

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

**PHYSICAL SETTING  
EARTH SCIENCE**

**Thursday, January 24, 2013 — 1:15 to 4:15 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):* Use your knowledge of Earth science to answer all questions. 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 Why is the surface of Mercury covered with meteor impact craters, while Earth's surface has relatively few craters?

- (1) Mercury is larger than Earth, so it gets hit with more meteors.
- (2) Mercury is an older planet, so it has a longer history of meteor impacts.
- (3) Earth's less dense water surface attracts fewer meteors.
- (4) Earth's hydrosphere and atmosphere destroyed or buried most meteor impact sites.

2 Which information best supports the inference that the universe began with an explosion?

- (1) measurements of rates of decay using carbon-14
- (2) measurements of cosmic background radiation
- (3) calculations of the distance from the Sun to each asteroid in the asteroid belt
- (4) calculations of the temperature and luminosity of stars

3 A blue shift of the light from a star indicates that the star

- (1) will soon become a main sequence star
- (2) will soon become a giant star
- (3) is moving closer to Earth
- (4) is moving away from Earth

4 Evidence that Earth revolves around the Sun is provided by the

- (1) apparent rising and setting of the Sun during one day
- (2) apparent rising and setting of *Polaris* during one day
- (3) seasonal changes in the apparent positions of constellations
- (4) hourly changes in the apparent direction of the swing of a Foucault pendulum

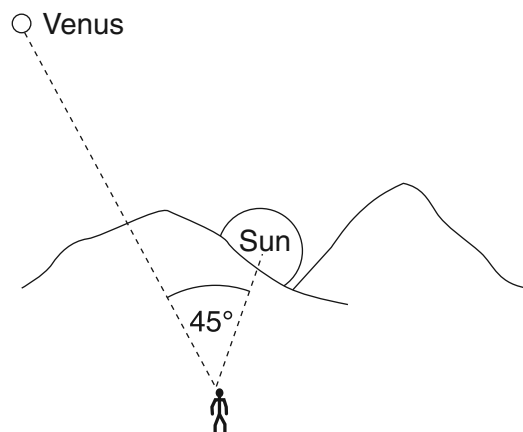
5 What causes many surface winds to deflect to the right in the Northern Hemisphere?

- (1) rotation of Earth on its axis
- (2) unequal heating of Earth's surface
- (3) gravitational force of the Moon
- (4) gravitational force of the Sun

6 During which Northern Hemisphere season is Earth closest to the Sun?

- (1) spring
- (2) summer
- (3) autumn
- (4) winter

7 An observer on Earth measures the angle of sight between Venus and the setting Sun.

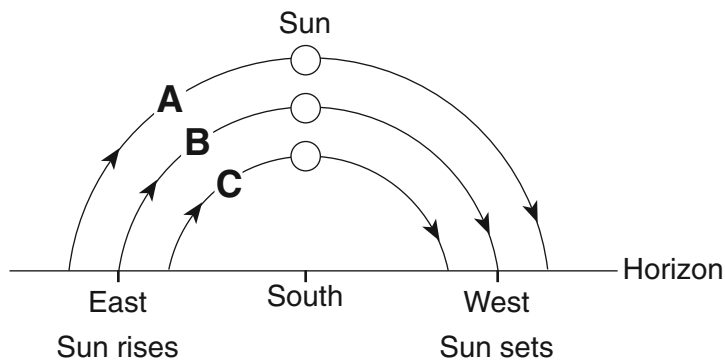


(Not drawn to scale)

Which statement best describes and explains the apparent motion of Venus over the next few hours?

- (1) Venus will set 1 hour after the Sun because Earth rotates at  $45^\circ$  per hour.
- (2) Venus will set 2 hours after the Sun because Venus orbits Earth faster than the Sun orbits Earth.
- (3) Venus will set 3 hours after the Sun because Earth rotates at  $15^\circ$  per hour.
- (4) Venus will set 4 hours after the Sun because Venus orbits Earth slower than the Sun orbits Earth.

- 8 The diagram below represents the horizon and the Sun's apparent paths, A, B, and C, on three different dates, as viewed from the same location in New York State.



Which table correctly shows the dates on which the apparent paths of the Sun were observed?

Path of Sun	Date
A	December 21
B	September 23
C	March 21

( 1 )

Path of Sun	Date
A	March 21
B	September 23
C	June 21

( 3 )

Path of Sun	Date
A	December 21
B	March 21
C	June 21

( 2 )

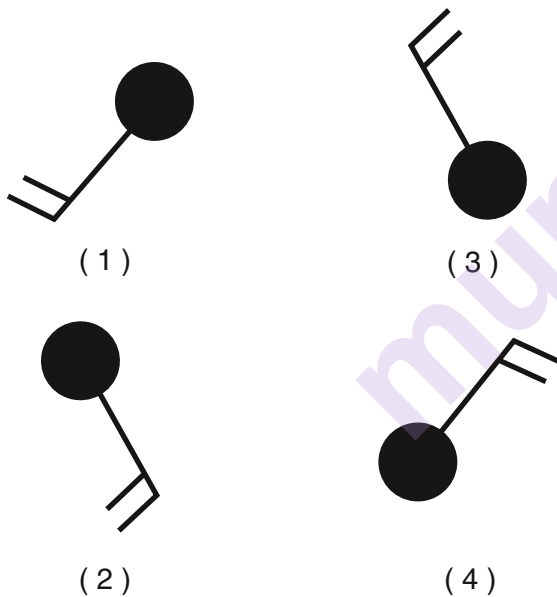
Path of Sun	Date
A	June 21
B	March 21
C	December 21

( 4 )

- 9 Scientists infer that most of Earth's earliest atmosphere was produced by
- (1) a collision with a giant gas cloud
  - (2) capturing gases from a nearby planet
  - (3) vaporizing comets that impacted Earth's surface
  - (4) the escape of gases from Earth's molten surface

- 10 An increase in the transparency of Earth's atmosphere is often caused by
- (1) a decrease in cloud cover
  - (2) a decrease in solar radiation
  - (3) an increase in airborne dust particles
  - (4) an increase in the duration of insolation

- 11 Which station model shows a wind direction from the southeast?



- 12 The direction of movement of the major surface ocean currents is most affected by Earth's
- (1) tilted axis
  - (2) prevailing winds
  - (3) rate of revolution
  - (4) tidal action

- 13 The winds shift from southwest to northwest as heavy rains and hail begin to fall in Albany, New York. These changes are most likely caused by the arrival of
- (1) an mT air mass
  - (2) a cT air mass
  - (3) a cold front
  - (4) a warm front

- 14 A city located on the coast of North America has warmer winters and cooler summers than a city at the same elevation and latitude located near the center of North America. Which statement best explains the difference between the climates of the two cities?

- (1) Ocean surfaces change temperature more slowly than land surfaces.
- (2) Warm, moist air rises when it meets cool, dry air.
- (3) Wind speeds are usually greater over land than over ocean water.
- (4) Water has a lower specific heat than land.

- 15 Most of the electromagnetic energy radiated from Earth's surface is in the form of

- (1) ultraviolet rays
- (2) infrared rays
- (3) gamma rays
- (4) x rays

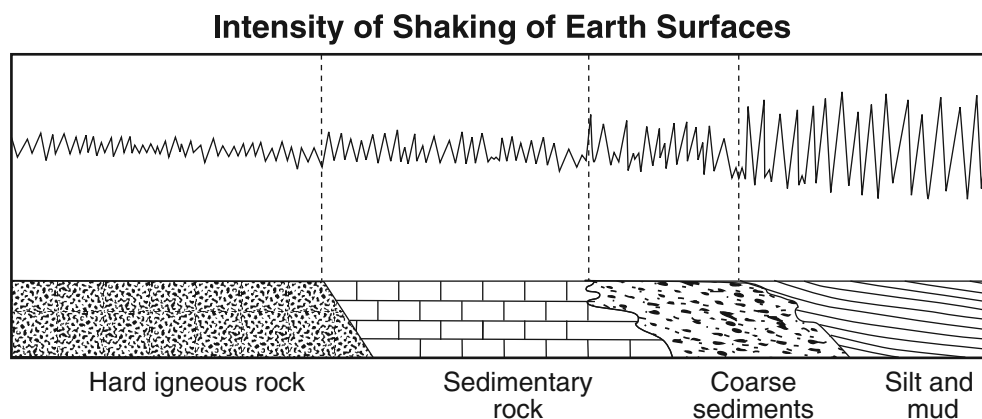
- 16 Which two 23.5°-latitude locations are influenced by cool surface ocean currents?

- (1) the east coast of North America and the west coast of Australia
- (2) the east coast of Asia and the east coast of North America
- (3) the west coast of Africa and the east coast of South America
- (4) the west coast of North America and the west coast of South America

- 17 The arrival time of the first earthquake *P*-wave at a seismograph station was 10:11:20 (hours:minutes:seconds). If the epicenter of the earthquake is 8000 km away, what was the approximate arrival time of the first *S*-wave from this earthquake?

- (1) 10:02:00
- (2) 10:09:20
- (3) 10:20:40
- (4) 10:32:00

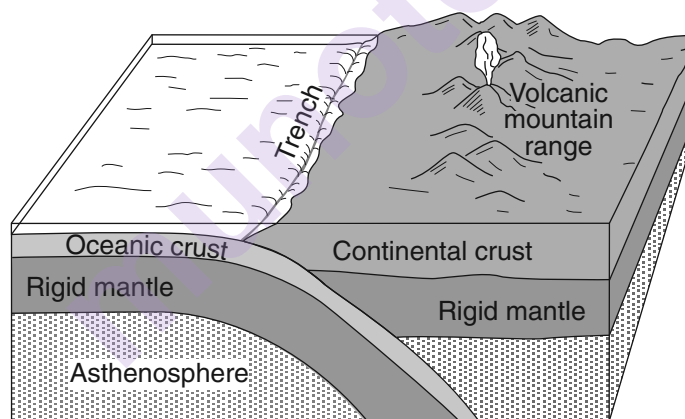
- 18 The diagram below represents the intensity of the shaking that occurs on different Earth surfaces during the same earthquake.



The greatest earthquake hazard to homes exists when they are built on

- |                       |                      |
|-----------------------|----------------------|
| (1) hard igneous rock | (3) coarse sediments |
| (2) sedimentary rock  | (4) silt and mud     |

Base your answers to questions 19 and 20 on the block diagram below, which shows a tectonic plate boundary.



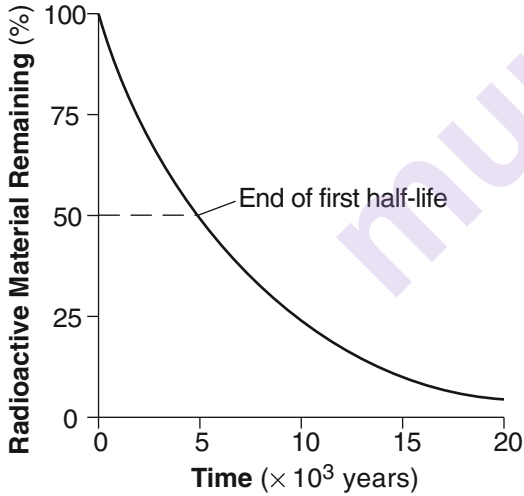
(Not drawn to scale)

- 19 Which tectonic plate boundary is best represented by this diagram?

- |  |
|--|
| (1) Nazca Plate and Pacific Plate boundary               |
| (2) Scotia Plate and South American Plate boundary       |
| (3) Juan de Fuca Plate and North American Plate boundary |
| (4) Antarctic Plate and Indian-Australian Plate boundary |

- 20 Compared to the oceanic crust, the continental crust is

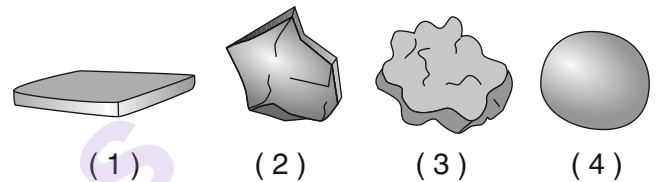
- |                                |                                |
|--------------------------------|--------------------------------|
| (1) more dense and more mafic  | (3) less dense and more mafic  |
| (2) more dense and more felsic | (4) less dense and more felsic |

- 21 Most of the sediment that is compacted and later forms shale bedrock is
- clay
  - silt
  - sand
  - pebbles
- 22 In which two Earth regions is oxygen the second most abundant element by volume?
- crust and hydrosphere
  - hydrosphere and troposphere
  - troposphere and core
  - core and crust
- 23 Which two properties are most useful in distinguishing between galena and halite?
- cleavage and color
  - luster and color
  - hardness and streak
  - streak and cleavage
- 24 The graph below shows the decay of a radioactive material over time.
- 
- How long does it take for this radioactive material to decay through 2 half-lives?
- $1 \times 10^3$  years
  - $5 \times 10^3$  years
  - $10 \times 10^3$  years
  - $40 \times 10^3$  years
- 25 A 65.5-million-year-old impact crater in Mexico provides evidence for the cause of the
- breakup of Pangaea
  - evolution of the earliest corals
  - Alleghenian orogeny
  - extinction of ammonoids

- 26 When did the earliest humans appear on Earth?
- before the earliest dinosaurs
  - before the earliest flowering plants
  - during the Pleistocene Epoch
  - during the Late Triassic Epoch

- 27 A landslide is an example of
- river deposition
  - glacial scouring
  - mass movement
  - chemical weathering

- 28 Each of the rock particles below has the same density and volume. Which particle will most likely settle at the fastest rate in moving water?



- 29 Which rock weathers most rapidly when exposed to acid rain?

- quartzite
- granite
- basalt
- limestone

- 30 What is the approximate minimum stream velocity needed to keep a particle in motion that has a diameter of 10 centimeters?

- 110 cm/s
- 190 cm/s
- 325 cm/s
- 425 cm/s

- 31 Which change is most likely to occur in a landscape if its climate changes from humid to arid?

- Wind will become a more important agent of erosion.
- Surface features will become more rounded.
- Chemical weathering will increase.
- Vegetation will increase.

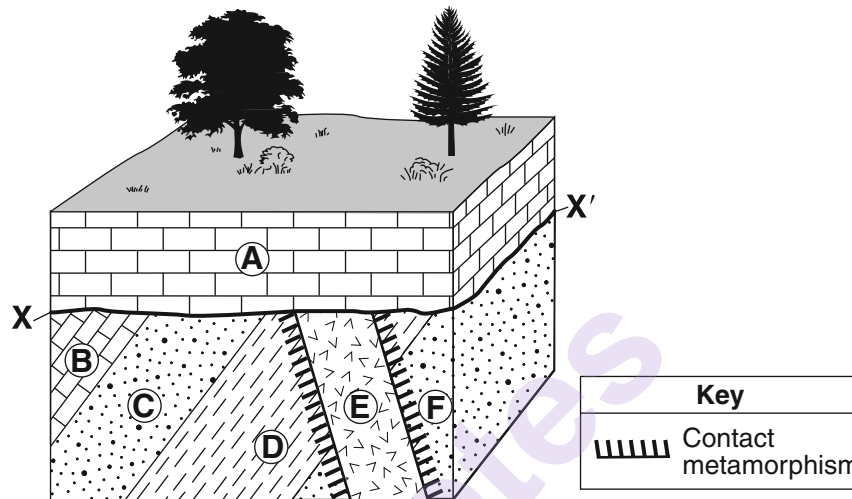
- 32 The surface bedrock in the Hudson Highlands consists mostly of

- diabase, dolostone, and granite
- slate, siltstone, and basalt
- gneiss, quartzite, and marble
- limestone, shale, sandstone, and conglomerate

33 The Catskills landscape region is classified as a plateau because it has

- (1) low elevations and mostly faulted or folded bedrock
- (2) low elevations and mostly horizontal bedrock
- (3) high elevations and mostly faulted or folded bedrock
- (4) high elevations and mostly horizontal bedrock

Base your answers to questions 34 and 35 on the block diagram below, which shows bedrock units A through F and boundary XX'.



34 The rock that formed in the contact metamorphic zone between rock unit E and rock unit D is

- (1) hornfels
- (2) marble
- (3) schist
- (4) anthracite coal

35 Which sequence best describes the geologic history, from oldest to youngest, that occurred at this site?

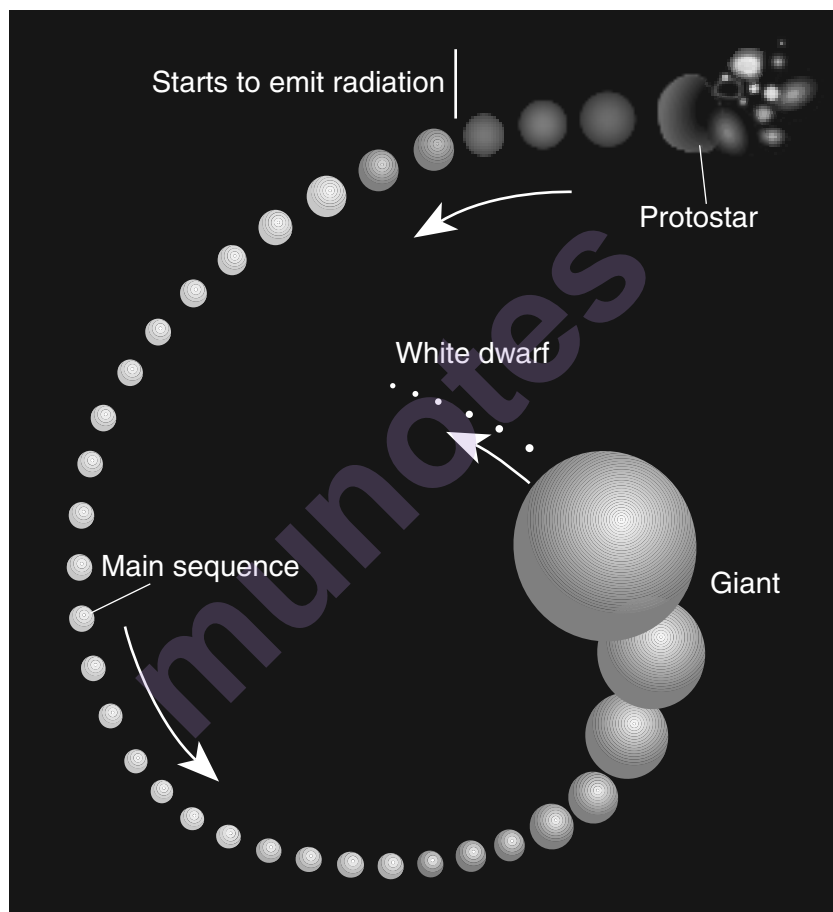
- (1) deposition of F, D, C, B → intrusion of E → uplift and erosion → deposition of A
  - (2) intrusion of E → deposition of F, D, C, B → uplift and erosion → deposition of A
  - (3) deposition of F, D, C, B, A → uplift and erosion → intrusion of E
  - (4) deposition of F, D, C, B, A → intrusion of E → uplift and erosion
-

## Part B-1

### Answer all questions in this part.

*Directions (36–50):* Use your knowledge of Earth science to answer all questions. For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*. Record your answers on your separate answer sheet.

Base your answers to questions 36 and 37 on the diagram below, which shows the change in the size of a star such as our Sun as it evolves from a protostar to a white dwarf star.



36 During which stage of development does the star have a cool surface temperature and the greatest luminosity?

- (1) protostar
- (2) main sequence

- (3) giant
- (4) white dwarf

37 Which process produces the energy radiated by the star when it becomes a main sequence star?

- (1) radioactive decay
- (2) nuclear fusion

- (3) conduction
- (4) convection



Base your answers to questions 38 through 40 on the passage below.

### Crustal Activity at Mid-Ocean Ridges

Mid-ocean ridges are found at one type of tectonic plate boundary. These ridges consist of extensive underwater mountain ranges split by rift valleys. The rift valleys mark places where two crustal plates are pulling apart, widening the ocean basins, and allowing magma from the asthenosphere to move upward. In some cases, mid-ocean ridges have migrated toward nearby mantle hot spots. This explains why mid-ocean ridges and mantle hot spots are found together at several locations.

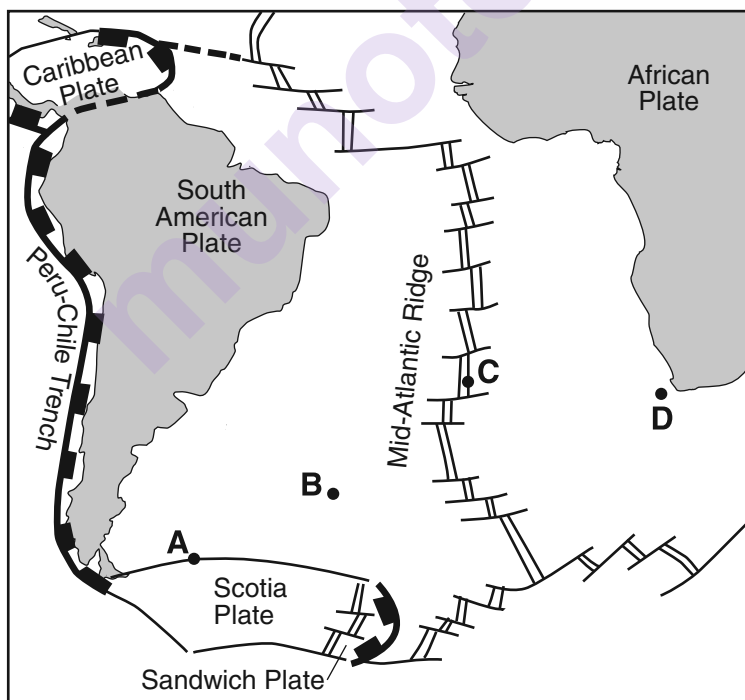
38 Which type of tectonic plate boundary is located at mid-ocean ridges?

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

39 Which mantle hot spot is located closest to a mid-ocean ridge?

- |                    |            |
|--------------------|------------|
| (1) Canary Islands | (3) Hawaii |
| (2) Easter Island  | (4) Tasman |

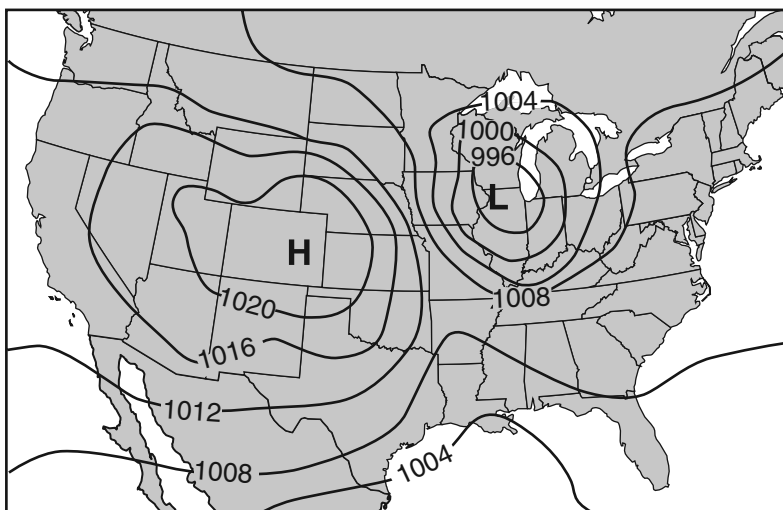
40 The map below shows a part of Earth's surface. Points A through D are locations on the ocean floor.



At which location is the temperature of the ocean floor bedrock most likely highest?

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

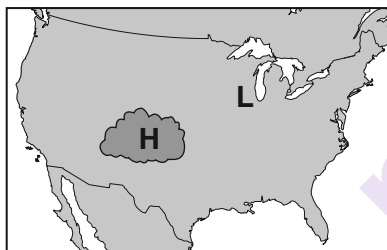
Base your answers to questions 41 through 44 on the weather map below, which shows the locations of a high-pressure center (**H**) and a low-pressure center (**L**) over a portion of North America. The isolines indicate surface air pressures.



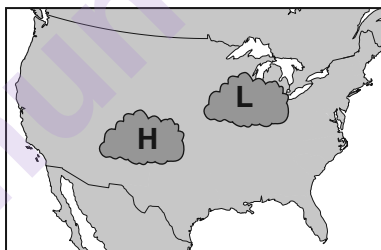
41 The data used to construct the isolines on this map were recorded in which units?

- (1) inches
- (2) millibars
- (3) feet
- (4) meters

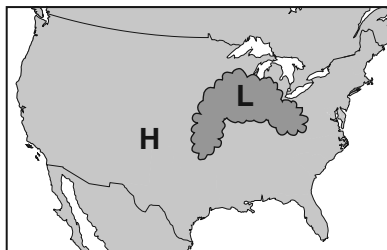
42 Which map shows the most likely location of clouds associated with these pressure centers?



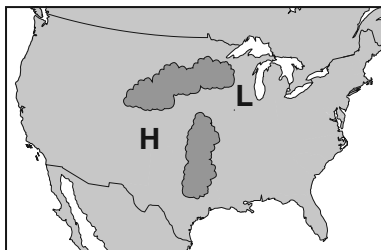
( 1 )



( 3 )

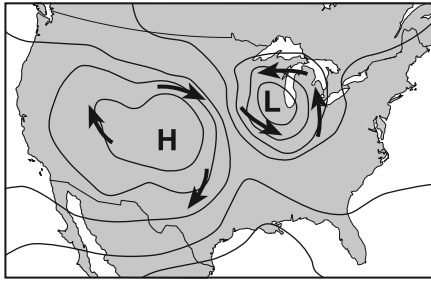


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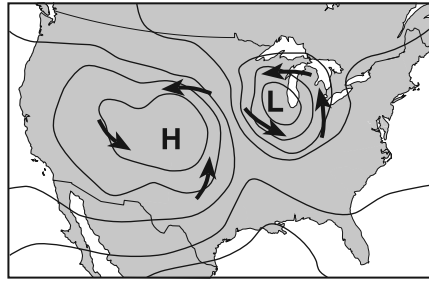


( 4 )

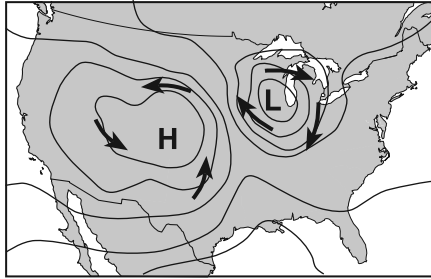
43 The arrows on which map best show the pattern of surface winds around these two pressure centers?



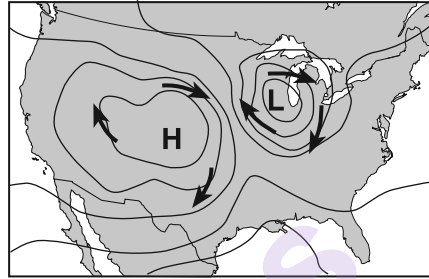
( 1 )



( 3 )

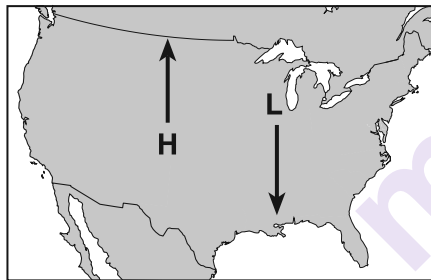


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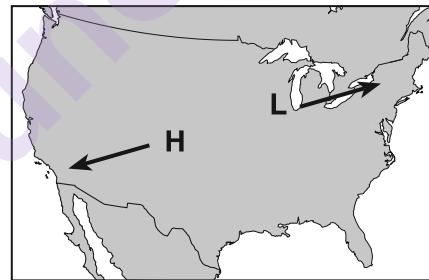


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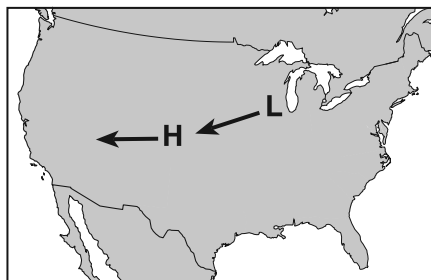
44 The arrows on which map show the most likely path in which these two pressure centers will move over the next few days?



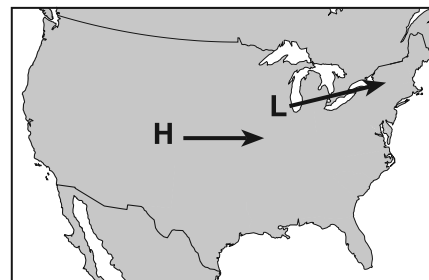
( 1 )



( 3 )

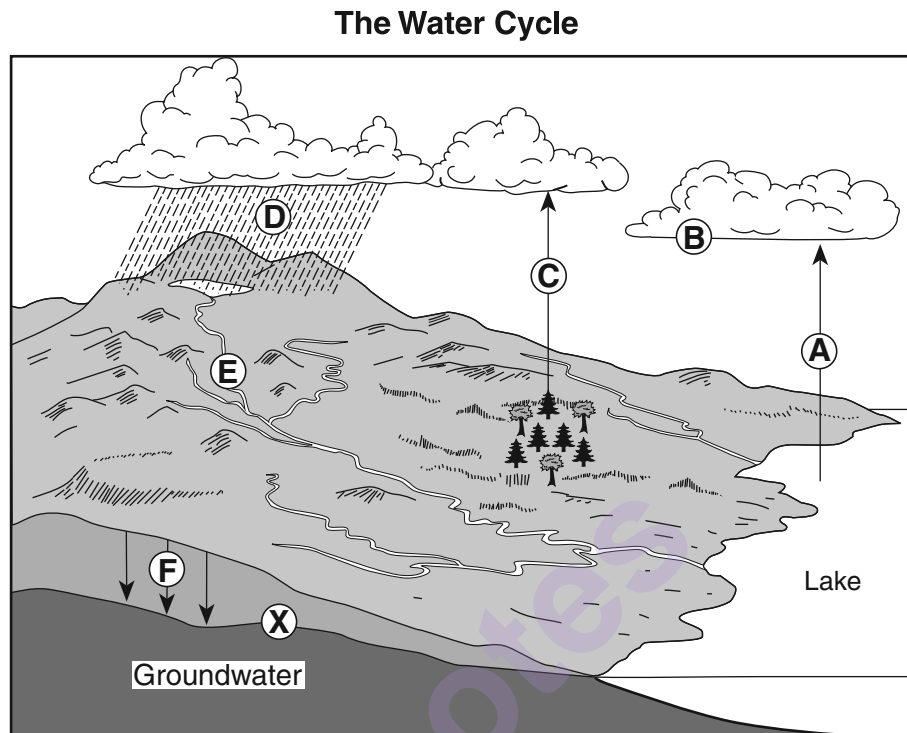


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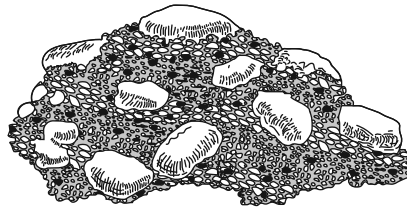
( 4 )

Base your answers to questions 45 through 48 on the diagram below, which shows a model of the water cycle. Letters *A* through *F* represent some processes of the water cycle. Letter *X* indicates the top of the underground zone that is saturated with water.



- 45 Which process is represented by letter *F*?
- |                  |                  |
|------------------|------------------|
| (1) capillarity  | (3) condensation |
| (2) infiltration | (4) vaporization |
- 46 What does letter *X* represent?
- |                     |                      |
|---------------------|----------------------|
| (1) the water table | (3) sea level        |
| (2) a floodplain    | (4) impermeable rock |
- 47 If the surface soil is saturated and precipitation increases, there will be
- |   |  |
|---|--|
| (1) a decrease in the amount of groundwater         | (3) an increase in the rate of capillarity |
| (2) a decrease in the surface elevation of the lake | (4) an increase in the amount of runoff    |
- 48 The processes of transpiration and evaporation are represented by letters
- |                           |                           |
|---------------------------|---------------------------|
| (1) <i>A</i> and <i>B</i> | (3) <i>C</i> and <i>A</i> |
| (2) <i>B</i> and <i>E</i> | (4) <i>D</i> and <i>E</i> |

Base your answers to questions 49 and 50 on the diagram below, which represents a rock composed of cemented pebbles and sand.



49 This rock should be classified as

- |                               |                                   |
|-------------------------------|-----------------------------------|
| (1) an intrusive igneous rock | (3) a bioclastic sedimentary rock |
| (2) an extrusive igneous rock | (4) a clastic sedimentary rock    |

50 Which change would most likely occur if this rock became buried deep within Earth's crust and was subjected to intense heat and pressure, but did *not* melt?

- (1) The density of the pebbles and sand would decrease.
  - (2) The rock would become a plutonic rock composed mostly of quartz.
  - (3) The rock would become more felsic with a higher concentration of magnesium.
  - (4) The pebbles would become distorted and the sand would be recrystallized.
-

**Part B–2**

**Answer all questions in this part.**

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

Base your answers to questions 51 through 53 on the diagram in your answer booklet, which shows Earth as viewed from space on December 21. Some latitudes are labeled.

- 51 On the diagram *in your answer booklet*, place an **X** at a location on Earth's surface where the Sun was directly overhead at some time on December 21. [1]
- 52 State *one* factor, other than the tilt of Earth's axis, that causes seasons to change on Earth. [1]
- 53 At which latitude is *Polaris* observed at an altitude of  $66.5^\circ$ ? [1]
-

Base your answers to questions 54 through 56 on the diagram of Bowen's Reaction Series below, which shows the sequence in which minerals crystallize as magma cools and forms different types of igneous rocks from the same magma. The arrow for each mineral represents the relative temperature range at which that mineral crystallizes.

**Bowen's Reaction Series**

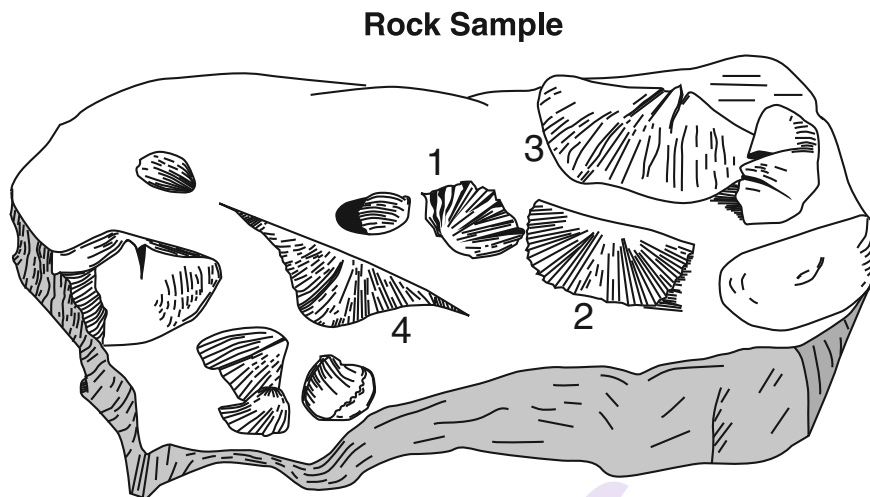
Temperature Conditions	Minerals that Crystallize from Magma as the Magma Cools	Igneous Rock Type
High temperature (first to crystallize)  Cooling magma ↓  Low temperature (last to crystallize)	Olivine	Ultramafic (peridotite)
	Pyroxene	Basaltic (basalt/gabbro)
	Amphibole	
	Biotite mica Plagioclase feldspar (More calcium rich) (More sodium rich)	Andesitic (andesite/diorite)
	Muscovite mica Quartz Potassium feldspar	Granitic (rhyolite/granite)

54 According to Bowen's Reaction Series, how is the chemical composition of plagioclase feldspar found in basaltic rock different from the chemical composition of plagioclase feldspar found in granitic rock? [1]

55 Describe the temperature conditions shown in Bowen's Reaction Series that explain why olivine and quartz are *not* usually found in the same igneous rock type. [1]

56 Identify *one* similarity and *one* difference between the igneous rocks andesite and diorite. [1]

Base your answers to questions 57 through 61 on the diagram and tables below. The diagram shows a rock sample containing fossils from a location in New York State at 42° N 78° 15' W. Fossils 1, 2, 3, and 4 are labeled. Table A lists the names and rock types of the New York State rock units from the Middle and Late Devonian in this area. The presence of fossil 1, 2, 3, or 4 in a rock unit is indicated by an X in the fossils column in the table. Table B identifies typical rocks formed within different marine (ocean) environments.



**Table A: New York State Rock Units in Area Where the Rock Sample was Found**

Geologic Age: Devonian	Name of Rock Unit	Type of Rock Found in Unit	Fossils			
			1	2	3	4
Late	Conewango	shales and sandstones	X	X		X
Late	Conneaut	shales and sandstones	X	X		X
Late	Canadaway	shales and sandstones	X	X	X	X
Late	West Falls	shales and sandstones	X	X	X	
Late	Sonyea	shale	X	X	X	
Late/Middle	Genesee	shale	X	X		
Middle	Tully	limestone	X	X		
Middle	Hamilton	limestone	X	X		
Middle	Onondaga	limestone (includes volcanic ash bed)		X		

**Table B: Sedimentary Rock Types Formed in Different Marine Environments**

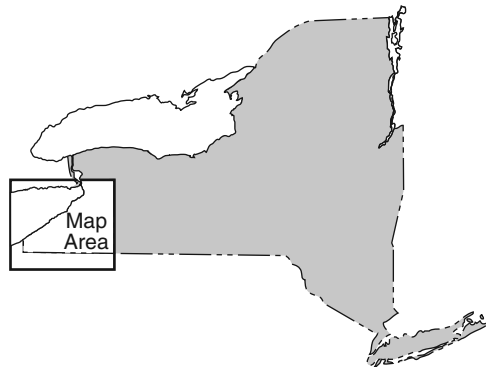
Sedimentary Rocks	Marine Environment
limestones	clear, shallow water
gray shales	muddy, oxygen rich
black shales	muddy, oxygen poor
siltstones and sandstones	silty to sandy bottom
evaporites	very salty, shallow seas
coarse-grained sandstones and conglomerates	tidal shores and deltas



- 57 On the map *in your answer booklet*, place an **X** at the location where this rock sample was collected. [1]
- 58 Based on the fossils present, the rock sample shown in the diagram came from which rock unit listed in table A? [1]
- 59 Identify the New York State index fossil group that includes fossil 4 shown on the rock sample. [1]
- 60 Identify the landmass that collided with the eastern coast of North America to create the Acadian mountain range and the basin for the deposition of the Devonian rock units in table A. [1]
- 61 According to the tables, in which marine environment was the Tully rock unit deposited? [1]
- 

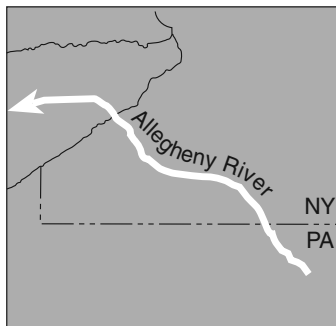
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Base your answers to questions 62 through 65 on the maps below. The southwest corner of the New York State map below is enlarged in maps I, II, and III. Arrows on maps I, II, and III show the location and direction of flow for part of the Allegheny River at different times during the Cenozoic Era. The present boundaries of New York State and Lake Erie are shown on each map. Point A on map III represents a location in New York State.

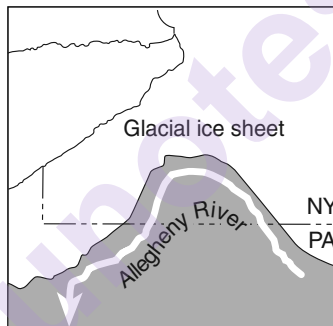


### Course of the Allegheny River

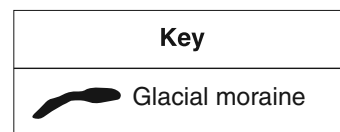
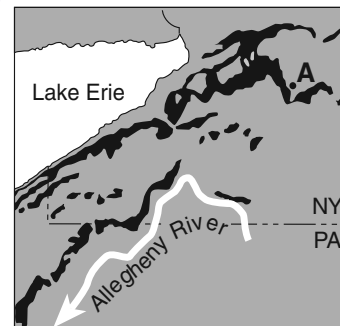
**Map I**  
During the Neogene Period



**Map II**  
22,000 Years Ago



**Map III**  
Present Day



- 62 Map II shows the course of the Allegheny River during a specific part of a geologic time period. State the name of this geologic time period. [1]
- 63 Explain why the direction of flow of the Allegheny River changed between the times shown on map I and map II. [1]
- 64 Identify the present-day feature that prevents the Allegheny River from returning to its earlier (Neogene) direction of flow to the northwest. [1]
- 65 The diagram *in your answer booklet* shows a partial cross section of a valley near location A on map III. On this diagram, draw a line beginning at X and ending at Y to show the shape of this valley after it was eroded by glacial ice that flowed down the valley. [1]

## Part C

**Answer all questions in this part.**

*Directions (66–85):* Use your knowledge of Earth science to answer all questions. 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 data table below, which shows the average carbon dioxide (CO<sub>2</sub>) concentrations in Earth's atmosphere for specific years from 1930 to 2010. Carbon dioxide is a greenhouse gas in Earth's atmosphere that contributes to global warming. The average carbon dioxide concentrations were measured in parts per million (ppm).

**Average Carbon Dioxide Concentrations  
in Earth's Atmosphere**

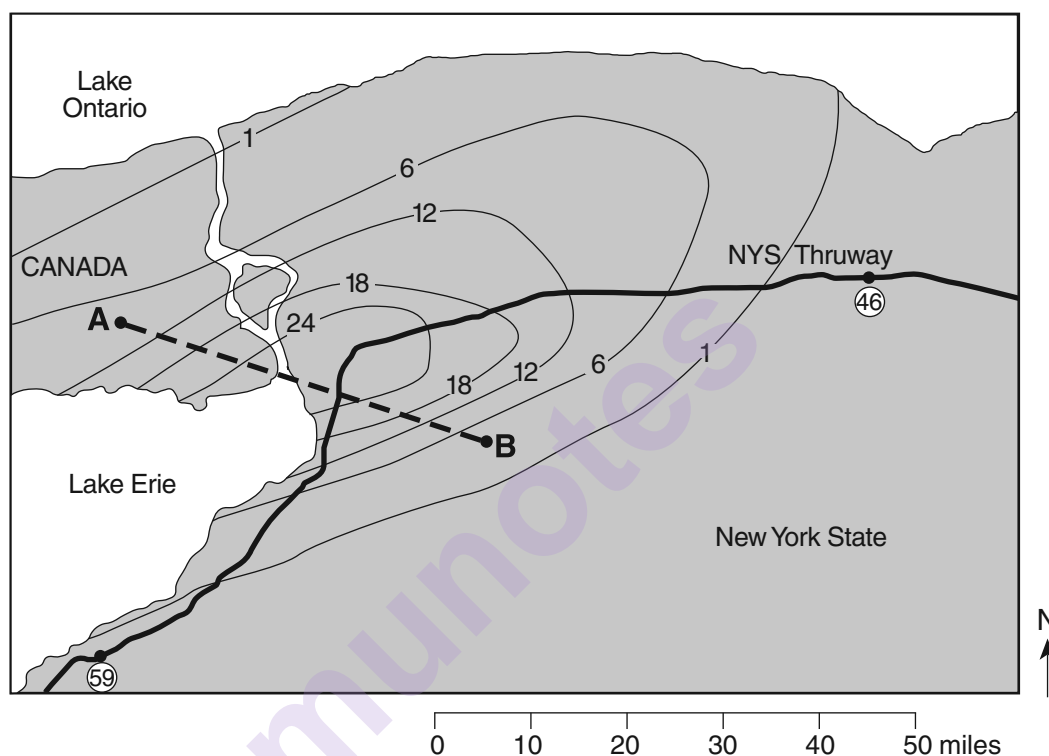
Year	Average CO <sub>2</sub> Concentration (ppm)
1930	306
1940	308
1950	310
1960	316
1970	326
1980	338
1990	354
2000	370
2010	390

- 66 On the grid in your answer booklet, construct a line graph by plotting the average carbon dioxide concentrations in Earth's atmosphere for *each* year shown on the data table. Connect the plots with a line. [1]
- 67 Calculate the rate of change from 2000 to 2010 of the average carbon dioxide concentrations, in parts per million per year. [1]
- 68 Identify *one* greenhouse gas, other than carbon dioxide, that contributes to global warming. [1]
-

Base your answers to questions 69 through 73 on the map and passage below.

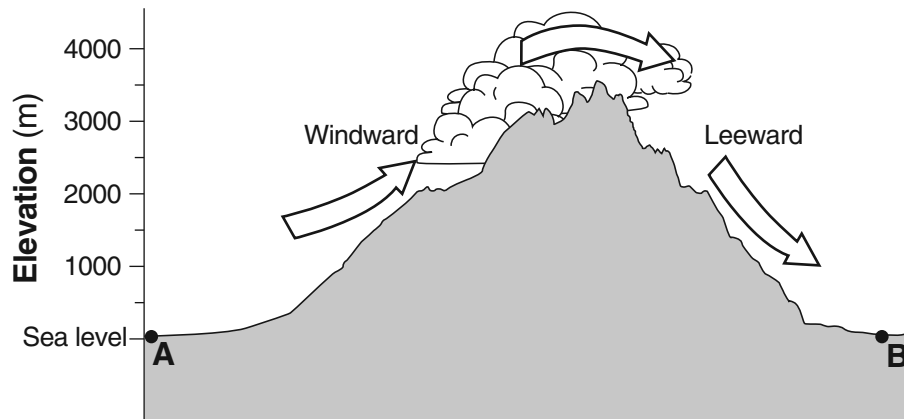
### A Lake-Effect Snowstorm

A snowstorm affected western New York State on October 12 and 13, 2006. A blend of weather conditions caused more than 24 inches of heavy, wet, lake-effect snow, bringing much of western New York to a standstill. The New York State Thruway was closed to traffic between exits 46 and 59, which are circled on the map. The isolines on the map show the amount of snowfall, measured in inches, resulting from this storm. Points A and B represent locations on Earth's surface.



- 69 On the grid in your answer booklet, construct a profile of the snowfall amounts along line AB by plotting the isoline amounts that cross line AB. The amounts for points A and B have been plotted. Complete the profile by connecting *all* the plots with a line. [1]
- 70 Approximately how many miles of this section of the Thruway were closed due to the snowstorm? [1]
- 71 Determine the number of inches of snow that was received in Niagara Falls, New York, from this snowstorm. [1]
- 72 Identify the most probable direction from which the wind was blowing to produce the pattern of snowfall shown on the map. [1]
- 73 Identify *two* hazards to human life or property that can result from a snowstorm of this size. [1]

Base your answers to questions 74 through 77 on the diagram below, which shows the windward and leeward sides of a mountain range. Arrows show the movement of air over a mountain. Points *A* and *B* represent locations at sea level on Earth's surface.



- 74 Identify *one* weather instrument that could be used to determine the dewpoint of the air at point *A*. [1]
- 75 What is the relative humidity at the base (bottom) of the cloud on the windward side of the mountain? [1]
- 76 Explain why air cools as it rises up this mountain. [1]
- 77 Compared to the temperature and relative humidity of the air at point *A*, describe how the temperature and relative humidity of the air are different as the air arrives at point *B*. [1]
-

Base your answers to questions 78 through 82 on the diagram in your answer booklet, which represents eight positions of the Moon in its orbit around Earth.

78 On the diagram *in your answer booklet*, circle the position of the Moon where a solar eclipse is possible. [1]

79 On the diagram *in your answer booklet*, shade the portion of the Moon that is in darkness to show the phase of the Moon at position 3, as viewed from New York State. [1]

80 Using the terms *rotation* and *revolution*, explain why the same side of the Moon always faces Earth. [1]

81 Explain why the Moon's gravity has a greater effect on Earth's ocean tides than the Sun's gravity. [1]

82 The table below shows times of ocean tides on March 4 for a city on the Atlantic coast of the United States.

**Ocean Tides on March 4**

Tide	Time
high	12:00 a.m.
low	6:13 a.m.
high	12:26 p.m.

Determine the time when the next low tide occurred. Include a.m. or p.m. in your answer, if needed. [1]

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Base your answers to questions 83 through 85 on the passage and data table below, which describe the exploration and characteristics of one of Saturn's moons, Titan.

### Huygens Probe Lands on Titan

The Huygens probe was carried to Saturn by the Cassini spacecraft and parachuted to the surface of Saturn's giant moon, Titan. The Huygens probe's landing site was littered with smooth, rounded, rocklike objects. Photographs taken of Titan's surface show drainage channels leading to an apparent shoreline. The question is, what are they draining? One of the photographs seems to show ground fog consisting not of water, but perhaps of ethane or methane.

**Titan Data**

<b>Distance from Saturn</b>	1.22 million km
<b>Diameter</b>	5150 km
<b>Average Density</b>	1.881 g/cm <sup>3</sup>
<b>Atmospheric Pressure at Surface</b>	1500 mb
<b>Mass (Earth = 1)</b>	0.022
<b>Air Temperature at Landing Site</b>	-291°F

83 What natural process occurring on Earth produces smooth, rounded rocks similar to those found at the probe's landing site on Titan? [1]

84 Approximately how many times farther is Titan from Saturn than Earth's Moon is from Earth? [1]

85 Identify the planet with a density closest to the density of Titan. [1]

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