

PHYSICAL SETTING EARTH SCIENCE

Friday, June 16, 2023 — 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 Which two characteristics classify Jupiter as a Jovian planet?

- (1) low density and large diameter
- (2) low density and small diameter
- (3) high density and large diameter
- (4) high density and small diameter

2 As observed from Earth, the wavelengths of light from the most distant galaxies are usually

- (1) blue shifted due to an expanding universe
- (2) blue shifted due to a contracting universe
- (3) red shifted due to an expanding universe
- (4) red shifted due to a contracting universe

3 The rate of Earth's revolution around the Sun is approximately

- (1) 1°/day
- (2) 15°/day
- (3) 24°/day
- (4) 360°/day

4 Different star constellations are observed from Earth at different times during the year because

- (1) constellations spin on an axis
- (2) constellations travel in an orbit around the Sun
- (3) Earth spins on its axis
- (4) Earth travels in an orbit around the Sun

5 The apparent change in the direction of swing of a Foucault pendulum provides evidence of Earth's

- (1) rotation
- (2) revolution
- (3) tilted axis
- (4) elliptical orbit

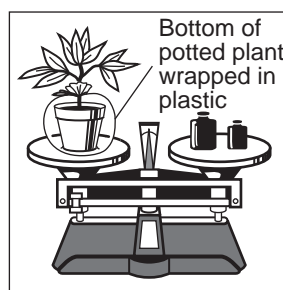
6 The Milky Way can best be described as

- (1) an elliptical galaxy
- (2) a collection of stars orbiting the Sun
- (3) a star that originated 4600 million years ago
- (4) one of billions of galaxies in the universe

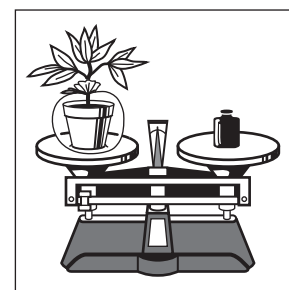
7 How much heat energy is required to change five grams of ice to liquid water at 0°C?

- (1) 334 joules
- (2) 1670 joules
- (3) 2260 joules
- (4) 11,300 joules

8 The diagram below represents the change in mass of a potted plant over time.



Starting mass just after plastic wrap is applied



Mass after 7 days

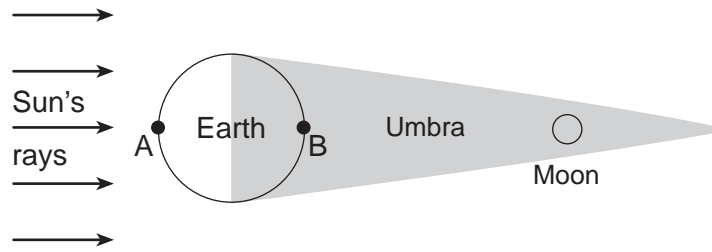
What is the cause and its effect on the change in mass of the potted plant over time?

- (1) Transpiration caused a decrease in mass.
- (2) Condensation caused a decrease in mass.
- (3) Transpiration caused an increase in mass.
- (4) Condensation caused an increase in mass.

9 Air temperatures are recorded as a weather balloon rises from Earth's surface. At first, the air temperature constantly decreases for 12 kilometers, then remains constant briefly before increasing for another 12 kilometers before the balloon bursts. In which layer did the balloon burst?

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

10 The diagram below represents the Moon passing through the darker part of Earth's shadow called the umbra. Letters A and B represent locations on Earth's surface.



(Not drawn to scale)

Which statement best identifies this event and at which location it would be viewed?

- (1) A solar eclipse is occurring and can be seen from location A.
- (2) A solar eclipse is occurring and can be seen from location B.
- (3) A lunar eclipse is occurring and can be seen from location A.
- (4) A lunar eclipse is occurring and can be seen from location B.

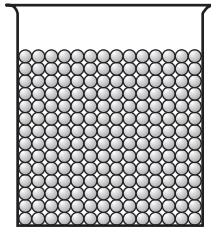
11 The photograph below shows an impact crater located in the southwestern United States.



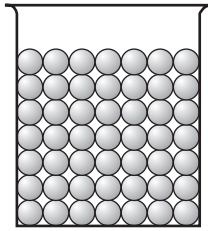
This crater most likely formed as a result of

- (1) an explosive volcanic eruption
- (2) the subduction at a plate boundary
- (3) an asteroid colliding with Earth
- (4) the evaporation of water from a lake

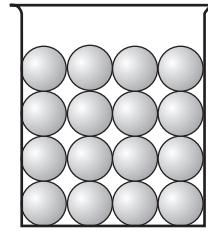
12 The diagrams below represent three containers, A, B, and C, which were filled with equal volumes of uniformly sorted plastic beads. To determine porosity, water was poured into each container until the water level rose to the top of the beads.



A



B



C

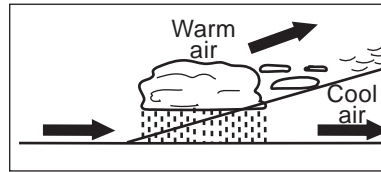
The porosity was found to be

- (1) greatest in container A
- (2) greatest in container B
- (3) greatest in container C
- (4) the same in all three containers

13 Which cross section represents the cloud patterns and the direction of air movement at a warm front?



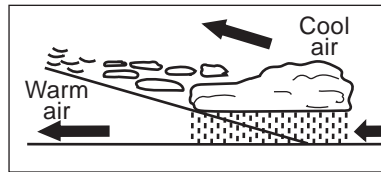
(1)



(3)



(2)

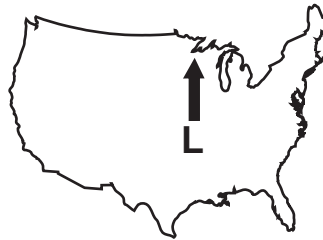


(4)

14 Which map shows the most likely path of a low pressure system (L) in the United States if it follows a normal storm track?



(1)



(3)

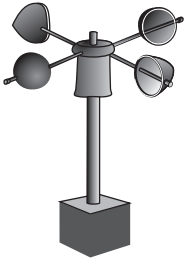


(2)

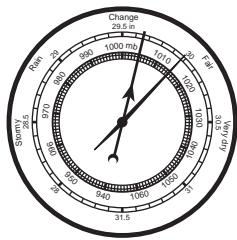


(4)

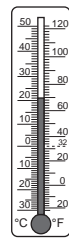
15 Which weather instrument is an anemometer?



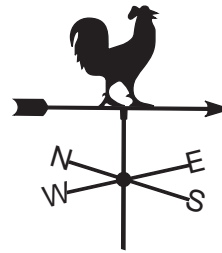
(1)



(2)

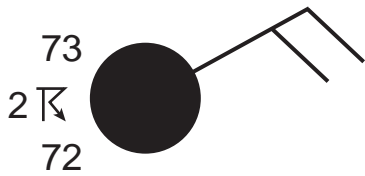


(3)



(4)

16 The station model below represents some weather information for a location in New York State.



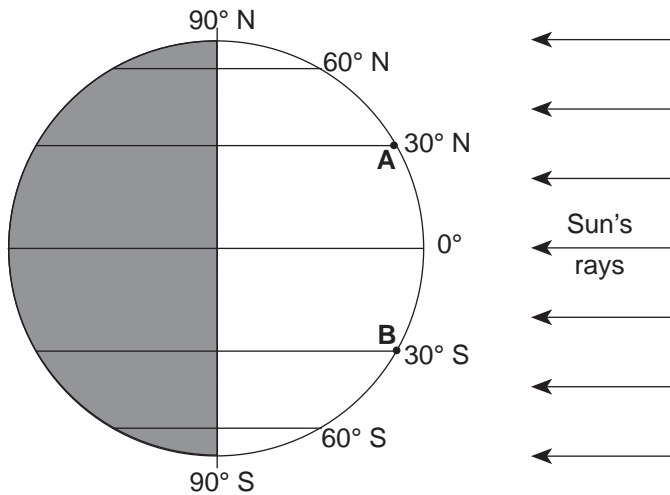
Based on the information on the station model, the weather at this location is

- (1) partly cloudy and windy with blowing snow
- (2) cloudy and windy with thunderstorms
- (3) cloudy and calm with visibility of 2 miles
- (4) partly cloudy and calm with an air temperature of 73°F

17 Electromagnetic energy travels through space from the Sun to the top of Earth's atmosphere by

- (1) conduction
- (2) convection
- (3) radiation
- (4) infiltration

18 The diagram below represents the position of Earth with respect to the Sun on March 21. A and B are two locations on Earth's surface.



The intensity of insolation over the next three months will

- (1) decrease for both A and B
- (2) decrease for A and increase for B
- (3) increase for both A and B
- (4) increase for A and decrease for B

19 Which event is primarily responsible for the production of oxygen that first entered into Earth's early atmosphere?

- (1) evolution of oxygen-producing organisms
- (2) radioactive decay of isotopes producing oxygen
- (3) separation of oxygen from hydrogen in water
- (4) oxygen-rich comets impacting Earth

20 Since the break up of Pangaea, it has been inferred that the continent of North America has been generally moving toward the

- (1) northwest
- (2) northeast
- (3) southwest
- (4) southeast

21 The fossil *Mucrospirifer* is considered to be an index fossil because it existed over a

- (1) small geographic region for a long period of time
- (2) small geographic region for a short period of time
- (3) large geographic region for a long period of time
- (4) large geographic region for a short period of time

22 Compared to Earth's outer core, the inner core properties are inferred to be

- (1) less dense and a solid
- (2) less dense and a liquid
- (3) more dense and a solid
- (4) more dense and a liquid

23 A seismic station 4000 kilometers from the epicenter of an earthquake records the arrival time of the first S-wave at 1:05:40 p.m. At what time did the first P-wave arrive at this station?

- (1) 12:58:40 p.m.
- (2) 1:00:00 p.m.
- (3) 1:05:40 p.m.
- (4) 1:11:20 p.m.

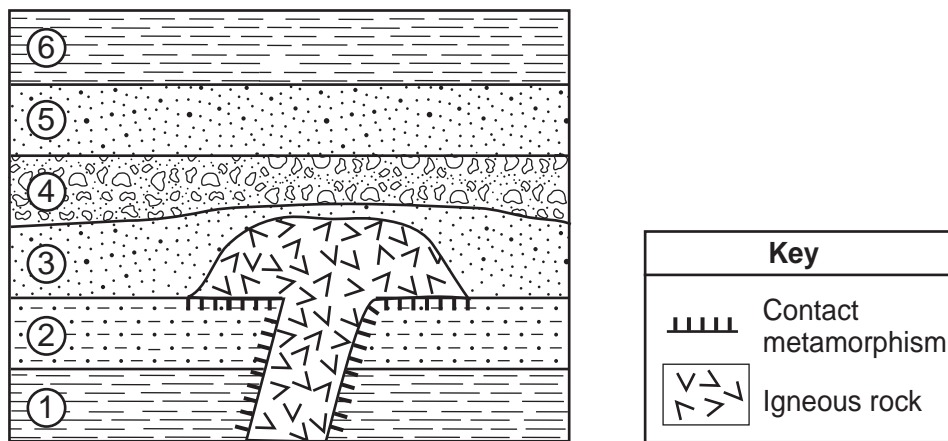
24 The photograph below shows fossilized ammonoids in a rock outcrop.



The presence of these fossils in the outcrop indicates that in the past, this region was most likely covered by

- (1) desert sand
- (2) ocean water
- (3) glacial ice
- (4) molten rock

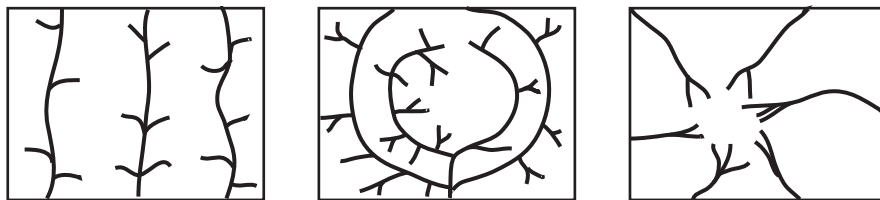
25 The cross section below represents rock units within Earth's crust. Sedimentary rock layers are labeled 1 through 6.



The age of the igneous rock is

- (1) older than rock layers 1 and 2
- (2) the same age as rock layer 3
- (3) older than rock layer 3
- (4) younger than rock layers 4, 5, and 6

26 The maps below show different stream drainage patterns.



What factor most likely causes these different stream drainage patterns?

- (1) age of bedrock
- (2) bedrock structure
- (3) types of fossils found in the bedrock
- (4) temperature variations in the bedrock

27 The photograph below shows boulders and other sediments that slid down a hillside.



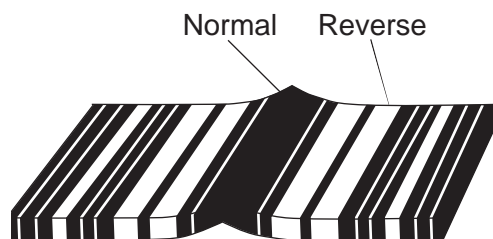
This rock slide is most likely an example of

- (1) mass movement due to prolonged periods of heavy traffic
- (2) mass movement following prolonged periods of heavy rain
- (3) abrasion by prolonged exposure to moving ice
- (4) abrasion following prolonged exposure to wind action

28 The Mariana Trench is Earth's deepest oceanic trench. This trench formed as the Pacific Plate was

- (1) overriding the Philippine Plate
- (2) overriding the Eurasian Plate
- (3) subducting under the Philippine Plate
- (4) subducting under the Eurasian Plate

29 The diagram below represents patterns of normal and reverse magnetic polarity in seafloor bedrock.



In which bedrock type and location can this magnetic pattern most likely be observed?

- (1) igneous bedrock at the East Pacific Ridge
 - (2) igneous bedrock at the Tasman Hot Spot
 - (3) sedimentary bedrock at the East Pacific Ridge
 - (4) sedimentary bedrock at the Tasman Hot Spot
- 30 Compared to the thickness and density of the continental crust, the relative thickness and density of Earth's oceanic crust are
- (1) thinner and less dense
 - (2) thinner and more dense
 - (3) thicker and less dense
 - (4) thicker and more dense
- 31 Iron found in some minerals in basalt can react with oxygen and break down into iron oxide particles. This change is an example of
- (1) deposition
 - (2) erosion
 - (3) chemical weathering
 - (4) physical weathering

32 Which feature provides the best evidence that thick glacial ice sheets once advanced southward over New York State?

- (1) parallel grooves in bedrock
- (2) sorted layers of sediments
- (3) caves found in limestone bedrock
- (4) V-shaped valleys

33 The photograph below shows the metamorphic rock gneiss.



Three minerals that would most likely be found in this rock are

- (1) pyroxene, calcite, and fluorite
 - (2) garnet, hornblende, and talc
 - (3) amphibole, augite, and hematite
 - (4) quartz, mica, and feldspar
- 34 Which igneous rock has a fine-grained texture and would have a mineral composition of 57% plagioclase feldspar, 28% amphibole, and 15% biotite?
- (1) gabbro
 - (2) pegmatite
 - (3) scoria
 - (4) andesite
- 35 What is a common use of the mineral composed of $\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{12}$?
- (1) ceramics
 - (2) jewelry
 - (3) building stones
 - (4) plaster of paris

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.

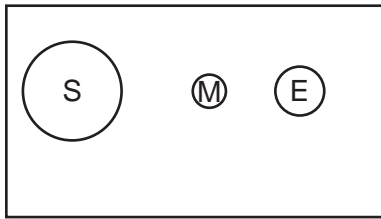
Base your answers to questions 36 through 39 on the passage below and on your knowledge of Earth science.

King Tides and Climate Change

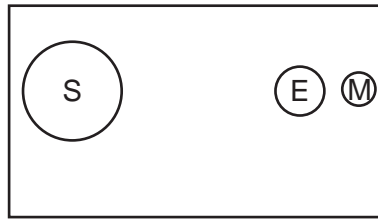
Spring tides are extremely high tides that occur when Earth, the Moon, and the Sun are aligned. A king tide is the common name given to an extremely high spring tide that occurs at perigee (when the Moon is closest to Earth in its orbit). King tides occur once or twice every year.

Normal high tides are now reaching higher and extending farther inland than in the past because of global climate change and rising sea levels. This causes low-lying shorelines to be at an increased risk of flooding. If climate continues to change and sea levels rise, spring tides and king tides will have a greater effect on shorelines and coastal flooding.

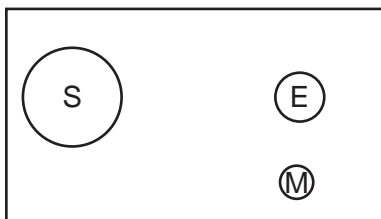
36 Which diagram best illustrates the positions of Earth (E), the Sun (S), and the Moon (M), and the relative distance between Earth and the Moon that results in a king tide?



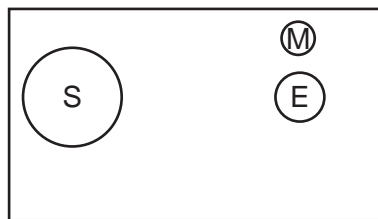
(1)



(3)



(2)

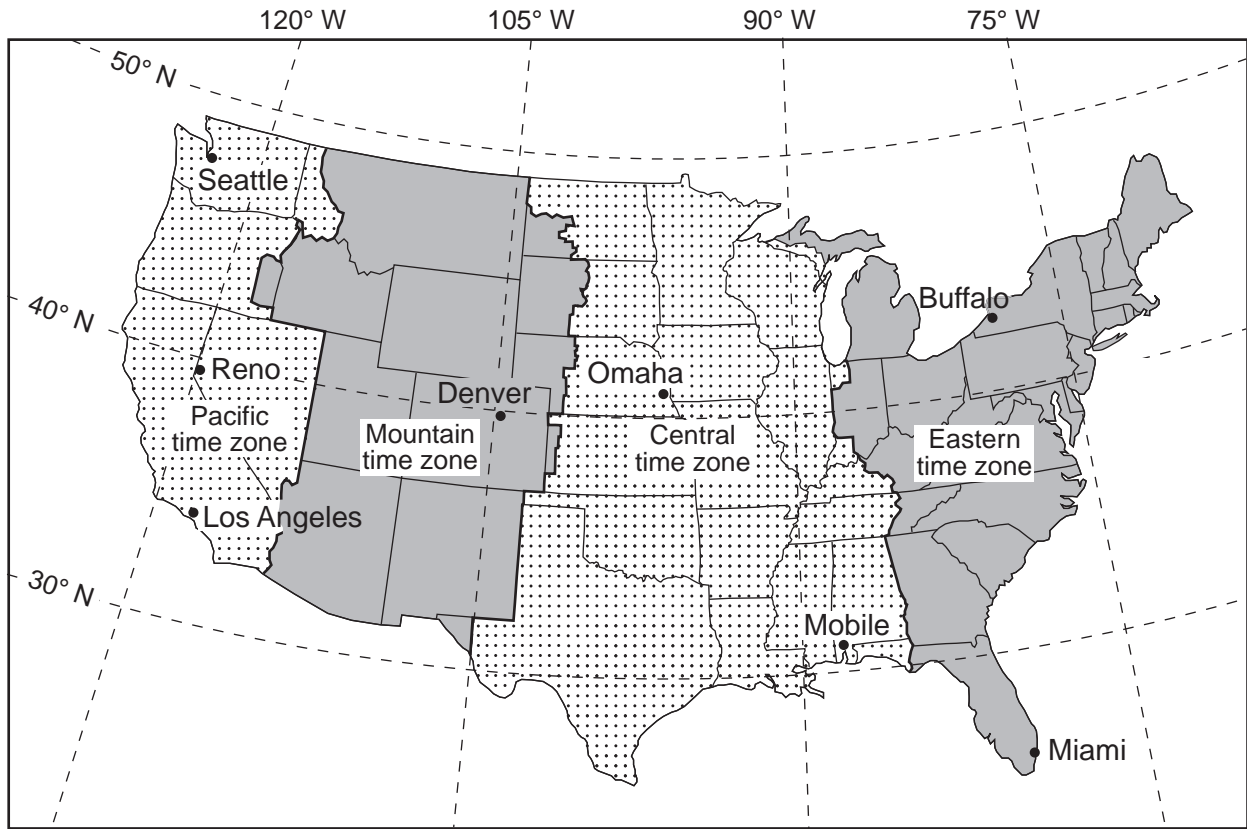


(4)

- 37 A coastal community can make advanced preparations for a king tide event because the motions of Earth and the Moon are
- (1) cyclic and predictable
 - (2) cyclic and unpredictable
 - (3) noncyclic and predictable
 - (4) noncyclic and unpredictable
- 38 Which factor is primarily causing global average sea levels to rise over time?
- (1) decreased incoming solar radiation
 - (2) decreased ocean water temperature
 - (3) increased amount of snowfall in Arctic regions
 - (4) increased melting of glacial ice
- 39 Two major greenhouse gases that may be linked to global warming are
- (1) carbon dioxide and nitrogen
 - (2) carbon dioxide and methane
 - (3) oxygen and nitrogen
 - (4) oxygen and methane
-

GO ON TO THE NEXT PAGE ⇨

Base your answers to questions 40 through 43 on the map below and on your knowledge of Earth science. The map shows the four time zones and some latitude and longitude lines across the continental United States. Some cities are labeled on the map.



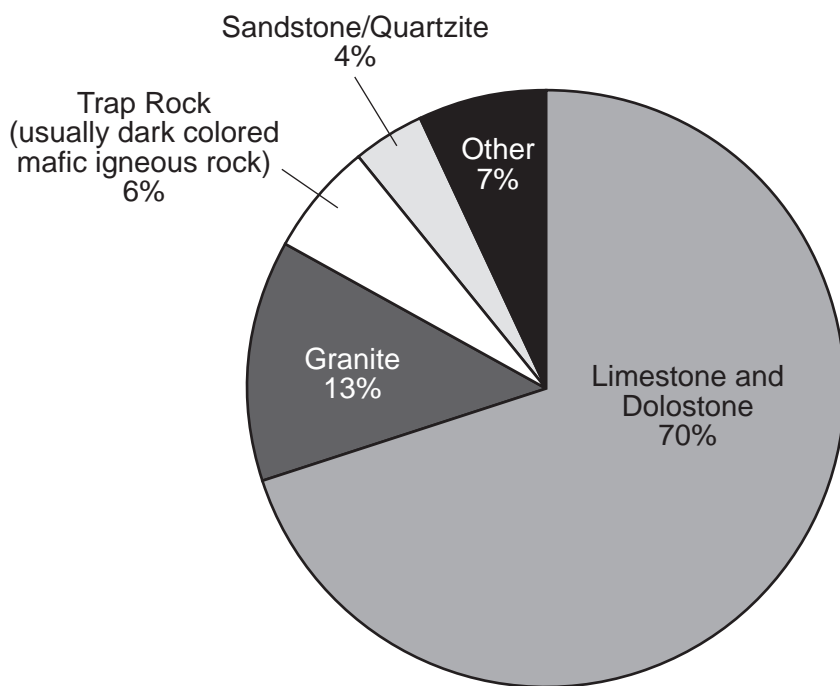
- 40 What time is it in Buffalo, New York, when it is 5:00 p.m. in Omaha, Nebraska?
- | | |
|---------------|---------------|
| (1) 6:00 p.m. | (3) 3:00 p.m. |
| (2) 7:00 p.m. | (4) 4:00 p.m. |
- 41 The altitude of Polaris, as measured by an observer in Reno, Nevada, is closest to
- | | |
|---------|----------|
| (1) 39° | (3) 119° |
| (2) 41° | (4) 121° |
- 42 Which city has the *shortest* duration of insolation on December 21?
- | | |
|------------|-------------|
| (1) Mobile | (3) Miami |
| (2) Omaha | (4) Seattle |
- 43 The four time zones shown on the map are based on Earth's
- | | |
|----------------------|------------------------|
| (1) tilted axis | (3) rate of rotation |
| (2) orbital velocity | (4) rate of revolution |

Base your answers to questions 44 through 47 on the information and pie chart below. The pie chart shows percentages of different rock types used to make crushed stone in the United States during 2017.

Crushed Stone

Crushed stone is the world's most basic mineral commodity. It is abundant, widely available, and inexpensive. In 2017, the United States produced 1.3 billion tons of crushed stone, most of which is used in highway and building construction.

United States Crushed Stone Rock Types



- 44 Which two elements are common to both rocks that make up the 4% section of the United States crushed stone rock types?
- (1) aluminum and iron
(2) silicon and oxygen
(3) calcium and magnesium
(4) nitrogen and potassium
- 45 Which rock would most likely be included in trap rock?
- (1) phyllite
(2) obsidian
(3) diabase
(4) rhyolite
- 46 Which crushed rock would most likely weather the fastest in areas that receive high levels of acidic rain?
- (1) trap rock
(2) granite
(3) quartzite
(4) limestone
- 47 When the driver of a dump truck raises the bed of the dump truck to release its load, quartzite tends to scratch the bottom and sides of the bed easier than limestone. Which property of the minerals in quartzite causes them to more easily scratch the bed of the dump truck?
- (1) streak
(2) luster
(3) hardness
(4) cleavage

Base your answers to questions 48 through 50 on the data table below and on your knowledge of Earth science. The data table lists samples of three different materials, the age of each sample, the radioactive isotope used to date each sample, and the location where the sample was found.

Sample	Age (years)	Radioactive Isotope Used to Date Sample	Location of Sample
Woolly rhinoceros tooth	39,400	carbon-14	Kaminnaya Cave, Altai Mt., Russia
Zircon crystals	4,400,000,000	uranium-238	Jack Hills region, Australia
Sediments with iridium	65,500,000	potassium-40	Italy

48 One reason why carbon-14 was used to determine the age of the woolly rhinoceros tooth was because carbon-14

- (1) never completely decays
- (2) has a very long half-life
- (3) can be found in most organic remains
- (4) is easily identified in Carboniferous bedrock

49 Approximately how much of the original uranium-238 is left in the sample of zircon crystals?

- (1) 100%
- (2) 50%
- (3) 25%
- (4) 12.5%

50 The iridium-enriched sediment layer was deposited at the end of which geological period?

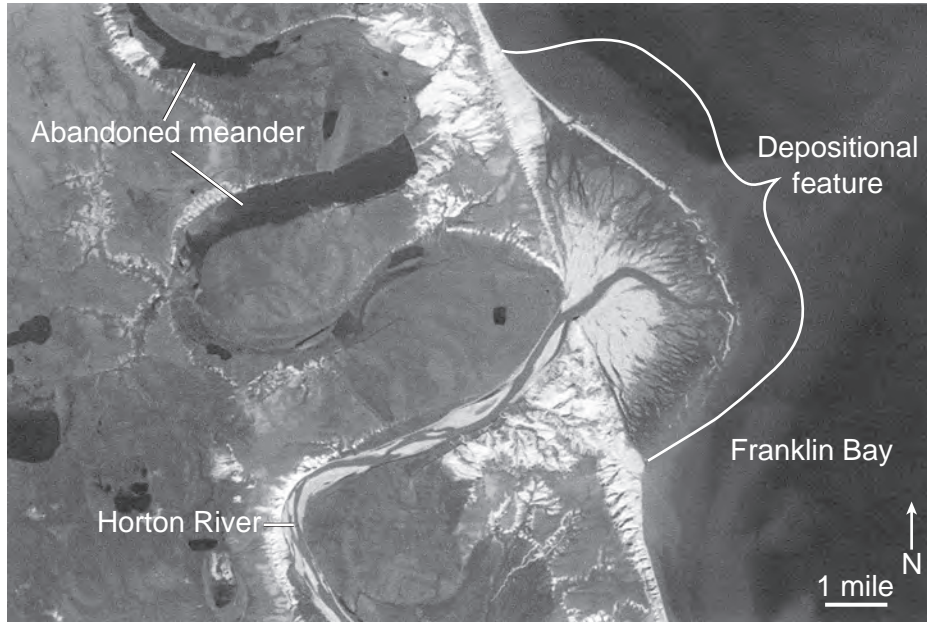
- (1) Permian
 - (2) Paleogene
 - (3) Quaternary
 - (4) Cretaceous
-

Part B–2

Answer all questions in this part.

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

Base your answers to questions 51 through 54 on the satellite image below and on your knowledge of Earth science. The satellite image shows the Horton River flowing into Franklin Bay in northwestern Canada. Large abandoned meanders, now lakes, indicate where the Horton River once flowed before it changed its path over time.



- 51 Identify the name of the large depositional feature formed by the sediment deposited where the Horton River flows into Franklin Bay. [1]
- 52 State the general relationship between the distance from the shoreline and the average diameters of the rock particles deposited in Franklin Bay. [1]
- 53 Identify the dominant process that occurs along the outside of a meander curve and the dominant process that occurs along the inside of a meander curve that caused this meandering river to change its path. [1]
- 54 Explain how abrasion causes rounding of rock particles as they are transported by the Horton River. [1]
-

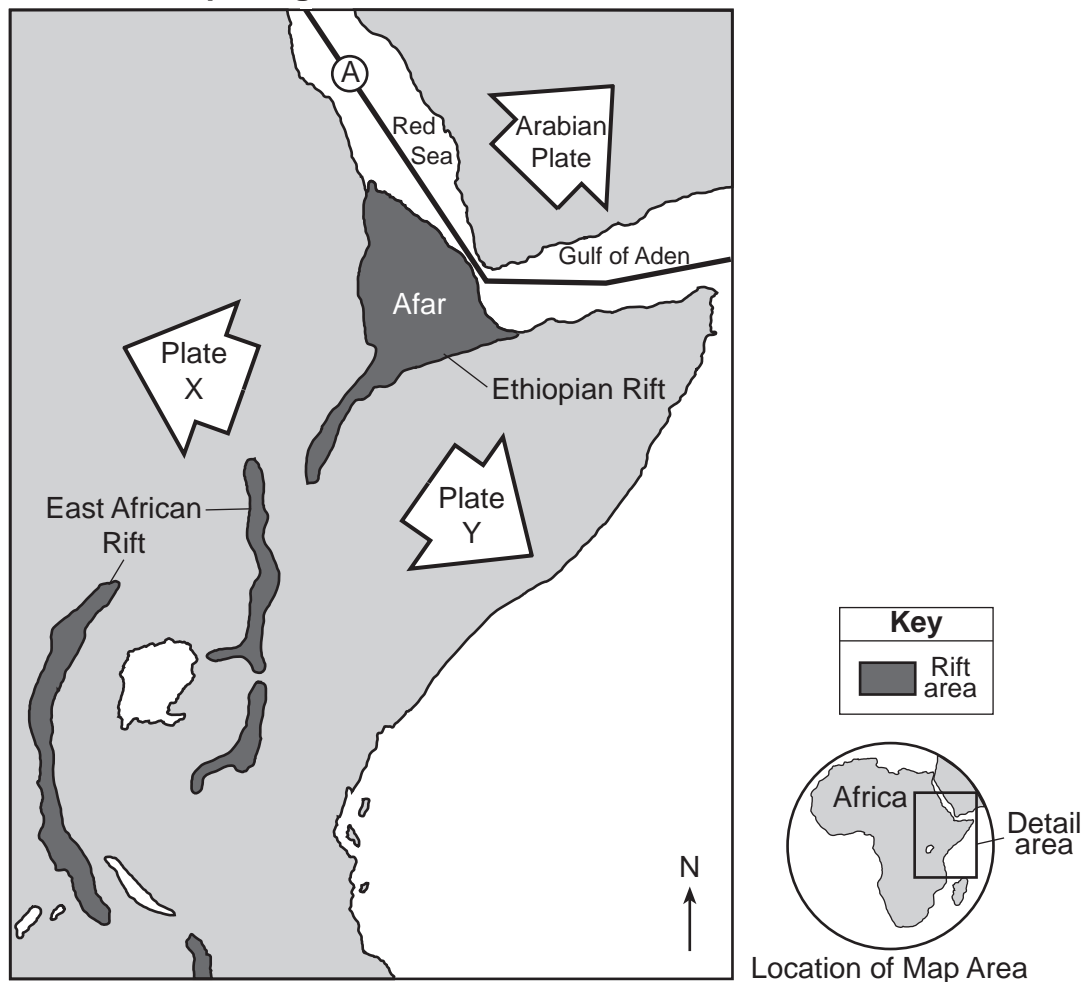
Base your answers to questions 55 through 57 on the passage and map below and on your knowledge of Earth science. The map shows the area of a portion of Africa that includes the Ethiopian Rift and the East African Rift. The large arrows show the directions that the Arabian Plate and the two new plates forming from the African Plate, labeled X and Y, are moving. Letter A represents a plate boundary.

East African Rift

The East African Rift System begins at a location where two tectonic plates meet in the Afar region of Africa. The two plates that meet at this location are the Arabian Plate to the north and the African Plate to the south. The African Plate is rifting to form two new plates.

The Nubian Plate is moving westward and the Somalian Plate is moving eastward relative to the rift. The rift system began approximately 25 million years ago and now stretches over 3000 kilometers from the Red Sea and Gulf of Aden down toward the southern tip of Africa. The process of rifting is believed to occur due to heat rising from magma below Earth's surface. In 2005, a part of the crust in the Afar region gave way, spreading the rift area by an additional 26 feet. This crack was filled with 600 billion gallons of molten rock, which solidified into basalt.

Splitting of African Plate



55 Identify the type of plate boundary at location A. [1]

56 Identify the names of the new plates, labeled plate X and plate Y, that are forming from the African Plate. [1]

57 Identify *one* tectonic event, other than volcanic activity, that is associated with this rifting in Africa. [1]

Base your answers to questions 58 and 59 on the isoline map on your answer booklet and on your knowledge of Earth science. The map shows the snowfall totals recorded in inches from a lake effect snowstorm that occurred as a result of cold air passing over the warmer water of Lake Michigan in January 2012. The 2-inch and 8-inch snowfall isolines are shown.

58 On the map *in your answer booklet*, draw the 4-inch and 6-inch snowfall isolines. Extend both isolines to the top edge of the map. [1]

59 The air mass that moved over Lake Michigan producing the snowstorm originated in Central Canada. Write the two-letter air mass symbol for this air mass that originated over Canada. [1]

Base your answers to questions 60 through 62 on the diagram on your answer booklet and on your knowledge of Earth science. The diagram represents the apparent path of the Sun for a location in New York State on October 21st. Three positions of the Sun are labeled A, B, and C. The length and direction of the shadow of a vertical stick are represented at three different times during the day. Compass directions along the horizon are labeled.

60 On the diagram *in your answer booklet*, write the letter in each box labeled “Sun position” that caused each of the three shadows. [1]

61 On the diagram *in your answer booklet*, draw the apparent path of the Sun from sunrise to sunset on March 21. [1]

62 Identify the letter of the Sun’s position where it is closest to solar noon. State *one* piece of evidence shown in the diagram that supports your answer. [1]

Base your answers to questions 63 through 65 on the passage below and on your knowledge of Earth science. The passage describes the life cycle of a Sun-like star.

The Life Cycle of a Sun-like Star

Stars like the Sun begin as a nebula, which is a large cloud of gas and dust in space. Under the right conditions, a clump in the nebula begins to rotate, contract, and heat up, causing the gas (mainly hydrogen) and dust to glow more brightly. This protostar, or early star, may reach a surface temperature of 3000 K with a luminosity 10 times greater than the Sun. As the protostar continues to collapse, heat and pressure in its core become so great that nuclear reactions begin to use the hydrogen as fuel to produce energy, and the protostar becomes a star. The pressure created by nuclear reactions in the star's core pushes outward and exactly balances the inward pull of gravity. This balance between forces allows the star to maintain a certain size and brightness for about 80% of its life. The star may reach a surface temperature of 5500 K and a luminosity equal to the Sun. After most of the hydrogen in the core is used up, a series of changes first causes the star to collapse, then greatly expand beyond its original size as the surface temperature lowers to 3000 K and the luminosity increases to 2000 times greater than the Sun. As the star reaches the end of its supply of nuclear fuel, its size changes to an equatorial diameter similar to the size of Earth. The surface temperature will be approximately 13,000 K and the luminosity will decrease to 0.001 that of the Sun.

63 *In your answer booklet*, complete the table by matching the stage of star development listed below to its description. Each stage will be used only once. [1]

Giant, Main Sequence, Nebula, Protostar, White Dwarf

64 Identify the force responsible for the contraction of gas and dust within a nebula. [1]

65 State the name of the gas that fuels the nuclear process in the core of a star for 80% of its life. [1]

Part C

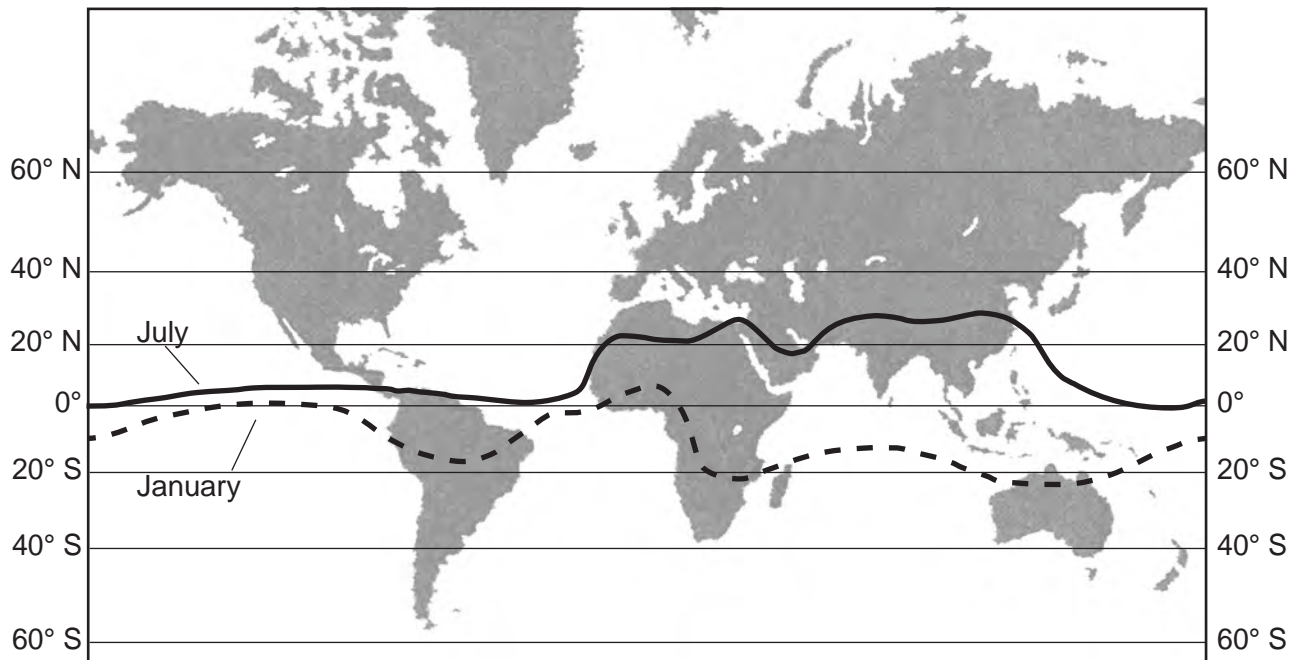
Answer all questions in this part.

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 passage and map below and on your knowledge of Earth science. The lines on the map show the average locations of the Intertropical Convergence Zone (ITCZ) in January and July.

ITCZ

The Intertropical Convergence Zone (ITCZ) is a band of low atmospheric pressure where prevailing winds generally blow toward the equator and come together. As the Sun's direct rays move northward from the equator after the Northern Hemisphere's spring equinox, the ITCZ also moves northward. As the Sun's direct rays move southward from the equator after the Northern Hemisphere's autumnal equinox, the ITCZ also moves southward. This northward and southward movement shifts a greater distance over land than over water.



- 66 Explain why the Intertropical Convergence Zone shifts northward after the Northern Hemisphere's spring equinox. [1]
- 67 Use the map to identify the maximum latitude that the Intertropical Convergence Zone reached when it shifted farthest north in July and the maximum latitude that it reached when it shifted farthest south in January. [1]
- 68 Explain why air is rising along the Intertropical Convergence Zone. [1]
-

Base your answers to questions 69 through 71 on the diagram on your answer booklet and on your knowledge of Earth science. The diagram represents a satellite in four positions, labeled *A* through *D*, in its orbit around a celestial object.

- 69 The celestial object represents one of the foci of this satellite's elliptical orbit. On the diagram *in your answer booklet*, draw an **X** to represent the position of the other focus of this orbit. [1]
- 70 Describe what would happen to the shape of the orbit represented in the diagram if the two foci were close together. [1]
- 71 Identify the letter of the position where the satellite experiences the greatest amount of gravitational attraction with the celestial object. Explain why the greatest amount of gravitational attraction occurs at this position. [1]
-

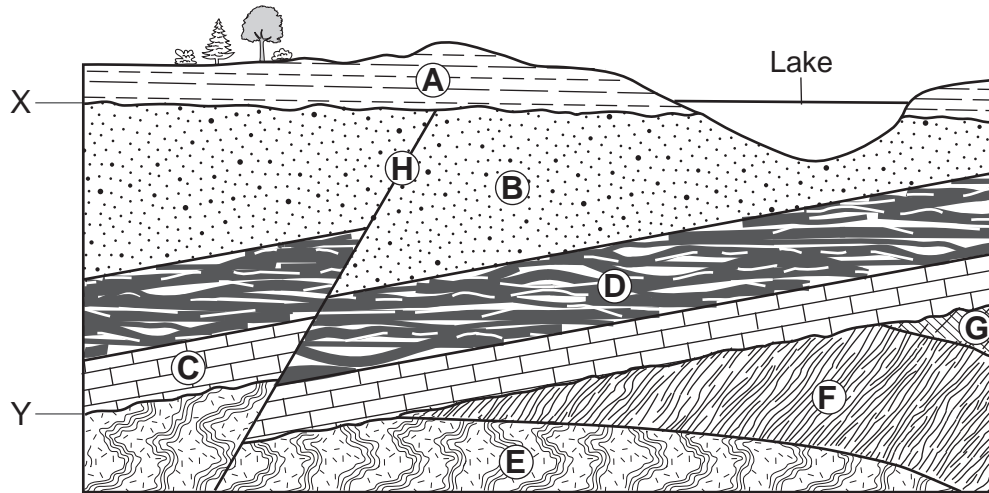
Base your answers to questions 72 through 74 on the data table below and on your knowledge of Earth science. The data table shows the barometric pressure at the center of Hurricane Katrina and the wind speed recorded at the same time each day from August 23 through August 30, 2005.

Hurricane Katrina Data

Date	Barometric Pressure (mb)	Wind Speed (mph)
August 23	1007	35
August 24	1002	45
August 25	985	75
August 26	965	100
August 27	945	115
August 28	902	165
August 29	960	75
August 30	991	30

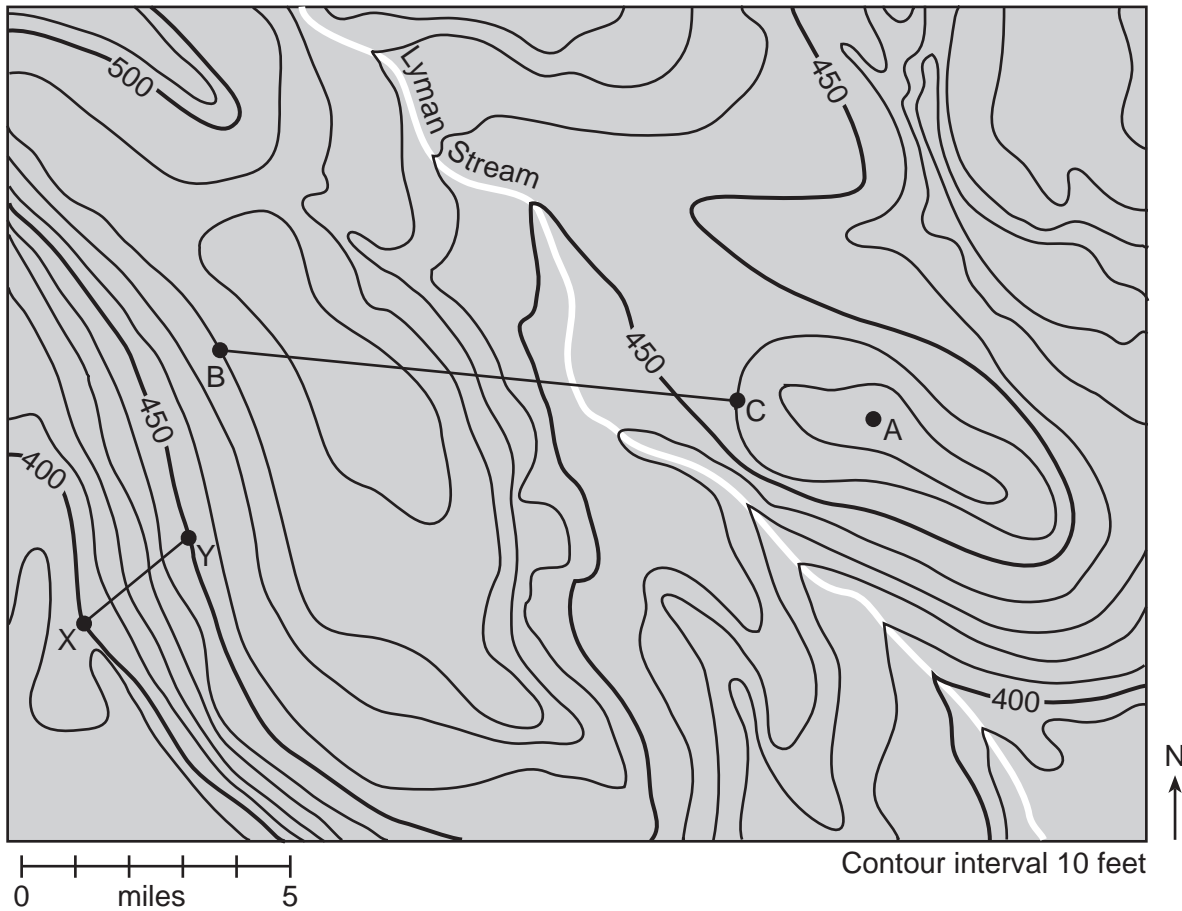
- 72 On the grid *in your answer booklet*, construct a line graph by plotting the data for the wind speed for each date shown on the data table. Connect *all eight* plots with a line. [1]
- 73 Hurricane Katrina made landfall on August 29. Describe *one* piece of evidence shown in the data table that supports this statement. [1]
- 74 Describe the relationship between barometric pressure and wind speed. [1]
-

Base your answers to questions 75 through 78 on the cross section below and on your knowledge of Earth science. The cross section represents rock units, labeled A through G, and a fault labeled H. Letters X and Y represent unconformities. The rock layers have *not* been overturned.



- 75 Identify, by letter, the only rock unit that remains in the original position in which the rock-forming sediments were deposited. [1]
- 76 Indicate the relative ages of rock layers A, B, C, and D, and fault H by listing the letters from oldest to youngest. [1]
- 77 Identify the letter and the name of the rock unit that has a bioclastic texture and is mostly composed of carbon. [1]
- 78 Layer C is Ordovician age bedrock. Identify the name of the trilobite index fossil and the name of the nautiloid index fossil that could be found in rock layer C. [1]
-

Base your answers to questions 79 through 82 on the topographic map below and on your knowledge of Earth science. Letters A, B, C, X, and Y are points on the map.



- 79 Calculate the gradient between points X and Y in feet per mile. [1]
- 80 Determine *one* possible elevation of point A. [1]
- 81 On the grid *in your answer booklet*, construct a topographic profile along line BC by plotting the elevation of each contour line that crosses line BC. Points B and C have already been plotted on the grid. Connect *all nine* plots with a line from B to C to complete the profile. [1]
- 82 State the general compass direction in which Lyman Stream flows. Describe the evidence shown by the contour lines on the map that supports this stream flowing downhill in that direction. [1]
-

Base your answers to questions 83 through 85 on the diagram on your answer booklet and on your knowledge of Earth science. The diagram represents temperatures that occur on either side of a mountain. Elevations are recorded in meters (m) above sea level and air temperature is recorded in degrees Celsius ($^{\circ}\text{C}$). Letters *A* and *B* represent reference lines on the diagram.

83 On the diagram *in your answer booklet*, draw one arrowhead on reference line *A* and one arrowhead on reference line *B* to indicate the direction of air flow on each side of the mountain. [1]

84 Compared to the air temperature and moisture conditions on the western side of the mountain at sea level, describe how the air temperatures and moisture conditions on the eastern side of the mountain at sea level are different. [1]

85 State the most probable air temperature that would occur on the west side of the mountain at 1500 meters and the most probable air temperature on the east side of the mountain at 1500 meters. [1]
