The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

EARTH AND SPACE SCIENCES

Tuesday, June 10, 2025 — 1:15 to 4:15 p.m., only

Student Name _____

School Name _____

The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

Print your name and the name of your school on the lines above.

Use your knowledge of **Earth and Space Sciences** to answer all questions in this examination. Before you begin this examination, you must be provided with the ***2024 Edition Reference Tables for Earth and Space Sciences***. You may need to use these reference tables to answer some of the questions.

You are to answer all questions in this examination. You may use scrap paper to work out the answers to the questions, but be sure to record your answers on your answer sheet and in your test booklet. A separate answer sheet for multiple-choice questions has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers for the constructed response questions in your test booklet.

All answers in your test booklet should be written in pen, except for graphs and drawings, which should be done in pencil.

When you have completed the examination, you must sign the declaration printed on your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet and test booklet cannot be accepted if you fail to sign this declaration.

NOTICE …

A four-function or scientific calculator and a copy of the ***2024 Edition Reference Tables for Earth and Space Sciences*** must be available for you to use while taking this examination.

Note that diagrams are not drawn to scale unless otherwise noted.

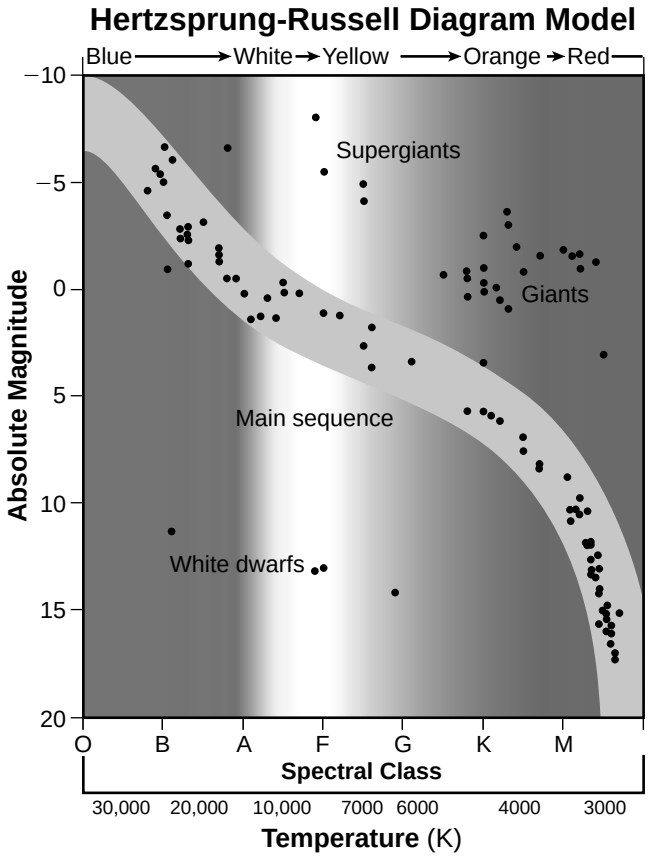
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Base your answers to questions 1 through 5 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***. Be sure to record your multiple choice questions on a separate answer sheet provided. Record your answers for the constructed response questions in your test booklet.

Our Sun – A Star

The Hertzsprung-Russell (H-R) diagram was developed from star charts by two scientists in different countries independently of each other in 1911. It classified stars based on their surface temperatures, observable color, and magnitude. Absolute magnitude is a measurement of how bright a star would appear if all stars are the same distance from Earth. The brighter the star, the lower the absolute magnitude value.

1 Our Sun is classified as a spectral class G star with a surface temperature between 5000 to 6000 K and an absolute magnitude of about five. Based on this information, complete the H-R diagram model by placing **one X** to indicate where the Sun is located. Also, identify the relative temperature and relative absolute magnitude of the Sun as it transitions to a red giant. [1]

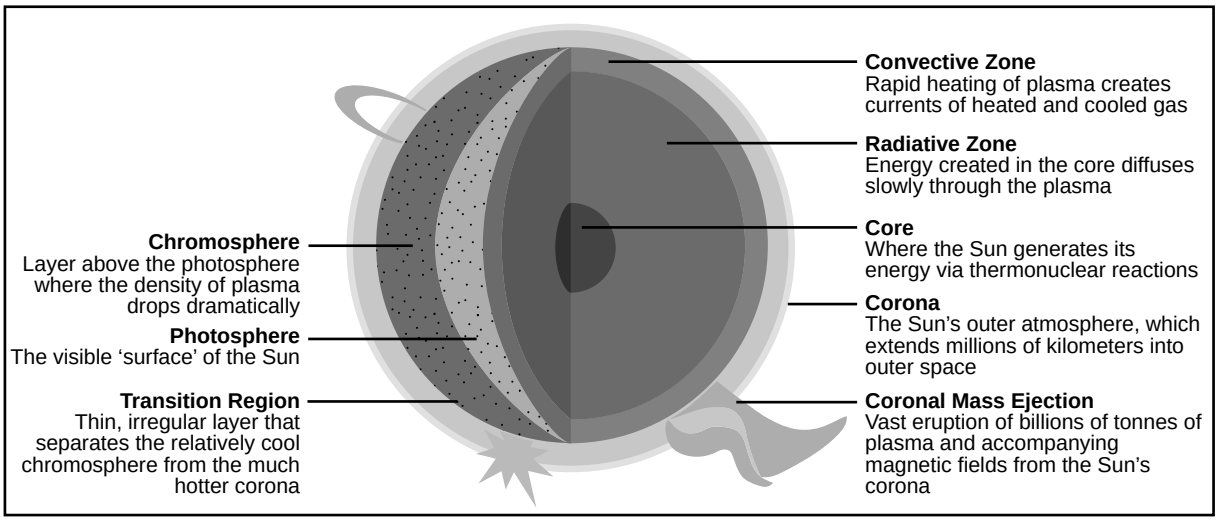


Change in relative temperature: _____

Change in relative absolute magnitude: _____

The model below shows the layers of the Sun and information about some features of each layer.

Model of Sun's Layers



(Not drawn to scale)

2 Based on the information in the model, which list of five of the Sun's layers are in the correct sequence to allow energy generated by fusion to eventually reach the Sun's surface as radiation?

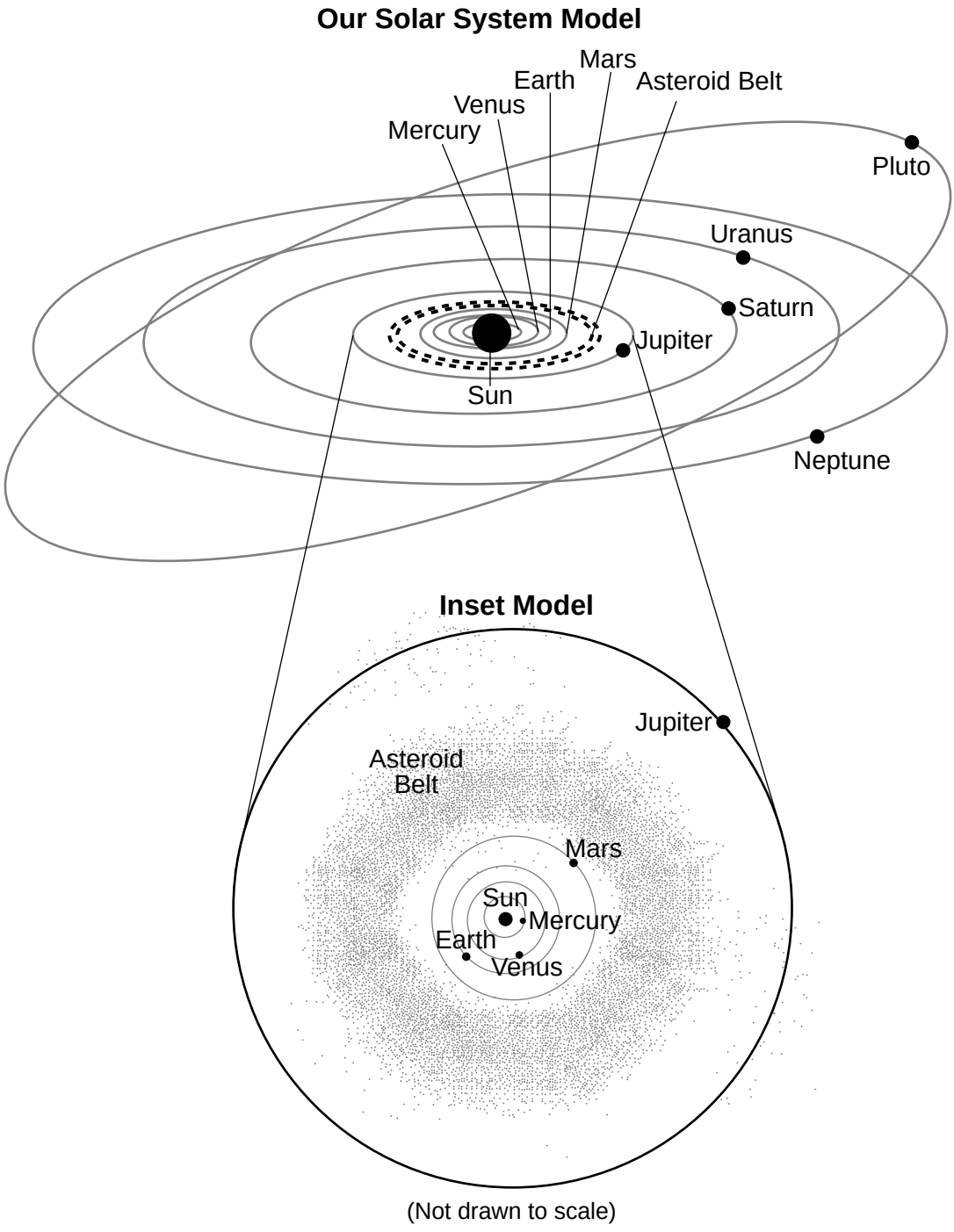
(1) core → chromosphere → photosphere → transition region → corona

(2) core → radiative zone → transition region → photosphere → corona

(3) core → photosphere → corona → transition region → chromosphere

(4) core → radiative zone → convective zone → photosphere → chromosphere

The model below represents the orbits of celestial bodies around our Sun. The inset model shows some information about the region of the solar system inside the orbit of Jupiter.



3 The table below shows the eccentricity of the orbits of Mercury and Venus around the Sun.

Planet	Eccentricity
Mercury	0.206
Venus	0.007

Place a check mark (✓) in the boxes to indicate the **two** statements that are correctly predicted by Kepler's Laws. [1]

☐ Venus orbits the Sun at a constant speed.

☐ Mercury travels faster in its orbit when it is closer to the Sun.

☐ Venus's orbit is less elliptical than Mercury's orbit.

☐ The orbital speeds of both planets are affected by their masses.

☐ Unlike Venus, the eccentricity of Mercury's orbit prevents Mercury from having a moon.

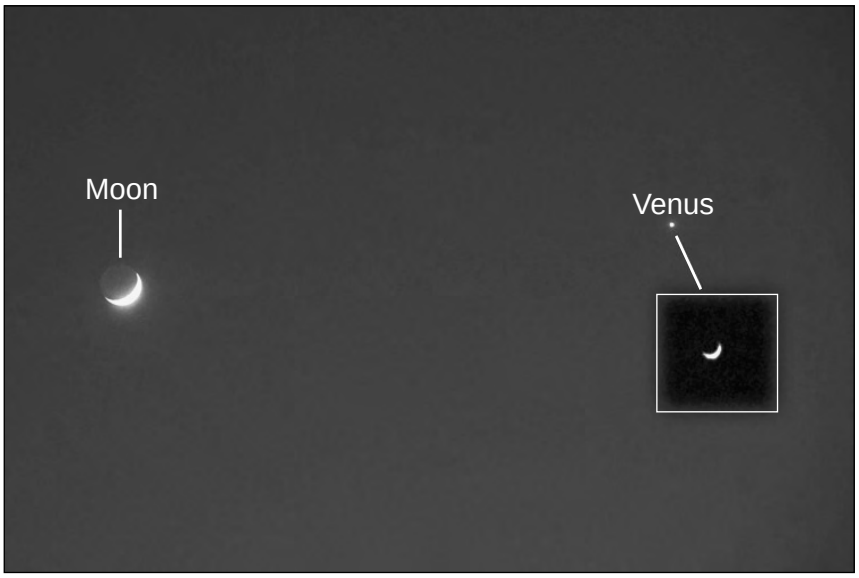
4 Based on the *Our Solar System Model*, if a new planet was identified that orbited the Sun at an average orbital distance greater than that of Mercury but less than that of Venus, the average speed of this planet would be

(1) greater than the average speed of Mercury, but less than the average speed of Venus
(2) less than the average speed of Mercury, but greater than the average speed of Venus
(3) greater than the average speed of Venus, but less than the average speed of Earth
(4) less than the average speed of Venus, but greater than the average speed of Earth

An observer on Earth sees phases of the Moon, but the Moon isn't the only solar system body to exhibit phases. Venus also has observable phases as viewed from Earth. Venus's orbit around the Sun is approximately 225 Earth days.

The photograph below shows a Moon phase and Venus viewed with unaided eyes in the night sky. The inset box shows Venus observed using a telescope. Both the Moon and Venus are in crescent phase.

Observed Phases of the Moon and Venus



5 Using *Our Solar System Model*, construct an explanation for why an observer on Earth can see a cycle of phases for the planet Venus. In the spaces below, write the terms for choices *A*, *B*, and *C* that correctly complete the passage. [1]

Choices A:	**Choices B:**	**Choices C:**
• inside	• closer to	• Moon
• outside	• farther from	• Sun

Venus orbits the Sun, circling ___A___ Earth's orbit in about 225 Earth days. This means that Venus is sometimes ___B___ Earth, while at other times it is positioned on the other side of the ___C___. It is this change in relative positions of Venus that causes an observer on Earth to see phases of Venus.

Choice *A*: _____

Choice *B*: _____

Choice *C*: _____

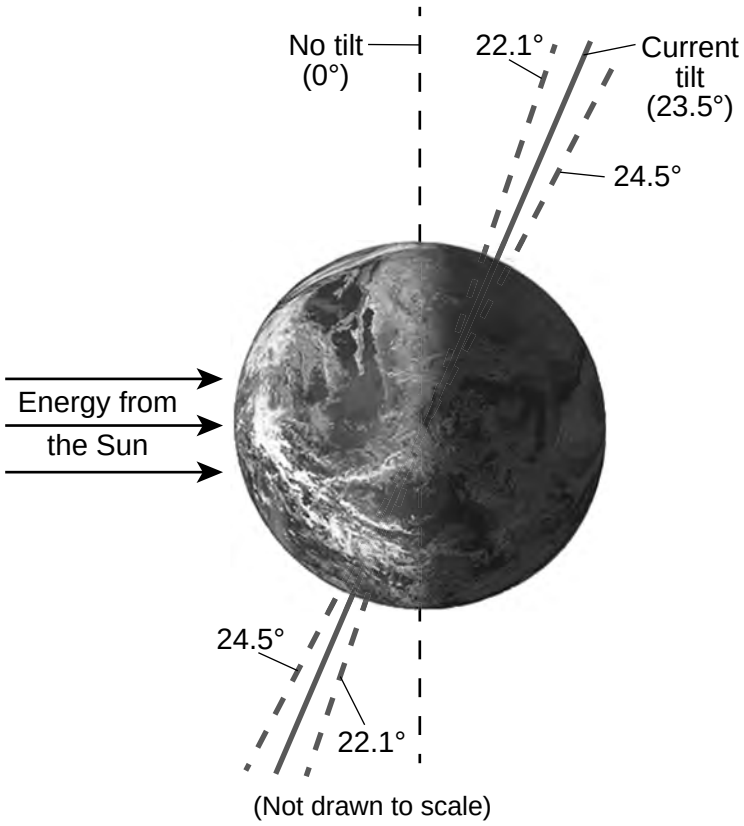
Base your answers to questions 6 through 10 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

Modeling Earth Systems to Understand Global Climate

The geologic record shows a long history of climate fluctuations as a result of many different factors. Climate scientists study models of Earth's motions, ocean currents, plate tectonic movement, and atmospheric composition to better understand energy flow into and out of Earth's systems.

Obliquity, the tilt of Earth's axis relative to the Sun, has a direct impact on Earth's climate. Earth's obliquity changes on a cycle that takes place over a period of 41,000 years. The obliquity is currently decreasing and will reach its minimum value of 22.1° in approximately 9800 years.

Maximum and Minimum Angles of Obliquity



6 During winter, which statement best describes the amount of energy Earth's northern hemisphere will receive and the impact on global ice formation when the obliquity is 22.1°, compared to Earth's present obliquity?

(1) Earth's northern hemisphere will receive less energy, and less ice will form in polar regions.

(2) Earth's northern hemisphere will receive less energy, and more ice will form in polar regions.

(3) Earth's northern hemisphere will receive more energy, and less ice will form in polar regions.

(4) Earth's northern hemisphere will receive more energy, and more ice will form in polar regions.

Another factor climate scientists have identified that contributes to changes in energy flow in Earth systems is ocean current circulation.

The model, *Diagram 1*, and *Diagram 2* show some information about circulation patterns in ocean currents. Points *X* and *Y* are locations on Earth's surface.

Ocean Currents Model

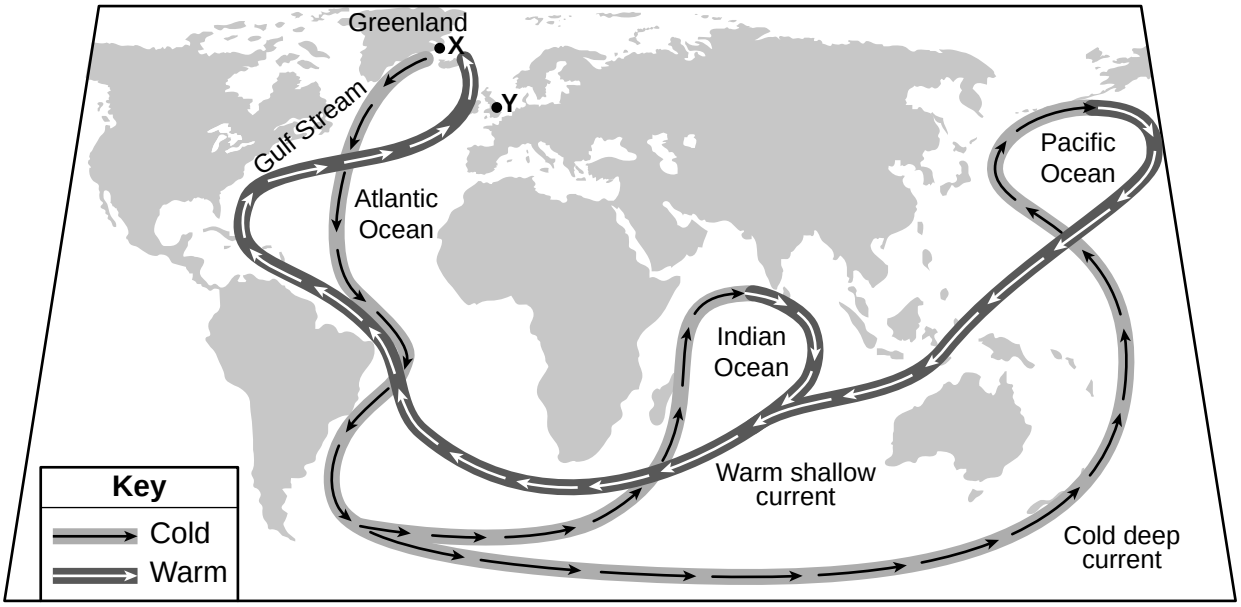


Diagram 1: How Currents Work

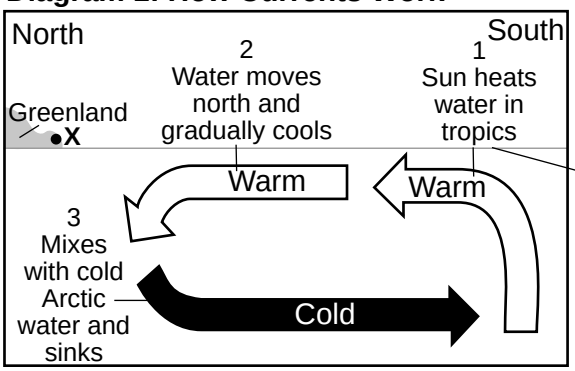
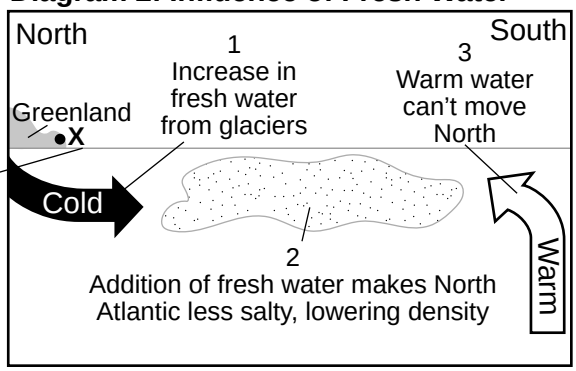


Diagram 2: Influence of Fresh Water



Surface of Ocean

7 Which statement most accurately describes the influence of melting glaciers at *X* on the strength of Earth's ocean currents?

(1) More fresh water is added to the oceans, causing the currents to become deeper.

(2) More fresh water is added to the oceans, causing the currents to weaken.

(3) More fresh water is added to the oceans, causing the water in the currents to become denser.

(4) More fresh water is added to the oceans, causing the water in the currents to become warmer.

8 Which statement most accurately describes the influence of present surface ocean currents on the climate at location *Y*?

(1) Location *Y* experiences warmer air temperatures with more precipitation.

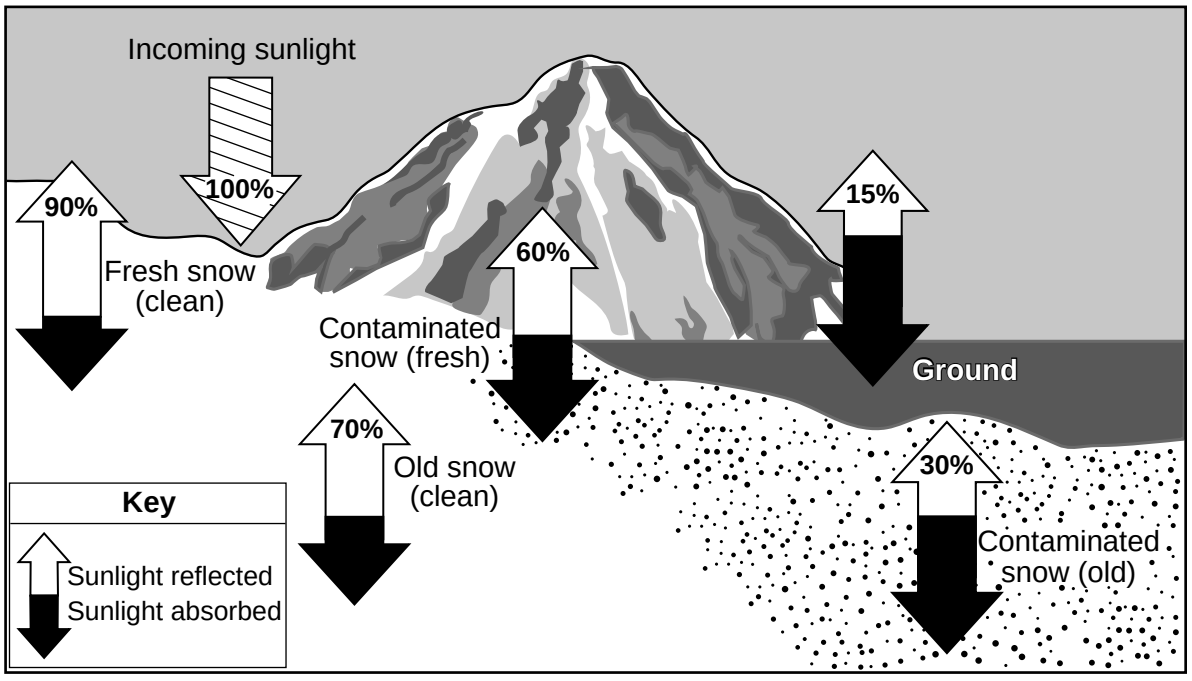
(2) Location *Y* experiences warmer air temperatures with less precipitation.

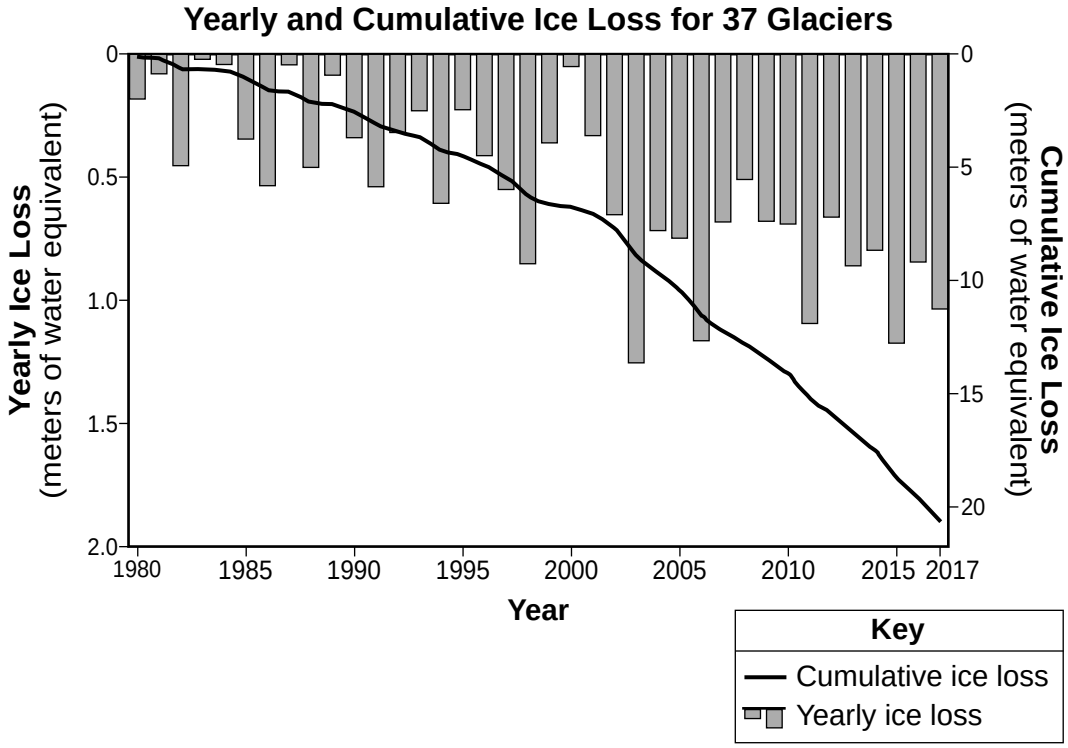
(3) Location *Y* experiences cooler air temperatures with more precipitation.

(4) Location *Y* experiences cooler air temperatures with less precipitation.

Since the Industrial Revolution, deposition of dark particles such as dust, dirt, and rock in glacial ice (contaminated snow) have caused glaciers to darken. This has led to feedbacks that have caused changes to other Earth systems.

Percent of Sunlight Reflected and Absorbed by Different Glacial Surfaces





9 Which model correctly represents the feedbacks that occur when dark surfaces are exposed in glacial areas and cause changes to one or more Earth systems?

(1) Increase in dark surface area on glaciers → Increased absorption of energy from Earth surface → Decreased glacial melting → Decreased glacial ice

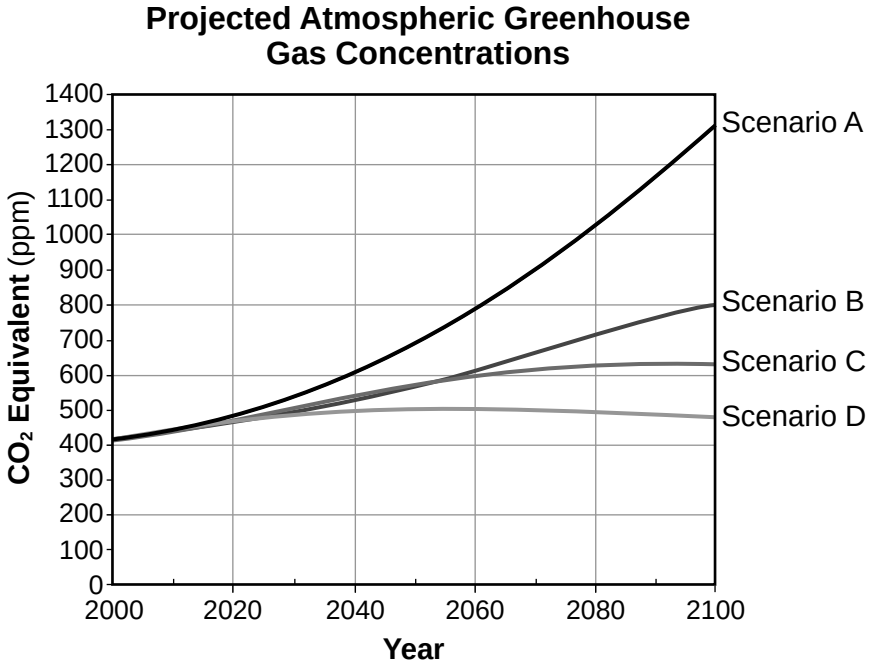
(2) Increase in dark surface area on glaciers → Increased absorption of energy from Earth surface → Decreased glacial melting → Increased glacial ice

(3) Increase in dark surface area on glaciers → Increased absorption of energy on Earth surface → Increased glacial melting → Increased glacial ice

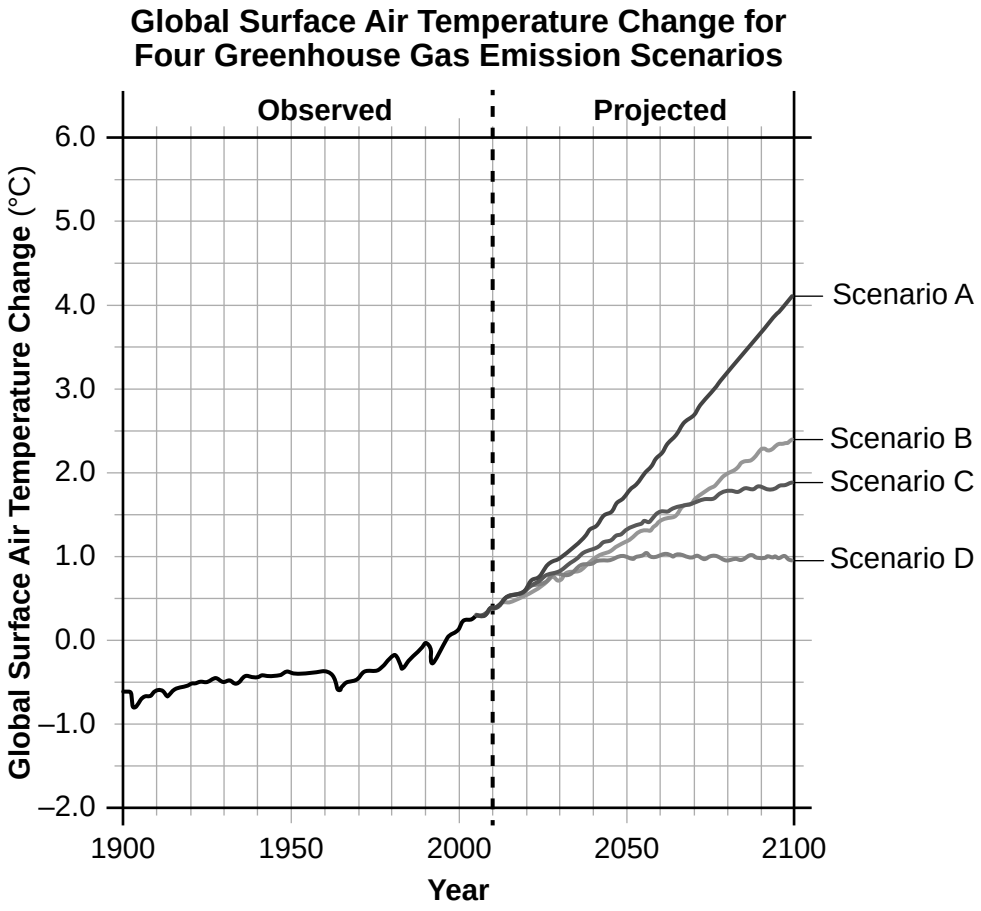
(4) Increase in dark surface area on glaciers → Increased absorption of energy on Earth surface → Increased glacial melting → Decreased glacial ice

Computer-based global climate models are helpful tools for collecting data on projected future climate conditions. These models use various scenarios, or possibilities, that assume different human-based decisions on how we address greenhouse gas emissions.

The graph below shows future greenhouse gas concentrations for four different greenhouse gas emission scenarios measured in parts per million (ppm).



The graph below shows some information about global surface air temperature changes. These models are compared to the average global surface air temperature between the years 1986 to 2005, indicated as 0.0°C.



10 Identify the numerical values for the projected concentration of greenhouse gases (CO_2 equivalent) and for the approximate future change to global surface temperature for the year 2100 using scenario *B* emissions. [1]

Projected CO_2 equivalent in 2100: _____ **ppm**

Projected global surface temperature change: _____ **°C**

Base your answers to questions 11 through 15 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

The Carbon Cycle

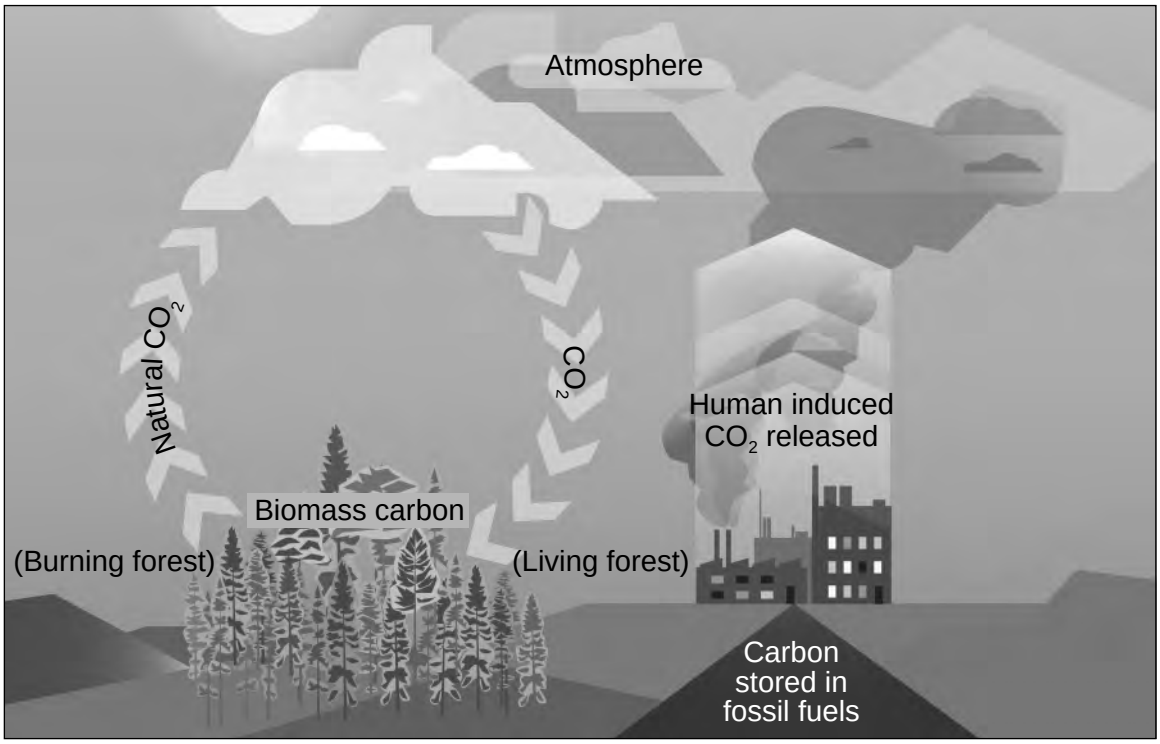
The global carbon cycle refers to the movement of the element carbon through different storage places, or reservoirs, on Earth. Carbon moves through these reservoirs at different rates. Most carbon near Earth's surface cycles fairly quickly. Carbon in the atmosphere recycles in about three to five years, while plants recycle carbon in about 50 years. The carbon found in soil and fossil reservoirs is recycled, on average, in about 3000 to 5000 years.

The carbon cycle has two parts. The "fast cycle" involves the biological processes of photosynthesis and decomposition. The "slow cycle" involves the time it takes for soil (inorganic) carbon to form from the weathering of rocks and soil.

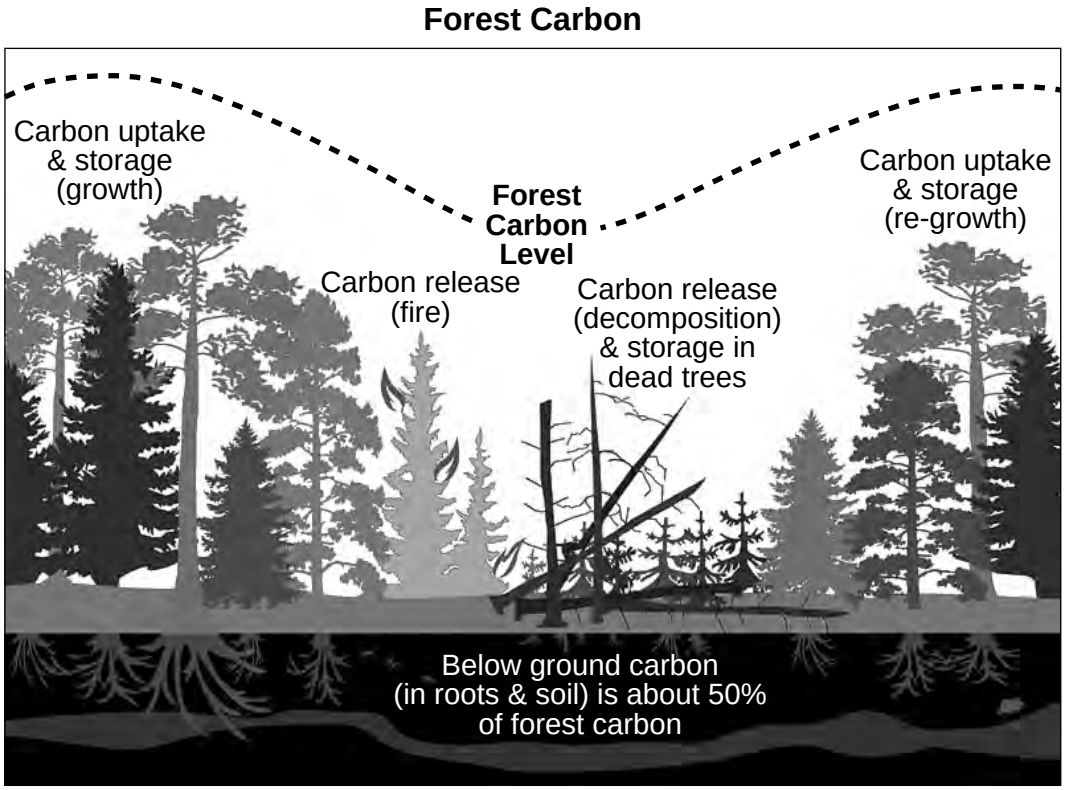
Wildfire events contribute to the carbon cycle. In 2020, megafires released an estimated 107 million metric tons of carbon dioxide into the atmosphere – equivalent to the amount released by about 23 million cars.

The model below shows some information about Earth's systems and the carbon cycle.

Model of Effects of Forest Fires and Burning Fossil Fuels on the Carbon Cycle



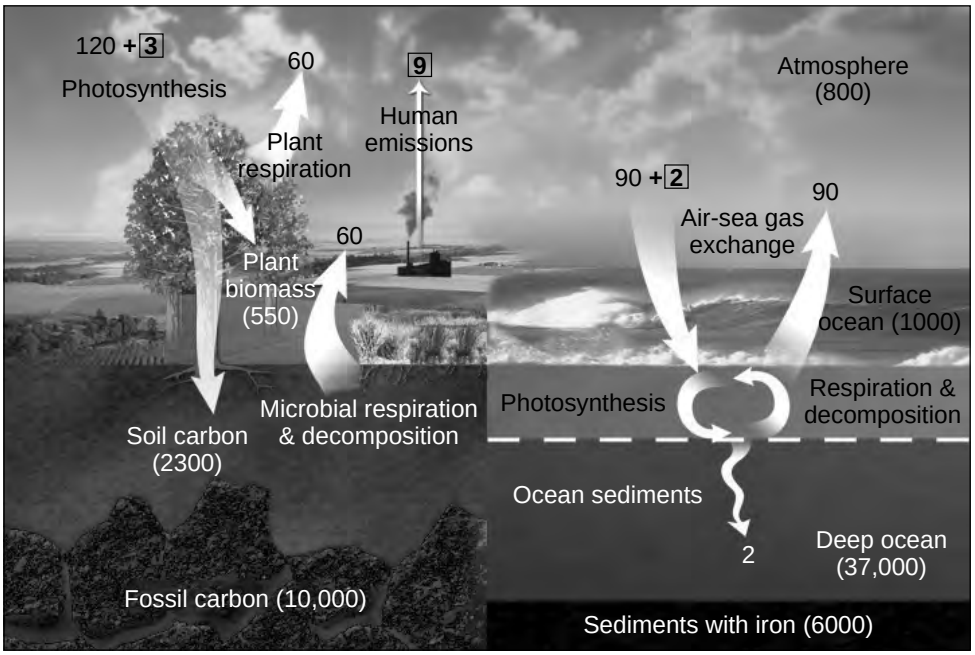
The model below represents how carbon levels change depending on what is happening with the trees in a forest.



11 Explain the process that the trees in a forest use to make energy for food *and* describe how this process is responsible for a decrease in atmospheric carbon dioxide levels. [1]

The model below shows the movement of carbon (arrows) through the four Earth spheres. The numbers indicate the amount of carbon naturally added or removed from the spheres in gigatons (GT) per year. The numbers in bold indicate the amount of carbon added or removed by human activity. Numbers in parentheses ( ) are amounts of stored carbon.

Model of Fast Carbon Cycle



12 Which statement correctly identifies the quantitative cycling of carbon between two of Earth's spheres as a result of natural processes and human activities?

(1) Fossil carbon releases 2300 GT, while microbial respiration and decomposition absorb 60 GT.

(2) The deep ocean stores 36,000 more GT of carbon than is released by air-sea gas exchange.

(3) Human emissions add nine times more carbon to the atmosphere than plant respiration, which is the same amount released to the atmosphere by microbial respiration and decomposition.

(4) The amount of carbon that leaves the atmosphere and is absorbed by the ocean is 92 GT, which is the same amount that is released by the oceans back into the atmosphere and absorbed by ocean sediments.

13 Which explanation describes how climate change from increased atmospheric carbon dioxide has influenced human activity?

(1) Humans have increased the replanting of trees in areas burned by wildfires in order to decrease the amount of local atmospheric carbon dioxide.

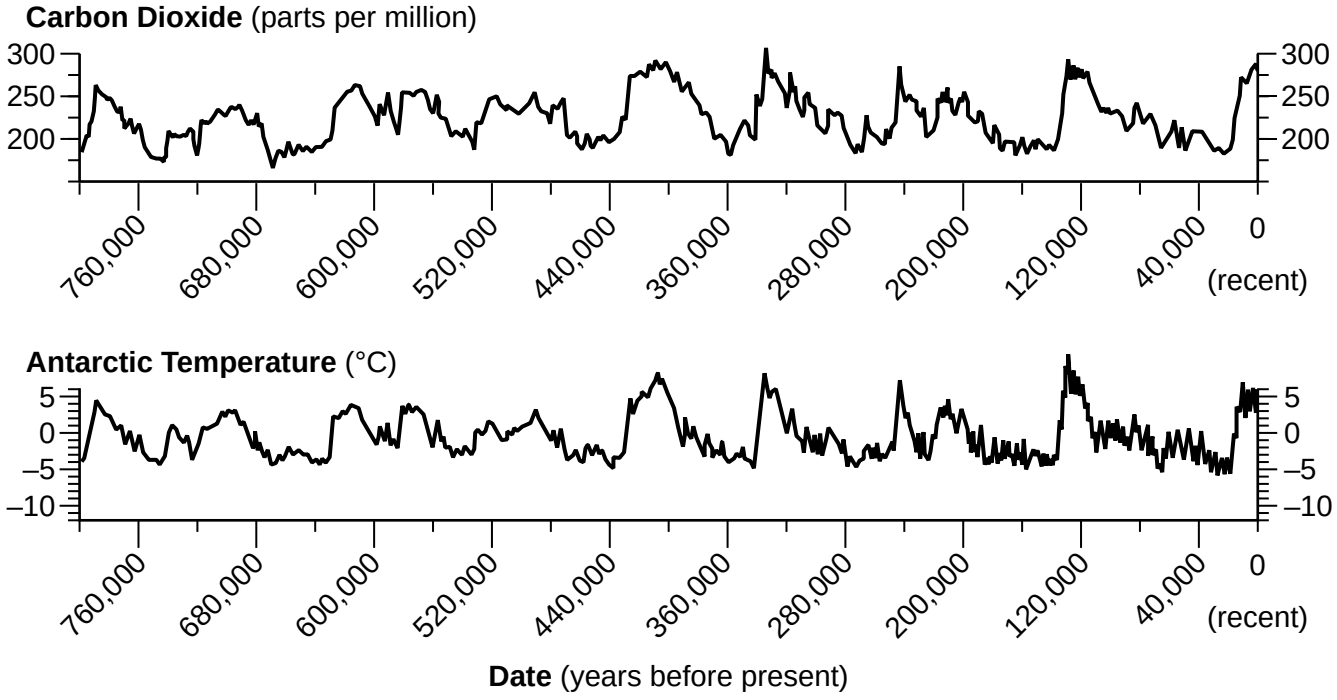
(2) Humans have increased the burning of fossil fuels in order to decrease the amount of carbon dioxide in the atmosphere.

(3) Humans have moved to cooler climate regions to adjust to a warming climate.

(4) Humans have decreased the number of dead trees in the forest by using them as fuel.

In Earth's past, the carbon cycle has changed due to changes in climate that resulted from several different factors. Changes in the Sun's energy, the amount of marine organisms that remove carbon dioxide from the atmosphere, and uplift of major mountain chains have all contributed to variations in CO_2.

Ice-core data provides a record of atmospheric carbon dioxide (measured from air trapped in the ice in parts per million (ppm)) and of Antarctic surface temperature changes over the last 800,000 years, as shown in the graphs below.



14 Which claim correctly summarizes the data in the graphs that a change to one Earth system caused a change to another Earth system?

(1) Increasing atmospheric CO_2 levels caused the Antarctic surface temperature to decrease over the same time period.

(2) Variations in atmospheric CO_2 levels did not affect the surface temperature in Antarctica over the last 800,000 years.

(3) Decreasing atmospheric CO_2 levels caused Antarctic surface temperatures to also decrease over the same time period.

(4) Atmospheric CO_2 levels stayed the same, causing Antarctic surface temperatures to also stay the same over the last 800,000 years.

15 Using the rate of regional climate change in Antarctica for the last 40,000 years, make an evidence-based forecast of how much Antarctic temperatures are predicted to change in the next 40,000 years. Describe a specific associated impact to **one** Earth system as a result of this temperature change. [1]

_____**°C in next 40,000 years**

Associated impact: _____

_____

_____

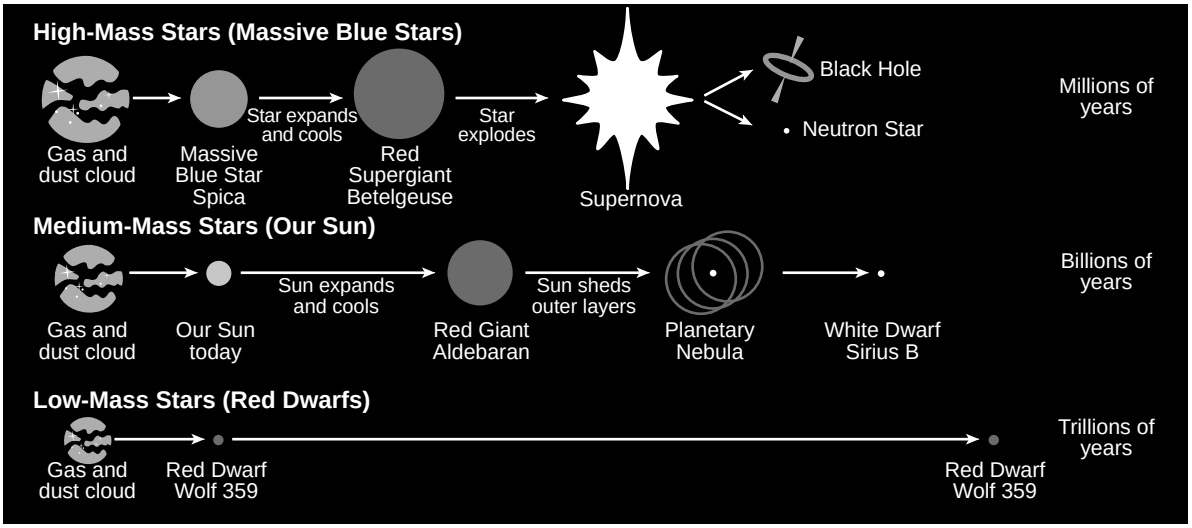
Base your answers to questions 16 through 20 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

Stars and the Big Bang

Our Sun is a 4.6 billion-year-old yellow dwarf star. It was formed either from matter produced during the Big Bang or from matter released when large stars reached supernova and exploded. This matter, in the form of hydrogen, contracted into a denser gas cloud due to gravity. The temperature at this cloud's core increased, allowing for the fusion of two hydrogen nuclei into one helium nucleus. The mass of this helium nucleus is slightly less than the mass of the hydrogen nuclei. This difference in mass is the source of the star's energy.

The model below shows some information about the life cycles of different stars.

Model of Life Cycles of Different Stars



16 Identify the factor that determines the lifespan of the Sun and other stars. [1]

_____

The table below shows some information about different types of stars. Solar mass is the mass of the star compared to the Sun.

Star	**Solar Mass**	**Distance from Sun** (light years)	**Approximate Lifespan** (yr)
Spica	10.3	260.9	less than 30 million
Betelgeuse	16.5	548	10 million
Sun	1.0	0	9 billion
Aldebaran	1.16	65	6.4 billion
Sirius B	0.98	8.6	0.23 billion
Wolf 359	0.09	7.86	4.1 trillion

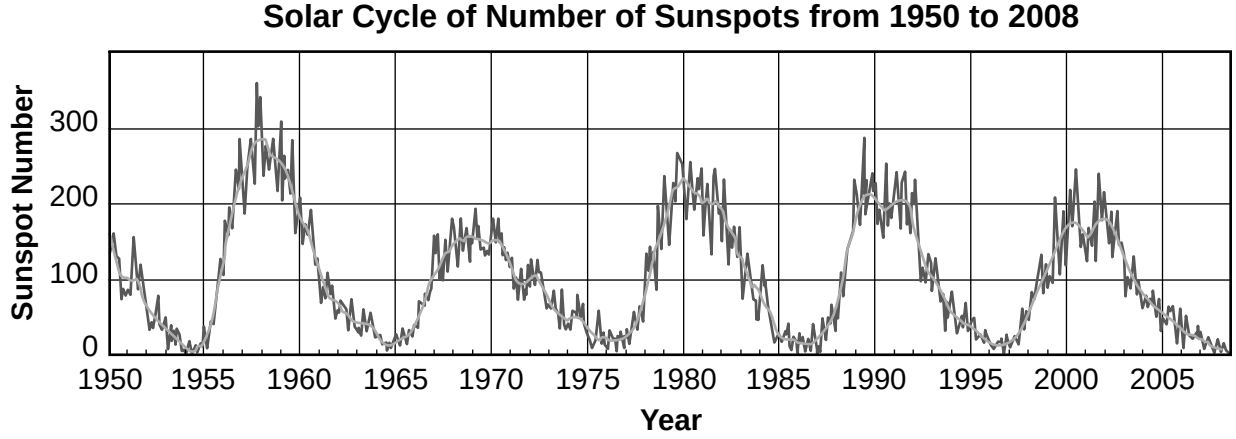
17 A student created a data table containing information on how stars synthesize common elements through nucleosynthesis. Which row of data correctly identifies all the characteristics for that star?

Row	**Star Name**	**Nucleosynthesis**	**Mass**	**Lifespan** (yr)
(1)	Sun	hydrogen $\xrightarrow{\text{changes directly to}}$ helium	medium mass	4.6 billion
(2)	Sirius B	carbon $\xrightarrow{\text{changes directly to}}$ oxygen	high mass	0.23 billion
(3)	Aldebaran	helium $\xrightarrow{\text{changes directly to}}$ carbon	medium mass	6.4 billion
(4)	Wolf 359	hydrogen $\xrightarrow{\text{changes directly to}}$ carbon	high mass	4.1 trillion

Sunspots are areas where the magnetic field is about 2500 times stronger than Earth's magnetic field. Because of this strong magnetic field, the magnetic pressure increases and the Sun's surrounding atmospheric pressure decreases. This lowers the temperature relative to surrounding areas because it inhibits the flow of new super-hot gas (plasma) to the surface.

Sunspots occur in pairs because they have magnetic fields pointing in opposite directions. However, from 1645 to 1715 there was nearly zero sunspot activity. This time period is referred to as the Maunder Minimum. Some scientists also called this time period on Earth "The Little Ice Age".

The graph below shows some information about sunspot frequency.

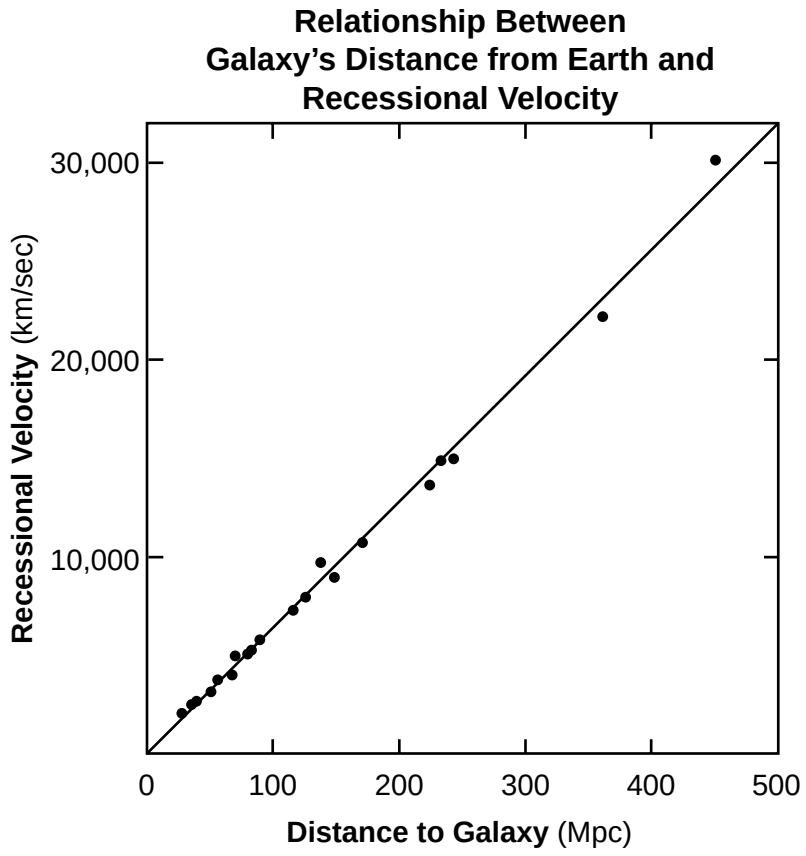


18 Using information from the passage and the graph, place a check mark (✓) in **three** boxes to identify the statements that accurately describe sunspots. [1]

- ☐ A decrease in the number of sunspots is inferred to decrease Earth's temperatures.
- ☐ The number of sunspots changes each year, occurring in approximately 11-year cycles.
- ☐ An increase in solar output is associated with a decrease in the number of sunspots.
- ☐ The average number of sunspots appearing each year has decreased steadily since 1950.
- ☐ Sunspots are regions of cooler temperatures on the surface of the Sun.

In the 1920s, Edwin Hubble studied the motion of galaxies. He found a relationship between a galaxy's velocity as measured from Earth (recessional velocity) and the galaxy's distance from Earth. This relationship is known as Hubble's Law. This law has implications for understanding how the universe has changed since the Big Bang.

The graph below shows data on several galaxies' distances from Earth in megaparsecs (Mpc) and their recessional velocities.



The *Relationship Between Galaxy's Distance from Earth and Recessional Velocity* graph shows that the recessional velocity of a galaxy __A__ as the galaxy's distance from Earth increases. This is evidence for the __B__ of the universe and suggests that the universe initially was __C__ at the time of the Big Bang. As a result, this data suggests that the universe is changing at __D__ rate.

19 Which table below correctly identifies the missing words and phrases labeled *A*, *B*, *C*, and *D* in the passage above?

(1)

A	increases proportionally
B	expansion
C	compacted
D	an accelerated

(2)

A	increases non-proportionally
B	expansion
C	inflated
D	a constant

(3)

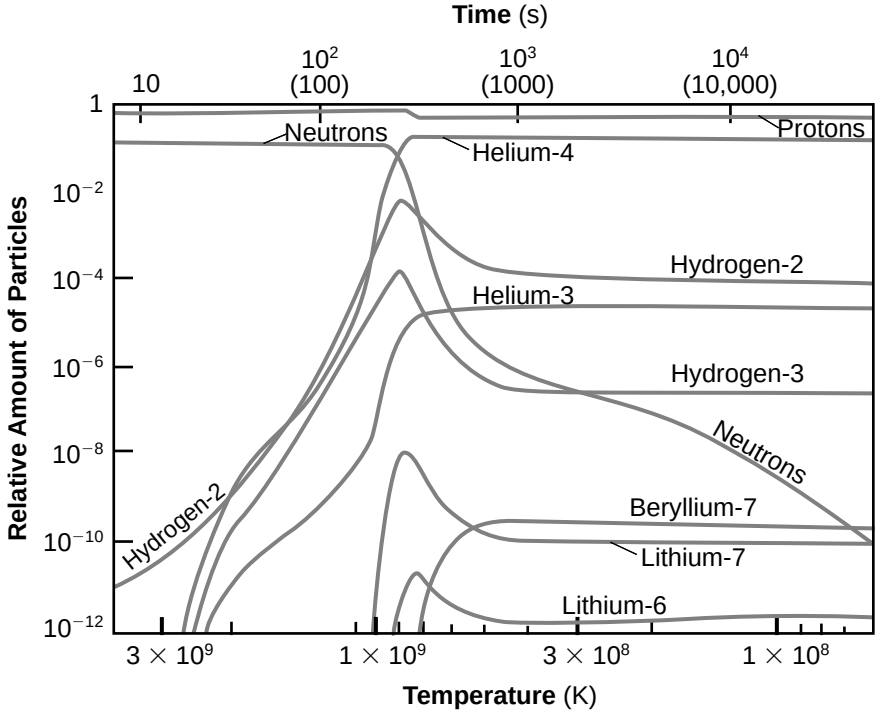
A	increases proportionally
B	expansion
C	inflated
D	a decreasing

(4)

A	increases non-proportionally
B	expansion
C	compacted
D	an accelerated

Particles were created as a result of the Big Bang. The first particles were subatomic particles like the protons, neutrons, and nuclei of lighter elements such as hydrogen, helium, lithium, and beryllium. The graph below shows some information about these particles, the temperature of the universe at the time they were created, and the amount of time after the Big Bang that they were created.

Relationship Between Relative Amount of Different Particles and Temperature of the Universe After the Big Bang Over Time



20 Based on information from the *Relationship Between Relative Amount of Different Particles and Temperature of the Universe After the Big Bang Over Time* graph, which table correctly identifies the composition of matter in the universe as evidence for the Big Bang theory?

(1)

From Beginning of Big Bang	**Particles Present**	**Temperature** (K)
from 10-100 seconds	H and He decreased	increased, then decreased

(2)

From Beginning of Big Bang	**Particles Present**	**Temperature** (K)
from 100-1000 seconds	H increased, then decreased while He increased, then remained constant	decreased

(3)

From Beginning of Big Bang	**Particles Present**	**Temperature** (K)
from 1000 -10,000 seconds	protons and neutrons decreased	decreased, then increased

(4)

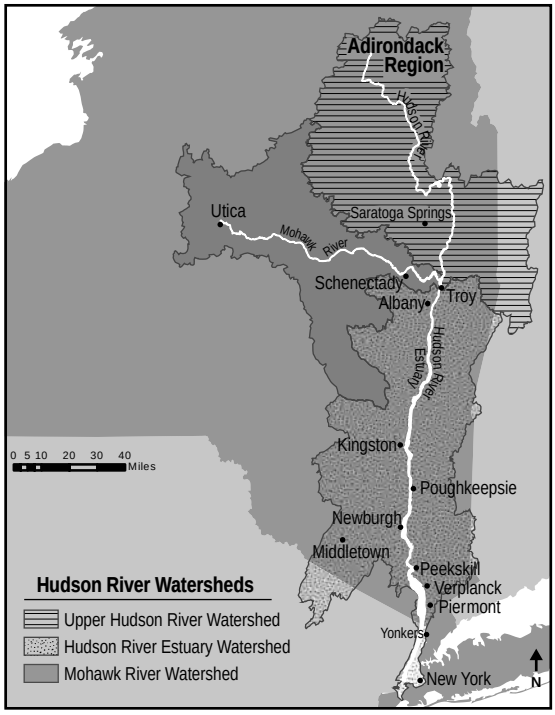
From Beginning of Big Bang	**Particles Present**	**Temperature** (K)
after 10,000 seconds	Be and Li remained constant	remained constant

Base your answers to questions 21 through 25 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

New York State's Hudson River

New York State's Hudson River watershed covers almost 1340 square miles and includes three different watersheds: Mohawk River, Hudson River Estuary, and Upper Hudson River watersheds. The Hudson River flows south for almost 325 miles from the Adirondacks to New York City. The 153-mile-section from Troy to New York Harbor in New York City is a tidal estuary. Here, fresh water flowing south down the river meets salt water pushing in from the Atlantic Ocean. The leading edge of sea water entering the estuary is called the salt front. The salt front moves with the tides, the weather, and the seasons. When there is heavy rain, more fresh water flows into the Hudson River. Cities and towns that take their drinking water from the Hudson River carefully track the salt front as it affects the quality of drinking water.

Hudson River Watersheds



21 Describe how heavy rain events along the Hudson River would affect the location of the salt front. [1]

The location of the salt front is measured in HRM (Hudson River Mile) units. Hudson River Mile 0 is at the southern tip of Manhattan in New York City.

The tables below show some information about the salinity along the Hudson River for several locations north of New York City on two different dates. Salinity is measured in milligrams of chloride per liter of water (mg/L), and the salt front is located where salinity is 100 mg/L.

Hudson River Salinity: October 6, 2004

Location	New York City	Yonkers	Piermont	Bear Mt.	Cold Spring	Ulster
Salinity (mg/L)	1805	1162	300	50	47	34
HRM	7	18	25	46	55	97

Hudson River Salinity: October 12, 2006

Location	New York City	Yonkers	Piermont	Verplanck	Cold Spring	Poughkeepsie	Ulster
Salinity (mg/L)	7362	4041	3177	830	50	30	64
HRM	7	18	25	41	55	76	97

22 A student makes a claim that the location of the salt front is constantly changing due to weather conditions. Which table below supports the student's claim by correctly identifying the two locations between which the salt front was located on October 6, 2004, and October 12, 2006?

(1)

October 6, 2004	Piermont and Bear Mountain
October 12, 2006	Poughkeepsie and Ulster

(2)

October 6, 2004	Piermont and Bear Mountain
October 12, 2006	Verplanck and Cold Spring

(3)

October 6, 2004	Yonkers and Piermont
October 12, 2006	Verplanck and Cold Spring

(4)

October 6, 2004	New York City and Yonkers
October 12, 2006	Yonkers and Piermont

An advancing salt front along the Hudson River can affect the quality of drinking water for communities such as Poughkeepsie, which use fresh water from the river as a source of drinking water. For this reason, two different environmental groups carefully monitor the salt front in the river.

Since over 10 million people in New York State rely on the Hudson River for clean drinking water, both environmental groups have developed a plan to evaluate salt front advancement and to prevent the salt from entering the drinking water intakes.

This $400,000 plan has a budget to monitor and evaluate salt front advancement over the next 35 years. This budget has two components summarized below:

- Allocate $250,000 to predict salt front location from 2025–2075 using stream and river flow data.
- Allocate $150,000 to develop a proactive action plan to maintain safe drinking water for several water treatment plants.

23 Based on evidence in the plan developed by the environmental groups, which explanation correctly describes how the availability of fresh water will influence communities along the Hudson River?

(1) Cities along the Hudson River will need to spend considerable amounts of money to find alternative drinking water sources as the salinity decreases over the next 50 years.

(2) Cities along the Hudson River will need to spend $400,000 to monitor the salt front over the next 50 years.

(3) Communities that use the Hudson River for drinking water will spend $400,000 to monitor salinity and develop plans to purify water if necessary at water treatment plants.

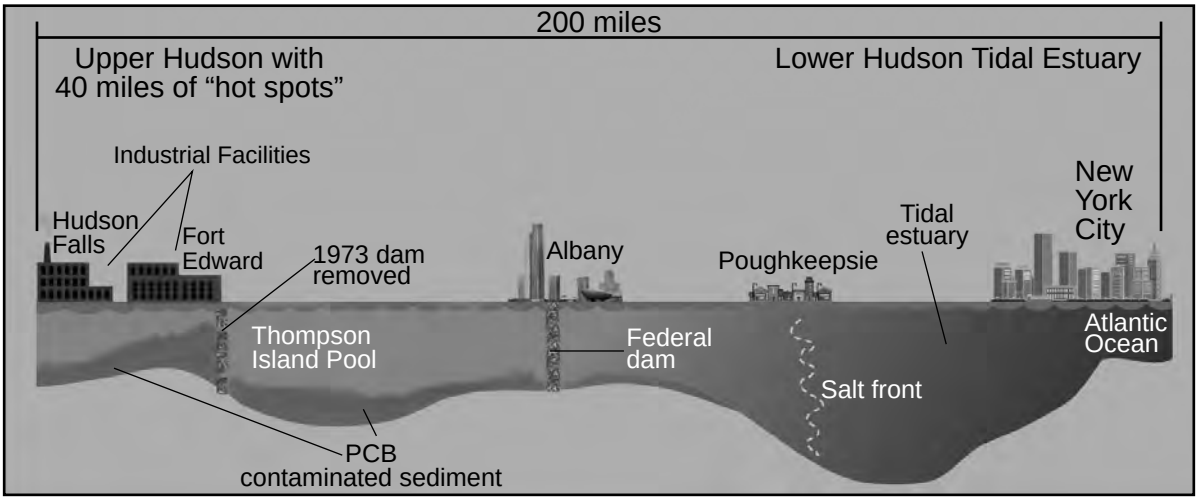
(4) Communities that use the Hudson River for drinking water will need to spend $150,000 to predict whether the salt front will affect their drinking water.

The location of the salt front and its effect on drinking water quality is not the only issue facing residents along the Hudson River.

Between 1947 and 1977, industries that manufactured substances used in fire prevention and oil insulators, called PCBs (polychlorinated biphenyls), were found to be toxic to humans and life in the river. By then, the industry, located north of Albany, had dumped an estimated 1.3 million pounds of PCBs into the river. Once in the river, the chemicals mixed with sediments on the river bottom and along the shorelines. The removal of a dam in the upper Hudson in 1973 further released large amounts of contaminated sediments.

In 1984, the Environmental Protection Agency (EPA) classified a 200-mile stretch of the river as a federal Superfund site that required the removal of the PCBs from the river sediment. A 40-mile stretch north of Albany was termed as a "hot spot" where PCB contaminated sediment was removed by dredging between 2009 and 2015. The model below shows some information on PCBs in the Hudson River.

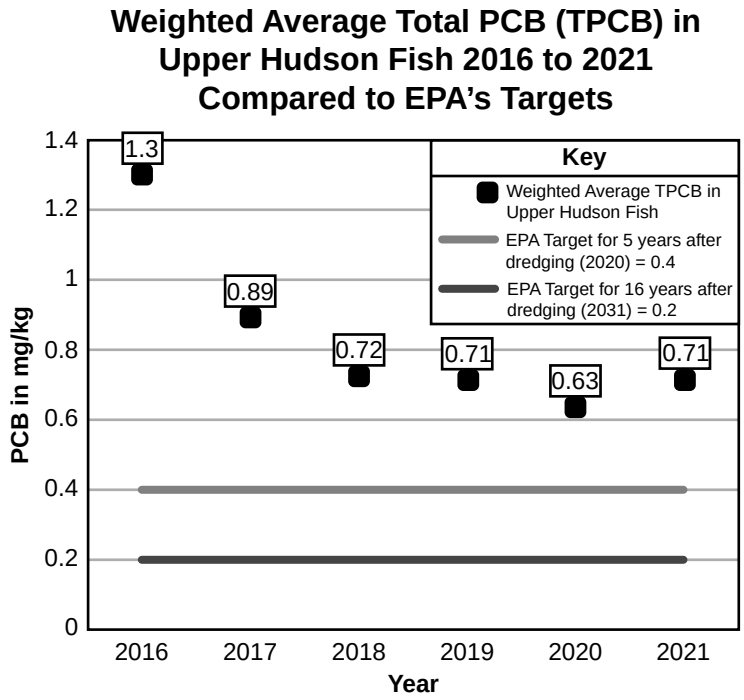
Hudson River PCB Superfund Site: 200-Mile Stretch



(Not drawn to scale)

Eating contaminated fish is the single greatest human exposure to PCBs. The PCBs in the upper Hudson River have been present for 70 years and have accumulated in fish.

The EPA issued an advisory to not eat fish taken from the upper Hudson River. In 2002, the EPA adopted targets of PCB concentrations in fish to be reached by 2020 and 2031. The graph below shows PCB concentrations of fish taken from the upper Hudson River and these targets.



24 Based on the model and graph, which would be the next logical solution that would cause the *greatest* decrease in PCB levels in fish in the Hudson River?

(1) Do nothing and let the river naturally remove the PCBs into the Atlantic Ocean.

(2) Dredge additional areas that still have PCBs in sediment to permanently remove pollutants from the river.

(3) Build another large dam where the dam was removed to capture most PCBs before the contaminated sediment moves downstream.

(4) Breed larger fish that can remove PCBs from the water and sediments.

25 Explain how the graph supports the claim that dredging of the Hudson River has only been partially effective at reducing PCB levels in fish, compared to EPA targets. [1]

Base your answers to questions 26 through 30 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

The Origin of Our Solar System

The Sun and eight planets in the Solar System formed at the same time. Evidence of their formation can be found throughout the Solar System. Scientists have used data from planets, meteorites, and Earth to determine how the Solar System formed and its early history. The data table below lists some information for the eight planets.

Solar System Data

Type of Planet	Name	Number of Moons
Terrestrial planets	Mercury	0
	Venus	0
	Earth	1
	Mars	2
Jovian planets	Jupiter	80 (approx.)
	Saturn	83 (approx.)
	Uranus	24
	Neptune	14

26 Which statement best describes the differences between terrestrial planets and Jovian planets in the solar system as a result of the early history of their formation?

(1) Terrestrial planets have longer periods of revolution and fewer moons than Jovian planets.

(2) Terrestrial planets have greater densities and longer periods of revolution than Jovian planets.

(3) Terrestrial planets have larger diameters and are closer to the Sun than Jovian planets.

(4) Terrestrial planets have smaller diameters and greater densities than Jovian planets.

27 Which value would be the most accurate prediction for the period of revolution for Saturn?

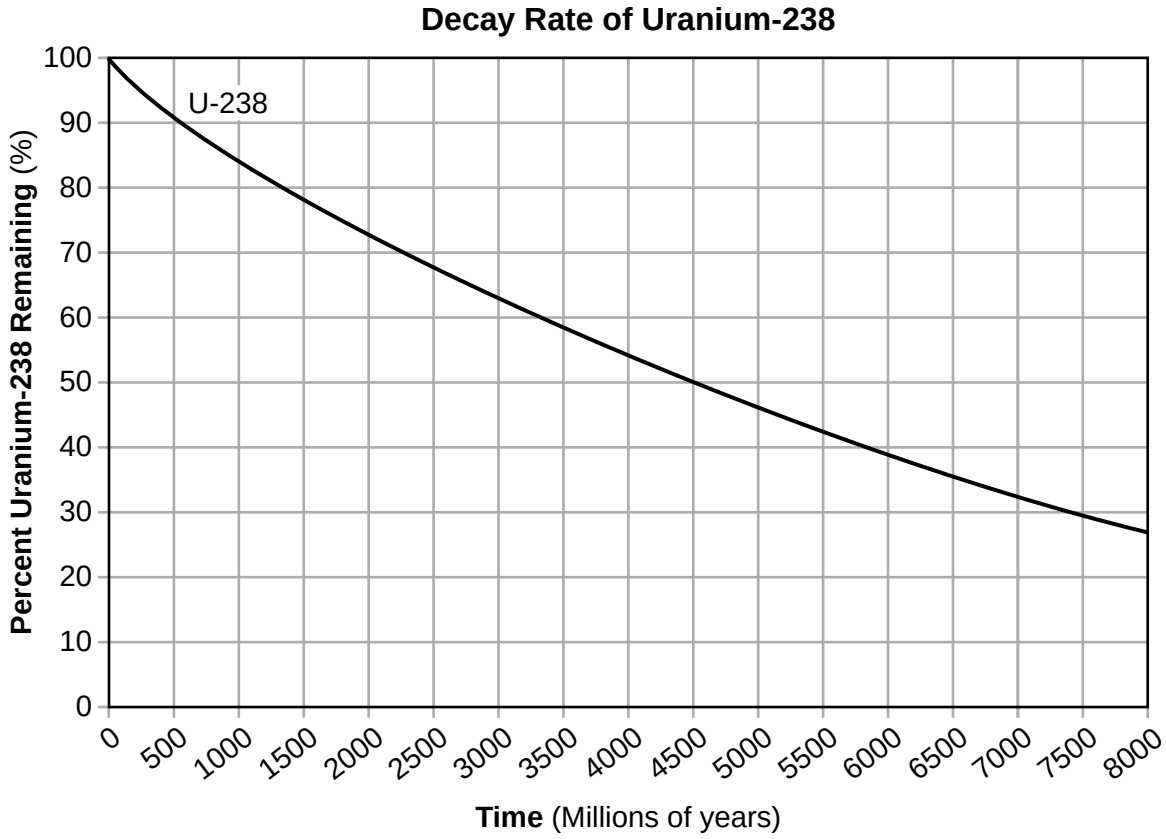
(1) 5358 Earth days

(2) 10,759 Earth days

(3) 23,560 Earth days

(4) 28,286 Earth days

Meteorites on Earth have been helpful in reconstructing the history of our solar system and our planet. Samples taken from meteorites have been age dated using absolute dating techniques that measure the amount of Uranium-238 compared to the amount of its decay product in samples found on Earth. The graph below shows some information about Uranium-238.

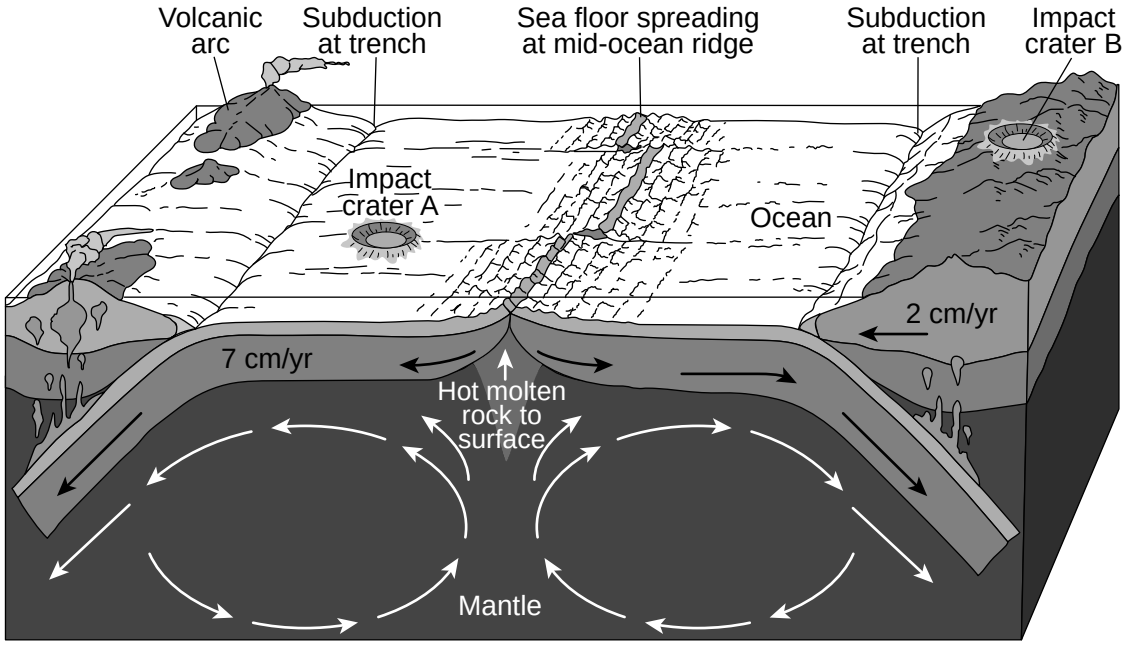


28 A sample of a meteorite was tested and found to contain 50% Uranium-238. Use evidence from the graph to make a claim about how the radiometric dating of meteorites can be used to construct an account about when Earth formed. [1]

Throughout Earth's history, meteorites have created impact craters on continental and ocean crust surfaces. However, of the approximately 200 craters confirmed on Earth's surface, only about 20 are located within ocean crust. This is surprising since approximately 70% of Earth's surface is covered in water. It is suggested by scientists that the movement of Earth's plates may play a role in the lack of evidence of impact craters observed on ocean crust.

The approximate rates of movement of oceanic and continental crust are indicated on the model in cm/yr. Two impact craters are labeled.

Model of Plate Tectonic Movement



(Not drawn to scale)

29 Which statement most accurately identifies why evidence of impact crater *A* will most likely *not* be preserved for as long as impact crater *B*?

(1) Impact crater *A* is located on faster moving ocean crust and will be destroyed by subduction.

(2) Impact crater *A* is located on a slower moving plate and will be subducted before impact crater *B*.

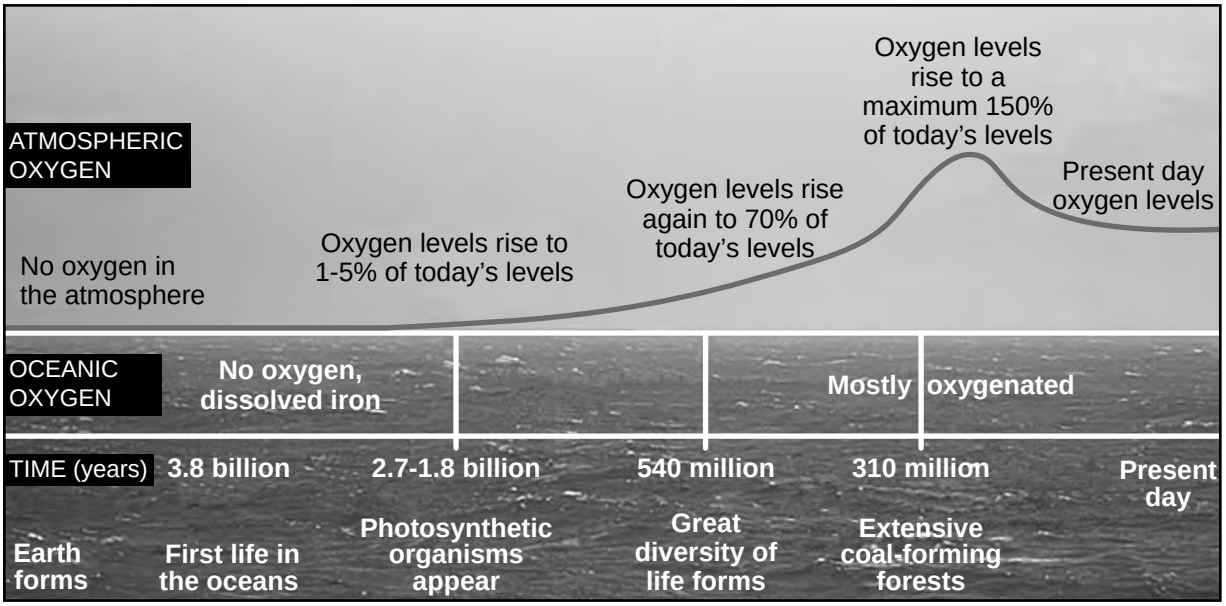
(3) Impact crater *A* will be destroyed by hot molten rock at the mid-ocean ridge.

(4) Impact crater *A* will be destroyed by eruptions from the nearby volcanic arc.

Earth's systems do not operate independently. For instance, changes in the ocean's temperature can influence atmospheric temperatures. A similar coevolutionary process occurred in Earth's early history when oxygen levels were transitioning from Earth's ocean to the atmosphere.

The model below shows some information about Earth's ocean and atmosphere.

Model of Changing Oxygen Levels Through Earth's History



30 Identify the process that caused the oxygen levels in Earth's oceans and atmosphere to change. Then, construct an argument, based on evidence, that describes how oxygen levels changed in Earth's oceans and atmosphere *and* how these changes led to a coevolution of life on two Earth spheres. [1]

Process: _____

Argument with evidence: _____

_____

_____

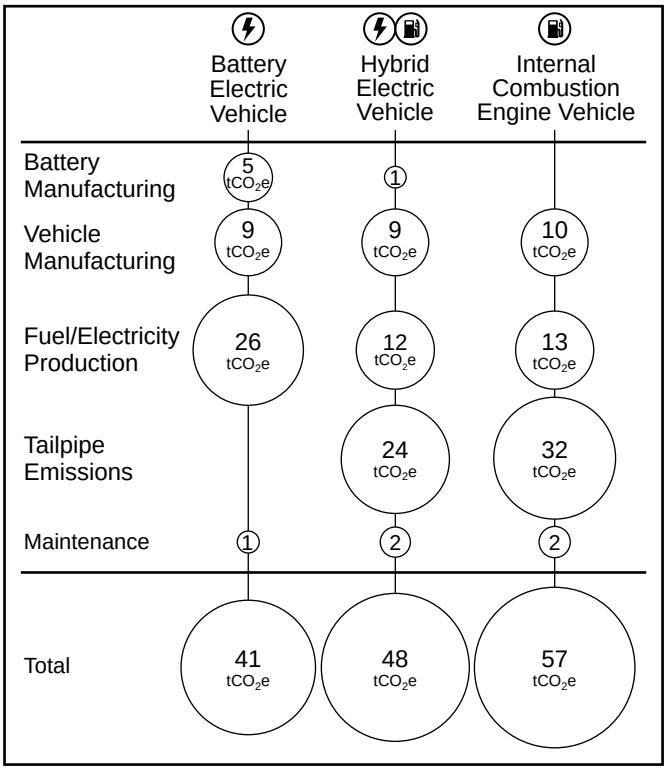
Base your answers to questions 31 through 35 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

Mining and Use of Lithium

Lithium is a highly reactive alkali metal that is used in the manufacturing of lubricants, pharmaceuticals, glass, and rechargeable batteries. The demand for lithium has grown because lithium is often used in modern electronics like phones, laptops, and electric cars. When in operation, a battery electric vehicle produces zero tailpipe emissions.

The infographic below summarizes the average amount of emissions, measured in tons of carbon dioxide (tCO_2e) associated with the manufacturing and use of three different types of vehicles during their lifetime.

Life Cycle Emissions Associated with Production and Use of Different Types of Vehicles



31 Identify the type of vehicle from the infographic that has the ***smallest*** negative impact on the environment. Justify your response by providing evidence from the infographic. [1]

Type of vehicle: _____

Evidence: _____

_____

The data table below summarizes originally proposed toll rates for motorists entering New York City by Port Authority bridges and tunnels from New Jersey. Vehicles eligible for the Green Pass Discount include plug-in hybrid electric vehicles and battery electric vehicles.

Bridge and Tunnel Tolls for Motorists Entering New York City from New Jersey

Class	Vehicle Type	# of Axles	Toll Off-peak Hours Eastbound toll only	Toll Peak Hours Eastbound toll only
1	**Vehicles with two axles and single rear wheels** (includes two axle recreational vehicles with single rear wheels and no additional axles in tow) 	2	$12.75	$14.75
7	**Class 1 or 11 (Including Class 1 Recreational Vehicles) with Trailer** (minimum three single wheel axles) 	3 & Up	$24.25 Additional axles $11.50 each	$26.25 Additional axles $11.50 each
Discount Plans (Enrollment Required)	**Green Pass** Eligible low-emission class 1 vehicles	2	$9.25 Additional axles $11.50 each	$14.75 Additional axles $11.50 each
	Green Pass Eligible low-emission class 7 vehicles	2	$20.75 Additional axles $11.50 each	$26.25 Additional axles $11.50 each

32 Vehicles entering New York City add pollutants to the air in a congested urban area. Describe the economic benefit to motorists who drive class 1 and class 7 vehicles during off-peak hours that qualify for the Green Pass toll rate. Also, discuss how the wants and needs of society are affected by the Port Authority toll plan. [1]

Economic benefit: _____

_____

Wants and needs of society: _____

_____

_____

Lithium is currently sourced from surface mines or underground brine reservoirs. Lithium ore extracted from open pit mines is dried in fossil fuel burning kilns. The underground reservoir brine method uses evaporating ponds and solar energy to collect lithium from brine water having a high concentration of various salts. The table below shows some information related to these two mining methods.

	Mining Methods	
	Mine	**Reservoir Brine Method**
Emission of Carbon Dioxide (per 1000 kg of lithium)	15,000 kg	5000 kg
Use of Water (per 1000 kg of lithium)	170 m^3	469 m^3
Use of Land (per 1000 kg of lithium)	464 m^2	3124 m^2

33 Which table below correctly summarizes the benefits of extracting lithium by mining or the reservoir brine method?

Benefits	**Mining**	**Reservoir Brine Method**
lower emission of CO_2		✓
less use of water	✓	
less use of land		✓

(1)

Benefits	**Mining**	**Reservoir Brine Method**
lower emission of CO_2	✓	
less use of water		✓
less use of land	✓	

(3)

Benefits	**Mining**	**Reservoir Brine Method**
lower emission of CO_2	✓	
less use of water		✓
less use of land		✓

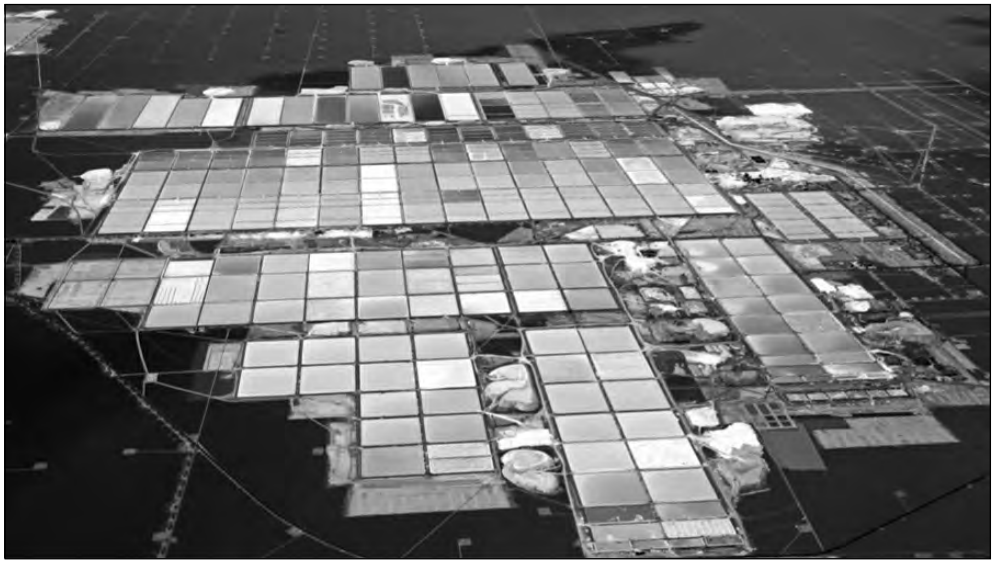
(2)

Benefits	**Mining**	**Reservoir Brine Method**
lower emission of CO_2		✓
less use of water	✓	
less use of land	✓	

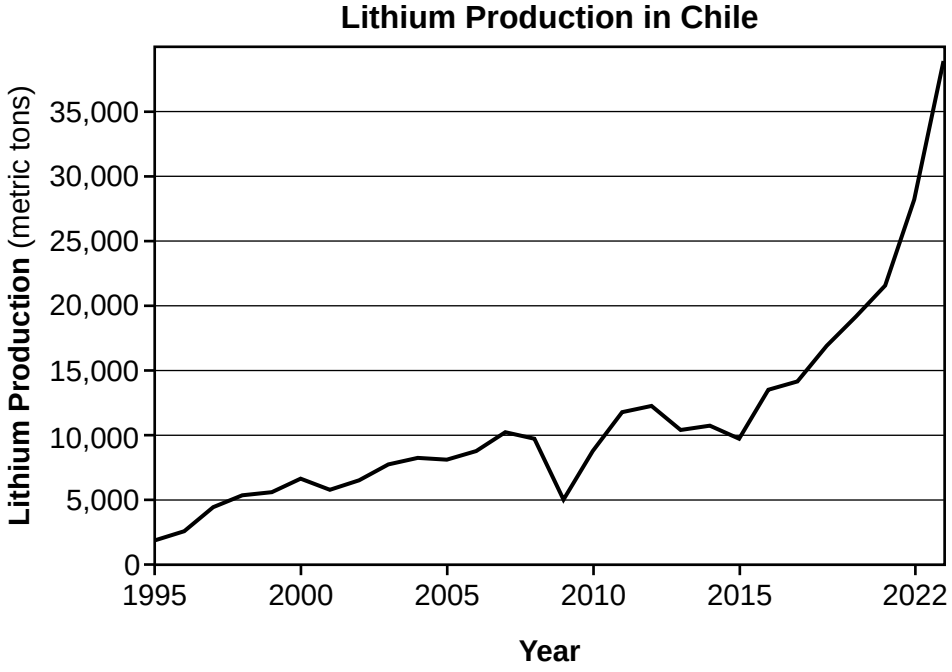
(4)

Lithium production has impacts on land use in the Atacama region of Chile. The photograph shows solar evaporation ponds at a brine extraction and processing facility.

Brine Extraction Facility



The graph below shows some information about lithium.



34 Which statement correctly identifies the changes to the lithosphere that were needed for reservoir brine lithium extraction in Chile between 1995 and 2022?

(1) The amount of land surface needed for evaporation ponds increased at a consistent rate from 2005 to 2010.

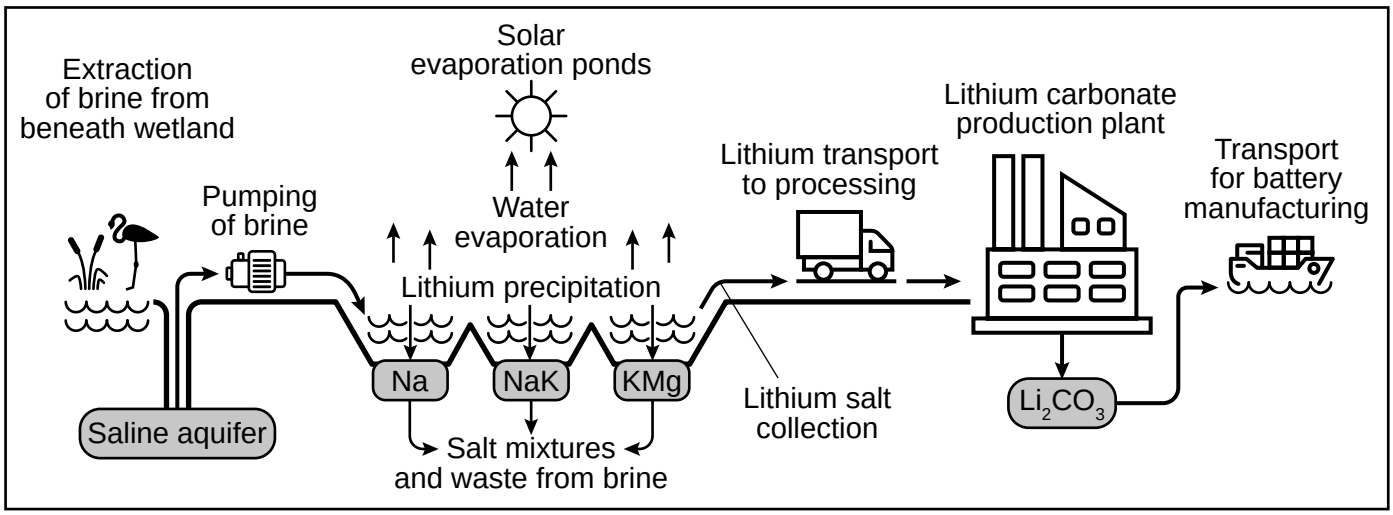
(2) The amount of land surface needed for evaporation ponds was lowest in 1995 and greatest in 2015.

(3) The amount of land surface needed for evaporation ponds increased between 2015 and 2022.

(4) The amount of land surface needed for evaporation ponds only decreased from 2010 to 2015.

The Andean flamingo, a bird native to wetlands in the Atacama region of Chile and other locations where lithium deposits occur, is listed as a vulnerable species. The model below shows some information about the reservoir brine method. The graph shows projected changes from 2020 to 2060 in Atacama wetland areas due to lithium mining.

Model of Reservoir Brine Method



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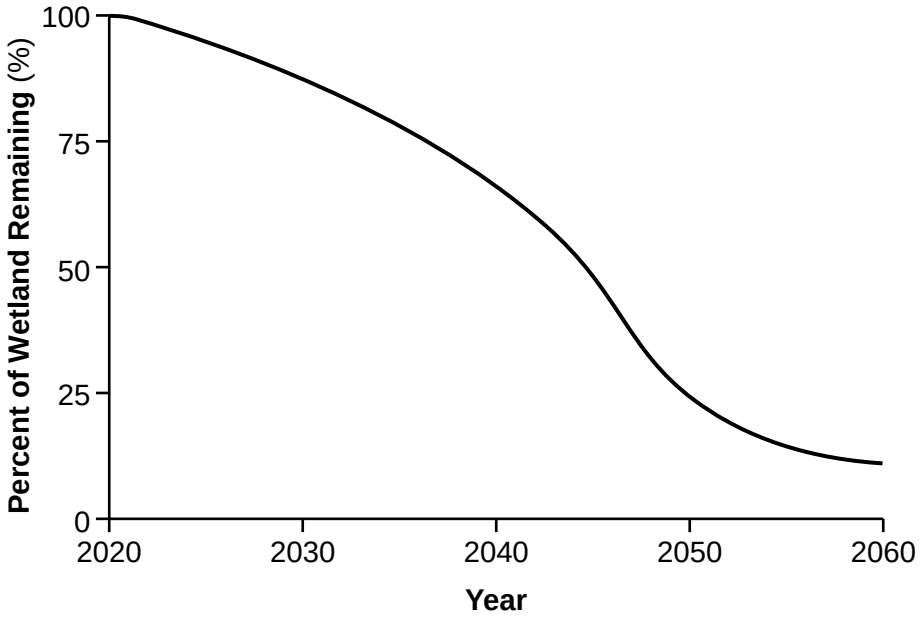
Projected Atacama Wetland Losses



35 Which statement correctly identifies how the processing and management of saline brine for lithium production in the Atacama region of Chile negatively impacts the Andean flamingo habitat?

(1) Pumping of brine from solar evaporation ponds adds brine to wetlands.

(2) Pumping of brine from saline aquifers reduces water that would be available for wetlands.

(3) Evaporation of water from saline aquifers reduces water that would be available for wetlands.

(4) Evaporation of water from solar evaporation ponds adds water to wetlands.

Base your answers to questions 36 through 40 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

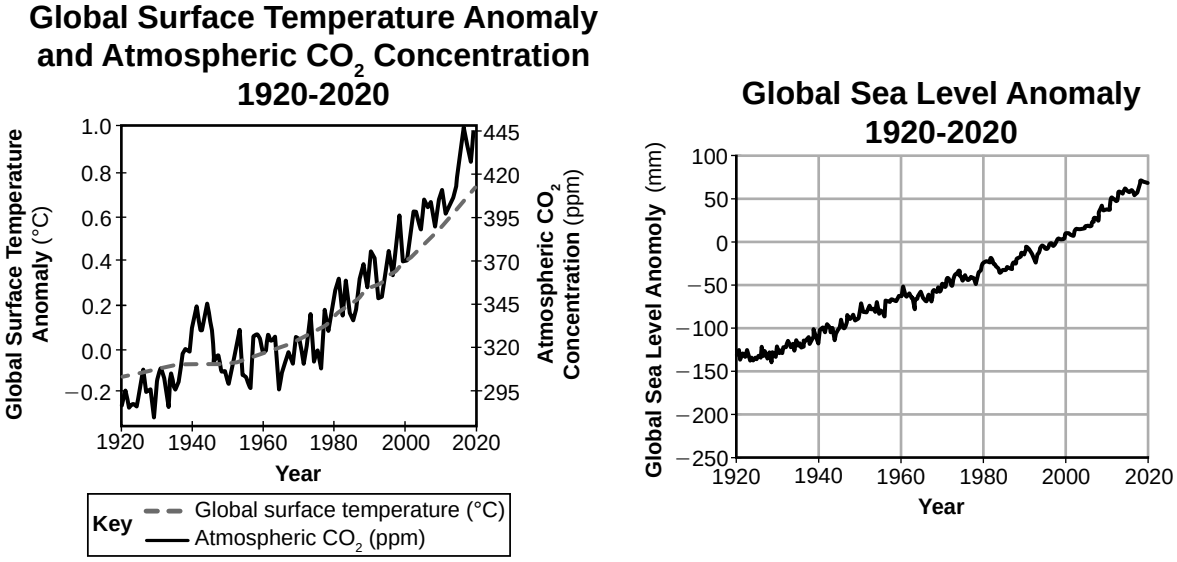
Ghost Forests

"Ghost forest" is a term used to describe a group of dead trees or tree stumps that remain standing. Ghost forests often form due to environmental change or natural disasters that impact coastal forests. As sea level changes, the invading seawater can advance and overtake the fresh water that many tree species in coastal forests need to exist. This salty water slowly poisons living trees, leaving dead and dying timber. Ghost forests can be found in almost every coastal state in the United States.

Coastal forests serve as efficient carbon sinks, collecting and storing atmospheric carbon. They are critical for maintaining water quality as they naturally filter, cool, and slow the movement of groundwater and streams. Coastal forests protect against erosion, buffer storm surges, provide wildlife habitats, and ensure water quality and quantity. As saltwater intrusion intensifies, the supply of coastal wood needed by the timber industry will also shrink, harming the economy of rural areas that depend on it.

Coastal Ghost Forest

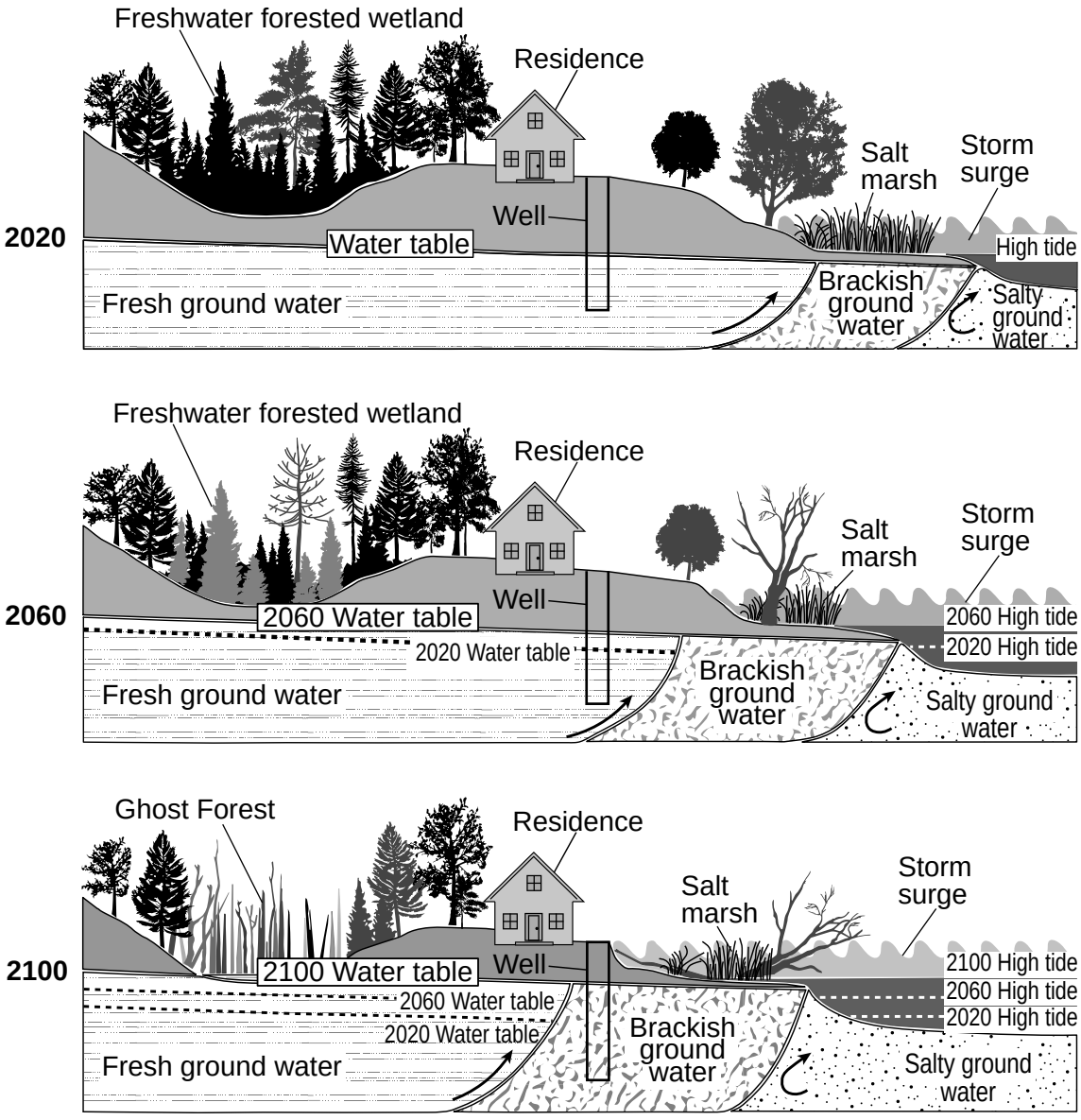
The graphs below show some information about global temperature, CO_2, and sea level. An anomaly is a change from an expected value. An anomaly value of 0 represents no change from the historical average.



36 In addition to increased carbon dioxide emissions, which row in the table below correctly describes the factors and their effect on coastal flooding in areas where ghost forest land cover has increased from 1920 to 2020?

Row	Total Change in Temperature Anomaly	Total Global Sea Level Anomaly	Coastal Flooding
(1)	−0.9°C	70 mm	decreased
(2)	−0.9°C	195 mm	decreased
(3)	0.9°C	195 mm	increased
(4)	0.9°C	70 mm	increased

The infographic below shows the predicted development of a ghost forest in a coastal area near a residence from the year 2020 to 2100. Brackish water is a mix of fresh and salty water.



37 Based on the infographic, identify **one** natural resource that will be affected by the rise in sea level, and construct an explanation about how the change in the availability of this resource will affect human activity. [1]

Natural resource: _____

Effect on human activity: _____

_____

38 A student makes the claim that the amount of living forest acreage will decrease as the amount of ghost forest acreage increases in the coastal area near this residence. Which associated impact to an Earth system will most likely occur?

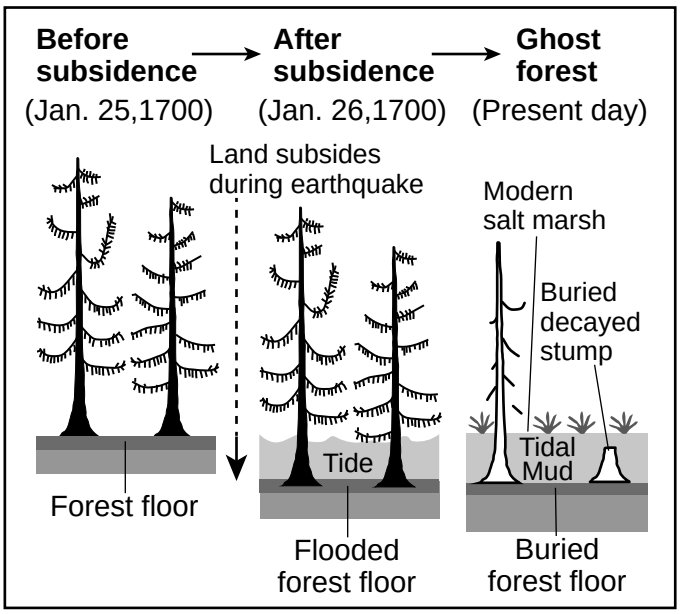
(1) The increase in wetland area will decrease local humidity.

(2) The loss of ground vegetation will cause an increase in water runoff and soil erosion.

(3) As high tide water levels increase, the local climate will cool due to more solar energy being reflected.

(4) New species that live on dead and decaying wood in ghost forests will increase the biodiversity of the ecosystem.

The model below shows the effects of subsidence in the creation of ghost forests as a result of an earthquake that occurred on January 26, 1700, along the west coast of the United States.



(Not drawn to scale)

39 Use the model to compare the temporal scale of land subsidence associated with the earthquake to the temporal scale of land subsidence associated with the development of a ghost forest. [1]

Temporal scale of land subsidence associated with an earthquake: _____

_____

Temporal scale of land subsidence associated with the development of a ghost forest: _____

_____

_____

Six proposed solutions for reducing the expansion of ghost forests are below.

Proposed Solutions

1. Fortify seawalls with concrete
2. Use sand and soil to create dunes with grasses along the coast
3. Limit development along coastal wetlands
4. Install sand fencing to reduce loss of sand from wind erosion
5. Preserve and restore the biodiversity of vegetation in tidal areas
6. Install tall rock walls and other artificial breakwaters

40 Which three proposed solutions reduce the expansion of ghost forests and would most likely be accomplished with minimal environmental impact and maximum aesthetic value to local residents?

(1) 1, 3, 4
(2) 1, 4, 6
(3) 2, 5, 6
(4) 2, 3, 5

Base your answers to questions 41 through 45 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

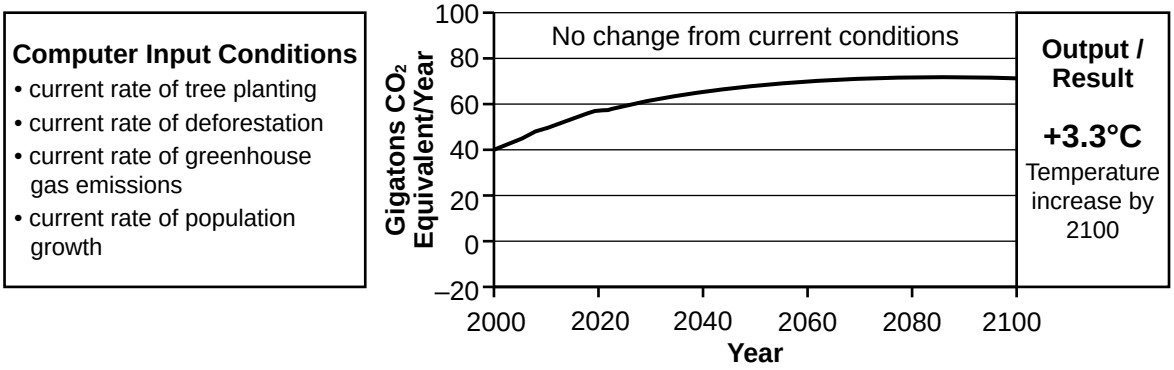
Human Impact on Earth

Global human population has increased dramatically in the last 50 years, which has increasingly stressed Earth's natural resources. This has created challenges in the management of those natural resources while also creating opportunities to find solutions to those challenges.

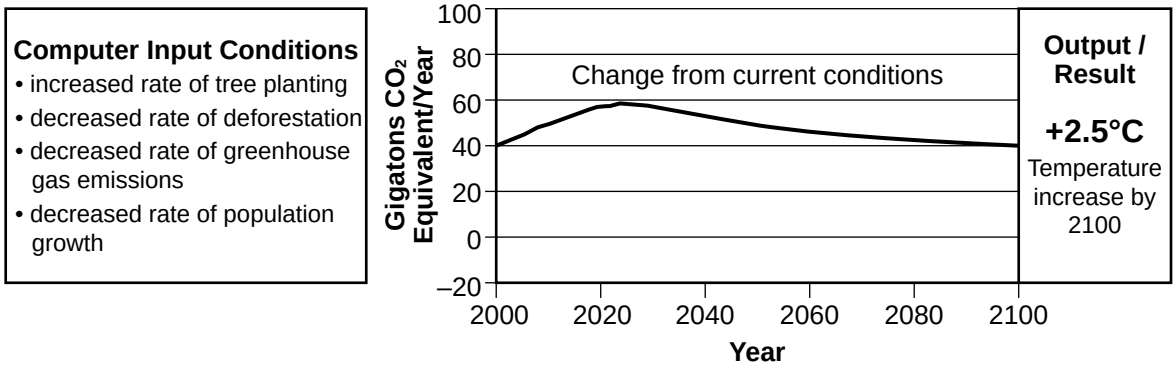
The EN-ROADS simulator is an online tool that allows users to manipulate variables in order to see their effects on climate change. A student used this simulator to estimate the global temperature change by the year 2100 if no changes to current conditions were made and if changes from current conditions were made.

The graphs show the results of the simulations. *Simulation 1* shows the possible outcome of greenhouse gas net emissions and the associated atmospheric global temperature change under current conditions. *Simulation 2* shows the possible outcome of greenhouse gas net emissions and the associated atmospheric global temperature change due to a different set of computer input conditions.

Simulation 1: Greenhouse Gas Net Emissions– No Change from Current Human Practices



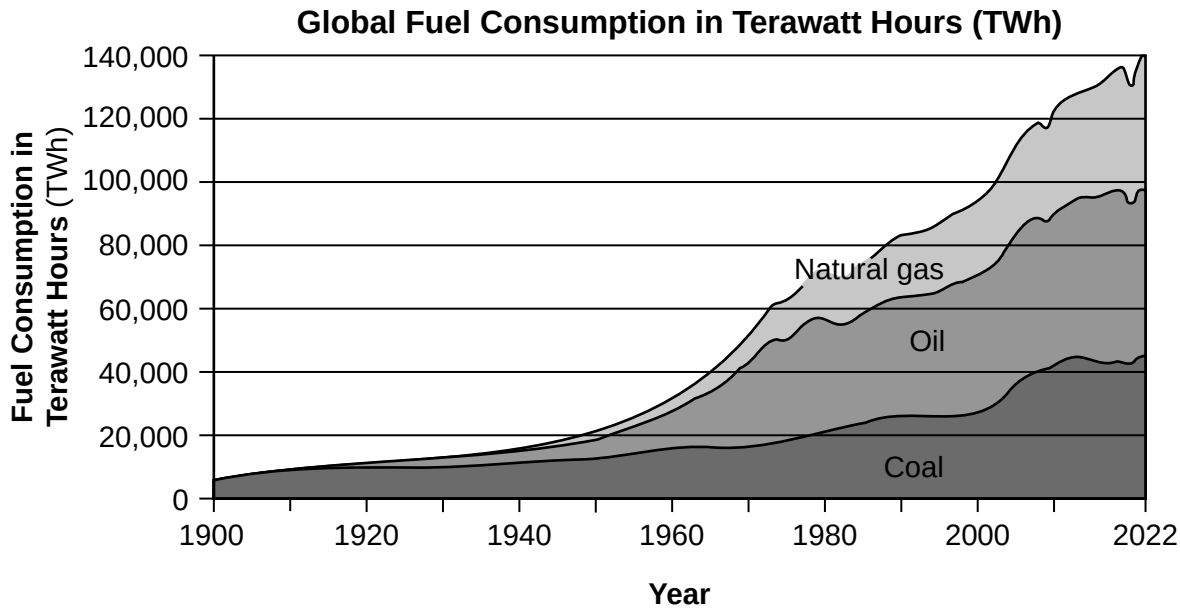
Simulation 2: Greenhouse Gas Net Emissions– Changed Human Practices

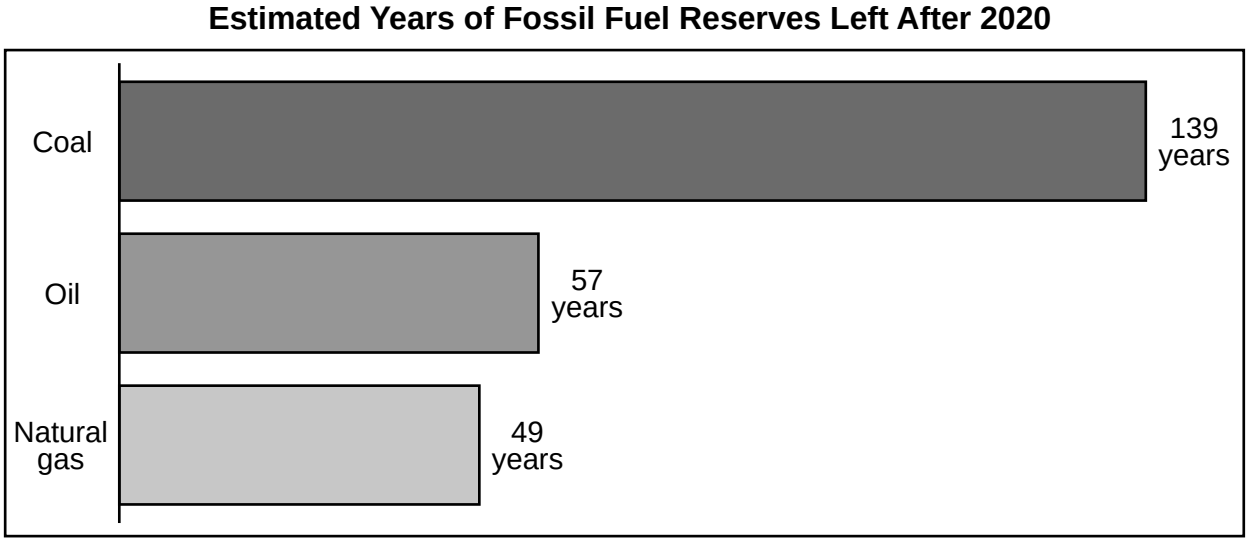


41 Based on the information from *Simulation 1* and *Simulation 2*, which row in the table below correctly matches both a method of managing natural resources and the resulting effect on human population, greenhouse gases in the atmosphere, and biodiversity beginning in 2020?

Row	Method of Managing Natural Resources	Effect on Human Population	Amount of Greenhouse Gases in Atmosphere	Effect on Biodiversity
(1)	replanting forests	positive	decrease	positive
(2)	replanting forests	positive	no change	negative
(3)	decreasing deforestation	positive	no change	positive
(4)	decreasing deforestation	positive	decrease	negative

The graphs below show some information about different types of fossil fuels.





42 Based on the information in both graphs, which statement correctly identifies the relationship between the management of fossil fuels since 1950 and the future sustainability of these resources?

(1) The yearly consumption of fossil fuels has increased by more than six times and the production of some types of these resources is not sustainable beyond the year 2150.

(2) The yearly consumption of fossil fuels has increased by more than ten times and the production of some types of these resources is sustainable beyond the year 2170.

(3) The yearly consumption of fossil fuels has doubled and the production of some types of these resources is sustainable for the next 30 years.

(4) The yearly consumption of fossil fuels has tripled and the production of some types of these resources is not sustainable for the next 30 years.

The table below shows some information about arable land from 1961 to 2016. Arable land is land that can be used for growing crops and supporting livestock.

World Arable Land per Person 1961 to 2016

Year	Hectares of Arable Land per Person (1 hectare = 2.47 acres)
1961	0.36
1972	0.3
1983	0.26
1994	0.25
2005	0.21
2016	0.19

43 Based on the graphs and table, which statement correctly provides evidence to support the claim that increased consumption of fossil fuels caused a change in the amount of world arable land per person?

(1) Atmospheric temperature increased, which increased soil evaporation and increased the amount of arable land.

(2) Atmospheric temperature increased, which decreased soil evaporation and decreased the amount of arable land.

(3) Atmospheric temperature increased, which decreased soil evaporation and increased the amount of arable land.

(4) Atmospheric temperature increased, which increased soil evaporation and decreased the amount of arable land.

The Cheetah Conservation Fund (CCF) is a non-profit organization that is working to ensure the survival of the cheetah and its habitat in Namibia, Africa. The central part of this African country was once a mixed woodland savannah. However, overgrazing by livestock (cattle raised for meat), hunting of elephants and rhinos, and removal of mature trees has changed the landscape to be dominated by thornbushes. This restricts the ability of animals in this habitat to hunt. CCF harvests these thornbushes to make Bushblok, a miniature log which can be used as a biomass fuel source.

44 Describe how the manufacturing of Bushblok logs addresses a problem in Namibia. Explain how these logs benefit the cheetah population and reduce the impact of human activity on cheetah habitat in Namibia. [1]

Problem: _____

_____

_____

Benefit: _____

_____

_____

45 Increasing the use of biomass is one of many actions that the CCF is taking to reduce the rate of climate change. Which additional solution, if *increased*, could be used along with biomass as another renewable energy source?

(1) drilling for oil

(2) mining of natural gas

(3) use of solar panels

(4) burning woodland trees

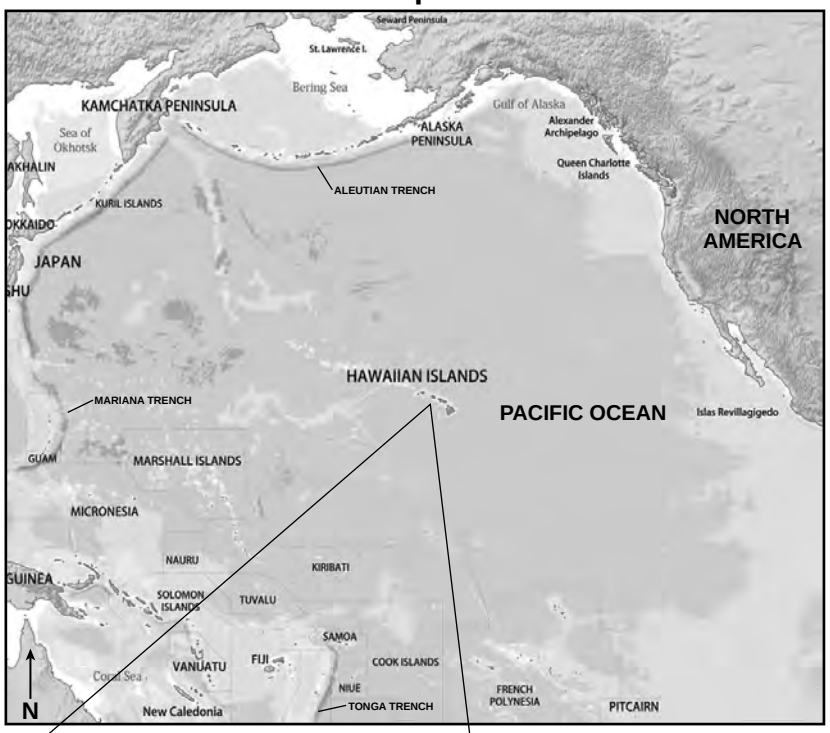
Base your answers to questions 46 through 50 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the ***2024 Edition Reference Tables for Earth and Space Sciences***.

Tectonics of the Hawaiian Islands

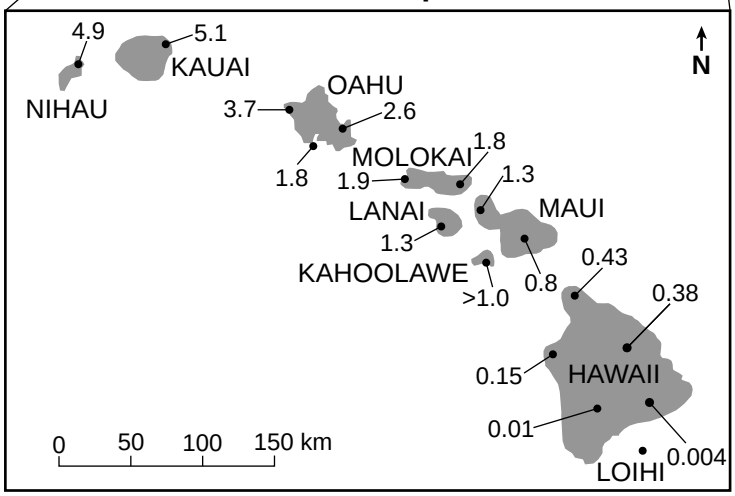
The Hawaiian Islands are situated near the center of the Pacific Plate and are volcanic peaks representing a history of volcanic eruptions. The island of Hawaii is over a hotspot, where a magma source in the mantle pushes upward to Earth's surface creating active volcanoes. The island of Hawaii itself is still being formed by ongoing volcanic activity at Mauna Loa and Kilauea volcanoes, both of which are currently situated over the hotspot. Loihi, an undersea volcano, also sits above the hotspot and will likely become the next Hawaiian island. The other islands in the chain are extinct volcanoes.

The maps show some information about the Hawaiian islands. Varying ages of bedrock on many of the islands are indicated in millions of years. The model shows three stages of island formation over a mantle hotspot.

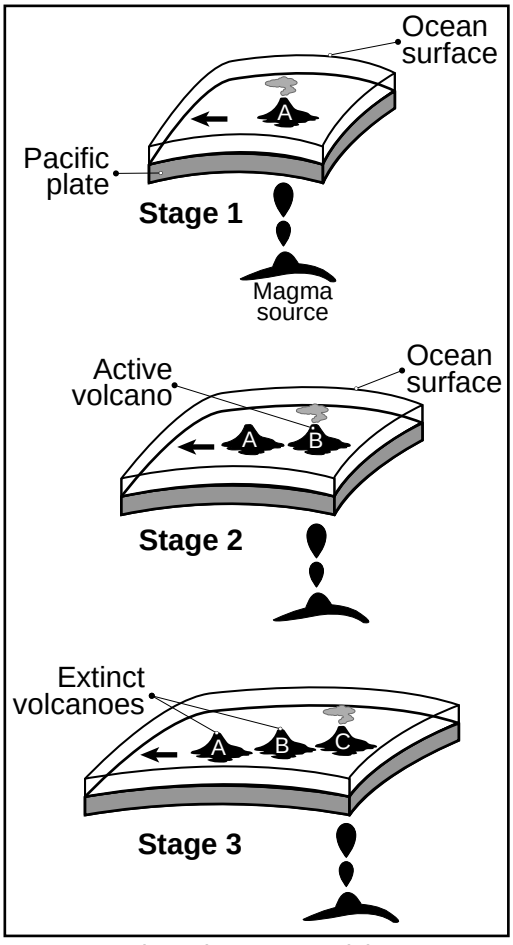
Map 1



Inset Map



Model



(Not drawn to scale)

46 Which table correctly pairs the Earth process with the surface feature that created the Hawaiian Islands chain?

Earth Process	Surface Feature
sinking magma	mid-ocean ridge

(1)

Earth Process	Surface Feature
tectonic uplift	volcanoes

(3)

Earth Process	Surface Feature
rising magma	volcanoes

(2)

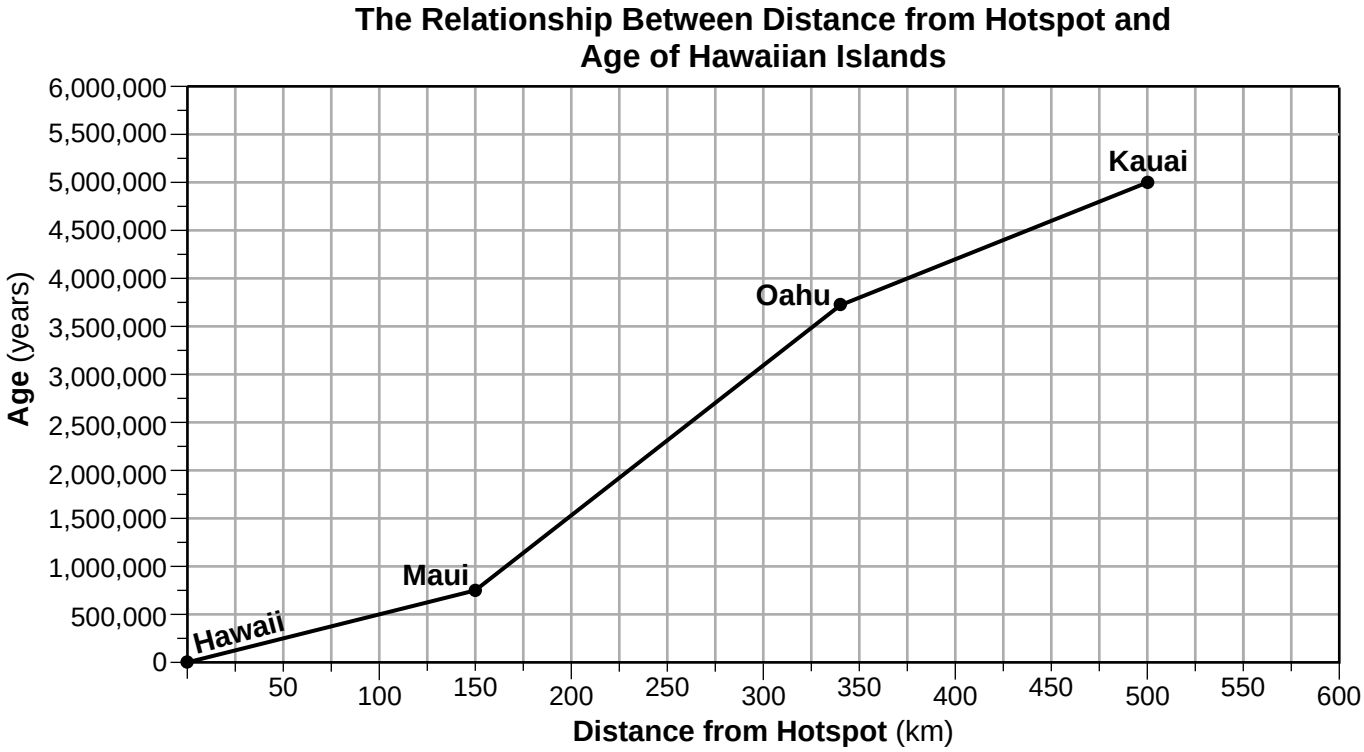
Earth Process	Surface Feature
tectonic subduction	oceanic trench

(4)

47 A student makes a claim that the motion of the Pacific Plate can be used to determine the pattern of ages of the Hawaiian Islands. Use evidence from the maps to describe the relationship between the pattern in the ages of the islands and the compass direction that the Pacific Plate is moving. [1]

Pattern in ages: _____

Compass direction of movement: _____



Two samples of ocean crust were collected between some of the Hawaiian Islands. Data for samples *X* and *Y* is shown below.

Sample	**Approximate Age** (y)	**Approximate Distance** (km)
X	500,000	90
Y	2,750,000	275

48 Between which islands were the samples collected?

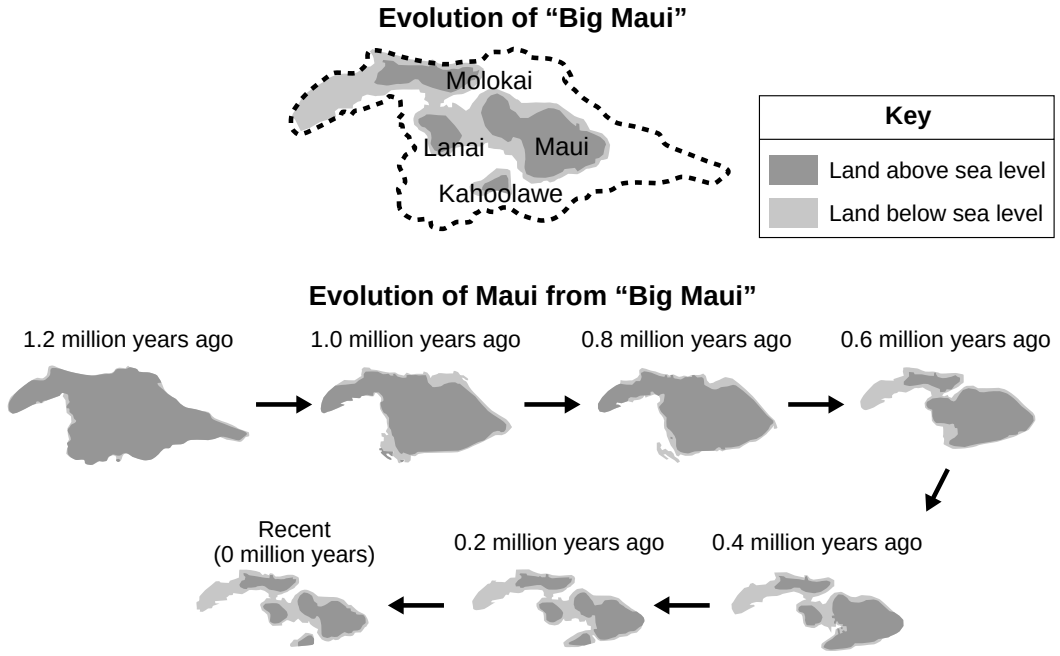
(1) *X* – between Hawaii and Maui
Y – between Oahu and Kauai

(2) *X* – between Oahu and Kauai
Y – between Hawaii and Maui

(3) *X* – between Hawaii and Maui
Y – between Maui and Oahu

(4) *X* – between Maui and Oahu
Y – between Hawaii and Maui

The models below show the geologic history of the formation of present-day Maui.



49 Based on the models, which table correctly identifies the spatial change, the temporal change, and one possible surface process that contributed to the evolution of Big Maui? [1]

(1)

Spatial Change	Surface Feature	Surface Process
1 large island to 4 separated islands	1.2 billion years	sea level rise

(2)

Spatial Change	Surface Feature	Surface Process
4 separated islands to 1 large island	4.2 million years	deposition along shorelines

(3)

Spatial Change	Surface Feature	Surface Process
1 large island to 4 separated islands	1.2 million years	sinking of landmass

(4)

Spatial Change	Surface Feature	Surface Process
4 separated islands to 1 large island	4.2 billion years	sea level drop

The photographs below show some shoreline locations on the island of Maui. Human development along the shoreline has impacted coastal regions. Scientists designed solutions to reduce this impact.

Photograph 1: Shoreline Location 1

Photograph 2: Shoreline Location 2

Photograph 3: Shoreline Location 3 Along Coastal Highway

50 Identify the geoscience problem being addressed in the photographs. Describe how the solutions shown in photograph 2 *or* photograph 3 reduce the impact of human development on natural geoscience processes that occur in coastal regions. [1]

Geoscience problem: _____

How solutions reduce impact: _____

_____

_____

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EARTH AND SPACE SCIENCES

The State Education Department / The University of the State of New York

Regents Examination in Earth and Space Sciences – June 2025

Scoring Key: (Multiple-Choice Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Earth and Space Sciences	June '25	**2**	4	MC	1	1
Earth and Space Sciences	June '25	**4**	2	MC	1	1
Earth and Space Sciences	June '25	**6**	3	MC	1	1
Earth and Space Sciences	June '25	**7**	2	MC	1	1
Earth and Space Sciences	June '25	**8**	1	MC	1	1
Earth and Space Sciences	June '25	**9**	4	MC	1	1
Earth and Space Sciences	June '25	**12**	4	MC	1	1
Earth and Space Sciences	June '25	**13**	1	MC	1	1
Earth and Space Sciences	June '25	**14**	3	MC	1	1
Earth and Space Sciences	June '25	**17**	3	MC	1	1
Earth and Space Sciences	June '25	**19**	1	MC	1	1
Earth and Space Sciences	June '25	**20**	2	MC	1	1
Earth and Space Sciences	June '25	**22**	2	MC	1	1
Earth and Space Sciences	June '25	**23**	3	MC	1	1
Earth and Space Sciences	June '25	**24**	2	MC	1	1
Earth and Space Sciences	June '25	**26**	4	MC	1	1
Earth and Space Sciences	June '25	**27**	2	MC	1	1
Earth and Space Sciences	June '25	**29**	1	MC	1	1
Earth and Space Sciences	June '25	**33**	4	MC	1	1
Earth and Space Sciences	June '25	**34**	3	MC	1	1
Earth and Space Sciences	June '25	**35**	2	MC	1	1
Earth and Space Sciences	June '25	**36**	3	MC	1	1
Earth and Space Sciences	June '25	**38**	2	MC	1	1
Earth and Space Sciences	June '25	**40**	4	MC	1	1
Earth and Space Sciences	June '25	**41**	1	MC	1	1
Earth and Space Sciences	June '25	**42**	1	MC	1	1
Earth and Space Sciences	June '25	**43**	4	MC	1	1
Earth and Space Sciences	June '25	**45**	3	MC	1	1
Earth and Space Sciences	June '25	**46**	2	MC	1	1
Earth and Space Sciences	June '25	**48**	3	MC	1	1
Earth and Space Sciences	June '25	**49**	3	MC	1	1

Regents Examination in Earth and Space Sciences – June 2025

Scoring Key: Constructed-Response Questions

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Earth and Space Sciences	June '25	**1**	–	CR	1	1
Earth and Space Sciences	June '25	**3**	–	CR	1	1
Earth and Space Sciences	June '25	**5**	–	CR	1	1
Earth and Space Sciences	June '25	**10**	–	CR	1	1
Earth and Space Sciences	June '25	**11**	–	CR	1	1
Earth and Space Sciences	June '25	**15**	–	CR	1	1
Earth and Space Sciences	June '25	**16**	–	CR	1	1
Earth and Space Sciences	June '25	**18**	–	CR	1	1
Earth and Space Sciences	June '25	**21**	–	CR	1	1
Earth and Space Sciences	June '25	**25**	–	CR	1	1
Earth and Space Sciences	June '25	**28**	–	CR	1	1
Earth and Space Sciences	June '25	**30**	–	CR	1	1
Earth and Space Sciences	June '25	**31**	–	CR	1	1
Earth and Space Sciences	June '25	**32**	–	CR	1	1
Earth and Space Sciences	June '25	**37**	–	CR	1	1
Earth and Space Sciences	June '25	**39**	–	CR	1	1
Earth and Space Sciences	June '25	**44**	–	CR	1	1
Earth and Space Sciences	June '25	**47**	–	CR	1	1
Earth and Space Sciences	June '25	**50**	–	CR	1	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **June 2025 Regents Examination in Earth and Space Sciences** will be available on the Department's web site at **https://www.nysedregents.org/earth_space_sciences/** no later than June 26, 2025. Conversion charts provided for the previous administrations of the Physical Setting/Earth Science examination must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

EARTH AND SPACE SCIENCES

Tuesday, June 10, 2025 — 1:15 to 4:15 p.m., only

RATING GUIDE

Directions to the Teacher:

Refer to the directions on page 2 before rating student papers.

Updated information regarding the rating of this examination may be posted on the New York State Education Department's web site during the rating period. Check this web site at: https://www.nysed.gov/state-assessment/high-school-regents-examinations and select the link "Scoring Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents Examination period.

Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Regents Examination in Earth and Space Sciences. Additional information about scoring is provided in the publication *Information Booklet for Scoring Regents Examinations in the Sciences*.

Allow 1 credit for each correct response.

At least two science teachers must participate in the scoring of the open-ended questions on a student's paper. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score more than approximately one-half of the open-ended questions on a student's answer paper. Teachers may not score their own students' answer papers.

Students' responses must be scored strictly according to the Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. Do not attempt to correct the student's work by making insertions or changes of any kind. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Fractional credit is *not* allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not be given when the wording of the questions allows such omissions.

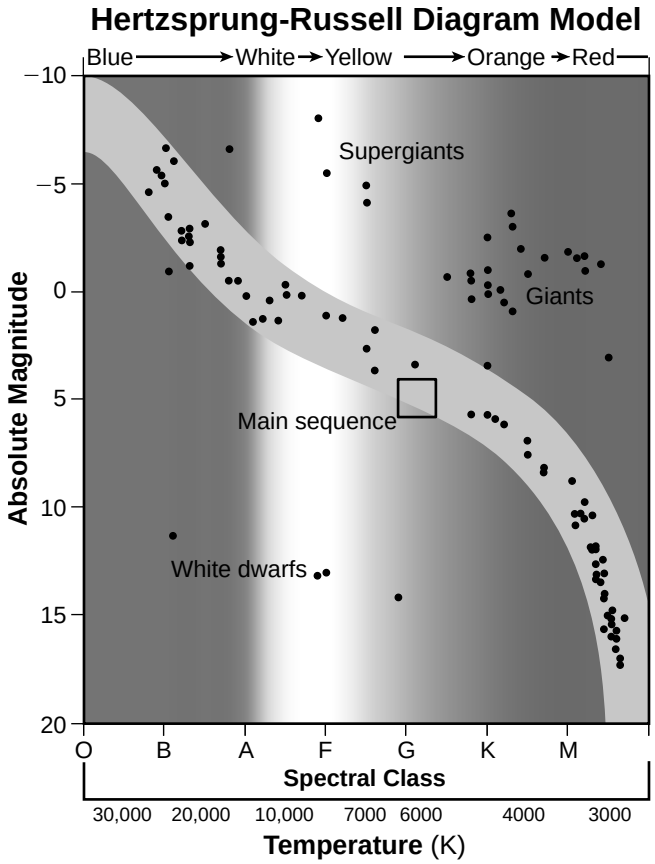
For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the space provided. Then the student's raw score on the test should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: https://www.nysed.gov/state-assessment/high-school-regents-examinations no later than June 26, 2025. The student's scale score should be entered in the box labeled "Scale Score" on the student's answer sheet. The scale score is the student's final examination score.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student's final score.

1 [1] Allow 1 credit for placing the center of an **X** within the box shown below *and* a correct relative temperature and relative absolute magnitude.

Example of a 1-credit response:



Acceptable responses include, but are not limited to:

Changes in relative temperature:

— cooler

— lower temperature

Changes in relative absolute magnitude:

— decreased

— lower magnitude value

Note: It is recommended that an overlay of the same scale as a student answer sheet be used to ensure reliability in rating.

2 [1] Allow 1 credit for 4.

3 [1] Allow 1 credit for indicating *two* statements with a check mark (✓), as shown below:

☐	Venus orbits the Sun at a constant speed.
✓	Mercury travels faster in its orbit when it is closer to the Sun.
✓	Venus's orbit is less elliptical than Mercury's orbit.
☐	The orbital speeds of both planets are affected by their masses.
☐	Unlike Venus, the eccentricity of Mercury's orbit prevents Mercury from having a moon.

4 [1] Allow 1 credit for 2.

5 [1] Allow 1 credit for all *three* correct responses, as shown below:

Choice A: inside

Choice B: closer to

Choice C: Sun

6 [1] Allow 1 credit for 3.

7 [1] Allow 1 credit for 2.

8 [1] Allow 1 credit for 1.

9 [1] Allow 1 credit for 4.

10 [1] Allow 1 credit for *both* a correct CO_2 equivalent and a global surface temperature change.

Projected CO_2 equivalent in 2100: any value from 795 to 805.

Projected global surface temperature change: any value that would round to 2.4.

11 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— Trees are growing, so they take in carbon dioxide during photosynthesis, which stores carbon in trees and soil, preventing it from entering the atmosphere as CO_2.

— Trees that are being replanted in a forest will take in carbon dioxide from the atmosphere during photosynthesis and reduce the amount that is in the atmosphere.

12 [1] Allow 1 credit for 4.

13 [1] Allow 1 credit for 1.

14 [1] Allow 1 credit for 3.

15 [1] Allow 1 credit for any value from -10°C to 12°C *and* a correct associated impact.
Acceptable impacts include, but are not limited to:

— glaciers will melt, causing sea levels to rise

— ocean circulation will be disrupted

Note: If a student indicates a negative temperature change (cooling), the associated impact must reflect this change.

16 [1] Allow 1 credit for mass.

17 [1] Allow 1 credit for 3.

18 [1] Allow 1 credit for all *three* check marks, as shown below:

✓	A decrease in the number of sunspots is inferred to decrease Earth's temperatures.
✓	The number of sunspots changes each year, occurring in approximately 11-year cycles.
	An increase in solar output is associated with a decrease in the number of sunspots.
	The average number of sunspots appearing each year has decreased steadily since 1950.
✓	Sunspots are regions of cooler temperatures on the surface of the Sun.

19 [1] Allow 1 credit for 1.

20 [1] Allow 1 credit for 2.

21 [1] Allow 1 credit for an acceptable response. Acceptable responses include, but are not limited to:

— The salt front would move closer to the Atlantic Ocean because there is more fresh water from the rain event entering the river.

— The increased rain would add more fresh water to the Hudson River, moving the salt front closer to the Atlantic Ocean.

22 [1] Allow 1 credit for 2.

23 [1] Allow 1 credit for 3.

24 [1] Allow 1 credit for 2.

25 [1] Allow 1 credit for an acceptable response. Acceptable responses include, but are not limited to:

— PCB levels in fish did decrease, but not to the EPA target levels.

— PCB levels in fish stabilized at around 0.7 mg/kg and then increased in 2021, showing it's not effective.

— The PCB levels as of 2021 in fish have not met the EPA targets for 2020.

26 [1] Allow 1 credit for 4.

27 [1] Allow 1 credit for 2.

28 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— Based on the graph, the age of the meteorite is 4.5 billion years old, so Earth must also be almost 4.5 billion years old since they formed at about the same time.

— 50% of Uranium-238 is remaining, which indicates the sample is 4.5 billion years old, so Earth must be almost the same age.

— The age of Earth must be about 4.5 billion years old because the age of the meteorite is 4.5 billion years old since they both formed at about the same time.

29 [1] Allow 1 credit for 1.

30 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— Microorganisms (protists/eukaryotes) in the ocean produced oxygen through the process of photosynthesis that then entered the atmosphere, causing increased weathering rates and allowing for the evolution of animal life.

— Photosynthetic life in the ocean caused oxygen concentrations to increase in the ocean and then be released into the atmosphere, which allowed for greater diversity of ocean and land organisms.

Note: Responses must include the release of oxygen from the ocean by photosynthetic ocean organisms to the atmosphere.

31 [1] Allow 1 credit for Battery Electric Vehicle *and* appropriate evidence. Acceptable responses include, but are not limited to:

— Carbon dioxide is a pollutant, and the total emissions for an electric vehicle are 41 tCO_2e compared to 48 tCO_2e for the hybrid and 57 tCO_2e for the internal combustion engine.

— Carbon dioxide is a greenhouse gas, and the total emissions for electric vehicles are 16 tCO_2e less than that of internal combustion engine vehicles and 7 less than hybrid electric vehicles.

32 [1] Allow 1 credit for both an economic benefit *and* an example of how the wants and needs of society are affected by it. Acceptable responses include, but are not limited to:

Economic benefit:

— Class 1 and class 7 drivers that drive during off-peak hours with a Green Pass will save $3.50.

— Class 1 and class 7 vehicles will pay less in tolls for off-peak hours.

Wants and needs of society:

— Class 1 and class 7 vehicles driven during off-peak hours with a Green Pass will emit less air pollution.

— People who drive internal combustion vehicles will contribute more air pollution when driving during off-peak hours, so they will have to pay more money to drive in New York City.

33 [1] Allow 1 credit for 4.

34 [1] Allow 1 credit for 3.

35 [1] Allow 1 credit for 2.

36 [1] Allow 1 credit for 3.

37 [1] Allow 1 credit for identifying either fresh water/drinking water *or* wood/timber as a natural resource and an acceptable explanation. Acceptable responses include, but are not limited to:

Effect on human activity (fresh water):

— Salt water will intrude into the freshwater well, which would negatively impact the quality of drinking water and cause the resident to move their well.

— Residents in the house would experience saltwater contamination to the drinking water supply, causing the residents to possibly relocate their home.

— They will have to get a filter or fresh water by other means.

Effect on human activity (wood):

— The salt water intrusion would kill the trees in the freshwater forested wetland over time, which would reduce the supply of available lumber for building and heating.

— As the salt water invades the tree roots, the trees will slowly die, negatively impacting the lumber industry.

38 [1] Allow 1 credit for 2.

39 [1] Allow 1 credit for *both* temporal scale responses. Acceptable responses include, but are not limited to:

Temporal scale of land subsidence associated with earthquakes:

— happens over seconds/minutes/hours

— happens in less than one day

Temporal scale of land subsidence associated with the development of ghost forests:

— happens over years/decades/centuries

— occurs over much longer periods of time than earthquake sinking

40 [1] Allow 1 credit for 4.

41 [1] Allow 1 credit for 1.

42 [1] Allow 1 credit for 1.

43 [1] Allow 1 credit for 4.

44 [1] Allow 1 credit for *both* a description of a problem and a benefit. Acceptable responses include, but are not limited to:

Problem:

— Humans have changed the habitat by allowing thornbush populations to increase, which inhibits cheetahs from finding adequate food.

— Removal of mature trees by humans has caused thornbush to grow, which inhibits cheetah hunting.

Benefit:

— Bushblok production will benefit the cheetah by removing thornbush overgrowth so hunting behavior of cheetahs can occur.

— Thornbush plants are removed by humans, benefitting the cheetah by improving the habitat to allow for hunting.

45 [1] Allow 1 credit for 3.

46 [1] Allow 1 credit for 2.

47 [1] Allow 1 credit for an acceptable evidence. Acceptable responses include, but are not limited to:

Pattern of ages:

— The islands get older to the northwest.

— The islands get younger to the southeast.

— Islands get older with increasing distance from the hotspot.

Compass direction of movement:

— The Pacific Plate moves to the northwest.

— The Pacific Plate moves from the southeast to the northwest.

48 [1] Allow 1 credit for 3.

49 [1] Allow 1 credit for 3.

50 [1] Allow 1 credit for erosion *or* sea level rise *and* an acceptable response. Acceptable responses include, but are not limited to:

— Sandbags are beneficial because the waves will hit the sandbags and keep the coastline in place.

— Sandbags are beneficial because as water rises, the sandbags will prevent flooding from higher waves.

— The wall/rocks are a barrier to waves washing away the sediment under the highway.

— The wall/rocks will prevent water from flooding the road as water levels rise.

The *Chart for Determining the Final Examination Score for the June 2025 Regents Examination in Earth and Space Sciences* will be posted on the Department's web site at: https://www.nysed.gov/state-assessment/high-school-regents-examinations no later than June 26, 2025.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

1. Go to https://www.nysed.gov/state-assessment/teacher-feedback-state-assessments.
2. Click Regents Examinations.
3. Complete the required demographic fields.
4. Select the test title from the Regents Examination dropdown list.
5. Complete each evaluation question and provide comments in the space provided.
6. Click the SUBMIT button at the bottom of the page to submit the completed form.

THE STATE EDUCATION DEPARTMENT

THE UNIVERSITY OF THE STATE OF NEW YORK / ALBANY, NY 12234

June 2025 Earth and Space Sciences Test Map to the Standards

Question	Type	Points	Performance Expectation
1	Constructed Response	1	HS-ESS1-1
2	Multiple Choice	1	HS-ESS1-1
3	Constructed Response	1	HS-ESS1-4
4	Multiple Choice	1	HS-ESS1-4
5	Constructed Response	1	HS-ESS1-7
6	Multiple Choice	1	HS-ESS2-4
7	Multiple Choice	1	HS-ESS2-4
8	Multiple Choice	1	HS-ESS3-5
9	Multiple Choice	1	HS-ESS2-2
10	Constructed Response	1	HS-ESS3-5
11	Constructed Response	1	HS-ESS2-2
12	Multiple Choice	1	HS-ESS2-6
13	Multiple Choice	1	HS-ESS3-1
14	Multiple Choice	1	HS-ESS2-2
15	Constructed Response	1	HS-ESS3-5
16	Constructed Response	1	HS-ESS1-1
17	Multiple Choice	1	HS-ESS1-3
18	Constructed Response	1	HS-ESS1-1
19	Multiple Choice	1	HS-ESS1-2
20	Multiple Choice	1	HS-ESS1-2
21	Constructed Response	1	HS-ESS2-5
22	Multiple Choice	1	HS-ESS2-2
23	Multiple Choice	1	HS-ESS3-1
24	Multiple Choice	1	HS-ESS3-4
25	Constructed Response	1	HS-ESS2-2
26	Multiple Choice	1	HS-ESS1-6
27	Multiple Choice	1	HS-ESS1-4
28	Constructed Response	1	HS-ESS1-6
29	Multiple Choice	1	HS-ESS2-1
30	Constructed Response	1	HS-ESS2-7
31	Constructed Response	1	HS-ESS3-2
32	Constructed Response	1	HS-ETS1-1
33	Multiple Choice	1	HS-ESS3-2
34	Multiple Choice	1	HS-ESS3-6
35	Multiple Choice	1	HS-ESS3-3
36	Multiple Choice	1	HS-ESS2-2
37	Constructed Response	1	HS-ESS3-1
38	Multiple Choice	1	HS-ESS3-5
39	Constructed Response	1	HS-ESS2-1
40	Multiple Choice	1	HS-ETS1-3
41	Multiple Choice	1	HS-ESS3-3
42	Multiple Choice	1	HS-ESS3-3
43	Multiple Choice	1	HS-ESS2-2
44	Constructed Response	1	HS-ESS3-4
45	Multiple Choice	1	HS-ETS1-2
46	Multiple Choice	1	HS-ESS2-1
47	Constructed Response	1	HS-ESS1-5
48	Multiple Choice	1	HS-ESS1-5
49	Multiple Choice	1	HS-ESS2-1
50	Constructed Response	1	HS-ESS3-4

* This item map identifies the Performance Expectation with which each test question is aligned. All NYSP-12SLS Performance Expectations are three-dimensional (https://www.nysed.gov/sites/default/files/programs/standards-instruction/p-12-science-learning-standards.pdf). The integration of these three dimensions provides students with a context for the content of science (DCI), the methods by which science knowledge is acquired and understood (SEP), and the ways in which the sciences are connected through concepts that have universal meaning across the disciplines (CCC).

The State Education Department / The University of the State of New York

Regents Examination in Earth and Space Sciences – June 2025

Chart for Converting Total Test Raw Scores to Final Exam Scores (Scale Scores)

(Use for the June 2025 exam only.)

Raw Score	Scale Score	Performance Level
50	**100**	5
49	**99**	5
48	**98**	5
47	**96**	5
46	**95**	5
45	**93**	5
44	**92**	5
43	**91**	5
42	**89**	5
41	**88**	5
40	**86**	5
39	**85**	5
38	**84**	4
37	**82**	4
36	**81**	4
35	**80**	4
34	**78**	4

Raw Score	Scale Score	Performance Level
33	**77**	4
32	**76**	3
31	**75**	3
30	**73**	3
29	**72**	3
28	**71**	3
27	**70**	3
26	**69**	3
25	**67**	3
24	**66**	3
23	**65**	3
22	**64**	2
21	**62**	2
20	**61**	2
19	**60**	2
18	**58**	2
17	**57**	2

Raw Score	Scale Score	Performance Level
16	**55**	2
15	**53**	1
14	**51**	1
13	**49**	1
12	**47**	1
11	**45**	1
10	**42**	1
9	**39**	1
8	**36**	1
7	**33**	1
6	**29**	1
5	**25**	1
4	**21**	1
3	**16**	1
2	**11**	1
1	**6**	1
0	**0**	1

To determine the student's final examination score (scale score), find the student's total test raw score in the column labeled "Raw Score" and then locate the scale score that corresponds to that raw score. The scale score is the student's final examination score. Enter this score in the space labeled "Scale Score" on the student's answer sheet.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart change from one administration to another, it is crucial that for each administration the conversion chart provided for that administration be used to determine the student's final score. The chart above is usable only for this administration of the Regents Examination in Earth and Space Sciences.