

PHYSICAL SETTING EARTH SCIENCE

Wednesday, August 14, 2019 — 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 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 Most asteroids in our solar system are located in the asteroid belt between the orbits of Mars and Jupiter. What is the approximate distance from the Sun to the asteroid belt?

(1) 129 million km (3) 403 million km
(2) 210 million km (4) 1103 million km

- 2 The table below shows tide data for a location on the north shore of Long Island, in New York State.

| Day | Tide | Time |
|-----------|-----------|------------|
| Tuesday | High Tide | 12:11 a.m. |
| | Low Tide | 6:23 a.m. |
| | High Tide | 12:36 p.m. |
| | Low Tide | 6:49 p.m. |
| Wednesday | High Tide | 1:02 a.m. |
| | Low Tide | 7:15 a.m. |
| | High Tide | 1:27 p.m. |

Based on these data, what is the most likely time of the next high tide?

(1) 1:53 a.m. (3) 7:40 a.m.
(2) 1:53 p.m. (4) 7:40 p.m.

- 3 Which planet takes longer to complete one rotation on its axis than it does to complete one orbit of the Sun?

(1) Mercury (3) Earth
(2) Venus (4) Mars

- 4 Jupiter is a Jovian planet. Compared to the terrestrial planets, Jupiter has a

(1) shorter period of revolution
(2) shorter distance to the Sun
(3) greater density
(4) greater mass

- 5 The entire constellation of Orion is visible in the night sky in January to an observer in New York State. Which statement explains why this constellation is *not* visible in the night sky to this observer in June?

(1) Earth rotates on its axis.
(2) Earth revolves around the Sun.
(3) The constellation Orion orbits the Sun.
(4) The tilt of Earth's axis changes throughout the year.

- 6 The approximate age of the universe is estimated to be

(1) 4.6 million years (3) 13.8 million years
(2) 4.6 billion years (4) 13.8 billion years

- 7 The photograph below shows the apparent path of the Sun photographed at 20-minute intervals and combined into one photograph.



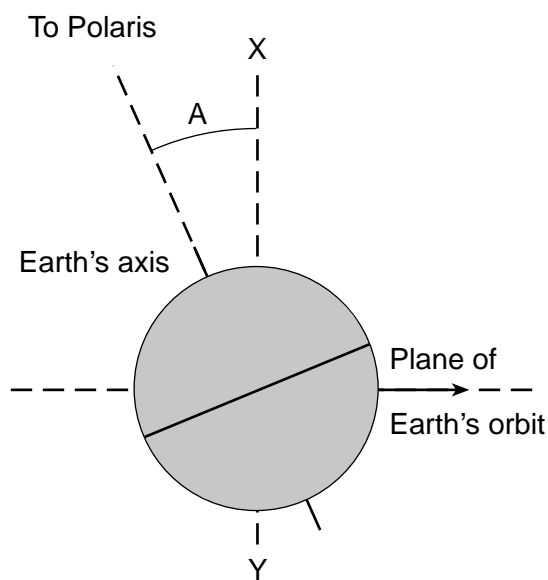
Baker, Robert H. *An Introduction to Astronomy*

Which motion is responsible for the apparent path of the Sun shown in the photograph?

(1) Earth's rotation (3) Sun's rotation
(2) Earth's revolution (4) Sun's revolution

- 8 The mass extinction of the dinosaurs, approximately 65.5 million years ago, is inferred by most scientists to have been caused by
- (1) a large energy surge from the surface of the Sun
 - (2) the occurrence of a major ice age
 - (3) an impact event occurring on Earth's surface
 - (4) earthquakes occurring along crustal plate boundaries

- 9 The diagram below represents Earth as viewed from space. Letter A represents the angle of tilt of Earth's rotational axis. Line XY is perpendicular to the plane of Earth's orbit.



What is the value of the angle represented by letter A?

- (1) 15.0°
 - (2) 23.5°
 - (3) 66.5°
 - (4) 90.0°
- 10 In the spring, when snow cover on the land melts, the water will most likely infiltrate Earth's surface where that land surface is
- (1) still frozen with a steep slope
 - (2) still frozen with a gentle slope
 - (3) no longer frozen with a steep slope
 - (4) no longer frozen with a gentle slope

- 11 Water is returned from Earth's surface to the atmosphere by
- (1) condensation and transpiration
 - (2) condensation and precipitation
 - (3) evaporation and transpiration
 - (4) evaporation and precipitation

- 12 Which type of sediment sample normally has the greatest permeability rate?
- (1) unsorted pebbles
 - (2) unsorted sand
 - (3) sorted pebbles
 - (4) sorted sand

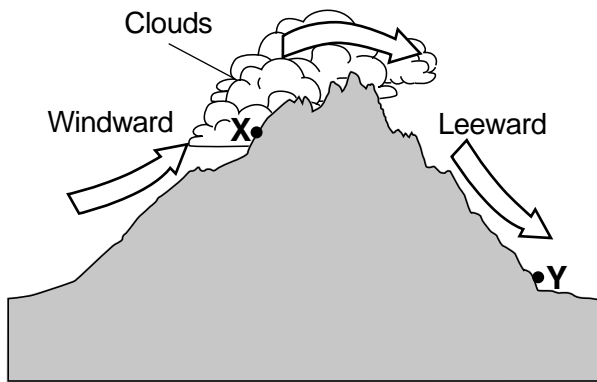
- 13 The presence of which atmospheric condition will most likely result in clear skies in Binghamton, New York?
- (1) high humidity
 - (2) high-pressure center
 - (3) increasing wind speed
 - (4) dewpoint equal to air temperature

- 14 Which changes in air temperature and atmospheric pressure will normally be recorded by a weather balloon when it is released at Earth's surface and rises through the troposphere?
- (1) a decrease in both air temperature and atmospheric pressure
 - (2) a decrease in air temperature and an increase in atmospheric pressure
 - (3) an increase in both air temperature and atmospheric pressure
 - (4) an increase in air temperature and a decrease in atmospheric pressure

- 15 Which gas is most effective in absorbing incoming harmful ultraviolet radiation in Earth's stratosphere before that radiation reaches Earth's surface?
- (1) nitrogen
 - (2) hydrogen
 - (3) oxygen
 - (4) ozone

- 16 The major cause of monsoon rains in India and southeast Asia is seasonal
- (1) shifts in the prevailing wind belts
 - (2) shifts in ocean currents
 - (3) changes in the energy radiated from the Sun
 - (4) changes in worldwide atmospheric temperatures

17 The cross section below represents the windward and leeward sides of a mountain. The arrows show the direction of air movement over the mountain. Points X and Y represent locations on Earth's surface.



Compared to the temperature and water vapor content of the air at location X, the temperature and water vapor content at location Y are most likely

- (1) warmer and wetter (3) cooler and wetter
- (2) warmer and drier (4) cooler and drier

18 Which surface ocean current transports cool water to lower latitudes?

- (1) Gulf Stream
- (2) Peru Current
- (3) West Greenland Current
- (4) East Australia Current

19 Which land surface characteristics produce the greatest amount of absorption of insolation at Earth's surface?

- (1) dark color and rough texture
- (2) dark color and smooth texture
- (3) light color and rough texture
- (4) light color and smooth texture

20 The planetary surface winds and air currents near Earth's equator are usually

- (1) converging and sinking
- (2) diverging and sinking
- (3) converging and rising
- (4) diverging and rising

21 Oxygen in Earth's early atmosphere was first produced during the Precambrian from

- (1) cyanobacteria in Earth's oceans
- (2) volcanic activity along plate boundaries
- (3) the absorption of sunlight by plants
- (4) evaporation of ocean water

22 Which life-form existed on Earth for the *shortest* period of time?

- (1) dinosaurs (3) ammonoids
- (2) trilobites (4) placoderm fish

23 During the late Silurian epoch, very salty seas extended from New York State to Michigan. These environmental conditions resulted in the formation of halite layers. At the same time, *Eurypterus remipes* lived in nearby environments. Both the halite layers and *Eurypterus remipes* fossils can now be used to identify a specific geologic time interval because both formed over a

- (1) large geographic area and in a short geologic time
- (2) large geographic area and in a long geologic time
- (3) small geographic area and in a short geologic time
- (4) small geographic area and in a long geologic time

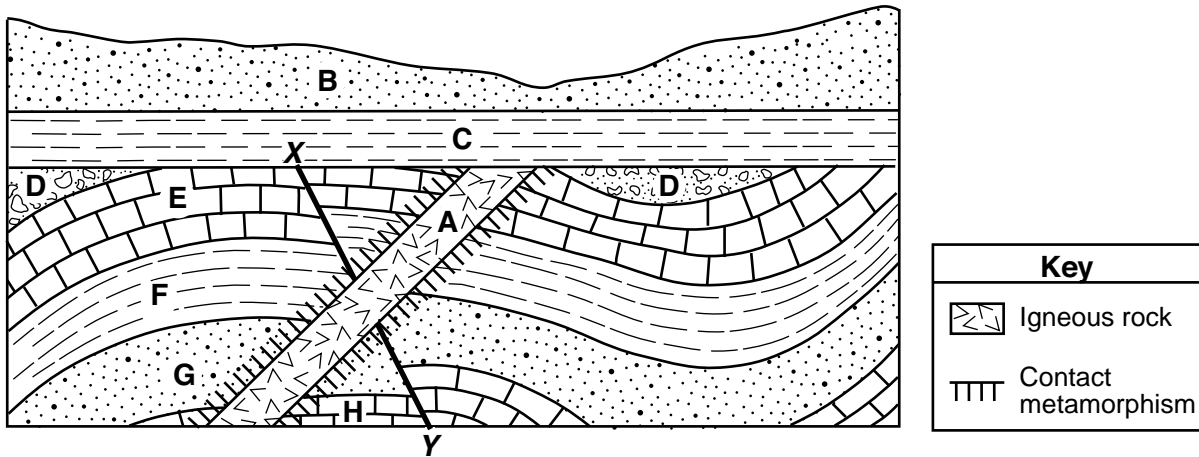
24 If it takes a P-wave five minutes to travel from the epicenter of an earthquake to a seismic station, approximately how long will it take an S-wave to travel that same distance?

- (1) 15 minutes (3) 9 minutes
- (2) 12 minutes (4) 4 minutes

25 Earthquake S-waves do *not* pass through which two interior Earth layers?

- (1) rigid mantle and asthenosphere
- (2) asthenosphere and stiffer mantle
- (3) stiffer mantle and outer core
- (4) outer core and inner core

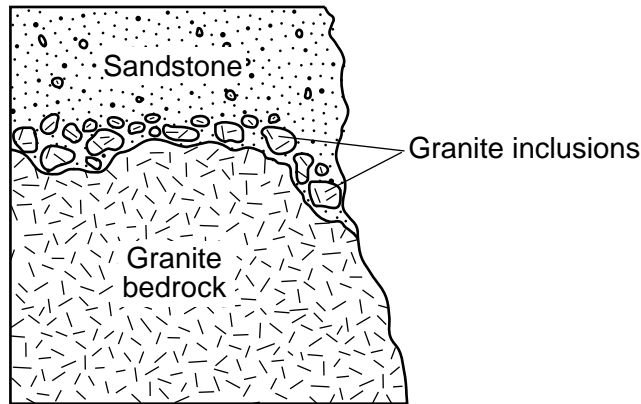
26 The cross section below represents the bedrock structure of a section of Earth's crust. Letters A through H represent rock units. Line XY represents a fault. The rock layers have *not* been overturned.



When did faulting along line XY occur?

- (1) after the intrusion of rock unit A
- (2) after the deposition of rock units B, C, and D
- (3) after the formation of rock units E and F
- (4) before the formation of rock units G and H

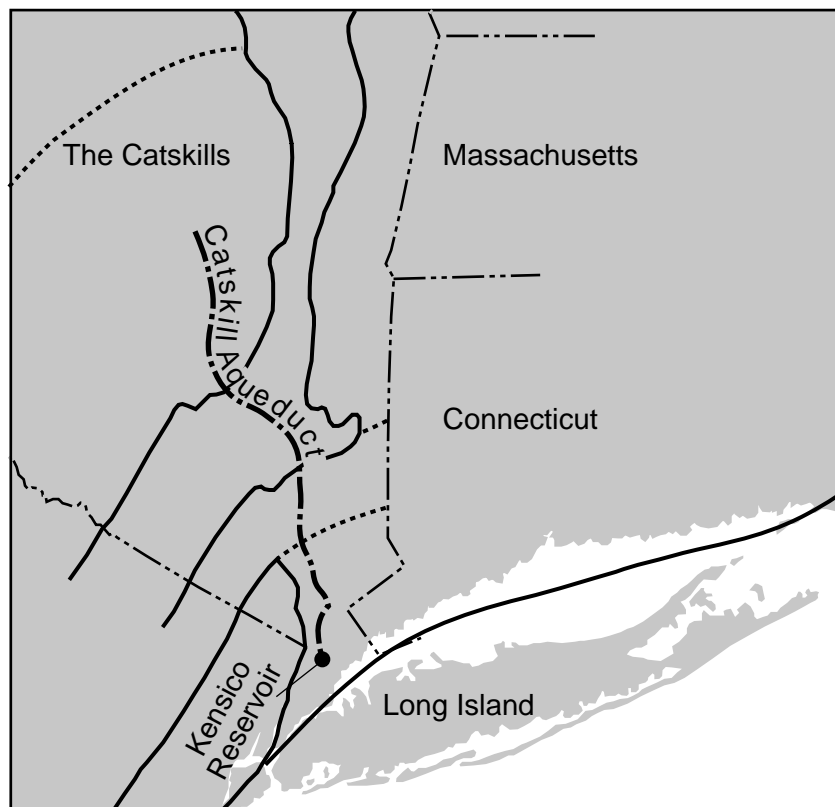
27 The cross section below represents rock units within Earth's crust.



The age of the granite that makes up the inclusions is most likely

- (1) older than the sandstone, but the same age as the granite bedrock
- (2) older than the sandstone and the granite bedrock
- (3) younger than the sandstone, but the same age as the granite bedrock
- (4) younger than the sandstone and the granite bedrock

28 A portion of the Generalized Landscape Regions of New York State map below shows the location of the Catskill Aqueduct that flows into the Kensico Reservoir, which supplies the residents of New York City with drinkable water.



Which sequence shows the order of landscape regions that are crossed as water flows through the Catskill Aqueduct?

- (1) Allegheny Plateau, Hudson-Mohawk Lowlands, Taconic Mountains, Newark Lowlands
- (2) Allegheny Plateau, Hudson-Mohawk Lowlands, Hudson Highlands, Manhattan Prong
- (3) Atlantic Coastal Plain, Newark Lowlands, Hudson Highlands, Hudson-Mohawk Lowlands
- (4) Atlantic Coastal Plain, Manhattan Prong, Hudson Highlands, Allegheny Plateau

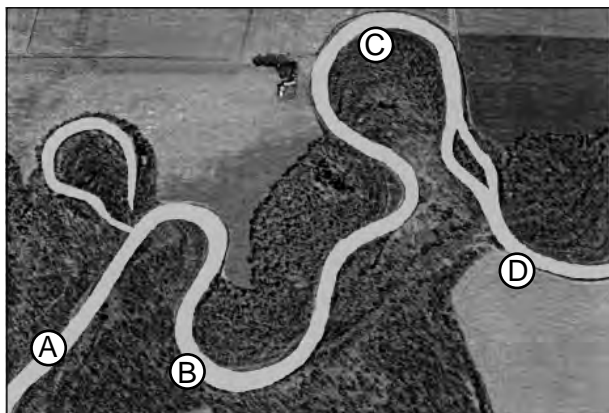
29 The map below shows the land area in New York State drained by the Oswego River and its tributaries.



The land area drained by the Oswego River and its tributaries is called a

- (1) delta
- (2) watershed
- (3) water table
- (4) floodplain

30 The photograph below shows a portion of the Genesee River in western New York. Letters A, B, C, and D are locations in the river.



At which location would deposition of sediments most likely be greater than erosion?

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

31 The rate of soil development in tropical areas is usually greater than the rate of soil development in arctic areas because tropical areas have

- (1) less chemical weathering and a scarcity of living organisms
- (2) less chemical weathering and an abundance of living organisms
- (3) more chemical weathering and a scarcity of living organisms
- (4) more chemical weathering and an abundance of living organisms

32 New York State's Finger Lakes exist today because

- (1) U-shaped valleys were dammed by glacial sediments
- (2) V-shaped valleys are being eroded by streams
- (3) a drop in sea level occurred, leaving the lakes
- (4) a rise in sea level occurred, flooding the region

33 Which igneous rock could physically weather to beach sand that contains the minerals pyroxene, plagioclase feldspar, and olivine?

- (1) dunite
- (2) granite
- (3) peridotite
- (4) gabbro

34 Which two physical properties of graphite make it a good mineral for use in pencils?

- (1) luster and fracture
- (2) cleavage and color
- (3) hardness and streak
- (4) greasy feel and composition

35 Which mineral is produced when two atoms of iron chemically combine with three atoms of oxygen?

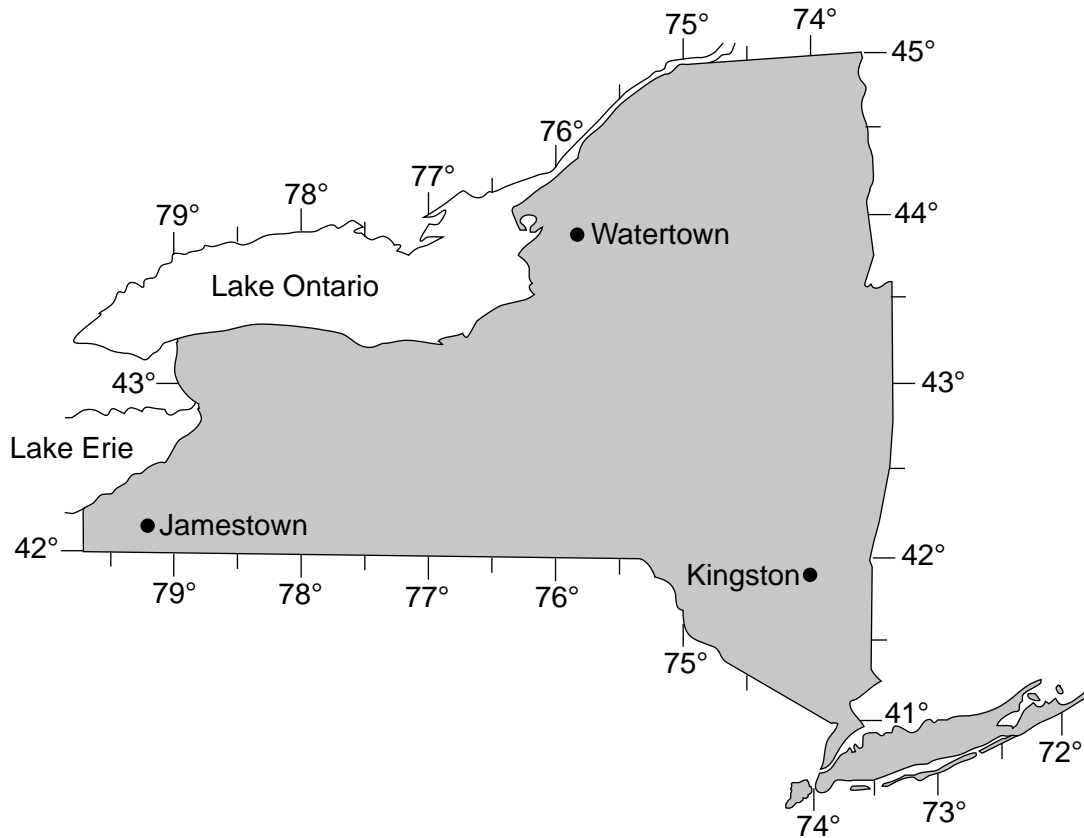
- (1) garnet
- (2) pyrite
- (3) magnetite
- (4) hematite

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 map below and on your knowledge of Earth science. The map shows the locations of Jamestown, Watertown, and Kingston in New York State.



- 36 Compared to the time of sunrise in Kingston, the time of sunrise in Jamestown would be approximately
- | | |
|--------------------|------------------------|
| (1) 1 hour earlier | (3) 20 minutes earlier |
| (2) 1 hour later | (4) 20 minutes later |
- 37 An observer in Watertown, New York, would see the star *Polaris* at an altitude of approximately
- | | |
|---------|---------|
| (1) 44° | (3) 75° |
| (2) 45° | (4) 76° |
- 38 Earth's system of longitude is based on which motion?
- | | |
|------------------------|---------------------------------------|
| (1) Earth's rotation | (3) Earth's revolution around the Sun |
| (2) the Sun's rotation | (4) the Sun's revolution around Earth |
-

Base your answers to questions 39 through 41 on the passage and photograph below and on your knowledge of Earth science. The photograph shows a portion of the Patagonia Marble Caves found in South America.

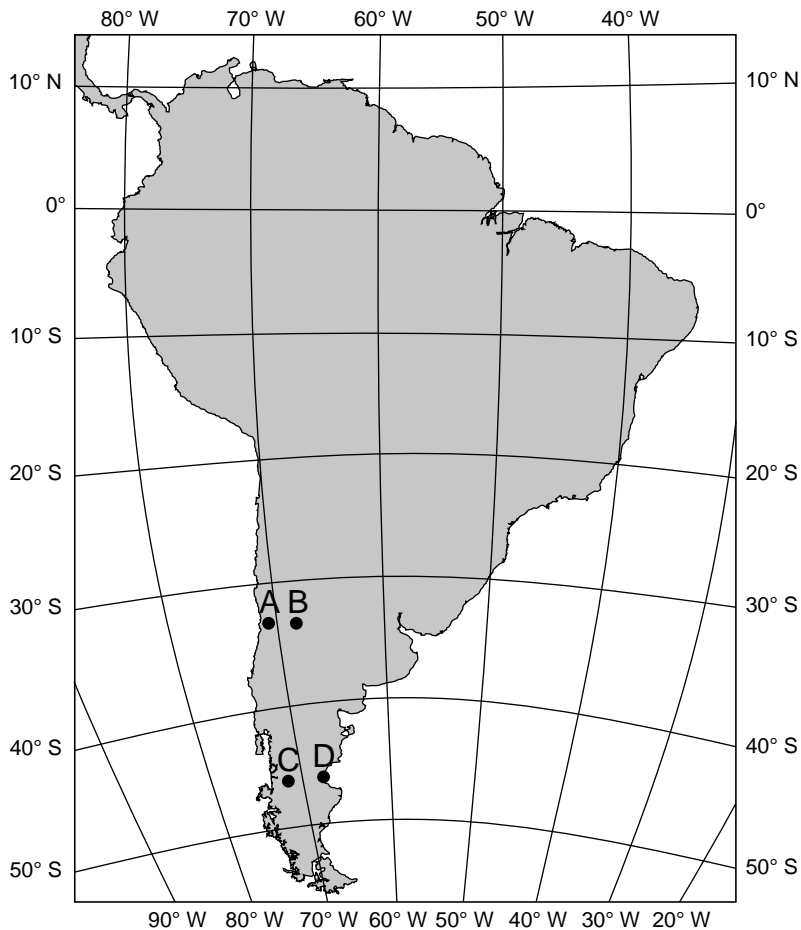
Patagonia Marble Caves

The Patagonia Marble Caves of South America are found on the shores of General Carrera Lake at a location of 46.5° S 72° W. Most of the water in the lake comes from the melting of nearby glaciers. Many small particles carried by the glacier remain suspended in the meltwater that fills this lake, causing a distinct blue color. Over the last 6200 years, the water of the lake has been weathering and eroding the marble bedrock found along the shores and within the lake itself. The marble dissolved faster at the water surface, where the moving water is interacting with the marble bedrock, producing countless caves, mazes, columns, and tunnels in the marble.



<http://www.dont-complain.com/2015/01/17/marble-caves-chile/>

39 The map below shows four locations in South America, labeled A, B, C, and D.



Which lettered point on the map best represents the location of the Patagonia Marble Caves?

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

40 Which two processes formed the marble bedrock shown in the photograph?

- (1) heat and pressure
- (2) compaction and cementation
- (3) melting and solidification
- (4) precipitation and evaporation

41 Most marble is composed primarily of

- (1) quartz and/or potassium feldspar
 - (2) calcite and/or dolomite
 - (3) halite and/or olivine
 - (4) pyroxene and/or plagioclase feldspar
-

44 Which table correctly identifies weather instruments *A* and *B* and the weather variable that each measures?

| | Weather Instrument | Weather Variable Measured |
|---|---------------------------|----------------------------------|
| A | wind vane | wind direction |
| B | anemometer | wind speed |

(1)

| | Weather Instrument | Weather Variable Measured |
|---|---------------------------|----------------------------------|
| A | wind vane | wind speed |
| B | anemometer | wind direction |

(3)

| | Weather Instrument | Weather Variable Measured |
|---|---------------------------|----------------------------------|
| A | anemometer | wind speed |
| B | wind vane | wind direction |

(2)

| | Weather Instrument | Weather Variable Measured |
|---|---------------------------|----------------------------------|
| A | anemometer | wind direction |
| B | wind vane | wind speed |

(4)

GO ON TO THE NEXT PAGE ➡

Base your answers to questions 45 through 47 on the diagrams below and on your knowledge of Earth science. Diagram A represents a Foucault pendulum set up at a particular location on Earth. The line on the floor marked 0 is the path of the pendulum when it was first set in motion. Diagram B represents the curving of planetary winds located in two areas of Earth's surface due to the Coriolis effect.

Diagram A: Foucault's Pendulum

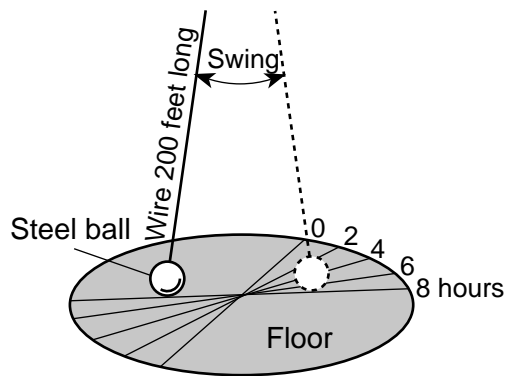
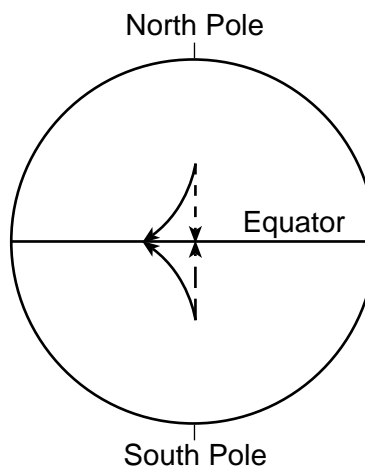


Diagram B: Coriolis Effect on Planetary Winds



(Not drawn to scale)

| Key | |
|------------|----------------------------|
| - - - → | Original direction of wind |
| —→ | Deflected path of wind |

45 The apparent shift in the direction of swing of a Foucault pendulum and the curving of winds by the Coriolis effect are both evidence of Earth's

- | | |
|-----------|----------------|
| (1) tilt | (3) rotation |
| (2) shape | (4) revolution |

46 In diagram A, the apparent shift of the path of the pendulum is shown at two-hour intervals for the first eight hours of pendulum motion. During the eight hours, the pendulum's path was displaced 60 degrees from where it started. How many degrees did the apparent path of the pendulum change each hour (h)?

- | | |
|------------|------------|
| (1) 7.5°/h | (3) 60°/h |
| (2) 15°/h | (4) 120°/h |

47 In diagram *B*, what are the names of the planetary wind belts formed by the deflected winds shown in the Northern and Southern hemispheres?

| Hemisphere | Wind Belt |
|------------|-----------------|
| Northern | Southeast winds |
| Southern | Northwest winds |

(1)

| Hemisphere | Wind Belt |
|------------|-----------------|
| Northern | Southwest winds |
| Southern | Northwest winds |

(3)

| Hemisphere | Wind Belt |
|------------|-----------------|
| Northern | Northeast winds |
| Southern | Southeast winds |

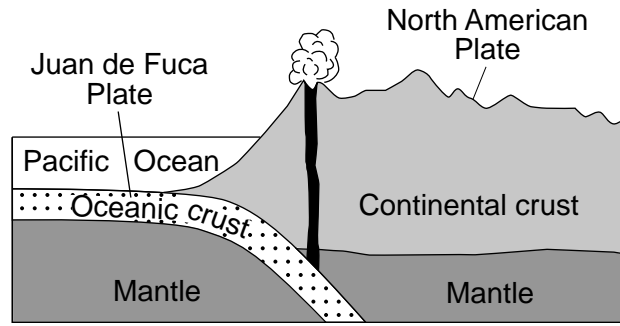
(2)

| Hemisphere | Wind Belt |
|------------|-----------------|
| Northern | Northwest winds |
| Southern | Southeast winds |

(4)

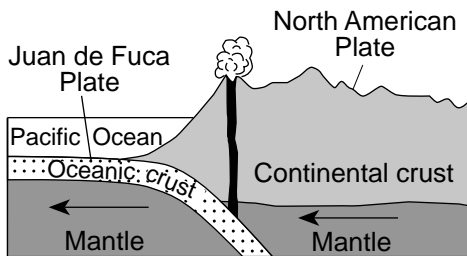
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Base your answers to questions 48 through 50 on the cross section below and on your knowledge of Earth science. The cross section shows the boundary between the Juan de Fuca Plate and the North American Plate.



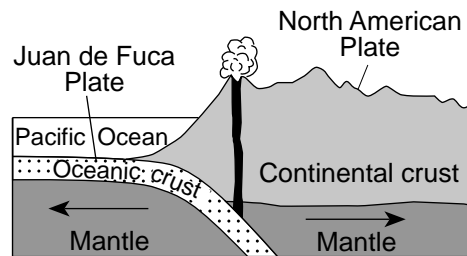
(Not drawn to scale)

48 In which diagram do the arrows best represent the relative motion of the upper mantle at this plate boundary?



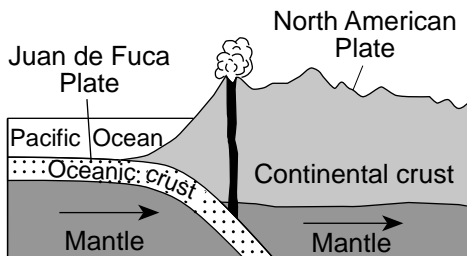
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(1)



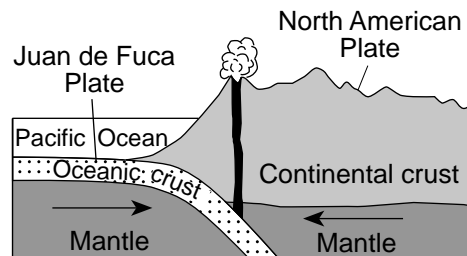
(Not drawn to scale)

(3)



(Not drawn to scale)

(2)



(Not drawn to scale)

(4)

49 Compared to the crust of the North American Plate, the crust of the Juan de Fuca Plate is

- (1) thicker and less dense
- (2) thicker and more dense
- (3) thinner and less dense
- (4) thinner and more dense

50 The boundary between the asthenosphere and the stiffer mantle is located below the Earth's surface at a depth of approximately

- (1) 100 km
- (2) 700 km
- (3) 2500 km
- (4) 3000 km

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 passage below, the cross section in your answer booklet, and on your knowledge of Earth science. The passage describes the discovery of ocean floor magnetism. The cross section represents a pattern of normal and reverse polarity of the magnetic field preserved in the igneous bedrock of the oceanic crust west of the Mid-Atlantic Ridge. The magnetic polarity pattern of the bedrock on the east side of the ridge has been left blank.

Ocean Floor Magnetism

Scientists in the early 1960s were surprised to find there was a pattern in the ocean floor magnetism preserved in the bedrock of the Atlantic Ocean floor. They found that the magnetism in the bedrock was arranged in an orderly pattern parallel to the Mid-Atlantic Ridge. This mountain ridge, often marked by earthquakes and volcanic eruptions, runs roughly north-south. Earth is currently in a period of normal polarity. However, the magnetic record preserved in the rocks indicates that Earth's magnetic poles have reversed positions many times in the past. Since the initial discovery of this ocean floor magnetism, similar magnetic patterns have also been found parallel to the mid-ocean ridges in all of the other oceans.

- 51 Complete the diagram *in your answer booklet* by shading in the pattern of normal polarity on the east side of the Mid-Atlantic Ridge center. Assume that the rate of plate movement was constant on both sides of the ridge center. Your answer must show the correct width and placement of each normal polarity section. [1]
- 52 Identify the type of tectonic plate boundary at the mid-ocean ridges where these magnetic patterns were produced. [1]
- 53 On the set of axes *in your answer booklet*, draw a line to represent the relationship between the distance from the Mid-Atlantic Ridge and the age of the ocean floor bedrock. [1]
-

Base your answers to questions 54 through 56 on the photograph below and on your knowledge of Earth science. The photograph is of a rock sample composed of pebbles that have been cemented together.



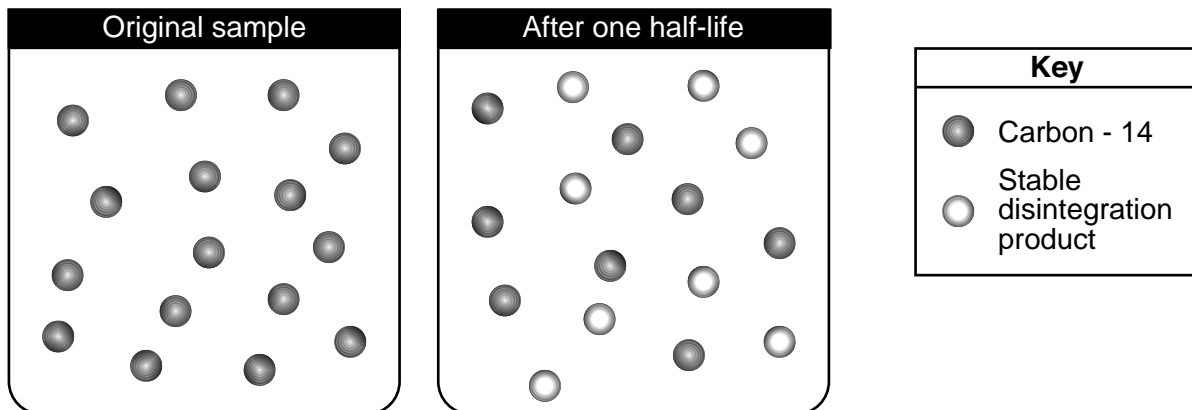
www.geolsoc.org.uk

54 Identify the name of the sedimentary rock. [1]

55 Identify the total possible range of particle diameters, in centimeters, for a particle to be classified as a pebble. [1]

56 Describe the evidence from the photograph that supports the inference that the particles in this rock were most likely transported by running water. [1]

Base your answers to questions 57 through 59 on the diagrams below and on your knowledge of Earth science. The diagrams represent a model of the disintegration of a sample of the radioactive isotope carbon-14 (^{14}C).

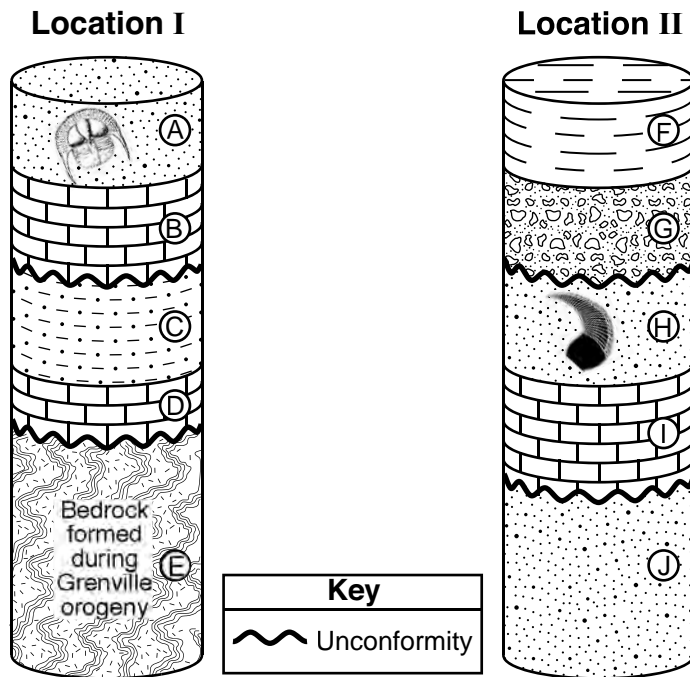


57 Determine the number of carbon-14 atoms that would most likely remain at the end of the second half-life. [1]

58 Identify the stable disintegration product that is produced when carbon-14 decays. [1]

59 Identify the radioactive isotope that has a half-life that is approximately the same as the estimated age of Earth, by using the Radioactive Decay Data table in the *Earth Science Reference Tables*. [1]

Base your answers to questions 60 through 62 on the diagrams below and on your knowledge of Earth science. The diagrams represent drill core samples from two different locations (I and II). A drill core is a cylinder of rock material removed from the bedrock. Letters A through J represent different rock layers. Some layers contain index fossils. The rock layers shown have *not* been overturned.

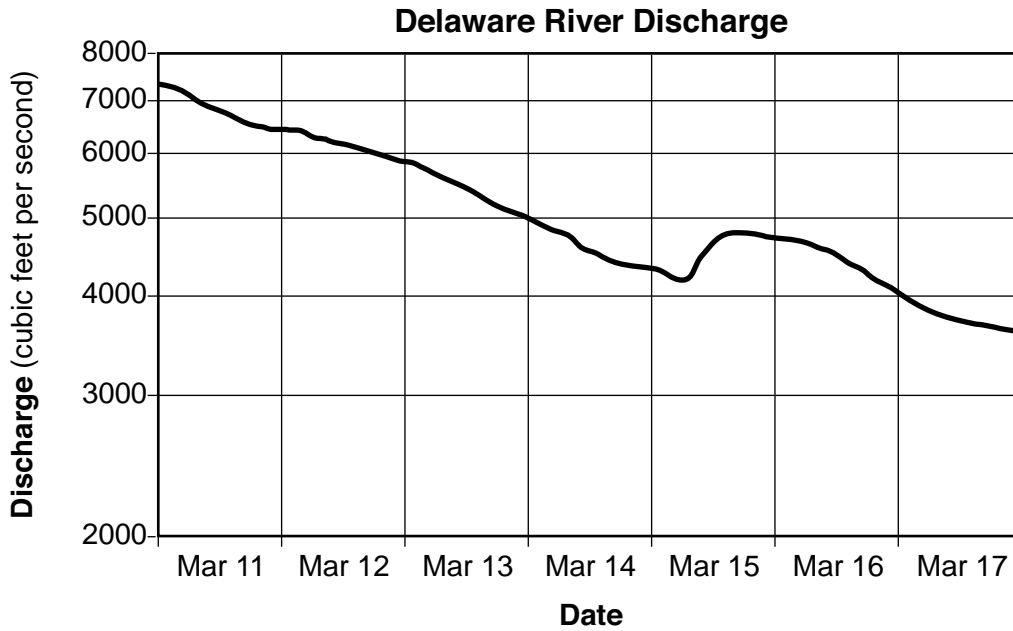


60 Identify the geologic period when rock layer A was deposited. [1]

61 List the relative ages of rock layers D, E, F, and G by listing the letters from oldest to youngest. [1]

62 Identify *two* processes that formed the unconformities in these drill cores. [1]

Base your answers to questions 63 through 65 on the graph below and on your knowledge of Earth science. The graph shows the discharge of the Delaware River at Barryville, New York, for a one-week period during March 2004.



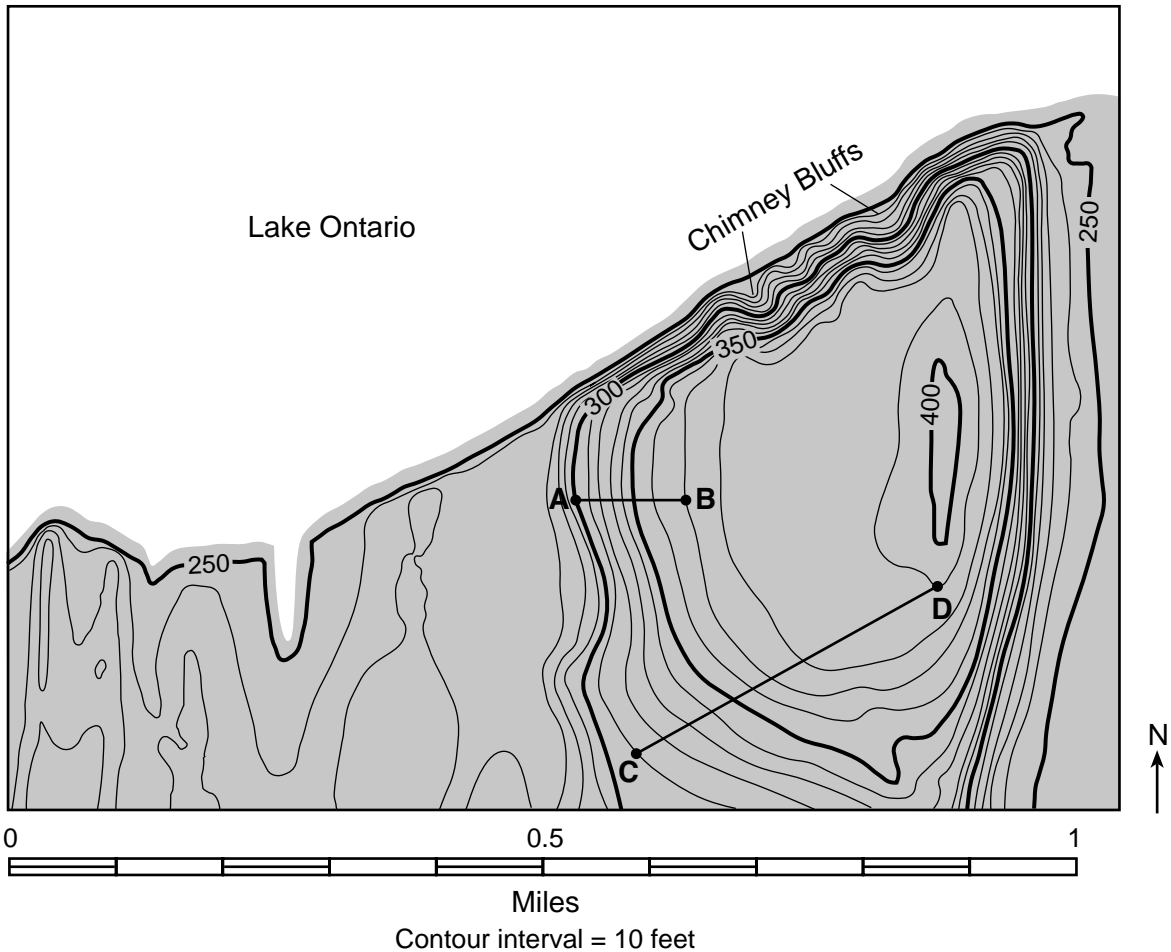
- 63 Identify the date shown on the graph when the river was most likely carrying the greatest amount of sediment. [1]
- 64 State *one* possible cause for the increase in stream discharge on March 15. [1]
- 65 The Delaware River flows out of the Catskills and into the Atlantic Ocean. Identify the general compass direction toward which the Delaware River flows along the Pennsylvania–New York State border. [1]
-

Part C

Answer all questions in this part.

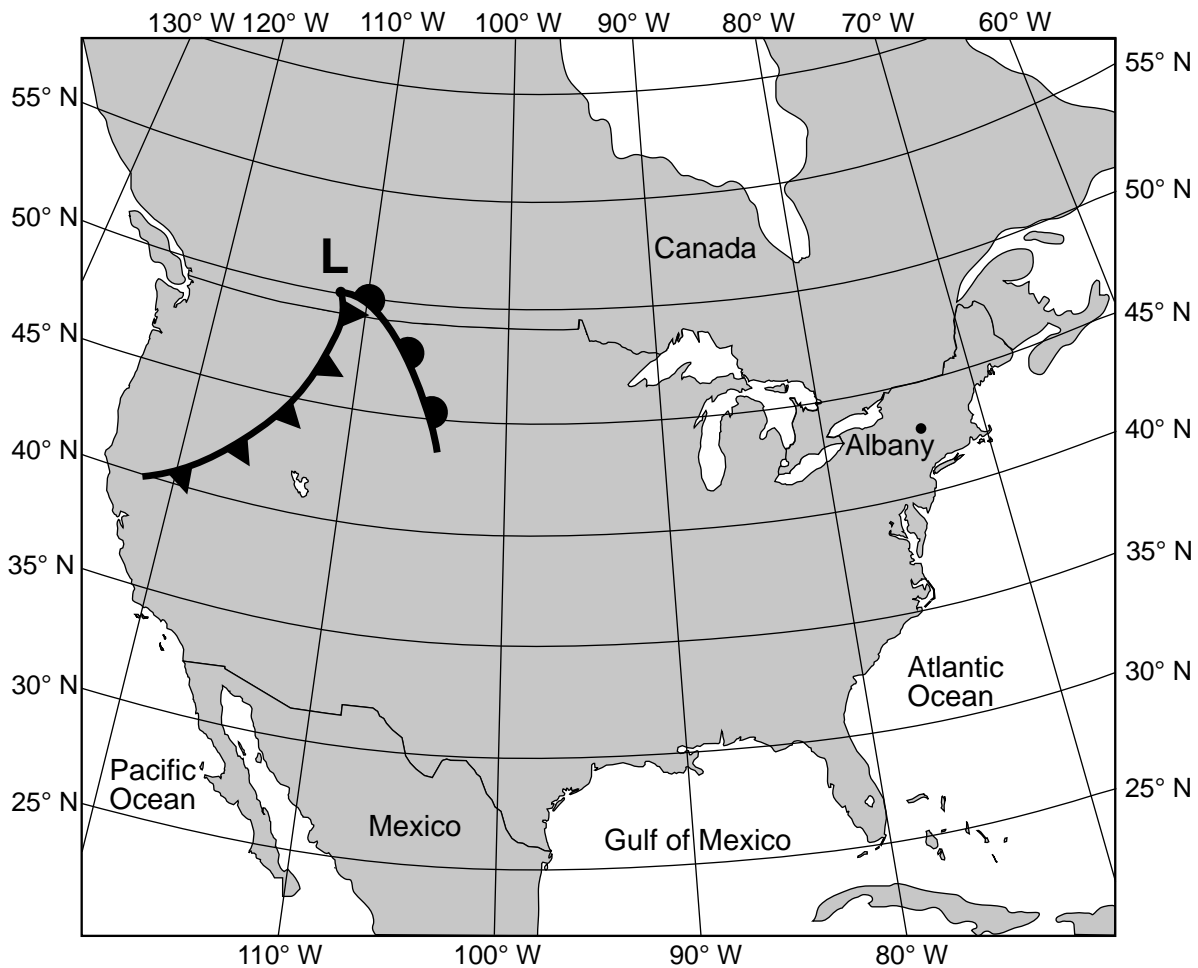
Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 66 through 68 on the topographic map below and on your knowledge of Earth science. The map shows an eroded drumlin at Chimney Bluffs State Park along the shoreline of Lake Ontario east of Rochester, New York. Lines *AB* and *CD* are reference lines. Elevations are shown in feet.

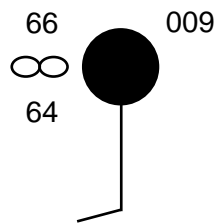


- 66 Calculate the gradient along the line between points *A* and *B* in feet per mile. [1]
- 67 On the grid in your answer booklet, construct a topographic profile along line *CD* by plotting the elevation of each contour line that crosses line *CD*. The elevations for points *C* and *D* have been plotted on the grid. Connect *all nine* plots with a line from point *C* to point *D* to complete the profile. [1]
- 68 Describe *one* piece of evidence represented by the contour lines on the map that indicates the north side of Chimney Bluffs is steep. [1]
-

Base your answers to questions 69 through 71 on the weather map below and on your knowledge of Earth science. The map shows the center of a low-pressure system (L). The location for Albany, New York, is shown.



69 The station model below represents the weather conditions for Albany, New York.



Complete the table *in your answer booklet* by indicating the weather conditions represented on the station model for Albany, New York. [1]

70 Write the standard two-letter air-mass symbol to identify the air mass that normally forms over the Gulf of Mexico. [1]

71 Identify *one* process that causes clouds to form in the moist air rising along the frontal boundaries of the low-pressure system. [1]

Base your answers to questions 72 through 74 on the passage and data table below and on your knowledge of Earth science. The data table shows the monthly average high air temperatures, in degrees Fahrenheit (°F), and monthly average snowfall, in inches (in), at the summit (top) of Mount Washington in New Hampshire.

Mount Washington

Mount Washington, located in the state of New Hampshire, is one of the highest mountains east of the Mississippi River. This mountain, as well as many mountains across upstate New York and the northeast, has deep-cut glacial valleys formed by continental glaciers approximately 1.7 to 1.8 million years ago. Hurricane-force wind gusts are observed at the summit of Mount Washington on the average of 110 days per year, including a record wind speed of 231 miles per hour. It also receives very high levels of snow, averaging 282 inches (23.5 feet) of snow per year.

Mount Washington Monthly Average High Air Temperatures and Average Snowfall

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|
| Average High Air Temperature (°F) | 14 | 15 | 21 | 30 | 41 | 50 | 54 | 53 | 47 | 36 | 28 | 18 |
| Average Snowfall (in) | 44 | 40 | 45 | 36 | 12 | 1 | Trace | 0.1 | 2 | 18 | 38 | 46 |

- 72 On the grid *in your answer booklet*, construct a line graph by plotting the average high air temperatures for each month listed in the data table. Connect *all twelve* plots with a line. [1]
- 73 Identify the climate factor that best explains why Mount Washington has relatively low air temperatures throughout the year. [1]
- 74 State the name of the geologic epoch when continental glaciers last carved the valleys around Mount Washington and across upstate New York. [1]
-

Base your answers to questions 75 through 78 on the table below and on your knowledge of Earth science. The table shows the velocities, in kilometers per second (km/s), for several galaxies, represented by letters A, B, C, D, and E, that are moving away from Earth. The vast majority of stars and galaxies in the universe are moving away from our solar system. Scientific evidence indicates that the farther away a galaxy is, the faster it is moving away.

| Velocities of Galaxies Moving Away From Earth | |
|--|------------------------|
| Galaxy | Velocity (km/s) |
| A | 61,000 |
| B | 15,000 |
| C | 1200 |
| D | 39,000 |
| E | 22,000 |

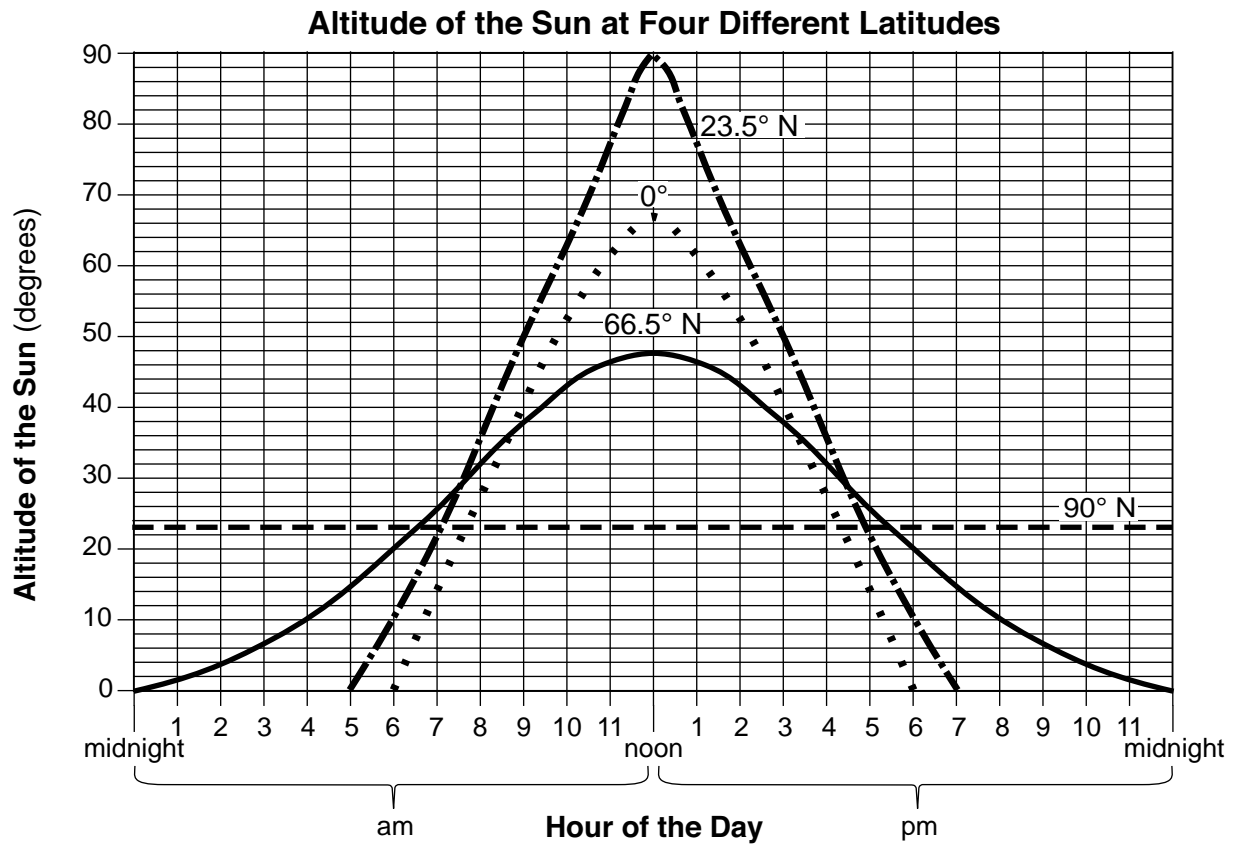
75 List the galaxies in order from closest to Earth to farthest from Earth. [1]

76 Identify the name of the theory for the formation of the universe that scientists developed after observing that most galaxies are moving away from each other. [1]

77 Identify the evidence scientists use to determine that a galaxy is moving away from Earth. [1]

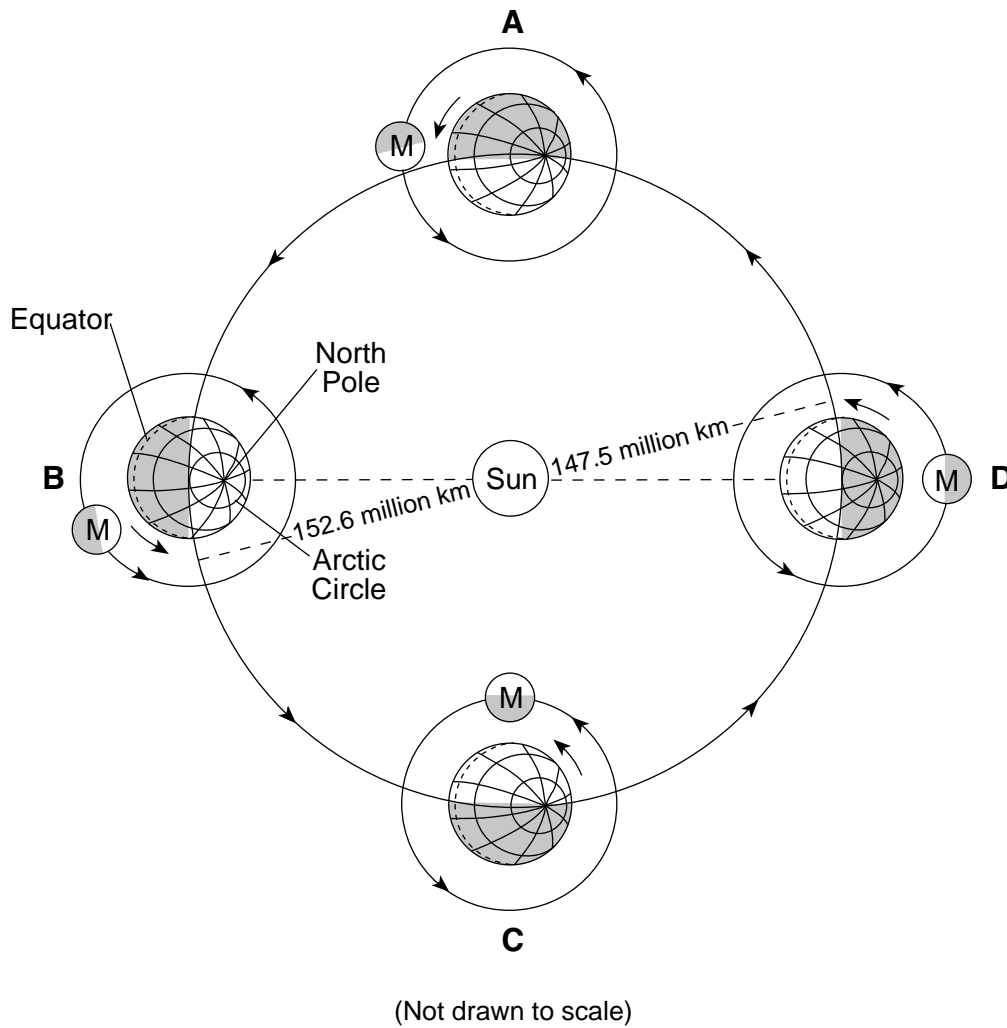
78 A star in one of these galaxies has a surface temperature of 8000 K and a luminosity of 10. Identify the stage and color of this star. [1]

Base your answers to questions 79 through 81 on the graph below and on your knowledge of Earth science. The graph shows the altitude of the Sun for a 24-hour period on a certain day of the year at four different latitudes.



- 79 Identify the date represented by the data shown on the graph. [1]
- 80 Identify the latitude that has the greatest intensity of insolation at approximately noon on this date, and describe the evidence shown on the graph to support your answer. [1]
- 81 Identify the compass direction toward which an observer's shadow would extend if the observer is located exactly at 90° N at noon on this date. [1]

Base your answers to questions 82 through 85 on the diagram below and on your knowledge of Earth science. The diagram represents Earth in its orbit around the Sun and the Moon (M) in different positions in its orbit around Earth. Letters A through D represent four positions of Earth in its orbit. Earth is closest to the Sun near position D and farthest from the Sun near position B.



82 The photograph below shows the surface of the Moon as seen from Earth during the full moon phase.



Identify the lettered position of Earth and the Moon when this full moon phase can be observed, and state the name of the eclipse that could occur at this position. [1]

83 Identify the Northern Hemisphere season that is beginning at position A. [1]

84 Explain why the gravitational attraction between the Sun and Earth increases as Earth moves from position C to position D. [1]

85 Describe *one* piece of evidence shown by the diagram that indicates this is a heliocentric model. [1]

PHYSICAL SETTING EARTH SCIENCE

Wednesday, August 14, 2019 — 8:30 to 11:30 a.m., only

ANSWER BOOKLET

Student

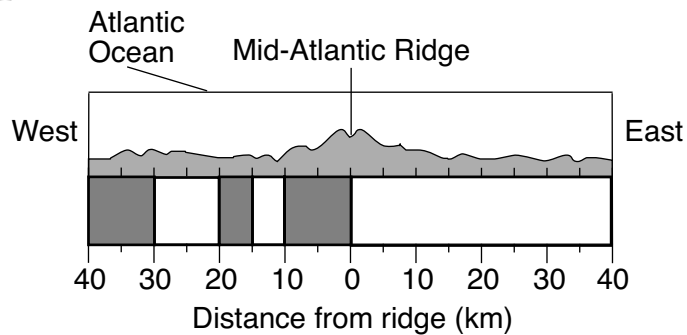
Teacher

School Grade

Record your answers for Part B–2 and Part C in this booklet.

Part B–2

51



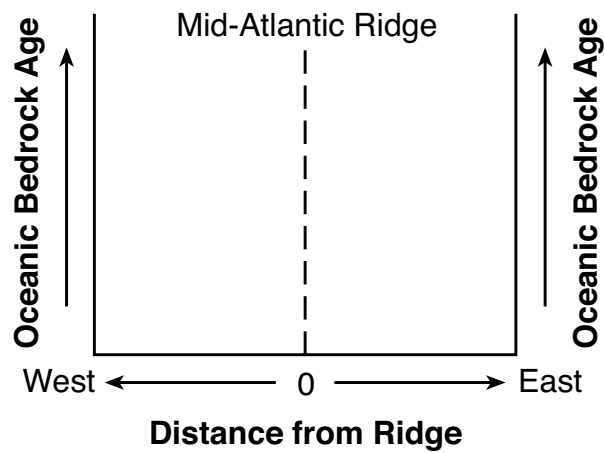
Key to Magnetic Polarity of Bedrock

Reverse polarity

Normal polarity

52 _____ plate boundary

53



54 _____

55 The range is from _____ **cm** to _____ **cm**.

56 _____

57 _____

58 _____

59 _____

60 _____ **Period**

61 _____ → _____ → _____ → _____
Oldest → Youngest

62 Process 1: _____

Process 2: _____

63 _____

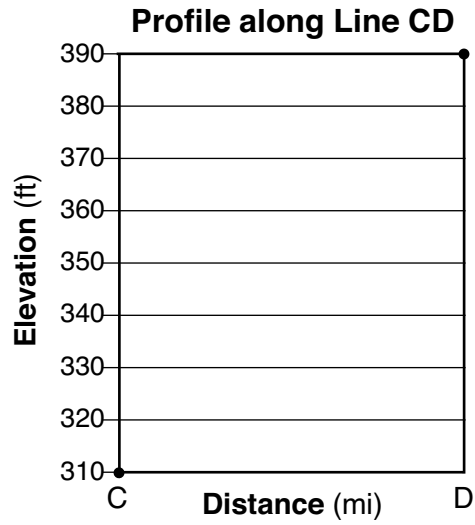
64 _____

65 _____

Part C

66 _____ ft/mile

67



68 _____

69

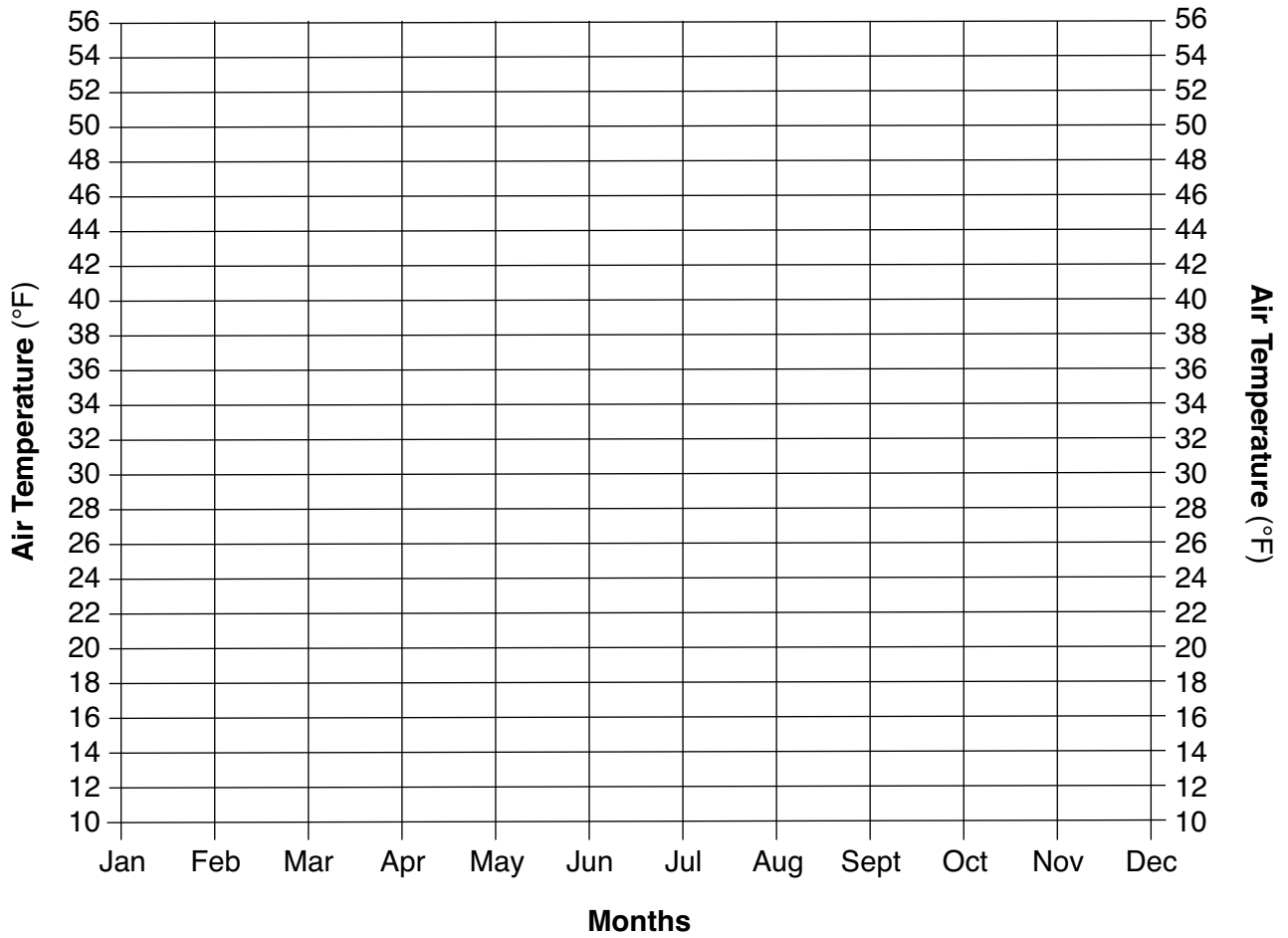
| Weather in Albany, New York | |
|------------------------------------|----|
| Dewpoint | °F |
| Amount of cloud cover | % |
| Barometric pressure | mb |
| Present weather | |

70 _____

71 _____

72

Monthly Average High Air Temperatures



73 _____

74 _____ Epoch

75 Closest to Earth: _____



Farthest from Earth: _____

76 _____

77 _____

78 Stage: _____

Color: _____

79 _____

80 Latitude: _____

Evidence: _____

81 _____

82 Lettered position: _____

Name of eclipse: _____

83 _____

84 _____

85 _____

Regents Examination in Physical Setting/Earth Science – August 2019**Scoring Key: Parts A and B-1 (Multiple-Choice Questions)**

| Examination | Date | Question Number | Scoring Key | Question Type | Credit | Weight |
|--------------------------------|-------------|------------------------|--------------------|----------------------|---------------|---------------|
| Physical Setting/Earth Science | August '19 | 1 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 2 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 3 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 4 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 5 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 6 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 7 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 8 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 9 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 10 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 11 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 12 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 13 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 14 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 15 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 16 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 17 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 18 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 19 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 20 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 21 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 22 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 23 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 24 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 25 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 26 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 27 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 28 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 29 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 30 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 31 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 32 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 33 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 34 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 35 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 36 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 37 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 38 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 39 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 40 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 41 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 42 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 43 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 44 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 45 | 3 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 46 | 1 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 47 | 2 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 48 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 49 | 4 | MC | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 50 | 2 | MC | 1 | 1 |

Regents Examination in Physical Setting/Earth Science – August 2019

Scoring Key: Parts B-2 and C (Constructed-Response Questions)

| Examination | Date | Question Number | Scoring Key | Question Type | Credit | Weight |
|--------------------------------|------------|-----------------|-------------|---------------|--------|--------|
| Physical Setting/Earth Science | August '19 | 51 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 52 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 53 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 54 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 55 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 56 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 57 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 58 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 59 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 60 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 61 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 62 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 63 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 64 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 65 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 66 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 67 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 68 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 69 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 70 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 71 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 72 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 73 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 74 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 75 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 76 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 77 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 78 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 79 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 80 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 81 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 82 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 83 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 84 | | CR | 1 | 1 |
| Physical Setting/Earth Science | August '19 | 85 | | CR | 1 | 1 |

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

The chart for determining students' final examination scores for the **August 2019 Regents Examination in Physical Setting/Earth Science** will be posted on the Department's web site at <http://www.p12.nysed.gov/assessment/> on the day of the examination. 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

PHYSICAL SETTING/EARTH SCIENCE

Wednesday, August 14, 2019 — 8:30 to 11:30 a.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: <http://www.p12.nysed.gov/assessment/> 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 Physical Setting/Earth Science. 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 Part B–2 and Part C 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. The student’s score for the Earth Science Performance Test should be recorded in the space provided. Then the student’s raw scores on the written test and the performance test should be converted to a scale score by using the conversion chart that will be posted on the Department’s web site at: <http://www.p12.nysed.gov/assessment/> on Wednesday, August 14, 2019. 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.

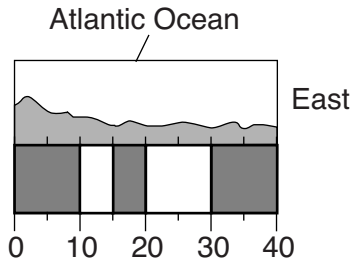
Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student’s final score.

Part B–2

Allow a maximum of 15 credits for this part.

To ensure the accuracy of overlays, select a printer setting such as *full*, *actual size*, or *100%* when printing this document. Do **not** select the *fit to page* setting.

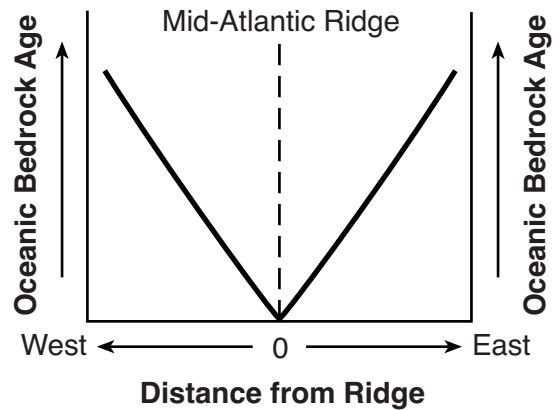
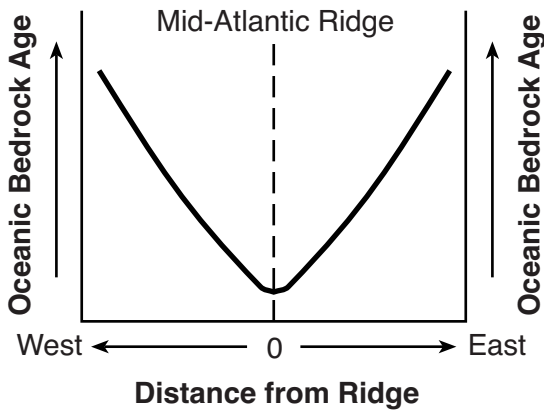
- 51 [1] Allow 1 credit if the width and placement of the shaded areas are correctly indicated, as shown below.



- 52 [1] Allow 1 credit for divergent/diverging.

- 53 [1] Allow 1 credit for a U-shape or V-shape with the youngest age at the Mid-Atlantic Ridge and the oldest ages farthest from the ridge.

Examples of 1-credit responses:



Note: Allow credit even if the oldest ages are *not* exactly at the same “oceanic bedrock age” level.

54 [1] Allow 1 credit for conglomerate.

55 [1] Allow 1 credit for 0.2 cm to 6.4 cm.

56 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- Rounded pebbles usually indicate transportation by running water.
- Sediments tumbling or bouncing in a stream produce the round shapes.
- The particles are smooth and have round shapes.

57 [1] Allow 1 credit for 4 *or* four.

58 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- nitrogen-14
- ^{14}N
- $^{14}\text{C} \rightarrow ^{14}\text{N}$

59 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

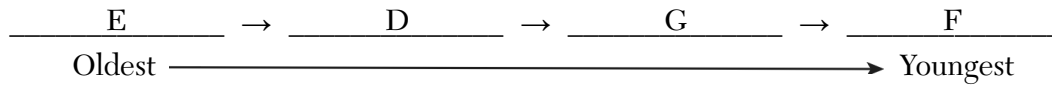
- uranium-238
- ^{238}U

Note: Do *not* accept “uranium” alone because there are different isotopes of uranium.

60 [1] Allow 1 credit for Ordovician Period.

Note: Do *not* accept “Middle Ordovician” because that is an epoch.

61 [1] Allow 1 credit for the correct order shown below.



62 [1] Allow 1 credit for *two* acceptable processes. Acceptable responses include, but are not limited to:

- uplift/emergence
- weathering
- erosion
- submergence/subsidence/sinking
- deposition/sedimentation/precipitation
- burial

63 [1] Allow 1 credit for March 11.

64 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- precipitation
- rain shower
- snowmelt
- increased runoff
- flooding
- increase in the volume of water in the stream

Note: Do *not* allow credit for “velocity of water” or “increase in water velocity” because water velocity is a result of an increase in water volume or discharge.

65 [1] Allow 1 credit for southeast/SE *or* south/S *or* south southeast/SSE.

Part C

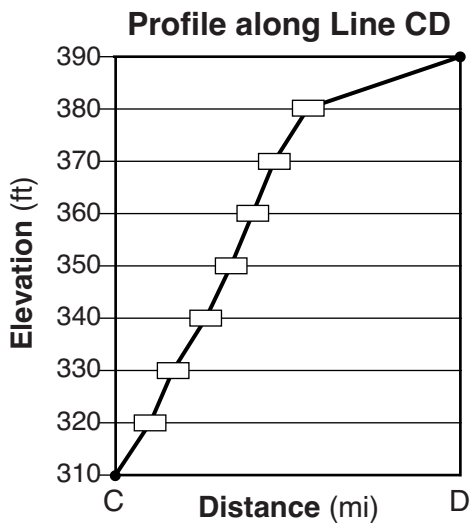
Allow a maximum of 20 credits for this part.

66 [1] Allow 1 credit for any value from 636 to 778 ft/mile.

67 [1] Allow 1 credit if the centers of *all seven* plots are within or touch the rectangles shown below and *all nine* plots are correctly connected with a line, from *C* to *D*, that passes within or touches each rectangle.

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

Allow credit if the line misses a plot, but is still within or touches the rectangle.



68 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The contour lines are close together on the north side of Chimney Bluffs.
- The spacing between the contour lines is small.
- There is a great change in elevation in a short distance on the north side.

69 [1] Allow 1 credit if *all four* weather conditions are correctly recorded as shown below.

| Weather in Albany, New York | |
|-----------------------------|-----------|
| Dewpoint | 64°F |
| Amount of cloud cover | 100% |
| Barometric pressure | 1000.9 mb |
| Present weather | Haze |

70 [1] Allow 1 credit for mT. Allow credit for either uppercase or lowercase letters.

Note: Do *not* allow credit if air-mass letters are reversed, such as Tm. For students who used the Spanish edition, either exclusively or in conjunction with the English edition of the exam, allow credit for the correct two-letter air-mass symbol as it appears in either the English or Spanish *2011 Edition Reference Tables for Physical Setting/Earth Science*.

71 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

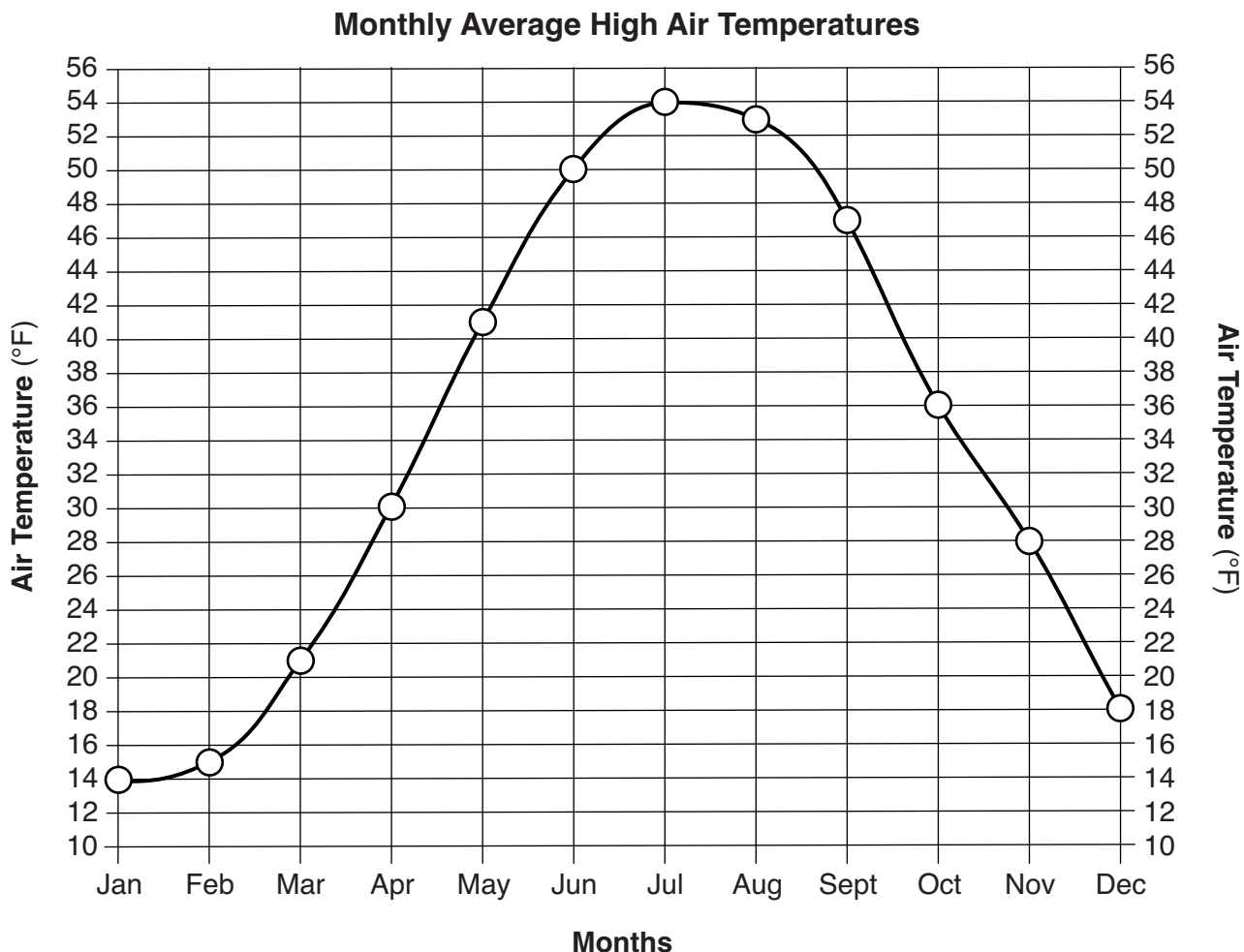
- condensation
- cooling
- expansion
- deposition/phase change directly from water vapor to ice

- 72 [1] Allow 1 credit if the centers of *all twelve* plots are within or touch the circles shown below and are correctly connected with a line that passes within or touches each circle.

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

Allow credit if the student-drawn line does not pass through the student plot points but is still within or touches the circles.

Do *not* allow credit if the student makes any attempt to graph average snowfall on the Monthly Average High Temperatures graph because the vertical axis is in degrees Fahrenheit, not inches.



- 73 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- elevation
- height above sea level
- high altitude

Note: Do *not* allow credit for “mountain” or “top of a mountain” because this identifies the location from which the data were taken but does not identify the climate factor affecting this mountain that causes low air temperatures.

- 74 [1] Allow 1 credit for Pleistocene Epoch.

75 [1] Allow 1 credit for a correct list as shown below.

Closest to Earth: C



 B

 E

 D

Farthest from Earth: A

Note: Allow credit if the correct velocities are substituted for the letters.

76 [1] Allow 1 credit for the Big Bang theory *or* the Big Bang.

77 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The Doppler effect shows a red shift in light.
- Spectral lines are shifted toward the red end of the spectrum.
- Wavelengths of the light from the galaxies appear to be longer.
- Doppler effect
- red shift

Note: Do *not* allow credit for “cosmic background radiation” because, even though this is evidence for the Big Bang event, it is not used to determine that a galaxy is moving away from Earth.

78 [1] Allow 1 credit if *both* responses are acceptable.

Stage: main sequence *or* early stage

Color: white

- 79** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- June 20
 - June 21
 - June 22
 - summer solstice
- 80** [1] Allow 1 credit for 23.5° N *or* Tropic of Cancer and acceptable evidence. Acceptable evidence includes, but is not limited to:
- The graph shows the altitude of the Sun is greatest at 23.5° N.
 - Sun is highest in the sky.
 - The Sun's altitude is 90° .
 - The Sun is directly overhead.
- 81** [1] Allow 1 credit for south.
- 82** [1] Allow 1 credit for lettered position *D* and lunar eclipse.
- 83** [1] Allow 1 credit for spring.
- 84** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Earth is getting closer to the Sun.
 - The distance between Earth and the Sun is decreasing.
 - Earth's orbit is elliptical, and position *D* is closer to the Sun.
- 85** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- The Sun is near the center of the diagram.
 - Earth orbits the Sun.
 - The small arrows by Earth indicate that Earth rotates.

Regents Examination in Physical Setting/Earth Science

August 2019

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

The *Chart for Determining the Final Examination Score for the August 2019 Regents Examination in Physical Setting/Earth Science* will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on Wednesday, August 14, 2019. Conversion charts provided for previous administrations of the Regents Examination in Physical Setting/Earth Science must NOT be used to determine students' final scores for this administration.

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 <http://www.forms2.nysed.gov/emsc/osa/exameval/reexameval.cfm>.
2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the **SUBMIT** button at the bottom of the page to submit the completed form.

Map to Core Curriculum

| August 2019 Physical Setting/Earth Science | | | |
|---|--|--|--|
| Question Numbers | | | |
| Key Ideas/Performance Indicators | Part A | Part B | Part C |
| Standard 1 | | | |
| Math Key Idea 1 | | 46, 53, 57 | 66, 67, 72, 84 |
| Math Key Idea 2 | 14 | 42, 43 | 66, 68, 79, 80 |
| Math Key Idea 3 | | | |
| Science Inquiry Key Idea 1 | 8, 10, 12, 21 | 39, 61, 62 | 71, 72, 73, 76, 77, 81 |
| Science Inquiry Key Idea 2 | 2 | | |
| Science Inquiry Key Idea 3 | 1, 3, 4, 5, 14, 18, 20, 21, 22, 23, 24, 25, 28, 33, 34, 35 | 36, 40, 41, 42, 43, 44, 47, 48, 49, 50, 52, 54, 55, 58, 59, 60, 64, 65 | 66, 69, 70, 71, 74, 78 |
| Engineering Design Key Idea 1 | | | |
| Standard 2 | | | |
| Key Idea 1 | | | |
| Key Idea 2 | | | |
| Key Idea 3 | | | |
| Standard 6 | | | |
| Key Idea 1 | 10, 30 | 38 | |
| Key Idea 2 | 7, 9, 15, 17, 20, 25, 26, 27, 28, 29, 30 | 36, 37, 39, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 60, 61, 62, 63, 64 | 67, 69, 70, 75, 80, 82, 83, 84, 85 |
| Key Idea 3 | | | |
| Key Idea 4 | | | |
| Key Idea 5 | 2, 5, 23 | 36, 51, 61 | 71, 83 |
| Key Idea 6 | | | |
| Standard 7 | | | |
| Key Idea 1 | | | |
| Key Idea 2 | | | |
| Standard 4 | | | |
| Key Idea 1 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 21, 22, 23, 26, 27 | 36, 37, 38, 39, 45, 46, 57, 58, 59, 60, 61, 62 | 74, 75, 76, 77, 78, 79, 81, 82, 83, 84, 85 |
| Key Idea 2 | 13, 14, 16, 17, 18, 19, 20, 24, 25, 28, 29, 30, 31, 32 | 42, 43, 44, 47, 48, 49, 50, 51, 52, 53, 55, 56, 63, 64, 65 | 66, 67, 68, 69, 70, 71, 72, 73, 80 |
| Key Idea 3 | 15, 33, 34, 35 | 40, 41, 54 | |
| Reference Tables | | | |
| ESRT 2011 Edition (Revised) | 1, 3, 4, 14, 18, 20, 21, 22, 23, 24, 25, 28, 33, 34, 35 | 36, 40, 41, 42, 43, 44, 47, 48, 49, 50, 52, 54, 55, 58, 59, 60, 64, 65 | 66, 69, 70, 71, 74, 78 |

The State Education Department / The University of the State of New York
Regents Examination in Physical Setting/Earth Science – August 2019
Chart for Converting Total Test Raw Scores to Final Examination Scores (Scale Scores)
(Not to be used for the Braille Edition)

To determine the student's final score, locate the student's Total Performance Test Score across the top of the chart and the Total Written Test Score down the side of the chart. The point where the two scores intersect is the student's final examination score. For example, a student receiving a Total Performance Test Score of 10 and Total Written Test Score of 66 would receive a final examination score of 85.

| | | Total Performance Test Score | | | | | | | | | | | | | | | | |
|---------------------------------|-----------|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Total Written Test Score | 85 | 100 | 99 | 99 | 99 | 98 | 98 | 97 | 96 | 96 | 95 | 94 | 93 | 91 | 90 | 88 | 87 | 85 |
| | 84 | 99 | 99 | 98 | 98 | 98 | 97 | 96 | 96 | 95 | 94 | 93 | 92 | 91 | 89 | 88 | 86 | 84 |
| | 83 | 99 | 99 | 98 | 98 | 98 | 97 | 96 | 96 | 95 | 94 | 93 | 92 | 91 | 89 | 88 | 86 | 84 |
| | 82 | 98 | 98 | 98 | 97 | 97 | 96 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 87 | 85 | 83 |
| | 81 | 97 | 97 | 97 | 96 | 96 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 88 | 86 | 84 | 82 |
| | 80 | 97 | 97 | 97 | 96 | 96 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 88 | 86 | 84 | 82 |
| | 79 | 97 | 96 | 96 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 90 | 89 | 88 | 87 | 85 | 83 | 82 |
| | 78 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 91 | 89 | 88 | 87 | 86 | 84 | 83 | 81 |
| | 77 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 92 | 91 | 91 | 89 | 88 | 87 | 86 | 84 | 83 | 81 |
| | 76 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 91 | 91 | 90 | 89 | 88 | 86 | 85 | 83 | 82 | 80 |
| | 75 | 94 | 94 | 93 | 93 | 92 | 92 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 84 | 83 | 81 | 79 |
| | 74 | 93 | 93 | 92 | 92 | 92 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 85 | 83 | 82 | 80 | 78 |
| | 73 | 93 | 93 | 92 | 92 | 92 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 85 | 83 | 82 | 80 | 78 |
| | 72 | 92 | 92 | 92 | 91 | 91 | 90 | 90 | 89 | 88 | 87 | 86 | 85 | 84 | 82 | 81 | 79 | 77 |
| | 71 | 92 | 91 | 91 | 90 | 90 | 89 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 80 | 78 | 77 |
| | 70 | 91 | 90 | 90 | 89 | 89 | 88 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 79 | 77 | 76 |
| | 69 | 91 | 90 | 90 | 89 | 89 | 88 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 79 | 77 | 76 |
| | 68 | 90 | 90 | 89 | 89 | 88 | 88 | 87 | 86 | 85 | 85 | 84 | 82 | 81 | 80 | 78 | 77 | 75 |
| | 67 | 89 | 89 | 88 | 88 | 87 | 87 | 86 | 85 | 85 | 84 | 83 | 82 | 80 | 79 | 77 | 76 | 74 |
| | 66 | 88 | 88 | 87 | 87 | 86 | 86 | 85 | 85 | 84 | 83 | 82 | 81 | 80 | 78 | 77 | 75 | 73 |
| 65 | 87 | 87 | 87 | 86 | 86 | 85 | 84 | 84 | 83 | 82 | 81 | 80 | 79 | 77 | 76 | 74 | 72 | |
| 64 | 86 | 86 | 86 | 85 | 85 | 84 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 75 | 73 | 71 | |
| 63 | 86 | 86 | 86 | 85 | 85 | 84 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 75 | 73 | 71 | |
| 62 | 86 | 85 | 85 | 84 | 84 | 83 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 74 | 72 | 71 | |
| 61 | 85 | 84 | 84 | 84 | 83 | 82 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 73 | 72 | 70 | |
| 60 | 84 | 84 | 83 | 83 | 82 | 82 | 81 | 80 | 80 | 79 | 78 | 77 | 75 | 74 | 72 | 71 | 69 | |
| 59 | 83 | 83 | 82 | 82 | 81 | 81 | 80 | 79 | 79 | 78 | 77 | 76 | 74 | 73 | 71 | 70 | 68 | |
| 58 | 82 | 82 | 81 | 81 | 81 | 80 | 79 | 79 | 78 | 77 | 76 | 75 | 74 | 72 | 71 | 69 | 67 | |
| 57 | 81 | 81 | 81 | 80 | 80 | 79 | 78 | 78 | 77 | 76 | 75 | 74 | 73 | 71 | 70 | 68 | 66 | |
| 56 | 80 | 80 | 80 | 79 | 79 | 78 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 69 | 67 | 65 | |
| 55 | 80 | 79 | 79 | 78 | 78 | 77 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 68 | 66 | 65 | |
| 54 | 79 | 78 | 78 | 78 | 77 | 77 | 76 | 75 | 74 | 74 | 72 | 71 | 70 | 69 | 67 | 66 | 64 | |
| 53 | 78 | 78 | 77 | 77 | 76 | 76 | 75 | 74 | 74 | 73 | 72 | 71 | 69 | 68 | 66 | 65 | 63 | |
| 52 | 77 | 77 | 76 | 76 | 75 | 75 | 74 | 73 | 73 | 72 | 71 | 70 | 69 | 67 | 66 | 64 | 62 | |
| 51 | 76 | 76 | 75 | 75 | 75 | 74 | 73 | 73 | 72 | 71 | 70 | 69 | 68 | 66 | 65 | 63 | 61 | |
| 50 | 75 | 75 | 75 | 74 | 74 | 73 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 65 | 64 | 62 | 60 | |
| 49 | 75 | 74 | 74 | 73 | 73 | 72 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 63 | 61 | 60 | |
| 48 | 74 | 73 | 73 | 72 | 72 | 71 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 62 | 60 | 59 | |
| 47 | 73 | 73 | 72 | 72 | 71 | 71 | 70 | 69 | 68 | 68 | 67 | 65 | 64 | 63 | 61 | 60 | 58 | |
| 46 | 72 | 72 | 71 | 71 | 70 | 70 | 69 | 68 | 68 | 67 | 66 | 65 | 63 | 62 | 60 | 59 | 57 | |
| 45 | 71 | 71 | 70 | 70 | 69 | 69 | 68 | 68 | 67 | 66 | 65 | 64 | 63 | 61 | 60 | 58 | 56 | |

**Final Examination Scores
 Regents Examination in Physical Setting/Earth Science – August 2019 – continued**

| | | Total Performance Test Score | | | | | | | | | | | | | | | | |
|---------------------------------|-----------|------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Total Written Test Score | 44 | 70 | 70 | 70 | 69 | 69 | 68 | 67 | 67 | 66 | 65 | 64 | 63 | 62 | 60 | 59 | 57 | 55 |
| | 43 | 69 | 69 | 69 | 68 | 68 | 67 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 58 | 56 | 54 |
| | 42 | 69 | 68 | 68 | 67 | 67 | 66 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 57 | 55 | 54 |
| | 41 | 68 | 67 | 67 | 67 | 66 | 65 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 56 | 55 | 53 |
| | 40 | 67 | 67 | 66 | 66 | 65 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 58 | 57 | 55 | 54 | 52 |
| | 39 | 65 | 65 | 64 | 64 | 64 | 63 | 62 | 62 | 61 | 60 | 59 | 58 | 57 | 55 | 54 | 52 | 50 |
| | 38 | 64 | 64 | 64 | 63 | 63 | 62 | 61 | 61 | 60 | 59 | 58 | 57 | 56 | 54 | 53 | 51 | 49 |
| | 37 | 63 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 52 | 50 | 48 |
| | 36 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 51 | 49 | 48 |
| | 35 | 62 | 61 | 61 | 61 | 60 | 60 | 59 | 58 | 57 | 57 | 55 | 54 | 53 | 52 | 50 | 49 | 47 |
| | 34 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 56 | 56 | 55 | 54 | 53 | 52 | 50 | 49 | 47 | 45 |
| | 33 | 59 | 59 | 58 | 58 | 58 | 57 | 56 | 56 | 55 | 54 | 53 | 52 | 51 | 49 | 48 | 46 | 44 |
| | 32 | 58 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 48 | 47 | 45 | 43 |
| | 31 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 46 | 44 | 43 |
| | 30 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 52 | 51 | 51 | 50 | 48 | 47 | 46 | 44 | 43 | 41 |
| | 29 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 51 | 51 | 50 | 49 | 48 | 46 | 45 | 43 | 42 | 40 |
| | 28 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 49 | 48 | 47 | 46 | 44 | 43 | 41 | 39 |
| | 27 | 52 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 41 | 39 | 37 |
| | 26 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 40 | 38 | 37 |
| | 25 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 46 | 46 | 45 | 44 | 43 | 41 | 40 | 38 | 37 | 35 |
| | 24 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 45 | 45 | 44 | 43 | 42 | 40 | 39 | 37 | 36 | 34 |
| 23 | 47 | 47 | 47 | 46 | 46 | 45 | 44 | 44 | 43 | 42 | 41 | 40 | 39 | 37 | 36 | 34 | 32 | |
| 22 | 46 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 35 | 33 | 31 | |
| 21 | 45 | 44 | 44 | 44 | 43 | 43 | 42 | 41 | 40 | 40 | 38 | 37 | 36 | 35 | 33 | 32 | 30 | |
| 20 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 40 | 40 | 39 | 38 | 37 | 35 | 34 | 32 | 31 | 29 | |
| 19 | 42 | 42 | 41 | 41 | 41 | 40 | 39 | 39 | 38 | 37 | 36 | 35 | 34 | 32 | 31 | 29 | 27 | |
| 18 | 41 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 31 | 30 | 28 | 26 | |
| 17 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 28 | 26 | 25 | |
| 16 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 35 | 34 | 34 | 33 | 31 | 30 | 29 | 27 | 26 | 24 | |
| 15 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 32 | 31 | 30 | 29 | 27 | 26 | 24 | 22 | |
| 14 | 36 | 36 | 36 | 35 | 35 | 34 | 33 | 33 | 32 | 31 | 30 | 29 | 28 | 26 | 25 | 23 | 21 | |
| 13 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 23 | 21 | 20 | |
| 12 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 29 | 29 | 28 | 27 | 26 | 24 | 23 | 21 | 20 | 18 | |
| 11 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 28 | 28 | 27 | 26 | 25 | 23 | 22 | 20 | 19 | 17 | |
| 10 | 30 | 30 | 30 | 29 | 29 | 28 | 27 | 27 | 26 | 25 | 24 | 23 | 22 | 20 | 19 | 17 | 15 | |
| 9 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 17 | 15 | 14 | |
| 8 | 28 | 27 | 27 | 27 | 26 | 26 | 25 | 24 | 23 | 23 | 21 | 20 | 19 | 18 | 16 | 15 | 13 | |
| 7 | 26 | 26 | 25 | 25 | 24 | 24 | 23 | 22 | 22 | 21 | 20 | 19 | 18 | 16 | 15 | 13 | 11 | |
| 6 | 24 | 24 | 24 | 23 | 23 | 22 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 14 | 13 | 11 | 9 | |
| 5 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 11 | 9 | 8 | |
| 4 | 21 | 21 | 20 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 15 | 14 | 12 | 11 | 9 | 8 | 6 | |
| 3 | 20 | 20 | 19 | 19 | 18 | 18 | 17 | 17 | 16 | 15 | 14 | 13 | 12 | 10 | 9 | 7 | 5 | |
| 2 | 18 | 18 | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 7 | 5 | 3 | |
| 1 | 17 | 16 | 16 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 5 | 4 | 2 | |
| 0 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 9 | 8 | 6 | 5 | 3 | 2 | 0 | |