

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

**PHYSICAL SETTING
EARTH SCIENCE**

Wednesday, August 17, 2022 — 8:30 to 11:30 a.m., only

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

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

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

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

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

Notice ...

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

DO NOT START THIS EXAMINATION 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.

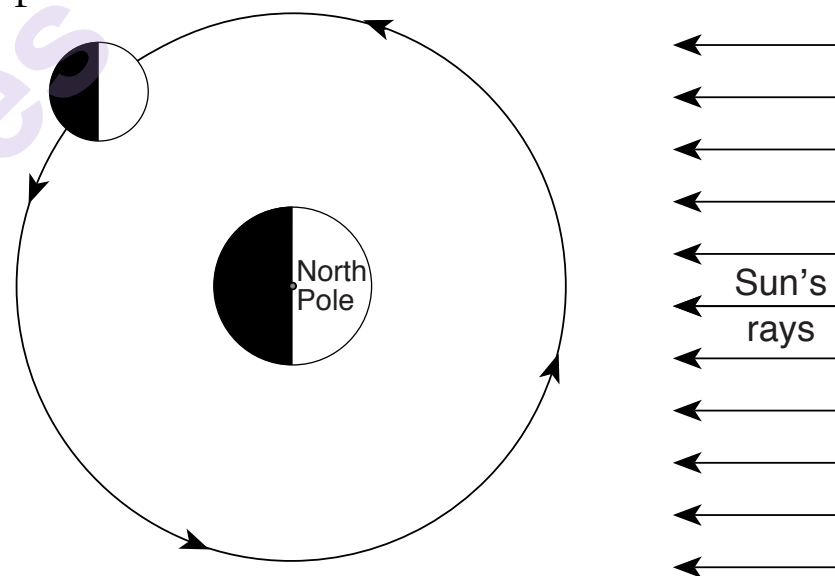
1 Compared to the masses and densities of terrestrial planets, Jovian planets have

- (1) less mass and are less dense
- (2) less mass and are more dense
- (3) greater mass and are less dense
- (4) greater mass and are more dense

2 The star *Vega* has an average surface temperature of 10,000 K and has a luminosity 70 times greater than that of the Sun. Which type of star is *Vega*?

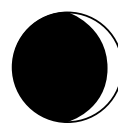
- | | |
|----------------|-------------------|
| (1) supergiant | (3) white dwarf |
| (2) giant | (4) main sequence |

3 The diagram below represents the Moon at one position in its orbit around Earth.

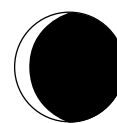


(Not drawn to scale)

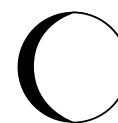
Which diagram represents the phase of the Moon as viewed by an observer in New York State when the Moon is located at the position shown?



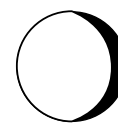
(1)



(2)

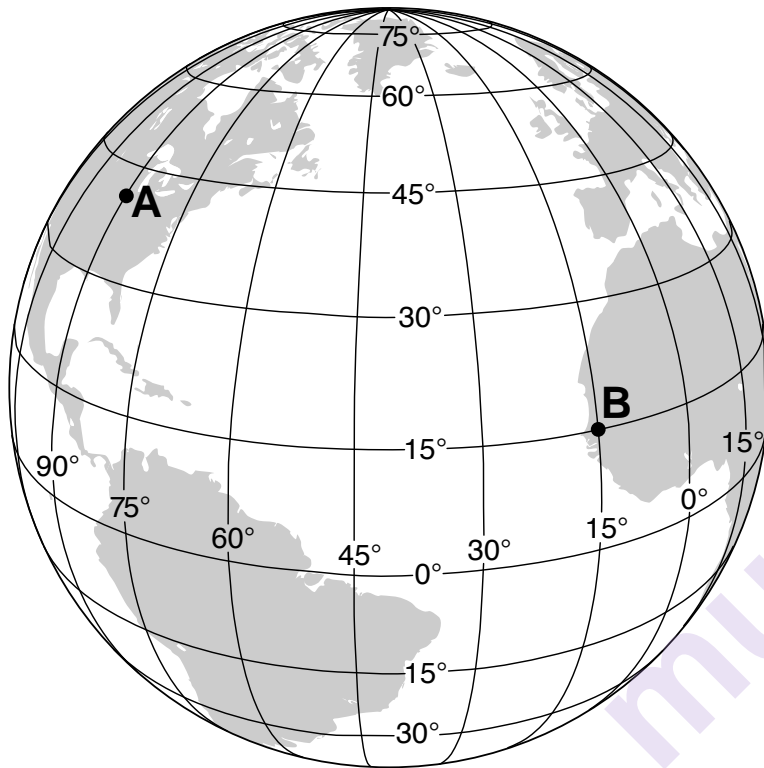


(3)



(4)

- 4 The diagram below represents latitudes and longitudes on Earth. Locations *A* and *B* are surface locations.



The solar time difference between location *A* and location *B* is

- | | |
|-------------|-------------|
| (1) 5 hours | (3) 3 hours |
| (2) 2 hours | (4) 6 hours |

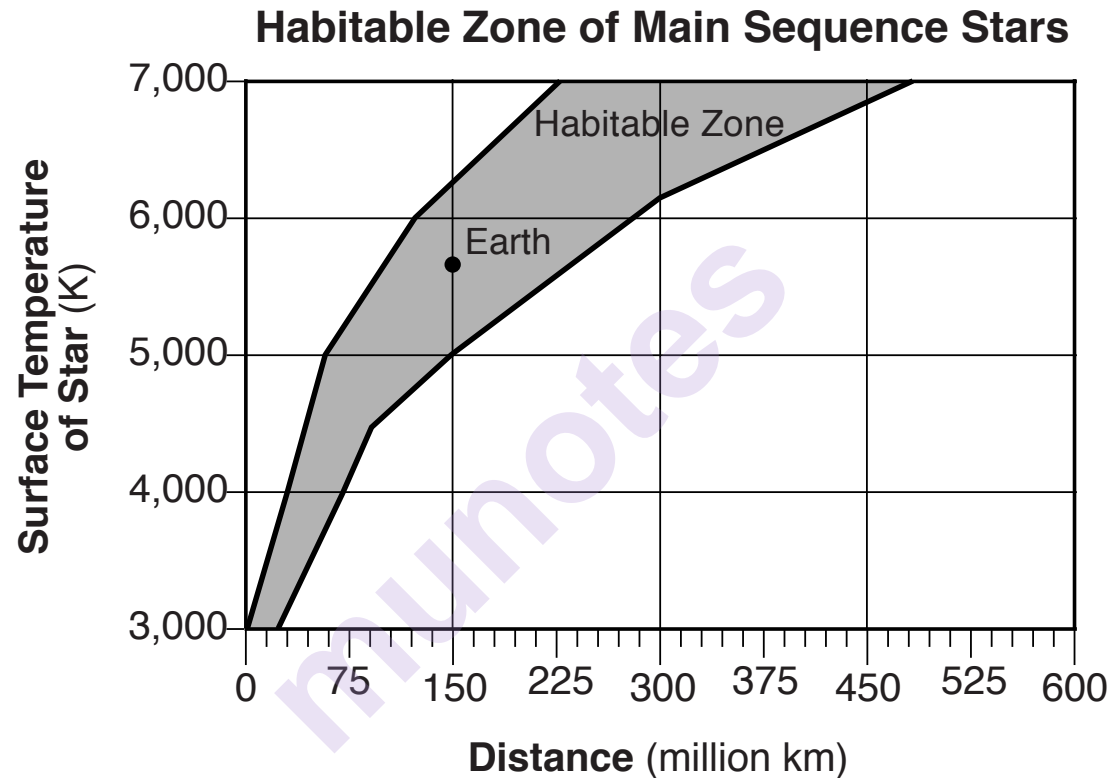
- 5 The constellation Orion can be observed from New York State in the night sky during winter, but it can *not* be observed in the night sky during summer due to

- (1) Earth's rotation on its axis
- (2) Earth's revolution around the Sun
- (3) Orion's rotation on its axis
- (4) Orion's revolution around Earth

- 6 What is Earth's approximate rate of movement along its orbit?

- | | |
|-----------------|------------------|
| (1) 1° per day | (3) 15° per day |
| (2) 1° per hour | (4) 15° per hour |

- 7 The graph below shows the possible distances, in millions of kilometers, that a planet could be from a star in order to possibly support life as we know it (the Habitable Zone), based on the star's surface temperature in Kelvin (K). The location of Earth has been plotted based on our Sun's surface temperature of 5778 K.



Which planet in our solar system would be in the Habitable Zone, if the Sun's surface temperature was 4000 K?

- (1) Mercury
- (2) Venus
- (3) Mars
- (4) Jupiter

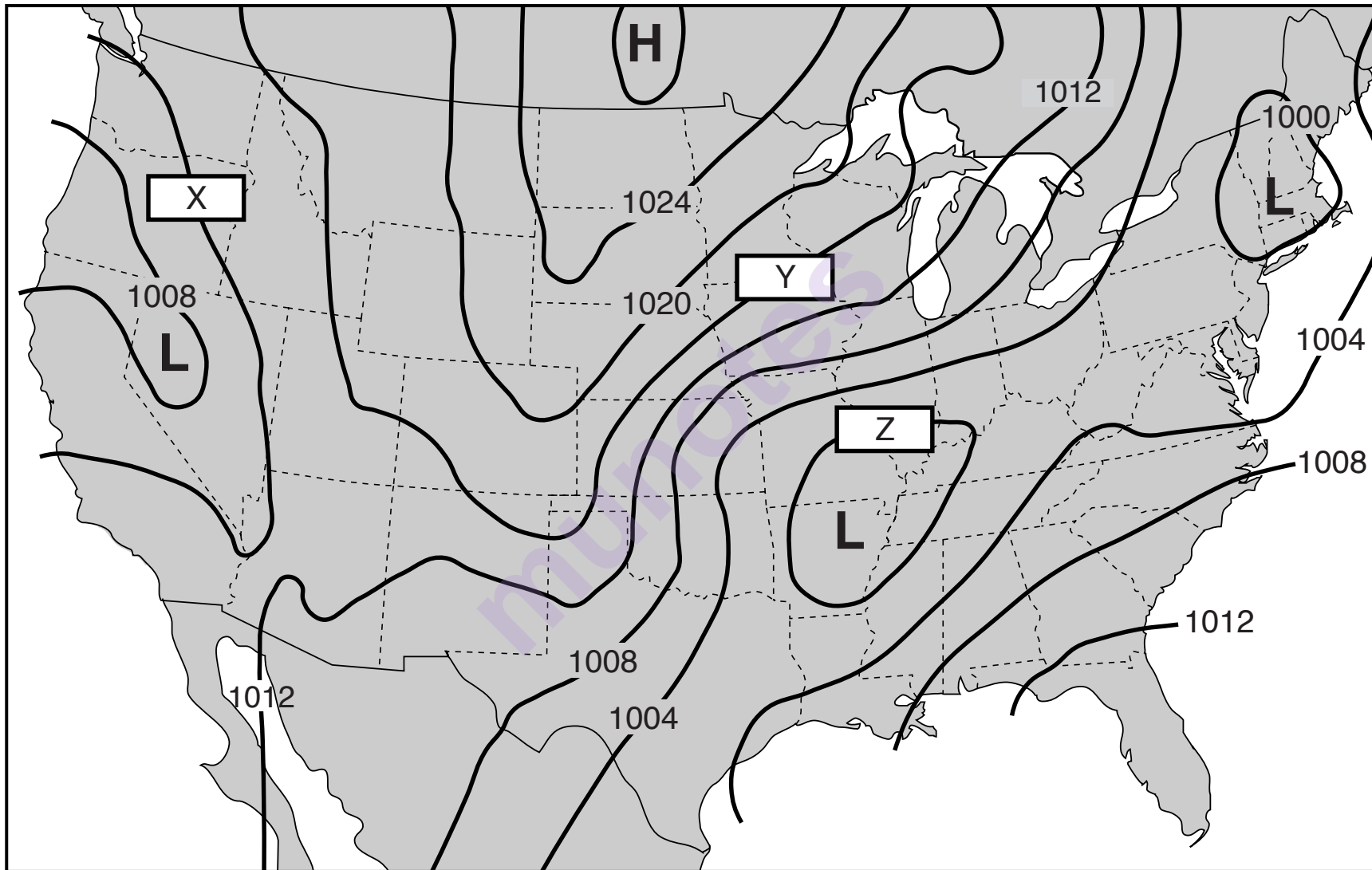
8 The map below shows the location of Chicxulub Crater, formed approximately 65 million years ago by an asteroid impact.



This impact crater has been most closely linked to

- | | |
|--------------------------------|---|
| (1) meteor showers | (3) the eccentricity of Earth's orbit |
| (2) worldwide mass extinctions | (4) the formation of the Gulf of Mexico |

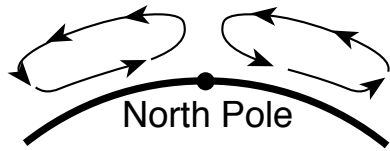
9 The weather map below shows isobars that are labeled in millibars (mb). Three isobars are labeled X, Y, and Z.



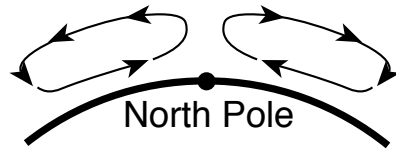
What are the values for the isobars labeled X, Y, and Z?

- | | |
|---|---|
| (1) X = 1012 mb; Y = 1016 mb; Z = 1000 mb | (3) X = 1010 mb; Y = 1024 mb; Z = 1000 mb |
| (2) X = 1010 mb; Y = 1016 mb; Z = 1008 mb | (4) X = 1012 mb; Y = 1024 mb; Z = 1008 mb |

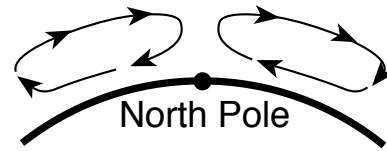
10 Which cross section best represents the general atmospheric circulation over the North Pole?



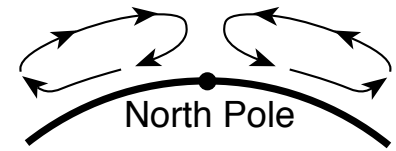
(1)



(2)



(3)



(4)

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- 11 The map below shows the most likely positions and speeds of the polar front jet stream in summer and in winter.



The Atmosphere, 7th ed., Lutgens and Tarbuck, p. 174 (Fig. 7-11)

Question 11 is continued on the next page.

Question 11 continued

In winter, the polar front jet stream has a more southerly path with winds traveling at speeds that are generally

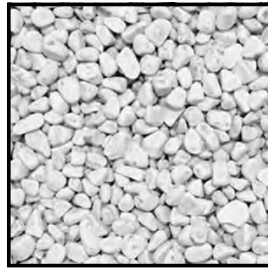
- (1) less than in summer, and Earth's Northern Hemisphere tilts away from the Sun
- (2) less than in summer, and Earth's Northern Hemisphere tilts toward the Sun
- (3) greater than in summer, and Earth's Northern Hemisphere tilts away from the Sun
- (4) greater than in summer, and Earth's Northern Hemisphere tilts toward the Sun

12 Equal areas of which surface will typically absorb the greatest amount of insolation?



Smooth
White Marble
Tile

(1)



Rough
White Marble
Gravel

(2)



Smooth
Black Marble
Tile

(3)



Rough
Black Marble
Gravel

(4)

- 13 At a location in the Northern Hemisphere, a camera was placed outside at night with the lens pointing at a group of stars. The shutter was left open for a few hours, resulting in the photograph of star trails shown below.



Source: <https://www.leyetscapes.com/edu/how-to-shoot-star-trails.html>

What is the name of the star in the center of the photograph that did not leave a star trail?

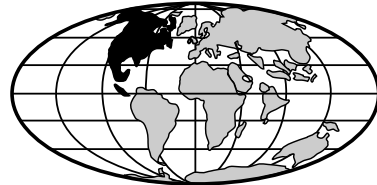
- | | |
|-----------------------|-------------------|
| (1) <i>Betelgeuse</i> | (3) the Sun |
| (2) <i>Polaris</i> | (4) <i>Sirius</i> |

- 14 Outgassing of water vapor, carbon dioxide, and nitrogen initially formed Earth's early
- | | |
|-----------------|-------------------|
| (1) lithosphere | (3) asthenosphere |
| (2) hydrosphere | (4) atmosphere |
- 15 Which type of electromagnetic radiation listed below has the longest wavelength?
- | | |
|-----------------|--------------------------|
| (1) infrared | (3) red visible light |
| (2) ultraviolet | (4) violet visible light |
- 16 When major volcanic eruptions send large amounts of ash and dust into the atmosphere, worldwide air temperatures usually become
- | |
|--|
| (1) warmer, because the atmosphere is less transparent |
| (2) warmer, because the atmosphere is more transparent |
| (3) cooler, because the atmosphere is less transparent |
| (4) cooler, because the atmosphere is more transparent |
- 17 From September 1 to June 1, the number of daylight hours observed each day in New York State will
- | |
|-----------------------------|
| (1) decrease, only |
| (2) increase, only |
| (3) decrease, then increase |
| (4) increase, then decrease |

18 Which map best shows the inferred positions of Earth's landmasses between the Alleghenian orogeny and the initial opening of the Atlantic Ocean?



(1)



(3)



(2)



(4)

19 In the past, cyanobacteria produced oceanic oxygen that combined with iron in seawater to form iron oxide layers on ocean floors. These iron oxide layers were formed during the

- (1) Early Archean (3) Late Archean
- (2) Early Carboniferous (4) Late Carboniferous

20 Which group of organisms are found only as fossils today?

- (1) vascular plants (3) brachiopods
- (2) nautiloids (4) placoderm fish

21 Compared to the granitic continental crust, the basaltic oceanic crust is

- (1) thinner and less dense
- (2) thinner and more dense
- (3) thicker and less dense
- (4) thicker and more dense

22 Which table correctly matches the layers of Earth's interior with the appropriate description?

Earth's Layer	Description
Lithosphere	Lowest density and rigid
Mantle	Partial melting and convection currents in upper region
Outer Core	Completely liquid
Inner Core	Highest pressure, composed of iron and nickel

(1)

Earth's Layer	Description
Lithosphere	Lowest density and rigid
Mantle	Partial melting and convection currents in upper region
Outer Core	Highest pressure, composed of iron and nickel
Inner Core	Completely liquid

(3)

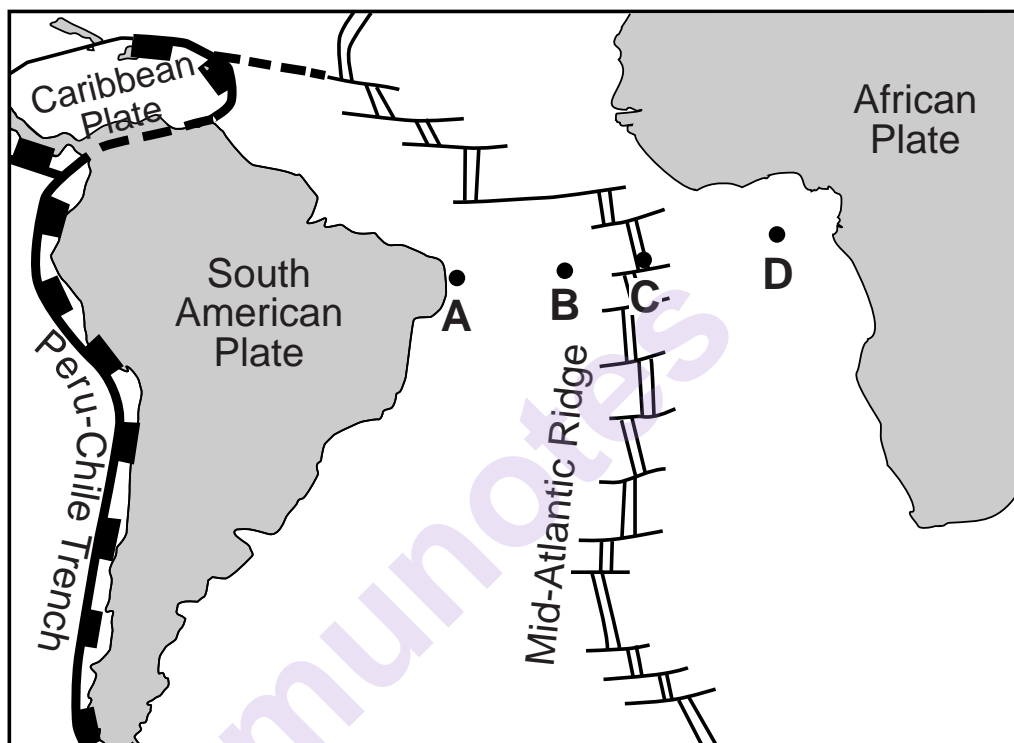
Earth's Layer	Description
Lithosphere	Partial melting and convection currents in upper region
Mantle	Lowest density and rigid
Outer Core	Completely liquid
Inner Core	Highest pressure, composed of iron and nickel

(2)

Earth's Layer	Description
Lithosphere	Lowest density and rigid
Mantle	Completely liquid
Outer Core	Partial melting and convection currents in upper region
Inner Core	Highest pressure, composed of iron and nickel

(4)

- 23 The map below shows a tectonic plate boundary in the Atlantic Ocean between South America and Africa. Letters A, B, C, and D represent locations on Earth's surface.



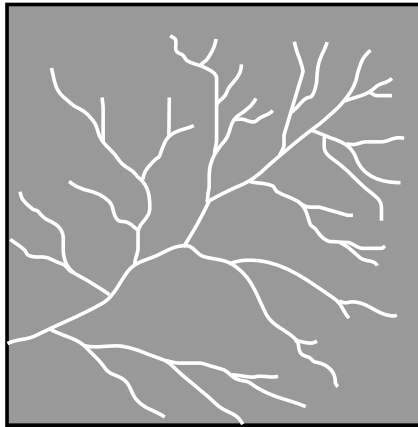
The most recently formed oceanic crust would be located closest to location

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

24 Most of the tectonic plate boundaries of the Scotia Plate are classified as

- (1) transform boundaries with the plates moving in a relative east–west direction
- (2) transform boundaries with the plates moving in a relative north–south direction
- (3) divergent boundaries with the plates moving in a relative east–west direction
- (4) divergent boundaries with the plates moving in a relative north–south direction

25 The diagram below represents a stream drainage pattern.



This stream drainage pattern is most likely a direct result of the

- (1) elevation of the bedrock above sea level
- (2) type of fossils in the bedrock
- (3) age of the bedrock
- (4) underlying bedrock structure

26 Which New York State river generally flows southward?

- (1) Genesee
- (2) Hudson
- (3) Niagara
- (4) St. Lawrence

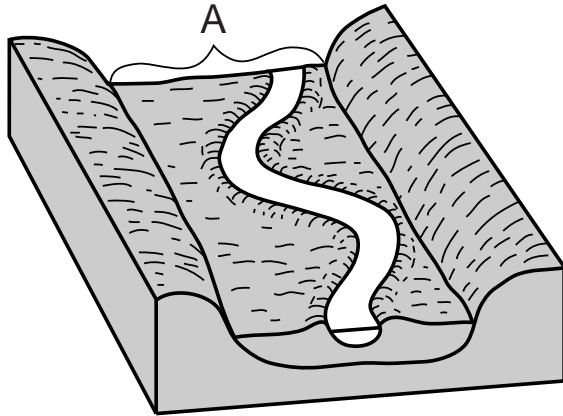
27 The sediment deposited by a landslide is usually

- (1) sorted and layered
- (2) sorted and non-layered
- (3) unsorted and layered
- (4) unsorted and non-layered

28 Which rock exhibits a bubbling reaction when hydrochloric acid is placed on it?

- (1) rock gypsum
- (2) limestone
- (3) obsidian
- (4) slate

- 29 The block diagram below represents a portion of a meandering stream and the valley it has produced. One landscape feature is labeled A.



The landscape feature labeled A is best described as

- | | |
|-------------------|-------------------|
| (1) a delta | (3) a water table |
| (2) a flood plain | (4) an escarpment |

- 30 The photograph below shows an elongated hill that was originally deposited by a glacier.



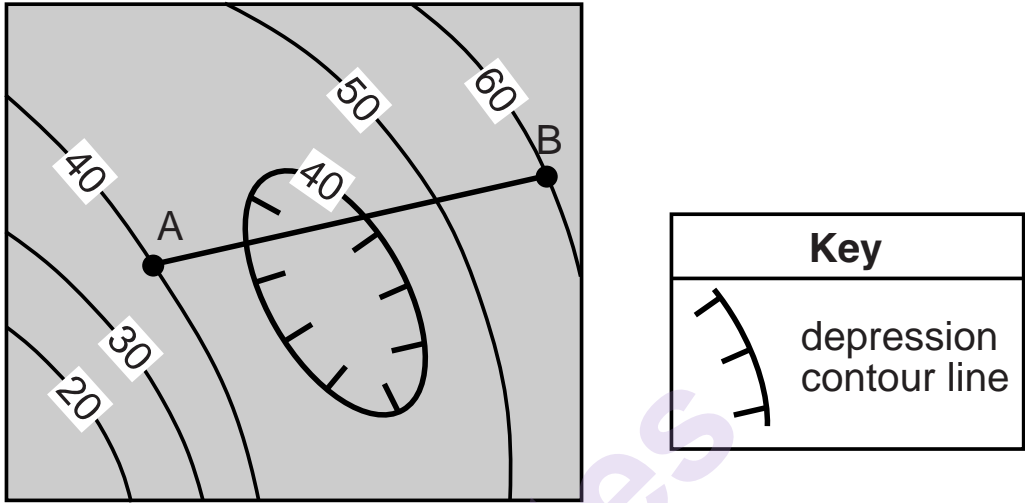
<https://www.geocaching.com/>

This landscape feature is identified as a

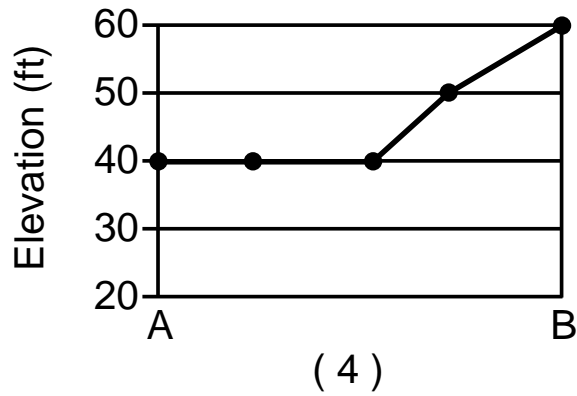
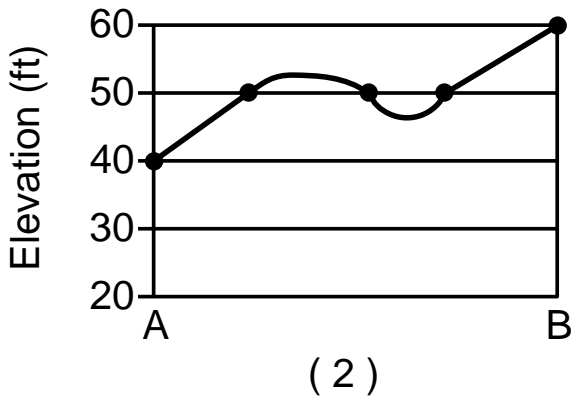
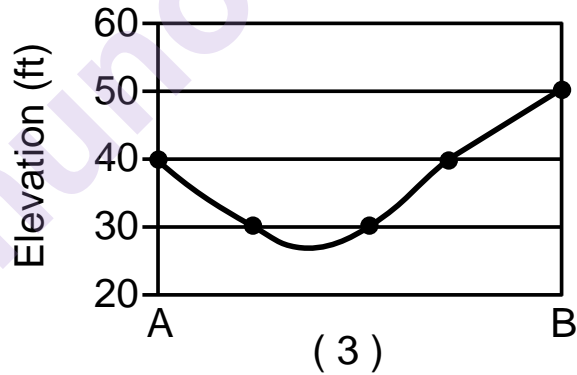
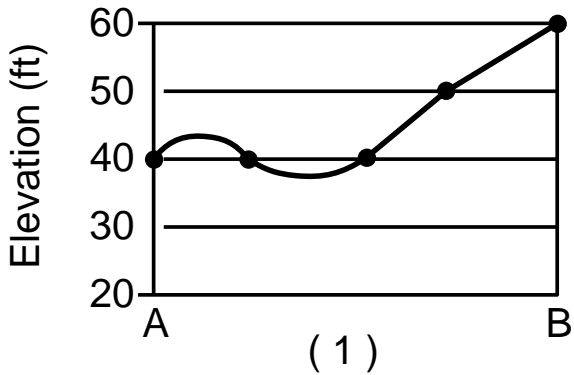
- | | |
|----------------------|-------------------|
| (1) dune | (3) drumlin |
| (2) terminal moraine | (4) outwash plain |

- 31 Which particles most likely will be deposited first as the velocity of a stream carrying a mixture of particles decreases?
- (1) small, flat, low-density particles
 - (2) small, round, low-density particles
 - (3) large, flat, high-density particles
 - (4) large, round, high-density particles

32 The topographic map below shows elevations in feet. Line AB is a reference line.



Which profile best represents the change in elevation along the line from A to B ?



33 The map below shows Fire Island, located on the southern coast of Long Island.



Which agent of erosion deposited the sediments that formed Fire Island, and continues to shape it?

- (1) wind action
- (2) running water
- (3) wave action
- (4) mass movement

34 Which chart correctly matches rock salt and rock gypsum with how the minerals from these rocks

Rock Type	Mineral Use
Rock salt	ore of lead
Rock gypsum	building stones

(1)

Rock Type	Mineral Use
Rock salt	food additive
Rock gypsum	ore of iron

(3)

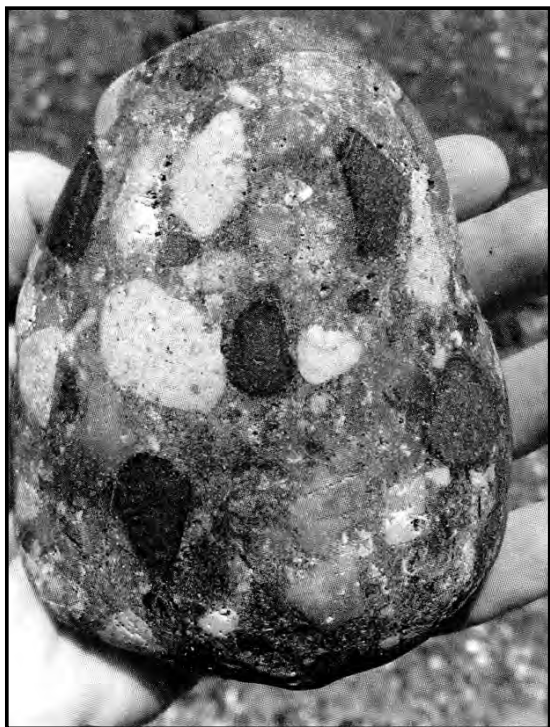
Rock Type	Mineral Use
Rock salt	roofing
Rock gypsum	jewelry

(2)

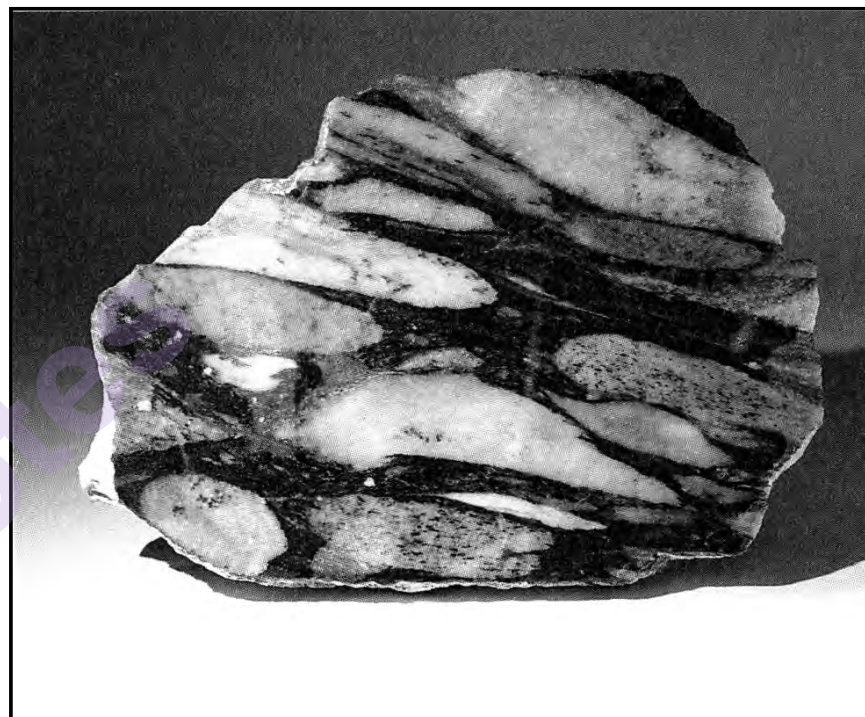
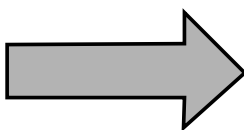
Rock Type	Mineral Use
Rock salt	melts ice
Rock gypsum	plaster of paris

(4)

35 The photographs below show samples of two different rocks, labeled A and B. The arrow represents the process by which a rock like rock A can change into a rock like rock B.



Rock A



Rock B

Which process does the arrow represent?

- (1) metamorphism
- (2) erosion

- (3) melting
- (4) cementation

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 table below and on your knowledge of Earth science. The table below lists the half-lives for five radioactive isotopes.

Radioactive Isotope	Half-life
holmium-166	26.80 hours
gold-198	2.70 days
iodine-131	8.02 days
beryllium-10	1.39 million years
lutetium-176	37.8 billion years

36 After 8.1 days, how much of a 100-gram sample of gold-198 will remain?

- (1) 6.25 g
- (2) 12.5 g
- (3) 25 g
- (4) 50 g

37 Which radioactive isotope has a half-life closest to the half-life of the radioactive isotope rubidium-87?

- (1) iodine-131
- (2) gold-198
- (3) beryllium-10
- (4) lutetium-176

38 A sample of holmium-166, located deep underground, is subjected to high temperature and pressure. The half-life of this sample of holmium-166 will be

- (1) 13.40 hours
- (2) 24.30 hours
- (3) 26.80 hours
- (4) 28.70 hours

Base your answers to questions 39 through 41 on the passage and photograph below and on your knowledge of Earth science. The photograph shows the coastal area of Crescent City, California.

Tsunami Capital

The tsunami capital of the continental United States is Crescent City, located on the coast in northern California. Since 1933, thirty-one tsunamis have been observed there. Crescent City is vulnerable to tsunamis because of the low elevation of the land and the shape of its shoreline. The wave energy from a tsunami is funneled into a narrow stretch of shoreline. This causes the wave height to grow very tall, flooding more land. The largest and most destructive tsunami to hit Crescent City occurred in March 1964, killing eleven people. The epicenter of a very large earthquake, located at 60° N and 147° W, caused this destructive tsunami.



39 Which factor causes Crescent City, California, to be highly vulnerable to tsunamis?

- (1) coastal (marine) climate
- (2) monsoon events
- (3) direction of prevailing winds
- (4) topography of the shoreline

40 The distance from the epicenter of the March 1964 earthquake to Crescent City is 2600 kilometers. How long did it take the first *P*-wave to reach Crescent City?

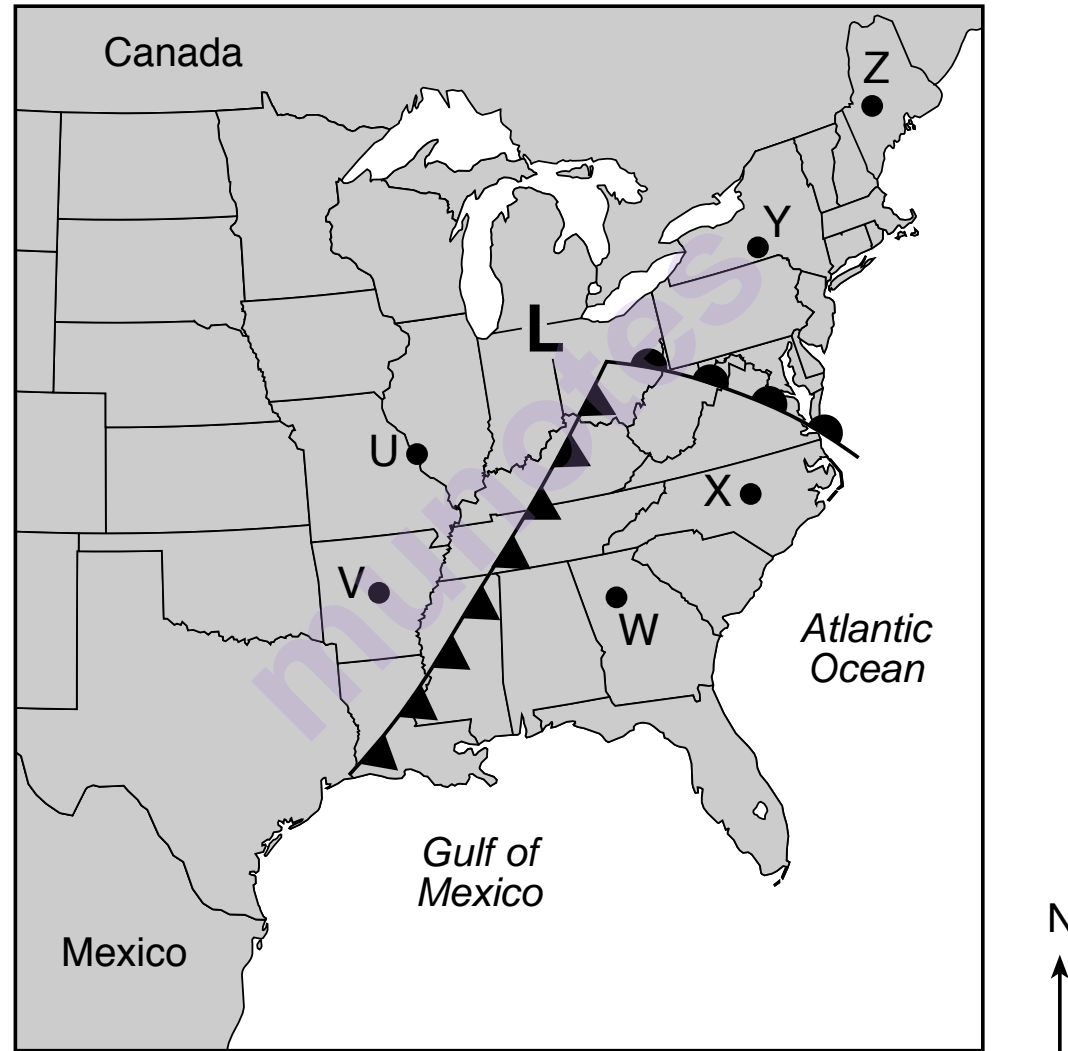
- (1) 3 minutes 20 seconds
- (2) 4 minutes 10 seconds
- (3) 5 minutes 0 seconds
- (4) 9 minutes 10 seconds

41 Once a tsunami warning is issued, which action should residents of Crescent City take to prevent loss of life?

- (1) evacuate to higher ground
 - (2) board up windows
 - (3) go into their basements
 - (4) get under a sturdy desk or table
-

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Base your answers to questions 42 and 43 on the map below and on your knowledge of Earth science. The map shows a low-pressure system over the eastern United States. Points U through Z represent locations on Earth's surface.



42 Which two locations most likely have the warmest air temperatures?

(1) Y and Z

(2) U and V

(3) V and W

(4) W and X

43 The winds at location *U* are most likely coming from the

(1) northeast

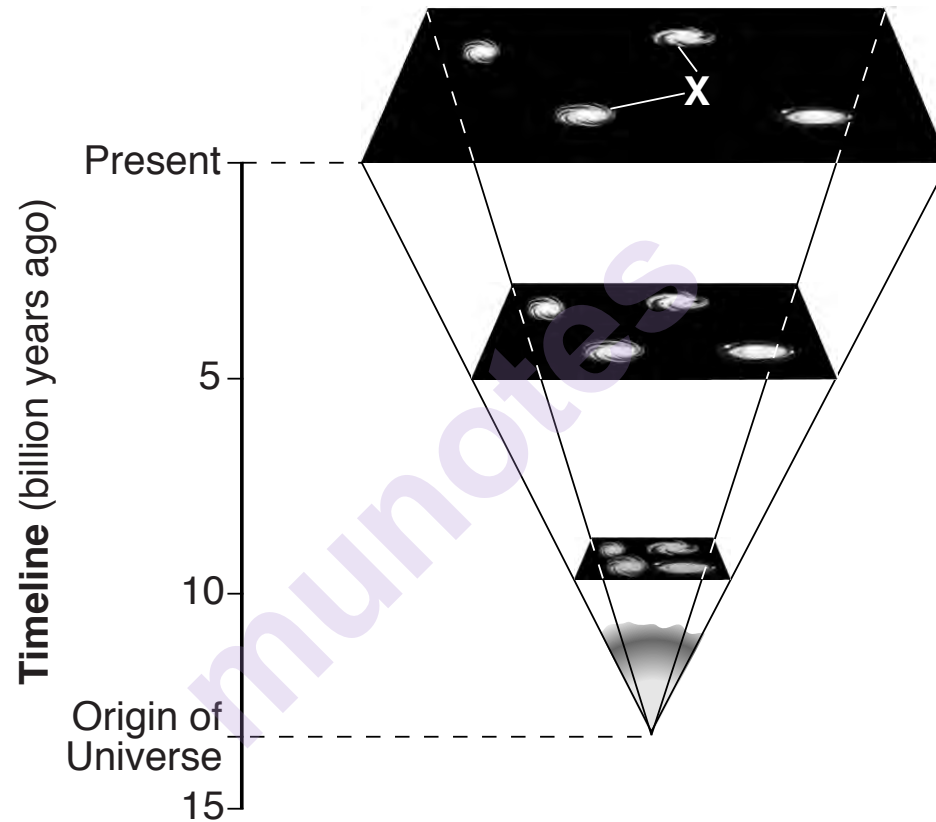
(2) northwest

(3) southeast

(4) southwest

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Base your answers to questions 44 through 46 on the diagram below and on your knowledge of Earth science. The diagram represents the expansion of a portion of the universe from its origin until the present. The timeline represents billions of years. Letter X indicates two celestial objects.



44 Approximately how many billion years ago (bya) did the Big Bang occur?

- (1) 4.6 bya
- (2) 10.0 bya

- (3) 13.8 bya
- (4) 15.0 bya

45 The two spiral-shaped celestial objects labeled X are

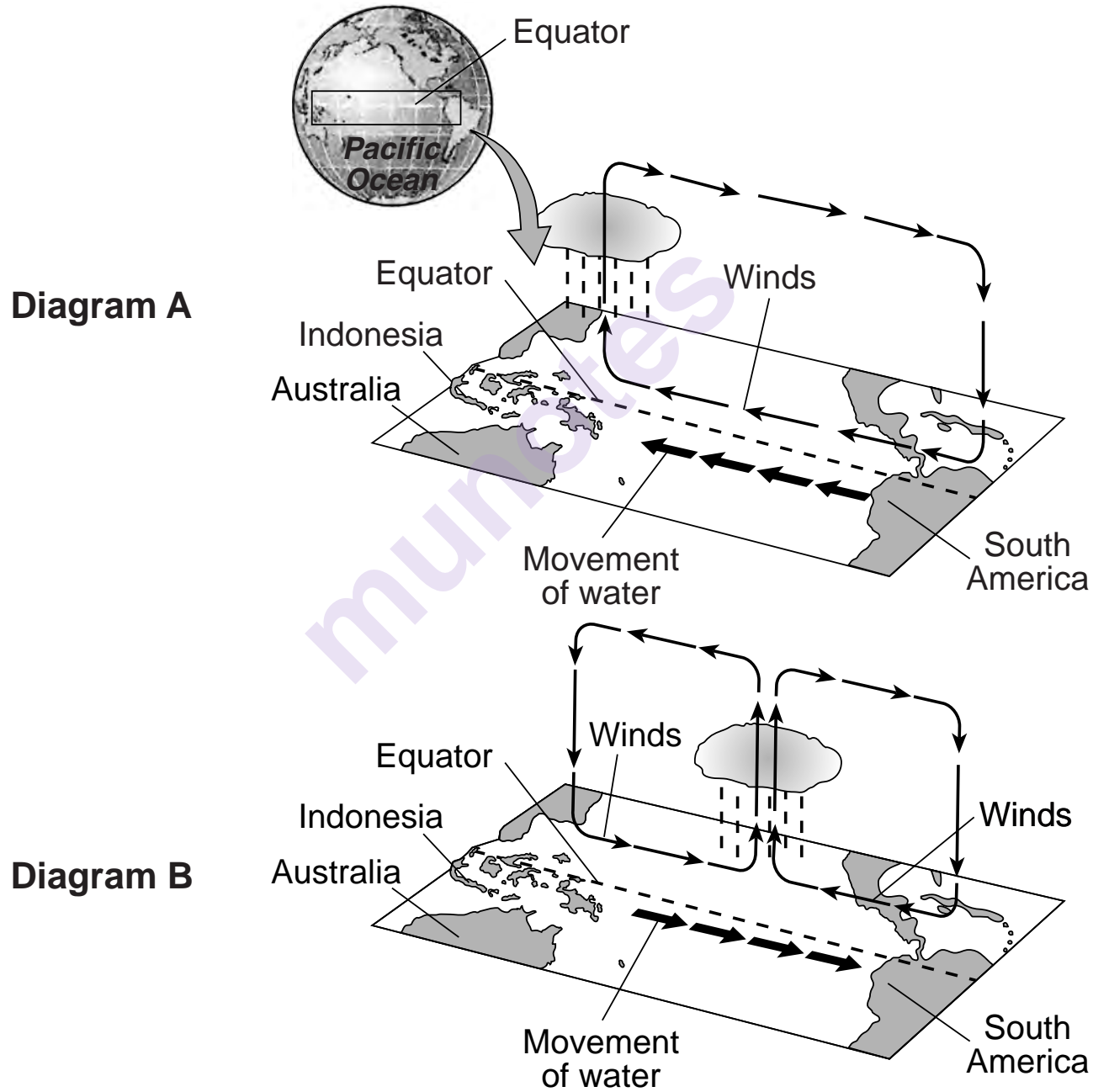
- | | |
|--------------|---------------|
| (1) galaxies | (3) asteroids |
| (2) planets | (4) comets |

46 Two pieces of evidence that support the theory that the universe is expanding are the

- (1) red shift of light from distant stars and the existence of nuclear fusion
 - (2) red shift of light from distant stars and the existence of cosmic background radiation
 - (3) blue shift of light from distant stars and the existence of nuclear fusion
 - (4) blue shift of light from distant stars and the existence of cosmic background radiation
-

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Base your answers to questions 47 and 48 on the diagrams below and on your knowledge of Earth science. The diagrams, labeled *A* and *B*, represent two different types of oceanic and atmospheric conditions that occur across the Pacific Ocean in a region close to the equator. Bold arrows represent movement of surface water in the ocean. Thinner arrows represent circulation of air above the equator.



47 In diagram A, which location normally receives less precipitation due to higher atmospheric pressure?

(1) Indonesian coast	(3) middle of Pacific Ocean
(2) South American coast	(4) Australian coast

48 The pattern of the thinner arrows in the atmosphere in both diagrams indicates the presence of

(1) conduction	(3) evaporation
(2) convection	(4) radiation

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Base your answers to questions 49 and 50 on the table below and on your knowledge of Earth science. The table lists the times of high and low tides in New York Harbor from December 4, 2017 through December 7, 2017. The time of the second low tide on December 6 has been left blank.

**New York Harbor Tides
December 4 through 7, 2017**

	Low Tide	High Tide
Date	Time	Time
Dec 4	2:07 a.m.	8:02 a.m.
	2:56 p.m.	8:39 p.m.
Dec 5	2:58 a.m.	8:54 a.m.
	3:47 p.m.	9:38 p.m.
Dec 6	3:50 a.m.	9:52 a.m.
		10:40 p.m.
Dec 7	4:44 a.m.	10:54 a.m.
	5:33 p.m.	11:43 p.m.

49 According to the information provided in the New York Harbor Tides table, at approximately what time did the second low tide occur on December 6, 2017?

- | | |
|---------------|---------------|
| (1) 4:01 a.m. | (3) 4:39 a.m. |
| (2) 4:01 p.m. | (4) 4:39 p.m. |

50 The highest high tides and lowest low tides in New York Harbor usually occur when the Moon is

- (1) closest to Earth, and the Sun, Moon, and Earth are aligned
 - (2) closest to Earth, and the Sun, Moon, and Earth are at right angles
 - (3) farthest from Earth, and the Sun, Moon, and Earth are aligned
 - (4) farthest from Earth, and the Sun, Moon, and Earth are at right angles
-

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Part B–2

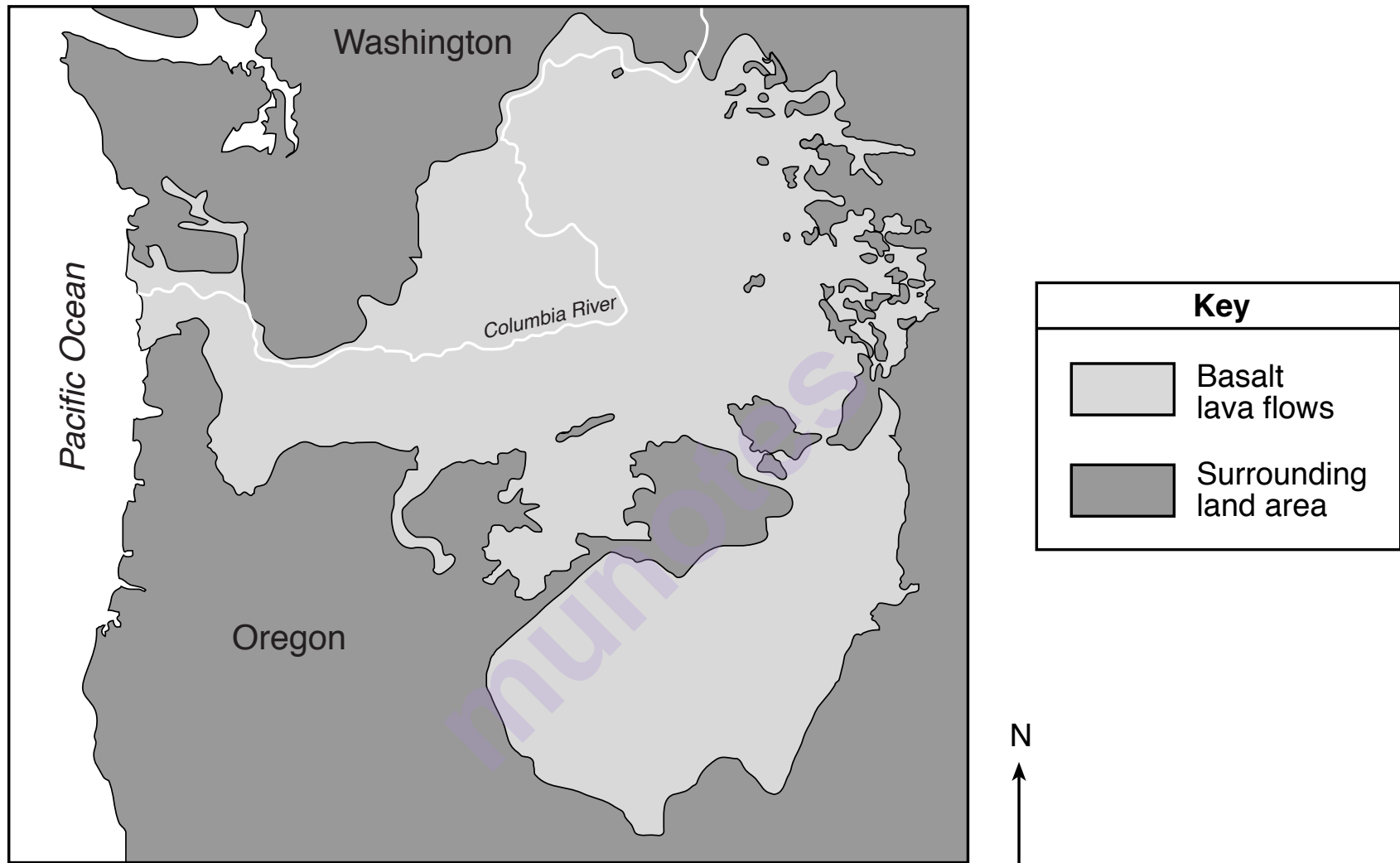
Answer all questions in this part.

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 passage and map on the next page, and your knowledge of Earth science. The map of the northwestern United States shows the location of the Columbia River Basalts.

Columbia River Basalts

The Columbia River Basalts are a formation of several horizontal lava flows from eruptions that took place between 6 million and 17 million years ago. These flows covered a portion of the northwestern United States. The lava erupted from cracks in Earth's surface and flowed westward toward the Pacific Ocean. These horizontal basalt layers are currently about 1200 meters above sea level. The lava was created when the North American Plate moved over a mantle hot spot.



- 51 Identify the geologic epoch when the Columbia River Basalts formed. [1]
- 52 Identify the present mantle hot spot that most likely produced the lava that created the Columbia River Basalts. [1]
- 53 The mantle plumes that created the lava flows of the Columbia River Basalts are inferred to have risen from the boundary between the stiffer mantle and the outer core. Identify the interior temperature and depth at this boundary. [1]

Base your answers to questions 54 through 57 on the diagram *in your answer booklet* and on your knowledge of Earth science. The diagram represents the Moon's orbit around Earth.

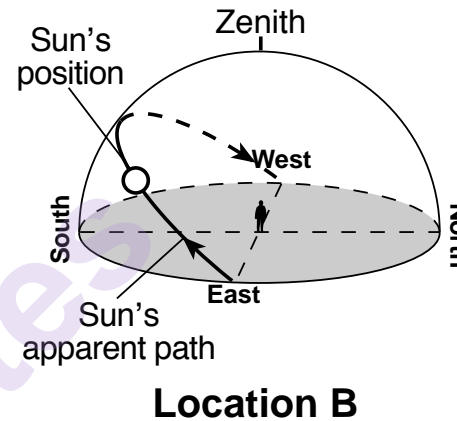
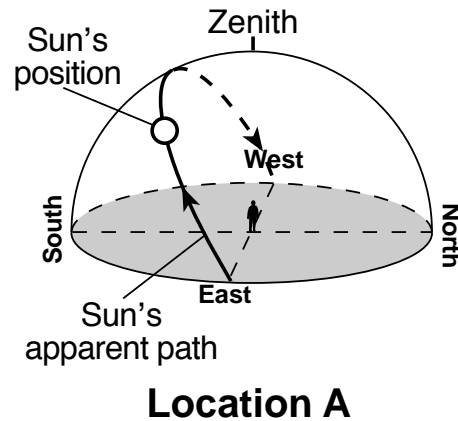
54 On the diagram *in your answer booklet*, place an **X** on the Moon's orbit to show the Moon's position during a solar eclipse. [1]

55 State the average distance between Earth and the Moon. Include units with your answer. [1]

56 Describe the actual shape of the Moon's orbit. [1]

57 Explain why the Moon's period of revolution and period of rotation cause the same side of the Moon to always face Earth. [1]

Base your answers to questions 58 through 60 on the two Sun's path diagrams below and on your knowledge of Earth science. The diagrams represent the apparent path of the Sun observed at locations *A* and *B* on Earth's surface on September 21. The positions of the Sun and the zenith (position directly overhead) are shown for an observer at each location.



- 58 State the approximate time of day represented at location *A*, based on the Sun's present position. Include a.m. or p.m. in your answer. [1]
- 59 Describe the change in the length of a shadow cast by the observer at location *B* from sunrise to sunset. [1]
- 60 Identify Earth's motion that causes the Sun to appear to move along each path shown. [1]
-

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Base your answers to questions 61 through 63 on the data table below, on the graph in your answer booklet, and on your knowledge of Earth science. The data table shows the air temperatures and dewpoints in degrees Celsius ($^{\circ}\text{C}$) for a period of time at a location in New York State. The graph in your answer booklet shows the air temperatures from noon to 5 p.m. and the dewpoints from noon to 11 p.m.

Time	Air Temperature ($^{\circ}\text{C}$)	Dewpoint ($^{\circ}\text{C}$)
Noon	26.0	17.0
1 p.m.	27.0	16.0
2 p.m.	29.0	14.0
3 p.m.	29.5	14.0
4 p.m.	30.5	15.5
5 p.m.	29.0	16.5
6 p.m.	30.0	18.5
7 p.m.	29.5	16.5
8 p.m.	27.0	17.0
9 p.m.	26.5	17.0
10 p.m.	25.0	18.5
11 p.m.	19.0	18.5

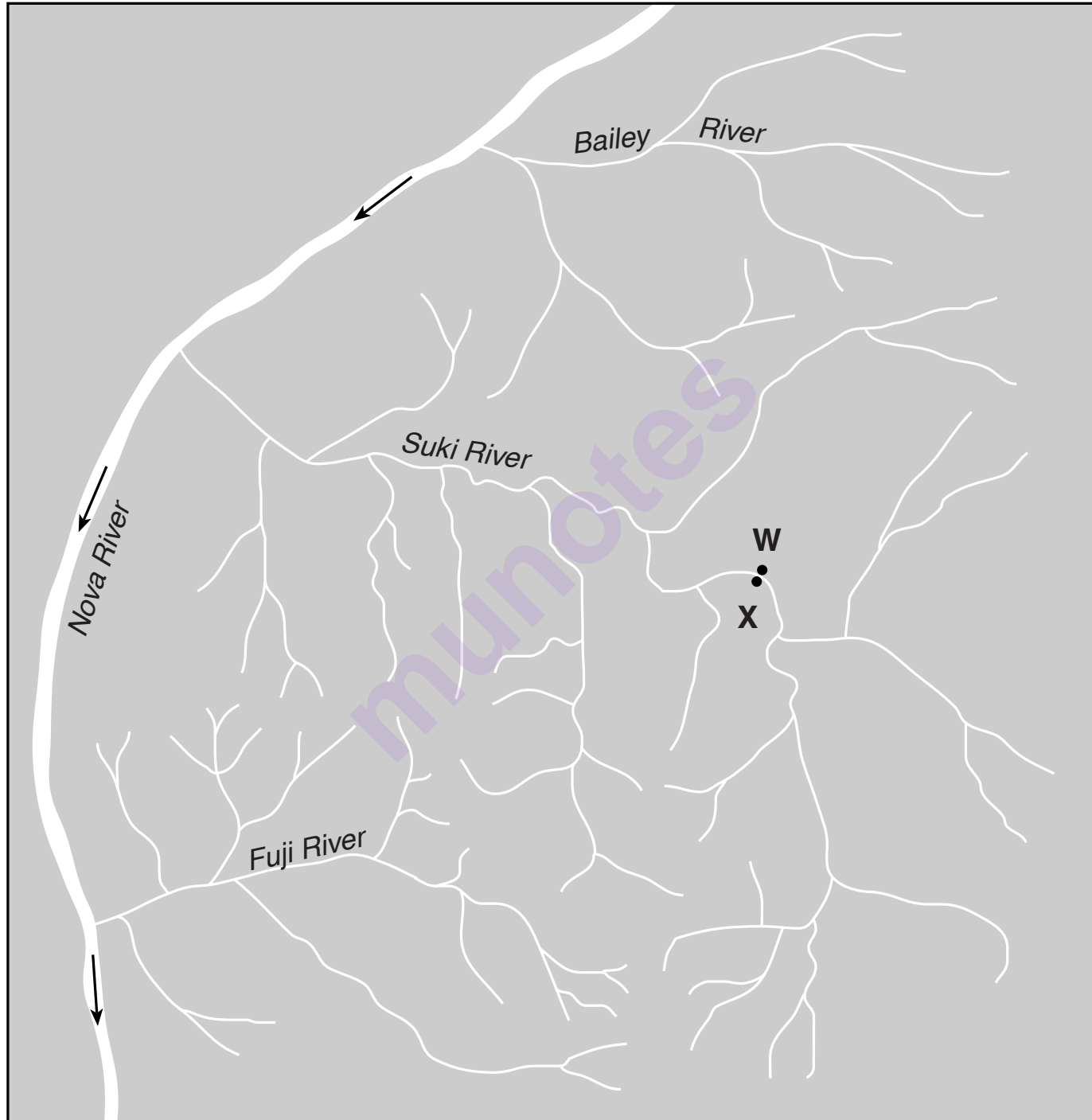
- 61 Complete the line graph *in your answer booklet* by plotting the remaining air temperatures for each hour from 6 p.m. to 11 p.m. The data from noon to 5 p.m. have already been plotted. Connect *all six* plots with a line that starts at the 5 p.m. data plot. [1]
- 62 Identify the time shown in the data table when dew or fog would most likely form. Explain why that time has the greatest chance for the formation of dew or fog. [1]
- 63 Identify *one* weather instrument that consists of a dry-bulb thermometer and a wet-bulb thermometer that is used to determine dewpoint. [1]
-

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Base your answers to questions 64 and 65 on the map on the next page and on your knowledge of Earth science. The map shows a portion of the Nova River and three of its tributaries. Points W and X represent locations on the banks of the Suki River. The arrows on the map indicate the direction of flow of the Nova River.

64 Determine the minimum stream velocity, in centimeters per second (cm/s), required for the Nova River to transport a pebble with a diameter of 6.4 cm. [1]

65 Explain why the stream velocity and rate of erosion of the streambank are greater at location W than at location X. [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 69 on the map in your answer booklet and on your knowledge of Earth science. The map shows the total amount of snowfall, measured in inches, from a lake-effect snowstorm that affected a portion of New York State from February 2 through February 4, 2017. The 10-inch and 50-inch snowfall isolines have been drawn. Oswego, Watertown, and Old Forge are labeled on the map. Points A and B represent locations on Earth's surface.

- 66 On the map *in your answer booklet*, draw the 20-, 30-, and 40-inch snowfall isolines. [1]
- 67 Calculate the snowfall gradient between locations A and B in inches per mile. [1]
- 68 Identify the name of the New York State landscape region where the greatest amount of snowfall occurred.
[1]

69 The table below lists some weather conditions for Watertown near the end of this storm.

Dewpoint (°F)	Present Weather	Wind Direction	Wind Speed (knots)
23	snow showers	from the northwest	25

On the weather station model *in your answer booklet*, using the proper format, record the weather conditions listed in the table. [1]

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Base your answers to questions 70 through 73 on the data table below and on your knowledge of Earth science. The data table shows the range of temperatures at which different minerals crystallize as molten magma cools and solidifies.

Mineral	Range of Temperatures at Which Each Mineral Crystallizes (°C)
Olivine	1400 to 1150
Pyroxene	1300 to 1000
Amphibole	1100 to 800
Biotite Mica	950 to 750
Potassium Feldspar	800 to 600
Quartz	550 to 500
Plagioclase Feldspar	1300 to 600

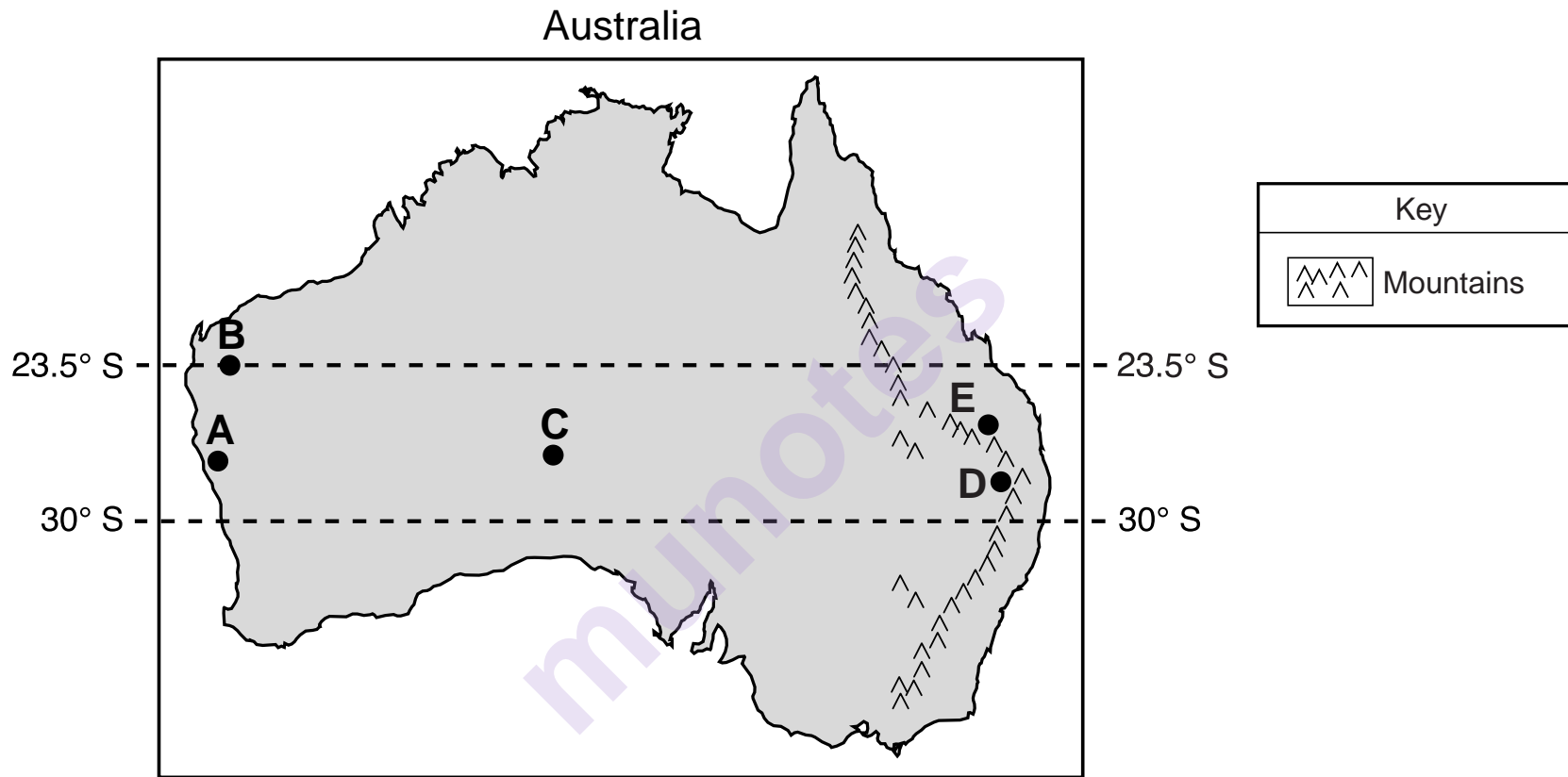
70 Complete the graph *in your answer booklet* by drawing a bar to represent the range of temperatures at which each mineral crystallizes. Shade in each bar drawn. The bars for the range of temperatures at which olivine and pyroxene crystallize have already been drawn. [1]

71 Identify the mineral listed on the data table that would most likely be the last to crystallize as the magma cools and solidifies. [1]

- 72 List the *two* elements that are commonly found in olivine, pyroxene, and potassium feldspar. [1]
- 73 Identify the general characteristics of color and density of an igneous rock composed of only the minerals olivine and pyroxene. [1]
-

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Base your answers to questions 74 through 77 on the map of Australia below and on your knowledge of Earth science. Points A through E on the map represent locations on Earth's surface that have different climates.



74 Identify the ocean current that most affects the climate of location A. [1]

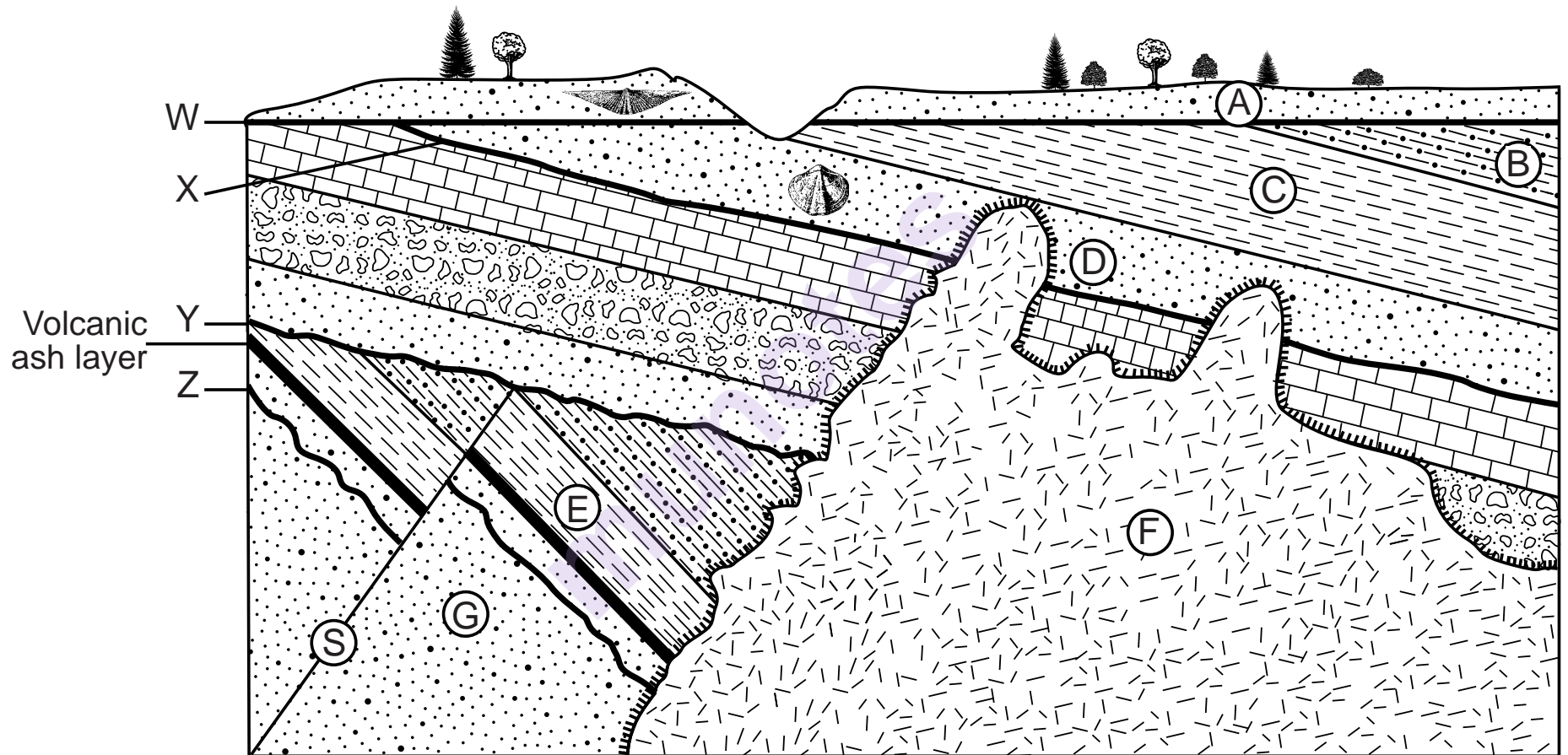
75 Identify the month and day when the noon sun would be directly overhead at location B. [1]

- 76 Write the two-letter air-mass symbol used to identify an air mass that originates over location *C*. [1]
- 77 Locations *D* and *E* are located the same distance from the Pacific Ocean. Explain why location *D* has a drier climate than location *E*. [1]
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Base your answers to questions 78 through 80 on the cross section below and on your knowledge of Earth science. Letters A through G identify rock units. Letter S identifies a fault. Lines W, X, Y, and Z are unconformities. Index fossils are represented in two of the rock units, and a volcanic ash layer has been labeled. The rock units have *not* been overturned.

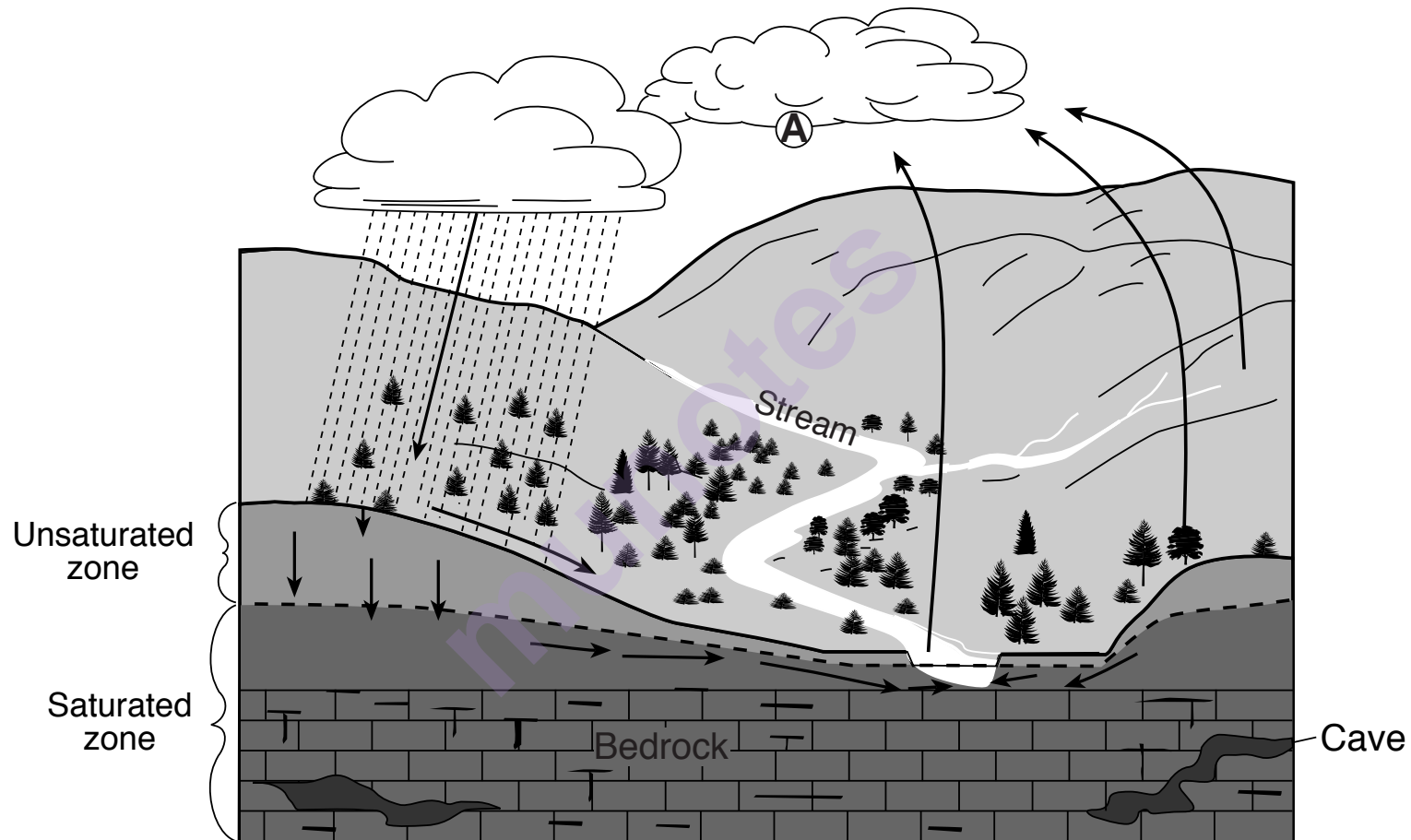


Key	
	Contact metamorphism
	Igneous rock

- 78 Describe *one* piece of evidence shown in the cross section that indicates that rock units *B* and *C* have been disturbed by crustal movement. [1]
- 79 In the blanks *in your answer booklet*, place the letters *E*, *F*, *G*, *S*, and *Z* in the correct order to represent the relative ages of these rock units and features, from oldest to youngest. [1]
- 80 Based on the index fossils found in rock units *A* and *D*, determine approximately how many million years ago (mya) unconformity *W* formed. [1]
-

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Base your answers to questions 81 and 82 on the diagram below and on your knowledge of Earth science. The diagram represents a landscape containing a stream. The arrows represent the movement of water in the water cycle. Letter A is a location where a certain water cycle process is occurring.



- 81 Identify the water cycle process causing cloud formation to occur at location A, and state whether energy is gained or released by the water vapor during this process. [1]
- 82 Describe how the rate of runoff and the rate of infiltration would be affected if the trees were removed from this landscape. [1]
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Base your answers to questions 83 through 85 on the passage and diagram below and on your knowledge of Earth science. Diagram A represents the path of a rocket launched from near the equator toward the North Pole on a nonrotating Earth. Diagram B represents the path of a rocket that appears to curve because Earth is rotating beneath the rocket. Earth's winds are affected in a similar way.

The Coriolis Effect

Earth's rotation causes moving air to curve (deflect) in one direction in the Northern Hemisphere and curve in the opposite direction in the Southern Hemisphere. This is called the Coriolis effect. One factor that controls the amount of deflection of the winds is latitude. The deflection is greatest at the poles, and decreases to zero at the equator. The Coriolis effect is significant for winds that travel long distances over Earth. Other planets may have an even stronger Coriolis effect. There is a direct relationship between a planet's rate of rotation and the amount of deflection due to the Coriolis effect.

Diagram A

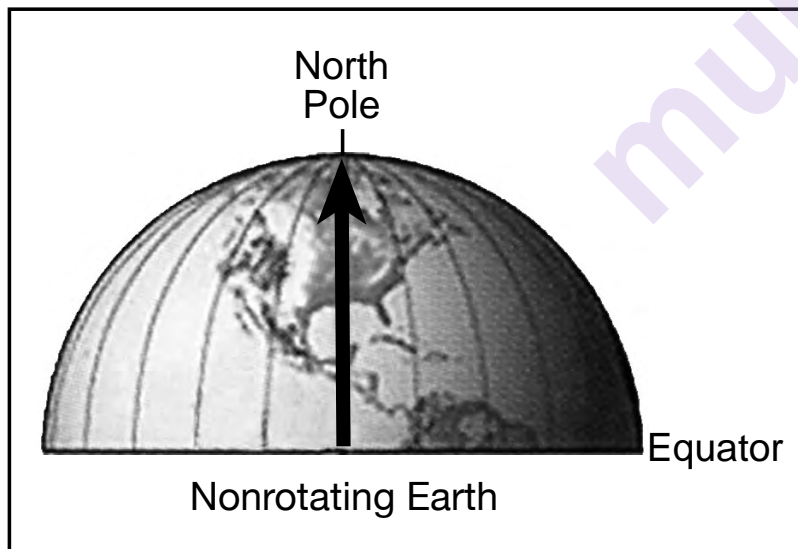
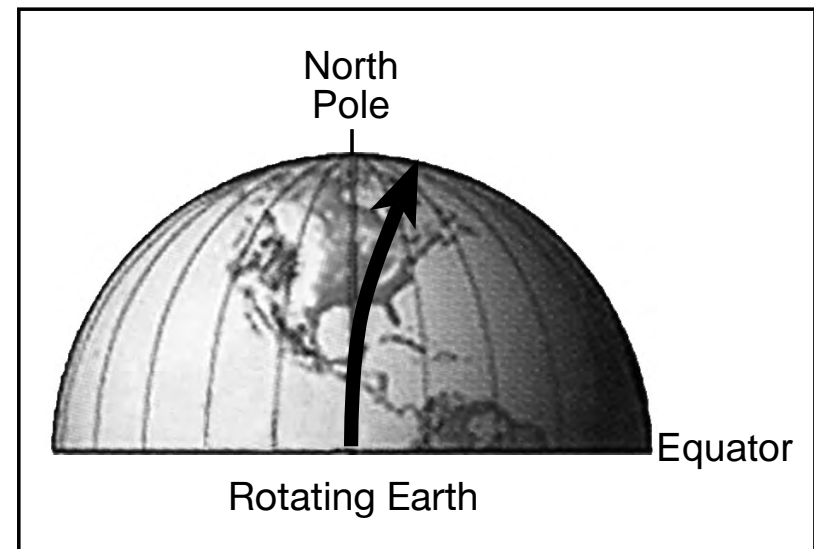


Diagram B



Adapted from: Bell, Trudy. 2001. *Science 101: Weather*.

- 83 For an observer on Earth, identify the direction a rocket's path appears to curve, due to the Coriolis effect, as it travels from near the equator toward the North Pole. [1]
- 84 Describe the relationship between latitude and the amount that the winds deflect due to the Coriolis effect. [1]
- 85 Identify the scientific device that is used on Earth to prove that Earth rotates on its axis. [1]
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