

PHYSICAL SETTING EARTH SCIENCE

Thursday, January 25, 2018 — 9:15 a.m. to 12:15 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 deflection of Earth's planetary winds is an example of

- (1) the Coriolis effect
- (2) the Doppler effect
- (3) convection
- (4) gravitational pull

2 The universe is approximately 13.8 billion years old. Compared to the age of the solar system, the age of the universe is approximately

- (1) the same age as the solar system
- (2) two times older than the solar system
- (3) three times older than the solar system
- (4) four times older than the solar system

3 Planets that are closest to the Sun are identified as

- (1) low-density Jovian
- (2) low-density terrestrial
- (3) high-density Jovian
- (4) high-density terrestrial

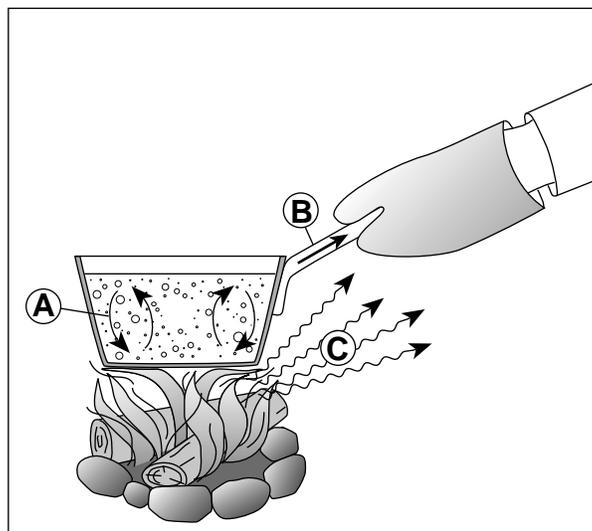
4 Which process of the water cycle occurs when water absorbs 2260 Joules of heat energy per gram?

- (1) melting of ice
- (2) condensation of water vapor
- (3) evaporation of water
- (4) freezing of water

5 In which temperature zone of Earth's atmosphere is the polar jet stream located?

- (1) lower thermosphere
- (2) lower mesosphere
- (3) upper stratosphere
- (4) upper troposphere

6 Arrows in the diagram below show three methods of energy transfer labeled A, B, and C.



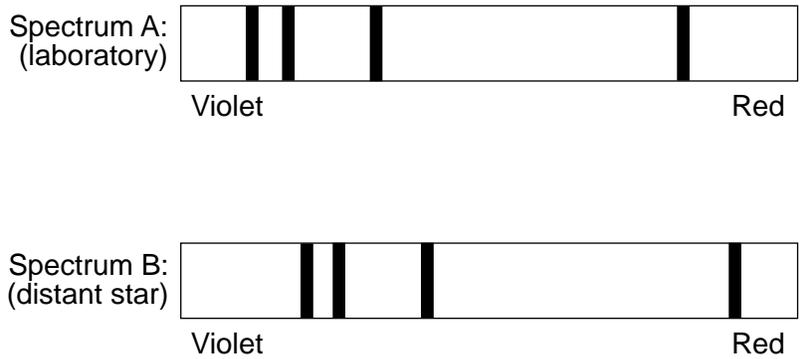
Which list correctly identifies the energy transfer processes A, B, and C?

- | | |
|------------------|------------------|
| (1) A—conduction | (3) A—convection |
| B—convection | B—radiation |
| C—radiation | C—conduction |
| (2) A—convection | (4) A—conduction |
| B—conduction | B—radiation |
| C—radiation | C—convection |

7 What is the relative humidity of the air when the dry-bulb temperature is 4°C and the dewpoint is -4°C ?

- | | |
|---------|---------|
| (1) 42% | (3) 51% |
| (2) 46% | (4) 56% |

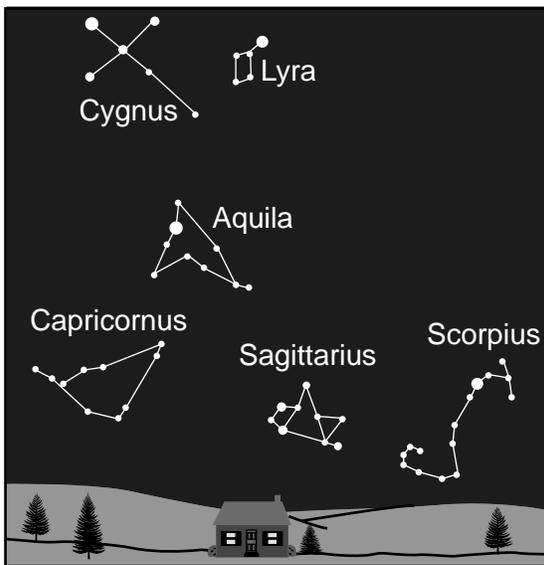
8 The diagram below represents the light spectra given off by the same element as observed under two different conditions. Spectrum A was observed when that element was heated in a laboratory. Spectrum B shows the same element as seen in the light from a distant star.



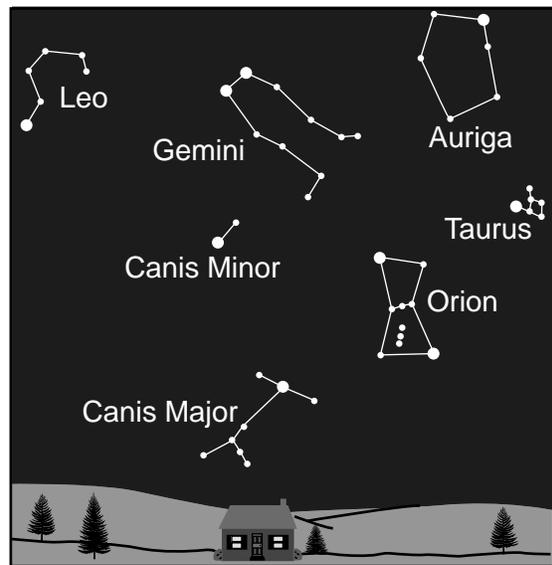
The light spectrum observed from this distant star shows a

- (1) red shift, which indicates that the star is moving away from Earth
- (2) red shift, which indicates that the star is moving toward Earth
- (3) blue shift, which indicates that the star is moving away from Earth
- (4) blue shift, which indicates that the star is moving toward Earth

9 The diagrams below represent the constellations seen by an observer in New York State while looking toward the southern horizon at midnight on July 9 and January 8.



Southern horizon
July 9

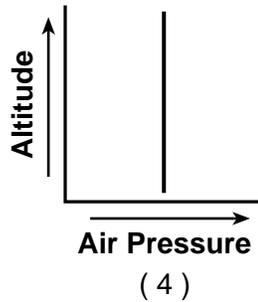
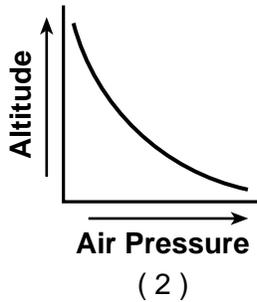
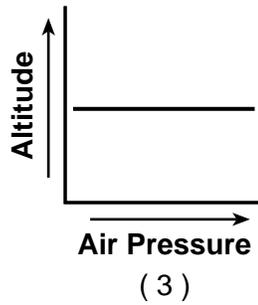
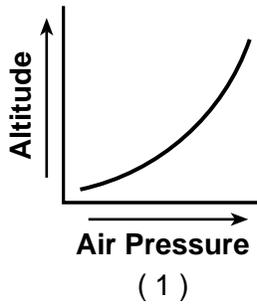


Southern horizon
January 8

Which motion is mainly responsible for the difference in the constellations visible at midnight on these two dates?

- (1) The Sun orbits Earth.
- (2) Earth orbits the Sun.
- (3) The stars in the constellations orbit Earth.
- (4) Earth orbits the stars in the constellations.

10 Which graph best shows the general relationship between air pressure and altitude?



11 Most clouds form in the atmosphere when moist air

- (1) rises, expands, and cools to the dewpoint
- (2) rises, expands, and warms to the dewpoint
- (3) sinks, compresses, and cools to the dewpoint
- (4) sinks, compresses, and warms to the dewpoint

12 Equal areas of which surface would absorb the greatest amount of insolation on a sunny day?

- (1) light-colored, smooth surface
- (2) light-colored, rough surface
- (3) dark-colored, smooth surface
- (4) dark-colored, rough surface

13 Which natural event periodically weakens western surface ocean currents in the equatorial Pacific Ocean, resulting in a change in air temperature and precipitation patterns in the United States?

- (1) El Niño
- (2) transpiration
- (3) ocean tides
- (4) volcanic eruptions

14 Ocean gyres in the Northern Hemisphere consist of a number of surface ocean currents that, together, generally flow clockwise in a roughly circular pattern. Which list contains three warm surface ocean currents that make up most of the North Atlantic Ocean gyre?

- (1) Kuroshio Current, North Pacific Current, and California Current
- (2) Canary Current, North Equatorial Current, and Equatorial Countercurrent
- (3) Labrador Current, North Atlantic Current, and East Greenland Current
- (4) North Equatorial Current, Gulf Stream Current, and North Atlantic Current

15 Most of the oceanic oxygen that began to enter Earth's atmosphere in the early Proterozoic Era was probably produced by

- (1) formation of silicate rocks
- (2) photosynthesis by cyanobacteria
- (3) impact events on Earth's surface
- (4) outgassing from volcanoes

16 During which geologic period did plants and animals first appear in land environments?

- (1) Cambrian
- (2) Ordovician
- (3) Silurian
- (4) Devonian

17 Sedimentary rock layers that were deposited between 488 million and 444 million years ago are found on the surface at which two New York State locations?

- (1) Ithaca and Jamestown
- (2) Utica and Syracuse
- (3) Oswego and Old Forge
- (4) Albany and Massena

18 A volcanic ash layer is a good geologic time marker for correlating rock layers because the ash layer was deposited over a

- (1) limited geographic area over a short time
- (2) limited geographic area over a long time
- (3) wide geographic area over a short time
- (4) wide geographic area over a long time

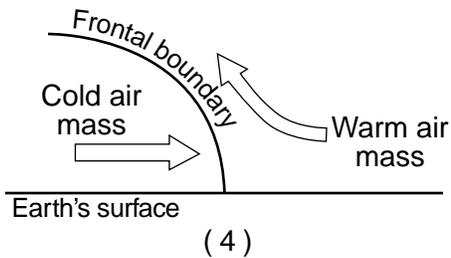
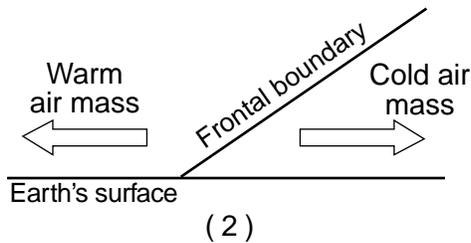
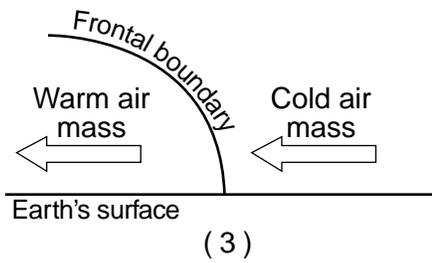
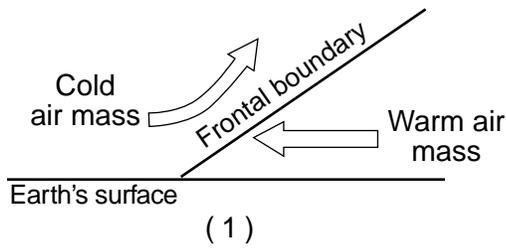
19 The photograph below shows the results of a landslide.



This landslide is an example of

- (1) wind abrasion
- (2) glacial deposition
- (3) wave action
- (4) mass movement

20 Which cross section correctly represents a cold front and the air-mass movements associated with this front?



- 21 Earth's interior at a depth of 3500 kilometers is believed to be
- (1) liquid at a temperature of approximately 4900°C
 - (2) solid at a temperature of approximately 4900°C
 - (3) liquid at a temperature of approximately 5400°C
 - (4) solid at a temperature of approximately 5400°C

- 22 Compared to the density and composition of the oceanic crust, the continental crust is
- (1) less dense and more mafic
 - (2) less dense and more felsic
 - (3) more dense and less mafic
 - (4) more dense and less felsic

- 23 An earthquake occurs at 10:05 a.m. At 10:09 a.m., the first *P*-wave from this earthquake is detected at a seismic station. Approximately how many kilometers (km) from the epicenter is this seismic station located?
- (1) 1000 km
 - (2) 2000 km
 - (3) 2600 km
 - (4) 5600 km

- 24 The aerial photograph below shows two streams that have been displaced by tectonic movement along the San Andreas fault. The arrows show the relative direction of movement along the fault.



This movement occurred along which type of plate boundary?

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

- 25 The magnitude of an earthquake is a number that represents the
- (1) arrival time of the first *P*-wave
 - (2) difference in arrival times between *P*- and *S*-waves
 - (3) distance to the epicenter
 - (4) energy released by an earthquake

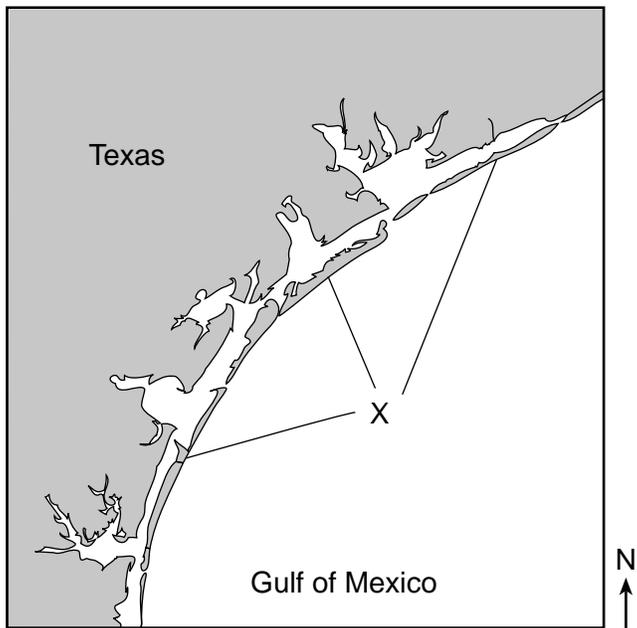
- 26 The Genesee River flows across both the Allegheny Plateau and the Erie-Ontario Lowlands in New York State. This river flows
- (1) northward, in the same general direction as the Hudson River
 - (2) northward, in the same general direction as the Niagara River
 - (3) southward, in the same general direction as the Hudson River
 - (4) southward, in the same general direction as the Niagara River

- 27 What is the name of the largest sediment that can be transported by a stream moving at a velocity of 100 centimeters per second (cm/s)?
- (1) silt
 - (2) sand
 - (3) pebbles
 - (4) cobbles

- 28 Which mineral is commonly used as an abrasive?
- (1) garnet
 - (2) halite
 - (3) sulfur
 - (4) graphite

- 29 If a metamorphic rock bubbles when a drop of acid is placed on its surface, the rock is most likely
- (1) schist
 - (2) slate
 - (3) marble
 - (4) quartzite

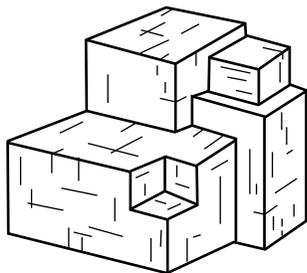
30 The map below shows a portion of the coast of Texas. Letter X indicates features formed by wave action.



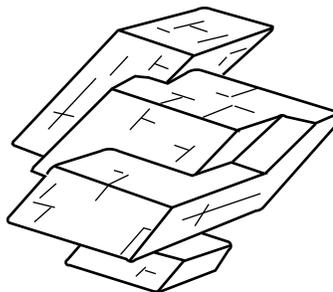
What is the name of the features indicated by letter X?

- (1) barrier islands
- (2) island arc
- (3) deltas
- (4) moraines

31 The diagrams below represent the crystal shape and type of cleavage of two different minerals.



Crystal shape: cubic
Cleavage: three directions
– all at right angles

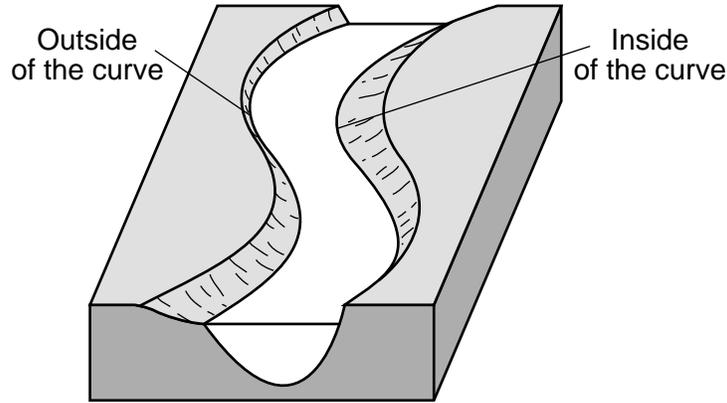


Crystal shape: rhombohedral
Cleavage: three directions
– *not* at right angles

The crystal shape and type of cleavage of these two minerals are determined mainly by the minerals'

- (1) color and type of luster
- (2) streak and hardness
- (3) composition and atomic arrangement
- (4) density and magnetism

32 The block diagram below represents a meandering stream.



Which table indicates where the greatest stream velocity and the greatest rate of stream erosion occur?

Greatest Stream Velocity	Greatest Stream Erosion
outside of the curve	outside of the curve

(1)

Greatest Stream Velocity	Greatest Stream Erosion
inside of the curve	inside of the curve

(3)

Greatest Stream Velocity	Greatest Stream Erosion
outside of the curve	inside of the curve

(2)

Greatest Stream Velocity	Greatest Stream Erosion
inside of the curve	outside of the curve

(4)

33 The diagram below represents the size and shape of a pebble. This pebble and 20 other pebbles having a similar size and shape were placed in a rock tumbler with water and allowed to abrade for five days.



Which diagram best represents the size and shape of this pebble after the five-day period?



(1)



(2)

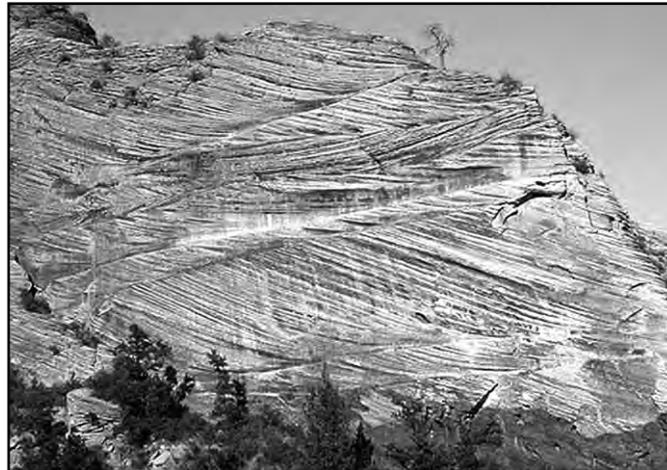


(3)



(4)

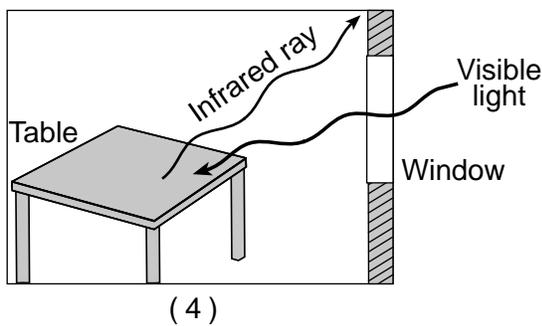
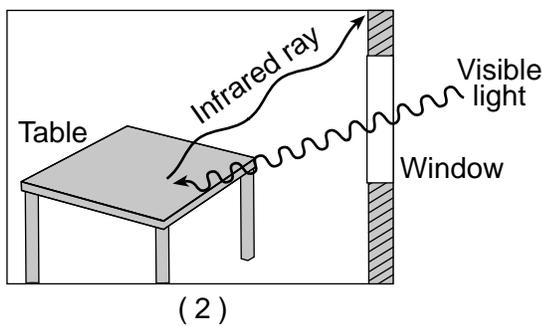
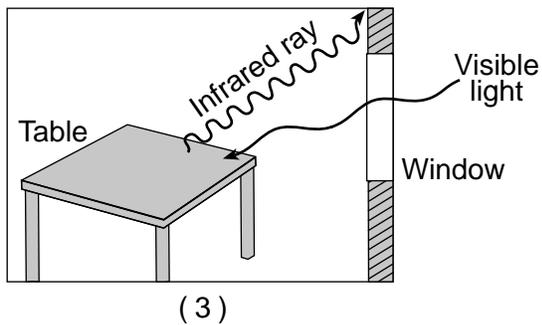
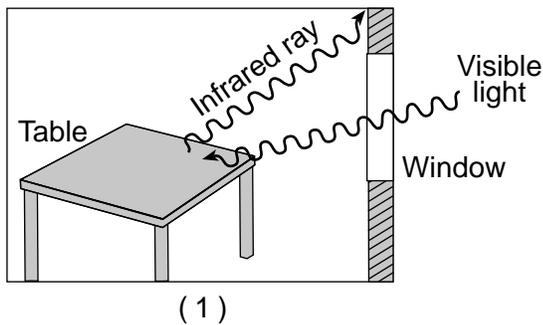
34 The photograph below shows bedrock composed of sediments that have been deposited by wind.



This bedrock is most likely

- (1) sandstone
- (2) limestone
- (3) hornfels
- (4) granite

35 Which diagram below best represents both the relative wavelength of visible light entering a house through a window and the relative wavelength of infrared rays being given off by a table within the house?

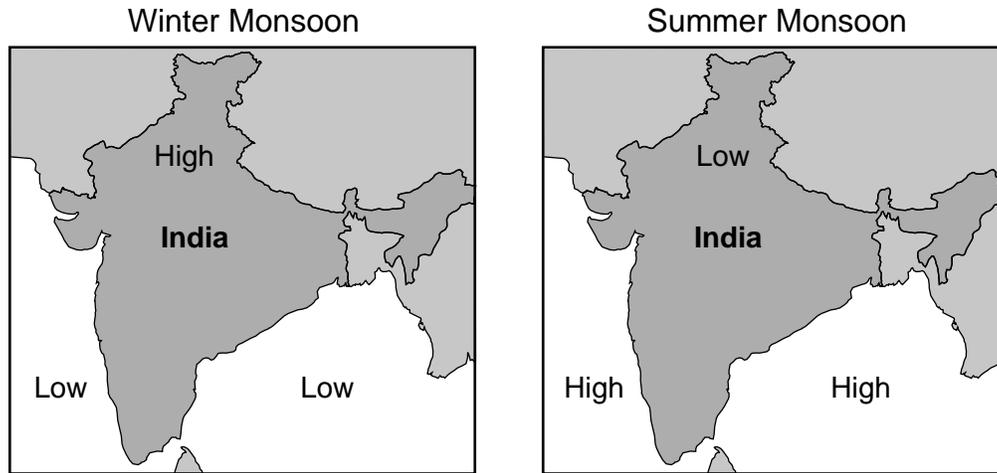


Part B-1

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 and 37 on the maps below and on your knowledge of Earth science. The maps show a portion of India and Southeast Asia, bordering on the Indian Ocean, during the winter and summer monsoon seasons. Large areas of high and low air pressure are shown during each season.



36 Which two-letter symbol represents the most likely air mass formed over portions of the Indian Ocean shown on the maps?

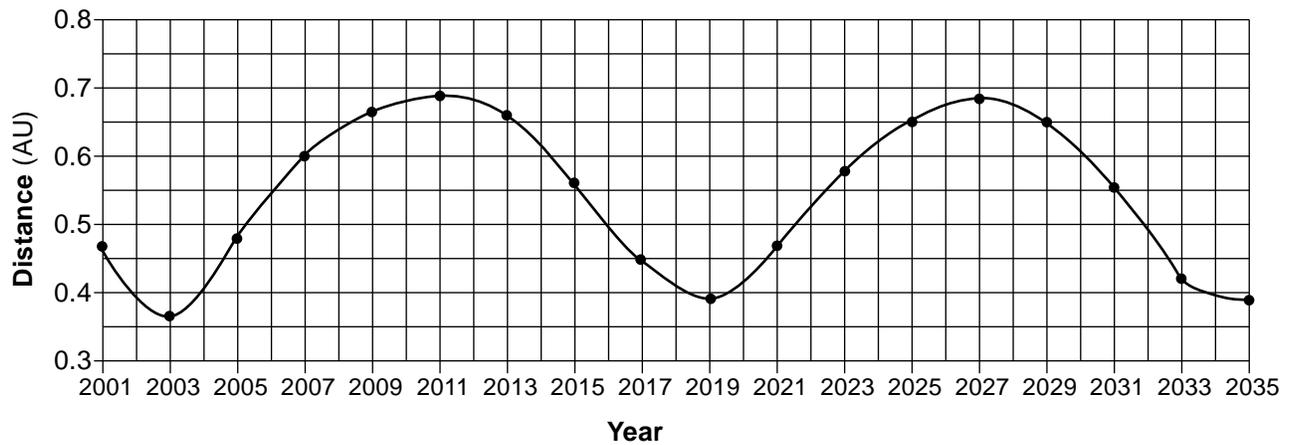
- (1) mP
- (2) mT
- (3) cP
- (4) cT

37 The heavy monsoon rains affecting India and Southeast Asia occur during

- (1) winter, when winds blow from the land
 - (2) winter, when winds blow toward the high pressure
 - (3) summer, when winds blow from the ocean
 - (4) summer, when winds blow toward the high pressure
-

Base your answers to questions 38 through 40 on the graph below and on your knowledge of Earth science. The graph shows the closest distance between Earth and Mars during each year from 2001 to 2035. Distances are measured in astronomical units (AU). One AU equals the average distance from Earth to the Sun.

Closest Distance Each Year Between Earth and Mars



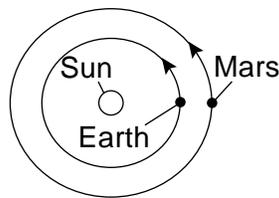
38 Mars reaches its closest distance to Earth approximately every

- (1) 16 years
- (2) 8 years
- (3) 3 years
- (4) 0.36 years

39 How many million kilometers is one astronomical unit?

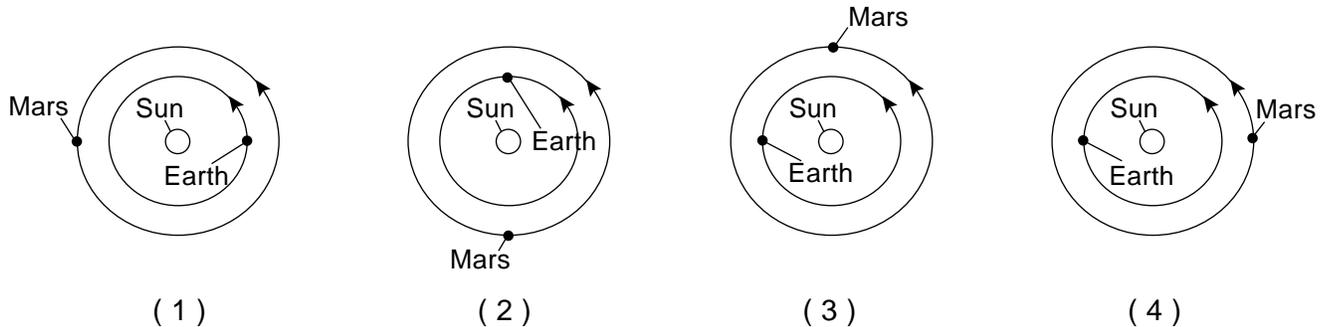
- (1) 108.2 million km
- (2) 149.6 million km
- (3) 227.9 million km
- (4) 377.5 million km

40 The diagram below represents the positions of Earth and Mars in their orbits around the Sun when they were closest in the year 2003.

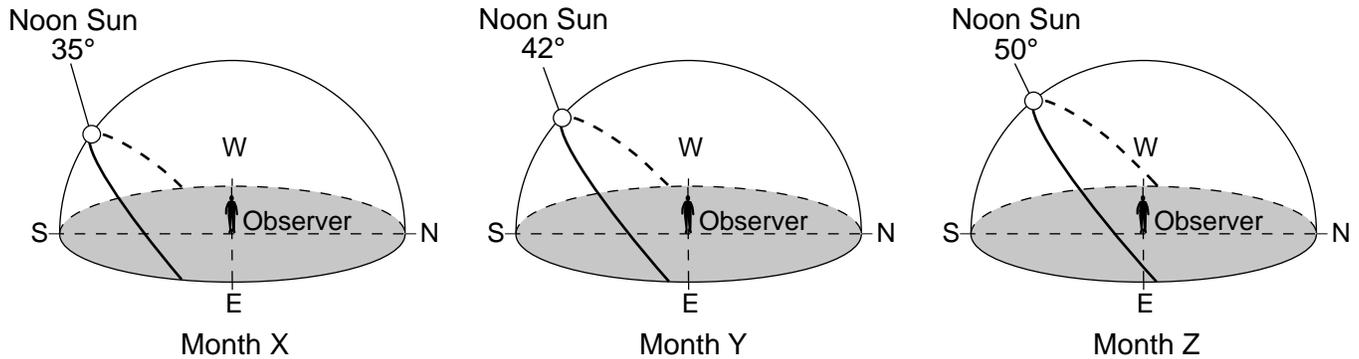


(Not drawn to scale)

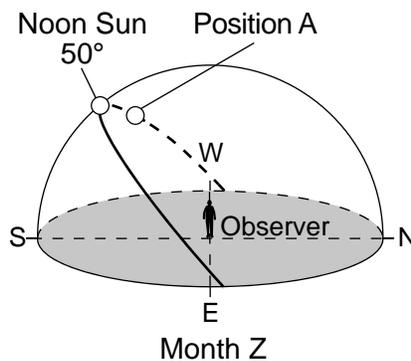
Which diagram represents the positions of Earth and Mars approximately one-half of an Earth year (183 days) later?



Base your answers to questions 41 through 44 on the three Sun's path diagrams below and on your knowledge of Earth science. The diagrams represent the position of the noon Sun along its apparent daily path as seen by an observer on the first day of three consecutive months (X, Y, and Z). The observer was located in Utica, New York.

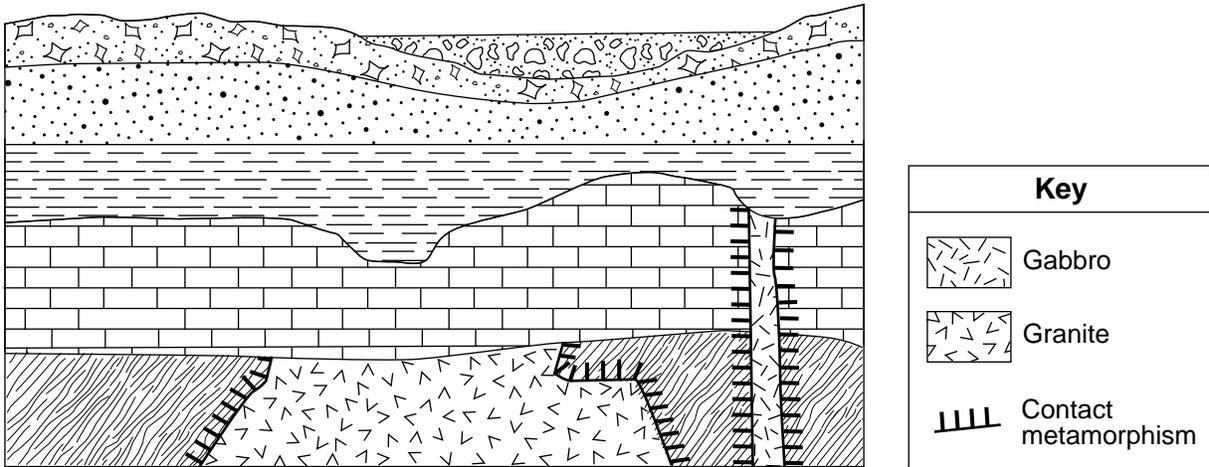


- 41 Which dates are represented by months X, Y, and Z?
- (1) X-February 1, Y-March 1, Z-April 1
 (2) X-May 1, Y-June 1, Z-July 1
 (3) X-August 1, Y-September 1, Z-October 1
 (4) X-November 1, Y-December 1, Z-January 1
- 42 Which characteristic of the Sun's apparent daily path stays constant from month X to month Z?
- (1) locations of sunrise and sunset
 (2) altitude of the noon Sun
 (3) length of time that the Sun moves along its apparent path
 (4) rate of the Sun's movement along its apparent path
- 43 For an observer in the Southern Hemisphere at 43° S latitude, the highest altitude of the noon Sun occurs when the Sun is above the
- (1) eastern horizon
 (2) western horizon
 (3) northern horizon
 (4) southern horizon
- 44 Position A represents the position of the Sun at another time of day during month Z. What is the time of day when the Sun is at position A?



- (1) 1 p.m.
 (2) 5 p.m.
 (3) 7 a.m.
 (4) 11 a.m.

Base your answers to questions 45 through 47 on the geologic cross section of a portion of Earth's crust shown below and on your knowledge of Earth science. None of the rock units has been overturned.



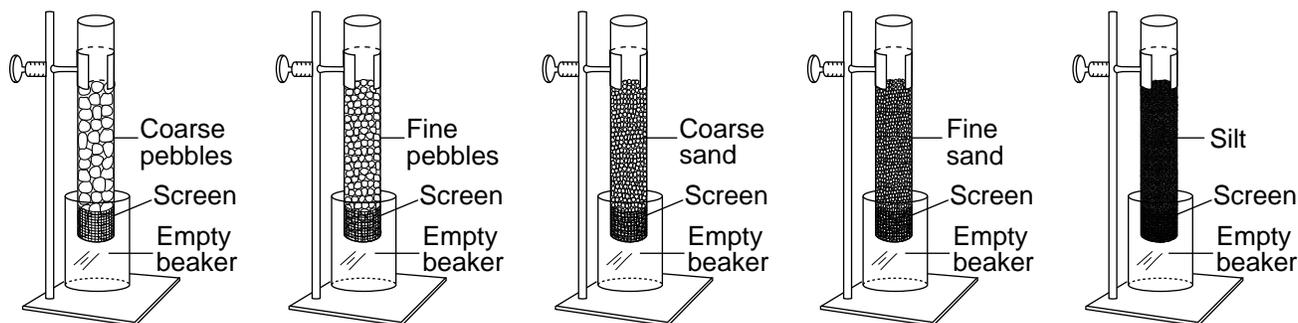
- 45 The youngest rock unit shown in the cross section is
- (1) breccia (2) conglomerate (3) sandstone (4) shale
- 46 Which process most probably produced the irregularly shaped boundary between the limestone and the shale?
- (1) folding (2) faulting (3) contact metamorphism (4) erosion
- 47 Which sequence shows the relative ages of the gabbro, granite, and schist from oldest to youngest?
- (1) gabbro → granite → schist (2) gabbro → schist → granite (3) schist → granite → gabbro (4) schist → gabbro → granite
-

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 and 52 on the diagram and data table below, and on your knowledge of Earth science. The diagram represents the laboratory materials used for an investigation of the effects of particle size on water retention. Five separate columns were filled to the same level with particles. The particle type is indicated for each column. The particles within each column are of uniform shape. A volume of 50 milliliters (mL) of water was poured through each column, and the amount of water retained was determined. The data table shows the results of this experiment.



(Not drawn to scale)

Water Retention

Particle Type (size)	Water Retained (mL)
Coarse pebbles	7
Fine pebbles	15
Coarse sand	32
Fine sand	38
Silt	46

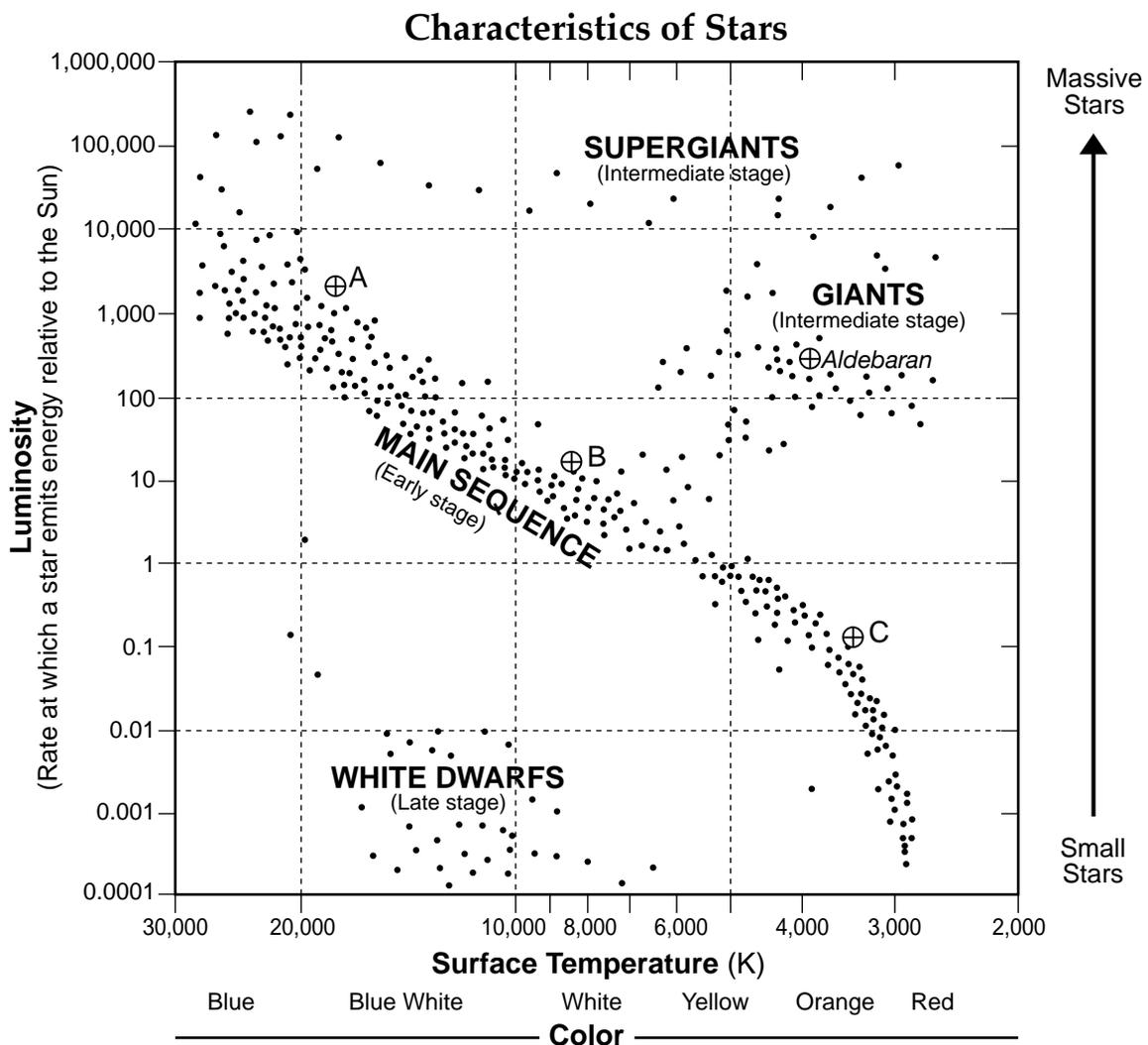
- 51 Describe the general relationship between particle size and the amount of water retained. [1]
- 52 Name the particle type used in the investigation that most likely had the greatest permeability when the 50 milliliters of water were poured through these columns. [1]
-

Base your answers to questions 53 through 55 on the passage and the Characteristics of Stars graph below, and your knowledge of Earth science. Letters A, B, and C represent main sequence stars on the graph. The giant star *Aldebaran* is also shown.

Globular Star Clusters

Globular star clusters appear as small, hazy spots among the other stars. These clusters are groups of hundreds of thousands of stars held together by gravity. Individual stars within a cluster can be seen by using powerful telescopes, allowing scientists to determine their luminosities and temperatures.

All of the stars in a given cluster formed at the same time. In young clusters, most of the stars are classified as main sequence stars. As the stars in a cluster age, they eventually use up their core hydrogen and expand, changing from main sequence stars to giants. The most massive main sequence stars become supergiants. The less massive a star is in the cluster, the longer it remains a main sequence star. Over time, the number of main sequence stars in a cluster decreases.



- 53 Compared to the relative amount of time that star *A* remains in the main sequence, state how the relative amount of time that star *C* remains in the main sequence is different. Explain why this amount of time is different. [1]
- 54 The globular star cluster containing stars *A*, *B*, and *C* is located in the same galaxy as our Sun. Identify the name of this galaxy. [1]
- 55 Identify the nuclear process that uses up a star's core hydrogen and produces the energy released by stars in a globular cluster. [1]
-

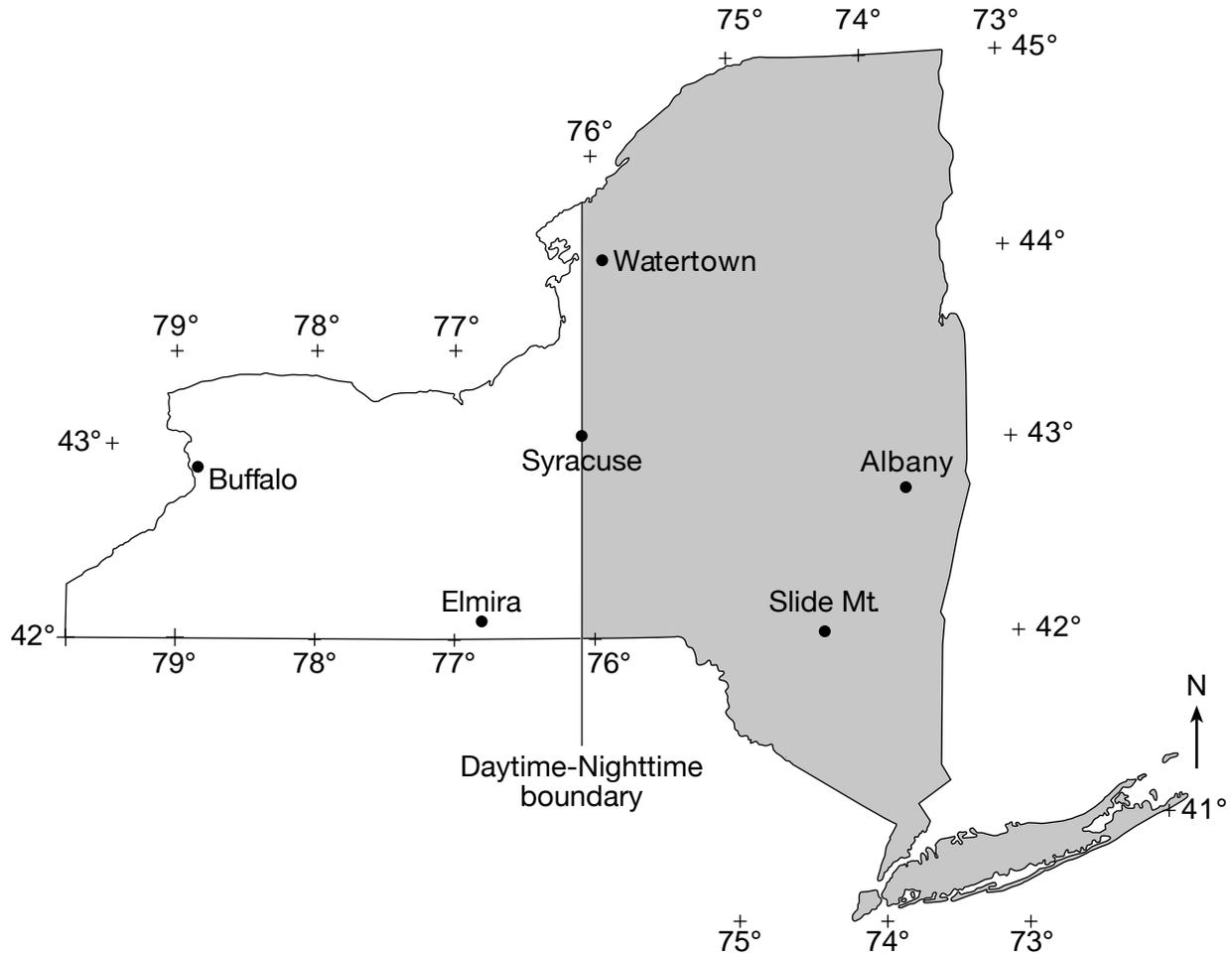
Base your answers to questions 56 through 58 on the topographic map in your answer booklet and on your knowledge of Earth science. Points *A* and *B* represent locations on Earth's surface. Elevations are shown in feet. The 50-ft and 55-ft contour lines are *not* shown on the map.

- 56 On the map *in your answer booklet*, draw the 50-ft and 55-ft contour lines. The contour lines must extend to the edges of the map. [1]
- 57 Calculate the gradient between points *A* and *B*. [1]
- 58 Identify the general compass direction toward which Ames Stream flows. Describe the contour line evidence shown on the map that supports your answer. [1]
-

Base your answers to questions 59 through 61 on the map in your answer booklet and on your knowledge of Earth science. The map shows an imaginary continent on a planet that has climate conditions similar to Earth. The continent is surrounded by oceans. Points *A* through *D* represent locations on the continent.

- 59 On the map *in your answer booklet*, draw one curved arrow between 0° and 30° N to indicate the direction of prevailing planetary winds between these latitudes. [1]
- 60 Compared to the average air temperature and the average moisture conditions at *A*, describe how the relative average air temperature and the relative average moisture conditions at *B* are different. [1]
- 61 Identify the primary factor that causes location *C* to have a colder climate than location *D*. [1]
-

Base your answers to questions 62 through 65 on the map below and on your knowledge of Earth science. The map shows areas of daylight and darkness in New York State on March 21. Six locations are labeled on the map.



- 62 Identify the Earth motion that causes the daytime-nighttime boundary to appear to move. [1]
- 63 State the number of hours of nighttime that people in Syracuse will experience on March 21. [1]
- 64 State the name of the location labeled on this map where sunset will next be observed after Syracuse. [1]
- 65 State the altitude of *Polaris* as seen by an observer on Slide Mountain. [1]
-

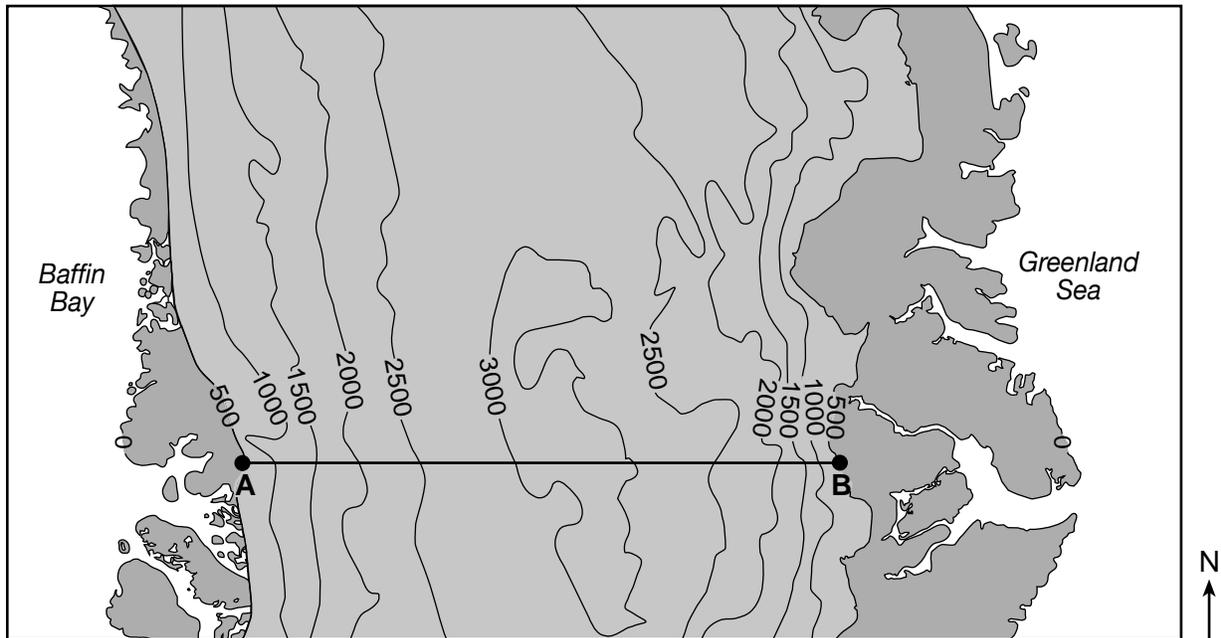
Part C

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 map and passage below and on your knowledge of Earth science. The map shows isolines that represent the thickness of a portion of the Greenland Ice Sheet in meters (m). Letters *A* and *B* represent points on the ice sheet's surface.

Thickness of Greenland Ice Sheet



Greenland Ice Sheet

The Greenland Ice Sheet is a vast body of ice covering roughly 80 percent of the surface of Greenland. The ice sheet is almost 2400 kilometers long in a north-south direction. The ice sheet, consisting of layers of snow compressed over more than 100,000 years, contains a valuable record about Earth's past climates. The ice sheet glaciers continue to flow seaward and deposit sediment, but global warming has affected them. Warmer air temperatures have caused increased melting, resulting in a thinning of the ice sheet and faster glacial movement at the ice sheet edges.

- 66 On the grid *in your answer booklet*, construct a profile along line *AB* by plotting the thickness of the ice sheet where each isoline crosses line *AB*. Thicknesses of the ice sheet at *A* and *B* have been plotted on the grid. Connect *all twelve* plots with a line from *A* to *B* to complete the profile. [1]
- 67 Describe *one* glacial feature that could be found on the exposed surface bedrock of Greenland that would indicate the direction that the ice moved. [1]
- 68 Identify *two* major greenhouse gases that are inferred to contribute to global warming and increased temperatures in Greenland. [1]

Base your answers to questions 69 through 71 on the data table below, on the graph in your answer booklet, and on your knowledge of Earth science. The data table shows the percentage of the stable disintegration product produced over time by the radioactive decay of isotope X after each half-life. The graph shows the percentage of radioactive isotope X remaining over time during the radioactive decay of isotope X.

Disintegration Product of Isotope X

Percentage of Stable Disintegration Product (%)	Time (years)	Number of Half-Lives
0	0	0
50	5700	1
75	11,400	2
87.5	17,100	3
93.75	22,800	4

69 On the graph *in your answer booklet*, plot the percentage of stable disintegration product for each of the times shown on the data table and connect *all five* plots with a line. [1]

70 Determine the number of years (y) it takes for only 25% of radioactive isotope X to remain in a sample. [1]

71 Identify radioactive isotope X and its stable disintegration product. [1]

Base your answers to questions 72 through 75 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram represents two positions of the Moon as it orbits Earth. Positions 1 and 2 are on opposite sides of Earth. Point C represents the location of a crater on the Moon's surface when the Moon is at position 1.

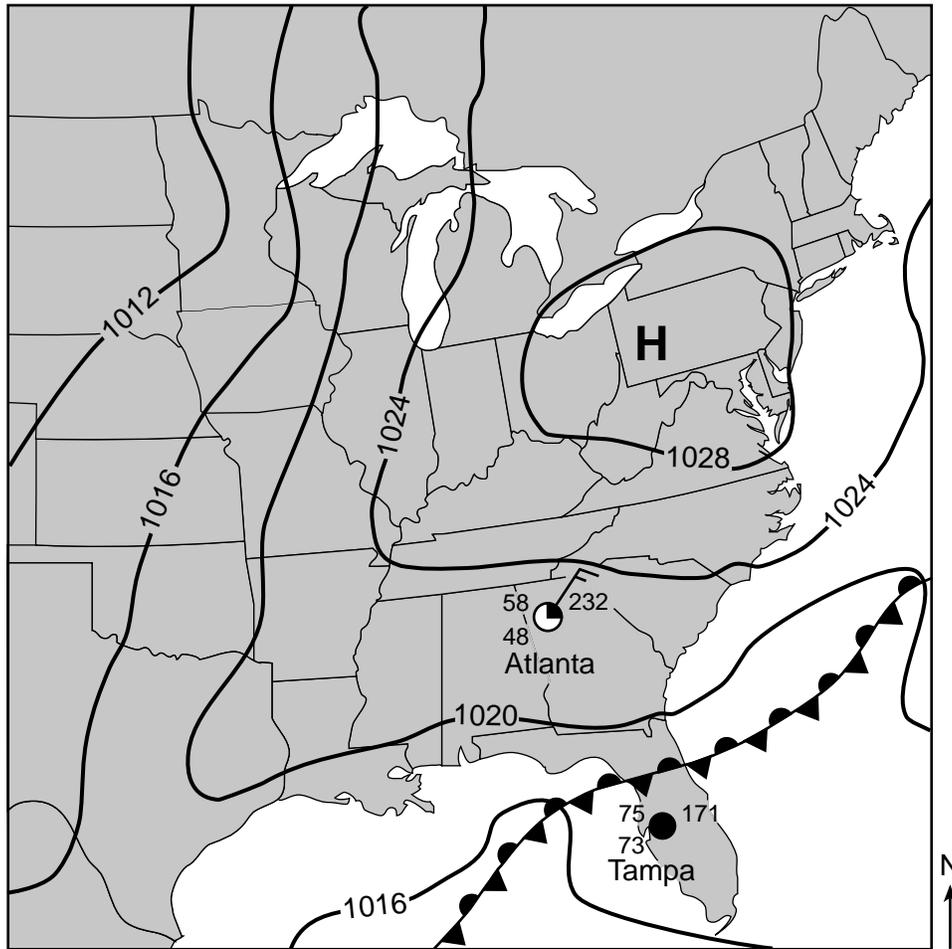
72 On the diagram *in your answer booklet*, draw a dot (•) on the Moon at position 2 to indicate the location of crater C when the Moon is at position 2. [1]

73 On the diagram *in your answer booklet*, place an **X** on the Moon's orbit to indicate the position of the Moon when a lunar eclipse could be viewed from Earth. [1]

74 Determine the number of days needed for the Moon to move from position 1 to position 2, completing one-half of its orbit. [1]

75 On the diagram *in your answer booklet*, shade the portion of the Moon that is in darkness as viewed from New York State when the Moon is at position 1. [1]

Base your answers to questions 76 through 78 on the weather map below and on your knowledge of Earth science. On the weather map, the location of the center of a high-pressure system (**H**) and a front are shown. Isobar values are labeled in millibars (mb). Weather station models represent the weather conditions at Atlanta, Georgia, and Tampa, Florida.

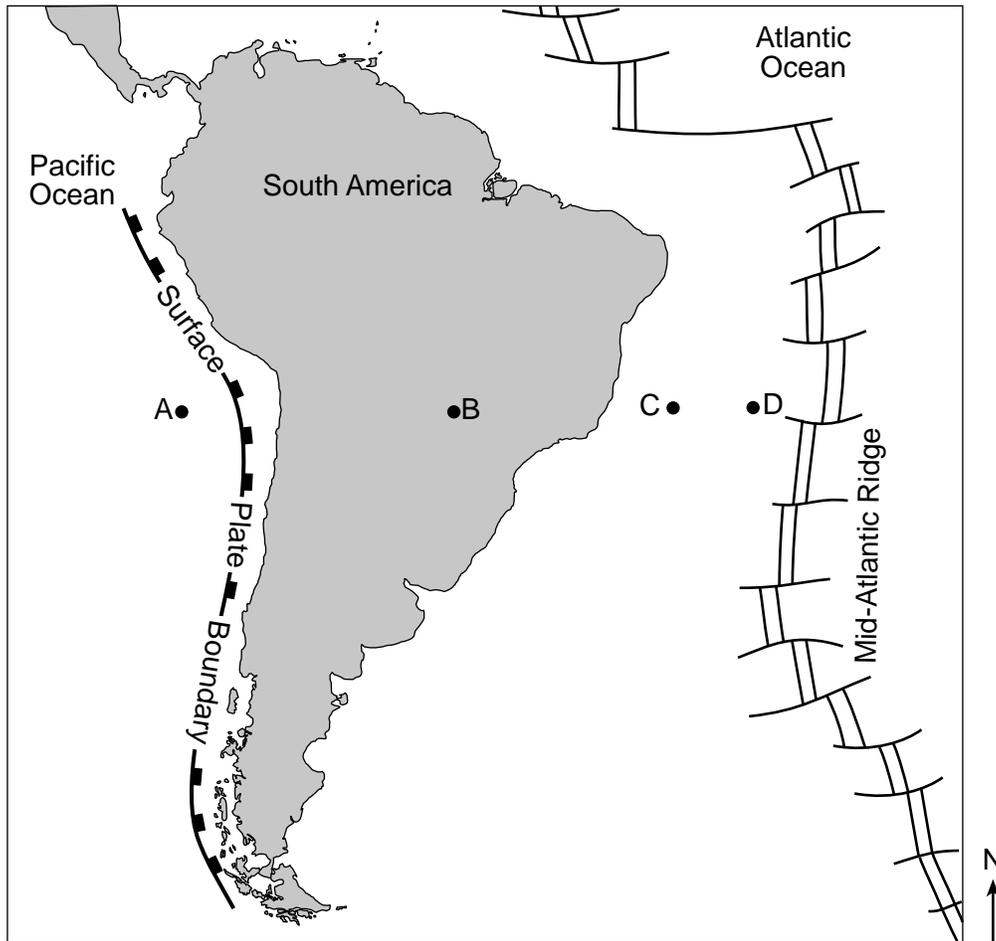


76 Complete the table *in your answer booklet* with the actual weather conditions represented by the weather station model at Atlanta, Georgia. [1]

77 Identify the type of front shown on the map. [1]

78 Describe *one* piece of evidence shown on the map that indicates that Tampa, Florida, has a high probability of precipitation. [1]

Base your answers to questions 79 through 81 on the map below and on your knowledge of Earth science. The map shows the surface location of a tectonic plate boundary along the western coast of South America. The Mid-Atlantic Ridge is also shown. Points A through D represent locations on Earth's surface.

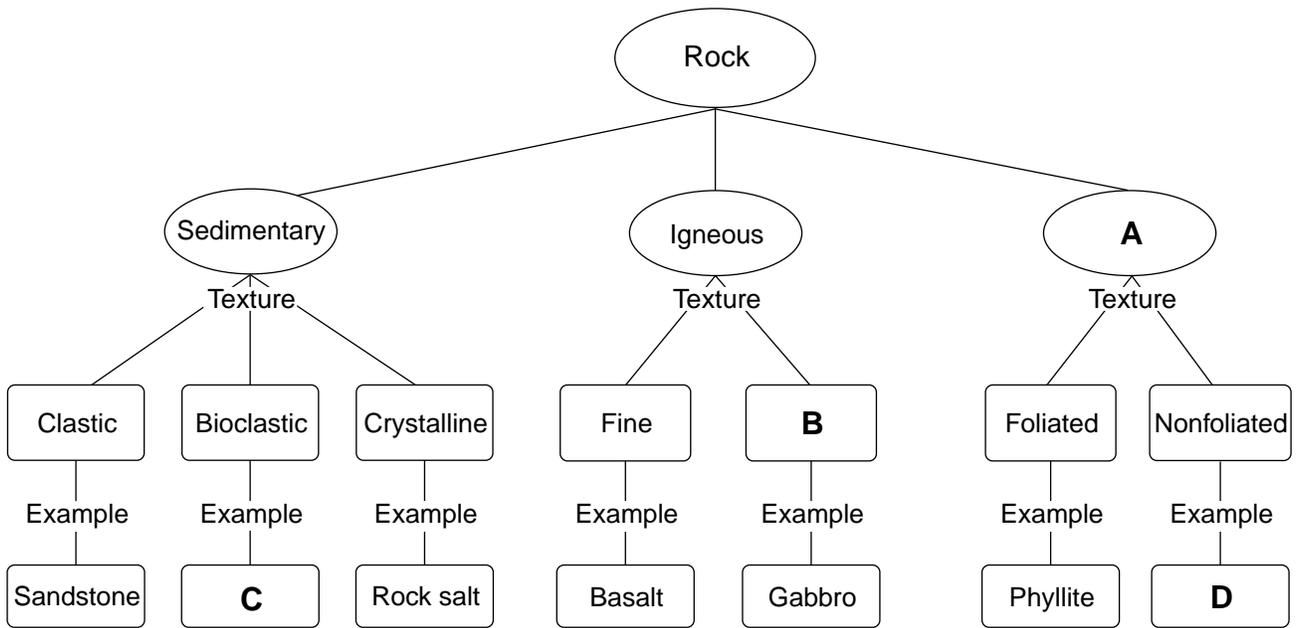


79 Identify the names of the tectonic plates at locations A and B. [1]

80 Compared to the relative age of the surface oceanic bedrock at location C, state the relative age of the surface oceanic bedrock at location D. Explain why this difference in relative age occurs. [1]

81 Identify the term for the large ocean wave produced by offshore earthquakes that is hazardous to humans living along the west coast of South America. Describe *one* emergency action that should be taken to avoid loss of life when a warning for an approaching large wave has been given. [1]

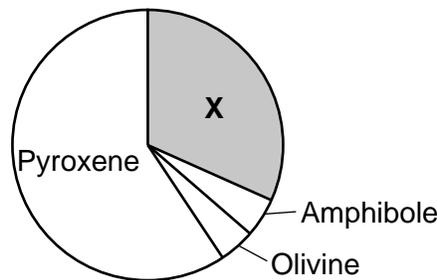
Base your answers to questions 82 through 85 on the flowchart below and on your knowledge of Earth science. Letters *A* through *D* represent information that is missing in the chart.



82 Complete the table *in your answer booklet* by writing the missing information represented by letters *A* through *D*. [1]

83 Identify the *two* elements that make up the chemical composition of the mineral in rock salt. [1]

84 The pie graph below shows the percentages of four minerals that compose the igneous rock gabbro. Letter *X* represents one of the minerals.



Identify the mineral represented by letter *X* in the graph. [1]

85 Identify the name of *one* foliated rock formed when phyllite undergoes increased heat and pressure. [1]
