

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

**PHYSICAL SETTING
EARTH SCIENCE**

Wednesday, January 29, 2014 — 1:15 to 4:15 p.m., only

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

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

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

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

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

Notice . . .

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

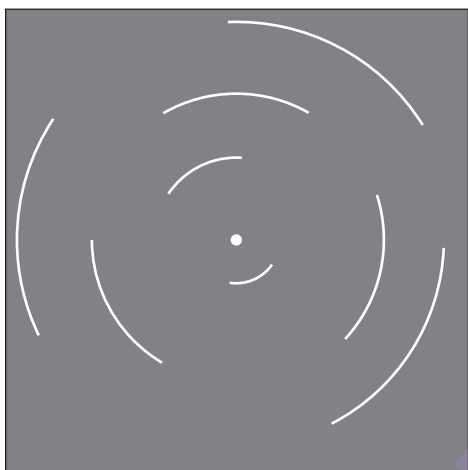
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part.

Directions (1–35): 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 At a location in the Northern Hemisphere, a camera was placed outside at night with the lens pointing straight up. The shutter was left open for four hours, resulting in the star trails shown below.



At which latitude were these star trails observed?

- (1) 1° N (3) 60° N
(2) 30° N (4) 90° N
- 2 Why are some constellations visible to New York State observers at midnight during April, but *not* visible at midnight during October?
- (1) Constellations move within our galaxy.
(2) Constellations have elliptical orbits.
(3) Earth revolves around the Sun.
(4) Earth rotates on its axis.
- 3 A red shift in the light from very distant galaxies suggests that the universe is
- (1) fixed and stationary (3) contracting
(2) moving randomly (4) expanding

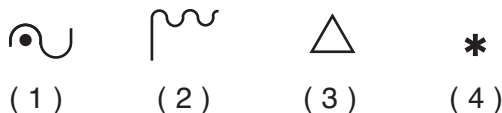
- 4 Which motion causes the Coriolis effect on Earth?

- (1) revolution of Earth around the Sun
(2) revolution of the Moon around Earth
(3) rotation of Earth on its axis
(4) rotation of the Moon on its axis

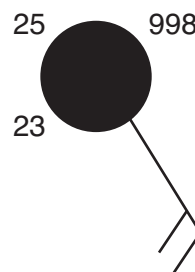
- 5 When water vapor condenses, how much heat energy will be released into the atmosphere?

- (1) 2260 joules/gram (3) 4.18 joules/gram
(2) 334 joules/gram (4) 2.11 joules/gram

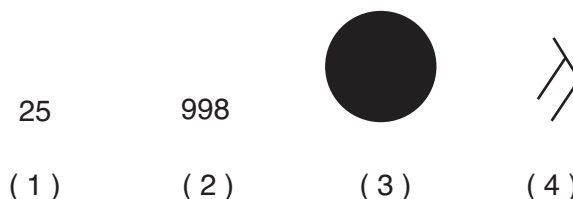
- 6 Liquid water sometimes turns into ice when it comes in contact with Earth's surface. Which present weather symbol on a station model represents this type of precipitation?



- 7 A weather station model is shown below.



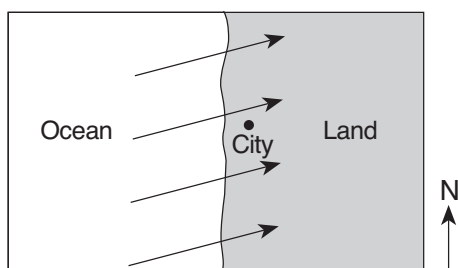
Which information shown on the station model is most closely associated with measurements from an anemometer?



8 A dry-bulb temperature of 30°C and a wet-bulb temperature of 29°C were recorded at a weather station. What are the relative humidity and the most likely weather conditions?

- (1) Relative humidity is 29% with clear skies.
- (2) Relative humidity is 29% with a good chance of snow.
- (3) Relative humidity is 93% with clear skies.
- (4) Relative humidity is 93% with a good chance of rain.

9 The arrows on the map below show the prevailing winds at a midlatitude coastal city.



This city most likely has a climate that is

- (1) arid, with a small difference between the highest and lowest yearly temperatures
- (2) arid, with a large difference between the highest and lowest yearly temperatures
- (3) humid, with a small difference between the highest and lowest yearly temperatures
- (4) humid, with a large difference between the highest and lowest yearly temperatures

10 During an El Niño event, the South Equatorial Current reverses direction and flows over the top of northern portions of the Peru Current, causing

- (1) warmer surface ocean waters along the northeast coast of South America
- (2) warmer surface ocean waters along the northwest coast of South America
- (3) cooler surface ocean waters along the northeast coast of South America
- (4) cooler surface ocean waters along the northwest coast of South America

11 An air mass entering Alaska from the northern Pacific Ocean would most likely be labeled on a weather map as

- (1) cP (3) mP
- (2) cT (4) mT

12 Most tornadoes in the Northern Hemisphere are best described as violently rotating columns of air surrounded by

- (1) clockwise surface winds moving toward the columns
- (2) clockwise surface winds moving away from the columns
- (3) counterclockwise surface winds moving toward the columns
- (4) counterclockwise surface winds moving away from the columns

13 The major source of oxygen in Earth's Early Proterozoic atmosphere is inferred to have been produced by

- (1) oceanic cyanobacteria
- (2) outgassing from volcanic eruptions
- (3) radioactive decay in Earth's inner core
- (4) evaporation of ocean water

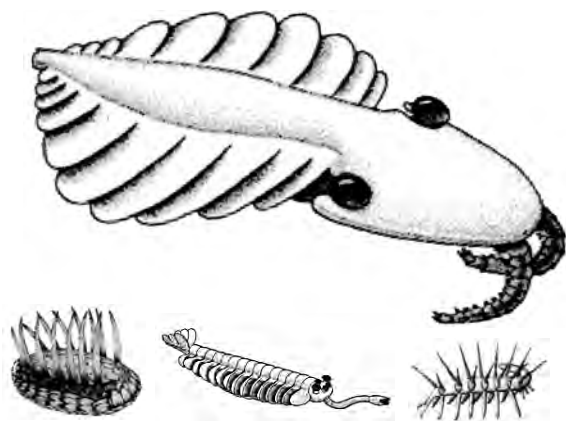
14 Earth has sedimentary bedrock of marine origin that is four billion years old. Which inference can be made from this information?

- (1) Earth had oceans four billion years ago.
- (2) Sedimentary rocks formed from magma when Earth cooled four billion years ago.
- (3) Most sedimentary rocks are at least four billion years old.
- (4) Life existed on Earth four billion years ago.

15 *Valcouroceras* is a New York State index fossil. Which mountain-building event occurred in New York State during the time when *Valcouroceras* was living in oceans covering parts of New York State?

- (1) Alleghenian orogeny (3) Taconian orogeny
- (2) Acadian orogeny (4) Grenville orogeny

- 16 The diagram below represents some fauna (animals) found fossilized in Canada's Burgess shale.



(Not drawn to scale)

During which geologic epoch did these animals live?

- (1) Middle Cambrian (3) Late Triassic
(2) Early Pennsylvanian (4) Paleocene
- 17 A group hiking in the Catskill region of New York State finds several large boulders composed of metamorphic rock. These boulders most likely resulted from the weathering of bedrock formed in the
- (1) Catskills, and were transported to their present location by mass movement
(2) Catskills, and were transported to their present location by glaciers
(3) Adirondack Mountains, and were transported to their present location by mass movement
(4) Adirondack Mountains, and were transported to their present location by glaciers
- 18 The formation of the Canary Islands was primarily caused by their location near a
- (1) subduction zone (3) divergent boundary
(2) mantle hot spot (4) transform fault
- 19 A *P*-wave takes 5 minutes to travel from the epicenter of an earthquake to a seismic station. Approximately how many minutes will it take an *S*-wave to travel that same distance?
- (1) 15 min (3) 9 min
(2) 12 min (4) 4 min
- 20 Which two Earth layers are separated by the Moho boundary?
- (1) rigid mantle and plastic mantle
(2) outer core and stiffer mantle
(3) stiffer mantle and asthenosphere
(4) crust and rigid mantle
- 21 During a rainstorm, when soil becomes saturated, the amount of infiltration
- (1) decreases and runoff decreases
(2) decreases and runoff increases
(3) increases and runoff decreases
(4) increases and runoff increases
- 22 Sediment is deposited as a river enters a lake because the
- (1) velocity of the river decreases
(2) force of gravity decreases
(3) volume of water increases
(4) slope of the river increases
- 23 Stream drainage patterns that develop in a landscape region are controlled mostly by
- (1) bedrock structure
(2) precipitation amounts
(3) nearness to a large body of water
(4) air temperature variations
- 24 The most abundant metallic element by mass in Earth's crust makes up 8.23% of the crust. Which group of minerals all normally contain this metallic element in their compositions?
- (1) garnet, calcite, pyrite, and galena
(2) biotite mica, muscovite mica, fluorite, and halite
(3) talc, quartz, graphite, and olivine
(4) plagioclase feldspar, amphibole, pyroxene, and potassium feldspar

25 Which sequence of events affecting moist air within Earth's atmosphere causes cloud formation?

- (1) rising → expanding → cooling → condensation
- (2) rising → contracting → warming → evaporation
- (3) sinking → expanding → warming → condensation
- (4) sinking → contracting → cooling → evaporation

26 In which environment is the amount of transpiration usually the greatest?



(1)



(3)

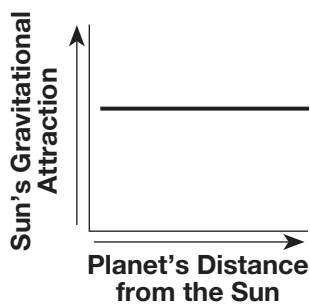


(2)

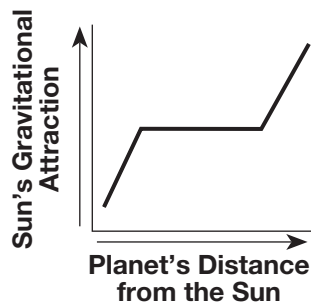


(4)

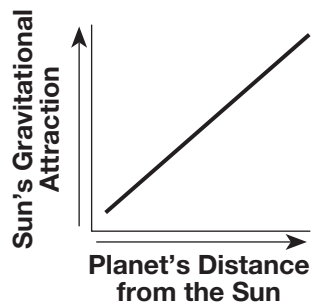
27 Which graph best shows the general relationship between a planet's distance from the Sun and the Sun's gravitational attraction to the planet?



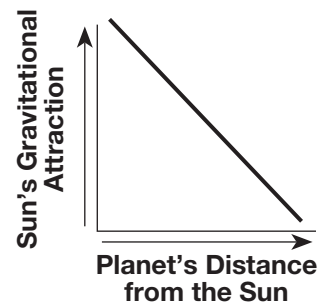
(1)



(2)

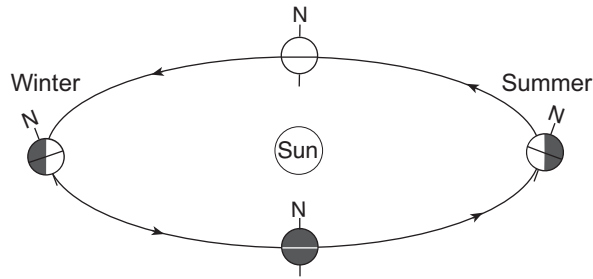


(3)

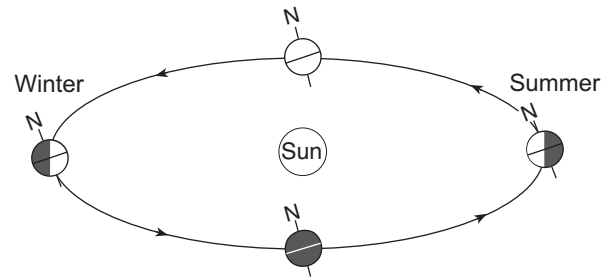


(4)

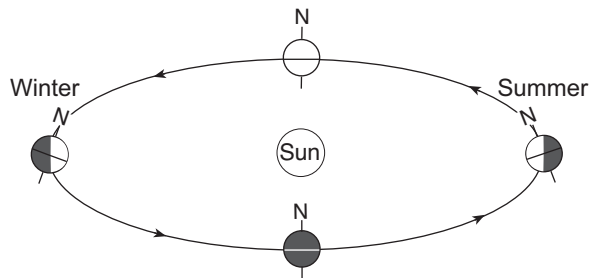
28 Which diagram best represents the tilt of Earth's axis that causes the Northern Hemisphere seasons shown?
(Diagrams are not drawn to scale.)



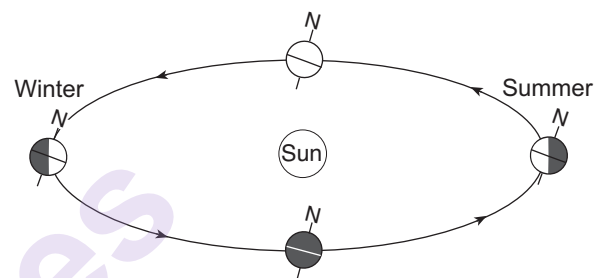
(1)



(3)

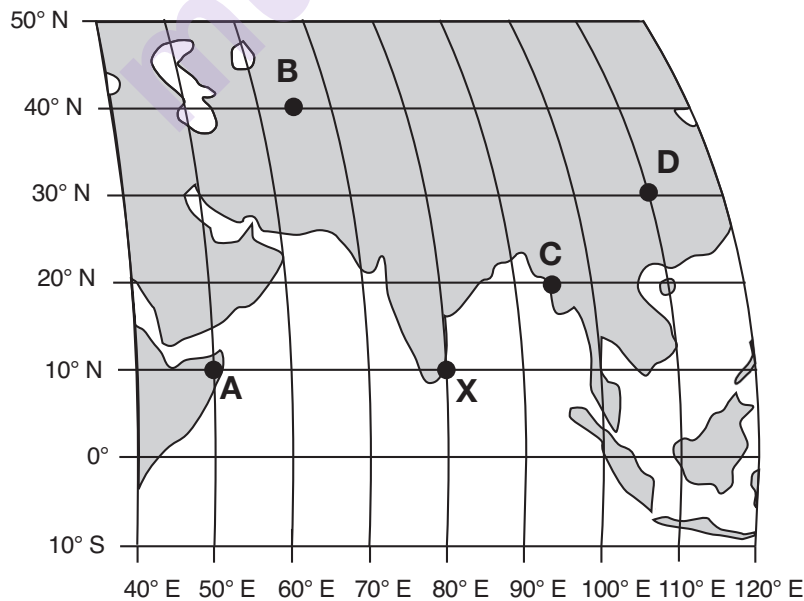


(2)



(4)

29 The map below shows a portion of Earth's system of latitude and longitude and five surface locations labeled A, B, C, D, and X.

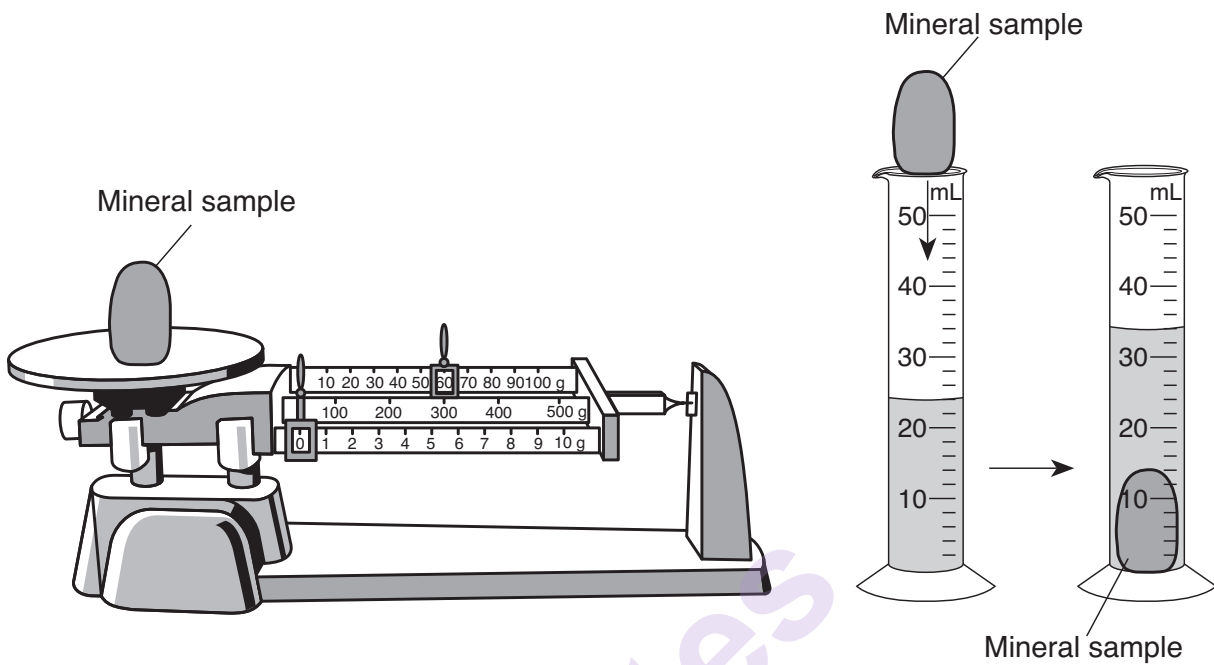


It is solar noon at location X. At which location will solar noon next occur?

- (1) A
- (2) B

- (3) C
- (4) D

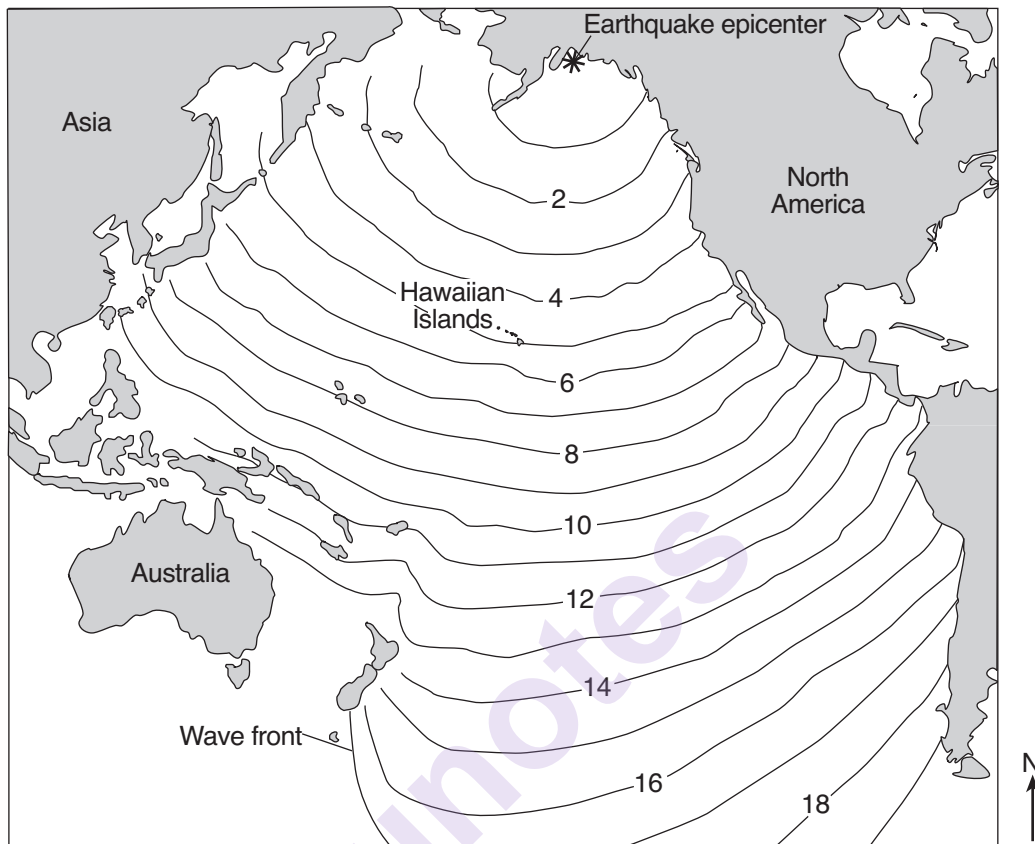
30 The diagram below represents the mass and volume of a mineral sample being measured. These measurements were used to determine the density of the mineral sample.



What is the density of this mineral sample?

- (1) 6 g/mL
- (2) 24 g/mL
- (3) 34 g/mL
- (4) 60 g/mL

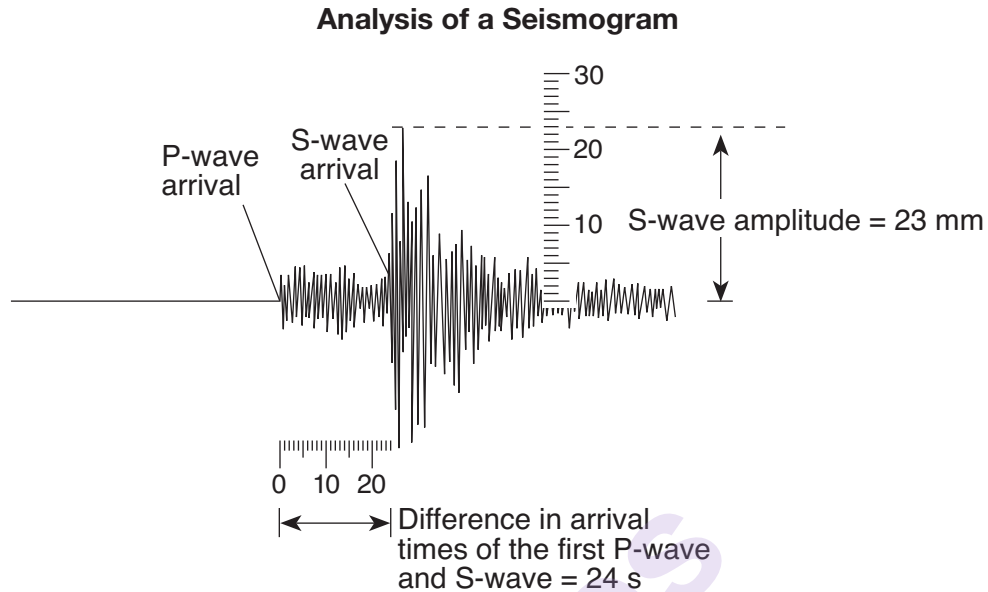
- 31 The map below shows changes in the position of the tsunami wave front produced by the 1964 Alaskan earthquake. The numbers indicate the time, in hours, for the wave front to reach the positions indicated by the isolines.



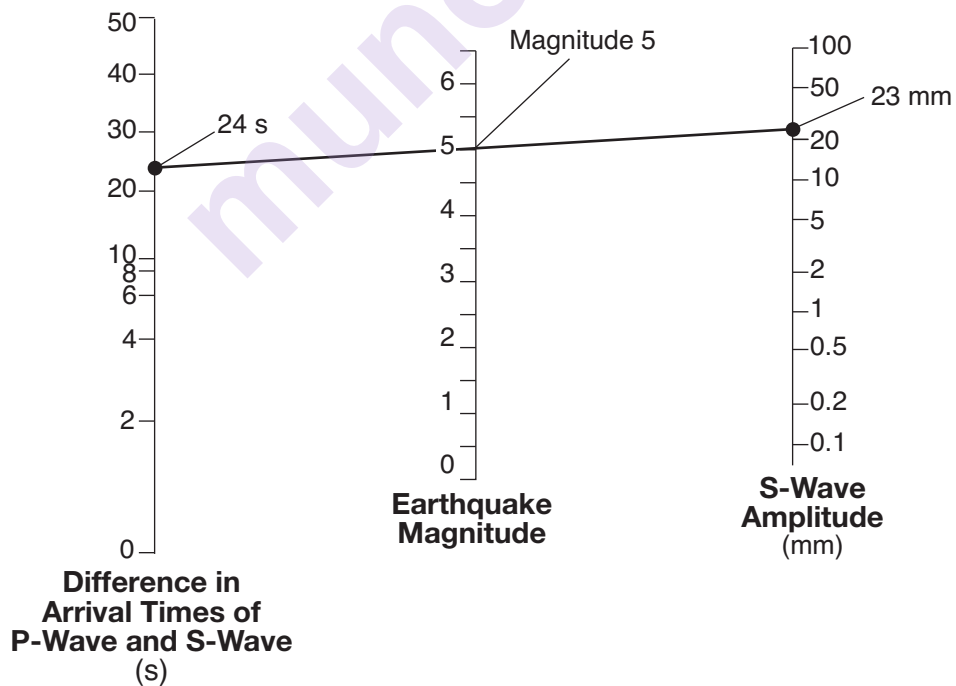
If the wave front reached the Hawaiian Islands at 10:30 p.m., at approximately what time did the earthquake occur?

- | | |
|---------------|---------------|
| (1) 1:30 p.m. | (3) 3:30 a.m. |
| (2) 5:30 p.m. | (4) 4:30 a.m. |

- 32 The diagram below represents the analysis of a seismogram used to calculate an earthquake's magnitude on the Richter Scale. This seismogram shows the difference in arrival times, in seconds, of the first *P*-wave and *S*-wave and the amplitude of the *S*-wave in millimeters.



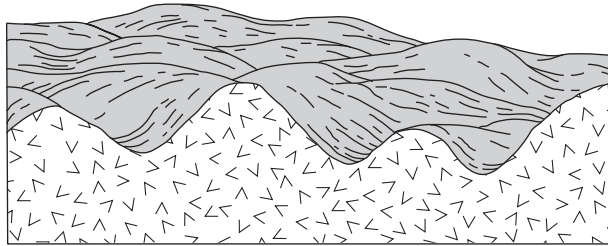
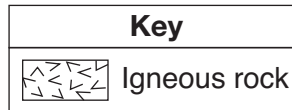
The diagram below represents how the earthquake's magnitude is determined by drawing a line connecting the difference in arrival times of the *P*-wave and the *S*-wave, and the *S*-wave amplitude.



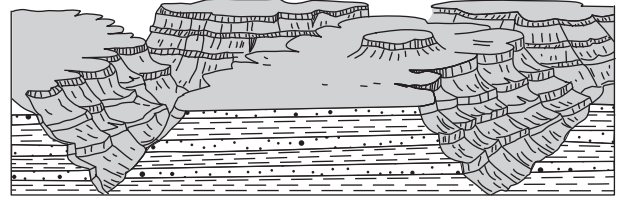
What is the magnitude of a recorded earthquake if the difference in arrival times of the first *P*-wave and *S*-wave is 2 seconds and the *S*-wave amplitude is 20 millimeters?

- (1) 3.8 (3) 3.0
(2) 2.0 (4) 4.8

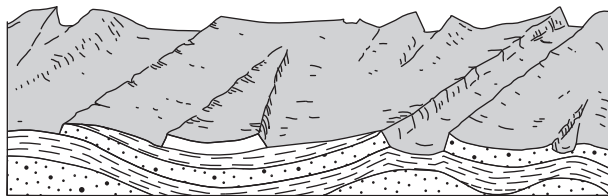
33 Which cross section best represents a plateau landscape region?



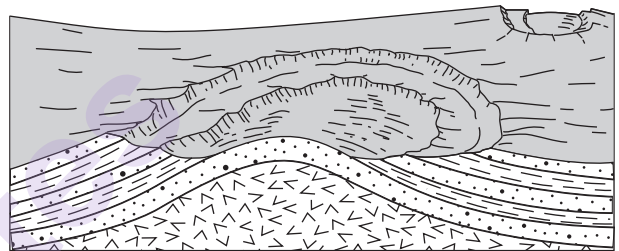
(1)



(3)

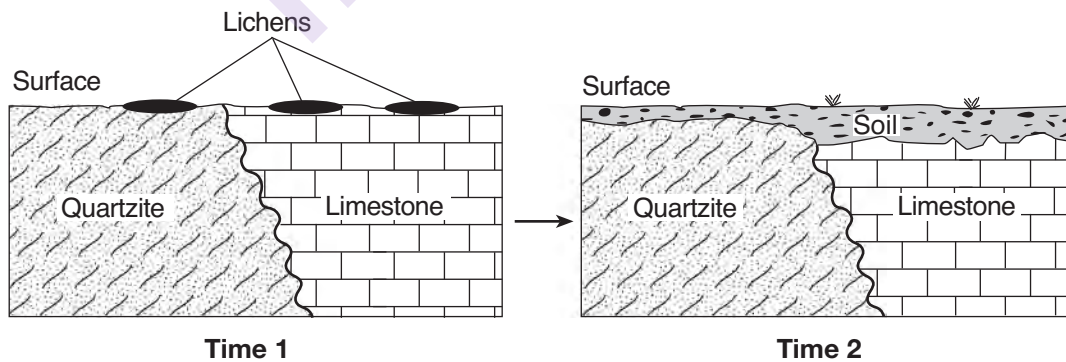


(2)



(4)

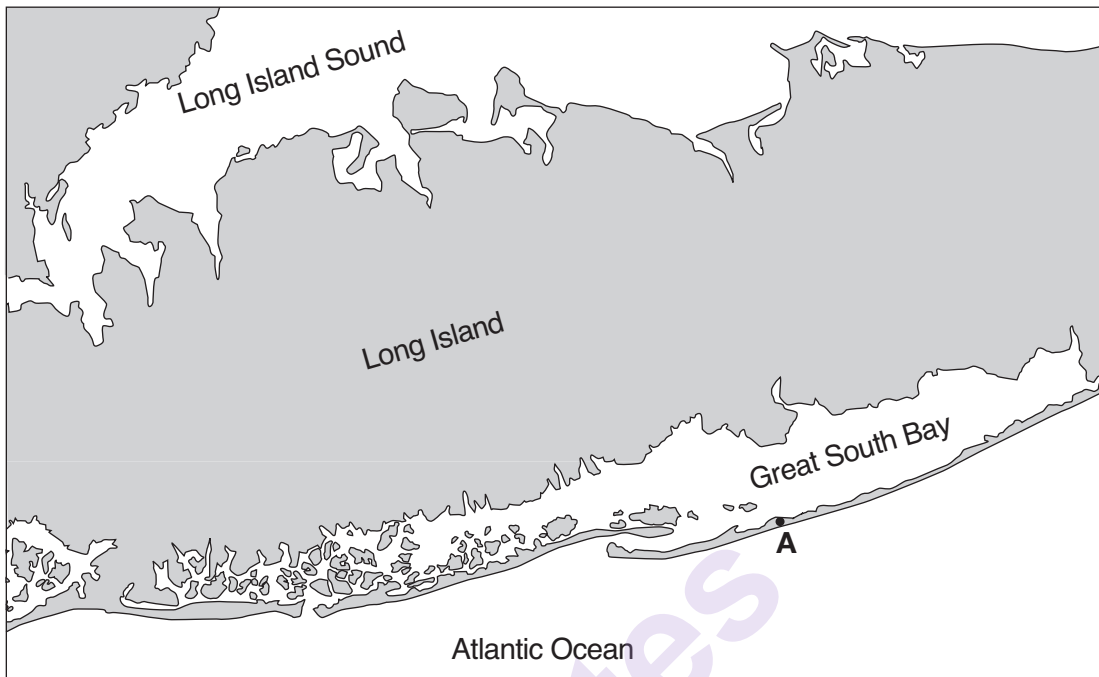
34 Lichens are usually the first organisms that appear in barren, rocky areas. They use rootlike structures to split bedrock into small fragments. Lichens also secrete acidic solutions that help break down rock. The cross sections below represent an area when lichens first appeared (time 1) and that same area hundreds of years later, after it was changed by lichens and exposed to air and water (time 2).



The soil shown in time 2 was formed mainly by

- (1) compaction and cementing
- (2) weathering and biological activity
- (3) faulting and tilting of rock strata
- (4) mass movement and deposition of particles

- 35 The map below shows coastal features of a portion of Long Island, New York. Point A represents a location on a landscape feature that resulted from wave action and longshore currents.



On which landscape feature is point A located?

- (1) moraine
- (2) delta
- (3) barrier island
- (4) floodplain

Part B–1

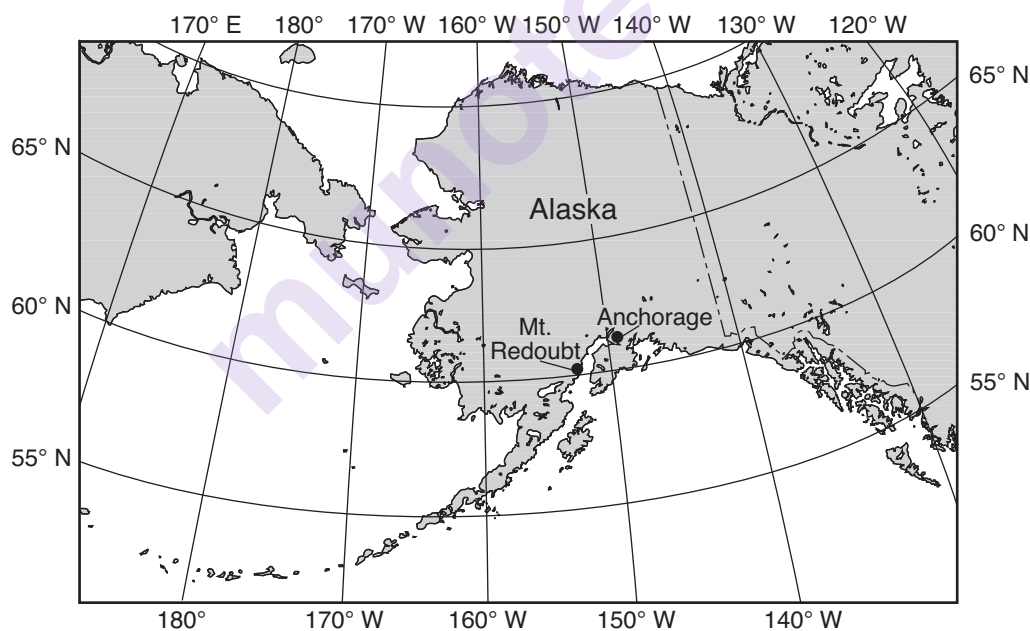
Answer all questions in this part.

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

Base your answers to questions 36 through 38 on the passage and map below and on your knowledge of Earth science. The map shows the locations of the Mt. Redoubt volcano and Anchorage, Alaska.

Mt. Redoubt Volcano

In Anchorage, Alaska, scientists are monitoring sensors located on nearby Mt. Redoubt. The sensors measure seismic activity at the top of the volcano. No one lives near the volcano itself, so there is no danger to humans from lava flows, but ash can be dangerous when breathed in, and can damage airplanes and automobiles if the ash is drawn into their engines. When Mt. Redoubt erupted in 1989, a huge ash cloud reached an approximate height of 7.6 miles above sea level, and spread ash across Alaska for five months. The ash was composed largely of silica, which cooled rapidly as the ash rose into the atmosphere. In March 2009, Mt. Redoubt erupted again.



36 Mt. Redoubt's seismic activity is due to the interaction of which two tectonic plates?

- | | |
|---|--|
| (1) Pacific Plate and Eurasian Plate | (3) North American Plate and Pacific Plate |
| (2) Eurasian Plate and North American Plate | (4) Philippine Plate and Eurasian Plate |

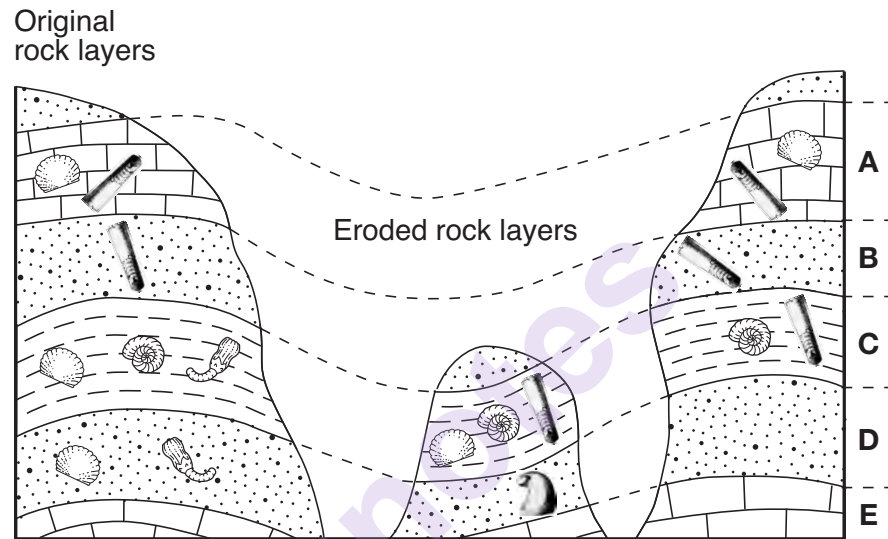
37 The height of the ash cloud from the 1989 eruption reached an altitude in Earth's atmosphere located

- (1) between sea level and the lower troposphere
- (2) between the troposphere and the stratosphere
- (3) in the middle of the stratosphere
- (4) in the middle of the mesosphere

38 How did the huge ash cloud that covered Alaska in 1989 affect the amount of insolation reaching Earth's surface and the air temperatures near Earth's surface?

- (1) Insolation decreased and temperatures increased.
 - (2) Insolation increased and temperatures decreased.
 - (3) Both insolation and temperatures increased.
 - (4) Both insolation and temperatures decreased.
-

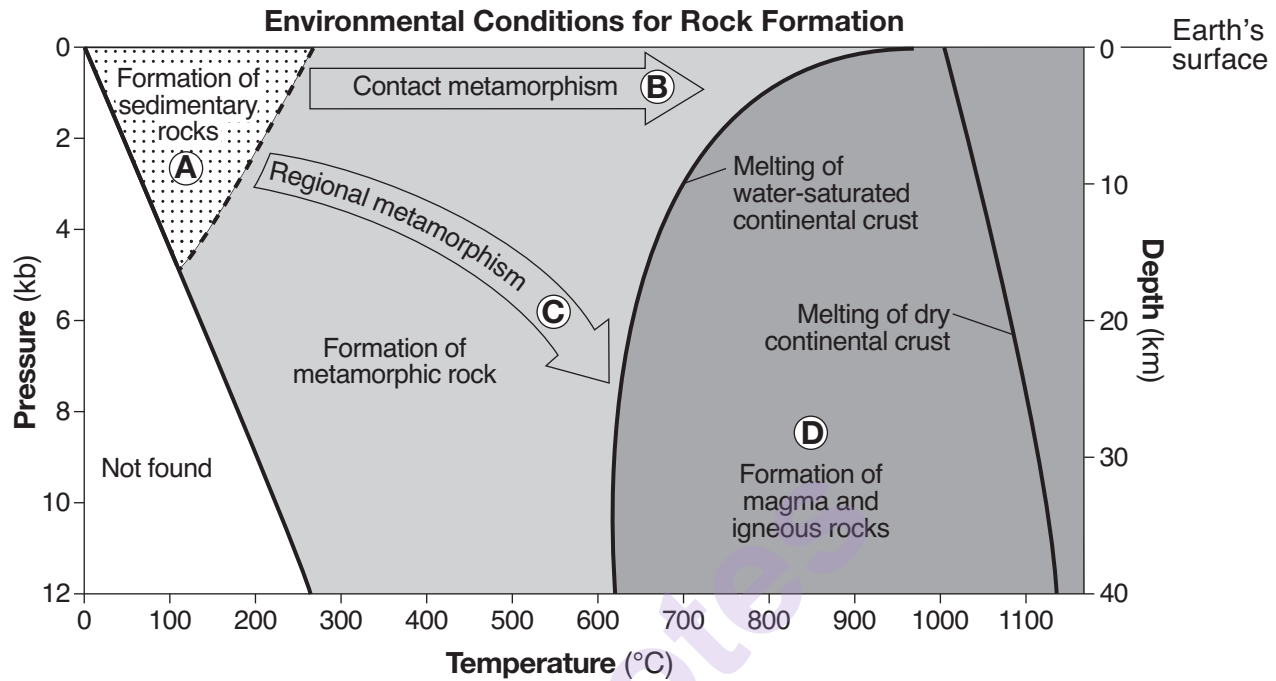
39 The diagram below represents three bedrock outcrops. The layers have *not* been overturned. Letters A through E identify different rock layers. Fossils found in the rock layers are shown.



Which fossil could be classified as an index fossil?

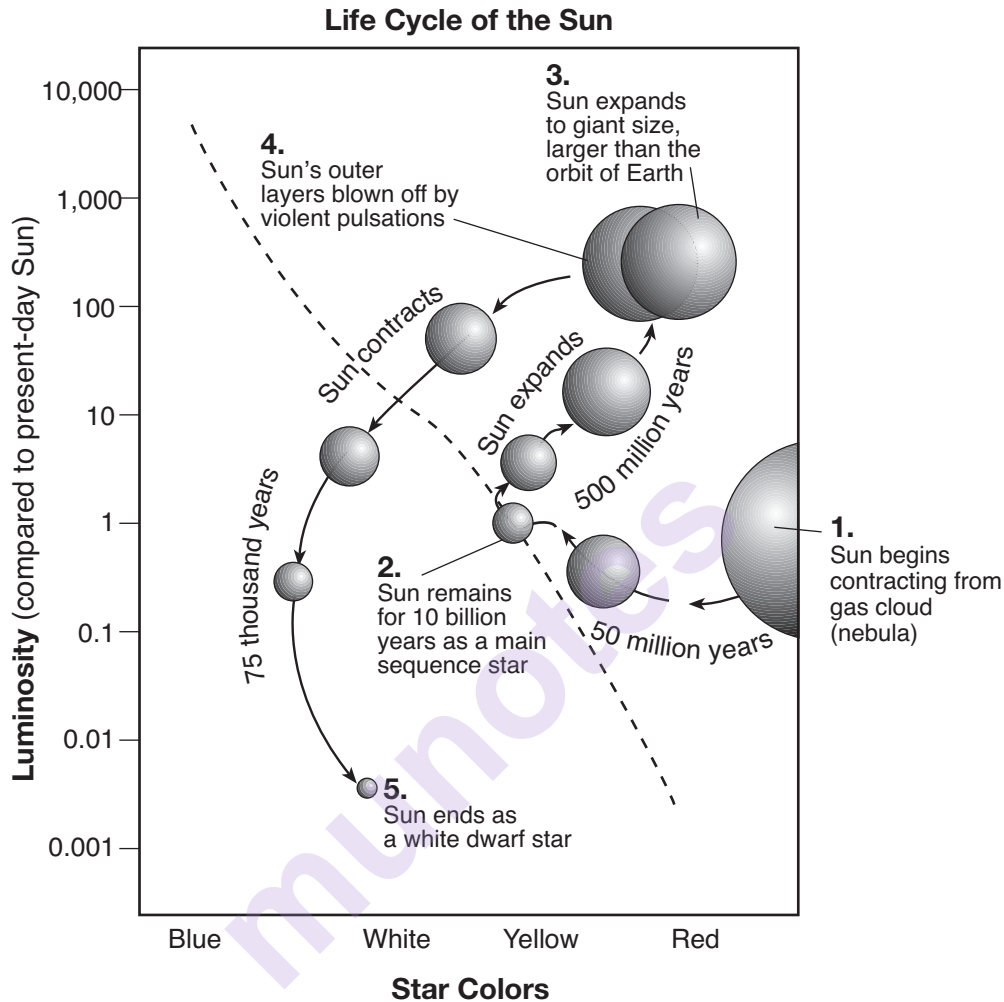
- (1) 
- (2) 
- (3) 
- (4) 

Base your answers to questions 40 through 42 on the graph below and on your knowledge of Earth science. The graph shows the temperature, pressure, and depth environments for the formation of the three major rock types. Pressure is shown in kilobars (kb). Letters A through D identify different environmental conditions for rock formation.



- 40 Which rock is most likely to form directly from rock material at a depth of 30 km and a temperature of 1000°C?
- | | |
|---------------|-------------|
| (1) quartzite | (3) shale |
| (2) scoria | (4) granite |
- 41 Which letter represents the environmental conditions necessary to form gneiss?
- | | |
|-------|-------|
| (1) A | (3) C |
| (2) B | (4) D |
- 42 At what pressure and temperature is sand most likely to be compacted into sandstone?
- | | |
|--------------------|---------------------|
| (1) 2 kb and 150°C | (3) 10 kb and 400°C |
| (2) 6 kb and 200°C | (4) 12 kb and 900°C |

Base your answers to questions 43 through 45 on the diagram below and on your knowledge of Earth science. The diagram represents the inferred changes to the luminosity and color of the Sun throughout its life cycle. The diagonal dashed line represents the main sequence stars. The numbers 1 through 5 represent stages in the life cycle of the Sun.



43 The Sun is inferred to spend the greatest amount of time in its life cycle

- (1) contracting from a gas cloud (nebula)
- (2) as a main sequence star
- (3) moving away from the main sequence and becoming a giant star
- (4) changing from a giant star to a white dwarf star

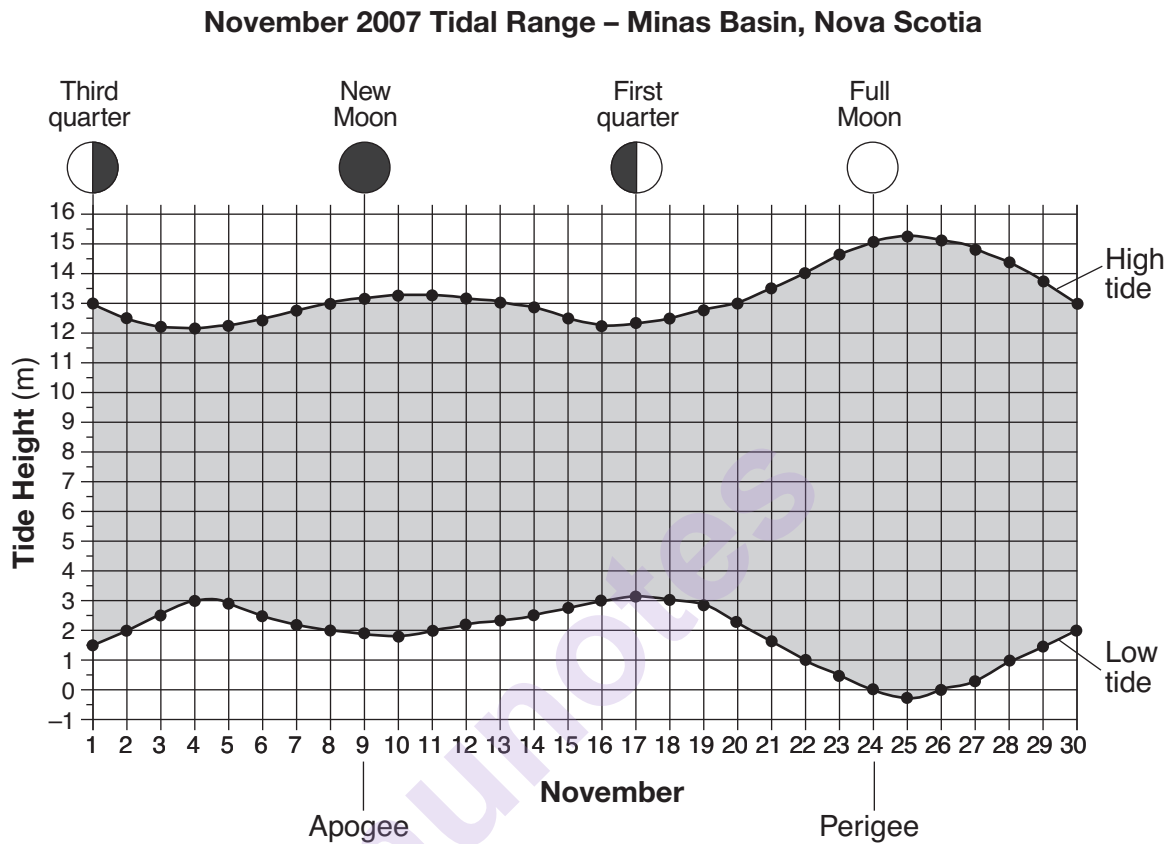
44 The Sun is inferred to be the most luminous when it is classified as a

- (1) white dwarf star
- (2) gas cloud (nebula)
- (3) main sequence star
- (4) giant star

45 For other stars in our galaxy that go through a similar life cycle to our Sun, which star is currently in the late stage of its life cycle?

- (1) *Alpha Centauri*
- (2) *Procyon B*
- (3) *Barnard's Star*
- (4) *Polaris*

Base your answers to questions 46 through 48 on the graph below and on your knowledge of Earth science. The graph shows the tidal range (the difference between the highest tide and the lowest tide) recorded in Minas Basin, Nova Scotia, during November 2007. The phase of the Moon on selected days is shown above the graph. The dates that the Moon was farthest from Earth (apogee) and closest to Earth (perigee) are indicated under the graph.



46 The tidal range on November 8 was approximately

- | | |
|----------|----------|
| (1) 11 m | (3) 13 m |
| (2) 2 m | (4) 15 m |

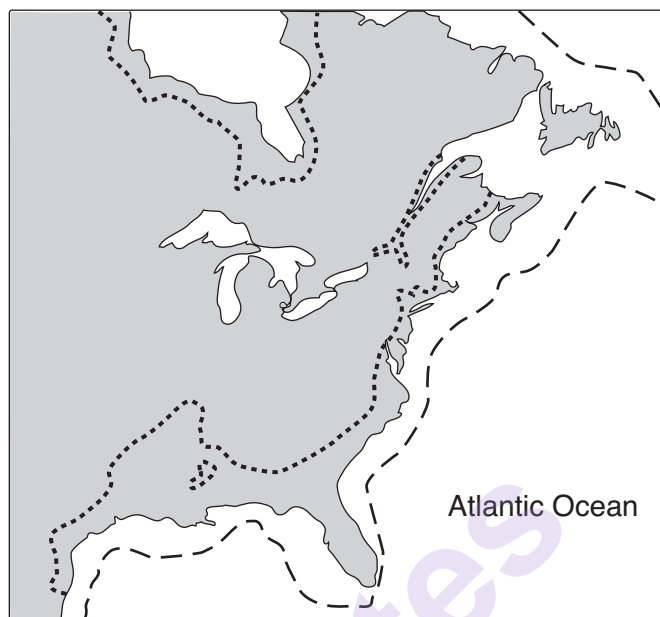
47 The highest high tides and the lowest low tides occurred when the Moon was near

- | | |
|----------------------------------|-----------------------------------|
| (1) apogee and a new-Moon phase | (3) perigee and a new-Moon phase |
| (2) apogee and a full-Moon phase | (4) perigee and a full-Moon phase |

48 The next first-quarter Moon after November 17 occurred closest to

- | | |
|-----------------|-----------------|
| (1) December 9 | (3) December 17 |
| (2) December 14 | (4) December 24 |

Base your answers to questions 49 and 50 on the map below and on your knowledge of Earth science. The map shows part of the North American coastline. The present coastline is shown as a solid line. The symbols on the key below indicate the inferred coastline 18,000 years ago and an inferred future coastline if global warming continues.



Key	
— — — —	Coastline 18,000 years ago
.....	Future coastline if global warming continues

49 Which statement best explains why 18,000 years ago the coastline was at a different location than it is today?

- (1) The climate of Earth was extremely hot and dry.
- (2) A large amount of Earth's water was stored in large continental ice sheets.
- (3) The east coast of North America was being subducted under the Eurasian Plate.
- (4) North America had just separated from Africa, and the Atlantic Ocean was forming.

50 The inferred position of the future coastline is based on the assumption that the

- (1) total amount of global precipitation will decrease
 - (2) thickness of the ozone layer will decrease
 - (3) concentration of carbon dioxide in Earth's atmosphere will increase
 - (4) rate of uplift of the North American continent will increase
-

Part B–2

Answer all questions in this part.

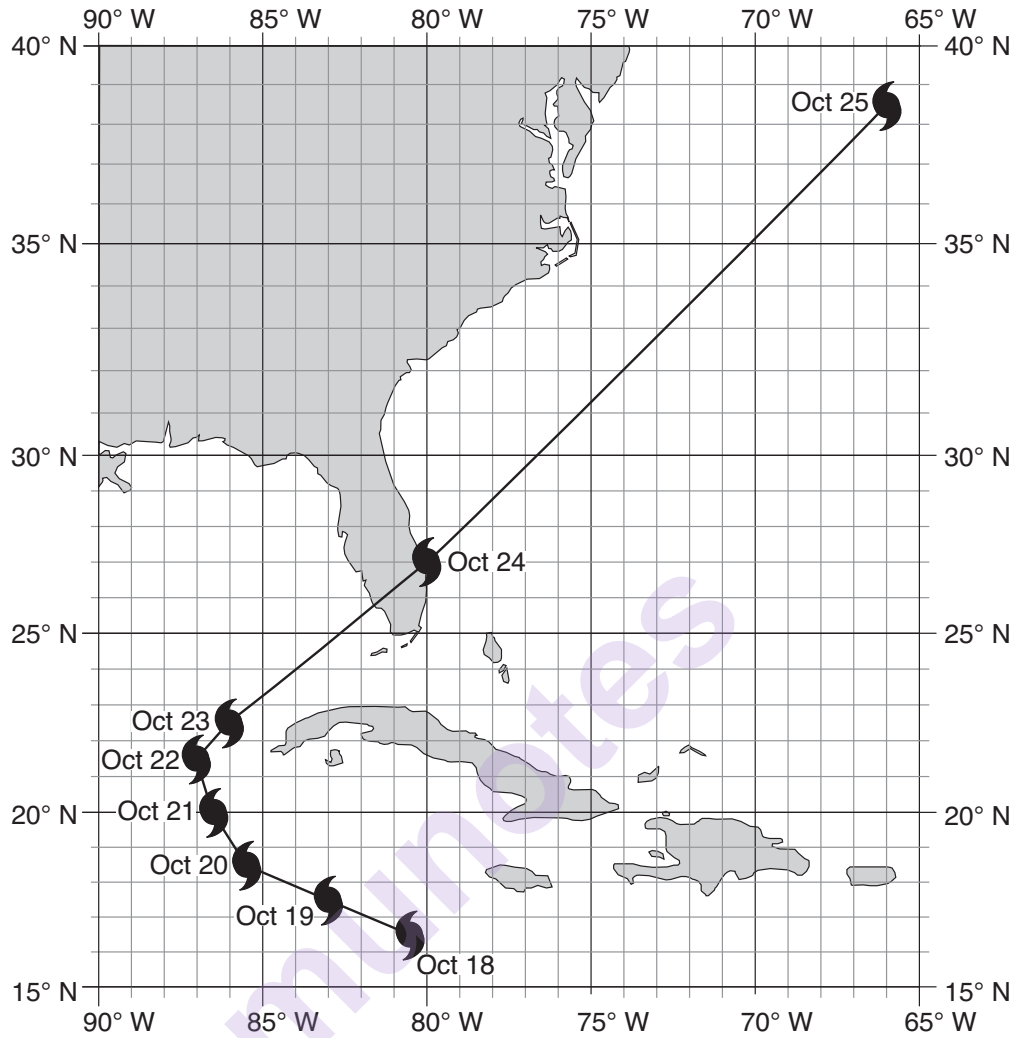
Directions (51–65): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Earth Science*.

Base your answers to questions 51 through 53 on the data table below, the map on the following page, and on your knowledge of Earth science. The data table shows the air pressure in the eye (center) and the maximum sustained wind speed around the eye of Hurricane Wilma from October 18 through October 25, 2005. The data were collected at the same time each day. The map shows the geographic locations of the eye of Hurricane Wilma from October 18 to October 25.

Data of Hurricane Wilma

Date	Air Pressure (mb)	Wind Speed (mph)
Oct. 18	977	75
Oct. 19	882	173
Oct. 20	915	144
Oct. 21	930	143
Oct. 22	946	115
Oct. 23	961	98
Oct. 24	956	104
Oct. 25	970	103

Locations of the Eye of Hurricane Wilma



- 51 Identify the latitude and longitude of the eye of Hurricane Wilma on October 24. Label your answer with the correct units and directions. [1]
- 52 State the compass direction in which Hurricane Wilma moved from October 22 through October 25. [1]
- 53 On the graph *in your answer booklet*, draw a line to indicate the general relationship between air pressure in the eye of the hurricane and the wind speed around the eye of this hurricane. [1]
-

Base your answers to questions 54 and 55 on the data table and information below and on your knowledge of Earth science. The data table shows the radioactive decay of carbon-14 and the age of fossil remains, in years (y). Part of the table has been left blank.

Data Table

Number of Half-Lives	Remaining Carbon-14 (%)	Age of Fossil Remains (y)
0	100	0
1	50	5,700
2	25	11,400
3	12.5	
4	6.25	
5	3.125	

54 Identify the decay product when carbon-14 undergoes radioactive disintegration. [1]

55 The carbon-14 in the fossil remains of a mastodont has undergone five half-lives of radioactive decay. Calculate the age of these fossil remains. [1]

Base your answers to questions 56 through 60 on the geologic cross section of Earth's crust in your answer booklet and on your knowledge of Earth science. Letters A through F identify rock units. Letter X identifies a fault. Wavy line YZ represents an unconformity. The locations of contact metamorphism and the map symbols for sedimentary rock layers B and E have been omitted.

56 On the cross section *in your answer booklet*, draw *two* arrows, one on each side of fault X, to show the relative direction of movement of the rock units that occurred during faulting. [1]

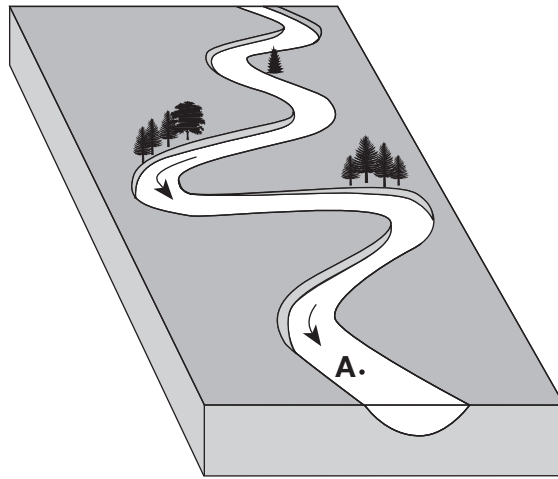
57 Layer B is composed of clay-sized particles and layer E is composed of halite crystals. On the cross section *in your answer booklet*, fill in layer B and layer E on *both* sides of the fault with the correct sedimentary rock map symbols. [1]

58 On the cross section *in your answer booklet*, draw the contact metamorphism symbol to indicate all locations where contact metamorphism has occurred. [1]

59 Indicate the relative ages of geologic features B, E, F, and X, by listing the letters from oldest to most recent. [1]

60 Identify *two* processes that produced the unconformity. [1]

Base your answers to questions 61 through 63 on the block diagram below and on your knowledge of Earth science. The diagram represents a meandering stream. Point A represents a location within the meandering stream. Arrows represent the direction of stream flow.



- 61 Identify the name of the largest sediment particles that can be transported at point A when the stream's velocity is 100 cm/s. [1]
- 62 Describe the relative changes in the stream velocity and the rate of erosion that will occur after 2 days of heavy rainfall. [1]
- 63 Explain why rock particles transported by the stream often become more rounded. [1]
-

Base your answers to questions 64 and 65 on the block diagram in your answer booklet and on your knowledge of Earth science. The diagram represents the pattern of normal and reversed magnetic polarity of the seafloor bedrock on the east side of a mid-ocean ridge center. The magnetic polarity of the bedrock on the west side of the ridge has been omitted. Arrows represent the direction of seafloor movement on either side of the ridge.

- 64 Complete the diagram *in your answer booklet* by shading the pattern of normal polarity on the west side of the ridge center. Assume the rate of plate movement was constant on both sides of the ridge center. Your answer must show the correct width and placement of *each* normal polarity section. [1]
- 65 Describe the general relationship between the distance from the ridge center and the age of the seafloor bedrock. [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 71 on the topographic map in your answer booklet and on your knowledge of Earth science. Dashed lines separate the map into sections I, II, III, and IV. Letters A through E represent locations on Earth's surface. The points in section I represent elevations in feet.

- 66 On the map *in your answer booklet*, complete the 600-ft, 700-ft, and 800-ft contour lines in section I. Extend the lines to the edge of the map. [1]
- 67 On the map *in your answer booklet*, draw a line showing the most likely path of a second creek that begins at location E and flows into Spruce Creek. [1]
- 68 Describe how the topography within section II is different from the topography within section IV. [1]
- 69 What is a possible elevation of location E? [1]
- 70 Calculate the gradient between locations A and B. [1]
- 71 On the grid *in your answer booklet*, construct a topographic profile along line CD by plotting the elevation of *each* contour line that crosses line CD. Connect *all* the plots with a line to complete the profile. [1]
-

Base your answers to questions 72 through 74 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram is a model of the sky (celestial sphere) for an observer at 50° N latitude. The Sun's apparent path on June 21 is shown. Point A is a position along the Sun's apparent path. Angular distances above the horizon are indicated.

- 72 On the celestial sphere diagram *in your answer booklet*, place an **X** on the Sun's apparent path on June 21 to show the Sun's position when the observer's shadow would be the longest. [1]
- 73 The Sun travels 45° in its apparent path between the noon position and point A. Identify the time when the Sun is at point A. Include a.m. or p.m. with your answer. [1]
- 74 Describe the general relationship between the length of the Sun's apparent path and the duration of daylight. [1]
-

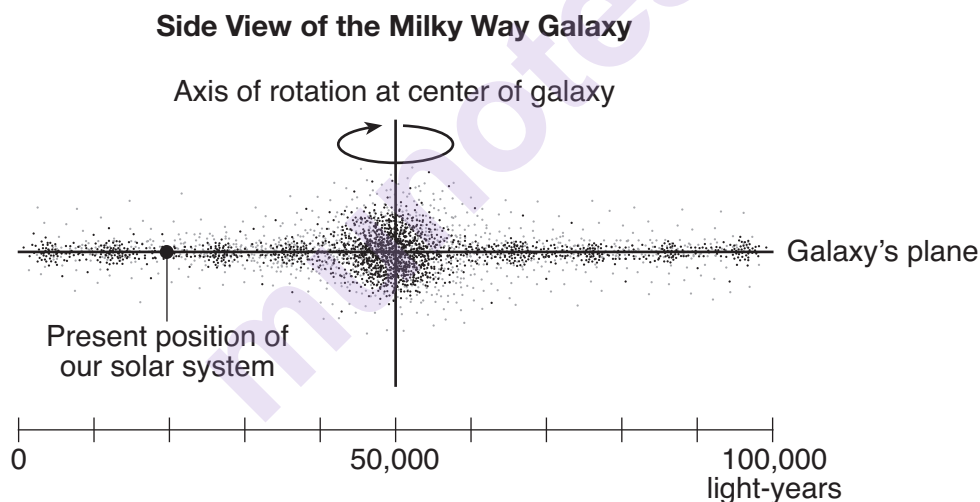
Base your answers to questions 75 through 77 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram represents the orbits of Earth, Venus, and Mercury. Earth, Venus, and Mercury are shown with a dot on each of their orbital paths. The numbers on each orbital path indicate the planet's positions on successive days in its revolution. Point *M* is a position on Earth's orbit. Each season in the Northern Hemisphere on Earth is labeled.

75 On the diagram *in your answer booklet*, place an **X** on each planet's orbital path to show the positions of Earth, Venus, and Mercury on the 55th day of *each* planet's orbit. [1]

76 Approximately how many revolutions does Mercury make around the Sun during one Earth year? [1]

77 What latitude on Earth receives the vertical rays from the Sun when Earth is at position *M*? [1]

Base your answers to questions 78 through 80 on the diagram below and on your knowledge of Earth science. The diagram represents the present position of our solar system in a side view of the Milky Way Galaxy. The distance across the Milky Way Galaxy is measured in light-years.



78 What is the distance, in light-years, from the center of the Milky Way Galaxy to our solar system? [1]

79 Galaxies are classified based on their shape. What is the shape of the Milky Way Galaxy when viewed from directly above? [1]

80 List the following astronomical features, in order of relative size, from smallest to largest. [1]

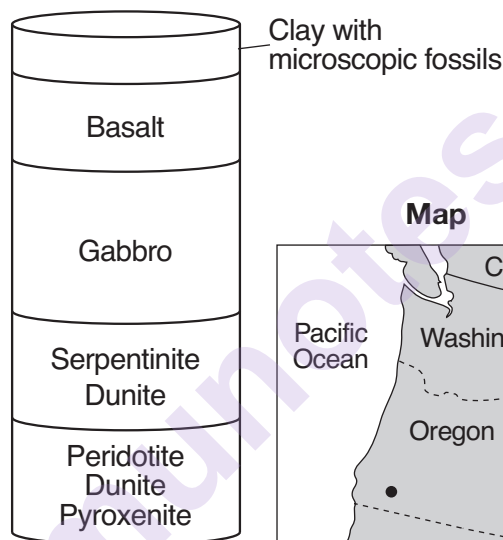
Sun
Jupiter
Milky Way Galaxy
Universe
Our solar system

Base your answers to questions 81 through 83 on the passage, diagram of an ophiolite drill-core sample, and map below and on your knowledge of Earth science. The dot on the map represents the location where the ophiolite drill-core sample was taken.

Ophiolites

In some places, segments of oceanic crust, sediment, upper mantle, and rock have been heaved up by tectonic movements onto the edges of continents, where they often become part of mountains. These displaced oceanic lithosphere segments are called ophiolites. They provide an opportunity to study the composition of oceanic lithosphere and are a key feature in recognizing past tectonic plate convergence along subduction zones. Drill-core samples of ophiolites typically have the layering pattern shown in the drill-core sample below.

**Oregon Ophiolite
Drill-Core Sample**



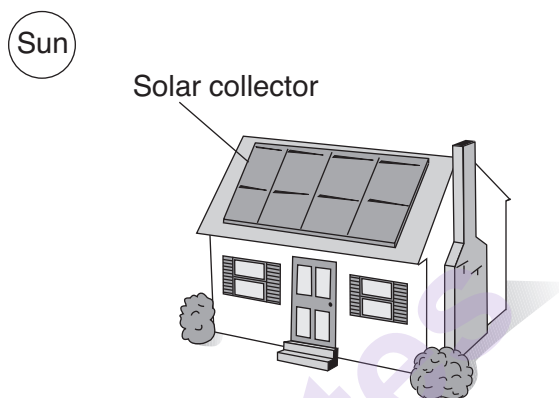
(Not drawn to scale)

- 81 What are the approximate crystal sizes in basalt and gabbro found in the Oregon drill-core sample? [1]
- 82 Describe how the mineral composition of dunite is different from the mineral composition of peridotite. [1]
- 83 Which layer in the ophiolite drill-core sample is composed of sediments? [1]
-

Base your answers to questions 84 and 85 on the passage and diagram below and on your knowledge of Earth science. The diagram represents a house located in New York State.

Solar Heating

Solar collectors in solar heating systems harness the power of the Sun to provide thermal energy for heating hot water and house interiors. There are several types of solar heating systems. The best system will depend on the geographic location and the intensity of the Sun. A solar heating system saves energy, reduces utility costs, and produces clean energy. The efficiency and reliability of solar heating systems have increased dramatically in recent years.



84 Explain why solar energy can still be collected on cloudy days. [1]

85 State *one* advantage of using solar energy instead of burning fossil fuels to produce thermal energy for your home. [1]

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