The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
EARTH SCIENCE

Thursday, June 14, 2018 — 9:15 a.m. to 12:15 p.m., only

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

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

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

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

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

Notice …

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

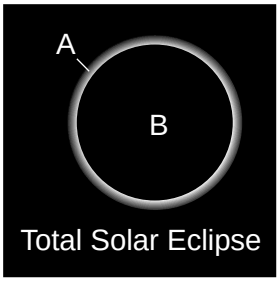
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

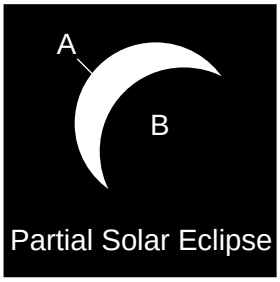
Answer all questions in this part.

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

1 The photographs below show two types of solar eclipses. Letters *A* and *B* represent two celestial objects.



Total Solar Eclipse



Partial Solar Eclipse

Which two celestial objects are represented by letters *A* and *B*?

(1) *A*-Moon; *B*-Sun
(2) *A*-Moon; *B*-Earth
(3) *A*-Sun; *B*-Moon
(4) *A*-Sun; *B*-Earth

2 Compared to the terrestrial planets, the Jovian planets

(1) are less massive
(2) are more dense
(3) have greater orbital velocities
(4) have shorter periods of rotation

3 Which event occurred more than 10 billion years ago?

(1) Big Bang
(2) origin of life on Earth
(3) Pangaea begins to break up
(4) origin of Earth and its Moon

4 In 1851, French physicist Léon Foucault used a swinging pendulum to demonstrate that Earth

(1) is rotating
(2) is revolving
(3) has a curved surface
(4) has a gravitational pull

5 Approximately how many degrees does Earth travel in its orbit in one month?

(1) 1°
(2) 15°
(3) 30°
(4) 360°

6 What is the relative humidity when the dry-bulb temperature is 16°C and the wet-bulb temperature is 10°C?

(1) 6%
(2) 14%
(3) 33%
(4) 45%

7 Boarding up windows would be one emergency action most likely taken to prepare for which natural disaster?

(1) earthquake
(2) hurricane
(3) flood
(4) tsunami

8 Which diagram best represents the general position and direction of flow of the polar front jet stream in the Northern Hemisphere during the winter months?

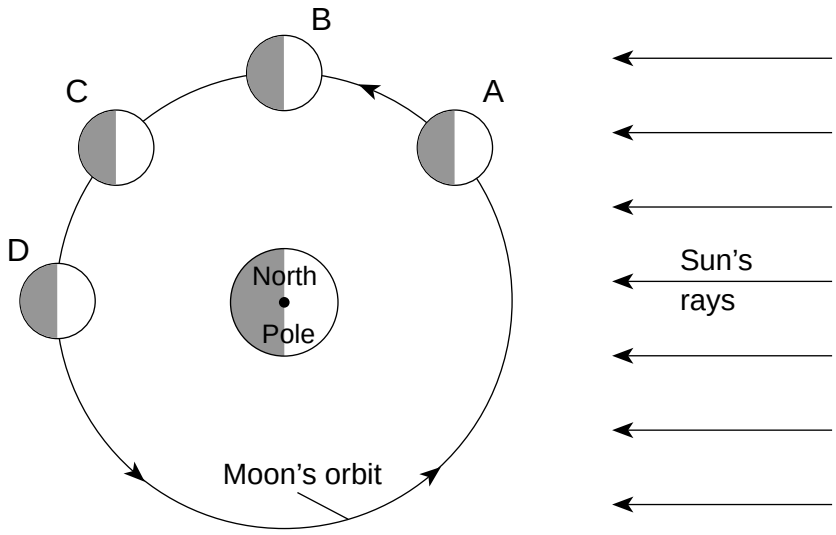

(1)


(3)


(2)

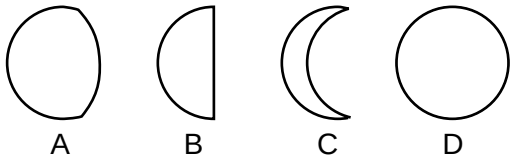

(4)

9 The diagram below represents four positions of the Moon, labeled *A* through *D*, as it orbits Earth.

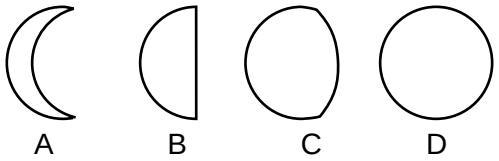


(Not drawn to scale)

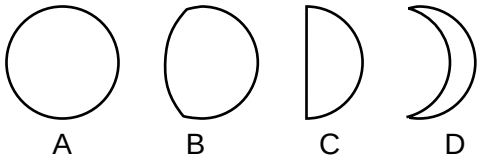
Which diagram best represents the sequence of Moon phases, as seen by an observer in New York State, when the Moon travels from position *A* to position *D* in its orbit around Earth?



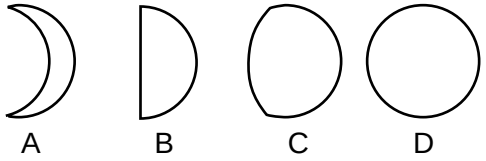
(1)



(3)



(2)



(4)

10 The diagrams below represent spectral lines of hydrogen gas observed in a laboratory and the spectral lines of hydrogen gas observed in the light from a distant star.

Spectral Lines of Hydrogen in a Laboratory

Shorter Wavelength **Longer Wavelength**

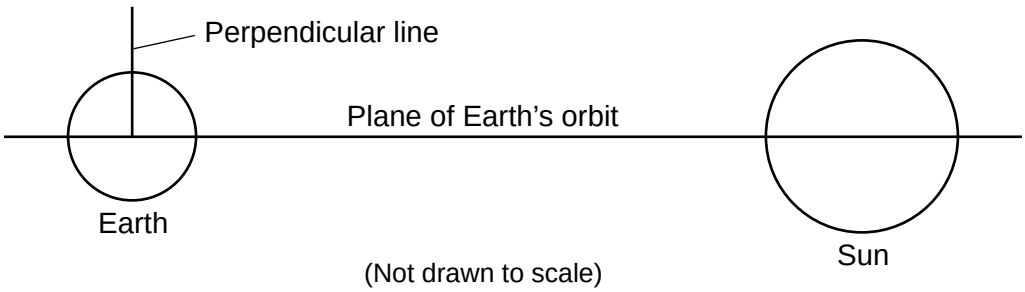
Spectral Lines of Hydrogen from a Distant Star

Shorter Wavelength **Longer Wavelength**

Compared to the spectral lines observed in the laboratory, the spectral lines observed in the light from the distant star have shifted toward the

(1) red end of the spectrum, indicating the star's movement toward Earth
(2) red end of the spectrum, indicating the star's movement away from Earth
(3) blue end of the spectrum, indicating the star's movement toward Earth
(4) blue end of the spectrum, indicating the star's movement away from Earth

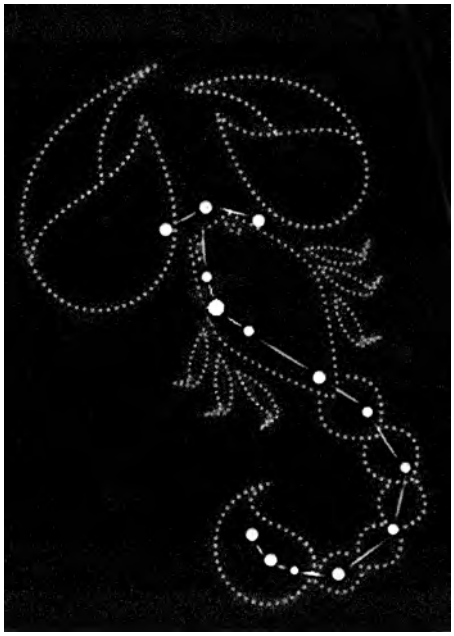
11 The diagram below represents a cross-sectional view of the plane of Earth's orbit around the Sun. A line drawn perpendicular to the plane of Earth's orbit is shown on the diagram.



How many degrees is Earth's rotational axis tilted with respect to the perpendicular line shown in the diagram?

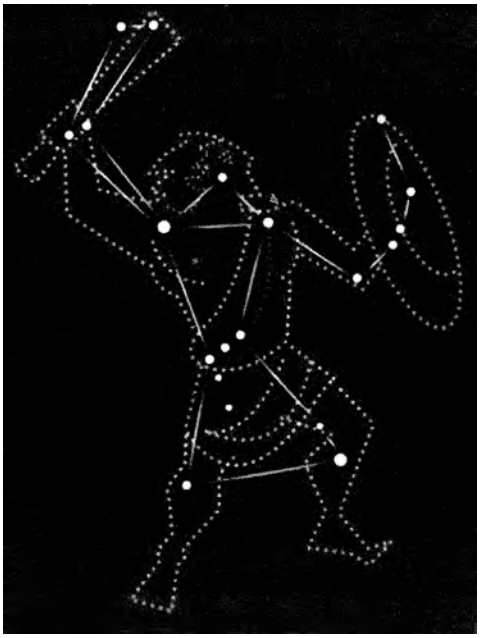
(1) 15° (3) 90°
(2) 23.5° (4) 180°

12 The larger white dots in the diagrams below represent stars in the constellations Scorpius and Orion. Information indicating when these constellations are visible from New York State is provided below the diagrams.



Scorpius

Visible in the New York State nighttime sky during July; not visible at all in January



Orion

Visible in the New York State nighttime sky during January; not visible at all in July

Which statement best explains why these two constellations are visible in the night sky in the months identified?

(1) Earth spins on its axis at a constant rate during a 24-hour period.
(2) Earth spins on its axis at a variable rate during the year.
(3) The nighttime side of Earth is facing different parts of our galaxy as Earth orbits the Sun.
(4) The nighttime side of Earth is facing different parts of our galaxy as the stars orbit Earth.

13 Which table correctly shows the interior temperature, melting point, and state (phase) of matter of the materials located 4000 kilometers below Earth's surface?

Interior Temperature (°C)	**Melting Point** (°C)	**State of Matter**
5700	5400	solid

(1)

Interior Temperature (°C)	**Melting Point** (°C)	**State of Matter**
5400	5700	solid

(3)

Interior Temperature (°C)	**Melting Point** (°C)	**State of Matter**
5700	5400	liquid

(2)

Interior Temperature (°C)	**Melting Point** (°C)	**State of Matter**
5400	5700	liquid

(4)

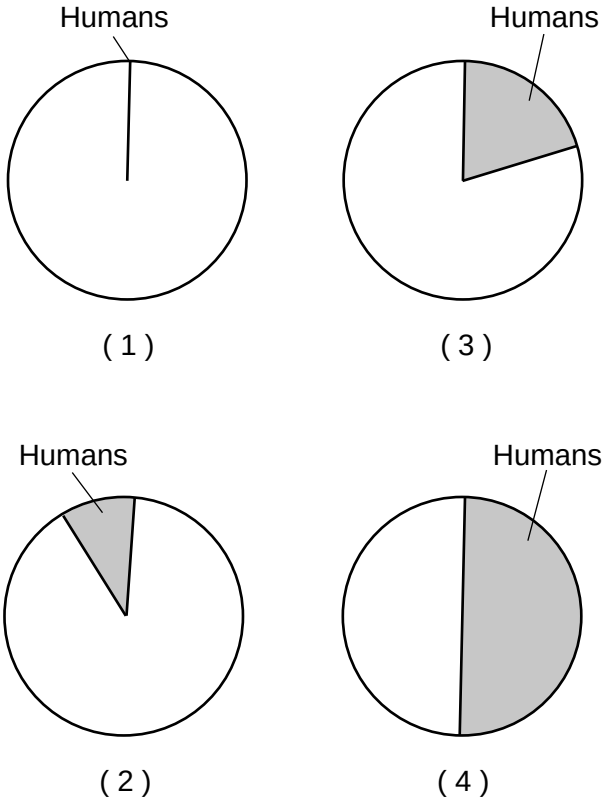
14 Which gas is a greenhouse gas that has increased in Earth's atmosphere partly as a result of deforestation over the last 100 years?

(1) ozone
(2) oxygen
(3) nitrogen
(4) carbon dioxide

15 Which ocean current brings warm water to the southeastern tip of Africa?

(1) Brazil Current
(2) Agulhas Current
(3) Guinea Current
(4) Benguela Current

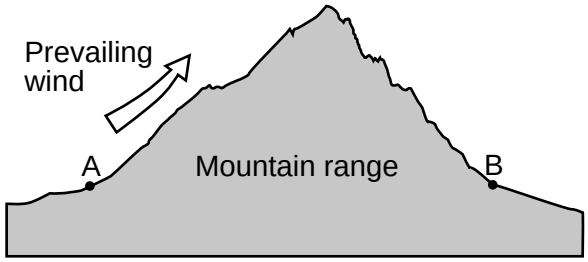
16 Which pie graph is shaded to best represent the approximate percentage of time that humans have existed during Earth's entire history?



17 Volcanic ash can be used as a time marker to correlate rock layers because the ash

(1) is deposited rapidly over a large area
(2) represents a buried erosional surface
(3) forms intrusive igneous rock
(4) cuts across rock layers

18 The cross section below represents a mountain range. Points *A* and *B* represent locations on Earth's surface.



Compared to the climate of location *A*, the climate of location *B* is most likely

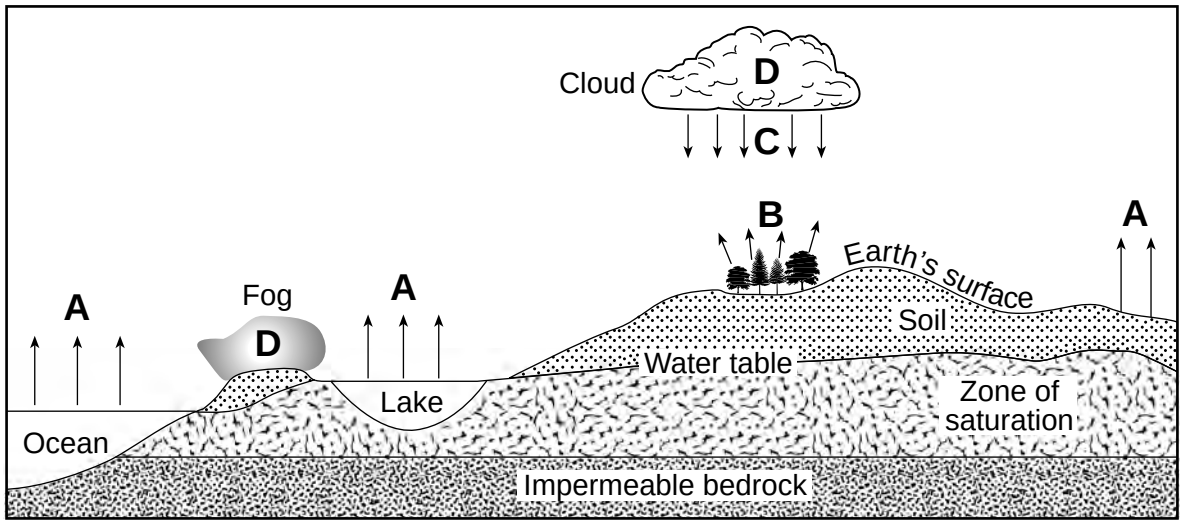
(1) cooler and wetter
(2) cooler and drier
(3) warmer and wetter
(4) warmer and drier

19 The photograph below shows conglomerate composed of pebbles cemented together with calcite.

Compared to the ages of the calcite cement and the conglomerate, the relative age of the pebbles is

(1) younger than both the calcite cement and the conglomerate
(2) younger than the calcite cement, but the same age as the conglomerate
(3) older than both the calcite cement and the conglomerate
(4) older than the calcite cement, but the same age as the conglomerate

20 The cross section below represents some parts of Earth's water cycle. Letters *A*, *B*, *C*, and *D* represent processes that occur during the cycle.



Which table correctly matches each letter with the process it represents?

Letter	Process
A	Condensation
B	Transpiration
C	Precipitation
D	Evaporation

(1)

Letter	Process
A	Condensation
B	Evaporation
C	Precipitation
D	Transpiration

(3)

Letter	Process
A	Evaporation
B	Precipitation
C	Transpiration
D	Condensation

(2)

Letter	Process
A	Evaporation
B	Transpiration
C	Precipitation
D	Condensation

(4)

21 Which table best shows the relationship between latitude and general climate conditions on Earth?

Latitude	Climate Conditions
90°N	Arid
60°N	Arid
30°N	Humid
0°	Humid
30°S	Humid
60°S	Arid
90°S	Arid

(1)

Latitude	Climate Conditions
90°N	Arid
60°N	Humid
30°N	Arid
0°	Humid
30°S	Arid
60°S	Humid
90°S	Arid

(2)

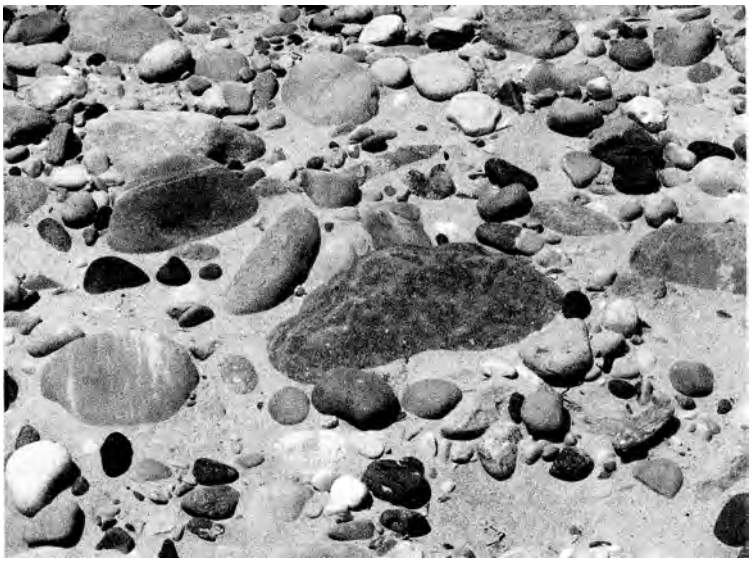
Latitude	Climate Conditions
90°N	Humid
60°N	Arid
30°N	Humid
0°	Humid
30°S	Humid
60°S	Arid
90°S	Humid

(3)

Latitude	Climate Conditions
90°N	Humid
60°N	Arid
30°N	Humid
0°	Arid
30°S	Humid
60°S	Arid
90°S	Humid

(4)

22 The photograph below shows different-sized rounded sediment.



Which table shows the most likely process and agent of erosion responsible for this rounded sediment?

Process	Agent of Erosion
sandblasting	running water

(1)

Process	Agent of Erosion
land slide	mass movement

(3)

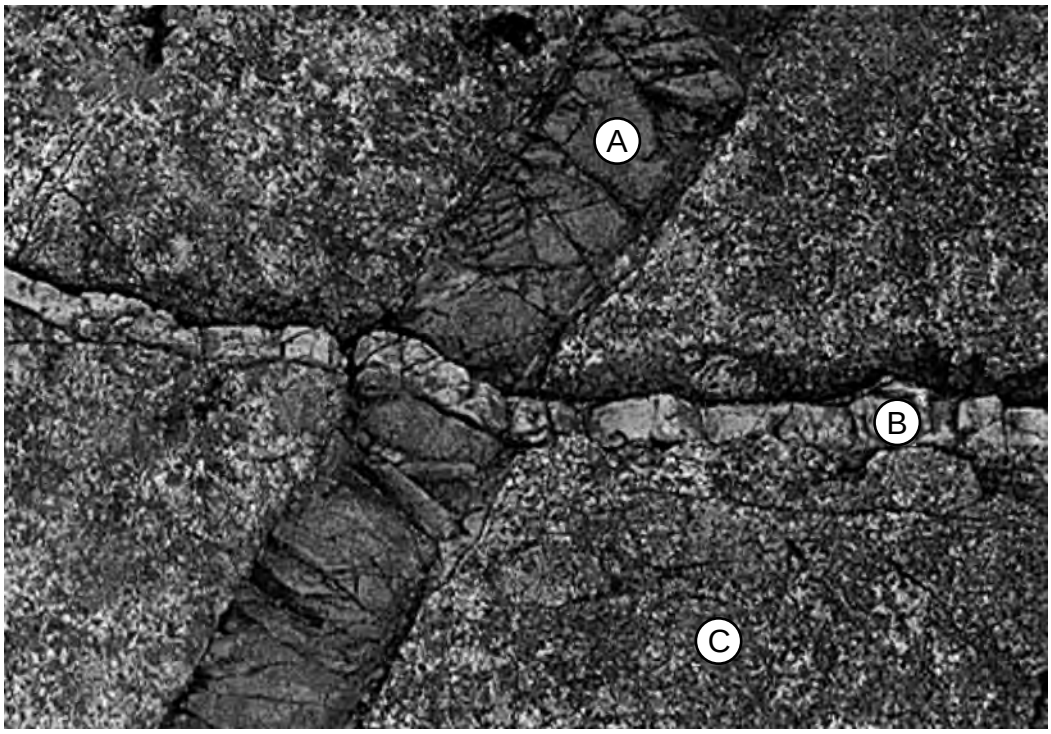
Process	Agent of Erosion
abrasion	wave action

(2)

Process	Agent of Erosion
deposition	wind

(4)

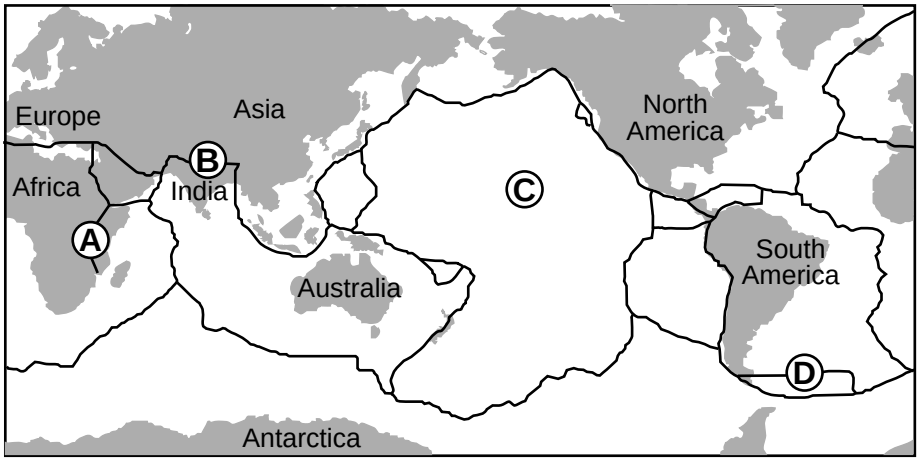
23 The photograph below shows an outcrop with two basaltic intrusions, labeled *A* and *B*, in a rock unit, labeled *C*.



What is the relative age of these three rock units from oldest to youngest?

(1) $B \longrightarrow A \longrightarrow C$
(2) $B \longrightarrow C \longrightarrow A$
(3) $C \longrightarrow A \longrightarrow B$
(4) $C \longrightarrow B \longrightarrow A$

24 The world map below shows Earth's major tectonic plate boundaries. Letters *A* through *D* represent four surface locations.



Which location is on a major rift valley?

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

25 The first *P*-wave of an earthquake took 11 minutes to travel to a seismic station from the epicenter of the earthquake. What is the seismic station's distance to the epicenter of the earthquake and how long did it take for the first *S*-wave to travel that distance?

(1) Distance to epicenter: 3350 km
S-wave travel time: 4 min 50 sec
(2) Distance to epicenter: 3350 km
S-wave travel time: 6 min 10 sec
(3) Distance to epicenter: 7600 km
S-wave travel time: 9 min
(4) Distance to epicenter: 7600 km
S-wave travel time: 20 min

26 The Catskills are commonly called mountains, but are actually part of the Allegheny Plateau. The Catskills are classified as a plateau because of their

(1) low elevation
(2) bedrock structure
(3) bedrock age
(4) high degree of metamorphism

27 The minimum stream velocity necessary to transport a sediment particle that is 0.1 centimeter in diameter is closest to

(1) 0.1 cm/s
(2) 0.002 cm/s
(3) 5.5 cm/s
(4) 10.0 cm/s

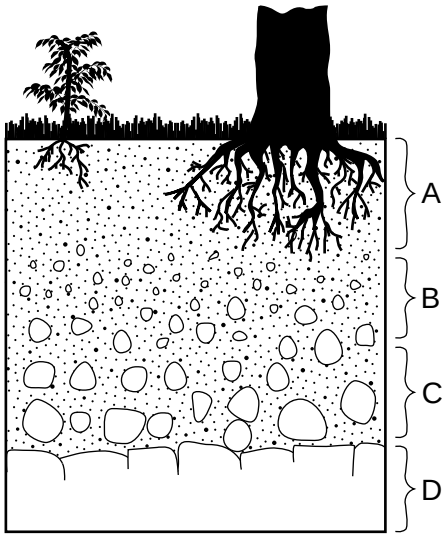
28 Which rock is classified as an evaporite?

(1) clastic shale
(2) foliated phyllite
(3) nonfoliated marble
(4) crystalline rock salt

29 Which pair of elements makes up most of Earth's crust by volume?

(1) nitrogen and potassium
(2) oxygen and silicon
(3) hydrogen and oxygen
(4) potassium and oxygen

30 The cross section below represents zones of soil labeled *A*, *B*, and *C*. Letter *D* represents underlying bedrock.



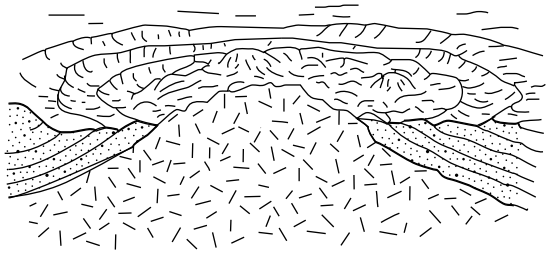
Which letter identifies the zone having the most organic and weathered material?

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

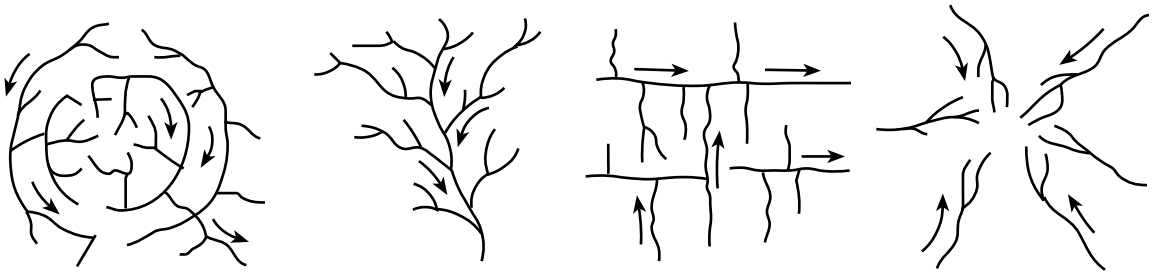
31 Which type of surface bedrock is most commonly found in the Utica, New York area?

(1) sedimentary, with limestone, shale, sandstone, and dolostone
(2) sedimentary, with limestone, shale, sandstone, and conglomerate
(3) metamorphic, with quartzite, dolostone, marble, and schist
(4) metamorphic, with gneiss, quartzite, marble, and slate

32 The diagram below represents a geologic landscape.

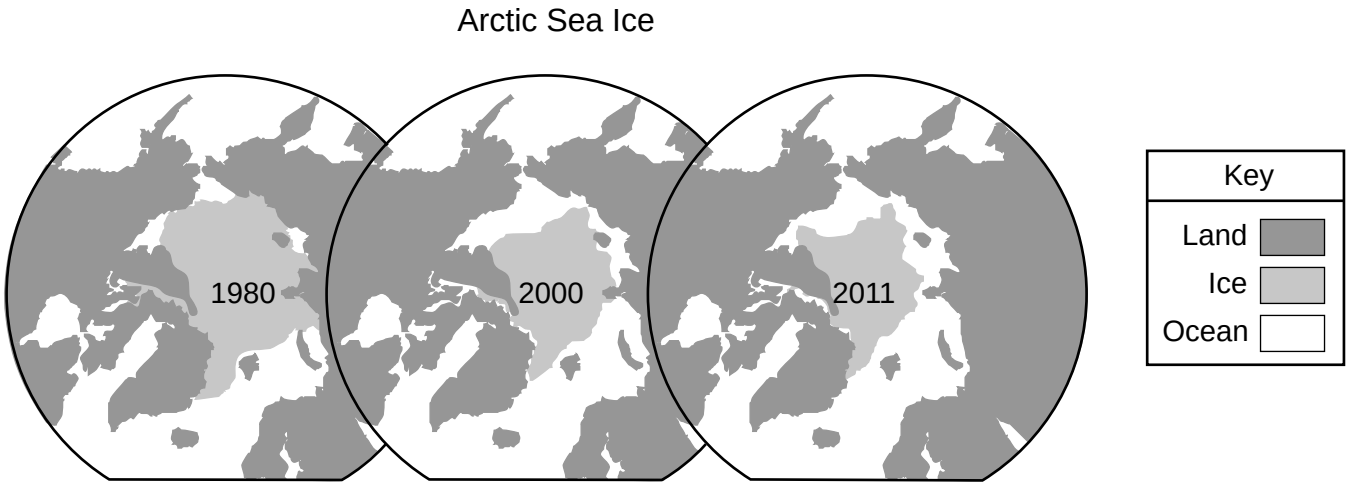


Which type of stream drainage pattern formed on this landscape?



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

33 The north polar view maps below show the average area covered by Arctic Sea ice in September of 1980, 2000, and 2011.



The maps best support the inference that Earth's climate is

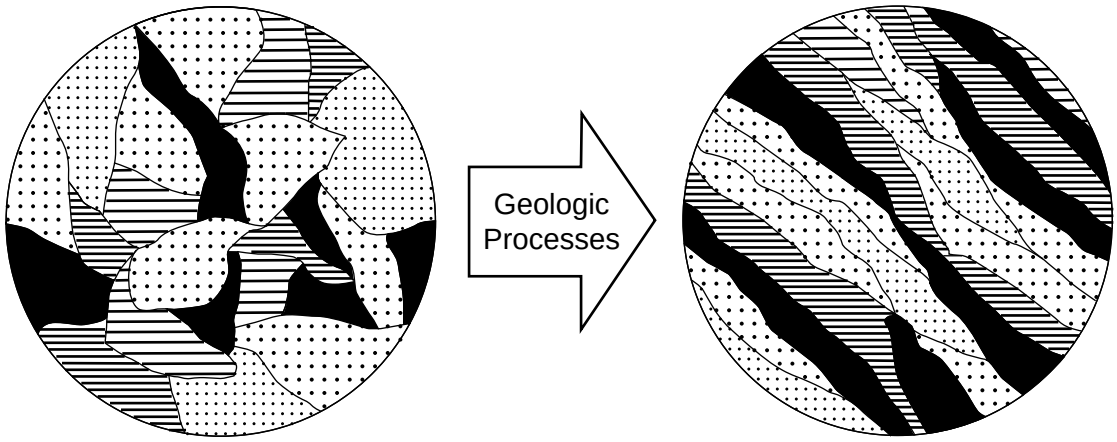
(1) cooling, because the average area covered by Arctic Sea ice is decreasing
(2) cooling, because the average area covered by Arctic Sea ice is increasing
(3) warming, because the average area covered by Arctic Sea ice is decreasing
(4) warming, because the average area covered by Arctic Sea ice is increasing

34 The photographs below shows two depositional features labeled *A* and *B*.

Which terms correctly identify depositional features *A* and *B*?

(1) *A*-delta; *B*-barrier island
(2) *A*-sand bar; *B*-island arc
(3) *A*-barrier island; *B*-delta
(4) *A*-island arc; *B*-sand bar

35 Diagrams *A* and *B* represent magnified views of the arrangement of mineral crystals in a rock before and after being subjected to geologic processes.



Which geologic processes are most likely responsible for the banding and alignment of mineral crystals represented in diagram *B*?

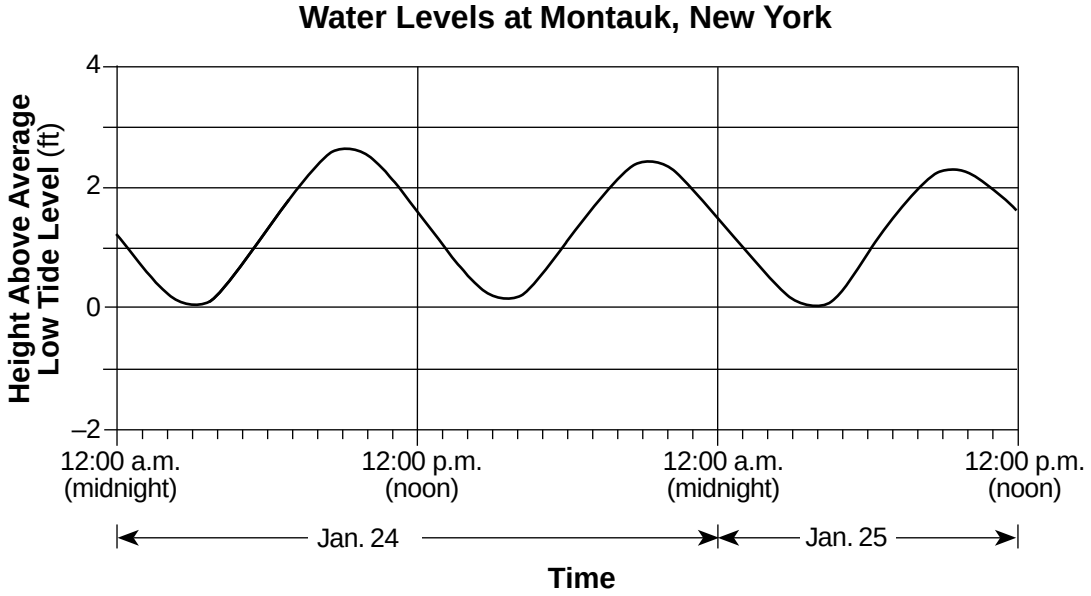
(1) melting and solidification
(2) heating and increasing pressure
(3) compaction and cementation
(4) weathering and erosion

Part B–1

Answer all questions in this part.

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

Base your answers to questions 36 through 39 on the graph below and on your knowledge of Earth science. The graph shows the observed water levels, in feet (ft), for a tide gauge located at Montauk, New York, on the easternmost end of Long Island, from January 24, 2008 to noon on January 25, 2008.



36 What was the height of the water above average low tide level at noon on January 24?

(1) 1.2 ft
(2) 1.6 ft
(3) 2.2 ft
(4) 2.6 ft

37 These changing water levels at Montauk can best be described as

(1) cyclic and predictable
(2) cyclic and not predictable
(3) noncyclic and predictable
(4) noncyclic and not predictable

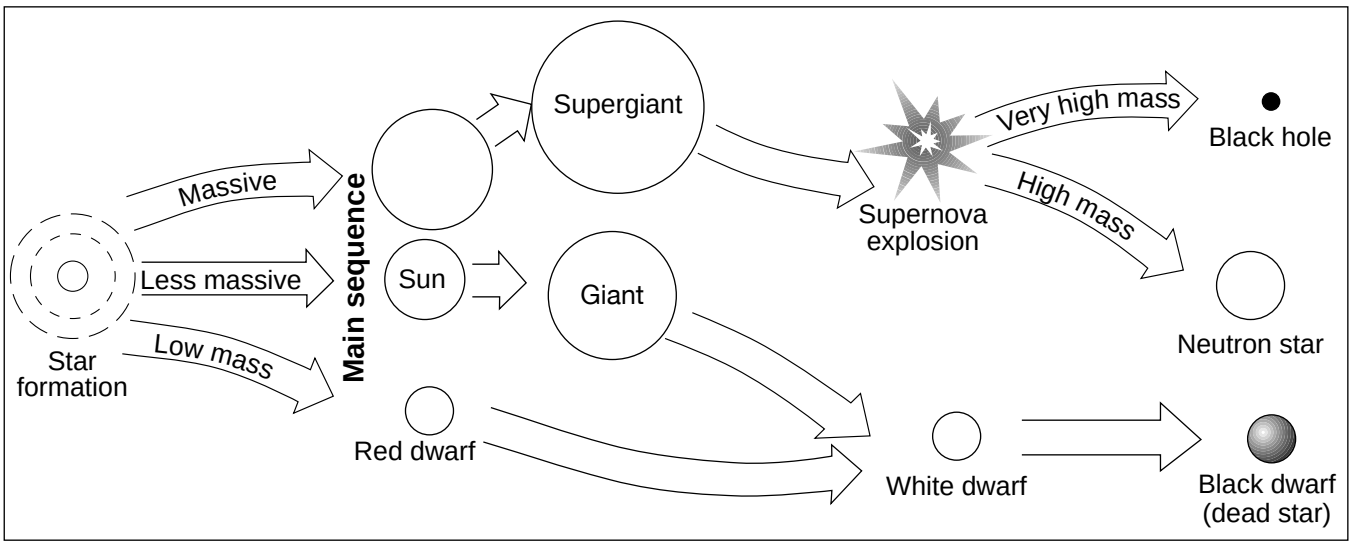
38 What causes the water-level variation pattern shown by the graph?

(1) changes in wind velocity produced by coastal storms
(2) changes in magnetic orientation of the North American Plate
(3) Earth's revolution and the distance from the equator
(4) Earth's rotation and the gravitational pull of the Moon

39 What is the approximate latitude and longitude of the tide gauge?

(1) 40°30' N 72°00' W
(2) 40°30' N 74°00' W
(3) 41°00' N 72°00' W
(4) 41°00' N 74°00' W

Base your answers to questions 40 through 42 on the diagram below and on your knowledge of Earth science. The diagram represents some of the inferred stages in the life cycle of stars according to their original mass.



(Not drawn to scale)

40 The final stage in the life cycle of the most massive stars is a

(1) black hole
(2) black dwarf
(3) supergiant
(4) white dwarf

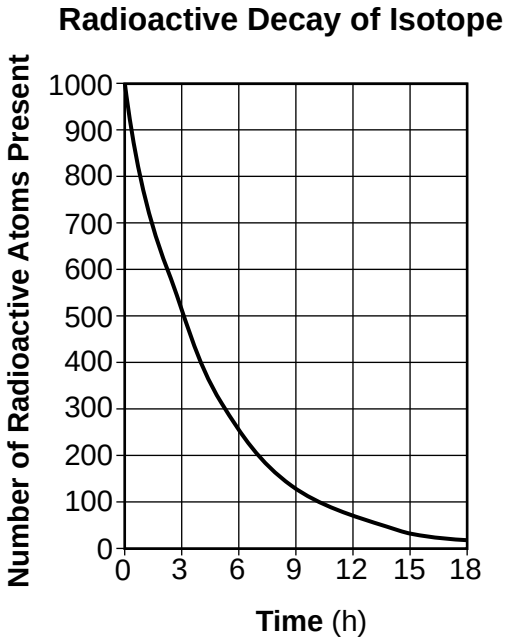
41 Which star may once have been similar to our Sun in mass and luminosity?

(1) *Deneb*
(2) *Spica*
(3) *Procyon B*
(4) *Proxima Centauri*

42 Energy is produced in the cores of main sequence stars when

(1) lighter elements undergo fusion into heavier elements
(2) heavier elements undergo fusion into lighter elements
(3) cosmic background radiation is absorbed
(4) cosmic background radiation is released

Base your answers to questions 43 and 44 on the graph below and on your knowledge of Earth science. The graph shows the number of radioactive Isotope *X* atoms present as a sample of the isotope undergoes radioactive decay.



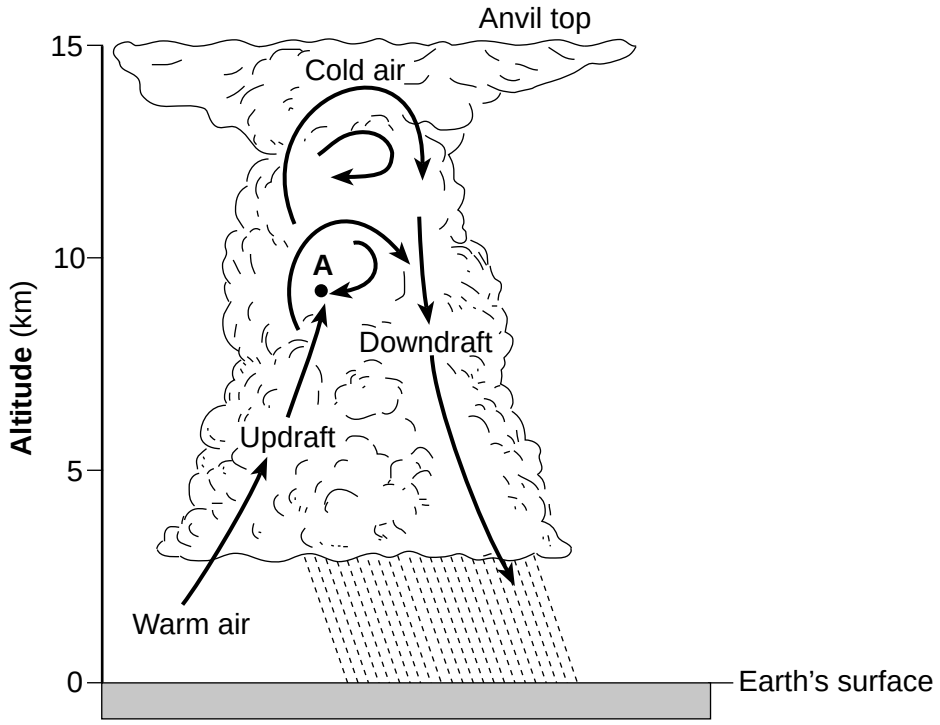
43 Based on the graph, the half-life of this radioactive isotope is

(1) 6 h
(2) 9 h
(3) 3 h
(4) 12 h

44 Based on the graph, what is the approximate number of radioactive atoms of Isotope *X* that are present when 8 hours of decay has occured?

(1) 90
(2) 115
(3) 155
(4) 200

Base your answers to questions 45 through 47 on the diagram below and on your knowledge of Earth science. The arrows in the diagram show air movement in a thunderstorm cloud. Point *A* represents a location in the atmosphere.



45 In which temperature zone of the atmosphere is point *A* located?

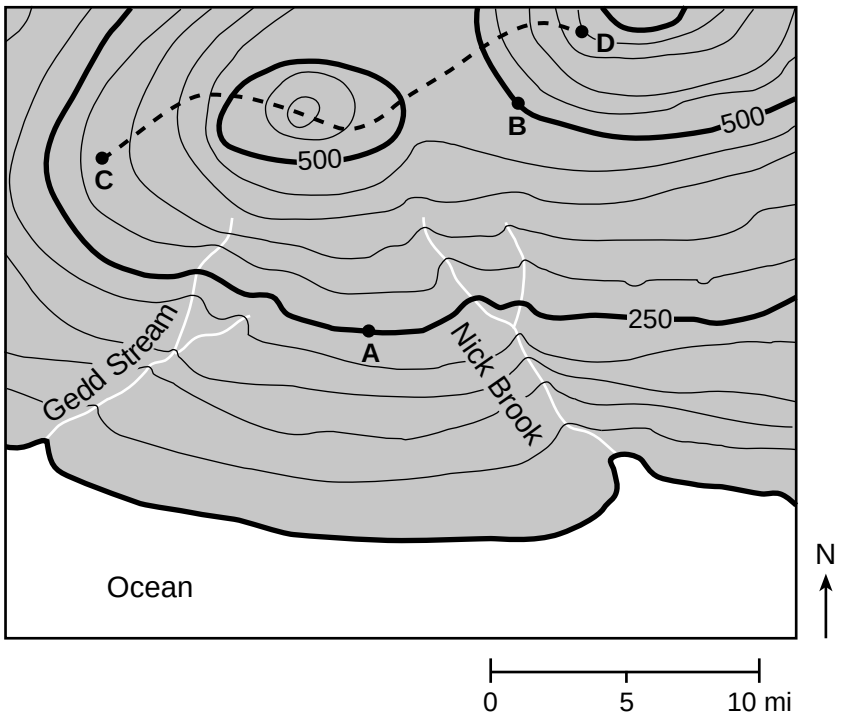
(1) thermosphere
(2) mesosphere
(3) stratosphere
(4) troposphere

46 The updrafts and downdrafts represented within this cloud are primarily caused by differences in

(1) altitude above sea level
(2) air density
(3) relative humidity
(4) specific heat

47 Which weather symbol would be placed on a station model to represent this weather event?

Base your answers to questions 48 through 50 on the topographic map below and on your knowledge of Earth science. On the map, points *A*, *B*, *C*, and *D* represent surface locations. The dashed line between points *C* and *D* represents a hiking trail. Elevations are in feet (ft).



48 What is the contour interval on this map?

(1) 25 ft
(2) 50 ft
(3) 150 ft
(4) 250 ft

49 The gradient between location *A* and location *B* is approximately

(1) 0.04 ft/mi
(2) 25 ft/mi
(3) 40 ft/mi
(4) 50 ft/mi

50 A person walks along the trail from location *C* to location *D*. The person will be walking

(1) downhill then uphill, only
(2) downhill, then uphill, then downhill again
(3) uphill then downhill, only
(4) uphill, then downhill, then uphill again

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 passage below and on your knowledge of Earth science.

The Mica Family

The familiar term "mica" is not the name of a specific mineral, but rather the name for a family of more than 30 minerals that share the same properties. All members of the mica family have high melting points and are similar in density, luster, hardness, streak, type of breakage, and crystal shape. As a result, telling the micas apart can be difficult. However, some common members of the family can be identified by color. For example, biotite is black to dark brown while muscovite can be light shades of several colors, or even colorless. When less common members of the mica family have any of these colors, or have similar colors, chemical tests are needed to tell them apart.

51 Identify the *two* chemical elements present in biotite mica that are *not* present in muscovite mica. [1]

52 Identify the luster, hardness, and dominant form of breakage for members of the mica family. [1]

53 State the name of the igneous rock in which crystals of biotite mica are larger than 10 millimeters in diameter. [1]

54 Large crystals of mica, sometimes weighing several hundred tons, have been found in igneous rock in Canada. Identify the environment of formation and the relative rate of cooling of the magma that formed the igneous rock containing these large crystals. [1]

Base your answers to questions 55 through 58 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram represents the Sun's apparent daily path for the first day of three seasons at 43° North latitude. The solid lines represent daytime paths as seen by an observer at this latitude. The dashed lines represent the nighttime paths that can *not* be seen by the observer.

55 On the diagram *in your answer booklet*, draw an **X** to represent the solar noon position of the Sun as seen by the observer on April 21. [1]

56 Identify the rate of the Sun's apparent movement, in degrees per hour, along its path on December 21. [1]

57 Identify the compass direction toward which the observer's shadow would point at solar noon on March 21. [1]

58 List the three dates shown on the diagram from the least number of nighttime hours to the greatest number of nighttime hours. [1]

Base your answers to questions 59 through 62 on the information below, on the map in your answer booklet, and on your knowledge of Earth science. The map shows a portion of the tectonic plates map from the *2011 Edition Reference Tables for Physical Setting/Earth Science*. Letters *A* and *B* represent locations on the ocean floor.

> The area between North America and South America is a tectonically active region of Earth. This region contains all of the types of tectonic plate boundaries, and it has frequent earthquake and volcanic activity. The tectonic plates on either side of the East Pacific Ridge move at an average rate of 7.5 cm/year.

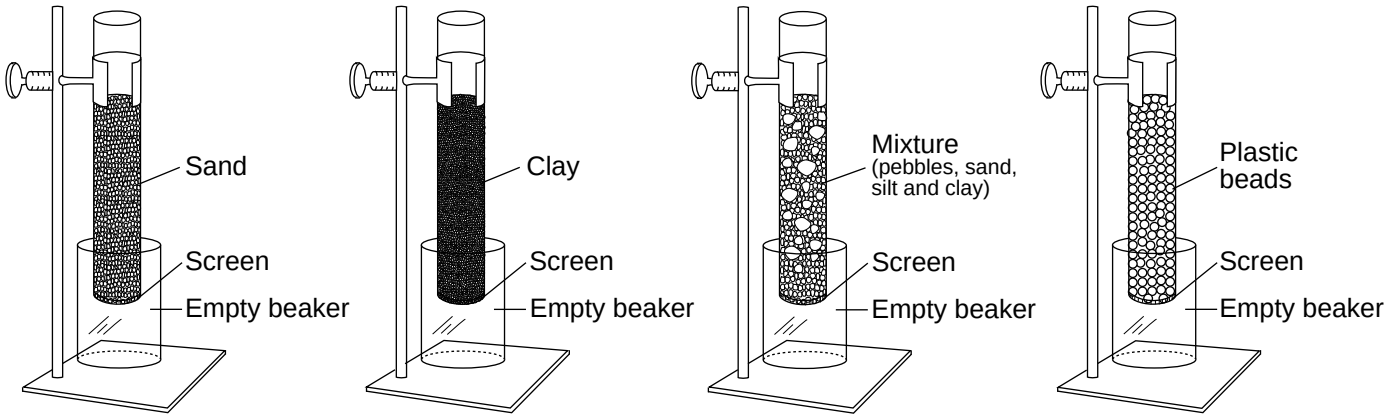
59 On the map *in your answer booklet*, draw *one* arrow in each of the two boxes to show the relative motion of the Caribbean Plate and the North American Plate. [1]

60 On the set of axes *in your answer booklet*, draw a line to represent the relative age of the ocean floor bedrock from location *A* to location *B*. [1]

61 Identify the name of the hot spot shown on the map, and identify the name of the tectonic plate under which the center of this hot spot is located. [1]

62 Identify the type of mafic igneous bedrock that is most likely to make up the oceanic crust at location *A*, and state the average density of this oceanic crust. [1]

Base your answers to questions 63 through 65 on the diagram and data table below and on your knowledge of Earth science. The diagram represents laboratory materials used for an investigation of the effects of particle diameter on permeability and porosity (percentage of pore space). Four separate plastic tubes were filled to the same level with different particles.



(Not drawn to scale)

Particle Type	**Particle Diameter** (cm)	**Time for Water to Infiltrate** (s)	**Porosity** (%)
Sand	0.1	7	42.0
Clay	0.0003	322	40.0
Mixture	from 0.0003 to 0.8	15	34.0
Plastic beads	0.4	4	44.0

63 Explain why the particle sizes fit together more closely in the mixture, resulting in the lowest porosity of all these particle types. [1]

64 The height of the column of sand is 28 centimeters. Calculate the rate of infiltration, in centimeters per second, for the water that flowed through the column of sand. [1]

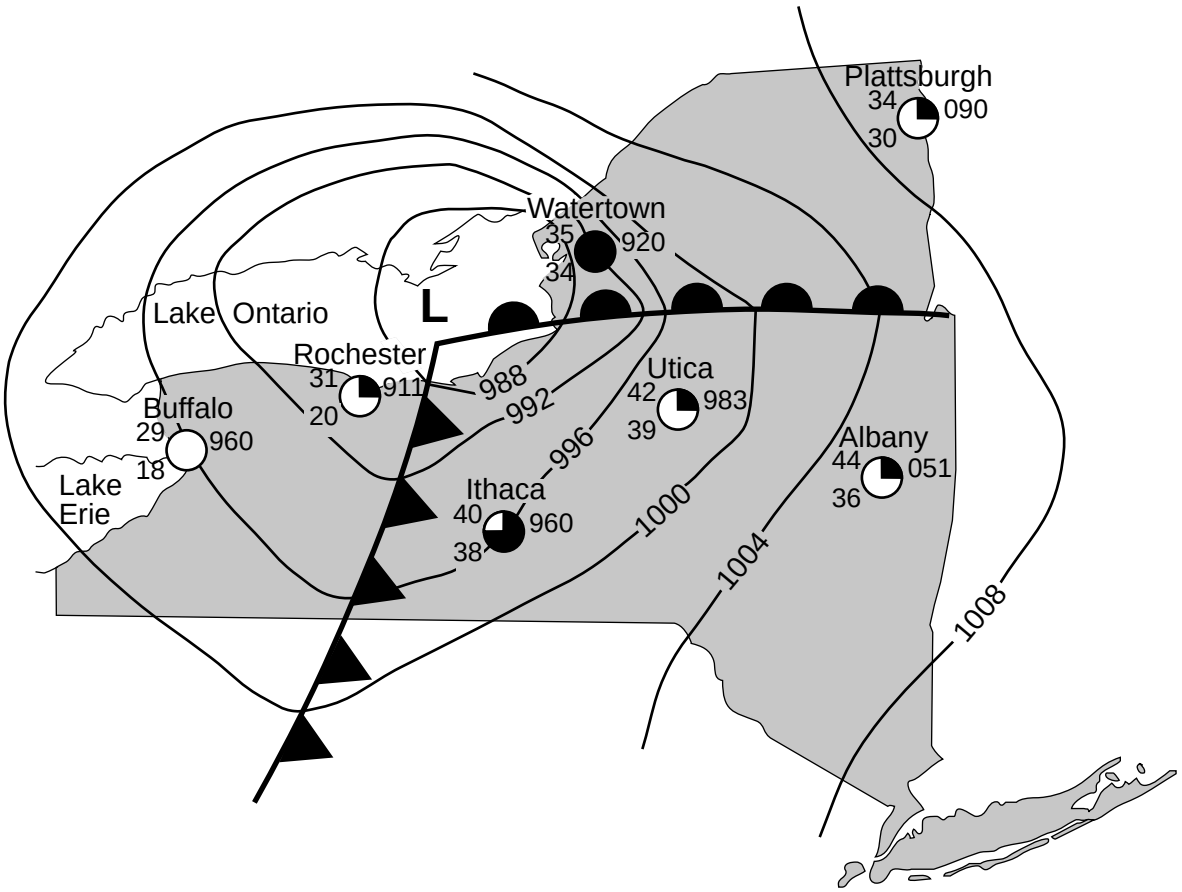
65 Based on the particle diameter of the plastic beads, identify the type of sediment represented by these beads. [1]

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 weather map below and on your knowledge of Earth science. The map shows the location of a wintertime low-pressure system over Lake Ontario with two fronts extending into New York State. Isobar values are recorded in millibars. Partial weather station data are shown for several locations.



66 Describe the evidence shown on the map that indicates that the highest wind speeds occurred near Watertown, New York. [1]

67 Complete the table *in your answer booklet* by recording the weather data shown on the station model for Albany, New York. [1]

68 State the compass direction toward which the center of this low-pressure system moved over the next two days if the low followed a normal storm track. [1]

Base your answers to questions 69 through 72 on the information and data table below and on your knowledge of Earth science. The data table shows the average body volume, including the shell, of a brachiopod at certain times in geologic history. The geologic ages are shown in million years ago (mya). The average body volumes including the shell are shown in milliliters (mL).

Cope's Rule

Cope's Rule states that the average size of animals preserved in the fossil record tends to increase as each group evolves from a previous group. This rule was first proposed in the 1800s by Edward Drinker Cope, a famous fossil hunter of that time. Recent research, involving well over 10,000 fossil groups spanning the time since the start of the Cambrian Period until today, has shown that Cope's Rule is accurate for most animal groups. Brachiopod data support Cope's Rule.

Brachiopod Data Table

Geologic Age (mya)	**Average Body Volume Including the Shell** (mL)
480	0.1
460	0.2
430	0.6
410	1.0
380	1.1

69 On the grid *in your answer booklet*, plot the average brachiopod body volume for each of the geologic ages listed in the data table. Connect *all five* plots with a line. [1]

70 Identify, by name, *two* geologic periods when the brachiopods represented in the data table were living. [1]

71 State the names of the *two* brachiopod index fossils found in New York State bedrock. [1]

72 The earliest horses appeared in the Eocene epoch and were about the size of a large dog of today. Explain how the evolution of horses supports Cope's Rule. [1]

Base your answers to questions 73 through 75 on the snowfall map in your answer booklet and on your knowledge of Earth science. The snowfall map shows some average yearly snowfall values, measured in inches, recorded for a portion of New York State. Some average yearly snowfall isolines have been drawn. Line *XY* is a reference line on the map. The cities of Watertown and Oswego are shown on the map.

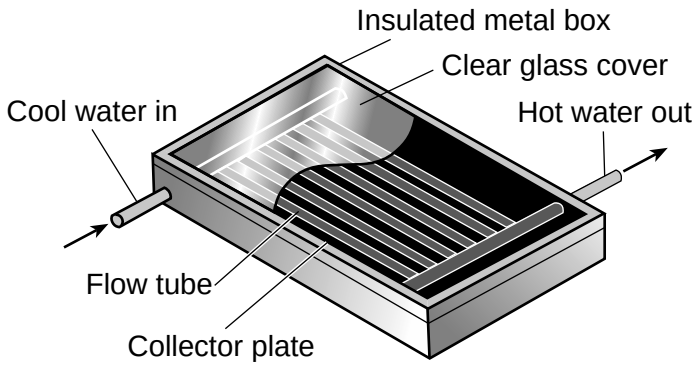
73 On the map *in your answer booklet*, draw the 240-inch average yearly snowfall isoline. [1]

74 On the grid *in your answer booklet*, construct a profile of the average annual snowfall along line *XY* by plotting the value of each isoline that crosses line *XY*. Connect *all six* plots with a line to complete the profile. [1]

75 The diagram *in your answer booklet* represents an observer standing next to the side of a building. Using the scale shown, draw an **X** on the side of the building to represent the height of the greatest amount of average yearly snowfall that is indicated on the map. [1]

Base your answers to questions 76 through 78 on the diagram below and on your knowledge of Earth science. The diagram represents a cutaway view of a flat-plate solar collector used to heat water at a New York State location.

Solar Collector



76 Identify the energy transfer process by which light travels through space from the Sun to the solar collector. [1]

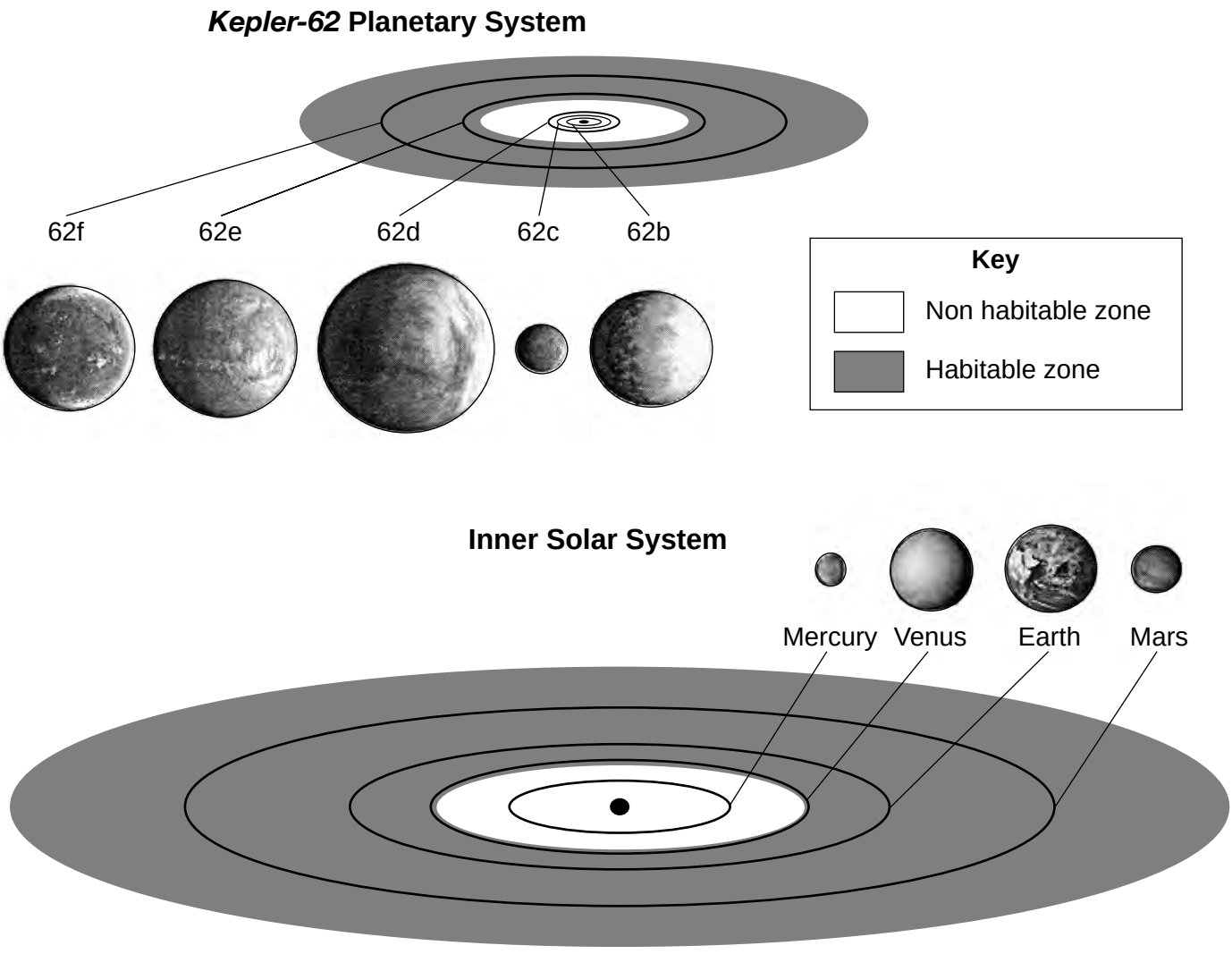
77 Explain why the flow tubes and collector plate inside the solar collector are black in color. [1]

78 The glass cover on this solar collector allows visible light to enter the collector. Identify the type of electromagnetic energy emitted by the flow tubes and collector plate that is trapped inside the collector by the glass cover. Also, circle the relative wavelength of this trapped electromagnetic energy compared to wavelengths of visible light. [1]

Base your answers to questions 79 through 82 on the passage and diagram below, on the data table on the next page, and on your knowledge of Earth science. The diagram compares the inner planets of our solar system to the planetary system surrounding the star *Kepler-62*, which is located in our galaxy. The data table shows some data for the planets in the *Kepler-62* system.

Kepler-62 Planetary System

Five planets orbit a seven-billion-year-old star, *Kepler-62*, which has a surface temperature of approximately 4900 Kelvin. Two of these planets are located within the habitable zone, which is the region around a star where life may exist due to the possible presence of water in the liquid phase. The shaded areas in the orbital diagrams below indicate the habitable zone of each system.



(Planets and orbits are drawn to scale)

Data Table

Name of Planet	**Distance from *Kepler-62*** (million kilometers)	**Equatorial Diameter** (compared to Earth's diameter)
62b	8.23	1.31
62c	13.76	0.54
62d	17.95	1.95
62e	63.88	1.6
62f	107.41	1.4

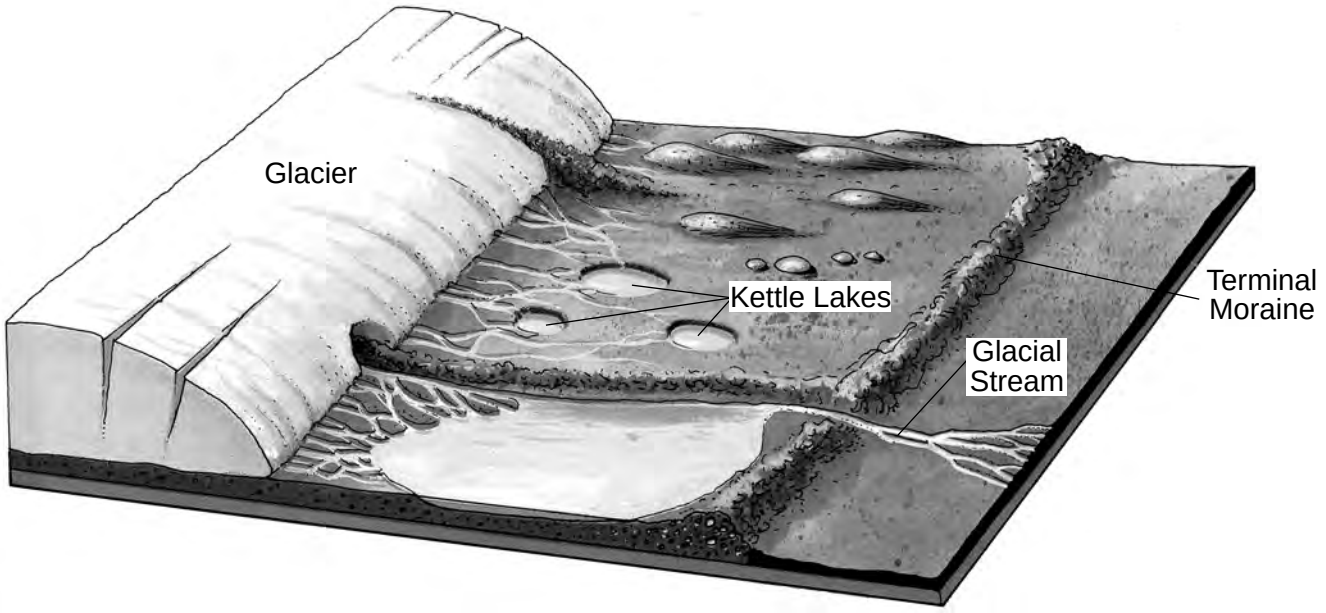
79 Identify the name of the galaxy where the *Kepler-62* planetary system is located. [1]

80 Identify the name of the planet in our solar system that has an equatorial diameter most similar in size to the equatorial diameter of planet Kepler-62c. [1]

81 Identify the name of the planet in the *Kepler-62* planetary system that has the shortest period of revolution, and explain why this planet has the shortest period of revolution. [1]

82 Identify the names of the *two* planets in the *Kepler-62* planetary system that may have liquid water on their surfaces, and explain why these planets may have liquid water on their surfaces. [1]

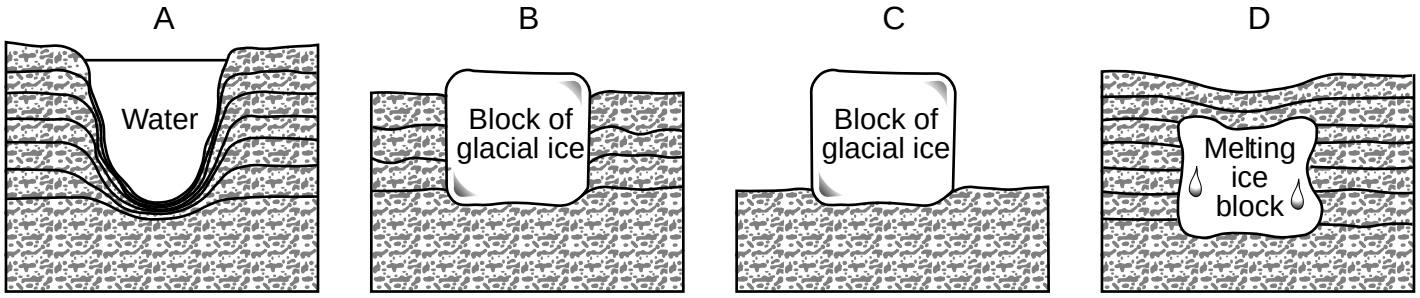
Base your answers to questions 83 through 85 on the block diagram below and on your knowledge of Earth science. The diagram represents glacial features formed by a continental glacier and its melt water.



83 Describe the arrangement of the sediments found within the terminal moraine, which marks the farthest advance of the glacier. [1]

84 The cross sections below, labeled *A*, *B*, *C*, and *D*, represent four stages in the development of a kettle lake. The stages are *not* shown in the correct order.

Stages in Kettle Lake Formation



In your answer booklet, place the letters in the correct order to indicate the sequence of development of a kettle lake from earliest stage to latest stage. [1]

85 Terminal moraines found on Long Island were deposited during the advance and retreat of glacial ice during the last ice age. Identify, by name, the geologic epoch during which these moraines were deposited. [1]

P.S./EARTH SCIENCE

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICAL SETTING
EARTH SCIENCE

Thursday, June 14, 2018 — 9:15 a.m. to 12:15 p.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 _____ and _____

52 Luster: _____

Hardness: _____

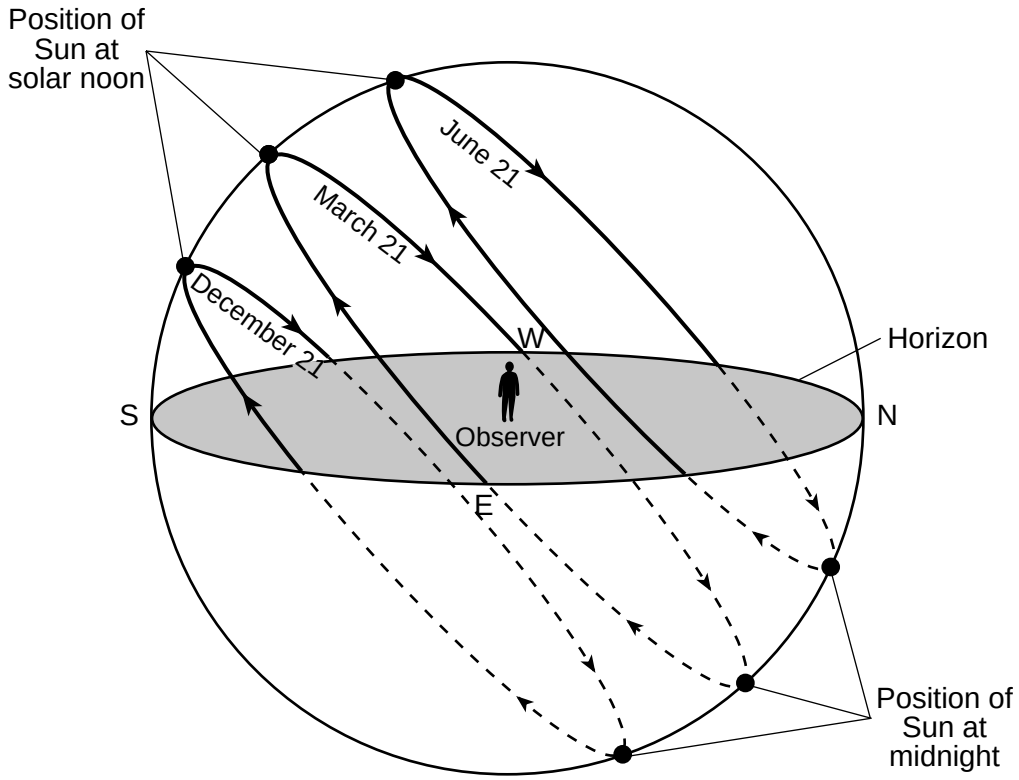
Dominant form of breakage: _____

53 _____

54 Environment of formation: _____

Relative rate of cooling: _____

55



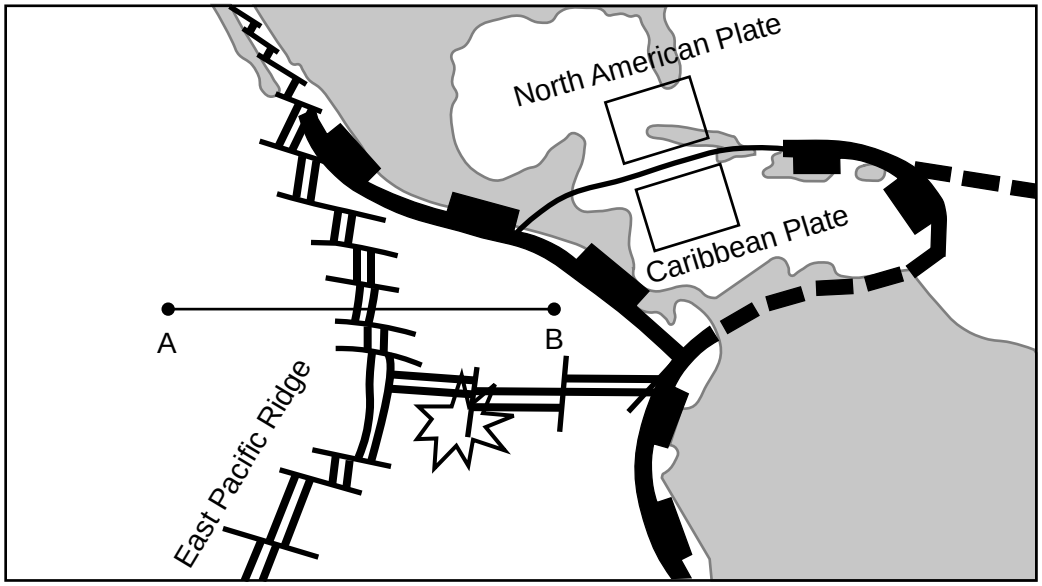
56 _____ **°/h**

57 _____

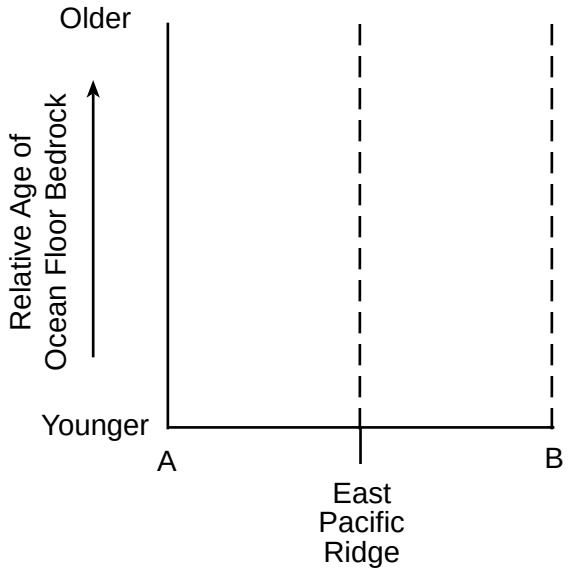
58 _____ → _____ → _____

Least number of nighttime hours ⟶ Greatest number of nighttime hours

59



60



61 _____ **Hot Spot**

_____ **Plate**

62 Type of bedrock: _____

Density: _____ **g/cm^3**

63 _____

_____

64 _____ cm/s

65 _____

Part C

66 _____

_____

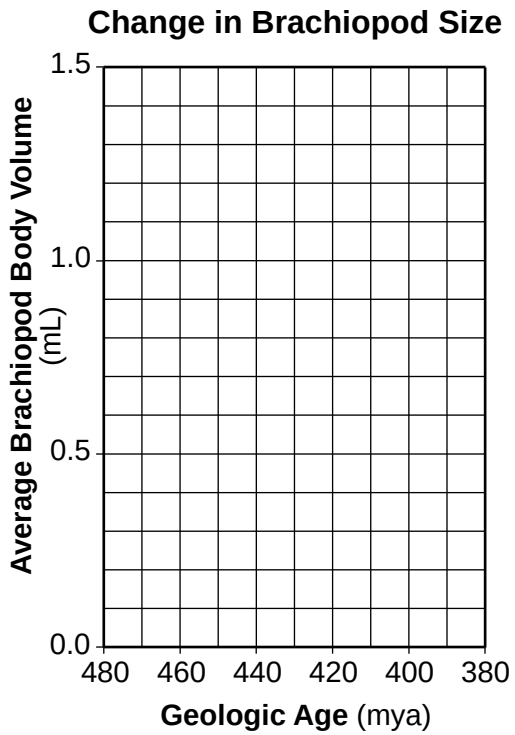
67

Albany, New York

Weather Variable	Weather Data
Dewpoint	°F
Cloud cover	%
Actual barometric pressure	mb

68 _____

69



70 _____ **Period** and _____ **Period**

71 _____ and _____

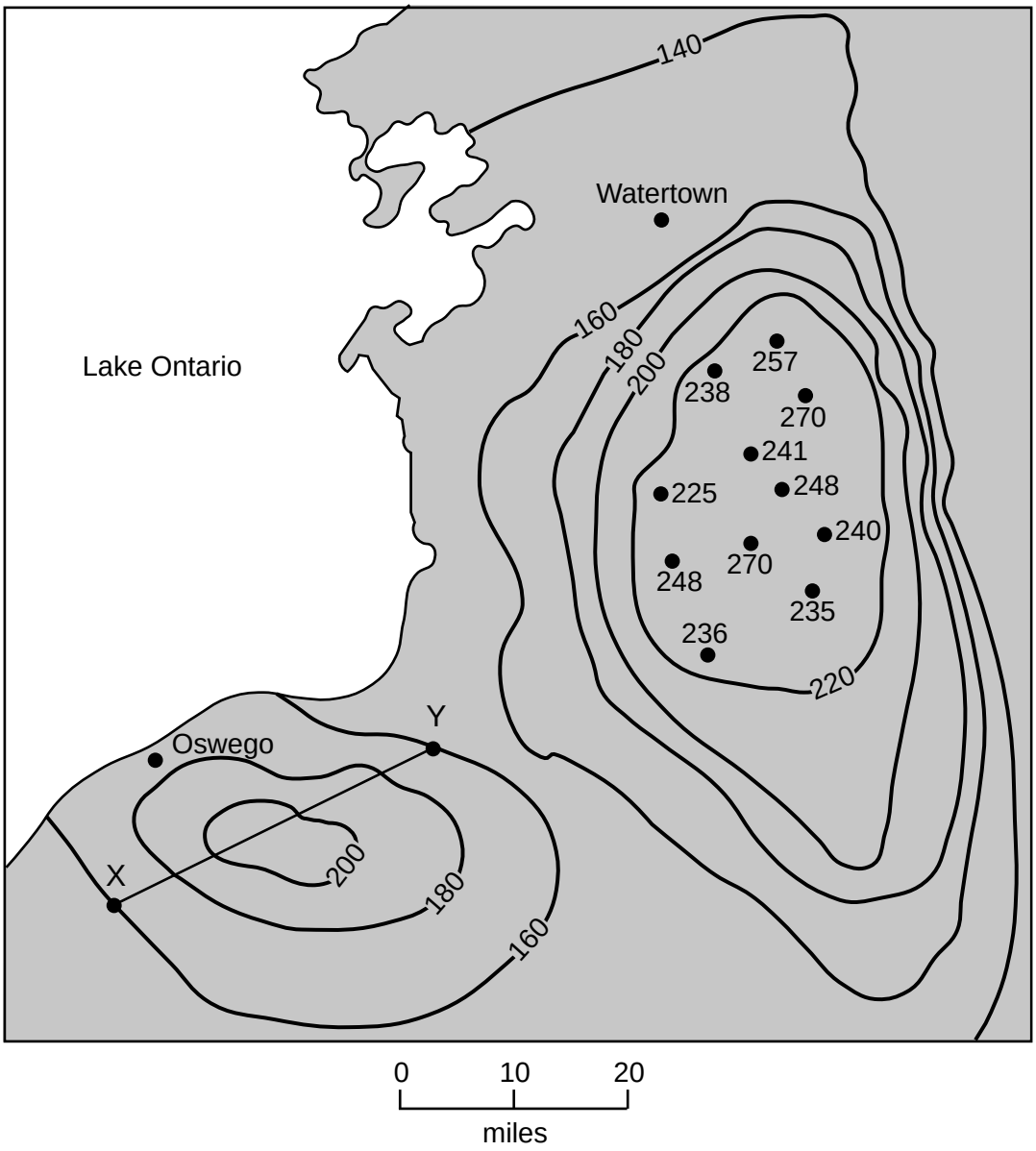
72 _____

_____

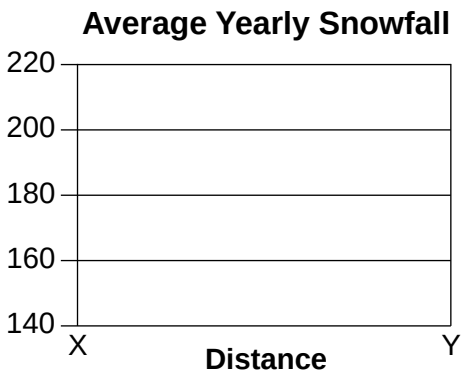
_____

73

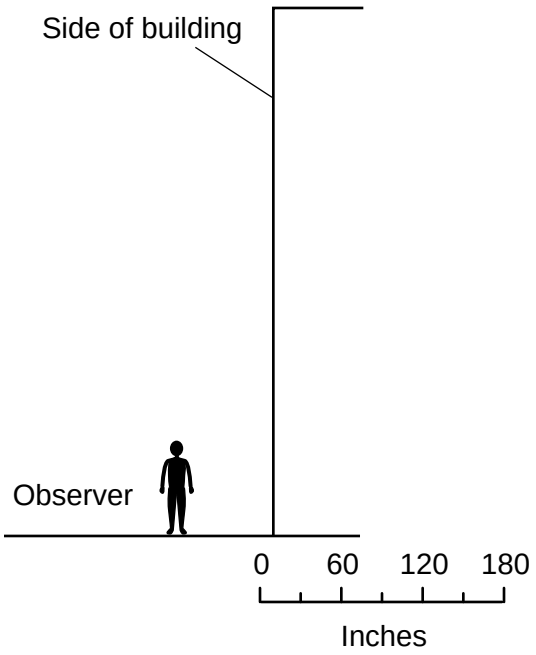
Average Yearly Snowfall Map



74


Average Yearly Snowfall
220
200
180
160
140
X
Y
Distance

75


Side of building
Observer
0
60
120
180
Inches

76 _____

77 _____

_____

78 Emitted electromagnetic energy: _____

Relative wavelength (circle one): shorter longer the same

79 _____

80 _____

81 Name of planet: _____

Explanation: _____

_____

82 _____ and _____

Explanation: _____

_____

83 _____

_____

84 _____ → _____ → _____ → _____

Earliest stage ⟶ Latest stage

85 _____ **epoch**

P.S./EARTH SCIENCE

FOR TEACHERS ONLY

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

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

Thursday, June 14, 2018 — 9:15 a.m. to 12:15 p.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 . . . . . **3**	10 . . . . . **2**	19 . . . . . **3**	28 . . . . . **4** . . . . .
2 . . . . . **4**	11 . . . . . **2**	20 . . . . . **4**	29 . . . . . **4** . . . . .
3 . . . . . **1**	12 . . . . . **3**	21 . . . . . **2**	30 . . . . . **1** . . . . .
4 . . . . . **1**	13 . . . . . **2**	22 . . . . . **2**	31 . . . . . **1** . . . . .
5 . . . . . **3**	14 . . . . . **4**	23 . . . . . **3**	32 . . . . . **1** . . . . .
6 . . . . . **4**	15 . . . . . **2**	24 . . . . . **1**	33 . . . . . **3** . . . . .
7 . . . . . **2**	16 . . . . . **1**	25 . . . . . **4**	34 . . . . . **1** . . . . .
8 . . . . . **1**	17 . . . . . **1**	26 . . . . . **2**	35 . . . . . **2** . . . . .
9 . . . . . **4**	18 . . . . . **4**	27 . . . . . **3**	

Part B–1

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

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 Thursday, June 14, 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 magnesium/Mg and iron/Fe.

52 [1] Allow 1 credit for a correct luster, hardness, and dominant form of breakage. Acceptable responses include, but are not limited to:

Luster:

— nonmetallic

— vitreous/glassy

— pearly

— silky

Hardness:

— Allow any value or range from 2.0 to 3.0.

Dominant form of breakage:

— cleavage/basal cleavage

— breaks into thin sheets

— one direction of cleavage

53 [1] Allow 1 credit for pegmatite.

54 [1] Allow 1 credit if *both* responses are correct. Acceptable responses include, but are not limited to:

Environment of formation:

— intrusive

— plutonic

— deep underground

Relative rate of cooling:

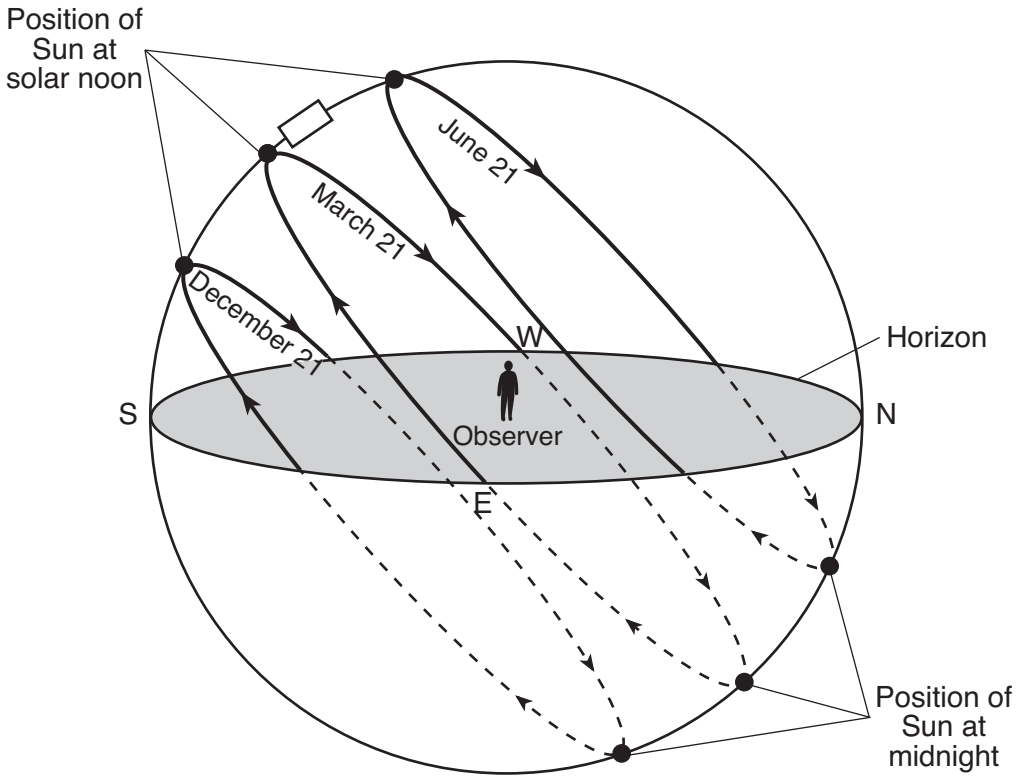
— slower/slowly

— took a longer time/long time

Note: Do *not* allow credit for "long" alone as this does not accurately describe a rate of cooling, but a duration.

55 [1] Allow 1 credit if the center of the **X** is within or touches the boxed area shown below.

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



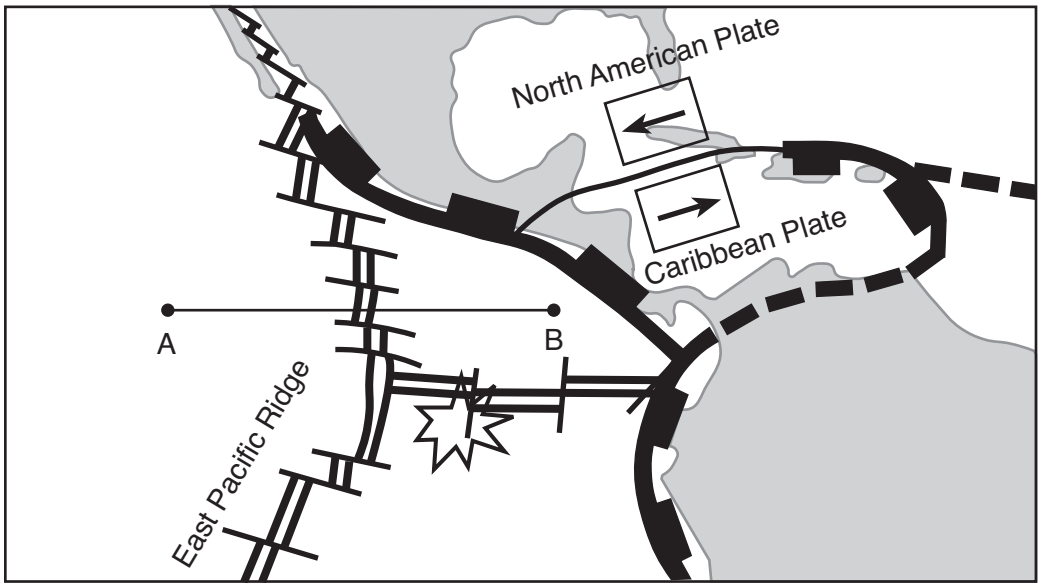
56 [1] Allow 1 credit for 15 °/h.

57 [1] Allow 1 credit for North/N.

58 [1] Allow 1 credit for a correct sequence as shown below.

June 21 (Least number of nighttime hours) → March 21 → December 21 (Greatest number of nighttime hours)

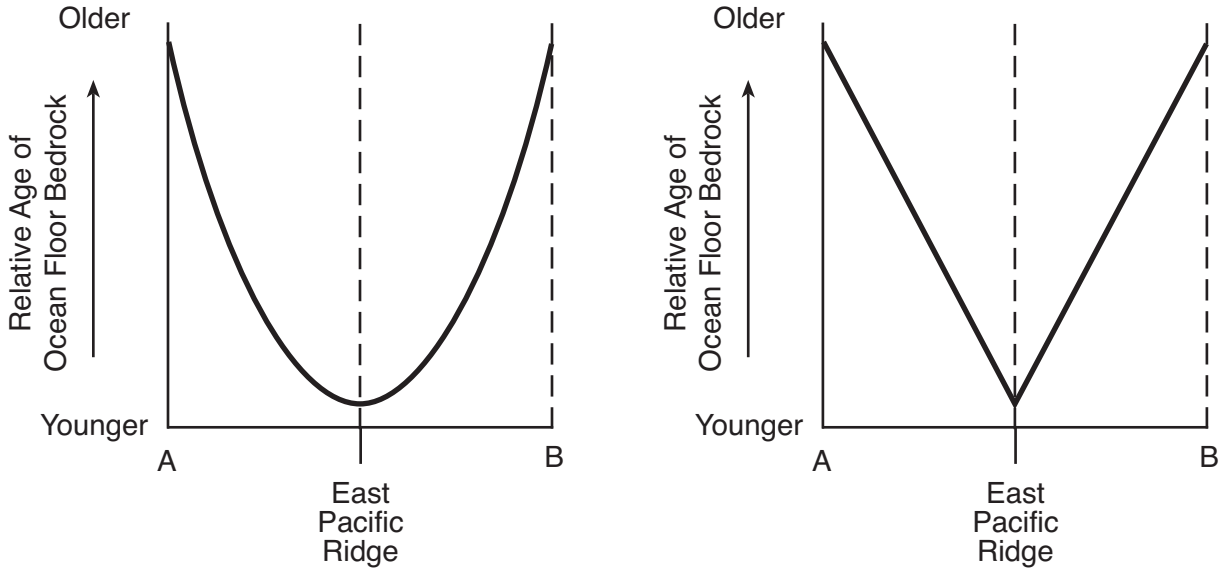
59 [1] Allow 1 credit for the correct direction of both arrows as shown below.



Note: Allow credit if arrows extend through the boxes or are drawn outside of the boxes (on the correct plates) as long as they show proper plate motion.

60 [1] Allow 1 credit for a V-shaped or U-shaped line showing the oldest bedrock ages above *A* and *B* and the youngest bedrock age at the East Pacific Ridge.

Examples of 1-credit responses:



Note: Allow credit even if the oldest bedrock ages above *A* and *B* are not the same relative age.

61 [1] Allow 1 credit for Galapagos Hot Spot and Nazca Plate.

62 [1] Allow 1 credit for basalt/basaltic bedrock and a density of 3.0 g/cm^3 *or* 3 g/cm^3.

63 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The smaller particles filled the pore space between the larger particles and decreased the total amount of open pore space.

— Pore spaces between the pebbles were filled by sand, silt or clay.

— Small particles take up spaces between larger particles.

Note: Do *not* allow credit for "it has less pores" or "less pore space" because that is restating the question.

Do *not* allow credit for "particles fit together more closely" or "particles are more closely packed" alone because this is stated in the question.

64 [1] Allow 1 credit for 4 cm/s.

65 [1] Allow 1 credit for pebbles.

Part C

Allow a maximum of 20 credits for this part.

66 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The isobars are closest together.

— Steepest pressure gradient occurs at Watertown.

— The closer the isolines/lines, the faster the wind speed.

67 [1] Allow 1 credit if *all three* weather variables are correct, as shown in the table below.

Albany, New York

Weather Variable	Weather Data	
Dewpoint	36	**°F**
Cloud cover	25	**%**
Actual barometric pressure	1005.1	**mb**

68 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— East/E

— East northeast/ENE

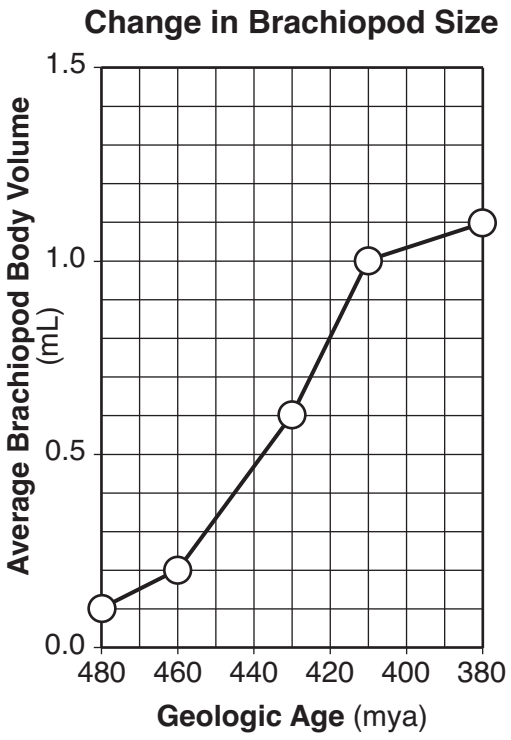
— Northeast/NE

— North northeast/NNE

69 [1] Allow 1 credit if the centers of *all five* plots are within or touch the circles shown and the plots are correctly connected with a line that passes within or touches the circles.

Note: Allow credit if the student-drawn line does *not* pass through the student plots but is still within or touches the circles.

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



70 [1] Allow 1 credit for any *two* of Ordovician Period, Silurian Period, and/or Devonian Period.

Note: Do *not* allow credit for Early, Middle, or Late Ordovician, Early or Late Silurian, or Early, Middle or Late Devonian because these are epochs *not* periods.

71 [1] Allow 1 credit for *Eospirifer* and *Mucrospirifer*.

72 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The fossil record shows that horses have become larger over geologic time.

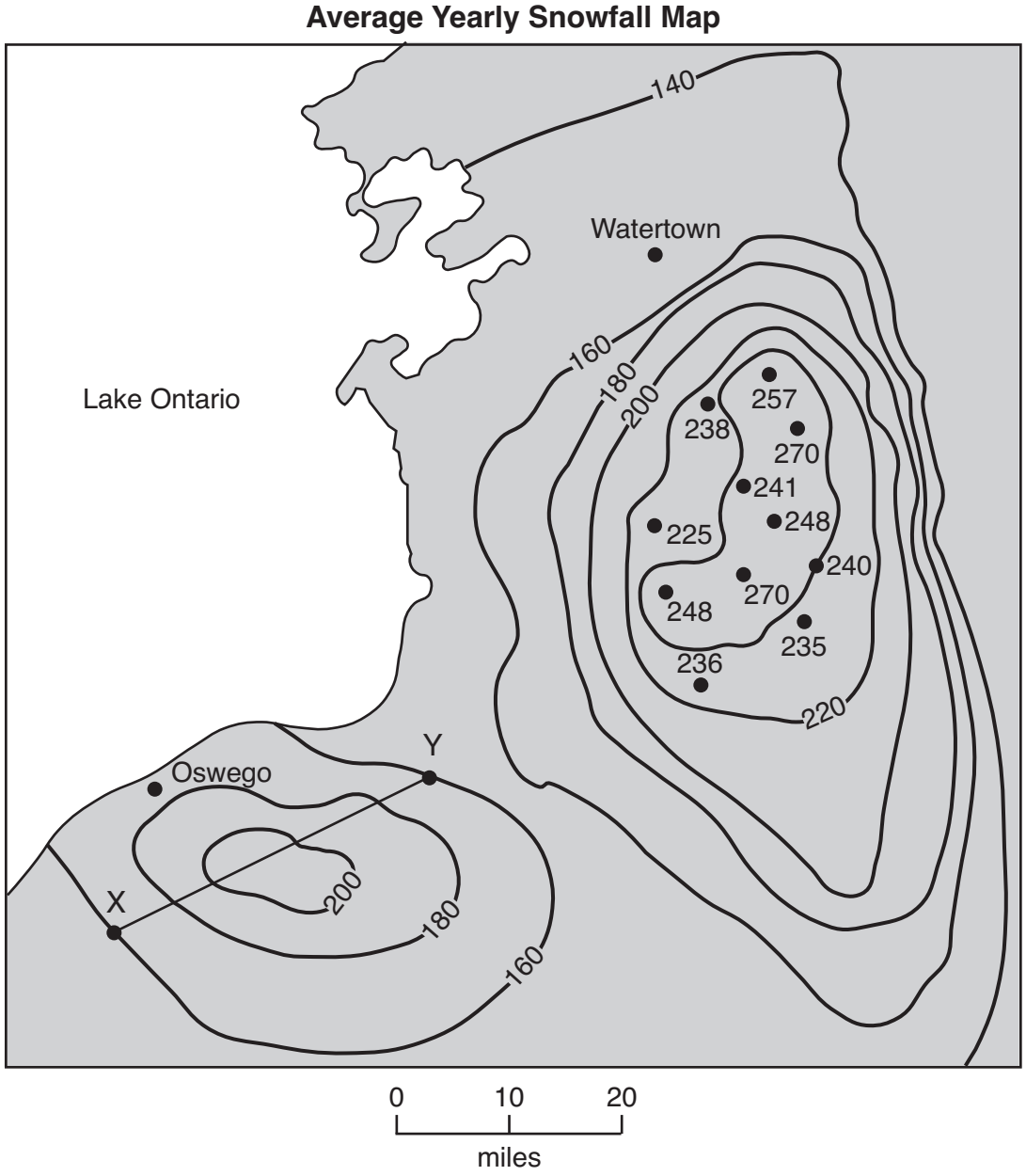
— Large dogs are much smaller than horses of today.

— The average horse of today is a large animal, so horses must have become larger since Eocene time.

73 [1] Allow 1 credit for correctly drawing the 240-inch isoline. The isoline must pass through or touch the 240 dot.

Note: If additional lines are drawn, all must be drawn correctly to receive credit.

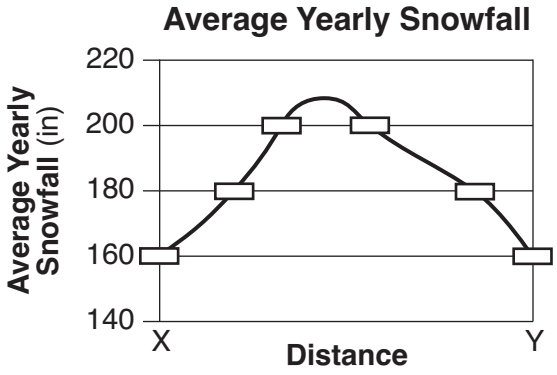
Example of a 1-credit response:



74 [1] Allow 1 credit if the centers of *all six* plots are within or touch the rectangles shown and are correctly connected with a line that passes within or touches each rectangle. The line must extend above the 200-inch line, but remain below the 220-inch line.

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

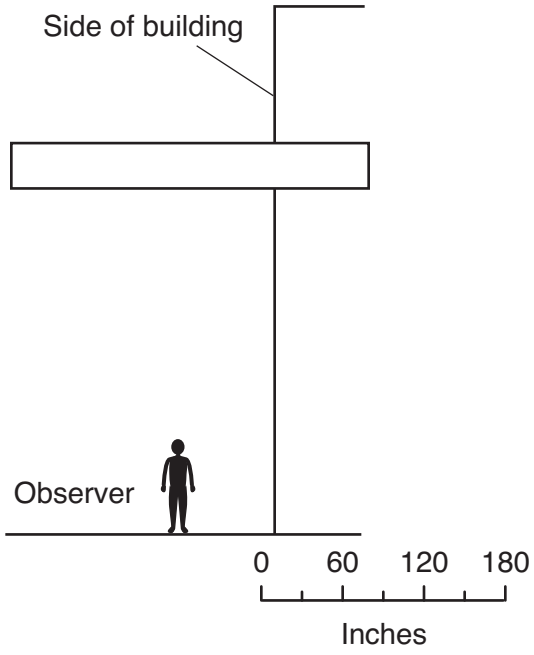
Allow credit if the student-drawn line does *not* pass through the student plots, but is still within or touches the rectangles.



75 [1] Allow 1 credit if the center of the **X** is within or touches the edge of the box shown.

Note: Allow credit if a symbol other than an **X** is used.

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



76 [1] Allow 1 credit for radiation.

77 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— Black is a good absorber of electromagnetic energy/sunlight/insolation.

— Black is a good absorber and a good radiator.

— Dark colors take in radiation better than light colors.

— Black absorbs more energy.

Note: Do *not* allow credit for "black absorbs energy" alone because all colors absorb energy. Black is just a better absorber of that energy.

78 [1] Allow 1 credit for infrared/IR and circling longer.

79 [1] Allow 1 credit for the Milky Way.

80 [1] Allow 1 credit for Mars.

81 [1] Allow 1 credit for Kepler-62b *or* 62b and an acceptable explanation. Acceptable explanations include, but are not limited to:

— Kepler-62b is closest to *Kepler-62*.

— The closer a planet is to a star, the shorter its period of revolution.

— Closer planets orbit faster.

— It has the shortest orbital path.

— Kepler-62b is closest to its sun.

82 [1] Allow 1 credit for Kepler-62e and Kepler-62f, and an acceptable explanation. Acceptable explanations include, but are not limited to:

— Kepler-62e and Kepler-62f are located in the habitable zone.

— Kepler-62e and Kepler-62f are located at a distance from *Kepler-62* to allow water to remain in the liquid phase.

— They have the correct temperature.

— These planets have the correct distance from the star.

Note: Do *not* allow credit for "located farthest from the star" alone, because this does not refer to the habitable zone.

83 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— The sediments are unsorted.

— The sediments are unlayered.

— mixed sediment sizes ranging from boulders to clay

— unorganized arrangement

84 [1] Allow 1 credit for C → B → D → A.

85 [1] Allow 1 credit for Pleistocene Epoch.

Regents Examination in Physical Setting/Earth Science

June 2018

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

The *Chart for Determining the Final Examination Score for the June 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 Thursday, June 14, 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

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

The State Education Department / The University of the State of New York

Regents Examination in Physical Setting/Earth Science – June 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 65 would receive a final examination score of 85.

Total Performance Test Score

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

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

Total Performance Test Score

Total Written Test Score	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
44	71	71	70	70	69	69	68	68	67	66	65	64	63	61	60	58	56
43	70	70	70	69	69	68	67	67	66	65	64	63	62	60	59	57	55
42	69	68	68	67	67	66	66	65	64	63	62	61	60	59	57	55	54
41	68	67	67	67	66	65	65	64	63	62	61	60	59	58	56	55	53
40	67	67	66	66	65	65	64	63	63	62	61	60	58	57	55	54	52
39	66	66	65	65	64	64	63	62	62	61	60	59	57	56	54	53	51
38	65	65	64	64	64	63	62	62	61	60	59	58	57	55	54	52	50
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	61	61	60	60	59	59	58	57	57	56	55	54	52	51	49	48	46
33	59	59	58	58	58	57	56	56	55	54	53	52	51	49	48	46	44
32	58	58	58	57	57	56	56	55	54	53	52	51	50	48	47	45	43
31	58	57	57	56	56	55	55	54	53	52	51	50	49	48	46	44	43
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	54	54	53	53	52	52	51	51	50	49	48	47	46	44	43	41	39
27	52	52	52	51	51	50	50	49	48	47	46	45	44	43	41	39	37
26	52	51	51	50	50	49	49	48	47	46	45	44	43	42	40	38	37
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	19	19	19	18	18	17	16	16	15	14	13	12	11	9	8	6	4
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