance is what keeps its seasons from ever changing at all

26. Both tornadoes and hurricanes are rotating storms, but they differ greatly in size and duration. Which statement correctly describes a key difference between a tornado and a hurricane?

- A. A tornado is far larger than a hurricane and can last for several weeks, while a hurricane is tiny and lasts for only a few minutes at most
- B. A tornado is small and short-lived, lasting minutes over a narrow path, while a hurricane is huge and can last for days over a wide area
- C. A tornado forms only over warm tropical oceans, while a hurricane forms only over dry land far from any large body of ocean water
- D. There is no real difference between a tornado and a hurricane, since the two words describe exactly the same kind of storm in every way

27. In general, average yearly temperatures are highest near the equator and decrease steadily as one travels toward the poles. What is the main reason temperature decreases with increasing latitude?

- A. Locations near the poles are much closer to the Sun than locations near the equator, which makes the polar regions the coldest on Earth
- B. The Sun shines only on the equator and is completely blocked from reaching any location at higher latitudes near the two poles
- C. Higher latitudes spin faster as the Earth rotates, and this faster spinning is what cools them down compared with the slower equator
- D. At higher latitudes sunlight strikes the surface at a lower, more slanted angle, spreading the same energy over a larger area and heating it less

28. A meteorologist needs to determine how much water vapor is present in the air. Which instrument is specifically designed to measure the humidity of the air?

- A. A barometer, the instrument used to measure the pressure of the atmosphere, whose rising or falling readings often signal weather changes
- B. An anemometer, the instrument used to measure the speed of the wind as it spins the small cups that are mounted on top of the device
- C. A hygrometer, the instrument used to measure the amount of water vapor, or humidity, that is present in the surrounding air
- D. A rain gauge, the instrument used to measure the amount of rainfall by collecting it in an open container and reading the depth of the water

29. During the day, the land along a coast heats up much faster than the nearby ocean water. Why does land heat up more quickly than water when both receive the same sunlight?

- A. Water must absorb much more energy than land to raise its temperature, so under the same sunlight the land heats up faster than the water
- B. Land reflects nearly all of the sunlight that strikes it, while water absorbs none, which is why the land warms so much faster than the water
- C. The ocean generates its own heat from within, so it is always far hotter than the land and never needs the Sun to warm it up at all

D. Land and water heat up at exactly the same rate, so any apparent difference in how fast they warm up is simply an optical illusion

30. On a weather map, a front is drawn as a boundary line between two different air masses. What exactly is a weather front?

A. A front is a single isolated cloud that drifts across the sky on its own and is completely unrelated to any movement of large air masses

B. A front is the exact center of a high-pressure system, where the air is sinking and the weather is calm, clear, fair, and unchanging

C. A front is the boundary between two air masses with different temperatures and moisture, and weather often changes as a front passes

D. A front is a permanent line painted on the ground by meteorologists to mark where they expect rain to fall during the coming season

31. Measurements show that the concentration of carbon dioxide in Earth's atmosphere has risen sharply since the Industrial Revolution. How is this rise in carbon dioxide connected to global climate change?

A. Rising carbon dioxide cools the planet by reflecting sunlight back into space, which is causing global average temperatures to fall over time

B. As a greenhouse gas, carbon dioxide traps heat in the atmosphere, so its buildup enhances the greenhouse effect and warms the planet

C. Carbon dioxide has no connection to climate at all, so its rise since the Industrial Revolution has had no effect on global temperatures

D. Rising carbon dioxide blocks all sunlight from reaching the surface, plunging the entire planet into a permanent and worsening deep freeze

32. Energy resources are often divided into renewable and nonrenewable types. What is the key difference between a renewable and a nonrenewable energy resource?

A. A renewable resource is naturally replenished within a human lifetime, while a nonrenewable resource exists in a limited supply that is used up far faster than it forms

B. A renewable resource exists in a fixed, limited amount that runs out quickly, while a nonrenewable resource is replaced naturally as fast as it is used

C. A renewable resource releases far more pollution than a nonrenewable one, which is the only real difference between the two types of resource

D. There is no real difference between renewable and nonrenewable resources, since every energy source on Earth is replaced at exactly the same rate

33. A factory draws in cool river water to cool its machinery and then returns the now-heated water to the river, raising the river's temperature. This type of pollution, in which heated water harms aquatic life, is known as:

A. Acid pollution, in which acidic chemicals lower the pH of a river and harm the fish and other organisms that are living in the water

B. Sediment pollution, in which large amounts of soil and mud wash into a river and cloud the water, blocking the sunlight aquatic plants need

C. Thermal pollution, in which heated water released into a river raises its temperature and harms the aquatic organisms living in the river

D. Plastic pollution, in which discarded plastic waste accumulates in a river and is mistaken for food by the fish and other aquatic animals

34. Wetlands such as marshes and swamps were once often drained and filled in, but are now recognized as valuable. Which of the following is an important benefit that natural wetlands provide?

A. Wetlands speed up flooding by funneling rainwater directly and rapidly into rivers, which is why preserving them is considered so valuable

B. Wetlands add large amounts of pollution to the water that flows through them, which is the main reason they are now carefully protected

C. Wetlands destroy the habitat of nearly every species that lives near them, so protecting wetlands is a way of reducing local biodiversity

D. Wetlands filter pollutants from water, absorb floodwaters, and provide habitat for many species, making them valuable natural systems

35. Mining provides important raw materials such as metals and coal, but it can also cause environmental harm. Which of the following is a common environmental impact of mining?

- A. Mining permanently improves the surrounding habitat and water quality, which is the main reason it is encouraged in environmentally sensitive areas
- B. Mining can disturb large areas of land and release pollutants into nearby soil and water, harming ecosystems around the mine site
- C. Mining has no environmental impact of any kind, since removing rock and minerals from the ground cannot affect the surrounding environment
- D. Mining adds large amounts of fertile topsoil to the land, which is why mined regions are always far better for farming after the mining ends

36. Transportation is a major source of greenhouse gas emissions. Which of the following changes to a transportation system would most directly reduce greenhouse gas emissions?

- A. Expanding public transit and encouraging electric vehicles powered by clean energy, which reduces the burning of gasoline and diesel fuel
- B. Encouraging everyone to drive large gasoline-powered vehicles alone for every trip, since this is the most efficient possible use of fuel
- C. Building many more coal-burning power plants to supply the transportation system, since coal produces the fewest greenhouse gas emissions
- D. Removing all bike lanes and sidewalks so that people are required to drive, since walking and biking release more greenhouse gases than cars

37. In an ecosystem, organisms such as fungi and bacteria break down dead plants and animals. Why are these decomposers important to the health of an ecosystem?

- A. Decomposers remove all of the nutrients from an ecosystem permanently, which prevents any new plants from ever being able to grow there
- B. Decomposers produce all of the oxygen in an ecosystem through photosynthesis, exactly as the green plants and algae do in the sunlight
- C. Decomposers break down dead material and return its nutrients to the soil, where the nutrients can be used again by living plants

D. Decomposers have no real role in an ecosystem, since dead plants and animals would simply vanish on their own without any help at all

38. A long-term drought reduces the amount of water available in a region's rivers and reservoirs. Which of the following is a responsible way for a community to respond to a serious water shortage?

A. Encouraging everyone to use as much water as possible as quickly as they can, in order to empty the reservoirs before the drought worsens

B. Filling all of the swimming pools and watering every lawn heavily each day, since using more water is the best way to end a drought quickly

C. Ignoring the shortage completely and making no changes at all, since the amount of water a community uses cannot affect its water supply

D. Conserving water through measures such as fixing leaks, limiting outdoor watering, and using water-efficient appliances and fixtures

39. Materials such as aluminum and glass can be melted down and reformed into new products over and over again without losing quality. Why does this property make them especially good materials to recycle?

A. Because they lose quality each time they are recycled, they can be reused only once before they must be thrown away into a landfill forever

B. Because they can be reused again and again, recycling them repeatedly conserves raw materials and the energy needed to make new products

C. Because recycling them requires far more energy and raw material than making new products, recycling these materials wastes resources overall

D. Because they decompose naturally within a few days, there is no real benefit to recycling them rather than simply throwing them away

40. As the human population grows, the demand for resources such as food, water, and energy also increases. Why does a growing human population put greater pressure on the environment?

A. A larger population uses fewer resources overall, since people automatically share everything equally and waste nothing as their numbers grow

- B. A growing population has no effect on the environment, since the number of people has no connection to how many resources are used
- C. More people require more food, water, energy, and land, which increases resource use, pollution, and the loss of natural habitats
- D. A larger population always reduces pollution and habitat loss, since more people means more hands available to protect the environment

41. A geologist observes a set of sedimentary rock layers and assumes that, when they first formed, they were deposited in flat, horizontal sheets. Which principle of relative dating is the geologist applying?

- A. The principle of original horizontality, which states that sedimentary layers are originally deposited in nearly flat, horizontal sheets
- B. The principle of cross-cutting relationships, which states that a feature cutting across rock layers is younger than the layers it cuts through
- C. The principle of superposition, which states that in an undisturbed sequence the lowest layers are the oldest and the highest are the youngest
- D. The principle of faunal succession, which states that fossil organisms appear in the rock record in a definite and recognizable order over time

42. Petrified wood looks like wood but is actually solid rock. It forms when buried wood is gradually replaced by minerals that are deposited by groundwater. What does this process of mineral replacement produce?

- A. A trace fossil, a preserved record of an organism's activity such as a footprint or burrow, rather than any part of the organism's body
- B. A mold fossil, a hollow impression in the rock that preserves only the outer shape of the original wood after it has rotted completely away
- C. An amber fossil, in which the organism is trapped and sealed inside hardened tree resin that protects its delicate structures from decay
- D. A petrified fossil, in which the original material is gradually replaced, particle by particle, with minerals, turning it into solid stone

43. We are currently living in the most recent era of geologic time, which began after the extinction of the dinosaurs and is often called the "Age of Mammals." What is this most recent era called?

A. The Paleozoic Era, the span of geologic time during which trilobites, early fish, and the first land plants appeared and flourished on Earth

B. The Cenozoic Era, the most recent era of geologic time, which began after the dinosaurs died out and during which mammals became dominant

C. The Mesozoic Era, the span of geologic time often called the Age of Reptiles, during which the dinosaurs were the dominant land animals

D. The Precambrian, the earliest and by far the longest span of geologic time, during which only simple, single-celled life existed on Earth

44. A rock contains a radioactive isotope and its decay product in a ratio of one part parent isotope to three parts daughter product. This means one-quarter of the original parent remains. If the half-life is 600 million years, how old is the rock?

A. About 600 million years old, since a one-to-three ratio of parent to daughter corresponds to just a single half-life having passed

B. About 1.8 billion years old, since a one-to-three ratio of parent to daughter corresponds to exactly three half-lives having passed

C. About 1.2 billion years old, since one-quarter of the parent remaining means two half-lives have passed, and two times 600 million is 1.2 billion

D. About 2.4 billion years old, since a one-to-three ratio means four half-lives have passed, and four times 600 million is 2.4 billion years

45. When Alfred Wegener first proposed continental drift, many scientists rejected the idea. What important part of the explanation was Wegener unable to provide, which later became the foundation of plate tectonics?

A. A convincing mechanism explaining what force could actually move the continents, which was later explained by the motion of tectonic plates

B. Any evidence at all that the continents had ever been joined, since Wegener had no fossil, rock, or coastline evidence to support his idea

C. A map showing the shapes of the continents, which had never been drawn before Wegener and which he was completely unable to produce

D. Proof that the Earth was round rather than flat, which scientists of his time still doubted and which Wegener could not demonstrate to them

46. The largest mass extinction in Earth's history, sometimes called "the Great Dying," occurred at the end of the Paleozoic Era and wiped out the majority of marine species. What does the occurrence of such a massive extinction reveal about life on Earth?

A. That life on Earth has always remained completely unchanged, since not a single species has ever gone extinct at any time in the planet's history

B. That extinctions are impossible, since once a species appears on Earth it can never disappear from the planet under any circumstances at all

C. That every species that has ever lived is still alive today, since the fossil record shows that no organism has ever truly become extinct

D. That life on Earth has undergone dramatic changes, with even very large and successful groups of organisms sometimes being wiped out

47. To reconstruct climates from before written records, scientists study natural records such as tree rings, ice cores, and ocean sediments. Why do scientists use several different natural records rather than relying on just one?

A. Using several records makes the conclusions far less reliable, so scientists do it only to make their research appear more complicated than it is

B. Different records each capture different clues about the past, and comparing them gives a more complete and reliable picture of ancient climates

C. Each natural record gives exactly the same information as all the others, so using several of them is simply a way of wasting time and effort

D. Only one of these records actually works, and scientists examine all of the others purely out of habit even though they reveal nothing useful

48. A layer of sedimentary rock is cut through by a vertical sheet of igneous rock that pushed up into it. Using the principles of relative dating, what is the correct age relationship between the sedimentary layer and the igneous sheet?

- A. The sedimentary layer is older than the igneous sheet, because the layer had to already exist before the igneous rock could cut up into it
- B. The igneous sheet is older than the sedimentary layer, because igneous rock is always older than any sedimentary rock that surrounds it
- C. The two are exactly the same age, because an igneous sheet and the layer it cuts through always form together at the very same instant
- D. Their relative ages cannot be determined at all, because there is no way to compare the age of an igneous rock with a sedimentary one

49. An engineering team has three possible designs for a bridge. One is cheapest but least durable, one is most durable but most expensive, and one is moderate in both. How should the team decide which design is best?

- A. Always choose the cheapest design without any further thought, since the lowest cost is the only factor that ever matters in engineering
- B. Always choose the most expensive design, since a higher price by itself is a guaranteed sign that a design will perform better than the others
- C. Choose a design completely at random, since there is no rational way to compare three different designs that each have different strengths
- D. Weigh the trade-offs between cost and durability against the project's criteria and constraints to select the design that best balances the goals

50. A scientist runs an experiment several times and gets slightly different results each time, then averages the results together. Why is it important to repeat an experiment several times instead of running it only once?

- A. Repeating the experiment is required only to make it take longer, since the very first single trial always gives the one perfectly correct result
- B. Repeating the experiment and averaging the results reduces the effect of random errors and gives a more reliable, trustworthy measurement
- C. Repeating the experiment guarantees that every trial will produce exactly the same result, which is the entire purpose of running it more than once
- D. Repeating the experiment makes the results far less accurate, so scientists do it only when they are deliberately trying to get a wrong answer

Practice Exam 45: Answer Key with Explanations

1. A — One year is set by Earth's revolution, the complete orbit it makes around the Sun, taking about 365 days. Rotation (the daily spin) governs day and night, while revolution governs the length of the year.
2. C — During spring tides the Sun and Moon are aligned, so their gravitational pulls combine and add together to produce especially large tides. This reinforcement of the two pulls creates the highest highs and lowest lows.
3. D — Two equally luminous stars look different in brightness because they lie at different distances, and a farther star appears dimmer. This is why apparent brightness must be combined with distance to determine a star's true output.
4. B — The Moon stays in orbit because of the gravitational pull between Earth and the Moon, which continually bends its motion into a curved path. Without that inward pull, the Moon would move off in a straight line.
5. C — Asteroids and comets are leftover rocky and icy bodies that never combined into a planet during the solar system's formation. They preserve material from the original cloud of gas and dust.
6. D — At full moon the Moon lies on the opposite side of Earth from the Sun, so the Sun fully lights the side facing us. This arrangement is why we see the entire near face brightly illuminated.
7. A — A light-year measures distance—the distance light travels in one year, about 9.5 trillion kilometers. Despite containing the word "year," it is a unit of length used for the vast distances between stars.
8. C — A thin atmosphere provides little insulation, so Mars has large temperature swings and cannot retain much surface heat. With so little air to trap warmth, daytime heat is quickly lost after dark.
9. B — The Milky Way appears as a band because we sit inside its flat disk and see its many stars edge-on. From within the disk, the galaxy's spiral structure is not visible as a spiral from our vantage point.
10. D — The Sun is a star, an enormous ball of hot gas that produces its own light and heat through nuclear fusion in its core. It is fundamentally the same kind of object as the other stars in the night sky.
11. A — The hemispheres have opposite seasons because Earth's axis is tilted, so when one hemisphere tilts toward the Sun the other tilts away. This is why summer in the north coincides with winter in the south.
12. C — Under intense heat and pressure without melting, an igneous rock can become a metamorphic rock. The rock cycle allows any rock type to transform into another given the right conditions.
13. B — S-waves cannot travel through liquids, so their failure to pass through a layer revealed that Earth's outer core is liquid. This shadow zone for S-waves is key evidence about the planet's internal structure.
14. D — Breaking rock into smaller pieces exposes much more total surface area to air and water, and chemical weathering acts on exposed surfaces. More surface area means faster weathering of the same volume of rock.
15. C — The process by which atoms arrange into an orderly, repeating solid structure is crystallization. It occurs as magma cools or as mineral-rich water evaporates, forming mineral crystals.

16. A — Deep ocean trenches form at convergent boundaries where one plate is forced down beneath another. The bending and descent of the subducting plate creates the deep trench at the surface above.
17. D — The largest, heaviest particles sink faster through water than smaller, lighter ones, so they reach the bottom first. This difference in settling speed produces graded bedding, coarse at the bottom and fine at the top.
18. B — Rainforest soils are nutrient-poor because heavy rainfall washes nutrients out and the dense plants quickly take up what remains. Most of the ecosystem's nutrients are held in the living vegetation rather than the soil.
19. C — Slate forming from shale and marble from limestone shows that metamorphic rocks form from pre-existing rocks changed by heat and pressure, so each has a parent rock. The original rock determines what the metamorphic product becomes.
20. A — With little plant cover to anchor the soil, loose dry sediment is easily lifted and carried by wind in deserts. Vegetation elsewhere holds soil in place, which is why wind erosion is far more effective in bare deserts.
21. D — A bowl-shaped depression that appears when an underground cavern's roof collapses is a sinkhole. It forms in limestone regions where groundwater has dissolved cavities beneath the surface.
22. B — The oceans supply by far the most water vapor through evaporation because they cover most of Earth's surface. Their vast area makes them the dominant source of atmospheric moisture.
23. C — A cloud that forms at or very near ground level when surface air cools to condensation is fog. It reduces visibility because the condensed droplets hang right at the surface where people travel.
24. B — The horizontal movement of air from higher toward lower pressure is wind. These pressure differences, created by uneven heating, drive air to flow and produce wind.
25. A — Near the equator the Sun stays high and sunlight remains fairly direct year-round, so heating changes little between seasons. The steady, direct solar input keeps equatorial temperatures warm and stable.
26. B — A tornado is small and short-lived, lasting minutes over a narrow path, while a hurricane is huge and can last for days over a wide area. This contrast in scale and duration is a key difference between the two rotating storms.
27. D — Temperature falls with latitude because sunlight strikes higher latitudes at a lower, slanted angle, spreading the same energy over a larger area. Spreading the energy thinner means less heating per unit area near the poles.
28. C — A hygrometer is the instrument designed to measure humidity, the amount of water vapor in the air. It provides the moisture data meteorologists need alongside temperature and pressure.
29. A — Land heats faster than water because water must absorb much more energy to raise its temperature. Under equal sunlight, this higher heat capacity of water leaves the land warming more quickly.
30. C — A front is the boundary between two air masses with different temperatures and moisture, and weather often changes as it passes. The meeting of contrasting air masses is what makes fronts important for forecasting.
31. B — Carbon dioxide is a greenhouse gas that traps heat in the atmosphere, so its buildup enhances the greenhouse effect and warms the planet. The sharp rise since the Industrial Revolution is linked to global warming.

32. A — A renewable resource is naturally replenished within a human lifetime, while a nonrenewable resource exists in a limited supply used up far faster than it forms. This difference in replacement rate defines the two categories.
33. C — Releasing heated water into a river and raising its temperature, harming aquatic life, is thermal pollution. Warmer water holds less dissolved oxygen, which stresses the organisms living there.
34. D — Wetlands filter pollutants, absorb floodwaters, and provide habitat for many species, making them valuable natural systems. These services are why draining wetlands is now recognized as a loss.
35. B — Mining can disturb large areas of land and release pollutants into nearby soil and water, harming surrounding ecosystems. These impacts are a recognized environmental cost of extracting raw materials.
36. A — Expanding public transit and encouraging electric vehicles powered by clean energy reduces the burning of gasoline and diesel, directly cutting transportation emissions. Less fuel combustion means fewer greenhouse gases released.
37. C — Decomposers break down dead material and return its nutrients to the soil, where living plants can reuse them. This recycling of nutrients is essential to keeping an ecosystem productive.
38. D — A responsible drought response is conserving water through measures such as fixing leaks, limiting outdoor watering, and using efficient fixtures. Reducing demand helps stretch the limited supply through the shortage.
39. B — Because aluminum and glass can be reused again and again without losing quality, recycling them repeatedly conserves raw materials and the energy needed to make new products. Their reusability makes recycling especially worthwhile.
40. C — A growing population requires more food, water, energy, and land, which increases resource use, pollution, and habitat loss. More people place greater overall demand on the environment.
41. A — Assuming sedimentary layers were first deposited in flat, horizontal sheets applies the principle of original horizontality. Tilted or folded layers are therefore understood to have been deformed after deposition.
42. D — Wood gradually replaced particle by particle with minerals deposited by groundwater becomes a petrified fossil, turning the original material into solid stone. This mineral replacement preserves the wood's form as rock.
43. B — The most recent era, beginning after the dinosaurs died out and marked by the rise of mammals, is the Cenozoic Era. It is often called the Age of Mammals and is the era we live in today.
44. C — A one-to-three parent-to-daughter ratio means one-quarter of the parent remains, which corresponds to two half-lives ($1 \rightarrow 1/2 \rightarrow 1/4$). Two times the 600-million-year half-life gives about 1.2 billion years.
45. A — Wegener could not provide a convincing mechanism for what force moved the continents, which led to rejection of his idea. Plate tectonics later supplied that mechanism through the motion of Earth's plates.
46. D — A mass extinction as severe as the Great Dying shows that life on Earth has undergone dramatic changes, with even large, successful groups sometimes wiped out. The fossil record documents these major turnovers in life.
47. B — Different natural records each capture different clues about past climate, so comparing tree rings, ice cores, and sediments gives a more complete and reliable picture. Cross-checking multiple lines of evidence strengthens the reconstruction.

48. A — The sedimentary layer is older than the igneous sheet because the layer had to already exist before the igneous rock could cut up into it. By cross-cutting relationships, the intruding feature is younger than what it cuts.
49. D — The team should weigh the trade-offs between cost and durability against the project's criteria and constraints to choose the design that best balances the goals. Systematic comparison, not cost alone, guides sound engineering decisions.
50. B — Repeating an experiment and averaging the results reduces the effect of random errors and yields a more reliable measurement. Multiple trials guard against a single anomalous result skewing the conclusion.