The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
EARTH SCIENCE

Wednesday, January 28, 2015 — 1:15 to 4:15 p.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 OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

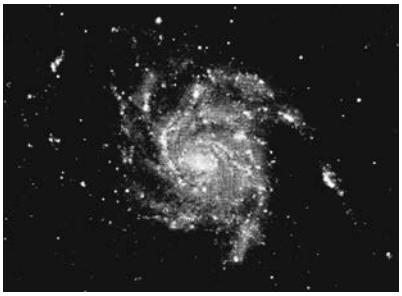
Answer all questions in this part.

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 theory that the universe is expanding is supported by data from the

(1) nuclear decay of radioactive materials
(2) nuclear fusion of radioactive materials
(3) blue shift of light from distant galaxies
(4) red shift of light from distant galaxies

2 The photograph below shows a feature of the universe as seen through a telescope.



This feature is best identified as

(1) a galaxy
(2) a comet
(3) an asteroid
(4) a star

3 Fourteen billion years represents the approximate age of

(1) Earth
(2) Earth's Moon
(3) our solar system
(4) the universe

4 Which terms describe the motion of most objects in our solar system?

(1) noncyclic and unpredictable
(2) noncyclic and predictable
(3) cyclic and unpredictable
(4) cyclic and predictable

5 Which planet has completed less than one orbit of the Sun in the last 100 years?

(1) Mars
(2) Mercury
(3) Neptune
(4) Uranus

6 Compared to the size and density of Earth, the Moon has a

(1) smaller diameter and lower density
(2) smaller diameter and higher density
(3) larger diameter and lower density
(4) larger diameter and higher density

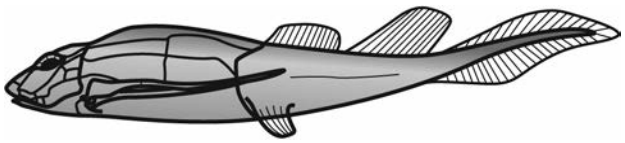
7 In the Northern Hemisphere, planetary winds are deflected to the right due to the

(1) Doppler effect
(2) Coriolis effect
(3) tilt of Earth's axis
(4) uneven heating of Earth's surface

8 Which event is inferred to have contributed to the significant global climate change that may have caused the mass extinctions of organisms at the end of the Late Cretaceous Epoch?

(1) the Big Bang
(2) an asteroid impact
(3) formation of Pangaea
(4) shifting of Earth's magnetic poles

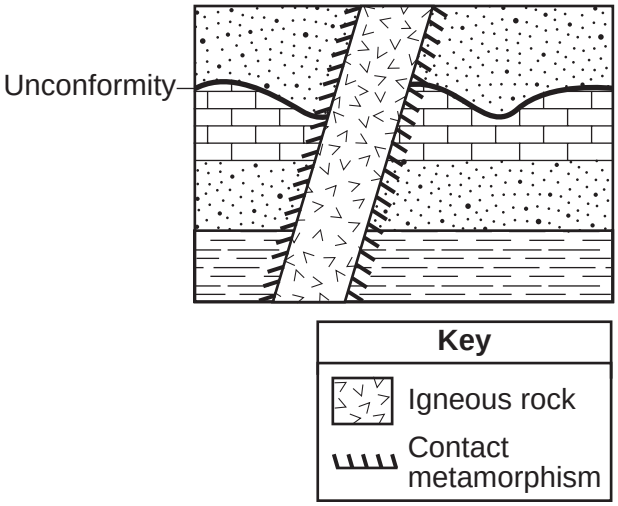
9 The diagram below represents the placoderm fish *Bothriolepis*, an index fossil found in New York State.



The surface bedrock at which location is most likely to contain this fossil?

(1) Ithaca
(2) Old Forge
(3) Albany
(4) New York City

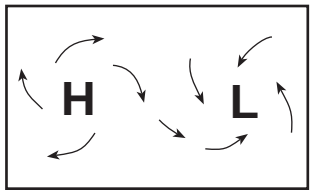
10 The geologic cross section below includes an unconformity and an igneous intrusion.



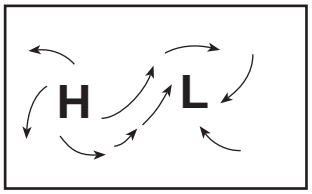
Which two events produced the geologic unconformity in the rock record?

(1) intrusion of magma, followed by contact metamorphism
(2) intrusion of magma, followed by erosion of rock layers
(3) erosion of rock layers, followed by deposition of more sediments
(4) erosion of rock layers, followed by intrusion of magma

11 Which map best represents the surface wind pattern around Northern Hemisphere high-pressure and low-pressure centers?



(1)



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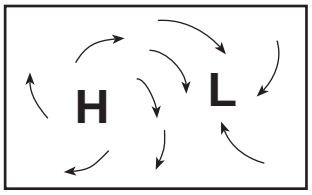

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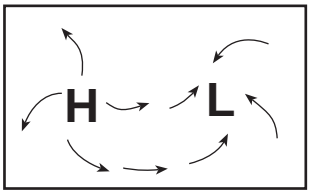
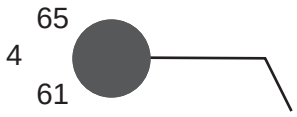


(4)

12 What is the dewpoint when the dry-bulb temperature is 12°C and the wet-bulb temperature is 7°C?

(1) 1°C
(2) −5°C
(3) 28°C
(4) 48°C

13 The station model below shows some weather conditions at a location on Earth's surface.



Which present weather symbol represents the most likely type of precipitation occurring at this location?

(1) (2) (3) (4)

14 In which atmospheric temperature zone does most precipitation occur?

(1) thermosphere
(2) mesosphere
(3) stratosphere
(4) troposphere

15 Which tectonic feature is associated with a complex or uncertain plate boundary?

(1) Southwest Indian Ridge
(2) East African Rift
(3) Mariana Trench
(4) Galapagos Hot Spot

16 Which types of surface bedrock are most likely found near Jamestown, New York?

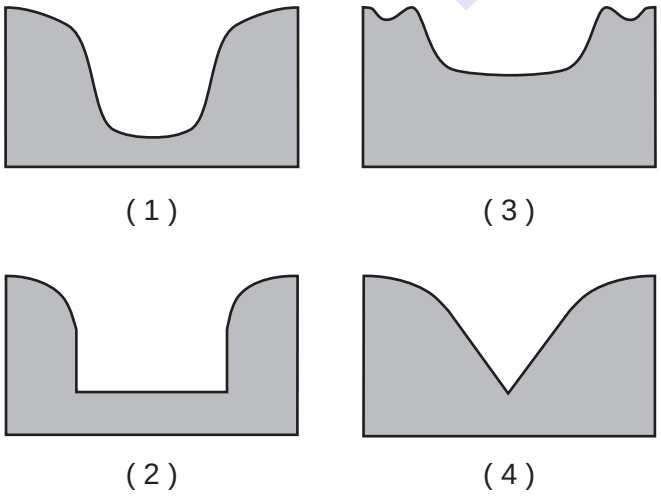
(1) slate and marble
(2) quartzite and granite
(3) shale and sandstone
(4) schist and gneiss

17 The map of North America below shows the source region of an air mass forming mostly over Mexico.

This air mass originating over Mexico is classified as

(1) continental polar
(2) continental tropical
(3) maritime polar
(4) maritime tropical

18 Which cross section best represents the valley shape where a rapidly flowing stream is cutting into the bedrock in a mountainous area?



19 The photograph below shows scratched and grooved bedrock with boulders on its surface.

Source: www.nr.gov.nl.ca

The scratches and grooves were most likely created when

(1) alternating thawing and freezing of water cracked the bedrock
(2) flooding from a nearby lake covered the bedrock
(3) a glacier dragged rocks over the bedrock
(4) rocks from a landslide slid along the bedrock

20 The natural sandblasting (abrasion) of surface bedrock in a desert region is the result of

(1) wind erosion
(2) wave erosion
(3) mass movement
(4) chemical precipitation

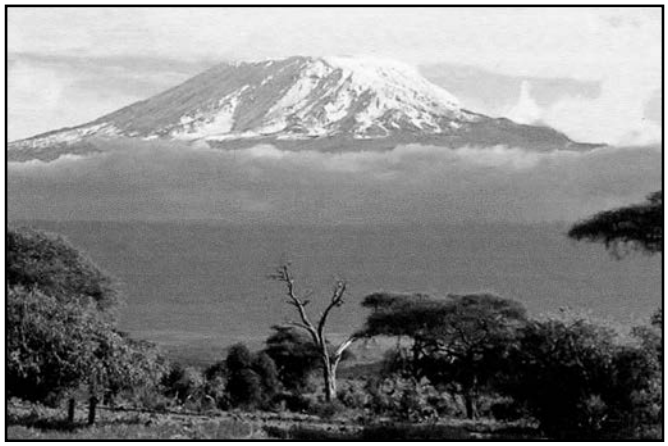
21 Which group of substances is arranged in order of *decreasing* specific heat values?

(1) iron, granite, basalt
(2) copper, lead, iron
(3) dry air, water vapor, ice
(4) liquid water, ice, water vapor

22 The minerals talc, muscovite mica, quartz, and olivine are similar because they

(1) have the same hardness
(2) are the same color
(3) contain silicon and oxygen
(4) break along cleavage planes

23 The photograph below shows Mt. Kilimanjaro, a volcano in Africa, located near the equator.



Which climate factor is responsible for the snow seen on Mt. Kilimanjaro?

(1) high latitude
(2) high elevation
(3) nearness to a cold ocean current
(4) nearness to a high-pressure weather center

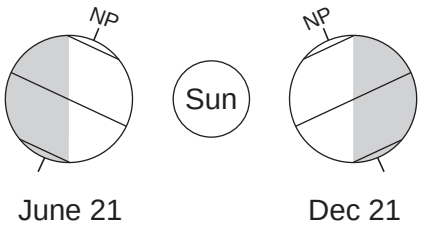
24 The photograph below shows a large outcrop of rock composed primarily of visible crystals of mica, quartz, and feldspar.

Based on the composition and foliated texture, this rock can best be identified as

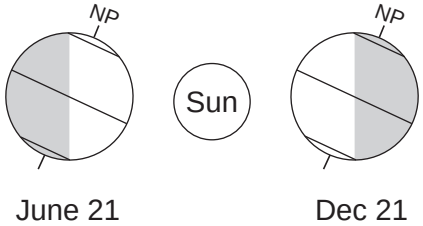
(1) marble
(2) schist
(3) slate
(4) anthracite coal

GO ON TO THE NEXT PAGE ⇨

25 Which diagram best represents the regions of Earth in sunlight on June 21 and December 21? [NP indicates the North Pole and the shading represents Earth's night side. Diagrams are not drawn to scale.]



(1)



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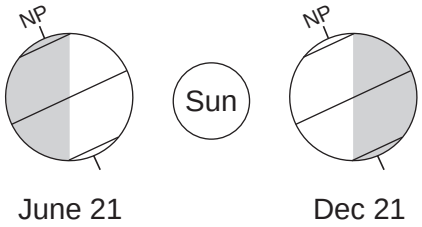

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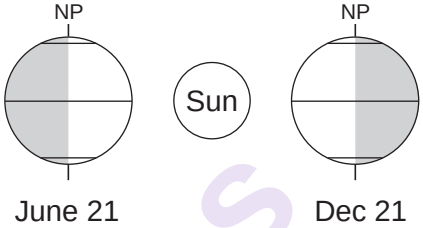
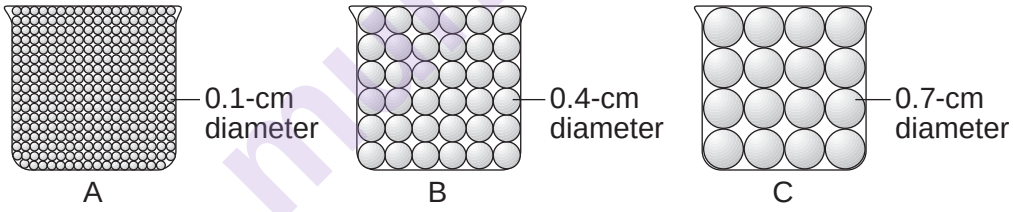


(4)

26 The diagram below represents three identical beakers, *A*, *B*, and *C*, each containing an equal volume of uniform-sized spherical beads. Water is poured into each beaker until all of the pore spaces are filled.



(Not drawn to scale)

Which table best indicates the percentage of pore space compared to the total volume of each beaker?

Beaker	Percentage of Pore Space
A	40
B	40
C	40

(1)

Beaker	Percentage of Pore Space
A	60
B	40
C	20

(2)

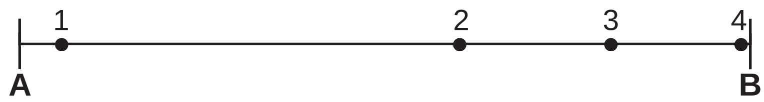
Beaker	Percentage of Pore Space
A	20
B	40
C	60

(3)

Beaker	Percentage of Pore Space
A	20
B	40
C	20

(4)

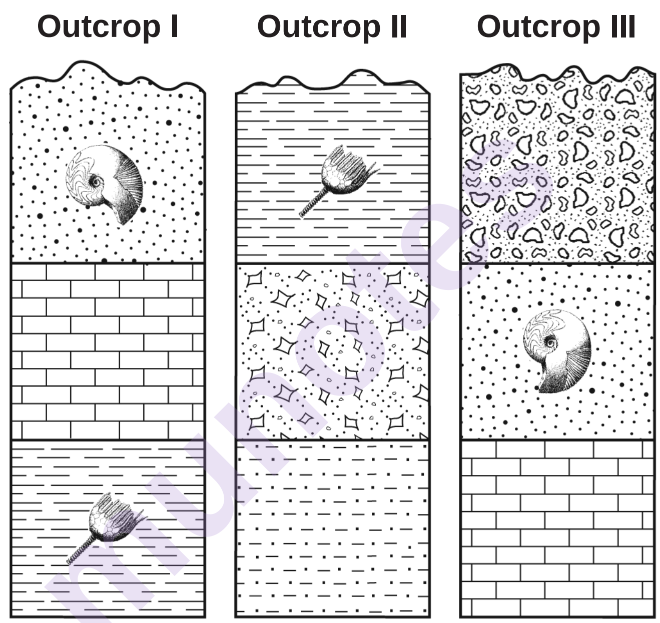
27 The timeline below represents time on Earth from the beginning of the Paleozoic Era (*A*) to the present (*B*).



Which numbered position best represents the time when humans first appeared in the fossil record?

(1) 1
(2) 2
(3) 3
(4) 4

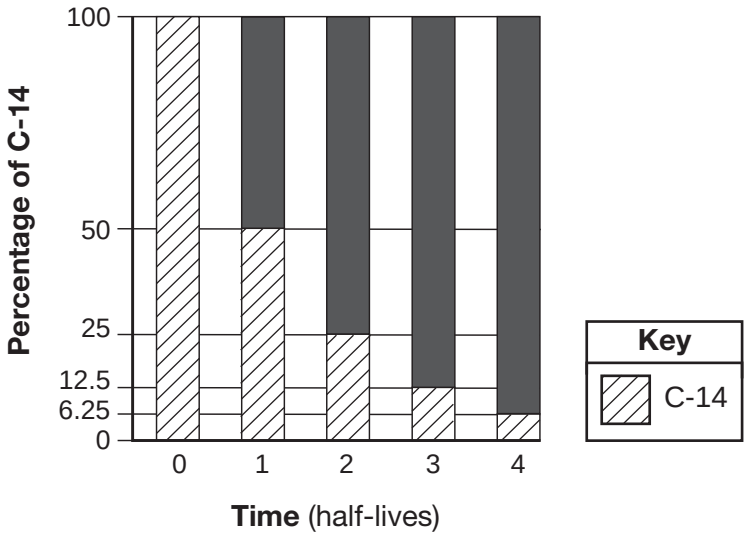
28 The cross sections below represent three outcrops, labeled I, II, and III, containing some New York State index fossils. The rock layers have *not* been overturned.



When the rock layers in the three outcrops are correlated, the oldest layer is the

(1) shale layer in outcrop I
(2) siltstone layer in outcrop II
(3) limestone layer in outcrop III
(4) conglomerate layer in outcrop III

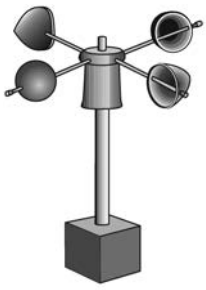
29 A bar graph of the radioactive decay of carbon-14 is shown below.



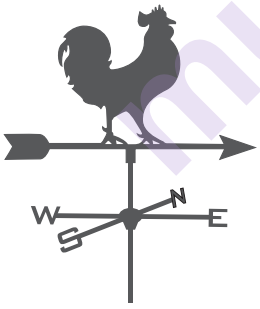
The solid black sections of the bars on the graph represent the percentages of

(1) carbon-14 from the original sample that has not decayed
(2) uranium-238 from the original sample that has not decayed
(3) nitrogen-14 decay product resulting from the radioactive decay
(4) lead-206 decay product resulting from the radioactive decay

30 Which weather instrument is used to determine wind direction?



(1)



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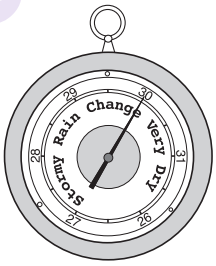
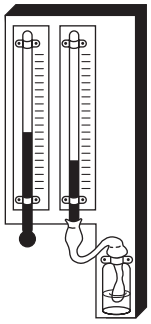
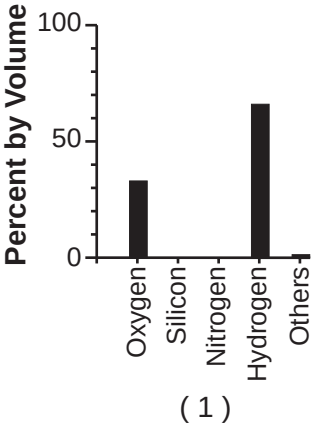


(3)

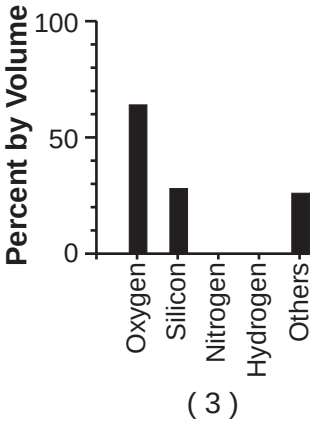


(4)

31 Which bar graph best shows the percent by volume of the elements that make up Earth's hydrosphere?



(1)



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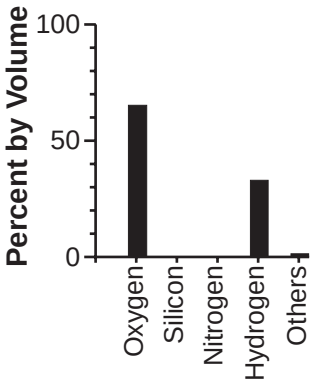

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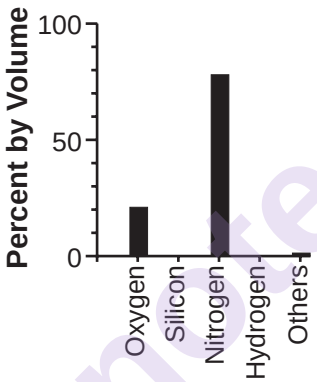
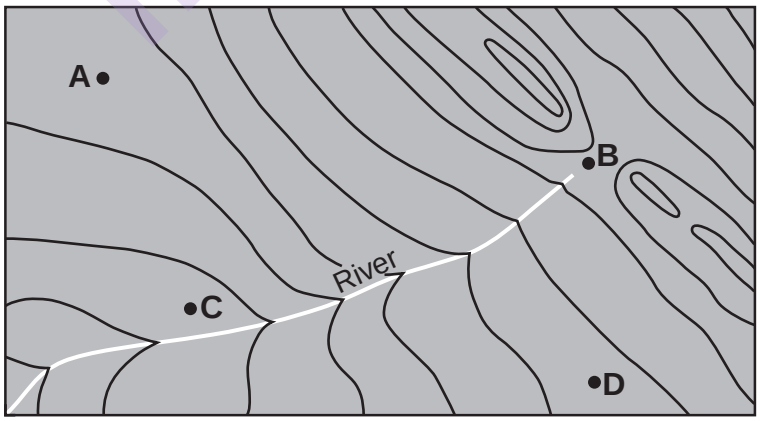


(4)

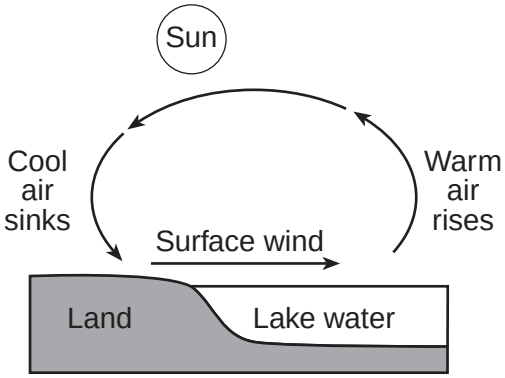
32 Four locations, *A*, *B*, *C*, and *D*, are represented on the topographic map below.



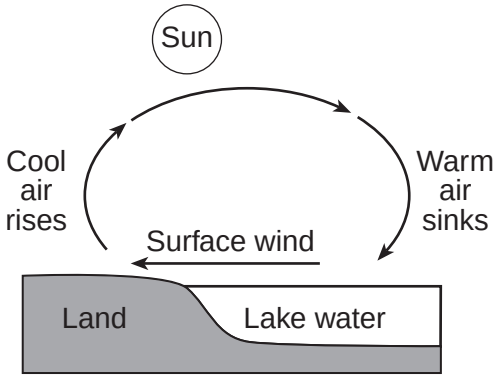
Which lettered location has the highest elevation?

(1) *A*
(2) *B*
(3) *C*
(4) *D*

33 Which cross section best represents how surface winds form by midafternoon near a shoreline on a hot summer day? [Diagrams are not drawn to scale.]



(1)



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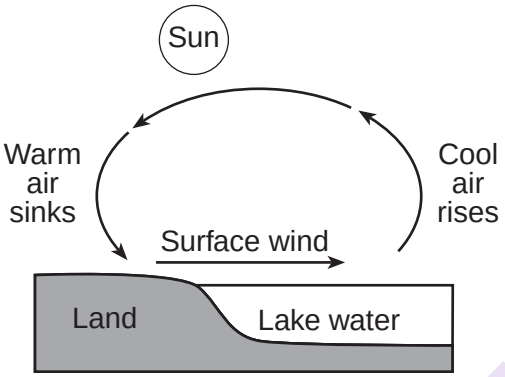

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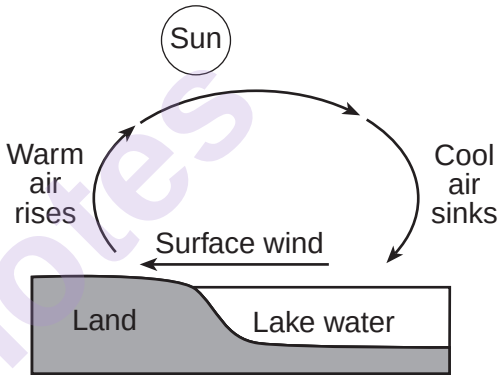
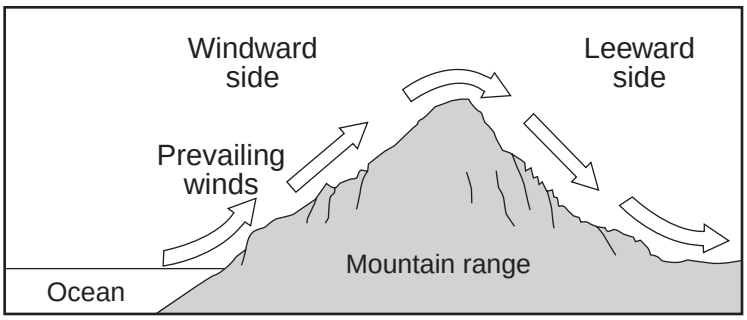


(4)

34 The cross section below represents a prevailing wind flow that causes different climates on the windward and leeward sides of a mountain range.

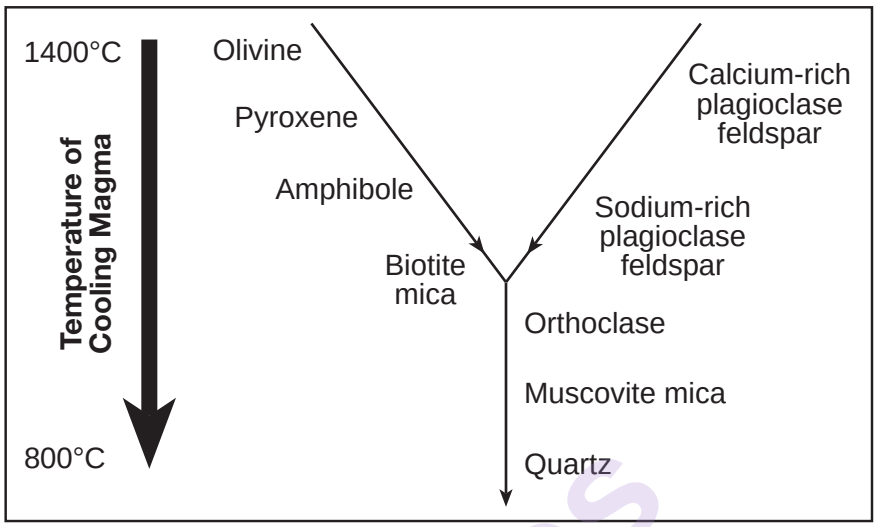


Compared to the temperature and moisture of the air rising on the windward side, the temperature and moisture of the air descending at the same altitude on the leeward side will be

(1) warmer and drier
(2) warmer and more moist
(3) cooler and drier
(4) cooler and more moist

35 The diagram of Bowen's Reaction Series below indicates the relative temperatures at which specific minerals crystallize as magma cools.

Bowen's Reaction Series
(Temperatures at which minerals crystallize)



Which statement is best supported by Bowen's Reaction Series?

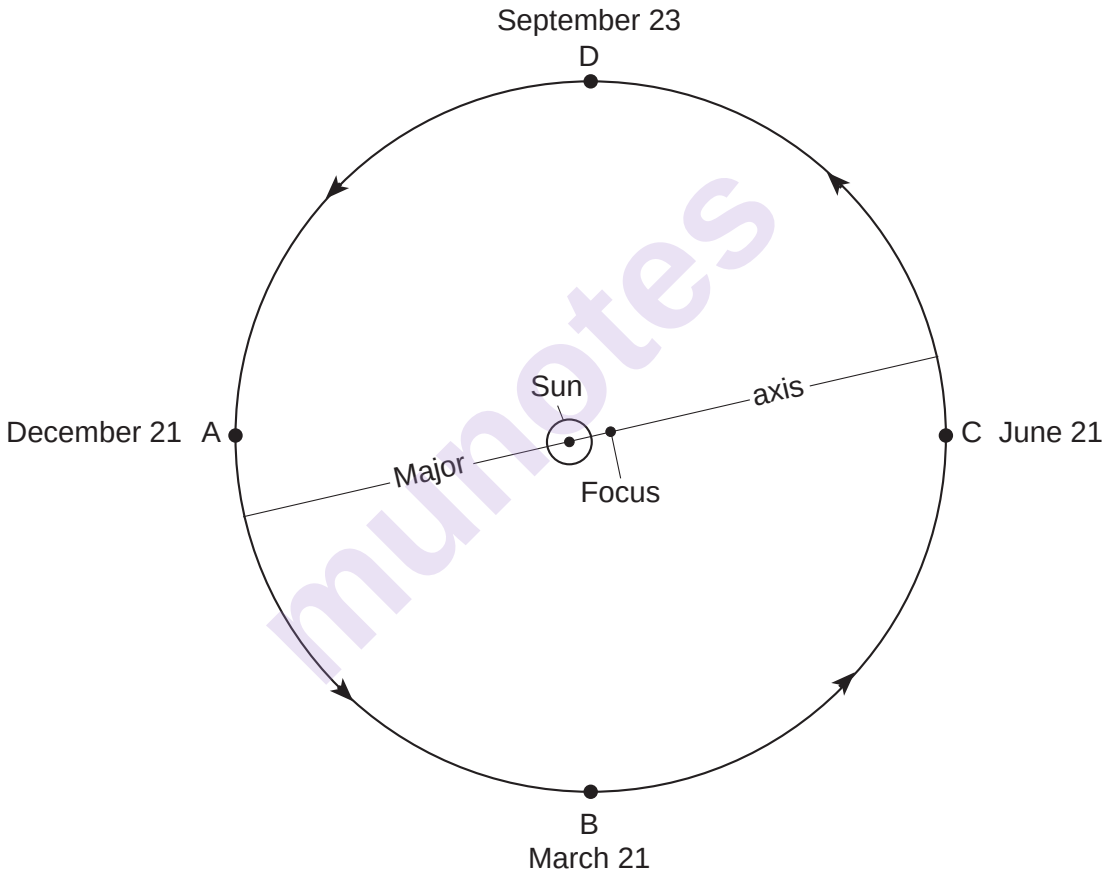
(1) Most minerals crystallize at the same temperature.
(2) Most felsic minerals usually crystallize before most mafic minerals.
(3) Muscovite mica and quartz are the last minerals to crystallize as magma cools.
(4) Biotite mica is the first mineral to crystallize as magma cools.

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 40 on the diagram below and on your knowledge of Earth science. The diagram represents Earth's revolution around the Sun. Points *A*, *B*, *C*, and *D* represent Earth's positions in its orbit on the first day of each of the four seasons. The major axis and the foci (the center of the Sun and the other focus) of Earth's orbit are shown.



(Not drawn to scale)

36 Approximately how many days (d) does it take Earth to travel from position *A* to position *C*?

(1) 91 d
(2) 182 d
(3) 274 d
(4) 365 d

37 Since Earth has an elliptical orbit, the

(1) distance between the Sun and Earth varies
(2) distance between the Sun and the other focus varies
(3) length of Earth's major axis varies
(4) length of Earth's period of revolution varies

38 At positions *A*, *B*, *C*, and *D*, the north end of Earth's axis of rotation is pointing toward

(1) *Betelgeuse*
(2) *Polaris*
(3) the center of the Milky Way
(4) the center of our solar system

39 The constellation Orion is visible at night in New York State when Earth is at position *A*, but *not* at position *C* because Earth's

(1) nighttime is shorter when Earth is at position *A*
(2) period of rotation is shorter than its period of revolution
(3) distance to Orion is too great for the constellation to be seen
(4) nighttime side is facing toward a different portion of space

40 At which two positions will an observer in New York State experience approximately 12 hours of daylight during one rotation of Earth?

(1) *A* and *B*
(2) *A* and *C*
(3) *B* and *C*
(4) *B* and *D*

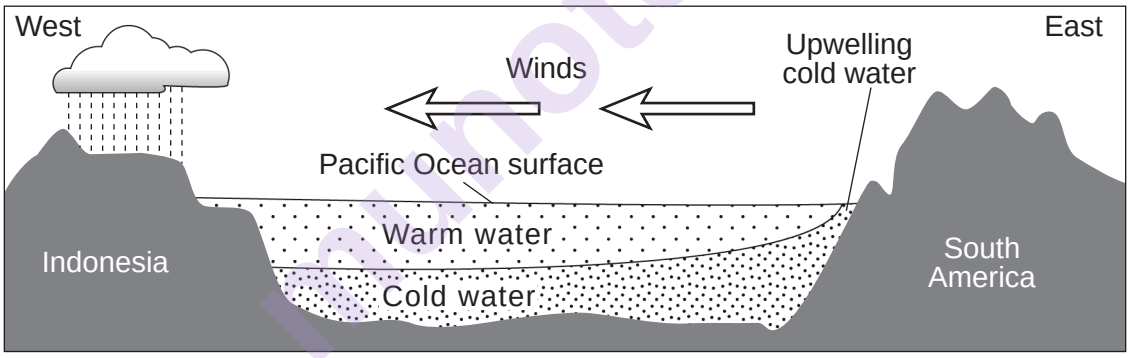
Base your answers to questions 41 through 44 on the passage and cross section below and on your knowledge of Earth science. The cross section represents a generalized region of the Pacific Ocean along the equator during normal (non-El Niño) conditions. The relative temperatures of the ocean water and the prevailing wind direction are indicated.

El Niño

Under normal Pacific Ocean conditions, strong winds blow from east to west along the equator. Surface ocean water piles up on the western part of the Pacific due to these winds. This allows deeper, colder ocean water on the eastern rim of the Pacific to be pulled up (upwelling) to replace the warmer surface water that was pushed westward.

During an El Niño event, these westward-blowing winds get weaker. As a result, warmer water does not get pushed westward as much, and colder water in the east is not pulled toward the surface. This creates warmer surface ocean water temperatures in the east, allowing the thunderstorms that normally occur at the equator in the western Pacific to move eastward. A strong El Niño is often associated with wet winters along the northwestern coast of South America and in the southeastern United States, and drier weather patterns in Southeast Asia (Indonesia) and Australia. The northeastern United States usually has warmer and drier winters in an El Niño year.

Normal Pacific Ocean Conditions (non-El Niño years)



(Not drawn to scale)

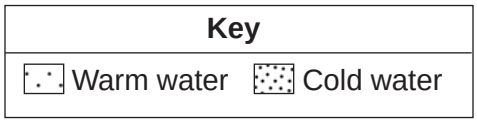
41 Which statement best describes the planetary wind belts that produce the winds represented in the cross section above?

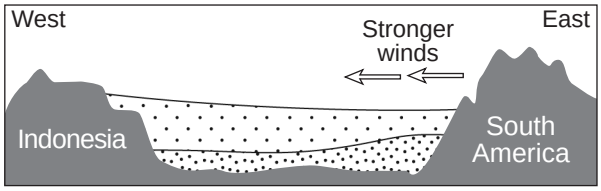
(1) Southwest and northwest winds diverge at the equator and blow toward the west.
(2) Southwest and northwest winds diverge at the equator and blow toward the east.
(3) Northeast and southeast winds converge at the equator and blow toward the west.
(4) Northeast and southeast winds converge at the equator and blow toward the east.

42 Compared to non-El Niño years, which climatic conditions exist near the equator on the western and eastern sides of the Pacific Ocean during an El Niño event?

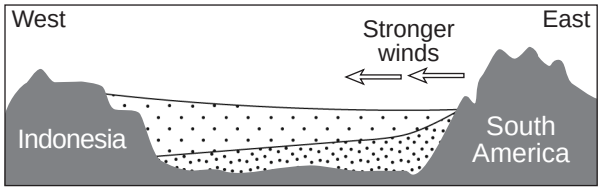
(1) The western Pacific is drier and the eastern Pacific is wetter.
(2) The western Pacific is wetter and the eastern Pacific is drier.
(3) The western and the eastern Pacific are both wetter.
(4) The western and the eastern Pacific are both drier.

43 Which cross section best represents the changed wind conditions and Pacific Ocean temperatures during an El Niño event? [Diagrams are not drawn to scale.]

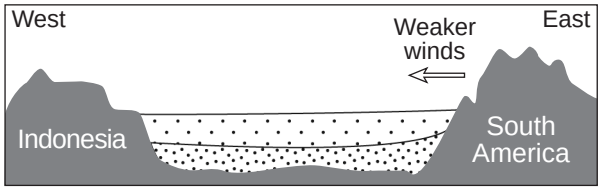




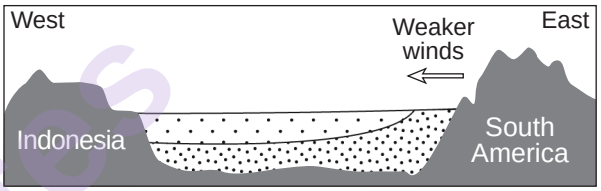
(1)



(3)



(2)

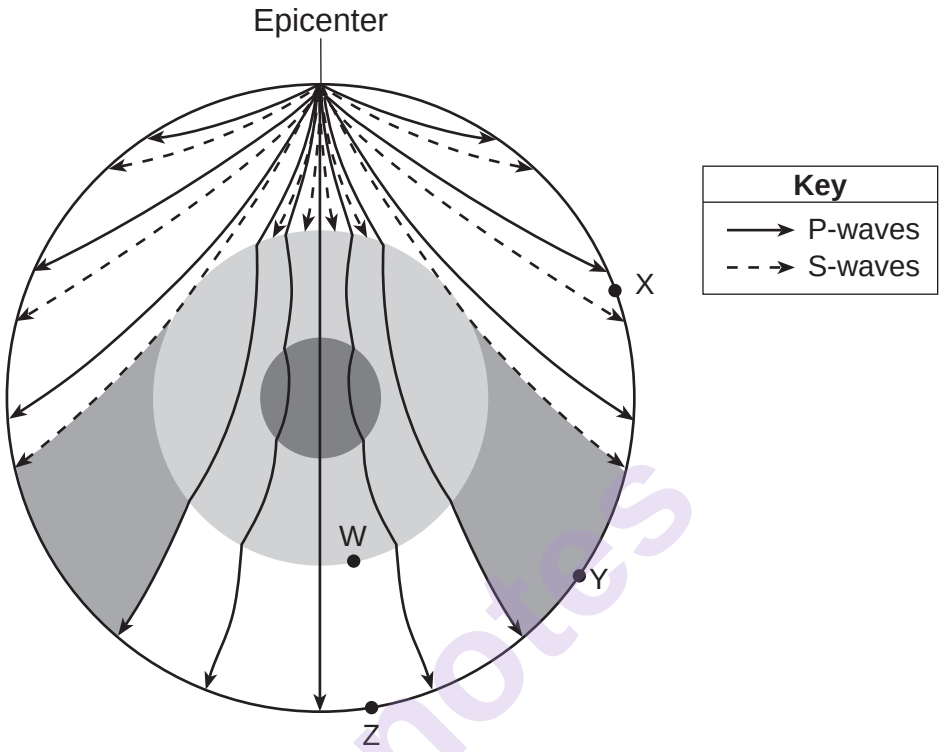


(4)

44 During an El Niño year, winter climatic conditions in New York State will most likely be

(1) colder and wetter
(2) colder and drier
(3) warmer and wetter
(4) warmer and drier

Base your answers to questions 45 through 47 on the cross section of Earth below and on your knowledge of Earth science. The cross section represents the pattern of seismic wave movement away from an earthquake. Point *W* represents a location at the boundary between two layers of Earth's interior. Points *X*, *Y*, and *Z* represent seismic stations on Earth's surface.



45 Which data best describe the depth below Earth's surface and the density of Earth's interior at location *W*?

(1) Depth: 600 km
Density: changes from 3.4 g/cm^3 to 5.6 g/cm^3

(2) Depth: 1000 km
Density: averages 4.5 g/cm^3

(3) Depth: 2900 km
Density: changes from 5.6 g/cm^3 to 9.9 g/cm^3

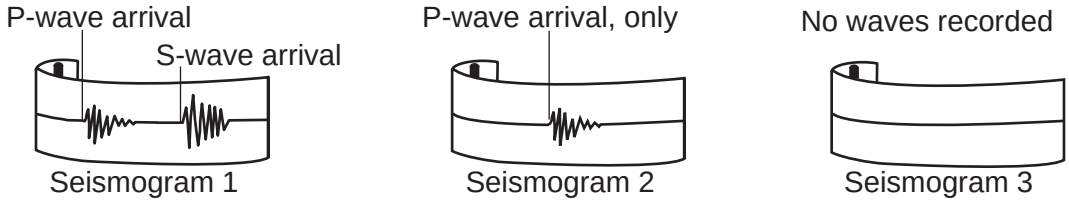
(4) Depth: 5100 km
Density: averages 11.1 g/cm^3

46 Which statement best explains why *no* *S*-waves were received directly from this earthquake at some seismic stations?

(1) An interior Earth layer absorbs *S*-waves.
(2) Earth's mantle reflects *S*-waves.
(3) *S*-waves travel slower than *P*-waves.
(4) *S*-waves travel only on Earth's surface.

47 The diagram below represents the seismograms of this earthquake recorded at seismic stations *X*, *Y*, and Z.

Seismograms



Which table best matches each seismic station with its likely seismogram?

Seismic Station	Seismogram
X	1
Y	2
Z	3

(1)

Seismic Station	Seismogram
X	2
Y	3
Z	1

(3)

Seismic Station	Seismogram
X	3
Y	2
Z	1

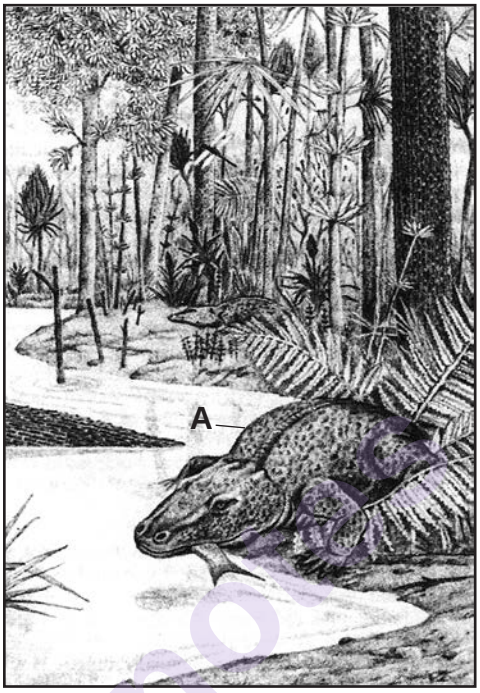
(2)

Seismic Station	Seismogram
X	1
Y	3
Z	2

(4)

Base your answers to questions 48 through 50 on the drawing below and on your knowledge of Earth science. The drawing represents a swamp-forest environment that existed in North America at the base of the Acadian Mountains during the Carboniferous Period. Organism *A* lived in this swamp-forest.

Carboniferous Swamp-Forest



Adapted: Raymo, C. and M., *Written in Stone: A Geological History of the Northeastern United States,* 2001, Black Dome Press Corp.

48 Organism *A* is a labyrinthodont and is most likely classified as

(1) a mastodont
(2) an amphibian
(3) a dinosaur
(4) a mammal

49 The Acadian Mountains were formed as a result of the collision between North America and

(1) Avalon
(2) South America
(3) Pangaea
(4) Queenston Delta

50 At the time represented by this drawing, the region now known as New York State was inferred to be located

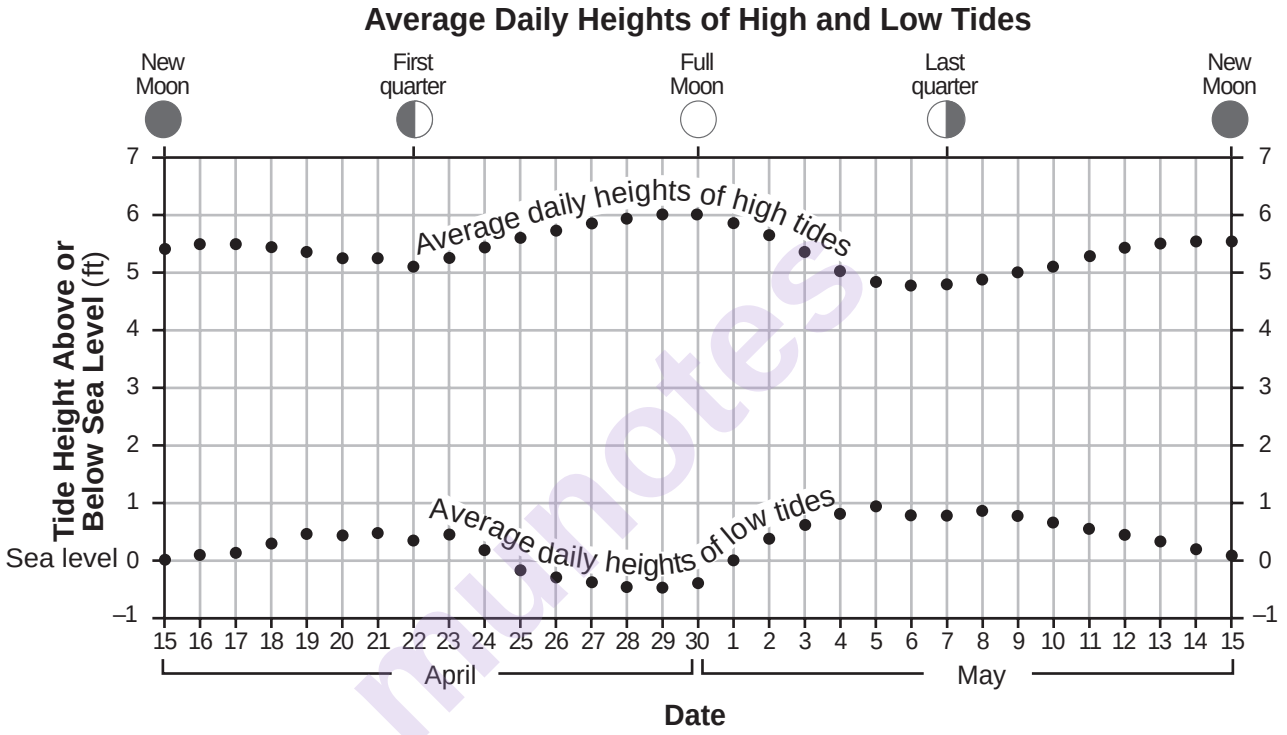
(1) at 45° S latitude
(2) at 45° N latitude
(3) near the equator
(4) near the North Pole

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 53 on the graph below and on your knowledge of Earth science. The graph shows the average daily heights above or below sea level of high and low tides from April 15 to May 15, for a New York State location. Five Moon phases are indicated at the dates on which they occurred.

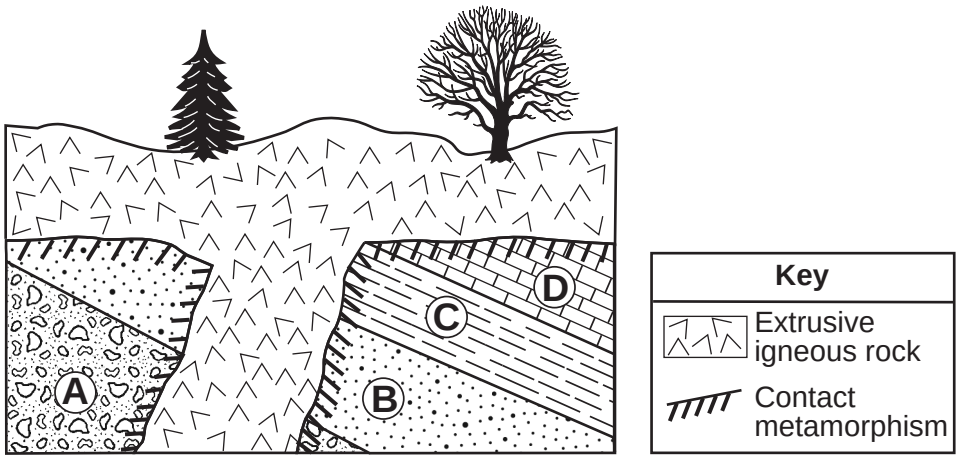


51 On the diagram *in your answer booklet,* place an **X** on the Moon's orbit to indicate the Moon's position on April 15. [1]

52 On the diagram *in your answer booklet,* circle the *two* numbers on Earth's surface that best represent the locations of high tide when the Moon is in the position shown on the diagram. [1]

53 Infer the date when the next first-quarter Moon phase occurred. [1]

Base your answers to questions 54 through 58 on the cross section below and on your knowledge of Earth science. The cross section represents a portion of Earth's crust. Letters *A*, *B*, *C*, and *D* indicate sedimentary rock layers that were originally formed from deposits in a sea. The rock layers have *not* been overturned.



(Not drawn to scale)

54 Geologic events *V* through *Z* are listed below.

V. Metamorphism of some sedimentary rock
W. Formation of sedimentary rock layers
X. Tilting and erosion of sedimentary rock layers
Y. Intrusion/extrusion of igneous rock
Z. Erosion of some igneous rock

List the letters *V* through *Z* to indicate the correct order of the geologic events, from oldest to youngest, that formed this portion of Earth's crust. [1]

55 Identify the name of the contact metamorphic rock formed at the boundary of the igneous rock and rock layer *B*. [1]

56 Describe *one* piece of evidence that suggests that rock layer *C* formed in a deeper sea environment than did rock layer *A*. [1]

57 Describe *one* piece of evidence represented in the cross section that indicates Earth's crust has moved at this location. [1]

58 Identify the mineral composition of rock layer *D*. [1]

Base your answers to questions 59 through 61 on the block diagram in your answer booklet, which represents a house in New York State with a well that supplies water for people. A truck is spreading salt near a gasoline station to melt the snow on the road. Two soil zones are labeled on the diagram.

59 Place an **X** on the block diagram *in your answer booklet* to indicate the location of the water table. [1]

60 Identify *one* process that occurred in rising, moist air that caused the clouds to form at this location. [1]

61 Explain why, in winter, most of the meltwater produced by salting the road will *not* infiltrate the soil. [1]

Base your answers to questions 62 through 65 on the map in your answer booklet and on your knowledge of Earth science. The map shows the generalized ages of surface bedrock of Iceland, an island located on the Mid-Atlantic Ridge rift. The location of the Mid-Atlantic Ridge rift is indicated. Points *A* and *B* represent locations on the surface bedrock, which is igneous in origin. The ages of the surface bedrock, in million years (my), are indicated in the key.

62 On the map *in your answer booklet,* identify the *two* tectonic plates, *one* on each side of the Mid-Atlantic Ridge rift at Iceland, by writing their names on the lines provided on the map. [1]

63 On the map *in your answer booklet,* draw *one* arrow through point *A* and *one* arrow through point *B* to indicate the relative direction that *each* plate is moving to produce the Mid-Atlantic Ridge rift. [1]

64 Identify *one* dark-colored, mafic igneous rock with a vesicular texture that is likely to be found on the surface of Iceland. [1]

65 Identify *one* feature in the mantle beneath Iceland that causes larger amounts of magma formation in Iceland than at most other locations along the rest of the Mid-Atlantic Ridge rift. [1]

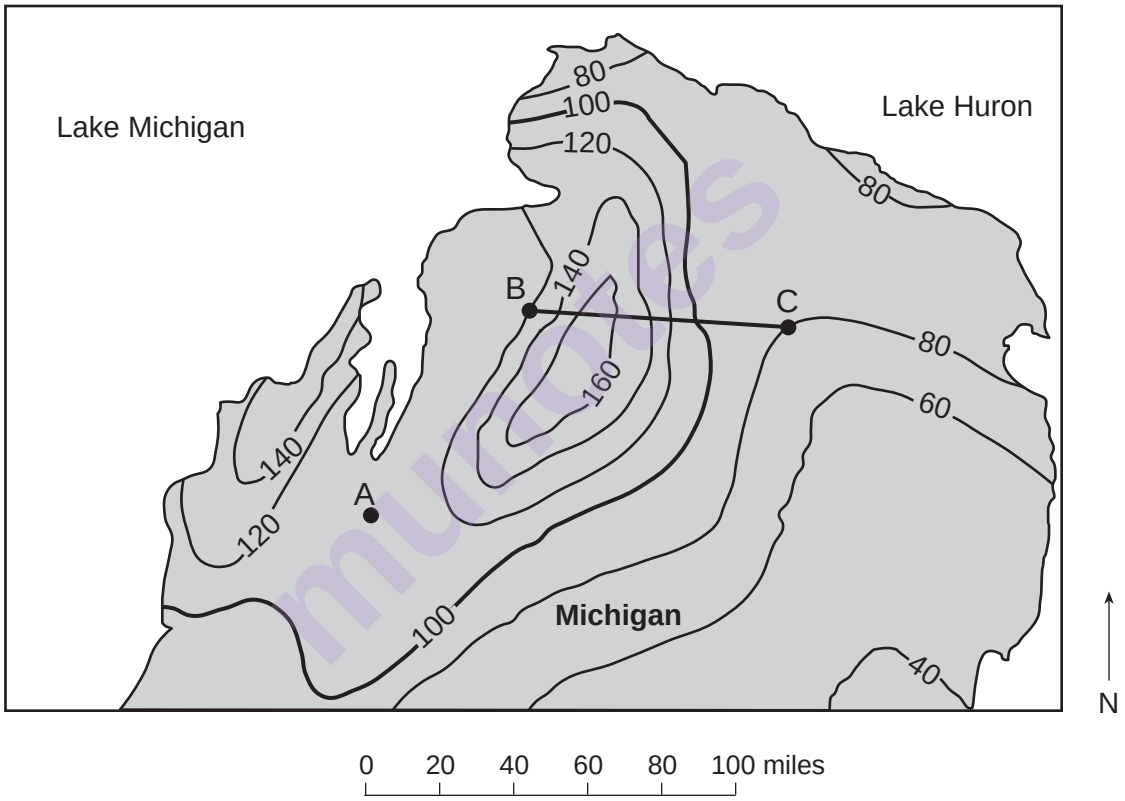
Part C

Answer all questions in this part.

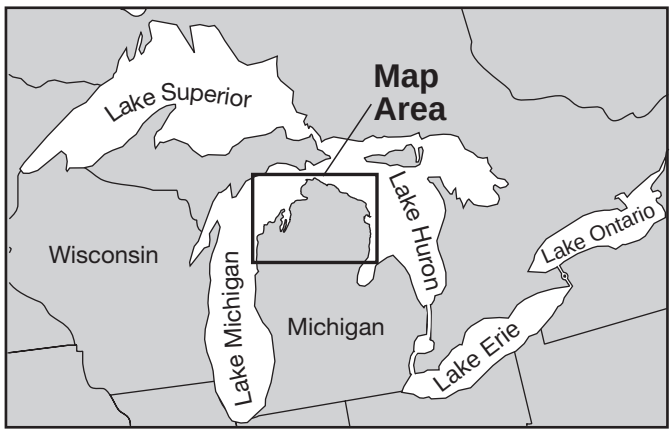
Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science.*

Base your answers to questions 66 through 68 on the maps below and on your knowledge of Earth science. The snowfall map shows isolines of average annual snowfall, measured in inches, across part of Michigan between two of the Great Lakes. Letters *A* through *C* represent locations on Earth's surface. The snowfall map is an enlargement of the map area outlined on the following Great Lakes regional map.

Average Annual Snowfall



Great Lakes Regional Map

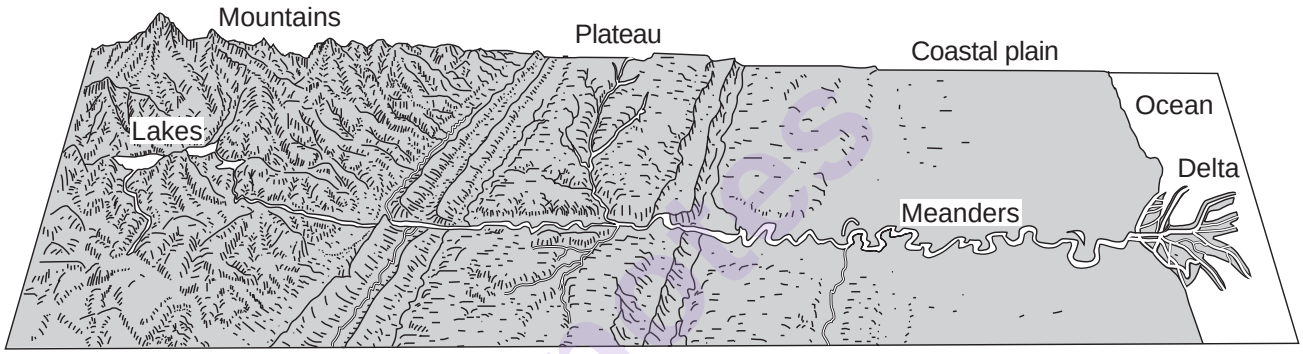


66 State the average annual snowfall at location *A*. [1]

67 On the grid *in your answer booklet*, construct a profile of the average annual snowfall along line *BC* by plotting the value of *each* isoline that crosses line *BC*. Connect *all eight* plots with a line to complete the profile. [1]

68 The surface elevation of Lake Huron is 176 meters above sea level. Identify *one* New York State river that receives water that flows from Lake Huron. [1]

Base your answers to questions 69 through 73 on the landscape diagram below and on your knowledge of Earth science. The diagram represents a long river system from its origin (source) in the mountains to its end (mouth) at the ocean.



69 Describe *one* characteristic of the coastal plain that caused the river to develop meanders. [1]

70 Identify *one* change that would cause an increase in the rate of stream erosion in the river valley in the mountains. [1]

71 Explain why the sediments deposited in the delta are arranged in layers. [1]

72 List *two* processes that would change the accumulated sediments in the delta into sedimentary rock. [1]

73 State *one* reason for the restriction of the construction of buildings near a meandering river on a coastal plain. [1]

Base your answers to questions 74 through 78 on the passage and data table below and on your knowledge of Earth science. The data table shows the apparent hourly change in the direction of a pendulum's swing, in degrees per hour (°/h), for six different Northern Hemisphere latitudes.

Foucault's Pendulum

In 1851, Jean-Bernard-Léon Foucault attached a heavy iron ball to a steel wire hanging from the high ceiling of a church in Paris to demonstrate an apparent motion caused by Earth's rotation. This pendulum could swing freely back and forth. A spike on the bottom of Foucault's pendulum produced straight lines in sand spread on the floor. The position of each new line appeared to gradually shift in a clockwise direction. Eventually, the pendulum returned to its original path, completing a 360° pattern in approximately 32 hours. At other northern latitudes, a Foucault pendulum will complete a 360° pattern of swing in different amounts of time. In the Northern Hemisphere, the number of degrees that a pendulum appears to change its clockwise direction of swing each hour varies with latitude.

Data Table

Latitude (° N)	**Apparent Rate of Change in the Direction of Swing** (°/h)
15	3.9
30	7.5
45	10.6
60	13.0
75	14.5
90	15.0

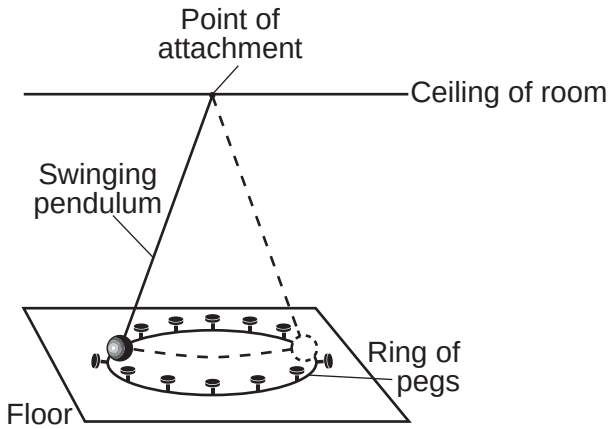
74 On the grid *in your answer booklet*, plot the apparent rate of change in a Foucault pendulum's direction of swing for *each* of the latitudes given in the data table. Connect the plots with a line. [1]

75 Based on the data table, state the relationship between latitude and the apparent rate of change in a Foucault pendulum's direction of swing. [1]

76 Based on the data table, state the approximate apparent rate of change in the direction of a pendulum's swing, in degrees per hour, at Riverhead, New York. [1]

77 Identify *one* location on Earth where the apparent direction of a pendulum's swing would complete a 360° circular pattern in 24 hours. [1]

78 The diagram below represents a swinging pendulum located in Earth's Northern Hemisphere. The pendulum knocked over two pegs during its first swing.



The diagram *in your answer booklet* represents a top view of the same pegs. Circle the next *two* pegs that would fall as the pendulum appears to change its direction of swing in the Northern Hemisphere. [1]

Base your answers to questions 79 through 82 on the Characteristics of Stars graph in your answer booklet and on your knowledge of Earth science.

79 The star *Canopus* has a surface temperature of 7400 K and a luminosity (relative to the Sun) of 1413. *In your answer booklet,* use an **X** to plot the position of *Canopus* on the graph, based on its surface temperature and luminosity. [1]

80 Identify *two* stars from the Characteristics of Stars graph that are at the same life-cycle stage as the Sun. [1]

81 Describe *one* characteristic of the star *Spica* that causes it to have a greater luminosity than *Barnard's Star*. [1]

82 Describe how the relative surface temperature and the relative luminosity of *Aldebaran* would change if it collapses and becomes a white dwarf like *Procyon B*. [1]

Base your answers to questions 83 through 85 on the table below, on the map in your answer booklet, and on your knowledge of Earth science. The table lists the latitude, longitude, and barometric pressure, in millibars (mb), of the center of a low-pressure system (**L**) as it moved across North America from March 14 to March 17. The map in your answer booklet shows the center of this low-pressure system (**L**) and associated fronts on March 14. The location of the low-pressure system 24 hours later on March 15 is also indicated.

The Center of the Low–Pressure System (L)

March Date	**Latitude**	**Longitude**	**Barometric Pressure** (mb)
14	50° N	112° W	999.7
15	52° N	95° W	999.5
16	54° N	79° W	998.5
17	56° N	64° W	998.0

83 On the map *in your answer booklet*, use the latitudes and longitudes listed in the data table to plot the March 16 and March 17 locations of the center of the low-pressure system (**L**) by placing an **X** at *each* location. [1]

84 Calculate the average speed, in kilometers per hour, at which this low-pressure center (**L**) traveled during the 24 hours between March 14 and March 15. [1]

85 On the station model *in your answer booklet*, using the proper format, record the barometric pressure of the low-pressure center (**L**) on March 16. [1]

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