

# PRACTICE EXAM 48: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

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1. Earth and the other planets all formed from a single rotating disk of gas and dust surrounding the young Sun. What is the name for this disk of material around the early Sun, from which the planets later developed?

A. The Oort cloud, a distant spherical shell of icy objects that is thought to surround the entire solar system at its very outer edge today

B. The Kuiper belt, a flat region of icy bodies that lies beyond the orbit of Neptune at the cold outer reaches of our solar system today

C. A protoplanetary disk, the rotating flat disk of gas and dust surrounding the young Sun from which Earth and the other planets later formed

D. A black hole, a region of space with gravity so strong that nothing, not even light, can escape from inside once it crosses the boundary

2. Astronomers find that nearly all stars have planets orbiting them. What does this discovery suggest about how planetary systems form?

A. That planetary systems form only around stars near the center of our galaxy and are very rare in the outer regions of the Milky Way at all

B. That planets can only form when two stars collide, which is so rare that planets must be extremely uncommon throughout the entire universe

C. That planets are deliberately placed around chosen stars by an outside force, which is the only way new planetary systems can ever come into existence

D. That planet formation appears to be a common natural outcome when a star forms from a collapsing cloud of gas and dust within a galaxy

3. A common belief is that the Moon physically rotates without ever spinning on its own axis, so the same side always faces Earth. What is the more accurate description of the Moon's motion?

A. The Moon rotates on its axis exactly once per orbit, which is why the same side keeps facing Earth throughout the entire orbit around the planet

B. The Moon does not move at all and stays completely fixed in space, while the Earth simply spins beneath it once each day from west toward east

C. The Moon rotates many times during each orbit, but its rotation is so fast that all sides of the Moon appear blurred together into one face seen from Earth

D. The Moon orbits in a complicated zigzag pattern that has nothing to do with rotation, which is the only reason that we always see the same side from Earth

4. Stars are not scattered randomly throughout the universe but instead are gathered into enormous gravitationally bound groups. What is one of these huge gravitationally bound groups of stars called?

A. A solar system, the system of one star and the planets, moons, and small bodies that orbit it, which is much smaller than the structure described here

B. A galaxy, a vast system of stars, gas, and dust held together by gravity, which contains anywhere from millions to many hundreds of billions of stars

C. A constellation, a pattern of stars in Earth's night sky that often appears to form a recognizable shape but whose stars are not truly bound by gravity

D. An asteroid belt, a region of small rocky bodies that orbit between the planets Mars and Jupiter within our own solar system rather than a group of stars

5. During a partial solar eclipse, observers in the path of the Moon's penumbra see only part of the Sun blocked. What is true about a solar eclipse versus a lunar eclipse?

A. Both eclipses always occur on exactly the same day each year, since solar and lunar eclipses are scheduled to alternate with each other regularly

B. A solar eclipse occurs at a full moon and a lunar eclipse at a new moon, which is the only arrangement that produces these two types of eclipses

C. A solar eclipse occurs when the Moon blocks the Sun from Earth's view at a new moon, while a lunar eclipse occurs when Earth's shadow falls on the Moon at a full moon

D. A solar eclipse and a lunar eclipse are exactly the same event seen from two slightly different angles, so the two terms can be used interchangeably

6. Although the Moon is far smaller than the Sun, the two appear about the same size in Earth's sky. What is the main reason the Sun and the Moon appear to be about the same size from Earth?

A. The Sun is much larger but also much farther away, and this happens to balance out so that the two appear about the same size from Earth's surface

B. The Sun and the Moon are actually exactly the same physical size in real space, which is why they appear identical in size from anywhere on Earth

C. The Moon is far larger than the Sun in real space, but its much greater distance from Earth makes it appear to match the smaller Sun in our sky

D. The Sun's light is bent strongly as it passes the Moon, which physically shrinks the apparent size of the Sun until it matches that of the Moon exactly

7. Mars has a thinner atmosphere, weaker gravity, and lower temperatures than Earth. Why is Mars considered a much less hospitable place for human life than Earth?

A. Mars has plenty of liquid water on its surface and a thick oxygen-rich atmosphere, yet its great distance from the Sun makes it inhospitable to life

B. Mars and Earth offer essentially identical conditions for life, since the atmosphere, surface temperatures, and gravity of the two planets are very similar

C. Mars is the most hospitable planet for human life in the solar system, since its thin atmosphere and low gravity create the ideal conditions for survival

D. Mars has a thin carbon dioxide atmosphere, almost no liquid surface water, weak gravity, and very cold temperatures, none of which favor human life

8. Astronomers use telescopes to study objects ranging from nearby planets to the most distant galaxies. What is the most general purpose of a telescope?

A. To physically transport human observers across vast distances of empty space to the locations of the distant stars and galaxies being studied

- B. To gather and focus light or other electromagnetic radiation from distant objects so they appear brighter, clearer, or more detailed to the observer
- C. To produce the light that distant stars give off, so that the stars are then bright enough for observers on Earth to be able to see clearly
- D. To slow down the speed of light coming from distant objects, which is the only way an observer is ever able to detect the light reaching the Earth

9. A common misconception is that astronauts on the Moon can hear sound exactly as people do on Earth. Why does sound not travel on the Moon the way it does on Earth?

- A. The Moon has no significant atmosphere, and sound waves need a medium such as air to travel through, so they cannot move freely on the Moon
- B. The Moon's gravity is too weak to allow sound waves to travel, even though there is plenty of air on its surface for the waves to move through freely
- C. The Moon's surface is too rough to reflect sound waves, which is the only reason that sound cannot travel between astronauts on the surface there
- D. The Sun is too far from the Moon for its sound waves to reach the surface, which prevents any sound at all from existing in the vicinity of the Moon

10. Spacecraft sent to other planets have shown surfaces with many features similar to those on Earth, such as canyons, volcanoes, and old impact craters. What can scientists learn by comparing these features on other planets with those on Earth?

- A. That every planet in the solar system has had exactly the same geologic history as the Earth, since the surfaces of the planets are completely identical
- B. That the planets and the Earth have not changed at all since their formation, since planetary surface features formed only during their very first day in space
- C. That similar geologic processes can occur on different planets, but each planet's history is also shaped by its own unique conditions, such as atmosphere and size
- D. That the planets are not actually solid and have no real surfaces at all, since the features in spacecraft images are simply optical illusions and reveal nothing

11. The Moon has affected life on Earth for billions of years, including by helping to drive the rhythm of ocean tides. Besides tides, what is one other long-term effect of the Moon on the Earth?

- A. The Moon controls all of the weather on Earth, since every storm, every wind, and every rainfall is caused by the Moon rather than the Sun
- B. The Moon constantly heats the Earth, since it provides nearly all of the warmth that the Earth's surface receives from anywhere in space
- C. The Moon's gravity helps stabilize Earth's tilt, which keeps the climate more steady over long times than it would be without the Moon
- D. The Moon physically blocks all sunlight from ever reaching the Earth, which is the main long-term effect of the Moon on life on the surface

12. Geologists divide Earth's history into very long spans called eons, with eras within each eon. Which of the following correctly describes a key distinction among the major divisions of geologic time?

- A. Eras are far longer than eons, since each era contains many eons within it according to the standard geologic time scale of the Earth
- B. The geologic time scale is built around mass extinctions, with the boundaries between eras frequently marking major changes in life
- C. The major divisions are based only on the colors of the rocks in each era, with no connection at all to fossils, life, or any geological events
- D. All of the eras are exactly the same length in time, since the geologic time scale is divided into perfectly equal segments measured in years

13. A geologist examines a sheet of igneous rock that contains broken pieces, called inclusions, of an older rock layer that was already in place. According to the principle of inclusions, which is older, the igneous sheet or the rock pieces inside it?

- A. The igneous sheet and the inclusions are exactly the same age, since inclusions and their surrounding rock always form together at the same instant
- B. The igneous sheet is older than the inclusions, since the igneous rock had to already exist before it could trap pieces of any other rock inside itself

C. Their relative ages cannot be determined, since inclusions and their surrounding rock provide no information at all about which of them is older

D. The inclusions are older than the surrounding igneous sheet, since the included pieces had to already exist as solid rock to be incorporated into the new igneous rock

14. Trilobites were a group of marine organisms that lived in oceans for over 250 million years before going extinct at the end of the Paleozoic Era. Why are trilobite fossils especially useful for relative dating of rock layers?

A. Trilobites lived only briefly, in only one tiny region, which is the combination that makes their fossils ideal as widely useful index fossils

B. Many trilobite species were widespread and short-lived, so different species can be used as index fossils to identify and correlate specific time periods

C. Trilobite fossils are all exactly the same age regardless of where they are found, which is why they reveal nothing useful about the ages of rock layers

D. Trilobites are still alive in modern oceans today, so finding their fossils only proves that a rock formed within the last few hundred years at most

15. When the dinosaurs went extinct about 66 million years ago, a long-dominant group of large land animals was suddenly gone. According to current evidence, which of the following best explains this mass extinction?

A. A large asteroid impact, combined with intense volcanic activity, drastically altered the climate, leading to the dinosaurs' extinction

B. The dinosaurs simply chose to leave the planet on their own and traveled to deeper parts of space, which is why they vanished from the fossil record

C. The dinosaurs were hunted to extinction by humans, who lived alongside them for millions of years and gradually eliminated every dinosaur species

D. The dinosaurs were never extinct, since current evidence shows that all of the dinosaur species are still alive in their original form today

16. Scientists studying the rocks of the very oldest continents on Earth have found ages of more than 4 billion years. What does the age of these oldest known continental rocks demonstrate?

- A. That the continents have always been arranged in exactly their current configuration since the Earth first formed in space billions of years ago
- B. That the continents are all younger than the Earth itself, since the oldest known rocks must be far younger than the time when the Earth first formed
- C. That the Earth is at least as old as its oldest dated continental rocks, which provides a useful minimum age estimate for the planet at billions of years
- D. That the Earth is exactly as old as its oldest dated continental rocks, since the very first rocks must have formed at the same instant the planet did

17. A radioactive isotope used to date very old rocks has a half-life of 2 billion years. Suppose a rock sample contains one-sixteenth of the original amount of this isotope. About how old is the rock?

- A. About 2 billion years old, since one-sixteenth of the isotope remaining corresponds to just a single half-life of the radioactive isotope having passed
- B. About 4 billion years old, since one-sixteenth of the isotope remaining corresponds to exactly two full half-lives of the radioactive isotope having passed
- C. About 16 billion years old, found by simply multiplying the two-billion-year half-life by the sixteen in the fraction one-sixteenth that remains
- D. About 8 billion years old, since one-sixteenth remaining means four half-lives have passed, and four times 2 billion years equals 8 billion years

18. Geologists use the principle of uniformitarianism, which holds that processes acting today, such as erosion and deposition, also acted in the past. How is this idea important for understanding Earth's history?

- A. It implies that the past is impossible to know in any detail, since the processes acting today are completely different from those that ever acted before
- B. It allows geologists to interpret ancient rocks and landforms by studying processes that can be observed today, since the same physical processes operate in both
- C. It states that the rocks of the past have nothing in common with rocks of today, so studying modern rocks is useless for understanding the past
- D. It says that all processes that occur on Earth happen only once, so the modern processes of erosion and deposition cannot have happened in the past at all

19. Plants left their first widespread fossil record on land during the Paleozoic Era, after long periods when life was confined to the oceans. What is the significance of plants colonizing the land?

A. Plants on land slowly transformed the surface environment, building soils, removing carbon dioxide from the air, and helping make the land suitable for animal life

B. Plants on land did not change the surface environment at all, so their arrival had no effect on the soils, atmosphere, or future evolution of animal life on Earth

C. Plants on land caused the immediate extinction of all marine life, since the moment the first land plants appeared every ocean species disappeared from the fossil record

D. Plants on land caused the Earth's atmosphere to fill entirely with carbon dioxide, which prevented any animals from ever evolving in the ocean again

20. When an unknown mineral is tested with a glass plate of known hardness 5.5 and the mineral scratches the glass, what can be concluded about the mineral's hardness?

A. The mineral's hardness is exactly 5.5 on the Mohs hardness scale, since any mineral that scratches glass has exactly the same hardness as the glass

B. The mineral's hardness must be less than 5.5 on the Mohs hardness scale, since only minerals softer than glass are capable of scratching it

C. The mineral's hardness cannot be determined at all from this test alone, since scratching a glass plate reveals nothing about a mineral's hardness

D. The mineral's hardness must be greater than 5.5 on the Mohs hardness scale, since only minerals harder than the glass are able to scratch it

21. Earth's outermost, rigid layer is made up of the crust and the very top of the mantle, broken into the tectonic plates. What is this single rigid outer layer called?

A. The asthenosphere, the soft, slowly flowing layer of the upper mantle that lies just beneath the rigid outer layer of the Earth on which the plates move

B. The outer core, the layer of churning liquid iron and nickel surrounding the inner core, whose motion is what generates the Earth's strong magnetic field

C. The lithosphere, the rigid outer layer of Earth made of the crust and the very top of the mantle, which is broken into the tectonic plates

D. The mesosphere, a layer of Earth's atmosphere located high above the surface, which is mistakenly used here to describe the outer layer of solid Earth

22. When two cold air masses converge and squeeze a warm air mass between them, the warm air can be lifted entirely off the ground, mixing layers and producing complex weather. What kind of front forms in this situation?

A. An occluded front, which forms when a cold front overtakes a warm front and lifts the warm air completely off the ground between two cold masses

B. A stationary front, which forms when the boundary between two air masses stalls in place and barely moves for several days at a time over one area

C. A sea-breeze front, which forms each afternoon along a coastline where cool ocean air pushes inland beneath the warmer air that lies over the land

D. A dry line, which forms inland where a boundary separates very dry desert air from the more humid air found closer to a large body of ocean water

23. Convection in the mantle moves heat from deeper layers toward the surface and is thought to drive the slow motion of tectonic plates. Where does the heat that powers mantle convection come from?

A. Sunlight that has penetrated all the way down into the mantle from above, which is the only source of heat that the interior of the planet has at all

B. The pressure of the ocean and atmosphere on Earth's surface, which is what supplies all of the heat that drives the slow circulation of the mantle

C. Cold material from the deep ocean trenches, which falls into the mantle and somehow generates the heat needed to drive convection of the mantle

D. The decay of radioactive elements within Earth and leftover heat from its formation, both of which supply the heat that drives mantle convection

24. A surveyor finds that the elevation of certain coastal land has slowly risen over many centuries since the last ice age, when massive ice sheets retreated. What does this slow rise of formerly ice-covered land most likely indicate?

- A. That the land is being pushed up by hidden geysers releasing hot water beneath it, which is the only way that formerly ice-covered land can ever rise
- B. That the land is slowly rebounding upward as the weight of the vanished glacial ice has been removed, in a process known as glacial rebound
- C. That the land is sinking even though it appears to be rising, since coastal land always sinks rather than rises after a long period of glacial coverage
- D. That the elevation of formerly ice-covered land never changes at all, regardless of whether or not it was once covered by very heavy glacial ice

25. A pumice rock and a granite rock are both made of similar minerals and formed from cooled magma, yet pumice is light and full of holes while granite is heavy and made of large crystals. What accounts for the major difference between these two igneous rocks?

- A. Pumice cooled extremely quickly at the surface, trapping gas bubbles, while granite cooled slowly deep underground, allowing large crystals to grow
- B. Pumice cooled very slowly deep underground, while granite cooled rapidly at the surface, which is the only reason their textures differ so greatly
- C. Pumice and granite have identical textures and densities, so any apparent difference between the two rocks is simply due to a viewer's optical illusion
- D. Pumice and granite are made of completely different elements and minerals, which is the actual reason that their textures and densities differ so much

26. A small stream that joins and adds its water to a larger stream or river is given a specific name in the study of watersheds. What is such a stream called?

- A. A delta, the fan-shaped deposit of sediment that builds up where a river slows down and drops its load as it flows into a calm lake or open sea
- B. An aquifer, a body of permeable rock or sediment that can store and transmit usable amounts of groundwater for people to draw out through their wells
- C. A tributary, a small stream or river that flows into and adds its water to a larger main river or stream somewhere along the main river's course
- D. 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 a long time

27. In dry, sandy regions, the wind can carry sand-sized particles that grind against rock surfaces over many years, gradually polishing or sculpting the rock. This shaping of rock by wind-blown particles is one form of:

A. Chemical weathering, the breakdown of rock through chemical reactions that change its minerals into new substances rather than just into smaller pieces of the same rock

B. Frost wedging, in which water seeps into cracks in the rock, freezes and expands, and gradually pries the rock apart into smaller pieces over many cycles

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

D. Abrasion, in which particles carried by wind, water, or ice strike a rock surface repeatedly and gradually wear it down by mechanical weathering

28. Most of Earth's fresh water is not in rivers or lakes but is held in another large frozen reservoir. Where is the majority of Earth's fresh water stored?

A. In the oceans, which contain by far the largest share of all the fresh water on the planet because of their immense total volume and surface area

B. In glaciers, ice sheets, and polar ice caps, which together hold the majority of Earth's fresh water locked away in frozen form on the land and at the poles

C. In the atmosphere as water vapor and clouds, which contain by far the largest share of the planet's fresh water at any given moment in time

D. In the rivers and lakes around the world, which together store the majority of Earth's fresh water and supply nearly all of the drinking water used by humans

29. A mountain range stretches across a continent, and a long, broad area of low land lies between two parallel ranges. This long, low area, sometimes formed where the crust has dropped down between two faults, is called:

A. A rift valley, a long, low area of land bounded by faults where the crust has dropped down between them, often where two plates are pulling apart

B. A flood plain, the flat, low-lying area beside a river that is periodically covered by water when the river overflows its banks during a flood event

C. A delta, the fan-shaped deposit of sediment that builds up at the mouth of a river where it slows down and drops its load into a still lake or sea

D. A glacial moraine, the long ridge of mixed rock and soil that is bulldozed up and left behind at the leading edge of a slowly moving sheet of ice

30. A community installs solar panels on the rooftops of public buildings to supply some of their electricity from sunlight. Which of the following best describes how this project benefits the environment?

A. It reduces the amount of fossil fuel that must be burned to supply the buildings' electricity, which lowers the resulting greenhouse gas emissions

B. It greatly increases the amount of fossil fuel that must be burned, since solar panels require constant fossil-fuel backup to produce any electricity at all

C. It has no effect on the environment whatsoever, since the source of a building's electricity has no connection to the resulting greenhouse gas emissions

D. It harms the environment by releasing large amounts of pollution from the solar panels as they operate, which makes the local air much dirtier than before

31. Some farms practice "polyculture," planting many different crop species together rather than growing only one. How can polyculture benefit both the farm and the environment compared with single-crop farming?

A. Mixing crops can reduce pest outbreaks, improve soil health, and increase biodiversity, since different plants and their associated organisms support each other

B. Mixing crops always reduces overall yields to zero, since plants of different species cannot grow next to one another without killing each other off completely

C. Mixing crops eliminates the need for soil, water, or sunlight, which is what makes polyculture so much more efficient than ordinary farming methods

D. Mixing crops has no effect on pests, soil, or biodiversity, since the kinds of plants growing in a field cannot influence any aspect of the field's ecosystem

32. Scientists warn that the loss of biodiversity in an ecosystem can have wide-ranging effects. Why are species often more interconnected within an ecosystem than they may first appear?

- A. Each species lives completely independently, so the loss of one species can never affect any other species in an ecosystem under any conditions at all
- B. Species are connected only by their colors and shapes, which is why the loss of one species cannot influence the survival of any other species nearby
- C. Species are linked through food webs and other relationships, so the loss of one species can affect many others that depend on it directly or indirectly
- D. Species are connected only by the random pattern of their habitats, which has no effect on whether the loss of one species harms others around it

33. Some communities use rain gardens, which are shallow planted areas that capture rainwater from roofs and pavement. How does a rain garden help reduce environmental problems?

- A. Rain gardens send all rainwater straight to nearby streams as quickly as possible, increasing the risk of flooding by speeding up the local water flow
- B. Rain gardens allow rainwater to soak into the soil rather than rushing into storm drains, reducing flooding, erosion, and the pollution carried by runoff
- C. Rain gardens cause permanent damage to the soil where they are built, which is the main reason that communities are now removing them from city blocks
- D. Rain gardens contribute large amounts of pollution to local water bodies, since the plants in a rain garden release toxic chemicals into the surrounding soil

34. Aquaculture, the farming of fish and other aquatic organisms in tanks, ponds, or ocean pens, has grown rapidly in recent decades as wild fish stocks decline. How can responsibly managed aquaculture help relieve pressure on the ocean?

- A. By increasing how much wild fish is caught from the ocean, since fish farming somehow forces fishing fleets to take far more wild fish each year
- B. By replacing all natural fish habitats with empty cement tanks, since the natural ocean is too unstable to ever support healthy fish populations on its own
- C. By having no effect on the ocean at all, since aquaculture and ocean fishing are completely separate and the activities of one do not influence the other
- D. By providing fish without taking them from wild populations, since farmed fish can meet some demand that would otherwise drive heavier ocean fishing

35. Reforestation, the planting of trees in areas where forests have been lost, is one strategy used to fight climate change. Why is reforestation valuable in addressing climate change?

- A. Growing trees absorb carbon dioxide from the atmosphere through photosynthesis, helping to reduce the buildup of this greenhouse gas in the air
- B. Growing trees release very large amounts of carbon dioxide directly into the atmosphere as they grow, which is the only reason reforestation is valuable
- C. Growing trees have no effect on atmospheric carbon dioxide, since plants do not interact with the atmosphere in any way that affects the climate at all
- D. Growing trees actively heat the atmosphere by radiating large amounts of warmth from their leaves, which is somehow viewed as helpful for the climate

36. A group of scientists studying a forest decide to track changes in the forest over many decades. Why is this kind of long-term ecological monitoring particularly valuable?

- A. It is valuable only as a way to keep scientists employed for long periods of time and reveals nothing meaningful about how ecosystems change at all
- B. It is valuable because a single visit to the forest provides exactly the same information as a multi-decade study, so the long study is purely a formality
- C. It is valuable because slow ecological changes, such as shifts due to climate change or invasive species, become visible only over long periods of time
- D. It is valuable only because it produces large amounts of paperwork, which is the actual goal of long-term monitoring programs in modern ecology

37. A river flows for thousands of kilometers and passes through several countries. Why is responsible management of a river system often a complex political and environmental challenge?

- A. Because every country a river crosses experiences exactly the same effects of pollution and water use, there is no reason for any countries to coordinate at all
- B. Because actions in one country, such as pollution or damming, can affect the water supply, ecosystems, and people in countries farther downstream
- C. Because rivers are completely contained within the borders of single countries, the actions of one country can never affect any neighbors along the river at all

D. Because rivers have no real connection to politics or the environment, the management of an international river system is never a complicated challenge

38. A community wants to reduce the heat trapped in its dense neighborhoods, where pavement and buildings warm the air on hot days. Which of the following changes would most directly help cool the city?

A. Paving every remaining open lot with dark asphalt, since asphalt is known to reflect heat away from city streets and keep the city much cooler overall

B. Removing all of the city's trees and gardens, since vegetation traps heat near the ground and replacing it with concrete is the best way to cool the city

C. Painting every roof in the city black, since dark roofs are known to reflect sunlight better than light ones and keep the spaces inside the buildings cool

D. Planting more street trees and creating green roofs and parks, since vegetation shades surfaces and cools the air through evaporation from leaves

39. On a sunny day, energy from the Sun travels through the empty vacuum of space to reach Earth without needing any matter to travel through. Through which of the layers of the atmosphere must this incoming solar energy then pass before it reaches the surface?

A. Through all of the atmospheric layers, from the outer exosphere down through the thermosphere, mesosphere, and stratosphere before reaching the troposphere and the ground

B. Through only the troposphere, since the other layers of the atmosphere are entirely transparent to sunlight and have no effect on the energy reaching the surface

C. Through only the stratosphere, since the layers above and below the stratosphere are completely transparent to incoming sunlight and do not interact with it at all

D. Through none of the atmospheric layers at all, since incoming sunlight goes directly from the Sun to the Earth's surface without ever passing through any layer

40. A region of high pressure typically brings clear, calm weather. Why is sinking air in a high-pressure system associated with clear skies rather than cloudy weather?

- A. Sinking air absorbs all of the clouds in the area, gathering them into the center of the high-pressure system, which is the reason the surrounding sky stays clear
- B. Sinking air rises in temperature in a way that has no effect on clouds, but the high-pressure system blocks any rain from forming, leaving the skies fair
- C. Sinking air warms as it descends, increasing its capacity to hold moisture, which discourages cloud formation and produces clear, calm weather at the surface
- D. Sinking air is far colder than rising air, which causes it to lose all moisture immediately, leaving behind clear and sunny weather across the surface below

41. A pilot flying through different layers of the atmosphere notices that the air becomes less dense as altitude increases. What is the main reason atmospheric density decreases with increasing altitude?

- A. The Earth's gravity becomes much weaker at higher altitudes, which is the only reason that the air in the atmosphere becomes less dense as one rises higher
- B. The temperature drops sharply at higher altitudes, and falling temperature alone is the reason that the density of the air decreases steadily with altitude
- C. The Sun's rays are stronger at higher altitudes, which somehow drives the air molecules apart from one another and makes the air less dense as altitude increases
- D. Most of the atmosphere's air is concentrated near the surface by gravity, so the higher one goes, the less air is above and below pressing the air molecules together

42. During the daytime, air over a freshly plowed dry field can become much hotter than air over a nearby lake. Why does the air over the dry field warm up more than the air over the lake?

- A. The dry land heats up faster than the water because water has a much higher capacity to absorb heat without changing temperature, so the air above the land warms more
- B. The lake heats up far faster than the dry land, which is why the air over the field always lags behind the air over the lake in temperature on a sunny day
- C. The Sun shines only on dry land and never on bodies of water, which is the reason the air over the field warms much more rapidly than the air over the lake
- D. The dry land and the lake heat at exactly the same rate, so the apparent difference in the temperature of the air above them is just an optical illusion

43. A weather observer reports cumulus clouds that have grown taller through the morning and are beginning to look like cauliflower-shaped towers. What is the most likely cause of this growth into tall cumulus clouds?

A. Cold, dry, sinking air over the region, which is the only condition that allows tall cumulus clouds to develop into the cauliflower-shaped towers described

B. Calm, layered, and stable air with no vertical motion, which provides exactly the right conditions for cumulus clouds to grow upward into tall cauliflower-like towers

C. Strong rising currents of warm, moist air, which lift water vapor high into the atmosphere where it condenses into the tall cauliflower-shaped towers of cumulus clouds

D. The slow horizontal drift of dry air across the sky, which is the only motion that allows cumulus clouds to spread upward into towering cauliflower-shaped towers

44. Average global temperatures have risen by about 1 degree Celsius since the late 1800s, while atmospheric carbon dioxide has risen sharply. What does the matching pattern in these two records most strongly support?

A. That rising carbon dioxide and rising temperature are completely unrelated, since the two patterns are very different from one another over the same time period

B. That rising carbon dioxide is closely linked to rising global temperature, consistent with carbon dioxide acting as a heat-trapping greenhouse gas

C. That rising carbon dioxide has been cooling the Earth, since the matching pattern between the two records shows that more carbon dioxide always leads to cooler temperatures

D. That rising temperatures cause carbon dioxide levels to drop, since the matching pattern shows the two records moving in exactly opposite directions throughout

45. Most rainfall and snowfall begin as tiny droplets or ice crystals high in the atmosphere that grow large enough to fall under their own weight. What process changes the water vapor in the air into the liquid droplets that make up clouds?

A. Sublimation, the process by which solid ice changes directly into water vapor without ever first becoming liquid water in the atmosphere

B. Evaporation, the process by which liquid water at the surface changes into water vapor that rises into the air and is later carried away by winds

C. Freezing, the process by which liquid water changes into solid ice when heat is removed from it under the right cold conditions at the surface

D. Condensation, the process by which water vapor in the cooling atmosphere changes back into the tiny droplets of liquid water that form clouds

46. Two locations sit at the same latitude, but one is near the ocean and one is far inland. The coastal location has much smaller seasonal temperature swings than the inland location. Which property of water best explains the coastal moderation of temperature?

A. Water heats up and cools down much more slowly than land does, so a nearby ocean smooths out the seasonal temperature swings of a coastal location

B. Water reflects nearly all incoming sunlight back into space, so coastal areas always receive far less sunlight than inland areas located at the same latitude

C. Water provides constant heating to coastal areas during every season, regardless of the time of year, which is the only reason coastal climates are so mild

D. Water has no measurable thermal properties, so the differences in temperature between coastal and inland locations must come from some other source entirely

47. Hurricane forecasters look at sea surface temperatures, atmospheric pressure, and wind patterns to predict where a tropical storm might form and how it might strengthen. Why does combining these different kinds of data make a hurricane forecast more accurate?

A. Using more data makes a forecast less reliable, which is why forecasters combine many sources only when they want to make a wrong prediction on purpose

B. Using more data makes a forecast more time-consuming to produce but does not change the actual accuracy of the prediction at all in any meaningful way

C. Each kind of data captures a different aspect of the conditions that drive hurricane formation, so combining them gives a more complete and reliable picture

D. Each kind of data provides exactly the same information, so combining them does not improve a forecast and simply wastes the forecaster's valuable time

48. A weather observer carefully records the date, time, location, and weather conditions every time a measurement is taken. Why is recording this metadata along with each observation important for science?

- A. Without this information, the measurements cannot be combined with other data, compared with past records, or interpreted, so the metadata is essential context
- B. Without this information, the measurements automatically become more accurate, since the absence of metadata is what improves the quality of scientific data
- C. Without this information, the measurements still mean exactly the same thing they did before, since the date, time, and location have no effect on the values
- D. Without this information, the measurements become completely unique and irreplaceable, which actually increases their value to scientists studying the data

49. An engineering team designing a new wind turbine wants to test several different blade shapes to see which generates the most power. The team will test only one blade shape at a time, keeping the wind speed, generator, and tower height constant. Why is it important to change only one variable at a time?

- A. Changing only one variable at a time ensures that any difference in power output can be attributed to the blade shape and not to some other factor
- B. Changing only one variable at a time guarantees that the test will produce a result that exactly matches the engineers' original predictions before any testing begins
- C. Changing only one variable at a time makes the test take much longer, which is the actual purpose of using a controlled test rather than changing many variables at once
- D. Changing only one variable at a time has no effect on the validity of the test, since experiments give equally valid results whether one or many variables are changed at once

50. A student writes the following sentence in a lab notebook: "The rock contains shiny gold flecks and felt heavier than the others." Which part of the sentence describes an inference rather than a direct observation?

- A. The fact that the rock contains shiny gold flecks, since this is the student's conclusion about what the rock contains rather than what was directly observed
- B. The fact that the rock felt heavier than the others, since this is purely the student's conclusion about the rock and not an actual observation made in the lab
- C. Both parts of the sentence describe observations and not inferences, since every statement that mentions a property of a rock counts as a direct observation
- D. The claim that the flecks are gold, since the flecks were observed to be shiny but identifying them as gold goes beyond observation into the realm of interpretation

## Practice Exam 48: Answer Key with Explanations

1. C — A protoplanetary disk is the rotating flat disk of gas and dust around a young star from which planets form. Earth and the other planets emerged from such a disk surrounding the young Sun.
2. D — Planets around nearly all stars suggest that planet formation is a common natural outcome when a star forms from a collapsing cloud of gas and dust. Planetary systems appear to be a routine byproduct of star birth rather than a rare event.
3. A — The Moon rotates on its axis exactly once per orbit, which is why the same side keeps facing Earth. This synchronous rotation, not a lack of spinning, produces the near-side/far-side appearance.
4. B — A galaxy is a vast system of stars, gas, and dust held together by gravity, containing anywhere from millions to many hundreds of billions of stars. Galaxies are the large gravitationally bound groupings into which stars assemble.
5. C — A solar eclipse happens at new moon when the Moon blocks the Sun from Earth's view, while a lunar eclipse happens at full moon when Earth's shadow falls on the Moon. The Sun–Earth–Moon alignment differs at each phase, producing different eclipse types.
6. A — The Sun is much larger but much farther away, and this balance makes the Sun and Moon appear nearly the same size in Earth's sky. The angular sizes happen to roughly match because size and distance offset each other.
7. D — Mars has a thin carbon dioxide atmosphere, almost no liquid surface water, weak gravity, and very cold temperatures, none of which favor human life. These combined conditions make Mars far less hospitable than Earth.
8. B — A telescope gathers and focuses light or other electromagnetic radiation from distant objects so they appear brighter, clearer, or more detailed. Aperture size and optical quality determine how much detail can be revealed.
9. A — Sound waves need a medium such as air to travel through, and the Moon has no significant atmosphere, so they cannot move freely there. Without air, vibrations have nothing to propagate through between astronauts.
10. C — Comparing planetary surfaces shows that similar geologic processes can occur on different planets, but each planet's history is also shaped by its own conditions like atmosphere and size. This contrast highlights both common processes and unique outcomes.
11. C — The Moon's gravity helps stabilize Earth's axial tilt, which keeps the climate more steady over long times than it would otherwise be. This stabilizing influence is an important long-term effect beyond the tides.
12. B — The geologic time scale is built around mass extinctions, with the boundaries between eras frequently marking major changes in life. These shifts in the fossil record provide natural divisions in Earth's history.
13. D — By the principle of inclusions, the included pieces had to already exist as solid rock to be incorporated, so the inclusions are older than the surrounding igneous sheet. Fragments inside a rock predate the rock that captured them.
14. B — Many trilobite species were widespread and short-lived, so different species can serve as index fossils to identify and correlate specific time periods. Wide distribution allows correlation, while short ranges give precision.
15. A — Current evidence indicates a large asteroid impact, combined with intense volcanic activity, drastically altered the climate, leading to the dinosaurs' extinction. The combination of impact effects and volcanism disrupted ecosystems worldwide.

16. C — The age of the oldest known continental rocks shows Earth is at least as old as those rocks, giving a useful minimum age in billions of years. The planet must be older still, since these rocks formed sometime after Earth itself.
17. D — One-sixteenth remaining means four half-lives have passed ( $1 \rightarrow 1/2 \rightarrow 1/4 \rightarrow 1/8 \rightarrow 1/16$ ). Four times the 2-billion-year half-life gives about 8 billion years.
18. B — Uniformitarianism lets geologists interpret ancient rocks and landforms by studying processes observable today, since the same physical processes operate in both. Modern processes thus serve as a key to reading the rock record.
19. A — Plants colonizing the land slowly transformed the surface environment, building soils, removing carbon dioxide, and helping make the land suitable for animal life. This set the stage for later terrestrial ecosystems.
20. D — A mineral that scratches a glass plate of hardness 5.5 must itself be harder than 5.5 on the Mohs scale, since only harder materials can scratch softer ones. The test places a lower bound on the mineral's hardness.
21. C — The rigid outer layer of Earth made of the crust and the very top of the mantle, broken into the tectonic plates, is the lithosphere. It rides on the softer asthenosphere beneath.
22. A — When a cold front overtakes a warm front and lifts the warm air completely off the ground between two cold masses, an occluded front forms. The catching-up of one front to another defines an occlusion.
23. D — The heat driving mantle convection comes from the decay of radioactive elements within Earth and leftover heat from the planet's formation. Both internal sources continually supply the energy that keeps the mantle slowly circulating.
24. B — Formerly ice-covered land slowly rising as the weight of vanished glaciers is removed is glacial rebound. The lithosphere recovers its shape after the load of ice that once depressed it is gone.
25. A — Pumice cooled extremely quickly at the surface, trapping gas bubbles, while granite cooled slowly underground, allowing large crystals to grow. Cooling rate is what produces the texture differences between these igneous rocks.
26. C — A small stream that flows into and adds its water to a larger river is a tributary. Tributaries are the network of feeders that build up a watershed's main rivers.
27. D — Particles carried by wind, water, or ice that strike a rock surface and wear it down by mechanical action is abrasion. The repeated grinding gradually smooths or sculpts the rock without changing its chemistry.
28. B — Most of Earth's fresh water is locked in glaciers, ice sheets, and polar ice caps. Frozen reservoirs hold far more fresh water than rivers, lakes, or the atmosphere.
29. A — A long, low area bounded by faults where the crust has dropped down, often where two plates are pulling apart, is a rift valley. East Africa's Rift Valley is a classic example formed by extensional tectonics.
30. C — Rooftop solar panels reduce the amount of fossil fuel that must be burned to supply the buildings' electricity, lowering greenhouse gas emissions. Substituting solar generation for fossil-fuel generation cuts the associated carbon output.
31. A — Mixing crops can reduce pest outbreaks, improve soil health, and increase biodiversity, since different plants and their associated organisms support each other. Polyculture builds resilience into the farm system.

32. C — Species are linked through food webs and other relationships, so the loss of one species can affect many others that depend on it directly or indirectly. These ecological connections magnify the impact of biodiversity loss.
33. B — Rain gardens let rainwater soak into the soil rather than rushing into storm drains, reducing flooding, erosion, and the pollution carried by runoff. They mimic natural infiltration in built environments.
34. D — Responsibly managed aquaculture provides fish without taking them from wild populations, meeting demand that would otherwise drive heavier ocean fishing. This can relieve pressure on overexploited wild stocks.
35. A — Growing trees absorb carbon dioxide from the atmosphere through photosynthesis, helping reduce the buildup of this greenhouse gas. This carbon uptake is why reforestation is part of many climate strategies.
36. C — Long-term monitoring reveals slow ecological changes, such as shifts due to climate change or invasive species, that become visible only over long periods. Multi-decade records capture trends that snapshot studies would miss.
37. B — Actions in one country, such as pollution or damming, can affect the water supply, ecosystems, and people in countries farther downstream. This is why managing international rivers requires coordination among many parties.
38. D — Planting street trees and adding green roofs and parks cools cities because vegetation shades surfaces and cools the air through evaporation from leaves. These nature-based measures directly counter the urban heat island effect.
39. A — Incoming solar energy passes through all of the atmospheric layers, from the exosphere down through the thermosphere, mesosphere, and stratosphere, before reaching the troposphere and the ground. Each layer can absorb or scatter some of that energy on the way down.
40. C — Sinking air warms as it descends, increasing its capacity to hold moisture, which discourages cloud formation and produces clear, calm weather. This is why high pressure is generally associated with fair weather.
41. D — Most of the atmosphere's air is held near the surface by gravity, so the higher one goes, the less air is above pressing the molecules together, and density falls. This is why air thins out steadily with altitude.
42. A — Land heats faster than water because water has a much higher capacity to absorb heat without changing temperature, so the air over the field warms more than the air over the lake. This same property is why coasts moderate temperature compared with inland areas.
43. C — Strong rising currents of warm, moist air lift water vapor high into the atmosphere where it condenses into the tall cauliflower-shaped cumulus towers. Vigorous updrafts are what build cumulus clouds vertically.
44. B — The matching rises in carbon dioxide and global temperature support the link between increasing carbon dioxide and warming, consistent with carbon dioxide acting as a heat-trapping greenhouse gas. The two records moving together is a key line of evidence.
45. D — The process that changes water vapor into the tiny liquid droplets that form clouds is condensation. As rising air cools to its dew point, vapor condenses on tiny particles to make cloud droplets.
46. A — Water heats and cools more slowly than land, so a nearby ocean smooths out the seasonal temperature swings of a coastal location. This high heat capacity gives coasts milder, less extreme climates than inland areas.

47. C — Each kind of data captures a different aspect of the conditions that drive hurricane formation, so combining them gives a more complete and reliable picture. Multiple data sources fill in gaps that any single source would leave.
48. B — Without date, time, and location, measurements cannot be combined, compared with past records, or properly interpreted, so the metadata is essential context. This contextual information is what makes the data scientifically usable.
49. A — Changing only one variable at a time ensures that any difference in the outcome can be attributed to that one factor rather than to something else. This controlled approach is what makes the experimental result trustworthy.
50. D — Observing shiny flecks is direct, but identifying them as gold goes beyond observation into interpretation, which is an inference. Recognizing the difference helps keep lab records accurate and honest.