

Large-Type Edition

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING EARTH SCIENCE

Tuesday, August 20, 2024 — 8:30 to 11:30 a.m., only

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.

Use your knowledge of Earth science to answer all questions in this examination. Before you begin this examination, you must be provided with the *2011 Edition Reference Tables for Physical Setting/Earth Science*. You will need these reference tables to answer some of the questions.

You are to answer all questions in all parts of 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 answer booklet. A separate answer sheet for Part A and Part B–1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B–1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B–2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer 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 answer booklet cannot be accepted if you fail to sign this declaration.

Notice ...

A four-function or scientific calculator and a copy of the *2011 Edition Reference Tables for Physical Setting/Earth Science* must be available for you to use while taking this examination.

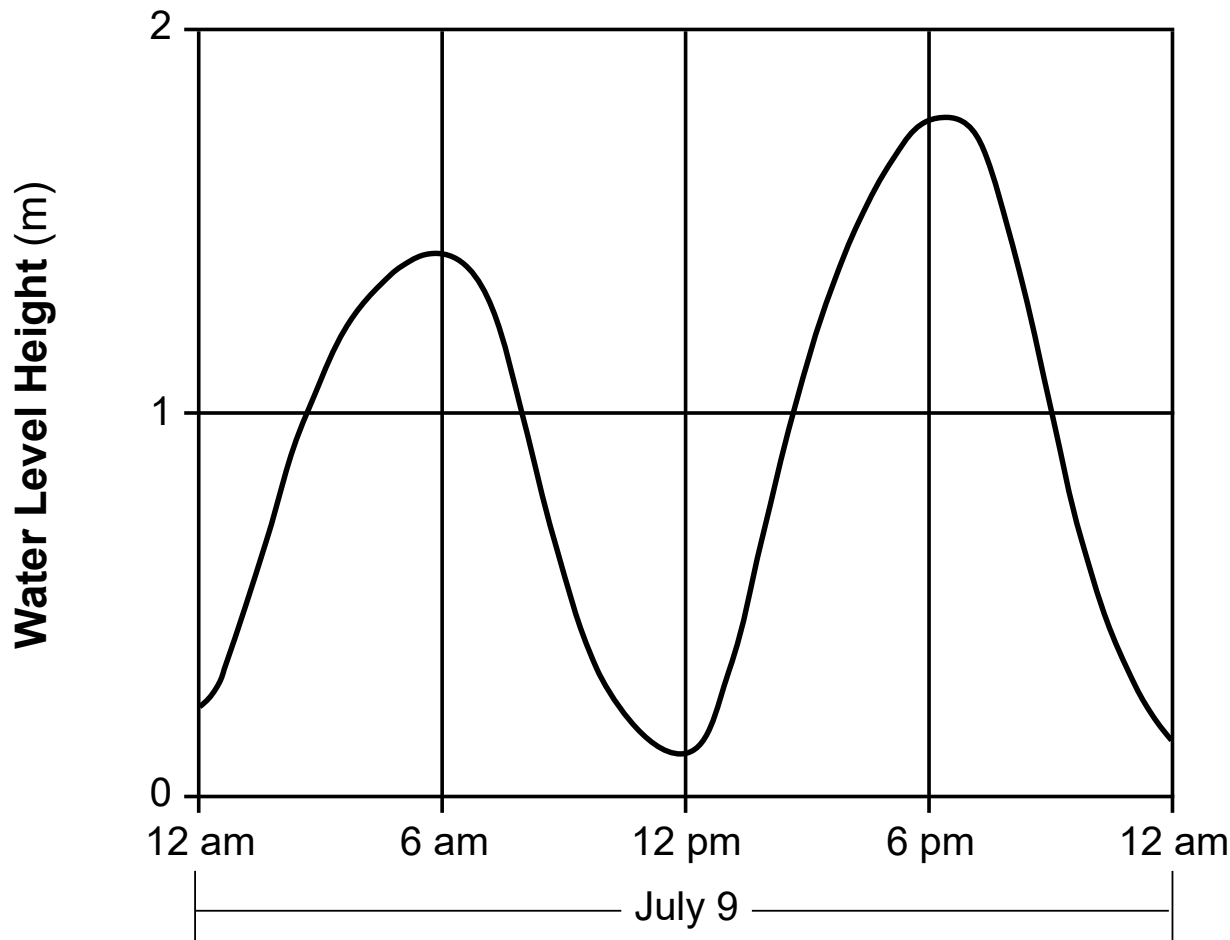
DO NOT START THIS EXAMINATION UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part.

Directions (1–35): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*. Record your answers on your separate answer sheet.

- 1 The graph below shows the change in water level height measured in meters (m) at the Brooklyn Bridge in New York City on July 9, 2018.



Question 1 continued

According to the pattern shown on the graph, the next high tide will occur on July 10 at approximately

- (1) 5:24 a.m.
 - (2) 6:53 a.m.
 - (3) 5:24 p.m.
 - (4) 6:53 p.m.
-

2 Which event is correlated with an asteroid impact on Earth that occurred approximately 65 million years ago?

- (1) extinction of the ammonoids
- (2) the breaking up of Pangaea
- (3) closing of the Iapetus Ocean
- (4) peak development of eurypterids

3 Light observed from most galaxies in our universe shows a shift toward the

- (1) blue end of the spectrum and is evidence of a contracting universe
- (2) blue end of the spectrum and is evidence of an expanding universe
- (3) red end of the spectrum and is evidence of a contracting universe
- (4) red end of the spectrum and is evidence of an expanding universe

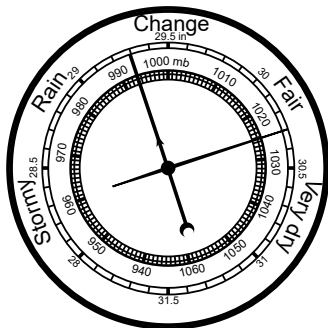
4 The Milky Way is classified as a

- (1) large constellation
- (2) metallic asteroid
- (3) spiral galaxy
- (4) white dwarf star

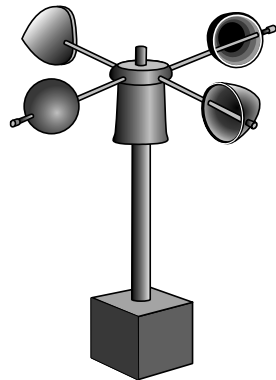
5 What is the approximate altitude of Polaris at Riverhead, New York?

- (1) 41°
- (2) 49°
- (3) 73°
- (4) 90°

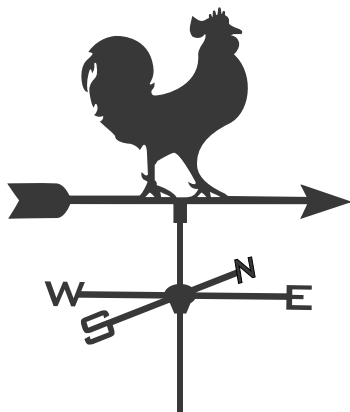
6 Which instrument provides direct evidence of Earth's rotation?



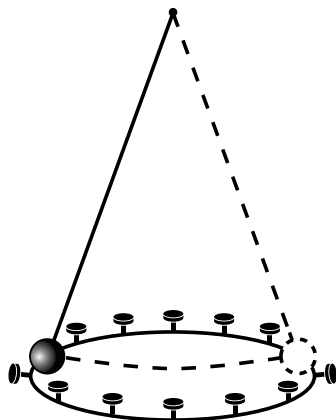
(1)



(3)



(2)

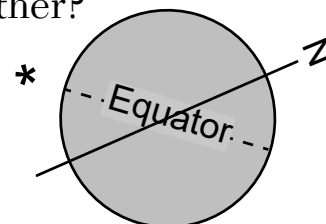


(4)

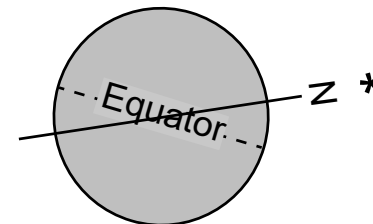
7 Rural areas on Long Island, New York, receive approximately the same amount of yearly precipitation as the urban areas of New York City. Compared to rural areas on Long Island, the urban areas of New York City most likely have

- (1) less runoff and less infiltration
- (2) less runoff and more infiltration
- (3) more runoff and less infiltration
- (4) more runoff and more infiltration

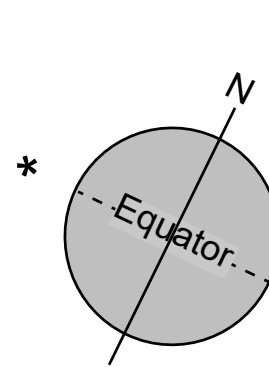
8 Which diagram best represents the positions of the equator, Earth's axis with the North Pole labeled (N), and Polaris (*) relative to each other?



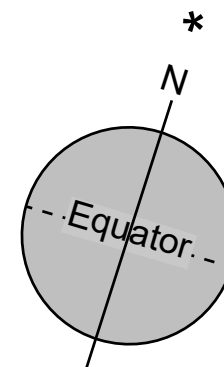
(1)



(3)



(2)



(4)

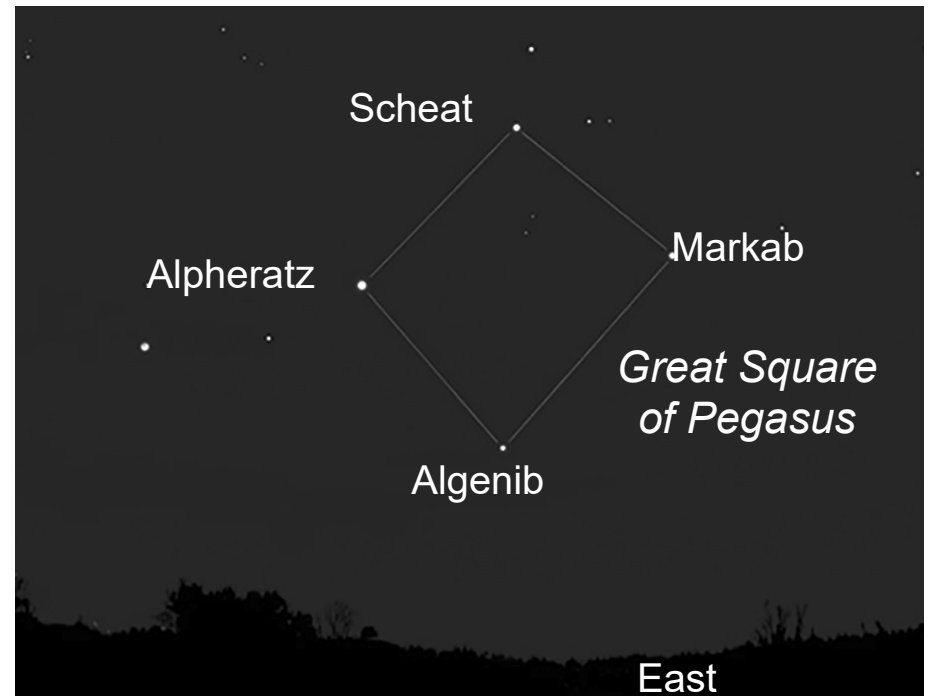
9 Earth's early atmosphere is inferred to have been formed during the Early Archean Era primarily by

- (1) asteroid impacts
- (2) coal-forming forests
- (3) radioactive decay
- (4) volcanic outgassing

10 In the water cycle, it can be inferred that precipitation has occurred if

- (1) grass is covered with frost
- (2) trees are covered with snow
- (3) coastal fog moves inland
- (4) ponds are covered with ice

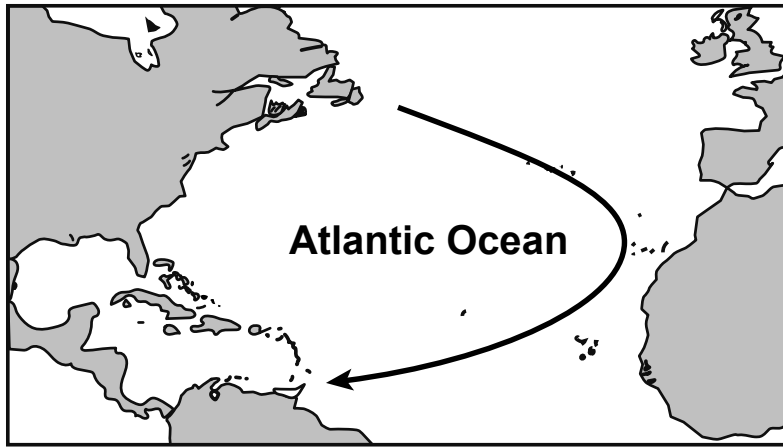
11 The photograph below shows the Great Square of Pegasus, consisting of a pattern of four stars, as viewed from New York State during the fall season.



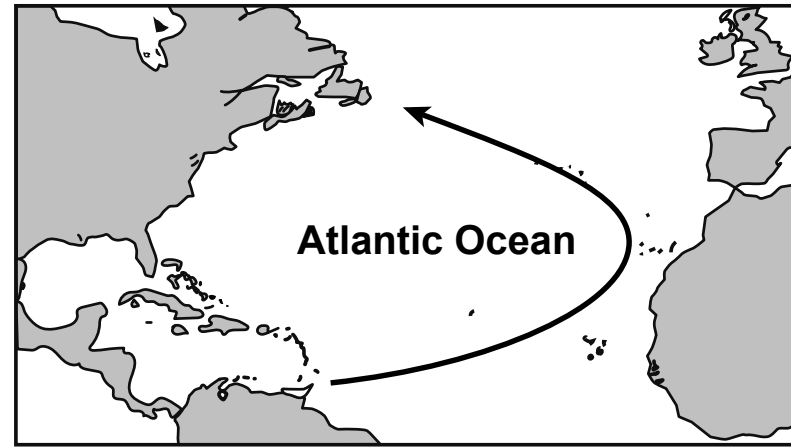
Which motion causes this square pattern of stars to be visible in the nighttime sky from New York State in the fall, but *not* in the spring?

- (1) rotation of Earth on its axis
- (2) rotation of stars in the Great Square of Pegasus
- (3) revolution of Earth around the Sun
- (4) revolution of the Great Square of Pegasus around Earth

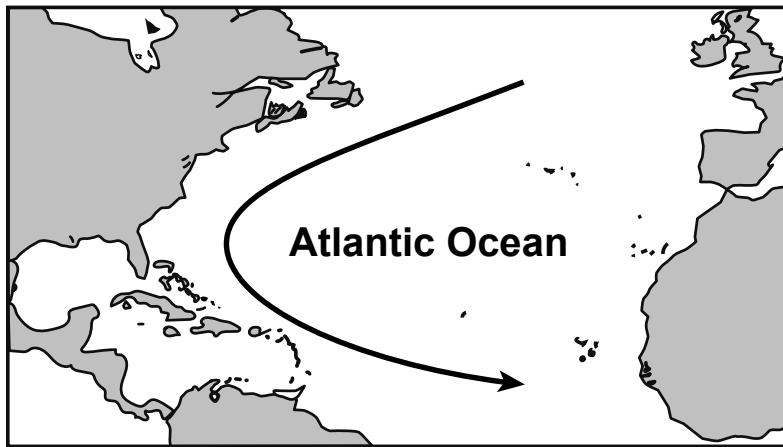
12 The arrow on which map shows the most likely path of a hurricane in the Atlantic Ocean?



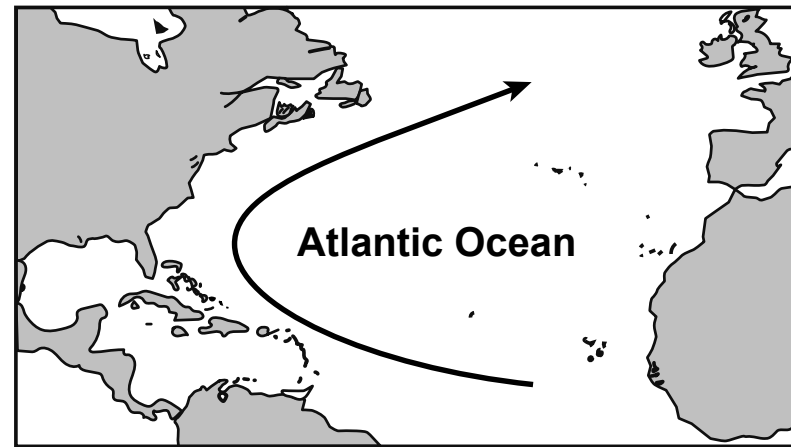
(1)



(3)

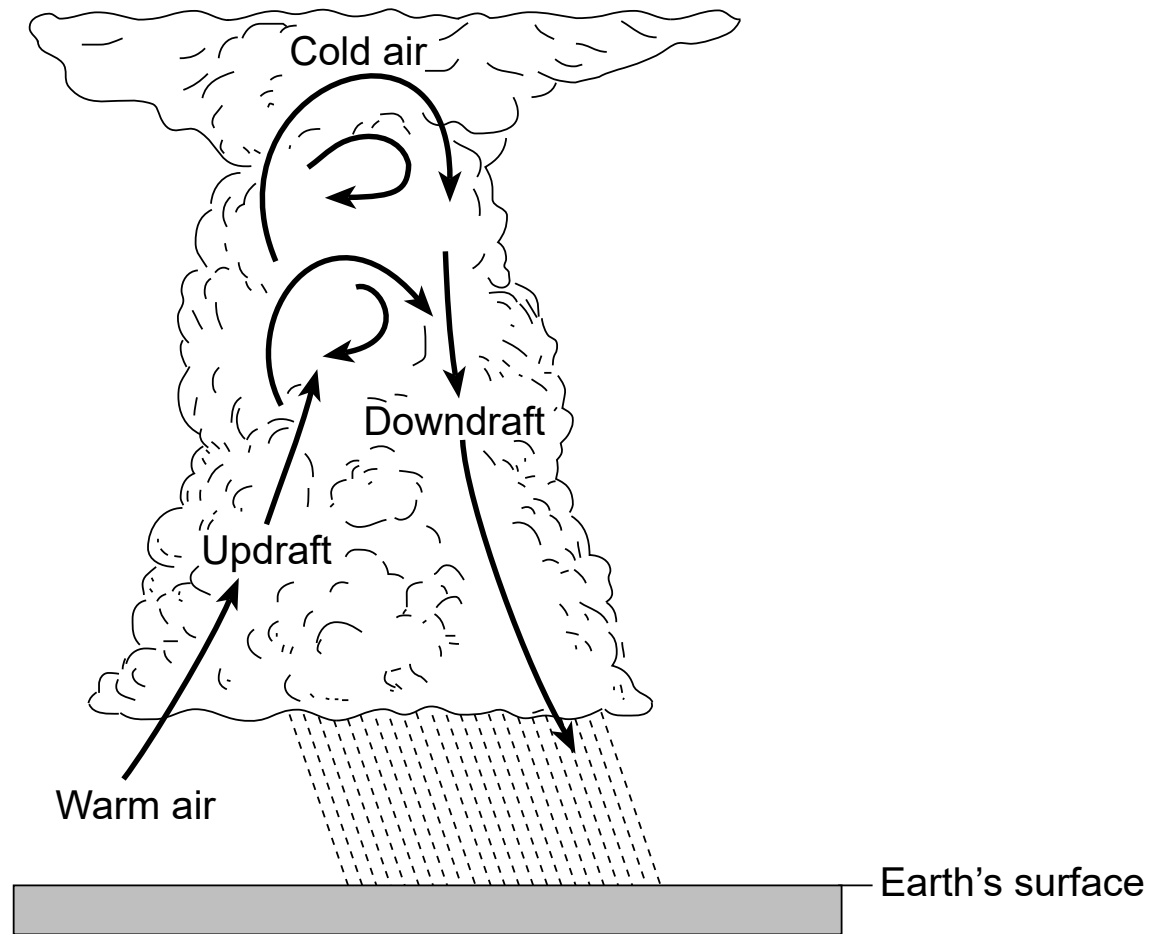


(2)



(4)

13 The diagram below represents a thunderstorm cloud. Arrows represent air motion within the cloud.



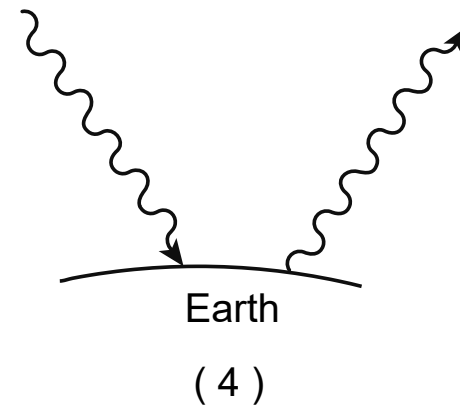
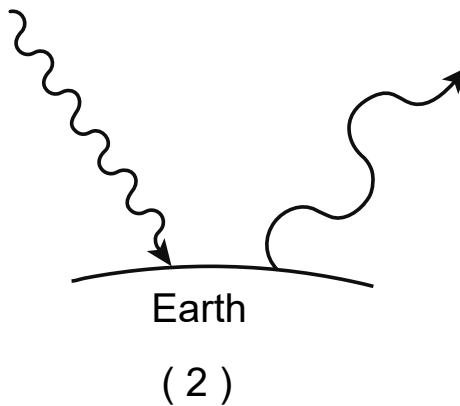
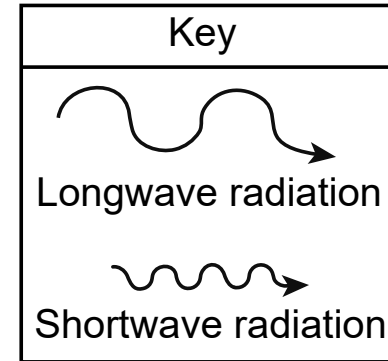
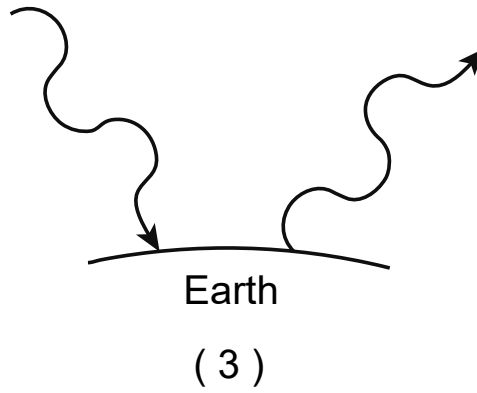
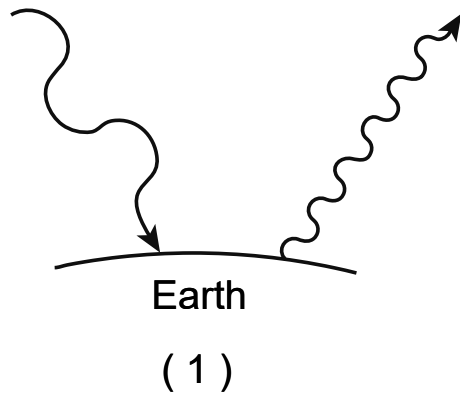
This air motion is caused by

- (1) density differences
- (2) electromagnetic energy
- (3) molecular collisions
- (4) increased transpiration

14 What is the relative humidity when the dry-bulb temperature is 28°C and the wet-bulb temperature is 15°C ?

- (1) 12%
- (2) 13%
- (3) 21%
- (4) 4%

15 Which diagram best represents the wavelength of incoming solar radiation received on Earth and the wavelength of outgoing radiation?



16 Which statement best explains why most of the surface of Lake Erie usually remains as liquid water in late autumn, even though surrounding land surfaces and air temperatures may be below freezing?

- (1) Water has a higher specific heat than land.
- (2) Land surfaces change temperature more slowly than water surfaces.
- (3) Warm winds from the land blow onto the surface of the lake.
- (4) Energy absorption by the water is needed in order to freeze the surface of the lake.

17 The photograph below shows the large-scale eruption of volcanic ash from Mount Kelud in Indonesia in 2014.



<https://www.exploredesa.com/2014/02/mount-kelud-made-explosive-eruption-feb-132014/>

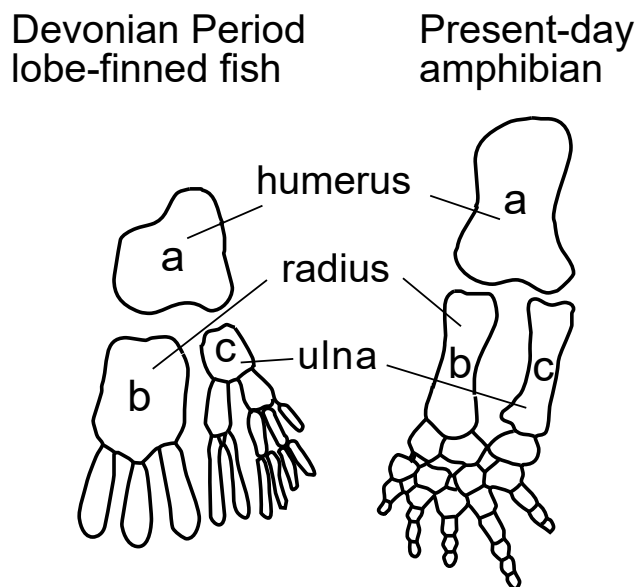
This volcanic ash in the atmosphere causes

- (1) less transparency and a decrease in reflection of insolation
- (2) less transparency and an increase in reflection of insolation
- (3) more transparency and a decrease in reflection of insolation
- (4) more transparency and an increase in reflection of insolation

18 Ireland and England, islands along the northwest coast of Europe, have climates that are warmer than the climate of New York State, even though these islands are located farther north. This increased average temperature is mostly due to heat supplied by the prevailing winds and the

- | | |
|----------------------------|------------------------------|
| (1) Canary Current | (3) North Equatorial Current |
| (2) North Atlantic Current | (4) Labrador Current |

- 19 The diagram below shows the front fin bones of a Devonian fish and the front leg bones of a present-day amphibian.



Similarities in bone structure and arrangement between these two animals support the inference that these animals

- (1) both lived during the Devonian Period
- (2) have a common ancestor
- (3) lived in an arid environment
- (4) became fossilized the same way

- 20 Surface bedrock found in the St. Lawrence Lowlands region of New York State was formed during which periods of geologic time?

- (1) Triassic and Jurassic
- (2) Mississippian and Pennsylvanian
- (3) Silurian and Devonian
- (4) Cambrian and Ordovician

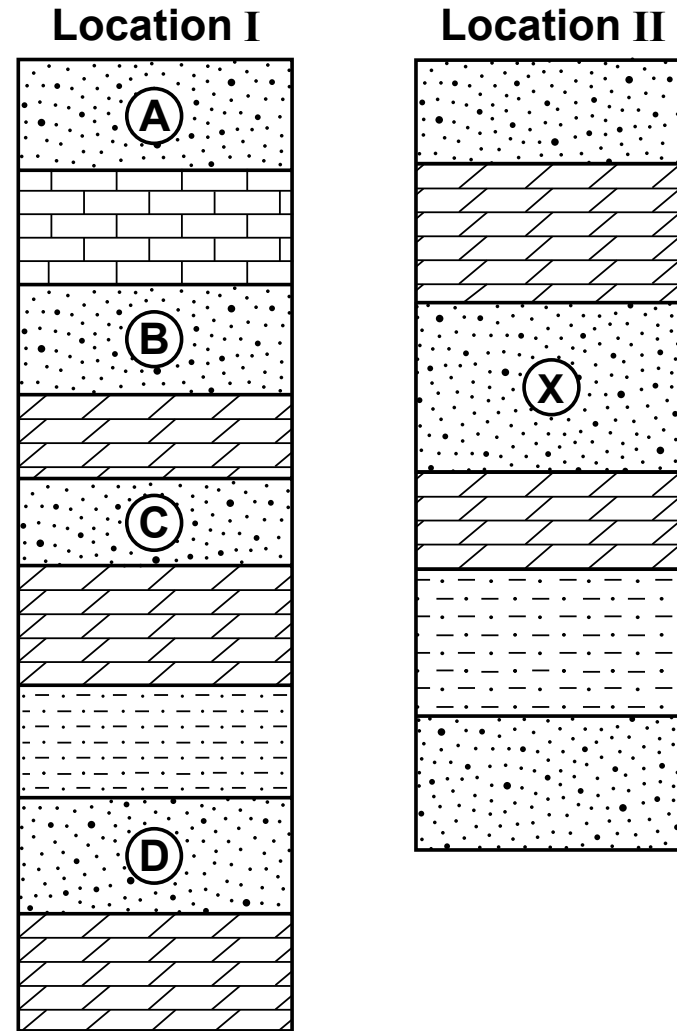
- 21 Volcanic ash is most useful for determining the relative age of rock layers because the ash is deposited during a

- (1) short period of time over a large area
- (2) short period of time over a small area
- (3) long period of time over a large area
- (4) long period of time over a small area

- 22 Sediments that form a sedimentary rock usually are deposited in a layer that is parallel to Earth's surface. This statement best describes the

- (1) law of superposition
- (2) theory of evolution
- (3) principle of original horizontality
- (4) rule of crosscutting relationships

23 The diagram below represents rock columns I and II, found at two different locations. Different rock layers are labeled. The rock layers have *not* been overturned.



Which labeled rock layer at location I would most likely have the same relative age as rock layer X at location II?

- (1) A
- (2) B

- (3) C
- (4) D

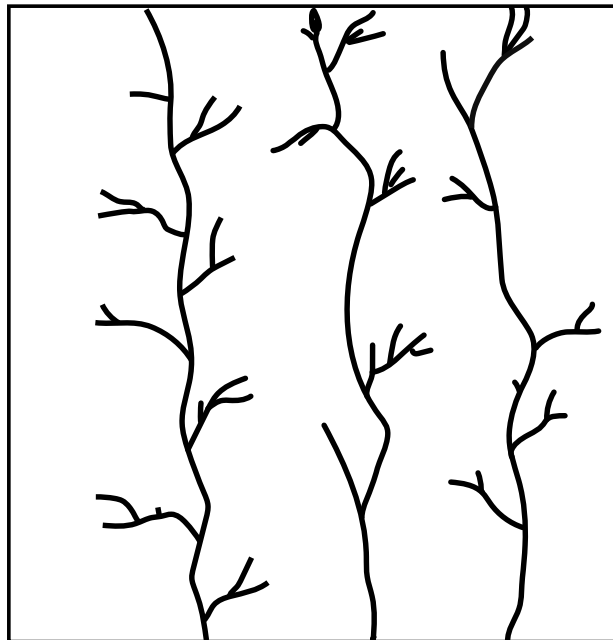
24 Which evidence supports the inference that South America and Africa were once joined together as part of the supercontinent Pangaea?

- (1) Desert climates are found in the interior of both South America and Africa.
- (2) Rock and fossil correlation can be made where the two continents appear to fit together.
- (3) Mountain glaciers are found in the interiors of both South America and Africa.
- (4) The age of oceanic bedrock is youngest along the coastlines of the two continents and oldest at the Mid-Atlantic Ridge.

25 The Tonga Trench is located at which type of plate boundary?

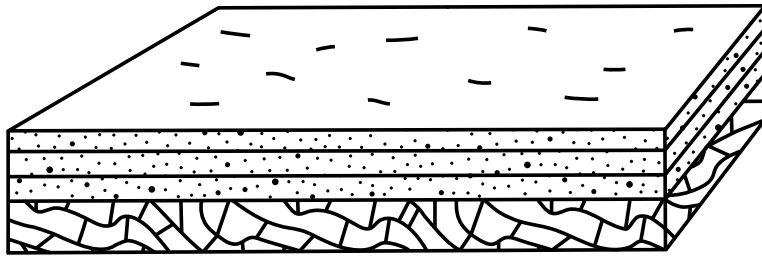
- (1) convergent
- (2) divergent
- (3) transform
- (4) complex

26 The map below shows a stream drainage pattern.

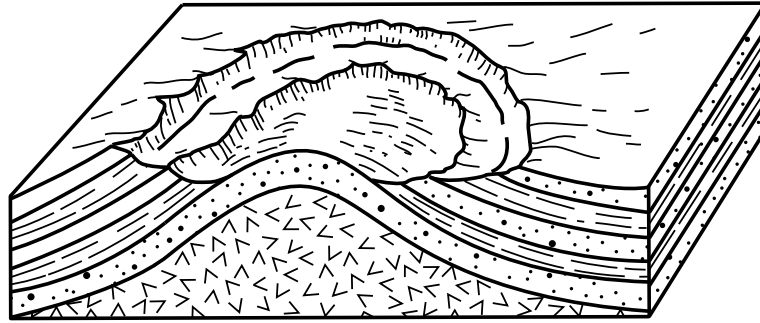


Question 26 continued

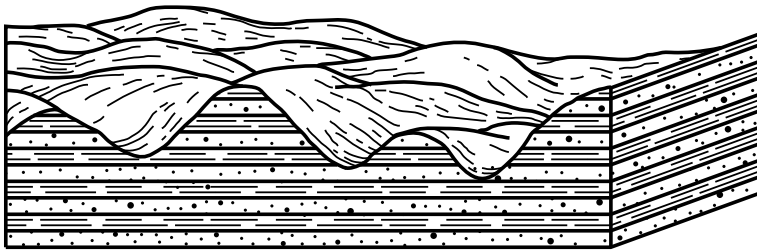
This drainage pattern most likely formed on the surface bedrock of which block diagram?



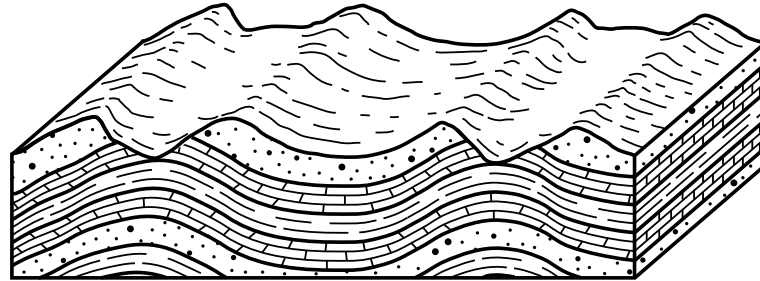
(1)



(3)



(2)



(4)

27 The Hudson River begins its flow at Lake Tear of the Clouds, near Mt. Marcy, New York, where it has a surface elevation of 4293 feet. It travels 162 miles to Troy, New York, where the river's surface elevation is two feet. The gradient of the Hudson River between Lake Tear of the Clouds and Troy is approximately

(1) 4291.00 ft/mi

(3) 26.49 ft/mi

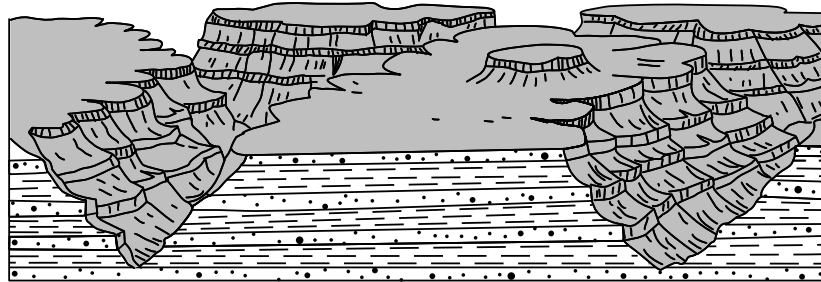
(2) 81.00 ft/mi

(4) 0.04 ft/mi

28 The mountain landscape at Old Forge, New York, and the plateau landscape at Slide Mt., New York, are classified based on the differences in

- | | |
|----------------|-----------------------|
| (1) climate | (3) stream drainage |
| (2) weathering | (4) bedrock structure |

29 The diagram below represents a landscape region located in the southwestern United States.



The steep slopes and sharp angular features of this region indicate that, compared to New York State, the climate where this landscape is developing most likely has

- (1) lower temperatures and a lower amount of precipitation
- (2) lower temperatures and a higher amount of precipitation
- (3) higher temperatures and a lower amount of precipitation
- (4) higher temperatures and a higher amount of precipitation

30 The photograph below shows a valley between two mountains in Acadia National Park in the state of Maine.



Photograph by G Meyer

The shape of this valley is best described as

- (1) U-shaped and eroded by moving ice
- (2) U-shaped and eroded by running water
- (3) V-shaped and eroded by moving ice
- (4) V-shaped and eroded by running water

GO RIGHT ON TO THE NEXT PAGE ➡

31 The photograph below shows three different pebbles that have been transported for different amounts of time in a stream.



The erosional process that has shaped these pebbles over time is

- | | |
|--|--|
| (1) abrasion, which causes less rounding | (3) sandblasting, which causes less rounding |
| (2) abrasion, which causes more rounding | (4) sandblasting, which causes more rounding |

32 Which satellite photograph below best shows the result of the deposition of river sediments into a large body of water?



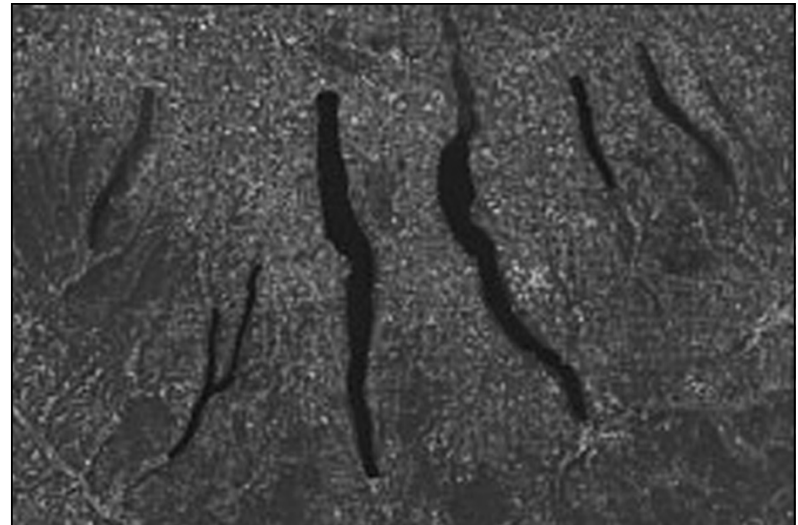
(1)



(3)

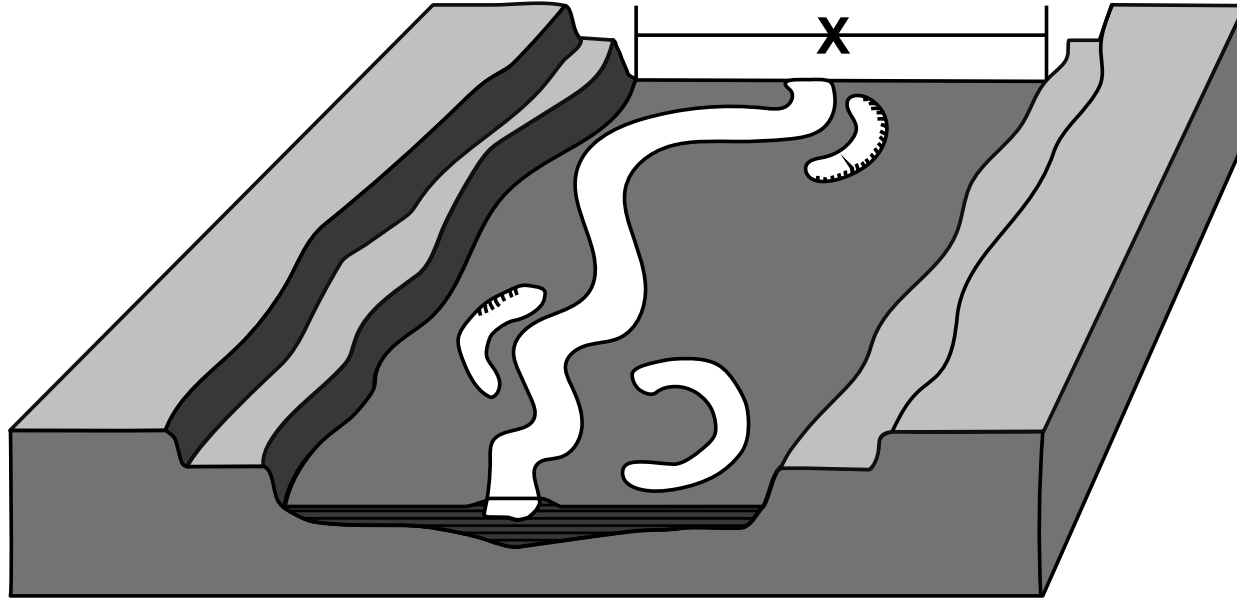


(2)



(4)

- 33 The diagram below represents a stream in a valley. Letter X represents a surface feature associated with the stream.



Which surface feature is represented by letter X?

- | | |
|-----------------|-----------------|
| (1) floodplain | (3) water table |
| (2) kettle lake | (4) watershed |
- 34 The famous green-sand beach on the Big Island of Hawaii gets its color from green colored grains of which mineral?
- | | |
|------------|--------------|
| (1) pyrite | (3) olivine |
| (2) gypsum | (4) hematite |
- 35 Which metamorphic rock forms only by contact metamorphism?
- | | |
|------------|--------------|
| (1) slate | (3) marble |
| (2) gneiss | (4) hornfels |

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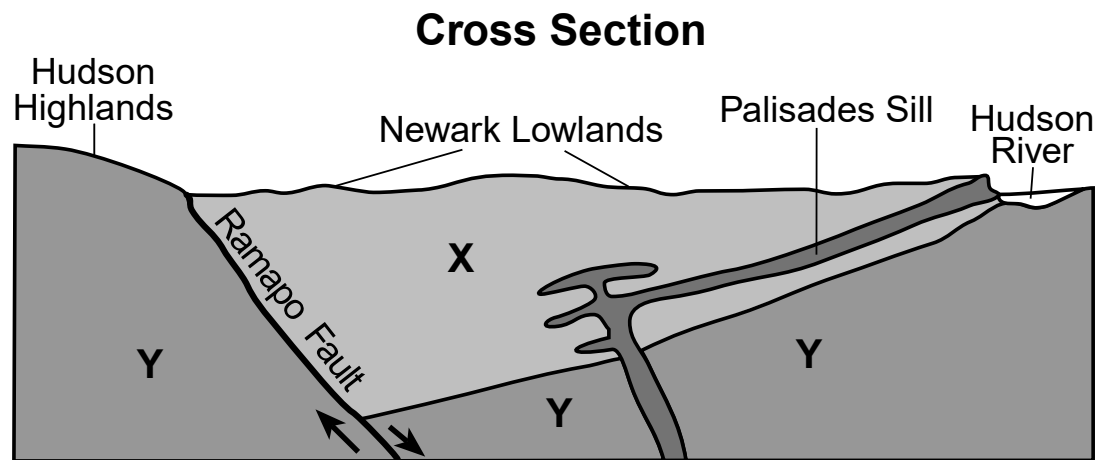
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Part B-1

Answer all questions in this part.

Directions (36–50): For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the 2011 Edition Reference Tables for Physical Setting/Earth Science. Record your answers on your separate answer sheet.

Base your answers to questions 36 through 38 on the geologic cross section below, which shows the bedrock structure beneath a portion of the Hudson Highlands and Newark Lowlands landscape regions along the border between New York State and northern New Jersey. Letters X and Y identify bedrock units shown in the cross section. The Palisades Sill igneous intrusion is identified.



36 Fossil evidence of which animal is most likely preserved in bedrock unit X?

(1) *Coelophysis*

(3) *Eurypterus*

(2) *Phacops*

(4) *Tetragraptus*

37 Compared to the other bedrock units, the relative age of the Palisades Sill intrusion is

(1) younger than X, but older than Y

(3) younger than both X and Y

(2) younger than Y, but older than X

(4) older than both X and Y

38 Approximately how many million years ago (mya) did the intrusion of the Palisades Sill occur?

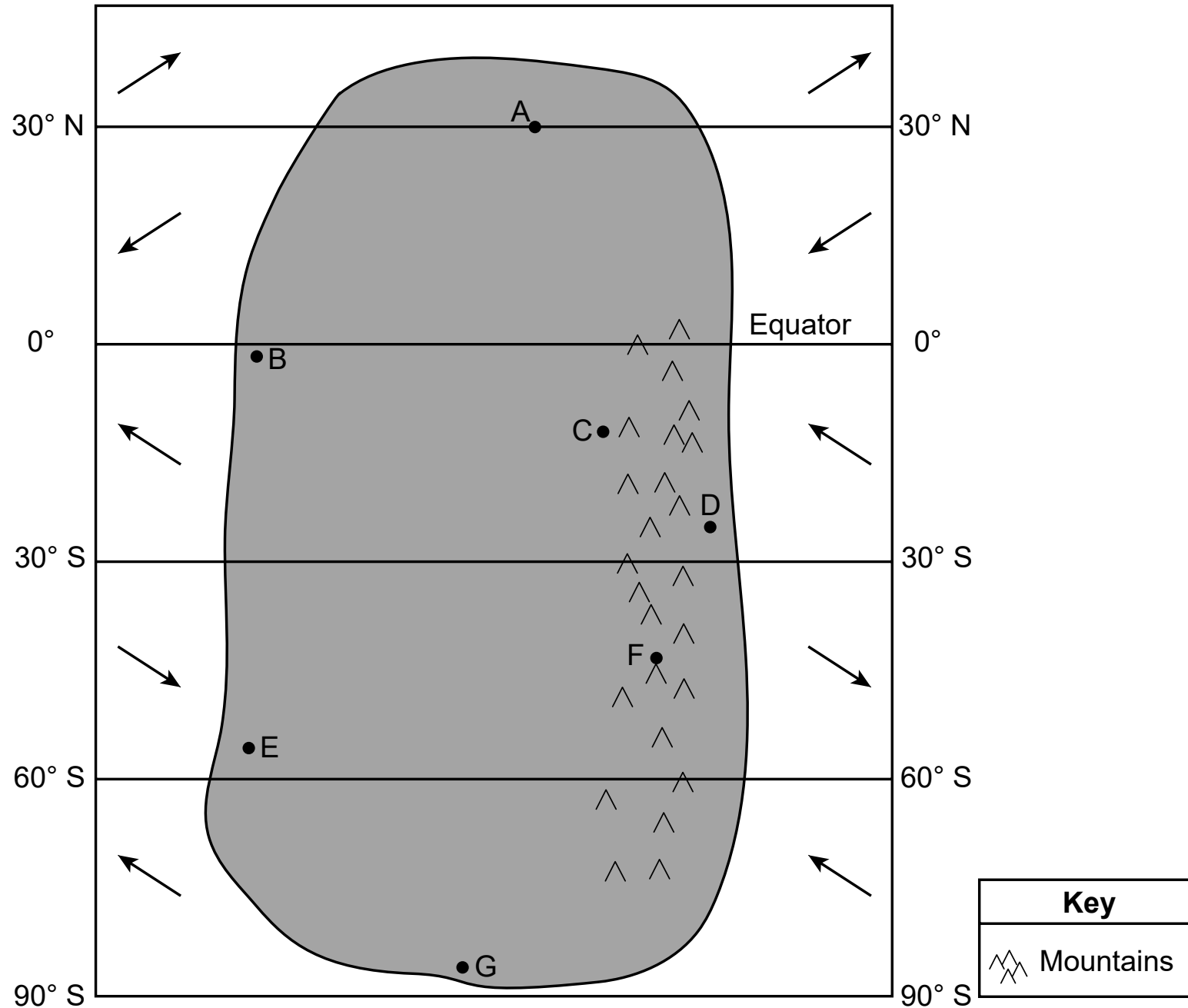
(1) 100 mya

(3) 300 mya

(2) 200 mya

(4) 400 mya

Base your answers to questions 39 and 40 on the map below and on your knowledge of Earth science. The map represents an imaginary continent on a planet that has climate conditions similar to Earth. Points A through G represent locations on the continent. The arrows represent the general direction of the prevailing winds.



39 Which climate factor causes location *B* to have a warmer climate than location *E*?

(1) latitude

(3) vegetative cover

(2) longitude

(4) nearness to a large body of water

40 At which location does high elevation cause temperatures to remain low all year with frequent snow events?

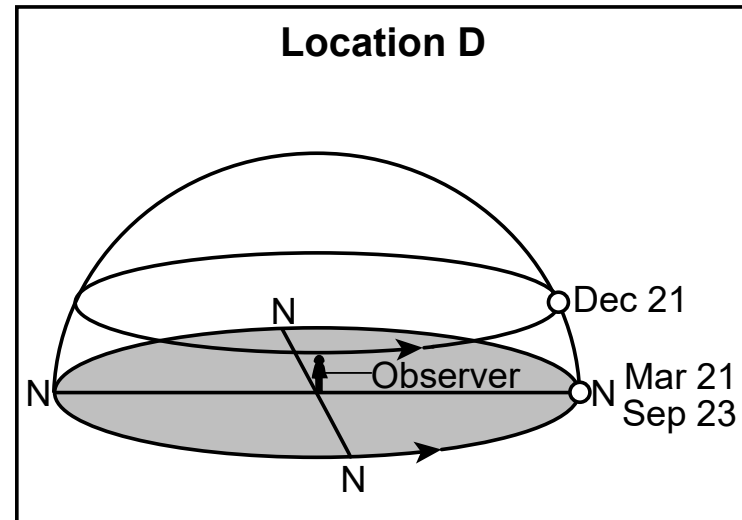
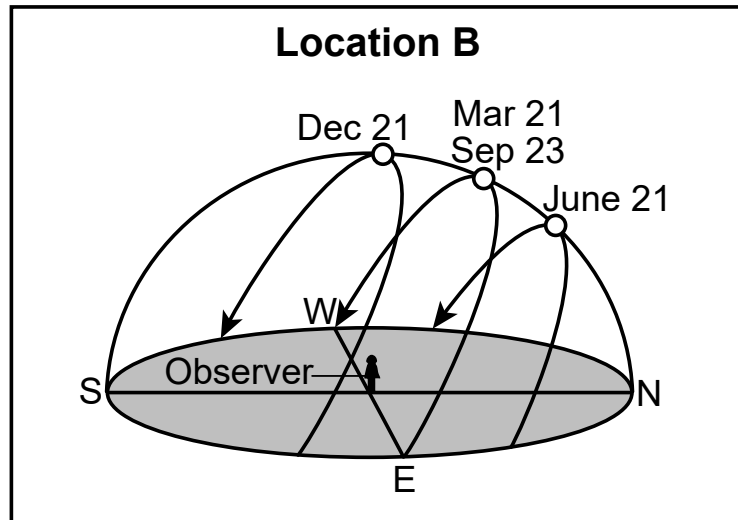
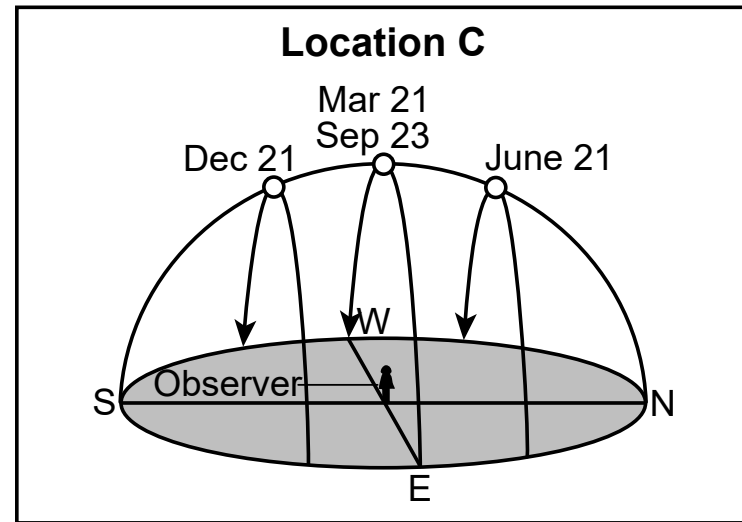
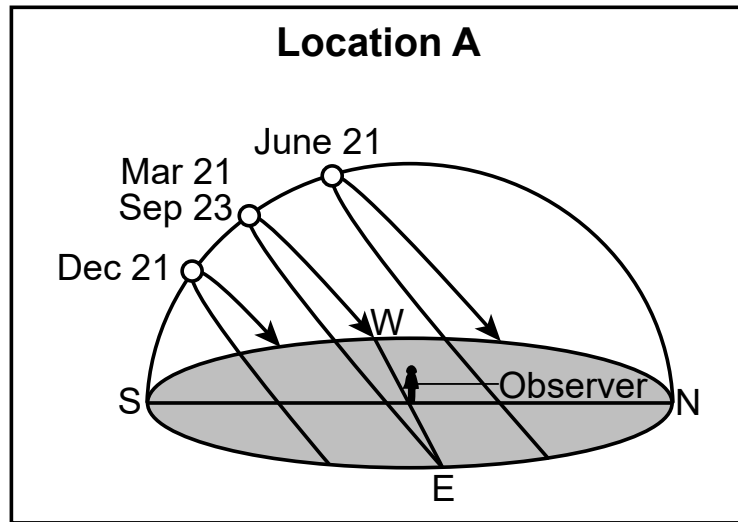
(1) *E*

(3) *G*

(2) *F*

(4) *D*

Base your answers to questions 41 through 44 on the diagrams below and on your knowledge of Earth science. The diagrams represent the apparent paths and solar noon positions of the Sun on specific dates at four different Earth locations, labeled A, B, C, and D.

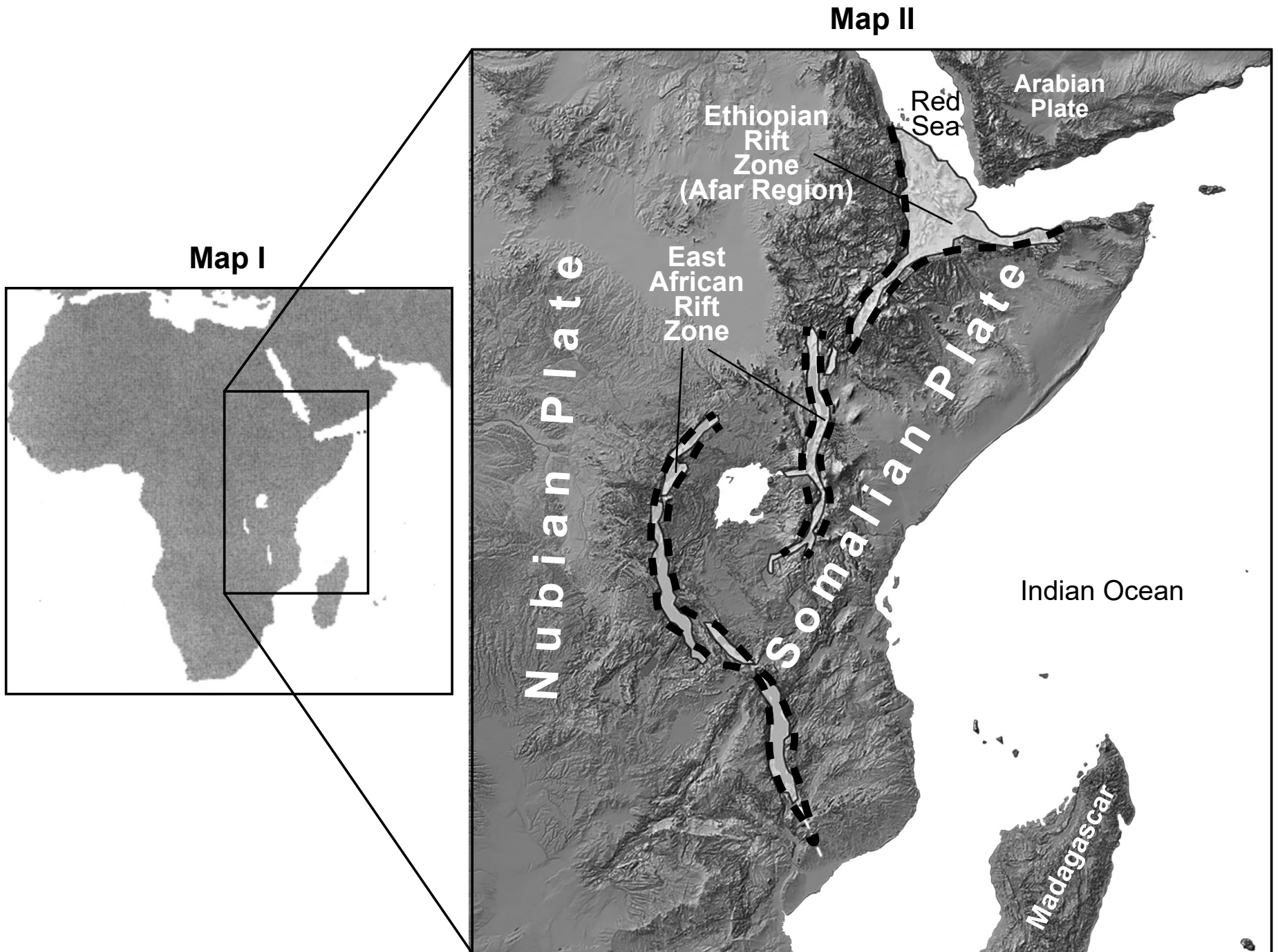


- 41 At which location and on which date would the observer *not* experience sunrise or sunset?
- (1) location *A* on June 21
 - (2) location *B* on December 21
 - (3) location *C* on March 21 or September 23
 - (4) location *D* on December 21
- 42 For the observer at location *B*, the Sun appears to move across the sky on June 21 at the rate of
- (1) $1^\circ/\text{hour}$
 - (2) $15^\circ/\text{hour}$
 - (3) $23.5^\circ/\text{hour}$
 - (4) $365^\circ/\text{hour}$
- 43 Which phrase most accurately describes the length and direction of the observer's noontime shadow at location *C* on December 21 and June 21?
- (1) same length, but in opposite directions
 - (2) same length in the same direction
 - (3) different lengths, but in the opposite directions
 - (4) different lengths in the same direction
- 44 Which statement best explains why the solar noon position of the Sun changes throughout the year at each of these locations?
- (1) The orbital velocity of Earth increases as it travels around the Sun.
 - (2) The tilt of Earth's axis changes in a cyclic pattern.
 - (3) Earth revolves around the Sun on a tilted axis.
 - (4) Earth rotates faster in the summer and slower in the winter.
-

Base your answers to questions 45 through 47 on the passage below, the maps on the next page, and on your knowledge of Earth science. Map I shows a boxed area in Africa that includes the East African Rift System. Map II shows details of the boxed area including rifts and developing plates. The dashed lines represent the borders of the rift zone.

The East African Rift System

The entire East African Rift System, which includes both the Ethiopian Rift and East African Rift, is located along the edges of three tectonic plates. The rifts that are the oldest and widest are in the Afar region to the north. The entire system extends southward, covering thousands of kilometers in Africa. In April 2018, a large crack, extending and stretching several kilometers, formed in the eastern branch of the East African Rift. Tectonic activity such as this causes larger plates to break up into smaller plates.



45 What event is associated with the formation of the large crack in the eastern branch of the East African Rift in April 2018?

(1) tsunami

(2) flooding

(3) downwarping

(4) earthquake

46 Which characteristic best describes the rock that forms at Earth's surface where these active rifts occur?

(1) volcanic

(2) plutonic

(3) clastic

(4) bioclastic

47 On which major tectonic plate is the Afar Region located?

(1) Eurasian Plate

(2) African Plate

(3) Arabian Plate

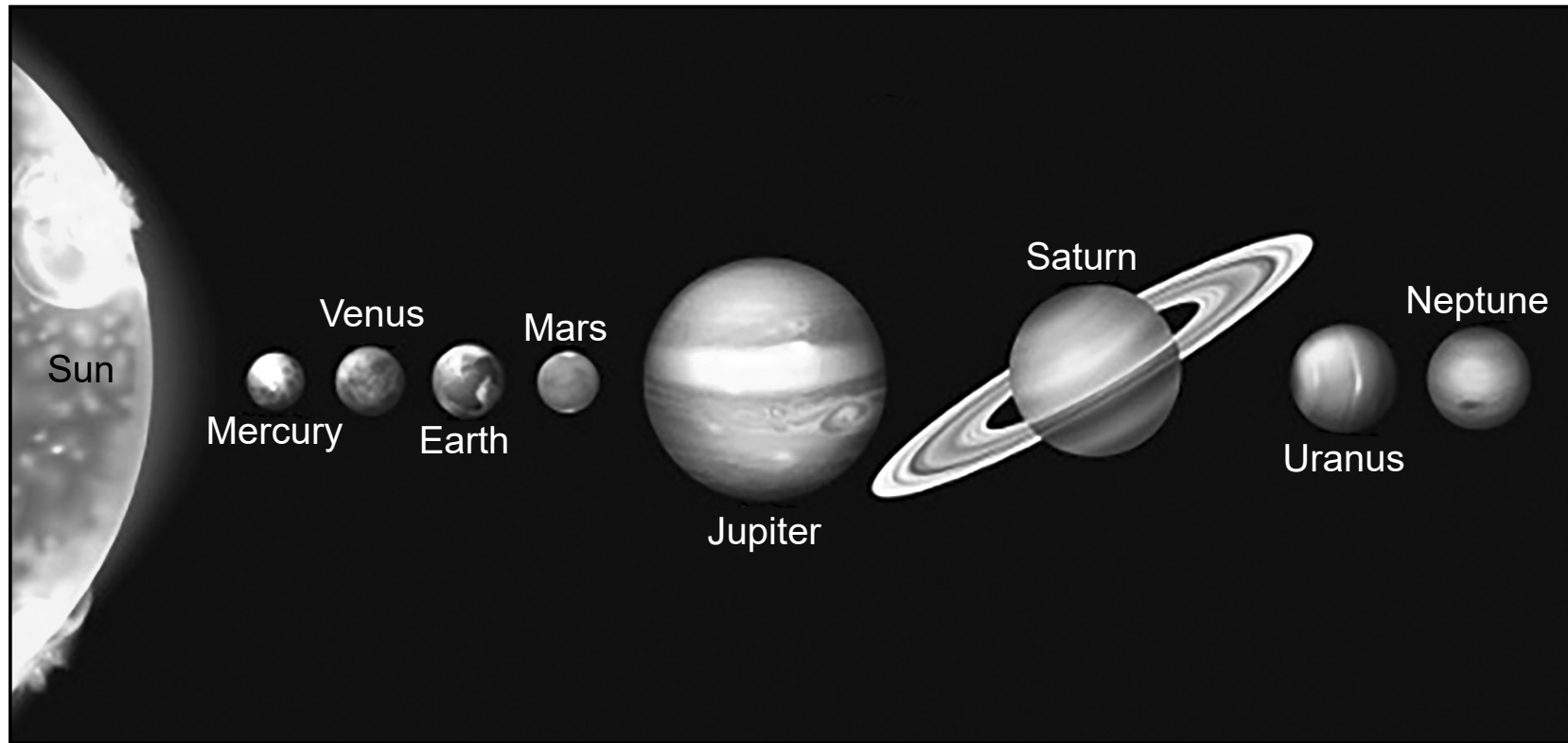
(4) Indian-Australian Plate

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Base your answers to questions 48 through 50 on the diagram below and on your knowledge of Earth science. The diagram represents our solar system planets in order of distance from the Sun.

Our Solar System



(Not drawn to scale)

48 In which set of planets is the orbital period of revolution of the first planet listed approximately one-half the orbital period of revolution of the second planet listed?

- | | |
|-------------------------|------------------------|
| (1) Jupiter and Neptune | (3) Uranus and Saturn |
| (2) Jupiter and Uranus | (4) Uranus and Neptune |

49 Compared to the planets closer to the Sun, the planets beyond Mars have

- | | |
|---------------------------------|---------------------------------|
| (1) warmer surface temperatures | (3) shorter periods of rotation |
| (2) greater densities | (4) layers of rocky composition |

50 The solar system formed from

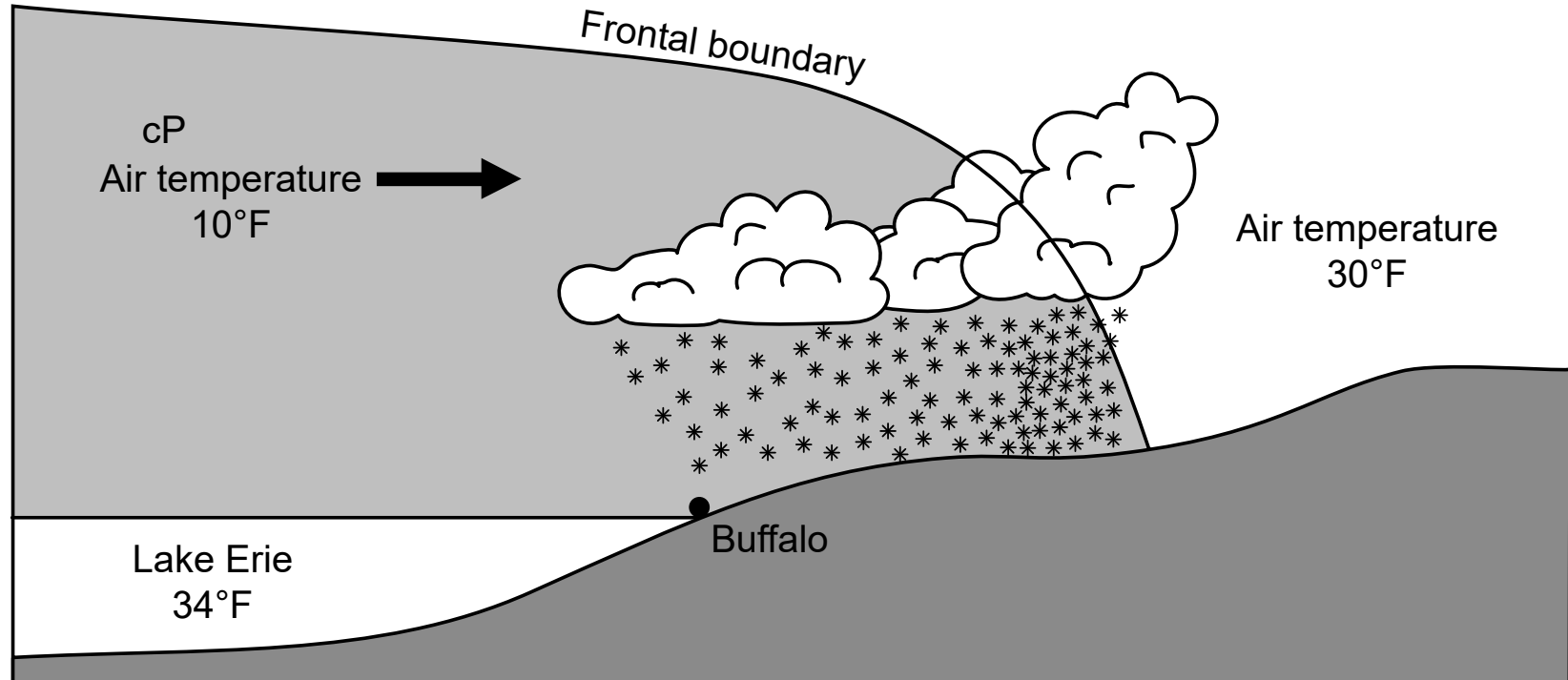
- | | |
|--|--|
| (1) precipitation over millions of years | (3) compaction and cementation of materials |
| (2) the outgassing from volcanic eruptions | (4) contraction of a giant cloud of gas and debris |
-

Part B-2

Answer all questions in this part.

Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 51 through 54 on the cross section below and on your knowledge of Earth science. The cross section represents a section of Lake Erie and Buffalo, New York, during a lake-effect snow storm. A frontal boundary is indicated. The arrow indicates the direction that the air mass is moving.



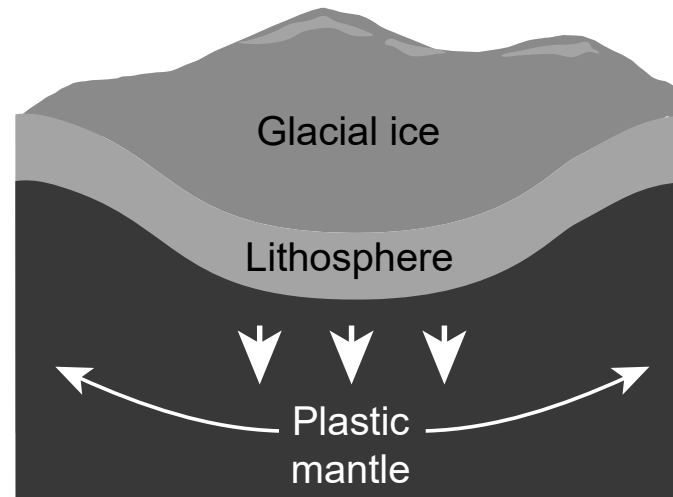
- 51 Identify the type of weather front represented in the cross section. [1]
- 52 Greatest amounts of lake-effect snow occur when wind blows across the greatest amount of the lake surface. Identify the compass direction toward which winds blow over Lake Erie to cause the most severe lake-effect snow in Buffalo. [1]
- 53 Explain how ice formation on Lake Erie's surface would reduce lake effect snowfall. [1]
- 54 List *two* emergency actions, other than stocking up on food and water, a person would take to prepare for a severe lake-effect snowstorm. [1]
-

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Base your answers to questions 55 through 60 on the information and cross sections below, the map on the next page, and on your knowledge of Earth science. The cross sections represent the same region in Canada approximately 20,000 years ago and approximately 12,000 years ago. The heavy dark line on the map separates the regions that are presently rising from the regions that are presently sinking.

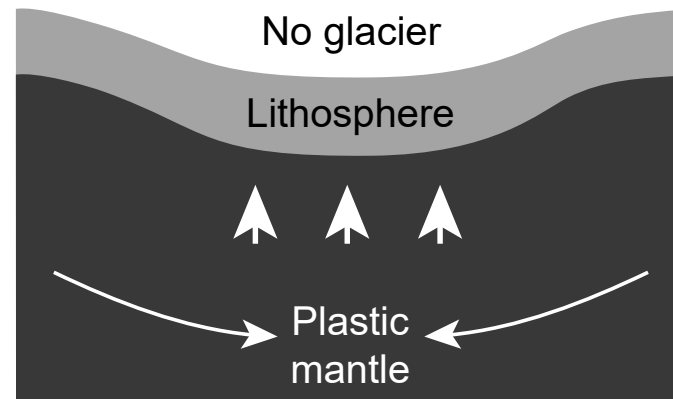
20,000 years ago:

Glacial ice sheets covered vast regions of Earth, causing Earth's lithosphere to sink from the weight of the ice. This increased weight caused the plastic mantle to be pushed away from this area.



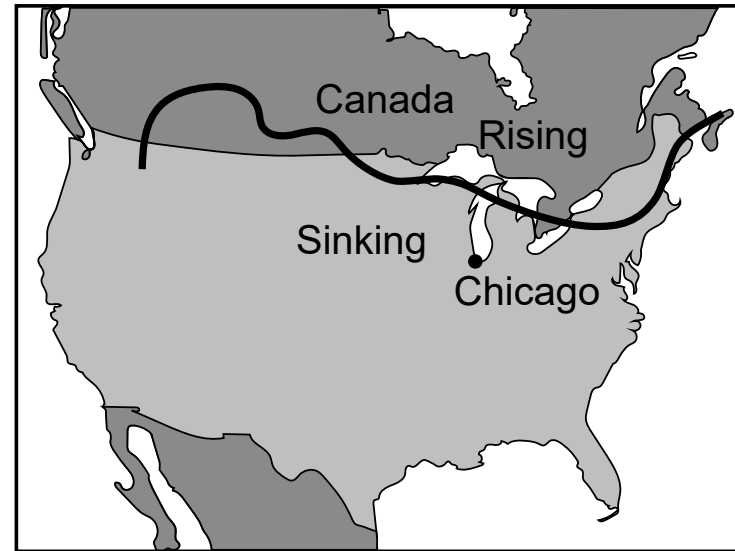
12,000 years ago:

As glaciers melt, the lithosphere rebounds (rises up). The plastic mantle can now flow back to the area.



Present day:

Chicago, Illinois, is located near the frontal edge of the last glacial advance. The city is slowly sinking, approximately 0.15 centimeter per year, because more of the plastic mantle under this city is flowing back toward Canada.



- 55 Identify the force that caused the crust to sink due to the weight of glacial ice. [1]
- 56 Identify the geologic time period and epoch when this ice sheet advanced south to the Chicago region and then retreated (melted) back toward northern Canada. [1]
- 57 Describe what is occurring in the plastic mantle that is causing Chicago to sink. [1]
- 58 Identify the *two* solid layers that make up Earth's lithosphere. [1]
- 59 Calculate the number of centimeters lower that Chicago will be after 20 years if the rate of sinking remains the same. [1]
- 60 Glacial moraines have been found along the boundary at the farthest advance of the glacial ice sheet. Describe the arrangement of sediments found in these moraines. [1]

Base your answers to questions 61 through 63 on the table below and on your knowledge of Earth science. The table shows the latitude and the Sun's angle of incidence at solar noon on March 21 for six locations on Earth.

Sun's Angle of Incidence at Solar Noon on March 21

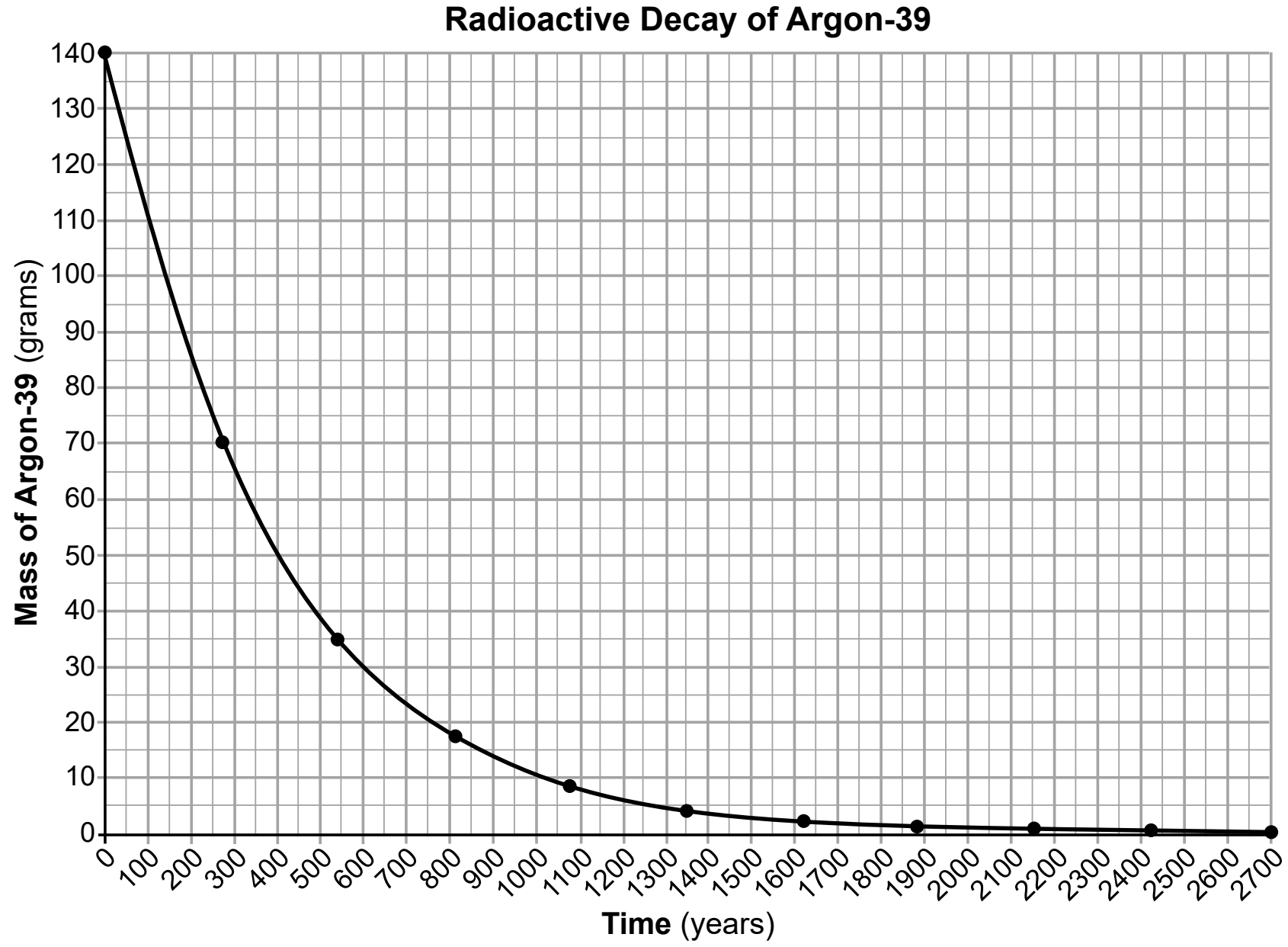
Location	Latitude (°N)	Angle of Incidence at Solar Noon (°)
Kuala Lumpur, Malaysia	3	87
Havana, Cuba	23	67
Cairo, Egypt	30	60
Beijing, China	40	50
London, England	52	38
Oslo, Norway	60	30

- 61 On the grid *in your answer booklet*, construct a line graph by plotting the data for the angles of incidence of the Sun's rays at solar noon on March 21 for each latitude shown on the data table. Connect *all six* plots with a line. [1]
- 62 On the same grid *in your answer booklet*, place an **X** to represent the latitude where the angle of incidence of the Sun's rays would be zero degrees on March 21. [1]
- 63 State the number of hours of daylight that occur at *all six* of these locations on March 21. [1]
-

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Base your answers to questions 64 and 65 on the graph below and on your knowledge of Earth science. The graph shows the decay of 140 grams of the radioactive isotope argon-39. The disintegration of argon-39 produces the stable decay product potassium-39.



64 Determine the half-life time period, in years (y), for argon-39. [1]

65 An original sample contains 100% of argon-39. Calculate the percentage of argon-39 that is left in this sample after three half-lives. [1]

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Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 66 through 69 on the map in your answer booklet, the data table below, and on your knowledge of Earth science. The map shows several dewpoint isolines over the surface of the United States at 3:00 p.m. on November 1, 2018. The 30°F dewpoint isoline has been partially drawn. Dewpoint values, in degrees Fahrenheit (°F), are indicated in the central portion of the United States. Three cities, Portland, Phoenix, and Albany, are labeled on the map. Points W and X represent surface locations. The data table shows the air temperature and dewpoint in Phoenix and Albany taken at 3:00 p.m. November 1, 2018.

Weather Data Taken at 3:00 p.m. November 1, 2018

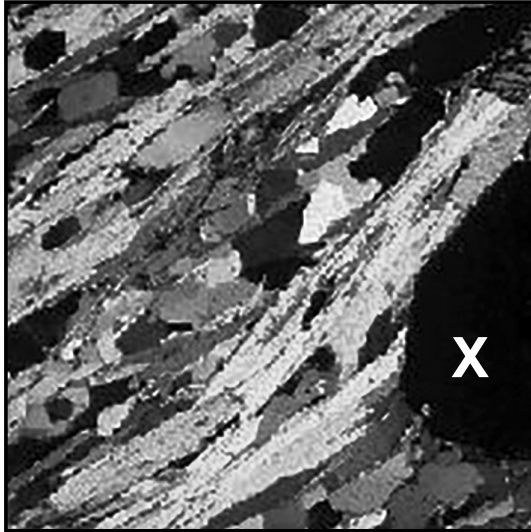
City	Air Temperature (°F)	Dewpoint (°F)
Phoenix	70	24
Albany	51	47

- 66 On the map *in your answer booklet*, starting from point W, complete the 30°F dewpoint isoline. [1]
- 67 Identify the most likely dewpoint in Portland at 3:00 p.m. on November 1, 2018. [1]
- 68 Location X was in a cT air mass. Describe the relative air temperature and the relative moisture conditions of this type of air mass. Do *not* use numbers in your response. [1]
- 69 State the name of the weather instrument that is used to measure dewpoint. [1]
-

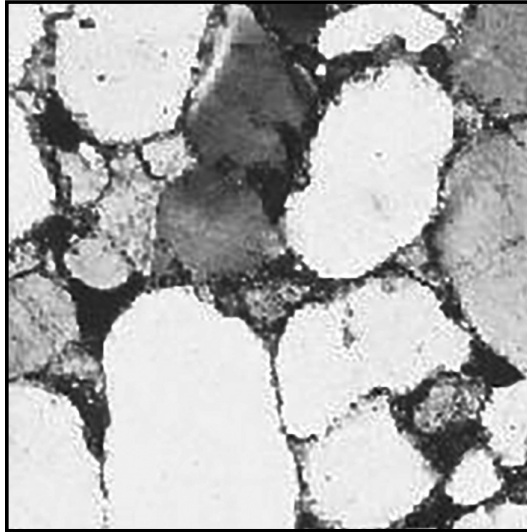
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Base your answers to questions 70 through 74 on the photographs below and on your knowledge of Earth science. The photographs show magnified portions of three thinly sliced pieces of rock (thin sections), labeled A, B, and C. Using a microscope, the observer is able to see the shapes and arrangements of the minerals within the rock in greater detail. Letter X indicates a mineral in rock A.

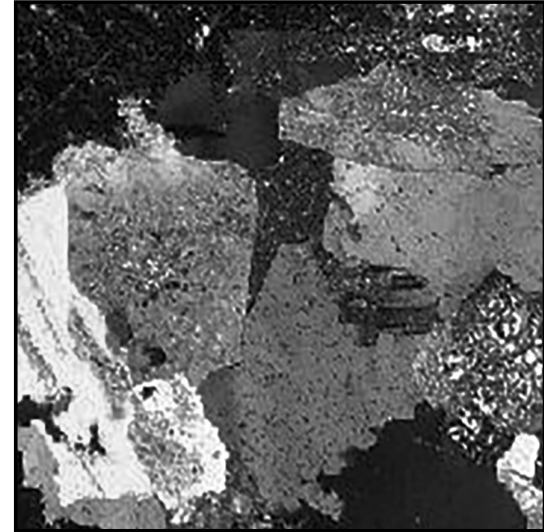
Rock A



Rock B

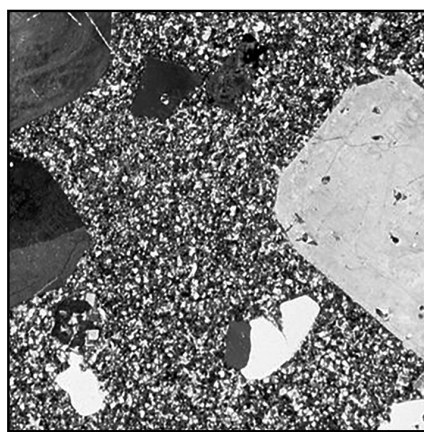


Rock C



70 Describe how the arrangement of minerals in thin section A indicates that the sample is a metamorphic rock. [1]

- 71 Mineral *X* in rock *A* is very hard, composed of four elements, and fractures when broken. It is dark red in color, and can be used in jewelry and abrasives. Identify the name of this mineral. [1]
- 72 The white, rounded quartz grains that are cemented together in rock *B* have an average diameter of 0.05 centimeter. Identify the name of the sedimentary rock shown in thin section *B*. [1]
- 73 Thin section *C* shows a coarse-grained igneous rock containing crystals of potassium feldspar, plagioclase feldspar, quartz, and mica. Identify the rock shown by thin section *C*. [1]
- 74 The photograph below shows another magnified thin section of an igneous rock consisting of coarse-grained crystals scattered among fine-grained crystals.



During the formation of the rock, the cooling rate changed. Describe how the cooling rate that produced the coarse-grained crystals differed from the cooling rate that produced the fine-grained crystals. [1]

Base your answers to questions 75 through 77 on the reading passage below, the diagram in your answer booklet, and on your knowledge of Earth science. The diagram represents two different positions, *A* and *B*, of Earth in its orbit around the Sun. The position of the Moon in its orbit around Earth is indicated at each Earth position. The Moon's position at *B* represents where the Moon would be after one complete revolution (sidereal month) that occurred while Earth moved from *A* to *B*. The parallel dashed lines represent the direction of the background distant stars in space.

Sidereal Month Versus Synodic Month

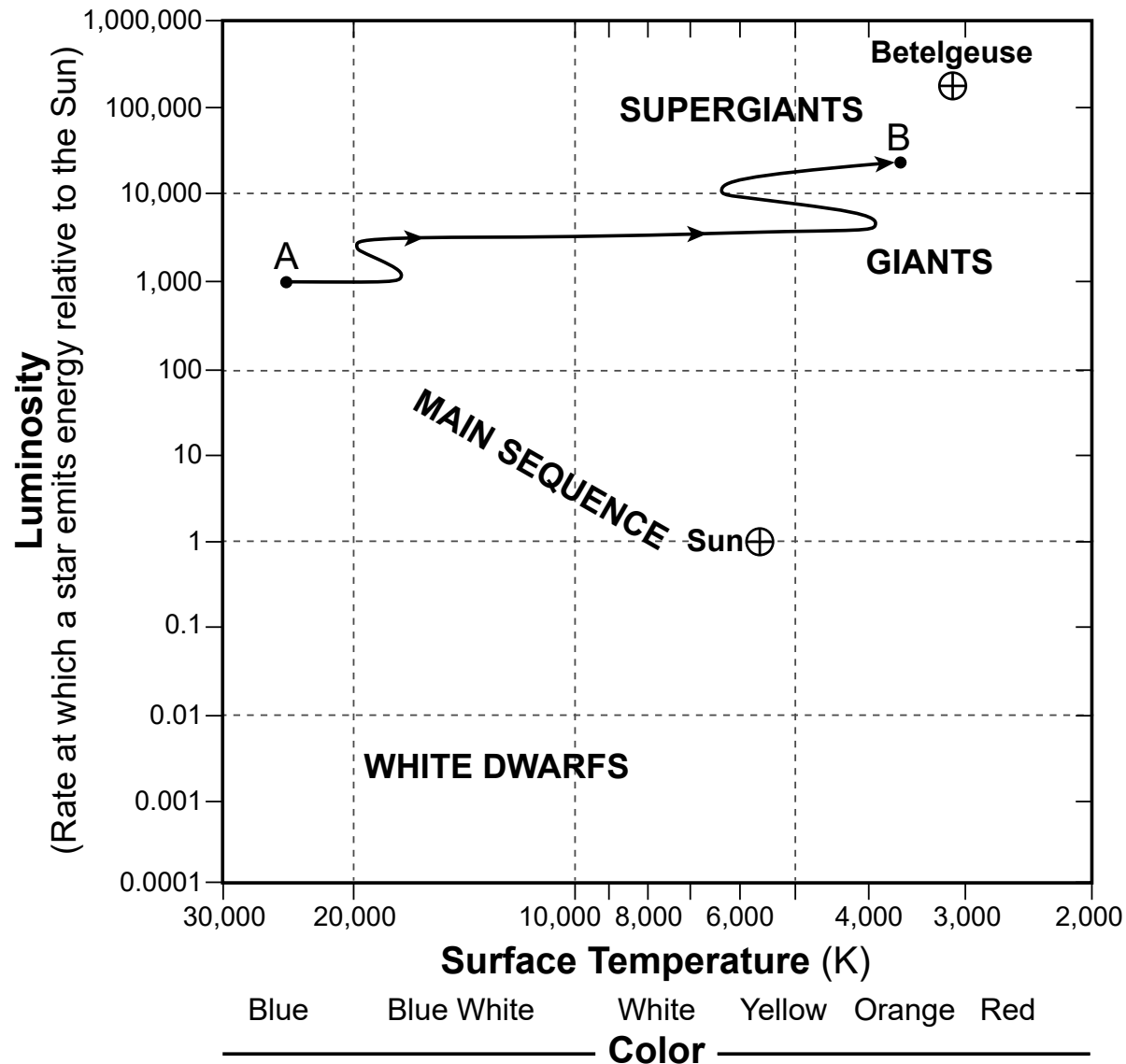
There is a difference between the amount of time for the Moon to complete one orbit around Earth (a sidereal month) and the amount of time to change phase from one New Moon to the next New Moon (a synodic month). The Moon's sidereal month is approximately 27.3 days, which is the period of revolution around Earth relative to the direction of distant background stars. However, because Earth is constantly moving along its orbit around the Sun, the Moon must travel slightly more than one revolution, or more than 360° , to move into the New Moon position again as viewed from Earth. This synodic month takes approximately 29.5 days.

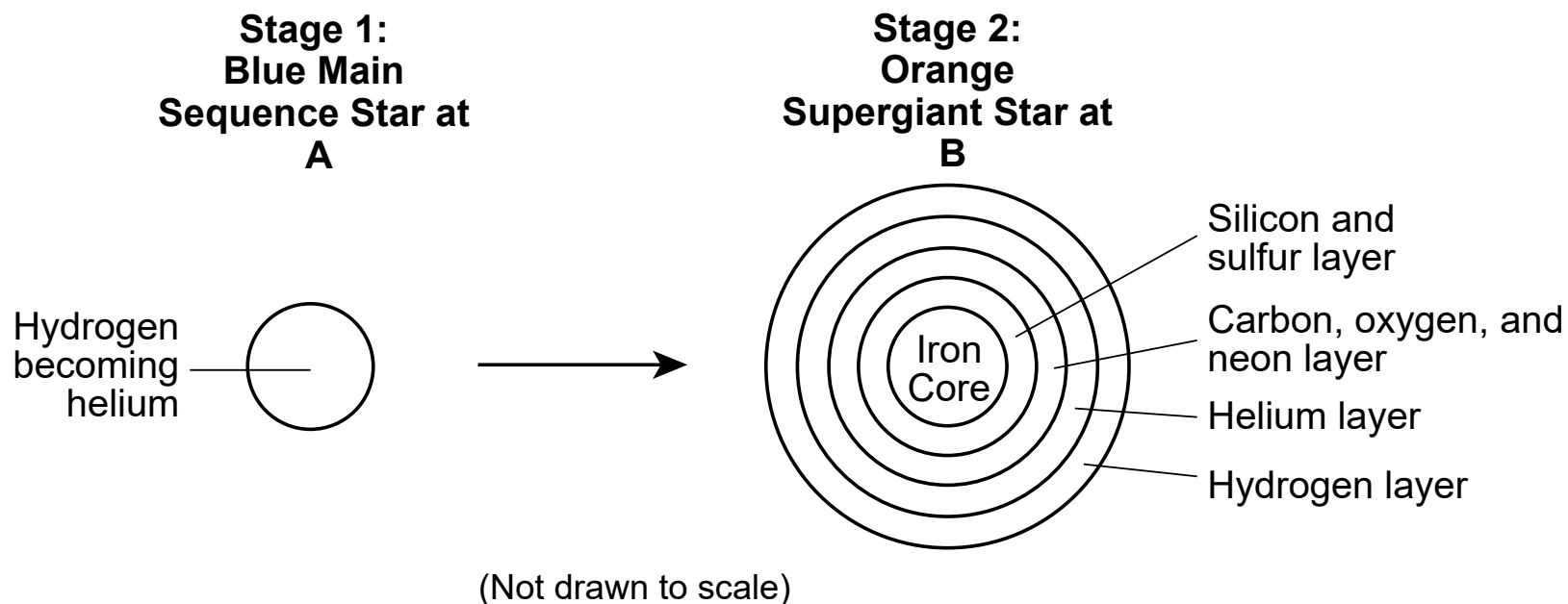
- 75 On the diagram *in your answer booklet*, place an **X** on the Moon's orbit at Earth position *B* to represent where the Moon will be in its New Moon phase. [1]
- 76 Identify the type of eclipse that can occur when Earth is at position *A*. Explain why this type of eclipse may occur. [1]
- 77 Identify *one* solar system object that has a period of rotation most similar to that of the sidereal month of the Moon. [1]
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Base your answers to questions 78 through 80 on the graph below, the diagram on the next page, and on your knowledge of Earth science. The graph shows the change in temperature and luminosity of a massive blue main sequence star, represented by letter *A*, as it evolves into an orange supergiant star represented by letter *B*. The Sun and the star Betelgeuse are labeled on the graph. The diagram represents two stages in the evolution of the star. Stage 1 indicates a nuclear process in the star's interior. Stage 2 represents the evolved layers in this same star when it becomes a supergiant.





- 78 Describe how the surface temperature and luminosity of the blue main sequence star at *A* generally changes as it becomes the orange supergiant star at *B*. [1]
- 79 State *one* similarity between the composition of the core of the supergiant at *B* and the composition of the core of Earth. [1]
- 80 Identify the nuclear process that occurs in this star, which converts lighter elements into heavier elements. [1]
-

Base your answers to questions 81 through 83 on the information and data table below and on your knowledge of Earth science. The data table shows the total area of forest, in kilohectares (kha), that has been destroyed in Indonesia in Southeast Asia due to deforestation from 2006 to 2012. One kilohectare is equal to an area of 3.86 square miles. The average global concentration of the greenhouse gas carbon dioxide (CO₂) in the atmosphere, measured in parts per million (ppm), is also shown for the same years.

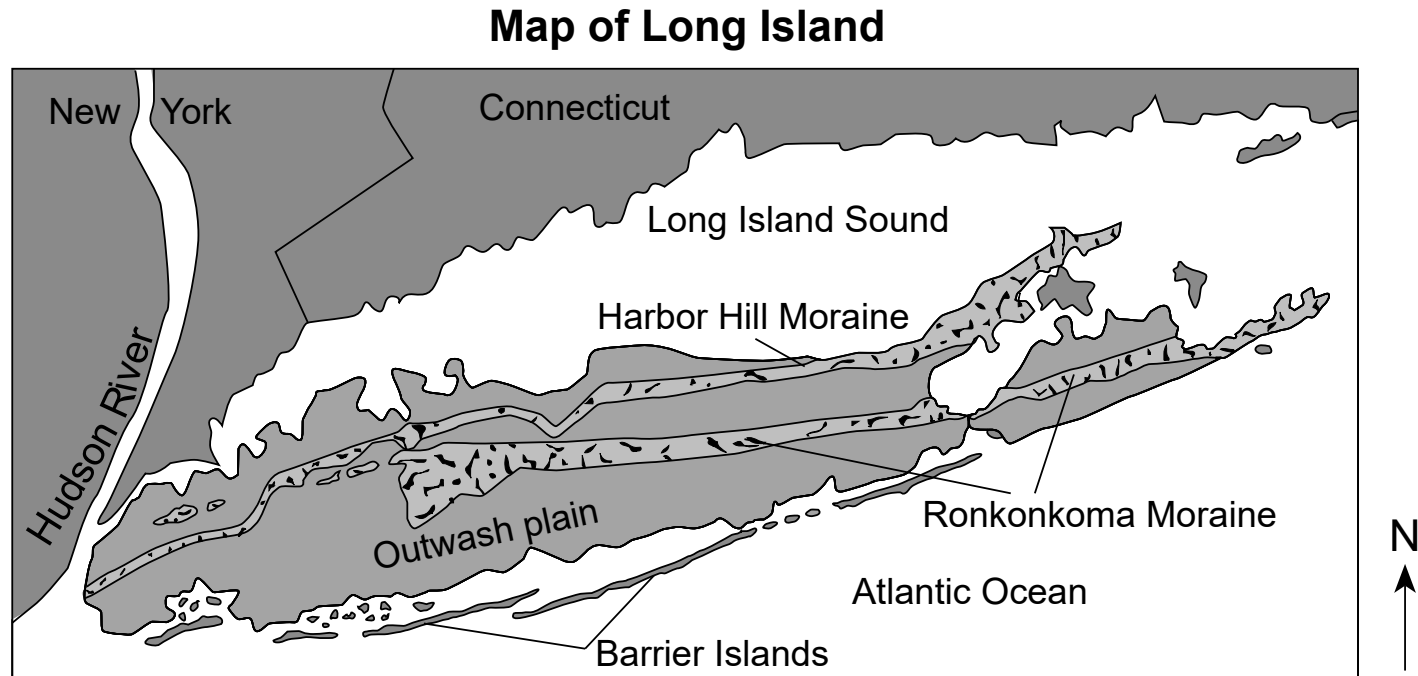
Deforestation

Deforestation is the destruction of forests by cutting down trees for wood or burning trees to make the land available for other uses, including urbanization and grazing cattle. A single hectare of forest can remove as much as 33.5 thousand kilograms of CO₂ per year from the atmosphere. When a forest is destroyed, less carbon dioxide is removed from the atmosphere.

Year	Area of Deforestation in Indonesia (kha)	Average Global CO₂ Concentration (ppm)
2006	510	381.9
2007	565	383.8
2008	505	385.6
2009	715	367.4
2010	565	389.9
2011	640	391.7
2012	845	393.9

- 81 Convert the area of deforestation in Indonesia during 2006 from kilohectares (kha) to square miles. [1]
- 82 State *one* reason, other than deforestation, for an increase in average global CO₂ concentration. [1]
- 83 Other than carbon dioxide, identify *one* other greenhouse gas. [1]
-

Base your answers to questions 84 and 85 on the map below and on your knowledge of Earth science. The map shows some barrier islands, an outwash plain, and two terminal moraines (the Harbor Hill and the Ronkonkoma) of Long Island, New York. A terminal moraine is a glacial deposit marking the farthest advance of a glacier.



- 84 Identify the name of the New York State landscape region where the Harbor Hill and Ronkonkoma Moraines are located. [1]
- 85 Identify the compass direction from which the continental glacier that deposited these terminal moraines on Long Island was advancing. [1]
-

