

PHYSICAL SETTING EARTH SCIENCE

Friday, August 17, 2018 — 8:30 to 11:30 a.m., only

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

Use your knowledge of Earth science to answer all questions in this examination. Before you begin this examination, you must be provided with the *2011 Edition Reference Tables for Physical Setting/Earth Science*. You will need these reference tables to answer some of the questions.

You are to answer all questions in all parts of this examination. You may use scrap paper to work out the answers to the questions, but be sure to record your answers on your answer sheet and in your answer booklet. A separate answer sheet for Part A and Part B–1 has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet. Record your answers to the Part A and Part B–1 multiple-choice questions on this separate answer sheet. Record your answers for the questions in Part B–2 and Part C in your separate answer booklet. Be sure to fill in the heading on the front of your answer booklet.

All answers in your answer booklet should be written in pen, except for graphs and drawings, which should be done in pencil.

When you have completed the examination, you must sign the declaration printed on your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet and answer booklet cannot be accepted if you fail to sign this declaration.

Notice ...

A four-function or scientific calculator and a copy of the *2011 Edition Reference Tables for Physical Setting/Earth Science* must be available for you to use while taking this examination.

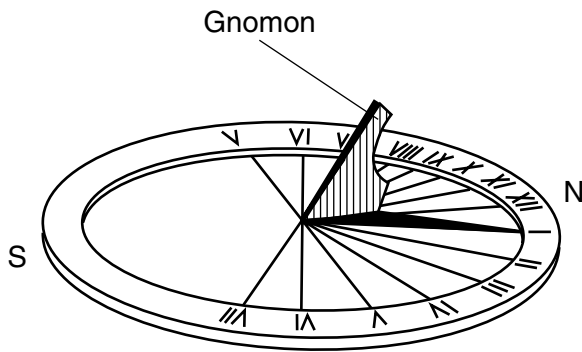
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part.

Directions (1–35): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*. Record your answers on your separate answer sheet.

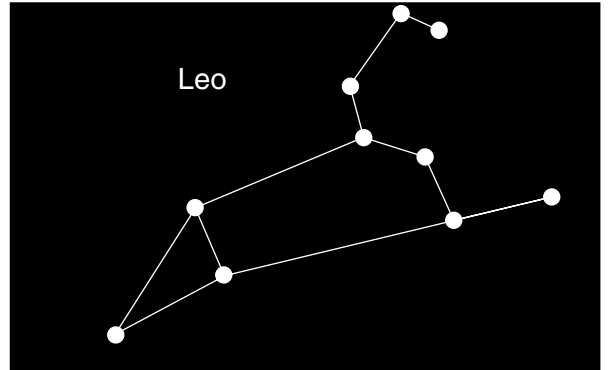
- 1 The diagram below represents a sundial positioned in New York State. During daylight, the shadow cast by the gnomon (pointer) moves across the disc, with the tip of the shadow pointing to the time of day.



This motion of the gnomon's shadow on the sundial is mainly due to

- (1) Earth's rotation
 - (2) Earth's revolution
 - (3) the Sun's rotation
 - (4) the Sun's revolution
- 2 The formation of the planet Uranus is estimated to have occurred approximately
- (1) 100,000 million years ago
 - (2) 2.0 billion years ago
 - (3) 4.6 billion years ago
 - (4) 13.7 billion years ago
- 3 Compared to the Jovian planets in our solar system, the terrestrial planets have
- (1) less mass and are less dense
 - (2) less mass and are more dense
 - (3) more mass and are less dense
 - (4) more mass and are more dense

- 4 The diagram below represents the constellation Leo that can be seen by an observer in New York State at midnight during March.



Leo is *not* visible to this observer at midnight during September because

- (1) Leo has rotated on its axis
 - (2) Leo has revolved in its orbit around the Sun
 - (3) Earth has rotated on its axis
 - (4) Earth has revolved in its orbit around the Sun
- 5 An observer in New York City measured the angle of insolation at solar noon each day. During which month did this observer see the noontime angle of insolation increase each day?
- (1) April
 - (2) July
 - (3) September
 - (4) December
- 6 The Coriolis effect occurs as a result of Earth's
- (1) rotation
 - (2) revolution
 - (3) tilted axis
 - (4) magnetic field

7 During the process of condensation, water vapor

- (1) releases 334 J/g of heat energy
- (2) releases 2260 J/g of heat energy
- (3) gains 334 J/g of heat energy
- (4) gains 2260 J/g of heat energy

8 Infiltration is generally greater than runoff where the land has a

- (1) gentle slope and permeable soil
- (2) gentle slope and impermeable bedrock
- (3) steep slope and permeable soil
- (4) steep slope and impermeable bedrock

9 Nearly 90% of the water vapor that enters Earth's atmosphere comes from the evaporation of Earth's surface waters. Most of the remaining 10% is water vapor that enters the atmosphere through

- (1) precipitation from clouds
- (2) transpiration from plants
- (3) condensation within the troposphere
- (4) melting of polar ice caps

10 What is the relative humidity if the dry-bulb temperature is 26°C and the wet-bulb temperature is 18°C?

- (1) 13 %
- (2) 33 %
- (3) 45 %
- (4) 51 %

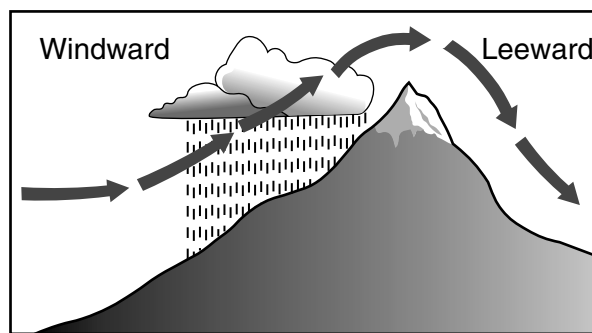
11 Most of the long-wave energy radiated from Earth and lost to space on a cloudless night is

- (1) ultraviolet
- (2) infrared
- (3) visible light
- (4) gamma rays

12 In addition to carbon dioxide, two other major greenhouse gases in Earth's atmosphere are

- (1) oxygen and nitrogen
- (2) oxygen and methane
- (3) water vapor and nitrogen
- (4) water vapor and methane

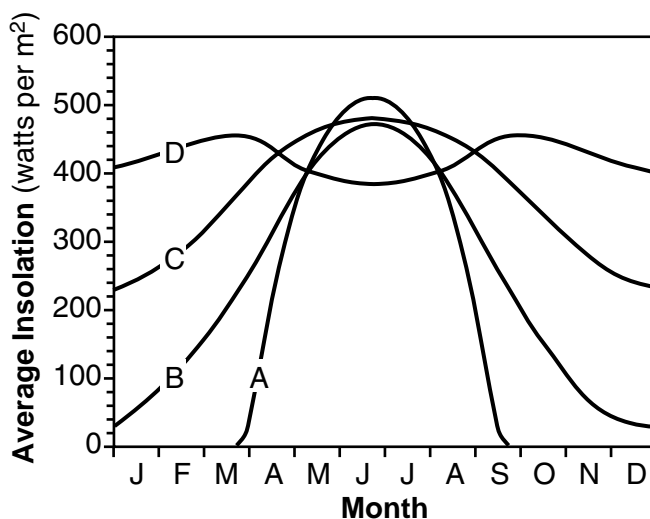
13 The arrows in the diagram below represent the movement of air over a mountain.



Clouds are forming on the windward side of this mountain because the air is

- (1) expanding and cooling to the dewpoint
- (2) expanding and warming to the dewpoint
- (3) compressing and cooling to the dewpoint
- (4) compressing and warming to the dewpoint

14 The graph below shows the average monthly amount of insolation received throughout a year at four locations (A, B, C, and D) on Earth.



Which line on the graph best represents the average monthly insolation received at the equator?

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

15 Earth's polar regions have cold, dry climates because the Sun's rays are at a

- (1) low angle, and upper atmospheric air is sinking
- (2) low angle, and upper atmospheric air is rising
- (3) high angle, and lower atmospheric air is sinking
- (4) high angle, and lower atmospheric air is rising

16 Atmospheric transparency will increase when

- (1) volcanic eruptions occur
- (2) fog is produced
- (3) insolation is reflected by clouds
- (4) precipitation removes dust particles from the air

17 The existence of which group of organisms spans the shortest geologic time?

- (1) birds
- (2) humans
- (3) dinosaurs
- (4) placoderm fish

18 Which New York State geologic event occurred most recently?

- (1) Taconian orogeny
- (2) Grenville orogeny
- (3) formation of the Catskill delta
- (4) dome-like uplift of the Adirondack region

19 The only dinosaur fossils found in New York State are footprints found on 210-million-year-old bedrock. In which New York State landscape region were these dinosaur fossils found?

- (1) Tug Hill Plateau
- (2) Newark Lowlands
- (3) Allegheny Plateau
- (4) Adirondack Mountains

20 The first *P*-wave of an earthquake travels 5600 kilometers from the epicenter and arrives at a seismic station at 10:05 a.m. At what time did this earthquake occur?

- (1) 9:49 a.m.
- (2) 9:56 a.m.
- (3) 10:02 a.m.
- (4) 10:14 a.m.

21 The photograph below shows a New York State index fossil.



What is the best classification of this fossil, and during which geologic time period did the organism that produced this fossil exist?

- (1) Classification: Coral
Geologic time period: Permian
- (2) Classification: Coral
Geologic time period: Ordovician
- (3) Classification: Trilobite
Geologic time period: Permian
- (4) Classification: Trilobite
Geologic time period: Ordovician

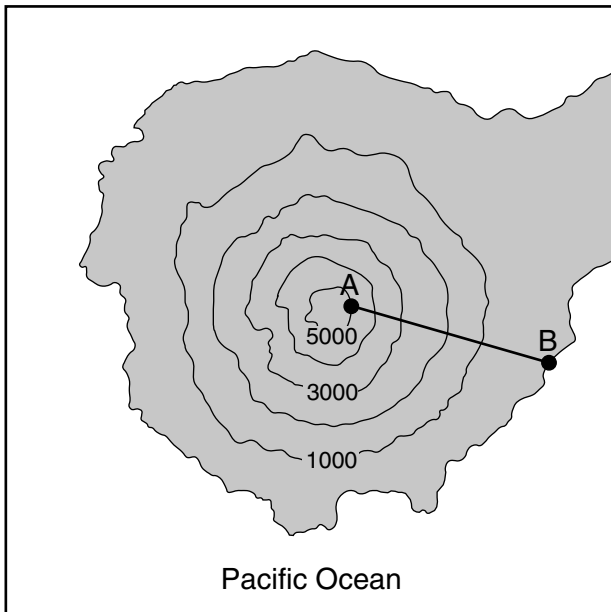
22 As a quartz pebble is transported by a stream, the pebble will become more rounded as a result of

- (1) dissolving as water is running over the rock
- (2) abrasion by colliding with other rocks
- (3) deposition in well-sorted layers
- (4) resistance to weathering and erosion

23 Which three minerals are most likely used in the construction of a house?

- (1) graphite, pyrite, and halite
- (2) garnet, galena, and sulfur
- (3) talc, amphibole, and fluorite
- (4) selenite gypsum, dolomite, and muscovite mica

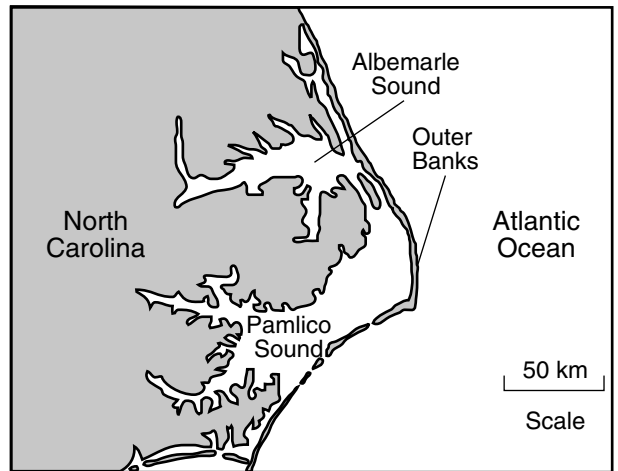
- 24 The topographic map below shows a portion of a volcanic island in the Pacific Ocean. Elevations are shown in feet. Letters A and B represent locations on Earth's surface. Locations A and B are 2.5 miles apart.



What is the approximate gradient from point A to point B on the island?

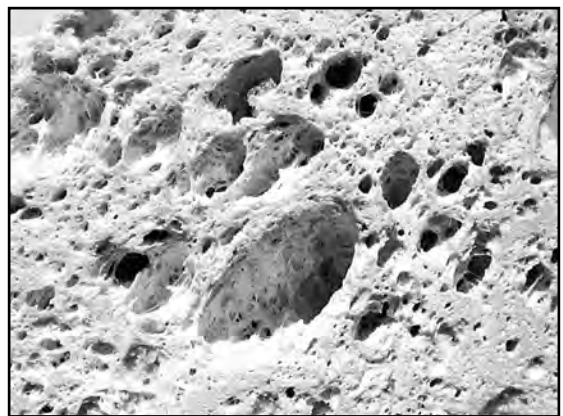
- (1) 1000 ft/mi (3) 2000 ft/mi
 (2) 1250 ft/mi (4) 2500 ft/mi
- 25 Which two rocks usually consist of only one mineral, but may contain additional minerals?
- (1) hornfels and diorite
 (2) quartzite and dunite
 (3) rock salt and basalt
 (4) gabbro and bituminous coal
- 26 Which rock has never melted, but was produced by great heat and pressure, which distorted and rearranged its minerals?
- (1) siltstone (3) pegmatite
 (2) breccia (4) metaconglomerate

- 27 The map below shows a portion of the North Carolina coastline, including some of the Outer Banks. The Outer Banks is a string of narrow barrier islands consisting of well-sorted sand along the Atlantic Ocean coast.



Which agent of erosion is primarily responsible for the formation of these barrier islands?

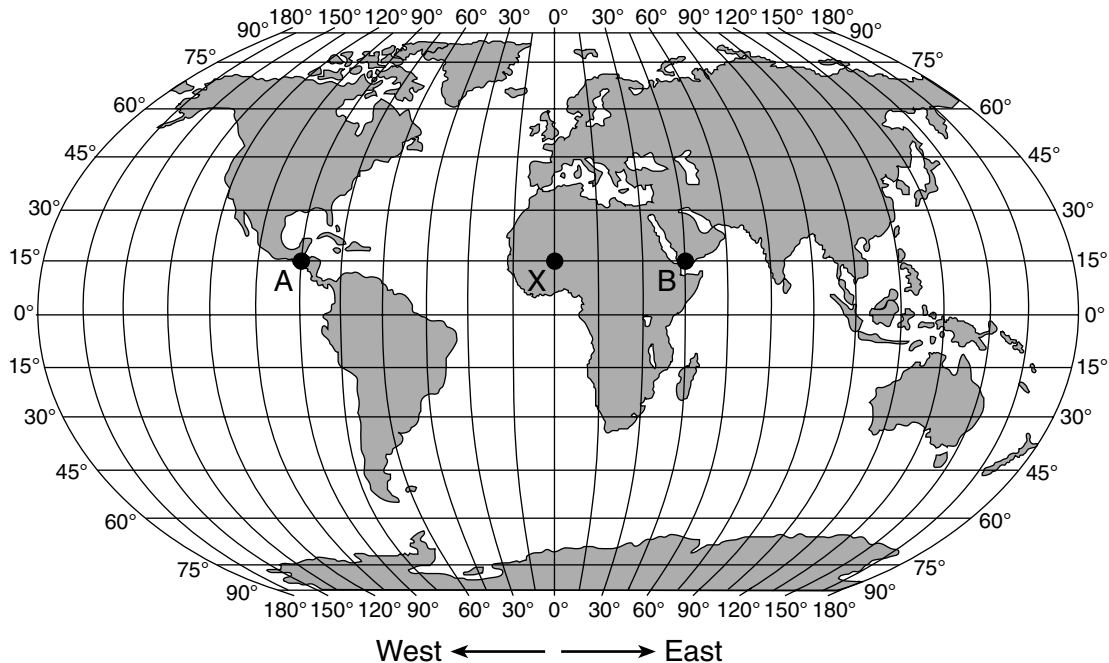
- (1) wave action (3) streams
 (2) landslides (4) glacial ice
- 28 The photograph below shows a magnified view of a portion of a rock that can float if placed in water.



Which terms best describe this rock?

- (1) non-crystalline and vesicular
 (2) coarse and non-vesicular
 (3) clastic and fragmental
 (4) foliated and banded

29 The map below shows three locations, labeled A, X, and B, on Earth's surface.



Which table correctly indicates the solar times at locations A and B when it is 12 noon at location X?

Location	Solar Time
A	6 a.m.
B	9 a.m.

(1)

Location	Solar Time
A	6 p.m.
B	9 a.m.

(3)

Location	Solar Time
A	6 a.m.
B	3 p.m.

(2)

Location	Solar Time
A	6 p.m.
B	3 p.m.

(4)

30 Which equation is used to determine the approximate rate of Earth's revolution?

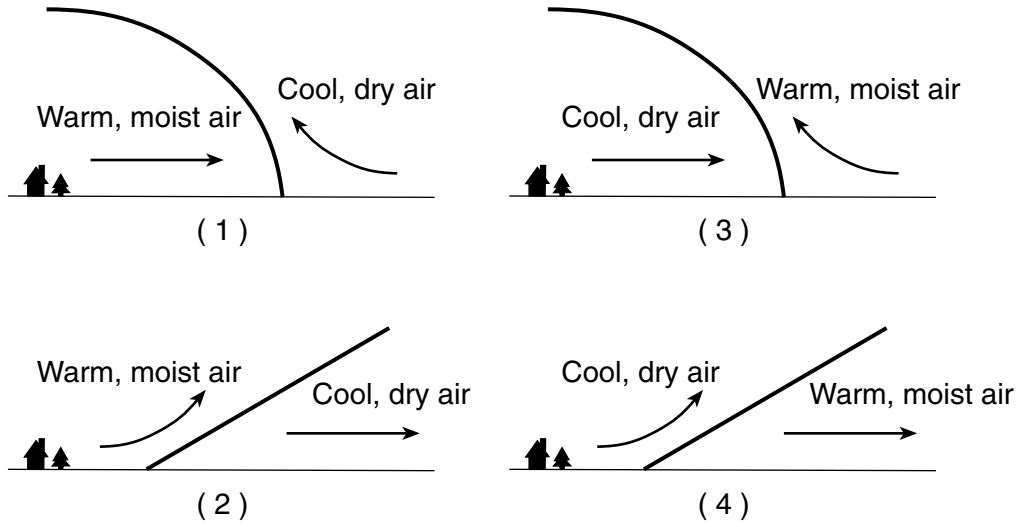
(1) Approximate rate of Earth's revolution = $\frac{365^\circ}{360 \text{ days}}$

(2) Approximate rate of Earth's revolution = $\frac{360^\circ}{24 \text{ hours}}$

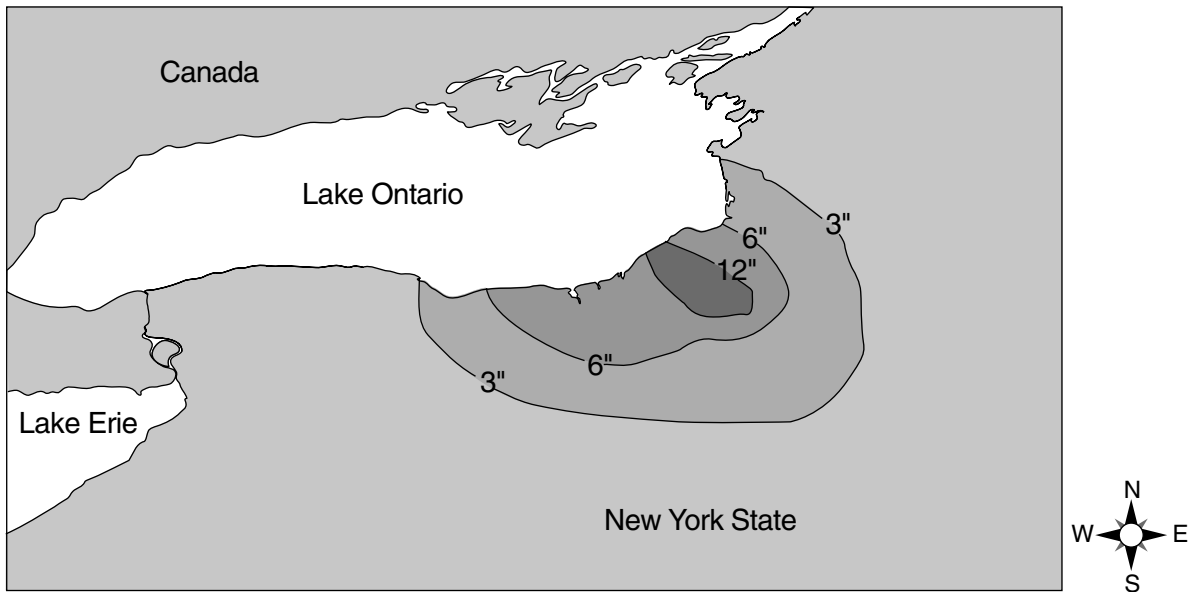
(3) Approximate rate of Earth's revolution = $\frac{360^\circ}{365 \text{ days}}$

(4) Approximate rate of Earth's revolution = $\frac{24^\circ}{360 \text{ hours}}$

31 Which cross section best represents a cold front?



32 The isolines on the map below show snowfall totals from a lake-effect storm that affected a portion of New York State.



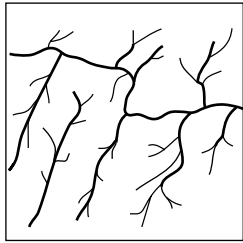
The surface winds that produced this storm came from which direction?

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

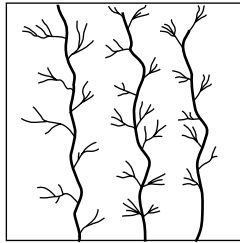
33 The photograph below shows Mount Rainier, a volcano in the state of Washington.



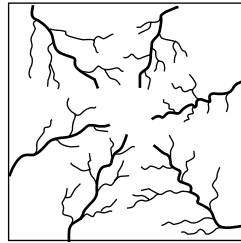
Which map best shows the complete stream drainage pattern for this mountain?



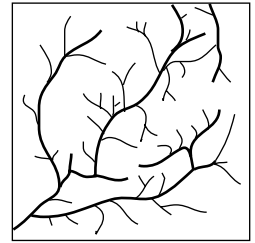
(1)



(2)



(3)



(4)

34 Which table best represents the characteristics of the continental crust and the oceanic crust?

Type of Crust	Density (g/cm ³)	Composition	Relative Thickness
Continental	3.0	basaltic	thicker
Oceanic	2.7	granitic	thinner

(1)

Type of Crust	Density (g/cm ³)	Composition	Relative Thickness
Continental	2.7	granitic	thinner
Oceanic	3.0	basaltic	thicker

(3)

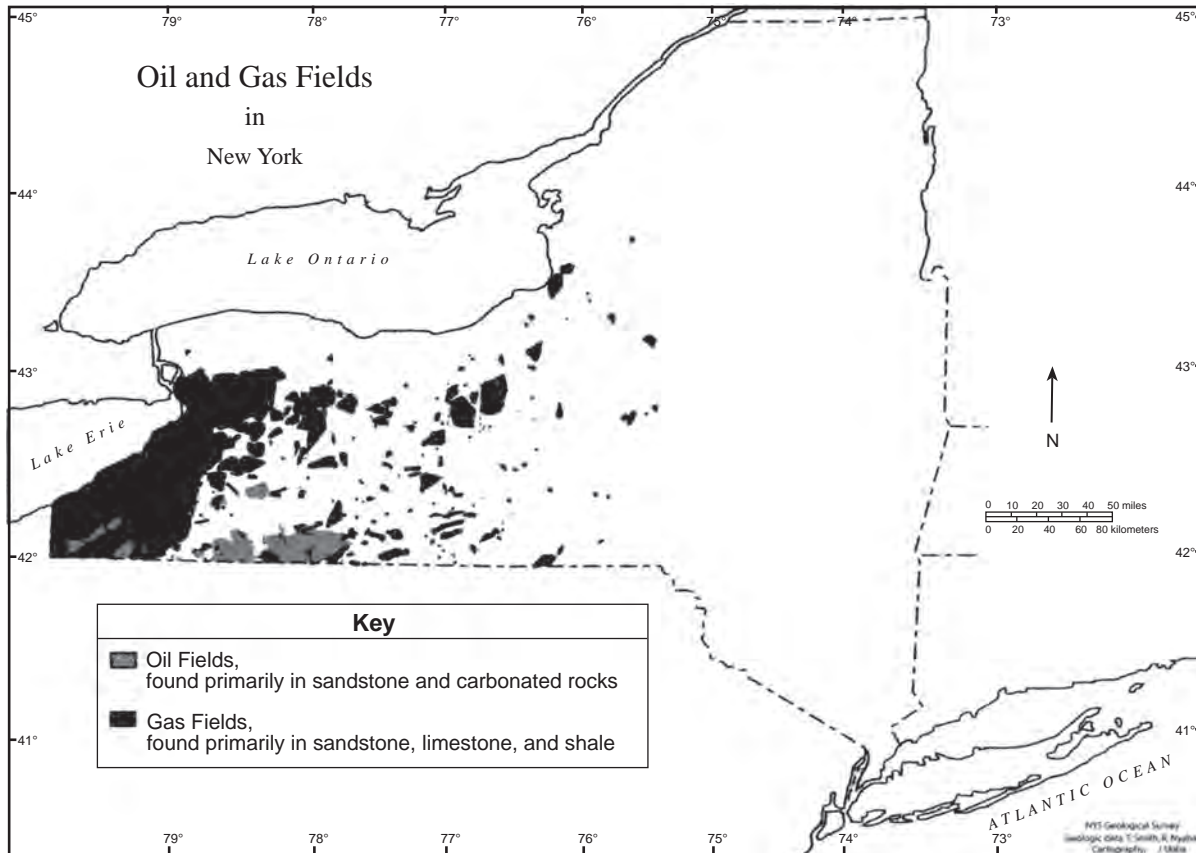
Type of Crust	Density (g/cm ³)	Composition	Relative Thickness
Continental	3.0	granitic	thicker
Oceanic	2.7	basaltic	thinner

(2)

Type of Crust	Density (g/cm ³)	Composition	Relative Thickness
Continental	2.7	granitic	thicker
Oceanic	3.0	basaltic	thinner

(4)

35 The map below shows the locations of some oil and gas fields in New York State.



Source: New York State Museum, State Geological Survey

Which type of bedrock contains these oil and gas deposits?

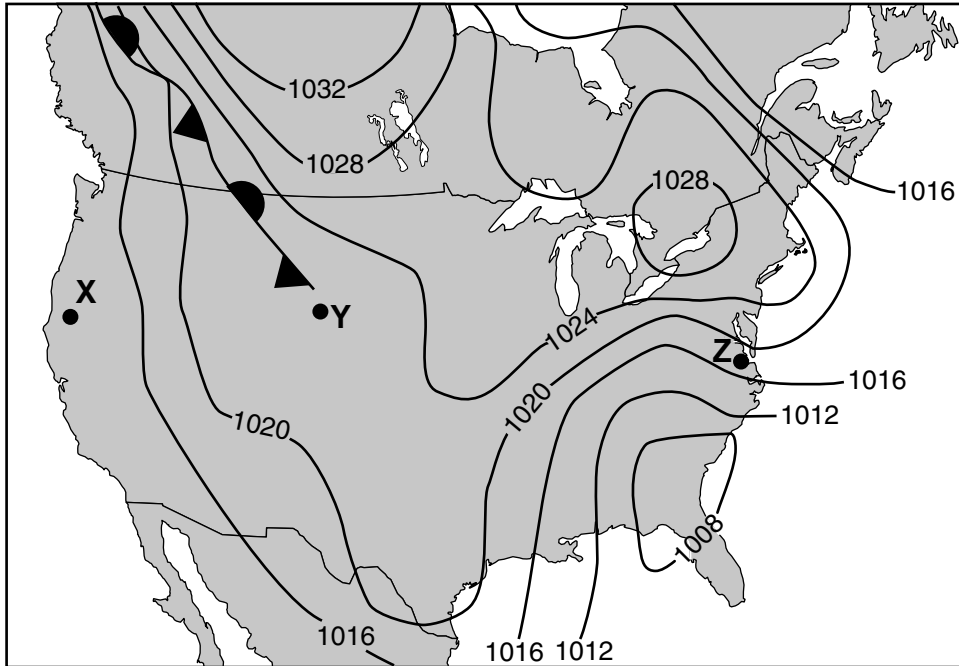
- (1) extrusive igneous rock
- (2) intrusive igneous rock
- (3) metamorphic rock
- (4) sedimentary rock

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 map below and on your knowledge of Earth science. The map shows typical weather systems over North America. Letters X, Y, and Z represent locations on the map. The isobars on the map are measured in millibars (mb).



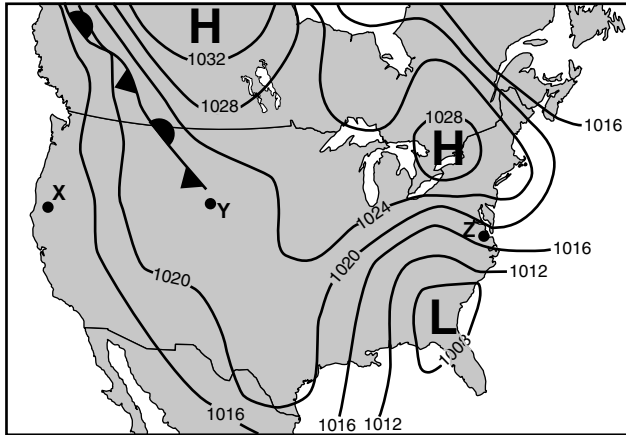
36 Which map information indicates that the wind velocity is greater at location Z than at location X?

- (1) Location Z is closer to the ocean.
- (2) The isobars are closer together at Z.
- (3) The latitude of location X is greater.
- (4) Location X is closer to the front.

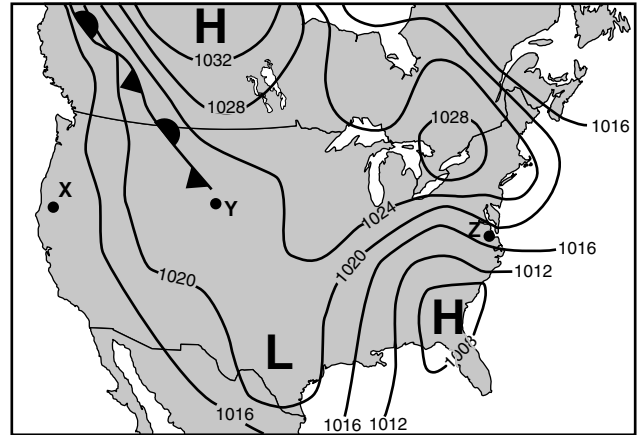
37 Which type of front extends northwest from location Y?

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

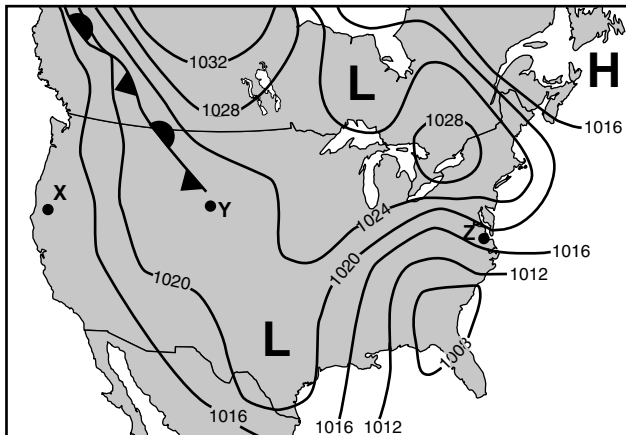
38 Which map best shows the locations for the centers of high pressure (H) and low pressure (L)?



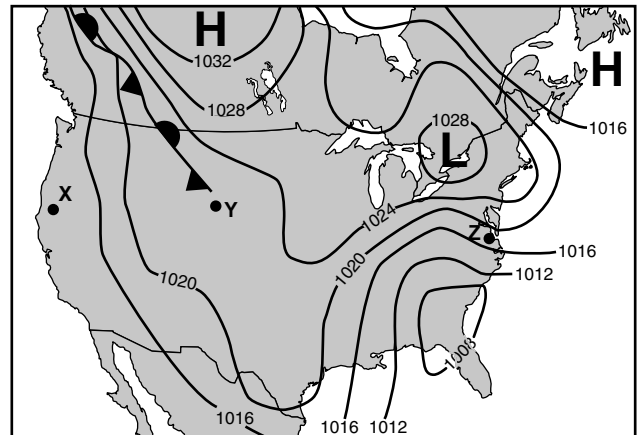
(1)



(3)



(2)



(4)

Base your answers to questions 39 through 41 on the passage below and on your knowledge of Earth Science.

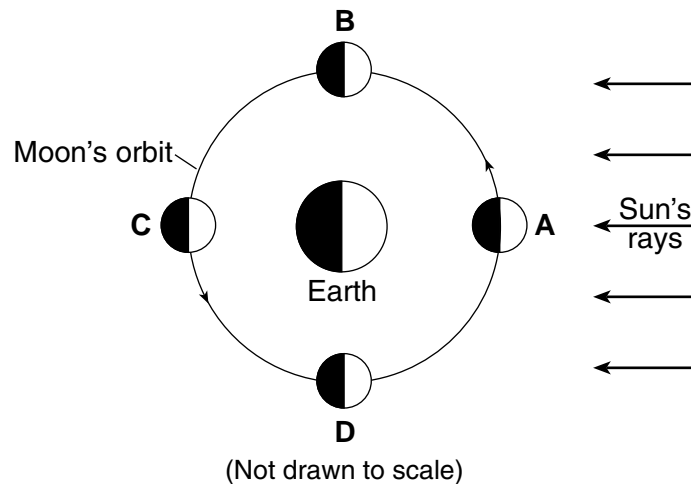
Supermoon Eclipse

On September 27, 2015, a rare total lunar eclipse of a supermoon occurred. A supermoon occurs when the entire lighted half of the Moon faces Earth (full Moon phase) and the Moon is at its closest point to Earth in its orbit. At this time, the Moon will appear 14% larger and 30% brighter than normal. Supermoon events are rare, but a total lunar eclipse during a supermoon is even more rare. There have been only six total supermoon lunar eclipses since 1900. The next one will not happen until 2033.

39 Supermoon total lunar eclipses are celestial events that

- (1) are random occurrences
- (2) are predictable
- (3) will never happen again after 2033
- (4) will happen every full Moon

40 The diagram below represents the Moon in four positions, A through D, in its orbit around Earth.



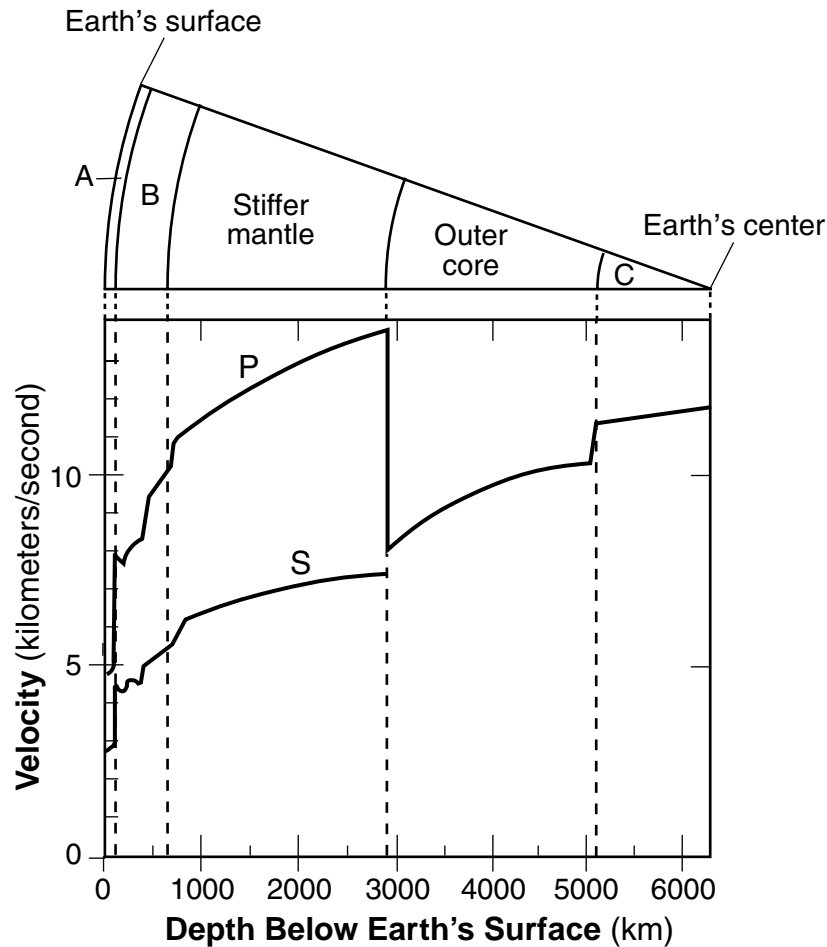
At which position in its orbit was the Moon located during the 2015 supermoon total lunar eclipse?

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

41 The time it took for the Moon to go from this supermoon to the next full moon phase was

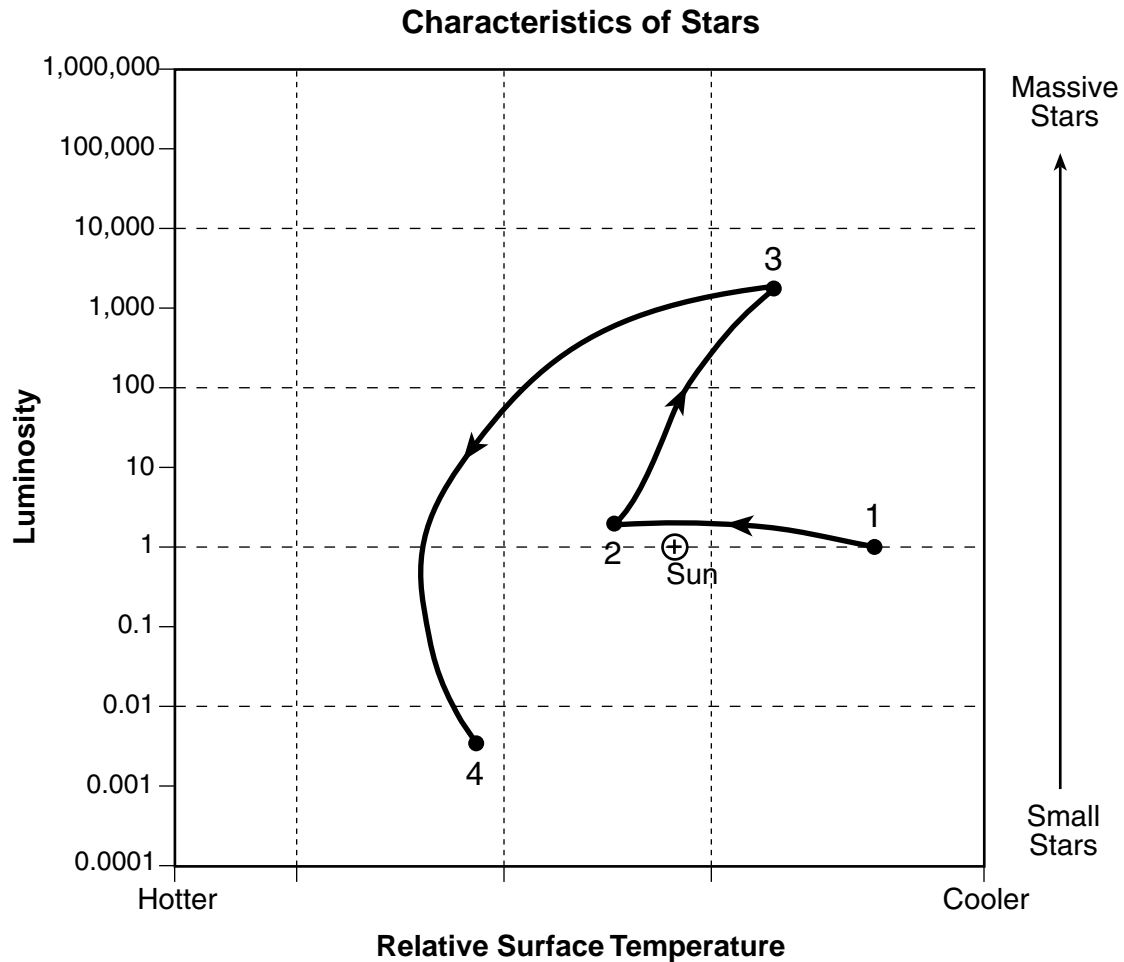
- (1) 15 days
 - (2) 27.3 days
 - (3) 29.5 days
 - (4) 365 days
-

Base your answers to questions 42 through 44 on the diagram and graph below and on your knowledge of Earth science. The diagram represents a portion of Earth's interior. Letters A, B, and C represent interior layers. The graph shows the velocity of P-waves and S-waves at various depths in Earth's interior.



- 42 Which layers of Earth's interior are represented by letters A and B?
- (1) A is the crust and B is the rigid mantle.
 - (2) A is the lithosphere and B is the asthenosphere.
 - (3) A is the asthenosphere and B is the crust.
 - (4) A is the rigid mantle and B is the lithosphere.
- 43 What is the approximate velocity in kilometers/second of the P-waves at a depth of 1000 kilometers?
- (1) 6.2 km/s
 - (2) 7.2 km/s
 - (3) 11.3 km/s
 - (4) 13.8 km/s
- 44 Some locations within layer C have an inferred density of
- (1) 3.4 g/cm³
 - (2) 5.6 g/cm³
 - (3) 11.5 g/cm³
 - (4) 12.9 g/cm³

Base your answers to questions 45 through 47 on the graph below and on your knowledge of Earth science. The graph shows the changes in a single star's luminosity and relative temperature from its formation (point 1) to its late stage (point 4) relative to the Sun.



- 45 Which is a possible surface temperature of this star at point 2?
- | | |
|------------|--------------|
| (1) 3000 K | (3) 7000 K |
| (2) 5000 K | (4) 10,000 K |
- 46 Between points 1 and 3, this star is visible to observers on Earth because it emits light energy. This energy is released by the process of nuclear fusion when
- (1) dust collides with the star
 - (2) dust is broken apart by radiation
 - (3) lighter elements combine to form heavier elements
 - (4) heavier elements are broken down to form lighter elements

47 Which table correctly classifies this star at points 3 and 4?

Point	Classification
3	Giant
4	White Dwarf

(1)

Point	Classification
3	Supergiant
4	Main Sequence

(3)

Point	Classification
3	White Dwarf
4	Supergiant

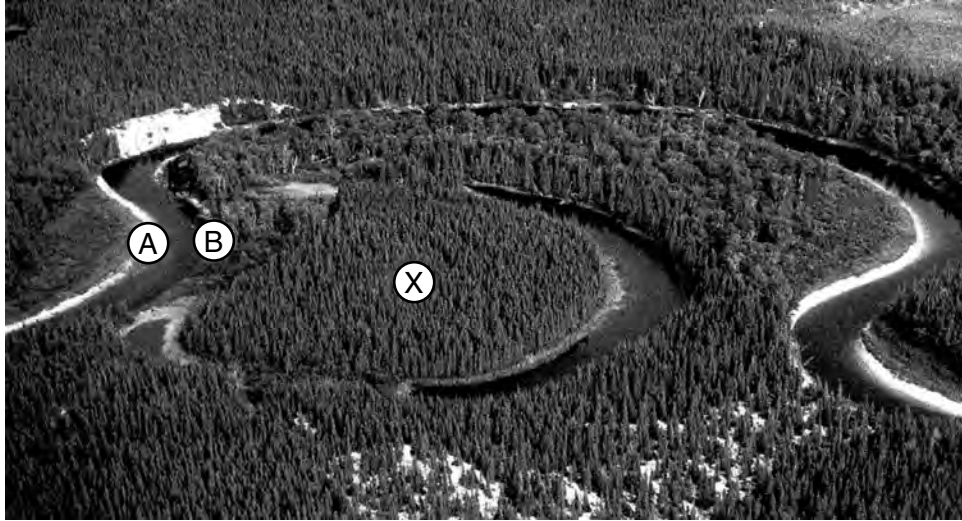
(2)

Point	Classification
3	Giant
4	Main Sequence

(4)

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Base your answers to questions 48 through 50 on the photograph below and on your knowledge of Earth science. The photograph shows a meandering stream in a wooded area. Points A and B represent locations on the streambanks. Letter X represents a flat area near the stream.



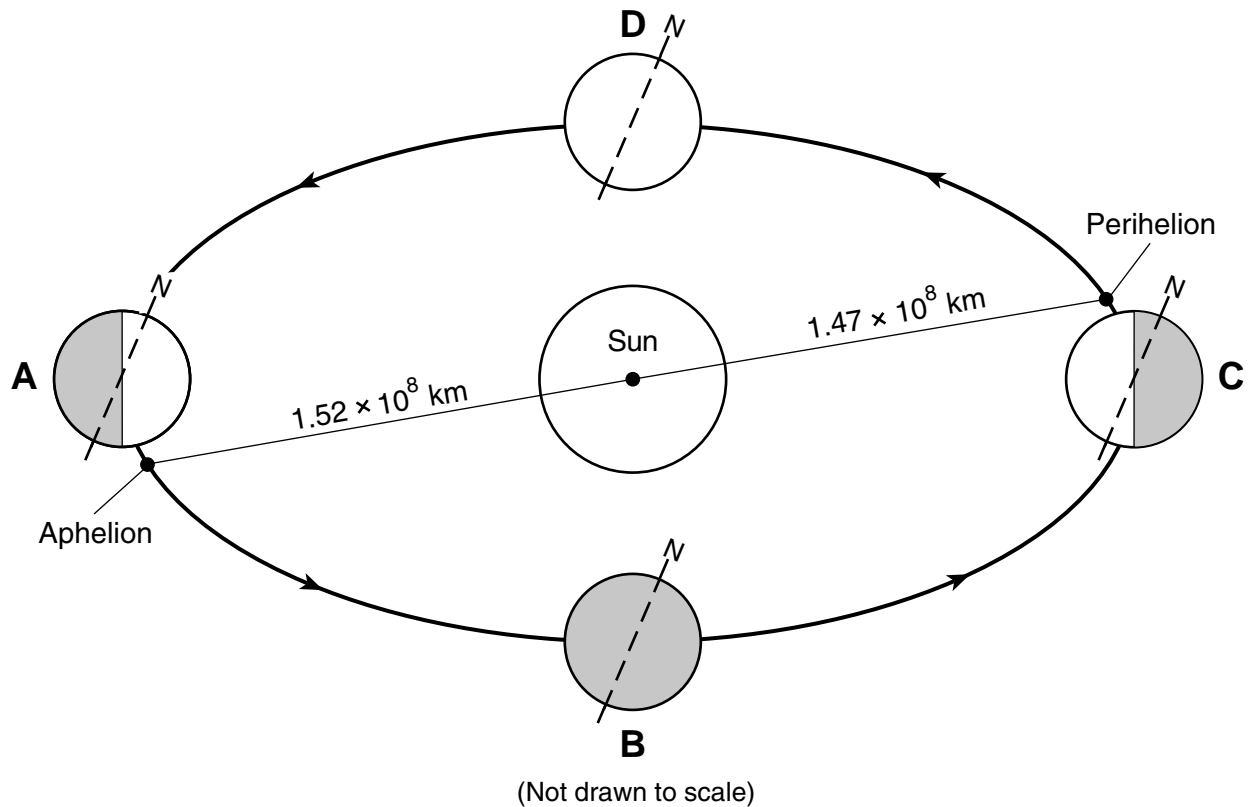
- 48 The streambank at location B is steeper than the streambank at location A because the water near location B is moving
- (1) slower than the water near location A, causing more erosion
 - (2) slower than the water near location A, causing more deposition
 - (3) faster than the water near location A, causing more erosion
 - (4) faster than the water near location A, causing more deposition
- 49 The area labeled letter X represents a portion of a
- (1) delta
 - (2) sand dune
 - (3) finger lake
 - (4) floodplain
- 50 Most of the particles deposited where the stream velocity *decreases* from 50 centimeters per second to 5 centimeters per second are
- (1) small cobbles and large pebbles
 - (2) small pebbles and large sand
 - (3) small sand and large silt
 - (4) small silt and large clay
-

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 diagram below and on your knowledge of Earth science. In the diagram, letters *A*, *B*, *C*, and *D* represent Earth's location on the first day of the four seasons as it orbits the Sun. Aphelion (Earth's farthest distance from the Sun) and perihelion (Earth's closest distance to the Sun) are labeled to show the approximate positions where they occur in Earth's orbit. The dashed lines represent Earth's axis, and the North Pole is labeled *N*.



- 51 State the number of degrees that Earth's axis is tilted from a line perpendicular to the plane of its orbit at each lettered location. [1]
- 52 Identify the season in New York State during which Earth is at perihelion. [1]
- 53 State the number of hours of daylight that an observer in New York State will experience when Earth is at position *D*. [1]
- 54 Identify the name of the star that is aligned with Earth's axis above the North Pole. [1]
-

Base your answers to questions 55 through 58 on the passage, chart of definitions and photograph below, and on your knowledge of Earth science. The passage is an excerpt from the 1994 novel *Inca Gold*, by Clive Cussler, which describes the formation of a sinkhole in the Andes Mountains of South America. The chart of definitions helps the reader understand some concepts in the passage. The photograph shows a sinkhole that formed in a South American village.

Excerpt from *Inca Gold*

...The sinkhole's early history began in the Cambrian era when the region was part of an ancient sea. Through the following geological eras, thousands of generations of shellfish and coral lived and died, their skeletal carcasses forming an enormous mass of lime and sand that compressed into a limestone and dolomite layer two kilometers thick. Then, beginning sixty-five million years ago, an intense earth uplifting occurred that raised the Andes Mountains to their present height. As the rain ran down from the mountains it formed a great underground water table that slowly began dissolving the limestone. Where it collected and pooled, the water ate upward until the land surface collapsed and created the sinkhole....

Chart of Definitions

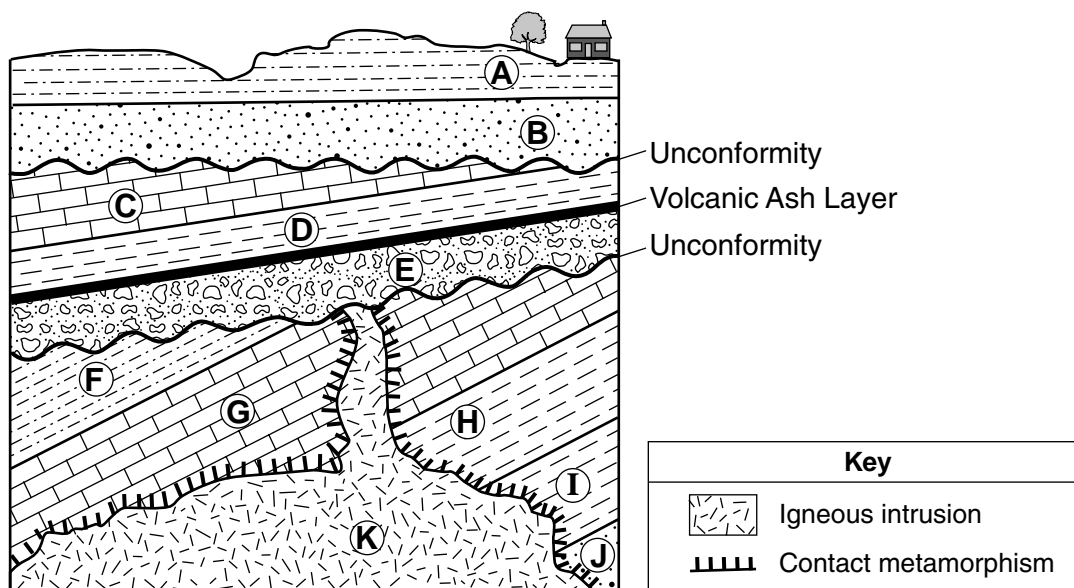
Sinkhole	A natural depression or hole in the ground surface caused by some form of collapse of the bedrock beneath. Most are caused when slightly acidic groundwater chemically breaks down the carbonate rocks or the carbonate cement holding the rock particles together. The removal of the carbonates by groundwater gradually forms a hollow space or cavern under the surface layer. As the roof of the cavern weakens, it sometimes collapses, forming a sinkhole.
Lime	A general term for material containing the element calcium that combined with oxygen.

Photograph of a Sinkhole



- 55 In the first line of the passage, referring to Cambrian as an “era” is scientifically incorrect. State the unit of geologic time that should be substituted for the word “era.” [1]
- 56 Identify *one* group of animals that became extinct at the time the passage states that intense uplifting of the Andes Mountains began. [1]
- 57 Using chemical symbols, state the chemical composition of the mineral found in limestone. [1]
- 58 Describe the chemical weathering that contributes to the formation of sinkholes. [1]
-

Base your answers to questions 59 through 61 on the geologic cross section below and on your knowledge of Earth science. The cross section represents rock units, labeled A through K, that have *not* been overturned. Two unconformities and a volcanic ash layer are indicated.



- 59 List the letters *E*, *H*, and *K* to indicate the correct order of rock unit formation, from oldest to youngest, that formed this portion of Earth’s crust. [1]
- 60 Identify *two* processes that most likely caused the formation of both unconformities. [1]
- 61 Identify *one* metamorphic rock that most likely formed within rock unit *G* at the boundary of rock unit *K*. [1]
-

Base your answers to questions 62 through 65 on the field map in your answer booklet and on your knowledge of Earth science. The map shows the depth of Cuba Lake, located in New York State at latitude $42^{\circ}14'$ N, longitude $78^{\circ}18'$ W. Isoline values indicate water depth, in feet. Points *A* and *B* represent locations on the shoreline of Cuba Lake. Points *W*, *X*, *Y*, and *Z* represent locations on the bottom of the lake. The 30-foot isoline has been partially drawn.

- 62 On the map *in your answer booklet*, complete the 30-foot water depth isoline from point *W* to point *X*. [1]
- 63 On the grid *in your answer booklet*, construct a profile of the bottom of Cuba Lake from point *A* to point *B*. 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]
- 64 State the compass direction and distance in feet (ft) from point *Y* to point *Z*. [1]
- 65 Identify the New York State landscape region where Cuba Lake is located. [1]
-

Part C

Answer all questions in this part.

Directions (66–85): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 66 through 68 on the table below and on your knowledge of Earth science. The data table lists some information about the dwarf planet Pluto, which revolves around our Sun, and the five known moons that orbit Pluto.

Data for Dwarf Planet Pluto and Its Five Moons

Object Name	Classification	Period of Revolution in Earth Days (d)	Eccentricity of Orbit	Diameter (km)
Pluto	Dwarf Planet	90,511.4 (247.8 years)	0.2488	2370
Charon	Moon	6.4	0.0022	1208
Styx	Moon	20.2	0.0058	10 to 15 *
Nix	Moon	24.9	0.0020	40
Kerberos	Moon	32.2	0.0033	13 to 34 *
Hydra	Moon	38.2	0.0059	33 to 43 *

* There is a range in diameters for these moons due to their irregular shapes.

66 Identify the name of Pluto's moon that most likely has an orbit farthest from Pluto. Explain how the data indicate that this moon's orbit has the greatest distance from Pluto. [1]

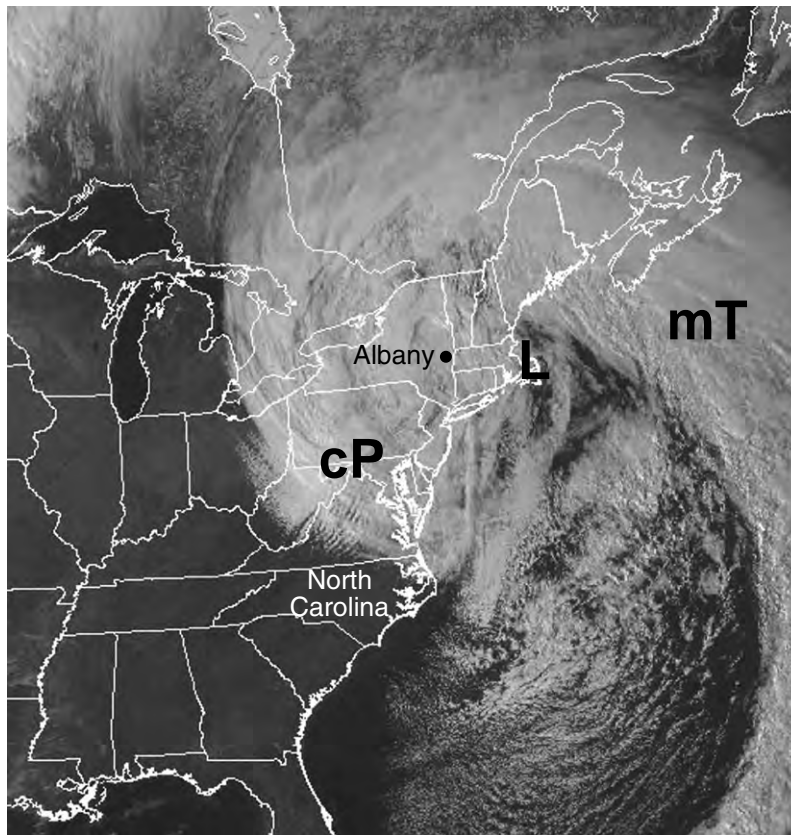
67 Describe the shape of the orbit of Pluto and the orbits of its five moons. [1]

68 Explain why Pluto and its five moons are considered to be part of our solar system. [1]

Base your answers to questions 69 through 73 on the passage and map below and on your knowledge of Earth science. The map shows a satellite image of a nor'easter that influenced the weather of the northeastern United States. The white areas represent clouds associated with this storm system. The locations of North Carolina and Albany, New York, are labeled on the map. The storm's low-pressure center is represented by letter **L**. Letters **cP** and **mT** represent two air masses.

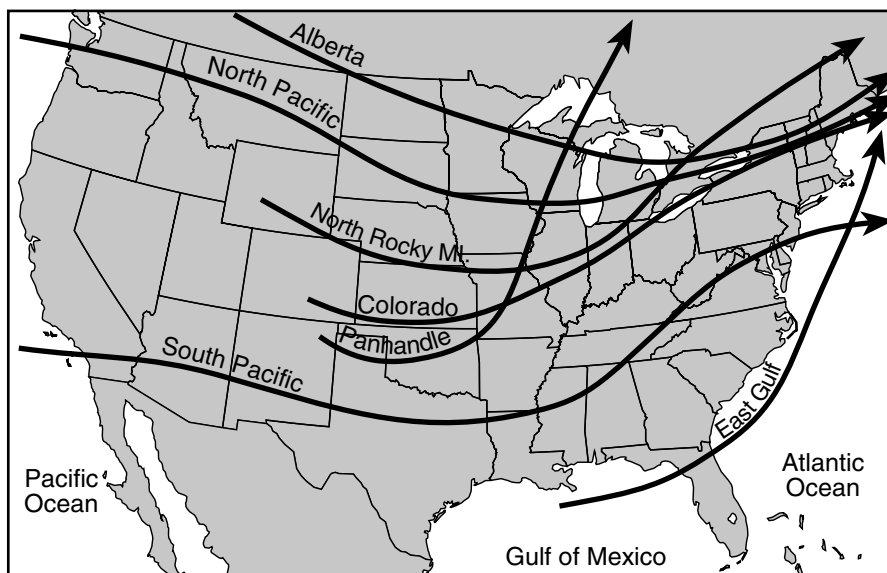
Nor'easters

A nor'easter is a large, low-pressure storm system that moves along the east coast of the United States. The wind over the land blows generally from the northeast as the center of the low passes by a location, hence the name nor'easter. Due to the circulation of winds around the center of the low-pressure system, large amounts of precipitation occur as moist air is carried from the ocean to the land. These storms usually intensify off of the North Carolina coast as they track toward the northeast.



- 69 Describe *two* characteristics of the circulation pattern of the surface winds around the center of the low-pressure area represented on the map. [1]
- 70 Circle the terms that best describe the relative moisture and relative temperature characteristics of the mT air mass compared to the cP air mass shown on the map. [1]

71 The map below shows some of the principal storm tracks across the United States and the names of these storm tracks.



Identify the name of the storm track that this nor'easter most closely followed. [1]

72 The table below shows weather conditions recorded in Albany, New York, at the time that the satellite image was taken.

Dewpoint	22°F
Barometric Pressure	988.0 mb
Cloud Cover	100%
Present Weather	Snow

On the station model *in your answer booklet*, use the correct symbols and proper format to indicate the four conditions in the table. [1]

73 Identify *one* weather instrument that was most likely used to determine the dewpoint at Albany, New York. [1]

Base your answers to questions 74 through 76 on the data table below and on your knowledge of Earth science. The data table shows the mass of a sample of radioactive carbon-14 remaining after each half-life.

Data Table

Number of Half-lives	Mass of Carbon-14 (g)
0	64
1	32
2	16
3	8
4	4
5	2
6	1

74 On the grid *in your answer booklet*, construct a line graph by plotting the data for the mass of carbon-14 in the sample for *each* half-life shown on the data table. Connect the plots with a line. [1]

75 Identify the stable disintegration product of the radioactive isotope carbon-14. [1]

76 Determine the number of grams of carbon-14 remaining in this sample at 17,100 years. [1]

Base your answers to questions 77 through 79 on the data tables below and on your knowledge of Earth science. Data table 1 shows the average maximum and average minimum water temperatures at different depths in Lake Michigan. Data table 2 shows the average maximum and average minimum land temperatures at different depths in soil at St. Paul Minnesota (MN).

Table 1

Water in Lake Michigan, 45° N		
Water Depth Range (m)	Average Temperature (°C)	
	Maximum (Occurs in Summer)	Minimum (Occurs in Winter)
0 – 10	24.0	4.0
10 – 20	19.5	4.0
20 – 30	12.5	4.0
30 – 40	7.5	4.0
40 – 60	5.5	4.0
60 – 110	4.5	4.0
110 – 150	4.0	4.0

Table 2

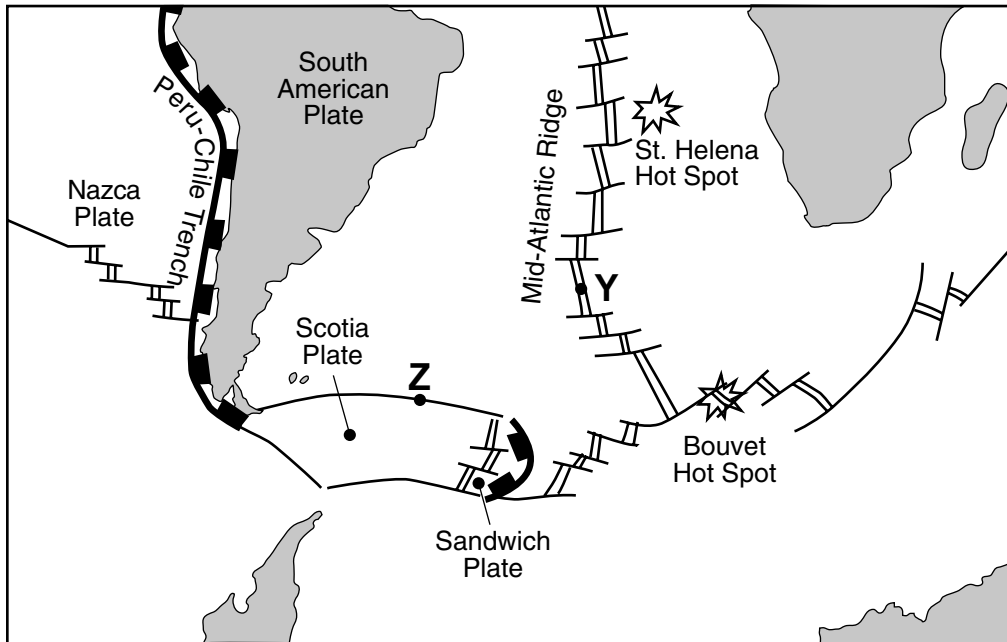
Land in St. Paul, MN, 45° N		
Soil Depth Range (m)	Average Temperature (°C)	
	Maximum (Occurs in Summer)	Minimum (Occurs in Winter)
0 – 0.1	25.5	-6.0
0.1 – 1	23.0	-1.5
1 – 2	19.5	2.0
2 – 3	16.0	4.5
3 – 4	13.5	7.0
4 – 5	12.5	8.5
5 – 6	11.0	10.0

77 Identify the water depth range and the soil depth range, in meters, that have the same average maximum temperature of 12.5°C. [1]

78 Describe the general relationship between depth and average temperature for both water and soil in the summer. [1]

79 Explain why the winter water surface is warmer than the winter land surface. [1]

Base your answers to questions 80 through 82 on the map below and on your knowledge of Earth science. The map shows an enlargement of a portion of the *Tectonic Plates* map from the *Physical Setting/Earth Science Reference Tables*. Arrows showing plate motion have been omitted. Points Y and Z represent locations on plate boundaries.



80 Identify the type of tectonic plate boundary found at location Z. [1]

81 State the names of the tectonic plates on *each* side of the Bouvet Hot Spot. [1]

82 The cross section *in your answer booklet* represents a portion of Earth's interior beneath point Y. On this cross section, draw an arrowhead on *each* of the *four* bold lines, to represent the direction of the convection currents in the asthenosphere. [1]

Base your answers to questions 83 through 85 on the passage below and on your knowledge of Earth science.

Glacier Movement

Glaciers are thick sheets of ice in motion. Mountain glaciers tend to move down the slopes of mountains from higher elevations to lower elevations, while continental ice sheets move over large areas of continents. The bottom of a glacier is under great pressure due to the weight of the thick sheet of ice. This pressure causes the bottom of the glacier to partially melt, allowing the glacier to move. As the glacier thickens, more pressure is created and the glacier moves faster. Different parts of a glacier can move at different rates, depending on the amount of pressure and friction between the glacier and the underlying bedrock.

83 Describe the relationship between the thickness of a glacier and its rate of movement downhill. [1]

84 Describe the most likely shape of the cross section of a valley formed as a result of erosion by a mountain glacier. [1]

85 Compared to sediments deposited by meltwater from a glacier, describe the difference in the arrangement of the sediment deposited directly by a glacier. [1]

PHYSICAL SETTING EARTH SCIENCE

Friday, August 17, 2018 — 8:30 to 11:30 a.m., only

ANSWER BOOKLET

Student

Teacher

School Grade

Record your answers for Part B–2 and Part C in this booklet.

Part B–2

51 _____ °

52 _____

53 _____ h

54 _____

55 _____

56 _____

57 _____

58 _____

59 Letters: _____, _____, _____

Oldest _____ → Youngest

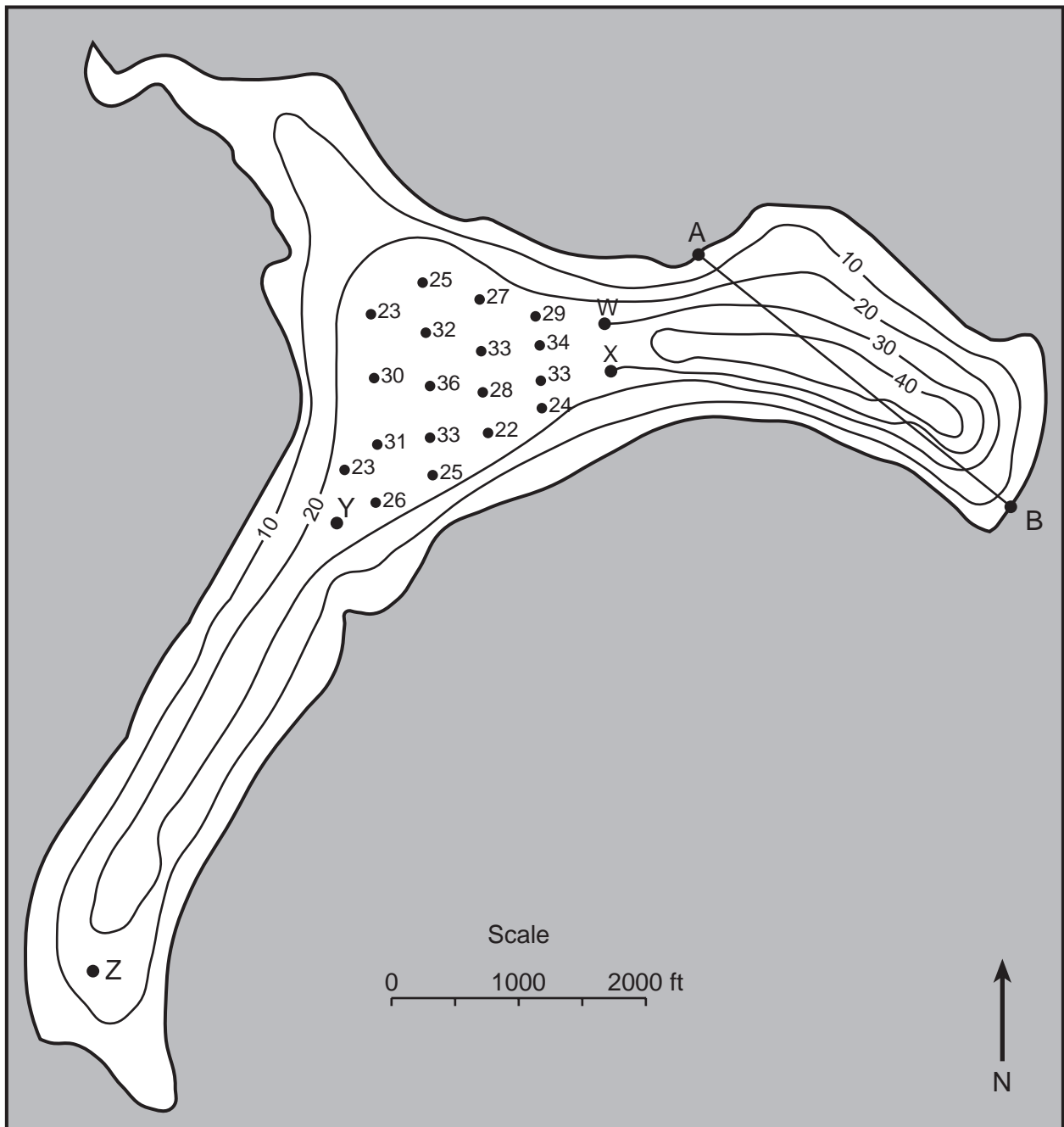
60 (1) _____

(2) _____

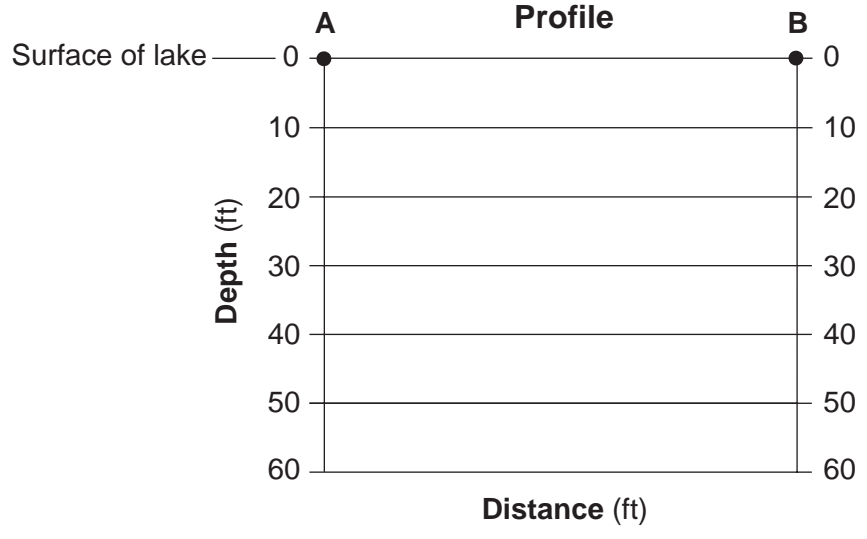
61 _____

62

Cuba Lake



63



64 Direction: _____

Distance: _____ ft

65 _____

Part C

66 Moon of Pluto: _____

Explanation: _____

67 _____

68 _____

69 Characteristic 1: _____

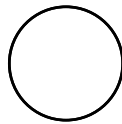
Characteristic 2: _____

70 Relative moisture of mT air mass (circle one): **more humid** **less humid** **the same**

Relative temperature of mT air mass (circle one): **cooler** **warmer** **the same**

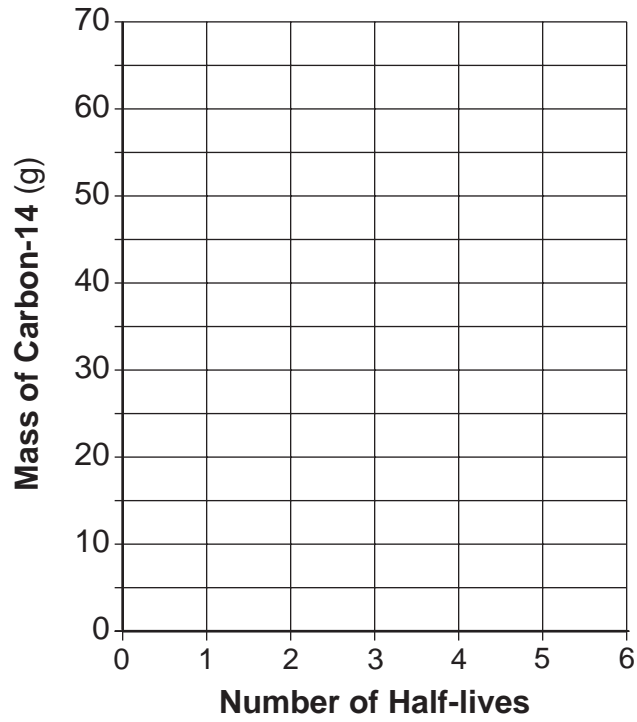
71 _____

72



73 _____

74



75 _____

76 _____ g

77 Water depth range: _____ m

Soil depth range: _____ m

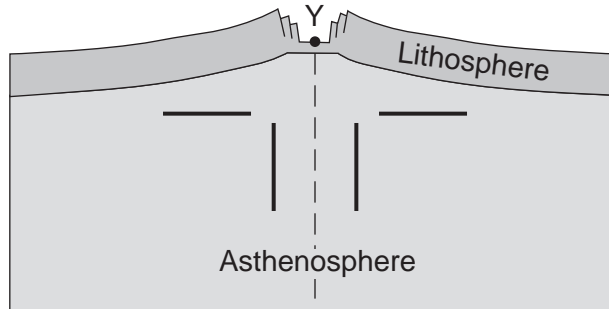
78 _____

79 _____

80 _____

81 _____ **Plate** and _____ **Plate**

82



(Not drawn to scale)

83 _____

84 _____

85 _____

FOR TEACHERS ONLY

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

P.S.–E.S. PHYSICAL SETTING/EARTH SCIENCE

Friday, August 17, 2018 — 8:30 to 11:30 a.m., only

SCORING KEY AND RATING GUIDE

Directions to the Teacher:

Refer to the directions on page 2 before rating student papers.

Updated information regarding the rating of this examination may be posted on the New York State Education Department’s web site during the rating period. Check this web site at: <http://www.p12.nysed.gov/assessment/> and select the link “Scoring Information” for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents Examination period.

Part A and Part B–1

Allow 1 credit for each correct response.

Part A

1 1	10 3	19 2	28 1
2 3	11 2	20 2	29 2
3 2	12 4	21 4	30 3
4 4	13 1	22 2	31 3
5 1	14 4	23 4	32 1
6 1	15 1	24 3	33 3
7 2	16 4	25 2	34 4
8 1	17 2	26 4	35 4
9 2	18 4	27 1	

Part B–1

36 2	40 3	44 4	48 3
37 4	41 3	45 3	49 4
38 1	42 2	46 3	50 2
39 2	43 3	47 1	

Directions to the Teacher

Follow the procedures below for scoring student answer papers for the Regents Examination in Physical Setting/Earth Science. Additional information about scoring is provided in the publication *Information Booklet for Scoring Regents Examinations in the Sciences*.

Do not attempt to correct the student's work by making insertions or changes of any kind. If the student's responses for the multiple-choice questions are being hand scored prior to being scanned, the scorer must be careful not to make any marks on the answer sheet except to record the scores in the designated score boxes. Marks elsewhere on the answer sheet will interfere with the accuracy of the scanning.

Allow 1 credit for each correct response.

At least two science teachers must participate in the scoring of the Part B–2 and Part C open-ended questions on a student's paper. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score more than approximately one-half of the open-ended questions on a student's answer paper. Teachers may not score their own students' answer papers.

Students' responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Fractional credit is *not* allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not be given when the wording of the questions allows such omissions.

For hand scoring, raters should enter the scores earned in the appropriate boxes printed on the separate answer sheet. Next, the rater should add these scores and enter the total in the space provided. The student's score for the Earth Science Performance Test should be recorded in the space provided. Then the student's raw scores on the written test and the performance test should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on Friday, August 17, 2018. The student's scale score should be entered in the box labeled "Scale Score" on the student's answer sheet. The scale score is the student's final examination score.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student's final score.

Part B–2

Allow a maximum of 15 credits for this part.

To ensure the accuracy of overlays, select a printer setting such as *full*, *actual size*, or *100%* when printing this document. Do **not** select the *fit to page* setting.

51 [1] Allow 1 credit for any value from 23.4° to 23.5° or its mathematical equivalent.

Note: Do *not* allow credit for a number with a direction, such as 23.5° N, because N indicates a latitude, not an angle.

52 [1] Allow 1 credit for winter.

53 [1] Allow 1 credit for 12 h.

54 [1] Allow 1 credit for *Polaris* or North Star.

55 [1] Allow 1 credit for Period.

56 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- dinosaurs
- ammonoids

Note: Do *not* allow credit for land plants alone because the question asks for animals.

57 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- CaCO_3
- Ca, C, and O (All three elements must be present for credit.)
- $\text{CaMg}(\text{CO}_3)_2$

58 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- The acid in water chemically reacts with the carbonates in the rocks.
- Limestone is chemically altered and changed into new materials.
- Slightly acidic groundwater chemically breaks down calcite and/or dolomite.
- Water flowing underground dissolves the limestone.

59 [1] Allow 1 credit for the sequence shown below:

Letters: H , K , E
 Oldest \longrightarrow Youngest

60 [1] Allow 1 credit for *two* correct responses. Acceptable responses include, but are not limited to:

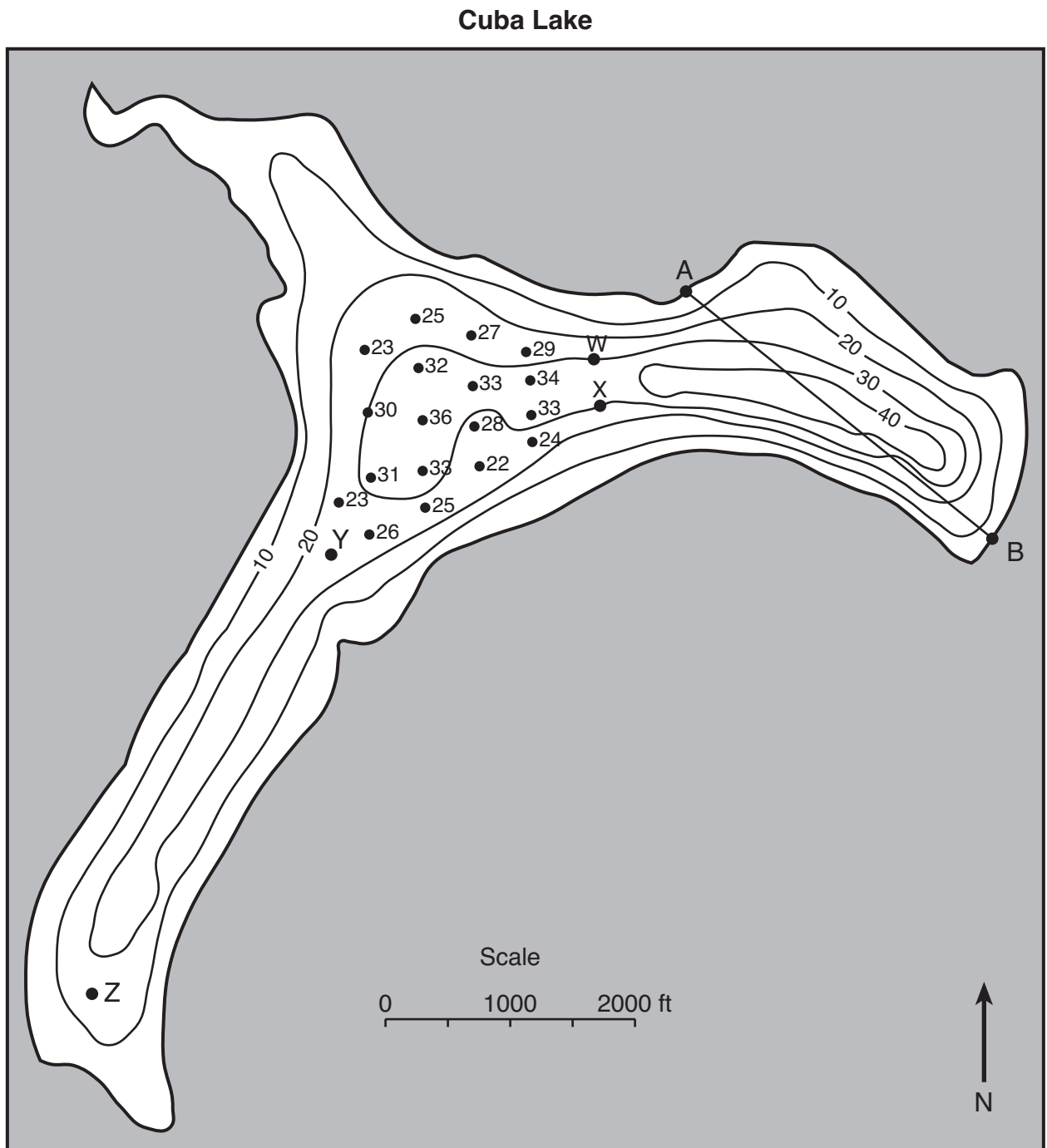
- uplift/emergence/tilting/folding
- erosion
- submergence/subsidence
- weathering
- deposition
- burial

61 [1] Allow 1 credit for marble *or* hornfels.

- 62 [1] Allow 1 credit if the 30-foot isoline is drawn correctly. If additional isolines are drawn, all must be correct to receive credit.

Note: The isoline must touch points X, W, and the point for 30.

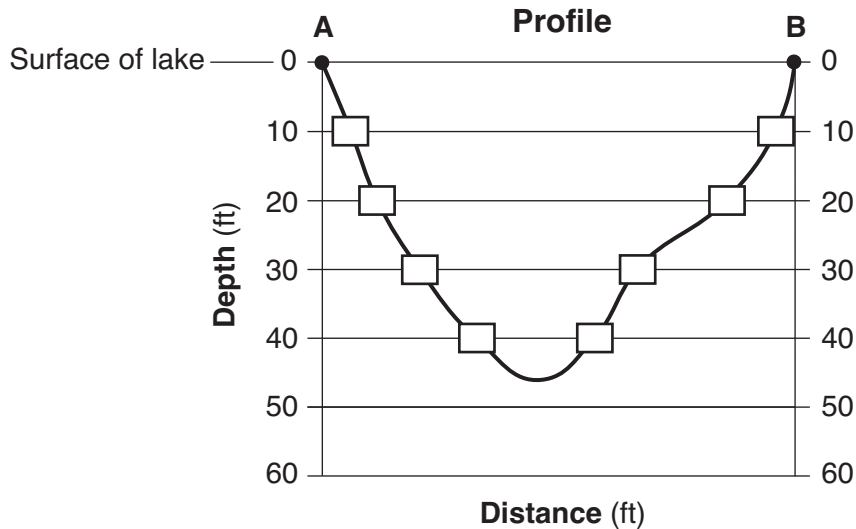
Example of a one-credit response:



- 63 [1] Allow 1 credit if *all eight* plots are within or touch the rectangles shown below and are correctly connected with a line from A to B that passes within or touches each rectangle. The line should extend below 40 feet, but remain above 50 feet.

Note: Allow credit if the line misses a plot, but is still within or touches the rectangle.

It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.



- 64 [1] Allow 1 credit if *both* responses for compass direction and distance are correct.

Compass direction:

- SW
- Southwest
- SSW

Distance:

- Any value from 3800 to 4200 ft.

- 65 [1] Allow 1 credit for Allegheny Plateau *or* Appalachian Plateau *or* Appalachian Uplands.

Part C

Allow a maximum of 20 credits for this part.


- 66** [1] Allow 1 credit for *both* the moon Hydra and a correct explanation. Acceptable responses include, but are not limited to:
- Hydra has the longest period of revolution.
 - As a moon's distance from Pluto increases, the time to make one revolution also increases.
 - Hydra travels the greatest distance in its orbit because it has the longest period of revolution.
- 67** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- elliptical
 - The orbits are eccentric.
 - The orbits are nearly, but not perfectly, circular.
 - oval
 - Pluto's orbit is elliptical, and the moons of Pluto have a more nearly circular orbit.
- 68** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- Pluto and its five moons revolve around the Sun.
 - All go around/orbit the Sun.
 - The gravitational attraction of the Sun influences the motion of Pluto and its moons.
 - Pluto revolves around the Sun, and its moons revolve around Pluto.
 - Pluto orbits the Sun.
- 69** [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- counterclockwise and in toward the center
 - counterclockwise and spiraling toward the center
 - inward and counterclockwise
 - counterclockwise and converging

70 [1] Allow 1 credit for circling *both* more humid and warmer.

71 [1] Allow 1 credit for East Gulf.

72 [1] Allow 1 credit if *all four* weather conditions are correctly indicated, using the proper format. A 1-credit response is shown below.

* 880
22

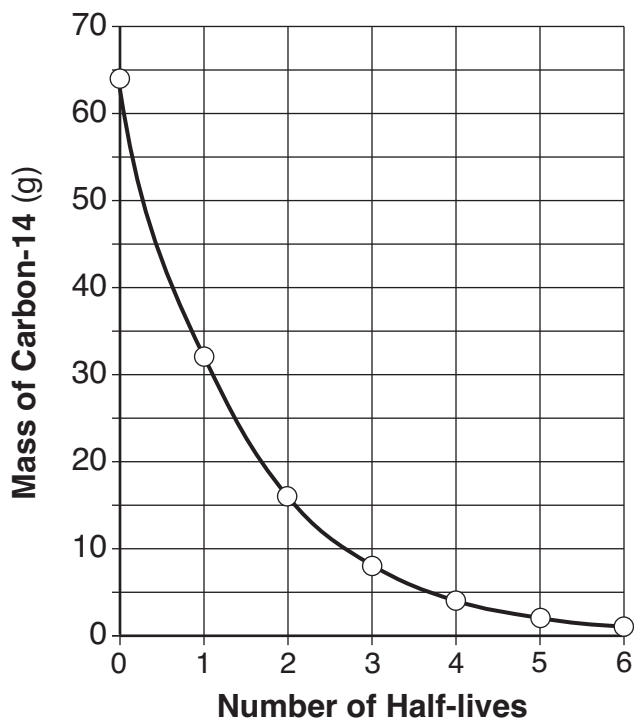


73 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- psychrometer/sling psychrometer
- dry-bulb thermometer/thermometer
- wet-bulb
- hygrometer

74 [1] Allow 1 credit if the centers of *all seven* of the students plots are within or touch the circles shown and *all seven* plots are correctly connected with a line that passes within or touches each circle.

Note: It is recommended that an overlay of the same scale as the student answer booklet be used to ensure reliability in rating.



75 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- ^{14}N
- nitrogen-14
- N-14

Note: Do *not* allow credit for nitrogen alone because nitrogen has more than one isotope, and the stable disintegration product is needed.

76 [1] Allow 1 credit for 8 g.

77 [1] Allow 1 credit for a water depth range of 20-30 m and a soil depth range of 4-5 m.

78 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- As depth increases, temperature decreases.
- It gets colder, the greater the depth.
- inverse relationship/negative relationship
- The shallower the depth, the greater the average temperature for soil and water.

79 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- Water has a higher specific heat.
- Water changes temperature more slowly.
- Land has a lower specific heat.
- It takes more energy to change the temperature of water than land.
- Land cools off more quickly than water.

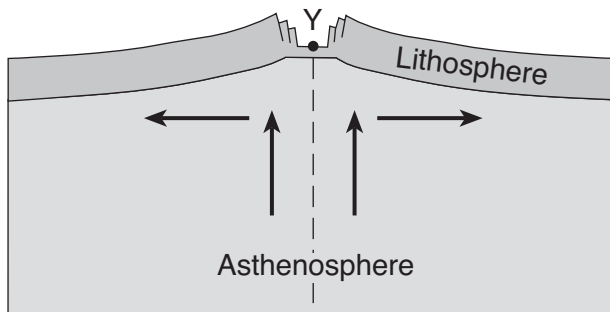
80 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- transform boundary
- transform fault
- strike-slip fault

81 [1] Allow 1 credit for African Plate and Antarctic Plate.

- 82 [1] Allow 1 credit for *four* arrowheads/arrows that indicate rising currents and a divergent movement in the asthenosphere.

Example of a 1-credit response:



(Not drawn to scale)

Note: If additional arrowheads or arrows are drawn, all must be correct to receive credit.

If a student draws his/her own arrows, all arrows must indicate a correct rising and diverging movement.

- 83 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- As the thickness of a glacier increases, the rate of movement increases.
 - Thicker glaciers move faster.
 - direct relationship
- 84 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- U-shaped
 - wide valley with steep sides
- 85 [1] Allow 1 credit. Acceptable responses include, but are not limited to:
- unsorted
 - mixed piles
 - not layered

Regents Examination in Physical Setting/Earth Science

August 2018

Chart for Converting Total Test Raw Scores to Final Examination Scores (Scale Scores)

The Chart for Determining the Final Examination Score for the August 2018 Regents Examination in Physical Setting/Earth Science will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on Friday, August 17, 2018. Conversion charts provided for previous administrations of the Regents Examination in Physical Setting/Earth Science must NOT be used to determine students' final scores for this administration.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

1. Go to <http://www.forms2.nysed.gov/emsc/osa/exameval/reexameval.cfm>.
2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the **SUBMIT** button at the bottom of the page to submit the completed form.

Map to Core Curriculum

August 2018 Physical Setting/Earth Science			
Question Numbers			
Key Ideas/Performance Indicators	Part A	Part B	Part C
Standard 1			
Math Key Idea 1	30	63	74, 76
Math Key Idea 2	20	43, 45, 47	66, 77, 78, 83
Math Key Idea 3		62	
Science Inquiry Key Idea 1	5, 8, 33, 34	46, 58, 59, 60	66, 68, 79, 84, 85
Science Inquiry Key Idea 2		59	
Science Inquiry Key Idea 3	2, 3, 7, 10, 11, 15, 17, 18, 19, 20, 21, 23, 24, 25, 26, 28, 30, 35	37, 39, 42, 44, 50, 55, 56, 57, 61, 65	72, 75, 76, 80, 81, 82
Engineering Design Key Idea 1			
Standard 2			
Key Idea 1			
Key Idea 2			
Key Idea 3			
Standard 6			
Key Idea 1	8	41	67, 68, 85
Key Idea 2	1, 4, 13, 14, 21, 24, 27, 28, 29, 31, 32, 33, 34, 35	36, 37, 38, 40, 42, 43, 45, 47, 48, 49, 51, 52, 53, 54, 59, 60, 61, 62, 63, 65	69, 70, 71, 72, 73, 74, 80, 81, 82
Key Idea 3		64	
Key Idea 4			
Key Idea 5	6	41, 45, 47, 53, 59	78
Key Idea 6			
Standard 7			
Key Idea 1	12		
Key Idea 2			
Standard 4			
Key Idea 1	1, 2, 3, 4, 5, 6, 7, 8, 9, 17, 18, 19, 21, 29, 30	39, 40, 41, 45, 46, 47, 51, 52, 53, 54, 55, 56, 59, 65	66, 67, 68, 74, 75, 76
Key Idea 2	10, 11, 12, 13, 14, 15, 16, 20, 22, 24, 27, 31, 32, 33, 34	36, 37, 38, 42, 43, 44, 48, 49, 50, 58, 60, 62, 63, 64, 65	69, 70, 71, 72, 73, 77, 78, 79, 80, 81, 82, 83, 84, 85
Key Idea 3	23, 25, 26, 28, 35	57, 61	
Reference Tables			
ESRT 2011 Edition (Revised)	2, 3, 7, 10, 11, 15, 17, 18, 19, 20, 21, 23, 24, 25, 26, 28, 30, 34, 35	37, 42, 44, 50, 55, 56, 57, 61, 65	72, 75, 76, 80, 81, 82

The State Education Department / The University of the State of New York
Regents Examination in Physical Setting/Earth Science – August 2018
Chart for Converting Total Test Raw Scores to Final Examination Scores (Scale Scores)
(Not to be used for the Braille Edition)

To determine the student's final score, locate the student's Total Performance Test Score across the top of the chart and the Total Written Test Score down the side of the chart. The point where the two scores intersect is the student's final examination score. For example, a student receiving a Total Performance Test Score of 10 and Total Written Test Score of 66 would receive a final examination score of 85.

		Total Performance Test Score																
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Total Written Test Score	85	100	99	99	99	98	98	97	96	96	95	94	93	91	90	88	87	85
	84	99	99	98	98	98	97	96	96	95	94	93	92	91	89	88	86	84
	83	99	99	98	98	98	97	96	96	95	94	93	92	91	89	88	86	84
	82	98	98	98	97	97	96	95	95	94	93	92	91	90	88	87	85	83
	81	97	97	97	96	96	95	95	94	93	92	91	90	89	88	86	84	82
	80	97	97	97	96	96	95	95	94	93	92	91	90	89	88	86	84	82
	79	97	96	96	95	95	94	94	93	92	91	90	89	88	87	85	83	82
	78	96	95	95	95	94	94	93	92	91	91	89	88	87	86	84	83	81
	77	96	95	95	95	94	94	93	92	91	91	89	88	87	86	84	83	81
	76	95	95	94	94	93	93	92	91	91	90	89	88	86	85	83	82	80
	75	94	94	93	93	92	92	91	90	90	89	88	87	86	84	83	81	79
	74	94	94	93	93	92	92	91	90	90	89	88	87	86	84	83	81	79
	73	93	93	92	92	92	91	90	90	89	88	87	86	85	83	82	80	78
	72	92	92	92	91	91	90	90	89	88	87	86	85	84	82	81	79	77
	71	92	91	91	90	90	89	89	88	87	86	85	84	83	82	80	78	77
	70	91	90	90	89	89	88	88	87	86	85	84	83	82	81	79	77	76
	69	91	90	90	89	89	88	88	87	86	85	84	83	82	81	79	77	76
	68	90	90	89	89	88	88	87	86	85	85	84	82	81	80	78	77	75
	67	89	89	88	88	87	87	86	85	85	84	83	82	80	79	77	76	74
	66	88	88	87	87	86	86	85	85	84	83	82	81	80	78	77	75	73
65	87	87	87	86	86	85	84	84	83	82	81	80	79	77	76	74	72	
64	86	86	86	85	85	84	84	83	82	81	80	79	78	77	75	73	71	
63	86	86	86	85	85	84	84	83	82	81	80	79	78	77	75	73	71	
62	86	85	85	84	84	83	83	82	81	80	79	78	77	76	74	72	71	
61	85	84	84	84	83	82	82	81	80	79	78	77	76	75	73	72	70	
60	84	84	83	83	82	82	81	80	80	79	78	77	75	74	72	71	69	
59	83	83	82	82	81	81	80	79	79	78	77	76	74	73	71	70	68	
58	82	82	81	81	81	80	79	79	78	77	76	75	74	72	71	69	67	
57	81	81	81	80	80	79	78	78	77	76	75	74	73	71	70	68	66	
56	80	80	80	79	79	78	78	77	76	75	74	73	72	71	69	67	65	
55	80	79	79	78	78	77	77	76	75	74	73	72	71	70	68	66	65	
54	79	78	78	78	77	77	76	75	74	74	72	71	70	69	67	66	64	
53	78	78	77	77	76	76	75	74	74	73	72	71	69	68	66	65	63	
52	77	77	76	76	75	75	74	73	73	72	71	70	69	67	66	64	62	
51	76	76	75	75	75	74	73	73	72	71	70	69	68	66	65	63	61	
50	75	75	75	74	74	73	73	72	71	70	69	68	67	65	64	62	60	
49	75	74	74	73	73	72	72	71	70	69	68	67	66	65	63	61	60	
48	74	73	73	72	72	71	71	70	69	68	67	66	65	64	62	60	59	
47	73	73	72	72	71	71	70	69	68	68	67	65	64	63	61	60	58	
46	72	72	71	71	70	70	69	68	68	67	66	65	63	62	60	59	57	
45	71	71	70	70	69	69	68	68	67	66	65	64	63	61	60	58	56	

**Final Examination Scores
 Regents Examination in Physical Setting/Earth Science – August 2018 – continued**

	Total Performance Test Score																
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
44	70	70	70	69	69	68	67	67	66	65	64	63	62	60	59	57	55
43	69	69	69	68	68	67	67	66	65	64	63	62	61	60	58	56	54
42	69	68	68	67	67	66	66	65	64	63	62	61	60	59	57	55	54
41	67	67	66	66	65	65	64	63	63	62	61	60	58	57	55	54	52
40	66	66	65	65	64	64	63	62	62	61	60	59	57	56	54	53	51
39	65	65	64	64	64	63	62	62	61	60	59	58	57	55	54	52	50
38	64	64	64	63	63	62	61	61	60	59	58	57	56	54	53	51	49
37	63	63	63	62	62	61	61	60	59	58	57	56	55	54	52	50	48
36	63	62	62	61	61	60	60	59	58	57	56	55	54	53	51	49	48
35	62	61	61	61	60	60	59	58	57	57	55	54	53	52	50	49	47
34	60	60	59	59	58	58	57	56	56	55	54	53	52	50	49	47	45
33	59	59	58	58	58	57	56	56	55	54	53	52	51	49	48	46	44
32	58	57	57	56	56	55	55	54	53	52	51	50	49	48	46	44	43
31	57	56	56	55	55	54	54	53	52	51	50	49	48	47	45	43	42
30	56	56	55	55	54	54	53	52	51	51	50	48	47	46	44	43	41
29	55	55	54	54	53	53	52	51	51	50	49	48	46	45	43	42	40
28	53	53	53	52	52	51	50	50	49	48	47	46	45	43	42	40	38
27	52	52	52	51	51	50	50	49	48	47	46	45	44	43	41	39	37
26	51	50	50	50	49	48	48	47	46	45	44	43	42	41	39	38	36
25	50	50	49	49	48	48	47	46	46	45	44	43	41	40	38	37	35
24	49	49	48	48	47	47	46	45	45	44	43	42	40	39	37	36	34
23	47	47	47	46	46	45	44	44	43	42	41	40	39	37	36	34	32
22	46	46	46	45	45	44	44	43	42	41	40	39	38	37	35	33	31
21	45	44	44	44	43	43	42	41	40	40	38	37	36	35	33	32	30
20	44	44	43	43	42	42	41	40	40	39	38	37	35	34	32	31	29
19	42	42	41	41	41	40	39	39	38	37	36	35	34	32	31	29	27
18	41	41	41	40	40	39	39	38	37	36	35	34	33	31	30	28	26
17	40	39	39	38	38	37	37	36	35	34	33	32	31	30	28	26	25
16	39	39	38	38	37	37	36	35	34	34	33	31	30	29	27	26	24
15	37	37	36	36	35	35	34	34	33	32	31	30	29	27	26	24	22
14	35	35	35	34	34	33	33	32	31	30	29	28	27	26	24	22	20
13	35	34	34	33	33	32	32	31	30	29	28	27	26	25	23	21	20
12	33	33	32	32	31	31	30	29	29	28	27	26	24	23	21	20	18
11	31	31	30	30	30	29	28	28	27	26	25	24	23	21	20	18	16
10	30	30	30	29	29	28	27	27	26	25	24	23	22	20	19	17	15
9	29	28	28	27	27	26	26	25	24	23	22	21	20	19	17	15	14
8	27	27	26	26	25	25	24	23	23	22	21	20	18	17	15	14	12
7	26	26	25	25	24	24	23	22	22	21	20	19	18	16	15	13	11
6	24	24	24	23	23	22	22	21	20	19	18	17	16	14	13	11	9
5	23	22	22	21	21	20	20	19	18	17	16	15	14	13	11	9	8
4	21	21	20	20	19	19	18	17	17	16	15	14	12	11	9	8	6
3	20	20	19	19	18	18	17	17	16	15	14	13	12	10	9	7	5
2	18	18	18	17	17	16	16	15	14	13	12	11	10	9	7	5	3
1	17	16	16	16	15	14	14	13	12	11	10	9	8	7	5	4	2
0	15	15	14	14	13	13	12	11	11	10	9	8	6	5	3	2	0