The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
EARTH SCIENCE

Wednesday, August 14, 2013 — 12:30 to 3:30 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 do all Jovian planets have in common?

(1) small diameters and low densities
(2) small diameters and high densities
(3) large diameters and low densities
(4) large diameters and high densities

2 Which event occurred approximately 4.6 billion years ago?

(1) evolution of the earliest fish
(2) evolution of stromatolites
(3) formation of the oldest known Earth rocks
(4) formation of Earth and our solar system

3 Which process combines lighter elements into heavier elements and produces energy within the Sun and other stars?

(1) fusion
(2) insolation
(3) conduction
(4) radioactive decay

4 Which evidence best supports the Big Bang theory?

(1) rate of rotation of the Sun
(2) existence of cosmic background radiation
(3) uniform radioactive decay of uranium-238
(4) separation of Earth's interior into different layers

5 Which star has a surface temperature most similar to the surface temperature of *Alpha Centauri*?

(1) *Polaris*
(2) *Betelgeuse*
(3) *Procyon B*
(4) *Sirius*

6 The red shift of light from most galaxies is evidence that

(1) most galaxies are moving away from Earth
(2) a majority of stars in most galaxies are red giants
(3) the light slows down as it nears Earth
(4) red light travels faster than other colors of light

7 Which motion causes some constellations to be visible in New York State only during winter nights and other constellations to be visible only during summer nights?

(1) Stars in constellations revolve around Earth.
(2) Stars in constellations revolve around the Sun.
(3) Earth revolves around the Sun.
(4) Earth rotates on its axis.

8 Sediment samples *A* through *D* below have the same volume and packing, but contain different percentages of various particle sizes.

Sample *A*: 75% clay and 25% silt
Sample *B*: 25% clay and 75% sand
Sample *C*: 50% pebbles and 50% sand
Sample *D*: 50% pebbles and 50% cobbles

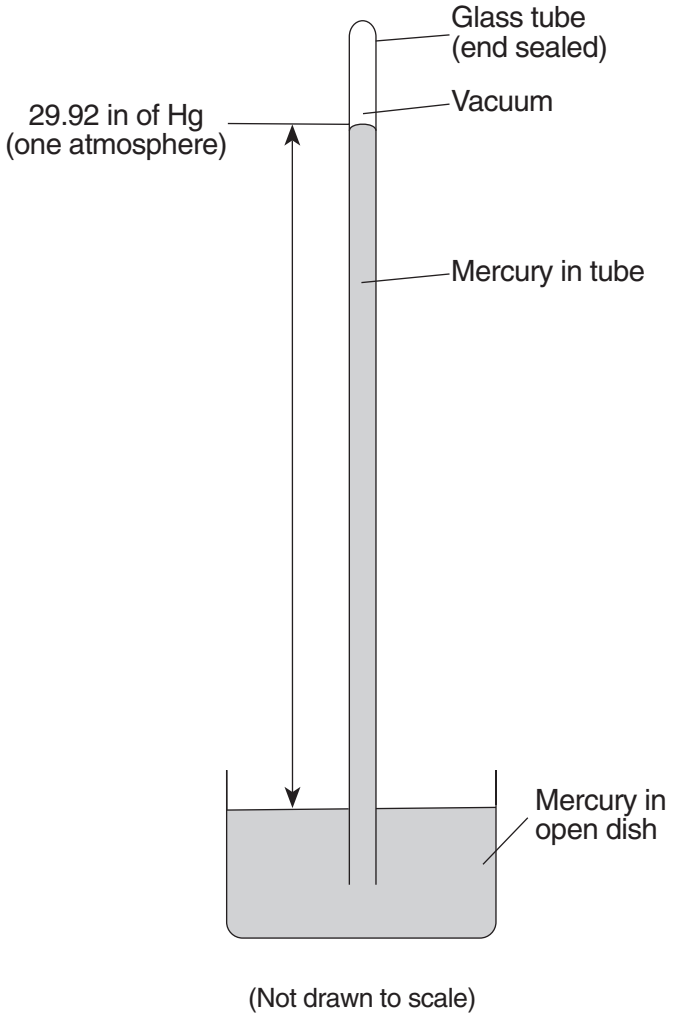
Which sample most likely has the greatest permeability?

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

9 Most of Earth's weather events take place in the

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

10 The diagram below represents a weather instrument.



(Not drawn to scale)

Which weather variable was this instrument designed to measure?

(1) air pressure
(2) dewpoint
(3) relative humidity
(4) amount of precipitation

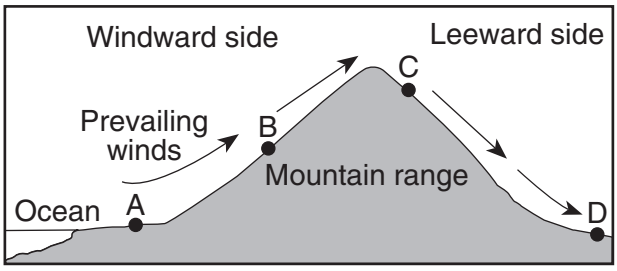
11 Jet stream winds over the United States generally move from

(1) east to west
(2) west to east
(3) north to south
(4) south to north

12 What is the dewpoint when the dry-bulb temperature is 8°C and the wet-bulb temperature is 2°C?

(1) 28°C
(2) 6°C
(3) 3°C
(4) −9°C

13 The cross section below represents prevailing winds moving over a coastal mountain range. Letters *A* through *D* represent locations on Earth's surface.



Which location will most likely have the *least* annual precipitation?

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

14 Which transfer of energy occurs mainly through the process of convection?

(1) electromagnetic energy transferred from the Sun to the Moon
(2) solar energy transferred through space to Earth's surface
(3) heated air in the lower atmosphere transferred upward by density differences
(4) heat from radioactive decay transferred by molecular collisions to surrounding mantle rock

15 In which planetary wind belt do most storms move toward the northeast?

(1) 30° N to 60° N
(2) 0° to 30° N
(3) 0° to 30° S
(4) 30° S to 60° S

16 What is the inferred pressure, in millions of atmospheres, in Earth's interior at a depth of 2900 kilometers?

(1) 1.4
(2) 9.9
(3) 3.0
(4) 4900

17 Compared to the oceanic crust, the continental crust is

(1) less dense and more basaltic
(2) less dense and more felsic
(3) more dense and more granitic
(4) more dense and more mafic

18 Which landmass is moving northward with Australia as part of the same tectonic plate?

(1) India
(2) Antarctica
(3) North America
(4) South America

19 The epicenter of an earthquake is located 6500 kilometers away from a seismic station. If the first *S*-wave arrived at this seismic station at 1:30 p.m., at what time did the first *P*-wave arrive?

(1) 1:20 p.m.
(2) 1:22 p.m.
(3) 1:38 p.m.
(4) 1:40 p.m.

20 Which two cities are located in the Interior Lowlands?

(1) Elmira and Binghamton
(2) Riverhead and New York City
(3) Massena and Old Forge
(4) Buffalo and Watertown

21 The large waterfall at Niagara Falls, New York, was originally located at the Niagara Escarpment. Which term best describes an escarpment?

(1) U-shaped valley
(2) V-shaped valley
(3) cliff
(4) drumlin

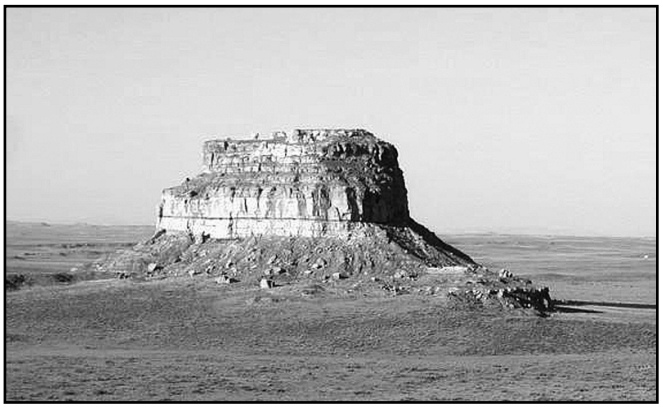
22 Trees growing on the edge of a river's meander are most likely to fall into the river due to

(1) deposition on the inside of the meander
(2) deposition on the outside of the meander
(3) erosion on the inside of the meander
(4) erosion on the outside of the meander

23 What is the approximate minimum stream velocity needed to keep a 6.4-cm-diameter particle in motion?

(1) 10 cm/s
(2) 50 cm/s
(3) 100 cm/s
(4) 200 cm/s

24 The photograph below shows a sandstone butte in an arid region.



Which agents of erosion are currently changing the appearance of this butte?

(1) glaciers and mass movement
(2) wave action and running water
(3) wind and mass movement
(4) running water and glaciers

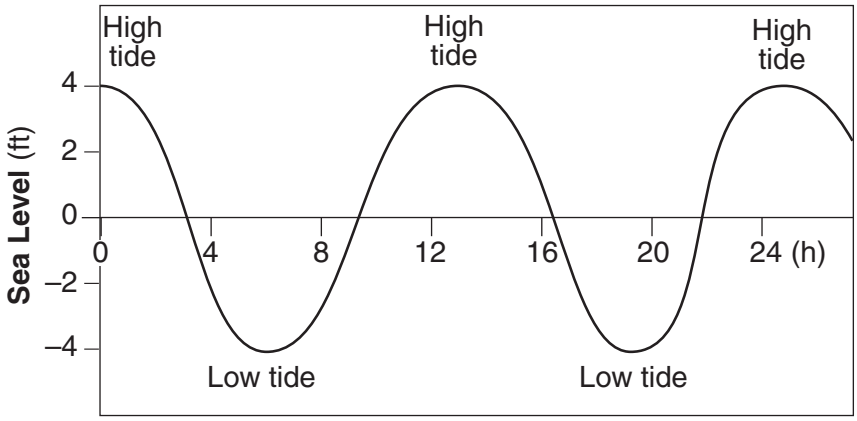
25 Sediment is deposited in a river delta because the

(1) velocity of the river decreases
(2) force of gravity decreases
(3) volume of the river increases
(4) gradient of the river increases

26 Which processes lead directly to the formation of igneous rock?

(1) weathering and erosion
(2) compaction and cementation
(3) heat and pressure
(4) melting and solidification

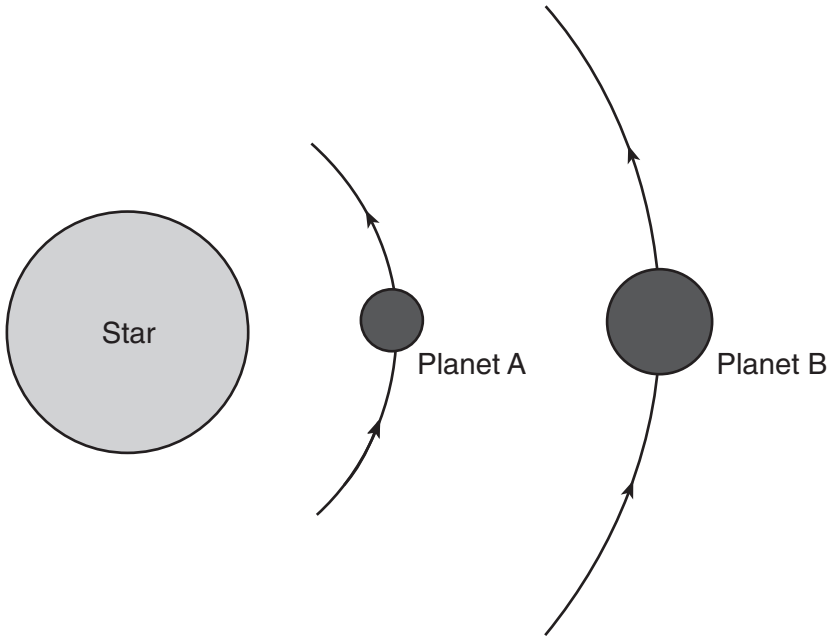
27 A graph of tidal sea-level changes at a coastal city is shown below.



The number of hours from one high tide to the next high tide is approximately

(1) 4 h
(2) 8 h
(3) 12 h
(4) 24 h

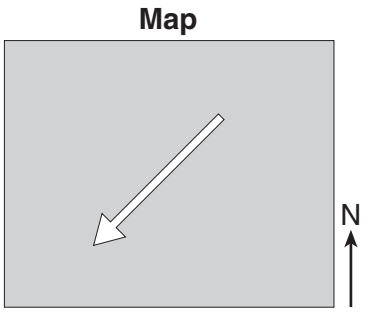
28 The diagram below represents planets *A* and *B*, of equal mass, revolving around a star.



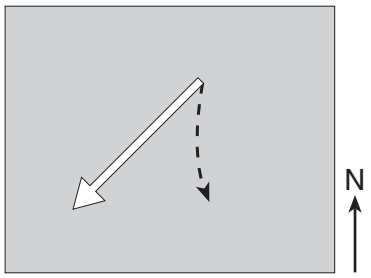
Compared to planet *A*, planet *B* has a

(1) weaker gravitational attraction to the star and a shorter period of revolution
(2) weaker gravitational attraction to the star and a longer period of revolution
(3) stronger gravitational attraction to the star and a shorter period of revolution
(4) stronger gravitational attraction to the star and a longer period of revolution

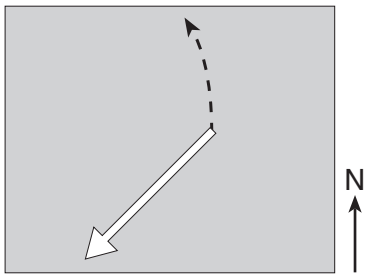
29 The arrow on the map below represents the direction a wind is blowing over a land surface in the Northern Hemisphere *without* showing the Coriolis effect.



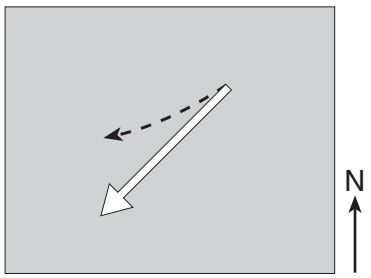
Which dashed arrow represents how the wind direction will change in the Northern Hemisphere due to the Coriolis effect?



(1)



(3)



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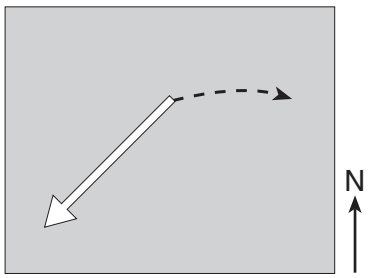
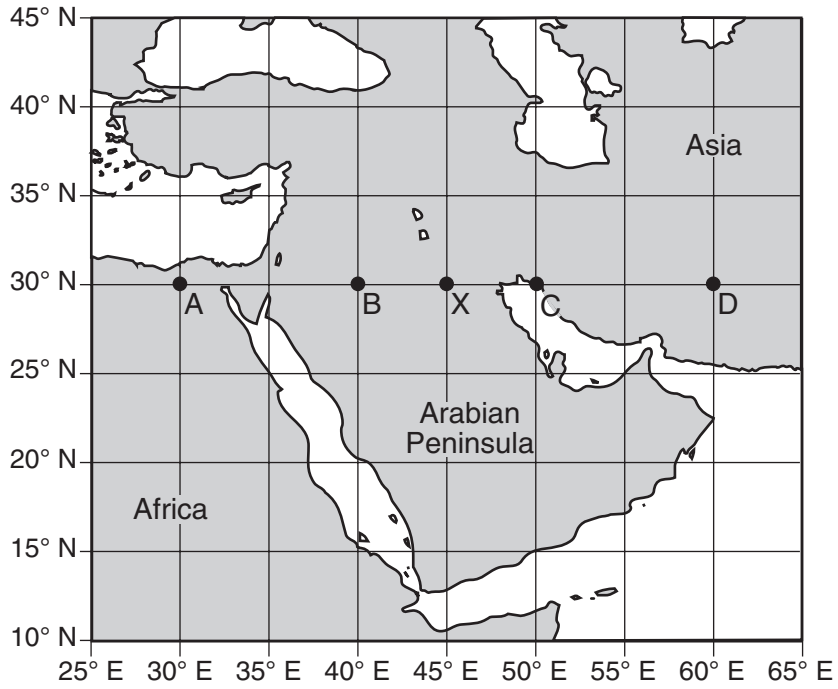


(4)

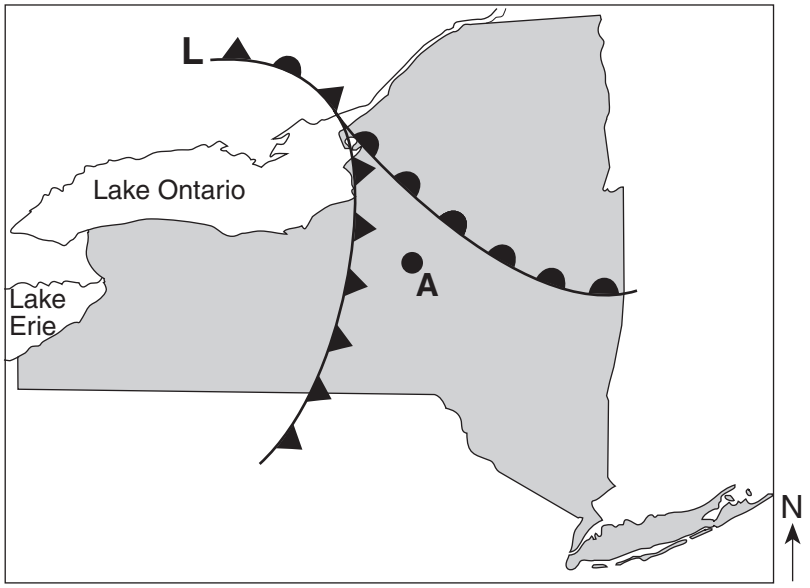
30 The map below shows a portion of the Middle East. Points *A*, *B*, *C*, *D*, and *X* are locations on Earth's surface.



When it is 10:00 a.m. solar time at location *X*, at which location is 11:00 a.m. solar time being observed?

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

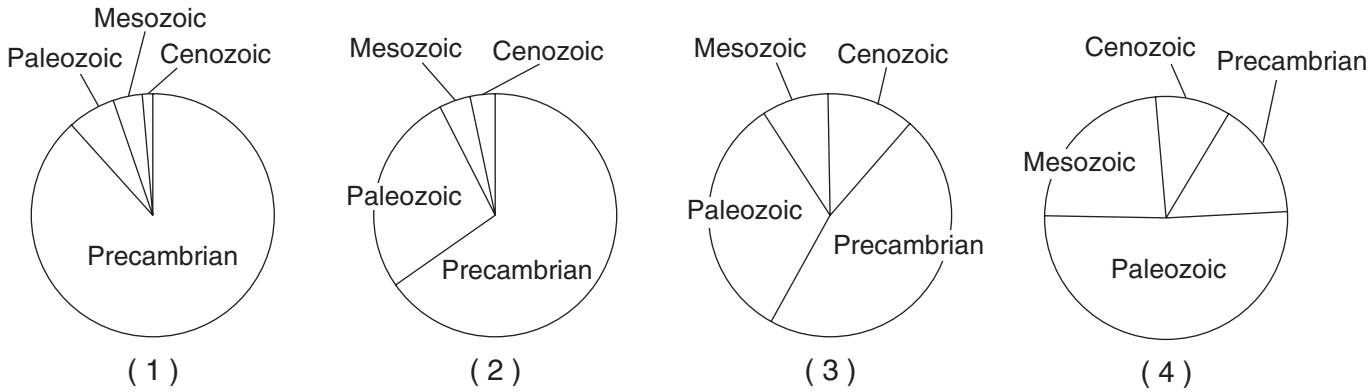
31 The weather map below shows a portion of a low-pressure system.



Which front will most likely pass over location *A* during the next two hours?

(1) warm
(2) stationary
(3) occluded
(4) cold

32 Which pie graph best shows the relative length of time of the major intervals of Earth's geologic history?



33 The table below lists some information about the minerals graphite and diamond.

Data Table

Mineral	Composition	Depth of Formation	Hardness	Electrical Conductor
graphite	carbon	shallow	1	good
diamond	carbon	very deep	10	poor

Some properties of diamond are different from those of graphite because diamond

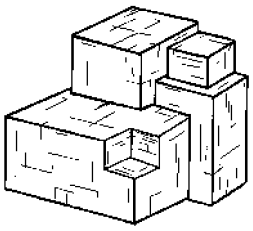
(1) has a different arrangement of atoms
(2) forms larger crystals
(3) has a different composition
(4) is older in geologic age

Base your answers to questions 34 and 35 on the data table below and on your knowledge of Earth science. The table provides information about four minerals, *A* through *D*.

Data Table

Mineral	Breakage	Hardness	Luster	Color
A	cleavage	2.5	metallic	silver
B	cleavage	2.5	nonmetallic	black
C	cleavage	3	nonmetallic	colorless
D	fracture	6.5	nonmetallic	green

34 The diagram below represents a sample of mineral *A*.



Mineral *A* is most likely

(1) garnet
(2) galena
(3) olivine
(4) halite

35 Which mineral can scratch *A*, *B*, and *C*, but can *not* scratch *D*?

(1) talc
(2) selenite gypsum
(3) fluorite
(4) quartz

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 passage below and on your knowledge of Earth science.

Ice Ages

Earth has undergone many ice ages, each lasting millions of years. Some scientists infer that most ice ages were caused by landmasses blocking the ocean currents between equatorial regions and the poles. Ice ages usually ended when the positions of continents allowed ocean currents to resume transporting equatorial heat to the poles.

During each ice age there were advances and retreats of glaciers. These cool glacial and warm interglacial climate intervals were caused mostly by changes in Earth's orbit and tilt. Earth is presently in a warm interglacial interval.

36 Earth's warm interglacial intervals are due primarily to

(1) changes in Earth's period of rotation
(2) changes in Earth's orbit and tilt
(3) increases in elevation of North America
(4) divergence at the Mid-Atlantic Ridge

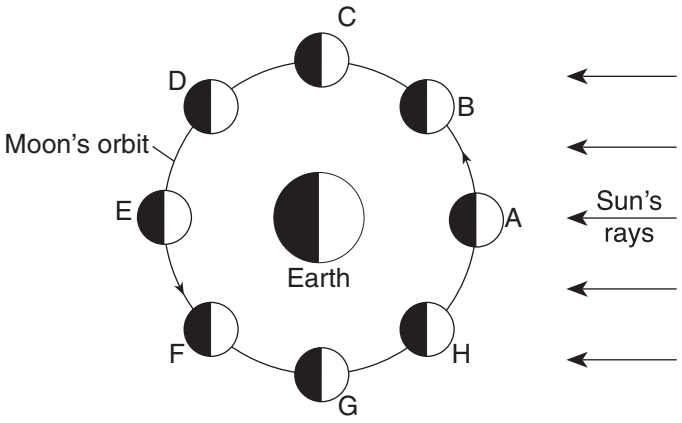
37 Approximately 359 million years ago, the average intensity of insolation received in a year by the land area that is now eastern North America was likely

(1) greater, because eastern North America was at a lower latitude
(2) greater, because eastern North America was at a higher latitude
(3) less, because eastern North America was at a lower latitude
(4) less, because eastern North America was at a higher latitude

38 Evidence that glaciers covered large areas of New York State is best provided by

(1) long-term temperature measurements
(2) folded layers of bedrock
(3) kettle lakes and drumlins
(4) the presence of streams and rivers

Base your answers to questions 39 through 41 on the diagram below and on your knowledge of Earth science. The diagram represents the Moon in eight positions, *A* through *H*, in its orbit around Earth.



(Not drawn to scale)

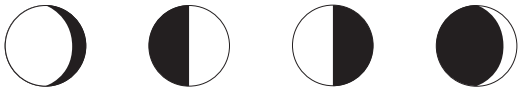
39 When a solar eclipse is viewed from Earth, the Moon must be located at orbital position

(1) *A*
(2) *E*
(3) *C*
(4) *G*

40 How many days are required for the Moon to complete a cycle of phases from the new Moon position represented in the diagram to the new Moon the following month?

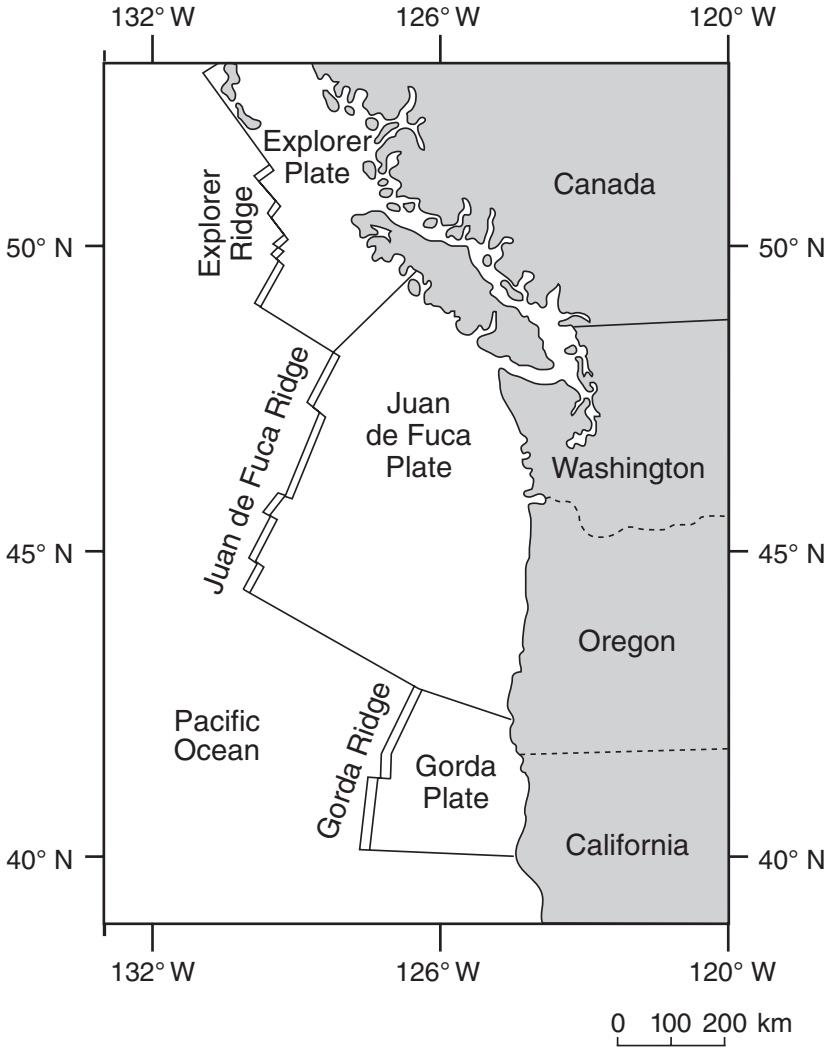
(1) 2.2 d
(2) 27.3 d
(3) 29.5 d
(4) 365.26 d

41 Which Moon phase is observed in New York State when the Moon is located at position *F*?

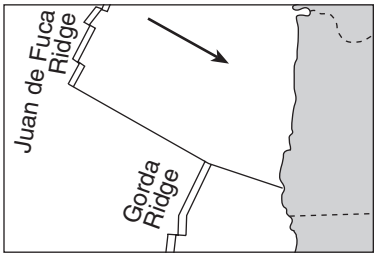


(1) (2) (3) (4)

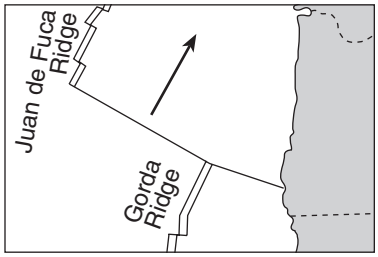
Base your answers to questions 42 and 43 on the map below and on your knowledge of Earth science. The map shows the coast of the northwestern United States. The Explorer and Gorda ridges and plates are parts of the Juan de Fuca tectonic system.



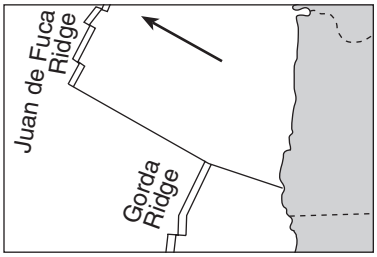
42 The arrow on which map best shows the direction of movement of the Juan de Fuca Plate in relation to the Juan de Fuca Ridge?



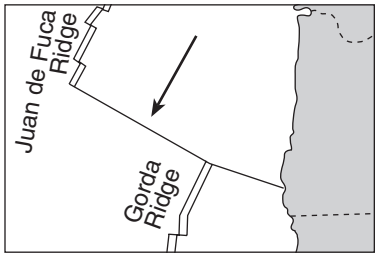
(1)



(3)



(2)

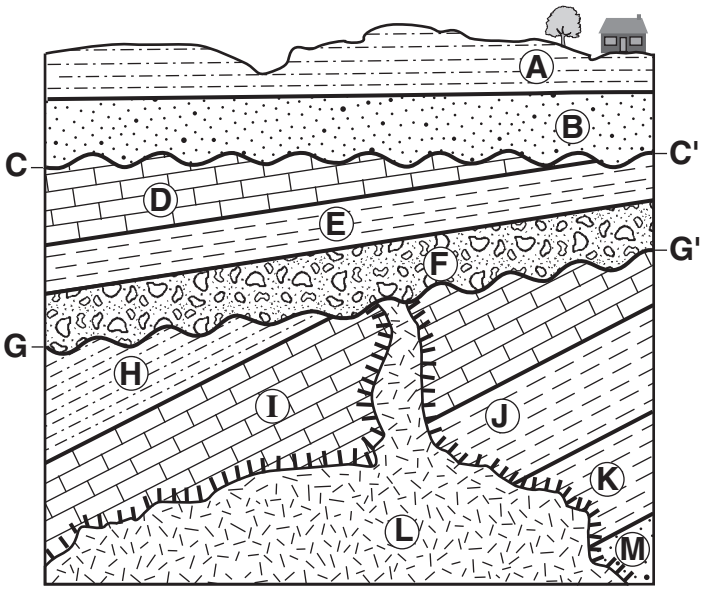


(4)

43 The Explorer Ridge is the boundary between the Explorer Plate and the

(1) North American Plate
(2) Pacific Plate
(3) Juan de Fuca Plate
(4) Gorda Plate

Base your answers to questions 44 through 47 on the cross section below and on your knowledge of Earth science. The cross section represents rock units that have *not* been overturned. Lines *CC′* and *GG′* represent unconformities. The geologic ages of some of the lettered rock units are shown below the cross section.



Rock Unit Geologic Age
B = Cretaceous Period
E = Permian Period
J = Silurian Period
M = Cambrian Period

Key	
	Igneous intrusion
	Contact metamorphism

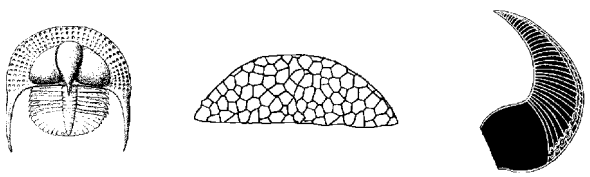
44 Which rock unit was formed most recently?

(1) *A*
(2) *F*
(3) *L*
(4) *M*

45 Why is there *no* contact metamorphism indicated between rock unit *L* and rock unit *F*?

(1) Conglomerate does not metamorphose.
(2) The intrusion was not hot enough to metamorphose rock unit *F*.
(3) The contact metamorphism within rock unit *F* eroded away.
(4) Rock unit *F* was deposited after the intrusion of rock unit *L*.

46 The diagrams below represent three index fossils found in one of the rock units.



These fossils are most likely found in

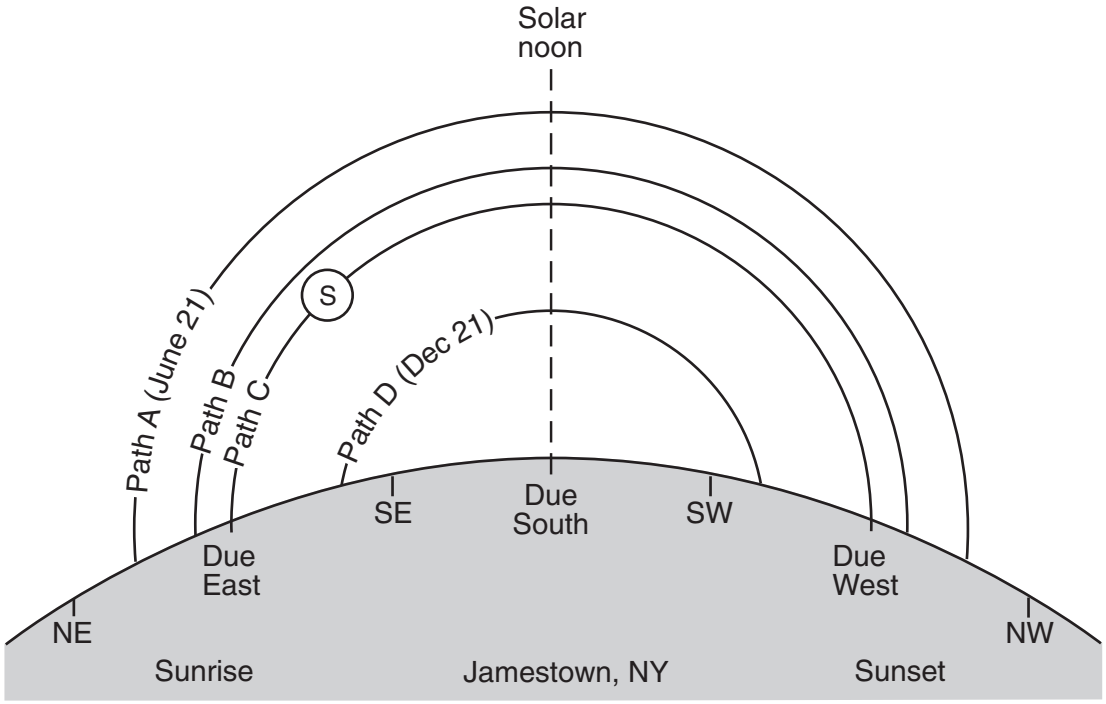
(1) rock unit *I*
(2) rock unit *J*
(3) rock unit *K*
(4) rock unit *M*

47 Which inference about rock units *D, E,* and *H* can best be supported by evidence in the cross section?

(1) They contain mostly sand-sized sediment.
(2) They contain both land and marine fossils.
(3) They were altered by contact metamorphism.
(4) They were deposited as horizontal layers and were later tilted.

Base your answers to questions 48 through 50 on the diagram below and on your knowledge of Earth science. The diagram represents four apparent paths of the Sun, labeled *A, B, C,* and *D,* observed in Jamestown, New York. The June 21 and December 21 sunrise and sunset positions are indicated. Letter *S* identifies the Sun's position on path *C* at a specific time of day. Compass directions are indicated along the horizon.

The Sun's Changing Position



48 The greatest duration of insolation in Jamestown occurs when the Sun appears to travel along path

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

49 At what time of day is the Sun at position *S*?

(1) 6 a.m.
(2) 9 a.m.
(3) 3 p.m.
(4) 6 p.m.

50 When the Sun appears to travel along path *D* at Jamestown, which latitude on Earth receives the most direct rays from the Sun?

(1) 42° N
(2) 23.5° N
(3) 0°
(4) 23.5° S

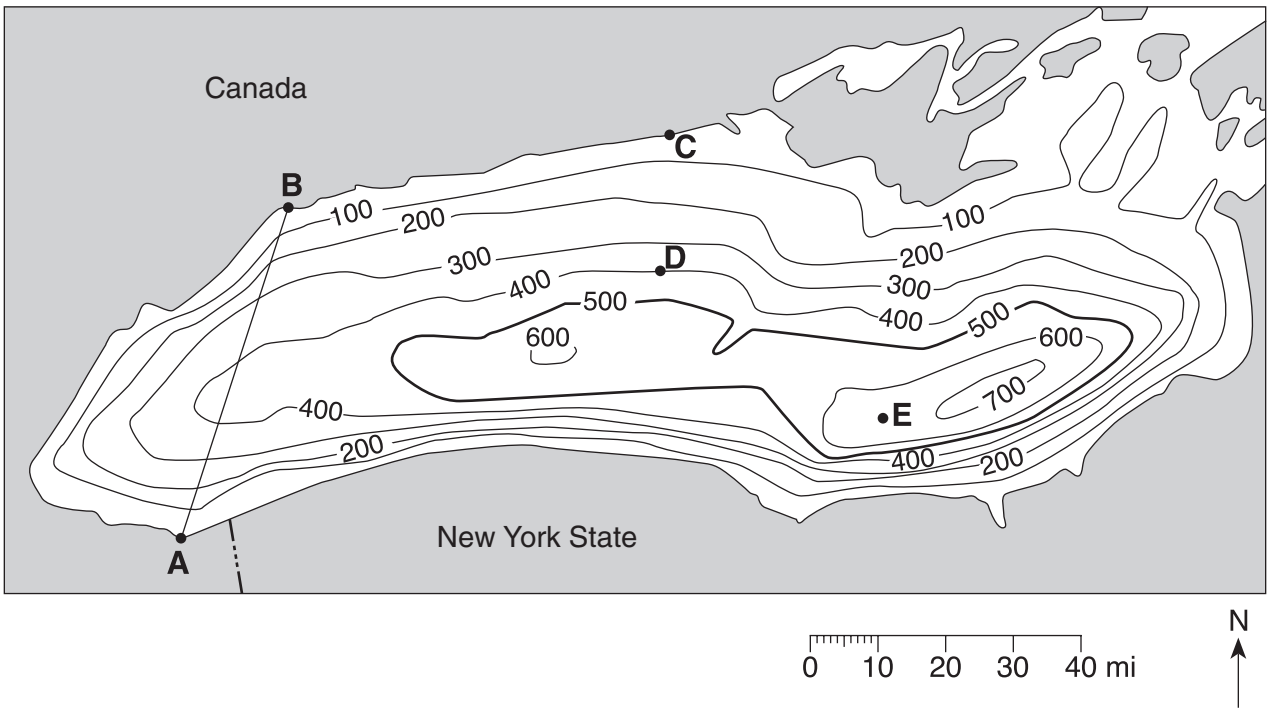
Part B–2

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 field map below and on your knowledge of Earth science. The map shows the depth of Lake Ontario. Isoline values indicate water depth, in feet. Points *A*, *B*, and *C* represent locations on the shoreline of Lake Ontario. Points *D* and *E* represent locations on the bottom of the lake.

Water Depth of Lake Ontario



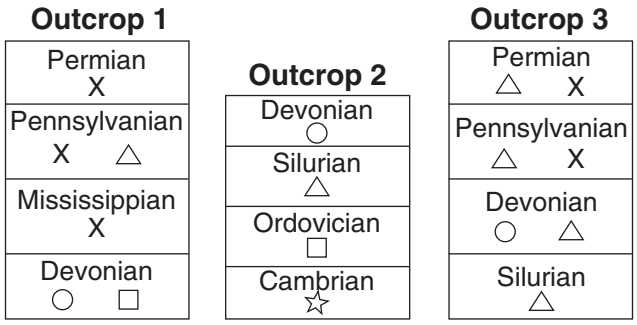
51 On the grid *in your answer booklet*, draw a profile of the bottom of western Lake Ontario by plotting the depth of the water along line *AB*. Plot *each* point where an isoline showing depth is crossed by line *AB*. Connect the plots with a line, starting at *A* and ending at *B*, to complete the profile. [1]

52 Calculate the gradient of the lake bottom between point *C* and point *D*. Label your answer with the correct units. [1]

53 What is a possible depth of the water at location *E*? [1]

54 What evidence shown on the map indicates that the southern section of the bottom of Lake Ontario has the steepest slope? [1]

Base your answers to questions 55 through 58 on the cross sections below and on your knowledge of Earth science. The cross sections represent three bedrock outcrops, 1, 2, and 3, found several kilometers apart. The geologic time period when each sedimentary rock layer formed is shown. The symbols (☆, ○, X, □, and △) represent fossils of different types of organisms present in the rock layers.



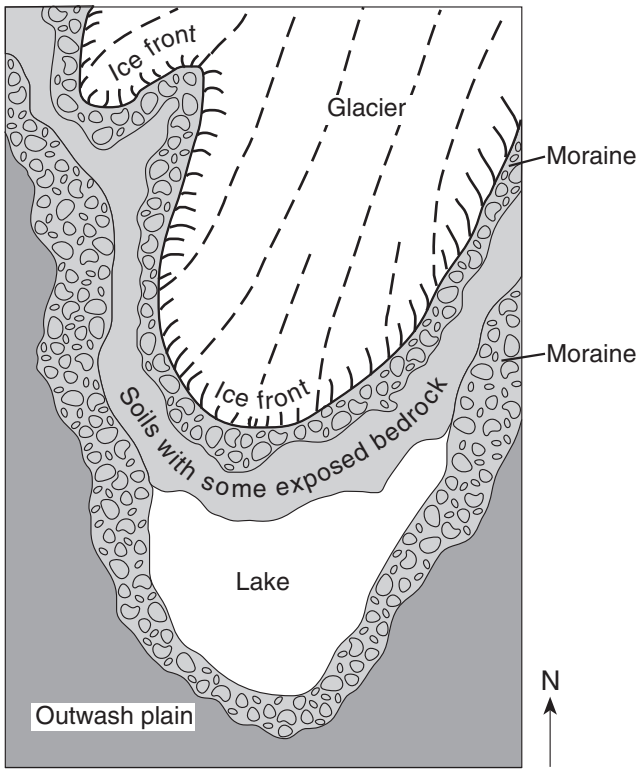
55 Draw the fossil symbol that represents the best index fossil. Describe *one* piece of evidence shown in the outcrops that indicates that this fossil has characteristics of a good index fossil. [1]

56 Write the outcrop number of the cross section that could be found in New York State. Describe the evidence that supports your answer. [1]

57 Explain why the geologic age of these rock layers could *not* be accurately dated using carbon-14. [1]

58 Explain why the index fossil *Coelophysis* is *not* preserved in any of the rock outcrops. [1]

Base your answers to questions 59 through 62 on the map below and on your knowledge of Earth science. The map shows a retreating valley glacier and the features that have formed because of the advance and retreat of the glacier.



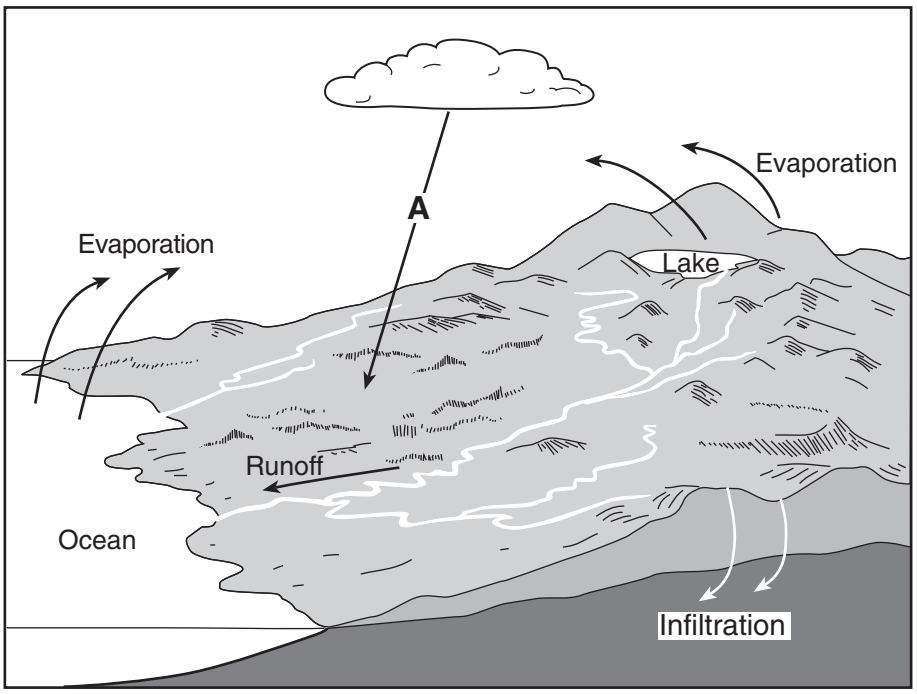
59 Describe *one* piece of evidence likely to be found on the exposed bedrock surfaces that could indicate the direction this glacier moved. [1]

60 Describe *one* difference between the arrangement of sediment in the moraines and the arrangement of sediment in the outwash plain. [1]

61 Describe the most likely shape of the valley being formed due to erosion by this glacier. [1]

62 Explain why the glacial ice absorbs *less* solar radiation than the surrounding exposed bedrock and soil. [1]

Base your answers to questions 63 through 65 on the model below and on your knowledge of Earth science. The model shows the movement of water in the water cycle. Arrow *A* represents a process within the water cycle.



63 Identify *one* water cycle process represented by arrow *A*. [1]

64 How many joules of heat energy are required to evaporate 2 grams of water from the lake surface? [1]

65 A portion of the land surface shown was recently paved with asphalt and concrete. Describe the change in the amount of runoff and infiltration that will occur. [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 69 on the table below and on your knowledge of Earth science. The table lists the average surface temperature, in kelvins, and the average orbital velocity, in kilometers per second, of each planet of our solar system.

Data Table

Planet	**Average Surface Temperature** (K)	**Average Orbital Velocity** (km/s)
Mercury	440	47.87
Venus	737	35.00
Earth	288	29.78
Mars	208	24.13
Jupiter	163	13.07
Saturn	133	9.69
Uranus	78	6.81
Neptune	73	5.43

66 On the grid *in your answer booklet*, construct a bar graph to represent the average surface temperature for *each* planet. [1]

67 Approximately 97% of Venus's atmosphere is carbon dioxide. Describe how carbon dioxide contributes to the unusually high average surface temperature of Venus. [1]

68 Use the set of axes *in your answer booklet* to draw a line that represents the general relationship between the mean distances of planets from the Sun and the average orbital velocities of the planets. [1]

69 The orbital velocity of Earth is sometimes faster and sometimes slower than its average orbital velocity. Explain why the orbital velocity of Earth varies in a cyclic pattern. [1]

Base your answers to questions 70 through 73 on the weather map in your answer booklet and on your knowledge of Earth science. The map shows air temperatures (in °F) at locations in the northeastern United States and part of Canada. Syracuse, New York, is labeled. Line *AB* represents a stationary frontal boundary.

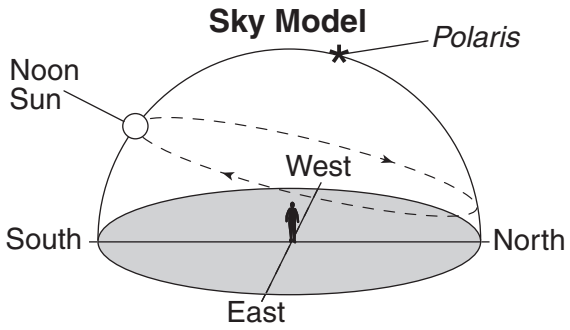
70 On the map *in your answer booklet*, draw the isotherm for 0°F. Extend each end of the isotherm to the edge of the map. [1]

71 Convert the air temperature at Syracuse from degrees Fahrenheit to degrees Celsius. [1]

72 Write the two-letter weather map symbol for the type of air mass that is most likely located north of frontal boundary *AB*. [1]

73 Explain why locations near the Atlantic Ocean have air temperatures that are warmer than locations farther inland. [1]

Base your answers to questions 74 through 76 on the sky model below and on your knowledge of Earth science. The model shows the Sun's apparent path through the sky as seen by an observer in the Northern Hemisphere on June 21.



74 Describe the evidence, shown in the sky model, which indicates that the observer is *not* located at the North Pole. [1]

75 The diagram *in your answer booklet* represents the position of Earth in its orbit on March 21. Place an **X** on Earth's orbit to represent Earth's orbital position when the apparent path of the Sun in the sky model was observed. [1]

76 Identify the cause of the apparent daily motion of the Sun through the sky. [1]

Base your answers to questions 77 through 79 on the passage below and on your knowledge of Earth science. The passage describes unusual lava from a volcano in Africa.

Unusual Volcano

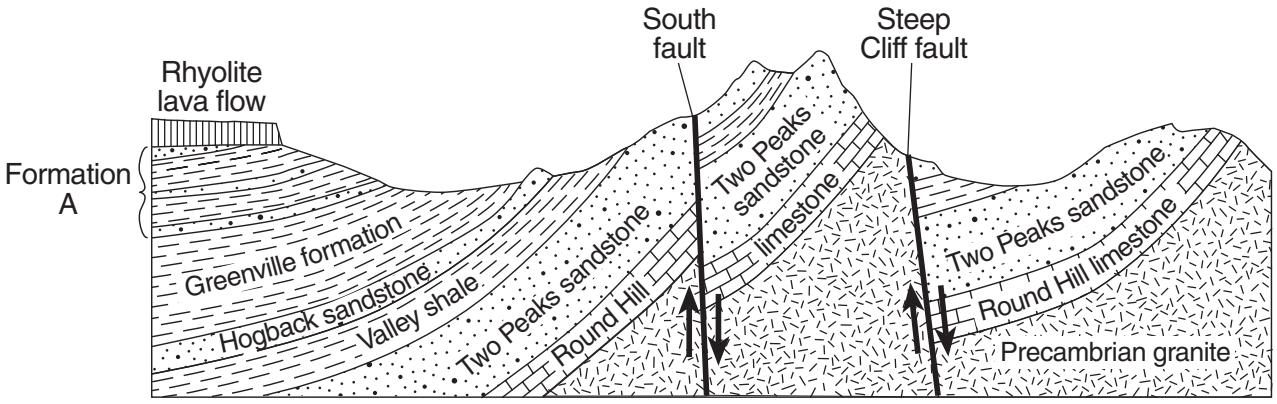
Nyiragongo, located at 2° S 29° E, is an active African volcano. It has the most fluid lava on Earth. The lava has a composition unlike any other lava in the world. The rare isotopes found in the lava are similar to those found in ancient asteroids. This fact leads scientists to infer that the lava may be as old as our solar system and that it comes from deep inside the mantle near Earth's outer core. Nyiragongo is one volcano in a ring of many volcanoes surrounding an area that is domed upward nearly a mile above sea level, causing scientists to infer that a new mantle hot spot is forming there.

77 Two rocks, scoria and basalt, have formed from the cooled lava that erupted from Nyiragongo. Describe the texture of *each* rock. [1]

78 Identify the type of tectonic plate boundary found in the vicinity of Nyiragongo. [1]

79 Identify *two* other locations on Earth, *not* on a plate boundary, where mantle rock is rising to Earth's surface. [1]

Base your answers to questions 80 through 82 on the cross section below and on your knowledge of Earth science. The cross section represents rock formations that exist in the southwestern part of the United States. Names of the faults and rock units are indicated on the diagram.

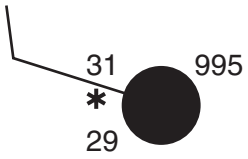


80 Formation *A* consists of three thin sandstone layers interbedded with shale layers. Hornfels and quartzite are found at the top of formation *A*. Describe how the hornfels and quartzite formed. [1]

81 Explain why the Two Peaks sandstone is *not* a continuous layer. [1]

82 List *three* minerals that are likely present in the Precambrian granite rock. [1]

Base your answers to questions 83 through 85 on the weather station model below and on your knowledge of Earth science. The model shows atmospheric conditions at Oswego, New York.



83 *In your answer booklet*, fill in the correct information for *each* weather variable listed for this station model. [1]

84 Explain how the data on the station model indicate a high relative humidity. [1]

85 Convert the coded air pressure shown on the station model into the actual millibars of air pressure. [1]

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