

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
EARTH SCIENCE

Friday, June 17, 2011 — 1:15 to 4:15 p.m., only

Use your knowledge of Earth science to answer all questions in this examination. Before you begin this examination, you must be provided with the *2010 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. 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 *2010 Edition Reference Tables for Physical Setting/Earth Science* must be available for you to use while taking this examination.

The use of any communications device is strictly prohibited when taking this examination. If you use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

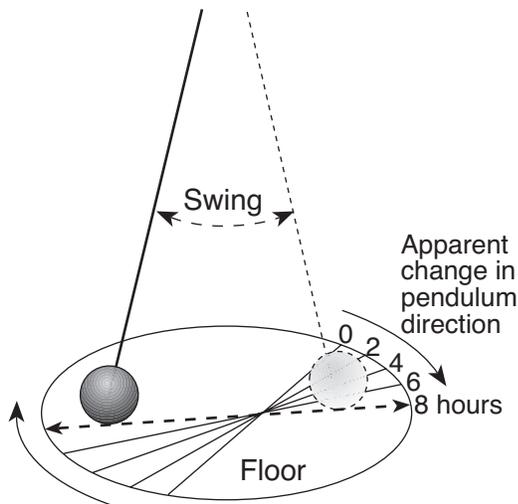
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

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 *2010 Edition Reference Tables for Physical Setting/Earth Science*. Record your answers on your separate answer sheet.

- 1 Why do the planets in our solar system have a layered internal structure?
 - (1) All planets cooled rapidly after they formed.
 - (2) The Sun exerts a gravitational force on the planets.
 - (3) Each planet is composed of materials of different densities.
 - (4) Cosmic dust settled in layers on the planets' surfaces.
- 2 The diagram below shows a large pendulum in motion over an 8-hour period.

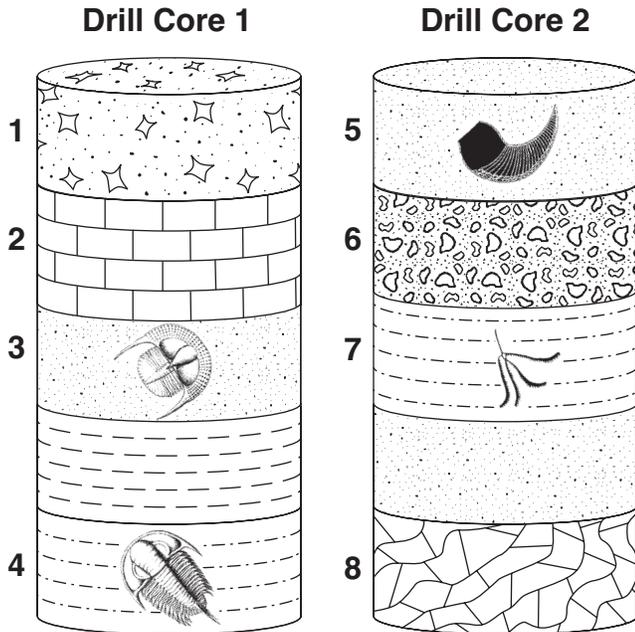


What is the main reason the pendulum appears to change its direction of swing over time?

- (1) tilt of Earth on its axis
 - (2) rotation of Earth on its axis
 - (3) revolution of Earth in its orbit
 - (4) speed of Earth in its orbit
- 3 On which day of the year does the Sun reach the greatest altitude at solar noon in New York City?
 - (1) June 21
 - (2) July 21
 - (3) August 21
 - (4) September 21

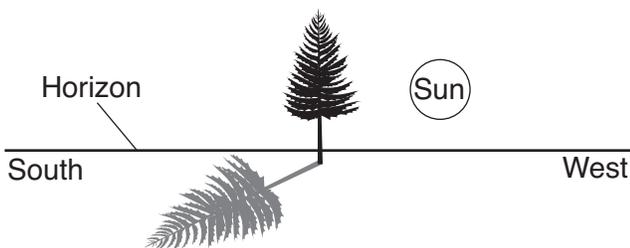
- 4 Cosmic background radiation provides direct evidence for the origin of
 - (1) the universe
 - (2) our solar system
 - (3) Earth's ozone layer
 - (4) Earth's earliest atmosphere
- 5 Planetary winds and ocean currents are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere due to
 - (1) seasonal changes
 - (2) plate tectonics
 - (3) the Doppler effect
 - (4) the Coriolis effect
- 6 What is the approximate altitude of *Polaris* at Syracuse, New York?
 - (1) 43°
 - (2) 47°
 - (3) 76°
 - (4) 90°
- 7 Most rocks that form from fragmental rock particles are classified as
 - (1) extrusive igneous
 - (2) intrusive igneous
 - (3) clastic sedimentary
 - (4) chemical sedimentary
- 8 Which group of organisms has the shortest record of life on Earth?
 - (1) eurypterids
 - (2) graptolites
 - (3) birds
 - (4) placoderm fish
- 9 What is inferred to be the main source of the free oxygen that first entered Earth's atmosphere?
 - (1) meteorite impacts releasing oxygen
 - (2) oxygen-producing organisms
 - (3) melting of glacial ice into hydrogen and oxygen
 - (4) radioactive decay of rocks containing oxygen

- 10 The drill-core samples below were taken from two locations 1000 kilometers apart. Rock layers 1 through 8 have been labeled. Some index fossils are shown in the layers.



Which numbered layers most likely formed at the same time?

- (1) 1 and 6 (3) 3 and 5
 (2) 2 and 8 (4) 4 and 7
- 11 A tree in New York State casts a shadow as shown in the diagram below.



What time of day and season are represented by the diagram?

- (1) early morning in winter
 (2) early morning in summer
 (3) late afternoon in winter
 (4) late afternoon in summer

- 12 Near which two latitudes are most of Earth's major deserts located?

- (1) 0° and 90° N (3) 30° N and 30° S
 (2) 30° S and 60° S (4) 60° S and 60° N

- 13 How much of an 800-gram sample of potassium-40 will remain after 3.9×10^9 years of radioactive decay?

- (1) 50 grams (3) 200 grams
 (2) 100 grams (4) 400 grams

- 14 Thin layers of volcanic ash act as excellent time markers in the correlation of bedrock because volcanic ash

- (1) is easily eroded and lasts only a short time on Earth's surface
 (2) stays in the atmosphere for millions of years
 (3) is deposited over millions of years
 (4) falls to Earth over a large area in a short period of time

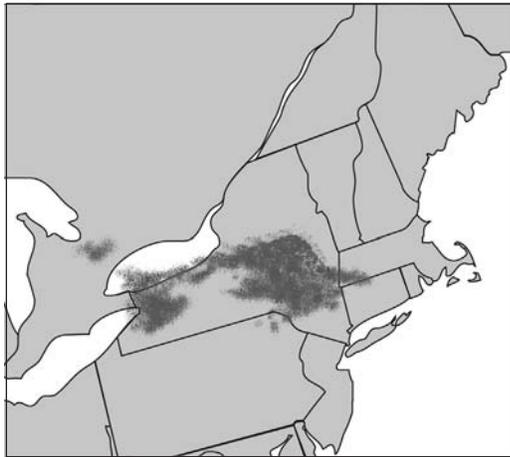
- 15 Evidence indicates that 251 million years ago a mass extinction of many life-forms occurred on Earth. Which form of life became extinct at this time?

- (1) trilobites (3) mammoths
 (2) dinosaurs (4) eurypterids

- 16 What is the dewpoint when the air temperature is 26°C and the relative humidity is 77%?

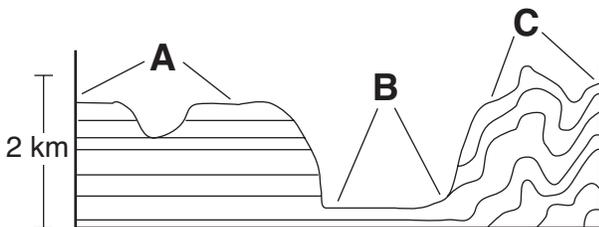
- (1) 3°C (3) 22°C
 (2) 20°C (4) 23°C

- 17 On the map below, dark-gray areas represent regions of lake-effect snow on a December day.



Which New York State location appears to be experiencing a lake-effect snowstorm?

- (1) New York City (3) Plattsburgh
 (2) Utica (4) Watertown
- 18 The cross section below shows the general bedrock structure of an area containing three different landscape regions, A, B, and C.

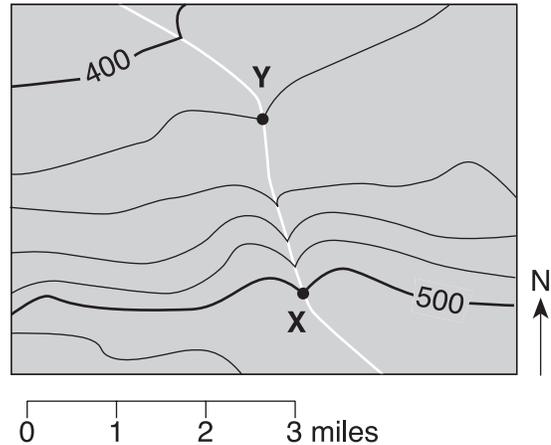


(Not drawn to scale)

Which list correctly identifies the type of landscapes represented by letters A, B, and C?

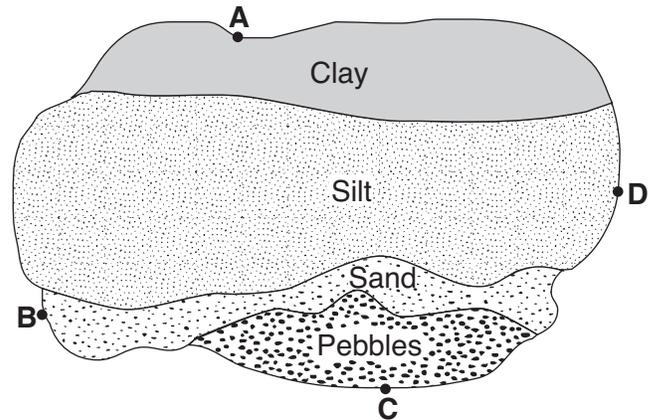
- (1) A = plain, B = plateau, C = mountain
 (2) A = mountain, B = plateau, C = plain
 (3) A = mountain, B = plain, C = plateau
 (4) A = plateau, B = plain, C = mountain
- 19 In New York State, the surface bedrock of the Catskills consists mainly of
- (1) weakly consolidated gravels and sands
 (2) quartzites, dolostones, marbles, and schists
 (3) conglomerates, red sandstones, basalt, and diabase
 (4) limestones, shales, sandstones, and conglomerates

- 20 The topographic map below shows a stream crossing several contour lines and passing through points X and Y. Elevations are measured in feet.



What is the approximate gradient between point X and point Y?

- (1) 10 ft/mi (3) 40 ft/mi
 (2) 20 ft/mi (4) 80 ft/mi
- 21 The map below shows an overhead view of sediments that have accumulated at the bottom of a lake. Points A through D represent locations on the shoreline of the lake.



A river most likely flows into the lake nearest to location

- (1) A (3) C
 (2) B (4) D
- 22 An increase in which gas in Earth's atmosphere will most significantly increase global temperatures?
- (1) methane (3) nitrogen
 (2) oxygen (4) hydrogen

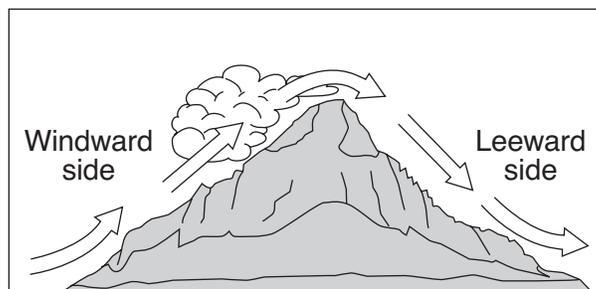
23 The topographic map below shows two hills located in upstate New York.



Which agent of erosion is most responsible for the shape of these hills?

- | | |
|-------------|--------------|
| (1) wind | (3) waves |
| (2) gravity | (4) glaciers |
- 24 During an El Niño event, surface water temperatures increase along the west coast of South America. Which weather changes are likely to occur in this region?
- (1) decreased air temperature and decreased precipitation
 - (2) decreased air temperature and increased precipitation
 - (3) increased air temperature and increased precipitation
 - (4) increased air temperature and decreased precipitation

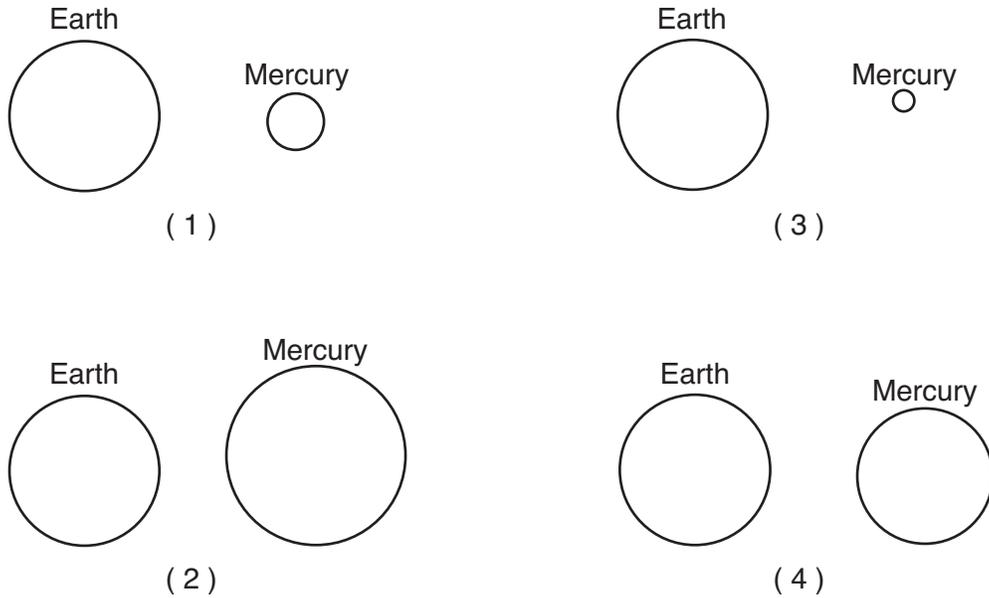
25 The diagram below shows air movement over a mountain.



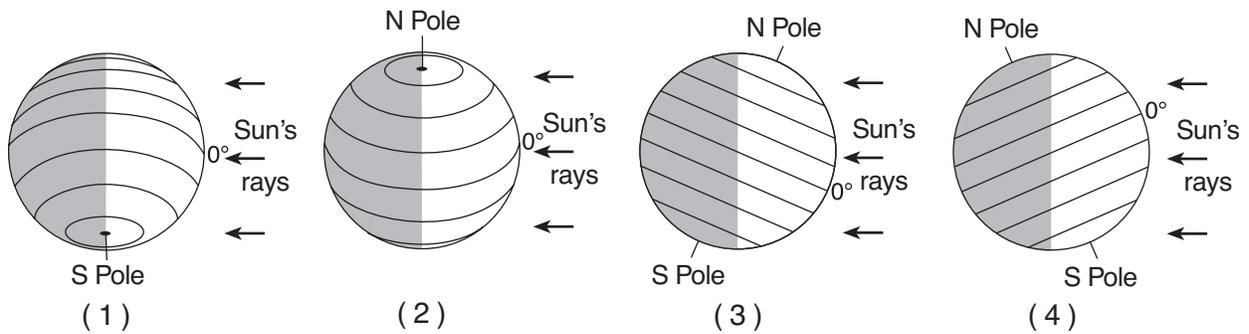
Compared to the climate on the windward side of the mountain, the climate on the leeward side of the mountain is

- (1) drier and warmer
 - (2) drier and cooler
 - (3) more humid and warmer
 - (4) more humid and cooler
- 26 Which factor has the greatest influence on the number of daylight hours that a particular Earth surface location receives?
- (1) longitude
 - (2) latitude
 - (3) diameter of Earth
 - (4) distance from the Sun
- 27 Energy is transferred from *Barnard's Star* to Earth mainly by
- (1) red shifts
 - (2) density currents
 - (3) conduction
 - (4) electromagnetic waves
- 28 A stream's velocity decreases from 100 cm/s to 5 cm/s. Which size sediment particles will still be transported by the stream?
- (1) pebbles, sand, silt, and clay
 - (2) sand, silt, and clay, only
 - (3) silt and clay, only
 - (4) clay, only

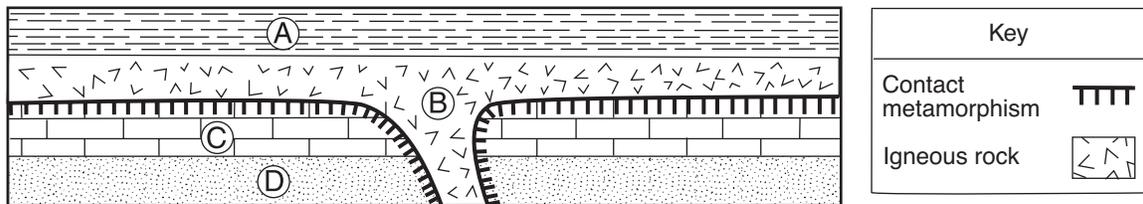
29 Which diagram most accurately represents the relative diameters of Earth and Mercury?



30 Which diagram represents the tilt of Earth's axis relative to the Sun's rays on December 15?



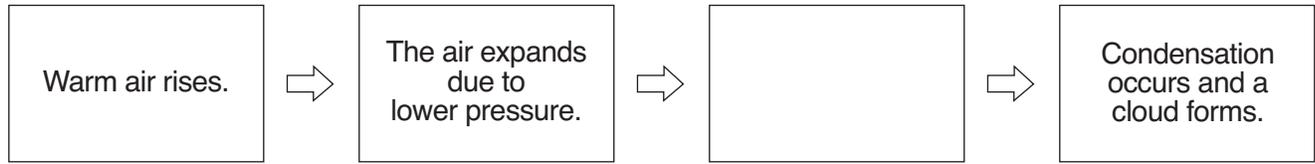
31 The cross section below shows four rock units, A, B, C, and D.



Which rock unit is youngest in age?

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

32 The incomplete flowchart below shows some of the changes that occur in warm air as it rises to form a cloud.



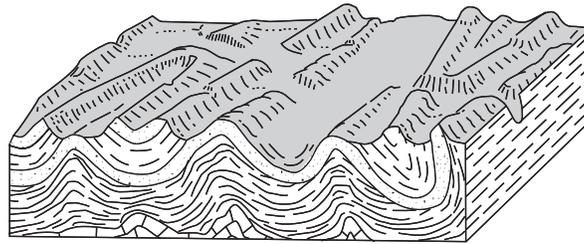
Which statement should be placed in the empty box to accurately complete the flowchart?

- (1) The air warms as it expands.
- (2) The air cools until it reaches the dewpoint.
- (3) The air's relative humidity decreases to zero.
- (4) The air enters the thermosphere.

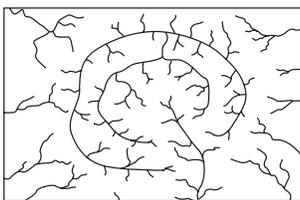
33 The highest surface wind speeds occur when there is a

- (1) 4-millibar air-pressure difference between two nearby locations
- (2) 4-millibar air-pressure difference between two distant locations
- (3) 20-millibar air-pressure difference between two nearby locations
- (4) 20-millibar air-pressure difference between two distant locations

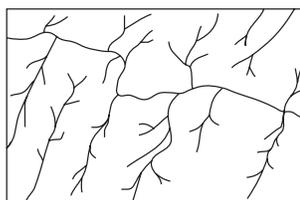
34 The block diagram below shows a portion of Earth's crust.



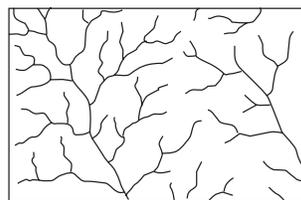
Which stream drainage pattern is most likely present on this crustal surface?



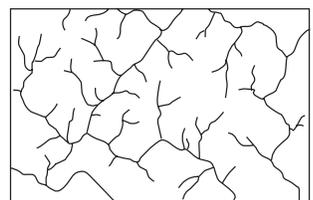
(1)



(2)

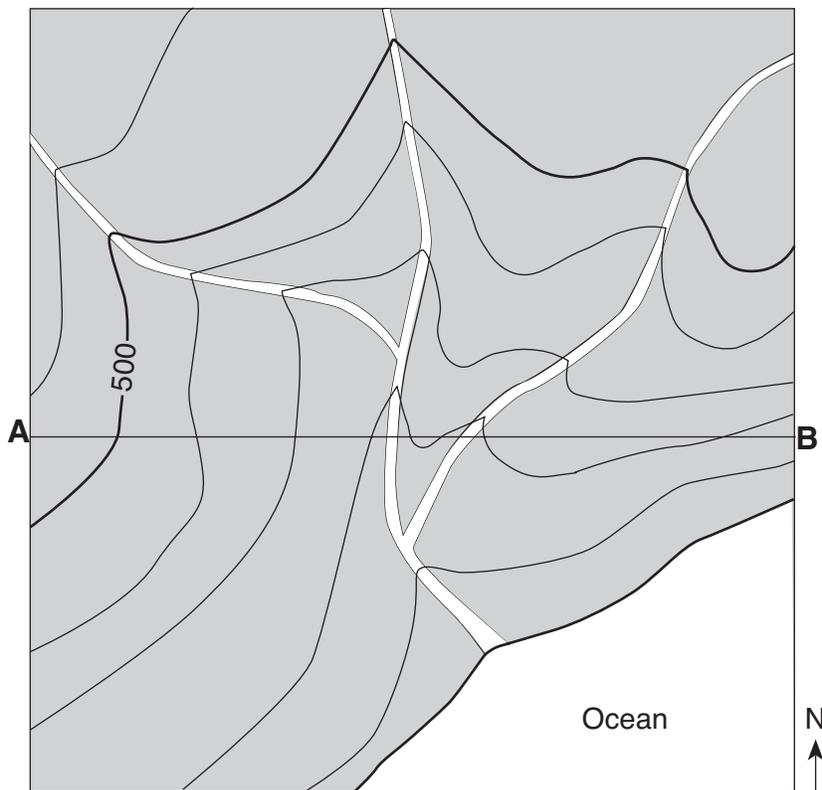


(3)



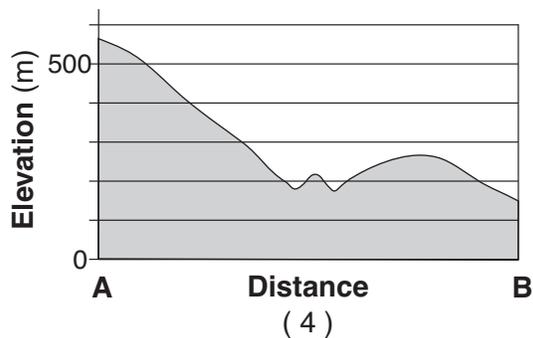
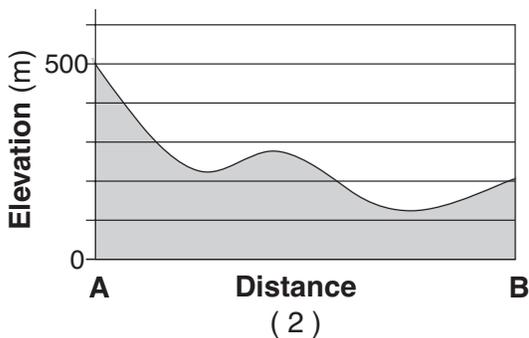
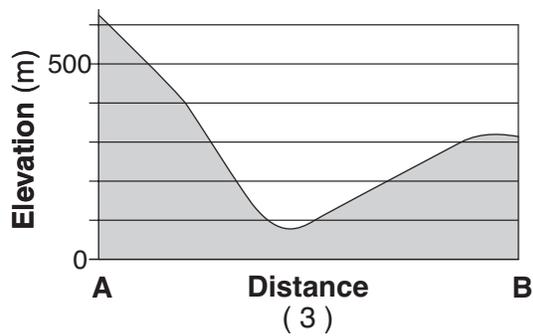
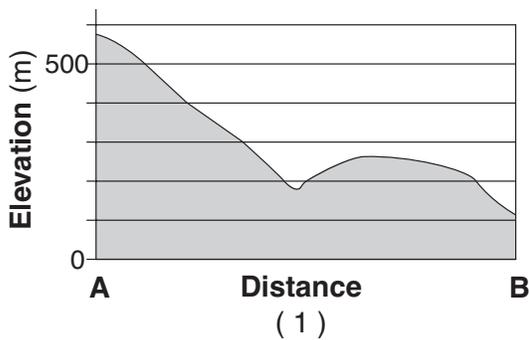
(4)

35 The contour map below shows elevations recorded in meters. Line *AB* is a reference line on the map.



Contour interval = 100 m

Which graph best represents the profile from point *A* to point *B*?

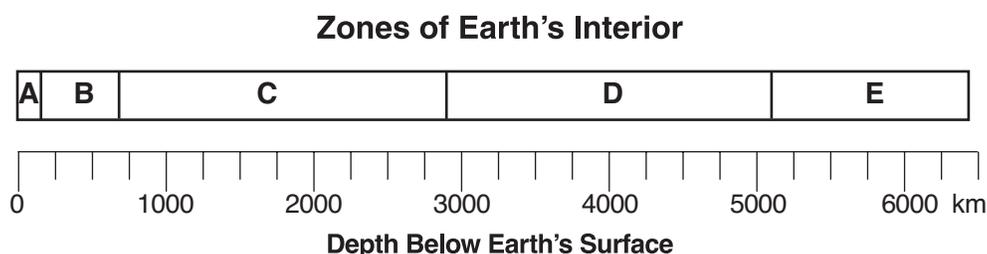


Part B-1

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 *2010 Edition Reference Tables for Physical Setting/Earth Science*. Record your answers on your separate answer sheet.

Base your answers to questions 36 through 40 on the diagram below, which represents zones of Earth's interior, identified by letters *A* through *E*. The scale shows depths below Earth's surface, measured in kilometers.



- 36 The Moho is a boundary located in zone
- (1) *A* (3) *E*
(2) *B* (4) *D*
- 37 What is the approximate thickness of zone *C*?
- (1) 650 km (3) 2250 km
(2) 1600 km (4) 2900 km
- 38 Which zone is characterized by partially melted rock and large-scale convection currents?
- (1) zone *A* (3) zone *C*
(2) zone *B* (4) zone *E*
- 39 Which zone of Earth's interior has a density closest to the densities of the other terrestrial planets?
- (1) zone *A* (3) zone *C*
(2) zone *E* (4) zone *D*
- 40 S-waves produced by an earthquake are transmitted through zones
- (1) *A* and *B*, but not zones *C*, *D*, and *E* (3) *C*, *D*, and *E*, but not zones *A* and *B*
(2) *A*, *B*, and *C*, but not zones *D* and *E* (4) *D* and *E*, but not zones *A*, *B*, and *C*
-

Base your answers to questions 41 through 43 on the data table below, which lists some properties of four minerals that are used as ores of zinc (Zn).

Mineral Property	Mineral			
	Smithsonite	Sphalerite	Willemite	Zincite
Composition	ZnCO ₃	ZnS	Zn ₂ SiO ₄	ZnO
Hardness	4–4.5	3.5–4	5.5	4
Density (g/cm ³)	4.4	4.0	4.0	5.6
Color	white, gray, green, blue, yellow	brown, yellow, red, green, black	white, yellow, green, reddish brown, black	deep red to orange yellow
Streak	white	white to yellow to brown	white	orange yellow

41 A mineral with a hardness of 5 would scratch

- (1) all four zinc minerals in the table
- (2) zincite, but not sphalerite, smithsonite, or willemite
- (3) zincite and sphalerite, but not smithsonite or willemite
- (4) zincite, sphalerite, and smithsonite, but not willemite

42 A sample of sphalerite has a mass of 176.0 grams. What is the volume of the sample?

- (1) 22.7 cm³
- (2) 31.4 cm³
- (3) 40.0 cm³
- (4) 44.0 cm³

43 Which mineral belongs in the same mineral group as quartz and olivine?

- (1) zincite
- (2) willemite
- (3) sphalerite
- (4) smithsonite

Base your answers to questions 44 through 46 on the map below, which shows a portion of the continent of North America and outlines the Mississippi River watershed. Points *A*, *B*, *C*, *D*, and *E* represent locations on Earth's surface.



Key	
—	Mississippi watershed boundary

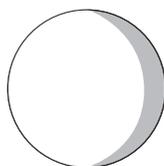
- 44 At which location would the Mississippi River's discharge most likely be the greatest?
- | | |
|--------------|--------------|
| (1) <i>A</i> | (3) <i>C</i> |
| (2) <i>B</i> | (4) <i>D</i> |
- 45 Sediments deposited by the river at location *B* are best described as
- | | |
|----------------------------|------------------------------|
| (1) sorted and layered | (3) unsorted and layered |
| (2) sorted and not layered | (4) unsorted and not layered |
- 46 Which landform is produced at location *E* where the Mississippi River enters the Gulf of Mexico?
- | | |
|---------------|----------------------|
| (1) a delta | (3) an escarpment |
| (2) a drumlin | (4) an outwash plain |

Base your answers to questions 47 through 50 on the calendar below, which shows the month of July of a recent year. The dates of major Moon phases, as seen in New York State, are shown.

July						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
 1	2	3	4	5	6	7
 8	9	10	11	12	13	14
15	 16	17	18	19	20	21
22	 23	24	25	26	27	28
29	 30	31				

Key	
	New Moon
	First-quarter Moon
	Full Moon
	Last-quarter Moon

47 The diagram below represents the phase of the Moon observed from New York State one night during the month of July.



On which date was this phase of the Moon visible from New York State?

- (1) July 4
- (2) July 11
- (3) July 19
- (4) July 26

48 On which date will the next first-quarter Moon phase occur?

- (1) August 6
- (2) August 10
- (3) August 16
- (4) August 22

49 Eclipses do *not* occur every month because the Moon's

- (1) rate of rotation is 15° each hour
- (2) orbit is inclined to Earth's orbit
- (3) period of revolution is 27.3 days
- (4) period of rotation and period of revolution are the same

50 Why does the Moon's gravity have a greater effect on Earth's ocean tides than the Sun's gravity?

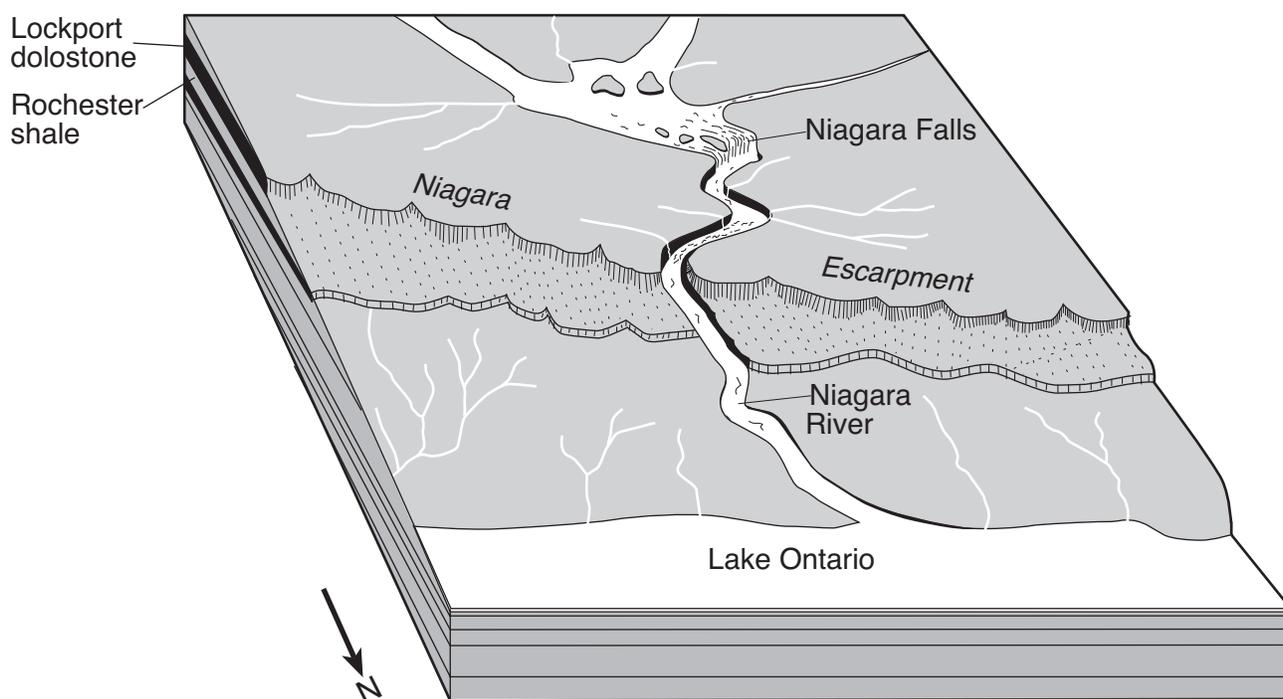
- (1) The Sun is composed mostly of gases.
- (2) The Sun's gravity influences more planets.
- (3) The Moon has a greater mass.
- (4) The Moon is much closer to Earth.

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 *2010 Edition Reference Tables for Physical Setting/Earth Science*.

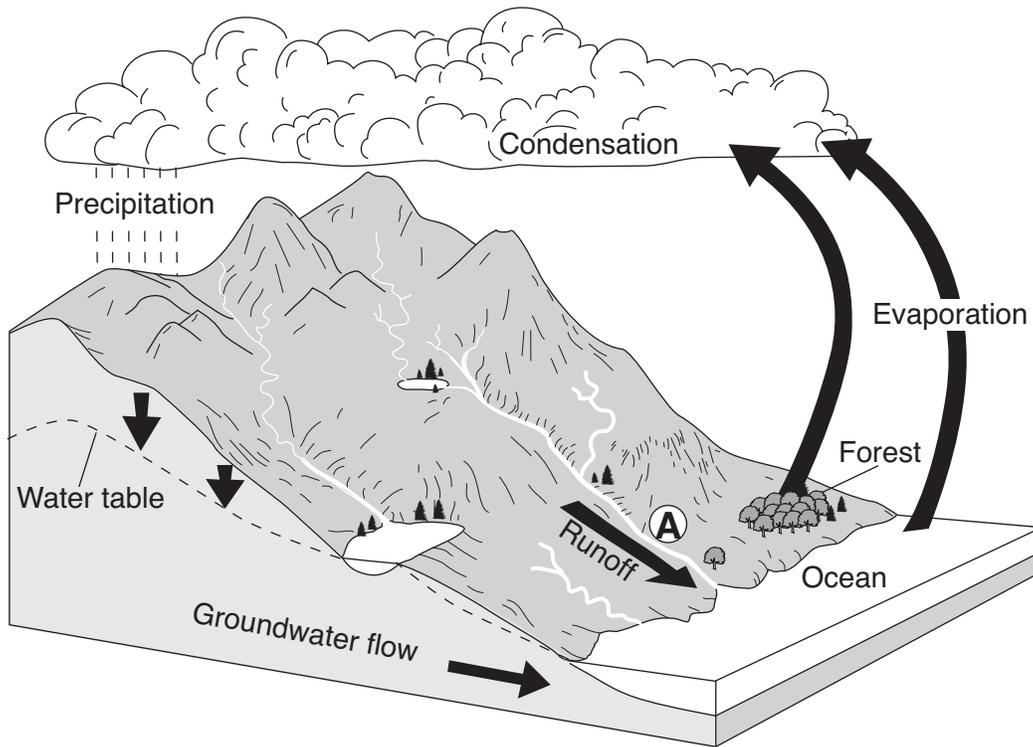
Base your answers to questions 51 and 52 on the block diagram and information below. The diagram is of the Niagara Falls region as viewed from the north.



The Niagara River began to flow over the Niagara Escarpment about 12,000 years ago when the last Pleistocene ice sheet melted and retreated north from the Niagara Escarpment. Since that time, Niagara Falls has eroded upriver, leaving a deep, steep-sided valley that is 11,000 meters long. The top bedrock layer of the escarpment is the Lockport dolostone which lies above the Rochester shale. The shale is more easily weathered than the dolostone. This causes the dolostone to be undercut. As a result, the dolostone breaks off in large blocks that tumble to the base of Niagara Falls.

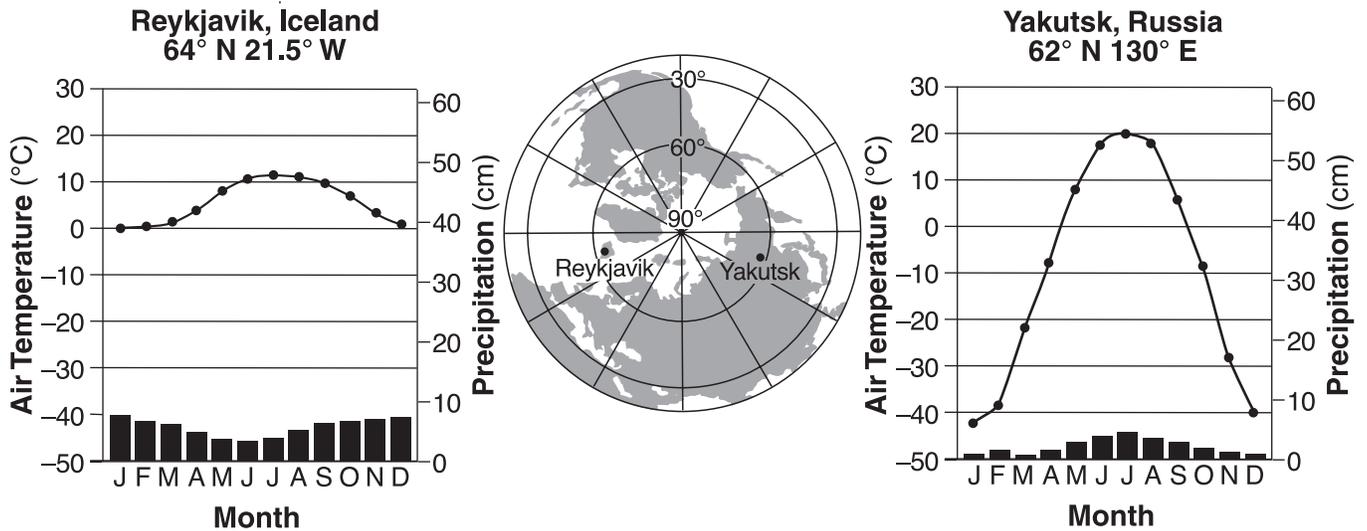
- 51 In which New York State landscape region is Niagara Falls located? [1]
- 52 Toward which compass direction is the location of Niagara Falls likely to move in the future? [1]
-

Base your answers to questions 53 through 55 on the diagram below, which represents Earth's water cycle. The arrows represent some water cycle processes. Letter A indicates a surface location on Earth.



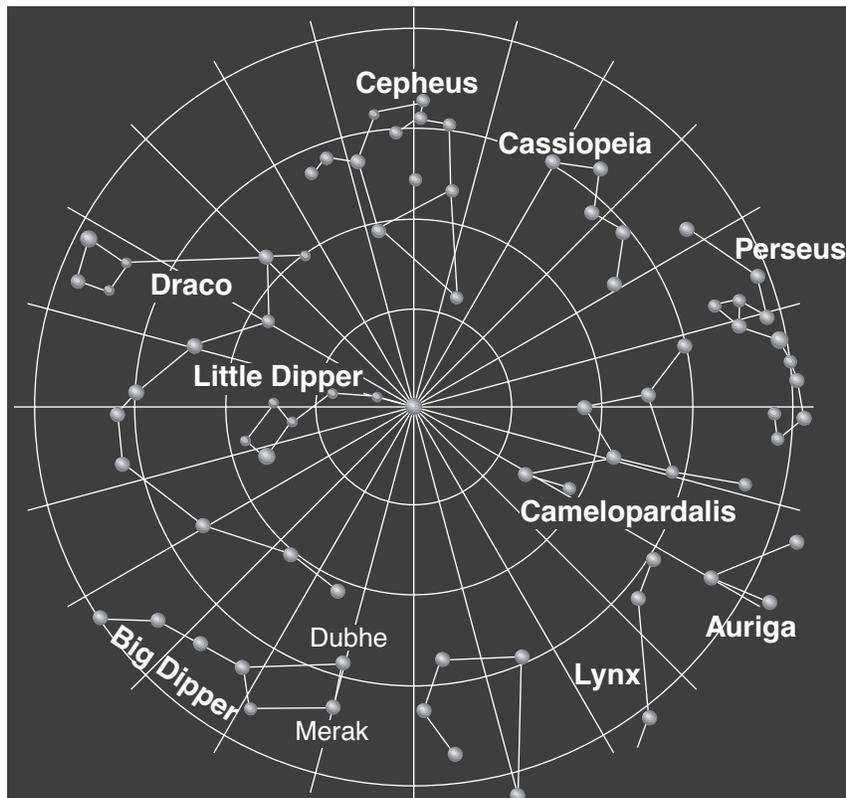
- 53 Other than evaporation, which water cycle process transfers large amounts of water vapor into the atmosphere from the forest? [1]
- 54 Describe *one* surface condition change at location A that would *decrease* the rate of runoff. [1]
- 55 How many joules (J) of heat energy are released by each gram of water vapor that condenses to form cloud droplets? [1]
-

Base your answers to questions 56 through 59 on the graphs and map below. The map shows a view of Earth from above the North Pole. Points on the map indicate the positions of Reykjavik, Iceland, and Yakutsk, Russia. The graphs show average monthly air temperature (line graphs) and amount of precipitation (bar graphs) for both locations.



- 56 Write the two-letter weather map symbol for an air mass that originates over Yakutsk. [1]
- 57 Explain why Reykjavik has cooler summers and warmer winters than Yakutsk. [1]
- 58 Describe *one* way the yearly precipitation in Yakutsk differs from that in Reykjavik. [1]
- 59 Identify *one* warm and *one* cool ocean current that affect the climate of Iceland. [1]
-

Base your answers to questions 60 through 65 on the star chart below, which shows the locations of several constellations visible in the night sky. These constellations appear to move counterclockwise around the star in the center of the chart. Straight lines are at 15-degree intervals. *Merak* and *Dubhe* are two stars in the Big Dipper.



(Not drawn to scale)

- 60 Identify the star located in the center of this star chart. [1]
- 61 How many degrees would the star directly below the “ss” in Cassiopeia appear to move in 3 hours? [1]
- 62 Which Earth motion causes the apparent daily movement of these constellations? [1]
- 63 Complete the table *in your answer booklet* by identifying the classification of the star *Dubhe*. The classification for the star *Merak* has been provided as an example. [1]
- 64 The stars *Merak* and *Dubhe* are located within the same galaxy as our Sun. Identify the galaxy in which these stars are located. [1]
- 65 On the chart of the night sky *in your answer booklet*, place an **X** to indicate the location of the Big Dipper at the same time of night 6 months later. [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 *2010 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 66 through 68 on the table below, which shows information about five large objects in the Kuiper Belt. The Kuiper Belt is located approximately 30 to 1000 astronomical units (AU) from the Sun. An astronomical unit is the average distance between Earth and the Sun, 149.6 million kilometers.

Kuiper Belt Data

Kuiper Belt Objects	Orbit Characteristics			Approximate Equatorial Diameter (km)
	Closest Distance to the Sun (AU)	Farthest Distance from the Sun (AU)	Eccentricity	
Varuna	40.47	45.13	0.053	900
Eris	37.77	97.56	0.442	2400
Quaoar	41.92	45.28	0.039	1260
Sedna	76.15	975.05	0.855	1500
Ixion	30.04	49.36	0.243	1065

66 The diagram *in your answer booklet* shows the orbits of some of the planets in our solar system. The approximate average distances from the Sun, in astronomical units, are indicated. On the diagram, place an **X** to show the closest distance of Ixion to the Sun. [1]

67 On the graph *in your answer booklet*, construct a bar graph of the equatorial diameter of each of the Kuiper Belt objects listed in the table. The diameter of Earth's Moon has been graphed for comparison. [1]

68 Identify the Kuiper Belt object with the longest period of revolution and state the evidence that supports that conclusion. [1]

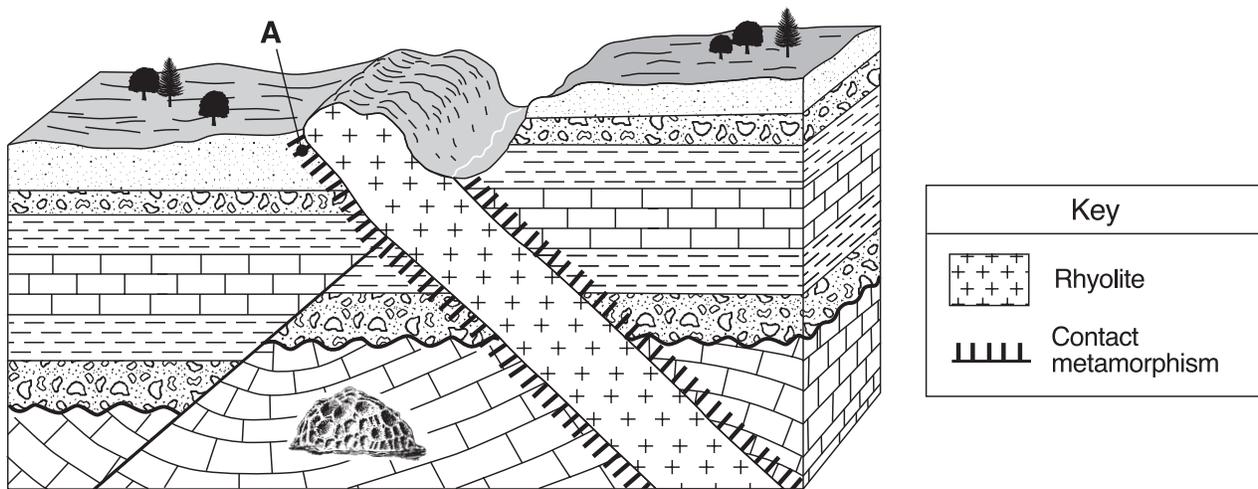
69 On the weather station model *in your answer booklet*, using the proper format, record the *four* weather conditions shown below. [1]

Dewpoint: 48°F
Air pressure: 998.3 mb
Wind: from the southeast
Wind speed: 10 knots

Base your answers to questions 70 through 74 on the two maps in your answer booklet. Map 1 shows air temperatures in the United States and Mexico, recorded in °F, at the points shown on the map. Map 2 shows the location of a low-pressure system at the time these air temperatures were measured. An occluded front extends from the center of the low-pressure system (L) to point A. Lines AB and AC are two other frontal boundaries. Two air masses are shown. The storm system later moved toward New York State and produced an ice storm.

- 70 On map 1 in your answer booklet, draw the 32°F isotherm. [1]
- 71 On map 2 in your answer booklet, draw weather front symbols on the correct sides of both line AB and line AC to show the most probable type and direction of movement of each front. [1]
- 72 Describe the general surface wind pattern associated with the low-pressure system shown on map 2. [1]
- 73 Explain what caused the center of this low-pressure system to move toward New York State. [1]
- 74 State *one* action New York State residents should have taken to prepare for the approaching ice storm. [1]

Base your answers to questions 75 through 79 on the block diagram below, which shows rock units that have not been overturned. Point A is located in the zone of contact metamorphism. A New York State index fossil is shown in one of the rock units.



(Not drawn to scale)

- 75 State the evidence shown by the block diagram that supports the inference that the fault is older than the rhyolite. [1]
- 76 Identify the geologic time period when the index fossil shown in the block diagram was a living organism. [1]
- 77 Identify the crystal size of the minerals in rhyolite and explain what this size indicates about the rate of cooling of the magma from which it formed. [1]
- 78 Identify the metamorphic rock that most likely formed at point A. [1]
- 79 Describe *one* piece of evidence that would indicate that the valley shown on the surface of the block diagram had been eroded and deepened by a glacier. [1]

Base your answers to questions 80 through 85 on the passage and map below. The map shows the volcanic island, Krakatau, before and after the 1883 eruption.

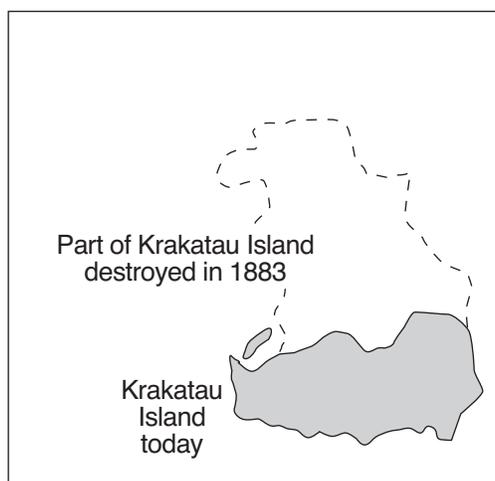
Krakatau

On August 27, 1883, one of the largest volcanic eruptions ever recorded in history occurred. Krakatau, a volcanic island nearly 800 meters in height, located at 6° S 105.5° E, exploded. Two-thirds of the island was destroyed by the blast. Blocks of pumice produced by the eruption were found floating in the ocean for months afterward.

Tsunamis produced by the eruption reached heights of 40 meters as they came ashore on nearby islands. These destructive waves traveled 6360 kilometers in just 12 hours. Over 36,000 people died and 165 coastal villages were destroyed.

Volcanic ash was blasted into the atmosphere to heights between 36 and 48 kilometers. Global temperatures cooled as the ash traveled on air currents around the world.

Volcanic Island of Krakatau



- 80 The diagram *in your answer booklet* shows where Krakatau formed, then exploded. Draw *one* arrow on *each* lithospheric plate to show the relative direction that both plates are moving to produce this type of volcano. [1]
- 81 The diagram *in your answer booklet* represents an average size person standing next to a tall building. Draw a horizontal line across the building to show the maximum height of the tsunami waves produced by the 1883 eruption of Krakatau. [1]
- 82 Determine the rate the tsunamis traveled across the ocean. Label your answer with the correct units. [1]
- 83 Identify the layer of the atmosphere into which the highest volcanic ash was blasted from the Krakatau eruption. [1]
- 84 Explain how the volcanic ash from the Krakatau eruption caused global temperatures to decrease. [1]
- 85 Describe the texture and density of pumice that allowed the blocks of pumice to float on the ocean. [1]
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