PRACTICE EXAM 31: EARTH AND SPACE SCIENCES REGENTS SIMULATION (50 QUESTIONS)

1. Two stars have the same actual luminosity, but Star A appears much brighter than Star B in Earth's night sky. What is the most likely explanation?

A. Star A is much hotter than Star B and therefore produces far more total energy each second

B. Star A is much older than Star B and has already entered its bright red giant stage

C. Star A emits most of its energy as visible light while Star B emits mostly infrared

D. Star A is much closer to Earth than Star B, so its light is spread over a smaller area

2. Which list correctly orders these forms of electromagnetic radiation from longest wavelength to shortest wavelength?

A. Gamma rays, X-rays, ultraviolet, visible light, infrared, and finally radio waves

B. Radio waves, infrared, visible light, ultraviolet, X-rays, and finally gamma rays

C. Visible light, radio waves, infrared, ultraviolet, gamma rays, and finally X-rays

D. Infrared, radio waves, visible light, X-rays, ultraviolet, and finally gamma rays

3. The light from a distant galaxy shows its spectral lines shifted toward the red end of the spectrum. What does this redshift indicate about the galaxy?

A. The galaxy is moving away from Earth, and its light waves are stretched to longer wavelengths

B. The galaxy is moving toward Earth, and its light waves are compressed to shorter wavelengths

C. The galaxy is composed mainly of cool red stars rather than hot blue stars overall

D. The galaxy is stationary relative to Earth but contains unusually large amounts of red dust

4. Which characteristic best distinguishes the inner terrestrial planets from the outer gas giant planets?

A. The terrestrial planets each have far more moons than any of the gas giant planets do

B. The terrestrial planets orbit the Sun much more slowly than the distant gas giant planets

C. The terrestrial planets are small, rocky, and dense, while gas giants are large and low in density

D. The terrestrial planets are made mostly of hydrogen and helium gas like the gas giants are

5. The Sun has shone steadily for billions of years. Which process allows the Sun to release energy for such an enormous length of time?

A. The gradual chemical combustion of hydrogen gas reacting with oxygen in the Sun's hot core

B. The slow gravitational contraction of the Sun converting potential energy into heat alone

C. The radioactive decay of heavy unstable elements concentrated deep in the Sun's center

D. The nuclear fusion of hydrogen into helium, converting a small amount of mass into energy

6. A lunar eclipse can occur only when the three bodies are aligned in which arrangement?

A. The Sun, Earth, and Moon are aligned with Earth between the Sun and the full moon

B. The Sun, Moon, and Earth are aligned with the Moon directly between the Sun and Earth

C. The Moon, Sun, and Earth are aligned with the Sun directly between Earth and the Moon

D. The three bodies form a right angle, with the Moon at the corner during a quarter phase

7. A planet travels in an elliptical orbit around the Sun. At which point in its orbit does the planet move fastest?

A. At aphelion, the point in the orbit where the planet is farthest from the Sun

B. The planet moves at a constant speed throughout its entire elliptical orbit at all times

C. At perihelion, the point in the orbit where the planet is closest to the Sun

D. At the two points where the orbit crosses the plane of Earth's own orbit exactly

8. On a Hertzsprung-Russell diagram, where are most stars, including the Sun, located?

A. In the upper-right region, where cool stars of very high luminosity are grouped together

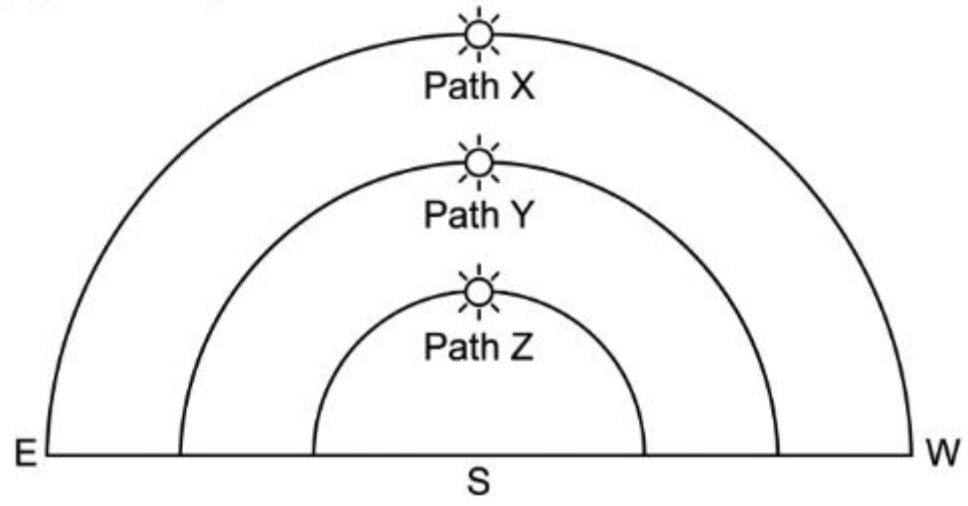
B. Along the main sequence, the diagonal band running from upper-left to lower-right

C. In the lower-left region, where only the faint, cool red dwarf stars are plotted

D. Scattered randomly across the diagram with no consistent pattern of any kind

9. The diagram shows the apparent paths of the Sun across the sky at one New York State location on three different dates. Which path corresponds to the summer solstice?

[Figure PQ-1]



A. Path Z, because the Sun follows its lowest and shortest arc on the summer solstice

B. Path Y, because the Sun follows an identical path on every date throughout the entire year

C. The Sun does not appear to follow any arc at this latitude during the summer months

D. Path X, because the Sun reaches its highest altitude and longest arc at the summer solstice

10. What is the primary difference between a comet and an asteroid in our solar system?

A. Comets orbit only within the inner solar system, while asteroids orbit only far beyond Neptune

B. Comets are much larger than any asteroid and are always visible to the unaided eye from Earth

C. Comets are made largely of ice and dust and grow tails near the Sun, while asteroids are rocky or metallic

D. Asteroids contain large amounts of frozen gases, while comets are composed entirely of solid iron

11. What keeps a planet in a stable orbit around the Sun rather than flying off into space or falling into the Sun?

A. A balance between the planet's forward motion and the Sun's inward gravitational pull

B. The outward push of the solar wind exactly canceling the planet's forward momentum

C. The magnetic attraction between the Sun's poles and the metallic core of the planet

D. The gravitational pull of distant background stars holding the planet at a fixed distance

12. Which sequence lists these geologic time intervals in the correct order from oldest to youngest?

A. Cenozoic Era, Mesozoic Era, Paleozoic Era, and finally the long Precambrian time span

B. Precambrian time, Paleozoic Era, Mesozoic Era, and finally the Cenozoic Era

C. Paleozoic Era, Precambrian time, Cenozoic Era, and finally the Mesozoic Era

D. Mesozoic Era, Cenozoic Era, Precambrian time, and finally the Paleozoic Era

13. In a sequence of rock layers, a buried erosional surface separates older tilted layers below from younger horizontal layers above. This feature is called:

A. A fault, where rock layers have been displaced by movement along a fracture in the crust

B. An intrusion, where molten rock has forced its way into preexisting solid rock layers

C. A fold, where rock layers have been bent by compression without breaking apart at all

D. An angular unconformity, a gap in the rock record marked by tilting and then erosion

14. What does the term "half-life" of a radioactive isotope describe?

A. The time required for half of the atoms in a radioactive sample to decay into another element

B. The total time required for an entire radioactive sample to decay completely into stable atoms

C. The time it takes for a sample to double the number of its original radioactive atoms present

D. Half the total age of any rock that happens to contain that particular radioactive isotope

15. Which set of conditions is most favorable for the preservation of an organism's remains as a fossil?

A. The organism dies on a dry, windswept hillside where it is exposed to weathering for years

B. The organism is scavenged and its bones are scattered across a wide forest floor over time

C. The organism is buried rapidly by sediment in a calm, low-oxygen environment soon after death

D. The organism decays slowly in warm, oxygen-rich water teeming with bacteria and scavengers

16. Radiometric dating indicates Earth is about 4.6 billion years old. The oldest materials used to establish this age are:

A. The oldest fossils of complex animals preserved within shale layers around the world

B. Meteorites and the oldest mineral crystals, which date from the solar system's formation

C. Thick layers of coal formed from ancient swamp forests buried deep beneath the continents

D. Annual growth rings counted in petrified tree trunks found across several continents

17. For most of Earth's long history, what was the dominant form of life on the planet?

A. Large land animals such as reptiles and early mammals roaming widely across the continents

B. Flowering plants and broad forests covering most of the available land surface area

C. Fish and other complex swimming animals filling the oceans from pole to pole entirely

D. Simple single-celled microorganisms living in the oceans for billions of years

18. Which observation about the ocean floor provides strong evidence for seafloor spreading?

A. The age of oceanic crust increases with distance from the mid-ocean ridges, symmetrically on both sides

B. The deepest parts of every ocean are located precisely at the exact center of each ocean basin

C. The ocean floor is the same age everywhere, having all formed at one single time in the past

D. Oceanic crust is found to be far older on average than any of the continental crust present

19. Two rock outcrops at different locations are shown side by side. A distinctive index fossil appears in one layer at each site. What can a geologist most reasonably conclude from this shared fossil?

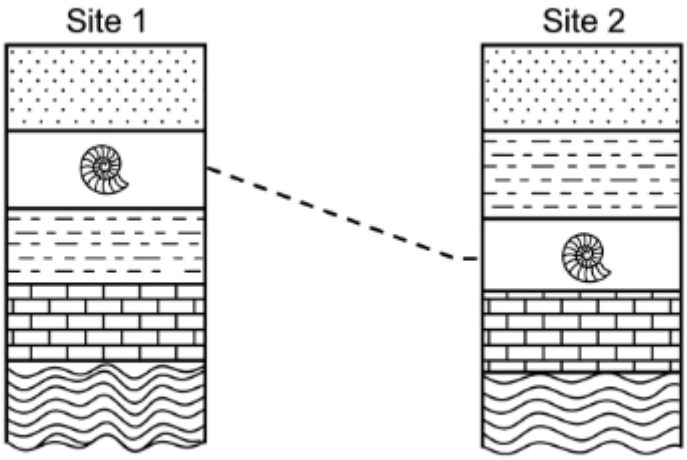


Figure PQ-2

A. The two outcrops were originally part of one continuous layer that has never once been disturbed

B. The two fossil-bearing layers formed during the same period of geologic time and can be correlated

C. The outcrop at Site 1 is far older overall than the outcrop shown at Site 2 on the right

D. The index fossil organism is still living today in both of these two separate locations

20. Limestone is buried deep within Earth and subjected to intense heat and pressure during mountain building. Which rock will it most likely become?

A. Sandstone, a sedimentary rock formed when loose sand grains are cemented together over time

B. Granite, a coarse igneous rock that forms when magma cools slowly far underground over time

C. Marble, a metamorphic rock formed when limestone recrystallizes under heat and pressure

D. Obsidian, a glassy igneous rock that forms when thick lava cools almost instantly at the surface

21. An igneous rock has very large, easily visible interlocking crystals. What does this texture indicate about how the rock formed?

A. The molten rock cooled extremely rapidly at Earth's surface right after a volcanic eruption

B. The rock formed from sediment that was compacted and cemented together deep underground

C. The rock was shattered and re-fused by a large meteorite impact early in Earth's history

D. The molten rock cooled very slowly deep underground, giving its crystals time to grow large

22. A mineral's physical properties such as hardness, cleavage, and crystal shape are determined primarily by which factor?

A. The temperature of the surrounding air at the exact moment the mineral is first discovered

B. The internal arrangement of its atoms and the chemical composition of the mineral itself

C. The total size and overall mass of the individual mineral sample being examined closely

D. The color of the light source used while a geologist observes the mineral specimen

23. Heat is transferred through Earth's mantle mainly by convection. Which statement best describes how convection moves heat?

A. Hot, less dense material rises while cooler, denser material sinks, creating a circulating flow

B. Heat passes directly from particle to particle through solid rock without any movement of material

C. Energy travels as electromagnetic waves through the empty space within the solid mantle layer

D. Heat is carried only by earthquakes that periodically shake the rock of the mantle violently

24. Which process in the water cycle releases energy into the atmosphere, helping to power storms?

A. Evaporation, which absorbs energy from the surroundings as liquid water becomes water vapor

B. Melting, which absorbs energy as solid ice changes into liquid water at the surface of the land

C. Runoff, which carries liquid water across the land surface back toward the ocean basins

D. Condensation, which releases stored latent heat as water vapor changes back into liquid droplets

25. A sample of clay has very small particles packed tightly together. It holds a large amount of water but releases it extremely slowly. Which statement best describes this clay?

A. The clay has both low porosity and low permeability because of its very small particle size

B. The clay has high permeability, allowing water to pass through it quickly and easily at all times

C. The clay has high porosity but low permeability, holding water yet resisting its flow through it

D. The clay has low porosity but high permeability, storing little water while letting it flow freely

26. A river meander is shown from above. At which position along the bend would erosion of the bank be greatest?

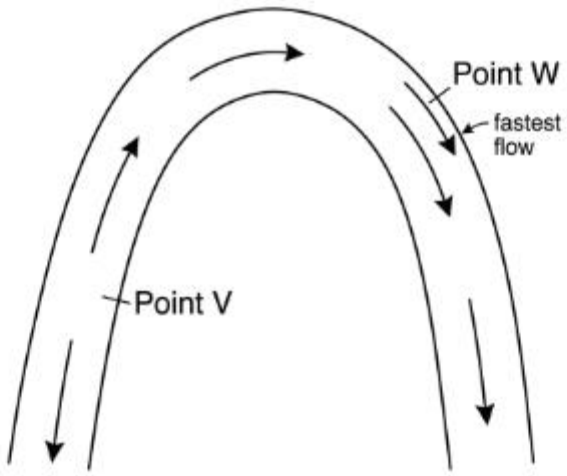


Figure PQ-3

A. Along the inner bank at Point V, where the water moves most slowly around the curve

B. Along the outer bank at Point W, where the water moves fastest around the curve

C. Erosion is exactly equal at every point along the meander regardless of the water speed

D. Only at the exact center of the straight section located directly upstream of the river bend

27. What is the key difference between weathering and erosion?

A. Weathering breaks rock down in place, while erosion is the transport of the broken material away

B. Weathering only happens underwater, while erosion only happens on dry land far from any water

C. Weathering transports rock fragments to new locations, while erosion breaks rock apart in place

D. Weathering affects only igneous rocks, while erosion affects only sedimentary rocks specifically

28. Which type of seismic wave travels fastest and is the first to be recorded at a seismograph station after an earthquake?

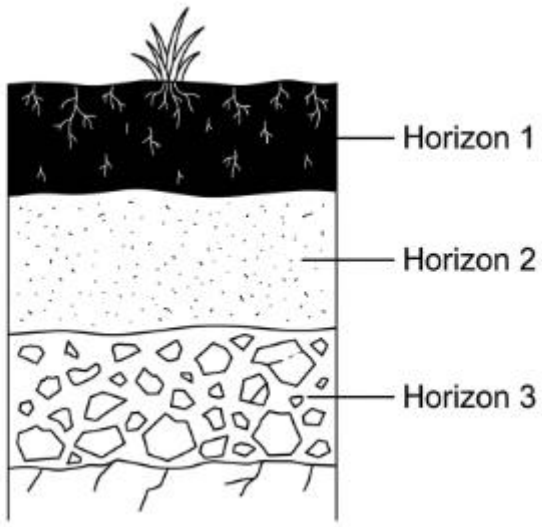
A. The surface waves, which cause the most violent ground shaking and the greatest structural damage

B. The S-waves, or secondary waves, which move material from side to side as they travel along

C. The P-waves, or primary waves, which compress and expand material in their direction of travel

D. The tsunami waves, which travel across the open ocean before reaching distant coastlines later

29. A soil profile is shown with three labeled horizons. Which horizon, richest in decayed organic material, is normally found at the top of a mature soil profile?



A. Horizon 3, the lowest layer that sits directly on top of the unweathered bedrock below

B. Horizon 1, the dark uppermost layer containing the most decayed organic material and roots

C. Horizon 2, the middle layer where minerals leached from above tend to accumulate over time

D. The organic material is spread evenly through all three horizons with no concentration anywhere

30. A landscape characterized by many caves, sinkholes, and underground streams most likely developed on which type of bedrock?

A. Solid granite, which strongly resists chemical weathering and rarely dissolves in groundwater

B. Layered sandstone, which resists dissolving but is easily eroded by fast-moving surface streams

C. Dense basalt, an igneous rock that forms broad flat plateaus from ancient flowing lava

D. Limestone, a soluble rock that dissolves in slightly acidic groundwater to form caves and sinkholes

31. A geologist places a drop of dilute hydrochloric acid on an unknown rock, and the rock fizzes vigorously. This reaction indicates the rock most likely contains which mineral?

A. Calcite, the carbonate mineral that reacts with acid by releasing bubbles of carbon dioxide gas

B. Quartz, a hard silicate mineral that is completely unreactive with dilute hydrochloric acid

C. Feldspar, an abundant silicate mineral that shows no reaction at all when exposed to weak acid

D. Pyrite, a metallic sulfide mineral that produces a magnetic response rather than any fizzing

32. As a weather balloon rises higher into the atmosphere, how do the air pressure and air density around it change?

A. Both air pressure and air density increase steadily as the balloon climbs to higher altitudes

B. Air pressure increases while air density decreases as the balloon rises through the atmosphere

C. Both air pressure and air density decrease as the balloon rises to higher altitudes overhead

D. Both air pressure and air density remain exactly constant at every altitude the balloon reaches

33. Clouds form when a rising parcel of moist air cools to a certain temperature. What is this temperature called, and what happens at it?

A. The freezing point, at which all of the water vapor in the air instantly turns into solid ice

B. The dew point, at which the air becomes saturated and water vapor condenses into tiny droplets

C. The boiling point, at which liquid water in the parcel rapidly evaporates into invisible vapor

D. The melting point, at which existing ice crystals high in the cloud turn back into liquid water

34. What is the fundamental cause of wind in Earth's atmosphere?

A. The rotation of Earth alone, which physically drags all of the air along with the spinning surface

B. The gravitational pull of the Moon tugging the entire atmosphere across the planet's surface daily

C. The magnetic field of Earth steering charged air particles along curved paths near the ground

D. Differences in air pressure, which cause air to move from areas of higher to lower pressure

35. The polar jet stream is a fast-moving ribbon of air high in the atmosphere. How does it most influence weather in the mid-latitudes?

A. It steers storm systems along its path and separates cold polar air from warmer air to the south

B. It blocks nearly all sunlight from reaching the surface, keeping the mid-latitudes permanently cold

C. It supplies the moisture for every rainstorm directly from the upper layers of the atmosphere

D. It prevents any air masses from ever moving, keeping mid-latitude weather completely unchanging

36. What is the key difference between weather and climate?

A. Weather describes only temperature, while climate describes only the amount of precipitation

B. Weather refers to conditions over many decades, while climate refers to conditions on a single day

C. Weather is the state of the atmosphere over a short time, while climate is the long-term average pattern

D. Weather applies only to the tropics, while climate applies only to the polar regions of Earth

37. Over tens of thousands of years, Earth has cycled between ice ages and warmer periods. Which factor is a major natural cause of these long-term climate cycles?

A. Sudden short-term changes in the amount of carbon dioxide released by passing comets nearby

B. Random daily fluctuations in the brightness of the Sun observed over just a few years at a time

C. The gradual cooling of Earth's molten core, steadily reducing the heat reaching the surface

D. Regular variations in Earth's orbit and the tilt of its axis that alter how sunlight is distributed

38. During an El Niño event, unusually warm surface water spreads across the eastern tropical Pacific Ocean. What is one common global effect of this change?

A. It permanently lowers global sea level by freezing large volumes of ocean water at the poles

B. It alters weather patterns worldwide, shifting rainfall and causing droughts or floods in many regions

C. It has no measurable effect on weather anywhere outside the immediate tropical Pacific region itself

D. It strengthens the ozone layer by adding large amounts of oxygen to the upper tropical atmosphere

39. Which instrument is used to measure the relative humidity of the atmosphere?

A. A barometer, which measures the weight of the column of air pressing down on the surface

B. An anemometer, which measures the speed of the wind as it moves past a fixed sensor

C. A psychrometer, which compares wet-bulb and dry-bulb temperatures to find relative humidity

D. A seismograph, which records the shaking of the ground produced by earthquake waves

40. A warm front approaches a region as warm air gradually rides up over retreating cold air. What weather is most typical ahead of an approaching warm front?

A. A long period of widespread, steady, light to moderate precipitation as the front slowly nears

B. A sudden violent squall line of thunderstorms followed by rapidly clearing and cooling conditions

C. Strong gusty winds and a sharp drop in temperature occurring within just a few minutes of passage

D. Completely clear skies with no clouds and no chance of any precipitation for many days ahead

41. Which statement describes a major advantage of generating electricity from solar and wind power compared with burning coal?

A. Solar and wind power can operate at full output continuously regardless of the weather conditions

B. Solar and wind facilities are always cheaper to build than any coal-fired power plant ever is

C. Solar and wind power produce large quantities of solid radioactive waste that is easy to store

D. Solar and wind power generate electricity without releasing carbon dioxide or air pollutants during operation

42. Excess fertilizer washing from farm fields into a lake can cause an overgrowth of algae. When the algae later die and decompose, what is the most harmful result for the lake?

A. The water becomes much clearer and richer in oxygen, greatly benefiting the fish populations there

B. Decomposing algae consume dissolved oxygen, which can suffocate fish and other aquatic organisms

C. The lake water becomes permanently frozen solid, eliminating all of the living organisms within it

D. The added nutrients make the lake water completely safe and pure for direct human drinking use

43. A farmer plants cover crops and plows along the contour of sloped land instead of straight up and down the slope. What is the main purpose of these practices?

A. To increase the speed at which rainwater runs off the field and into nearby streams more quickly

B. To completely eliminate the farmer's need to ever add any fertilizer or nutrients to the soil again

C. To reduce soil erosion by slowing runoff and holding the soil in place on the slope

D. To raise the temperature of the soil so that crops can be planted much earlier in the spring

44. A community in an earthquake-prone region updates its building codes to require flexible, reinforced structures. This action is best described as an effort to:

A. Reduce the loss of life and property damage by making buildings better able to withstand shaking

B. Prevent earthquakes from occurring beneath the community by stabilizing the underlying fault zone

C. Predict the exact date and time of the next major earthquake to strike the surrounding region

D. Increase the magnitude of future earthquakes so that the new buildings can be properly tested

45. As the global human population and its consumption of resources continue to grow, which outcome is most likely without changes in how resources are used?

A. Natural resources will automatically replenish themselves faster than they are being consumed

B. The demand for energy, water, and land will steadily decrease across the entire planet over time

C. Human activity will have a smaller and smaller impact on natural ecosystems with each passing year

D. Increasing pressure on resources and ecosystems, making sustainable management more important

46. Which individual action would most directly reduce a person's contribution to greenhouse gas emissions?

A. Leaving household lights and electronic devices switched on at all hours throughout every day

B. Using public transportation, biking, or walking instead of driving a gasoline-powered car alone

C. Setting the home thermostat to extreme temperatures during both the summer and winter months

D. Increasing the amount of single-use plastic products purchased and then discarded each week

47. The stratospheric ozone layer is important to life on Earth because it:

A. Traps heat near Earth's surface and is the single main cause of recent global warming trends

B. Provides the oxygen that humans and animals breathe directly from the upper atmosphere above

C. Absorbs much of the Sun's harmful ultraviolet radiation before it can reach the surface

D. Reflects incoming meteors away from Earth, preventing them from striking the ground below

48. Recycling aluminum cans rather than producing new aluminum from raw ore is beneficial mainly because it:

A. Produces aluminum of far higher quality than the original metal made from fresh raw ore

B. Requires no energy at all and creates absolutely no waste during the entire recycling process

C. Permanently removes aluminum from the environment so that it can never be reused again

D. Uses much less energy and conserves the raw materials needed to make brand-new aluminum

49. After building a prototype flood barrier, an engineering team tests it and discovers a weakness. According to the engineering design process, what should the team do next?

A. Abandon the entire project permanently, since any flaw means the design can never possibly succeed

B. Modify the design to address the weakness, then test the improved version again

C. Ignore the weakness and immediately mass-produce the prototype exactly as it was first built

D. Replace the entire engineering team with a completely new group before doing any further work

50. A scientist collects temperature data from many weather stations over fifty years to study climate trends. Why is using such a large, long-term data set important?

A. A large, long-term data set reveals reliable trends and reduces the influence of short-term variations

B. A large data set guarantees that every single measurement within it is perfectly accurate and error-free

C. A long record is useful only for predicting tomorrow's weather and nothing about climate at all

D. More data always makes any conclusion harder to reach, so smaller samples are generally better

ANSWERS KEY WITH EXPLANATIONS

1. D — When two stars have equal true luminosity, the one that looks brighter must be closer, because apparent brightness decreases with the square of distance as light spreads over a larger area. Star A's greater apparent brightness is explained by its smaller distance, not by any difference in its actual energy output.
2. B — The electromagnetic spectrum runs from longest to shortest wavelength as radio, infrared, visible, ultraviolet, X-rays, and gamma rays. Wavelength and energy are inversely related, so this same order also runs from lowest to highest energy, which is why gamma rays are both shortest and most energetic.
3. A — A redshift means the spectral lines are stretched toward longer wavelengths, which by the Doppler effect indicates the source is moving away from the observer. The pattern of greater redshift at greater distance is the central evidence that the universe is expanding.
4. C — Terrestrial planets are small, rocky, and dense, while the gas giants are large and have low overall density because they are composed mainly of hydrogen and helium. This contrast in size, composition, and density is the defining difference between the inner and outer planet groups.
5. D — The Sun's long-lived energy output comes from nuclear fusion, in which hydrogen nuclei fuse into helium and a tiny fraction of mass is converted to energy according to $E = mc^2$. Chemical burning or gravitational contraction alone could not sustain this output for billions of years, so fusion is the source.
6. A — A lunar eclipse requires Earth to be positioned directly between the Sun and a full Moon, so that Earth's shadow falls across the Moon. This Sun–Earth–Moon alignment at the full phase is what allows the shadow to darken the lunar surface.
7. C — By Kepler's second law, a planet sweeps equal areas in equal times, so it moves fastest when nearest the Sun. That closest point is perihelion, where the stronger gravitational pull corresponds to the planet's greatest orbital speed.
8. B — Most stars, including the Sun, lie along the main sequence, the diagonal band on an H-R diagram running from hot, bright stars at upper-left to cool, dim stars at lower-right. Stars spend most of their lives fusing hydrogen on this band, which is why it contains the great majority of stars.
9. D — At a New York latitude, the Sun reaches its highest altitude and traces its longest arc across the sky on the summer solstice, which corresponds to the highest path shown. The greater Sun angle and longer arc produce the most daylight and the most intense insolation of the year.
10. C — Comets are made largely of ice and dust and develop glowing tails as solar heating vaporizes their ices near the Sun, while asteroids are rocky or metallic bodies that do not. This difference in composition, and the resulting tail, distinguishes the two clearly.
11. A — A planet stays in orbit through a balance between its forward inertial motion and the Sun's inward gravitational pull, which continually bends that straight-line motion into a closed orbit. Without gravity the planet would fly off in a straight line; without forward motion it would fall inward.
12. B — The correct oldest-to-youngest order is Precambrian time, then the Paleozoic, Mesozoic, and Cenozoic Eras. Knowing this sequence is essential for placing fossils and rock layers in their proper relative position in Earth's history.

13. D — An angular unconformity is a buried erosional surface where older tilted layers lie beneath younger horizontal layers, recording deposition, tilting, erosion, and renewed deposition. The angular contact between differently oriented layers is the diagnostic feature of this gap in the rock record.
14. A — The half-life is the time required for half of the radioactive atoms in a sample to decay into a daughter product. This constant rate of decay is what makes radioactive isotopes reliable natural clocks for determining the absolute ages of rocks.
15. C — Fossilization is favored by rapid burial in a calm, low-oxygen environment soon after death, which protects remains from scavengers, decay, and weathering. Slow exposure, scattering, or oxygen-rich water destroys remains before they can be preserved, so quick burial is key.
16. B — Earth's 4.6-billion-year age is established from meteorites and the oldest mineral crystals, which formed at the time the solar system itself condensed. Earth's surface rocks have been recycled by geologic activity, so these unaltered early materials provide the most accurate age.
17. D — For most of Earth's history, simple single-celled microorganisms in the oceans were the dominant form of life, long before complex plants and animals appeared. Multicellular life is a comparatively recent development, occupying only the most recent portion of the geologic record.
18. A — The symmetrical increase in oceanic crust age with distance from a mid-ocean ridge shows that new crust forms at the ridge and spreads outward in both directions. This age pattern is direct evidence of seafloor spreading and supports plate tectonic theory.
19. B — A distinctive index fossil shared by layers at two different sites indicates those layers formed during the same span of geologic time and can be correlated. Because index fossils existed only briefly but spread widely, they let geologists match rock layers across separate locations.
20. C — When limestone is subjected to heat and pressure during mountain building, it recrystallizes into the metamorphic rock marble. The original calcite recrystallizes into interlocking grains, which is why marble forms specifically from a limestone parent rock.
21. D — Large, visible interlocking crystals indicate slow cooling deep underground, which gives mineral grains ample time to grow. Rapid surface cooling instead produces fine-grained or glassy textures, so coarse crystals point to an intrusive, slow-cooling origin.
22. B — A mineral's hardness, cleavage, and crystal shape arise from the orderly internal arrangement of its atoms and its chemical composition. Because these properties stem from atomic structure rather than sample size or lighting, they serve as consistent tools for mineral identification.
23. A — In mantle convection, hot, less dense rock rises while cooler, denser rock sinks, setting up a circulating flow that transfers heat upward. This movement of material, driven by density differences from heating, is the mechanism that also helps drive plate motion.
24. D — Condensation releases stored latent heat to the surrounding air as water vapor changes back into liquid droplets, and this energy release helps power storms. Evaporation and melting absorb energy, so condensation is the phase change that adds heat to the atmosphere.
25. C — Clay has high porosity because its many tiny spaces hold abundant water, but low permeability because those spaces are too small and poorly connected to let water move quickly. This combination explains why clay stores water yet drains very slowly.
26. B — Erosion is greatest along the outer bank of a meander, where the water moves fastest and carries the most energy. The faster flow on the outside undercuts the bank, while slower water on the inside deposits sediment, which is why meanders migrate outward over time.
27. A — Weathering is the breakdown of rock in place, whereas erosion is the transport of that broken material to a new location by water, wind, or ice. Keeping this distinction clear is fundamental: one process loosens material and the other moves it.

28. C — P-waves, or primary waves, travel fastest and arrive first because they compress and expand material in their direction of travel and can move through both solids and liquids. Their speed makes them the first signal recorded, ahead of the slower S-waves and surface waves.
29. B — The dark uppermost horizon of a mature soil profile contains the most decayed organic material and plant roots, making it the topsoil. Organic matter accumulates at the surface where plants grow, so this richest organic layer sits at the top of the profile.
30. D — Caves, sinkholes, and underground streams are characteristic of karst landscapes that develop on limestone, because slightly acidic groundwater slowly dissolves the soluble rock. Insoluble rocks like granite and basalt do not dissolve this way, so limestone is the parent material.
31. A — A vigorous fizz when dilute hydrochloric acid contacts a rock indicates calcite, a carbonate mineral that reacts with acid to release carbon dioxide bubbles. This simple acid test is a standard field method for identifying calcite-bearing rocks such as limestone.
32. C — As altitude increases, both air pressure and air density decrease, because less atmosphere lies above to press down and the thinning air contains fewer molecules per unit volume. A rising balloon therefore experiences steadily falling pressure and density together.
33. B — Clouds form when rising moist air cools to its dew point, the temperature at which the air becomes saturated and water vapor condenses into tiny droplets. Reaching this saturation temperature is the trigger for condensation and cloud formation.
34. D — Wind is driven by differences in air pressure, with air flowing from higher-pressure toward lower-pressure regions. These pressure differences, created by uneven heating of the surface, are the fundamental cause of all atmospheric winds.
35. A — The polar jet stream steers mid-latitude storm systems along its path and marks the boundary separating cold polar air from warmer air to the south. Its position therefore strongly influences which regions experience storms and shifting temperatures.
36. C — Weather is the short-term state of the atmosphere at a given moment, while climate is the long-term average of those conditions over many years. Distinguishing a momentary condition from a long-term pattern is the essential difference between the two terms.
37. D — Long-term ice age cycles are driven largely by regular variations in Earth's orbit and axial tilt, which change how sunlight is distributed across the planet over tens of thousands of years. These predictable orbital changes alter insolation enough to pace glacial and interglacial periods.
38. B — During El Niño, warm eastern tropical Pacific water shifts global atmospheric circulation, redistributing rainfall and producing droughts in some regions and floods in others far beyond the tropics. This worldwide reach is why El Niño is a major driver of year-to-year weather variability.
39. C — A psychrometer measures relative humidity by comparing wet-bulb and dry-bulb temperatures, since greater evaporative cooling of the wet bulb indicates drier air. The difference between the two readings is used to determine the relative humidity.
40. A — Ahead of a warm front, warm air slowly rises over retreating cold air along a gentle slope, producing widespread, steady, light to moderate precipitation over a long period. The gradual lifting explains the prolonged, gentle rain typical of warm fronts.
41. D — The major advantage of solar and wind power over coal is that they generate electricity without releasing carbon dioxide or air pollutants during operation. This reduction of emissions is the central environmental benefit driving their adoption.
42. B — When excess fertilizer triggers an algal bloom and the algae later die, their decomposition consumes dissolved oxygen, which can suffocate fish and other aquatic life. This oxygen depletion is the core harm of nutrient pollution and eutrophication in lakes.

43. C — Cover crops and contour plowing reduce soil erosion by slowing runoff and holding soil in place across a slope. By keeping the soil anchored and water moving more slowly, these conservation practices protect the land's fertility over time.
44. A — Strengthening building codes in an earthquake-prone area reduces loss of life and property by making structures better able to withstand shaking. This is a mitigation strategy, since earthquakes cannot be prevented or precisely predicted, only prepared for.
45. D — Continued growth in population and consumption places increasing pressure on resources and ecosystems, which is why sustainable management becomes more important. Resources do not replenish automatically faster than they are used, so deliberate stewardship is required to avoid depletion.
46. B — Choosing public transportation, biking, or walking instead of driving alone most directly cuts an individual's greenhouse gas emissions by reducing fossil fuel combustion. Transportation is a major personal emissions source, so changing how one travels has a large direct effect.
47. C — The stratospheric ozone layer protects life by absorbing much of the Sun's harmful ultraviolet radiation before it reaches the surface. This shielding reduces the UV exposure that can damage living tissue, which is why ozone depletion is a serious concern.
48. D — Recycling aluminum uses far less energy and conserves raw materials compared with refining new aluminum from ore. Because producing aluminum from ore is extremely energy-intensive, recycling delivers large energy savings and reduces the demand for raw bauxite.
49. B — When testing reveals a weakness in a prototype, the engineering design process calls for modifying the design to fix the problem and then retesting the improved version. This iterative cycle of test, refine, and retest is how engineering solutions are improved toward a working design.
50. A — A large, long-term data set reveals reliable trends and reduces the influence of short-term fluctuations that could mislead a study of climate. Averaging over many stations and many years separates the genuine long-term signal from day-to-day variability, which is why a big record matters.