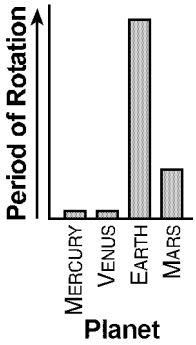
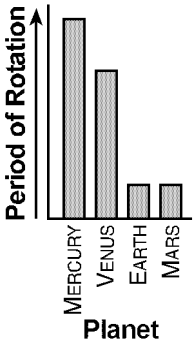
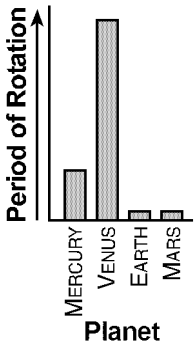
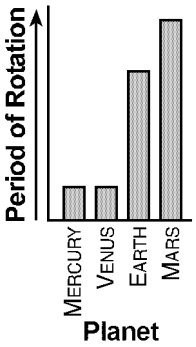
Name: _____

1) Which graph *best* represents the relative periods of rotation of Mercury, Venus, Earth, and Mars?

A)


C)


B)


D)


2) Carbon-14, an isotope used to date recent organic remains, would most likely be useful in determining the age of a fossil

A) Beluga whale
B) armored fish
C) *Coelophysis*
D) trilobite

3) Which mineral will scratch glass (hardness = 5.5), but *not* pyrite?

A) quartz
B) orthoclase
C) fluorite
D) gypsum

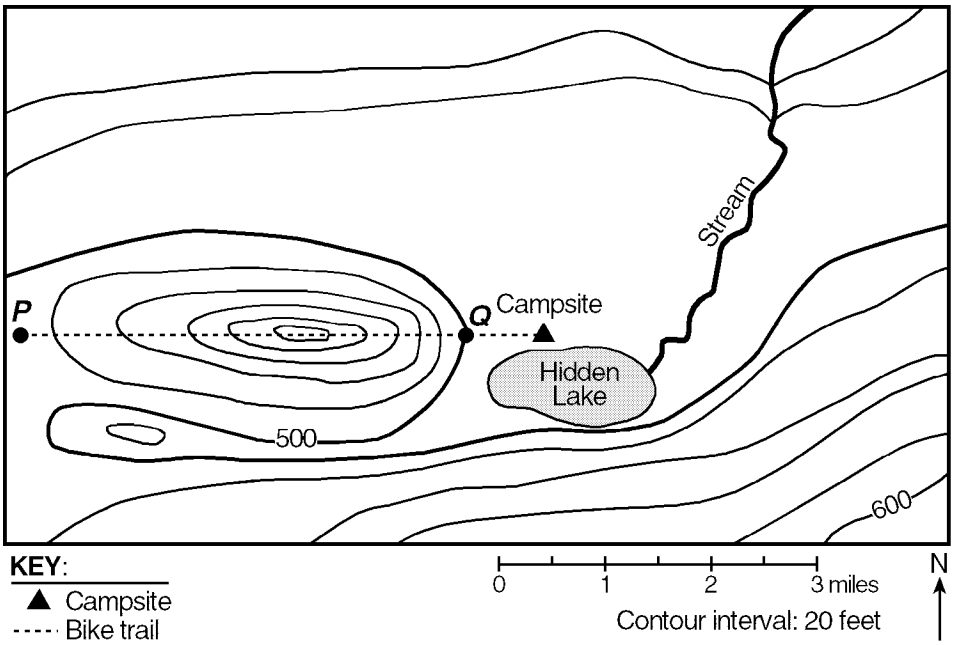
4) Which event occurred *earliest* in geologic history?

A) appearance of the earliest grasses
B) the Grenville Orogeny
C) the intrusion of the Palisades Sill
D) appearance of the earliest birds

Questions 5 through 10 refer to the following:

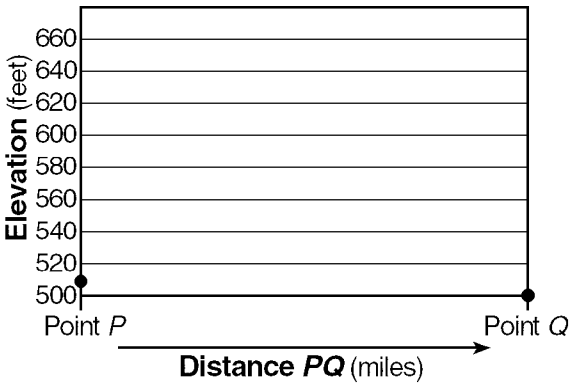
A group of Earth Science students decided to take an adventurous camping trip, so they rode bicycles to a New York State park that was located in an isolated area. They traveled up a steep hill. When they reached the top, they looked at the landscape and noticed a lake at the bottom of the hill. They named it Hidden Lake. To the left of Hidden Lake was a large field with a small stream. They decided to set up their campsite in the field near Hidden Lake. To get to the field, they cycled down a very steep slope.

The map below shows the location of the bicycle trail and the students' campsite. Points *P* and *Q* are reference points on the map.



5) State the evidence shown on the given map that indicates that the area directly north of Hidden Lake is relatively flat.

6) On the grid below, draw a profile of the landscape along the bicycle trail from point *P* to point *Q* by following the directions below.



(a) Plot the elevation along line *PQ* by marking with a dot each point where a contour line is crossed by line *PQ*. Point *P* and point *Q* have been plotted for you.

(b) Connect the dots to complete the profile.

7) The students decided to measure the speed of the stream by floating apples down a straight section of the stream. Describe the steps the students must take to determine the stream's surface rate of movement (speed) by using a stopwatch, a 10-foot rope, and several apples. Include the equation for calculating rate.

8) (a) The next day the students decided to move their campsite 1 mile directly east of their original campsite. On the given map, place another campsite symbol, ▲, to indicate the location of their second campsite.

(b) The students decided to take a different route home to avoid riding their bicycles up the steep hill. Plan a return route that will take the campers back to point *P* and that will involve the least change in elevation during the trip. On the given map, draw a line from the second campsite to point *P* to show the route. Place arrows on the line to show the direction that the students will be traveling.

9) (a) State the general compass direction in which the stream is flowing in the given map.

(b) State how contour lines provide the evidence for determining this direction.

10) (a) While exploring the stream, a student found a rock containing a trilobite fossil. Name the most likely type of rock this student found.

(b) State the geologic era during which the rock containing the trilobite most likely formed.

Questions 11 and 12 refer to the following:

NEW FOSSILS INDICATE ARCTIC CLIMATE USED TO BE FLORIDIAN

The frigid Arctic regions were as warm as present-day Florida some 90 million years ago, according to researchers who found fossils of a crocodile-like animal in northern Canada.

Six hundred miles from the North Pole, researchers from the University of Rochester found the fossilized remains of the champosaur, a toothy, 8-foot-long extinct crocodile.

"We found a whole collection of fossils, from both young and adults," said scientist John H. Tarduno.

"The champosaur is a cold-blooded animal that could not have survived in the current climate of the Canadian Arctic where the fossils were found," Tarduno said.

Temperatures at the fossil site now routinely drop to minus 60 degrees Fahrenheit in the winter. When the champosaur lived there 86 million to 92 million years ago, winter temperatures rarely dropped to freezing and summer readings of 80 degrees were common.

The cold-blooded champosaur depended on the environment for warmth and probably became immobile if the temperature was too cold. Most likely, the champosaur was too small to have migrated seasonally.

A field team from the University of Rochester found the fossils in a layer of sandstone located above a layer of basaltic lava.

11) Explain why *no* champosaur fossils were found within the layer of basaltic lava.

12) State the geologic time period in which the champosaur lived.

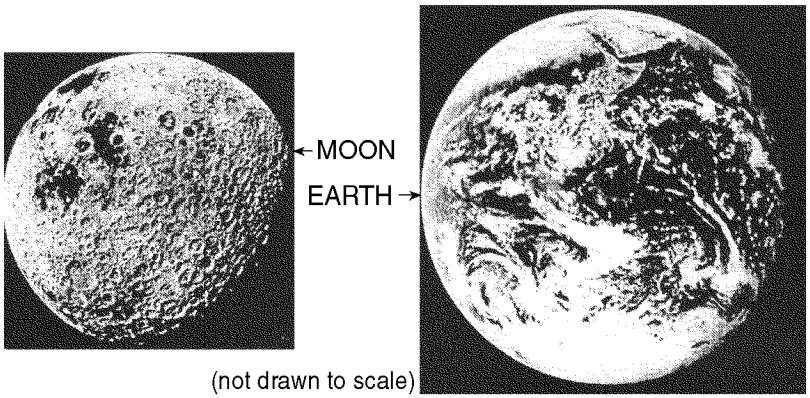
13) Accurate observations of the Sun were made by a New York State observer. This person observed the time of sunrise and the position of sunrise along the eastern horizon for each day during the month of May.

Describe how the time of sunrise changed for the observer each day during the month of May.

14) Which common rock is formed from the solidification of molten material?

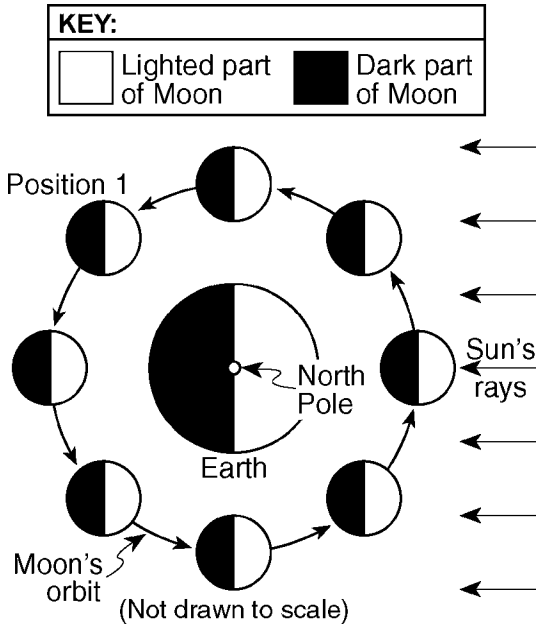
A) rhyolite B) coal C) rock gypsum D) slate

15) The photographs below show the Moon and Earth as viewed from space. It is inferred that Earth had many impact craters similar to those shown on the Moon.



Describe *one* process that has destroyed many of the impact craters that once existed on Earth.

16) The diagram below represents the Moon in its orbit, as viewed from above Earth's North Pole. Position 1 represents a specific location of the Moon in its orbit.



Which phase of the Moon will be seen from Earth when the Moon is at position 1?

A) 
B) 
C) 
D) 

17) Which two locations are in the same New York State landscape region?

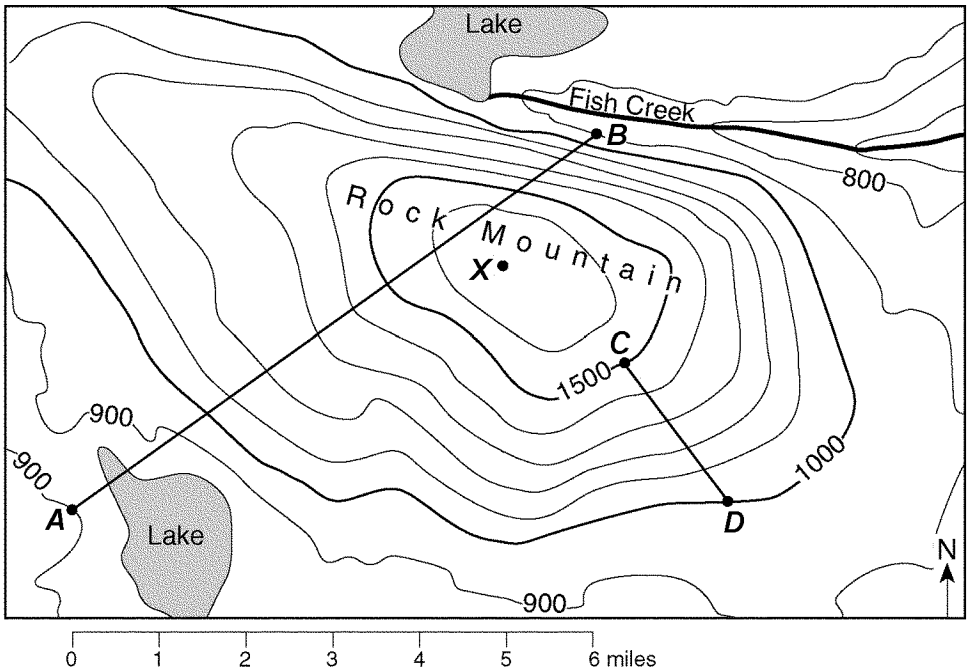
A) Albany and Old Forge
B) Jamestown and Ithaca
C) Binghamton and New York City
D) Massena and Mt. Marcy

18) During the Permian Period, sedimentary bedrock in the Appalachian Region was subjected to high temperature and pressure. Calcite deposits that had existed in this environment would most likely have formed

A) gneiss B) marble C) schist D) gabbro

Questions 19 through 21 refer to the following:

Points *A*, *B*, *C*, *D*, and *X* represent locations on the map below. Elevations are measured in feet.



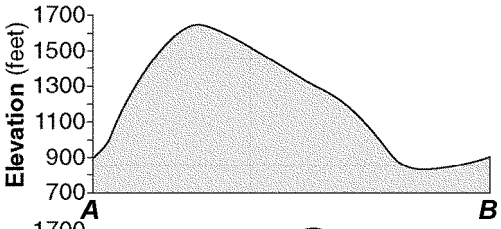
19) What is the average gradient of the slope along straight line *CD* in the map?

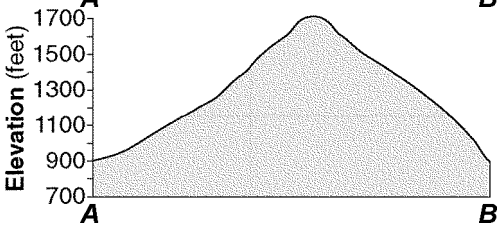
A) 500 ft/mi B) 250 ft/mi C) 100 ft/mi D) 1,000 ft/mi

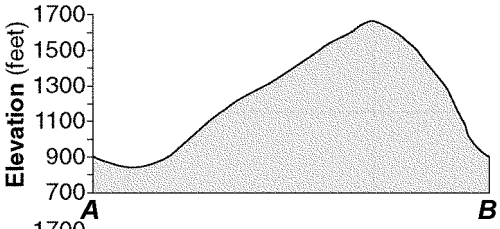
20) What is the *highest* possible elevation of point *X* on Rock Mountain in the map?

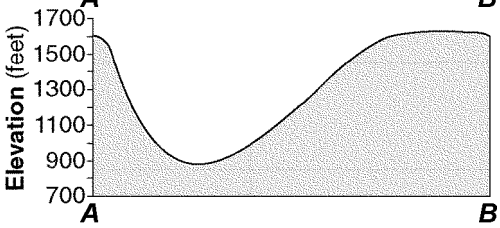
A) 1,601 ft B) 1,699 ft C) 1,600 ft D) 1,599 ft

21) Which cross section *best* represents the profile along straight line *AB* in the map?

A)


B)


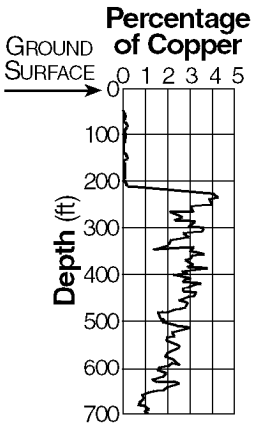
C)


D)


22) The *best* evidence that Earth spins on its axis is provided by
   A) eclipses of the Moon
   B) changes in the position of sunspots on the Sun
   C) apparent shifts in the swing of a Foucault pendulum
   D) variations in atmospheric density

23) The *best* evidence that Earth rotates is provided by the
   A) rate of uranium-238 decay and changes in atmospheric composition
   B) pattern of changing seasons and the depth of meteor impacts
   C) movement of Foucault pendulums and the Coriolis effect on air movement
   D) location of mid-oceanic ridge volcanoes and the distribution of index fossils

24) The graph below shows the concentration (percentage) of copper at various depths in the bedrock at a mine in Arizona.

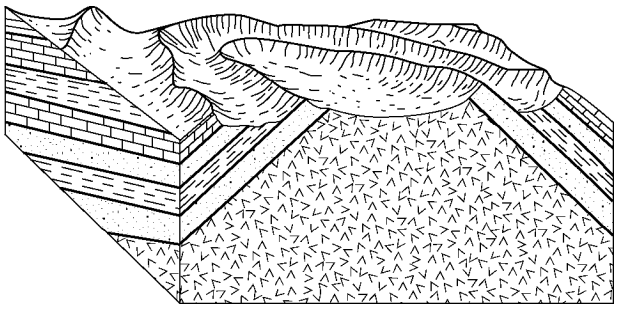


Between which depths should the bedrock be mined in order to obtain rock with the *highest* percentage of copper?

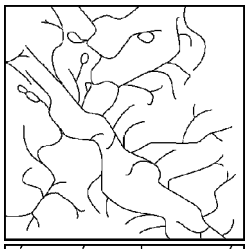
A) 330-360 ft B) 650-680 ft C) 230-260 ft D) 100-130 ft

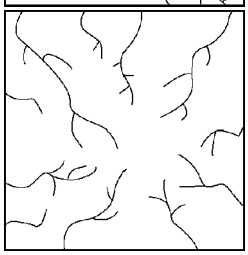
25) Which of the following processes could lead directly to the formation of pumice rock?
   A) metamorphism of unmelted rock material
   B) precipitation of minerals from evaporating seawater
   C) deposition of quartz sand
   D) explosive eruption of lava from a volcano

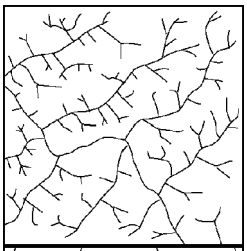
26) The block diagram below represents a deeply eroded dome.

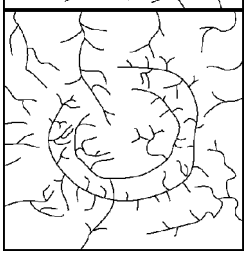


Which of the following maps shows the stream drainage pattern that would most likely develop on this deeply eroded dome?

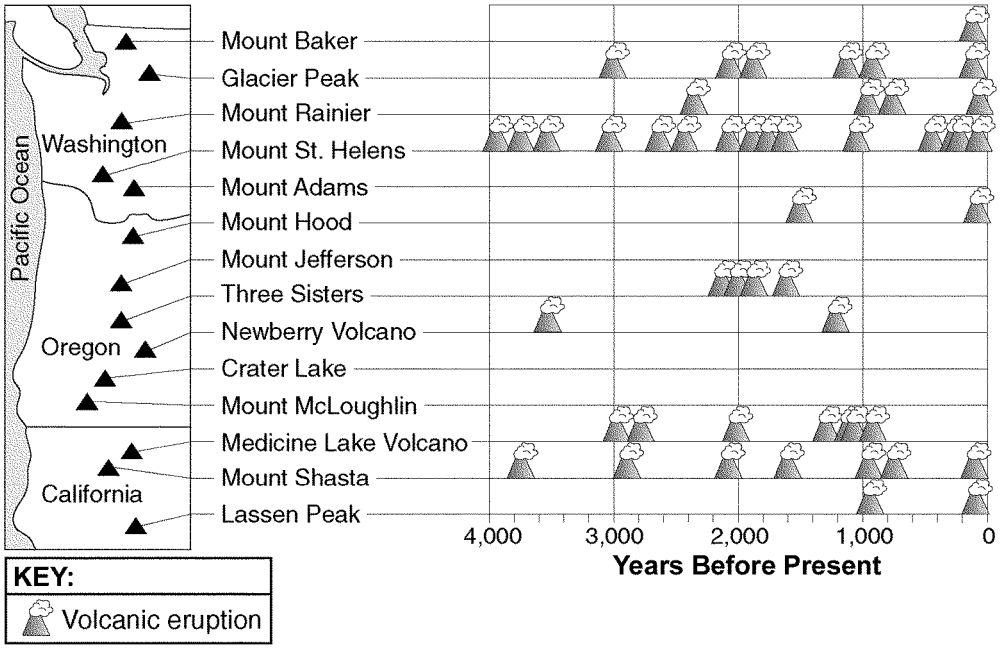
A) 

B) 

C) 

D) 

27) The map below shows the name and location of the volcanic peaks in the Cascade Mountain Range of the northwestern United States west of the Yellowstone Hot Spot. The table shows the major eruptions of each peak over the past 4,000 years.



During which geologic epoch did the volcanic activity shown on the table occur?

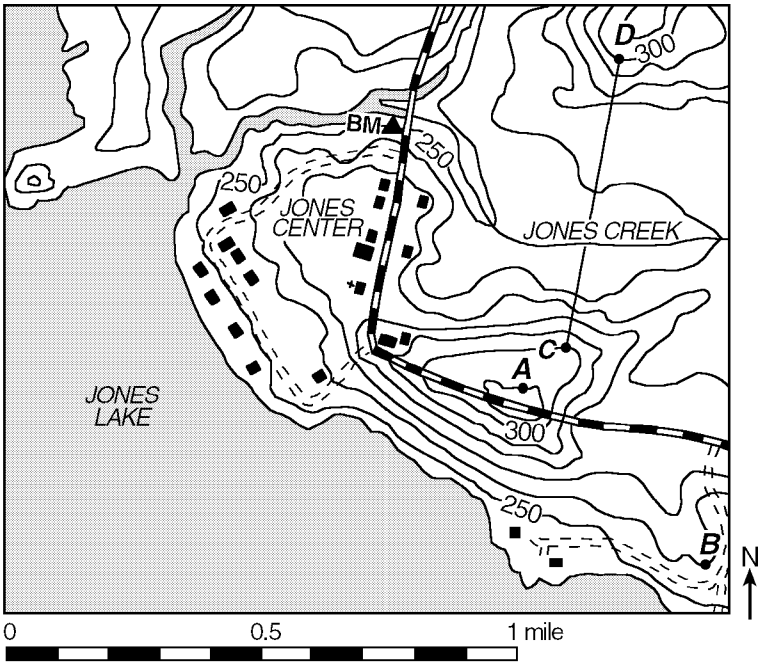
28) What are the *largest* particles that a stream can transport when its velocity is 200 centimeters per second?

A) silt B) pebbles C) cobbles D) sand

29) Name the weather instrument used to measure the air pressure at the center of a low pressure system.

Questions 30 through 32 refer to the following:

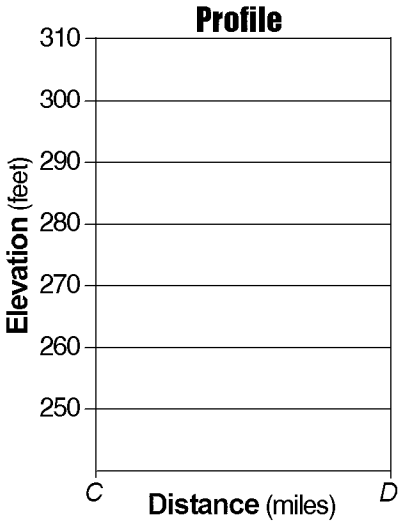
Points *A* through *D* are locations on the topographic map below. Elevations are in feet.



30) On the grid below, construct a profile of the land surface between point *C* and point *D* by following the directions below.

(a) Plot the elevations along line *CD* by marking with a dot each point where an isoline is crossed by line *CD*.

(b) Connect the dots to complete the profile.



31) Explain briefly how the map can be used to determine that Jones Creek is flowing westward into Jones Lake.

32) Determine the gradient from point *A* to point *B* by following the directions below.

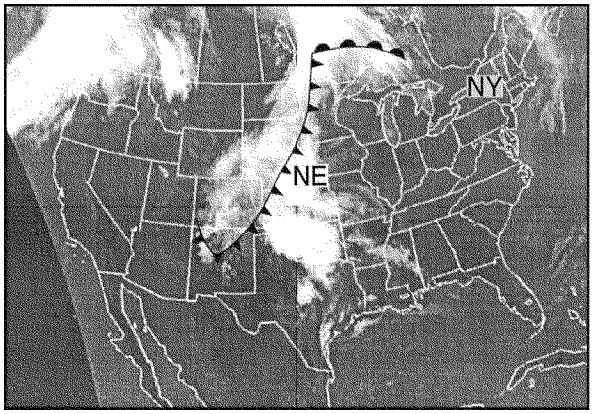
(a) Write the equation for determining the gradient.

(b) Substitute data from the map into the equation.

(c) Calculate the gradient and label it with the proper units.

Questions 33 and 34 refer to the following:

The satellite image below shows cloud patterns associated with weather fronts over the United States on a certain day. The states of Nebraska (NE) and New York (NY) have been labeled.



33) Which type of front was producing the weather in Nebraska when this image was taken?

A) warm front
B) cold front
C) stationary front
D) occluded front

34) At the time this satellite image was taken, what were the weather conditions in New York State?

A) very cloudy with no precipitation
B) cloudy with heavy precipitation
C) mostly cloudy in the northern part of the State and clear in the southern part
D) clear skies with no precipitation

35) Which planet has an orbit with an eccentricity *most* similar to the eccentricity of the Moon's orbit around Earth?

A) Earth
B) Pluto
C) Saturn
D) Jupiter

36) Which atmospheric conditions would cause smoke from a campfire on a beach to blow toward the ocean?
   A) humid air over the land and dry air over the ocean
   B) low-density air over the land and high-density air over the ocean
   C) warm air over the land and cool air over the ocean
   D) high air pressure over the land and low air pressure over the ocean

Questions 37 through 39 refer to the following:

The notes below were written by a student during field trips to three different locations in New York State.

NOTES:

Location *A*

Good view from this hilltop; chilly and windy. We rested to catch our breath, then collected samples. Rocks are visible everywhere. There are boulders, cobbles, and pebbles of many sizes and shapes mixed together. These surface rock fragments are composed of metamorphic rock sitting on the limestone bedrock. The teacher showed us parallel scratches in the bedrock. I saw almost no soil.

Location *B*

It is rocky and the stream-bank is steep. Where we are standing, we can see a waterfall and rapids. It is cool by the water. From the streambed we collected some pebbles and cobbles — some red, some white, others a mixture of many colors. The streambed is full of rocks of all sizes. The teacher warned us to be careful of the strong stream current.

Location *C*

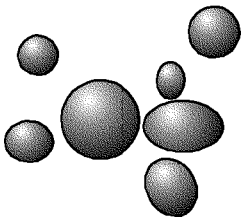
It is cool in the shade, and the rock cliff above us still has some ice on it from winter. The rocks we are sitting on have sharp edges. Rock fragments at the bottom of the cliff are the same color as the cliff. Our teacher warned us to watch out for falling rocks.

37) (a) State the agent of erosion that deposited most of the sediment found at location *A*.

   (b) State *one* observation recorded by the student that supports this conclusion.

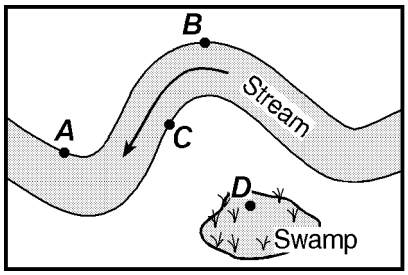
38) Explain how ice in cracks on the cliff at location *C* may have helped cause weathering of the bedrock on the face of the cliff.

39) Some samples of sediment collected from the streambed at location *B* are shown below.



Explain why these samples are smooth and have rounded shapes.

40) The map below shows the area surrounding a meandering stream.



At which point is erosion *greatest*?

A) *A* B) *B* C) *C* D) *D*

41) A student used a sling psychrometer to measure the humidity of the air. If the relative humidity was 65% and the dry-bulb temperature was 10°C, what was the wet-bulb temperature?

A) 3°C B) 7°C C) 10°C D) 5°C

42) The California Ocean Current, which flows along the west coast of North America, is a

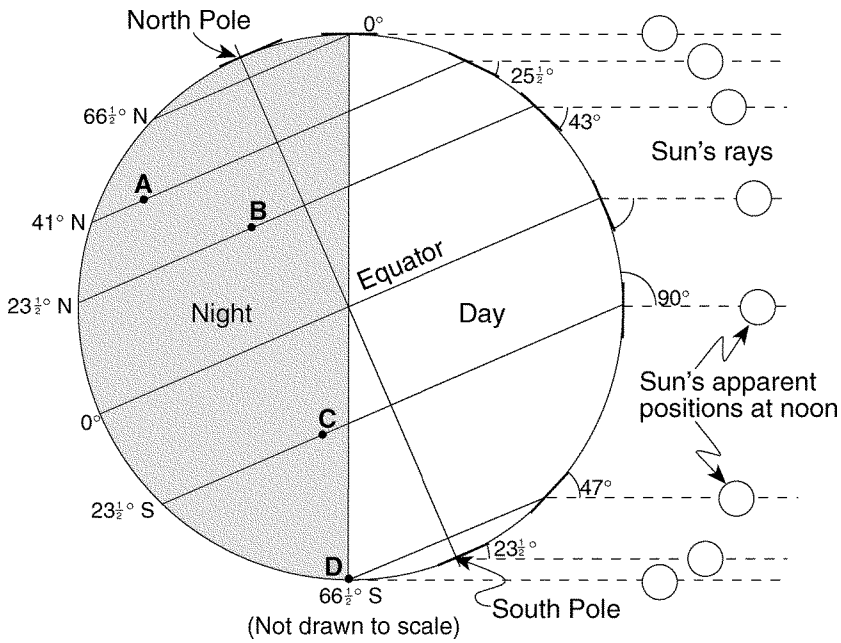
A) cool current, flowing north
B) cool current, flowing south
C) warm current, flowing south
D) warm current, flowing north

43) What is the average velocity of an earthquake's *S*-wave in its *first* 4 minutes of travel?

A) 1 km/min B) 500 km/min C) 4 km/min D) 250 km/min

Questions 44 through 46 refer to the following:

The diagram below shows the altitude and apparent position of the noontime Sun, as seen from various latitudes on Earth on a particular day of the year. Letters *A* through *D* represent locations on Earth's surface.



44) Which lettered location in the diagram will experience the *shortest* period of daylight during one Earth rotation on that particular day?

A) *A* B) *B* C) *C* D) *D*

45) Which season will begin at 41° N latitude, three months after the date represented in the diagram?

A) summer B) fall C) spring D) winter

46) What is the altitude of the noontime Sun at the Equator on the particular date shown in the diagram?

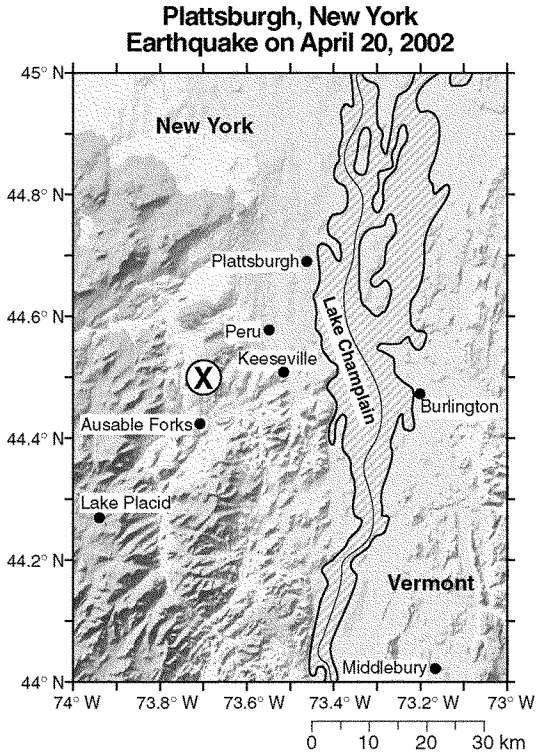
A) $23\frac{1}{2}°$ B) $66\frac{1}{2}°$ C) 90° D) 43°

47) In which direction do surface winds around low-pressure centers in the Northern Hemisphere generally move?

A) clockwise, away from the center of the low
B) clockwise, toward the center of the low
C) counterclockwise, away from the center of the low
D) counterclockwise, toward the center of the low

Questions 48 through 51 refer to the following:

The map below shows the location of the epicenter, (X), of an earthquake that occurred on April 20, 2002, about 29 kilometers southwest of Plattsburgh, New York.



48) What is the minimum number of seismographic stations needed to locate the epicenter of an earthquake?

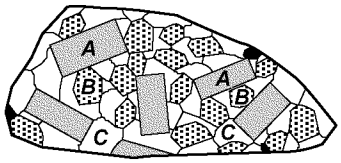
49) A seismic station located 1,800 kilometers from the epicenter recorded the *P*-wave and *S*-wave arrival times for the earthquake shown. What was the difference in the arrival time of the first *P*-wave and the first *S*-wave?

50) State the latitude and longitude of the earthquake epicenter shown in the map. [*Express your answers to the nearest tenth of a degree and include the compass directions*.]

51) Explain why the earthquake described was most likely felt with greater intensity by people in Peru, New York, than by people in Lake Placid, New York.

Questions 52 and 53 refer to the following:

The diagram below represents a felsic igneous rock. Letters *A*, *B*, and *C* represent three different minerals in the rock sample. The table describes the physical properties of minerals *A*, *B*, and *C* found in the igneous rock sample.



(Actual size)

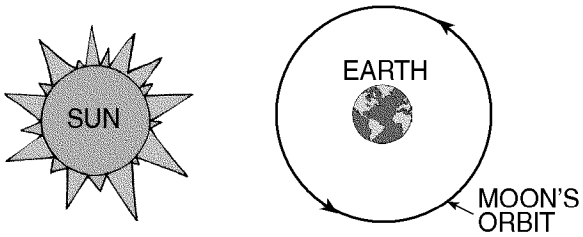
Mineral	Key	Physical Properties
A		pink, cleaves in two directions at 90°
B		white, cleaves in two directions, striations visible
C		colorless or clear with a glassy luster

52) State the names of minerals *A*, *B*, and *C* in the diagram shown.

53) State the texture of the igneous rock shown in the diagram.

Questions 54 through 56 refer to the following:

The diagram below shows the Sun, Earth, and the Moon's orbit around Earth as viewed from space.



(not drawn to scale)

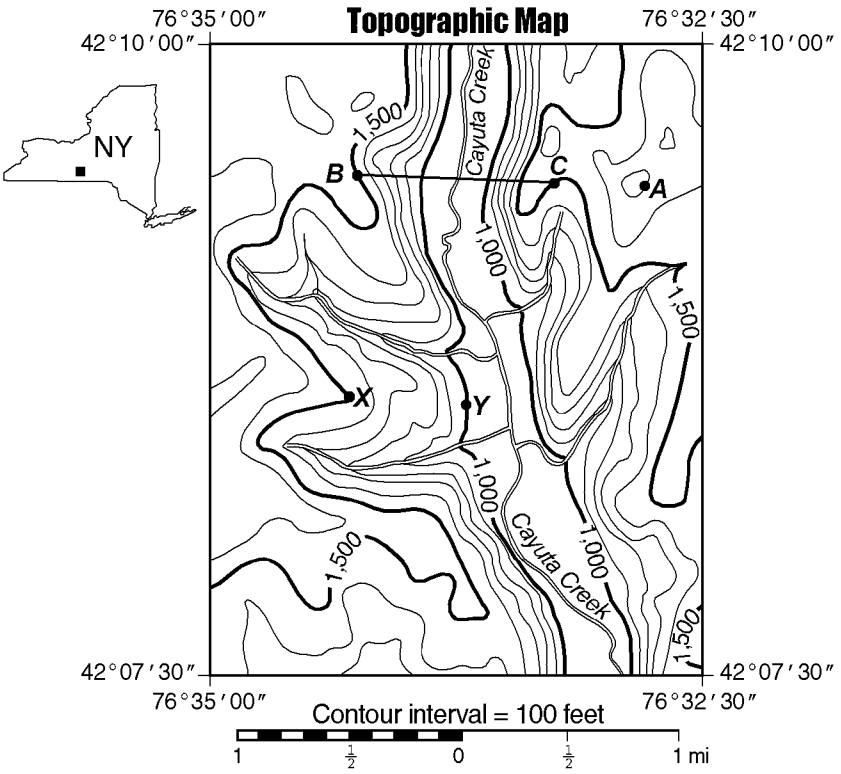
54) On the given diagram, draw a circle of approximately this size ◯ to represent the Moon's position in its orbit when a solar eclipse is viewed from Earth.

55) Approximately how many complete revolutions does the Moon make around Earth each month?

56) Explain why solar eclipses do *not* occur every time the Moon revolves around Earth.

Questions 57 through 61 refer to the following:

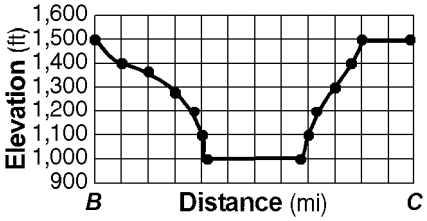
Points *A*, *B*, *C*, *X*, and *Y* are locations on the topographic map below. The small map identifies the New York State region shown in the topographic map.

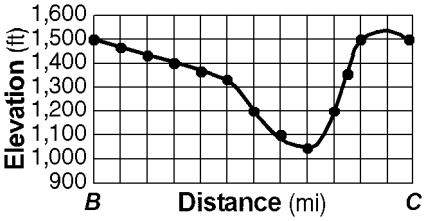


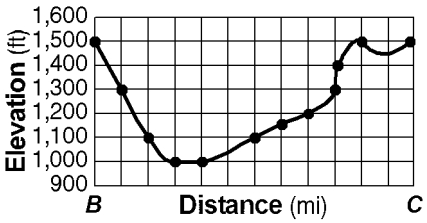
57) What is the approximate gradient between point *X* and point *Y*?

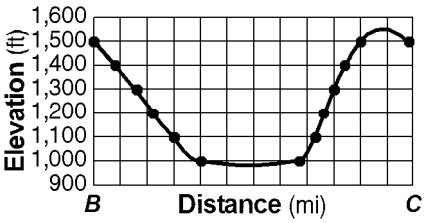
A) 100 ft/mi B) 500 ft/mi C) 1,000 ft/mi D) 250 ft/mi

58) Which graph *best* represents the profile from point *B* to point *C*?

A)


C)


B)


D)


59) Which evidence *best* supports the inference that the meltwater river that once occupied the Cayuta Creek valley was larger than the modern Cayuta Creek?

A) The tributary streams meet the modern Cayuta Creek at nearly right angles.
B) The modern Cayuta Creek lacks meanders and a flood plain.
C) The modern Cayuta Creek occupies a V-shaped valley.
D) The valley floor is wider than the modern Cayuta Creek.

60) What is the elevation of point *A* on the topographic map?

A) 1,600 ft B) 1,650 ft C) 1,700 ft D) 1,550 ft

61) At the end of the Ice Age, the valley now occupied by Cayuta Creek was a channel for southward flowing glacial meltwater. Into which present-day river valley did this meltwater most likely flow?

A) Susquehanna River
B) Genesee River
C) Hudson River
D) Delaware River

62) Which mountain range resulted from the collision of North America and Africa, as parts of Pangea joined together in the late Pennsylvanian Period?

A) Appalachian Mountains
B) Acadian Mountains
C) Taconic Mountains
D) Grenville Mountains

63) The Moon has many more impact craters visible on its surface than Earth has on its surface. State *two* reasons that Earth has so few visible impact craters.

Questions 64 through 69 refer to the following:

FIRE AND ICE — AND SLUGGISH MAGMA

On the night of November 13, 1985, Nevado del Ruiz, a 16,200-foot (4,938 meter) snow-capped volcano in northwestern Colombia, erupted. Snow melted, sending a wall of mud and water raging through towns as far as 50 kilometers away, and killing 25,000 people.

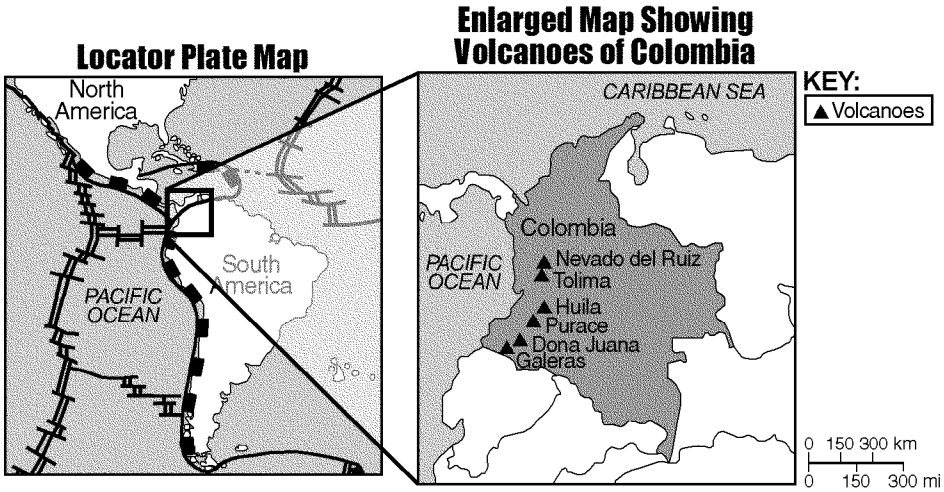
Long before disaster struck, Nevado del Ruiz was marked as a trouble spot. Like Mexico City, where an earthquake killed at least 7,000 people in October 1985, Nevado del Ruiz is located along the Ring of Fire. This ring of islands and the coastal lands along the edge of the Pacific Ocean are prone to volcanic eruptions and crustal movements.

The ring gets its turbulent characteristics from the motion of the tectonic plates under it. The perimeter of the Pacific, unlike that of the Atlantic, is located above active tectonic plates. Nevado del Ruiz happens to be located near the junction of four plate boundaries. In this area an enormous amount of heat is created, which melts the rock 100 to 200 kilometers below Earth's surface and creates magma.

Nevado del Ruiz hadn't had a major eruption for 400 years before this tragedy. The reason: sluggish magma. Unlike the runny, mafic magma that makes up the lava flows of oceanic volcanoes such as those in Hawaii, the magma at this type of subduction plate boundary tends to be sticky and slow moving, forming the rock andesite when it cools. This andesitic magma tends to plug up the opening of the volcano. It sits in a magma chamber underground with pressure continually building up. Suddenly, tiny cracks develop in Earth's crust, causing the pressure to drop. This causes the steam and other gases dissolved in the magma to violently expand, blowing the magma plug free. Huge amounts of ash and debris are sent flying, creating what is called an explosive eruption.

Oddly enough, the actual eruption of Nevado del Ruiz didn't cause most of the destruction. It was caused not by lava but by the towering walls of sliding mud created when large chunks of hot ash and pumice mixed with melted snow.

The enlarged map below shows the location of volcanoes in Colombia, South America.



64) Describe *one* emergency preparation that may reduce the loss of life from a future eruption of the Nevado del Ruiz volcano.

65) What are the names of the four tectonic plates located near the Nevado del Ruiz volcano?

66) What caused the magma to expand, blowing the magma plug free?

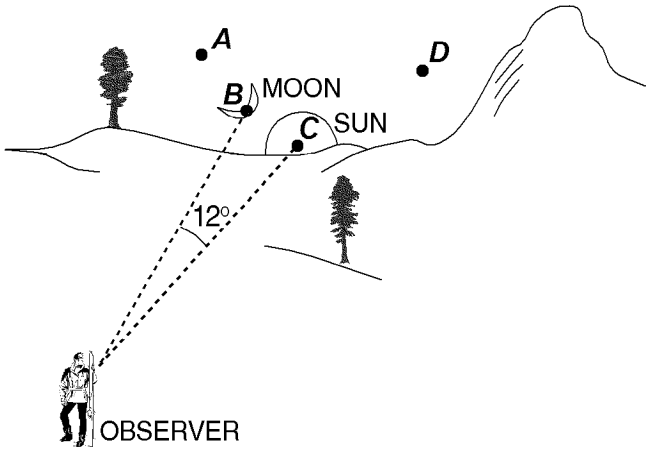
67) Vesicular texture is very common in igneous rocks formed during andesitic eruptions. Explain how this texture is formed.

68) Why are eruptions of Nevado del Ruiz generally more explosive than most Hawaiian volcanic eruptions?

69) What caused most of the destruction associated with the eruption of Nevado del Ruiz?

70) Which layer of Earth is composed of *both* the crust and the rigid mantle?

71) The diagram below shows the positions of the Moon and the Sun at sunset during an evening in New York State. Points *A*, *B*, *C*, and *D* represent positions along the western horizon.



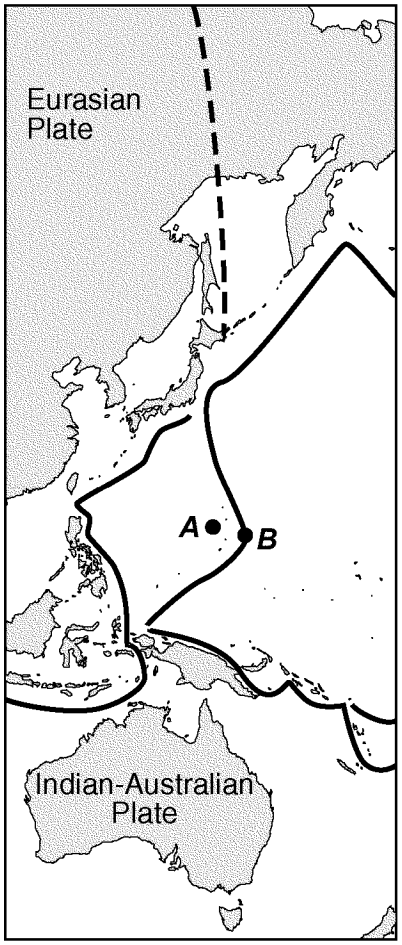
At sunset on the following evening, the Moon will be located at what position?

A) *A* B) *B* C) *C* D) *D*

Questions 72 and 73 refer to the following:

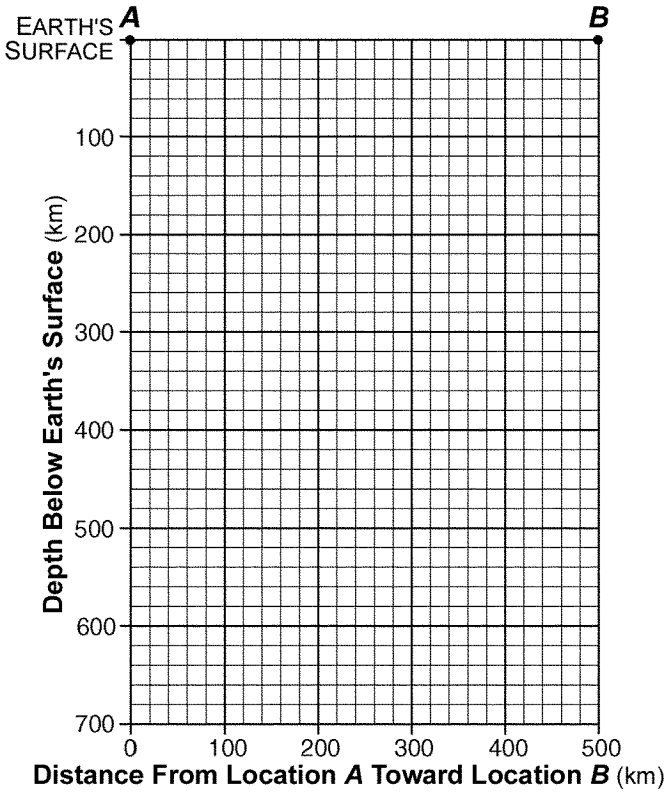
The map below shows some tectonic plates and the boundaries between them. Letters *A* and *B* are locations on Earth's surface. The data table shows the depth below Earth's surface of five earthquakes measured from location *A* toward location *B*.

MAP



DATA TABLE

Earthquake	Distance from Location *A* Toward Location *B* (km)	Depth Below Earth's Surface (km)
1	100	600
2	200	400
3	250	300
4	300	250
5	400	60

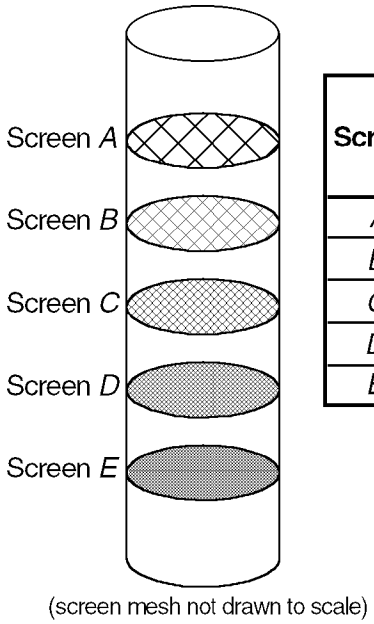


72) On the grid provided, plot the depths of the five earthquakes from location *A* toward location *B*.

73) Identify the type of plate boundary or geologic feature found at location *B* on the map shown.

Questions 74 through 76 refer to the following:

To sort a quartz sediment sample by particle size, a student shook the sample through a column containing screens *A* through *E*. The mesh of the screens (the open spaces between the wires) had different-sized openings, as represented by the diagram. The results of the sorting are given in the student's data table below.



Student Data Table

Screen	Screen Mesh Opening Size (cm)	Percentage of Particles Trapped by the Screen (%)
A	0.1	0
B	0.05	30
C	0.025	45
D	0.0125	15
E	0.00625	10

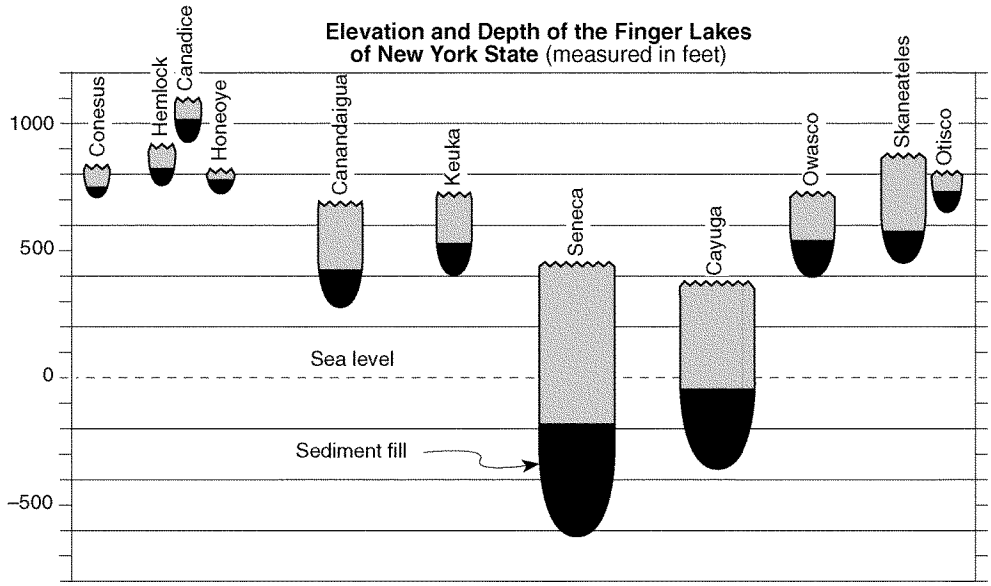
74) Explain why screens *B* through *E* must be arranged in the order shown in the given diagram to separate the sediments as shown in the student data table.

75) State *two* processes that must occur in nature to change a deposit of the given sediments into a clastic sedimentary rock.

76) What clastic sedimentary rock may be formed from particles of the same size as the given quartz sediment sample?

Questions 77 and 78 refer to the following:

A cross section of the Finger Lakes Region is shown below.



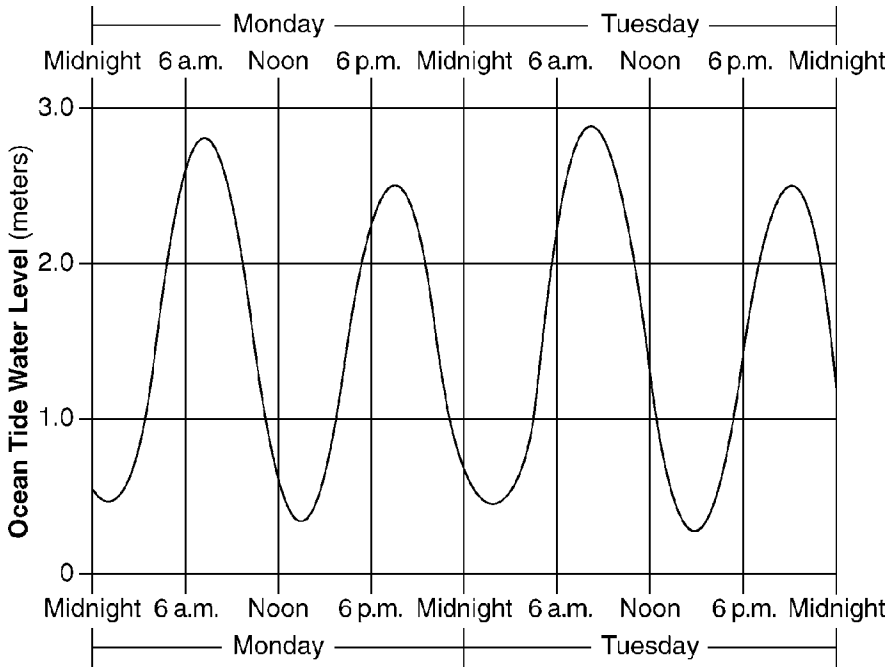
77) Identify *two* processes that normally occur to form the type of surface bedrock found in the Finger Lakes Region.

78) According to the cross section, how thick from top to bottom is the sediment fill in Seneca Lake?

79) Clouds usually form when
   A) relative humidity is 0%
   B) air temperature reaches the dewpoint
   C) evaporation has warmed the surrounding air
   D) condensation nuclei have been removed from the air

Questions 80 through 82 refer to the following:

The graph below shows the water levels of ocean tides measured in Boston, Massachusetts, for a 2-day period.



80) The given graph shows that high tides at Boston occur approximately every

A) 12.5 hours B) 3.5 hours C) 16.0 hours D) 6.0 hours

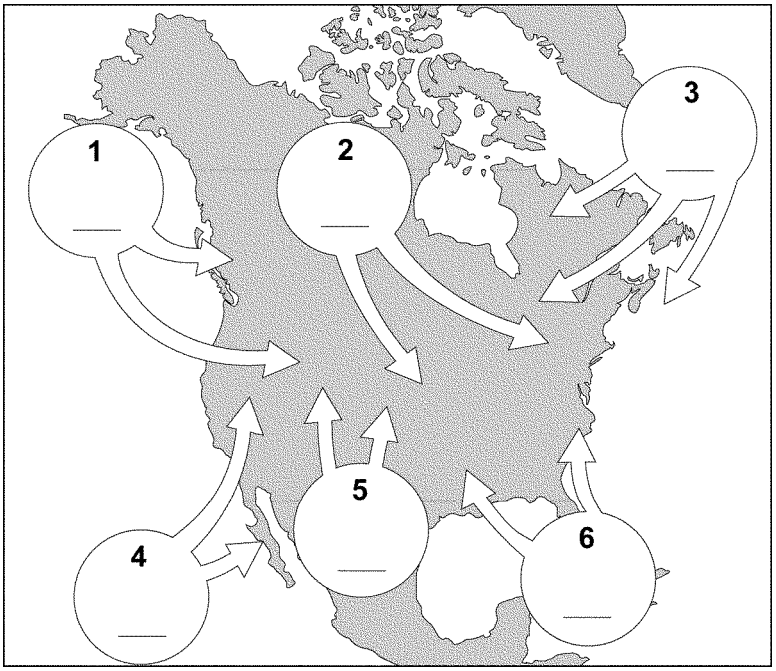
81) If the trends shown by the graph continue, which statement *best* describes the next low tide at Boston that is expected to occur on Wednesday?

A) It will occur about 10 p.m. with a 2.8-meter water level.
B) It will occur about 3 a.m. with a 0.4-meter water level.
C) It will occur about 6 a.m. with a 0.6-meter water level.
D) It will occur about 9 p.m. with a 2.6-meter water level.

82) The gravitational pull of the Moon has the greatest influence on the water levels of Earth's ocean tides. If the distance between the Moon and Earth were to *decrease* steadily for the week following the time shown on the graph, which water-level changes would be expected to occur?

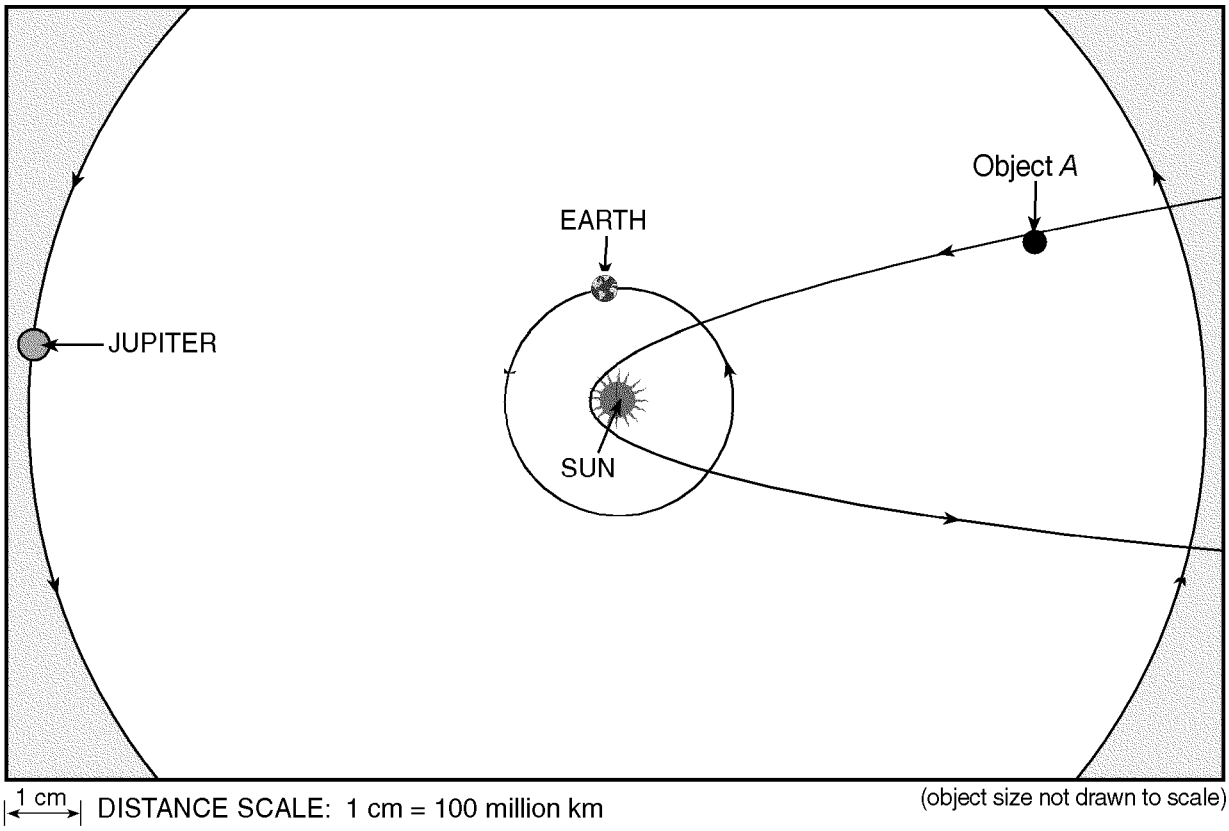
A) Both high tides and low tides would get lower.
B) High tides would get higher and low tides would get lower.
C) High tides would get lower and low tides would get higher.
D) Both high tides and low tides would get higher.

83) The map below shows six source regions for different air masses that affect the weather of North America. The directions of movement of the air masses are shown. Using the standard two-letter air-mass symbols from the Earth Science Reference Tables, label the air masses by writing the correct symbol in each circle on the map.



Questions 84 through 86 refer to the following:

The diagram below shows a model of the orbital path of Earth and the partial orbital path of Jupiter around the Sun. A partial orbit of another celestial object, labeled object *A*, is also shown. Celestial object *A* is a natural object that is part of our solar system. [*All distances are measured to scale from the center of the Sun in this model.*]



84) (a) On the given diagram, place an **X** to represent the position of Mars at the properly scaled distance from the Sun in this model.

(b) On the given diagram, starting at your plotted position of Mars, draw a scale model of Mars' orbital path. [*Be careful to showthe correct shape of the orbit.*]

85) Identify what type of solar-system object is most probably represented by celestial object *A* in the given diagram.

86) State *one* reason why determining the exact orbital path and period of revolution of celestial object *A* in the given diagram might be important to the continued existence of life on Earth.

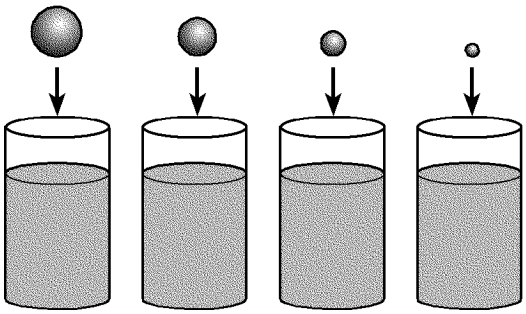
87) The *greatest* amount of rainwater infiltration occurs on the side of a hill if the surface of a permeable soil has

A) small soil particles and a gentle slope
B) large soil particles and a gentle slope
C) small soil particles and a steep slope
D) large soil particles and a steep slope

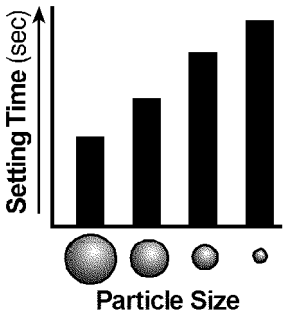
88) Why are the beaches that are located on the southern shore of Long Island often considerably cooler than nearby inland locations on hot summer afternoons?

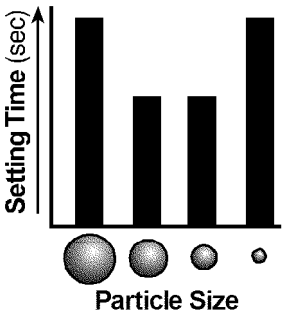
A) A land breeze develops due to the lower specific heat of water and the higher specific heat of land.
B) The beaches are farther from the Equator than the inland locations are.
C) A sea breeze develops due to the higher specific heat of water and the lower specific heat of land.
D) The beaches are closer to the Equator than the inland locations are.

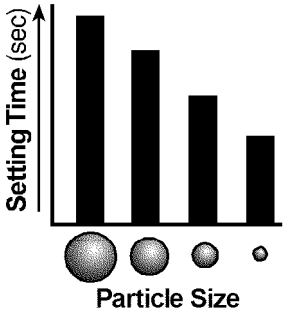
89) The diagram below shows four identical columns containing the same amount of water. Four different-sized spherical particles, made of the same uniform material, are dropped into the columns and settle to the bottom.

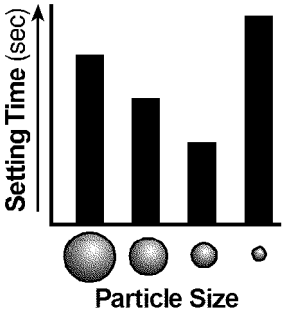


Which one of the following graphs *best* shows the relative settling times of the four particles?

A)


C)


B)


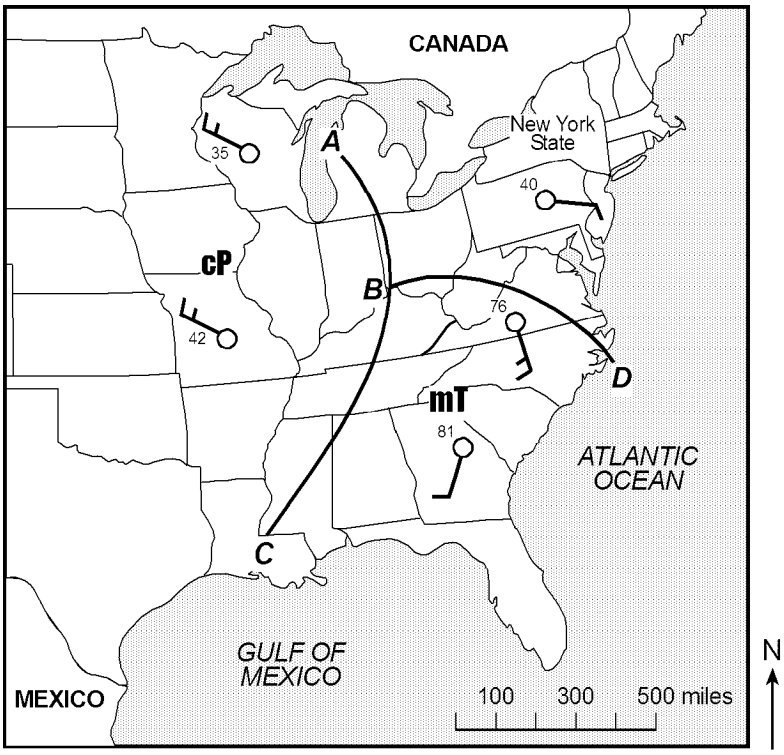
D)


90) The Milky Way galaxy is *best* described as
   A) a spiral-shaped formation composed of billions of stars
   B) a region in space between the orbits of Mars and Jupiter
   C) a type of solar system
   D) a constellation visible to everyone on Earth

91) Surface ocean currents located at 40° south latitude, 90° west longitude generally flow toward the
   A) southwest B) west C) southeast D) northeast

Questions 92 through 94 refer to the following:

The weather map below shows a low-pressure system over part of North America. Five weather stations are shown on the map. Lines AB, BC, and BD represent surface frontal boundaries. Line AB represents an occluded front that marks the center of a low-pressure system. Symbols **cP** and **mT** represent different air masses.



92) Other than low pressure, state *two* weather conditions associated with a low-pressure center.

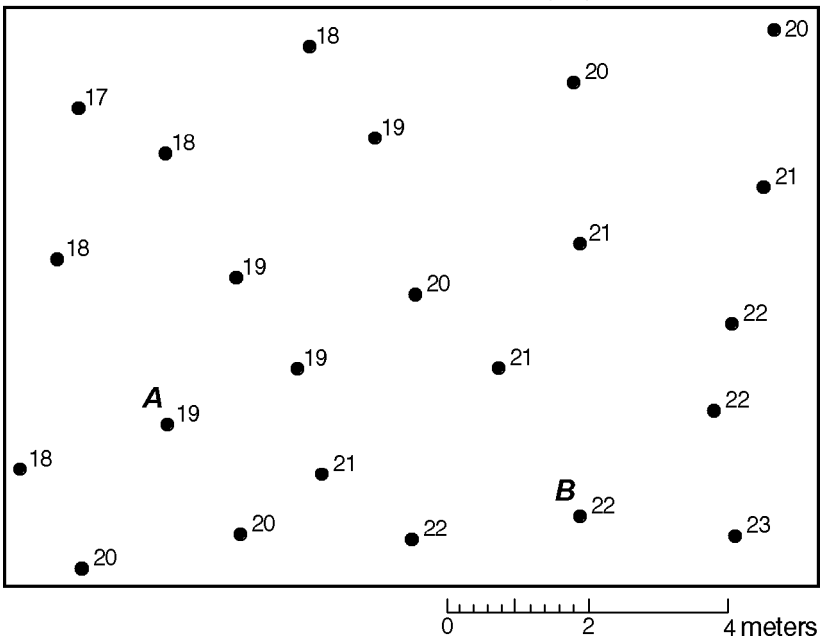
93) On the weather map, place the proper front symbols on lines AB, BC, and BD. Place the front symbols on the correct side of each line to show the direction of front movement.

94) Name the geographic region over which the **mT** air mass most likely formed.

Questions 95 through 97 refer to the following:

The temperature field map below shows temperature readings (°C) recorded by students in a science classroom. The readings were taken at the same time at floor level. Temperature readings for points *A* and *B* are labeled on the map.

Temperature Field Map (°C)



95) Determine the temperature gradient from point *A* to point *B* in the given map by following the directions below.

(a) Write the equation used to determine the gradient.

(b) Substitute values from the field map into the equation.

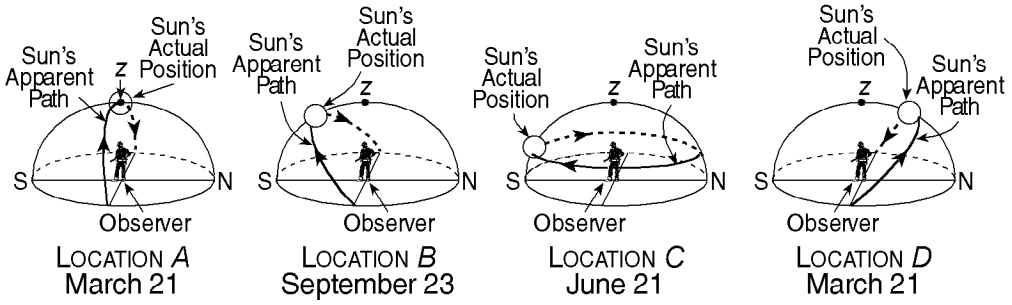
(c) Solve the equation and label the answer with the proper units.

96) State the temperature (in degrees Fahrenheit [°F]) of point *A* in the given map.

97) On the given temperature field map, use solid lines to draw the 18°C, 20°C, and 22°C isotherms. [*Isotherms must extend to the boundary of the map. Label each isotherm to indicate its temperature.*]

Questions 98 through 100 refer to the following:

The diagram below shows a model of the apparent path and position of the Sun in relation to an observer at four different locations, *A*, *B*, *C*, and *D*, on Earth's surface on the dates indicated. The zenith (*z*) and the actual position of the Sun in the model at the time of the observation are shown. [*The zenith is the point directly over the observer.*]



98) According to the Sun's actual position shown in the diagrams, the *most* intense insolation is being received by the observer at location

A) *A* B) *B* C) *C* D) *D*

99) Where on Earth's surface is the observer at location *C* located?

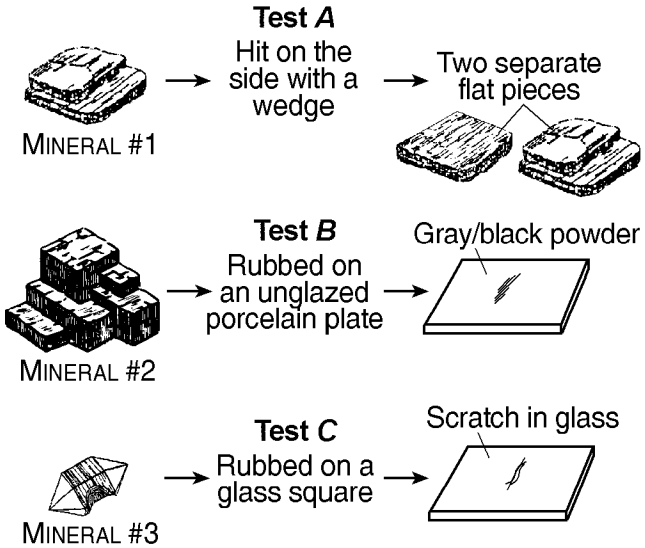
A) at the North Pole
B) at the Equator
C) at the South Pole
D) in South America

100) From sunrise to sunset at location *B*, the length of the observer's shadow will

A) increase, then decrease
B) decrease, only
C) decrease, then increase
D) increase, only

Questions 101 and 102 refer to the following:

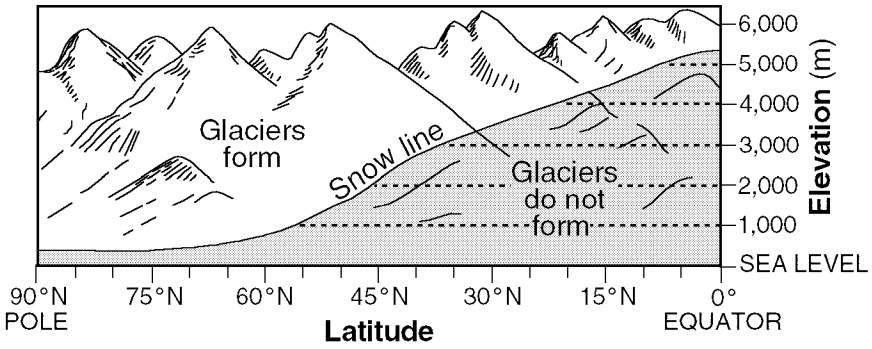
The diagram below shows three minerals with three different physical tests, *A*, *B*, and *C*, being performed on them.



101) The results of *all* three physical tests shown are *most* useful for determining the
A) geologic period when the minerals formed
B) identity of the minerals
C) rate of weathering of the minerals
D) environment where the minerals formed

102) Which sequence correctly matches each test, *A*, *B*, and *C*, with the mineral property tested?
A) *A* — cleavage; *B* — streak; *C* — hardness
B) *A* — streak; *B* — cleavage; *C* — hardness
C) *A* — cleavage; *B* — hardness; *C* — streak
D) *A* — streak; *B* — hardness; *C* — cleavage

103) The graph below shows the snow line (the elevation above which glaciers form at different latitudes in the Northern Hemisphere).

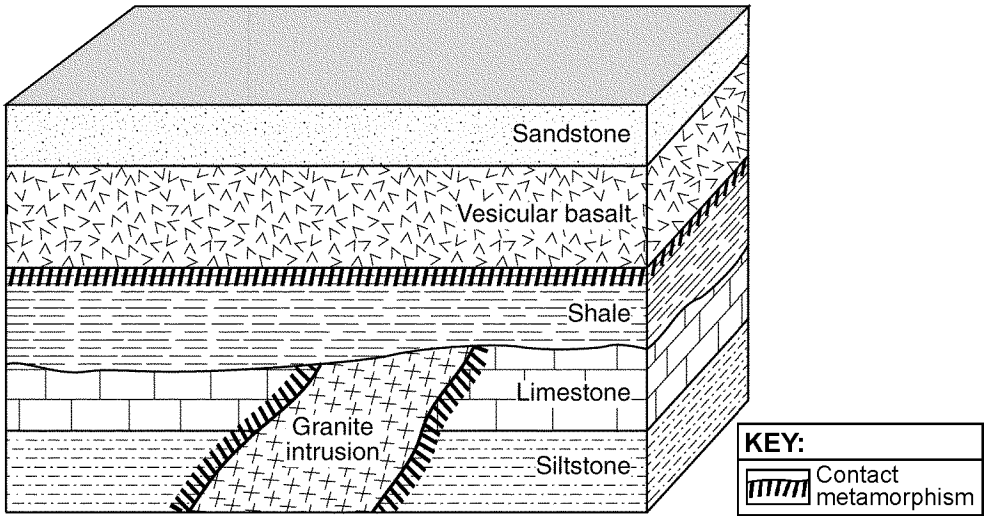


At which location would a glacier most likely form?
A) 30° N latitude at an elevation of 3,000 m
B) 15° N latitude at an elevation of 4,000 m
C) 0° latitude at an elevation of 6,000 m
D) 45° N latitude at an elevation of 1,000 m

104) Name *one* region of the United States that is likely to experience a major damaging earthquake. Explain why an earthquake is likely to occur in that region.

Questions 105 through 108 refer to the following:

Radioactive dating on the geologic cross section below indicates that the granite intrusion is 279 million years old and the vesicular basalt is 260 million years old. The rock layers have not been overturned.



105) During which geologic time period did the shale layer shown in the diagram form?

106) In the diagram shown, the granite intrusion caused part of the limestone layer to undergo metamorphism. What metamorphic rock would most likely be found in this zone of contact metamorphism?

107) Describe the rate of cooling that must occur for magma to form vesicular basalt.

108) List the six rock units shown in the diagram in the order from the *oldest* (1) to the *youngest* (6).

OLDEST (1) _____

(2) _____

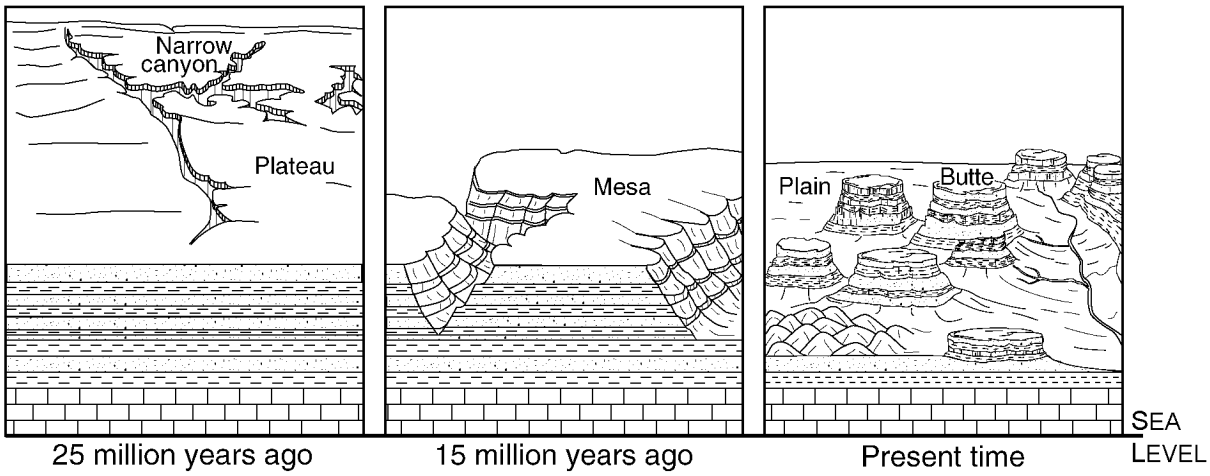
(3) _____

(4) _____

(5) _____

YOUNGEST (6) _____

109) The sequence of bedrock cross sections below represents the same landscape region over a period of geologic time.

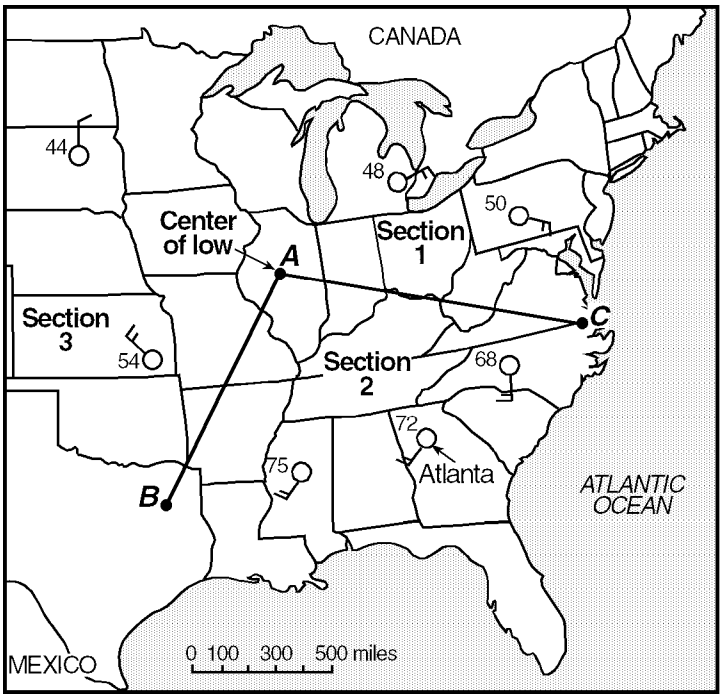


This sequence *best* represents

A) a humid region that experienced mostly erosional forces
B) a humid region that experienced mostly uplifting forces
C) an arid region that experienced mostly uplifting forces
D) an arid region that experienced mostly erosional forces

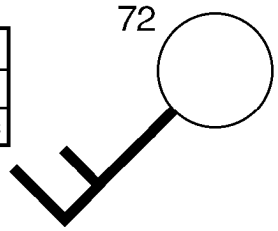
Questions 110 through 112 refer to the following:

The weather map below shows partial weather data for several weather stations. Point *A* is the center of a low-pressure system. Lines *AB* and *AC* represent the frontal boundaries between different air masses.



110) Atlanta, Georgia, has the following additional weather variable measurements.

Visibility	6 miles
Amount of cloud cover	1/2 or 50%
Air pressure	1001.1millibars



On the station model above, place these *three* weather measurements in their correct location using the proper format.

111) On the given map, draw the correct weather map symbols for the *two* different fronts located on lines *AB* and *AC*. The symbols must show the direction the fronts are moving.

112) In each of the *three* map sections shown (Section 1, Section 2, and Section 3), draw curved arrows to represent the general direction that surface winds will move in association with the center of the low-pressure system at location *A*.

113) A sample of wood found in an ancient tomb contains 25% of its original carbon-14. The age of this wood sample is approximately

A) 17,100 years
B) 2,800 years
C) 11,400 years
D) 5,700 years

114) A huge undersea earthquake off the Alaskan coastline could produce a

A) tsunami
B) cyclone
C) thunderstorm
D) hurricane

115) The table below shows the density of four mineral samples.

Mineral	**Density** (g/cm3)
Cinnabar	8.2
Magnetite	5.2
Quartz	2.7
Siderite	3.9

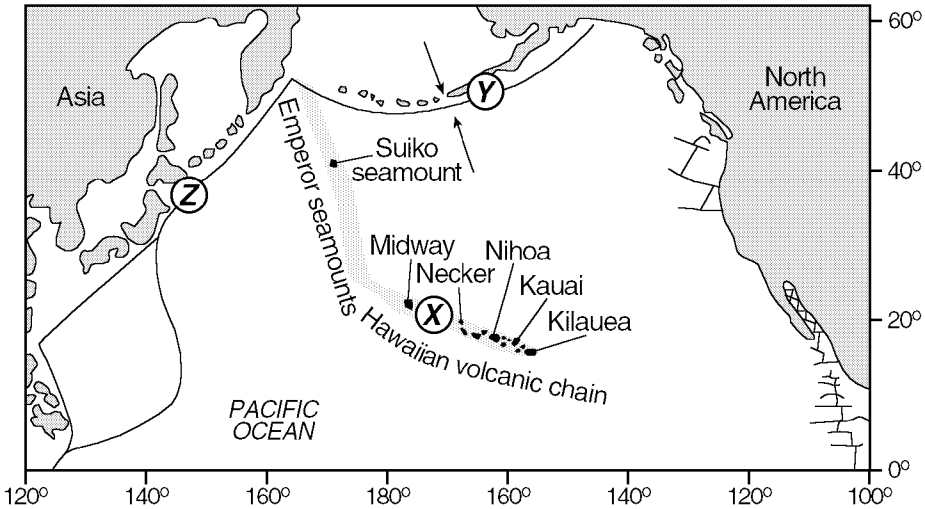
If the shape and size of the four mineral samples are the same, which mineral will settle most slowly in water?

A) siderite
B) cinnabar
C) magnetite
D) quartz

Questions 116 through 118 refer to the following:

The map below shows the locations of volcanic islands and seamounts that erupted on the seafloor of the Pacific Plate as it moved northwest over a stationary mantle hotspot beneath the lithosphere. The hotspot is currently under Kilauea. Island size is not drawn to scale. Locations *X*, *Y*, and *Z* are on Earth's surface.

Map of Volcanic Features



DATA TABLE: **Age of Volcanic Features**

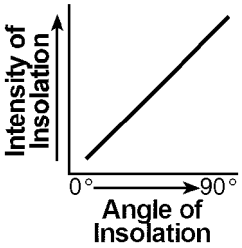
Volcanic Feature	Distance from Kilauea (km)	Age (millions of years)
Kauai	545	5.6
Nihoa	800	6.9
Necker	1,070	10.4
Midway	2,450	16.2
Suiko seamount	4,950	41.0

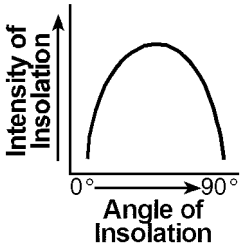
116) Which lithospheric plate boundary features are located at *Y* and *Z*?
- A) rift valleys created by seafloor spreading of the Pacific Plate
- B) trenches created by the subduction of the Pacific Plate
- C) secondary plates created by volcanic activity within the Pacific Plate
- D) mid-ocean ridges created by faulting below the Pacific Plate

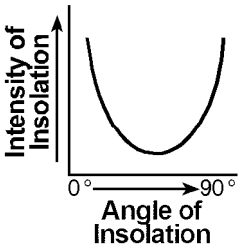
117) According to the data table, what is the approximate speed at which the island of Kauai has been moving away from the mantle hotspot, in kilometers per million years?
A) 100 B) 10 C) 1 D) 1,000

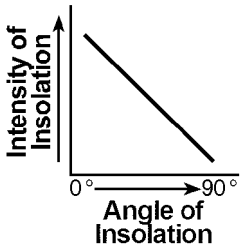
118) Approximately how far has location *X* moved from its original location over the hotspot?
A) 20 km B) 3,600 km C) 1,800 km D) 2,500 km

119) Which graph *best* represents the relationship between the angle of insolation and the intensity of insolation?

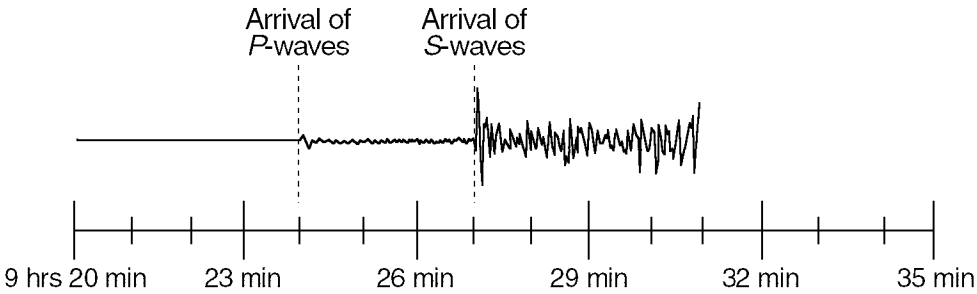
A)


C)


B)


D)


120) The seismogram below shows the arrival times of an earthquake's *P*-wave and *S*-wave recorded at a seismic station in Portland, Oregon.



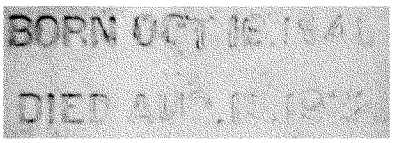
What was the distance from Portland to the earthquake's epicenter?

A) 1,800 km B) 2,500 km C) 3,200 km D) 4,100 km

121) Which one of the following statements *best* explains why climates at continental shorelines generally have a smaller yearly temperature range than inland climates at the same latitude?

A) Land changes temperature rapidly, due to the high specific heat and lack of transparency of land.
B) Land is a poor absorber and a poor conductor of heat energy.
C) Ocean water changes temperature slowly, due to the high specific heat and transparency of water.
D) Ocean water is a good absorber and a good conductor of heat energy.

122) The two photographs below show dates on tombstones found in a cemetery in St. Remy, New York. The tombstones were 5 meters apart and both faced north. Tombstone *A* had dates cut into the rock in 1922. Tombstone *B* had dates cut into the rock in 1892.



Tombstone *A* (1922)

Tombstone *B* (1892)

Which statement *best* explains why the dates are more difficult to read on tombstone *A* than on tombstone *B*?

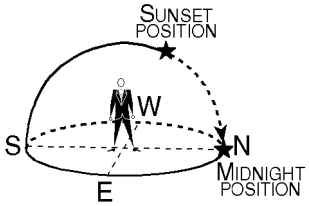
A) Tombstone *A* was exposed to less acid rain than tombstone *B*.
B) Tombstone *A* has undergone a longer period of weathering than tombstone *B*.
C) Tombstone *A* experienced cooler temperatures than tombstone *B*.
D) Tombstone *A* is composed of minerals less resistant to weathering than tombstone *B*.

123) Which diagram correctly shows the apparent motion of Polaris from sunset to midnight for an observer in northern Canada?

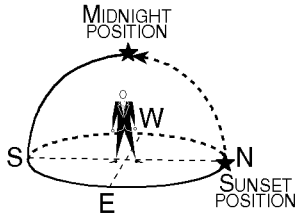
KEY:

★ Polaris
- - ➤ Apparent path of Polaris

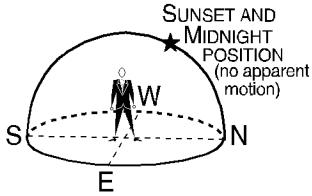
A)



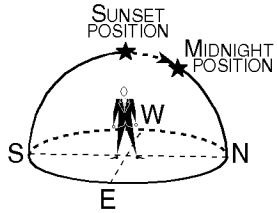
B)



C)



D)

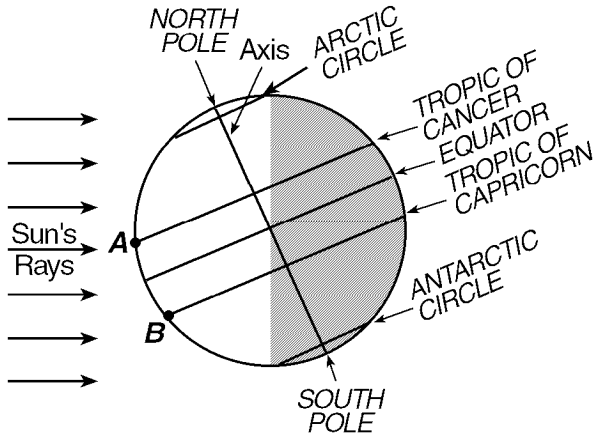


124) At which location will the *highest* altitude of the star Polaris be observed?

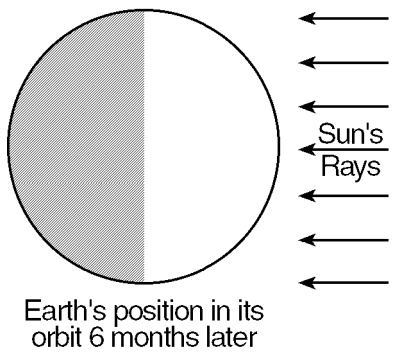
A) central United States
B) Equator
C) Arctic Circle
D) Tropic of Cancer

Questions 125 through 127 refer to the following:

The diagram below represents Earth at a specific position in its orbit as viewed from space. The shaded area represents nighttime. Points *A* and *B* are locations on Earth's surface.



125) The model of Earth below represents Earth in its orbit 6 months later.



(a) Draw the position of Earth's axis and label the axis.

(b) Label the North Pole.

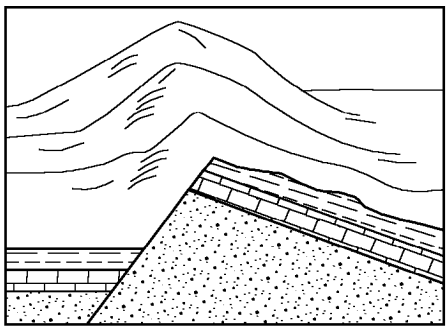
(c) Draw the position of Earth's Equator and label the Equator.

126) (a) State the month in which Earth is at the position shown in the diagram.

(b) State the latitude that receives the *most* intense radiation from the Sun when Earth is at this position in its orbit.

127) Describe the length of daylight at point *A* compared to the length of daylight at point *B* on the day represented by the diagram.

128) The diagram below shows the bedrock structure beneath a series of hills.



Which process was primarily responsible for forming the hills?

A) faulting B) folding C) deposition D) vulcanism

129) What is the basic difference between ultraviolet, visible, and infrared radiation?

A) wavelength
B) wave velocity
C) temperature
D) half-life

130) Which surface ocean current transports warm water to higher latitudes?

A) Falkland Current
B) Labrador Current
C) West Wind Drift
D) Gulf Stream

131) In a Doppler red shift, the observed wavelengths of light from distant celestial objects appear closer to the red end of the spectrum than light from similar nearby celestial objects. The explanation for the red shift is that the universe is presently

A) contracting, only
B) alternating between contracting and expand ing
C) remaining constant in size
D) expanding, only

Questions 132 and 133 refer to the following:

HOWE CAVERNS

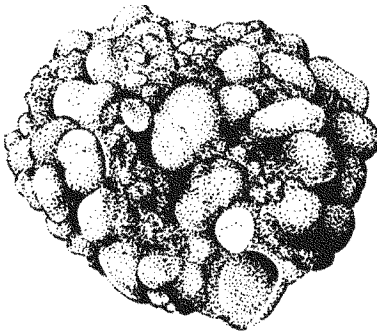
Many scientists believe that the formation of the rocks in which Howe Caverns is now found began millions of years ago. At that time, an ocean covered the eastern region of New York State. Hundreds of feet of calcium carbonate ($CaCO_3$) sediments were deposited in layers along the edge of this ocean. These layers eventually formed the sedimentary rock limestone, which makes up the walls of today's Howe Caverns.

Much later, tectonic forces raised this region of New York State above sea level exposing the rock to weathering and erosion. These tectonic forces cracked the thick limestone, creating pathways for groundwater to infiltrate and gradually increase the size of the cracks. Eventually some of the larger cracks provided pathways for the underground stream, which carved the winding passages of Howe Caverns seen today.

132) State *two* processes that caused these sediments to become limestone.

133) Identify *one* method that could be used to determine that the walls of Howe Caverns are made of limestone.

134) The diagram below shows a sedimentary rock sample.

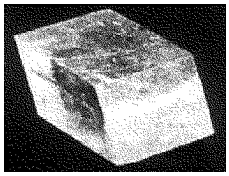


(shown actual size)

Which agent of erosion was most likely responsible for shaping the particles forming this rock?

A) glacial ice
B) wind
C) running water
D) mass movement

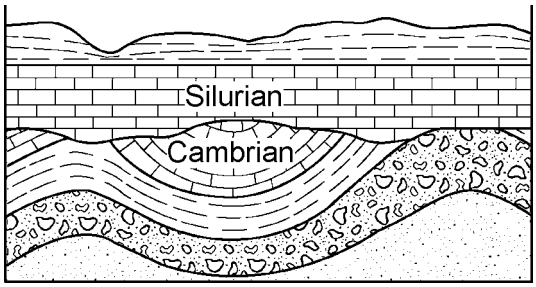
135) The photograph below shows a broken piece of the mineral calcite.



The calcite breaks in smooth, flat surfaces because calcite

A) is very soft
B) has a regular arrangement of atoms
C) contains certain impurities
D) is very dense

136) The geologic cross section below shows the geologic age of two rock layers separated by an unconformity.



The unconformity at the bottom of the Silurian rock layer indicates a gap in the geologic time record. What is the *minimum* time, in millions of years, shown by the gap?

A) 126
B) 13
C) 47
D) 101

137) Which list of three planets and Earth's Moon is arranged in order of increasing equatorial diameter?

A) Mercury, Mars, Earth's Moon, Pluto
B) Pluto, Earth's Moon, Mercury, Mars
C) Mars, Mercury, Pluto, Earth's Moon
D) Earth's Moon, Pluto, Mars, Mercury

138) Landscapes will undergo the *most* chemical weathering if the climate is

A) warm and dry
B) cool and wet
C) cool and dry
D) warm and wet

139) A seismic station in a small town recorded the arrival of the first *P*-wave at 1:30:00 (1 hour, 30 minutes, 00 seconds) and the first *S*-wave from the same earthquake at 1:34:30.

(a) Determine the distance, in kilometers, from the town to the epicenter of this earthquake.

(b) State what additional information is needed to determine the location of the epicenter of this earthquake.

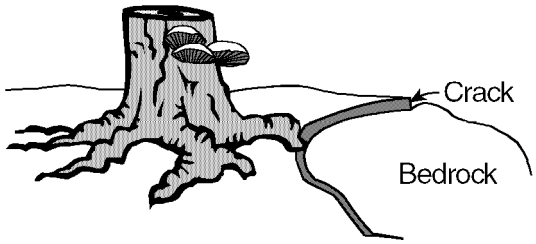
140) Compared to the average density of the terrestrial planets (Mercury, Venus, Earth, and Mars), the average density of the Jovian planets (Jupiter, Saturn, Uranus, and Neptune) is

A) greater
B) less
C) the same

141) Which group of organisms, some of which were preserved as fossils in early Paleozoic rocks, are still in existence today?

A) brachiopods
B) trilobites
C) eurypterids
D) graptolites

142) The diagram below shows the stump of a tree whose root grew into a small crack in bedrock and split the rock apart.

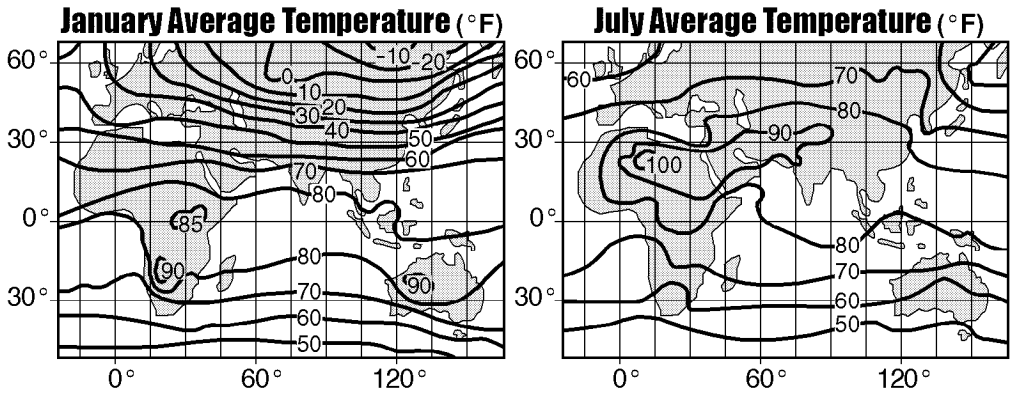


The action of the root splitting the bedrock is an example of

A) erosion
B) deposition
C) physical weathering
D) chemical weathering

Questions 143 and 144 refer to the following:

The isotherm maps below show the average monthly air temperatures (°F) over a portion of Earth's surface for January and July.



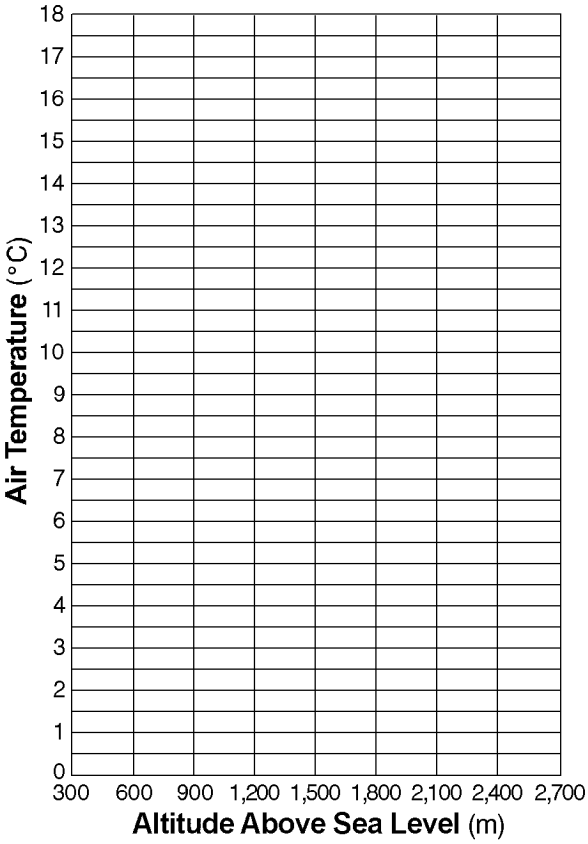
143) The *hottest* average January temperatures occur at approximately what latitude in the given diagram?

144) From January to July, there is a smaller temperature change in the Southern Hemisphere than in the Northern Hemisphere in the given diagram. Explain why the Southern Hemisphere's larger ocean-water surface causes this smaller temperature change.

Questions 145 through 148 refer to the following:

The table below shows air temperatures and air pressures recorded by a weather balloon rising over Buffalo, New York.

Altitude Above Sea Level (m)	Air Temperature (°C)	Air Pressure (mb)
300	16.0	973
600	16.5	937
900	15.5	904
1,200	13.0	871
1,500	12.0	842
1,800	10.0	809
2,100	7.5	778
2,400	5.0	750
2,700	2.5	721



145) On the given grid, construct a graph of altitude above sea level and air temperature by following the directions below.

(a) Plot an **X** for the air temperature recorded at each altitude shown on the table.

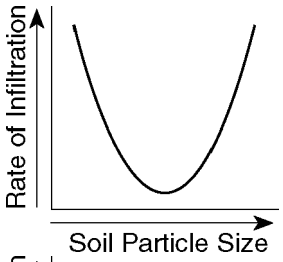
(b) Connect the **X**s with a solid line.

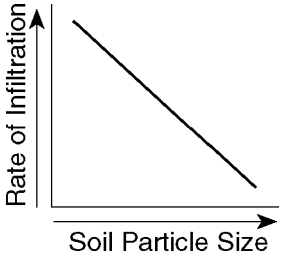
146) The rising weather balloon in the given diagram also recorded dewpoint temperatures. If the dewpoint at 1,500 meters was 12°C, what was the relative humidity of the air at 1,500 meters above sea level?

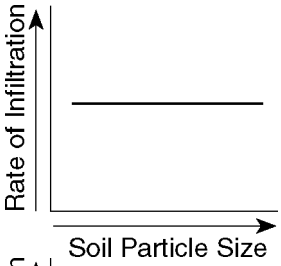
147) What weather instrument is usually attached to a weather balloon to measure air pressure?

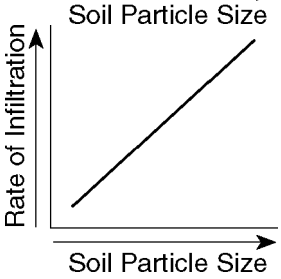
148) State the relationship shown in the given table between altitude above sea level and air pressure recorded by the rising weather balloon.

149) Which graph *best* represents the relationship between soil particle size and the rate at which water infiltrates permeable soil?

A)


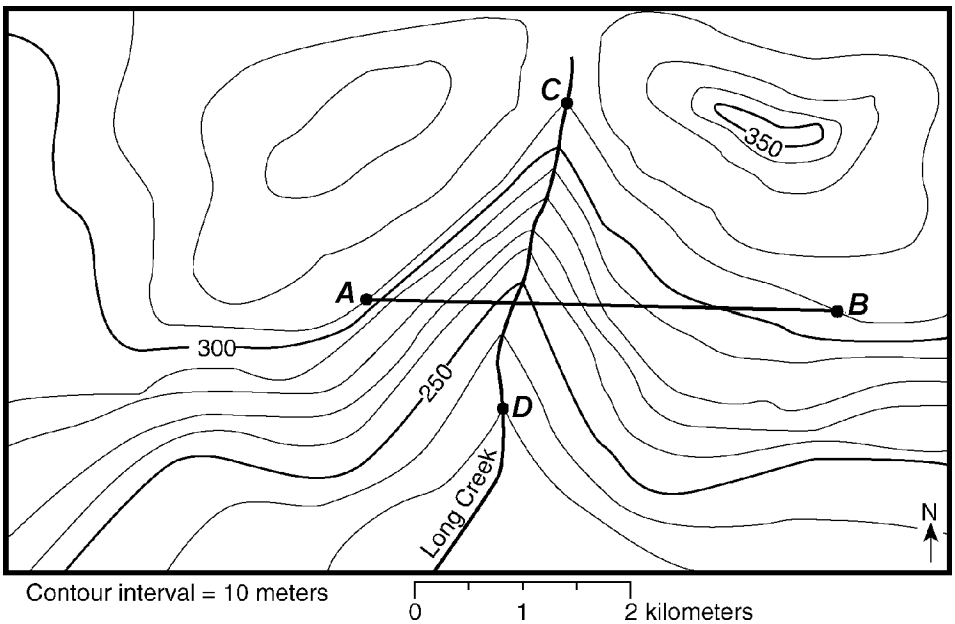
B)


C)


D)


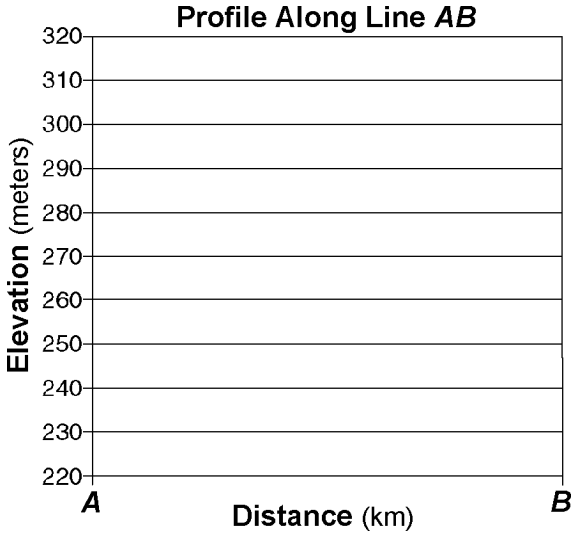
Questions 150 and 151 refer to the following:

Points *A*, *B*, *C*, and *D* are reference points on the topographic map shown below. Elevations are measured in meters.



150) Calculate the gradient of Long Creek between points *C* and *D* in the diagram and label the answer with the correct units.

151) On the grid below, construct a topographic profile along line *AB*, by plotting a point for the elevation of *each* contour line that crosses line *AB* in the diagram shown and connecting the points with a smooth, curved line to complete the profile.



152) During the intrusion of the Palisades Sill, contact metamorphism changed sandstone and shale into

A) diorite B) limestone C) marble D) hornfels

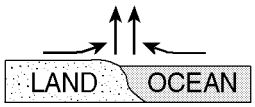
153) During nighttime cooling, most of the energy radiated by Earth's oceans into space is

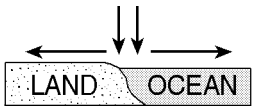
A) gamma rays
B) visible light rays
C) ultraviolet rays
D) infrared rays

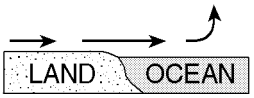
154) Which mineral is white or colorless, has a hardness of 2.5, and splits with cubic cleavage?

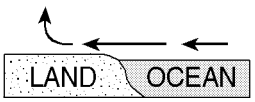
A) calcite B) mica C) halite D) pyrite

155) Adjacent land and ocean surfaces have the same temperature at sunrise on a clear, calm, summer day. Then the land and water are heated by the Sun for several hours. Which cross section shows the most likely direction of surface winds that will develop at this ocean shore?

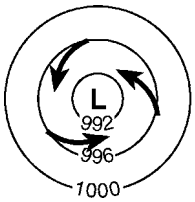
A) 

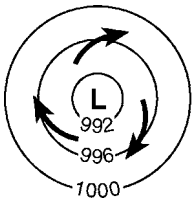
B) 

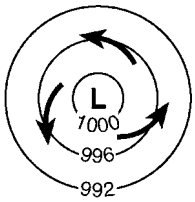
C) 

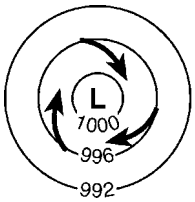
D) 

156) Which map view *best* represents the pattern of isobar values, in millibars, and the pattern of wind flow, shown by arrows, at Earth's surface surrounding a Northern Hemisphere low-pressure center?

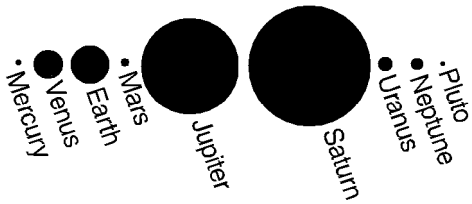
A) 

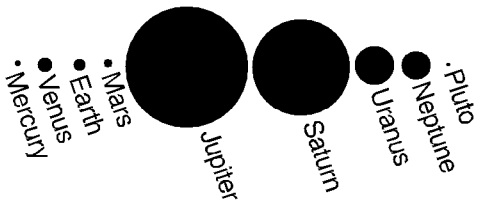
C) 

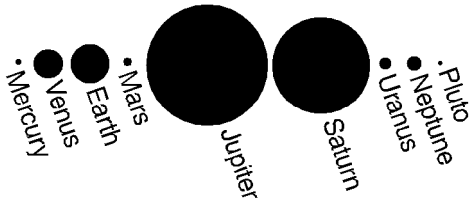
B) 

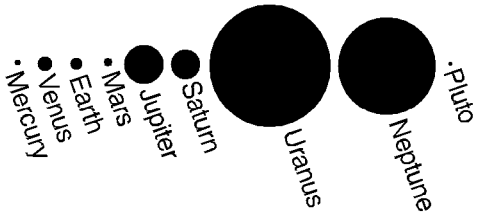
D) 

157) Which sequence correctly shows the relative size of the nine planets of our solar system?

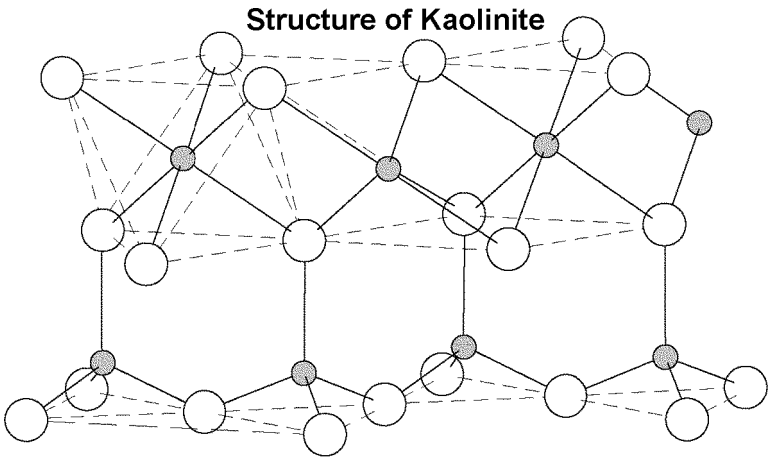
A) 

C) 

B) 

D) 

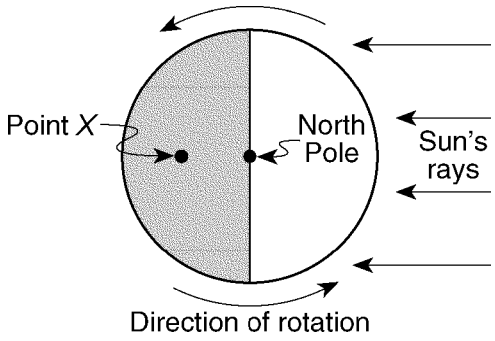
158) The diagram below represents a part of the crystal structure of the mineral kaolinite.



An arrangement of atoms, such as the one shown in the diagram, determines a mineral's

A) temperature of formation
B) infiltration rate
C) age of formation
D) physical properties

159) The diagram below represents the direction of Earth's rotation as it appears from above the North Pole. Point *X* is a location on Earth's surface.



The time at point *X* is *closest* to

A) 9 p.m.
B) 12 midnight
C) 12 noon
D) 9 a.m.

160) Two streams begin at the same elevation and have equal volumes. Which statement *best* explains why one stream could be flowing faster than the other stream?

A) The faster stream has a much steeper gradient.
B) The faster stream contains more dissolved minerals.
C) The faster stream has a temperature of 10°C, and the slower stream has a temperature of 20°C.
D) The streams are flowing in different directions.

161) The air outside a classroom has a dry-bulb temperature of 10°C and a wet-bulb temperature of 4°C. What is the relative humidity of this air?

A) 33%
B) 1%
C) 54%
D) 14%

162) Which phase change requires water to gain 540 calories per gram?

A) water vapor condensing
B) liquid water freezing
C) liquid water vaporizing
D) solid ice melting

163) How many times will the Sun's perpendicular rays cross Earth's Equator between March 1 of one year and March 1 of the next year?

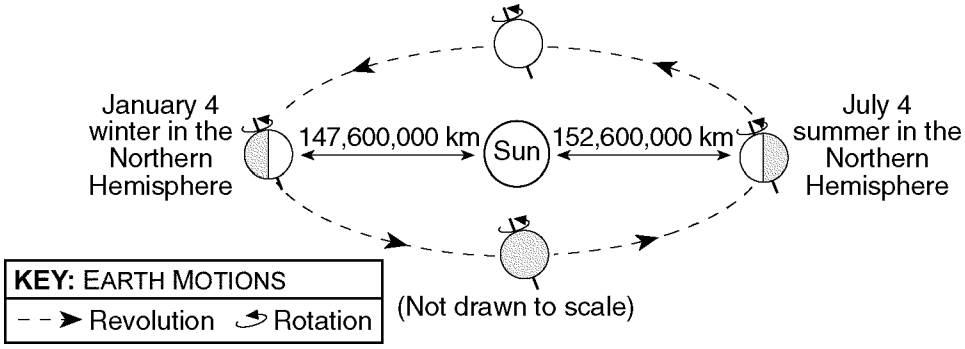
A) 1
B) 2
C) 3
D) 4

164) One result of a large volcanic eruption is that surface air temperatures decrease over a sizable region of Earth. This phenomenon occurs because volcanic eruptions usually decrease the

A) amount of moisture in the atmosphere
B) transparency of the atmosphere
C) number of dust particles entering the atmosphere
D) reflection of sunlight within the atmosphere

Questions 165 and 166 refer to the following:

The diagram below shows a model of Earth's orbit around the Sun. Two motions of Earth are indicated. Distances to the Sun are given for two positions of Earth in its orbit.

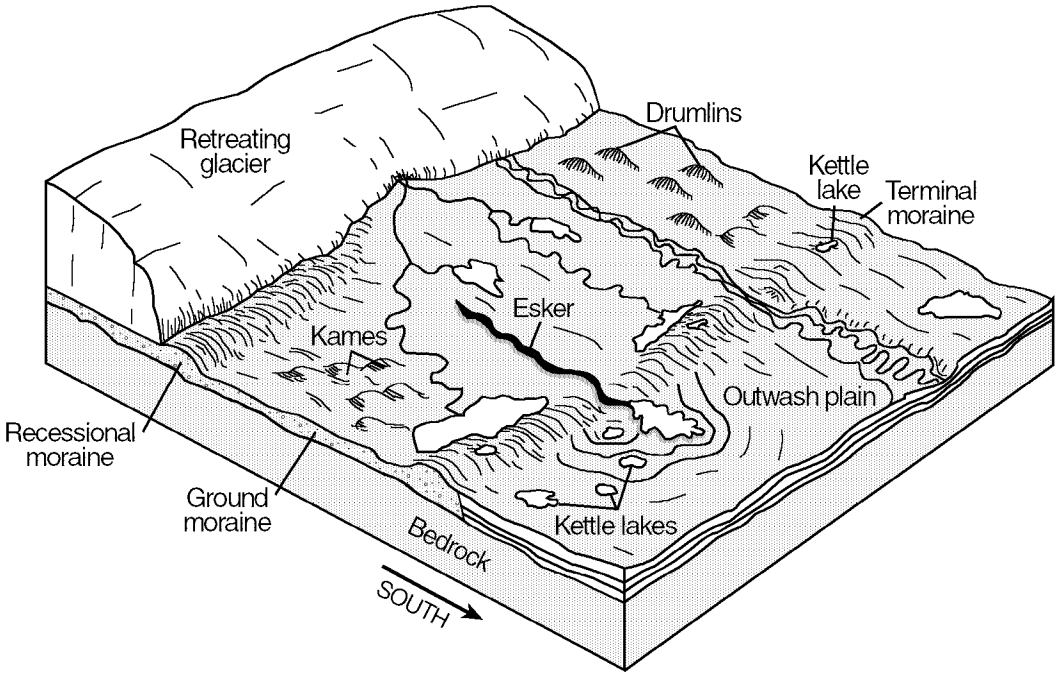


165) On the given diagram, place an **X** on Earth's orbit to indicate Earth's position on May 21.

166) Explain why New York State experiences summer when Earth is at its *greatest* distance from the Sun.

Questions 167 through 169 refer to the following:

The block diagram below shows some of the landscape features formed as the *most* recent continental glacier melted and retreated across western New York State.



167) The shape of elongated hills labeled drumlins is *most* useful in determining the

A) rate of glacial movement
B) age of the glacier
C) direction of glacial movement
D) thickness of the glacial ice

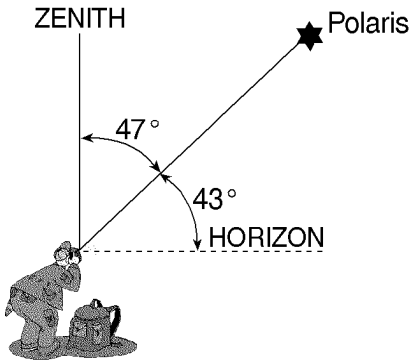
168) The moraines pictured in the block diagram were deposited directly by the glacier. The sediments within these moraines are most likely

A) unsorted by size and unlayered
B) unsorted by size and layered
C) sorted by size and layered
D) sorted by size and unlayered

169) During which geologic epoch did this glacier retreat from New York State?

A) Pleistocene
B) Early Mississippian
C) Late Pennsylvanian
D) Eocene

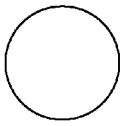
170) The diagram below shows an observer on Earth measuring the altitude of Polaris.



What is the latitude of this observer?

A) 43° S
B) 43° N
C) 47° N
D) 47° S

171) On the weather map station model below, using the proper format, record the six weather conditions shown below.

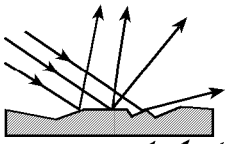


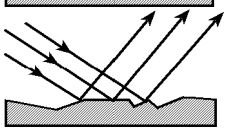
WIND: From the northwest
WIND SPEED: 10 knots
BAROMETRIC PRESSURE: 1022.0 mb
CLOUD COVER: 50%
VISIBILITY: 5 mi
PRECIPITATION (in the past 6 hours): .45 in.

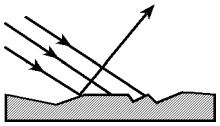
172) Which surface soil conditions allow the *most* infiltration of rainwater?

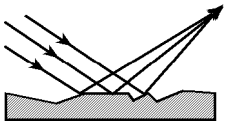
A) steep slope and permeable soil
B) gentle slope and permeable soil
C) steep slope and impermeable soil
D) gentle slope and impermeable soil

173) Which diagram *best* represents visible light rays after striking a dark, rough surface?

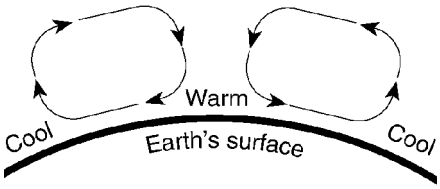
A) 

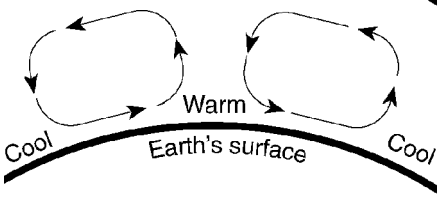
B) 

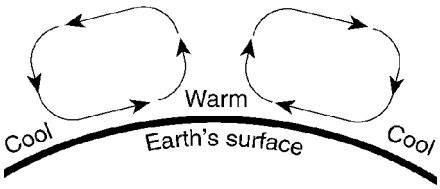
C) 

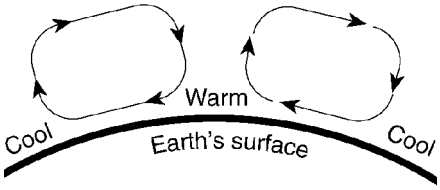
D) 

174) The cross sections below show different patterns of air movement in Earth's atmosphere. Air temperatures at Earth's surface are indicated in each cross section. Which cross section shows the most likely pattern of air movement in Earth's atmosphere that would result from the surface air temperatures shown?

A)


B)


C)


D)


175) Which planet takes more time to complete one rotation on its axis than to complete one revolution around the Sun?

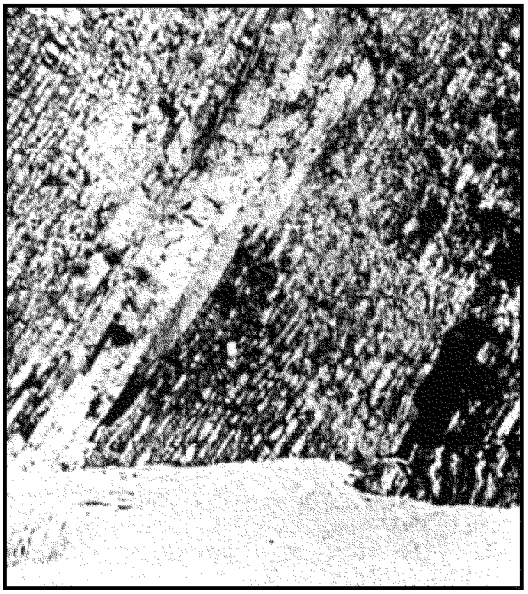
A) Mars B) Venus C) Jupiter D) Mercury

176) One complete cycle of the phases of the Moon takes approximately one

A) month B) week C) year D) day

Questions 177 and 178 refer to the following:

The photograph below shows an outcrop of sedimentary rock layers that have been tilted and slightly metamorphosed.



177) The tilted rock structure shown in the photograph is most likely the result of the

A) passage of seismic waves
B) deposition of rock fragments on a mountain slope
C) reversal of past magnetic poles
D) collision of crustal plates

178) Tilted, slightly metamorphosed rock layers such as these are typically found in which New York State landscape region?

A) Atlantic Coastal Plain
B) Erie-Ontario Lowlands
C) Tug Hill Plateau
D) Taconic Mountains

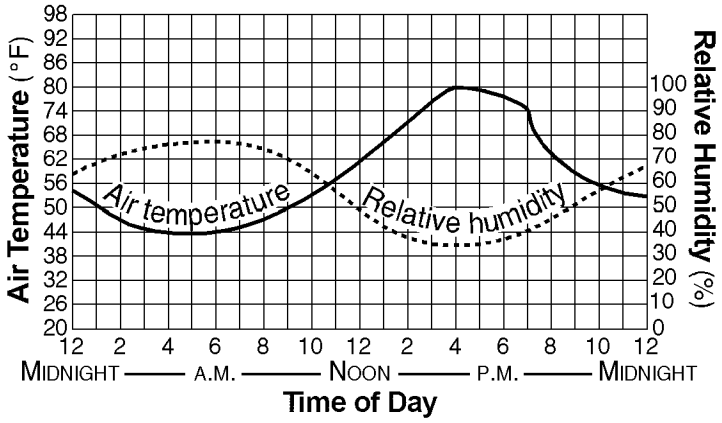
179) State the actual Earth motion that causes the Sun to appear to rise each day.

180) On March 21, at which location in New York State would sunrise occur first?

A) Buffalo
B) Riverhead
C) Syracuse
D) Massena

Questions 181 and 182 refer to the following:

The graph below shows air temperature and relative humidity at a single location during a 24-hour period.



181) At which time would the rate of evaporation most likely be *greatest*?

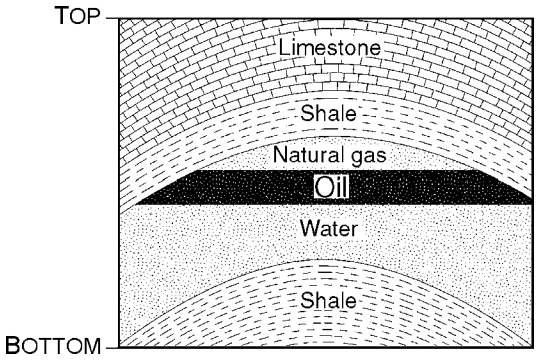
A) 11 p.m.
B) 10 a.m.
C) 6 a.m.
D) 4 p.m.

182) What was the approximate change in relative humidity from 12 noon to 4 p.m.?

A) 30%
B) 10%
C) 20%
D) 15%

Questions 183 and 184 refer to the following:

The bedrock cross section below represents part of Earth's crust where natural gas, oil, and water have moved upward through a layer of folded sandstone and filled the pore spaces at the top of the sandstone layer.



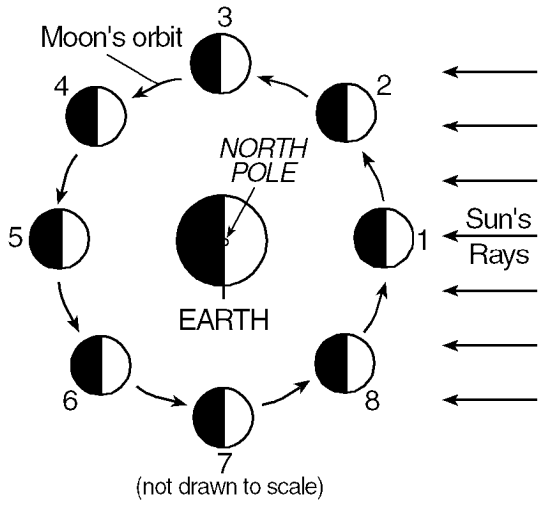
183) In the diagram shown, the final arrangement of the natural gas, oil, and water within the sandstone was caused by differences in their

A) density
B) radioactive half-life
C) specific heat
D) relative age

184) In the diagram shown, the natural gas, oil, and water are trapped within the top of the sandstone and do *not* move upward through the shale because, compared to the sandstone, the shale has

A) larger particles
B) larger pore spaces
C) lower permeability
D) less foliation

185) The diagram below shows the Moon orbiting Earth as viewed from space above the North Pole. The Moon is shown at eight different positions in its orbit.



At which two positions of the Moon is an eclipse of the Sun or Moon possible?

A) 3 and 7
B) 1 and 5
C) 2 and 6
D) 4 and 8

Questions 186 through 188 refer to the following:

THE BLUE MOON

A "Blue Moon" is the name given to the second full moon in a calendar month. Because there are roughly 29.5 days between full moons, it is unusual for two full moons to "fit" into a 30 or 31 day month (and impossible to fit into a 28 or 29 day month, so February can never have a Blue Moon). The saying "Once in a Blue Moon" means a rare occurrence, and predates the current astronomical use of the term, which is quite recent. In fact, Blue Moons are not all that rare, on average there will be one Blue Moon every 2.5 years. After 1999, the next Blue Moons will be in November 2001; July 2004; and June 2007. The last one before 1999 was in July 1996.

The term "Blue Moon" is believed to have originated in 1883 after the eruption of Krakatoa. The volcano put so much dust in the atmosphere that the Moon actually looked blue in color. This was so unusual that the term "once in a Blue Moon" was coined.

—"The Blue Moon"
David R. Williams
nssdc.gsfc.nasa.gov/planetary/lunar/blue_moon.html

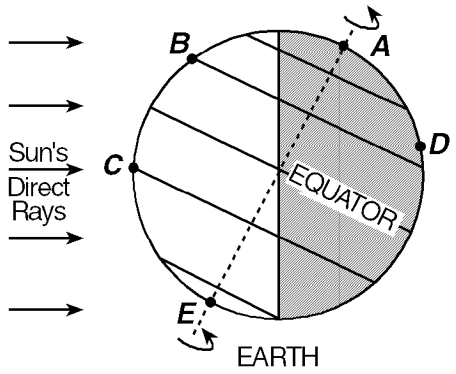
186) Based on the reading passage, what is the *greatest* number of full-Moon phases, visible from Earth, that are possible in a span of 1 year?

187) In the box below, draw the relative positions of Earth, the Moon, and the Sun, as viewed from space, so that a full-Moon phase would be visible to an observer on Earth. Label Earth, the Moon, and the Sun in your drawing.

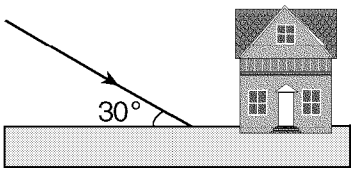
188) Based on the reading passage, explain why a Blue Moon never occurs during the month of February.

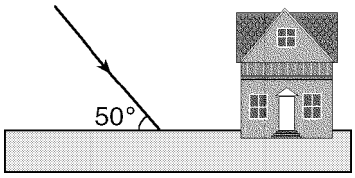
Questions 189 through 191 refer to the following:

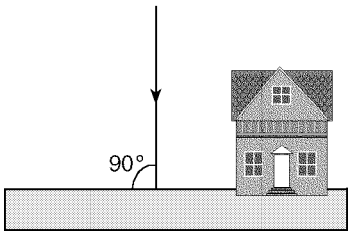
The diagram below shows the tilt of Earth on its axis in relation to the Sun on one particular day. Points *A* through *E* are locations on Earth's surface. Point *D* is located in the eastern United States. The dashed line represents Earth's axis.

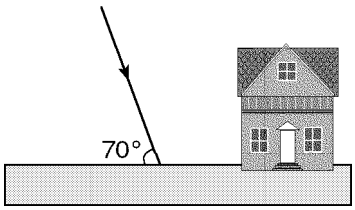


189) Which diagram *best* represents the angle of the Sun's rays received at location *C* at noon on this day?

A)


B)


C)


D)


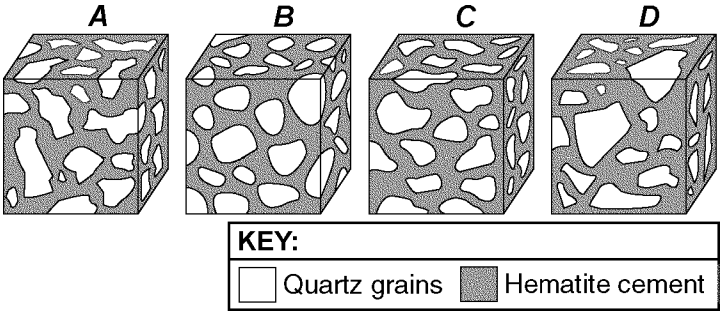
190) What is the latitude of location *A*?

A) $23\frac{1}{2}°$ N B) 0° C) 90° N D) $63\frac{1}{2}°$ S

191) On this day, which location has the *greatest* number of hours of daylight?

A) *E* B) *B* C) *C* D) *D*

192) The diagram below shows four magnified block-shaped sandstone samples labeled *A*, *B*, *C*, and *D*. Each sandstone sample contains quartz grains of different shapes and sizes. The quartz grains are held together by hematite cement.

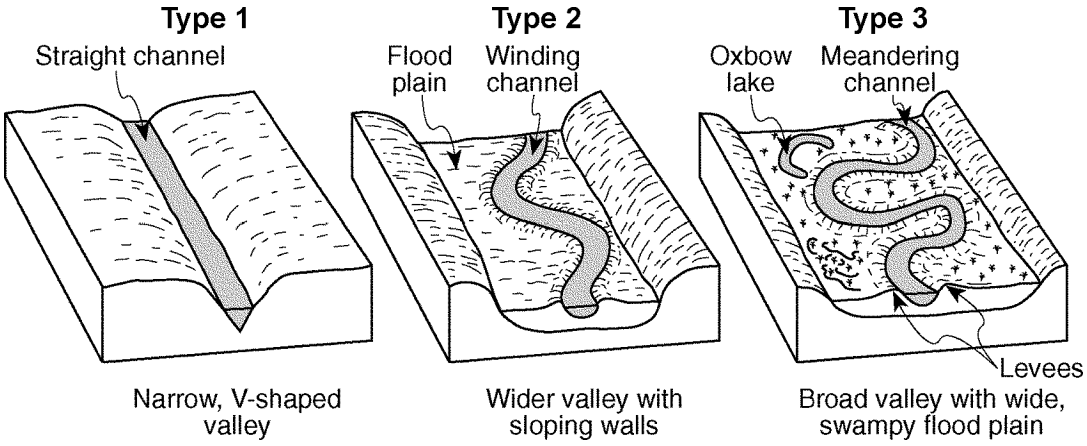


In which sample did the quartz grains undergo the *most* abrasion during erosional transport?

A) *A* B) *B* C) *C* D) *D*

Questions 193 through 195 refer to the following:

The block diagrams below show three types of streams with equal volumes.



193) Explain how the differences between the type 1 and type 3 stream channels shown in the diagrams indicate that the average velocities of the streams are different.

194) Explain how the cobbles and pebbles that were transported by the streams shown in the diagrams became smooth and rounded in shape.

195) Explain why the outside of the curve of a meandering channel experiences more erosion than the inside of the curve.

196) A gradual increase in atmospheric carbon dioxide would warm Earth's atmosphere because carbon dioxide is a

A) poor absorber of infrared radiation
B) poor reflector of ultraviolet radiation
C) good reflector of ultraviolet radiation
D) good absorber of infrared radiation

197) During a heavy rainfall, runoff will be *greatest* on a soil that has an infiltration (permeability) rate of

A) 1.2 cm/sec
B) 0.2 cm/sec
C) 0.1 cm/sec
D) 0.3 cm/sec

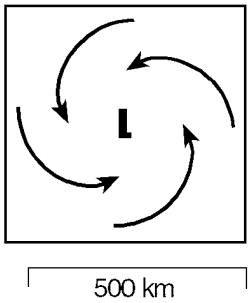
198) According to plate tectonic theory, during which geologic time interval did the continents of North America and Africa separate, resulting in the initial opening of the Atlantic Ocean?

A) Archean Eon
B) Paleozoic Era
C) Proterozoic Eon
D) Mesozoic Era

199) The study of how seismic waves change as they travel through Earth has revealed that

A) Earth's outer core is liquid because *S*-waves are not transmitted through this layer
B) seismic waves travel more slowly through the mantle because it is very dense
C) *P*-waves travel more slowly than *S*-waves through Earth's crust
D) Earth's outer core is solid because *P*-waves are not transmitted through this layer

200) A map view of surface air movement in a low-pressure system is shown below.

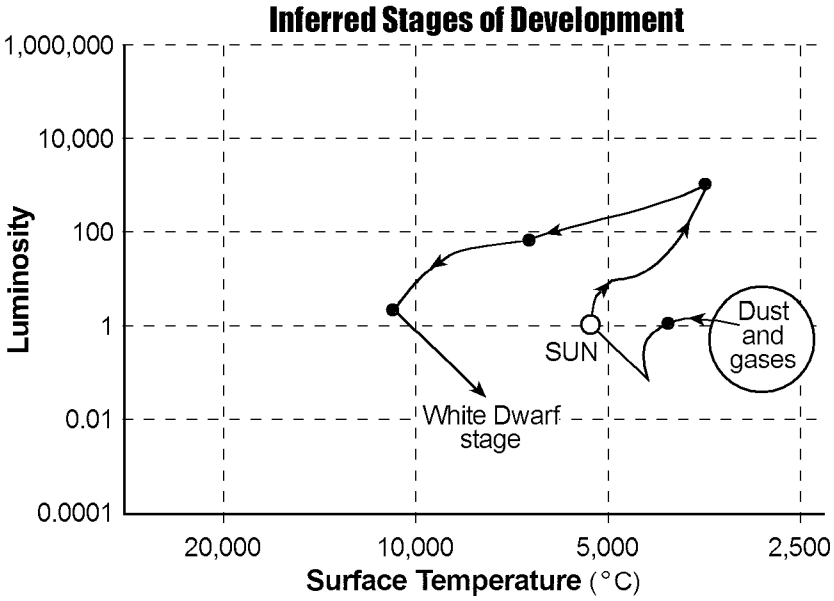


The air near the center of this low-pressure system usually will

A) rise and form clouds
B) squeeze together to form a high-pressure system
C) reverse direction
D) evaporate into a liquid

Questions 201 and 202 refer to the following:

The graph below shows the inferred stages of development of the Sun, showing luminosity and surface temperature at various stages.



201) Describe the changes in luminosity of the Sun that will occur from its current Main Sequence stage to its final White Dwarf stage. [*Refer to the Luminosity and Temperature of Stars Earth Science reference table.*]

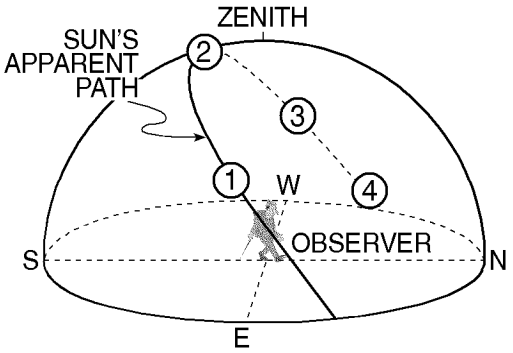
202) Which star shown on the *Luminosity and Temperature of Stars* graph in the Earth Science reference tables is currently at the Sun's final predicted stage of development?

203) A student filled a graduated cylinder with 1,000 milliliters of water to represent a radioactive substance. After 30 seconds, the student poured out one-half of the water in the cylinder to represent the decay occurring within the first half-life. The student repeated the process every 30 seconds. How much water did the student pour from the cylinder at the 2-minute mark?

A) 250.0 mL B) 125.0 mL C) 62.5 mL D) 12.5 mL

Questions 204 and 205 refer to the following:

The diagram below shows numbered positions of the Sun at four different times along the Sun's apparent daily path, as seen by an observer in New York State. Numbers 1 through 4 represent apparent positions of the Sun.



204) During which day of the year is the Sun in the given diagram most likely to follow the apparent path shown?

A) March 1
B) December 1
C) July 1
D) October 1

205) The observer in the given diagram had the *longest* shadow when the Sun was at position

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

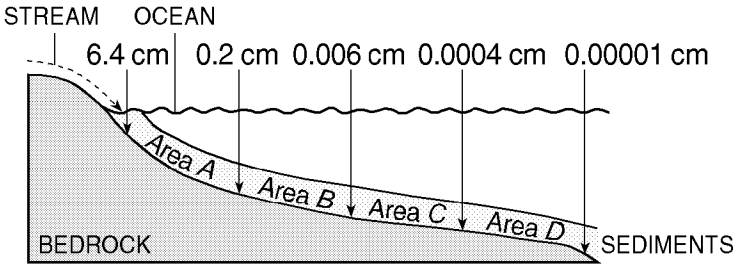
206) A student recorded the times of three successive high tides at one location as:

9:12 a.m.
9:38 p.m.
10:04 a.m.

What is the approximate time of the next high tide?

A) 10:30 p.m. B) 10:12 p.m. C) 11:04 p.m. D) 10:38 p.m.

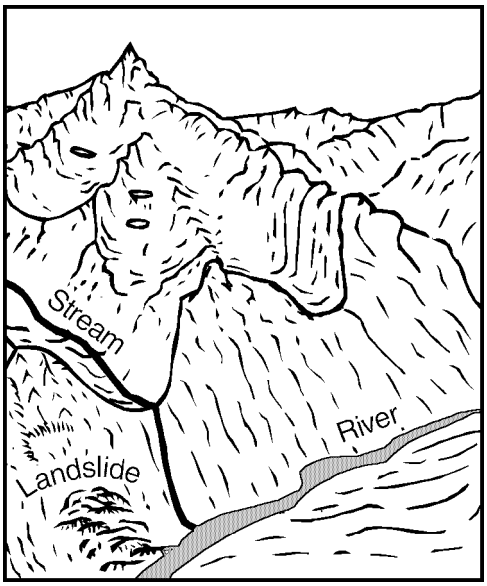
207) The profile below shows the average diameter of sediment that was sorted and deposited in specific areas *A*, *B*, *C*, and *D* by a stream entering an ocean.



As compaction and cementation of these sediments eventually occur, which area will become siltstone?

A) *A* B) *B* C) *C* D) *D*

208) The diagram below shows a glacial landscape.

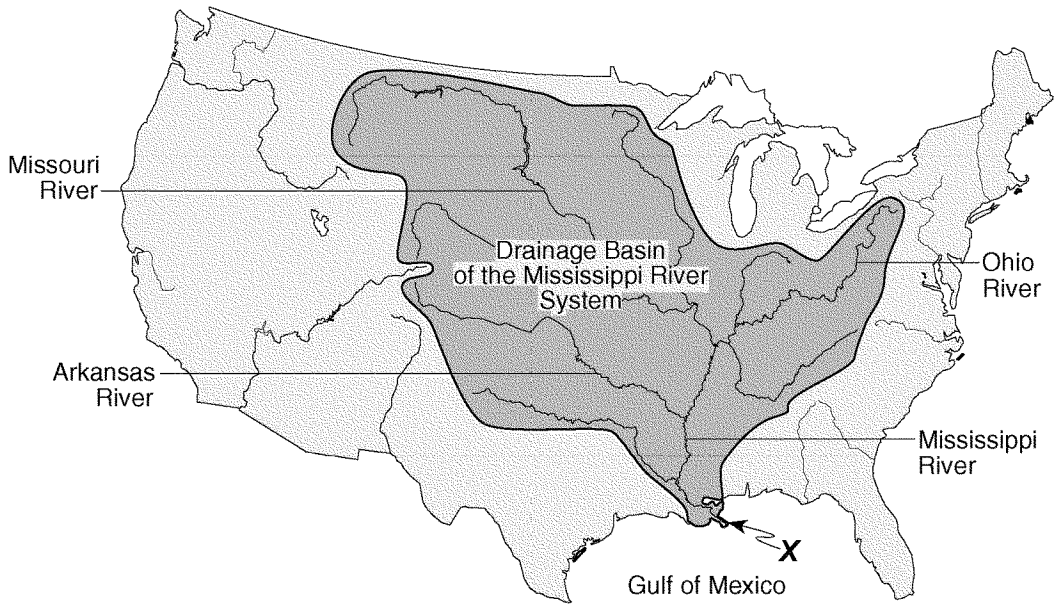


Which evidence suggests that ice created this landscape?

A) U-shaped valleys
B) sorted sediment on the valley floor
C) many stream valleys
D) the landslide near the valley floor

Questions 209 through 211 refer to the following:

The map below shows the drainage basin of the Mississippi River system. Several rivers that flow into the Mississippi River are labeled. The arrow at location *X* shows where the Mississippi River enters the Gulf of Mexico.



209) On the map shown, the entire land area drained by the Mississippi River system is referred to as a

A) levee
B) watershed
C) floodplain
D) meander belt

210) The structure formed by the deposition of sediments at location *X* on the map is *best* described as a

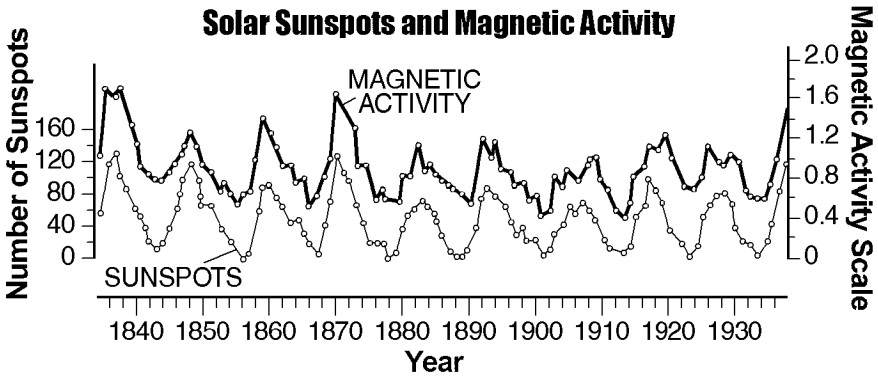
A) delta
B) tributary
C) drumlin
D) moraine

211) On the map shown, sediments deposited at location *X* by the Missisippi River most likely have which characteristics?

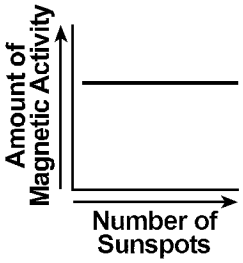
A) rock particles arranged in sorted beds
B) high-density minerals with hexagonal crystals
C) angular fragments arranged as mixtures
D) rocks with parallel scratches and grooves

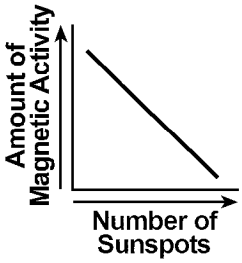
Questions 212 and 213 refer to the following:

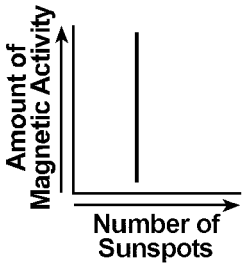
The graph below shows changes in the Sun's magnetic activity and changes in the number of sunspots over a period of approximately 100 years. Sunspots are dark, cooler areas within the Sun's photosphere that can be seen from Earth.

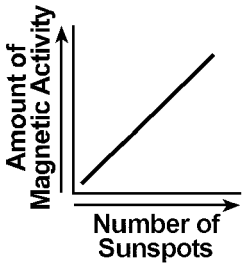


212) Which graph *best* represents the relationship between the number of sunspots and the amount of magnetic activity in the Sun?

A)


C)


B)


D)


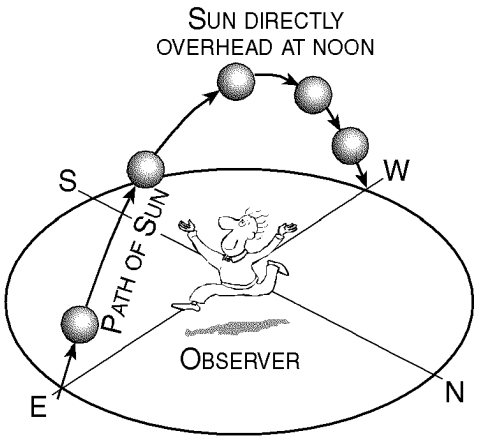
213) The graph indicates that years having the *greatest* number of sunspots occur

A) precisely at the beginning of each decade
B) in a cyclic pattern, repeating approximately every 6 years
C) in a cyclic pattern, repeating approximately every 11 years
D) randomly and unpredictably

214) On June 21, where will the Sun appear to rise for an observer located in New York State?

A) due west
B) south of due east
C) north of due east
D) due east

215) The diagram below shows the apparent path of the Sun as viewed by an observer at a certain Earth location on March 21.



At which latitude is the observer located?

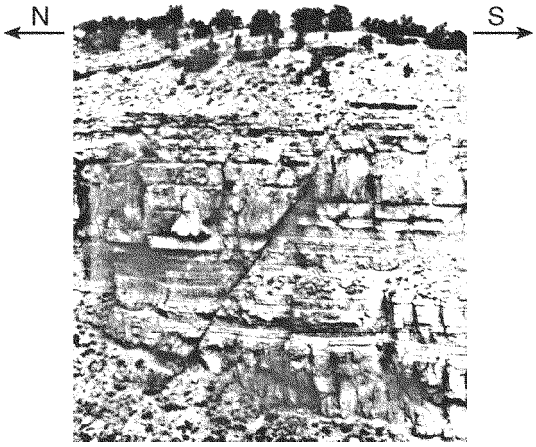
A) 90° N

B) the Equator (0°)

C) $66\frac{1}{2}$° N

D) $23\frac{1}{2}$° N

216) The photograph below shows an escarpment (cliff) located in the western United States. The directions for north and south are indicated by arrows. A fault in the sedimentary rocks is shown on the front of the escarpment.



The photograph shows that the fault most likely formed

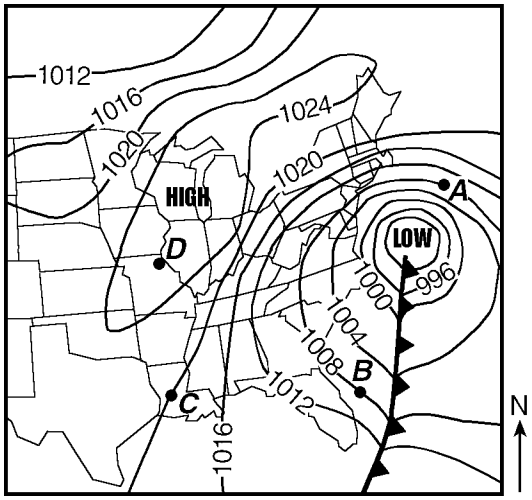
A) before the rock layers were deposited, when the south side moved upward
B) after the rock layers were deposited, when the north side moved downward
C) after the rock layers were deposited, when the north side moved upward
D) before the rock layers were deposited, when the south side moved downward

217) The Himalaya Mountains are located along a portion of the southern boundary of the Eurasian Plate. At the top of Mt. Everest (29,028 feet) in the Himalaya Mountains, climbers have found fossilized marine shells in the surface bedrock. From this observation, which statement is the *best* inference about the origin of the Himalaya Mountains?

A) The bedrock containing the fossil shells is part of an uplifted seafloor.
B) The Himalaya Mountains formed at a divergent plate boundary.
C) Sea level has been lowered more than 29,000 feet since the shells were fossilized.
D) The Himalaya Mountains were formed by volcanic activity.

Questions 218 through 220 refer to the following:

On the weather map below, points *A*, *B*, *C*, and *D* are locations on Earth's surface.



218) The *strongest* winds are *closest* to location

A) *A* B) *B* C) *C* D) *D*

219) The isolines on the map represent values of air

A) density
B) humidity
C) pressure
D) temperature

220) Which type of front extends southward from the center of the low?

A) occluded B) warm C) cold D) stationary

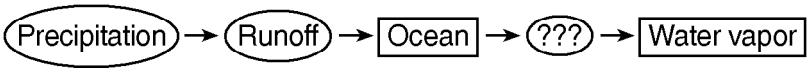
221) A list of three observed relationships is shown below.

- Erosional rate = depositional rate
- Amount of insolation = amount of terrestrial radiation
- Rate of condensation = rate of evaporation

In which situation would each relationship exist?

A) when dynamic equilibrium is reached
B) when global warming ceases and global cooling begins
C) when a change of state occurs
D) when a cyclic change occurs

222) The flowchart below shows part of Earth's water cycle. The question marks indicate a part of the flowchart that has been deliberately left blank.

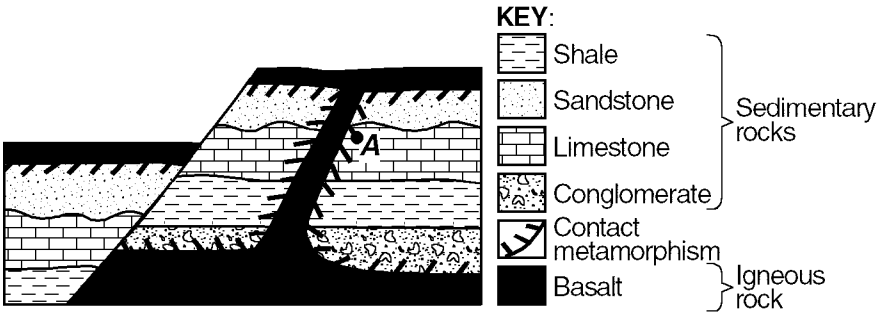


Which process should be shown in place of the question marks to *best* complete the flowchart?

A) deposition
B) evaporation
C) infiltration
D) condensation

Questions 223 through 227 refer to the following:

The diagram below shows a cross section of a portion of Earth's crust that has undergone geological processes. Overturning of rock layers has not occurred. Point *A* represents one location of metamorphic rock.



223) State the name of the inorganic sedimentary rock shown in the cross section that is composed of sediment with the *greatest* range in particle size.

224) State *one* piece of evidence that indicates basalt is the *youngest* rock unit in the cross section.

225) State the name of the rock, formed by contact metamorphism, located at *A*.

226) State *one* piece of evidence that shows that crustal uplift has occurred in this region.

227) As magma cools, what process changes it into basalt?

Questions 228 and 229 refer to the following:

The newspaper article below is written by Paul Recer and printed in the *Times Union* on October 9, 1998.

ASTRONOMERS PEER CLOSER TO BIG BANG

WASHINGTON — The faintest and most distant objects ever sighted — galaxies of stars more than 12 billion light years away — have been detected by an infrared camera on the Hubble Space Telescope.

The sighting penetrates for the first time to within about one billion light years of the very beginning of the universe, astronomers said, and shows that even at that very early time there already were galaxies with huge families of stars.

"We are seeing farther than ever before," said Rodger I. Thompson, a University of Arizona astronomer and the principal researcher in the study.

Thompson and his team focused an infrared instrument on the Hubble on a narrow patch of the sky that had been previously photographed in visible light. The instrument detected about 100 galaxies that were not seen in the visible light and 10 of these were at extreme distance.

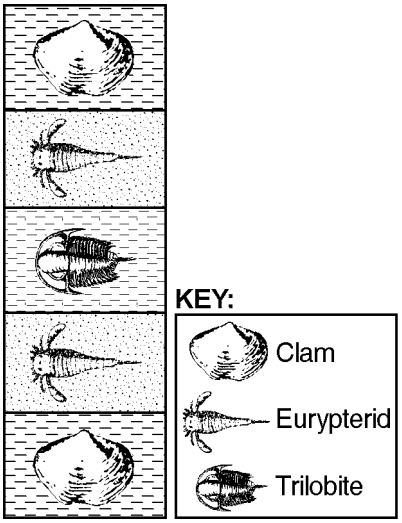
He said the galaxies are seen as they were when the universe was only about 5 percent of its present age. Astronomers generally believe the universe began with a massive explosion, called the "big bang," that occurred about 13 billion years ago.

Since the big bang, astronomers believe that galaxies are moving rapidly away from each other, spreading out and becoming more distant.

228) The big-bang theory is widely believed by astronomers to explain the beginning of the universe. Why does the light from distant galaxies support the big-bang theory discussed in the article?

229) Compare the age of Earth and our solar system to the age of the distant galaxies of stars discussed in the article.

230) The diagram below represents bedrock layers found in an outcrop. Three index fossils are found within the bedrock layers.



Which evidence *best* suggests that this outcrop has undergone crustal movement?

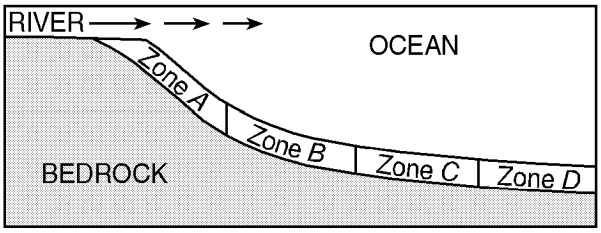
A) The sedimentary layers have the same thickness.
B) The same rock layers appear twice within the outcrop.
C) The trilobite fossil is not found in all five layers.
D) The eurypterid fossil is absent in the middle layer.

Questions 231 and 232 refer to the following:

The cross section below shows a sediment-laden river flowing into the ocean. The arrows show the direction of river flow. Different zones of sorted sediments, *A*, *B*, *C*, and *D*, have been labeled. Sediments have been taken from these zones and measured. The data table below shows the range of sediment sizes in each zone.

DATA TABLE

Zone	Major Sediment Sizes
A	0.04 cm to 6 cm
B	0.006 cm to 0.1 cm
C	0.0004 cm to 0.006 cm
D	Less than 0.0004 cm



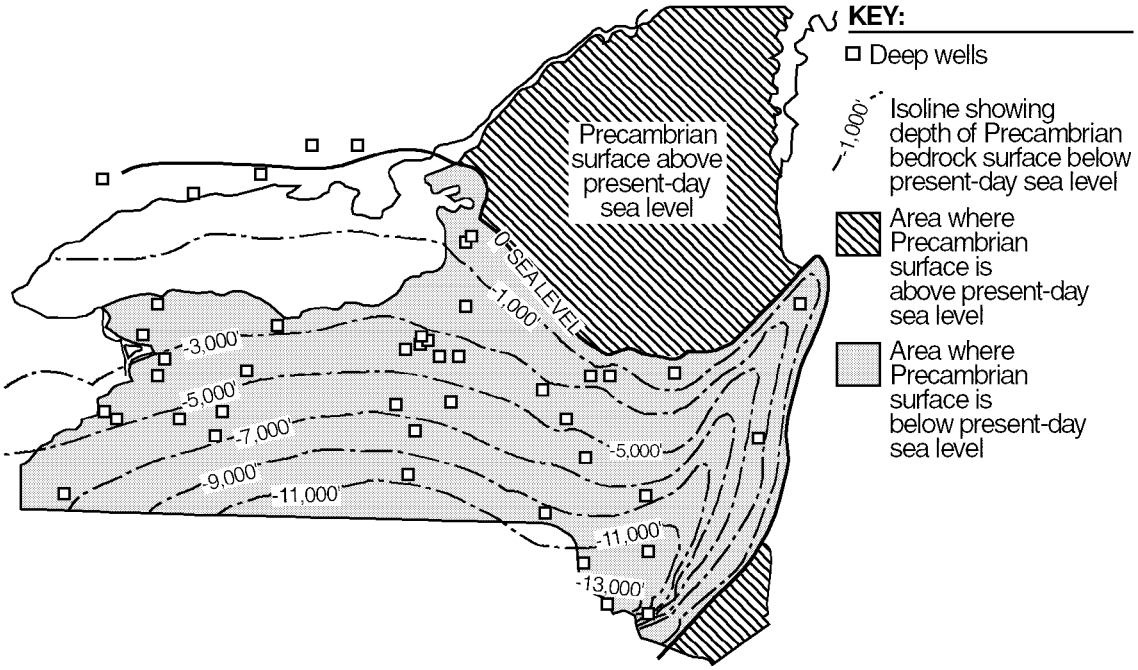
231) In the given diagram, the sedimentary rock, siltstone, will most likely form from sediments deposited in zone

A) *A* B) *B* C) *C* D) *D*

232) How is the pattern of horizontal sorting in the given diagram produced?
   A) Bigger particles are generally deposited first.
   B) Dissolved minerals are generally deposited first.
   C) Rounded sediments generally settle more slowly.
   D) High-density materials generally settle more slowly.

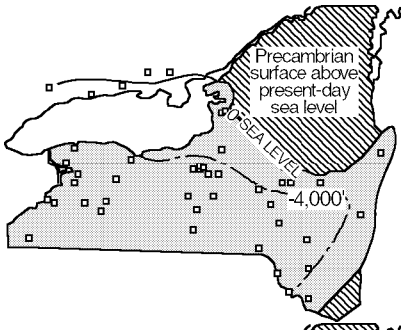
Questions 233 through 235 refer to the following:

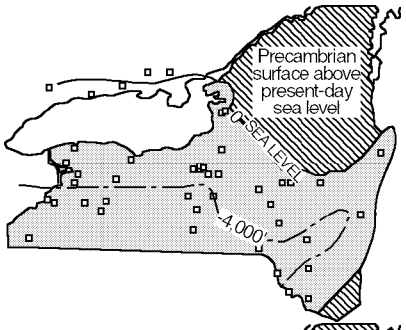
The map below shows most of New York State. Isolines indicate the depth of the Precambrian bedrock surface below present-day sea level. Depths are in feet.

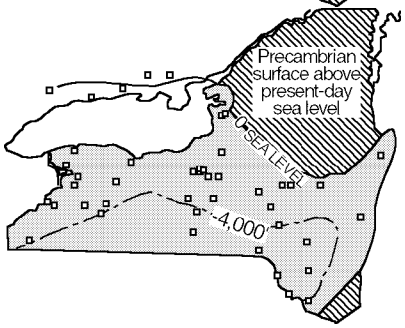


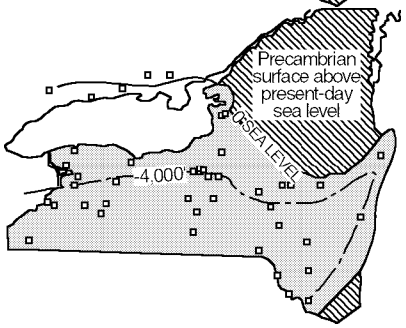
233) According to the map, in which two present-day New York State landscape regions is the *most* Precambrian bedrock likely to be exposed on the land surface?
   A) Erie-Ontario Lowlands and Tug Hill Plateau
   B) Allegheny Plateau and Catskills
   C) Adirondack Mountains and Hudson Highlands
   D) Hudson-Mohawk Lowlands and Champlain Lowlands

234) Which map *best* shows the location of the -4,000-foot isoline?

A)


C)


B)


D)


235) What is the geologic age of *most* of the bedrock covering the Precambrian rock in present-day New York State?

A) Archean B) Mesozoic C) Cenozoic D) Paleozoic

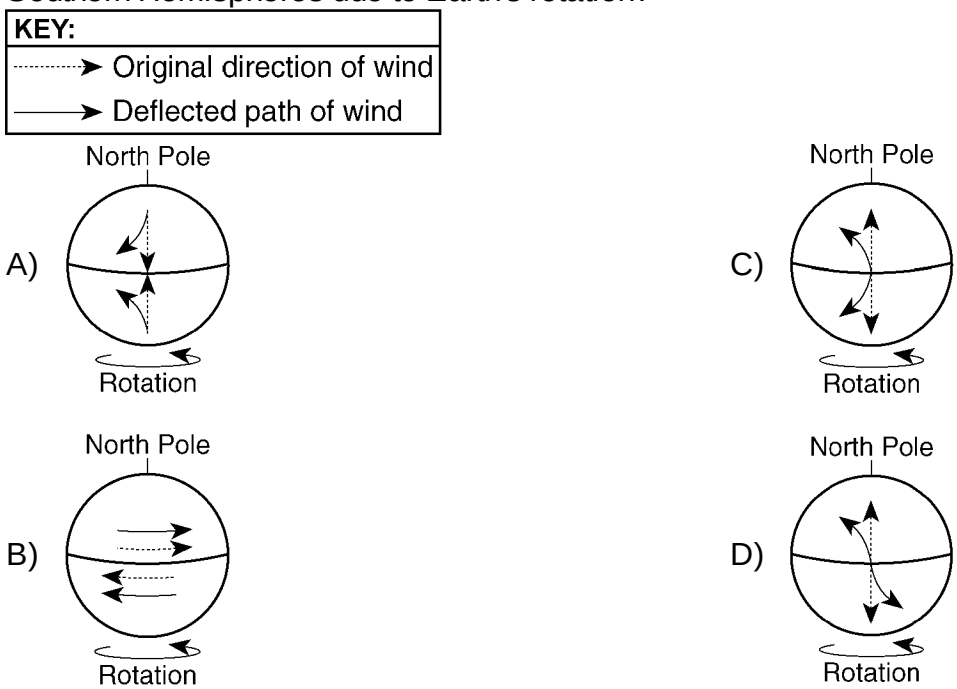
236) Compared to dull and rough rock surfaces, shiny and smooth rock surfaces are most likely to cause sunlight to be

A) scattered B) absorbed C) refracted D) reflected

237) Which observation provides the *best* evidence that Earth rotates?

A) The location of the constellations in relationship to Polaris changes from month to month.
B) The length of the shadow cast by a flagpole at noontime changes from season to season.
C) The direction of swing of a freely swinging pendulum changes during the day.
D) The position of the planets among the stars changes during the year.

238) Which diagram correctly shows how surface winds are deflected (curved) in the Northern and Southern Hemispheres due to Earth's rotation?



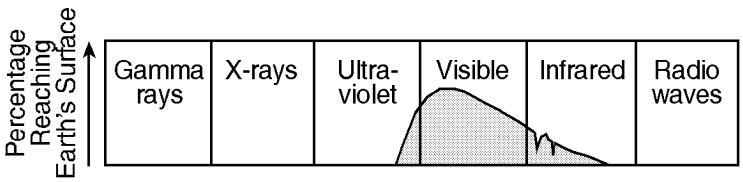
239) Compared to a maritime tropical air mass, a maritime polar air mass has a

A) higher temperature and less water vapor
B) lower temperature and more water vapor
C) higher temperature and more water vapor
D) lower temperature and less water vapor

240) An air mass classified as **mP** usually forms over which type of Earth surface?

A) warm ocean
B) cool ocean
C) warm land
D) cool land

241) The diagram below shows the types of electromagnetic energy given off by the Sun. The shaded part of the diagram shows the approximate amount of each type actually reaching Earth's surface.



Which conclusion is *best* supported by the diagram?

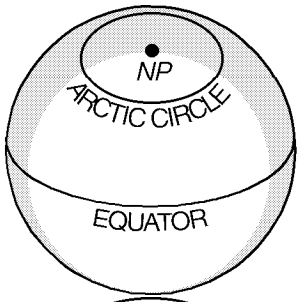
A) Ultraviolet and infrared radiation make up the greatest amount of electromagnetic energy reaching Earth's surface.
B) All types of electromagnetic energy reach Earth's surface.
C) Visible light makes up the greatest amount of electromagnetic energy reaching Earth's surface.
D) Gamma rays and x-rays make up the greatest amount of electromagnetic energy reaching Earth's surface.

242) Which one of the following diagrams most correctly shows the portion of Earth that is illuminated by sunlight and the portion that is in shadow on the first day of summer in the Northern Hemisphere?

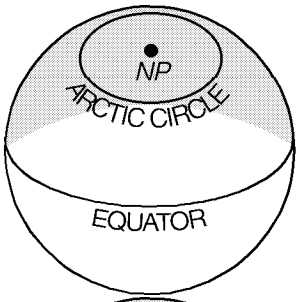
KEY:

= illuminated, = shadow, *NP* = North Pole

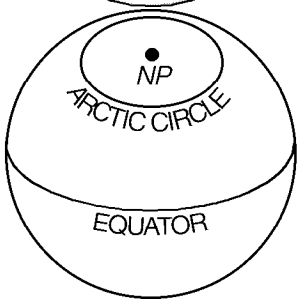
A)



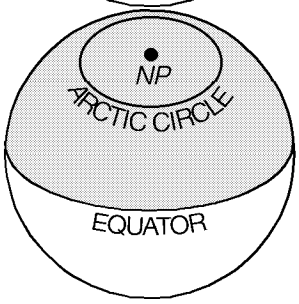
C)



B)



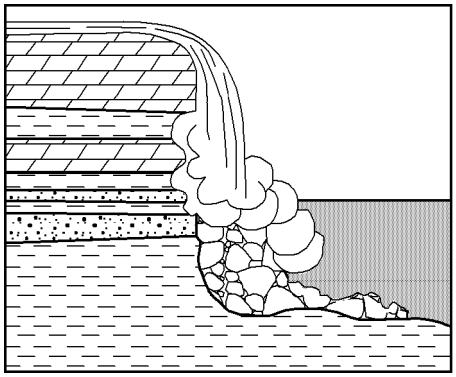
D)



243) The length of an Earth day is determined by the time required for approximately one

A) Earth revolution
B) Sun rotation
C) Sun revolution
D) Earth rotation

244) The cross section below shows sedimentary rocks being eroded by water at a waterfall.



The sedimentary rock layers are being weathered and eroded at different rates primarily because the rock layers

A) formed during different time periods
B) have different compositions
C) contain different fossils
D) are horizontal

245) Which planet's orbit around the Sun is most nearly circular?

A) Mercury
B) Neptune
C) Pluto
D) Venus

246) Which set of conditions would produce the *most* runoff of precipitation?

A) gentle slope and permeable surface
B) gentle slope and impermeable surface
C) steep slope and impermeable surface
D) steep slope and permeable surface

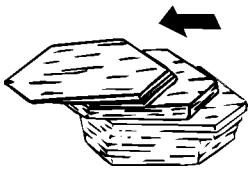
247) On which day of the year would the intensity of insolation at Kingston, New York, most likely be *greatest*?

A) December 21
B) March 21
C) September 23
D) June 21

248) The shore of which New York State body of water has large amounts of metamorphic bedrock exposed at the surface?

A) southern shore of Long Island Sound
B) southern shore of Lake Ontario
C) western shore of Lake Champlain
D) eastern shore of Lake Erie

249) The diagram below shows how a sample of the mineral mica breaks when hit with a rock hammer.



This mineral breaks in smooth, flat surfaces because it

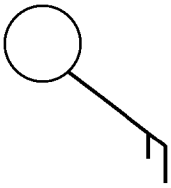
A) contains large amounts of iron
B) is very dense
C) has a regular arrangement of atoms
D) is very hard

250) Three planets that are relatively large, gaseous, and of low density are

A) Mars, Jupiter, and Uranus
B) Jupiter, Saturn, and Uranus
C) Venus, Jupiter, and Neptune
D) Mercury, Jupiter, and Saturn

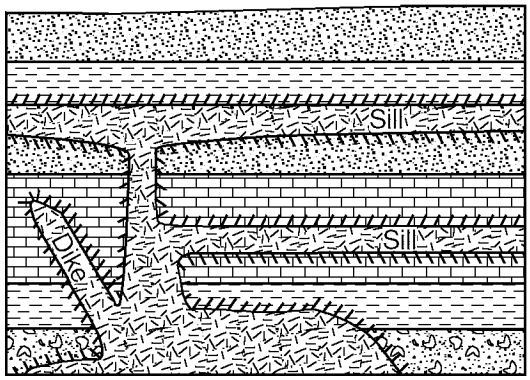
251) Plot the following data on the weather station model below.

Dewpoint = 74 °F, Cloud cover = 100%



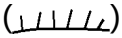
Questions 252 and 253 refer to the following:

On the geologic cross section below, overturning has not occurred. The dike and sills shown in the cross section are igneous intrusions.



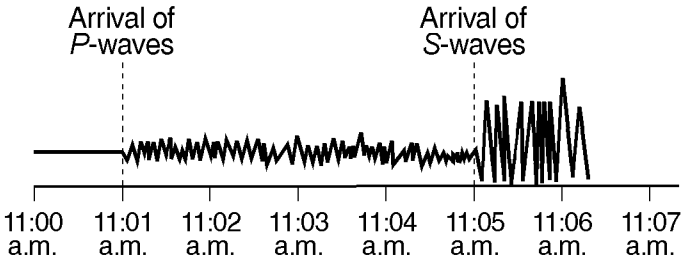
252) Which rock type is the *oldest*?

A) 
B) 
C) 
D) 

253) Which feature is represented by the symbol () along the edges of the dike and sills?

A) contact metamorphic rock
B) index fossils
C) an unconformity
D) a glacial moraine

Questions 254 and 255 refer to the following:



254) How many additional seismic stations *must* report seismogram information in order to locate this earthquake?

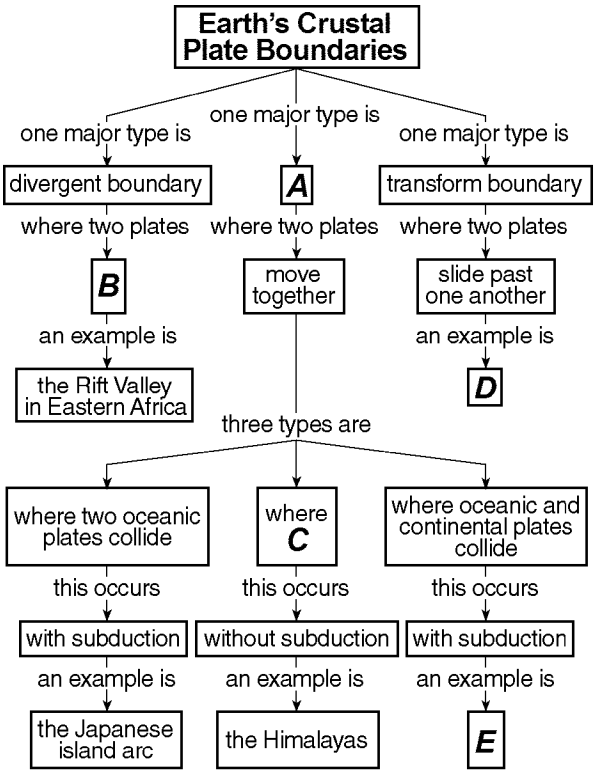
A) one
B) two
C) three
D) four

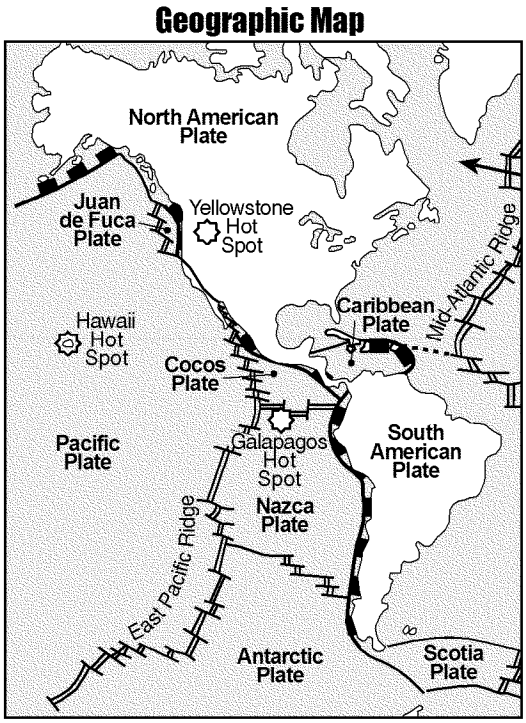
255) When did the *first P*-waves arrive at this seismic station?

A) 11 minutes after an earthquake occurred 3,500 km away
B) 3 minutes after an earthquake occurred 2,600 km away
C) 9 minutes after an earthquake occurred 3,500 km away
D) 5 minutes after an earthquake occurred 2,600 km away

Questions 256 and 257 refer to the following:

The diagram below shows an incomplete concept map identifying the types of plate boundaries. Information in the boxes labeled *A*, *B*, *C*, *D*, and *E* has been deliberately omitted.





256) On the given geographic map, write the letters *D* and *E* on the plate boundary locations where the indicated movements are occurring. Write the letters approximately the same size as shown on the concept map and locate the letters directly on the plate boundary.

257) On the chart below, write the information that should be placed in the boxes labeled *A*, *B*, and *C* that will correctly complete those portions of the concept map shown.

Letter	Information That Should be Placed in Each Box
A	
B	
C	

Questions 258 through 261 refer to the following:

GREENHOUSE EFFECT

The warming of Earth's surface and lower atmosphere tends to intensify with an increase in atmospheric carbon dioxide. The atmosphere allows a large percentage of the visible light rays from the Sun to reach Earth's surface. Some of this energy is reradiated by Earth's surface in the form of long-wave infrared radiation. Much of this infrared radiation warms the atmosphere when it is absorbed by molecules of carbon dioxide and water vapor. A similar warming effect is produced by the glass of a greenhouse, which allows sunlight in the visible range to enter, but prevents infrared radiation from leaving the greenhouse.

The absorption of infrared radiation causes Earth's surface and the lowest layer of Earth's atmosphere to warm to a higher temperature than would otherwise be the case. Without this "greenhouse" warming, Earth's average surface temperature could be as low as -73°C. The oceans would freeze under such conditions.

Many scientists believe that modern industrialization and the burning of fossil fuels (coal, oil, and natural gas) have increased the amount of atmospheric carbon dioxide. This increase may result in an intensified greenhouse effect on Earth causing significant alterations in climate patterns in the future. Scientists estimate that average global temperatures could increase by as much as 5°C by the middle of the 21st century.

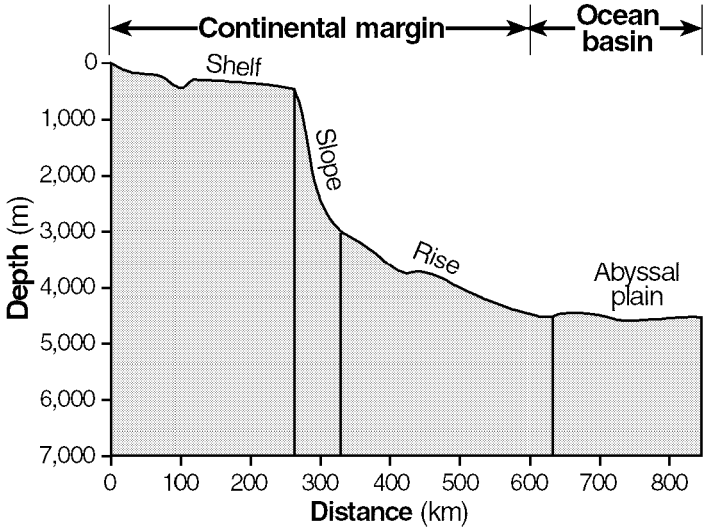
258) Explain why most scientists believe an increase in the greenhouse effect will cause sea levels to rise.

259) State *one* possible change humans could make to significantly reduce the amount of greenhouse gases added to the atmosphere each year.

260) According to the reading passage, the lowest layer of Earth's atmosphere has undergone a large increase in temperature due to the presence of greenhouse gases. State the name of this temperature-zone layer.

261) State a possible wavelength, in centimeters, of infrared radiation.

262) The profile below shows four regions of the ocean bottom.

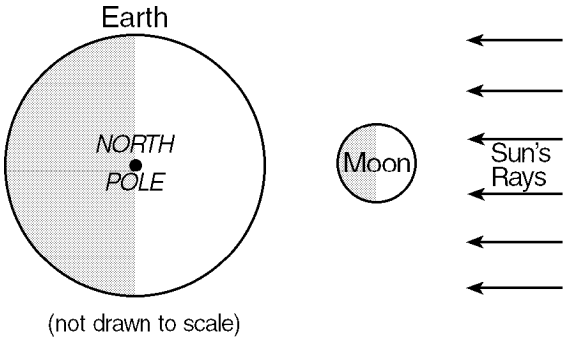


In which one of the following lists are these regions arranged in order of gradient from *least* steep to *most* steep?

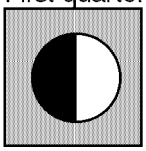
A) abyssal plain ⟶ shelf ⟶ rise ⟶ slope
B) slope ⟶ rise ⟶ shelf ⟶ abyssal plain
C) shelf ⟶ abyssal plain ⟶ rise ⟶ slope
D) rise ⟶ abyssal plain ⟶ shelf ⟶ slope

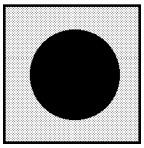
263) Identify by name the surface ocean current that cools the climate of locations on the western coastline of North America.

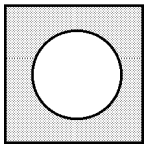
264) The diagram below shows Earth, the Moon, and the Sun's rays as viewed from space.

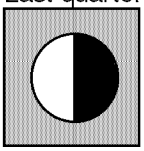


For observers on Earth, which one of the following phases of the Moon is represented by the diagram?

A) First quarter 

B) New 

C) Full 

D) Last quarter 

265) At the Aleutian Trench and the Peru-Chile Trench, tectonic plates are generally

A) converging
B) diverging
C) moving over a mantle hot spot
D) moving along a transform boundary

266) A square meter of surface of which of these natural areas would most likely absorb the *most* insolation during a clear day?

A) a beach with white sand
B) a snow-covered field
C) a dark-green forest
D) a fast-moving river

267) Which sedimentary rock is most likely to be changed to slate during regional metamorphism?

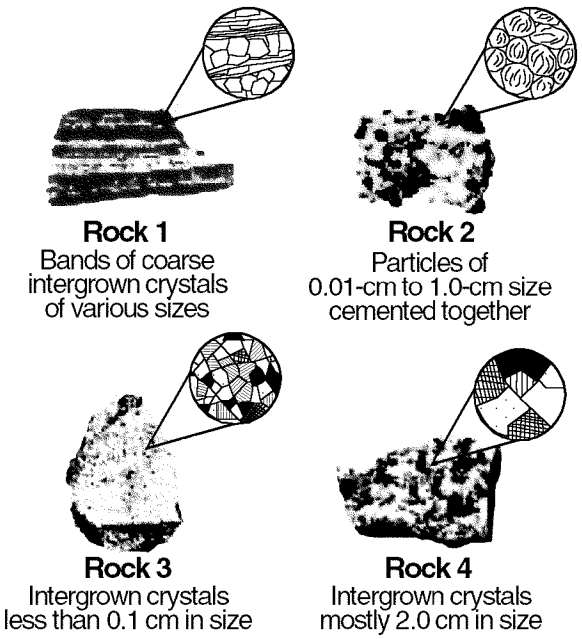
A) breccia
B) dolostone
C) conglomerate
D) shale

268) Which interaction between the atmosphere and the hydrosphere causes most surface ocean currents?

A) evaporation of water from the ocean surface
B) friction from planetary winds on the ocean surface
C) cooling of rising air above the ocean surface
D) seismic waves on the ocean surface

Questions 269 and 270 refer to the following:

Magnified views of the pictures of four rocks below are shown in the circles.



269) Which rock is metamorphic and shows evidence of foliation?

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

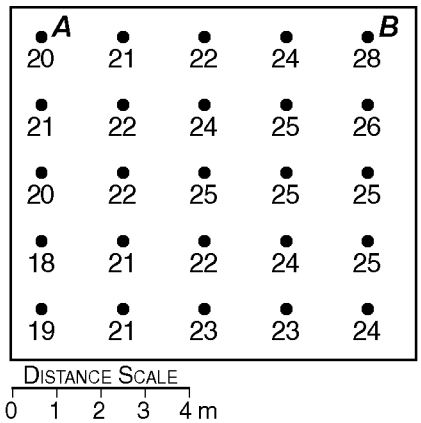
270) What do *all* four rock samples have in common?

A) They are organically formed.
B) They show cleavage.
C) They contain minerals.
D) They formed on Earth's surface.

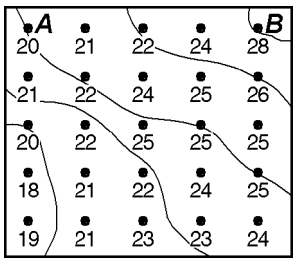
271) Specific mass extinction of living organisms and global climatic changes in geologic history are inferred by most scientists to have been caused by

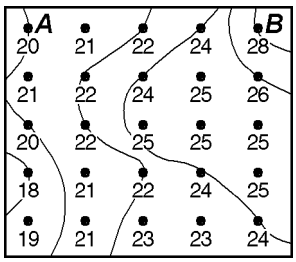
A) the gravitational pull of the Sun on Earth's surface
B) the impact of asteroids or large meteors on Earth's surface
C) large energy surges from the surface of the Sun
D) earthquakes occurring along crustal plate boundaries

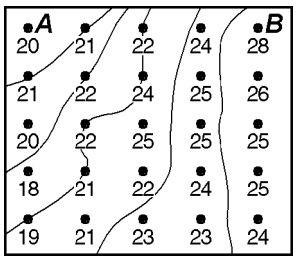
272) The field map below shows air temperature measurements, in degrees Celsius, taken at the same elevation within a closed room. Two reference points, *A* and *B*, are shown.

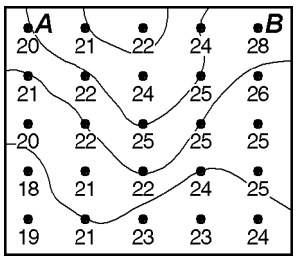


Which temperature field map shows correctly drawn isotherms?

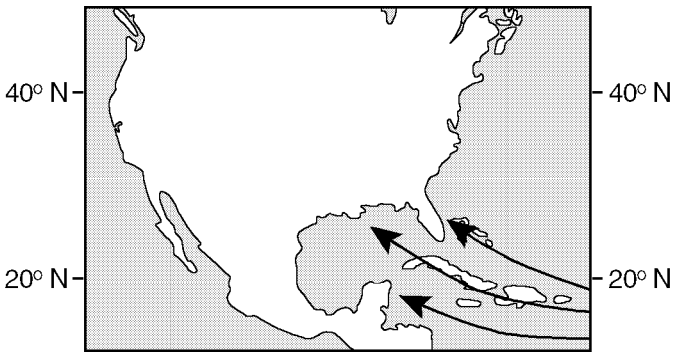
A)


C)


B)


D)


273) The map below shows part of North America.



The arrows shown on the map most likely represent the direction of movement of

A) ocean conduction currents
B) Earth's rotation
C) Atlantic Ocean hurricanes
D) the prevailing northeast winds

274) Which ocean current flows northeast along the eastern coast of North America?

A) North Equatorial
B) California
C) Labrador
D) Gulf Stream

275) When rainfall occurs, the rainwater will most likely become surface runoff if the land surface is

A) sandy
B) impermeable
C) covered with grass
D) nearly flat

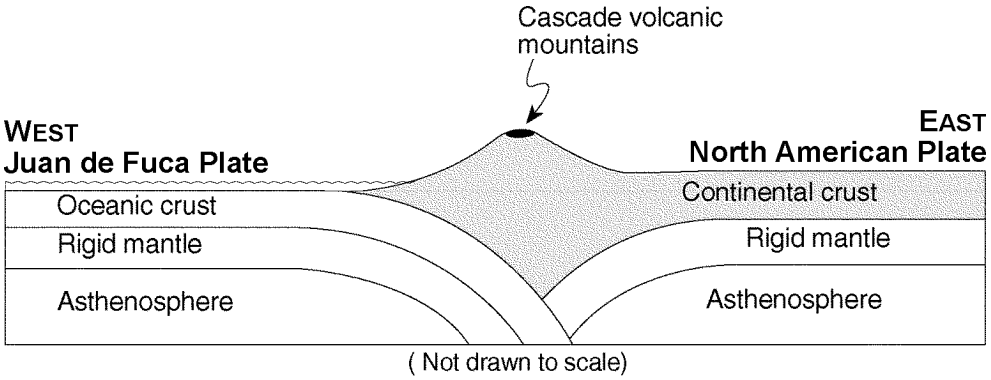
276) Which star is cooler and many times brighter than Earth's Sun?

A) Sirius
B) Barnard's Star
C) Rigel
D) Betelgeuse

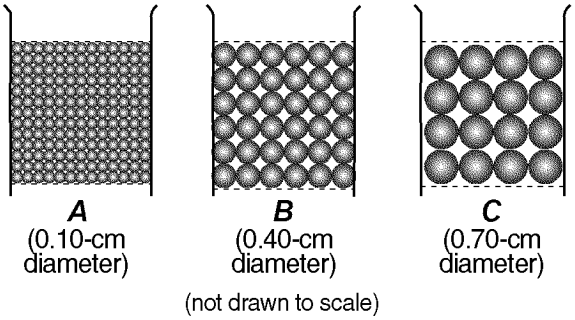
277) Scientists are concerned about the decrease in ozone in the upper atmosphere primarily because ozone protects life on Earth by absorbing certain wavelengths of

A) x-ray radiation
B) microwave radiation
C) infrared radiation
D) ultraviolet radiation

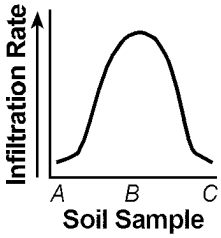
278) On the cross section below, place an arrow in the continental crust and an arrow in the oceanic crust to show the relative directions of plate movement.

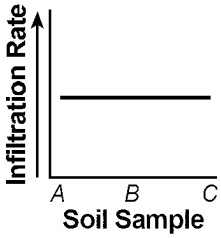


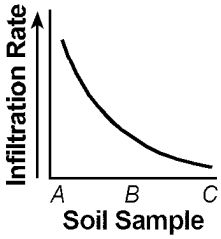
279) The diagrams below show the relative sizes of particles from soil samples *A*, *B*, and *C*. Equal volumes of each soil sample were placed in separate containers. Each container has a screen at the bottom. Water was poured through each sample to determine the infiltration rate.

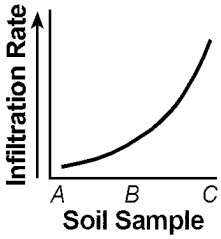


Which graph *best* shows how the infiltration rates of the three soil samples would compare?

A)


C)


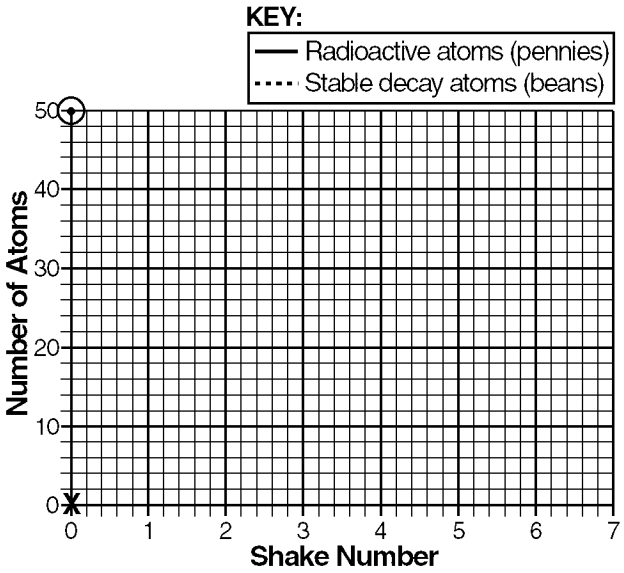
B)


D)


Questions 280 and 281 refer to the following:

The table below shows the results of a student's demonstration modeling radioactive decay. To begin, the student put 50 pennies heads up in a container. Each penny represented one radioactive atom. The student placed a top on the box and shook the box. Each penny that had flipped over to the tails up side was replaced with a bean that represented the stable decay product. The student continued the process until all of the pennies had been replaced by beans.

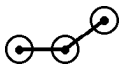
Shake Number	Number of Radioactive Atoms (pennies)	Number of Stable Decay Atoms (beans)
0	50	0
1	25	25
2	14	36
3	7	43
4	5	45
5	2	48
6	1	49
7	0	50



280) Assume that each shake number represents an additional 100 years. State the half-life of the radioactive material in this model.

281) On the given grid, graph the data shown on the table by following the steps below.

(a) Mark with a dot each number of radioactive atoms (pennies) after each shake. Surround each dot with a small circle (⊙). The zero shake has been plotted for you.

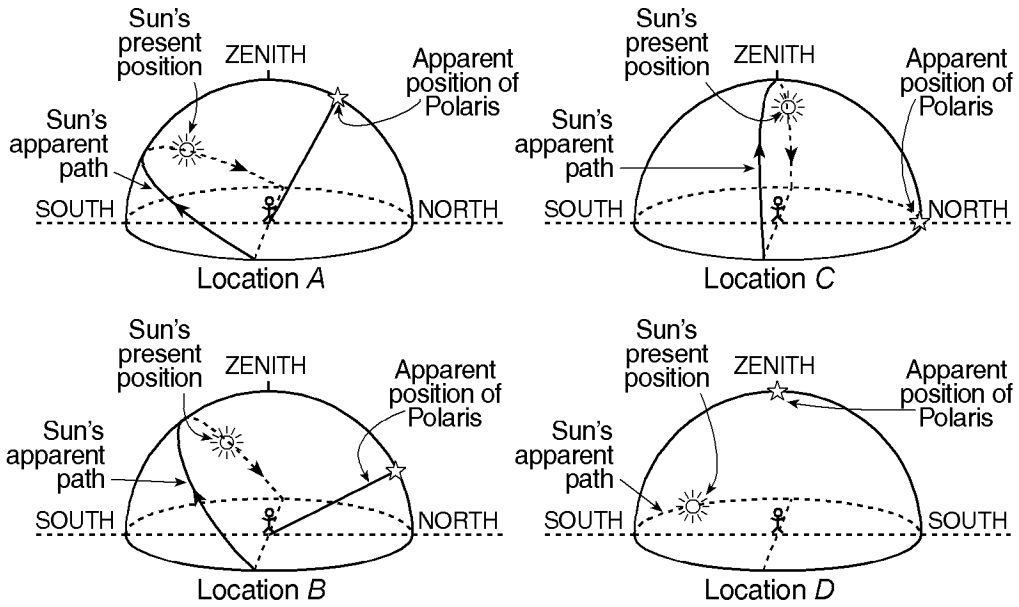
(b) Connect *all* the dots with a solid line.
EXAMPLE: 

(c) Mark with an **X** the number of stable decay atoms (beans) after each shake. The zero shake has been plotted for you.

(d) Connect all the **X**'s with a dashed line.

Questions 282 through 286 refer to the following:

The diagram below represents the apparent path of the Sun observed at four locations on Earth's surface on March 21. The present positions of the Sun, Polaris, and the zenith (position directly overhead) are shown for an observer at each location.



282) The observer at location *A* casts a shadow at the time represented in the diagram.

(a) State the compass direction in which the observer at location *A* must look to view her shadow.

(b) Describe the change in the length of the shadow that will occur between the time shown and sunset.

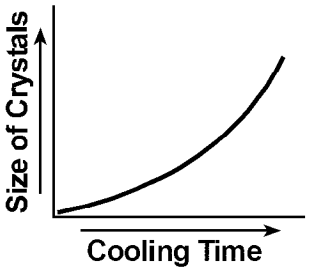
283) State the other day of the year when the Sun's apparent path is exactly the same as that shown for these four locations on March 21.

284) Explain why the intensity of sunlight at noon on March 21 is greater at location *C* than at the other locations.

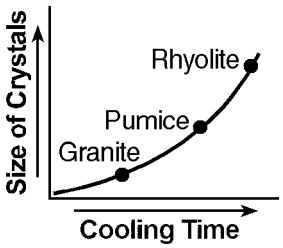
285) State the approximate time of day for the observer at location *B* when the Sun is at the position shown in the diagram.

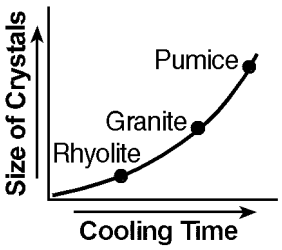
286) The observer at location *D* is located at a higher latitude than the other three observers. State *one* way that this conclusion can be determined from the diagram.

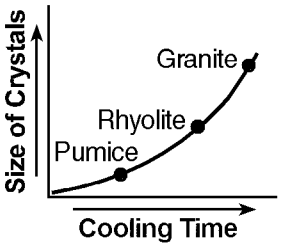
287) The graph below shows the relationship between the cooling time of magma and the size of the crystals produced.

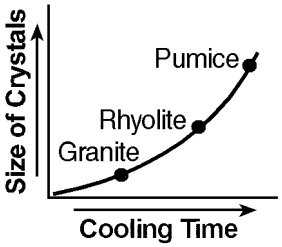


Which graph correctly shows the relative positions of the igneous rocks granite, rhyolite, and pumice?

A)


C)


B)


D)


288) **WATCHING THE GLACIERS GO**

Mountain glaciers and ice caps in tropical areas of the world are melting fast and may vanish altogether by the year 2020. That was the chilling news last year from Lonnie Thompson, a geologist at Ohio State University's Byrd Polar Research Center who has been studying icy areas near the equator in South America, Africa, and the Himalayas for two decades.

It doesn't take a glacier scientist to see the changes. In 1977, when Thompson visited the Quelccaya ice cap in Peru, it was impossible not to notice a school bus-size boulder stuck in its grip. When Thompson returned in 2000, the rock was still there but the ice wasn't — it had retreated far into the distance.

Most scientists believe the glaciers are melting because of global warming — the gradual temperature increase that has been observed with increasing urgency during the past decade. Last year a panel of the nation's top scientists, the National Research Council, set aside any lingering skepticism about the phenomenon, concluding definitively that average global surface temperatures are rising and will continue to do so.

—"Watching the Glaciers Go,"
Popular Science, vol. #7, January 2002

Describe *one* action humans could take to reduce the global warming that is melting the Quelccaya ice cap.

289) In which list are the forms of electromagnetic energy arranged in order from *longest* to *shortest* wavelengths?

A) infrared rays, radio waves, blue light, red light
B) x-rays, infrared rays, blue light, gamma ray
C) gamma rays, x-rays, ultraviolet rays, visible light
D) radio waves, infrared rays, visible light, ultraviolet rays

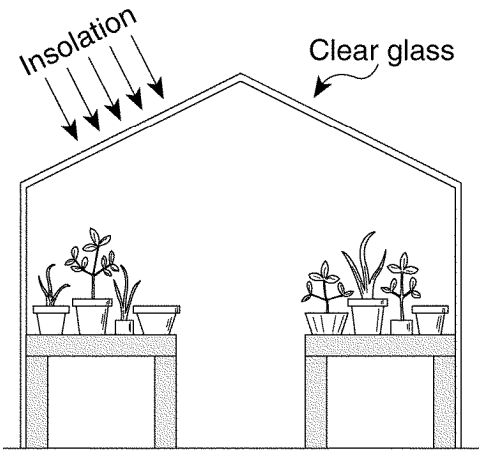
290) Which star color indicates the *hottest* star surface temperature?

A) yellow B) blue C) white D) red

291) In which one of the following lists are celestial features correctly shown in order of increasing size?

A) solar system ⟶ galaxy ⟶ planet ⟶ universe
B) planet ⟶ solar system ⟶ galaxy ⟶ universe
C) galaxy ⟶ solar system ⟶ universe ⟶ planet
D) universe ⟶ galaxy ⟶ solar system ⟶ planet

292) The diagram below shows a greenhouse.

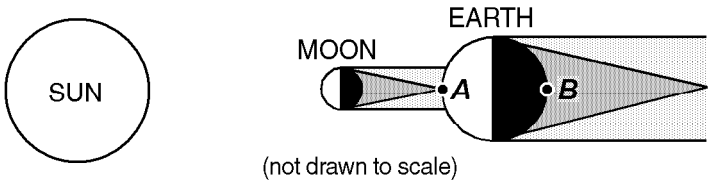


Greenhouse

What is the primary function of the clear glass of the greenhouse?

A) The glass reduces the amount of insolation entering the greenhouse.
B) The glass allows long wavelengths of radiation to enter, but reduces the amount of short-wavelength radiation that escapes.
C) The glass allows all wavelengths of radiation to enter and all wavelengths of radiation to escape.
D) The glass allows short wavelengths of radiation to enter, but reduces the amount of long-wavelength radiation that escapes.

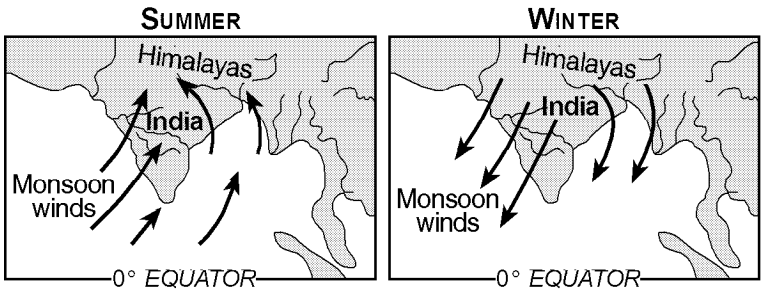
293) The diagram below shows the relative positions of the Sun, the Moon, and Earth when an eclipse was observed from Earth. Positions *A* and *B* are locations on Earth's surface.



Which statement correctly describes the type of eclipse that was occurring and the position on Earth where this eclipse was observed?

A) A solar eclipse was observed from position *B*.
B) A solar eclipse was observed from position *A*.
C) A lunar eclipse was observed from position *A*.
D) A lunar eclipse was observed from position *B*.

294) The arrows on the two maps below show how the monsoon winds over India change direction with the seasons.



How do these winds affect India's weather in summer and winter?

A) Winter is cooler and more humid than summer.
B) Summer is cooler and less humid than winter.
C) Winter is warmer and less humid than summer.
D) Summer is warmer and more humid than winter.

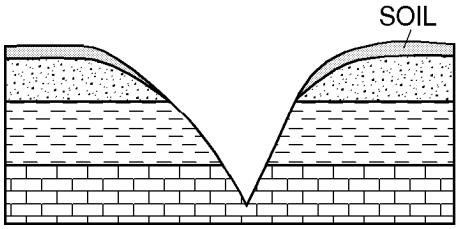
295) Which type of land surface would probably reflect the *most* incoming solar radiation?

A) dark colored and smooth
B) light colored and rough
C) dark colored and rough
D) light colored and smooth

296) Minerals from the *Properties of Common Minerals* Earth Science reference table are found in several different rocks. Which two rocks are primarily composed of a mineral that bubbles with acid?

A) granite and dolostone
B) slate and conglomerate
C) sandstone and quartzite
D) limestone and marble

297) The cross section below shows a V-shaped valley and the bedrock beneath the valley.

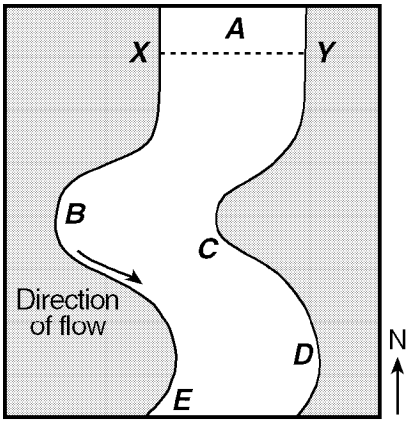


Which agent of erosion is responsible for cutting *most* V-shaped valleys into bedrock?

A) glacial ice
B) running water
C) surface winds
D) ocean waves

Questions 298 through 300 refer to the following:

The map below shows a portion of a stream that flows southward. Letters *A* through *E* represent locations in the stream. Line *XY* is the location of a cross section.



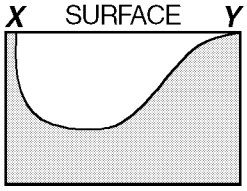
298) Where this stream's velocity decreases from 300 to 200 centimeters per second, which size sediment will be deposited?

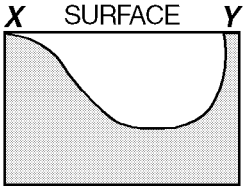
A) silt B) clay C) cobbles D) sand

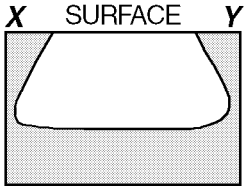
299) At which two locations in this stream is deposition normally dominant over erosion?

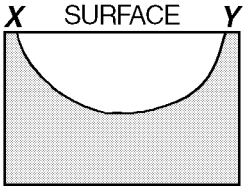
A) *D* and *C* B) *A* and *D* C) *B* and *E* D) *C* and *E*

300) Which cross section along line *XY best* represents the shape of the stream bottom?

A)


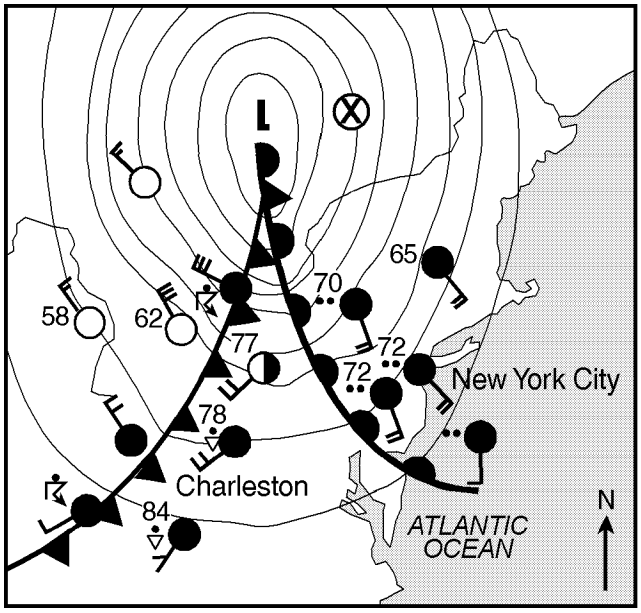
C)


B)


D)


Questions 301 through 304 refer to the following:

The weather map below shows a weather system over the northeastern United States and weather data for several locations. Isobars show a low-pressure (**L**) center. Point ⊗ is a location in Canada.



301) State the relationship between isobar spacing on the given map and wind velocity.

302) On the given weather map, draw a curved arrow through point ⊗ to show the general direction of surface winds on that side of the low-pressure center.

303) (a) Describe how clouds form when warm, humid air rises along a cold front. [*Include the terms dewpoint and either expansion or expands in your answer.*]

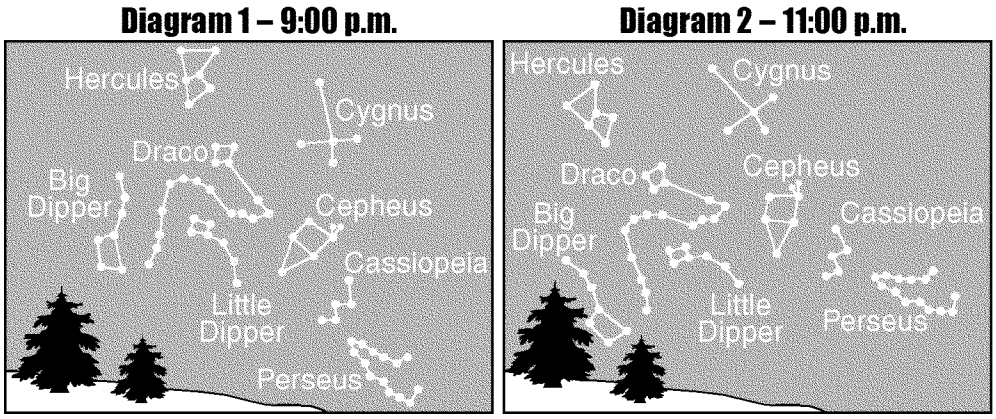
(b) State the phase change that occurs at the dewpoint.

304) Describe the five specific weather conditions for Charleston indicated by the station model on the given weather map. Complete the chart below and include appropriate units where necessary.

Weather Conditions	Description
(1) Air temperature	
(2) Present weather	
(3) Wind speed	
(4) Wind direction	from
(5) Cloud cover	

Questions 305 through 307 refer to the following:

Diagram 1 and diagram 2 below show some constellations in the night sky viewed by a group of students. Diagram 1 shows the positions of the constellations at 9:00 p.m. Diagram 2 shows their positions two hours later.

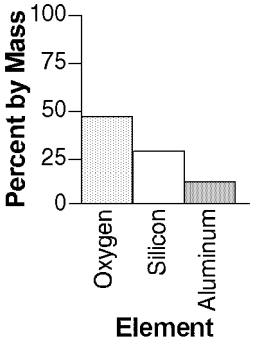


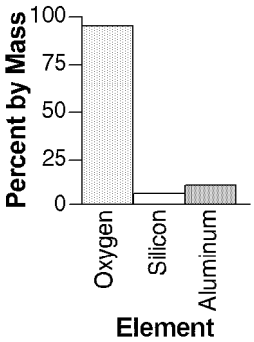
305) Circle Polaris on diagram 2.

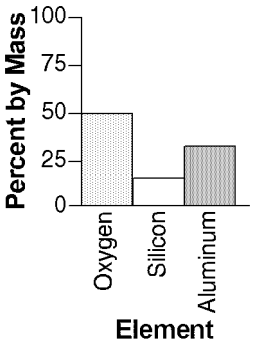
306) Describe the apparent direction of movement of the constellations Hercules and Perseus during the two hours between student observations.

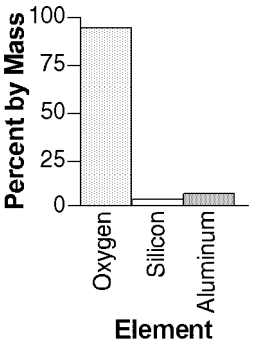
307) In which compass direction were the students facing?

308) Which graph correctly represents the three *most* abundant elements, by mass, in Earth's crust?

A)


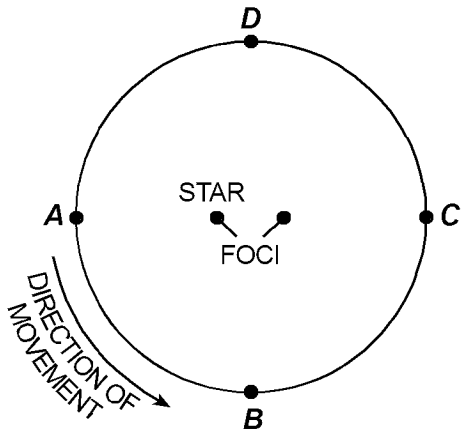
C)


B)


D)


Questions 309 through 311 refer to the following:

The diagram below represents the elliptical orbit of a planet traveling around a star. Points *A*, *B*, *C*, and *D* are four positions of this planet in its orbit.



309) The gravitational attraction between the star and the planet will be *greatest* at position

A) *A* B) *B* C) *C* D) *D*

310) The calculated eccentricity of this orbit is approximately

A) 0.3 B) 0.1 C) 0.2 D) 0.4

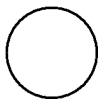
311) As the planet revolves in orbit from position *A* to position *D*, the orbital velocity will

A) decrease, then increase
B) continually increase
C) continually decrease
D) increase, then decrease

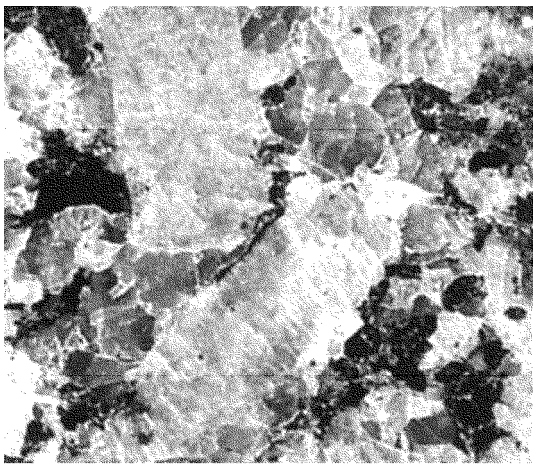
312) A weather station records the following data:

Air pressure is 1,001.0 millibars.
Wind is from the south.
Wind speed is 25 knots.

Using the proper weather map symbols, place this information in the correct locations on the weather station model provided below.



313) The photograph below shows the intergrown crystals of a pegmatite rock.



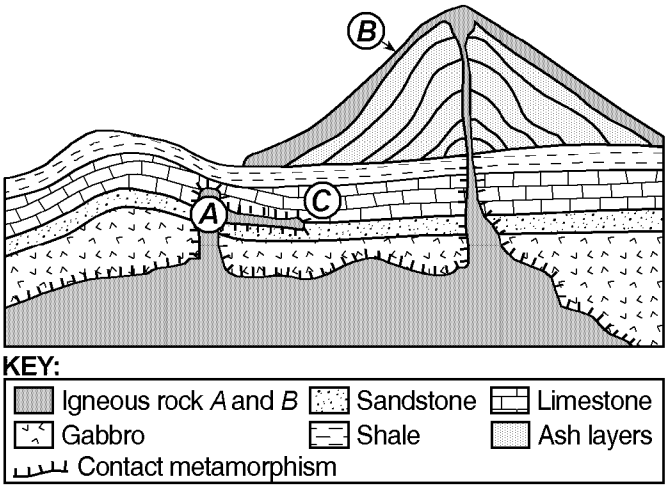
(Actual size)

Which characteristic provides the *best* evidence that this pegmatite solidified deep underground?

A) low density
B) felsic composition
C) very coarse texture
D) light color

Questions 314 and 315 refer to the following:

In the geologic cross section below, the large cone-shaped mountain on Earth's surface is a volcano. Letters *A*, *B*, and *C* represent certain rocks.



314) Which statement correctly describes the relative ages of rocks *A* and *C* and gives the *best* supporting evidence from the cross section?

A) *A* is older than *C*, because *A* has older index fossils.
B) *A* is older than *C*, because the intrusion of *A* cuts across rock layer *C*.
C) *A* is younger than *C*, because *A* is a lower sedimentary rock layer.
D) *A* is younger than *C*, because the intrusion of *A* metamorphosed part of rock layer *C*.

315) Rock *B* is most likely which type of igneous rock?

A) peridotite
B) pegmatite
C) basalt
D) granite

316) When 1 gram of liquid water at 0° Celsius freezes to form ice, how many total calories of heat are lost by the water?

A) 0.5 B) 80 C) 540 D) 1

Questions 317 through 320 refer to the following:

The passage below represents a magazine article.

LAKE-EFFECT SNOW

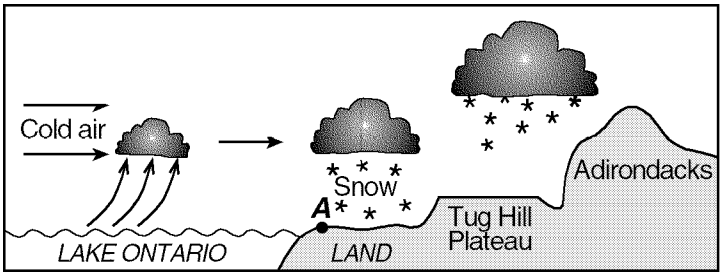
During the cold months of the year, the words "lake effect" are very much a part of the weather picture in many locations in New York State. Snow created by the lake effect may represent more than half the season's snowfall in some areas.

In order for heavy lake-effect snow to develop, the temperature of the water at the surface of the lake must be higher than the temperature of the air flowing over the water. The higher the water temperature and the lower the air temperature, the greater the potential for lake-effect snow.

A lake-effect storm begins when air flowing across the lake is warmed as it comes in close contact with the water. The warmed air rises and takes moisture along with it. This moisture, which is water vapor from the lake, is turned into clouds as it encounters much colder air above. When the clouds reach the shore of the lake, they deposit their snow on nearby land. A typical lake-effect storm is illustrated in the diagram below.

The area most likely to receive snow from a lake is called a "snowbelt." Lake Ontario's snowbelt includes the counties along the eastern and southeastern ends of' the lake. Because the lake runs lengthwise from west to east, the prevailing westerly winds are able to gather the maximum amount of moisture as they flow across the entire length of the lake. There can be lake-effect snowfall anywhere around the lake, but the heaviest and most frequent snowfalls occur near the eastern shore.

In parts of the snowbelt, the lake effect combines with a phenomenon known as orographic lifting to produce some very heavy snowfalls. After cold air has streamed over the length of Lake Ontario, it moves inland and is forced to climb the slopes of the Tug Hill Plateau and the Adirondack Mountains, resulting in very heavy snowfall.



317) State the name of the New York State landscape region that includes location *A* shown in the given diagram.

318) State why locations east and southeast of Lake Ontario are more likely to receive lake-effect snow than are locations west of the lake.

319) State the relationship that must exist between water temperature and air temperature for lake-effect snow to develop.

320) State why very heavy snowfall occurs in the Tug Hill Plateau region.

Questions 321 and 322 refer to the following:

The data table below provides information about the Moon, based on current scientific theories.

Information About the Moon

Subject	Current Scientific Theories
Origin of the Moon	Formed from a material thrown from a still-liquid Earth following the impact of a giant object 4.5 billion years ago
Craters	Largest craters resulted from an intense bombardment of rock objects around 3.9 billion years ago
Presence of Water	Mostly dry, but water brought in by the impact of comets may be trapped in very cold places at the poles
Age of rocks in terrae highlands	Most are older than 4.1 billion years; highland anorthosites (igneous rocks composed almost totally of feldspar) are dated at 4.4 billion years
Age of rocks in maria plains	Varies widely from 2 billion to 4.3 billion years
Composition of terrae highlands	Wide variety of rock types, but all contain more aluminum than rocks of maria plains
Composition of maria plains	Wide variety of basalts
Composition of mantle	Varying amounts of mostly olivine and pyroxene

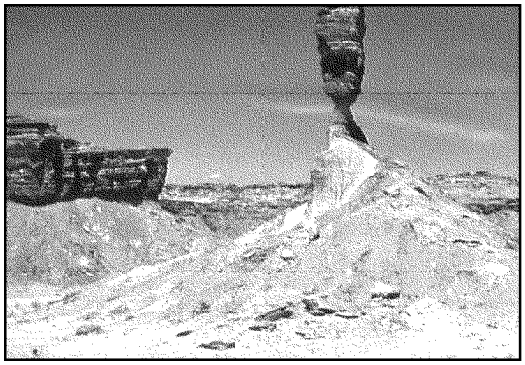
321) Which statement is supported by the information in the table?

A) Earth is 4.5 billion years older than the Moon.
B) Earth was liquid rock when the Moon was formed.
C) The Moon was once a comet.
D) The Moon once had saltwater oceans.

322) Which Moon feature is an impact structure?

A) maria plain
B) terrae highland
C) mantle
D) crater

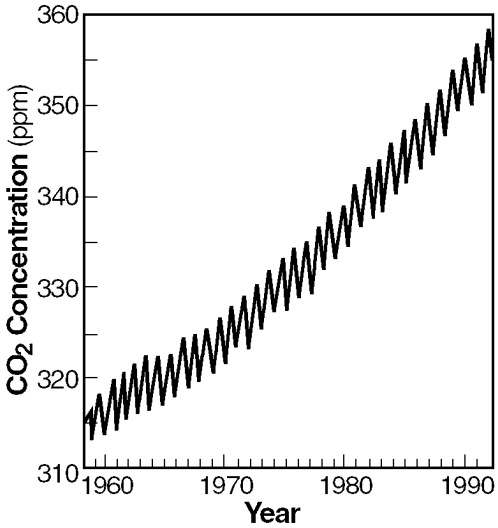
323) The picture below shows a geological feature in the Kalahari Desert of southwestern Africa.



Which process most likely produced the present appearance of this feature?

A) volcanic eruption
B) wind erosion
C) earthquake vibrations
D) plate tectonics

324) The graph below shows the change in carbon dioxide concentration in parts per million (ppm) in Earth's atmosphere from 1960 to 1990.



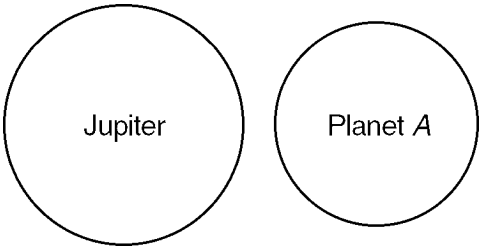
The most likely cause of the overall change in the level of carbon dioxide from 1960 to 1990 is an increase in the

A) number of violent storms
B) number of volcanic eruptions
C) use of nuclear power
D) use of fossil fuels

325) As air on the surface of Earth warms, the density of the air

A) decreases
B) remains the same
C) increases

326) The diagram below represents two planets in our solar system drawn to scale, Jupiter and planet *A*.



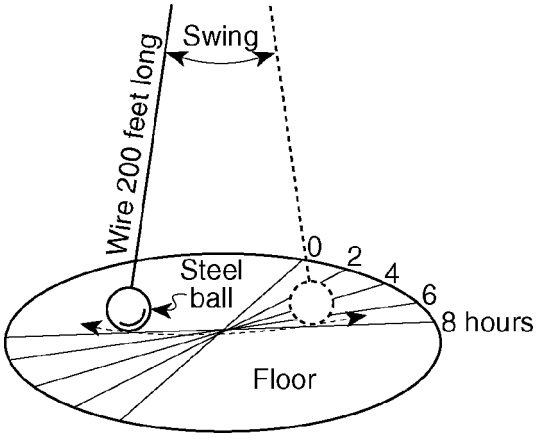
Planet *A* most likely represents

A) Saturn B) Venus C) Uranus D) Earth

327) The vesicular basalt in the given diagram includes zircon crystals containing the radioactive isotope U-235, which disintegrates to the stable isotope Pb-207. The zircon crystals have 98.44% of the original U-235 remaining, and 1.56% has decayed to Pb-207. Based on the table below, how many half-lives have elapsed since the formation of these crystals?

Percent of U-235 Remaining	Percent Decayed to Pb-207	Half-Lives Elapsed
99.22	0.78	$\frac{1}{64}$
98.44	1.56	$\frac{1}{32}$
96.88	3.12	$\frac{1}{16}$
93.75	6.25	$\frac{1}{8}$
87.50	12.5	$\frac{1}{4}$
75.0	25.0	$\frac{1}{2}$
50.0	50.0	1
37.5	62.5	$1\frac{1}{2}$
25.0	75.0	2
12.5	87.5	3
6.25	93.75	4

328) The diagram below represents a Foucault pendulum swinging freely for 8 hours.



The Foucault pendulum appears to gradually change its direction of swing due to Earth's

A) tilted axis
B) spin on its axis
C) orbit around the Sun
D) curved surface

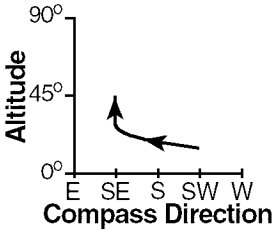
329) Outwash plains are formed as a result of deposition by

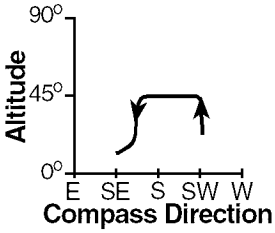
A) ocean waves
B) meltwater from glaciers
C) landslides
D) winds from hurricanes

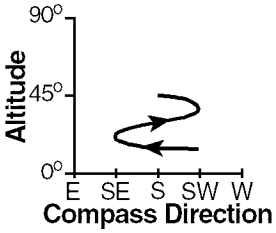
330) The table below shows the altitude and compass direction of one planet, as viewed by an observer in New York State at 10 p.m. on the first day of each month from April through November.

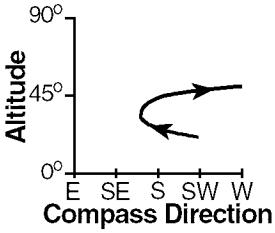
Month	Altitude	Compass Direction
April	20°	SW
May	23°	SSW
June	25°	S
July	29°	SSE
August	33°	SE
September	38°	S
October	42°	SW
November	45°	S

Which graph *best* represents a plot of this planet's apparent path, as viewed by the observer over the 7-month period?

A)


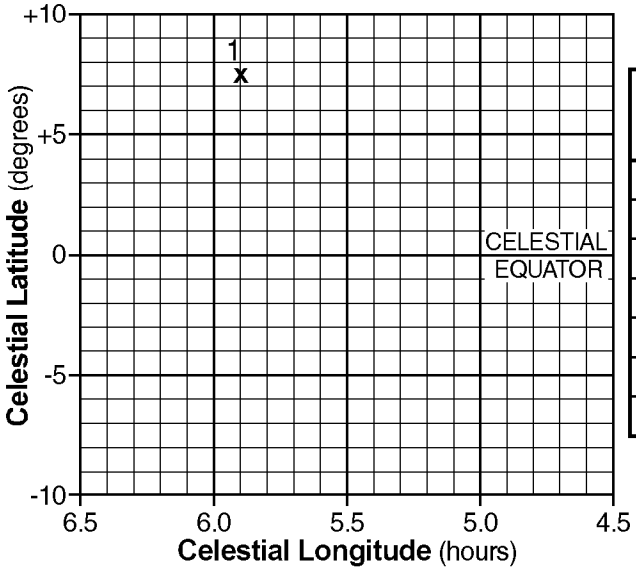
C)


B)


D)


Questions 331 through 334 refer to the following:

The table below lists the seven brightest stars, numbered 1 through 7, in the constellation Orion. This constellation can be seen in the winter sky by an observer in New York State. The table shows the celestial coordinates for the seven numbered stars of Orion.



Location of the Seven Brightest Stars in Orion

Star Number	Celestial Longitude (in hours)	Celestial Latitude (in degrees)
1	5.9	+7.4
2	5.4	+6.3
3	5.2	−8.2
4	5.8	−9.7
5	5.7	−1.9
6	5.6	−1.2
7	5.5	−0.3

331) State *one* reason why an observer in New York State can *never* observe the constellation Orion at midnight during July, but can observe the constellation Orion at midnight during January.

332) Star 1 plotted on the grid is the star *Betelgeuse*. Star 3 plotted on the grid is the star *Rigel*. How do the temperature and luminosity of *Betelgeuse* compare to the temperature and luminosity of *Rigel*?

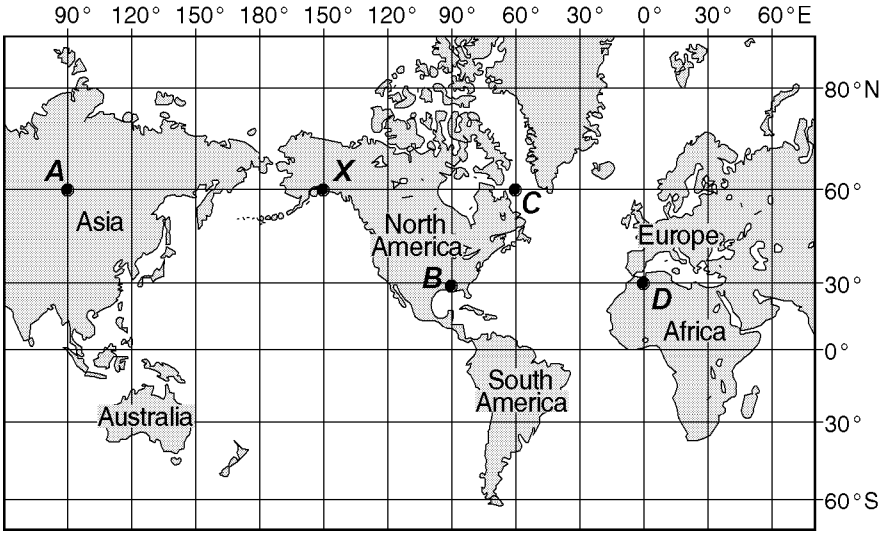
333) The seven stars of the constellation Orion that were plotted are located within our galaxy. Name the galaxy in which the plotted stars of Orion are located.

334) On the given grid, graph the data shown in the table by following the steps below.

(a) Mark with an **X**, the position of each of the seven stars. Write the number of the plotted star beside each **X**. [*The first star has been plotted for you.*]

(b) Show the apparent shape of Orion by connecting the **X**s in the following order:
5-1-2-7-3-4-5-6-7

335) Letters *A*, *B*, *C*, *D*, and *X* on the map below represent locations on Earth. The map shows the latitude-longitude grid.



Solar time is based on the position of the Sun. If the solar time is 1 p.m. at location *X*, at which location is the solar time 5 p.m.?

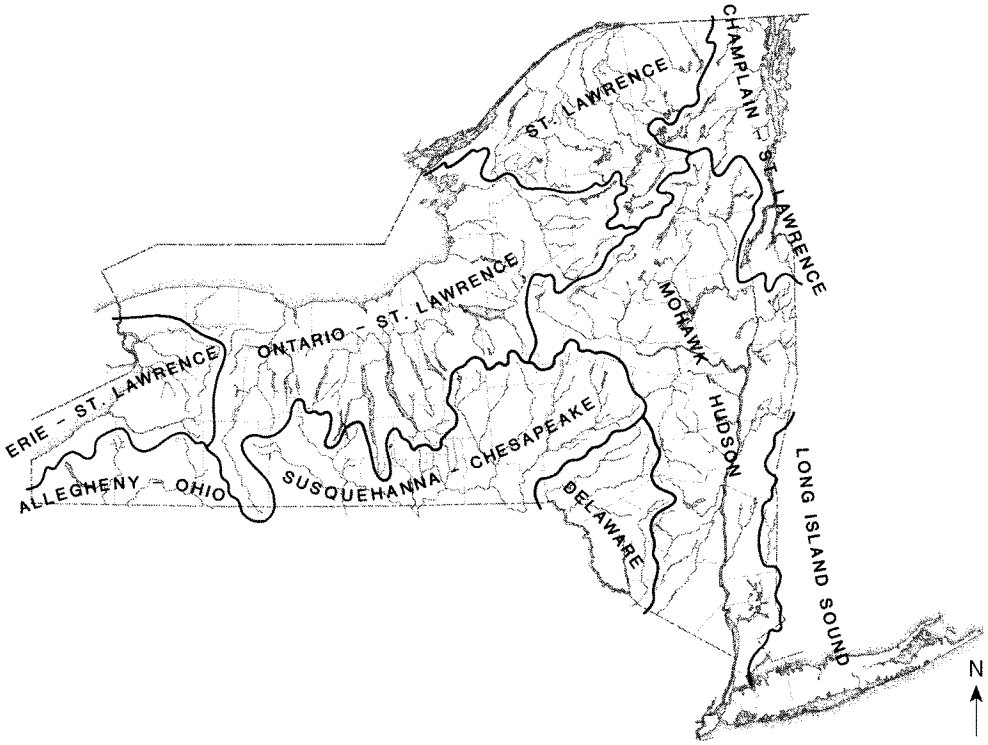
A) *A* B) *B* C) *C* D) *D*

336) Which part of the Sun's electromagnetic spectrum has the *longest* wavelength?

A) infrared radiation
B) visible light radiation
C) radio wave radiation
D) x-ray radiation

Questions 337 through 339 refer to the following:

The map below shows watershed regions of New York State.



337) In which watershed is the Genesee River located?

A) Susquehanna-Chesapeake
B) Mohawk-Hudson
C) Ontario-St. Lawrence
D) Delaware

338) On which type of landscape region are *both* the Susquehanna-Chesapeake and the Delaware watersheds located?

A) plateau
B) mountain
C) plain
D) lowland

339) Most of the surface bedrock of the Ontario-St. Lawrence watershed was formed during which geologic time periods?

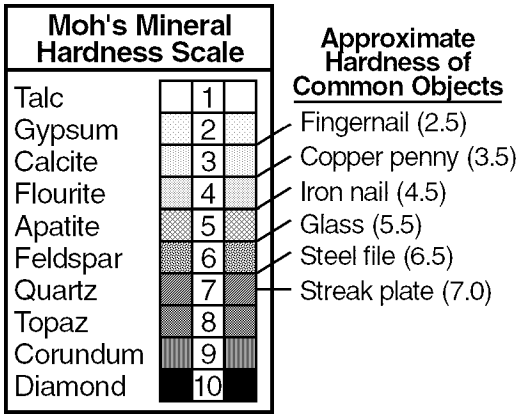
A) Mississippian, Pennsylvanian, and Permian
B) Triassic, Jurassic, and Cretaceous
C) Precambrian and Cambrian
D) Ordovician, Silurian, and Devonian

340) Which sequence of change in rock type occurs as shale is subjected to increasing heat and pressure?

A) shale ⟶ gneiss ⟶ phyllite ⟶ slate ⟶ schist
B) shale ⟶ slate ⟶ phyllite ⟶ schist ⟶ gneiss
C) shale ⟶ gneiss ⟶ phyllite ⟶ schist ⟶ slate
D) shale ⟶ schist ⟶ phyllite ⟶ slate ⟶ gneiss

Questions 341 and 342 refer to the following:

The diagrams below represent *Moh's Mineral Hardness Scale* and a chart showing the approximate hardness of some common objects.



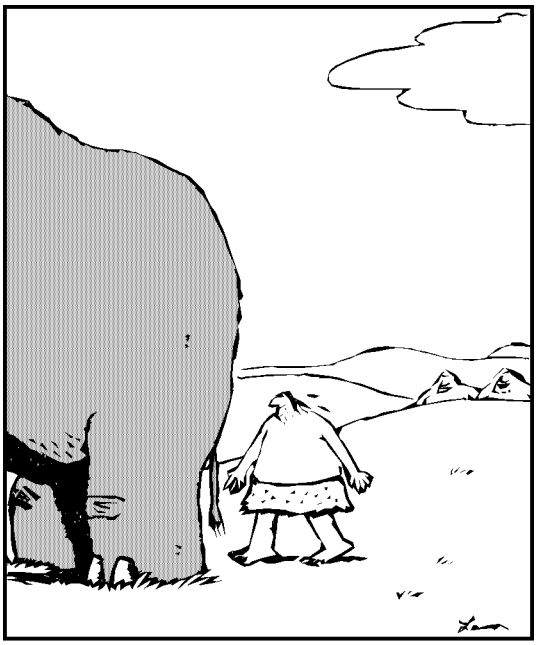
341) The hardness of these minerals is most closely related to the

A) mineral's abundance in nature
B) mineral's color
C) amount of iron the mineral contains
D) internal arrangement of the mineral's atoms

342) Which statement is *best* supported by this scale?

A) A piece of glass can be scratched by calcite, but not by quartz.
B) A piece of glass can be scratched by quartz, but not by calcite.
C) A fingernail will scratch quartz, but not calcite.
D) A fingernail will scratch calcite, but not quartz.

343) The cartoon below illustrates possible interaction between humans and mammoths.



The primitive game of
"Pull the mammoth's tail and run"

During which geologic timespan could this "game" have occurred?

A) Pennsylvanian Epoch
B) Paleozoic Era
C) Precambrian Era
D) Pleistocene Epoch

344) A student read an article in the local newspaper stating that a major earthquake can be expected to affect the region where the student lives within the next year. The student's family plans to stay in this region. As a result, the student decides to help prepare her home and family for this expected earthquake.

State *three* specific actions the student could take to increase safety or reduce injury or damage from an earthquake.

345) Which observable change would occur in New York State if Earth's rate of rotation were one-half its present rate?

A) The seasonal changes would not occur.
B) The Sun would rise in the southwest each day.
C) The length of a day would be longer.
D) The time needed to complete a cycle of Moon phases would be greater.

Questions 346 through 348 refer to the following:

The newspaper article shown below was taken and adapted from the *Los Angeles Times*.

VOLCANIC BLAST SHAPED EARTH

Study finds eruption split an ancient continent, creating Atlantic Ocean

The largest volcanic eruption in Earth's history — so powerful it split an ancient supercontinent and created the Atlantic Ocean — spewed millions of square miles of searing lava that extinguished much of life on ancient Earth.

From hundreds of basalt outcrops that rim the Atlantic coasts, scientists have pieced together evidence of the titanic eruption 200 million years ago. Researchers said that the eruption set the fractured landmasses adrift and, by wedging them apart, gradually opened the gulf that created the Atlantic — giving the map of the world the form it has today.

"This is one of the biggest things that has ever happened in Earth's history. This is a gigantic, igneous event and it all seems to have occurred in an amazingly brief amount of time."

To reconstruct the ancient catastrophe, a team of scientists analyzed basalt dikes, sills, and lavas from the New Jersey Palisades, the Brazilian Amazon, Spain, and West Africa.

By studying the chemical composition and dating the residual radioisotopes in the basaltic rocks, the researchers determined that the rocks all originated from the same eruption. Once they realized the outcrops were linked, they were able to determine that, in the distant past, the rocks all had been located together at the center of an immense continent called Pangea that once stretched, unbroken, from pole to pole.

346) Basaltic outcrops are not the only evidence of this ancient continental splitting. Describe another piece of evidence that supports the idea that the present-day continents were once part of the large ancient continent, Pangea, that split apart.

347) Scientists stated that rocks from the volcanic eruption that separated the continents are basalt. List *two* observable characteristics that are normally used to identify basaltic rock.

348) Name the geologic time period when this major volcanic eruption initially opened the Atlantic Ocean.

349) Which planet is approximately thirty times *farther* from the Sun than the Earth?

A) Uranus B) Saturn C) Neptune D) Jupiter

350) Energy is transferred from the Sun to Earth mainly by

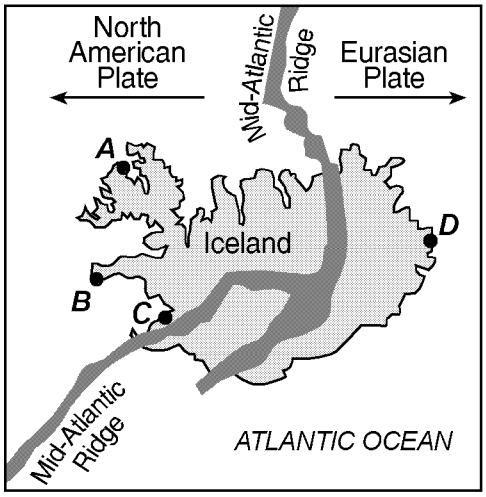
A) red shifts
B) molecular collisions
C) electromagnetic waves
D) density currents

351) What is the *best* way to determine if a mineral sample is calcite or quartz?

A) Place a drop of acid on the mineral.
B) Measure the mass of the mineral.
C) Observe the color of the mineral.
D) Place the mineral near a magnet.

Questions 352 and 353 refer to the following:

The map below shows Iceland, a country located on the Mid-Atlantic Ridge. Four locations are represented by the letters *A* through *D*.



352) The *youngest* bedrock is most likely found at which location?

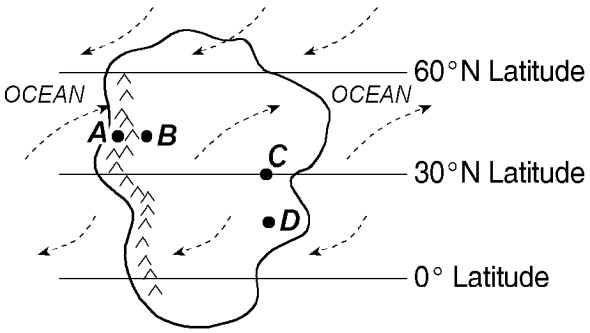
A) *A* B) *B* C) *C* D) *D*

353) The fine-grained texture of *most* of the igneous rock formed on the surface of Iceland is due to

A) high pressure under the island
B) rapid cooling of the molten rock
C) numerous faults in the island's bedrock
D) high density of the molten rock

Questions 354 through 356 refer to the following:

The map below shows an imaginary continent on Earth. Arrows represent prevailing wind directions. Letters *A* through *D* represent locations on the continent. Locations *A* and *B* are at the same latitude and at the same elevation at the base of the mountains.



354) Over the course of a year, compared to location *B*, location *A* will have

A) less precipitation and a smaller temperature range
B) less precipitation and a greater temperature range
C) more precipitation and a smaller temperature range
D) more precipitation and a greater temperature range

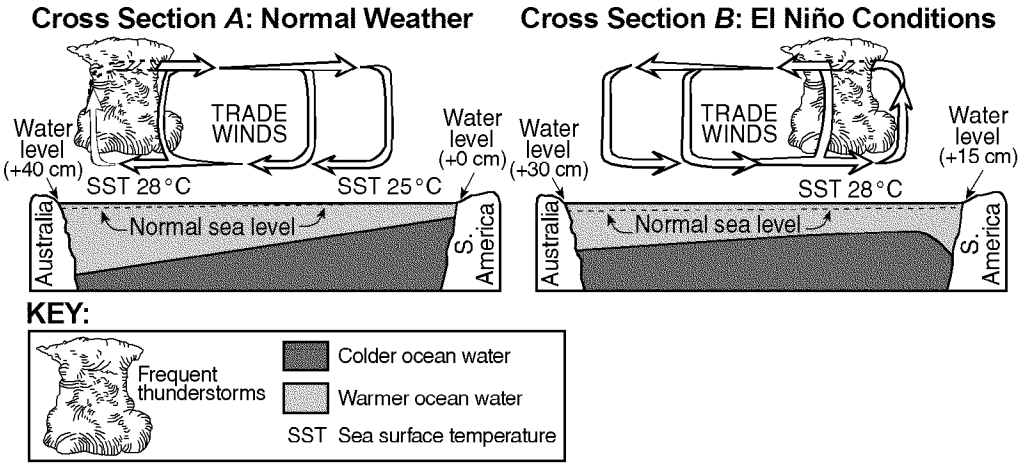
355) Compared to the observations made at location *D*, the observed altitude of Polaris at location *B* is
   A) always less
   B) only greater from March 21 to September 22
   C) only less from March 21 to September 22
   D) always greater

356) The climate at location *C* is much drier than at location *D*. This difference is *best* explained by the fact that location *C* is located
   A) closer to a large body of water
   B) farther from any mountain range
   C) at a latitude that experiences longer average annual daylight
   D) at a latitude where air is sinking and surface winds diverge

357) Most inferences about the characteristics of Earth's mantle and core are based on
   A) chemical changes in exposed and weathered metamorphic rocks
   B) well drillings from Earth's mantle and core
   C) the behavior of seismic waves in Earth's interior
   D) comparisons between Moon rocks and Earth rocks

Questions 358 through 362 refer to the following:

The two cross sections below represent the Pacific Ocean and the atmosphere near the Equator during normal weather (cross section *A*) and during El Niño conditions (cross section *B*). Sea surface temperatures (SST) are labeled and trade-wind directions are shown with arrows. Cloud buildup indicates regions of frequent thunderstorm activity. The change from normal sea level is shown at the side of each diagram.



358) During El Niño conditions, thunderstorms increase in the eastern Pacific Ocean region because the warm, moist air is
   A) less dense, sinking, compressing, and warming
   B) more dense, rising, expanding, and cooling
   C) less dense, rising, expanding, and cooling
   D) more dense, sinking, compressing, and warming

359) Compared to normal weather conditions, the shift of the trade winds caused sea levels during El Niño conditions to

A) decrease at Australia and increase at South America
B) increase at both Australia and South America
C) decrease at both Australia and South America
D) increase at Australia and decrease at South America

360) Earth's entire equatorial climate zone is generally a belt around Earth that has

A) high air pressure and wet weather
B) low air pressure and wet weather
C) low air pressure and dry weather
D) high air pressure and dry weather

361) The development of El Niño conditions over this region of the Pacific Ocean has caused

A) the reversal of Earth's seasons
B) changes in worldwide precipitation patterns
C) increased worldwide volcanic activity
D) decreased ozone levels in the atmosphere

362) Which statement correctly describes sea surface temperatures along the South American coast and Pacific trade winds during El Niño conditions?

A) The sea surface temperatures are cooler than normal, and Pacific trade winds are from the west.
B) The sea surface temperatures are cooler than normal, and Pacific trade winds are from the east.
C) The sea surface temperatures are warmer than normal, and Pacific trade winds are from the east.
D) The sea surface temperatures are warmer than normal, and Pacific trade winds are from the west.

Questions 363 and 364 refer to the following:

ANCIENT HUMAN FOOTPRINTS FOUND

PARIS — In the darkness of an underground cave lined with prehistoric paintings, French scientists believe they have discovered the oldest footprints of humans in Europe.

Embedded in damp clay, the imprints, slightly more than 8 inches long, appear to be those of a boy, 8 or 10 years old, who was walking barefoot between 25,000 and 30,000 years ago, prehistorians said Wednesday.

They said the dates are only hypothetical because there is no precise way to determine when the markings were made. But Michel-Andre Garcia, one prehistorian who has studied the site, said that the carbon datings in the cave and the context make this "a very strong hypothesis." The four footprints were found in the Ardeche region of southern France, deep inside the Chauvet cave. —*Times Union*, June 10, 1999

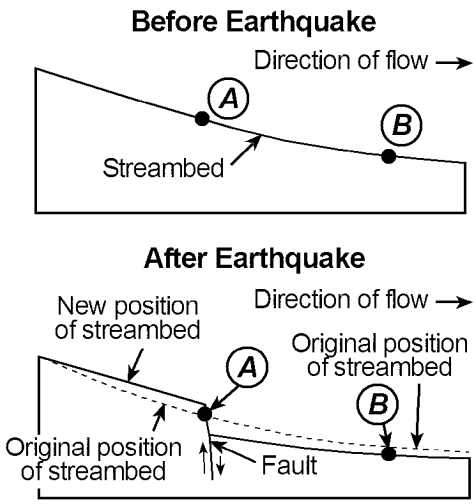
363) Scientists have inferred that these "oldest" European human footprints were made during which geologic epoch?

364) Which characteristic of the radioactive isotope carbon-14 explains why carbon-14, rather than the radioactive isotope uranium-238, was used by archeologists in dating the age of their findings?

365) The redshift of light from distant galaxies provides evidence that the universe is

A) remaining the same size
B) shrinking, only
C) expanding, only
D) shrinking and expanding in a cyclic pattern

366) The diagram below shows a stream profile before and after an earthquake. Points *A* and *B* are locations along the streambed.



What is the probable relationship between erosion and deposition at points *A* and *B* after the earthquake?

A) There is more deposition than erosion at points *A* and *B*.
B) There is more erosion at point *A* and more deposition at point *B*.
C) There is more deposition at point *A* and more erosion at point *B*.
D) There is more erosion than deposition at points *A* and *B*.

367) An unidentified mineral that is softer than calcite exhibits a metallic luster and cubic cleavage. This mineral most likely is

A) pyrite B) halite C) galena D) pyroxene

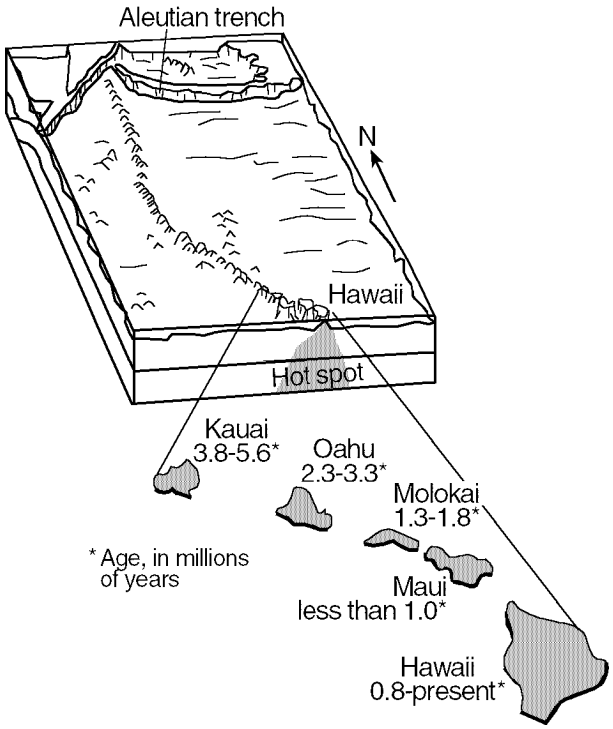
368) Which type of air mass usually contains the most moisture?

A) **cT** B) **cP** C) **mT** D) **mP**

369) On a certain day, the isobars on a weather map are very close together over eastern New York State. To make the people of this area aware of possible risk to life and property in this situation, the National Weather Service should issue

A) a high-wind advisory
B) an air-pollution advisory
C) a dense-fog warning
D) a heat-index warning

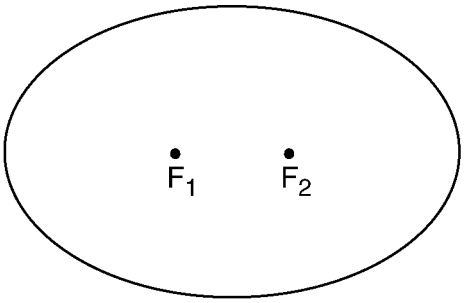
370) The block diagram below shows the bedrock age as measured by radioactive dating and the present location of part of the Hawaiian Island chain. These volcanic islands may have formed as the Pacific Plate moved over a mantle hot spot.



This diagram provides evidence that the Pacific Crustal Plate was moving toward the

A) southwest B) east C) northwest D) south

371) The diagram below is a constructed ellipse. F_1 and F_2 are the foci of the ellipse.



The eccentricity of this constructed ellipse is *closest* to the eccentricity of the orbit of which planet?

A) Earth B) Mercury C) Pluto D) Saturn

372) An increase in which gas would cause the *most* greenhouse warming of Earth's atmosphere?

A) hydrogen
B) oxygen
C) nitrogen
D) carbon dioxide

Questions 373 through 376 refer to the following:

The passage below provides some information about the sediments under Portland, Oregon, and the map shows where Portland is located.

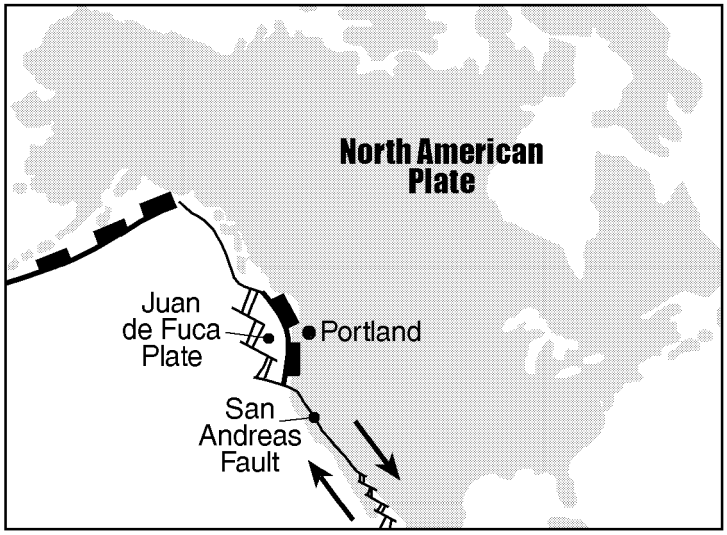
BAD SEISMIC COMBINATION UNDER PORTLAND: EARTHQUAKE FAULTS AND JIGGLY SEDIMENT

"Using a technique called seismic profiling, researchers have found evidence of ancient earthquake faults under Portland, Oregon. The faults may still be active, a USGS [United States Geological Survey] seismologist will announce tomorrow.

The research also turned up a 250-foot deep layer of silt and mud, deep under the city, which may have been caused by a catastrophic ice dam break some 15,000 years ago.

The two findings could together mean bad news, as soft sediment is known to amplify ground shaking during strong earthquakes. In the 1989 San Francisco earthquake, much of the damage to buildings was caused by liquefaction, a shaking and sinking of sandy, water-saturated soil along waterways...."

—Robert Roy Britt, excerpted from "Bad seismic combination under Portland: Earthquake faults and jiggly sediment", explorezone.com, 05/03/99



373) Describe *one* precaution that can be taken to prevent or reduce property damage in preparation for a future earthquake in Portland.

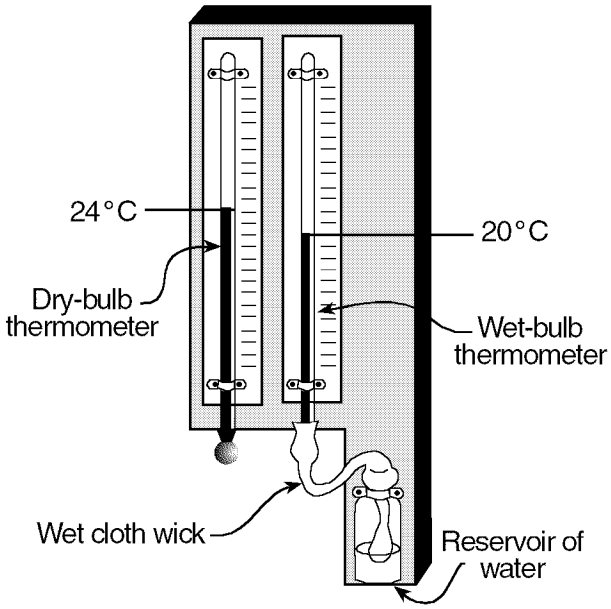
374) Explain why Portland is likely to experience a major earthquake.

375) What type of tectonic plate boundary is shown at the San Andreas Fault?

376) Why is the presence of a layer of silt and mud deep under the city a danger to Portland?

Questions 377 through 379 refer to the following:

The diagram below shows a hygrometer located on a wall in a classroom. The hygrometer's temperature readings are used by the students to determine the relative humidity of the air in the classroom.

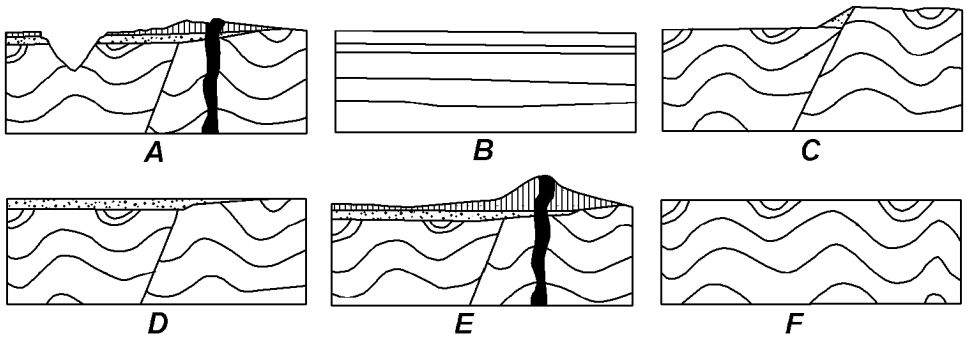


377) Describe how water evaporating from the wick attached to the wet-bulb thermometer lowers the temperature reading of that thermometer.

378) Besides relative humidity, identify another weather variable of the air in the classroom that may be determined by using *both* temperature readings on the hygrometer.

379) Based on the temperature readings shown in this diagram, determine the relative humidity of the air in the classroom.

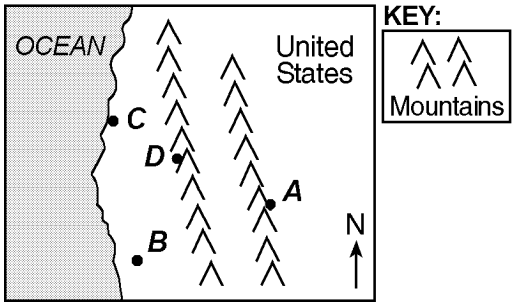
380) Geologic cross sections *A* through *F* shown below represent different stages in the development of one part of Earth's crust over a long period of geologic time.



What is the correct order of development from the original (*oldest*) stage to the *most* recent (*youngest*) stage?

A) *E* ⟶ *A* ⟶ *D* ⟶ *F* ⟶ *C* ⟶ *B*
B) *B* ⟶ *D* ⟶ *C* ⟶ *F* ⟶ *A* ⟶ *E*
C) *B* ⟶ *F* ⟶ *C* ⟶ *D* ⟶ *E* ⟶ *A*
D) *E* ⟶ *A* ⟶ *F* ⟶ *C* ⟶ *D* ⟶ *B*

381) The map below shows the location of four cities, *A*, *B*, *C*, and *D*, in the western United States where prevailing winds are from the southwest.

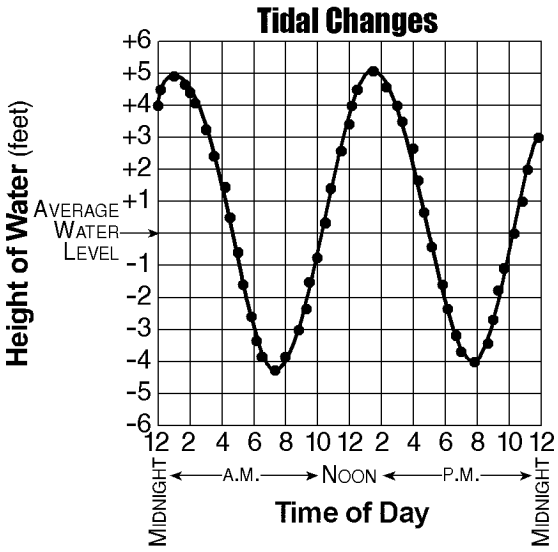


Which city most likely receives the *least* amount of average yearly precipitation?

A) *A*
B) *B*
C) *C*
D) *D*

Questions 382 and 383 refer to the following:

The graph below shows the recorded change in water level (ocean tides) at a coastal city in the northeastern United States during 1 day.



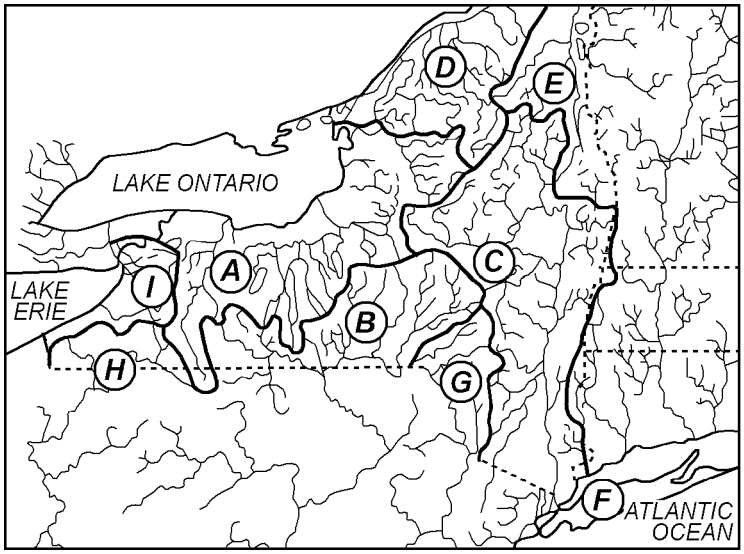
382) According to the pattern shown on the given graph, the next high tide will occur on the following day at approximately

A) 3:15 a.m. B) 12:30 a.m. C) 2:00 a.m. D) 4:00 a.m.

383) Which inference about tides is *best* made from the given graph?

A) The hourly rate of tidal change is always the same.
B) The tidal change is cyclic.
C) The rate of tidal change is greatest at high tide.
D) The tidal change is a random event.

384) The map below shows major streams in the New York State area. The bold lines mark off sections *A* through *I* within New York State.



What would be the *best* title for this map?

A) "Bedrock Geology Locations of New York State"
B) "Landscape Regions of New York State"
C) "Watershed Areas of New York State"
D) "Tectonic Plate Boundaries in New York State"

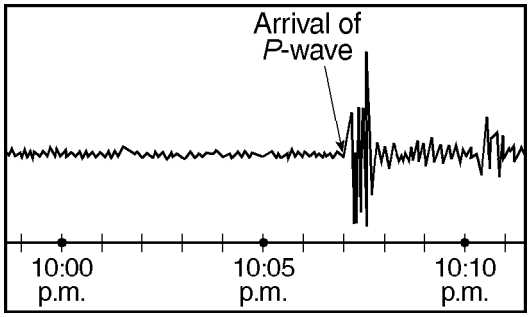
385) Which form of electromagnetic radiation has a wavelength of 1.0×10^{-3} centimeter?

A) radio waves
B) ultraviolet
C) infrared
D) microwaves

386) The tropopause is approximately how far above sea level?

A) 60 km
B) 12 km
C) 60 mi
D) 12 mi

387) The seismogram below shows the time that an earthquake *P*-wave arrived at a seismic station in Albany, New York.

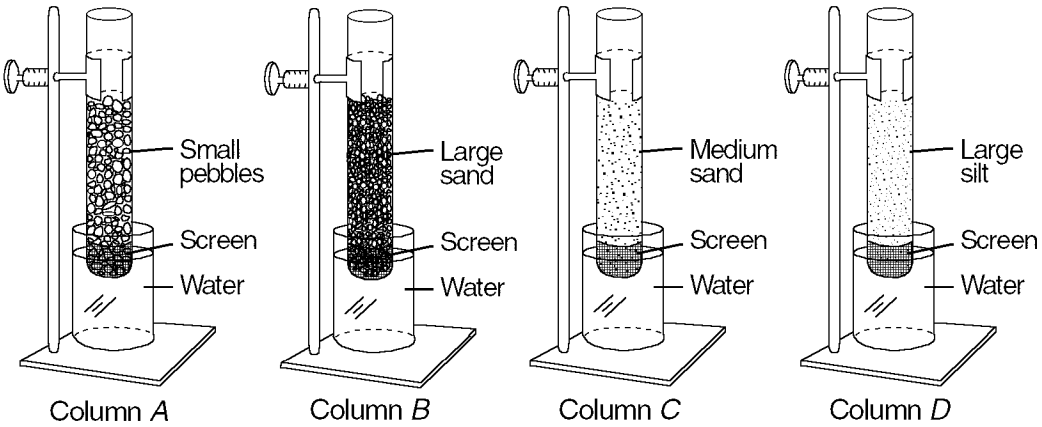


If the earthquake occurred at exactly 10:00 p.m., approximately how far from the earthquake epicenter was Albany, New York?

A) 4,000 km
B) 3,200 km
C) 1,900 km
D) 5,200 km

Questions 388 through 390 refer to the following:

Columns *A*, *B*, *C*, and *D* are partially filled with different sediments. Within each column, the sediment is uniform in size. A fine wire mesh screen covers the bottom of each column to prevent the sediment from falling out. The lower part of each column has just been placed in a beaker of water. Sediment sizes are not drawn to scale.



388) In which sediment will capillary action cause the water from the beaker to rise *fastest* in the column?

A) medium sand
B) large silt
C) small pebbles
D) large sand

389) In an experiment, the beakers of water were removed and replaced with empty beakers. The sediments were allowed to dry. Then water was poured into each column to compare the permeability of the sediments. The permeability rate of the medium sand sample was shown to be

A) greater than the silt sample but less than the pebble sample
B) less than the silt and pebble samples
C) less than the silt sample but more than the pebble sample
D) greater than the silt and pebble samples

390) Which column contains sediment with an average diameter *closest* to 0.1 centimeter?

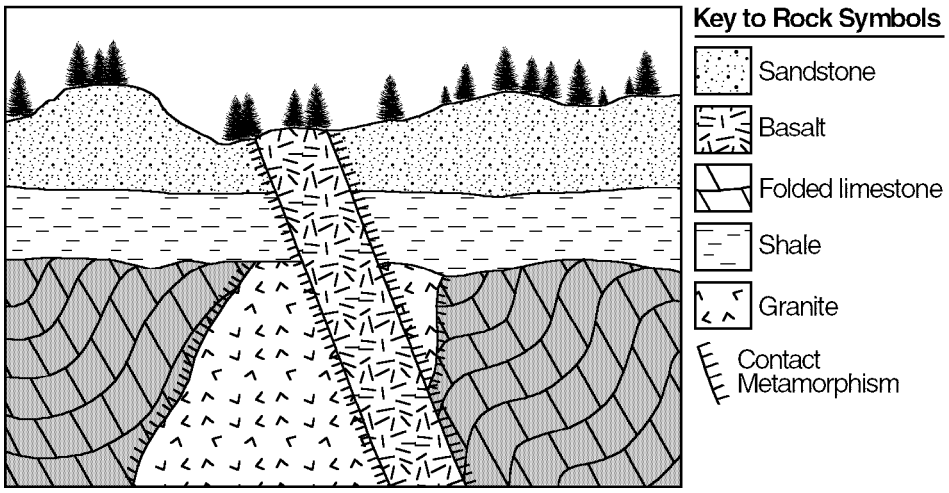
A) *A*
B) *B*
C) *C*
D) *D*

391) Which radioactive isotope is *most* useful for determining the age of mastodont bones found in late Pleistocene sediments?

A) uranium-238
B) rubidium-87
C) potassium-40
D) carbon-14

Questions 392 and 393 refer to the following:

The diagram below represents a cliff of exposed bedrock that was investigated by an Earth science class.



After the students examined the cliff, they made three correct inferences about the geologic history of the bedrock.

Inference 1: The shale layer is older than the basaltic intrusion.
Inference 2: The shale layer is older than the sandstone layer.
Inference 3: An unconformity exists directly under the shale layer.

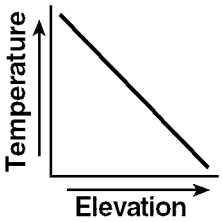
392) Explain how each inference is supported by evidence shown in the diagram.

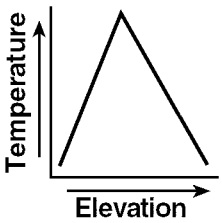
393) Students compared samples of the granite and basalt. State *one* observable characteristic other than crystal size that makes granite different from basalt.

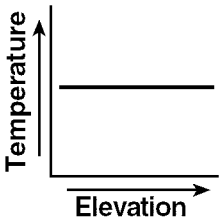
394) When the velocity of a stream suddenly decreases, the sediment being transported undergoes an increase in

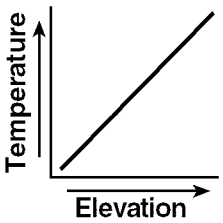
A) particle density
B) deposition
C) erosion
D) mass movement

395) Which graph *best* shows the general effect that differences in elevation above sea level have on the average annual temperature?

A)


B)


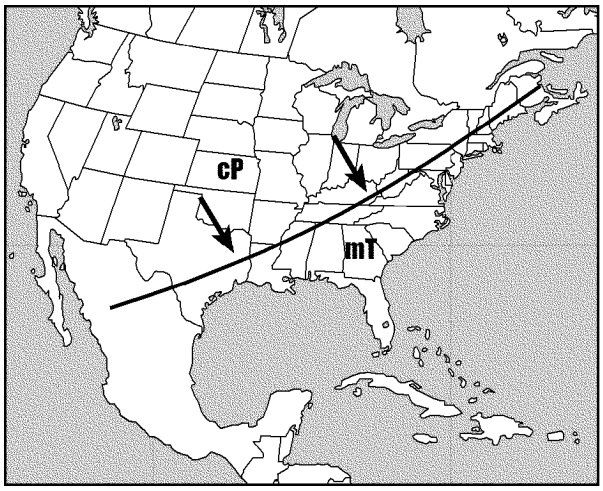
C)


D)


396) Which weather change is most likely indicated by rapidly falling air pressure?

A) A storm is approaching.
B) Skies are clearing.
C) Temperature is decreasing.
D) Humidity is decreasing.

397) The weather map below shows a large white band of clouds moving toward the southeast. The line shown in the middle of the white cloud band is the frontal boundary between a **cP** air mass and an **mT** air mass. Two large arrows show the direction the front is moving.

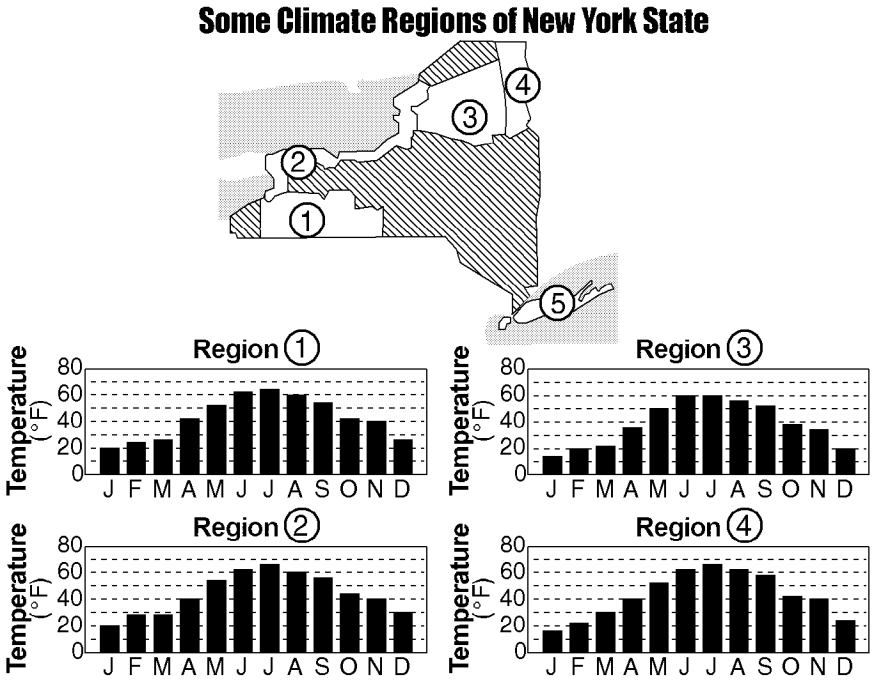


(a) On the frontal boundary line on the weather map above, draw the weather front symbol to represent the front moving toward the southeast.

(b) On the same weather map, place an **X** centered on the geographic region that was most likely the source of the warm, moist (**mT**) air mass.

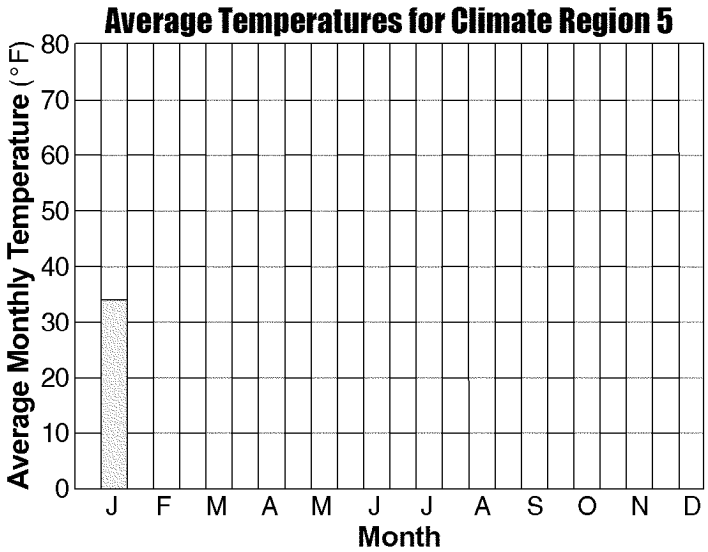
Questions 398 through 402 refer to the following:

The map below shows five climate regions of New York State. The bar graphs below show average monthly temperatures of four of these climate regions.



398) On the grid below, construct a bar graph of the average monthly temperatures provided below for climate region 5 in the given diagram. [*January has been completed for you.*]

Month	°F
January	34
February	36
March	42
April	52
May	61
June	72
July	79
August	74
September	68
October	55
November	49
December	39



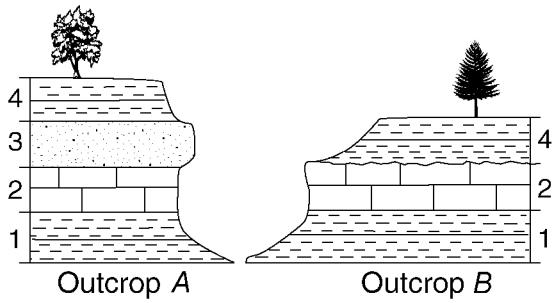
399) What climate variable, other than temperature, was also used to identify the areas in the given diagram as four different climate regions?

400) The average monthly temperatures for climate regions 1, 2, 3, and 4 in the given diagram show a similar yearly pattern of change. Identify *one* climate control factor that these four climate regions have in common that most probably causes this similarity in temperature pattern.

401) Describe how the Atlantic Ocean surrounding climate region 5 in the given diagram has most probably influenced the average temperatures of this region during January, February, and March.

402) What landscape characteristic of climate region 3 in the given diagram most likely causes it to have *both* cooler summer temperatures and cooler winter temperatures than climate region 2?

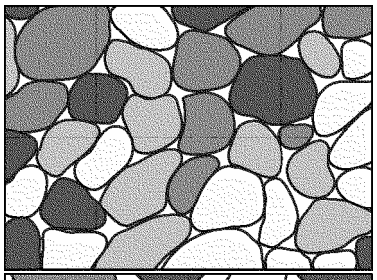
403) Bedrock outcrops *A* and *B* are located at two different locations along the Genesee River in western New York State. Rock layers 1, 2, and 4 are the same in both outcrops.

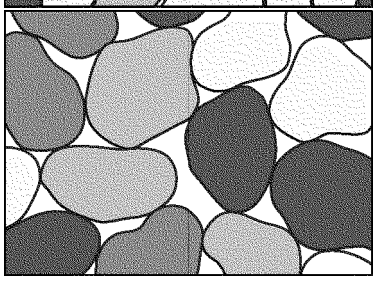


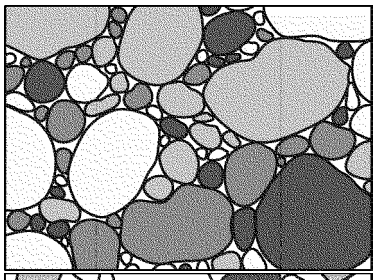
Which statement *best* explains why rock layer 3 is missing from outcrop *B*?

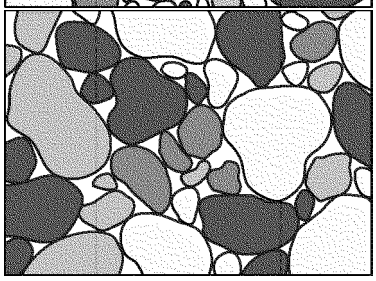
A) A fault exists between outcrops *A* and *B*.
B) A volcanic eruption destroyed rock layer 3 in outcrop *B*.
C) Metamorphism of outcrop *A* created rock layer 3.
D) Erosion created an unconformity between rock layers 2 and 4 in outcrop *B*.

404) The diagrams below represent four permeable sediment samples. The sediments are composed of the same material, but differ in particle size and sorting. Which sediment sample will most likely have the *fastest* groundwater infiltration rate?

A) 

B) 

C) 

D) 

Questions 405 through 407 refer to the following:

The data table below shows one cycle of equinoxes and solstices for the northern hemispheres of several planets in the solar system and the tilt of each planet's axis. Data for the planets are based on Earth's time system.

DATA TABLE

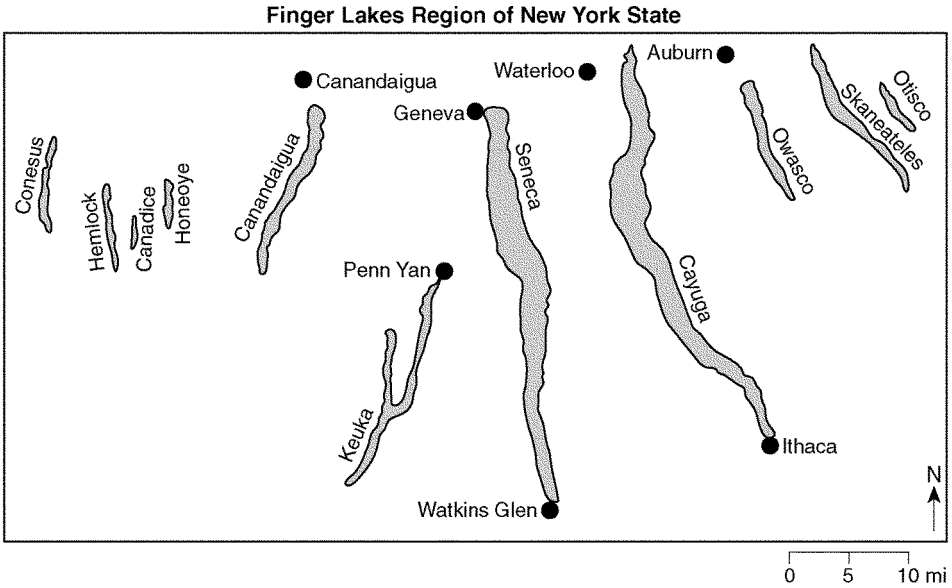
Planet	**Spring Equinox**	**Summer Solstice**	**Autumn Equinox**	**Winter Solstice**	**Tilt of Axis** (degrees)
Venus	June 25	August 21	October 16	December 11	3.0
Earth	March 21	June 21	September 23	December 22	23.5
Jupiter	1997	2000	2003	2006	3.0
Saturn	1980	1987	1995	2002	26.8
Uranus	1922	1943	1964	1985	82.0
Neptune	1880	1921	1962	2003	28.5

405) Identify *two* factors that cause seasons on Earth.

406) State the length, in years, of the spring season on Uranus.

407) Describe the relationship between a planet's distance from the Sun and the length of a season on that planet.

408) A map of the Finger Lakes Region is shown below.

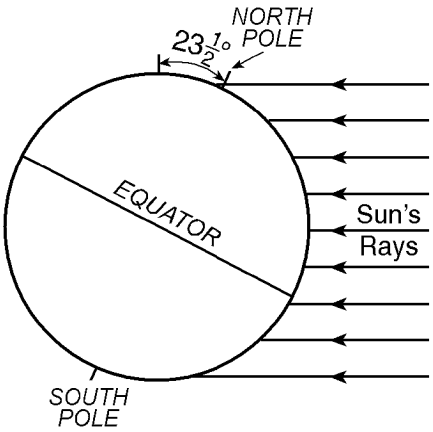


State *one* possible explanation for the north-south orientation of the Finger Lakes.

409) Surface winds on Earth are primarily caused by differences in

A) air density due to unequal heating of Earth's surface
B) rotational speeds of Earth's surface at various latitudes
C) ocean wave heights during the tidal cycle
D) distances from the Sun during the year

410) The diagram below represents the Sun's rays striking Earth at a position in its orbit around the Sun.

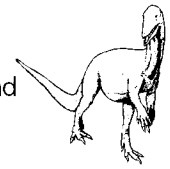


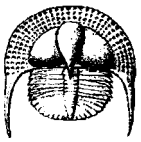
(a) On the given diagram, neatly and accurately shade the area of Earth that is in darkness.

(b) On the given diagram, draw the line of latitude that is receiving the Sun's direct perpendicular rays on this date.

(c) What month of the year is represented by the given diagram?

411) Which one of the following pairs of index fossils can be found in Ordovician bedrock?

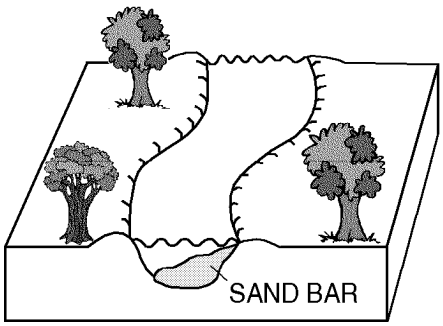
A)  and 

B)  and 

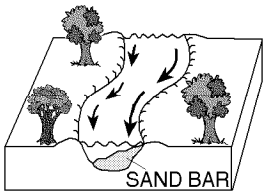
C)  and 

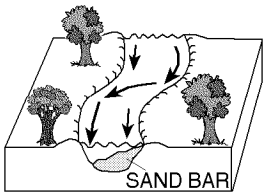
D)  and 

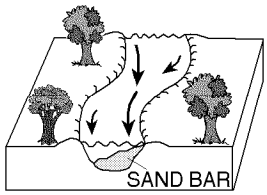
412) The diagram below shows a meandering stream flowing across nearly flat topography and over loose sediments.

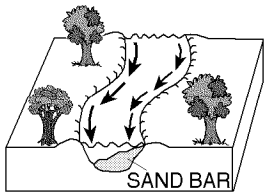


If arrow length represents stream velocity, which diagram *best* shows the relative stream velocities in this section of the stream?

A)


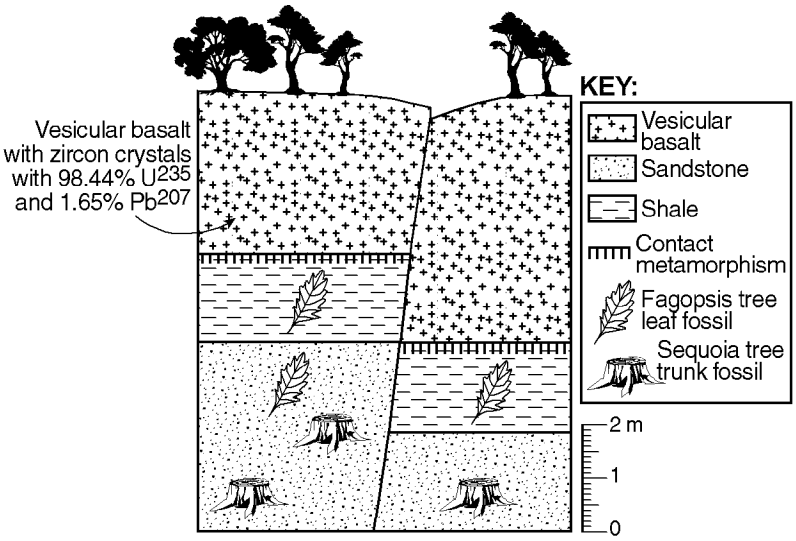
B)


C)


D)


Questions 413 through 416 refer to the following:

The geologic cross section below represents an outcrop of various types of bedrock and bedrock features in Colorado.



413) On the given cross section, indicate with arrows the direction of movement on *both* sides of the fault.

414) According to the given cross section, what is the amount of vertical movement of the shale along the fault? [*Express your answer to the nearest tenth of a meter.*]

415) The shale and sandstone layers shown in the diagram both contain fossilized leaves from the *Fagopsis* tree, an index fossil for the Oligocene Epoch. State a possible age for these rock layers, in million years.

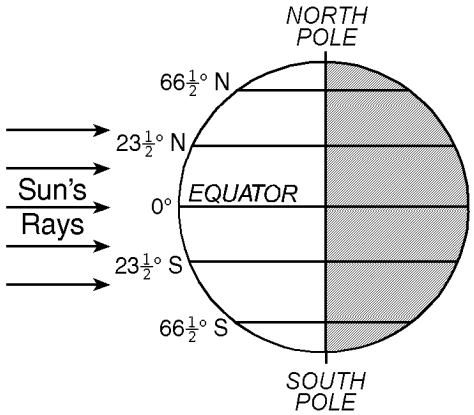
416) Based on the given diagram, place the geologic events listed below in order by numbering them from *oldest* (1) to *youngest* (4).

____The fault was formed.
____The shale was deposited.
____The vesicular basalt was formed.
____The sandstone was deposited.

417) Bedrock located near Old Forge, New York, would most likely have which characteristics?

A) foliated texture with mica and feldspar separated into bands
B) clastic texture consisting of angular sediments of mostly quartz and feldspar cemented together
C) non-crystalline, glassy texture with a dark color
D) crystalline texture composed predominantly of gypsum

418) The diagram below represents Earth at a specific position in its orbit as viewed from space. The shaded area represents nighttime.



Which Earth latitude receives the *greatest* intensity of insolation when Earth is at the position shown in the diagram?

A) 90° N B) $66\frac{1}{2}$° N C) 0° D) $23\frac{1}{2}$° N

419) The motion of a Foucault pendulum provides evidence of

A) Earth's revolution
B) the Sun's revolution
C) the Sun's rotation
D) Earth's rotation

420) Which phrase *best* describes coal?

A) glassy texture, volcanic
B) chemical precipitate
C) organic plant remains
D) low density, mafic

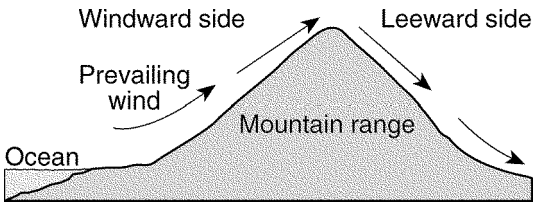
421) When the time of day for a certain ship at sea is 12 noon, the time of day at the Prime Meridian (0° longitude) is 5 p.m. What is the ship's longitude?

A) 75° W
B) 45° E
C) 45° W
D) 75° E

422) During a dry summer, the flow of most large New York State streams generally

A) stops completely because no water runs off into the streams
B) increases due to greater surface runoff
C) continues because some groundwater seeps into the streams
D) remains unchanged due to transpiration from grasses, shrubs, and trees

423) The cross section below shows the prevailing winds that cause different climates on the windward and leeward sides of this mountain range.



Compared to the climate conditions on the leeward side of this mountain range, the conditions on the windward side are usually

A) warmer and wetter
B) cooler and wetter
C) warmer and drier
D) cooler and drier

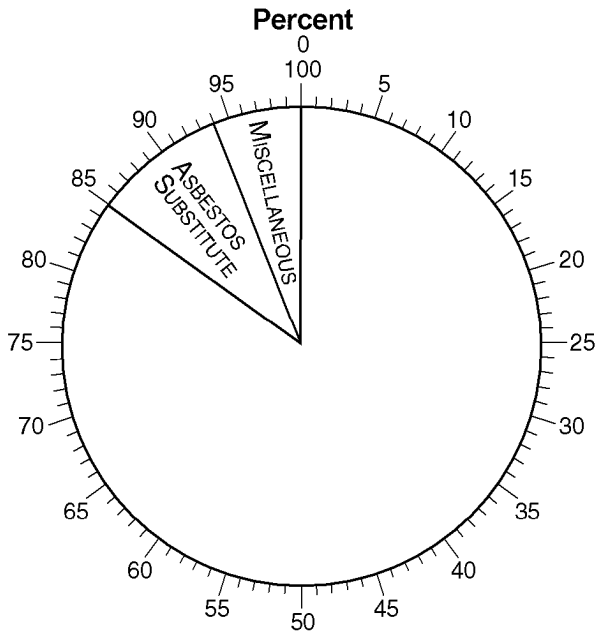
Questions 424 through 426 refer to the following:

The data table below shows the industrial uses of wollastonite, a mineral mined in the eastern Adirondack Mountains of New York State.

Industrial Uses of Wollastonite in the United States

Industrial Uses of Wollastonite	Percent of Total Use
Plastics	37
Ceramics	28
Metallurgy	10
Paint	10
Asbestos substitute	9
Miscellaneous	6

424) On the pie graph below, complete the graph to show the percent of each industrial use of wollastonite. Label each section of the pie graph with its industrial use. [*The percent for Miscellaneous and for Asbestos substitute has been drawn and labeled for you.*]



425) Wollastonite forms during the intense metamorphism of a sandy limestone. The expression below shows part of the process that results in the formation of wollastonite.

$$\underset{\text{MINERAL 1}}{CaCO_3} + \underset{\text{MINERAL 2}}{SiO_2} \xrightarrow{\text{Metamorphism}} \underset{\text{WOLLASTONITE}}{CaSiO_2} + \underset{\text{CARBON DIOXIDE}}{CO_2}$$

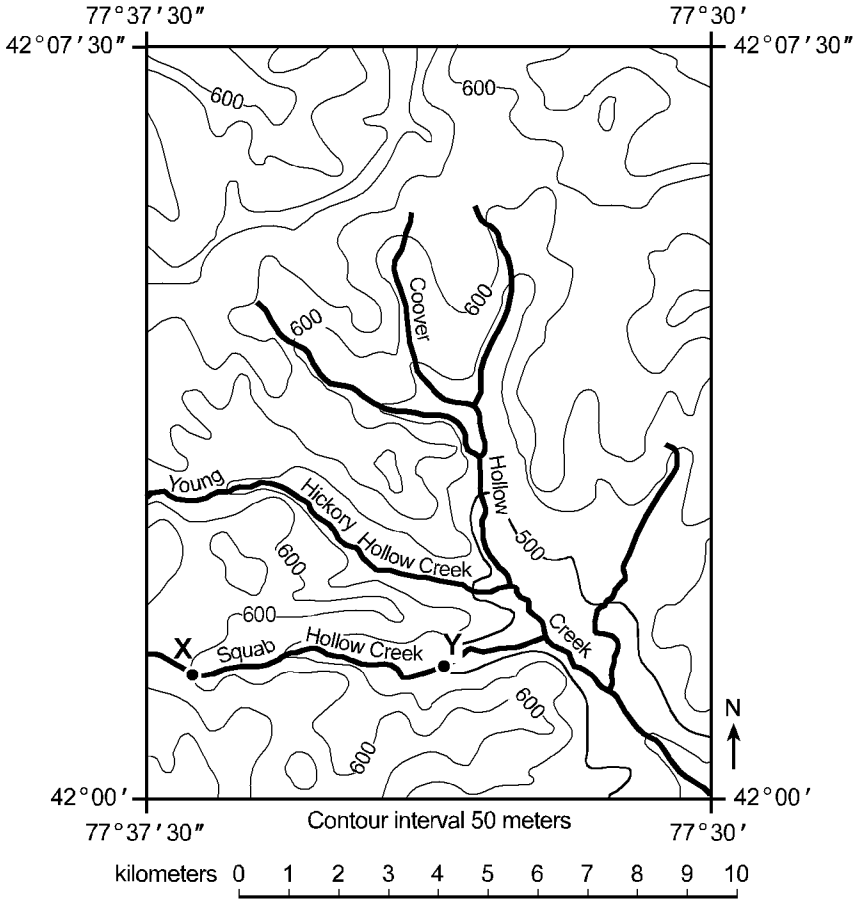
(a) Name the *two* minerals involved in the formation of wollastonite.

(b) What *two* conditions normally cause intense metamorphism?

426) Identify the geologic age of the New York State Adirondack Mountain bedrock in which wollastonite deposits are found.

Questions 427 through 429 refer to the following:

The topographic map below is of an area in New York State. Points *X* and *Y* are locations on Squab Hollow Creek.



427) Describe *one* way to determine the direction of flow of Coover Hollow Creek from information shown on the map.

428) In the space below, determine the gradient of Squab Hollow Creek between point *X* and point *Y* by following the directions below.

(a) Using the Earth Science Reference Tables, write the equation used to determine the gradient.

(b) Substitute values into the equation.

(c) Solve the equation and label the answer with the correct units.

429) Based on the latitude and longitude coordinates given, identify the New York State landscape region in which this map region is located.

430) Which characteristics of a building material would provide the *most* energy-absorbing exterior covering for a house?

A) light-colored and smooth-textured
B) dark-colored and smooth-textured
C) light-colored and rough-textured
D) dark-colored and rough-textured

431) According to the geologic record, during which geologic time period did the lithospheric plates that made up Pangea begin to break up?

432) At an altitude of 95 miles above Earth's surface, nearly 100% of the incoming energy from the Sun can be detected. At 55 miles above Earth's surface, most incoming x-ray radiation and some incoming ultraviolet radiation can no longer be detected. This missing radiation was most likely

A) absorbed in the mesosphere
B) reflected by the troposphere
C) absorbed in the thermosphere
D) reflected by the stratosphere

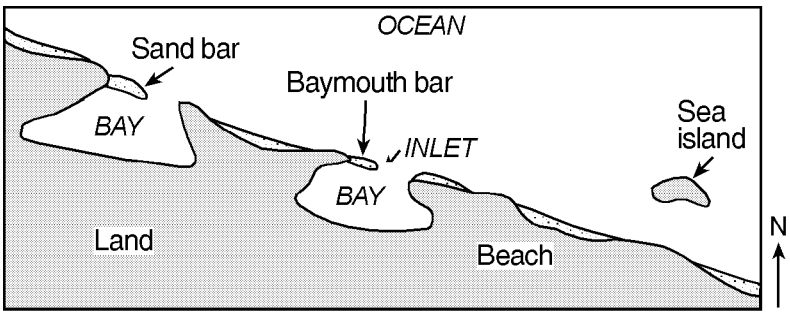
433) As the altitude increases within Earth's stratosphere, air temperature generally

A) decreases, then increases
B) increases, only
C) increases, then decreases
D) decreases, only

434) Compared to felsic igneous rocks, mafic igneous rocks contain greater amounts of

A) aluminum
B) pink feldspar
C) white quartz
D) iron

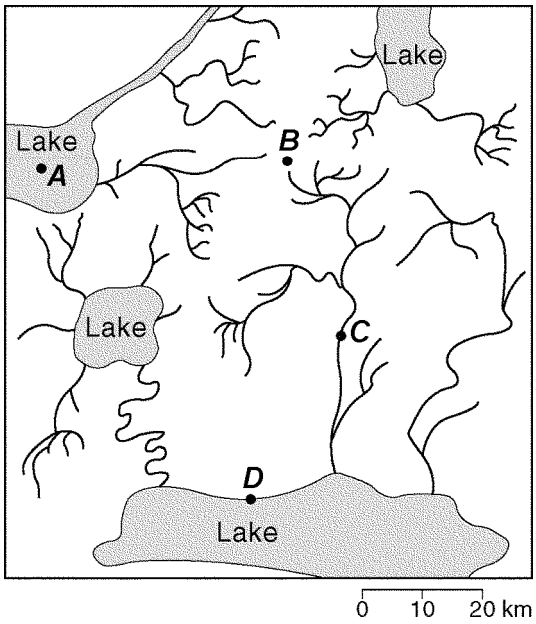
435) The map below shows some features along an ocean shoreline.



In which general direction is the sand being moved along this shoreline by ocean (long-shore) currents?

A) southwest
B) southeast
C) northwest
D) northeast

436) The map below shows the stream drainage patterns for a region of Earth's surface. Points *A*, *B*, *C*, and *D* are locations in the region.



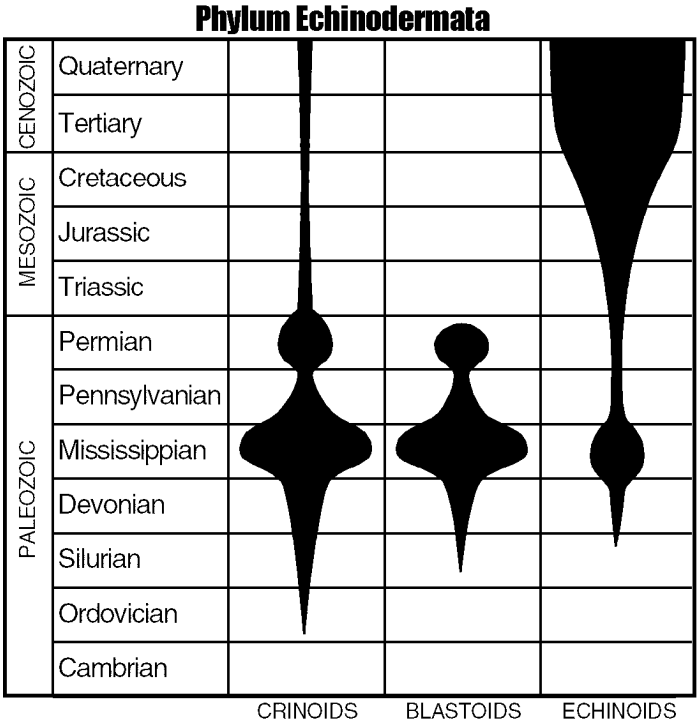
The *highest* elevation most likely exists at point

A) *A* B) *B* C) *C* D) *D*

437) During a rainfall, surface runoff will probably be *greatest* in an area that has a

A) steep slope and a gravel-covered surface
B) gentle slope and a tree-covered surface
C) steep slope and a clay-covered surface
D) gentle slope and a grass-covered surface

438) The diagram below shows the abundance of organisms called crinoids, blastoids, and echinoids throughout different geologic periods. The number of species living at any given time is represented by the width of the blackened areas.



Which statement about crinoids, blastoids, and echinoids is *best* supported by the diagram?

A) They have steadily increased in number since they first appeared.
B) They existed during the Devonian Period.
C) They are now extinct.
D) They came into existence during the same geologic period.

439) A student incorrectly measured the volume of a mineral sample as 83 cubic centimeters when the actual volume was 89 cubic centimeters. What was the student's approximate percent deviation (percentage of error)?

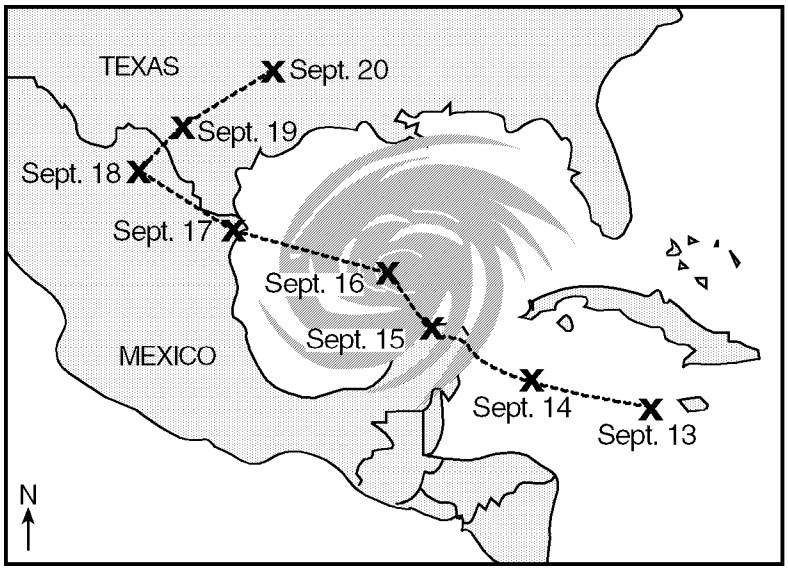
A) 9.3% B) 6.7% C) 14.8% D) 7.2%

440) What is the *largest* particle that can be kept in motion by a stream that has a velocity of 100 centimeters per second?

A) cobble B) silt C) pebble D) sand

Questions 441 and 442 refer to the following:

The map below represents a satellite image of Hurricane Gilbert in the Gulf of Mexico. Each *X* represents the position of the center of the storm on the date indicated.



441) Describe *one* threat to human life and property that could have been caused by the arrival of Hurricane Gilbert along the coastline at the Texas-Mexico border in the given map.

442) State *one* reason Hurricane Gilbert weakened between September 16 and September 18 in the given map.

Questions 443 and 444 refer to the following:

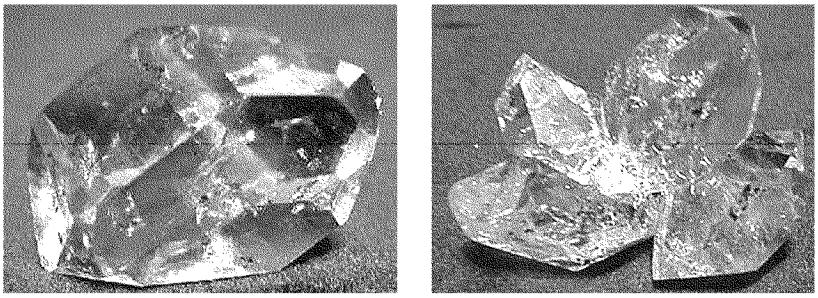
"HERKIMER DIAMONDS"

Gem-quality "Herkimer Diamonds" are hexagonal-shaped quartz crystals found in some of the surface bedrock of Herkimer, New York. Herkimer is located at approximately 43° north latitude and 75° west longitude. The oldest of these gemstones are believed to be approximately 500 million years old. These quartz crystals are magnificent works of nature that have a natural diamondlike geometric shape formed when the quartz crystallized. Natural "Herkimer Diamonds" were not cut or shaped by humans. Due to their appearance, "Herkimer Diamonds" are commonly used in jewelry. These quartz crystals are not true diamonds.

Mineral Characteristics of "Herkimer Diamonds" (Quartz) and True Diamonds

Mineral	Color	Chemical Composition	Luster	Hardness	Dominant Form of Breakage
"Herkimer Diamond" (quartz)	Colorless or variable	SiO_2	Glassy	7	Fracture
True diamond	Colorless or variable	C	Glassy	10	Cleavage

Photographs of "Herkimer Diamonds" (Quartz)

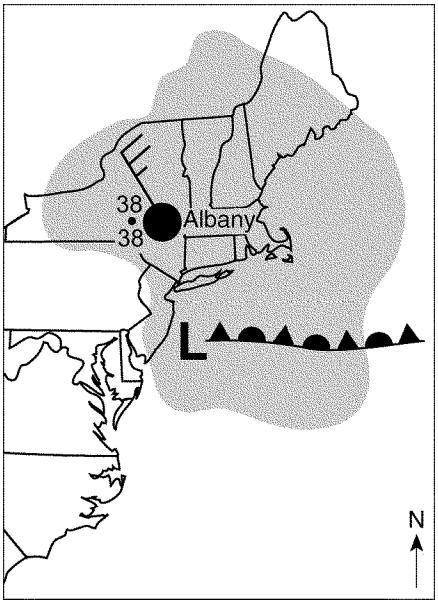


443) Based on the given information, list *two* mineral characteristics that differ between "Herkimer Diamonds" and true diamonds.

444) State *one* use for "Herkimer Diamonds" (quartz), other than their use in jewelry.

Questions 445 and 446 refer to the following:

The weather map below shows the position of a low-pressure system. The **L** is the center of the low. The shaded portion represents an area of precipitation. A weather station model for Albany, New York, is shown on the map.



445) Complete the weather data table for Albany, New York, based on the station model shown on the map.

Weather Data Table for Albany

Relative humidity (%)	
Wind direction from	
Wind speed (knots)	
Present weather	

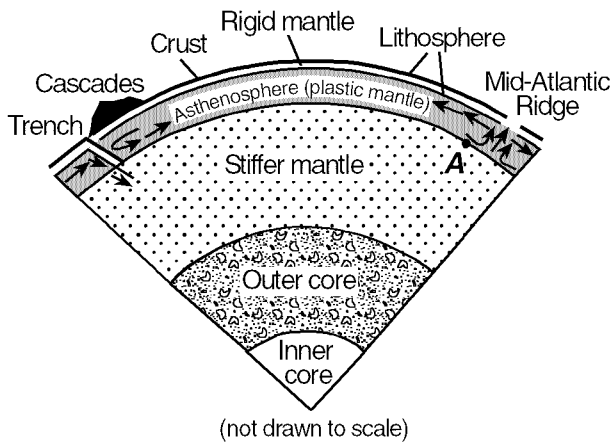
446) What type of front extends eastward from the low-pressure center shown on the map?

447) The two most abundant elements by mass in Earth's crust are oxygen and

A) silicon B) potassium C) nitrogen D) hydrogen

Questions 448 and 449 refer to the following:

The diagram below shows a portion of Earth's interior. Point *A* is a location on the interface between layers.



448) The temperature of rock at location *A* is approximately

A) 1,000°C B) 600°C C) 3,000°C D) 2,600°C

449) The arrows shown in the asthenosphere represent the inferred slow circulation of the plastic mantle by a process called

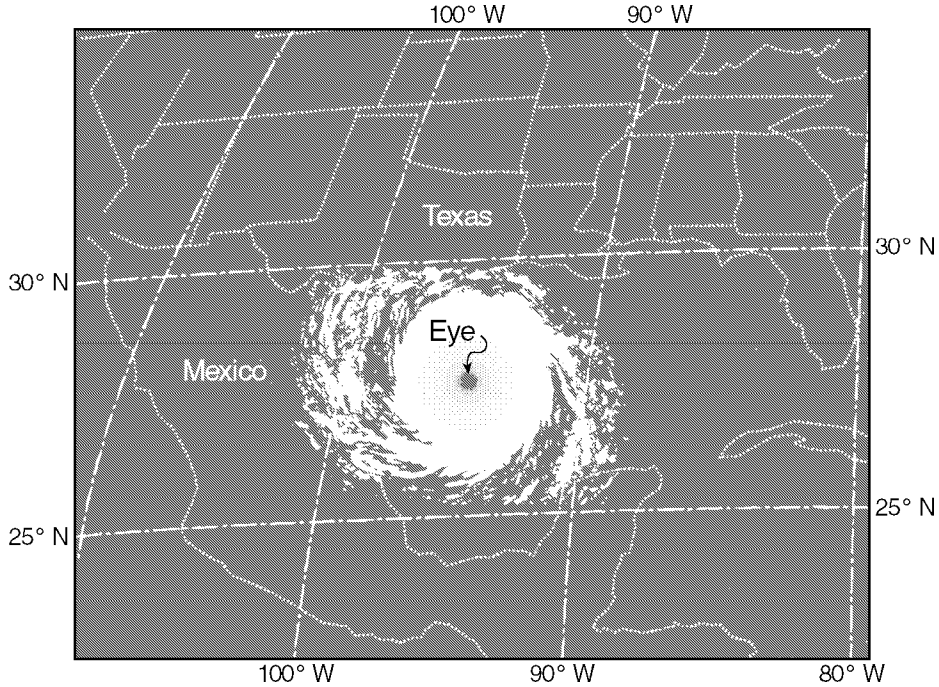
A) radiation B) conduction C) insolation D) convection

450) Starlight from distant galaxies provides evidence that the universe is expanding because this starlight shows a shift in wavelength toward the

A) gamma-ray end of the electromagnetic spectrum
B) blue-light end of the visible spectrum
C) red-light end of the visible spectrum
D) ultraviolet-ray end of the electromagnetic spectrum

Questions 451 through 455 refer to the following:

The weather satellite photograph of a portion of the United States and Mexico shows the clouds of a major hurricane approaching the eastern coastline of Texas and Mexico. The calm center of the hurricane, the eye, is labeled.



451) At the location shown in the photograph, the hurricane had maximum winds recorded at 110 miles per hour. Within a 24-hour period, the hurricane moved 150 miles inland and had maximum winds of only 65 miles per hour. State why the wind velocity of a hurricane usually decreases when the hurricane moves over a land surface.

452) State the latitude and longitude of the hurricane's eye. [*The compass directions must be included in the answer*.]

453) Cloud droplets form around small particles in the atmosphere. Describe how the hurricane clouds formed from water vapor. Include the terms "dewpoint" and either "condensation" or "condense" in your answer.

454) This hurricane has a pattern of surface winds typical of all low-pressure systems in the Northern Hemisphere. On the given satellite photograph, draw *three* arrows on the clouds to show the direction of the surface wind movement outside the eye of the hurricane.

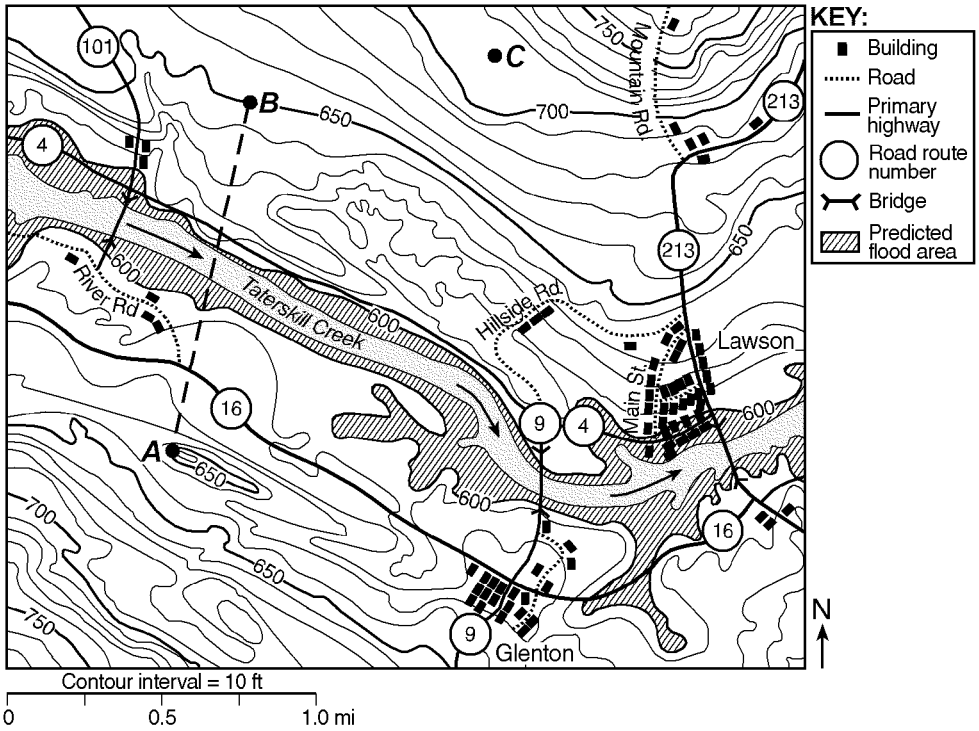
455) (a) State *two* dangerous conditions, other than hurricane winds, that could cause human fatalities as the hurricane strikes the coast.

(b) Describe *one* emergency preparation humans could take to avoid a problem caused by one of these dangerous conditions.

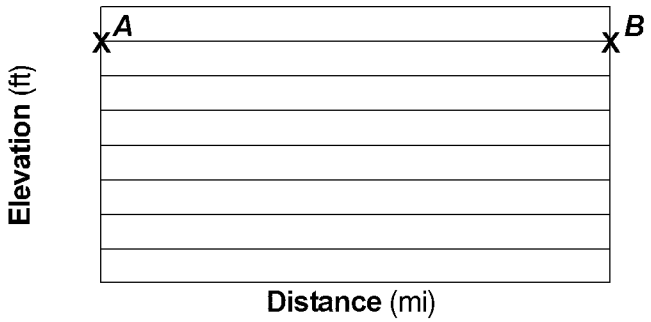
Questions 456 through 459 refer to the following:

The topographic map below shows a portion of the Taterskill Creek flowing past the towns of Lawson and Glenton. The shaded area is Taterskill Creek. The arrows in the creek show its direction of flow. Points *A*, *B*, and *C* are locations on the map. Points *A* and *B* are connected with a reference line.

Mercado Dam is located 32 miles upstream from Lawson. In the remote possibility of a failure of the Mercado Dam, the Taterskill Creek is expected to rise to the 600-foot contour line in the vicinity of the two towns.



456) On the grid below, construct a topographic profile from point *A* to point *B* in the given diagram, following the directions below.



(a) Write numbers along the vertical axis to show an appropriate scale for the elevations crossed by line *AB*. Your number scale should label at least half of the lines along the vertical axis and should not extend beyond the grid provided.

(b) Plot the elevation along line *AB* by marking an **X** at each point where a contour line is crossed. [*Point A and point B have been plotted for you.*]

(c) Connect *all* the **X**s to complete a profile that accurately reflects the elevation of the land.

457) Identify *two* emergency preparedness activities that town officials in Lawson could take before a dam failure to protect people and property from a flood.

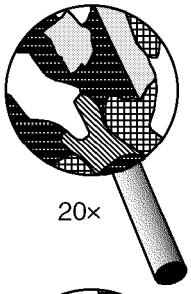
458) If Mercado Dam ruptured, the first floodwater would take exactly 4 hours to reach the town of Lawson in the given diagram. Calculate the average rate of travel for the leading edge of the floodwater. [*Label your answer with the correct units.*]

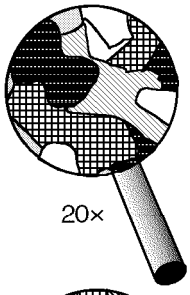
459) State a possible elevation for point *C* on the given map.

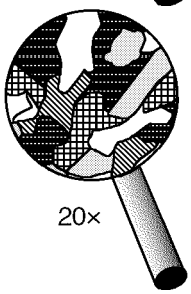
460) In what New York State landscape region is surface bedrock generally composed of metamorphic rock?

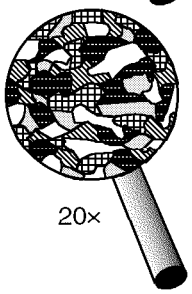
A) Adirondack Mountains
B) Newark Lowlands
C) the Catskills
D) Tug Hill Plateau

461) The diagrams below show the crystals of four different rocks viewed through the same hand lens. Which crystals most likely formed from molten material that cooled and solidified most rapidly?

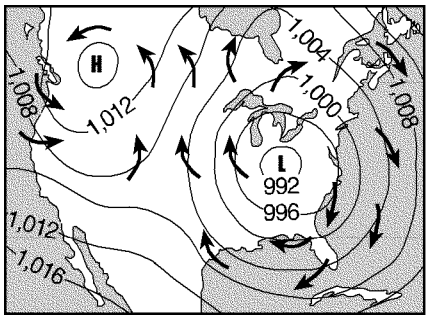
A)


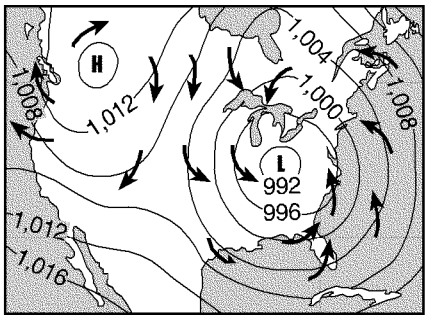
C)


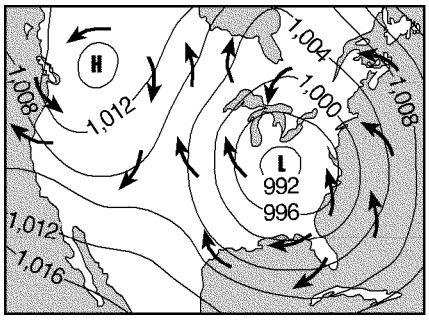
B)


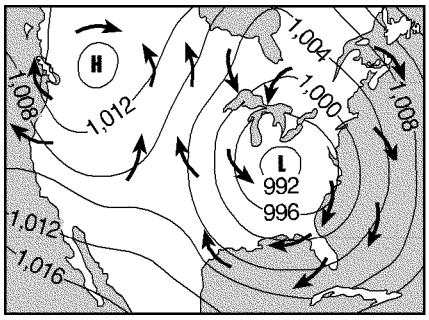
D)


462) Which map *best* represents the direction of surface winds associated with the high- and low-pressure systems?

A)


C)


B)


D)


463) A family wants to use rock materials as flooring in the entrance of their new house. They have narrowed their choice to granite or marble. Which of these rocks is more resistant to the physical wear of foot traffic and explain why this rock is more resistant.

464) Earth's hydrosphere is *best* described as the

A) solid outer layer of Earth
B) liquid outer layer of Earth
C) gaseous layer extending several hundred kilometers from Earth into space
D) magma layer located below Earth's stiffer mantle

465) Some glaciers currently exist near Earth's equator due to the cold, snowy climate of certain locations. Which type of landform exists where these glaciers occur?

466) Rainfall is most likely to infiltrate into soil that is

A) impermeable and unsaturated
B) impermeable and saturated
C) permeable and saturated
D) permeable and unsaturated

467) The list below shows characteristics that vary from place to place on Earth.

(*a*) Radioactive substances
(*b*) Bedrock structures
(*c*) Duration of insolation
(*d*) Hillslopes
(*e*) Stream patterns
(*f*) Atmospheric composition

Observations and measurements of which three characteristics would be *most* useful in describing landscapes?

A) *a*, *b*, and *c*
B) *b*, *c*, and *f*
C) *b*, *d*, and *e*
D) *d*, *e*, and *f*

Questions 468 through 470 refer to the following:

The paragraph below describes some factors that affect Earth's climate.

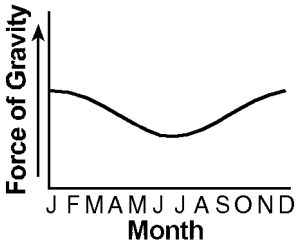
Earth's climate is in a delicate state of balance. Many factors affect climate. Any small change in the factors may lead to long-term cooling or warming of Earth's atmosphere. For example, during the last 100 years, measurements have shown a gradual increase in atmospheric carbon dioxide. This change has been linked to an increase in Earth's average atmospheric temperature. Variations in the tilt of Earth's axis have been similarly linked to the occurrence of ice ages. Both the increases in temperature and the occurrence of ice ages have been linked to changes in global sea level.

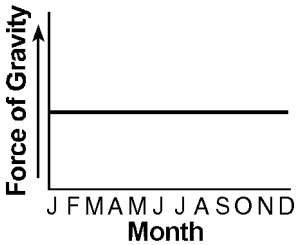
468) State what would happen to the average summer and winter temperatures in New York State if the tilt of Earth's axis were to decrease from $23\frac{1}{2}°$ to $20°$.

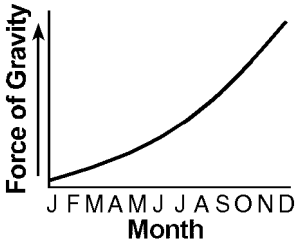
469) State *one* way that the recent increase in average global temperature can cause changes in ocean water level.

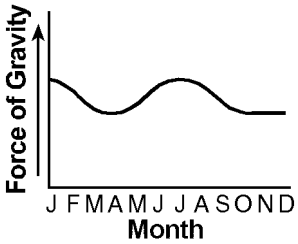
470) State *one* reason for the increase in the amount of carbon dioxide in Earth's atmosphere during the last 100 years.

471) Which graph *best* represents the force of gravity between Earth and the Sun during one revolution of Earth around the Sun?

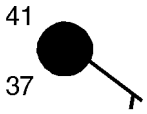
A)


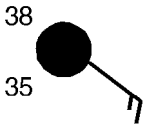
C)


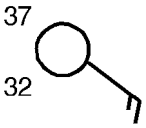
B)


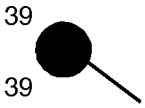
D)


472) Which weather station model shows the *highest* relative humidity?

A)


B)


C)


D)


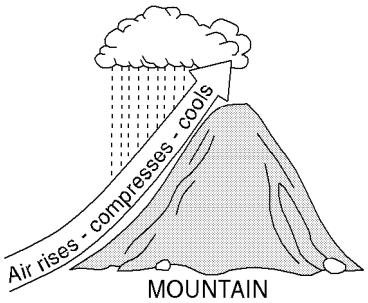
473) A stream with a velocity of 100 centimeters per second flows into a lake. Which sediment-size particles would the stream most likely deposit first as it enters the lake?

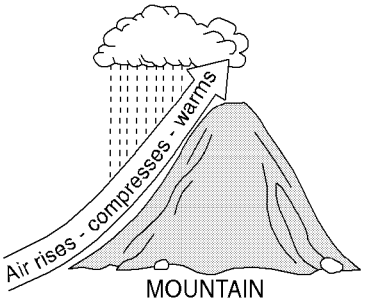
A) pebbles B) sand C) cobbles D) boulders

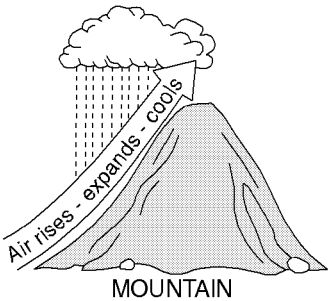
474) When granite melts and then solidifies, it becomes

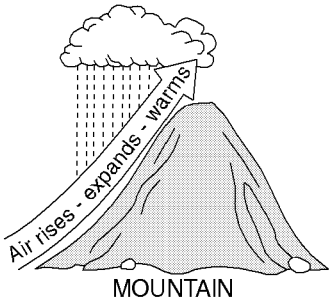
A) an igneous rock
B) a sedimentary rock
C) a metamorphic rock
D) sediments

475) Which diagram *best* illustrates how air rising over a mountain produces precipitation?

A)


C)


B)


D)


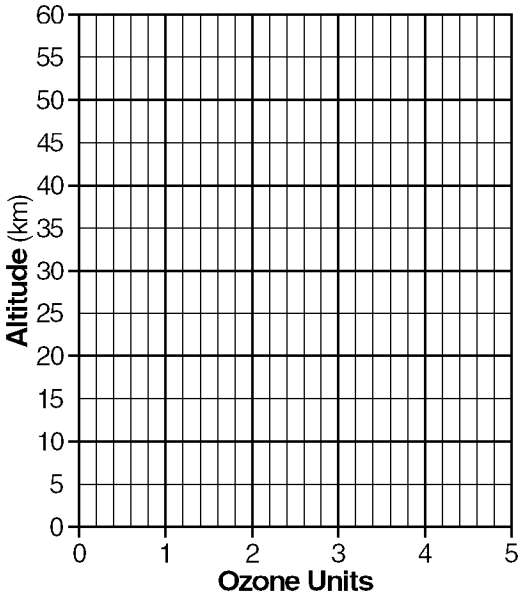
476) An air mass classified as **mT** usually forms over what type of Earth surface?

A) warm water
B) warm land
C) cool land
D) cool water

Questions 477 through 479 refer to the following:

The table below shows the concentration of ozone, in ozone units, in Earth's atmosphere at different altitudes. [*One ozone unit is equal to 10^{12} molecules per cubic centimeter.*]

Concentration of Ozone	
Altitude (km)	**Ozone Units**
0	0.7
5	0.6
10	1.1
15	3.0
20	4.9
25	4.4
30	2.6
35	1.4
40	0.6
45	0.2
50	0.1
55	0.0

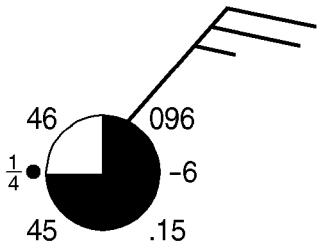


477) State how incoming solar radiation (insolation) is affected by the ozone in the atmosphere.

478) State the name of the temperature zone of the atmosphere in which the concentration of ozone is *greatest*.

479) Construct a line graph of the ozone concentration in the atmosphere recorded at the different altitudes shown on the table by plotting the data from the table and connecting the points.

480) The atmospheric conditions at a given location are represented by the weather station model below.



Fill in the correct information for each variable listed below, based on the weather station model above.

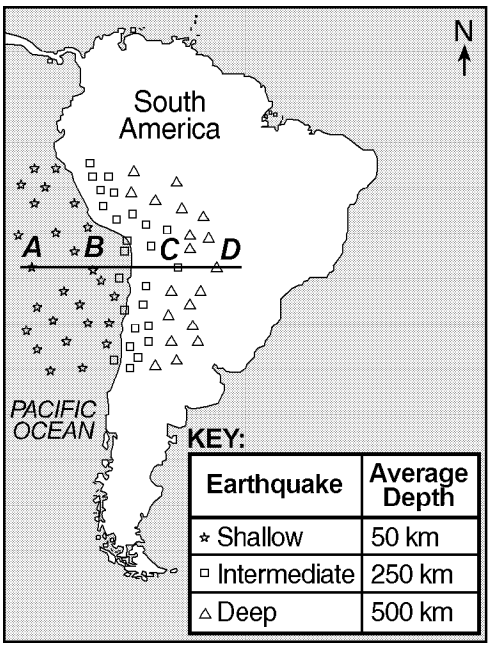
Air pressure: _____ mb
Air temperature: _____ °F
Amount of precipitation during last six hours: _____ inch(es)
Cloud cover: _____%
Present weather: _____

481) A human fingernail has a hardness of approximately 2.5. Which two minerals are softer than a human fingernail?

A) sulfur and fluorite
B) graphite and talc
C) calcite and halite
D) pyrite and magnetite

Questions 482 and 483 refer to the following:

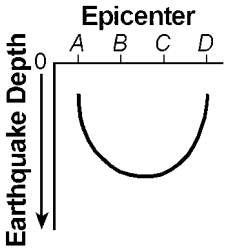
The map below shows the depths of selected earthquakes along the crustal plate boundary near the west coast of South America. Letters *A*, *B*, *C*, and *D* are epicenter locations along a west-to-east line at the surface. The relative depth of each earthquake is indicated.

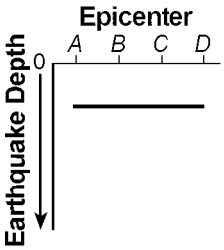


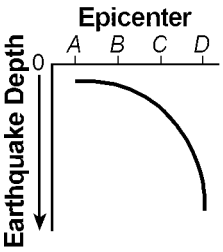
482) The earthquake beneath epicenter *D* in the given diagram occurred in which part of Earth's interior?

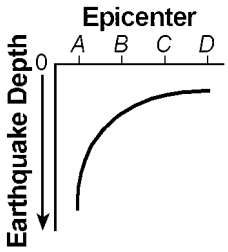
A) crust
B) stiffer mantle
C) rigid mantle
D) asthenosphere

483) Which graph *best* shows the depth of earthquakes beneath epicenters *A*, *B*, *C*, and *D* in the given diagram?

A)


C)


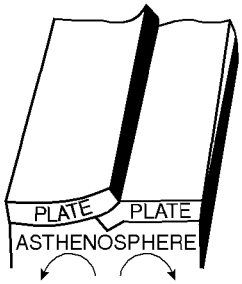
B)


D)


484) Which star has a higher luminosity and a lower temperature than the Sun?

A) *Alpha Centauri*
B) *Barnard's Star*
C) *Aldebaran*
D) *Rigel*

485) Which diagram correctly shows how mantle convection currents are most likely moving beneath colliding lithospheric plates?

A)


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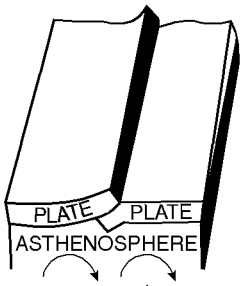
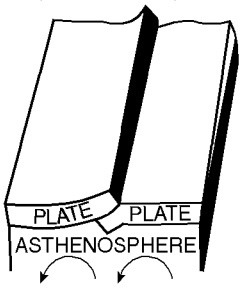
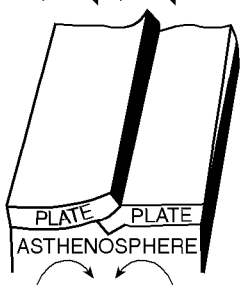


B)


D)


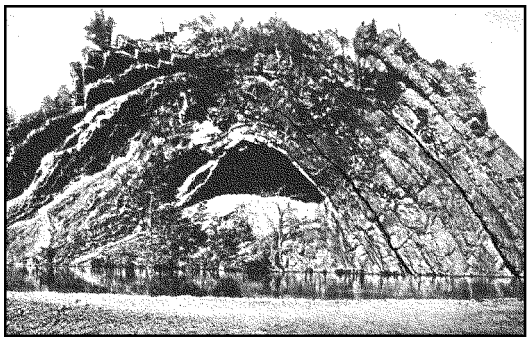
486) Which of these characteristics identify an Earth surface that is likely to be the *best* absorber of insolation?

A) dark colored and smooth
B) light colored and rough
C) dark colored and rough
D) light colored and smooth

487) Which change at a particular location in a stream usually causes more sediments to be deposited at that location?

A) increase in stream discharge
B) decrease in stream velocity
C) decrease in stream width
D) increase in stream slope

488) The photograph below shows deformed rock structure found on Earth's surface.



Deformed rock structure like this is most often caused by

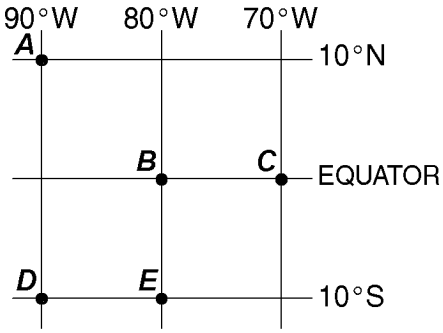
A) extrusion of magma
B) deposition of sediments
C) crustal plate collisions
D) glacial movement

489) In which layer of Earth's interior is the pressure inferred to be 1.0 million atmospheres?

A) outer core
B) stiffer mantle
C) rigid mantle
D) inner core

Questions 490 and 491 refer to the following:

The map below shows the latitude and longitude of five observers, *A*, *B*, *C*, *D*, and *E*, on Earth.



490) Which two observers would be experiencing the same apparent solar time?

A) *D* and *E*
B) *B* and *C*
C) *B* and *E*
D) *A* and *C*

491) What is the altitude of Polaris (the North Star) above the northern horizon for observer *A*?

A) 90°
B) 80°
C) 10°
D) 0°

492) There is evidence that an asteroid or a comet crashed into the Gulf of Mexico at the end of the Mesozoic Era. Consequences of this impact event may explain the

A) appearance of great coal-forming forests and insects
B) extinction of many kinds of marine animals, including trilobites
C) extinction of ammonoids and dinosaurs
D) appearance of the earliest birds and mammals

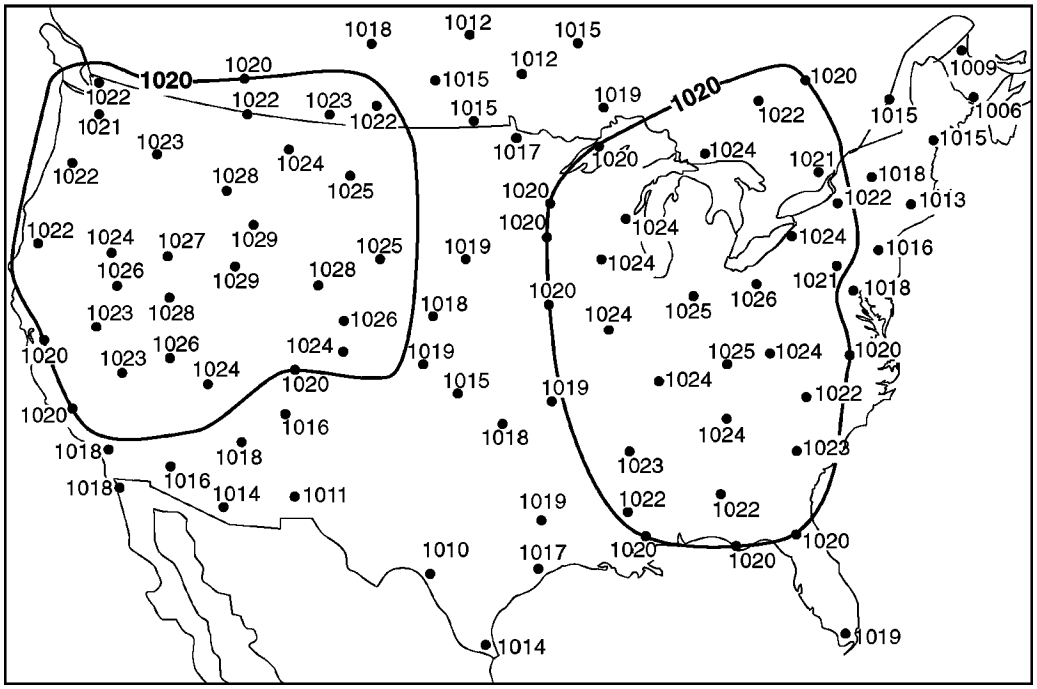
493) The surface bedrock of a region of eastern New York State is shale. Which statement *best* explains why the soil that covers the shale in this region contains abundant garnet and gneiss pebbles?

A) Volcanic lava flowed over the shale bedrock.
B) The soil consists of rock materials transported to this region by agents of erosion.
C) The soil formed from the chemical and physical weathering of shale.
D) A meteor impact scattered garnet and gneiss pebbles over the area.

Questions 494 and 495 refer to the following:

The weather map below shows surface air-pressure readings, in millibars, at various locations in the United States and Canada. The 1,020-millibar isobars have been drawn and labeled.

Surface Air Pressures



494) Draw the 1,024- and 1,028-millibar isobars on the weather map provided.

495) What weather instrument was most likely used to measure the air pressures recorded in the diagram?

496) Which process most likely formed a layer of the sedimentary rock, gypsum?

A) folding of clay-sized particles
B) solidification of magma
C) precipitation from seawater
D) melting of sand-sized particles

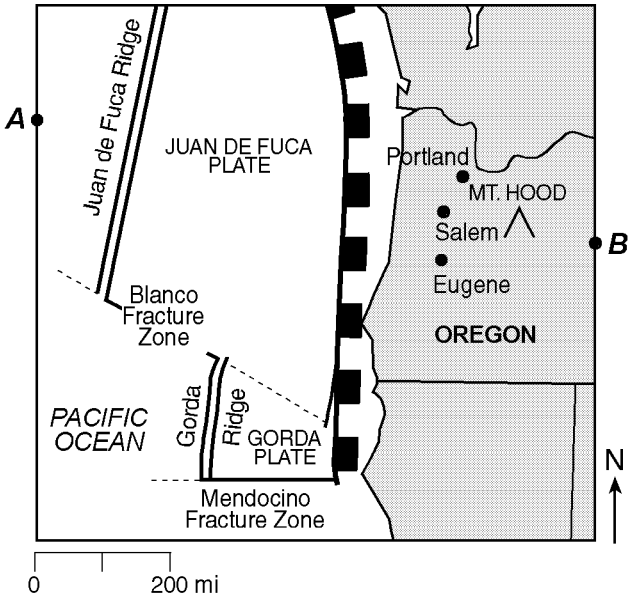
Questions 497 and 498 refer to the following:

HUGE QUAKE POSSIBLE IN OREGON VALLEY

Scientists have warned for years that a magnitude 8 or 9 earthquake could strike about 30 miles off the Oregon coast, causing huge tsunamis (large ocean waves) and tremendous damage.

Now scientists say these earthquakes could be centered much farther inland and cause severe damage to a larger area, including cities in Oregon such as Portland, Salem, and Eugene.

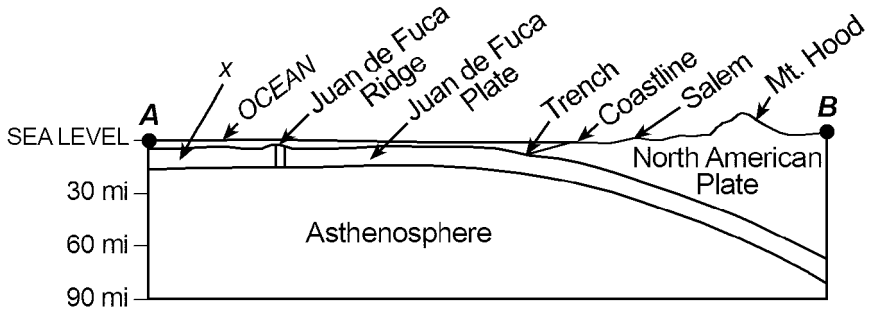
Geologic evidence suggests that strong quakes in this area occur about every 400 years, plus or minus 200 years. The last one, believed to be a magnitude 9, occurred 300 years ago. A magnitude 8 quake can cause tremendous damage. The San Francisco quake of 1906 has been estimated at 7.9. The Mexico City quake of 1985 that left thousands dead was measured at 8.1.



(Points *A* and *B* on the map are reference points.)

497) The cross section below shows the lithosphere and asthenosphere between points *A* and *B* on the map.

(a) On the cross section below, draw an arrow in the Juan de Fuca Plate to indicate the direction of the relative movement of the plate.



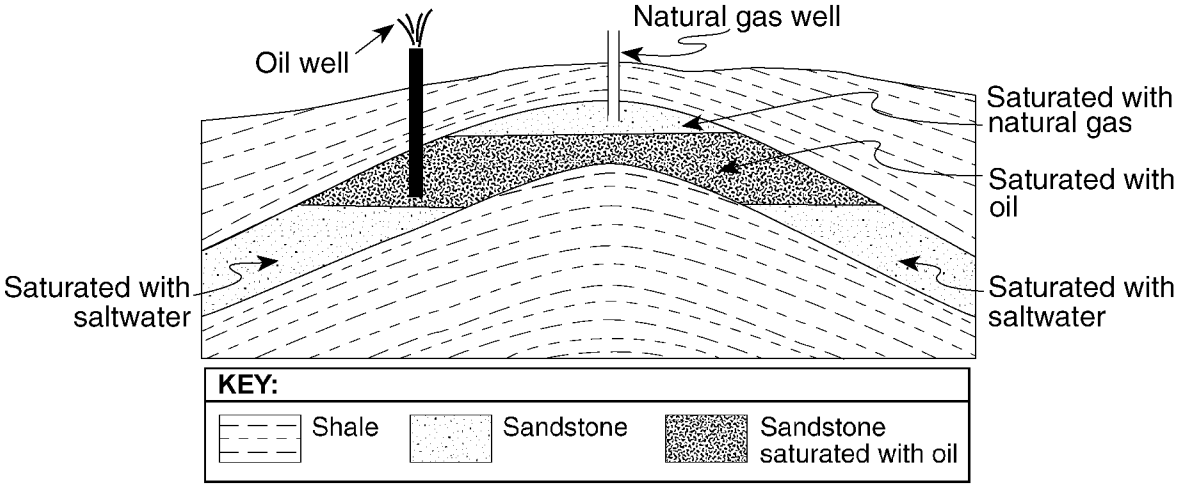
(b) Identify the type of tectonic plate boundary that exists at the Juan de Fuca Ridge.
(c) Identify the name of the plate in the cross section labeled *x*.
(d) How does the average earthquake depth beneath the Oregon coastline compare to the average earthquake depth beneath Mt. Hood?

498) An emergency management specialist in Portland, Oregon, is developing a plan that would help save lives or prevent property damage in the event of a future earthquake. Describe *two* actions or ideas that should be included in the plan.

499) During some winters, a few of the Finger Lakes remain unfrozen even though the land around the lakes is frozen. Explain how the specific heat of water can cause these lakes to remain unfrozen.

Questions 500 and 501 refer to the following:

The cross section below shows a typical bedrock structure where oil and natural gas deposits are found.



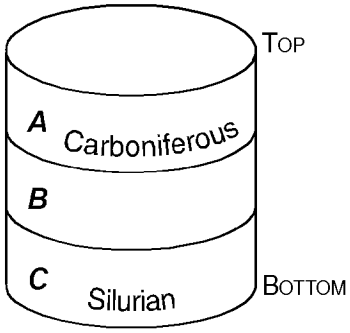
500) In the diagram shown, the natural gas, oil, and saltwater have formed layers at different levels in the same rock layer due to the

A) principle of superposition
B) differences in the density of the three materials
C) principle of original horizontality
D) differences in the geologic age of the three materials

501) According to the diagram, in which type of rock are these natural gas and oil deposits found?

A) foliated metamorphic rock
B) porous clastic sedimentary rock
C) coarse-textured igneous rock
D) intrusive crystalline sedimentary rock

502) The geologic drill core below shows bedrock layers *A*, *B*, and *C* that have not been overturned. The geological ages of layers *A* and *C* are shown.

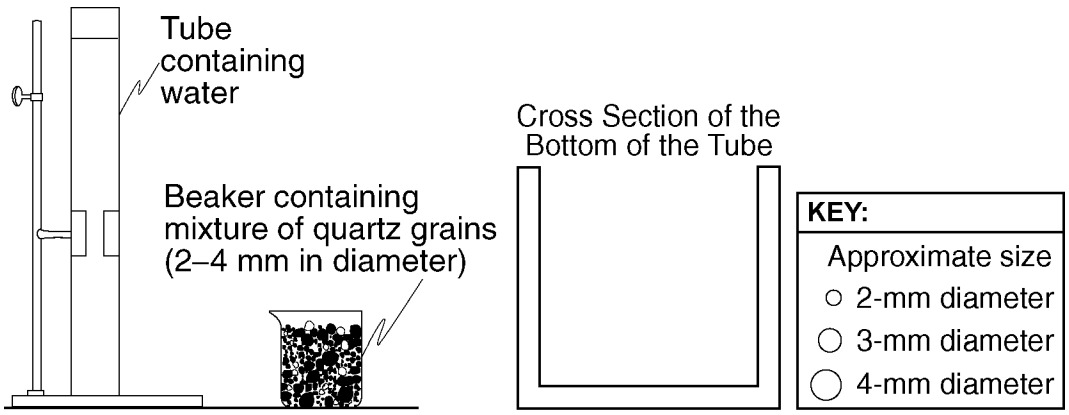


What is the geologic age of layer *B*?

A) Permian
B) Ordovician
C) Cambrian
D) Devonian

Questions 503 and 504 refer to the following:

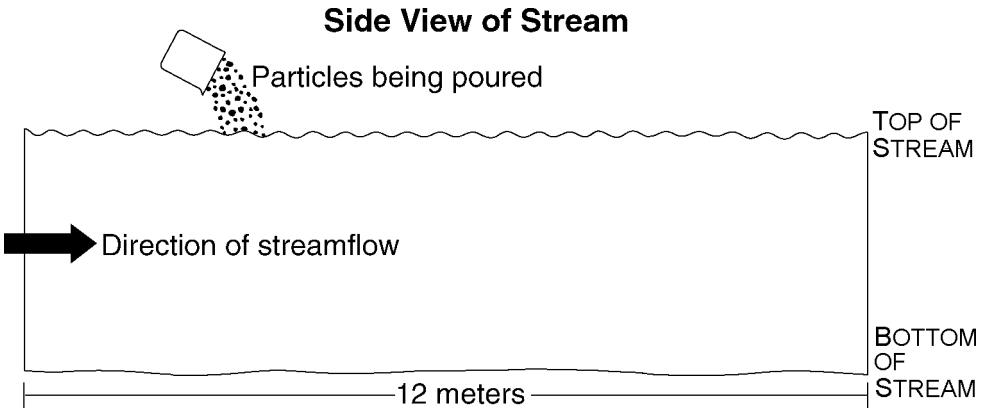
The diagram below shows a clear plastic tube containing water and a beaker containing a mixture of rounded quartz grains of different sizes.



(Not drawn to scale)

503) When the rounded quartz grains are poured all at once into the tube, the grains will settle to the bottom of the tube. In the "Cross Section of the Bottom of the Tube" diagram provided, draw the approximate grain sizes and pattern of arrangement of the rounded quartz grains at the bottom of the tube.

504) The side-view diagram below shows the same mixture and amount of rounded quartz grains being poured all at once into a moving stream with a depth of 3 meters.

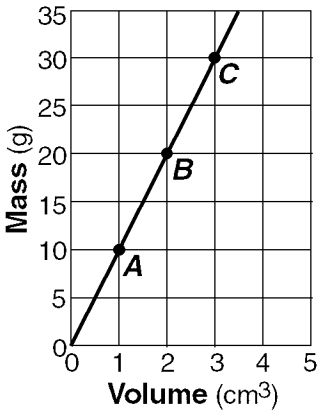


Describe the general location of the 2-mm-diameter rounded quartz grains compared to the 4-mm-diameter rounded quartz grains as they are transported and deposited downstream.

505) Approximately what percentage of the estimated age of Earth does the Cenozoic Era represent?

A) 5.0% B) 11.9% C) 1.4% D) 65.0%

506) The graph below shows the relationship between mass and volume for three samples, *A*, *B*, and *C*, of a given material.



What is the density of this material?

A) 10.0 g/cm^3 B) 5.0 g/cm^3 C) 1.0 g/cm^3 D) 20.0 g/cm^3

507) Buffalo, New York, and Plattsburgh, New York, are *both* located in landscape regions called

A) mountains B) highlands C) plateaus D) lowlands

508) The table below provides information about the mineral composition of a sample of beach sand from Hawaii.

Mineral	Composition (%)
Pyroxene	50
Plagioclase feldspar	40
Olivine	3
Amphibole	5
Unidentified minerals	2

If the sand deposited on this beach recently weathered from only one type of igneous rock, the rock was most likely

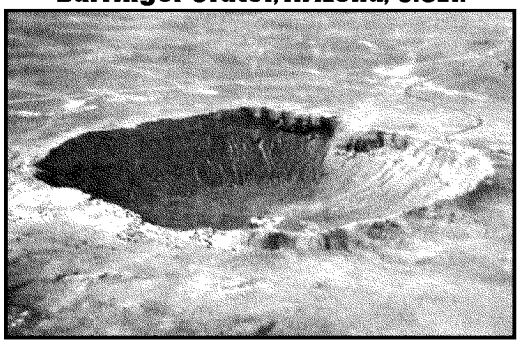
A) peridotite B) basalt C) granite D) diorite

509) The passage of the Moon into Earth's shadow causes a

A) lunar eclipse
B) new Moon
C) full Moon
D) solar eclipse

510) The photograph below shows an impact crater approximately 1 mile wide located in Diablo Canyon, Arizona. Describe the event that produced this crater.

Barringer Crater, Arizona, U.S.A.

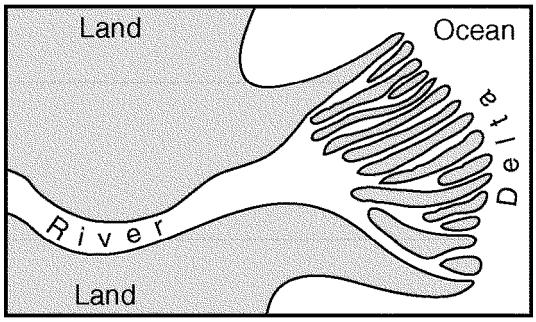


SOURCE: NASA

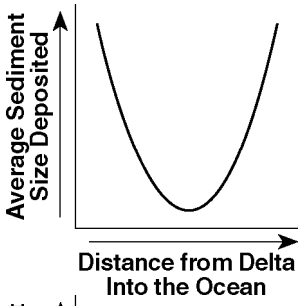
511) Andrija Mohorovicic discovered the interface between the crust and the mantle that is now named for him. His discovery of the "Moho" was based on analysis of

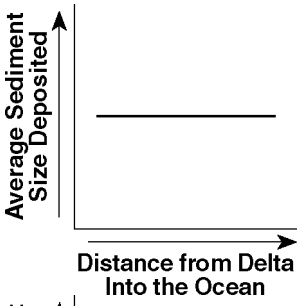
A) erosional surfaces
B) seismic waves
C) continental coastlines
D) landscape boundaries

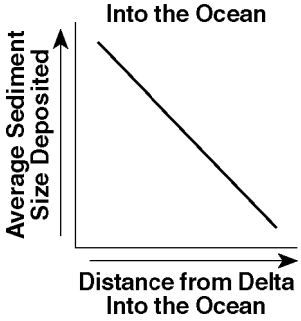
512) The map below shows a river emptying into an ocean, producing a delta.

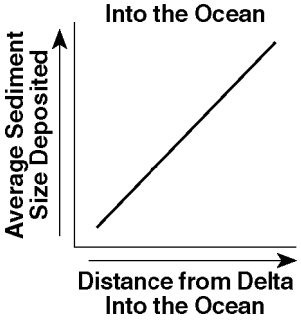


Which graph *best* represents the relationship between the distance from the river delta into the ocean and the average size of sediments deposited on the ocean floor?

A)


C)


B)


D)


513) A strong west wind steadily blew over Lake Ontario picking up moisture. As this moist air flowed over the Tug Hill Plateau, the plateau received a 36-inch snowfall. This snow fell from clouds that formed when rising air was

A) warmed by expansion, causing water vapor to evaporate
B) warmed by compression, causing water vapor to evaporate
C) cooled by compression, causing water vapor to condense
D) cooled by expansion, causing water vapor to condense

514) Which inference is *best* supported by the rock and fossil record in New York State?

A) The condor nested on the peaks of the ancestral Adirondack Mountains during the Grenville Orogeny.
B) *Coelophysis* wandered through jungles near present-day Albany.
C) Eurypterids lived in shallow seas near present-day Syracuse.
D) The first coral reefs formed off the shoreline of present-day Long Island.

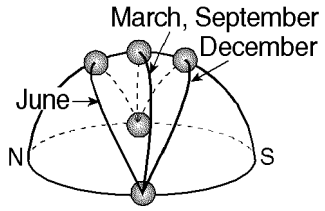
515) What mineral is an ore of iron and has a characteristic reddish brown streak?

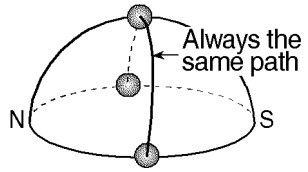
A) olivine B) hematite C) pyrite D) magnetite

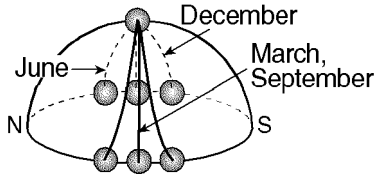
516) Compared to Pluto, Mercury moves more rapidly in its orbit because Mercury

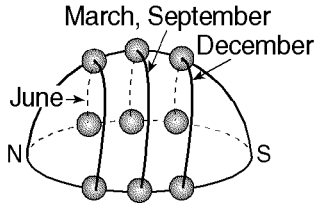
A) is closer to the Sun
B) is larger
C) is more dense
D) has a more elliptical orbit

517) Which model *best* represents the apparent path of the Sun observed at various times during the year at the Equator?

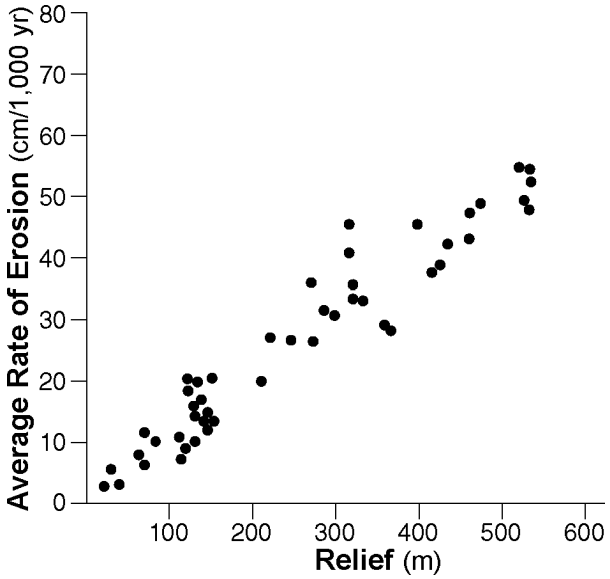
A)


B)


C)


D)


518) Each dot on the graph below shows the result of separate scientific studies of the relationship between the rates of erosion in regions of different relief. Relief is the local difference between the highest and the lowest elevations.



The results of these combined studies indicate that with each 100-meter increase in relief, the rate of erosion generally

A) decreases at a rate of 20 cm/1,000 years
B) increases at a rate of 10 cm/1,000 years
C) decreases at a rate of 10 cm/1,000 years
D) increases at a rate of 20 cm/1,000 years

519) What is the dewpoint when the dry-bulb temperature is 24°C and the wet-bulb temperature is 15°C?

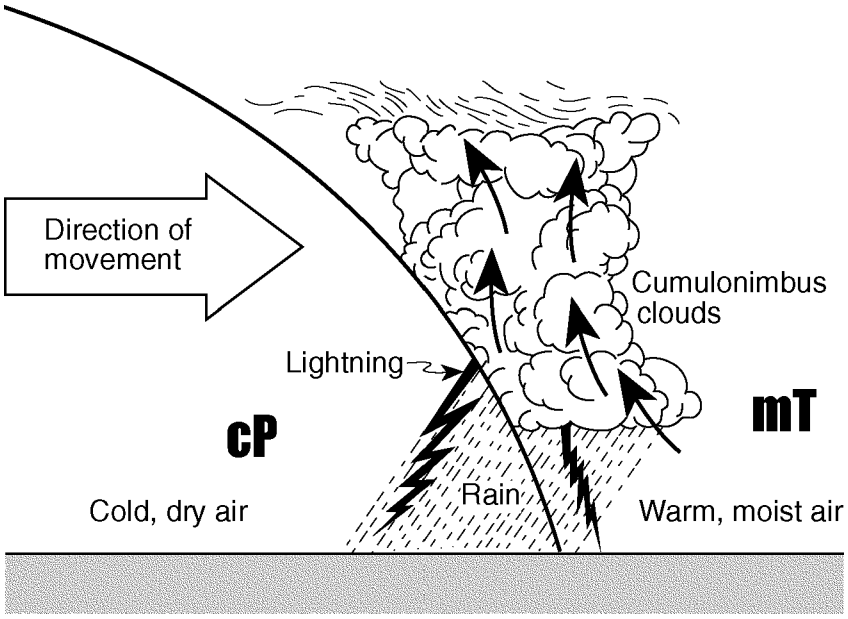
A) 4°C
B) 36°C
C) 8°C
D) -18°C

520) During which era did the initial opening of the present-day Atlantic Ocean most likely occur?

A) Late Proterozoic
B) Mesozoic
C) Paleozoic
D) Cenozoic

Questions 521 through 523 refer to the following:

The cross section below shows a typical cold front moving over New York State in early summer.



521) Central Canada was the geographic source region for the **cP** air mass shown in the cross section. Identify the most likely geographic source region for the **mT** air mass shown in the cross section.

522) State *one* process that causes clouds to form in the rising air shown in the diagram.

523) Explain why the warm, moist air is rising at the frontal boundary in the diagram.

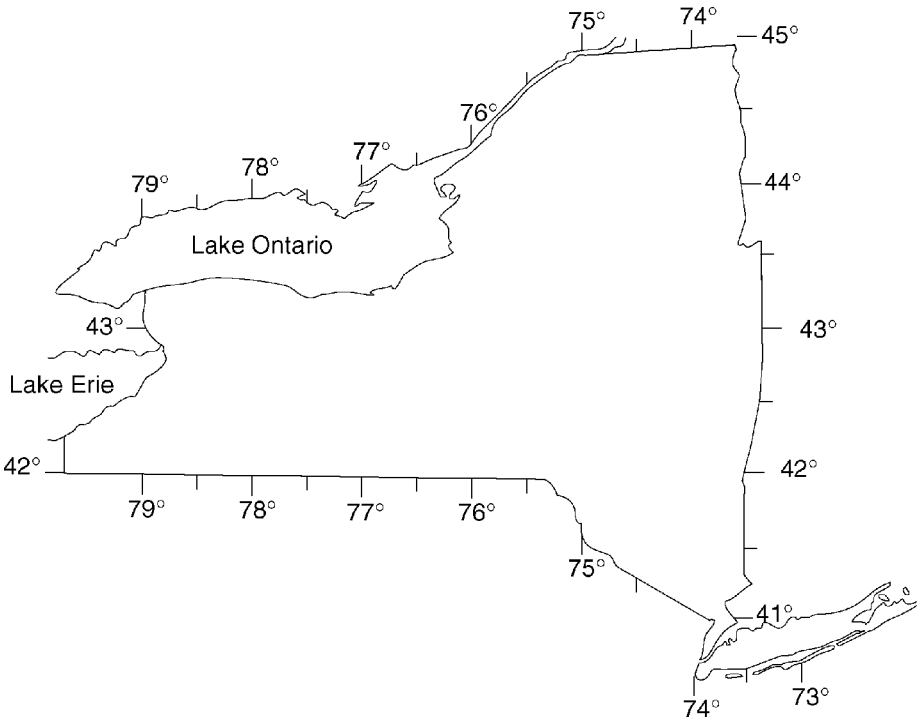
524) The absolute age of a rock is the approximate number of years ago that the rock formed. The absolute age of an igneous rock can *best* be determined by

A) comparing the sizes of the crystals found in the upper and lower parts of the rock
B) examining the rock's relative position in a rock outcrop
C) comparing the amounts of decayed and undecayed radioactive isotopes in the rock
D) examining the environment in which the rock is found

525) **"HERKIMER DIAMONDS"**

Gem-quality "Herkimer Diamonds" are hexagonal-shaped quartz crystals found in some of the surface bedrock of Herkimer, New York. Herkimer is located at approximately 43° north latitude and 75° west longitude. The oldest of these gemstones are believed to be approximately 500 million years old. These quartz crystals are magnificent works of nature that have a natural diamondlike geometric shape formed when the quartz crystallized. Natural "Herkimer Diamonds" were not cut or shaped by humans. Due to their appearance, "Herkimer Diamonds" are commonly used in jewelry. These quartz crystals are not true diamonds.

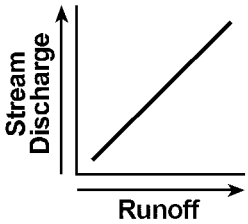
On the New York State map below, mark with a dot the location of Herkimer, New York. Draw a small circle around your dot (⊙) to make the dot easily seen.

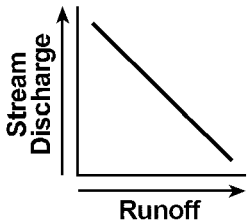


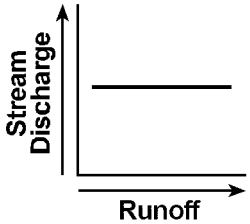
526) As a ship crosses the Prime Meridian, an observer on the ship measures the altitude of *Polaris* at 60°. What is the ship's location?

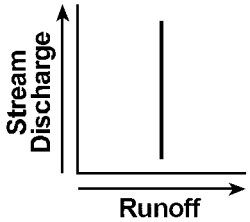
A) 60° north latitude and 0° longitude
B) 0° latitude and 60° west longitude
C) 60° south latitude and 0° longitude
D) 0° latitude and 60° east longitude

527) Which graph *best* represents the relationship between surface-water runoff and stream discharge?

A) 

C) 

B) 

D) 

528) When a continental crustal plate collides with an oceanic crustal plate, the continental crust is forced to move over the oceanic crust. What is the primary reason that the continental crust stays on top of the oceanic crust?

A) Continental crust deforms less easily.
B) Continental crust is less dense.
C) Continental crust contains more mafic minerals.
D) Continental crust melts at higher temperatures.

529) Which planet would float if it could be placed in water?

A) Saturn B) Pluto C) Mercury D) Earth

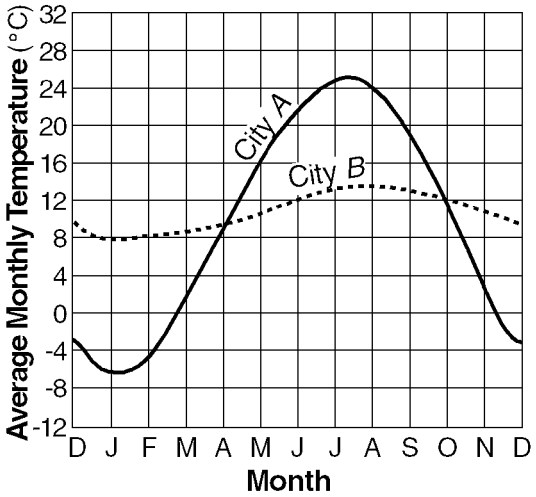
530) What are the two most abundant elements by mass found in Earth's crust?

A) oxygen and silicon
B) sodium and chlorine
C) calcium and carbon
D) aluminum and iron

531) Which physical characteristic *best* describes the rock phyllite?

A) glassy texture with gas pockets
B) foliated texture with microscopic mica crystals
C) clastic texture with angular fragments
D) bioclastic texture with cemented shell fragments

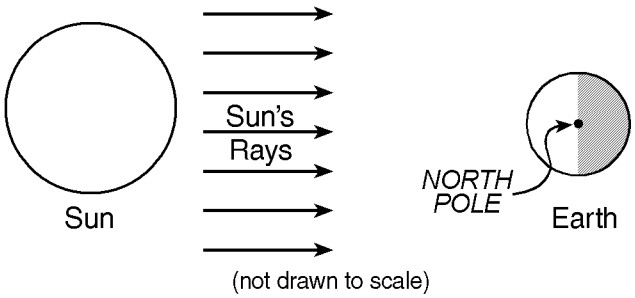
532) The graph below shows the average monthly temperatures for two cities, *A* and *B*, which are *both* located at 41° north latitude.



Which statement *best* explains the difference in the average yearly temperature range for the two cities?

A) City *B* has a greater yearly duration of insolation.
B) City *B* is located near a large body of water.
C) City *B* is located in a different planetary wind belt.
D) City *B* receives less yearly precipitation.

533) The diagram below represents the Sun and Earth as viewed from space on a certain date.



(a) Using a symbol for the Moon of approximately this size ◯, draw the position of the Moon on the diagram above at the time when the full Moon phase is observed from Earth.

(b) Draw an arrow on the diagram above that shows the Earth motion that causes surface ocean currents and surface winds to curve (Coriolis effect).

Questions 534 through 536 refer to the following:

The paragraph below provides background information regarding recent fossil discoveries in Canada.

Scientific evidence indicates that the *earliest* mammals may have evolved approximately 225 million years ago from an ancient reptile group called the therapsids. For millions of years afterward, early mammals and therapsids coexisted until the therapsids apparently became extinct 165 million years ago. However, geologists have recently found a fossil they believe to be a therapsid that is only 60 million years old. They found the fossil, which they have named *Chronoperates paradoxus* (paradoxical time-wanderer), near Calgary in Canada. This find suggests that for 105 million years after the apparent extinction of the therapsids, a few of the reptiles continued to live in a narrow geographic range in Canada.

534) Explain briefly why *Chronoperates paradoxus* would *not* be a good index fossil.

535) According to fossil evidence, during which geologic period did the *earliest* mammals appear on Earth?

536) State one method geologists could have used to determine that *Chronoperates paradoxus* lived 60 million years ago.

Questions 537 through 539 refer to the following:

FOSSIL WITH SIGNS OF FEATHERS IS CITED AS BIRD-DINOSAUR LINK

Paleontologists have discovered in China a fossil dinosaur with what are reported to be clear traces of feathers from head to tail, the most persuasive evidence so far, scientists say, that feathers predated the origin of birds and that modern birds are descendants of dinosaurs.

Entombed in fine-grained rock, the unusually well-preserved skeleton resembles that of a duck with a reptilian tail, altogether about three feet in length. Its head and tail are edged with the imprint of downy fibers. The rest of the body, except for bare lower legs, shows distinct traces of tufts and filaments that appear to have been primitive feathers. On the backs of its short forelimbs are patterns of what look like modern bird feathers.

Other dinosaur remains with what appear to be featherlike traces have been unearthed in recent years, but nothing as complete as this specimen, paleontologists said. Etched in the rock like a filigree decoration surrounding the skeleton are imprints of where the down and feathers appear to have been.

The 130-million-year-old fossils were found a year ago by farmers in Liaoning Province in northeastern China. After an analysis by Chinese and American researchers, the fossil animal was identified as a dromaeosaur, a small fast-running dinosaur related to velociraptor. The dinosaurs belonged to a group of two-legged predators known as advanced theropods...

—excerpted from "Fossils With Signs of Feathers Is Cited as Bird-Dinosaur Link", John Noble Wilford, *New York Times*, April 26, 2001

The drawing below shows an artist's view of the dinosaur, based on the fossilized remains.

537) The reference to the bird-dinosaur link mentioned in the reading passage is most likely referring to the concept of

A) recycling
B) dynamic equilibrium
C) plate tectonics
D) evolution

538) During which period of geologic time have paleontologists inferred that the feathered dinosaur mentioned in the reading passage existed?

A) Cretaceous
B) Cambrian
C) Permian
D) Paleogene

539) The feathered dinosaur shown is *not* considered an index fossil because it

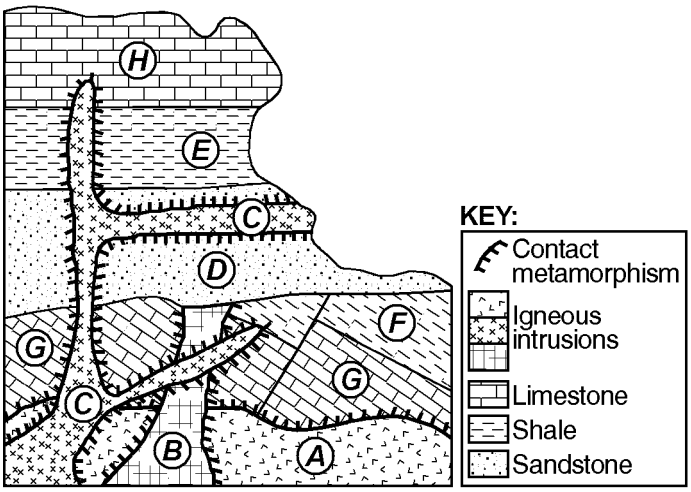
A) was preserved in ash
B) existed too long ago
C) was a land-dwelling animal
D) was found in only one area

540) A cycle of Moon phases can be seen from Earth because the

A) Moon revolves around Earth
B) Moon's axis is tilted
C) Moon's distance from Earth changes at a predictable rate
D) Moon spins on its axis

Questions 541 and 542 refer to the following:

The diagram below shows a cross section of Earth's crust.



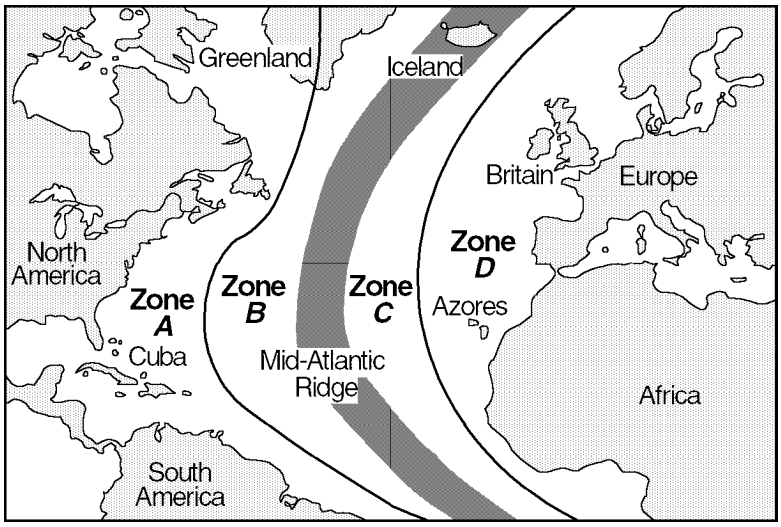
541) The *most* apparent buried erosional surface is found between which two rock units?

A) *E* and *H* B) *C* and *D* C) *A* and *B* D) *D* and *F*

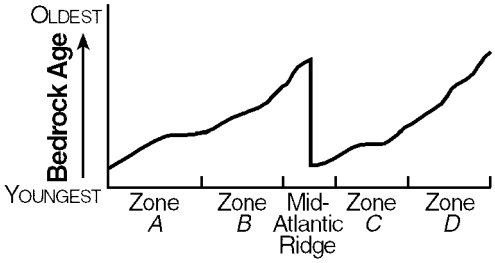
542) Which statement gives an accurate age relationship for the bedrock in the cross section?

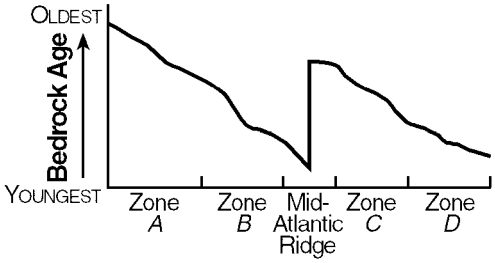
A) Intrusion *C* is younger than intrusion *B*.
B) Intrusion *C* is older than layer *E*.
C) Intrusion *B* is older than intrusion *A*.
D) Intrusion *A* is younger than intrusion *C*.

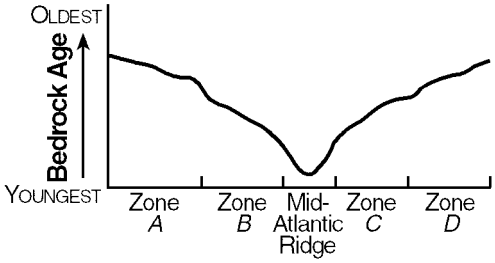
543) The map below shows the Atlantic Ocean divided into zones *A*, *B*, *C*, and *D*. The Mid-Atlantic Ridge is located between zones *B* and *C*.

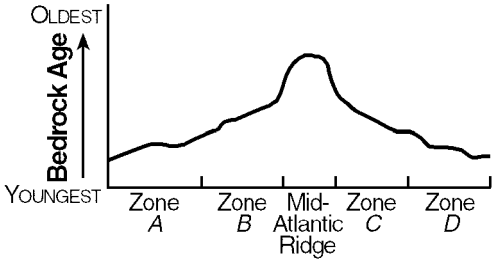


Which graph *best* represents the geologic age of the surface bedrock on the ocean bottom?

A)


C)


B)


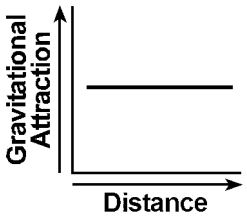
D)


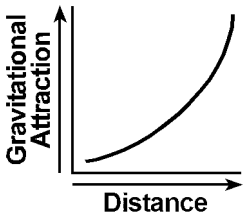
544) The rock shown below has a foliated texture and contains the minerals amphibole, quartz, and feldspar arranged in coarse-grained bands.

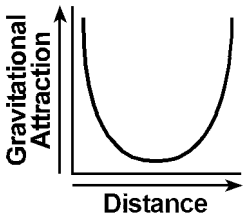
Which type of rock is shown?

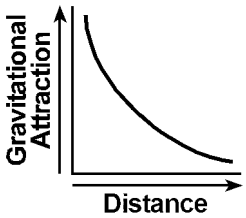
A) quartzite B) slate C) dunite D) gneiss

545) Which graph *best* represents the change in gravitational attraction between the Sun and a comet as the distance between them increases?

A)


C)


B)


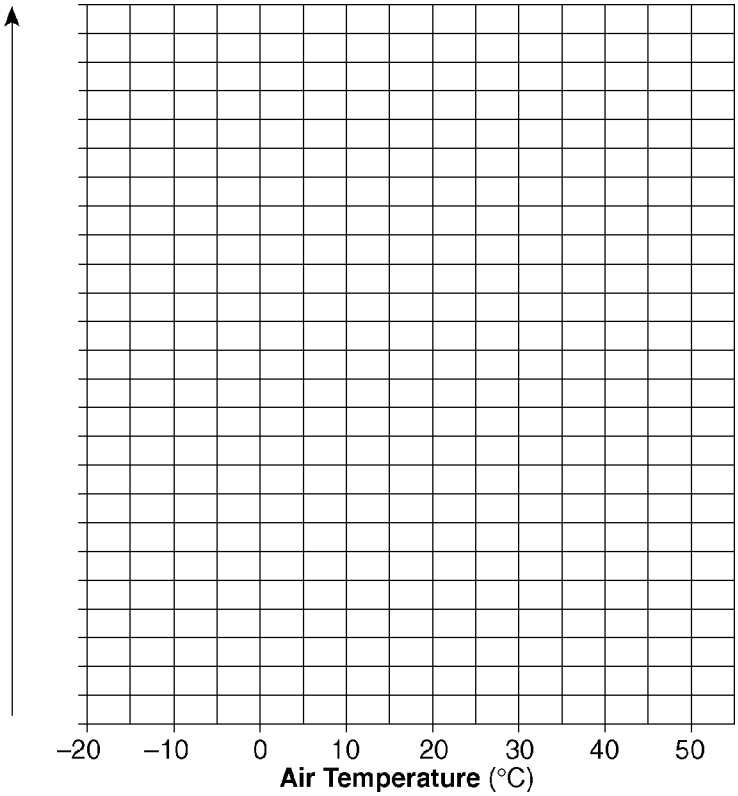
D)


Questions 546 and 547 refer to the following:

The data table below shows the amount of water vapor, in grams per cubic meter, that will saturate 1 cubic meter of air at different temperatures.

Amount of Water Vapor that will Saturate 1 Cubic Meter of Air at Different Temperatures

Air Temperature (°C)	Water Vapor (g/m^3)
–20	1
–10	2
0	5
10	9
20	17
30	29
40	50



546) For the data shown, describe the relationship between the air temperature and the amount of water vapor necessary to saturate the air.

547) On the grid provided, construct a line graph of the data, following the directions below.

(a) Place the name of the correct variable along the y-axis. Include the correct units.

(b) Mark an appropriate numerical scale showing equal intervals along the y-axis.

(c) Plot the amount of water that will saturate 1 cubic meter of air at the temperatures shown in the data table. Connect the points with a smooth, curved line.

548) The table below shows the rate of erosion and the rate of deposition at four stream locations.

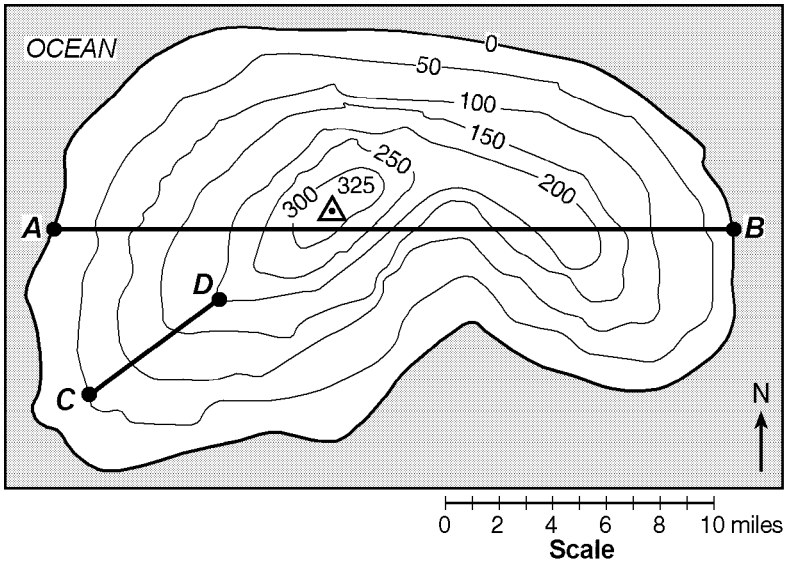
Location	Rate of Erosion (tons/year)	Rate of Deposition (tons/year)
A	3.00	3.25
B	4.00	4.00
C	4.50	4.65
D	5.60	5.20

A state of dynamic equilibrium exists at location

A) *A* B) *B* C) *C* D) *D*

Questions 549 and 550 refer to the following:

On the topographic map of an island shown below, elevations are expressed in feet. Points *A*, *B*, *C*, and *D* are locations on the island. A triangulation point shows the highest elevation on the island.



549) What is the average gradient, in feet per mile, along the straight line from point *C* to point *D*?

550) On the grid below, construct a topographic profile representing the cross-sectional view between point *A* and point *B*, following the directions below.

(a) Plot the elevation of the land along line *AB* by marking, with a dot, the elevation of each point where a contour line is crossed by line *AB*.

(b) Connect the dots with a smooth, curved line to complete the topographic profile.

551) The length of an Earth year is based on Earth's

A) revolution of 15°/hr
B) revolution of approximately 1°/day
C) rotation of approximately 1°/day
D) rotation of 15°/hr

552) Compared to an inland location, a location on an ocean shore at the same elevation and latitude is likely to have

A) cooler winters and cooler summers
B) cooler winters and warmer summers
C) warmer winters and cooler summers
D) warmer winters and warmer summers

553) Rocks can be classified as sedimentary, igneous, or metamorphic based primarily upon differences in their

A) age
B) density
C) color
D) origin

554) Which observation provides the *best* evidence that Earth revolves around the Sun?

A) Different star constellations are seen from Earth at different times of the year.
B) Stars seen from Earth appear to circle *Polaris*.
C) Earth's planetary winds are deflected by the Coriolis effect.
D) The change from high ocean tide to low ocean tide is a repeating pattern.

555) Which igneous rock, when weathered, could produce sediment composed of the minerals potassium feldspar, quartz, and amphibole?

A) granite
B) gabbro
C) andesite
D) basalt

556) An extrusive igneous rock with a mineral composition of 35% quartz, 35% potassium feldspar, 15% plagioclase feldspar, 10% biotite, and 5% amphibole is called

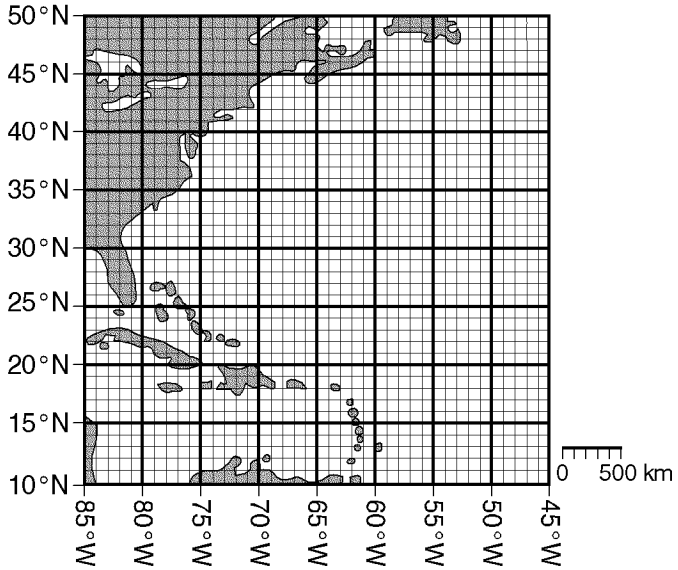
A) gabbro
B) granite
C) rhyolite
D) basaltic glass

Questions 557 through 559 refer to the following:

The data table below shows recorded information for a major Atlantic hurricane.

Hurricane Data

Date	Time	Latitude	Longitude	Maximum Winds (knots)	Air Pressure (mb)
Sept. 10	11:00 am	19°N	59°W	70	989
Sept. 11	11:00 am	22°N	62°W	95	962
Sept. 12	11:00 am	23°N	67°W	105	955
Sept. 13	11:00 am	24°N	72°W	135	921
Sept. 14	11:00 am	26°N	77°W	125	932
Sept. 15	11:00 am	30°N	79°W	110	943



557) Describe the relationship between air pressure and wind speed associated with the hurricane shown.

558) (a) Using the latitude and longitude data in the given table, place an **X** on the map for each location of the hurricane during these 6 days. Connect all the **X**s with a solid line.

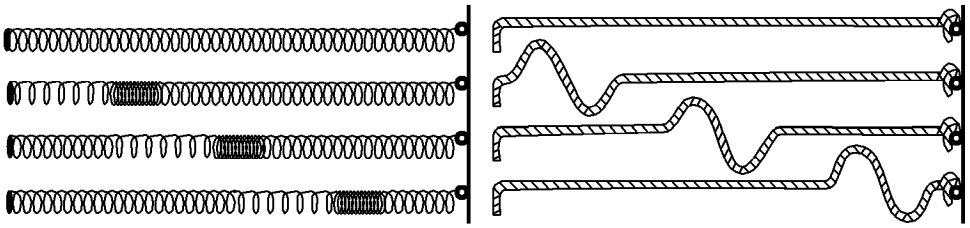
(b) Label the September 15 (9/15) position of the hurricane on the map.

(c) Starting from the plotted position on September 15, draw a dashed line on the map to indicate the storm's most likely path for the next 5 days.

559) Identify the weather instrument used to measure the air pressure associated with the hurricane shown.

Questions 560 and 561 refer to the following:

The diagram below shows models of two types of earthquake waves.



Model *A* **Model *B***

560) In the given diagram, model *A best* represents the motion of earthquake waves called

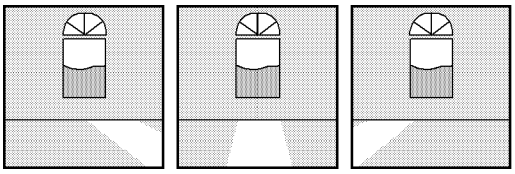
A) *S*-waves (shear waves) that travel slower than *P*-waves (compressional waves) shown in model *B*
B) *S*-waves (shear waves) that travel faster than *P*-waves (compressional waves) shown in model *B*
C) *P*-waves (compressional waves) that travel slower than *S*-waves (shear waves) shown in model *B*
D) *P*-waves (compressional waves) that travel faster than *S*-waves (shear waves) shown in model *B*

561) The difference in seismic station arrival times of the two waves represented by the models in the given diagram helps scientists determine the

A) amount of damage caused by an earthquake
B) time of occurrence of the next earthquake
C) intensity of an earthquake
D) distance to the epicenter of an earthquake

Questions 562 and 563 refer to the following:

The diagram below shows sunlight entering a room through the same window at three different times on the same winter day.



SUNRISE NOON SUNSET

562) This room is located in a building in New York State. On which side of the building is the window located?

A) east B) west C) south D) north

563) The apparent change in the Sun's position shown in the diagram is *best* explained by

A) the Sun's axis tilted at an angle of $23\frac{1}{2}°$

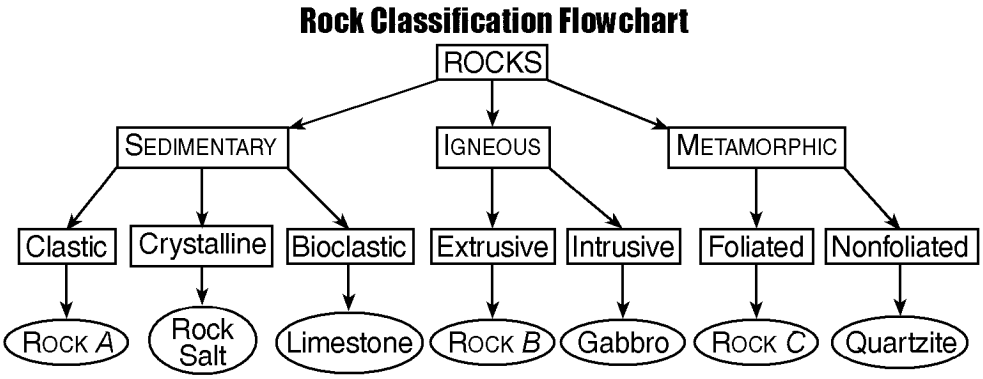
B) Earth rotating at a rate of 15° per hour

C) the Sun rotating at a rate of 15° per hour

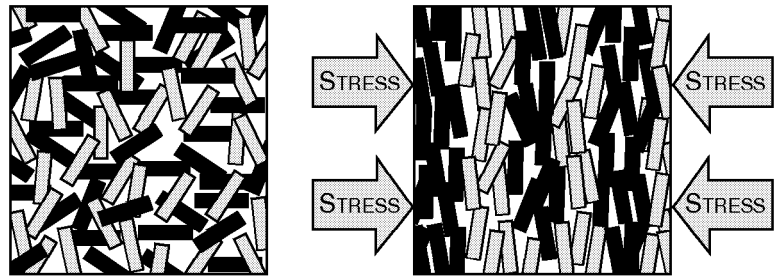
D) Earth's axis tilted at an angle of $23\frac{1}{2}°$

Questions 564 through 567 refer to the following:

On the *Rock Classification* flowchart below, letters *A*, *B*, and *C* represent specific rocks in this classification scheme.



564) The diagram below represents two magnified views showing the arrangement of minerals before and after metamorphism of rock *C* in the given flowchart. State the name of rock *C*.



Mineral Arrangement Before Metamorphism

Rock *C* Showing Banding After Metamorphism

565) Rock *A* in the given flowchart is composed of very fine-grained quartz and feldspar particles 0.005 centimeter in diameter. State the name of rock *A*.

566) Rock *B* in the given flowchart has a glassy, vesicular texture and is composed mainly of potassium feldspar and quartz. State the name of rock *B*.

567) Granite could be placed in the same position in the given flowchart as gabbro. Describe *two* differences between granite and gabbro.

568) In which New York State landscape region is most of the surface bedrock composed of metamorphic rock?

A) Catskills
B) Adirondacks
C) Erie-Ontario Lowlands
D) Newark Lowlands

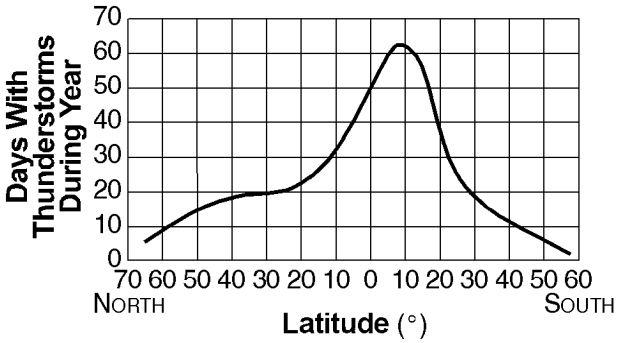
569) On a field trip 40 kilometers east of the Finger Lakes, students observed a boulder of gneiss on the surface bedrock. This observation *best* supports the inference that the

A) surface sedimentary bedrock melted and solidified to form a boulder of gneiss
B) gneiss boulder was formed from sediments that were compacted and cemented together
C) surface sedimentary bedrock was weathered to form a boulder of gneiss
D) gneiss boulder was transported from its original area of formation

570) A student in an eastern city of the United States read in a newspaper that the maximum length of the daylight period for the year had just been reached. What was the date of this newspaper?

A) March 22
B) December 22
C) June 22
D) September 22

571) The graph below shows the average number of days each year that thunderstorms occur at different latitudes on Earth.



According to the graph, what is the approximate number of days each year that thunderstorms occur at locations along the 40° N parallel of latitude?

A) 24 days
B) 18 days
C) 32 days
D) 8 days

572) State the general relationship between a planet's distance from the Sun and the time a planet takes to complete one orbit around the Sun.

573) When the dry-bulb temperature is 22° C and the wet-bulb temperature is 13° C, the relative humidity is

A) 41%
B) 33%
C) 59%
D) 10%

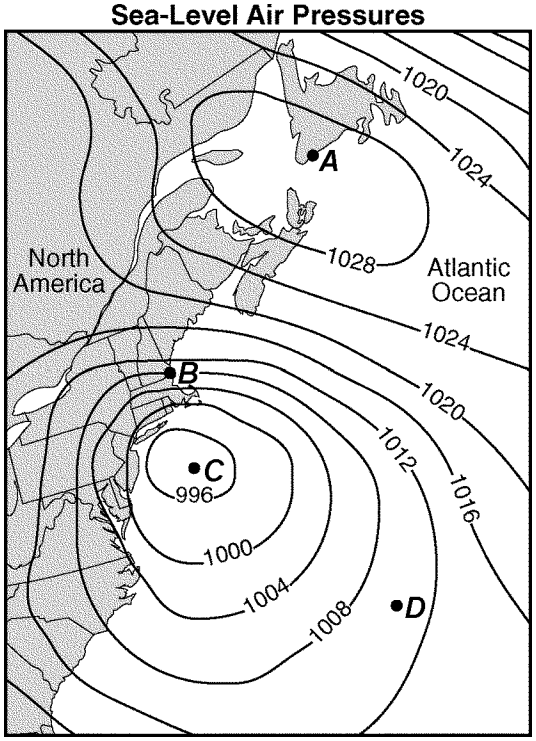
574) The time required for the Moon to show a complete cycle of phases when viewed from Earth is approximately

A) 1 week
B) 1 month
C) 1 day
D) 1 year

Questions 575 through 577 refer to the following:

The map below shows sea-level air pressure, in millibars, for a portion of the eastern coast of North America. Points *A*, *B*, *C*, and *D* are sea-level locations on Earth's surface.

Sea-Level Air Pressures



575) The air pressure recorded at point *D* on the map was most likely

A) 1,012 mb B) 1,006 mb C) 1,014 mb D) 1,010 mb

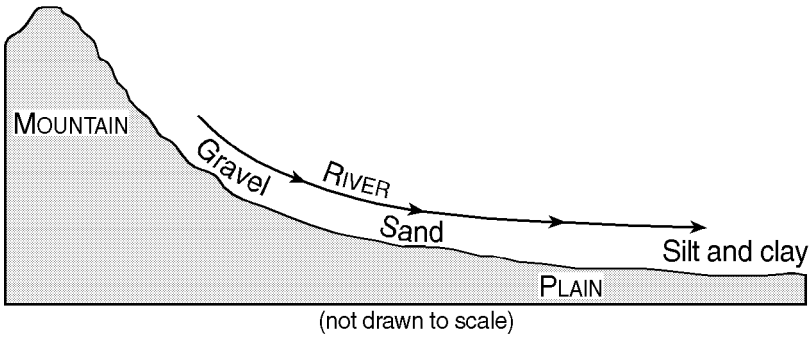
576) Which of the following weather instruments was used to measure the air pressures recorded on the map?

A) barometer
B) wind vane
C) sling psychrometer
D) thermometer

577) Which location on the map most likely recorded the *highest* wind speed?

A) *A* B) *B* C) *C* D) *D*

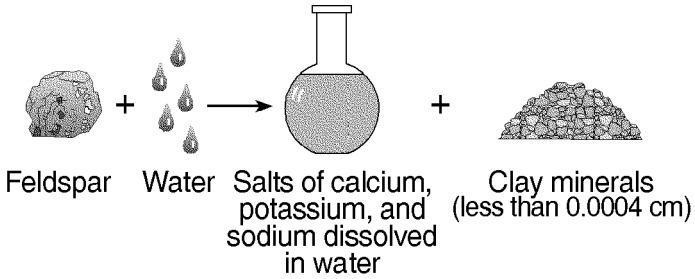
578) The cross section below illustrates the general sorting of sediment by a river as it flows from a mountain to a plain.



Which factor most likely caused the sediment to be sorted in the pattern shown?

A) hardness of the surface bedrock
B) velocity of the river water
C) mineral composition of the sediment
D) temperature of the water

579) The diagram below represents a naturally occurring geologic process.



Which process is *best* illustrated by the diagram?

A) metamorphism
B) erosion
C) weathering
D) cementation

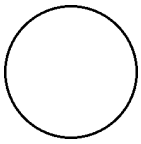
Questions 580 through 582 refer to the following:

A student using a sling psychrometer obtained a dry-bulb reading of 20 °C and a wet-bulb reading of 16 °C for a parcel of air outside the classroom.

580) State the change in relative humidity as the air temperature and the dewpoint get closer to the same value.

581) State the dewpoint.

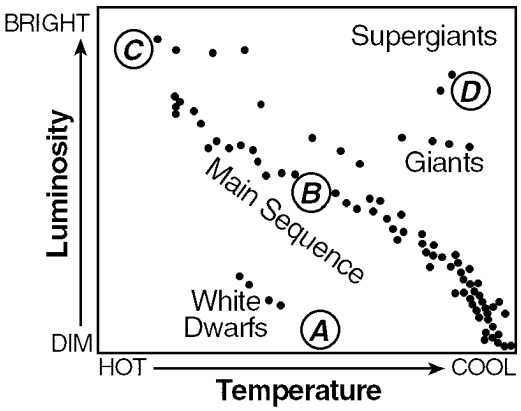
582) On another day, the student determined the dewpoint was 70° F. Record the dewpoint, using the proper format, in the correct location on the weather station model below.



583) To an observer in Buffalo, New York, the North Star, Polaris, is always located above the northern horizon at an altitude of approximately

A) 90° B) 43° C) $66\frac{1}{2}$° D) $23\frac{1}{2}$°

584) The graph below represents the brightness and temperature of stars visible from Earth.

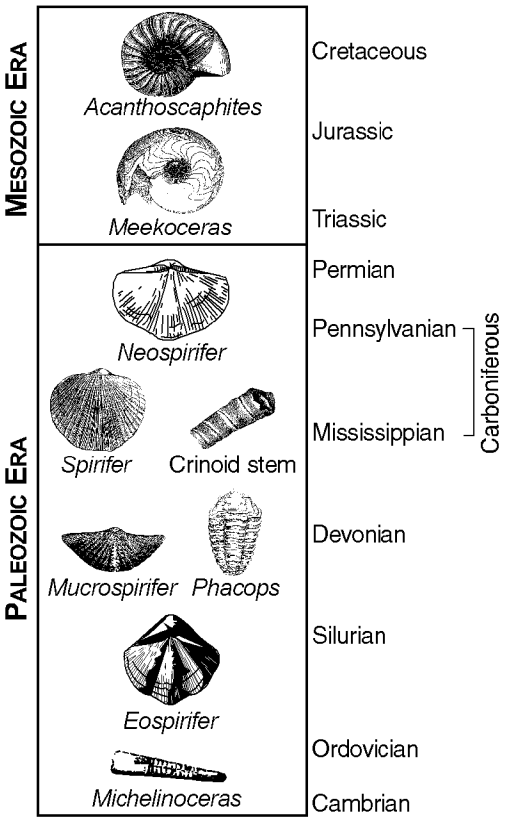


Which location on the graph *best* represents a star with average brightness and temperature?

A) *A* B) *B* C) *C* D) *D*

Questions 585 and 586 refer to the following:

The chart below shows the geologic ages of some well-known fossils.



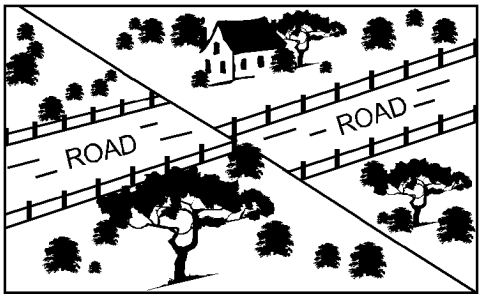
585) The *Spirifer*, Crinoid stem, and *Neospirifer* fossils might be found in some of the surface bedrock of which New York State landscape region?

A) the Adirondack Mountains near Mt. Marcy
B) the Allegheny Plateau southeast of Jamestown
C) the Erie-Ontario Lowlands northeast of Niagara Falls
D) the Catskills near Slide Mountain

586) Which New York State fossil is found in rocks of the same period of geologic history as *Meekoceras*?

A) *Coelophysis*
B) *Eurypterus*
C) Placoderm fish
D) Condor

587) The diagram below shows land features that have been disrupted by an earthquake.

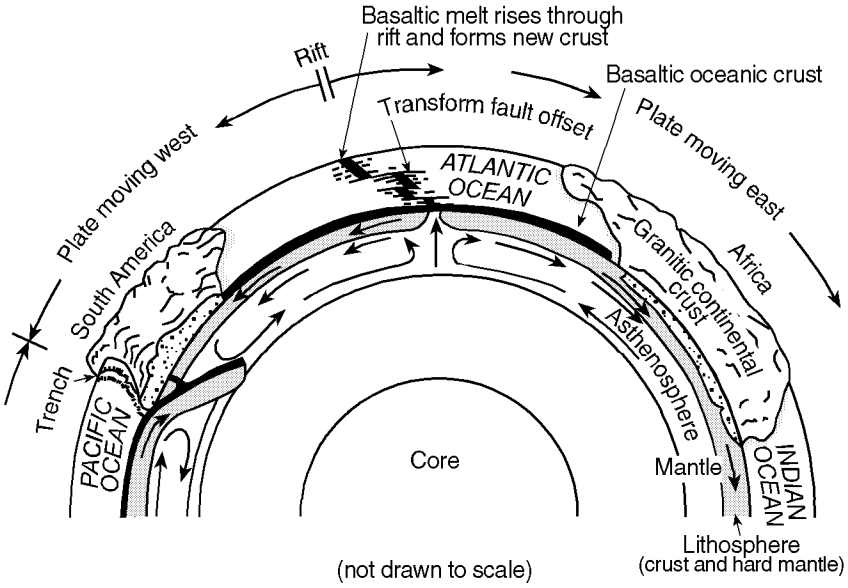


Which type of crustal movement most likely caused the displacement of features in this area?

A) vertical lifting of surface rock
B) folding of surface rock
C) down-warping of the crust
D) movement along a transform fault

Questions 588 through 590 refer to the following:

The diagram below shows a model of the relationship between Earth's surface and its interior.



588) According to the diagram, the deep trench along the west coast of South America is caused by movement of the oceanic crust that is

A) uplifting over the continental crust
B) colliding with the Atlantic oceanic crust
C) sinking at the Mid-Atlantic ridge
D) sinking beneath the continental crust

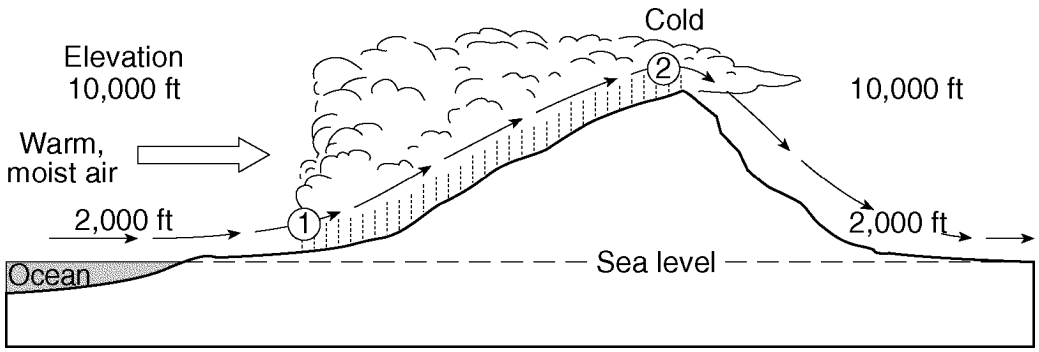
589) The motion of the convection currents in the mantle beneath the Atlantic Ocean appears to be mainly making this ocean basin

A) wider
B) narrower
C) shallower
D) deeper

590) Mid-ocean ridges (rifts) normally form where tectonic plates are

A) sliding past each other
B) converging
C) diverging
D) stationary

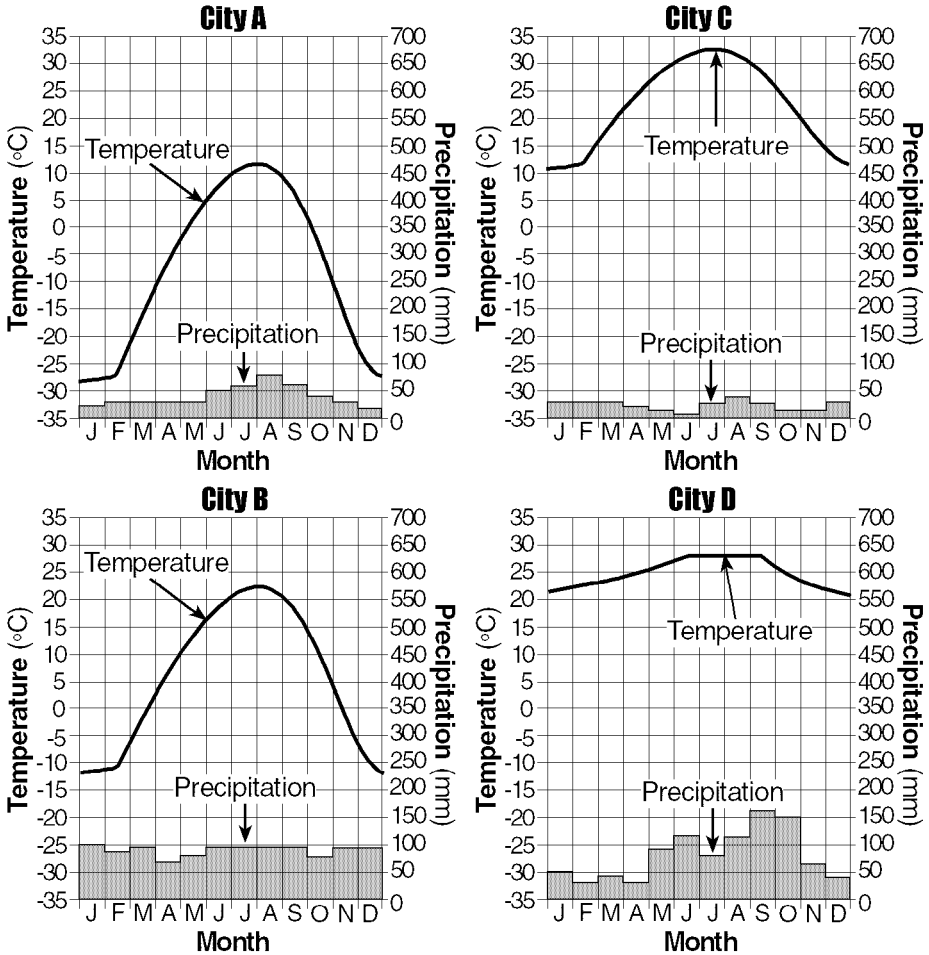
591) The diagram below shows warm, moist air moving off the ocean and over a mountain, causing precipitation between points 1 and 2.



Describe *two* changes that occur to the warm, moist air between points 1 and 2 that would cause cloud formation.

Questions 592 and 593 refer to the following:

Each graph below represents data for a different city in North America. The line graphs connect the average monthly temperatures in degrees Celsius. The bar graphs indicate the average monthly precipitation in millimeters.



592) In which one of the following sequences are the cities in the given graphs listed in order of decreasing average yearly precipitation?

A) *B*, *D*, *A*, *C* B) *C*, *A*, *D*, *B* C) *D*, *C*, *B*, *A* D) *A*, *B*, *C*, *D*

593) For what two cities in the given graphs is the winter precipitation most likely to be snow?

A) *B* and *C* B) *A* and *B* C) *B* and *D* D) *A* and *C*

594) Unsorted, angular, rough-surfaced cobbles and boulders are found at the base of a cliff. What most likely transported these cobbles and boulders?

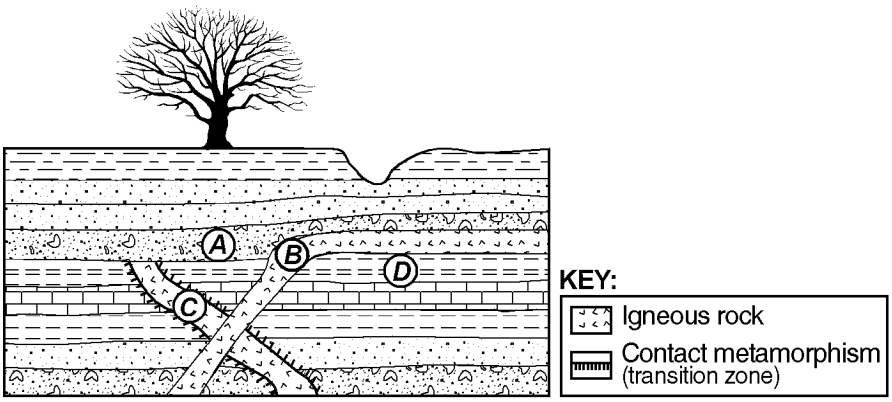
A) ocean currents
B) wind
C) running water
D) gravity

595) Weather-station measurements indicate that the dewpoint temperature and air temperature are getting farther apart and that air pressure is rising. Which type of weather is most likely arriving at the station?

A) cool, dry air
B) a warm front
C) maritime tropical air
D) a snowstorm

Questions 596 through 598 refer to the following:

The cross section below represents a portion of Earth's crust. Letters *A*, *B*, *C*, and *D* are rock units.



596) Describe *one* observable characteristic of rock *A* that indicates that rock *A* is sedimentary.

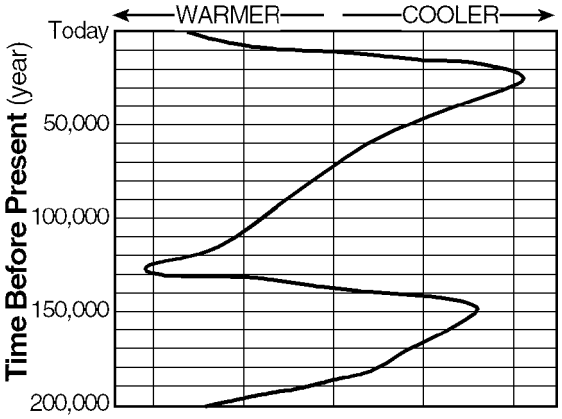
597) In relation to rock units *A* and *B* in the cross section, when was igneous rock *C* formed?

598) Igneous rock *B* was formed after rock layer *D* was deposited but before rock layer *A* was deposited. Using the contact metamorphism symbol shown in the key, draw that symbol in the proper locations on the cross section provided to indicate those rocks that underwent contact metamorphism when igneous rock *B* was molten.

599) The apparent shift in the direction of swing of a Foucault pendulum is caused by Earth's

A) revolution
B) tilted axis
C) spherical shape
D) rotation

600) The diagram below shows trends in the temperature of North America during the last 200,000 years, as estimated by scientists.



What is the total number of major glacial periods that have occurred in North America in the last 200,000 years?

A) 4 B) 2 C) 3 D) 5

601) Which planet has an orbital eccentricity *most* like the orbital eccentricity of the Moon?

A) Mars B) Pluto C) Mercury D) Saturn

602) Which geologic feature is caused primarily by chemical weathering?

A) blocks of basalt at the base of a steep slope
B) the smooth, polished surface of a rock in a dry, sandy area
C) large caves in limestone bedrock
D) a pattern of parallel cracks in a granite mountain

603) Because Venus has greater atmospheric carbon dioxide (CO_2) content than Earth has, the surface temperature of Venus is

A) warmer, due to absorption of long-wave (infrared) radiation by a greenhouse gas
B) warmer, due to absorption of short-wave (ultraviolet) radiation by a greenhouse gas
C) cooler, due to absorption of short-wave (ultraviolet) radiation by a greenhouse gas
D) cooler, due to absorption of long-wave (infrared) radiation by a greenhouse gas

604) What is the general pattern of air movement on March 21 at Earth's Equator (0°)?

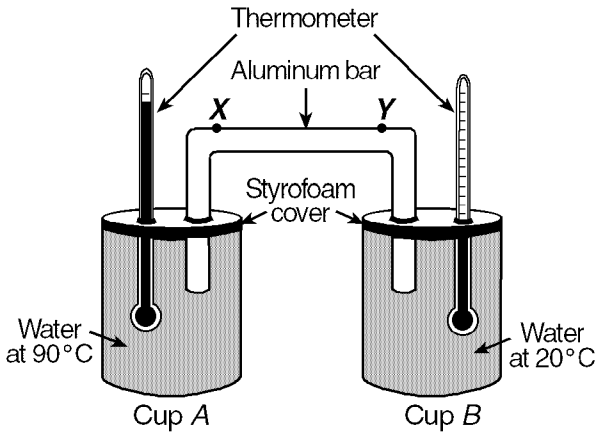
A) downward, due to low temperature and high pressure
B) upward, due to low temperature and high pressure
C) upward, due to high temperature and low pressure
D) downward, due to high temperature and low pressure

605) How do Jupiter's density and period of rotation compare to Earth's?

A) Jupiter is less dense and has a longer period of rotation.
B) Jupiter is more dense and has a shorter period of rotation.
C) Jupiter is more dense and has a longer period of rotation.
D) Jupiter is less dense and has a shorter period of rotation.

Questions 606 and 607 refer to the following:

Hot water at 90°C is poured into cup *A*. Cool water at 20°C is poured into cup *B*. Styrofoam covers are placed on the cups. An aluminum bar and a thermometer are placed through holes in each cover. Points *X* and *Y* are locations on the aluminum bar. The data table shows temperature readings taken every minute for 20 minutes.



	Temperature of Water (°C)			Temperature of Water (°C)	
Minute	Cup *A*	Cup *B*	Minute	Cup *A*	Cup *B*
0	90	20	11	76	23
1	88	20	12	75	23
2	86	20	13	74	23
3	85	21	14	73	23
4	83	21	15	72	24
5	82	22	16	71	24
6	81	22	17	70	24
7	80	22	18	69	24
8	79	22	19	68	25
9	78	23	20	67	25
10	77	23			

606) Which change in the experiment would increase the heating rate of the water in cup *B*?

A) keeping cup *B* covered, but uncovering cup *A*
B) making the aluminum bar longer between points *X* and *Y*
C) keeping cup *A* covered, but uncovering cup *B*
D) making the aluminum bar shorter between points *X* and *Y*

607) What was the approximate rate of temperature change for the water in cup *A* for the first 10 minutes?

A) 13.0 C°/min
B) 0.77 C°/min
C) 1.3 C°/min
D) 7.7 C°/min

608) A high air-pressure, dry-climate belt is located at which Earth latitude?

A) 60°N
B) 30°N
C) 15°N
D) 0°

609) A student uses a sling psychrometer outdoors on a clear day. The dry-bulb (air) temperature is 10°C. The water on the wet bulb will most likely

A) evaporate, causing the wet-bulb temperature to be equal to the air temperature
B) condense, causing the wet-bulb temperature to be equal to the air temperature
C) evaporate, causing the wet-bulb temperature to be lower than the air temperature
D) condense, causing the wet-bulb temperature to be higher than the air temperature

610) A major belt of asteroids is located between Mars and Jupiter. What is the approximate average distance between the Sun and this major asteroid belt?

A) 850 million kilometers
B) 110 million kilometers
C) 390 million kilometers
D) 220 million kilometers

611) Most water vapor enters Earth's atmosphere by the processes of

A) condensation and precipitation
B) radiation and cementation
C) conduction and convection
D) evaporation and transpiration

612) The table below describes the characteristics of three landscape regions, *A*, *B*, and *C*, found in the United States.

Landscape	Bedrock	Elevation/Slopes	Streams
A	Faulted and folded gneiss and schist	High elevation Steep slopes	High velocity Rapids
B	Layers of sandstone and shale	Low elevation Gentle slopes	Low velocity Meanders
C	Thick horizontal layers of basalt	Medium elevation Steep to gentle slopes	High to low velocity Rapids and meanders

Which list *best* identifies landscapes *A*, *B*, and *C*?

A) *A* — mountain, *B* — plain, *C* — plateau
B) *A* — plain, *B* — plateau, *C* — mountain
C) *A* — plain, *B* — mountain, *C* — plateau
D) *A* — plateau, *B* — mountain, *C* — plain

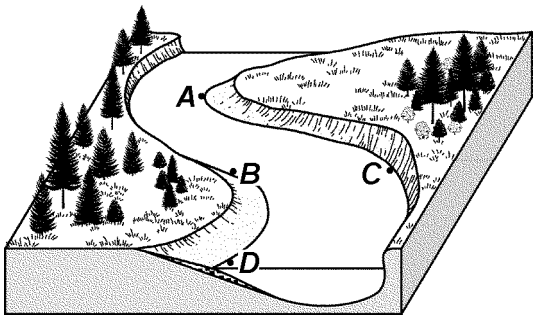
613) A person in New York State worked outdoors in sunlight for several hours on a day in July. Which type of clothing should the person have worn to absorb the *least* electromagnetic radiation?

A) dark colored with a smooth surface
B) dark colored with a rough surface
C) light colored with a smooth surface
D) light colored with a rough surface

614) The apparent rising and setting of the Sun, as viewed from Earth, is caused by

A) the Sun's revolution
B) Earth's rotation
C) Earth's revolution
D) the Sun's rotation

615) The diagram below shows points *A*, *B*, *C*, and *D* on a meandering stream.



At which point does the *greatest* stream erosion occur?

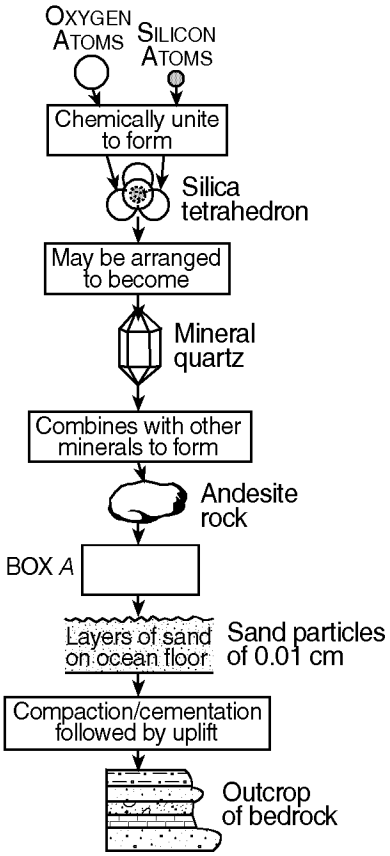
A) *A*
B) *B*
C) *C*
D) *D*

616) A very large, circular, impact crater under the coast of Mexico is believed to be approximately 65 million years old. This impact event is inferred to be related to the

A) formation of Pangea
B) advance and retreat of the last continental ice sheet
C) appearance of the earliest trilobites
D) extinction of the dinosaurs

Questions 617 through 619 refer to the following:

The flowchart below shows a sequence of geologic processes at or near Earth's surface. Box *A* has been deliberately left blank. [*The diagrams are not drawn to scale.*]

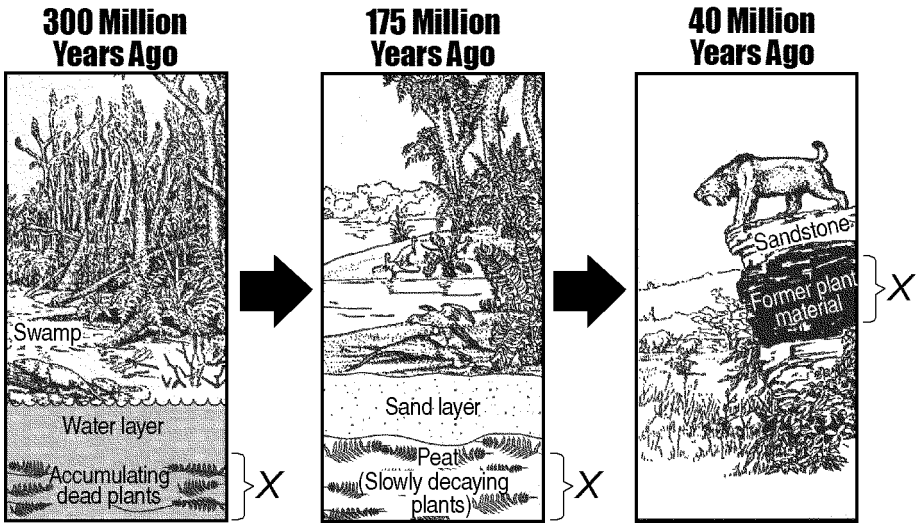


617) State *one* geologic process represented by box *A*.

618) Identify the *three* minerals that are normally found with quartz in samples of andesite rock.

619) Identify by name *one* type of rock layer, other than sandstone, shown in the outcrop.

620) The sequence of diagrams below represents the gradual geologic changes in layer *X*, located just below Earth's surface.



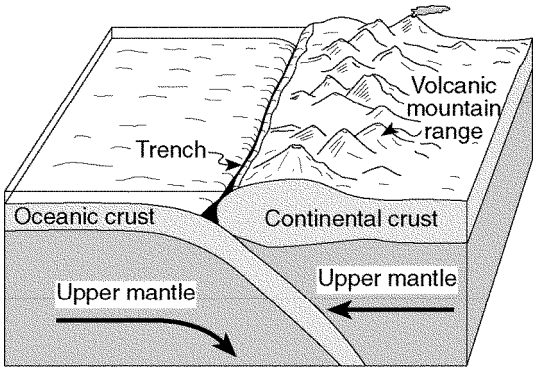
Which type of sedimentary rock was formed at layer *X*?

A) rock salt
B) coal
C) shale
D) conglomerate

621) Which New York State river flows generally southward?

A) Niagara River
B) Hudson River
C) Genesee River
D) St. Lawrence River

622) The diagram below shows the interaction of two tectonic plates.

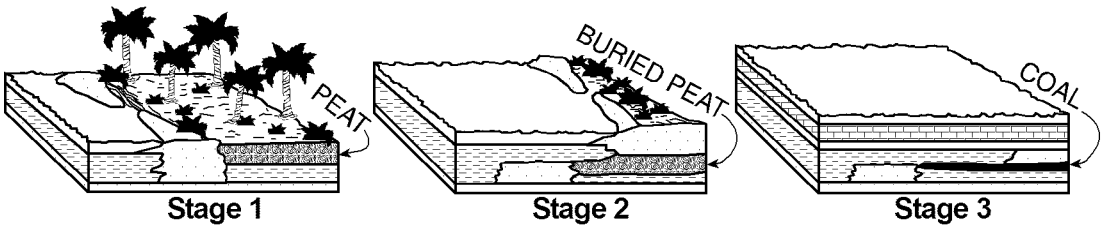


(Not drawn to scale)

The type of plate boundary represented in the diagram most likely exists between the

A) Antarctic Plate and the Indian-Australian Plate
B) Antarctic Plate and the African Plate
C) South American Plate and the Nazca Plate
D) South American Plate and the African Plate

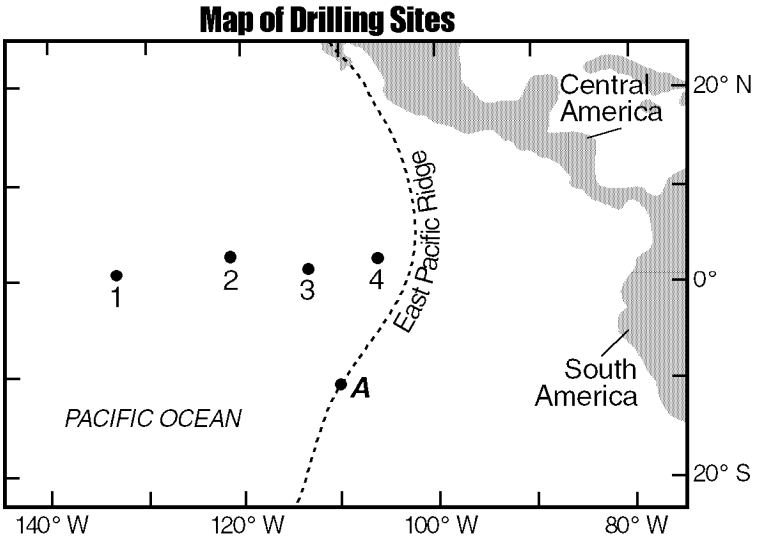
623) The sequence of diagrams below shows how coal is formed.



Describe the material and *two* processes involved in the formation of coal.

Questions 624 through 626 refer to the following:

The map below shows the locations of deep-sea core drilling sites numbered 1 through 4. The approximate location of the East Pacific Ridge is shown by a dashed line. Point *A* is located on the East Pacific Ridge.



624) At point *A*, the East Pacific Ridge is the boundary between the
- A) Pacific Plate and the South American Plate
- B) South American Plate and the Nazca Plate
- C) Pacific Plate and the Nazca Plate
- D) Cocos Plate and the North American Plate

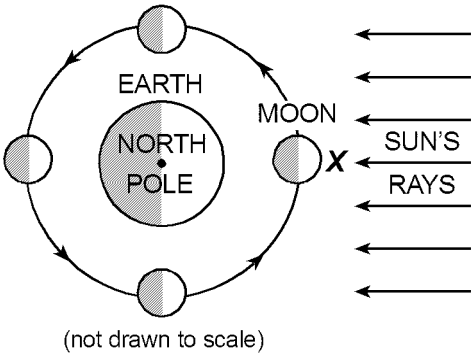
625) Compared to the thickness and density of the continental crust of South America, the oceanic crust of the Pacific floor is
- A) thicker and less dense
- B) thinner and less dense
- C) thinner and more dense
- D) thicker and more dense

626) At which drilling site would the *oldest* igneous bedrock most likely be found?
- A) 1
- B) 2
- C) 3
- D) 4

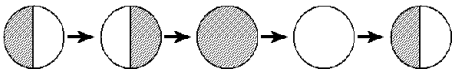
627) On a clear summer day, the surface of land is usually warmer than the surface of a nearby body of water because the water

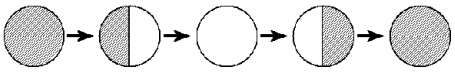
A) has a higher specific heat
B) reflects less insolation
C) has a higher density
D) receives less insolation

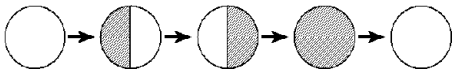
628) The diagram below shows the Moon at four positions in its orbit around Earth as viewed from above the North Pole.

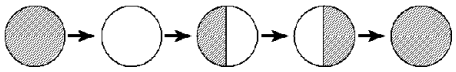


Beginning with the Moon at position *X* (the new-Moon phase), which sequence of Moon phases would be seen by an observer on Earth during 1 month?

A) 

B) 

C) 

D) 

629) The data in the chart below records the apparent diameter of the Sun to an observer in New York State during one year.

Apparent Diameter of the Sun During the Year

Date	Apparent Diameter (' = minutes, " = seconds)
January 1	32'32"
February 10	32'25"
March 20	32'07"
April 20	31'50"
May 30	31'33"
June 30	31'28"
August 10	31'34"
September 20	31'51"
November 10	32'18"
December 30	32'32"

Explain why the apparent diameter of the Sun appears to change throughout the year as Earth revolves around the Sun.

630) The table below shows the duration of insolation (hours of daylight) measured by four observers, *W*, *X*, *Y*, and *Z*, at four different Earth latitudes on both March 21 and June 21. There were clear skies at all four latitudes on both days.

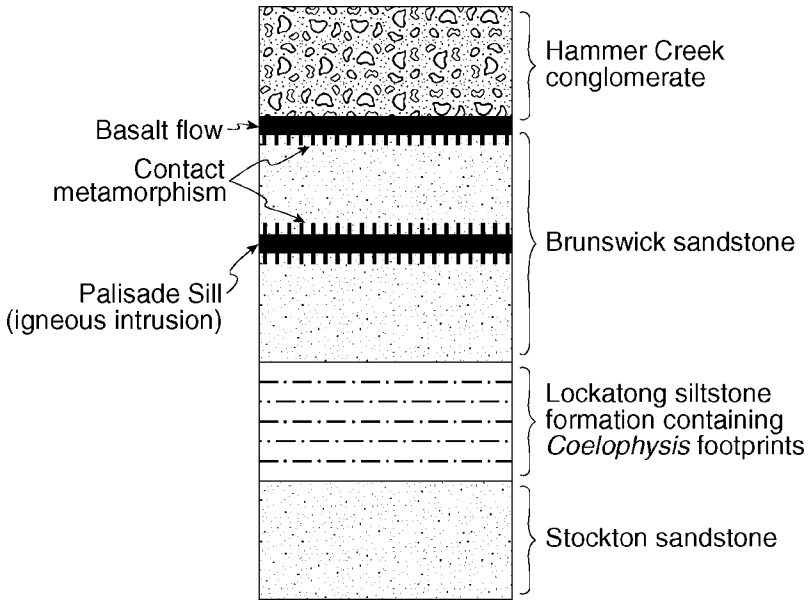
Observer	Duration of Insolation March 21	Duration of Insolation June 21
W	12 hr	0 hr
X	12 hr	12 hr
Y	12 hr	18 hr
Z	12 hr	24 hr

Which observer was located at the Equator?

A) *W* B) *X* C) *Y* D) *Z*

Questions 631 through 633 refer to the following:

The cross section below shows several rock formation found in New York State. The rock layers have not been overturned.

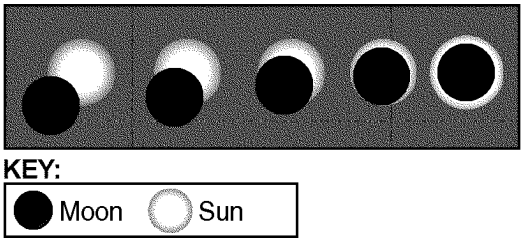


631) How does the given cross section indicate that the Stockton sandstone is the *oldest* rock layer?

632) State *one* piece of evidence from the diagram that supports the fact that the Palisade Sill is younger than the Brunswick sandstone.

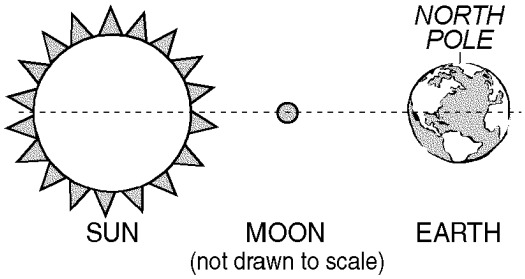
633) State *one* tectonic event affecting North America that occurred at the same time as the Palisade Sill intrusion shown.

634) What is represented by the diagram below?



A) stages in an eclipse of the Moon
B) changing phases of the Moon
C) stages in an eclipse of the Sun
D) changing phases of the Sun

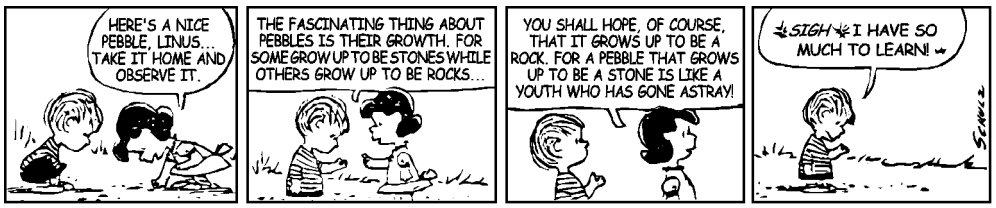
635)



The diagram above shows the Sun, the Moon, and Earth in line with one another in space. On the diagram, draw two dots (•) on the surface of Earth to indicate the locations where the *highest* ocean tides are most likely occurring.

636) New York State's Adirondacks are classified as a mountain landscape region. Describe *one* bedrock characteristic and *one* land surface characteristic that were used to classify the Adirondacks as a mountain landscape region.

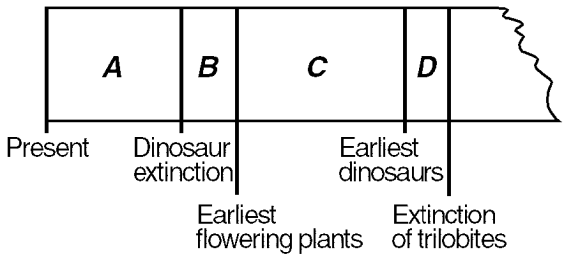
637) In the cartoon below, Lucy gives Linus incorrect information about pebbles.



If Lucy wanted to give Linus correct information about pebbles, which statement would be *most* accurate?

A) Magma is composed of pebbles.
B) Pebble is the name given to the smallest-size sediment.
C) Any large rock that weathers could become a pebble.
D) Pebbles can become cemented together to form a rock called gabbro.

638) The diagram below is a portion of a geologic time line. Letters *A* through *D* represent the time intervals between the labeled events, as estimated by some scientists.



Fossil evidence indicates that the *earliest* birds developed during which time interval?

A) *A* B) *B* C) *C* D) *D*

Questions 639 through 641 refer to the following:

On the Hurricane Tracking Map below, Table *I* below represents the storm track data for an Atlantic hurricane. Location, wind velocity, air pressure, and storm strength are shown for the storm's center at 3 p.m. Greenwich time each day. Table *II* shows a scale of relative storm strength. The map shows the hurricane's path.

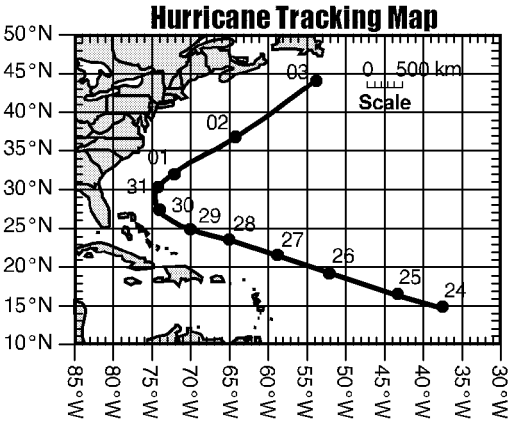
Data Table I

Latitude (°N)	Longitude (°W)	Date	Wind Velocity (knots)	Air Pressure (millibars)	Storm Strength
14	37	Aug. 24	30	1,006	Tropical depression
16	44	Aug. 25	70	987	Category-1 hurricane
19	52	Aug. 26	90	970	Category-2 hurricane
21	59	Aug. 27	80	997	Category-1 hurricane
23	65	Aug. 28	80	988	Category-1 hurricane
25	70	Aug. 29	80	988	Category-1 hurricane
27	73	Aug. 30	65	988	Category-1 hurricane
30	74	Aug. 31	85	976	Category-2 hurricane
32	72	Sept. 01	85	968	Category-2 hurricane
37	64	Sept. 02	70	975	Category-1 hurricane
44	53	Sept. 03	65	955	Category-1 hurricane

Data Table II

Storm Strength Scale	Relative Strength
Tropical depression	WEAKEST
Tropical storm	↓
Category 1	
Category 2	
Category 3	
Category 4	
Category 5	STRONGEST

Hurricane Tracking Map



639) In the table below, calculate the average daily rate of movement of the hurricane during the period from 3 p.m. August 24 to 3 p.m. August 28. The hurricane traveled 2,600 kilometers during this 4-day period. [*Follow the directions given below.*]

a	rate of change =
b	rate of change =
c	rate of change =

(a) Write the equation used to determine the rate of change.

(b) Substitute data into the equation.

(c) Calculate the rate and label it with the proper units.

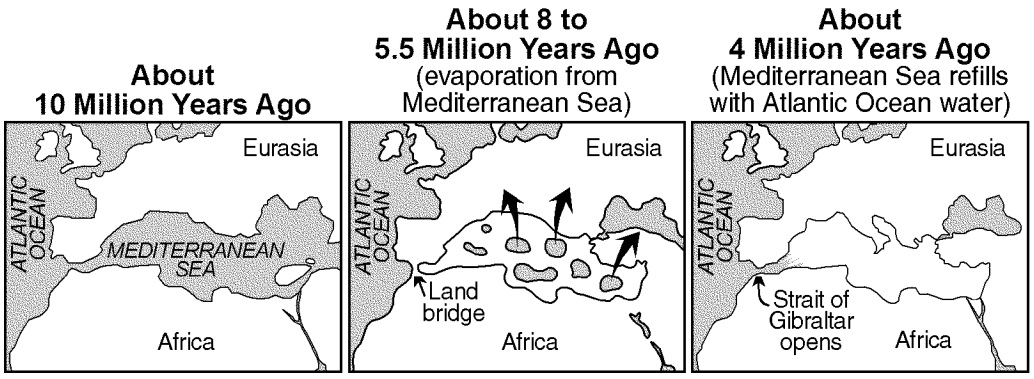
640) Describe *two* characteristics of the circulation pattern of the surface winds around the center (eye) of a Northern Hemisphere low-pressure hurricane.

641) The hurricane did *not* continue moving toward the same compass direction during the entire period shown by the data table. Explain why the hurricane changed direction.

642) Describe a specific characteristic of insolation received in the tropical climate belt region at 0° latitude that causes the average monthly temperature to remain warm all year.

Questions 643 and 644 refer to the following:

The maps below show changes in the distribution of land and water in the Mediterranean Sea region that scientists believe took place over a period of 6 million years.



643) Which type of rock was precipitated from seawater as the Mediterranean Sea evaporated between 8 million years ago and 5.5 million years ago?

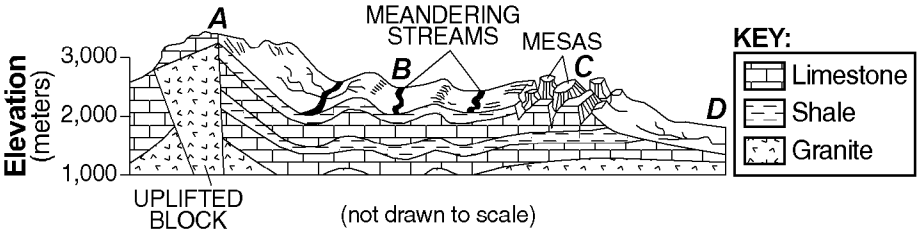
A) rock salt
B) sandstone
C) metaconglomerate
D) basalt

644) During which geologic time period did the changes shown in the maps take place?

A) Permian
B) Cretaceous
C) Cambrian
D) Neogene

Questions 645 through 647 refer to the following:

The geologic cross section below represents the bedrock structure beneath four landscape regions, *A*, *B*, *C*, and *D*.



The table below shows characteristics of the four landscape regions *A*, *B*, *C*, and *D*.

Landscape Region	Relief	Bedrock
A	great relief, high peaks, deep valleys	faulted and tilted structure; many bedrock types, including igneous
B	moderate relief, rounded peaks, wide valleys	folded sedimentary bedrock
C	moderate to high relief	horizontal sedimentary bedrock layers
D	very little relief, low elevations	horizontal sedimentary bedrock layers

645) The meandering streams shown in landscape region *B* usually form where there are

A) gentle gradients
B) many fractures in the bedrock
C) numerous escarpments
D) volcanic cones

646) Which terms *best* describe the surface landscapes of *A*, *B*, *C*, and *D* in the given diagram?

A) *A* — plain, *B* — mountains, *C* — ridges and valleys, *D* — plateau
B) *A* — plateau, *B* — plain, *C* — mountains, *D* — ridges and valleys
C) *A* — ridges and valleys, *B* — plateau, *C* — plain, *D* — mountains
D) *A* — mountains, *B* — ridges and valleys, *C* — plateau, *D* — plain

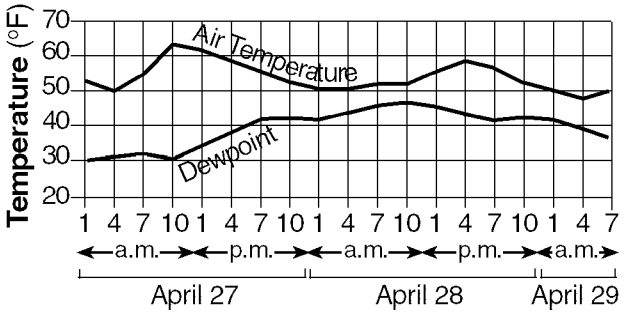
647) The sharp, angular flat-topped hills (mesas) in landscape region *C* in the given diagram were most likely produced by a climate that was

A) polar
B) humid
C) tropical
D) dry

648) In which New York State landscape region is Niagara Falls located?

A) St. Lawrence Lowlands
B) Tug Hill Plateau
C) Erie-Ontario Lowlands
D) Allegheny Plateau

649) The graph below is a computer-generated forecast of air temperature and dewpoint for a city during a period of $2\frac{1}{4}$ days.



At what time during this period is the rate of evaporation expected to be *highest*?

A) April 29 at 4 a.m.
B) April 28 at 4 p.m.
C) April 28 at 10 a.m.
D) April 27 at 10 a.m.

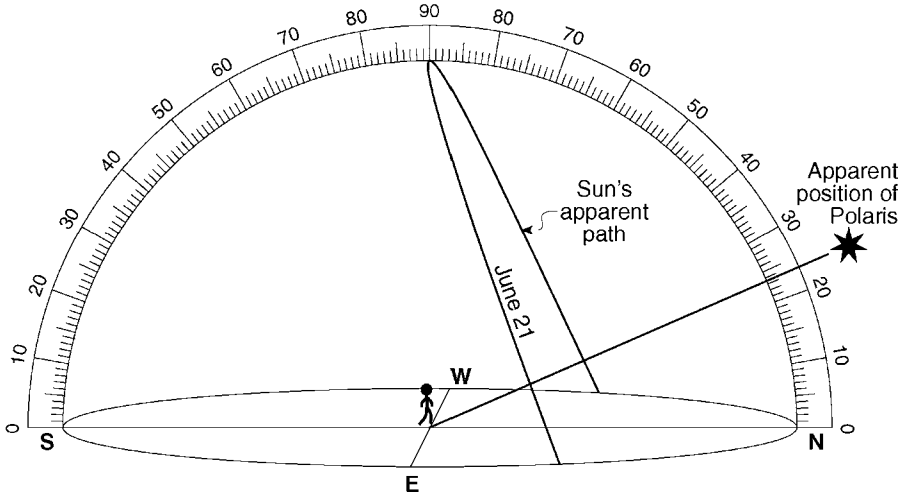
650) An air temperature of 95 °C most often exists in which layer of the atmosphere?

A) mesosphere
B) stratosphere
C) thermosphere
D) troposphere

Questions 651 through 654 refer to the following:

The diagram below shows observations made by a sailor who left his ship and landed on a small deserted island on June 21. The diagram represents the apparent path of the Sun and the position of *Polaris*, as observed by the sailor on this island.

Sailor's Observations on the Deserted Island



651) Based on the sailor's observations, what is the latitude of this island? [*Include the units and the compass direction in your answer*.]

652) The sailor was still on the island on September 23. On the diagram provided, draw the Sun's apparent path for September 23, as it would have appeared to the sailor. [*Be sure your September 23 path indicates the correct altitude of the noon Sun and begins and ends at the correct points on the horizon*.]

653) In the situation described, the sailor observed a 1-hour difference between solar noon on the island and solar noon at his last measured longitude onboard his ship. How many degrees of longitude is the island from the sailor's last measured longitude onboard his ship?

654) On the diagram provided, draw an arrow on the June 21 path of the Sun to show the Sun's direction of apparent movement from sunrise to sunset.

655) Earth's orbital velocity is *slowest* on July 5 because

A) the highest maximum temperatures occur in the Northern Hemisphere
B) the Moon is closest to Earth
C) Earth, the Moon, and the Sun are located along a straight line in space
D) Earth's distance from the Sun is greatest

656) The four particles shown in the table below are of equal volume and are dropped into a column filled with water.

Particle	Shape	Density
A	flat	2.5 g/cm^3
B	flat	3.0 g/cm^3
C	round	2.5 g/cm^3
D	round	3.0 g/cm^3

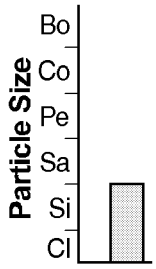
Which particle would usually settle most rapidly?

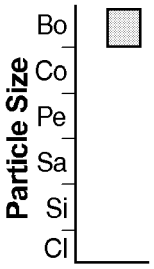
A) *A* B) *B* C) *C* D) *D*

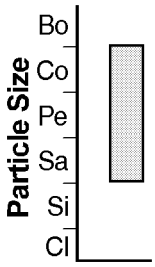
657) Which graph *best* represents the range of particle sizes that can be carried by a glacier?

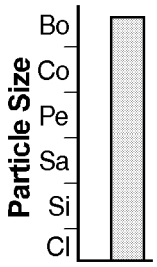
KEY:

Cl = clay	Sa = sand	Co = cobbles
Si = silt	Pe = pebbles	Bo = boulders

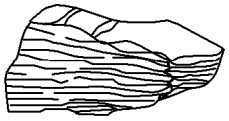
A) 

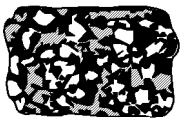
B) 

C) 

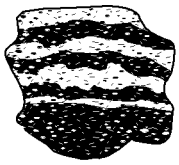
D) 

658) The diagrams below represent four rock samples. Which rock was formed by rapid cooling in a volcanic lava flow? [*The diagrams are not drawn to scale.*]

A) 
Easily split layers of 0.0001-cm-diameter particles cemented together

B) 
Interlocking 0.5-cm-diameter crystals of various colors

C) 
Glassy black rock that breaks with a shell-shape fracture

D) 
Bands of alternating light and dark minerals

659) Which two kinds of adjoining bedrock would most likely have a zone of contact metamorphism between them?

A) limestone and sandstone
B) limestone and granite
C) shale and sandstone
D) shale and conglomerate

660) The table below shows the duration of insolation at different latitudes for three different days during the year.

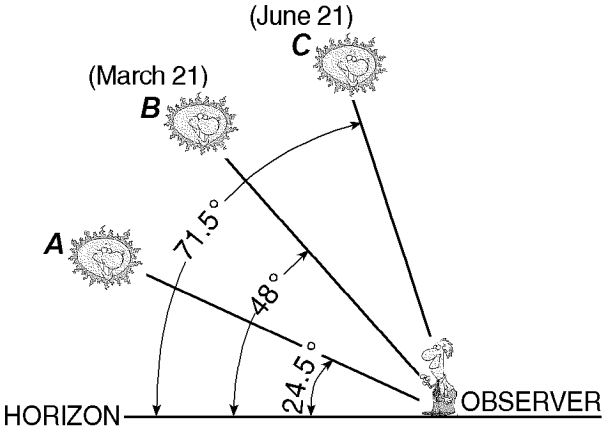
Latitude	Day 1 Duration of Insolation (hours)	Day 2 Duration of Insolation (hours)	Day 3 Duration of Insolation (hours)
90°N	24	12	0
80°N	24	12	0
70°N	24	12	0
60°N	18½	12	5½
50°N	16¼	12	7¾
40°N	15	12	9
30°N	14	12	10
20°N	13¼	12	10¾
10°N	12½	12	11½
0°	12	12	12

Which dates are represented most correctly by Day 1, Day 2, and Day 3, respectively?

A) June 21, September 22, December 21
B) December 21, March 21, June 21
C) September 22, December 21, March 21
D) March 21, September 22, December 21

Questions 661 through 663 refer to the following:

The diagram below shows the altitude of the Sun at solar noon on certain dates. The positions of the Sun, labeled *A*, *B*, and *C*, were measured by an observer at 42° north latitude. The date when the Sun was observed at position *A* has been deliberately left blank.



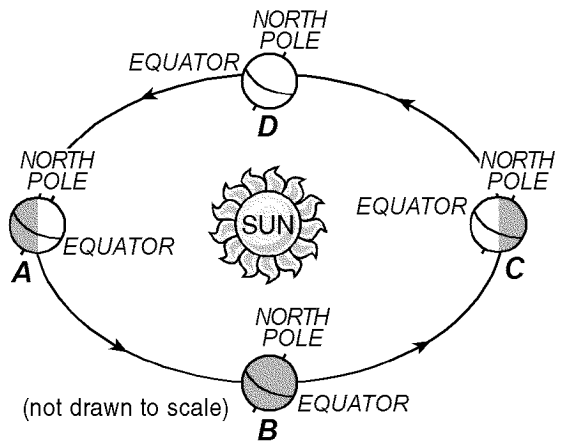
661) Position *B* in the given diagram represents the Sun's position at solar noon on March 21. On what other date of the year would the noontime Sun be observed at position *B*?

662) Which season begins in New York State when the noontime Sun is observed at position *A* in the given diagram?

663) What is the total change in altitude that occurs as the noontime Sun appears to move from position *A* to position *C* in the given diagram?

664) An Earth science class is preparing a booklet on emergency preparedness. State *one* safety measure that should be taken to minimize danger from each of the following threats:
(1) thunderstorm
(2) tornado
(3) volcanic eruption

665) The diagram below represents Earth at four different positions, *A*, *B*, *C*, and *D*, in its orbit around the Sun.



Between which positions would New York State be experiencing the summer season?

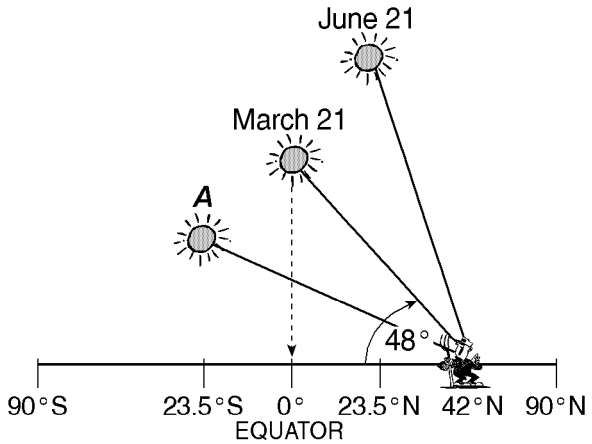
A) *C* and *D*
B) *B* and *C*
C) *A* and *B*
D) *A* and *D*

666) How long would it take for the first *S*-wave to arrive at a seismic station 4,000 kilometers away from the epicenter of an earthquake?

A) 13 min 20 sec
B) 7 min 0 sec
C) 5 min 40 sec
D) 12 min 40 sec

Questions 667 through 669 refer to the following:

The diagram below represents the position of the Sun with respect to Earth's surface at solar noon on certain dates. The latitudes of six locations on the same line of longitude are shown. The observer is located at 42° N in New York State. The date for the Sun at position *A* has been deliberately left blank.



667) At which New York State location could the observer be located?

A) New York City
B) Slide Mountain
C) Plattsburgh
D) Mount Marcy

668) When the Sun is at the March 21 position, New York State will usually have

A) longer days than nights
B) 12 hours of daylight and 12 hours of darkness
C) the highest annual altitude of the Sun at solar noon
D) the lowest annual altitude of the Sun at solar noon

669) When the Sun is at position *A*, which latitude receives the *most* direct rays of the Sun?

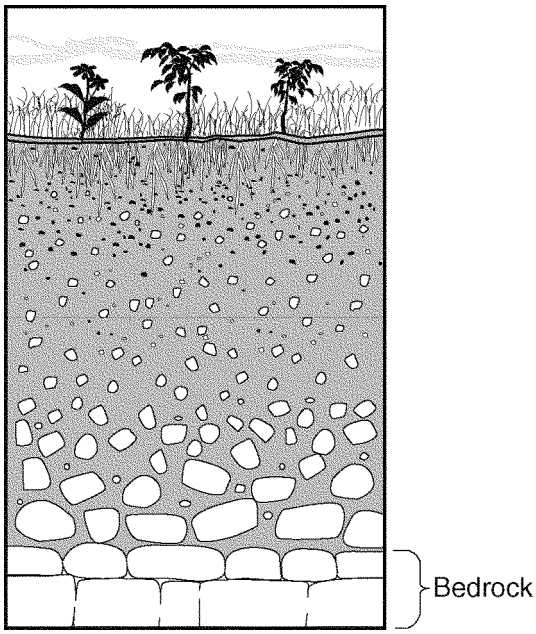
A) Equator (0°)
B) Antarctic Circle (66.5° S)
C) Tropic of Cancer (23.5° N)
D) Tropic of Capricorn (23.5° S)

670) It is inferred that during the early Archean Era, the atmosphere of Earth contained water vapor, carbon dioxide, nitrogen, and other gases in small amounts. These gases probably came from

A) precipitation of groundwater
B) volcanic eruptions
C) convection currents in the mantle
D) evaporation of Paleozoic oceans

671) State *one* greenhouse gas that is an excellent absorber of infrared radiation and may be responsible for global warming.

672) The cross section below shows a soil profile.



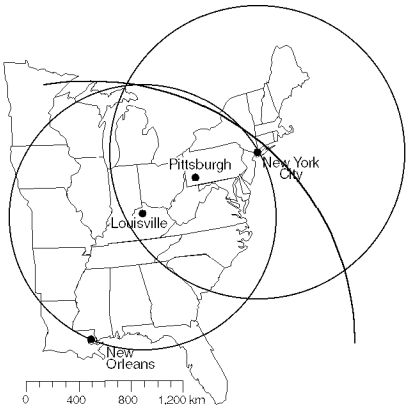
This soil was formed primarily by

A) weathering and biological activity
B) erosion by glaciers
C) erosion by running water
D) capillarity and human activity

Questions 673 and 674 refer to the following:

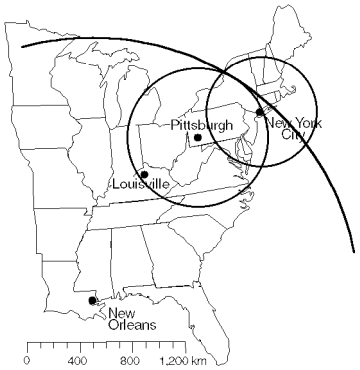
Seismic stations are located at the four cities shown on the map below. Letter *X* represents the epicenter of an earthquake determined from seismic waves recorded at all four cities.

673) Which map correctly shows how the location of the epicenter was determined?

A)


C)


B)


D)


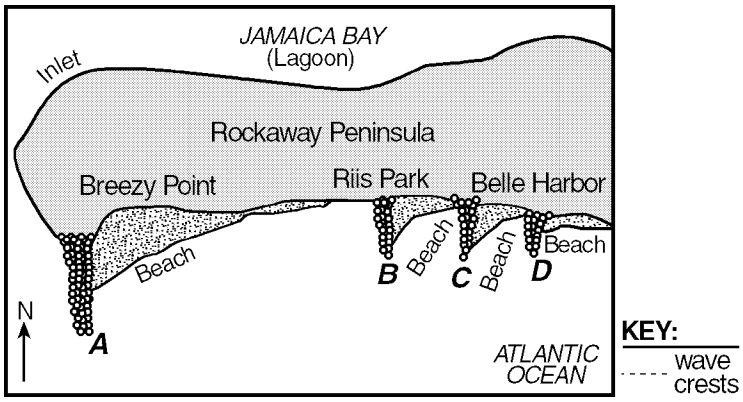
674) At which city is there a difference of approximately 3 minutes and 20 seconds between the arrival times of the *P*-waves and the *S*-waves?

A) Louisville
B) New Orleans
C) Pittsburgh
D) New York City

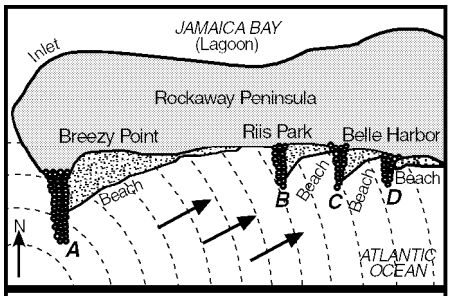
675) Most of Earth's surface ocean current patterns are primarily caused by

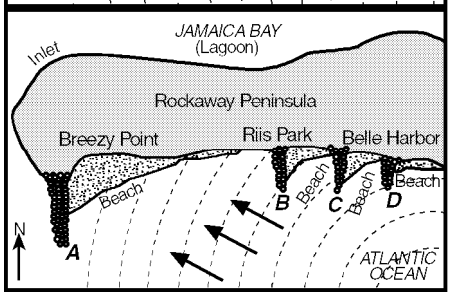
A) river currents
B) the force of gravity
C) the impact of precipitation
D) prevailing winds

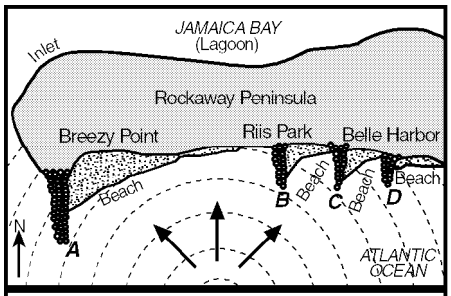
676) The map below shows Rockaway Peninsula, part of Long Island's south shore, and the location of several stone barriers, *A*, *B*, *C*, and *D*, that were built to trap sand being transported along the coast by wave action.

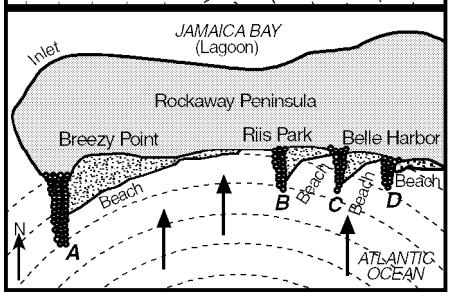


On which one of the following maps do the arrows *best* show the direction of wave movement that created the beaches in this area?

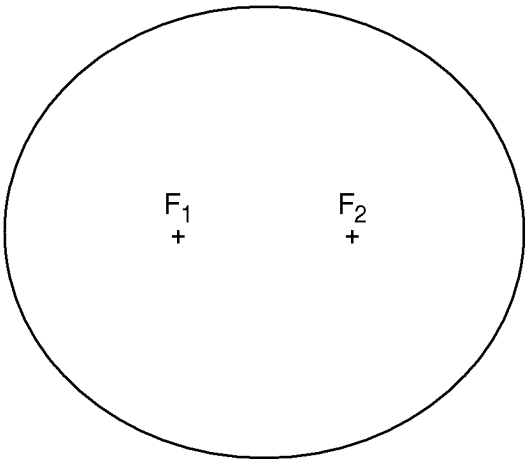
A)


B)


C)


D)


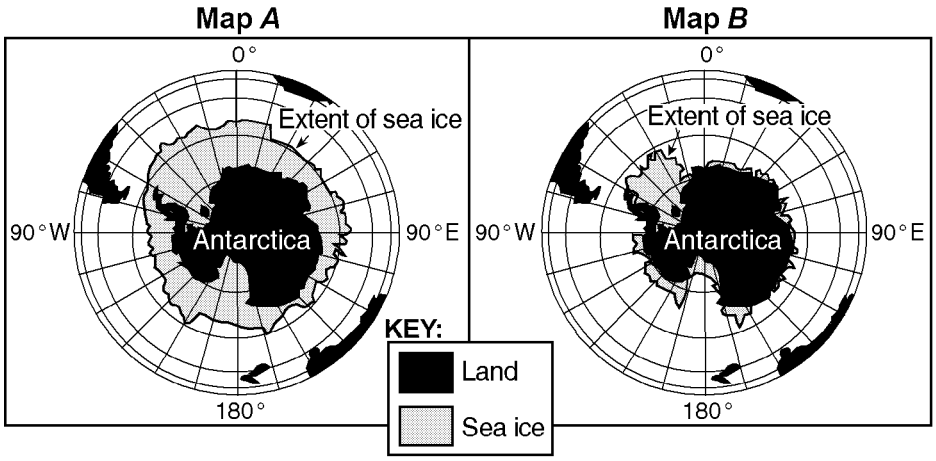
Questions 677 and 678 refer to the following:



677) State how the eccentricity of the given ellipse compares to the eccentricity of the orbit of Mars.

678) Calculate the eccentricity of the ellipse to the *nearest* thousandth.

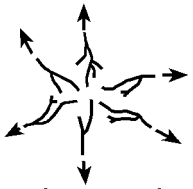
679) The maps below show the amount of sea ice surrounding the continent of Antarctica at two different times of the year. Map *A* represents late August when the area covered by sea ice approaches its greatest extent. Map *B* represents the minimum extent of sea ice.

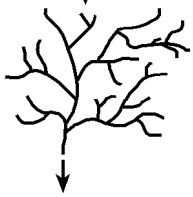


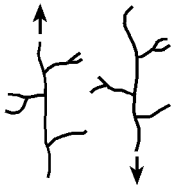
Which month is most probably represented by map *B*?

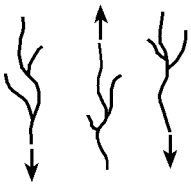
A) May B) June C) October D) February

680) Which stream-drainage pattern most likely developed on the surface of a newly formed volcanic mountain?

A) 

B) 

C) 

D) 

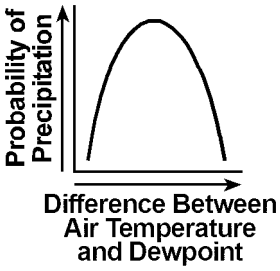
681) Near which location in New York State would a geologist have the *greatest* chance of finding dinosaur footprints in the surface bedrock?

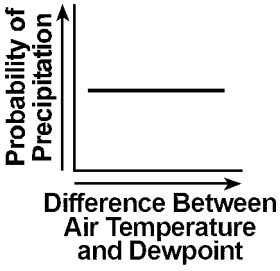
A) 42° 10′ N latitude, 74° 30′ W longitude
B) 43° 30′ N latitude, 76° W longitude
C) 41° 10′ N latitude, 74° W longitude
D) 44° 30′ N latitude, 75° 30′ W longitude

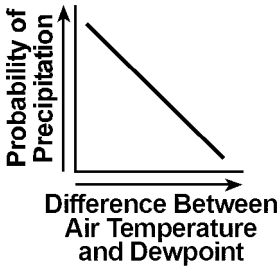
682) Compared to Earth's crust, Earth's core is believed to be

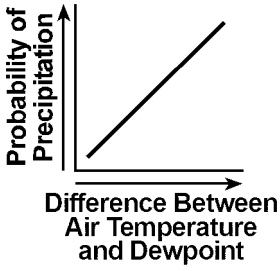
A) more dense, hotter, and composed of more iron
B) less dense, hotter, and composed of less iron
C) more dense, cooler, and composed of less iron
D) less dense, cooler, and composed of more iron

683) Which graph *best* shows the relationship between the probability of precipitation and the difference between air temperature and dewpoint?

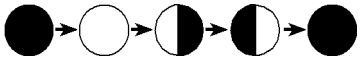
A) 

B) 

C) 

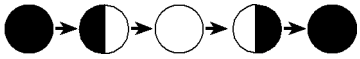
D) 

684) Which diagram sequence correctly shows the order of Moon phases, as viewed from Earth, for a period of 1 month? [*Note that some phases have been omitted.*]

A) 

B) 

C) 

D) 

685) An observer measured the air temperature and the dewpoint and found the difference between them to be 12°C. One hour later, the difference between the air temperature and the dewpoint was found to be 4°C. Which statement *best* describes the changes that were occurring?

A) The relative humidity was increasing and the chance of precipitation was increasing.
B) The relative humidity was increasing and the chance of precipitation was decreasing.
C) The relative humidity was decreasing and the chance of precipitation was decreasing.
D) The relative humidity was decreasing and the chance of precipitation was increasing.

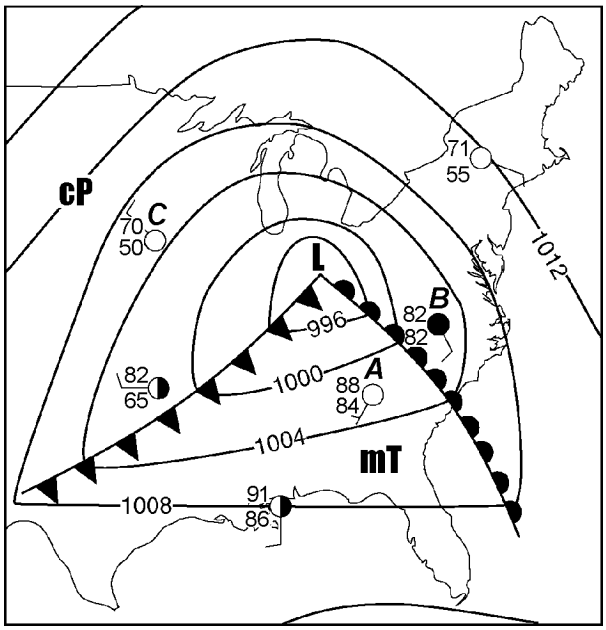
686) The satellite photograph below shows a geologic feature composed of silt, sand, and clay.

The geologic feature shown in the photograph was primarily deposited by which agent of erosion?

A) wind
B) running water
C) glaciers
D) wave action

Questions 687 through 690 refer to the following:

The weather map below shows a low-pressure system and some atmospheric conditions at weather stations *A*, *B*, and *C*.



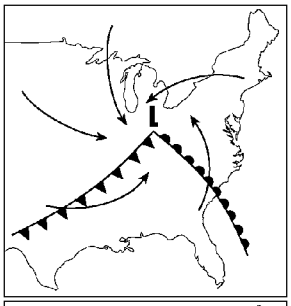
687) If the weather system shown follows a normal storm track, the low-pressure center (**L**) will generally move toward the

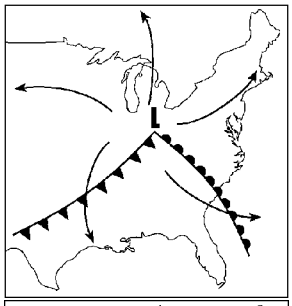
A) northeast B) southeast C) northwest D) southwest

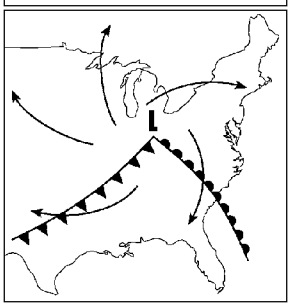
688) Which type of weather is usually associated with a **cP** air mass, as shown near weather station *C* on the map?

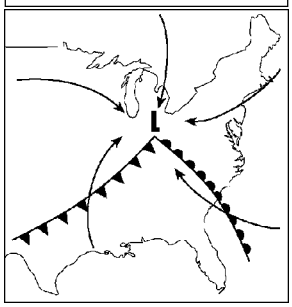
A) moist and cool
B) dry and warm
C) moist and warm
D) dry and cool

689) The arrows on which map *best* represent the direction of surface winds associated with the low-pressure system shown in the diagram?

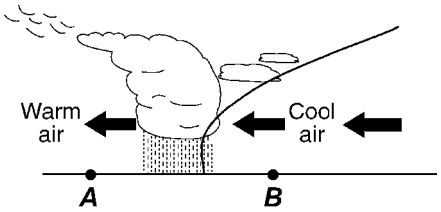
A)


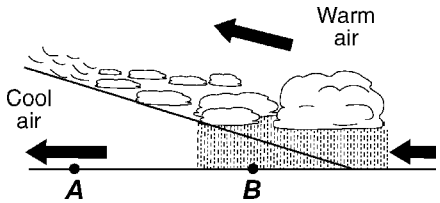
C)


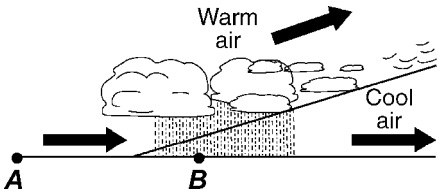
B)


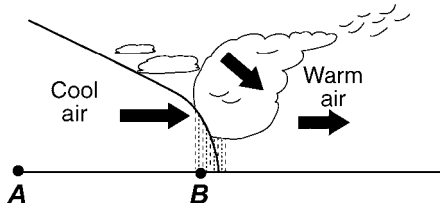
D)


690) Which cross section *best* represents the air masses, air movement, clouds, and precipitation occurring behind and ahead of the warm front located between stations *A* and *B* on the map?

A)


C)


B)


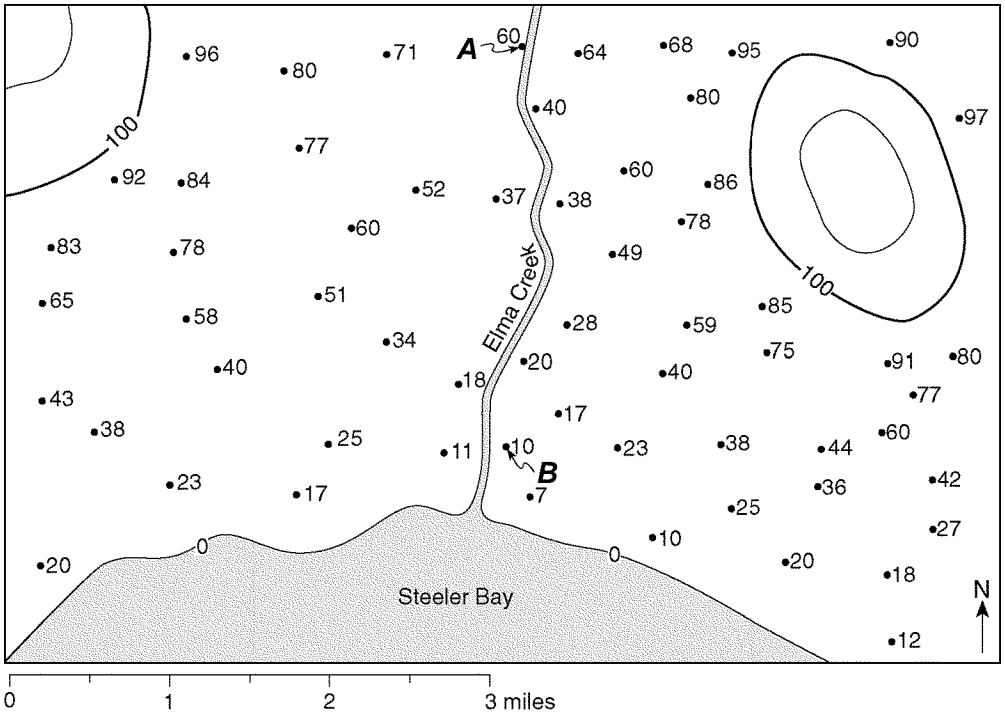
D)


691) According to the *Properties of Common Minerals* Earth Science reference table, which mineral leaves a green-black powder when rubbed against an unglazed porcelain plate?

A) graphite B) hematite C) pyrite D) galena

Questions 692 through 694 refer to the following:

The field map below shows elevations, measured in feet, of a number of points in a certain geographic region. Contour lines have been drawn for the 100-foot and 120-foot elevations. Points *A* and *B* represent two spot elevations on the map.



692) According to the map shown, toward which general compass direction does Elma Creek flow?

693) On the map provided, draw the 60-foot contour line. [*Make sure that the contour line extends to the edges of the map*.]

694) Calculate the gradient between points *A* and *B* in the map. [*Label the answer with the correct units*.]

695) Which type of rock most likely contains fossils?

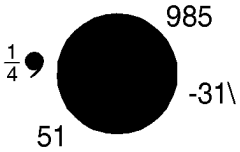
A) schist B) shale C) scoria D) gabbro

696) Liquid water can store more heat energy than an equal amount of any other naturally occurring substance because liquid water

A) has its greatest density at 4 ° C
B) can be changed into a solid or a gas
C) covers 71% of Earth's surface
D) has the higher specific heat

Questions 697 through 699 refer to the following:

The diagram below represents a weather station model.



697) What is the actual air pressure shown by the given weather station model?

698) On the given weather station model, draw the proper symbols to indicate a wind of 25 knots blowing from the southeast.

699) (a) What specific type of precipitation is occurring at the weather station in the given diagram?

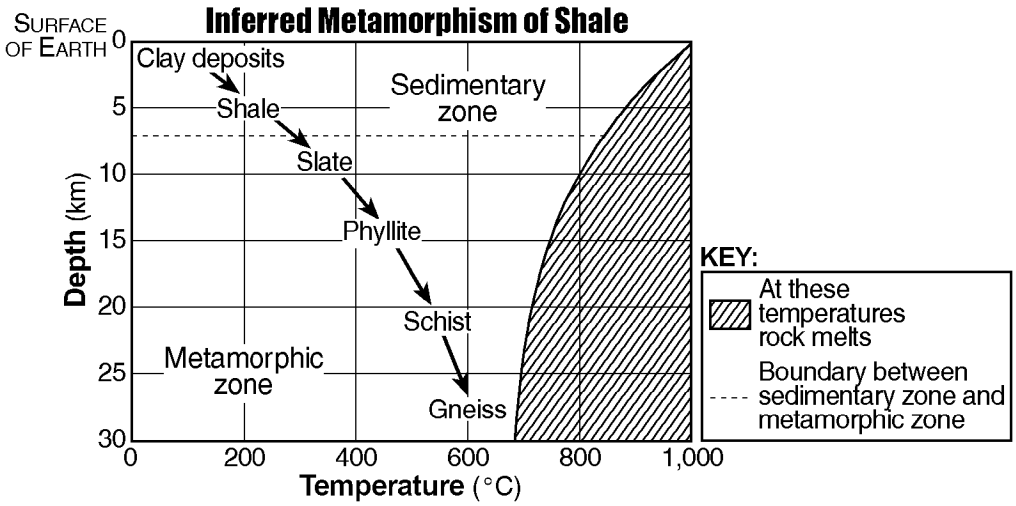
(b) State *one* additional weather condition shown by the station model. [*Explain how this weather condition provides evidence of high relative humidity.*]

700) A student incorrectly measured the volume of a mineral sample as 63 cubic centimeters. The actual volume was 72 cubic centimeters. What was the student's approximate percent deviation (percentage of error)?

A) 9.0% B) 12.5% C) 14.2% D) 15.3%

Questions 701 and 702 refer to the following:

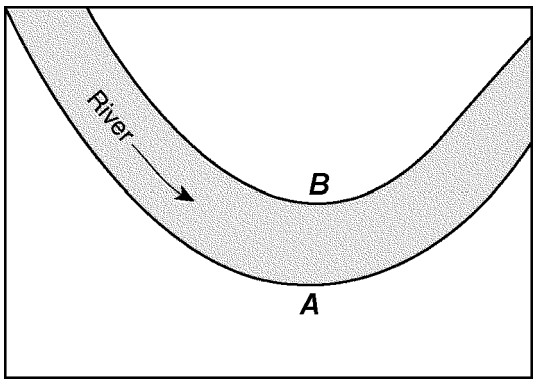
The graph below shows a generalized sequence of rock types that form from original clay deposits at certain depths and temperature conditions within Earth's interior.



701) According to the diagram, which type of metamorphic rock is normally formed when clay materials are buried to a depth of 14 kilometers?

702) Explain why gneiss would *not* form at a depth of 27 kilometers and at a temperature of 800 °C.

703) The map below shows the path of a river. The arrow shows the direction the river is flowing. Letters *A* and *B* identify the banks of the river.



The water depth is greater near bank *A* than bank *B* because the water velocity near bank *A* is

A) slower, causing erosion to occur
B) faster, causing deposition to occur
C) slower, causing deposition to occur
D) faster, causing erosion to occur

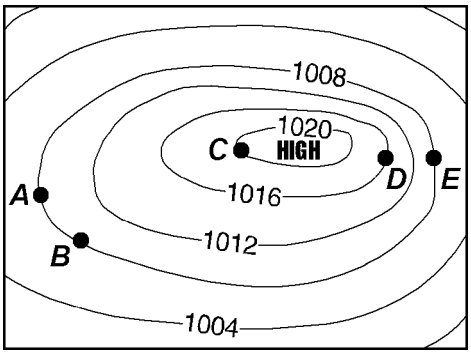
704) Fossilized footprints of *Coelophysis* dinosaurs have been found in bedrock *closest* to which New York State location?

A) Old Forge
B) Watertown
C) Niagara Falls
D) New York City

705) An environmental scientist needs to prepare a report on the potential effects that a proposed surface mine in New York State will have on the watershed where the mine will be located. In which reference materials will the scientist find the most useful data with which to determine the watershed's boundaries?

A) tectonic plate maps
B) geologic time scales
C) planetary wind maps
D) topographic maps

706) The air-pressure field map below represents a high-pressure system over the central United States. Isobars show the air pressure, in millibars. Letters *A* through *E* represent locations on Earth's surface.



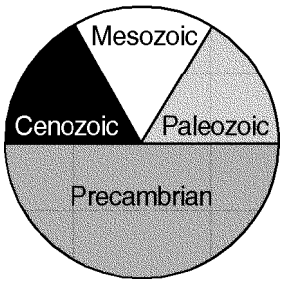
Between which two locations is the wind speed *greatest*?

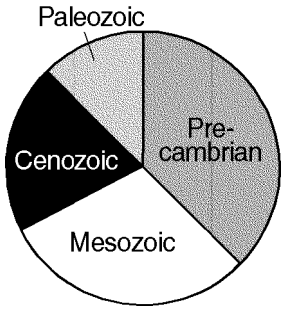
A) *D* and *E*
B) *A* and *B*
C) *C* and *D*
D) *B* and *C*

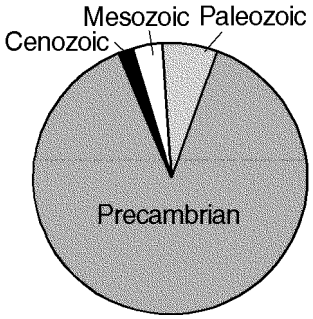
707) Which condition would cause surface runoff to increase in a particular location?

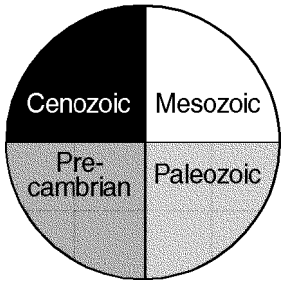
A) covering a dirt road with pavement
B) planting grasses and shrubs on a hillside
C) reducing the gradient of a steep hill
D) having a decrease in the annual rainfall

708) Which graph shows the relative duration of geologic time for the Precambrian, Paleozoic, Mesozoic, and Cenozoic time intervals?

A)


C)


B)


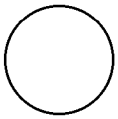
D)


709) The following weather data was collected at a location in the eastern United States.

DATA TABLE

Air temperature	65°F
Dewpoint	64°F
Visibility	2 miles
Present weather	drizzle
Wind direction	from the west
Wind speed	5 knots
Amount of cloud cover	100%
Barometric pressure	996.2 millibars

STATION MODEL



On the station model above, using the proper format, record:

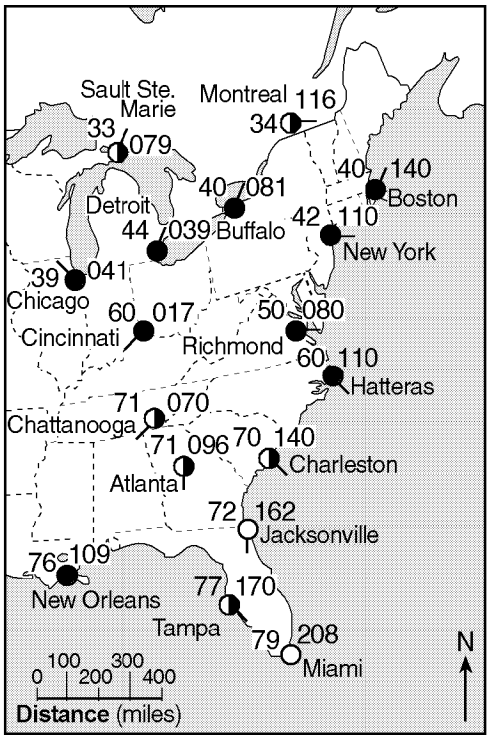
- the amount of cloud cover
- the barometric pressure
- the symbol for the present weather

710) Uranium-238 that crystallized at the same time Earth formed has undergone approximately how many half-lives of radioactive decay?

A) four half-lives
B) two half-lives
C) three half-lives
D) one half-life

Questions 711 through 714 refer to the following:

The weather map below shows partial weather-station data for several cities in eastern North America.



711) State the general relationship between air temperature and latitude for locations shown on the map.

712) On the weather given map, draw isotherms every 10 ° F, starting with 40 ° F and ending with 70 ° F. [*Isotherms must extend to the edges of the map.*]

713) Based on the given weather map, calculate the temperature gradient between Richmond, Virginia, and Hatteras, North Carolina, by following the directions below.

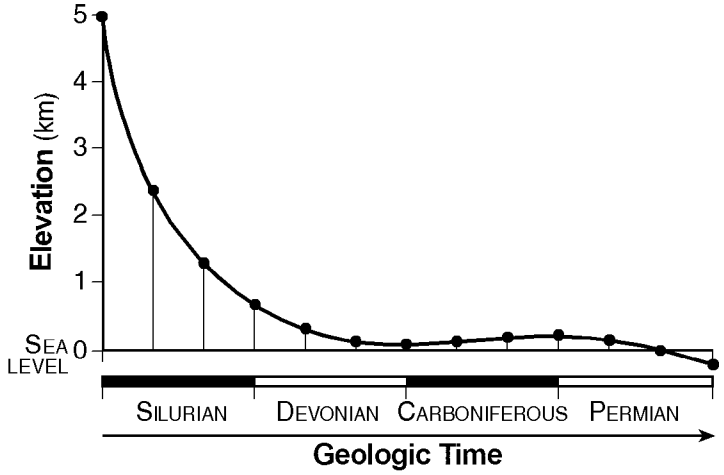
(a) Write the equation for gradient.

(b) Substitute data from the given map into the equation.

(c) Calculate the average gradient and label your answer with the correct units.

714) State the actual air pressure, in millibars, shown at Miami, Florida on the given weather map.

715) The graph below shows the average change in the elevation of a mountain range over time.



According to the graph, the rate of uplifting was greater than the rate of erosion during which geologic time period?

A) Carboniferous
B) Devonian
C) Silurian
D) Permian

716) Which activity demonstrates chemical weathering?

A) abrasion of a streambed by tumbling rocks
B) freezing of water in the cracks of a sandstone sidewalk
C) dissolving of limestone by acid rain
D) grinding of talc into a powder

717) The data below represent some of the weather conditions at a New York State location on a winter morning.

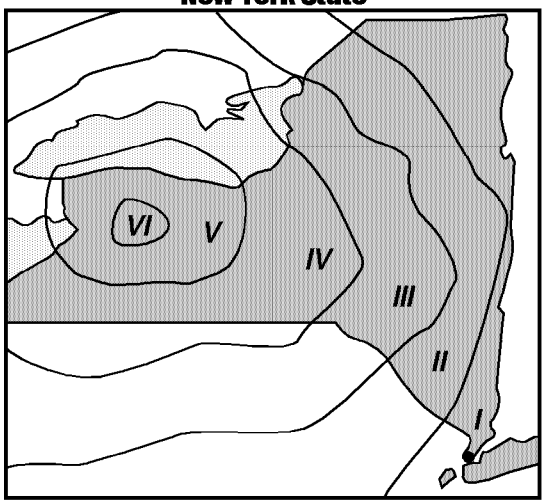
Air Temperature (dry-bulb temperature)	0°C
Relative Humidity	81%
Present Weather	snow

What was the dewpoint at this time?

A) 2°C
B) 1°C
C) -3°C
D) -5°C

718) The map below shows the intensity values (Earth-shaking effects observed by people) during an earthquake that occurred in New York State. The numbered areas on the map were determined from the *Modified Mercalli Scale* shown below. The scale is used to group locations according to the observed effects of an earthquake.

New York State



Modified Mercalli Scale

Intensity	Observed Effects
I	Usually only detected by intruments
II	Felt by a few persons at rest, especially on upper floors
III	Hanging objects swing; vibration like a passing truck; noticeable indoors
IV	Felt indoors by many, outdoors by few; a sensation like a heavy truck striking a building, parked automobiles rock
V	Felt by nearly all; sleepers awakened; liquids disturbed; unstable objects overturned, some dishes and windows broken
VI	Felt by all; many frightened and run outdoors; some heavy furniture moved; glassware broken; books fall off shelves; damage slight
VII	Difficult to stand; noticed in moving automobiles; damage to some masonry; weak chimneys broken at roofline
VIII	Partial collapse of masonry; chimneys, factory stacks, columns fall; heavy furniture overturned; frame houses moved on foundations

At which one of the following locations in New York State could everyone feel the vibrations caused by this earthquake?

A) 43° 30′ N 75° 30′ W
B) 43° 00′ N 78° 30′ W
C) 42° 45′ N 74° 00′ W
D) 4l° 00′ N 74° 00′ W

719) What is the age of the most abundant surface bedrock in the Finger Lakes region of New York State?

A) Permian
B) Pennsylvanian
C) Devonian
D) Cambrian

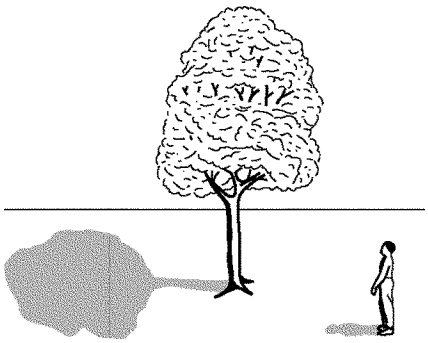
720) The apparent daily path of the Sun changes with the seasons because

A) the Sun revolves
B) Earth's axis is tilted
C) Earth's distance from the Sun changes
D) the Sun rotates

721) The coldest climates on Earth are located at or near the poles primarily because Earth's polar regions

A) absorb the greatest amount of insolation
B) are usually farthest from the Sun
C) receive less total yearly hours of daylight
D) receive mostly low-angle insolation

722) The diagram below shows the noontime shadows cast by a student and a tree.



If the time is solar noon and the student is located in New York State, in what direction is the student facing?

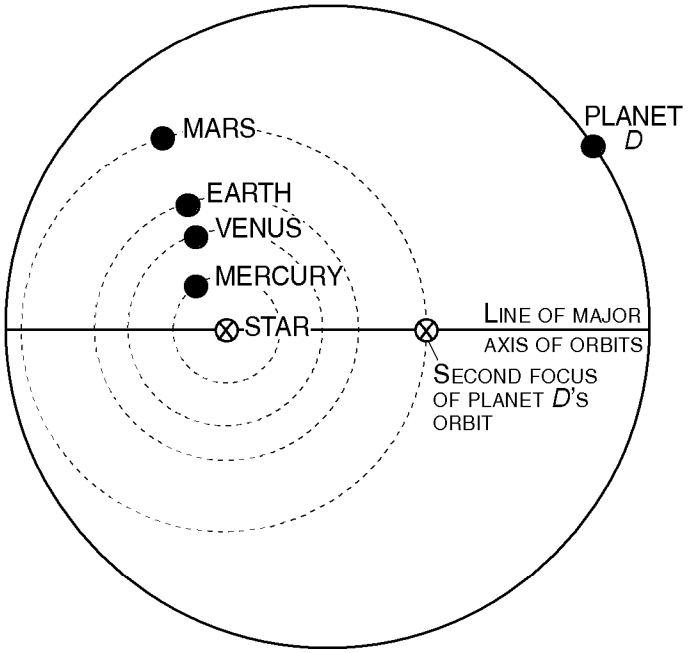
A) west B) east C) north D) south

723) Which rock is foliated, shows mineral alignment but *not* banding, and contains medium-sized grains of quartz and pyroxene?

A) phyllite B) gneiss C) quartzite D) schist

Questions 724 and 725 refer to the following:

The diagram below shows the orbit of planet *D* around the star *Upsilon Andromedae*. The dashed lines show where the paths of the first four planets of our solar system would be located if they were going around *Upsilon Andromedae* instead of the Sun. All distances are drawn to scale.



724) Based on the given diagram, describe the changes in gravitational force between planet *D* and the star *Upsilon Andromedae* during one complete orbit around the star. [*Be sure to describe where the force is greatest and where the force is least.*]

725) Describe the eccentricity of planet *D*'s orbit relative to the eccentricities of the orbits of the other planets in the solar system shown.

726) Which method of energy transfer is primarily responsible for energy being lost from Earth into space?

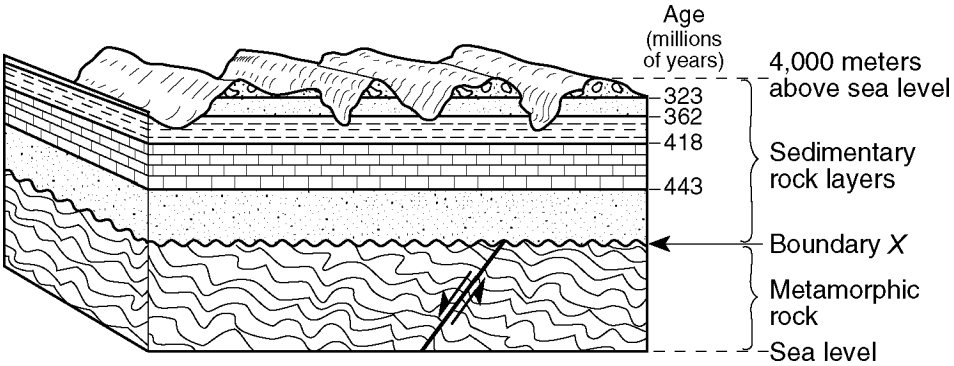
A) convection
B) solidification
C) conduction
D) radiation

727) The Coriolis effect provides evidence that Earth

A) rotates
B) has seasons
C) revolves
D) has a tilted axis

Questions 728 through 730 refer to the following:

The cross section below shows a portion of Earth's crust. The age, in millions of years, of each boundary between the different sedimentary rock layers is shown. The age of boundary *X* between the sedimentary rock and the metamorphic rock is not shown. Assume no overturning has occurred.



728) Identify by name *one* index fossil that existed when the limestone rock shown in the cross section was being formed.

729) Describe how the rock type below boundary *X* in the given cross section was formed.

730) Identify the geologic feature represented by boundary *X* in the cross section shown.

731) Scientists believe that Earth's early atmosphere changed in composition as a result of

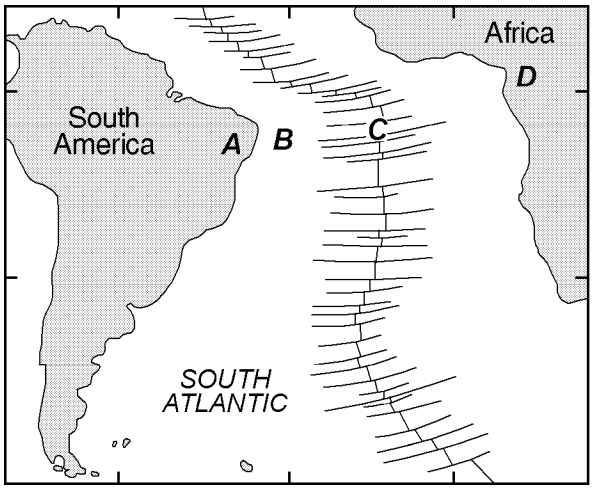
A) the appearance of oxygen-producing organisms
B) the drifting of the continents
C) the changes in Earth's magnetic field
D) a transfer of gases from the Sun

732) Which statement correctly compares the size, composition, and density of Neptune to Earth?

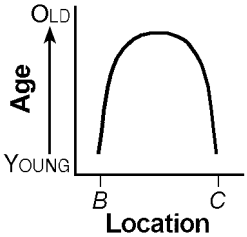
A) Neptune is smaller, more solid, and more dense.
B) Neptune is smaller, more gaseous, and less dense.
C) Neptune is larger, more solid, and more dense.
D) Neptune is larger, more gaseous, and less dense.

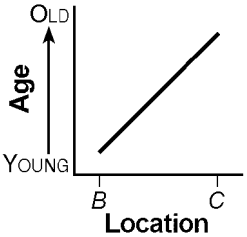
Questions 733 through 735 refer to the following:

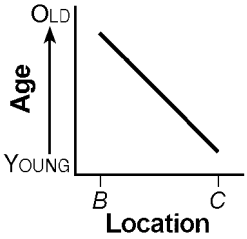
The map below shows the continents of Africa and South America, the ocean between them, and the ocean ridge and transform faults. Locations *A* and *D* are on the continents. Locations *B* and *C* are on the ocean floor.

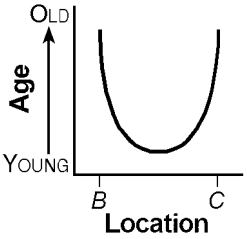


733) Which graph *best* shows the relative age of the ocean-floor bedrock from location *B* to location *C*?

A)


C)


B)


D)


734) The *hottest* crustal temperature measurements would most likely be found at which location?

A) *A* B) *B* C) *C* D) *D*

735) Which table *best* shows the relative densities of the crustal bedrock at locations *A*, *B*, *C*, and *D*?

A)

Relative Densities of Crust

More Dense	Less Dense
A, *D*	*B*, *C*

C)

Relative Densities of Crust

More Dense	Less Dense
B, *C*	*A*, *D*

B)

Relative Densities of Crust

More Dense	Less Dense
A, *B*	*C*, *D*

D)

Relative Densities of Crust

More Dense	Less Dense
C, *D*	*A*, *B*

Questions 736 through 738 refer to the following:

In the 1930s, most scientists believed that Earth's crust and interior were solid and motionless. A small group of scientists were talking about "continental drift," which is the idea that Earth's crust is not stationary, but is constantly shifting and moving.

From seismic data, geophysical evidence, and laboratory experiments, scientists now generally agree that lithospheric plates move at the surface. Both Earth's surface and interior are in motion. Solid rock in the mantle can be softened and shaped when subjected to the heat and pressure within Earth's interior over millions of years.

Subduction processes are believed by many scientists to be the driving force of plate tectonics. At present, this theory cannot be directly observed and confirmed. The lithospheric plates have moved in the past and are still moving today. The details of why and how they move will continue to challenge scientists.

736) In the reading passage, the Earth's crust is described as "constantly shifting and moving." Give *one* example of geologic evidence that supports the conclusion that continents have drifted apart.

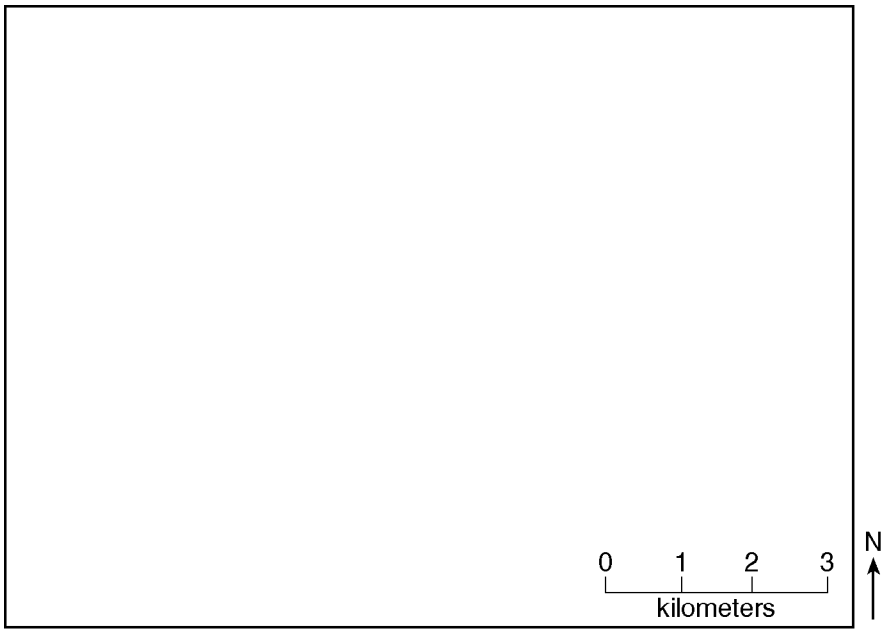
737) According to the Earth Science Reference Tables, at what inferred depth is mantle rock partially melted and slowly moving below the lithospheric plates?

738) The information in the reading passage suggests that "subduction processes are the driving force of plate tectonics." Identify a specific location of a subduction zone on Earth.

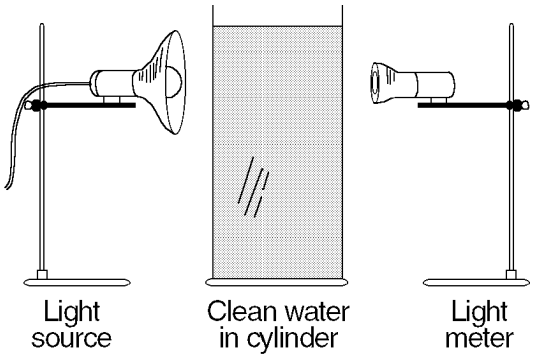
739) What is the inferred temperature at the boundary between Earth's stiffer mantle and outer core?

A) 6,200°C B) 4,500°C C) 5,000°C D) 2,500°C

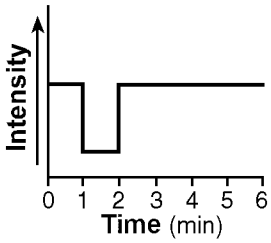
740) An island measures 10 kilometers from east to west and 8 kilometers from north to south. A single hill on the east side of the island has a maximum elevation of 57 meters and is steepest to the north. Draw a simple contour map to represent this island, using a distance scale of 1 centimeter = 1 kilometer and a contour interval of 10 meters.

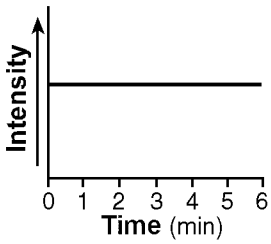


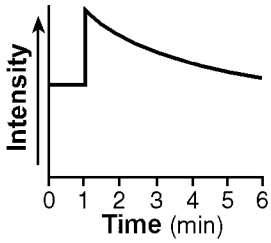
741) The diagram below shows a cylinder filled with clean water. At the left of the cylinder is a light source, and at the right of the cylinder is a meter that measures the intensity (brightness) of light as it passes through the water. One minute after the light is turned on, a mixture of sand, silt, and clay is poured into the cylinder.

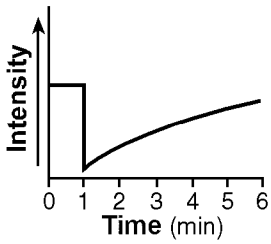


Which graph shows the probable change in light intensity (brightness) recorded during the 6-minute period after the light is turned on?

A)


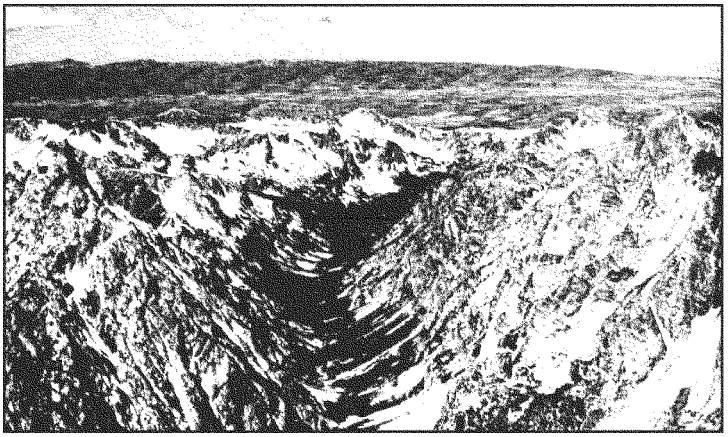
B)


C)


D)


Questions 742 and 743 refer to the following:

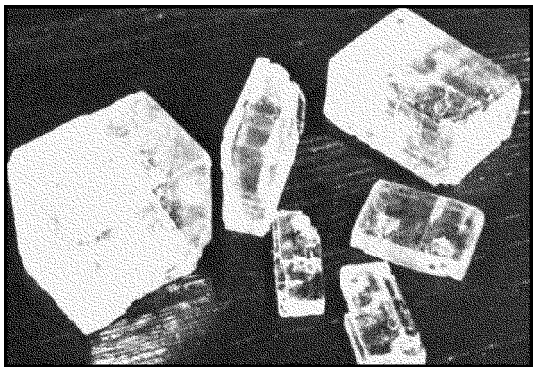
The photograph below shows a mountainous region cut by a large valley in its center.



742) Describe additional geologic evidence that might be found on the valley floor that would support the idea that glacial ice formed the valley shown.

743) What characteristic of the large valley shown supports the inference that glacial ice formed the valley?

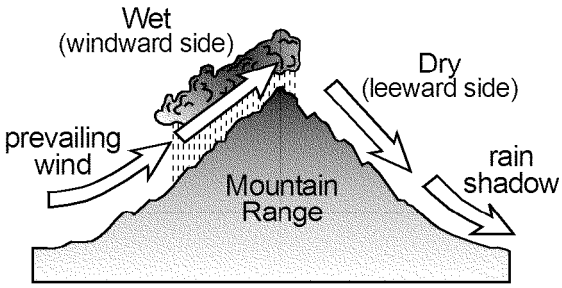
744) The photograph below shows a piece of halite that has been recently broken.



Which physical property of halite is demonstrated by this pattern of breakage?

A) hardness B) luster C) cleavage D) streak

745) The cross section below shows how prevailing winds have caused different climates on the windward and leeward sides of a mountain range.



Why does the windward side of this mountain have a wet climate?

A) Rising air compresses and warms, causing the water vapor to condense.
B) Rising air expands and warms, causing the water droplets to evaporate.
C) Rising air compresses and cools, causing the water droplets to evaporate.
D) Rising air expands and cools, causing the water vapor to condense.

746) During which geologic time period did the *earliest* reptiles and great coal-forming forests exist?

A) Pennsylvanian C) Mississippian
B) Quaternary D) Devonian

747) On June 21, some Earth locations have 24 hours of daylight. These locations are *all* between the latitudes of

A) 47° N and $66\frac{1}{2}$° N
B) $66\frac{1}{2}$° N and 90° N
C) $23\frac{1}{2}$° N and 47° N
D) 0° and $23\frac{1}{2}$° N

748) Weather along most fronts is usually cloudy with precipitation because the warm air along most fronts is usually

A) rising and warming, causing water vapor to condense
B) sinking and warming, causing water to evaporate
C) sinking and cooling, causing water to evaporate
D) rising and cooling, causing water vapor to condense

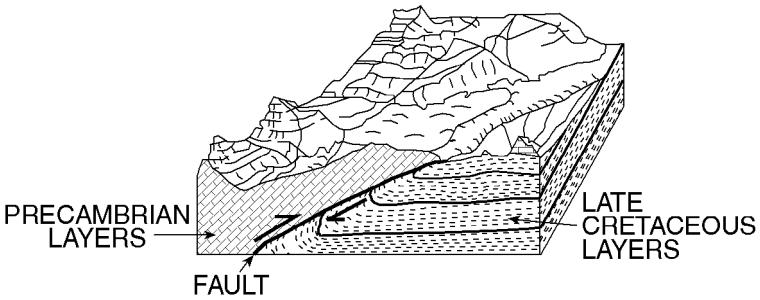
749) Warm water from tropical oceans is carried to northern Europe by the Gulf Stream and the

A) Brazil Current
B) Alaska Current
C) North Atlantic Current
D) Canaries Current

750) In which direction on the horizon does the Sun appear to rise on July 4 in New York State?

A) due south
B) due north
C) south of due east
D) north of due east

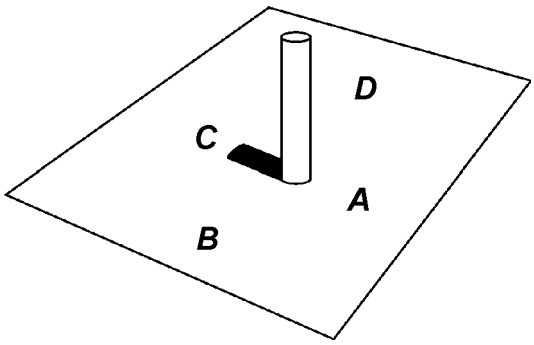
751) The geologic block diagram below shows surface features and subsurface structures of a section of Montana.



The faulting shown in the diagram could have occurred

A) 520 million years ago
B) 50 million years ago
C) 250 million years ago
D) 2,100 million years ago

752) The diagram below shows the noontime shadow cast by a vertical post located in New York State.



Which letter indicates a location west of the post?

A) *A* B) *B* C) *C* D) *D*

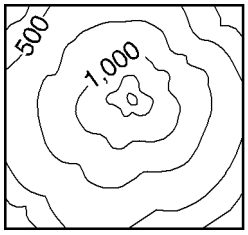
753) Land surfaces of Earth heat more rapidly than water surfaces because

A) less of Earth's surface is covered by land than by water
B) more energy from the Sun falls on land than on water
C) land has a lower specific heat than water
D) sunlight penetrates to greater depths in land than in water

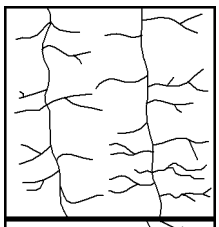
754) A sample of wood that originally contained 100 grams of carbon-14 now contains only 25 grams of carbon-14. Approximately how many years ago was this sample part of a living tree?

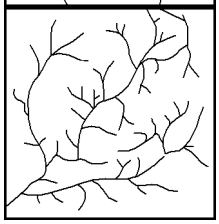
A) 5,700 years
B) 17,100 years
C) 2,850 years
D) 11,400 years

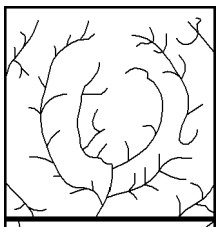
755) The topographic map below shows a particular landscape.

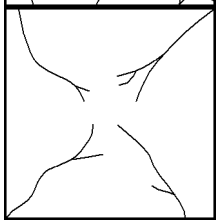


Which map *best* represents the stream drainage pattern for this landscape?

A) 

B) 

C) 

D) 

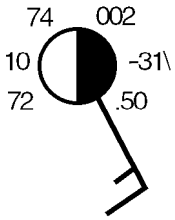
756) Earth's rate of revolution around the Sun is approximately

A) 15° per hour
B) 360° per day
C) 1° per day
D) 23.5° per hour

757) Which object orbits Earth in *both* the Earth-centered (geocentric) and Sun-centered (heliocentric) models of our solar system?

A) the Sun
B) Venus
C) Polaris
D) the Moon

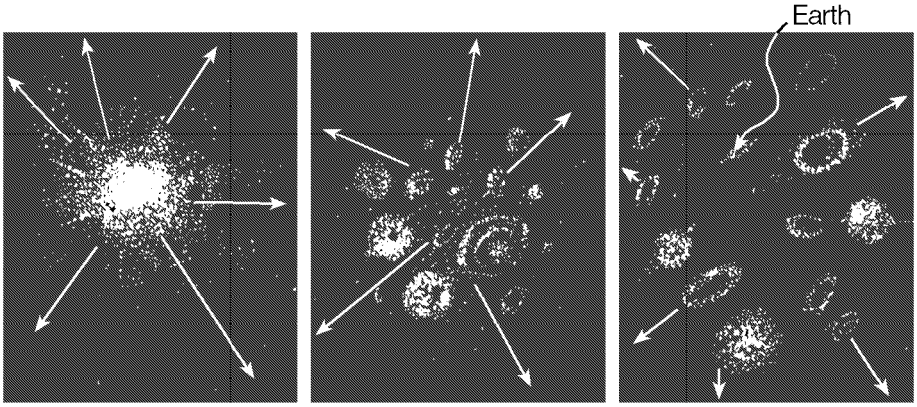
758) The station model below shows the weather conditions at Massena, New York, at 9 a.m. on a particular day in June.



What was the barometric pressure at Massena 3 hours earlier on that day?

A) 1009.1 mb
B) 999.7 mb
C) 997.1 mb
D) 1003.3 mb

759) The diagram below illustrates three stages of a current theory of the formation of the universe.



STAGE 1
A ball of hydrogen exploded.

STAGE 2
A huge hydrogen cloud moved outward with cloud parts condensing to form galaxies.

STAGE 3
The galaxies continue to move outward

A major piece of scientific evidence supporting this theory is the fact that wavelengths of light from galaxies moving away from Earth in stage 3 are observed to be

A) shorter than normal (a red shift)
B) longer than normal (a red shift)
C) longer than normal (a blue shift)
D) shorter than normal (a blue shift)

Questions 760 through 762 refer to the following:

FOSSILIZED JELLYFISH FOUND IN WISCONSIN

Fossil hunters have unearthed the largest collection of fossilized jellyfish ever discovered, including the largest fossilized jellyfish ever found.

The remains of soft-bodied animals, such as jellyfish, are relatively rare because they don't have bones, fossil dealer Dan Damrow, James W. Hagadorn of the California Institute of Technology and Robert H. Dott Jr. of the University of Wisconsin at Madison noted in describing the find in the journal Geology.

About a half-billion years ago, during the Cambrian period, the quarry in Mosinee, Wis., where the deposits were found was a small lagoon. The jellyfish apparently died when they were washed up by a freak tide or storm, the researchers said. The jellyfish remains were probably preserved because of a lack of erosion from sea water and wind, and a lack of scavengers, the researchers concluded.

"It is very rare to discover a deposit which contains an entire stranding event of jellyfish," Hagadorn said. "These jellyfish are not just large for the Cambrian, but are the largest jellyfish in the entire fossil record.

—*Washington Post*, January 2002

760) The fossilized jellyfish discussed in the reading passage were most likely discovered in which type of rock?

A) pumice B) granite C) sandstone D) slate

761) Which two marine organisms most likely lived at the same time as the jellyfish mentioned in the reading passage?

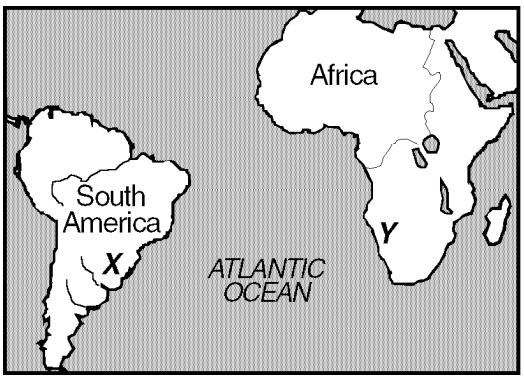
A) crinoids and dinosaurs
B) brachiopods and gastropods
C) amphibians and eurypterids
D) ammonoids and placoderm fish

762) Which of the following evidence would lead scientists to suspect that a tide or storm had washed up the jellyfish, described in the reading passage, on a beach?

A) Primitive life existed on land 500 million years ago.
B) The rock containing the jellyfish fossils has distorted crystal structure.
C) Large ripple marks were found in the fossil-containing rock layers.
D) Tree root fossils appear to have been pitted and folded.

763) Describe the arrangement of sediment deposited directly from glaciers.

764) The map below shows the present-day locations of South America and Africa. Remains of *Mesosaurus*, an extinct freshwater reptile, have been found in similarly aged bedrock formed from lake sediments at locations *X* and *Y*.

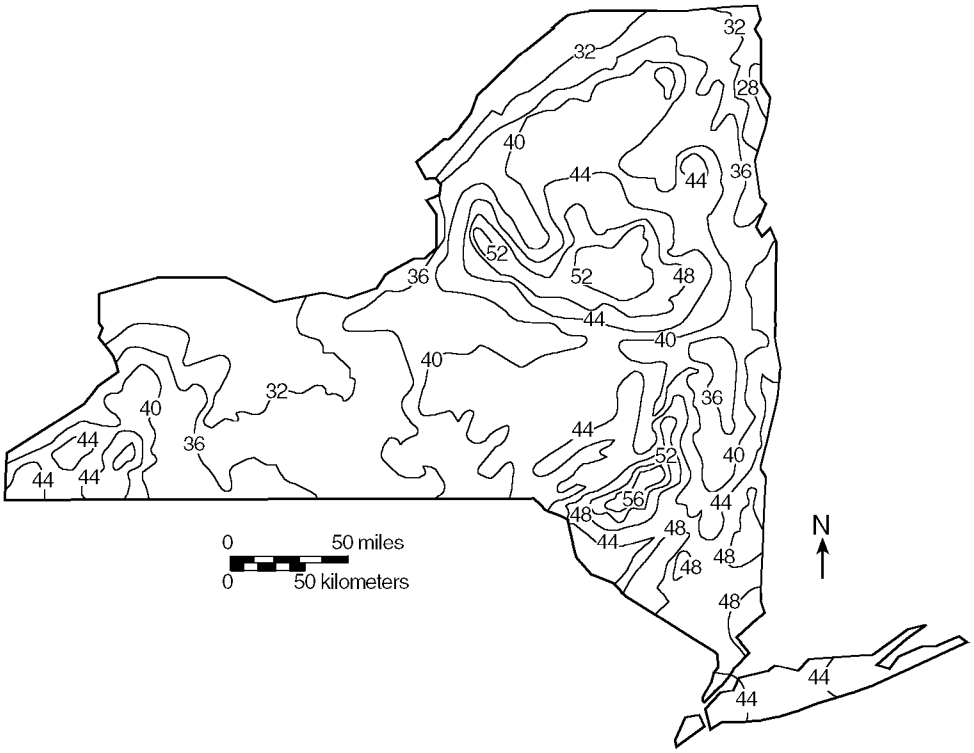


Which one of the following statements represents the *most* logical conclusion to draw from this evidence?

A) The continents of South America and Africa were joined when *Mesosaurus* lived.
B) *Mesosaurus* migrated across the ocean from location *X* to location *Y*.
C) The present climates at locations *X* and *Y* are similar.
D) *Mesosaurus* came into existence on several widely separated continents at different times.

Questions 765 and 766 refer to the following:

The field map below shows the average annual precipitation in New York State for the past 25 years. Isoline values represent inches per year.



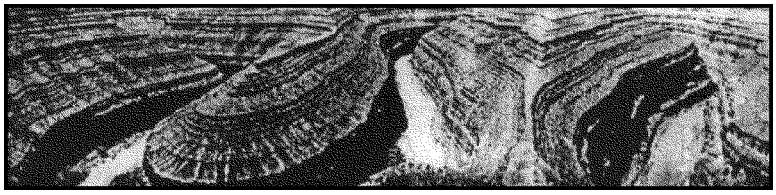
765) Jamestown received more rainfall per year than Elmira. A reason for this difference is that Jamestown is located

A) at a lower elevation
B) in the prevailing southerly wind belt
C) at a higher latitude
D) closer to a large body of water

766) Which of these locations had the *lowest* average annual precipitation?

A) Kingston
B) New York City
C) Old Forge
D) Plattsburgh

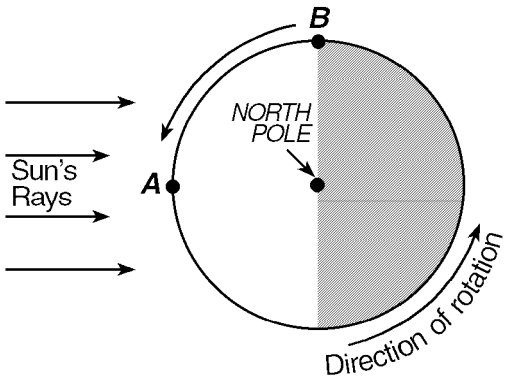
767) The photograph below shows an eroded plateau found in the southwestern United States.



Which processes most likely developed this landscape?

A) crustal uplift and glacial erosion
B) crustal folding and stream erosion
C) crustal uplift and stream erosion
D) crustal folding and glacial erosion

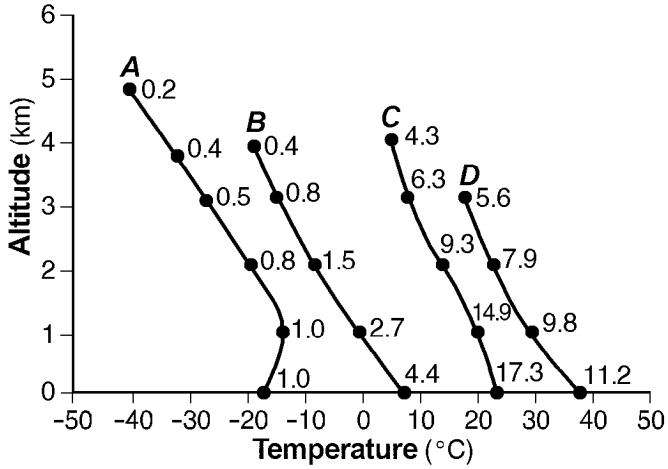
768) The diagram below shows Earth as viewed from above the North Pole. Points *A* and *B* are locations on Earth's surface.



At location *A*, the time is 12 noon. What is the time at location *B*?

A) 6 p.m.
B) 6 a.m.
C) 3 p.m.
D) 12 midnight

769) The graph below shows changes in the atmosphere occurring above typical airmass source regions *A*, *B*, *C*, and *D*. Changes in air temperature and altitude are shown as the graphed lines. Changes in water-vapor content, in grams of vapor per kilogram of air, are shown as numbers on each graphed line.

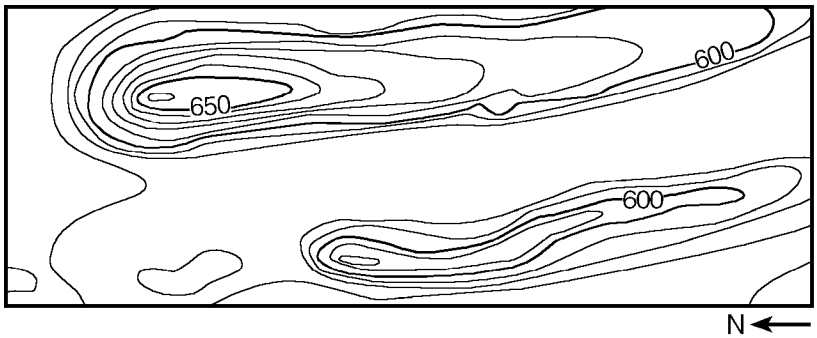


Which list *best* identifies each air-mass source region?

A) *A* — **mP**, *B* — **mT**, *C* — **cT**, *D* — **cP**
B) *A* — **cP**, *B* — **mP**, *C* — **mT**, *D* — **cT**
C) *A* — **cT**, *B* — **cP**, *C* — **mP**, *D* — **mT**
D) *A* — **mT**, *B* — **cT**, *C* — **cP**, *D* — **mP**

Questions 770 through 772 refer to the following:

The map below shows a portion of a drumlin field near Palmyra, New York. Elevations are in feet.



770) What is the contour interval of the given map?

A) 25 ft B) 20 ft C) 5 ft D) 10 ft

771) The drumlins in the given map are composed of sediments transported and deposited directly by glacial ice. These sediments are likely to be

A) well sorted in horizontal layers
B) unsorted and not in layers
C) well-rounded, sand-sized particles
D) found underwater, mixed with organic materials

772) At the location in the given map, the glacial ice generally advanced from what compass direction?

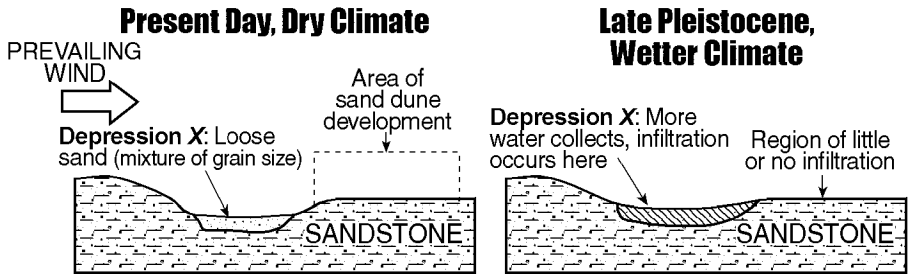
A) west B) east C) south D) north

773) Which two stars have the *most* similar luminosity and temperature?

A) *Sirius* and *Procyon B*
B) *Alpha Centauri* and the Sun
C) *Rigel* and *Betelgeuse*
D) *Betelgeuse* and *Barnard's Star*

Questions 774 and 775 refer to the following:

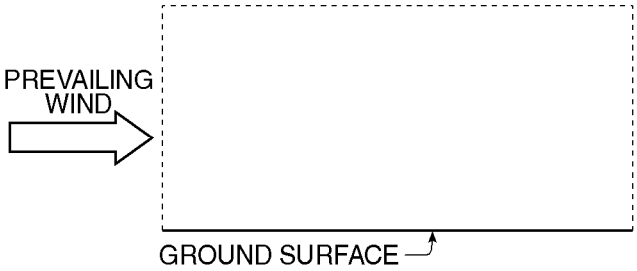
The cross section below represents a part of Texas where weakly cemented sandstone is exposed at the surface. The mineral cement holding the sandstone grains together is calcite. Area *X* is a circular depression of loose sand that has been partially removed by prevailing winds. Sand dunes have developed downwind from depression *X*.



774) The cross section on the right shows the area of Texas near the end of the last ice age when the area had a much wetter climate. More infiltration of rainwater was occurring at area *X*. Scientists infer that depression *X* was an area where slightly acidic rainwater collected and infiltrated into the sandstone.

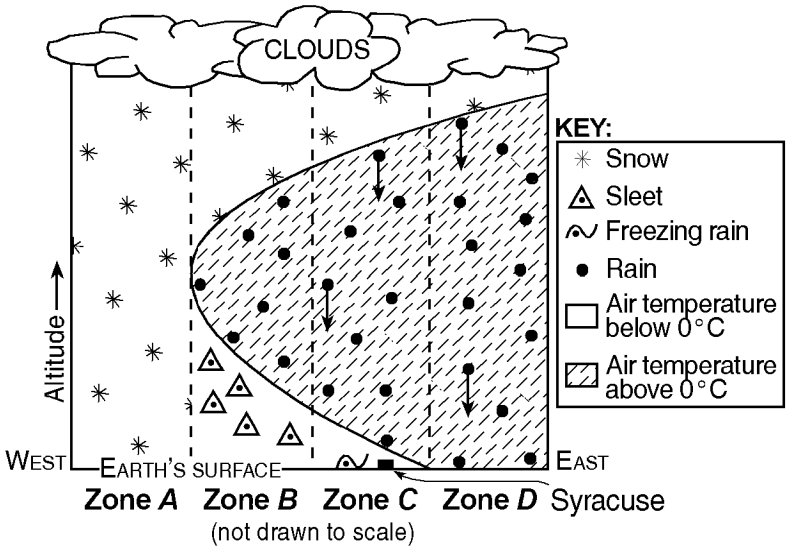
Describe the effect that the slightly acidic infiltrating water had on the calcite cement holding the sandstone together.

775) On the diagram of the area of sand dune development below, draw a sketch showing the general sideview of a sand dune formed by a wind blowing in the direction indicated. Your sketch should clearly show any variations in the slope of the sides of the dune.



Questions 776 through 779 refer to the following:

The atmospheric cross section below represents a winter storm system. Zones *A*, *B*, *C*, and *D* are located on a west to east line at approximately 43° N latitude across New York State. This cross section shows how solid and liquid forms of precipitation depend on the air temperature above Earth's surface. The storm is moving from west to east.



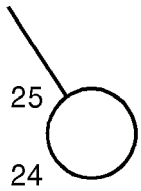
776) Describe the general air movement and temperature change that caused the clouds associated with the storm shown in the diagram to form.

777) Explain why sleet is occurring in Zone *B* in the given diagram.

778) As the storm in the given diagram moves eastward, the type of precipitation received in Syracuse changes. State the type of precipitation that will immediately follow freezing rain.

779) At the time of the events represented by the given cross section, Syracuse, New York, is experiencing the following weather conditions:

Cloud cover	100%
Wind speed	15 knots
Present weather	Freezing rain
Precipitation	1.23 inches past 6 hours
Visibility	1 mile



The temperature, dewpoint, and wind direction are shown on the weather station model above. Using proper format, add the information shown in the table to the model.

780) Students wish to study the effect of elevation above sea level on air temperature and air pressure. They plan to hike in the Adirondack Mountains from Heart Lake, elevation 2,179 feet, to the peak of Mt. Marcy, elevation 5,344 feet. Which instruments should they use to collect their data?

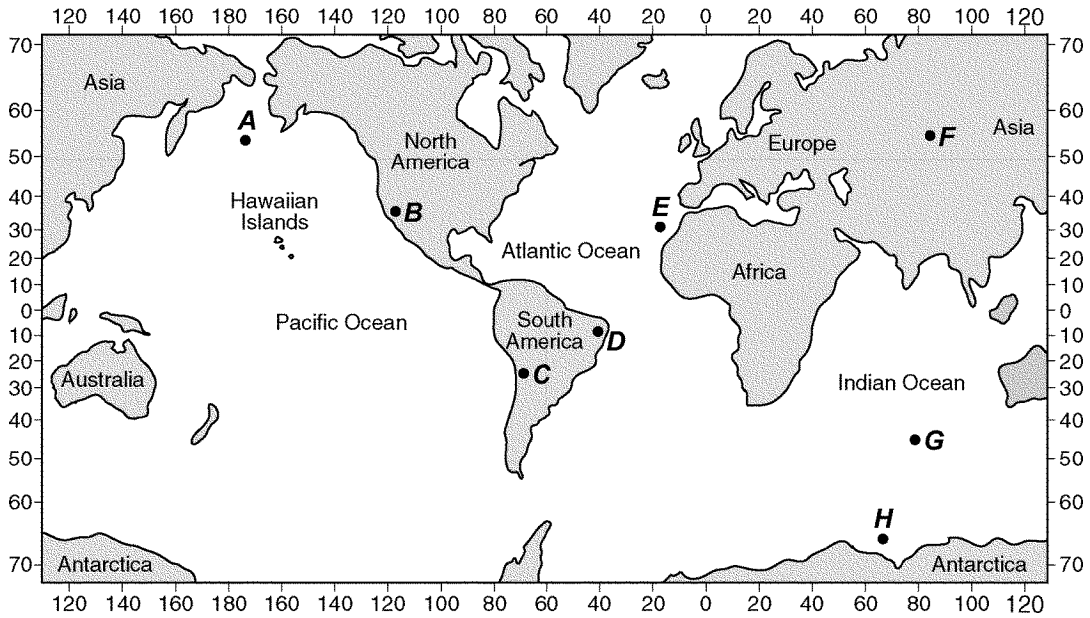
A) anemometer and barometer
B) thermometer and barometer
C) anemometer and psychrometer
D) thermometer and psychrometer

781) The characteristic of the radioactive isotope uranium-238 that makes this isotope useful for accurately dating the age of a rock is the isotope's

A) common occurrence in sediments
B) constant half-life
C) resistance to weathering and erosion
D) organic origin

Questions 782 through 785 refer to the following:

In the world map shown below, letters *A* through *H* represent locations on Earth's surface.



782) Explain why most earthquakes that occur in the crust beneath location *B* in the map are shallower than most earthquakes that occur in the crust beneath location *C*.

783) Explain why location *A* in the map has a greater probability of experiencing a major earthquake than location *D*.

784) Explain why a volcanic eruption is more likely to occur at location *E* in the map than at location *F*.

785) Explain why the geologic age of the oceanic bedrock increases from location *G* to location *H* in the map.

786) Which weather change usually occurs when the difference between the air temperature and the dewpoint temperature is decreasing?

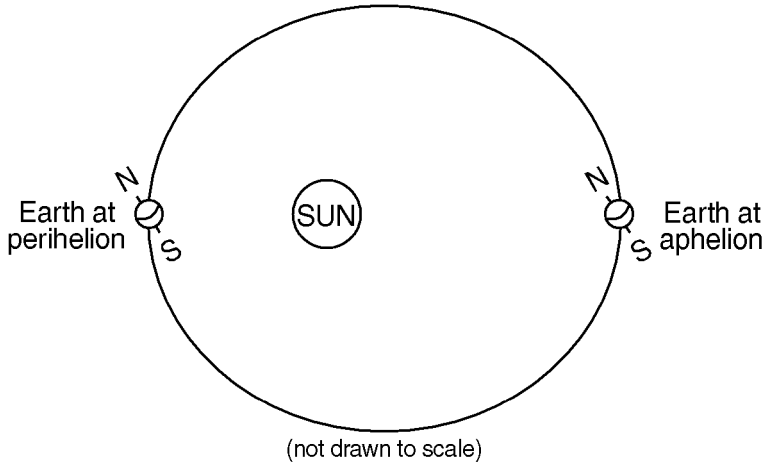
A) The relative humidity increases.
B) The amount of cloud cover decreases.
C) The probability of precipitation decreases.
D) The barometric pressure increases.

787) What is the dewpoint temperature when the dry-bulb temperature is 12°C and the wet-bulb temperature is 4°C?

A) 4°C B) 19°C C) 8°C D) -9°C

Questions 788 through 791 refer to the following:

The diagram below represents an exaggerated model of Earth's orbital shape. Earth is closest to the Sun at one time of year (perihelion) and farthest from the Sun at another time of year (aphelion).



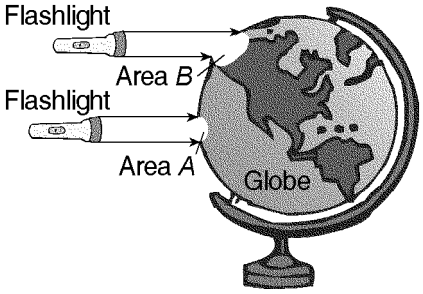
788) State the actual geometric shape of Earth's orbit.

789) Describe the change that takes place in the apparent size of the Sun, as viewed from Earth, as Earth moves from perihelion to aphelion.

790) State the relationship between Earth's distance from the Sun and Earth's orbital velocity.

791) Identify the season in the Northern Hemisphere when Earth is at perihelion.

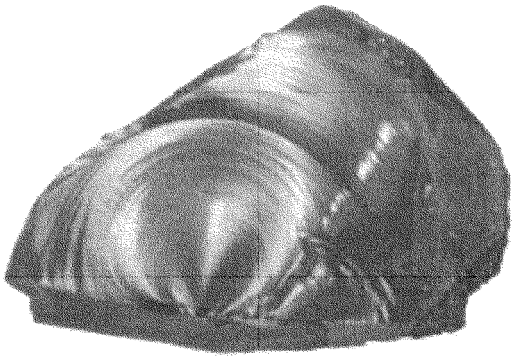
792) The diagram below shows a classroom demonstration. Two identical flashlights were placed in the positions shown and they illuminated areas of varying size, *A* and *B*, on a classroom globe. Thermometers were then placed at the center of each illuminated area to measure the rate of temperature increase. Readings were taken over a period of 30 minutes.



Students most likely observed that the temperature of area *A* increased at a

A) faster rate than the temperature of area *B* because area *A* received rays with less total energy
B) slower rate than the temperature of area *B* because area *A* received rays that were more slanted
C) faster rate than the temperature of area *B* because area *A* received rays that were more perpendicular to the surface
D) slower rate than the temperature of area *B* because area *A* received rays that were less concentrated

793) The picture below shows the igneous rock obsidian.



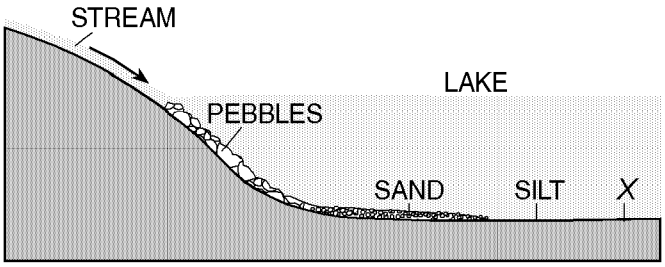
The obsidian's glassy texture indicates that it formed from magma that cooled

A) slowly, on Earth's surface
B) quickly, on Earth's surface
C) quickly, deep below Earth's surface
D) slowly, deep below Earth's surface

794) The occurrence of parallel scratches on bedrock in a U-shaped valley indicates that the area has most likely been eroded by

A) a glacier
B) a stream
C) wind
D) waves

795) The cross section below illustrates the normal pattern of sediments deposited where a stream enters a lake. Letter *X* represents a particular type of sediment.



(not drawn to scale)

(a) Briefly explain why deposition of sediment usually occurs where a stream enters a lake.

(b) Name the type of sediment most likely represented by letter *X*.

Questions 796 and 797 refer to the following:

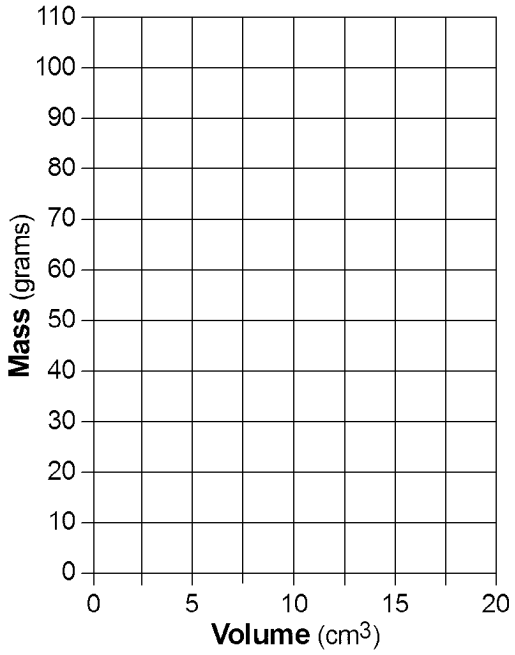
The data table below shows the volume and mass of three different samples, *A*, *B*, and *C*, of the mineral pyrite.

Pyrite

Sample	**Volume** (cm^3)	**Mass** (g)
A	2.5	12.5
B	6.0	30.0
C	20.0	100.0

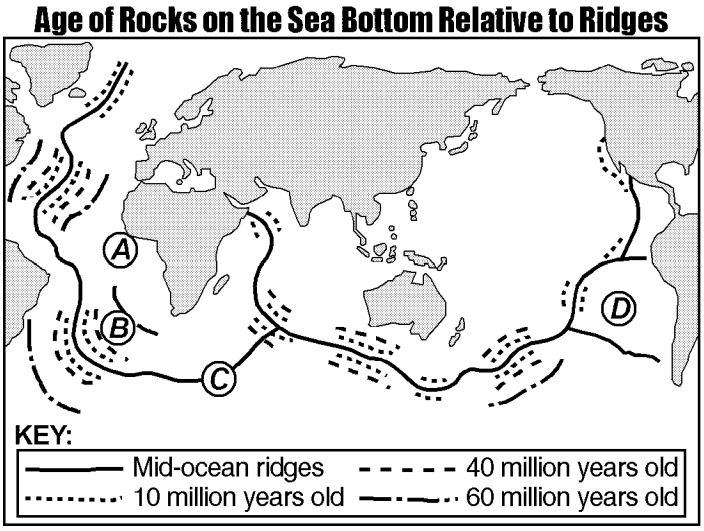
796) State the mass of a 10.0-cm^3 sample of pyrite.

797) On the grid below, plot the data (volume and mass) for the three samples of pyrite and connect the points with a line.



Questions 798 through 800 refer to the following:

The map below shows the location of mid-ocean ridges and the age of some oceanic bedrock near these ridges. Letters *A* through *D* are locations on the surface of the ocean floor.



798) Rising convection currents in the asthenosphere would most likely be under location

A) *A* B) *B* C) *C* D) *D*

799) What is the most probable age, in millions of years, of the bedrock at location *B*?

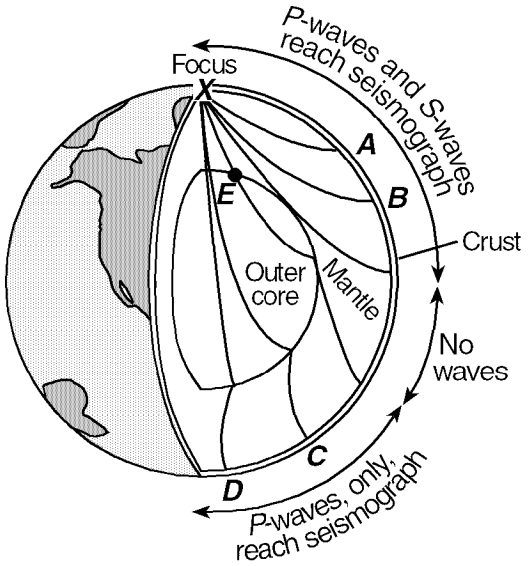
A) 48 B) 12 C) 5 D) 62

800) The age of oceanic bedrock on either side of a mid-ocean ridge is supporting evidence that at the ridges, tectonic plates are

A) being subducted
B) converging
C) locked in place
D) diverging

Questions 801 and 802 refer to the following:

The diagram below shows a cutaway view of Earth in which the interior layers are visible. The paths of earthquake waves generated at point *X* are shown. *A*, *B*, *C*, and *D* are locations of seismic stations on Earth's surface, and point *E* is located in Earth's interior.



801) Both *P*-waves and *S*-waves were received at seismic stations *A* and *B* in the given diagram, but only *P*-waves were received at seismic stations *C* and *D*. Which one of the following statements *best* explains why this occurred?

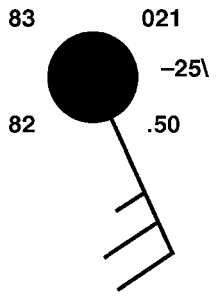
A) *S*-waves travel faster than *P*-waves.
B) *S*-waves are much weaker than *P*-waves.
C) The liquid outer core prevents *S*-waves from traveling to seismic stations *C* and *D*.
D) The solid outer core prevents *S*-waves from traveling to seismic stations *C* and *D*.

802) The actual rock temperature at point *E* in the given diagram is inferred to be approximately

A) 6,200 °C
B) 1,500 °C
C) 5,000 °C
D) 2,900 °C

Questions 803 and 804 refer to the following:

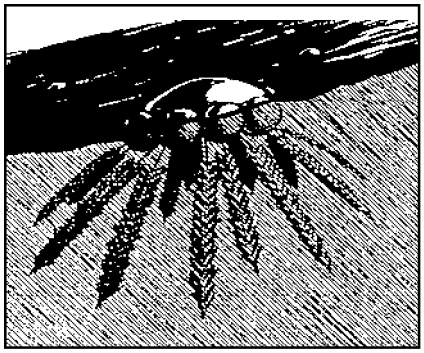
The station model below shows the weather conditions at Rochester, New York, at 4 p.m. on a particular day in June.



803) According to the station model shown, what was the actual barometric pressure, to the nearest tenth of a millibar?

804) The winds shown by the given station model were blowing from which compass direction and at what wind speed?

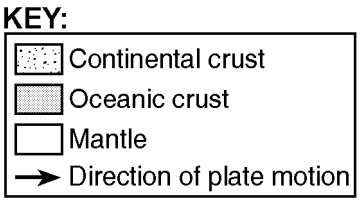
805) Some marine organisms swim or float in the ocean, and others live on or in the sediment of the ocean floor. A group of floating organisms called graptolites were common in some ancient seas that covered New York State and are found in some New York State bedrock.

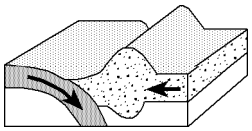


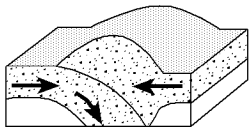
Floating graptolites

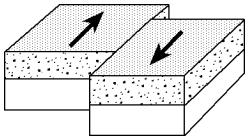
State *one* reason why certain species of graptolites are used as an index fossil.

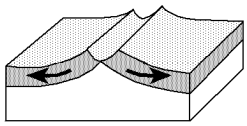
806) Which cross section below *best* represents the crustal plate motion that is the primary cause of the volcanoes and deep rift valleys found at midocean ridges?



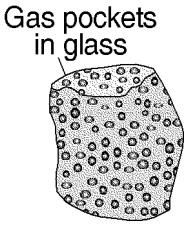
A) 

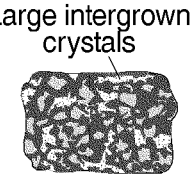
C) 

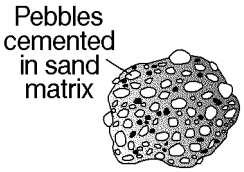
B) 

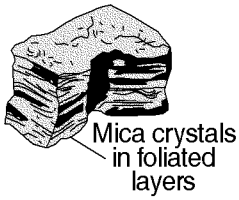
D) 

807) Which rock most probably formed directly from lava cooling quickly at Earth's surface?

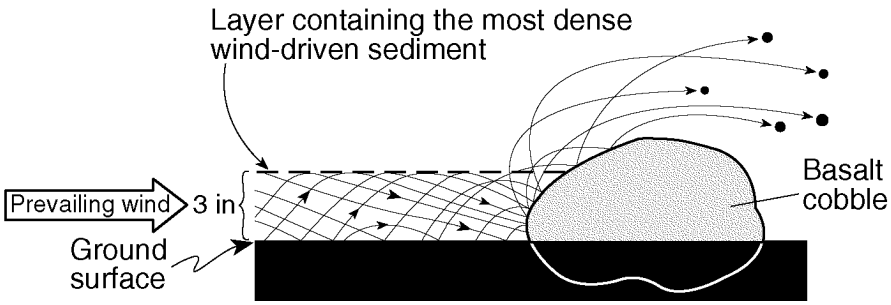
A) 

C) 

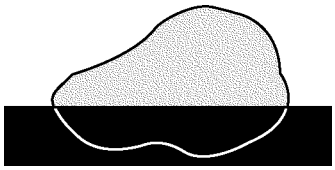
B) 

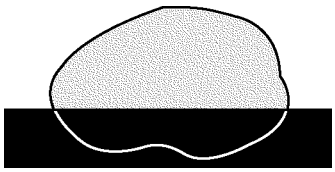
D) 

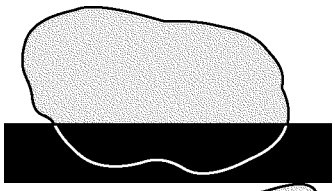
808) The cross section below shows the movement of wind-driven sand particles that strike a partly exposed basalt cobble located at the surface of a windy desert.

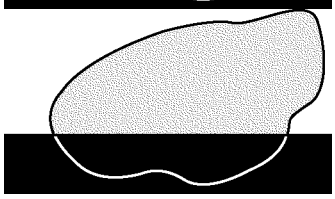


Which cross section *best* represents the appearance of this cobble after many years of exposure to the wind-driven sand?

A) 

B) 

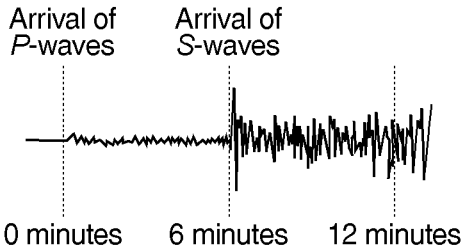
C) 

D) 

809) Earth's fossil record shows evidence that

A) life-forms existed on land before life-forms existed in water
B) more complex life-forms probably have evolved from less complex life-forms
C) older bedrock contains a great variety of life-forms, while younger bedrock contains less variety of life-forms
D) very few life-forms have become extinct

810) The seismogram below shows *P*-wave and *S*-wave arrival times at a seismic station following an earthquake.



The distance from this seismic station to the epicenter of the earthquake is approximately

A) 5,600 km B) 4,400 km C) 3,200 km D) 1,600 km

811) Which two gases in Earth's atmosphere are believed by scientists to be greenhouse gases that are major contributors to global warming?

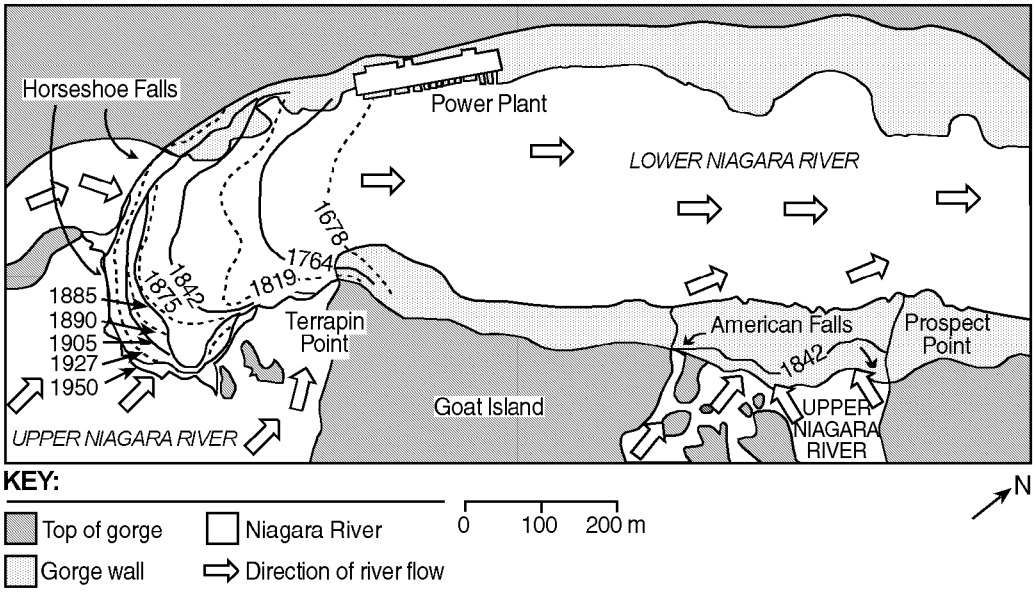
A) oxygen and nitrogen
B) carbon dioxide and methane
C) hydrogen and helium
D) ozone and chlorine

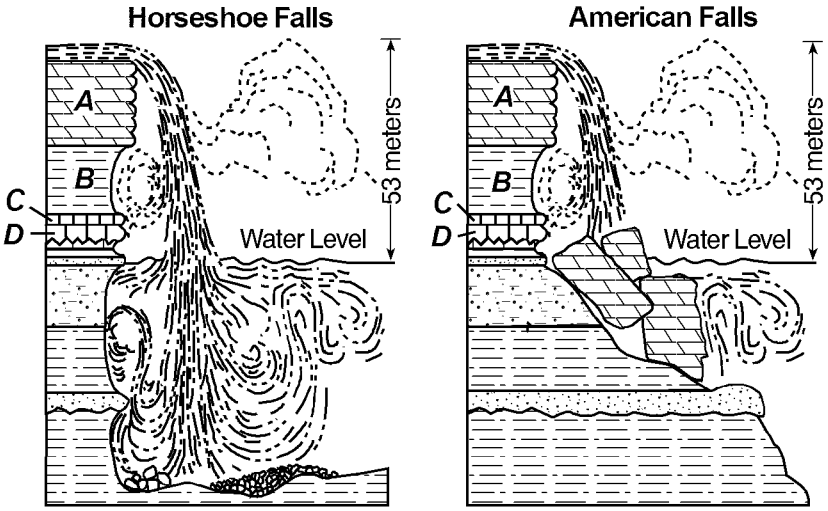
812) Which home-building material is made mostly from the mineral gypsum?

A) window glass
B) plastic pipes
C) drywall panels
D) iron nails

Questions 813 and 814 refer to the following:

The map below shows measured changes in the position of Niagara Falls since 1678. The cross sections show the two parts of Niagara Falls: Horseshoe Falls and American Falls. Letters *A* through *D* represent the same rock layers at both locations.





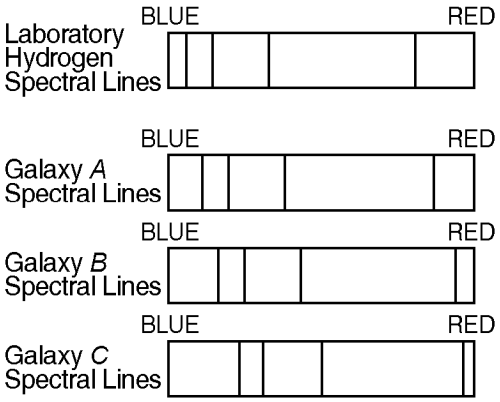
813) What rock layer in the given map shows the *most* resistance to weathering and erosion at Horseshoe Falls?

A) *A*
B) *B*
C) *C*
D) *D*

814) Which one of the following statements *best* explains why Horseshoe Falls has eroded back more than American Falls since 1842?

A) Dolostone is the top rock layer at Horseshoe Falls.
B) More water flows over Horseshoe Falls.
C) More water flows over American Falls.
D) Dolostone is the top rock layer at American Falls.

815) In the diagram below, the spectral lines of hydrogen gas from three galaxies, *A*, *B*, and *C*, are compared to the spectral lines of hydrogen gas observed in a laboratory.



What is the *best* inference that can be made concerning the movement of galaxies *A*, *B*, and *C*?

A) Galaxies *A*, *B*, and *C* are all moving toward Earth.
B) Galaxies *A*, *B*, and *C* are all moving away from Earth.
C) Galaxy *A* is moving away from Earth, but galaxies *B* and *C* are moving toward Earth.
D) Galaxy *B* is moving away from Earth, but galaxies *A* and *C* are moving toward Earth.

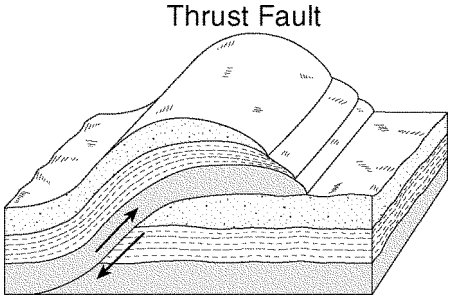
816) What is the approximate location of the Canary Islands Hot Spot?

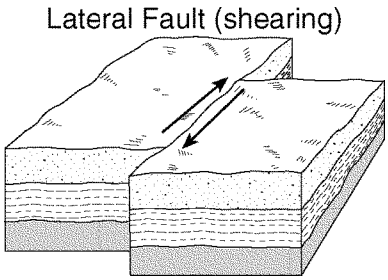
A) 32° N 18° E
B) 32° S 18° E
C) 32° S 18° W
D) 32° N 18° W

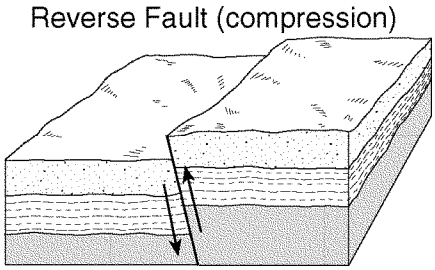
817) Which three minerals are most commonly found in the igneous rock granite?

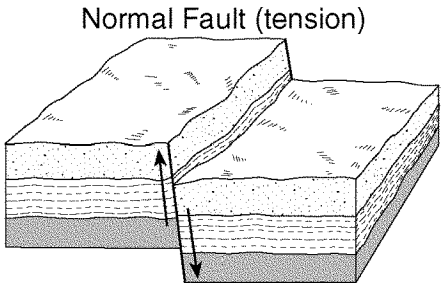
A) plagioclase feldspar, potassium feldspar, and quartz
B) plagioclase feldspar, pyroxene, and olivine
C) amphibole, biotite mica, and gypsum
D) amphibole, calcite, and hematite

818) The diagrams below show four major types of fault motion occurring in Earth's crust. Which type of fault motion *best* matches the general pattern of crustal movement at California's San Andreas fault?

A)


C)


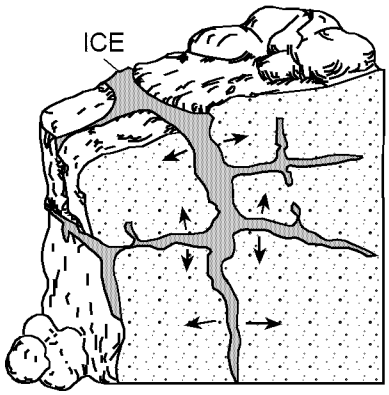
B)


D)


819) What is the dewpoint temperature when the dry-bulb temperature is 16°C and the wet-bulb temperature is 11°C?

A) 9°C B) 7°C C) -17°C D) 5°C

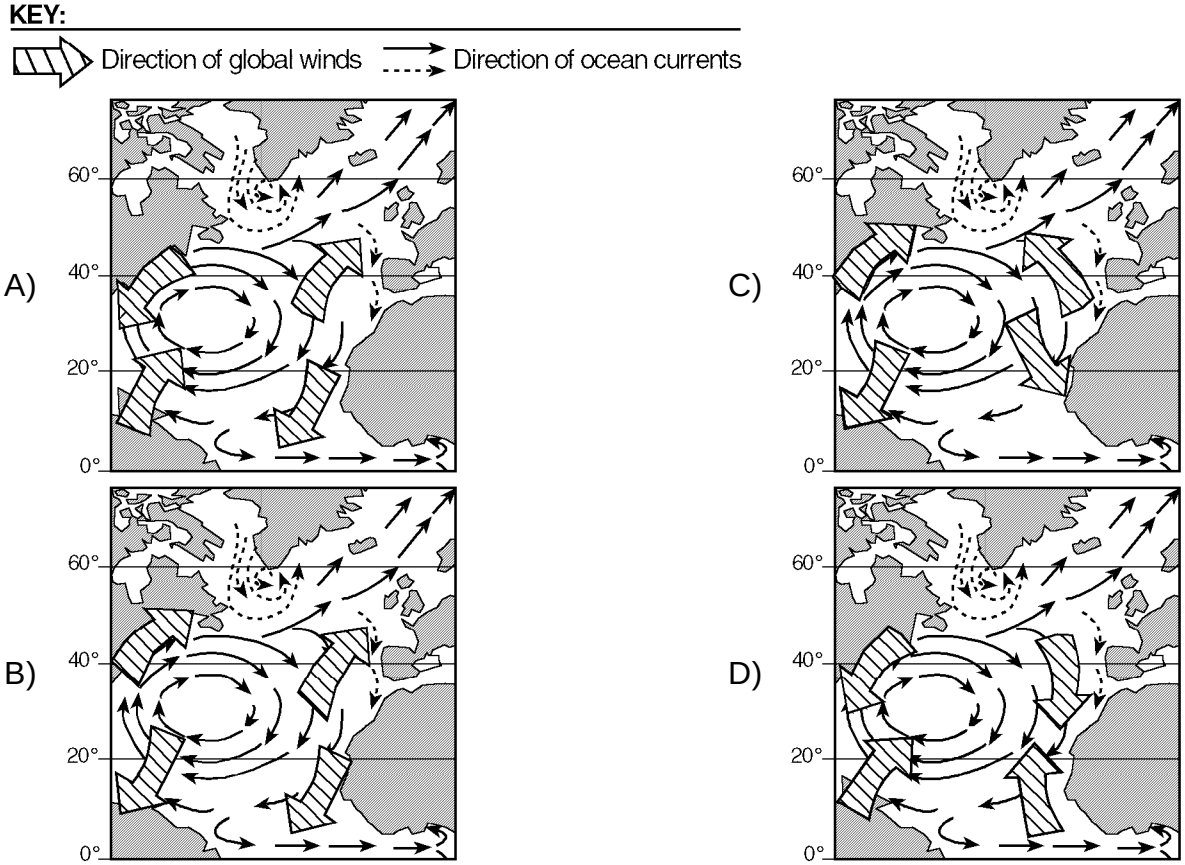
820) The diagram below shows granite bedrock with cracks. Water has seeped into the cracks and frozen. The arrows represent the directions in which the cracks have widened due to weathering.



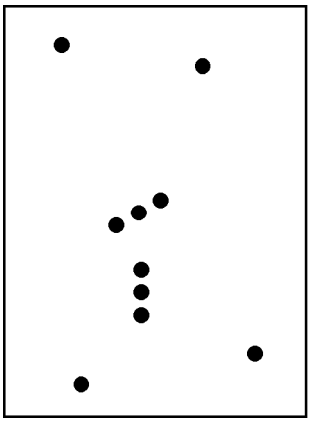
Which statement *best* describes the physical weathering shown by the diagram?

A) This type of weathering is common in regions of primarily warm and humid climates.
B) Enlargement of the cracks occurs because water expands when it freezes.
C) This type of weathering occurs only in bedrock composed of granite.
D) The cracks become wider because of chemical reactions between water and the rock.

821) Which map *best* represents the global prevailing surface wind patterns responsible for generating Atlantic Ocean currents?



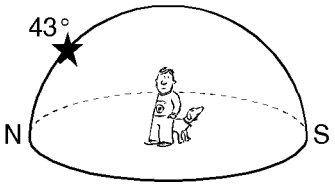
822) The diagram below represents the major stars of the constellation Orion, as viewed by an observer in New York State.

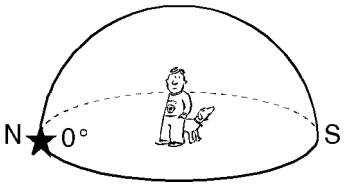


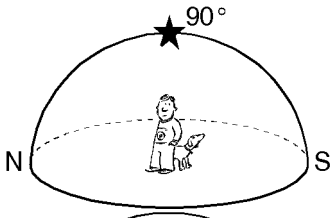
Which statement *best* explains why Orion can be observed from New York State on December 21 but *not* on June 21?

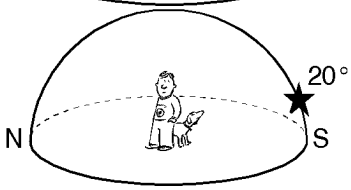
A) Earth rotates on its axis.
B) Orion has an eccentric orbit around the Sun.
C) Earth revolves around the Sun.
D) Orion has an eccentric orbit around Earth.

823) Which diagram represents the approximate altitude of Polaris as seen by an observer located in Syracuse, New York?

A) 

B) 

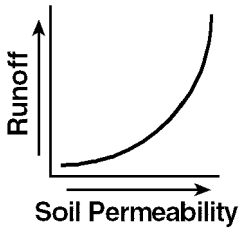
C) 

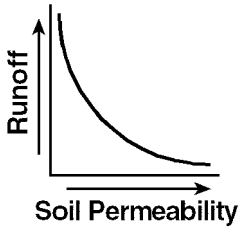
D) 

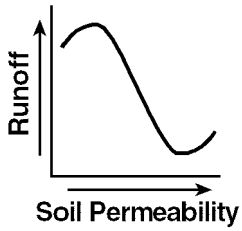
824) Large garnet mineral crystals are found in the metamorphic surface bedrock in which New York State landscape region?

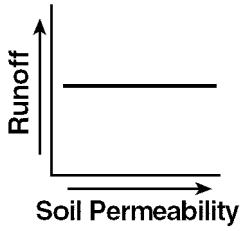
A) Catskills
B) Adirondacks
C) Tug Hill Plateau
D) Erie-Ontario Lowlands

825) Which graph shows the effect of soil permeability on the amount of runoff in an area?

A) 

B) 

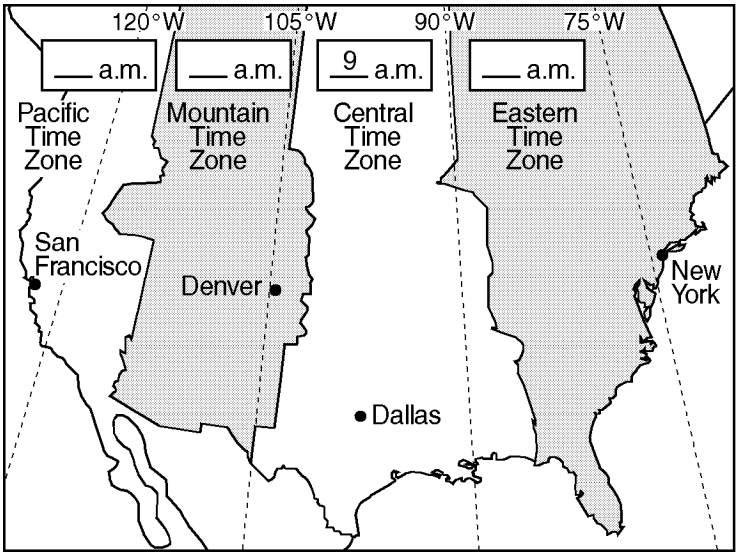
C) 

D) 

826) According to the *Properties of Common Minerals* Earth Science reference table, which mineral scratches dolomite and is scratched by olivine?

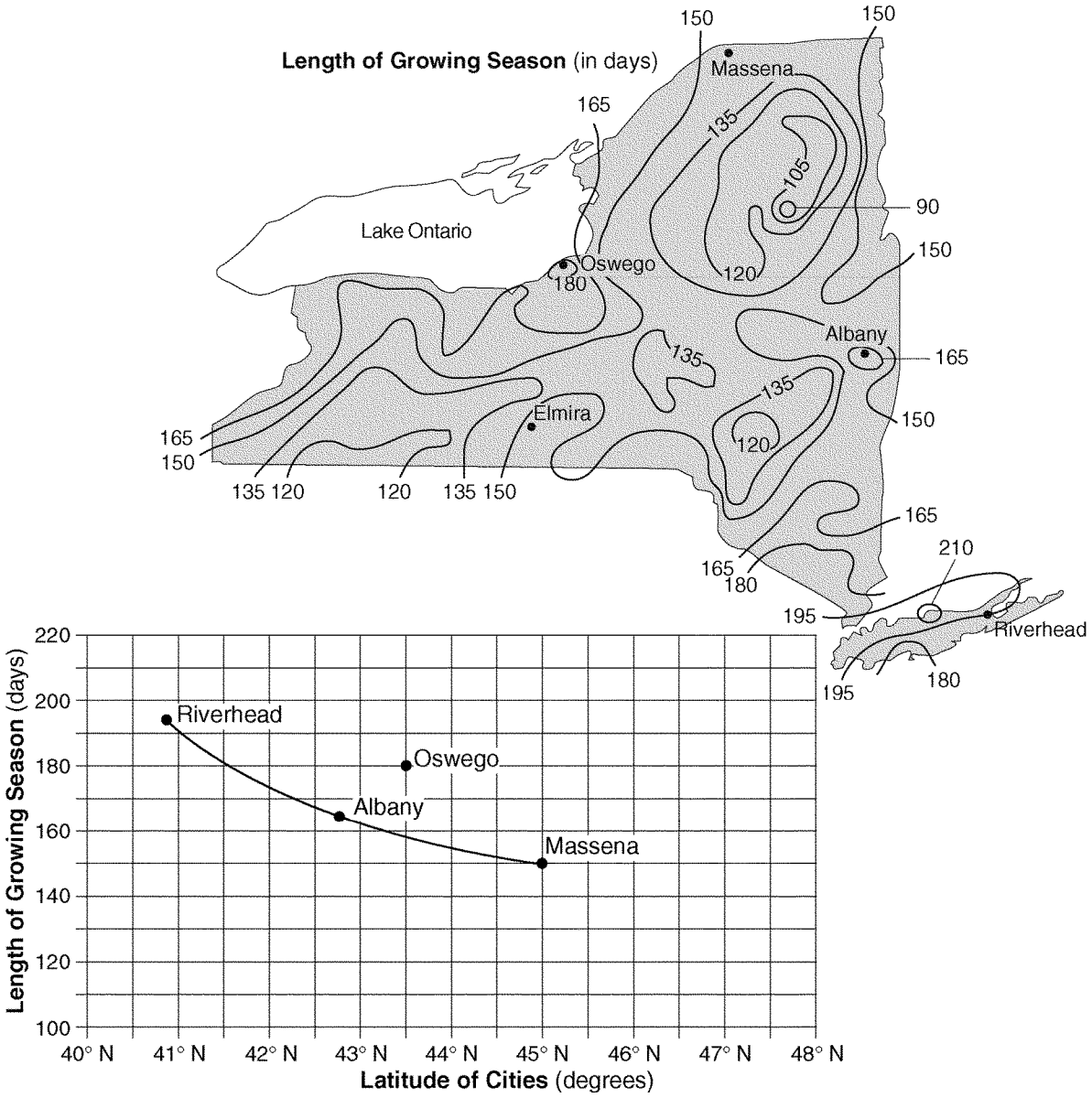
A) galena
B) potassium feldspar
C) muscovite mica
D) quartz

827) On the United States time zone map provided below, indicate the standard time in each time zone when it is 9 a.m. in the Central Time Zone. The dashed lines represent the standard-time meridians for each time zone. [*Be sure to indicate the time for all three zones.*]



Questions 828 through 830 refer to the following:

The map below shows the length of the growing season in New York State, expressed in days. The growing season is the average number of days between the last frost in spring and the first frost in fall. The graph line shows the relationship between the latitudes of Riverhead, New York; Albany, New York; and Massena, New York; and the length of the growing season at these three locations.

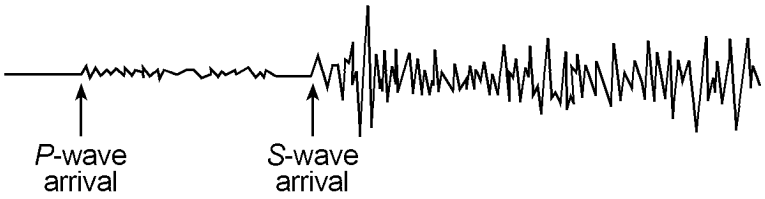


828) Using the given data, compare the length of the growing season in a lowland region with the length of the growing season in a mountain region at approximately the same latitude.

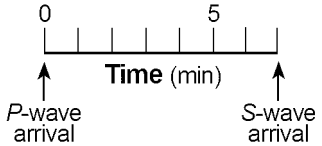
829) For Riverhead, Albany, and Massena, state the relationship between latitude and the length of the growing season shown by the graph.

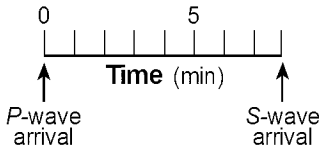
830) The data for Oswego, New York, have been plotted separately on the graph. Explain why the location of Oswego causes it to have a growing season longer than other cities at the same latitude.

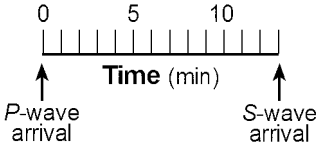
831) The diagram below is a seismogram of the famous San Francisco earthquake of 1906, recorded at a seismic station located 6,400 kilometers from San Francisco.

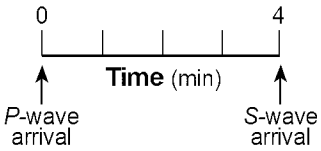


Which time scale *best* represents the arrival-time difference between *P*-waves and *S*-waves at this station?

A)


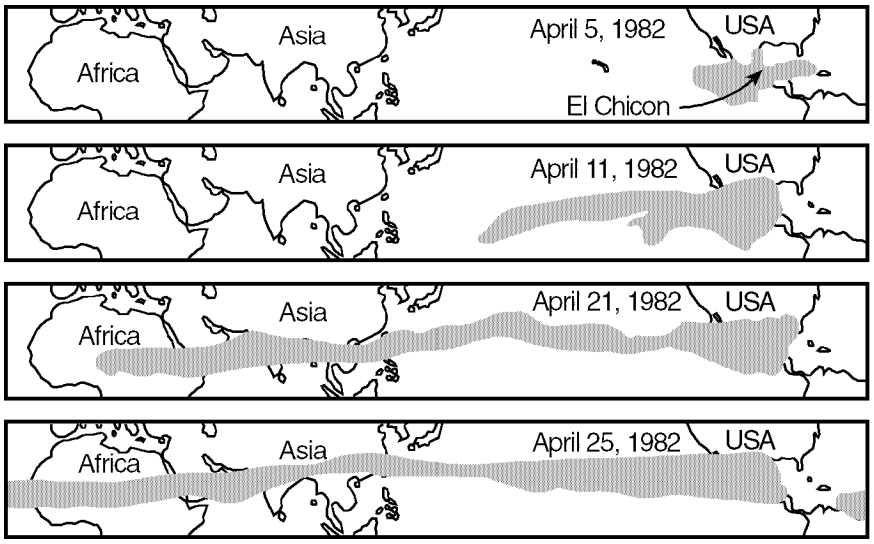
B)


C)


D)


Questions 832 through 835 refer to the following:

The maps below show the spread of a volcanic ash cloud from the 1982 eruption of El Chicon in Mexico, as seen from weather satellites.



832) State what caused the *main* ash cloud to spread in the pattern shown on the map of April 25, 1982.

833) As the ash cloud moved away from El Chichon, some ash particles fell back to Earth.

(a) Describe how the size of the particles affected the pattern of deposition.

(b) Describe how the density of the particles affected the pattern of deposition.

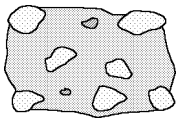
834) State the most likely effect of the ash cloud on the temperature of areas under the cloud on April 25, 1982.

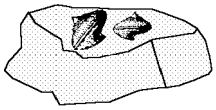
835) Identify the direction toward which the ash cloud spread from April 5 to April 25.

836) In general, the probability of flooding decreases when there is an increase in the amount of

A) snow melt
B) precipitation
C) infiltration
D) runoff

837) Which rock sample *best* shows the physical properties normally associated with regional metamorphism?

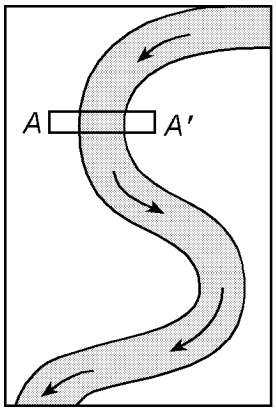
A) 

B) 

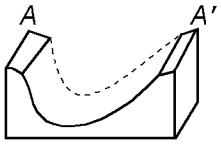
C) 

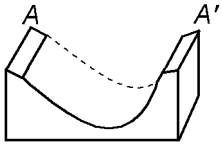
D) 

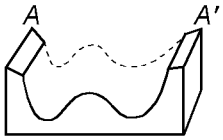
838) The map below shows a meandering river. *A-A′* is the location of a cross section. The arrows show the direction of the riverflow.

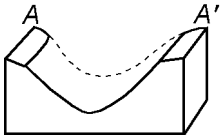


Which cross section *best* represents the shape of the river bottom at *A-A′*?

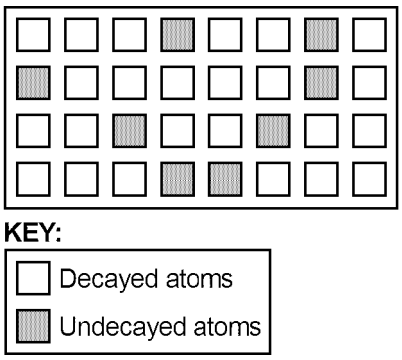
A) 

B) 

C) 

D) 

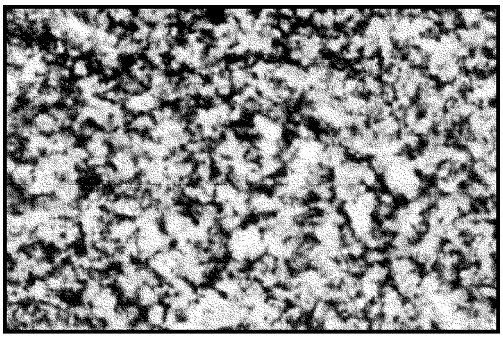
839) The diagram below represents the present number of decayed and undecayed atoms in a sample that was originally 100% radioactive material.



If the half-life of the radioactive material is 1,000 years, what is the age of the sample represented by the diagram?

A) 4,000 years
B) 3,000 years
C) 1,000 years
D) 2,000 years

840) The photograph below shows actual crystal sizes in a light-colored igneous rock that contains several minerals, including potassium feldspar, quartz, and biotite mica.



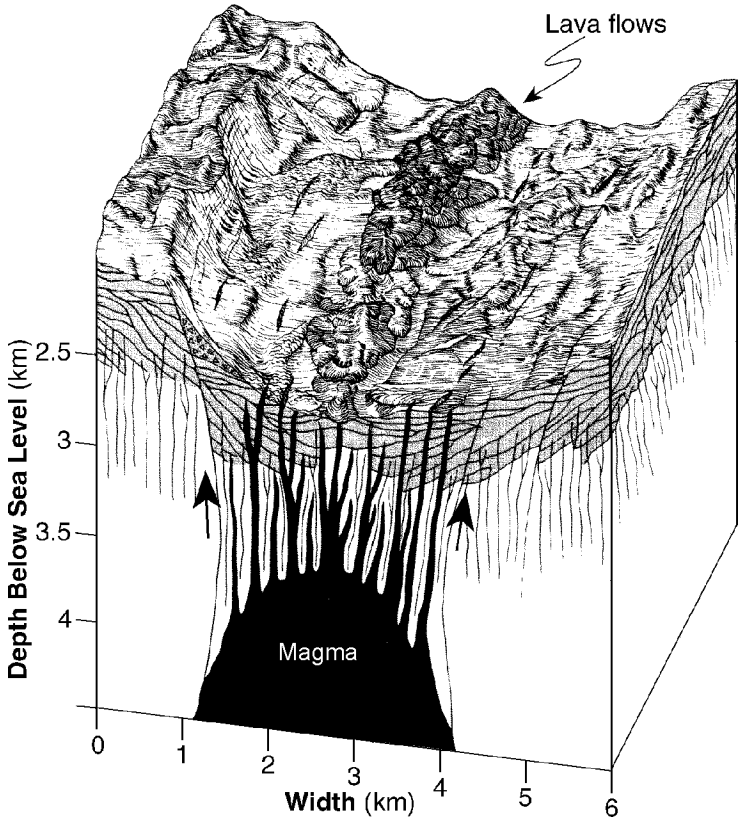
(shown actual size)

The rock should be identified as

A) basalt B) granite C) rhyolite D) gabbro

Questions 841 through 843 refer to the following:

The diagram below shows details of a section of a rift valley in the center of a mid-ocean ridge. The vertical lines in the diagram represent faults and fractures within the ocean floor bedrock.



841) The dark-colored lava flows shown in the diagram were pushed from the magma chamber onto the surface of the ocean floor. Which characteristics are present in the solid rock that formed when the lava flows cooled?

A) generally small grain size and felsic composition
B) generally large grain size and felsic composition
C) generally small grain size and mafic composition
D) generally large grain size and mafic composition

842) What will be the primary result of the continuation of the geologic processes indicated at the location shown in the diagram?

A) New oceanic crust will form.
B) Earth's circumference will increase.
C) Earth's magnetic field will reverse direction.
D) Continental crust will be forced downward.

843) Which type of crustal plate boundary is shown in the diagram?

A) convergent B) universal C) transform D) divergent

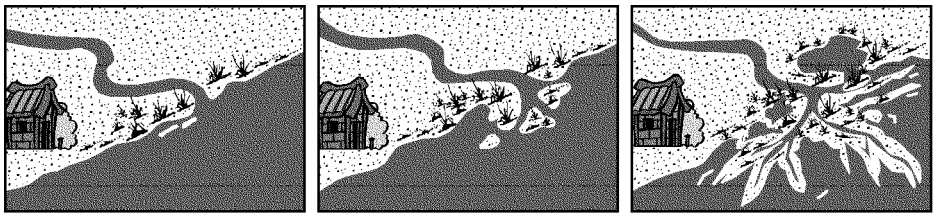
844) Which *two* New York State landscape regions are formed mostly of surface bedrock that is approximately the same geologic age?

A) Erie-Ontario Lowlands and Adirondack Mountains
B) Manhattan Prong and Atlantic Coastal Plain
C) Tug Hill Plateau and St. Lawrence Lowlands
D) Adirondack Mountains and Allegheny Plateau

845) The average temperature at Earth's North Pole is colder than the average temperature at the Equator because the Equator

A) has more cloud cover
B) has a thicker atmosphere
C) receives less ultraviolet radiation
D) receives more intense insolation

846) The diagrams below show gradual stages 1, 2, and 3 in the development of a river delta where a river enters an ocean.

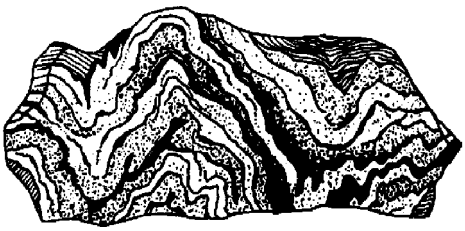


Stage 1 Stage 2 Stage 3

Which statement *best* explains why the river delta is developing at this site?

A) The rate of deposition is greater than the rate of erosion.
B) Sea level is slowly falling.
C) Sea level is slowly rising.
D) The rate of deposition is less than the rate of erosion.

847) The diagram below shows a rock with deformed structure and intergrown crystals.



The rock was probably formed by

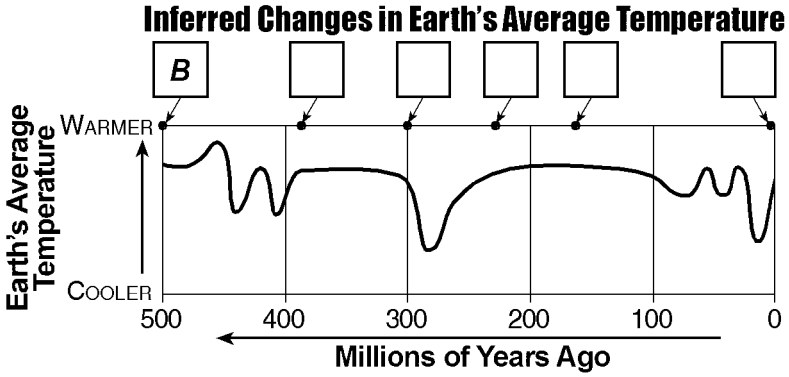
A) heat and pressure that changed a preexisting rock
B) sediments that were deposited on the ocean floor
C) a meteor impact on Earth's surface
D) volcanic lava that cooled on Earth's surface

Questions 848 and 849 refer to the following:

The table below labeled “Animal Key” shows symbols to represent various animal groups that exist on Earth. The graph below shows inferred changes in Earths average temperatures over the last 500 million years.

ANIMAL KEY:

Letter	*A*	*B*	*C*	*D*	*E*	*F*
Picture						
Animal Group	Birds	Fish	Amphibians	Mammals	Humans	Reptiles



848) The two factors listed below could have caused the temperature variations shown on the given graph.

FACTORS:

(*A*) Increase in carbon dioxide (CO_2) and water vapor (H_2O gas) content of Earth's atmosphere.
(*B*) Increase in volcanic ash in Earth's atmosphere.

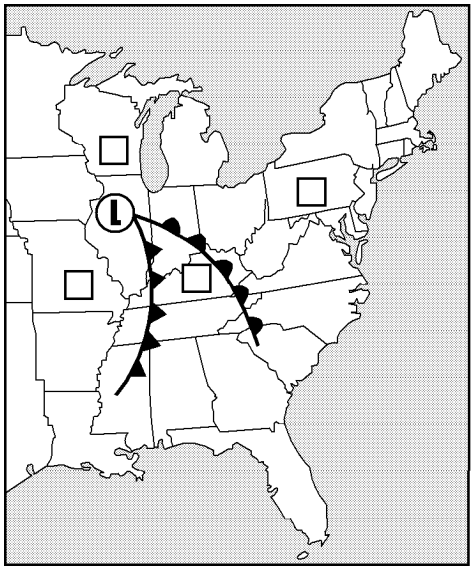
For each factor, state the effect that the increase described would have had on Earth's temperature, and explain why that temperature change would have taken place.

849) On the given graph, indicate when each of the life-forms in the table is believed to have first appeared on Earth by placing the letter for each animal group in the correct box. [*The correct location for earliest fish, letter B, has already been plotted in the graph.*]

850) During which phase change of water is the *most* energy released into the environment?

A) water freezing
B) ice melting
C) water vapor condensing
D) water evaporating

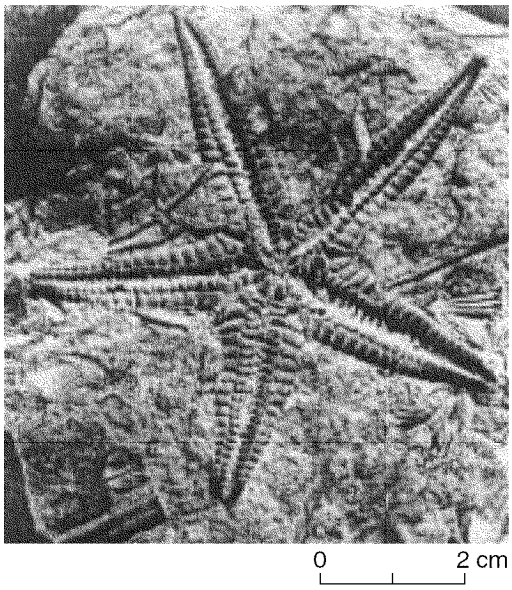
851) The weather map below shows a typical midlatitude low-pressure system centered in Illinois.



(a) On this weather map, indicate which boxed area has the *highest* surface air temperatures by marking an **X** in one of the four boxes on the map.

(b) On the weather map above, draw an arrow to predict the normal storm track that this low-pressure center would be expected to follow.

852) The Devonian-aged siltstone shown in the photograph below occurs as surface bedrock near Hamilton, New York.



What does the presence of the fossils suggest about the Hamilton area during the Devonian?

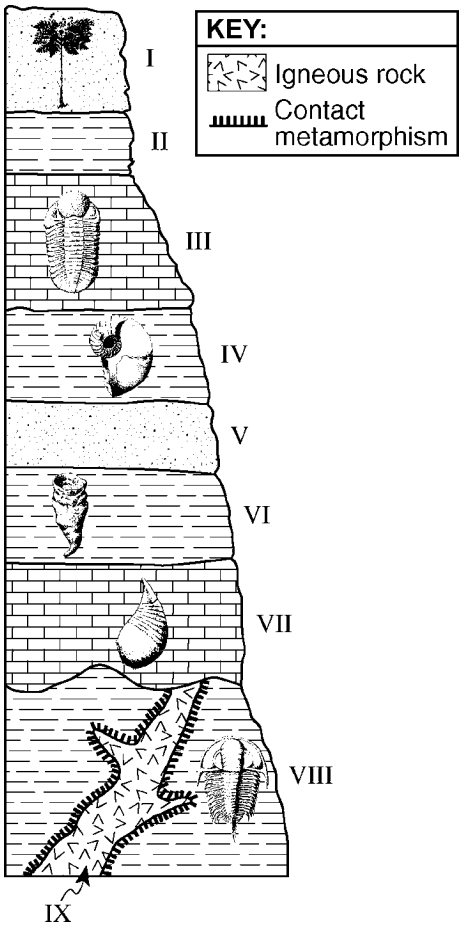
A) It had a marine environment sometime between 418 and 362 million years ago.
B) It had a marine environment sometime between 443 and 418 million years ago.
C) It had a terrestrial environment sometime between 418 and 362 million years ago.
D) It had a terrestrial environment sometime between 443 and 418 million years ago.

853) How are the minerals biotite mica and muscovite mica different?

A) Biotite mica contains iron and/or magnesium, but muscovite mica does not.
B) Biotite mica is colorless, but muscovite mica is not.
C) Muscovite mica scratches quartz, but biotite mica does not.
D) Muscovite mica cleaves into thin sheets, but biotite mica does not.

Questions 854 through 856 refer to the following:

A cross section of a bedrock outcrop is shown below. Index fossils found in some of the rock units are also shown. The rock units are labeled *I* through *IX*.



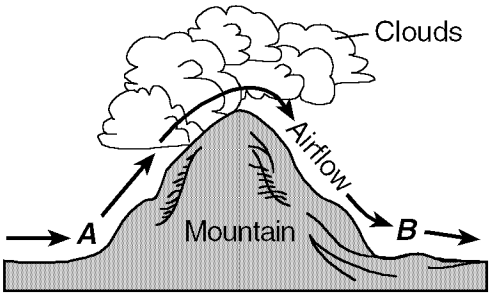
854) The fossil shown in rock unit *VIII* in the diagram is a member of an extinct group of fossils. State *two* other index fossils that are also members of the same group of extinct fossils.

855) For the cross section shown, number the relative age of rock units *VII*, *VIII*, and *IX* from 1 to 3, with number 1 indicating the oldest rock and number 3 indicating the youngest rock.

856) Based on the fossils shown in the limestone and shale layers of the cross section, state the type of environment in which these sedimentary rocks were deposited.

Questions 857 and 858 refer to the following:

In the diagram of the mountain below, the arrows represent the direction of airflow over the mountain.



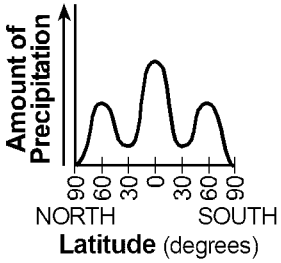
857) Compared to the temperature and humidity conditions at location *A*, the conditions at location *B* are

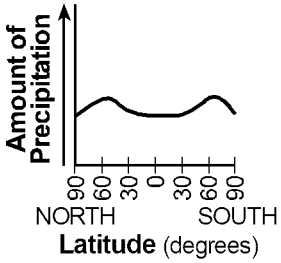
A) cooler and more humid
B) warmer and less humid
C) warmer and more humid
D) cooler and less humid

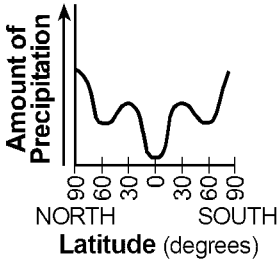
858) As the air moves up the windward side of the mountain shown, the air

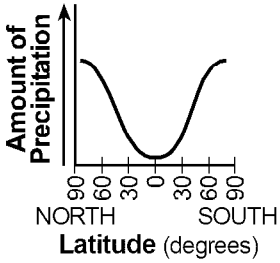
A) expands and warms
B) compresses and warms
C) expands and cools
D) compresses and cools

859) Which graph *best* shows the average annual amounts of precipitation received at different latitudes on Earth?

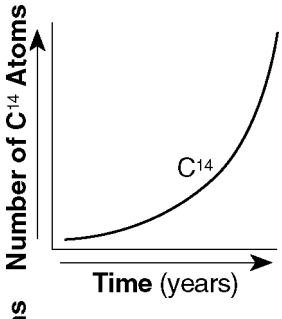
A)


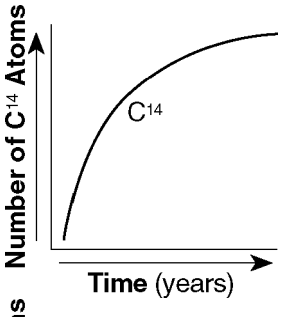
B)


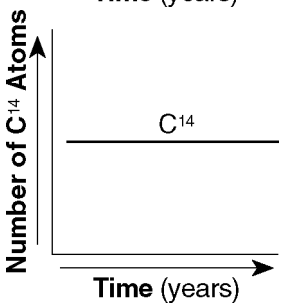
C)


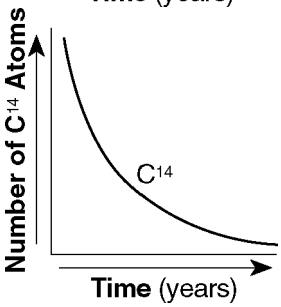
D)


860) Which graph *best* shows the radioactive decay of carbon-14?

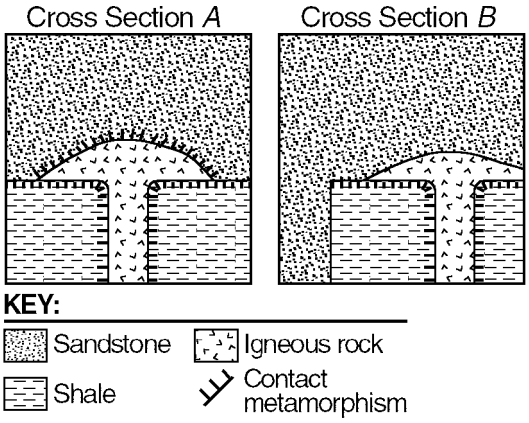
A)


C)


B)


D)


861) The diagrams below represent two different geologic cross sections in which an igneous formation is found in sedimentary bedrock layers. The layers have not been overturned.



Which one of the following statements *best* describes the relative age of each igneous formation compared to the overlying sandstone bedrock?

A) In *A*, the igneous rock is younger than the sandstone and in *B*, the igneous rock is older than the sandstone.
B) In both *A* and *B*, the igneous rock is younger than the sandstone.
C) In both *A* and *B*, the igneous rock is older than the sandstone.
D) In *A*, the igneous rock is older than the sandstone and in *B*, the igneous rock is younger than the sandstone.

862) Which two ocean currents are *both* warm currents that primarily flow away from the equator?

A) Alaska Current and Falkland Current
B) Guinea Current and Labrador Current
C) Brazil Current and Agulhas Current
D) Canaries Current and Gulf Stream Current

863) Fossil pollen has been recovered from sediments deposited in late-Pleistocene lakes. The pollen's geologic age can most accurately be measured by using

A) rubidium-87
B) oxygen-18
C) potassium-40
D) carbon-14

864) The internal atomic structure of a mineral most likely determines the mineral's

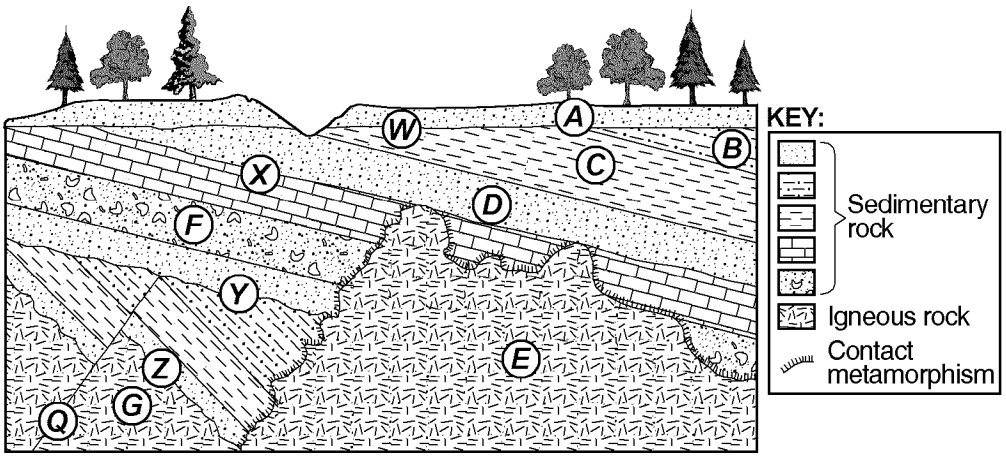
A) size, location, and luster
B) color, streak, and age
C) origin, exposure, and fracture
D) hardness, cleavage, and crystal shape

865) During which process does heat transfer occur because of density differences?

A) conduction
B) radiation
C) reflection
D) convection

Questions 866 through 870 refer to the following:

On the geologic cross section of bedrock below, *A* through *G* identify rock layers and *Q* represents a fault. Lines *W*, *X*, *Y*, and *Z* are locations of unconformities. The rocks have not been overturned.



866) Which rock most likely formed in the zone of contact between rock *E* and rock *F* in the given diagram?

A) metaconglomerate
B) slate
C) obsidian
D) sandstone

867) Which rock or feature in the given diagram is *oldest*?

A) unconformity *Z*
B) fault *Q*
C) rock *A*
D) rock *G*

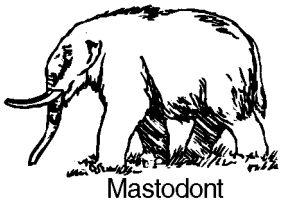
868) The unconformities shown in the cross section represent

A) buried erosional surfaces
B) volcanic ash deposits
C) locations of index fossils
D) boundaries between oceanic and continental crust

869) Rock layers *B*, *C*, and *D* formed during the Devonian Period. Which fossil might be found in these rock layers?

A) 
Elliptocephala

C) 
Phacops

B) 
Mastodont

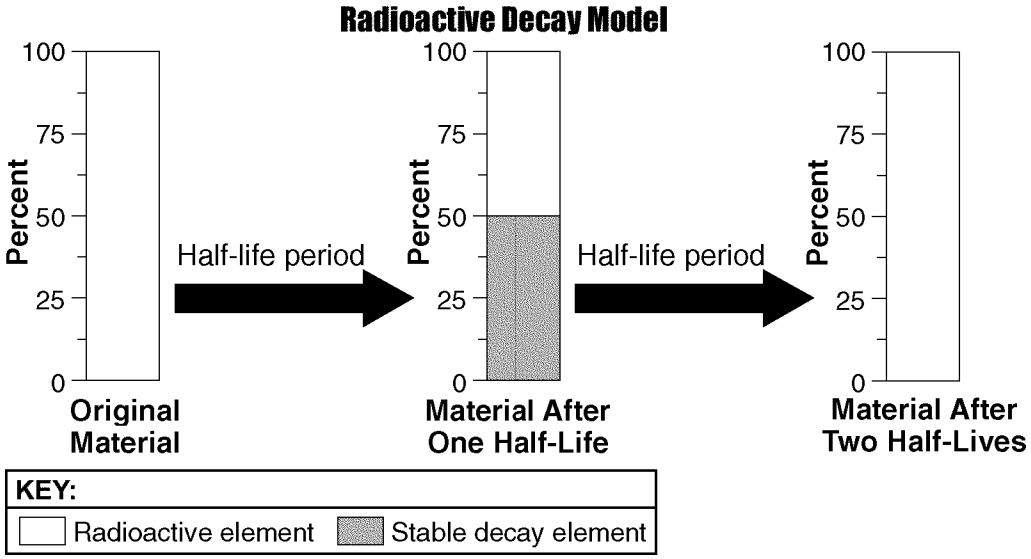
D) 
Cystiphyllum

870) The movement of bedrock along fault *Q* in the given cross section most probably produced

A) an earthquake
B) a volcanic lava flow
C) zones of contact metamorphism
D) gaps in the rock record

Questions 871 and 872 refer to the following:

The diagram below represents a model of the radioactive decay of a particular element. The diagram shows the decay of a radioactive element (□) into the stable decay element (■) after one half-life period.



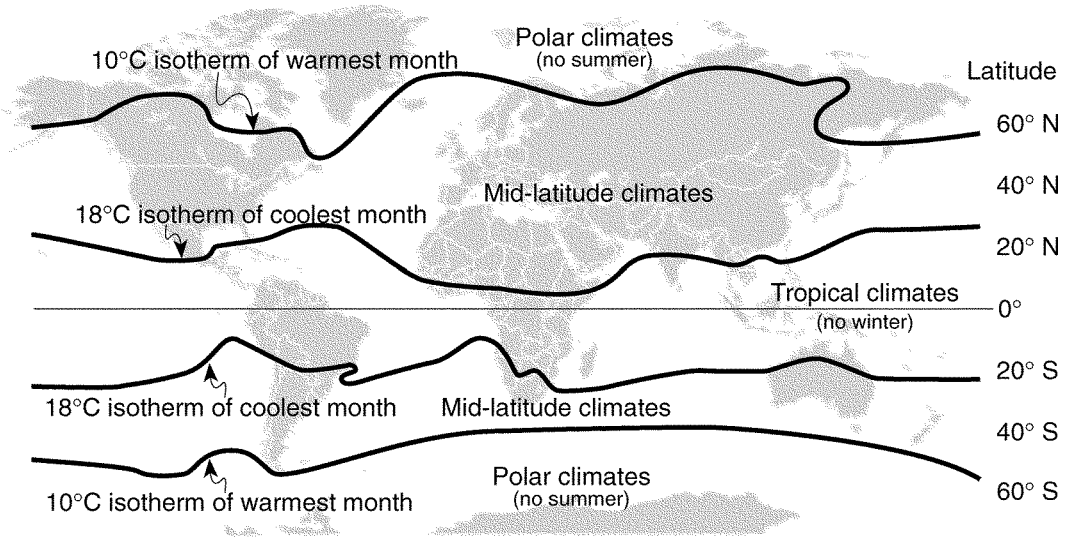
871) On the diagram provided, shade in the amount of stable decay element present after the second half-life period.

872) If the radioactive element in the model shown is carbon-14, how much time will have passed after one half-life?

873) Earth's outer core and inner core are *both* inferred to be
A) composed of a high percentage of iron
B) under the same pressure
C) solid
D) liquid

874) Ocean tides are *best* described as
A) predictable and noncyclic
B) unpredictable and cyclic
C) unpredictable and noncyclic
D) predictable and cyclic

875) The map below shows one method of classifying Earth's surface into latitudinal climate belts. In the tropical climate belt, the average monthly temperatures never drop below 18 °C. In the polar climate belts, the average monthly temperatures never rise above 10 °C. The isotherms show the average monthly temperature of the coolest and warmest months. Effects of elevation have been omitted.



According to the isotherms on the map, locations in the mid-latitude climate belts have average monthly temperatures between what values?

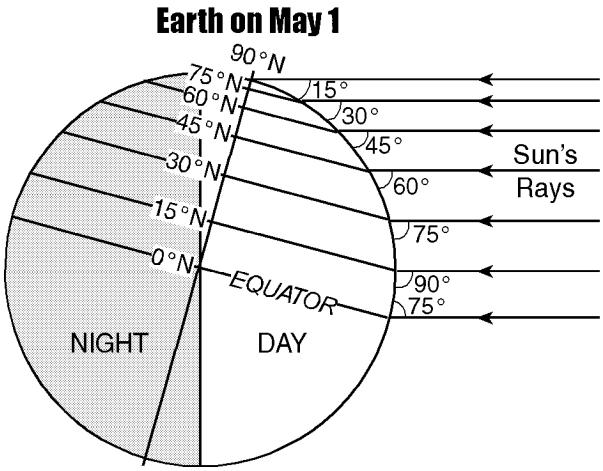
876) According to the *Luminosity and Temperature of Stars* Earth Science reference table, the Sun is classified as a
A) white dwarf star with a temperature of approximately 10,000 °C and a luminosity of 0.01
B) main sequence star with a temperature of approximately 6,000 °C and a luminosity of 1
C) blue supergiant star with a temperature of approximately 20,000 °C and a luminosity of 700,000
D) main sequence star with a temperature of approximately 4,000 °C and a luminosity of 100

877) Which two rocks have the *most* similar mineral composition?

A) quartzite and rock salt
B) marble and rhyolite
C) limestone and basalt
D) granite and phyllite

Questions 878 and 879 refer to the following:

The diagram below shows the angle of the Sun's noontime rays received at different Earth latitudes on May 1.



878) At which latitude in the given diagram can the noontime Sun be observed in the northern part of the sky?

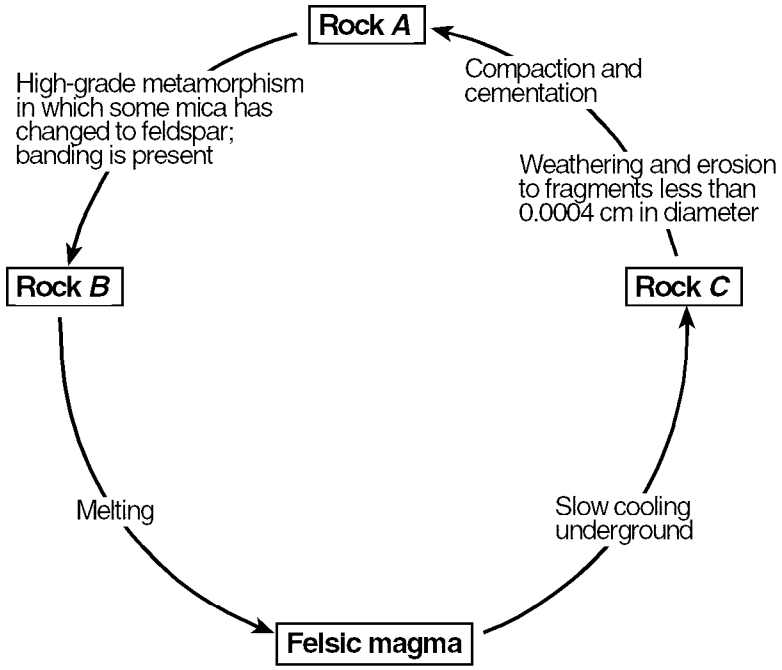
A) 90°N
B) 60°N
C) 0°
D) 30°N

879) Which changes can be expected to occur at 45°N in the given diagram over the next 30 days?

A) The duration of insolation will decrease and the temperature will increase.
B) The duration of insolation will increase and the temperature will increase.
C) The duration of insolation will increase and the temperature will decrease.
D) The duration of insolation will decrease and the temperature will decrease.

Questions 880 and 881 refer to the following:

The diagram below represents a rock cycle.



880) State the specific names of rocks *A*, *B*, and *C* in the diagram. [*Do not write the terms "sedimentary," "igneous," and "metamorphic."*]

881) State *one* condition or process that would cause the high-grade metamorphism of rock *A*.

882) In New York State, dry, cool air masses (**cP**) often interact with moist, warm air masses (**mT**). Which statement correctly matches each air mass with its usual geographic source region?

A) **cP** is from northern Canada and **mT** is from the Gulf of Mexico.
B) **cP** is from northern Canada and **mT** is from the deserts of the southwestern United States.
C) **cP** is from the North Atlantic Ocean and **mT** is from the Gulf of Mexico.
D) **cP** is from the North Atlantic Ocean and **mT** is from the deserts of the southwestern United States.

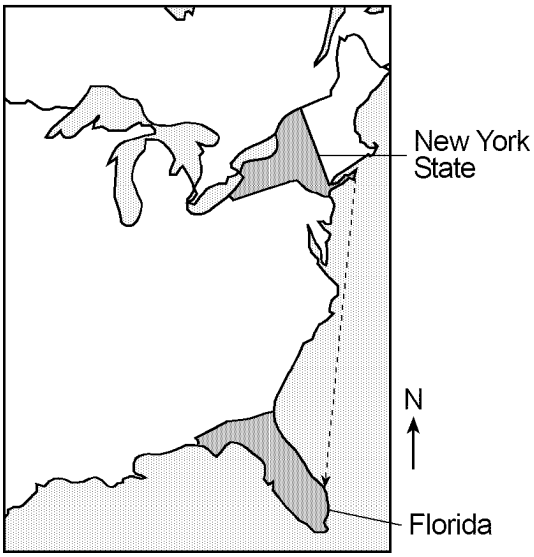
883) The table below gives information about the radioactive decay of carbon-14.

Half-life	Mass of Original Carbon-14 Remaining (grams)	Number of Years
0	1	0
1	$\frac{1}{2}$	5,700
2	$\frac{1}{4}$	11,400
3	$\frac{1}{8}$	17,100
4	$\frac{1}{16}$	
5		
6		
7		

After how many years will $\frac{1}{128}$ gram of the original carbon-14 remain?

A) 22,800 yr B) 34,200 yr C) 39,900 yr D) 28,500 yr

884) The dashed line on the map below shows a ship's route from Long Island, New York, to Florida. As the ship travels south, the star Polaris appears lower in the northern sky each night.



The *best* explanation for this observation is that Polaris

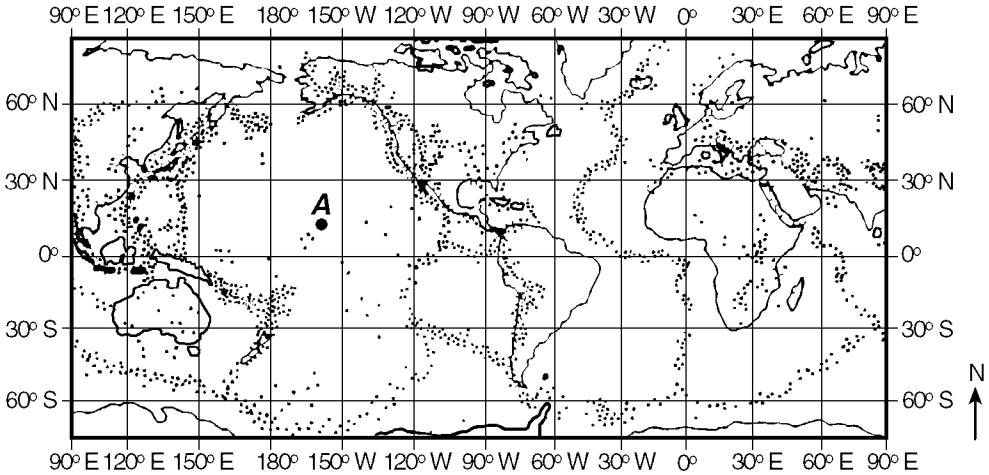
A) is located directly over Earth's Equator
B) is located directly over Earth's North Pole
C) rises and sets at different locations each day
D) has an elliptical orbit around Earth

885) A stream with a water velocity of 150 centimeters per second decreases to a velocity of 100 centimeters per second. Which sediment size will most likely be deposited?

A) boulders B) pebbles C) sand D) cobbles

Questions 886 and 887 refer to the following:

The dots on the map below show the distribution of major earthquake epicenters. The shaded circle labeled *A* represents a location on Earth's surface.



886) Location *A* in the given diagram is *best* described as an area that is
- A) within a rift valley at a mid-ocean ridge
- B) above a mantle hot spot near the center of a crustal plate
- C) within a deep-sea trench between two converging plates
- D) at the boundary between two diverging plates

887) Which one of the following conclusions can *best* be inferred from the data shown on the given map?
- A) Most earthquakes occur west of the Prime Meridian and north of the Equator.
- B) Most earthquakes are concentrated in zones along plate boundaries.
- C) Earthquakes generally are evenly distributed over the surface of Earth.
- D) Most earthquakes occur on continents.

888) Which element is *most* abundant in Earth's lithosphere?
- A) oxygen
- B) hydrogen
- C) nitrogen
- D) silicon

889) The large coal fields found in Pennsylvania provide evidence that the climate of the northeastern United States was much warmer during the Carboniferous Period. This change in climate over time is *best* explained by the
- A) evolution of life
- B) effects of seasons
- C) movements of tectonic plates
- D) changes in the environment caused by humans

Questions 890 through 893 refer to the following:

The reading passage below discusses acid rain. Map *I* below shows the locations of some major United States producers of nitrogen oxide and sulfur dioxide that are released into Earth's atmosphere. Map *II* below shows the pH concentration of acid rain in the United States.

ACID RAIN

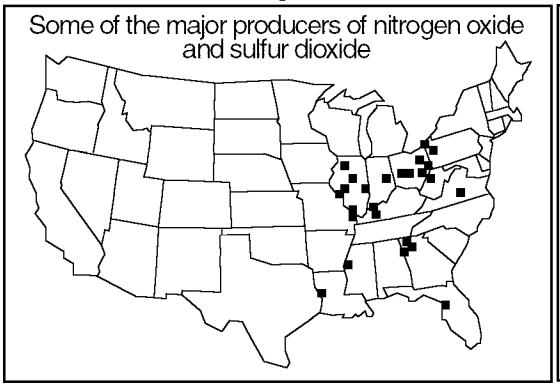
Acid deposition consists of acidic substances that fall to Earth. The *most* common type of acid deposition is rain containing nitric acid and sulfuric acid. Acid rain forms when nitrogen oxide and sulfur dioxide gases combine with water and oxygen in the atmosphere.

Human-generated sulfur dioxide results primarily from coal-burning electric utility plants and industrial plants. Human-generated nitrogen oxide results primarily from burning fossil fuels in motor vehicles and electric utility plants.

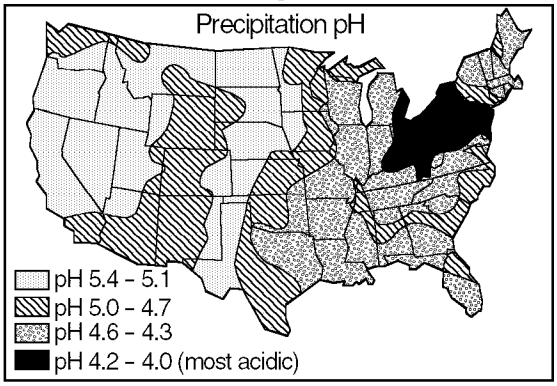
Natural events, such as volcanic eruptions, forest fires, hot springs, and geysers, also produce nitrogen oxide and sulfur dioxide.

Acid rain affects trees, human-made structures, and surface water. Acid damages tree leaves and decreases the tree's ability to carry on photosynthesis. Acid also damages tree bark and exposes trees to insects and disease. Many statues and buildings are composed of rocks containing the mineral calcite, which reacts with acid and chemically weathers more rapidly than other common minerals. Acid deposition lowers the pH of surface water. Much of the surface water of the Adirondack region has pH values too acidic for plants and animals to survive.

Map I



Map II



890) State *one* reason that the northeastern part of the United States has more acid deposition than other regions of the country.

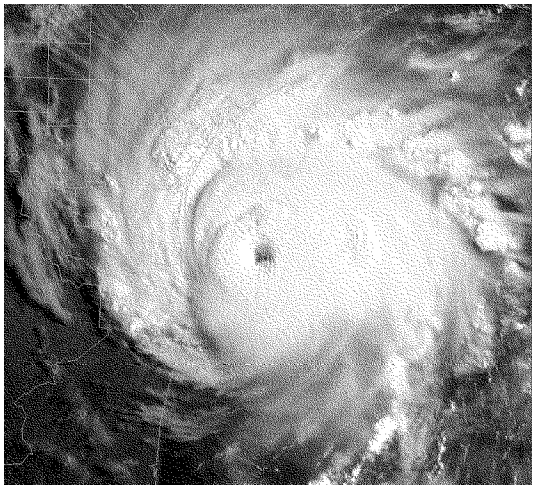
891) Explain why completely eliminating human-generated nitrogen oxide and sulfur dioxide will *not* completely eliminate acid deposition.

892) Describe *one* law that could be passed by the government to prevent some of the problems of acid deposition.

893) State *one* sedimentary or *one* metamorphic rock that is most chemically weathered by acid rain.

Questions 894 through 897 refer to the following:

The satellite image below shows a Northern Hemisphere hurricane.



894) Which air mass is normally associated with the formation of hurricanes?

A) maritime tropical
B) maritime polar
C) continental polar
D) continental tropical

895) When the eye of the hurricane shown reaches 43° N latitude, the hurricane will most likely be pushed by planetary winds toward the

A) northeast
B) northwest
C) southwest
D) southeast

896) Clouds form in the hurricane shown because the air is

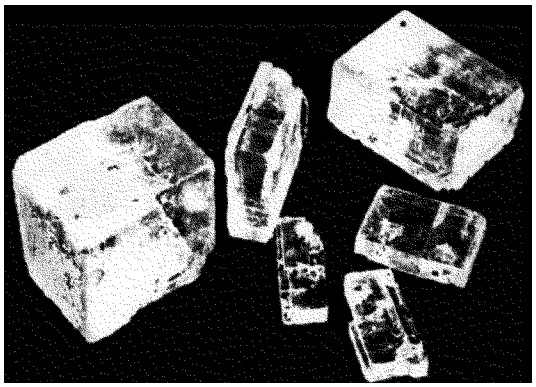
A) rising, expanding, and cooling
B) rising, compressing, and warming
C) sinking, compressing, and warming
D) sinking, expanding, and cooling

897) What is the usual surface wind pattern around the eye of a Northern Hemisphere hurricane, as shown in the satellite image?

A) clockwise and outward
B) clockwise and inward
C) counterclockwise and inward
D) counterclockwise and outward

Questions 898 and 899 refer to the following:

The photograph below shows several broken samples of the same colorless mineral.



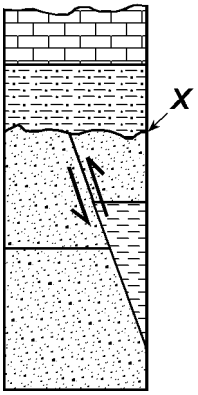
898) Which mineral is most likely shown in the photograph?

A) galena B) calcite C) quartz D) halite

899) Which physical property of the mineral is most easily seen in the photograph?

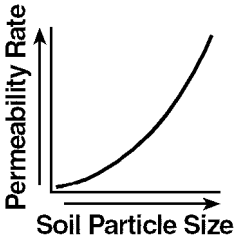
A) fracture B) streak C) cleavage D) hardness

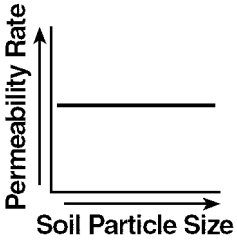
900) The diagram below shows a cross section of New York State bedrock that has not been overturned. Line *X* represents an unconformity.

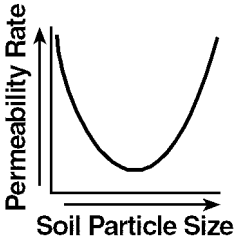


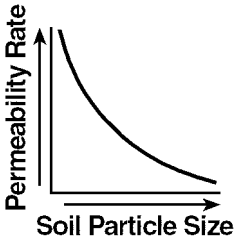
The index fossil *Eurypterus* is found in the limestone layer. What trilobite index fossil could be found in the shale layer?

901) Which graph *best* represents the general relationship between soil particle size and the permeability rate of infiltrating rainwater?

A) 

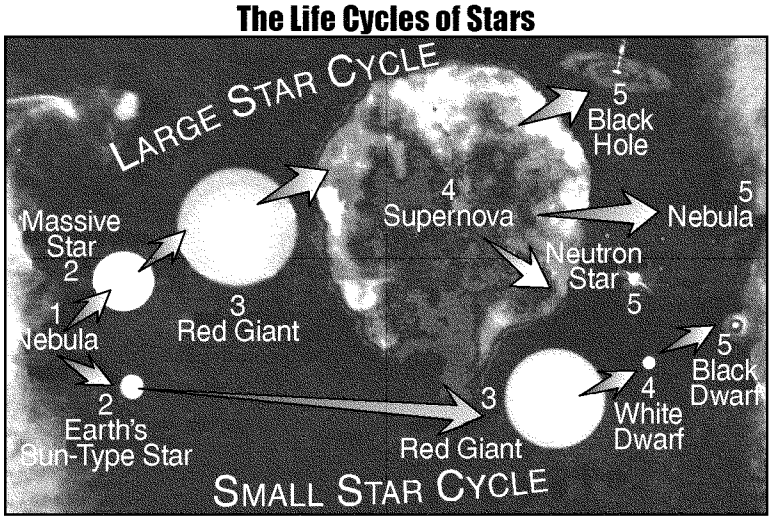
C) 

B) 

D) 

Questions 902 through 904 refer to the following:

The diagram below shows two possible sequences in the life cycle of stars, beginning with their formation from nebular gas clouds in space.



902) Stars like Earth's Sun most likely formed directly from a

A) red giant B) nebula C) black dwarf D) supernova

903) According to the given diagram, a star like Earth's Sun will eventually

A) become a neutron star
B) explode in a supernova
C) change into a white dwarf
D) become a black hole

904) According to the given diagram, the life-cycle path followed by a star is determined by the star's initial

A) temperature and origin
B) luminosity and color
C) luminosity and structure
D) mass and size

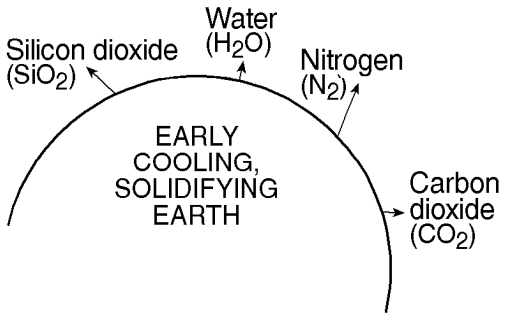
905) Earth is farthest from the Sun during the Northern Hemisphere's summer, and Earth is closest to the Sun during the Northern Hemisphere's winter. During which season in the Northern Hemisphere is Earth's orbital velocity *greatest*?

A) fall B) winter C) summer D) spring

906) Bedrock of which four consecutive geologic periods is *best* preserved in New York State?

A) Devonian, Carboniferous, Permian, Triassic
B) Cambrian, Ordovician, Silurian, Devonian
C) Jurassic, Cretaceous, Tertiary, Quaternary
D) Permian, Triassic, Jurassic, Cretaceous

907) The diagram below shows four different chemical materials escaping from the interior of early Earth.



Which material contributed *least* to the early composition of the atmosphere?

A) CO_2 B) SiO_2 C) H_2O D) N_2

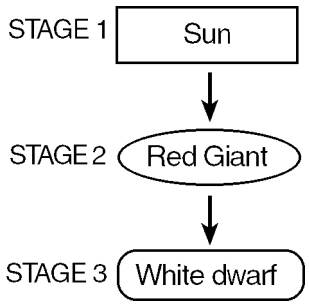
908) According to the *Geologic History of New York State* in the Earth Science Reference Tables, the inferred latitude of New York State 362 million years ago was *closest* to

A) the Equator
B) 45° south
C) the North Pole
D) where it is now

909) Earth's outer core is *best* inferred to be

A) solid, with an average density of approximately 11 g/cm^3
B) liquid, with an average density of approximately 4 g/cm^3
C) solid, with an average density of approximately 4 g/cm^3
D) liquid, with an average density of approximately 11 g/cm^3

910) Stars are believed to undergo evolutionary changes over millions of years. The flowchart below shows stages of predicted changes in the Sun.

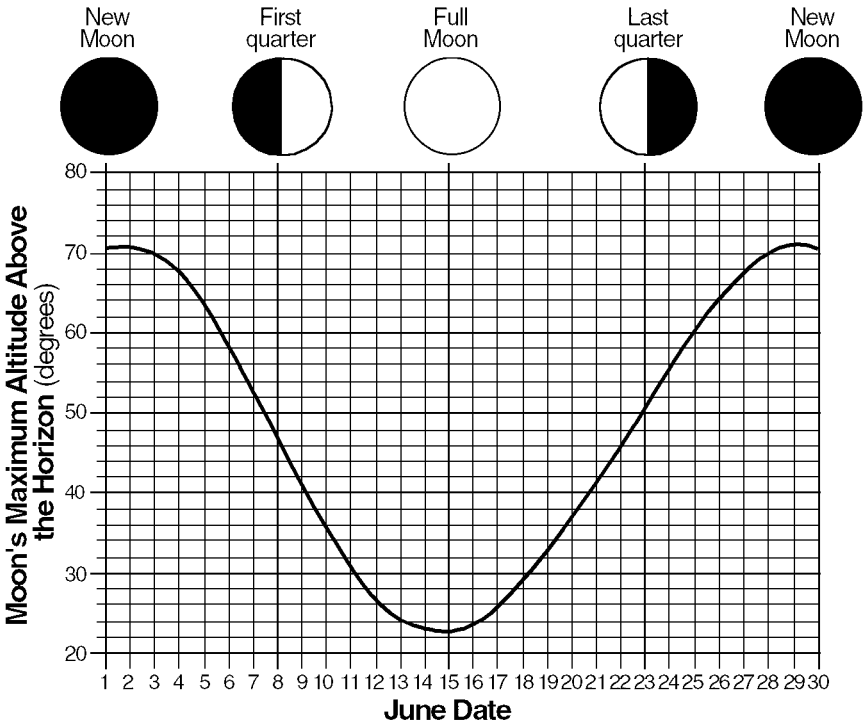


According to the *Luminosity and Temperature of Stars* Earth Science reference table and the flowchart above, the Sun will become

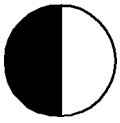
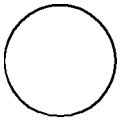
A) cooler and brighter in stage 2, then hotter and dimmer in stage 3
B) hotter and brighter in stage 2, then cooler and dimmer in stage 3
C) cooler and dimmer in stage 2, then hotter and brighter in stage 3
D) hotter and dimmer in stage 2, then cooler and brighter in stage 3

Questions 911 through 914 refer to the following:

The graph below shows the maximum altitude of the Moon, measured by an observer located at a latitude of 43° N during June in a particular year. The names and appearance of the four major Moon phases are shown at the top of the graph, directly above the date on which the phase occurred.



911) Which diagram *best* represents the Moon's phase observed on June 11?

A) 
B) 
C) 
D) 

912) Which city is *closest* in latitude to the location where these observations were made?

A) Albany
B) New York City
C) Binghamton
D) Syracuse

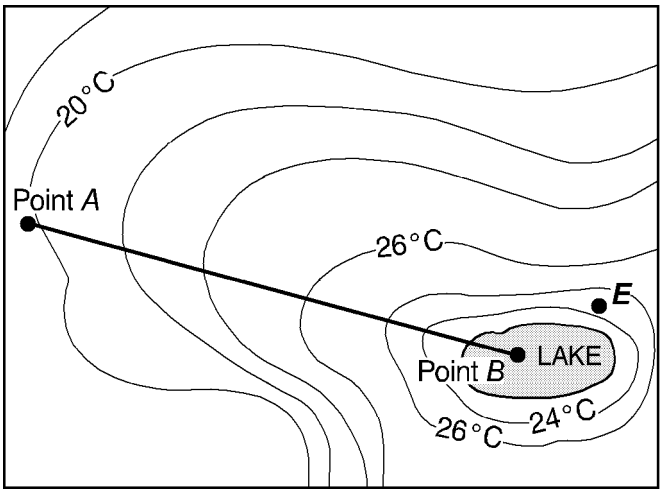
913) Which terms describe *both* the changes in the maximum altitude of the Moon and the changes in the Moon's phases over a period of several years?

A) noncyclic and predictable
B) cyclic and predictable
C) cyclic and unpredictable
D) noncyclic and unpredictable

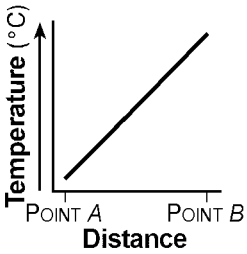
914) What was the maximum altitude of the Moon on June 22?

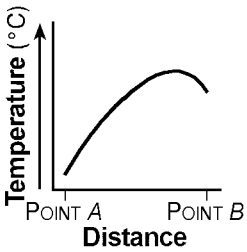
A) 43°
B) 46°
C) 40°
D) 50°

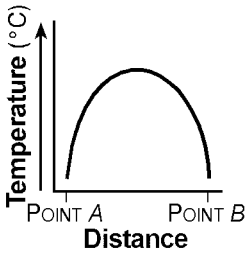
915) The temperature field map below represents surface air temperatures within a park. The location of a lake within the park is also indicated.

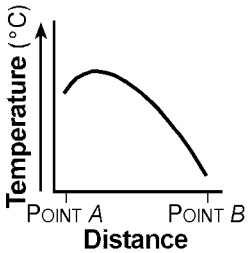


Which graph *best* represents the temperature profile along a straight line from point *A* to point *B*?

A)


B)


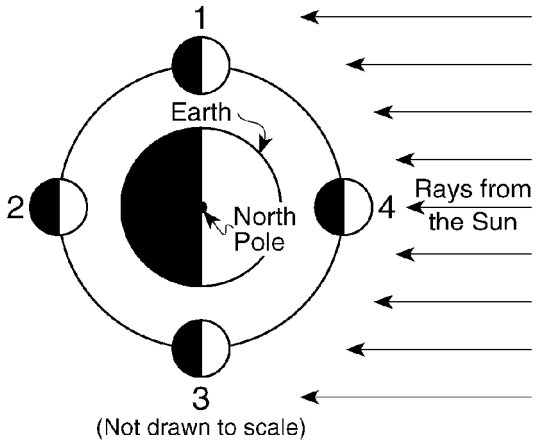
C)


D)


916) A student determines the density of a mineral to be 1.5 grams per cubic centimeter. If the accepted value is 2.0 grams per cubic centimeter, what is the student's percent deviation (percent error)?

A) 33.3%
B) 25.0%
C) 50.0%
D) 40.0%

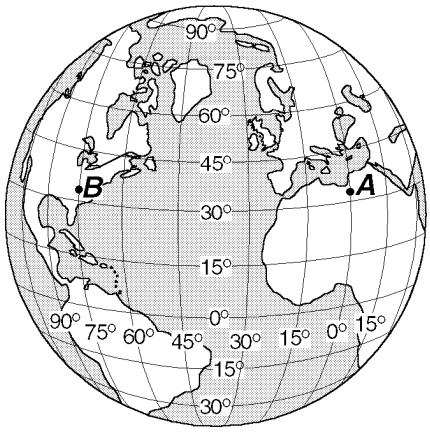
917) The diagram below shows the Moon at four positions in its orbit around Earth.



An observer on Earth could see a solar eclipse when the Moon is at position

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

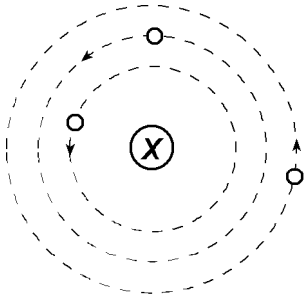
918) The diagram below shows the latitude-longitude grid on an Earth model. Points *A* and *B* are locations on the surface.



On Earth, the solar time difference between point *A* and point *B* would be

A) 24 hours B) 12 hours C) 1 hour D) 5 hours

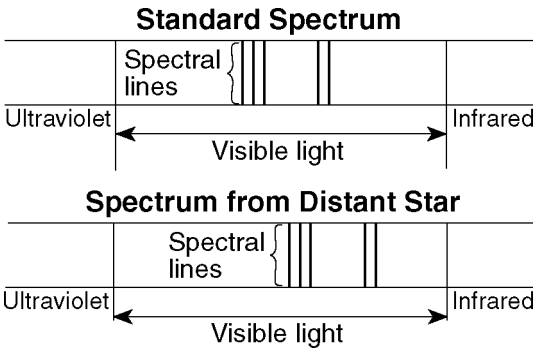
919) The diagram below represents a simple geocentric model. Which object is represented by the letter *X*?



(not drawn to scale)

A) Earth B) Moon C) Sun D) Polaris

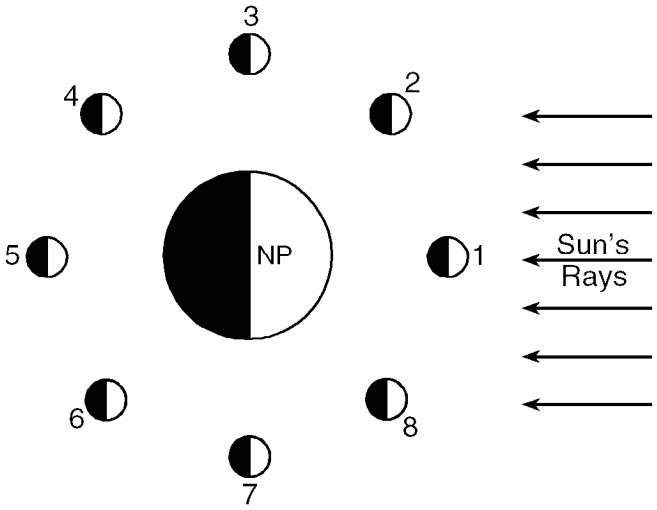
920) The diagram below shows a standard spectrum compared to a spectrum produced from a distant star.



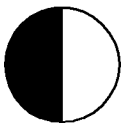
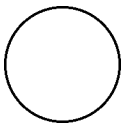
Which conclusion can be made by comparing the standard spectrum to the spectrum produced from this distant star?

A) The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving toward Earth.
B) The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving away from Earth.
C) The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving toward Earth.
D) The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving away from Earth.

921) The diagram below shows the Moon in different positions as it revolves around Earth, as observed from above the North Pole (*NP*).

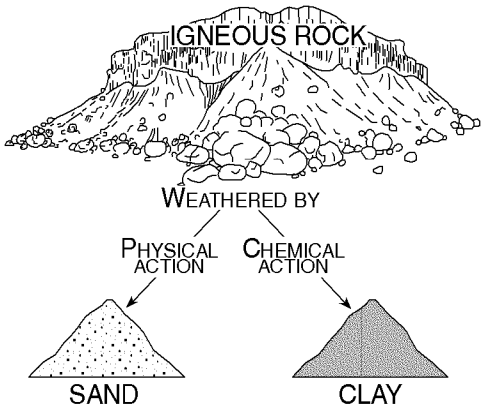


Which image correctly represents the Moon at position 8, as observed from Earth?

A) 
B) 
C) 
D) 

Questions 922 through 924 refer to the following:

The diagram below shows igneous rock that has undergone mainly physical weathering into sand and mainly chemical weathering into clay.



922) Compare the particle size of the physically weathered fragments to the particle size of the chemically weathered fragments in the given diagram.

923) Describe the change in temperature and moisture conditions that would cause an increase in the rate of chemical weathering into clay.

924) If the igneous rock is a layer of vesicular andesite, identify *three* types of mineral grains that could be found in the sand shown in the diagram.

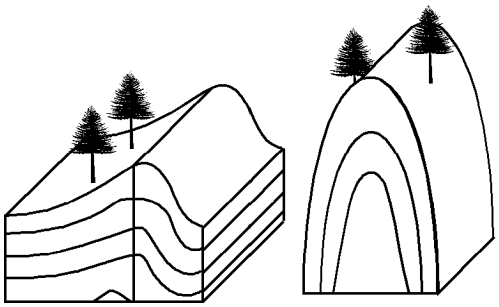
925) Summer days in the continental United States are likely to be hotter than winter days because in summer

A) the Sun gives off more energy
B) Earth's northern axis is tilted toward the Sun
C) the number of sunspots increases
D) Earth is closer to the Sun

926) Landscapes with horizontal bedrock structure, steep slopes, and high elevations are classified as

A) mountain regions
B) lowland regions
C) plain regions
D) plateau regions

927) The cross sections of crust below represent two regions of sedimentary rock layers that have been altered.

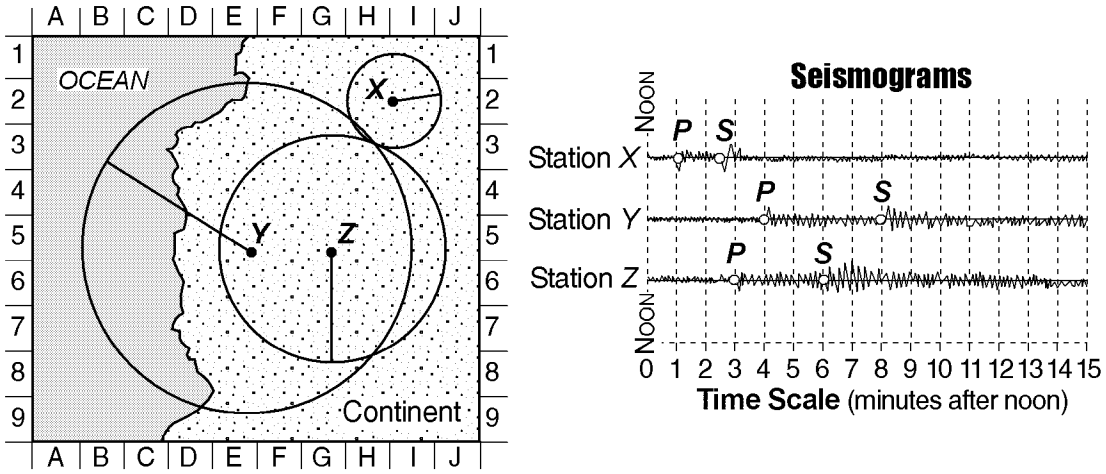


The sedimentary bedrock in *both* regions originally formed as

A) folded layers
B) faulted layers
C) recrystallized layers
D) horizontal layers

Questions 928 through 931 refer to the following:

The diagram below shows three seismograms of the same earthquake recorded at three different seismic stations, *X*, *Y*, and *Z*. The distances from each seismic station to the earthquake epicenter have been drawn on the map. A coordinate system has been placed on the map to describe locations. [*The map scale has not been included.*]



928) The *S*-waves from this earthquake that travel toward Earth's center will

A) be totally reflected off the crust-mantle interface
B) be absorbed by the liquid outer core
C) reach the other side of Earth faster than those that travel around Earth in the crust
D) be deflected by Earth's magnetic field

929) Approximately how far away from station *Y* is the epicenter?

A) 3,900 km
B) 5,200 km
C) 1,300 km
D) 2,600 km

930) Seismic station *Z* is 1,700 kilometers from the epicenter. Approximately how long did it take the *P*-wave to travel to station *Z*?

A) 6 min 30 sec
B) 1 min 50 sec
C) 3 min 30 sec
D) 2 min 50 sec

931) On the map, which location is *closest* to the epicenter of the earthquake?

A) *E*-5 B) *G*-1 C) *H*-8 D) *H*-3

932) Glaciers often form parallel scratches and grooves in bedrock because glaciers

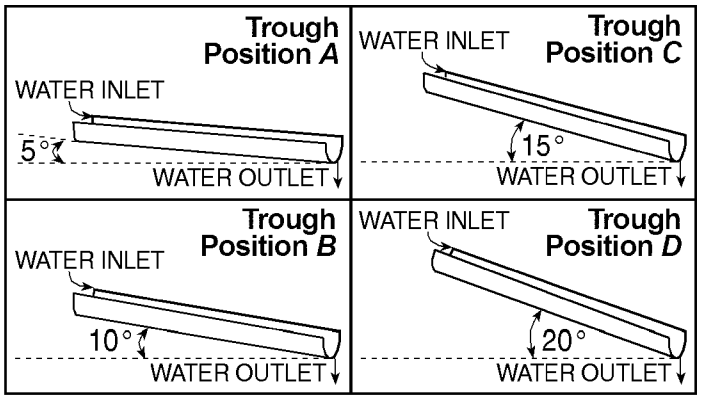
A) drag loose rocks over Earth's surface
B) deposit rounded sand in V-shaped valleys
C) deposit sediment in unsorted piles
D) continually melt and refreeze

933) What is the minimum rate of flow at which a stream of water can maintain the transportation of pebbles 1.0 centimeter in diameter?

A) 50 cm/sec
B) 100 cm/sec
C) 200 cm/sec
D) 150 cm/sec

Questions 934 and 935 refer to the following:

A student used water, a trough, a timer, a Ping-Pong ball, and a metric ruler to investigate waterflow. The trough was set at different angles to compile the data in the data table below.



DATA TABLE

Trough Position	Slope (degrees)	Length of Trough (meters)	Time (seconds)	Velocity (meters/second)
A	5	1.5	4.4	
B	10	1.5	3.5	
C	15	1.5	2.7	
D	20	1.5	2.3	

934) State the purpose of the student's investigation shown.

935) (a) Calculate the average velocity of the water flowing down the trough in each position shown in the diagram, *A*, *B*, *C*, and *D*. Record your answers in the given data table. [*Express your answers to the nearest tenth.*]

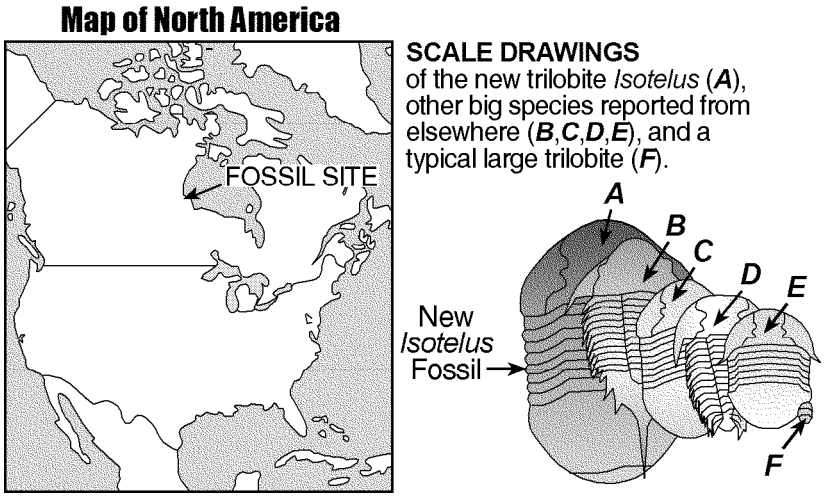
(b) Based on the data and the values you calculated for average stream velocity, state an appropriate conclusion to this investigation.

Questions 936 through 939 refer to the following:

The reading passage below provides some background information about a recent fossil discovery. The map of Canada shows the fossil site. The scale drawing shows the new trilobite fossil compared to other trilobite fossils.

THE WORLD'S BIGGEST TRILOBITE

A team of Canadian paleontologists examining rock units along the shore of Hudson Bay in northern Manitoba has discovered the world's largest recorded complete fossil of a trilobite, a many-legged, sea-dwelling animal inferred to have lived during the late Ordovician Period. The giant creature, measuring 70 centimeters in length, is a new species of the genus *Isotelus*. This remarkable discovery adds to our knowledge of the diversity of life following one of the greatest increases in the number and types of life-forms in history. The new *Isotelus* species existed just before the end of the Ordovician Period.



936) The actual new *Isotelus* fossil is approximately how many times larger than scale drawing *A*?

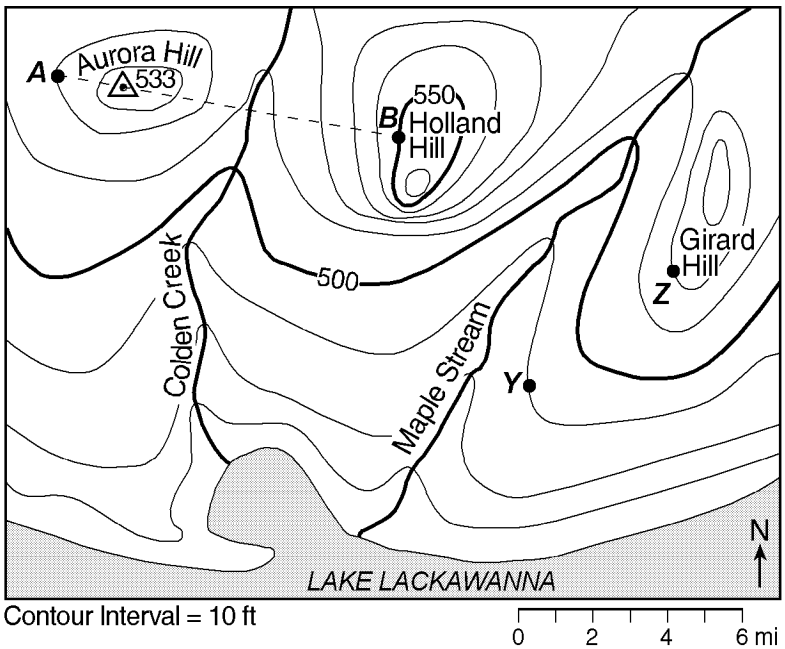
937) What New York State nautiloid index fossil would most likely be found in the bedrock just below the new *Isotelus* fossil shown?

938) In what type of rock was the new *Isotelus* fossil in the given diagram most probably found?

939) At the time the new *Isotelus* fossil in the given diagram lived and died, during the Ordovician Period, what was the approximate latitude of the fossil site according to plate tectonic theory?

Questions 940 through 943 refer to the following:

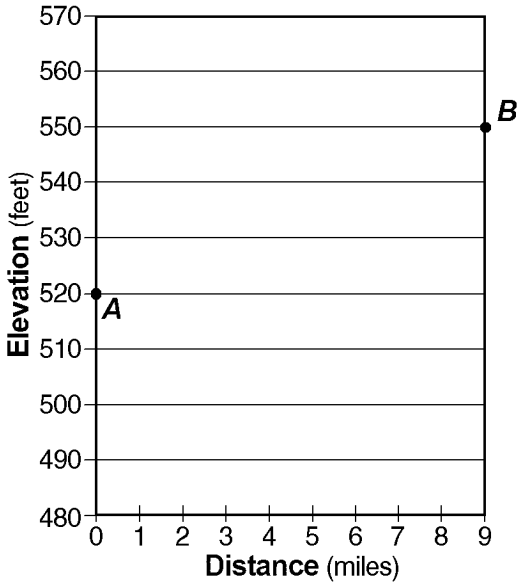
On the topographic map below, points *A*, *B*, *Y*, and *Z* are reference points on the topographic map. The symbol △533 represents the highest elevation on Aurora Hill.



940) On the grid below, construct a topographic profile from point *A* to point *B* by following the directions below.

(a) Plot the elevation along line AB by marking with an **X** each point where a contour line is crossed by line AB. [*Points A and B have been plotted for you.*]

(b) Complete the profile by correctly connecting the plotted points with a smooth, curved line.

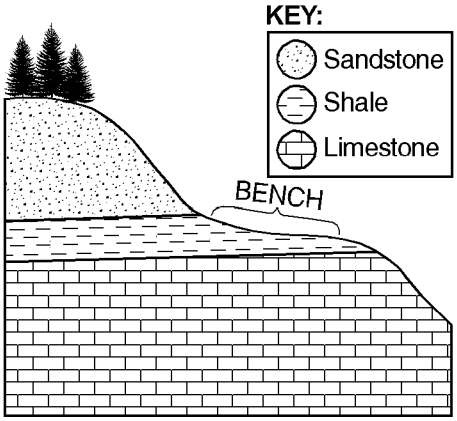


941) Describe the evidence shown on the map that indicates that the southern side of Holland Hill has the *steepest* slope.

942) State the general compass direction in which Maple Stream is flowing.

943) Calculate the gradient between points *Y* and *Z* on the map. [*Label the answer with the correct units*.]

944) The geologic cross section below shows a hill-slope and the rock layers that underlie it.

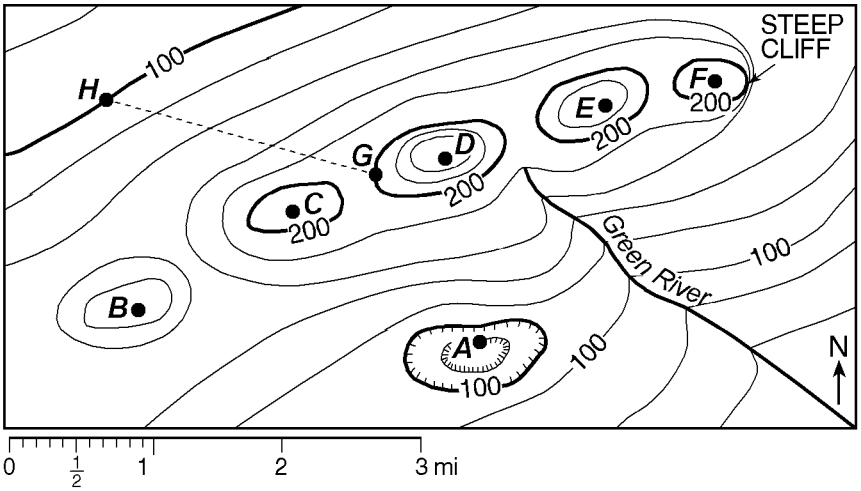


Which difference between the sandstone, shale, and limestone layers caused the formation of the relatively gently sloped section labeled "bench"?

A) rock age
B) amount of uranium-238
C) fossil content
D) resistance to weathering

Questions 945 through 948 refer to the following:

On the contour map below, letters *A* through *H* represent locations in the area represented by the map. Contour lines are labeled in feet.



945) Which letter in the given diagram represents the *highest* elevation?

946) Calculate the gradient of the slope along the dashed line between points *G* and *H* on the given map. [*Label the answer with the correct units.*]

947) State how the shape of the contour lines crossing the Green River in the given map indicates that this river flows toward the southeast.

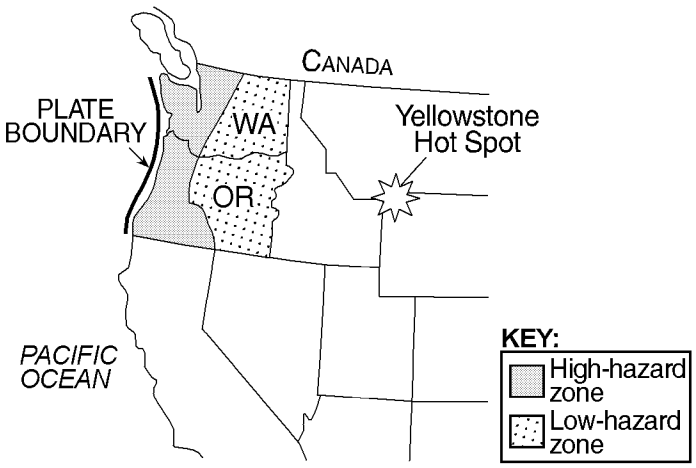
948) Explain how the contour lines on the given map indicate that the location labeled "Steep Cliff" is accurately named.

Questions 949 and 950 refer to the following:

On the map of the western United States below, the states of Washington and Oregon have been labeled. The plate boundary shown on the map is the source area for high-magnitude earthquakes in Washington and Oregon. Two hazardous zones associated with these earthquakes are also shown.

WASHINGTON AND OREGON EARTHQUAKES

Large-magnitude earthquakes have occurred in Washington and Oregon as a result of crustal movement along thrust faults bordering the coasts of these states. Thrust faults occur when one section of Earth's crust slides over another section. Associated with the sudden movement of these thrust faults, coastlines can drop several feet, flooding forests with saltwater. Geologists have discovered evidence from various geologic ages of flooded coastal forests in the bedrock layers of Washington and Oregon. They have also found layers of sandstone thought to have been derived from sand deposits left by tsunamis. Using the rock record, scientists conclude that very large magnitude earthquakes occur every 300 to 500 years with the most recent large quake occurring about 200 years ago.



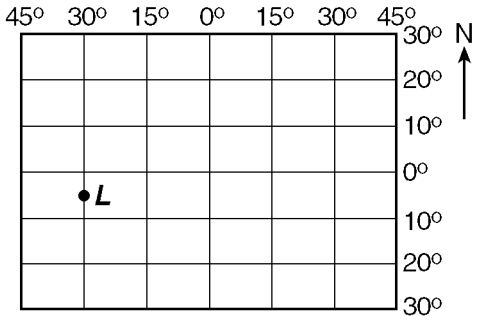
949) (a) What is a tsunami?

(b) State how tsunamis can affect coastal regions.

950) (a) Identify the tectonic plates on *both* sides of the plate boundary shown on the given map.

(b) Identify the type of tectonic plate boundary shown on the map that is responsible for the thrust faults along the Washington and Oregon coastline.

951) The diagram below represents part of Earth's latitude-longitude system.



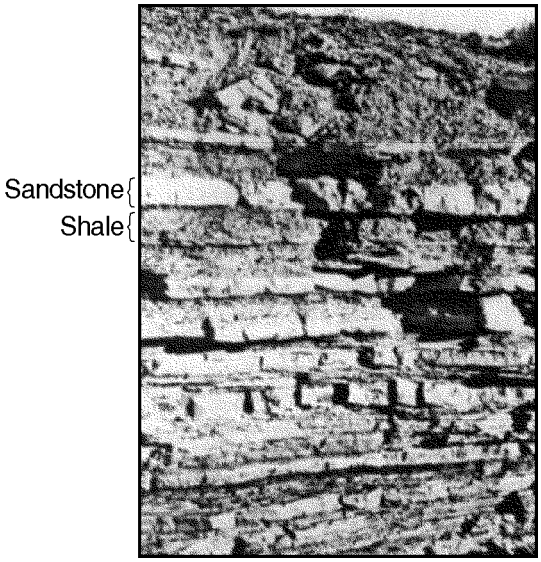
What is the latitude and longitude of point *L*?

A) 5° N, 30° E
B) 5° S, 30° W
C) 5° E, 30° N
D) 5° W, 30° S

952) An Earth Science student observed the following weather conditions in Albany, New York, for 2 days: The first day was warm and humid with southerly winds. The second day, the temperature was 15 degrees cooler, the relative humidity had decreased, and wind direction was northwest. Which type of air mass most likely had moved into the area on the second day?

A) continental tropical
B) maritime polar
C) continental polar
D) maritime tropical

953) The photograph below shows an outcrop of horizontal rock layers in New York State.



Rock outcrops like this are most commonly found in which area of New York State?

A) Hudson Highlands
B) Appalachian Plateau
C) Atlantic Coastal Plain
D) Adirondack Mountains

954) At which latitude and longitude in New York State would a salt mine in Silurian-age bedrock most likely be located?

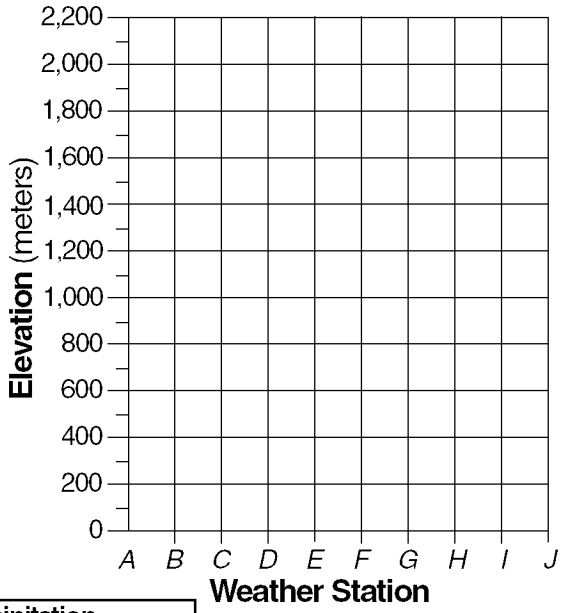
A) 43° N 77° W
B) 44° N 76° W
C) 44° N 74° W
D) 41° N 72° W

Questions 955 through 957 refer to the following:

The data table below shows the elevation and average annual precipitation at ten weather stations, *A* through *J*, located along a highway that passes over a mountain.

DATA TABLE

Weather Station	Elevation (m)	Average Annual Precipitation (cm)
A	1,350	20
B	1,400	24
C	1,500	50
D	1,740	90
E	2,200	170
F	1,500	140
G	800	122
H	420	60
I	300	40
J	0	65



SYMBOL CHART

Key for Average Annual Precipitation			
0–25 cm	26–75 cm	76–127 cm	128–170 cm

955) On the given grid, graph the data shown on the data table by following the directions below.

(a) Mark the grid with a point showing the elevation of each weather station.

(b) Surround each point with the proper symbol from the symbol chart to show the amount of average annual precipitation for the weather station.

956) State the relationship between the elevation of weather stations *A* through *E* and the average annual precipitation at these weather stations.

957) Although stations *C* and *F* are at the same elevation, they have very different amounts of average annual precipitation. Explain how the prevailing wind direction might cause this difference.

958) Which nonfoliated rock forms only in a zone of contact metamorphism?

A) hornfels
B) conglomerate
C) pegmatite
D) quartzite

959) The observed difference in density between continental crust and oceanic crust is most likely due to differences in their

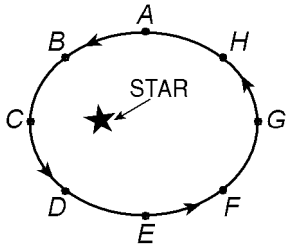
A) porosity
B) composition
C) thickness
D) rate of cooling

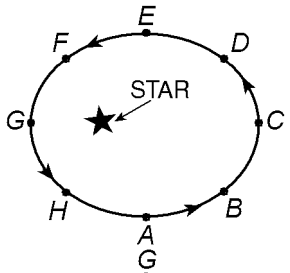
960) State *two* processes responsible for the formation of an igneous rock.

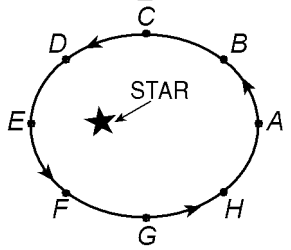
961) The table below shows gravitational data for a planet traveling in an elliptical orbit around a star. The table shows the relative gravitational force between the star and this planet at eight positions in the orbit (letters *A* through *H*). Higher numbers indicate stronger gravitational attraction.

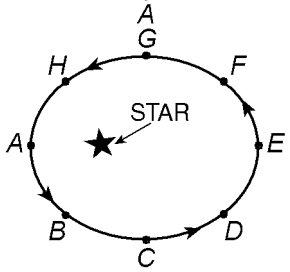
Planet's Position in the Orbit	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Relative Gravitational Force Between Star and Planet	52	42	25	12	10	12	25	42

Which diagram *best* represents the positions of the planet in its orbit that would produce the gravitational forces shown in the data table?

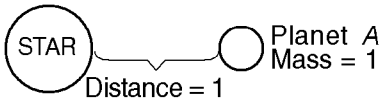
A) 

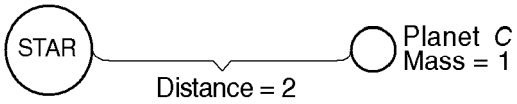
C) 

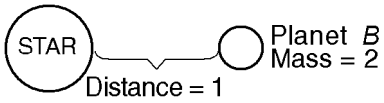
B) 

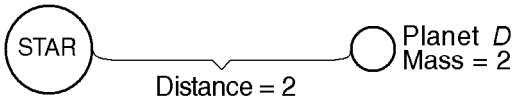
D) 

962) In each diagram below, the mass of the star is the same. In which diagram is the force of gravity *greatest* between the star and the planet shown?

A) 

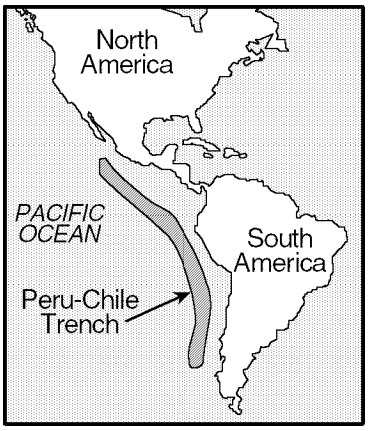
C) 

B) 

D) 

Questions 963 through 965 refer to the following:

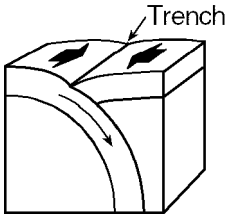
The map below shows the location of the Peru-Chile Trench.

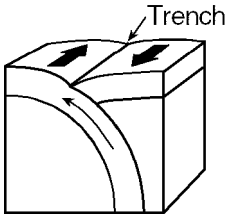


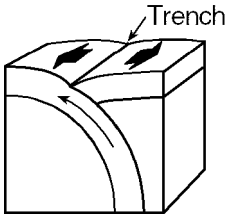
963) The Peru-Chile Trench marks the boundary between the

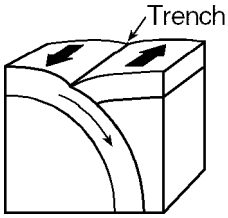
A) Caribbean Plate and the Scotia Plate
B) Nazca Plate and the South American Plate
C) North American Plate and the Cocos Plate
D) Pacific Plate and the Antarctic Plate

964) In which diagram do the arrows *best* represent the motions of Earth's crust at the Peru-Chile Trench?

A)


B)


C)


D)


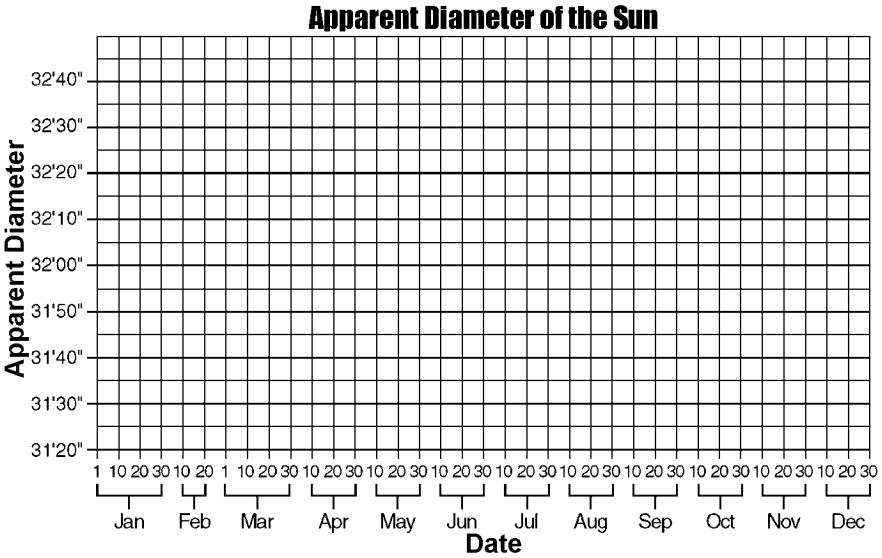
965) Which observation provides the *best* evidence of the pattern of crustal movement at the Peru-Chile Trench?

A) the direction of flow of warm ocean currents
B) comparison of the rates of sediment deposition
C) the locations of shallow-focus and deep-focus earthquakes
D) the mineral composition of samples of mafic mantle rock

966) The data table below lists the apparent diameter of the Sun, measured in minutes and seconds of a degree, as it appears to an observer in New York State. (Apparent diameter is how large an object appears to an observer.)

Apparent Diameter of the Sun During the Year

Date	Apparent Diameter (' = minutes, " = seconds)
January 1	32'32"
February 10	32'25"
March 20	32'07"
April 20	31'50"
May 30	31'33"
June 30	31'28"
August 10	31'34"
September 20	31'51"
November 10	32'18"
December 30	32'32"



On the grid provided, graph the data shown on the table by marking with a dot the apparent diameter of the Sun for each date listed and connecting the dots with a smooth, curved line.

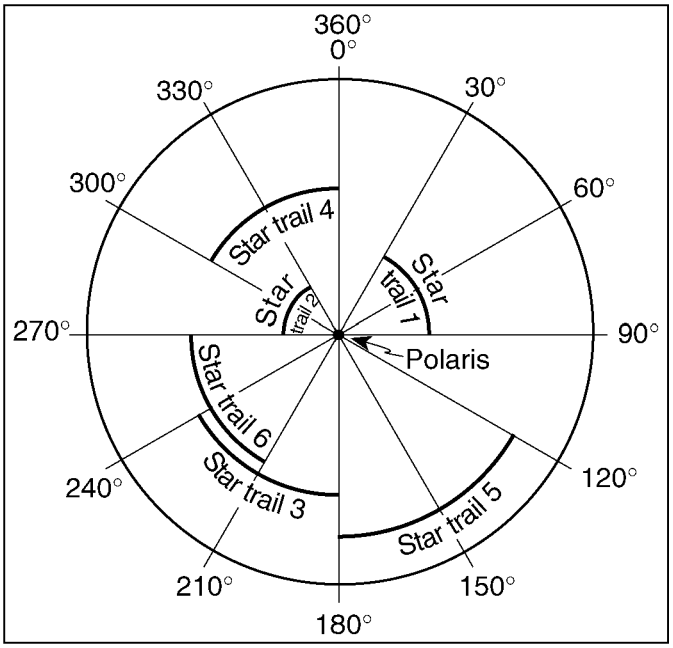
967) The long, sandy islands along the south shore of Long Island are composed mostly of sand and rounded pebbles arranged in sorted layers. The agent of erosion that most likely shaped and sorted the sand and pebbles while transporting them to their island location was

A) glaciers
B) ocean waves
C) wind
D) landslides

968) When small particles settle through water faster than large particles, the small particles are probably

A) better sorted
B) flatter
C) more dense
D) lighter

969) A camera was placed outside at night and pointed directly at *Polaris* and several other stars. The lens was kept open and a time-exposure photograph was taken. The diagram below represents that photograph of *Polaris* and star trails, with an angular protractor to measure apparent motion.



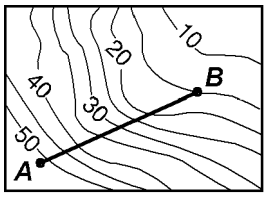
How many hours was the lens kept open to create the star trails in this photograph?

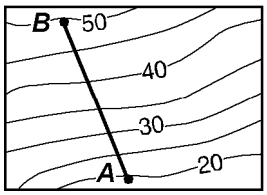
A) 6 hours B) 1 hour C) 4 hours D) 3 hours

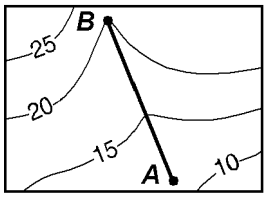
970) The diagram below shows a stream flowing past points *X* and *Y*. If the velocity of the stream at point *X* is 100 centimeters per second, which statement *best* describes the sediments being transported past these points?

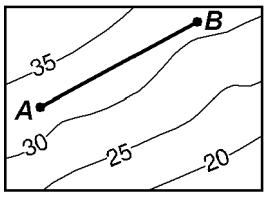
A) Some pebbles being transported at point *Y* are bigger than those being transported at point *X*.
B) Some pebbles and cobbles are being transported at points *X* and *Y*, but not sand, silt, or clay.
C) At points *X* and *Y*, only clay is being transported.
D) At points *X* and *Y*, only sand, silt, and clay are being transported.

971) On each topographic map below, the straightline distance from point *A* to point *B* is 5 kilometers. Which topographic map shows the *steepest* gradient between *A* and *B*?

A)


C)


B)


D)


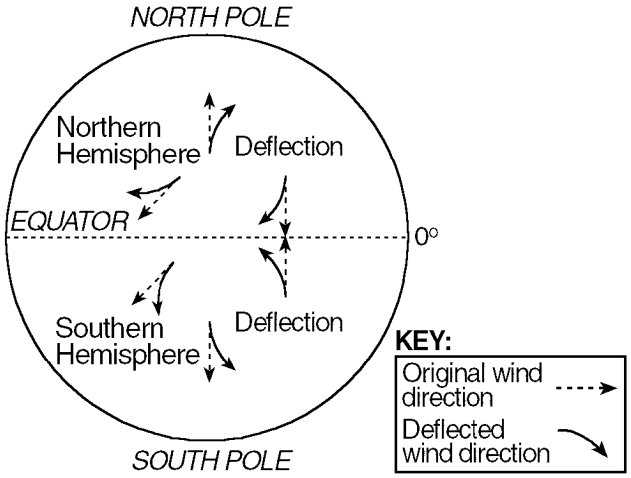
972) Which color of the visible spectrum has the *shortest* wavelength?

A) yellow B) blue C) violet D) red

973) The planetary winds in Earth's Northern Hemisphere generally curve to the right due to Earth's

A) spin on its axis
B) orbit around the Sun
C) magnetic field
D) force of gravity

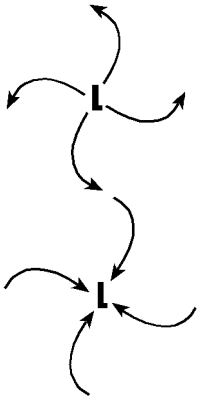
974) The diagram below shows some examples of how surface winds are deflected in the Northern and Southern Hemispheres because of Earth's rotation.

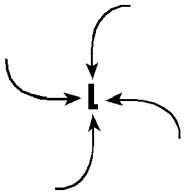


Earth's rotation causes winds to be deflected to the

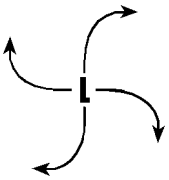
A) left in both the Northern and Southern Hemispheres
B) right in both the Northern and Southern Hemispheres
C) right in the Northern Hemisphere and left in the Southern Hemisphere
D) left in the Northern Hemisphere and right in the Southern Hemisphere

975) Which map view *best* shows the movement of surface air around a low-pressure system in the Northern Hemisphere?

A) 

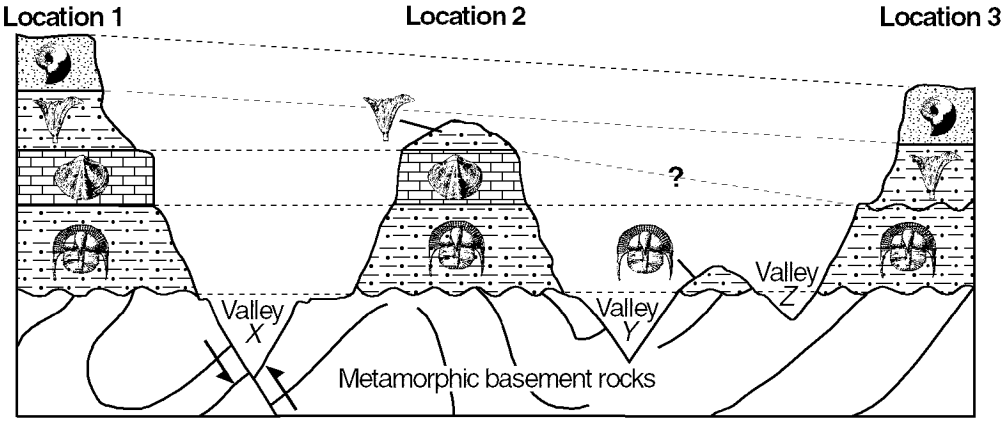
C) 

B)

D) 

Questions 976 through 979 refer to the following:

The geologic cross section below shows a view of rock layers at Earth's surface. The dashed lines connect points of the same age. Major fossils contained within each rock layer are shown. The valleys are labeled *X*, *Y*, and *Z*.



976) Which fossil would most likely be found in the same siltstone layer as the *Cryptolithus* fossil?

A) 

C) 

B) 

D) 

977) In this region, valley *X* is more deeply eroded than either valley *Y* or valley *Z*. The most likely explanation for this occurrence is that the metamorphic rock near *X* has been

A) weakened by faulting
B) folded by pressure
C) covered by sedimentary rocks
D) intruded by melted rock

978) In which type of environment were the sediments that formed these sedimentary rock layers most likely deposited?

A) terrestrial plateau
B) glacial
C) mountainous
D) marine

979) The sedimentary rock layers at the three locations can be most accurately correlated by comparing the

A) fossils in the sedimentary rocks
B) thickness of the sedimentary rock layers
C) foliation bands in the metamorphic basement rocks
D) minerals in the igneous rocks

980) Earth's troposphere, hydrosphere, and lithosphere contain relatively large amounts of which element?

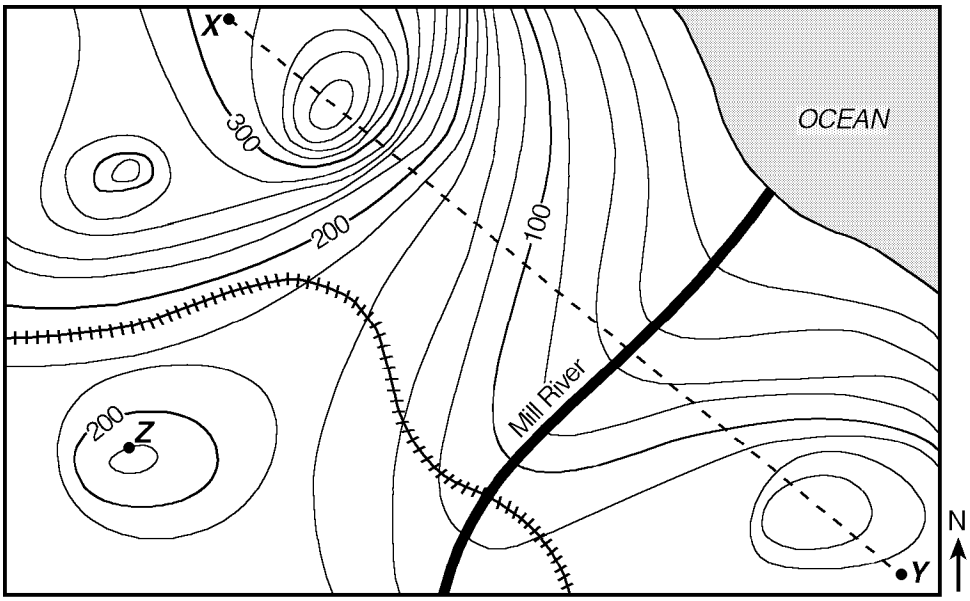
A) potassium
B) oxygen
C) iron
D) hydrogen

981) Predictable changes in the direction of swing of a Foucault pendulum provide evidence that

A) Earth's orbit is slightly elliptical
B) Earth is tilted on its axis
C) Earth's magnetic poles reverse over time
D) Earth rotates on its axis

Questions 982 through 984 refer to the following:

Points *X*, *Y*, and *Z* are locations on the topographic map below. Elevations are expressed in meters.

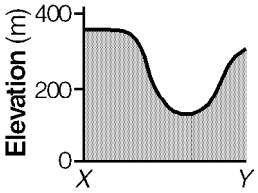


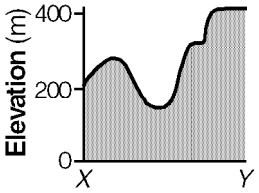
Contour interval = 20 meters

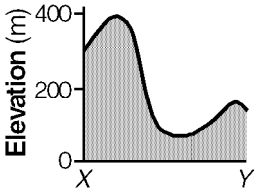
982) Mill River generally flows toward the

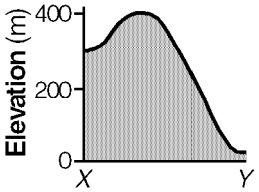
A) southeast
B) northwest
C) northeast
D) southwest

983) Which profile *best* represents the topography along the dashed line from point *X* to point *Y*?

A) 

C) 

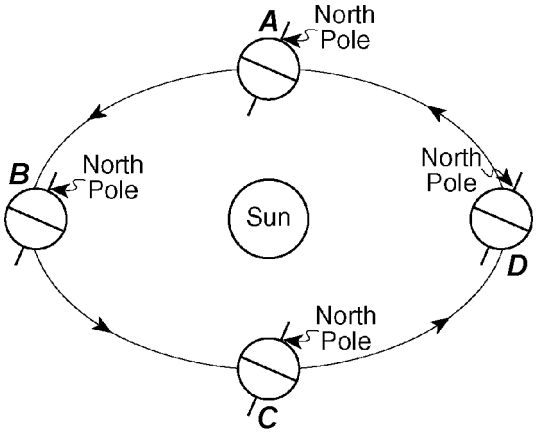
B) 

D) 

984) What is the elevation of point *Z*?

A) 240 m B) 250 m C) 190 m D) 220 m

985) The diagram below represents an exaggerated view of Earth revolving around the Sun. Letters *A*, *B*, *C*, and *D* represent Earth's location in its orbit on the first day of each of the four seasons.



(Not drawn to scale)

Which location in Earth's orbit represents the first day of fall (autumn) for an observer in New York State?

A) *A* B) *B* C) *C* D) *D*

986) Soil composed of which particle size usually has the *greatest* capillarity?

A) pebbles
B) coarse sand
C) fine sand
D) silt

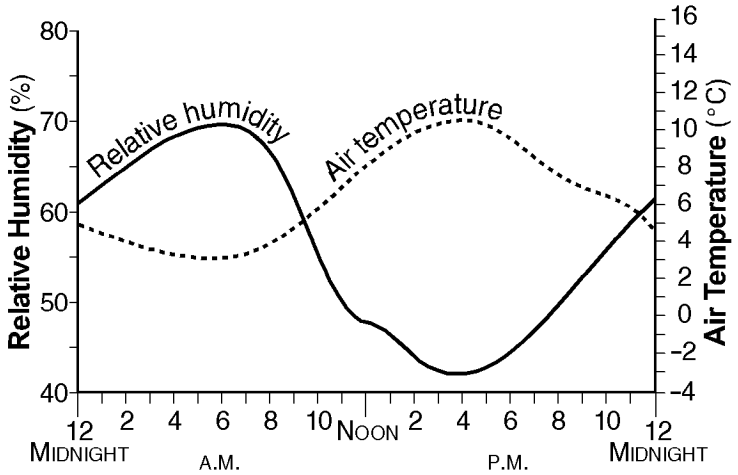
987) Tectonic plate boundaries may be classified as divergent, convergent, or transform. For each location listed in the data table below, place an *X* in the proper column to indicate the type of plate boundary at that location.

Plate Boundaries DATA TABLE

Location	Type of Plate Boundary		
	Divergent	Convergent	Transform
East Pacific Ridge			
Aleutian Trench			
West side of the South American Plate			
San Andreas Fault			

Questions 988 and 989 refer to the following:

The graph below shows the changes in relative humidity and air temperature during a spring day in Washington, D.C.



988) Which statement *best* describes the relationship between relative humidity and air temperature as shown by the graph?

A) Relative humidity increases as air temperature increases.
B) Relative humidity remains the same as air temperature decreases.
C) Relative humidity decreases as air temperature decreases.
D) Relative humidity decreases as air temperature increases.

989) What were the relative humidity and air temperature at noon on this day?

A) 47% and 48 °F
B) 65% and 32 °F
C) 47% and 32 °F
D) 65% and 48 °F

990) Where is the most deposition likely to occur?

A) at the mouth of a river, where it enters an ocean
B) at a site where glacial ice scrapes bedrock
C) at the top of a steep slope in a streambed
D) on the side of a sand dune facing the wind

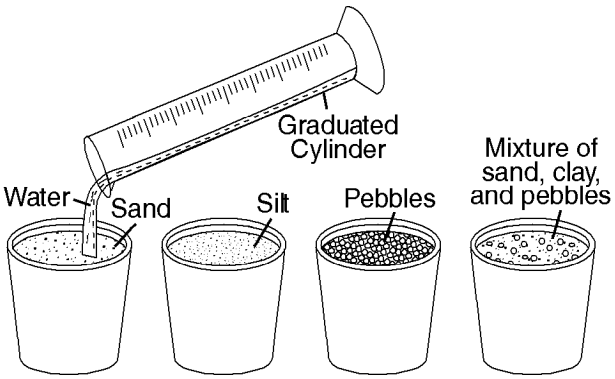
991) Which statement *best* describes sediments deposited by glaciers and rivers?

A) Glacial deposits are sorted, and river deposits are unsorted.
B) Glacial deposits and river deposits are both unsorted.
C) Glacial deposits and river deposits are both sorted.
D) Glacial deposits are unsorted, and river deposits are sorted.

992) Surface bedrock of the Allegheny Plateau is most likely to contain fossils of the *earliest*

A) amphibians
B) flowering plants
C) dinosaurs
D) grasses

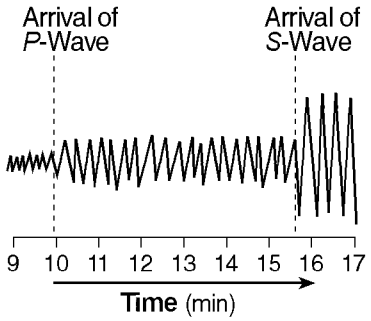
993) A student performed a laboratory activity in which water was poured slowly into four cups containing equal volumes of loosely packed sediment samples, as shown in the diagram below. All particles were spherical in shape and uniform in size within a container. After the water level reached the surface of each sample, the student determined the amount of water that had been added.

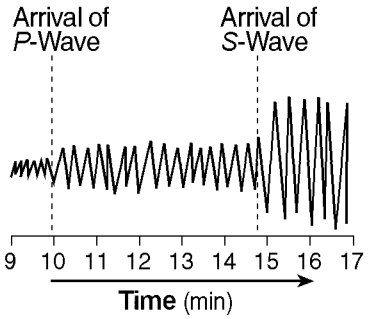


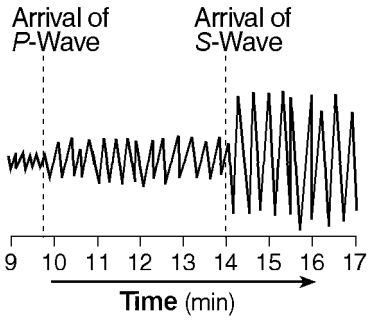
The results of the activity should have indicated that approximately equal amounts of water were added to the cups of

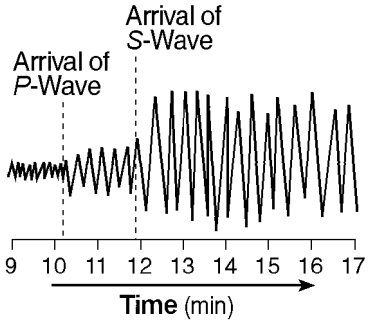
A) pebbles and the mixture, only
B) silt and pebbles, only
C) sand, silt, and pebbles, only
D) sand, pebbles, and the mixture, only

994) Which seismogram was recorded approximately 4,000 kilometers from an earthquake epicenter?

A)


C)


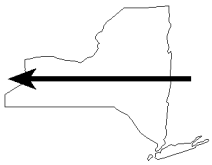
B)


D)


995) In which map does the arrow show the general direction that *most* low-pressure storm systems move across New York State?

A)


C)

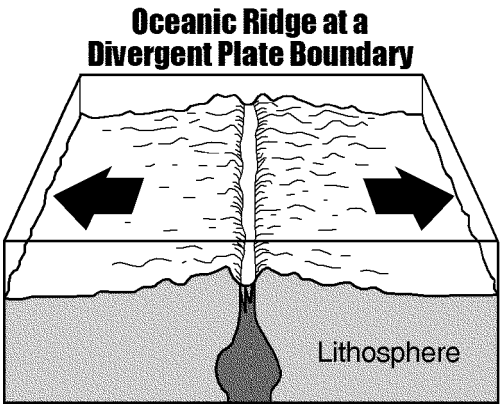

B)


D)


996) Which object is located at one foci of the elliptical orbit of Mars?

A) Jupiter B) Earth C) Betelgeuse D) the Sun

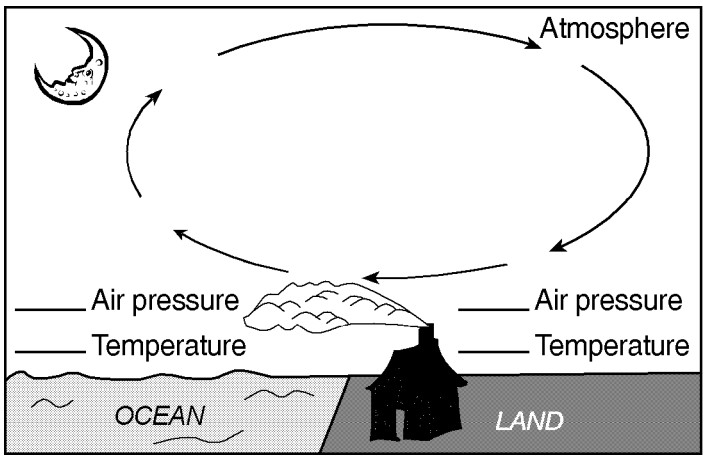
997) The diagram below shows a tectonic plate boundary.



Which mantle hot spot is at a plate boundary like the one shown in the diagram above?

A) Galapagos Hot Spot
B) Yellowstone Hot Spot
C) Hawaii Hot Spot
D) Canary Islands Hot Spot

998) The cross section below represents a house at an ocean shoreline at night. Smoke from the chimney is blowing out to sea.



(a) Label the *two* lines provided on the cross section above to show where air pressure is relatively "high" and where it is relatively "low."

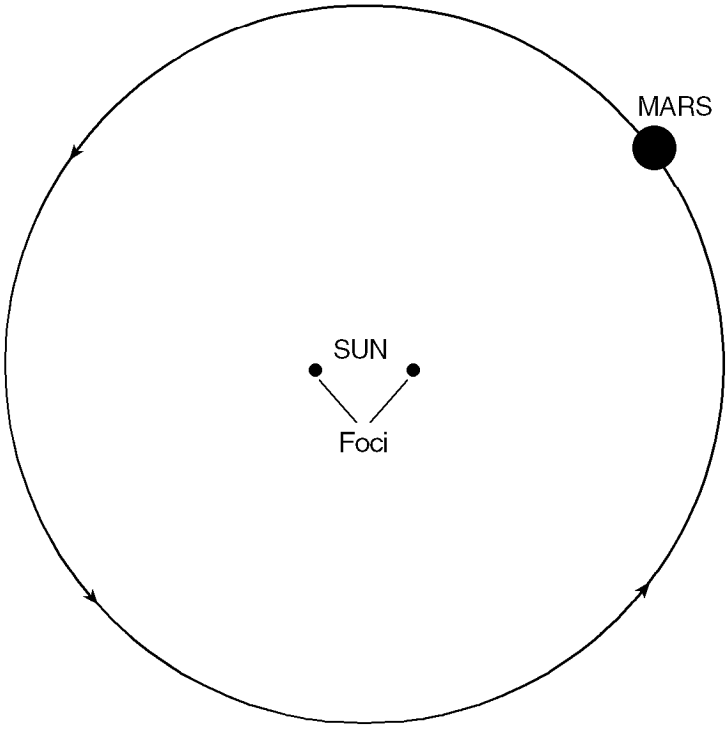
(b) Assume that the wind blowing out to sea on this night is caused by local air-temperature conditions. Label the *two* lines provided on the cross section above to show where Earth's surface air temperature is relatively "warm" and where it is relatively "cool."

999) Which river is a tributary branch of the Hudson River?

A) Susquehanna River
B) Genesee River
C) Mohawk River
D) Delaware River

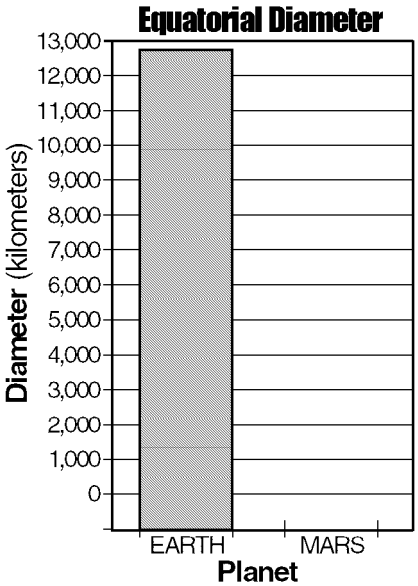
Questions 1000 through 1002 refer to the following:

The diagram below represents Mars orbit around the Sun.



(not drawn to scale)

1000) The bar graph below shows the equatorial diameter of Earth.



On the grid above, construct the bar that represents the equatorial diameter of Mars.

1001) State the difference between the shape (*not* the size) of Earth's orbit and the shape of Mars orbit in the given diagram.

1002) On the given diagram:
(1) Draw and label the major axis of Mars orbit.
(2) Place an *X* on the orbit to show the location of Mars *greatest* orbital velocity.

1003) An earthquake's *P*-wave arrived at a seismograph station at 02 hours 40 minutes 00 seconds. The earthquake's *S*-wave arrived at the same station 2 minutes later. What is the approximate distance from the seismograph station to the epicenter of the earthquake?

A) 2,400 km B) 4,000 km C) 1,100 km D) 3,100 km

1004) Surface ocean currents curve to the right in the Northern Hemisphere because

A) the Moon travels in an orbit around Earth
B) Earth travels in an orbit around the Sun
C) Earth spins on its axis
D) the Moon spins on its axis

Questions 1005 through 1007 refer to the following:

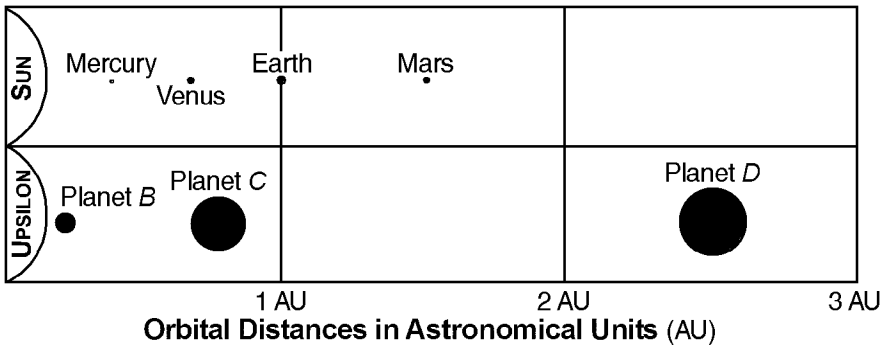
Astronomers have discovered strong evidence for the existence of three large extrasolar (outside our solar system) planets that orbit *Upsilon Andromedae*, a star located 44 light years from Earth. The three planets are called planet *B*, planet *C*, and planet *D*. Some of the information gathered about these three new planets is shown in the table below. The period of revolution for planet *C* has been deliberately left blank.

Characteristics of Planets *B*, *C*, and *D* Orbiting Star *Upsilon Andromedae*

Planet	Mass	Distance from *Upsilon Andromedae*	Period of Revolution
B	¾ of the mass of Jupiter	0.06 AU	4.6 Earth days
C	2 times the mass of Jupiter	0.83 AU	
D	4 times the mass of Jupiter	2.50 AU	3.5 to 4.0 Earth years

1 AU = average distance of Earth from the sun

The diagram below compares a part of our solar system to the *Upsilon Andromedae* planetary system. Planet distances from their respective star and the relative size of each planet are drawn to scale. [*The scale for planet distances is not the same scale used for planet size.*]



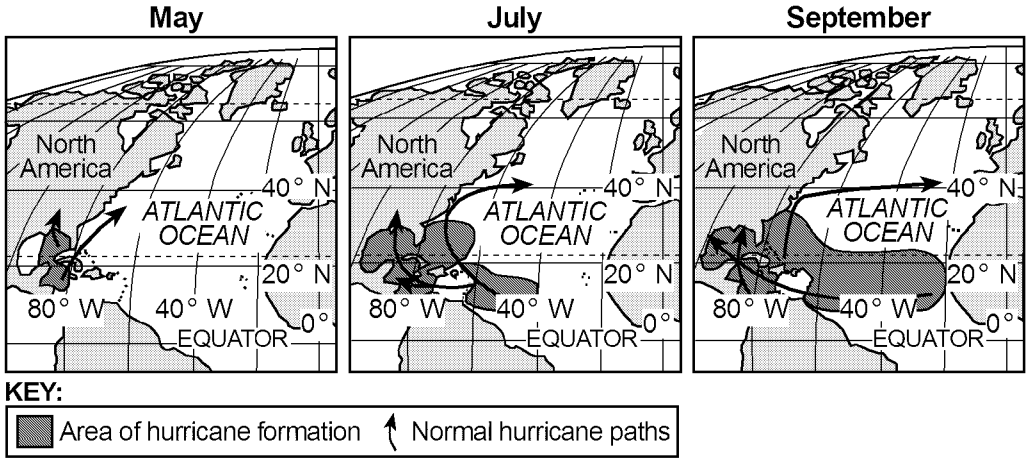
1005) If our solar system had a planet located at the same distance from the Sun as planet *C* is from *Upsilon Andromedae*, what would be its approximate period of revolution?

1006) Planet *D*'s diameter is 10 times greater than Earth's diameter. What planet in our solar system has a diameter *closest* in size to the diameter of planet *D*?

1007) As planet *B* travels in its orbit, describe the change in orbital velocity of planet *B* as the distance between *Upsilon Andromedae* and planet *B* decreases.

Questions 1008 and 1009 refer to the following:

The maps below show areas of hurricane formation and normal hurricane paths in the Atlantic Ocean during May, July, and September. The areas of hurricane formation usually have surface ocean-water temperatures greater than 80° F.



1008) State *one* reason why most hurricane paths curve northeastward as hurricanes move north of 30° N latitude.

1009) How does the area of hurricane formation change from May to September?

1010) Which statement about the minerals plagioclase feldspar, gypsum, biotite mica, and talc can *best* be inferred from the *Properties of Common Minerals* Earth Science reference table?

A) These minerals have different chemical properties, but they have similar physical properties.
B) The physical and chemical properties of these minerals determine how humans use them.
C) These minerals have different physical and chemical properties, but they have identical uses.
D) These minerals have the same chemical and physical properties.

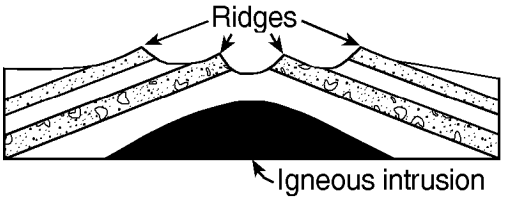
1011) If Earth's axis were tilted 35° instead of 23.5°, the average temperatures in New York State would most likely

A) decrease in summer and increase in winter
B) increase in both summer and winter
C) increase in summer and decrease in winter
D) decrease in both summer and winter

1012) The Sun's position in space is *best* described as the approximate center of

A) the universe
B) our solar system
C) a constellation
D) the Milky Way galaxy

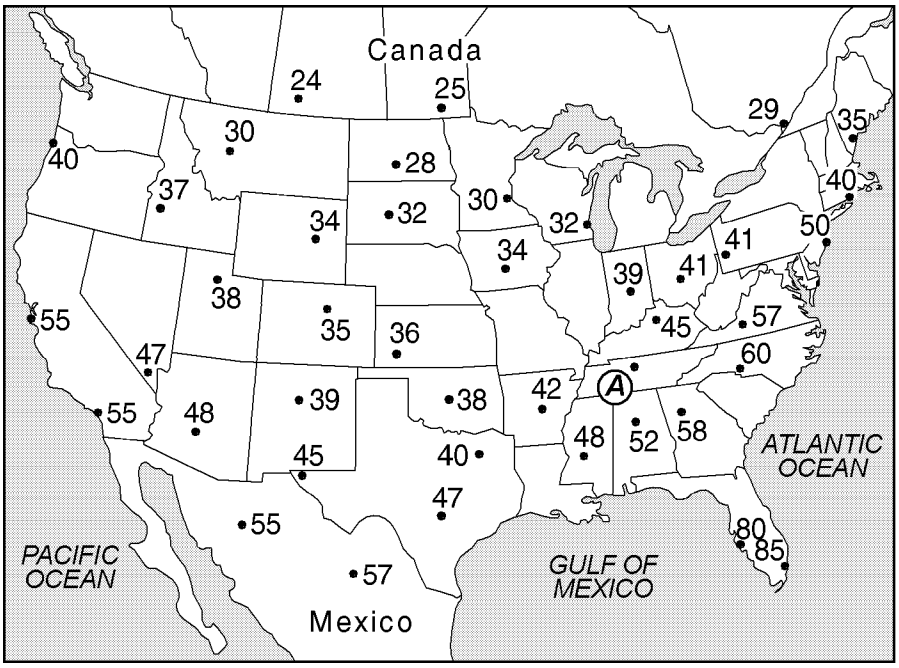
1013) The cross section below shows rock layers that underwent crustal movement during an igneous intrusion in the Cretaceous Period.



Which statement *best* describes the cause of the ridges shown?

A) The rock layers were evenly weathered.
B) Some rock layers were more resistant to weathering and erosion.
C) The igneous intrusion flowed over the surface.
D) More deposition occurred at the ridge sites after uplift.

1014) The temperature field map below shows air temperatures, in degrees Fahrenheit, recorded at the same time at weather stations across North America. [*The air temperature at location A has been deliberately left blank.*]

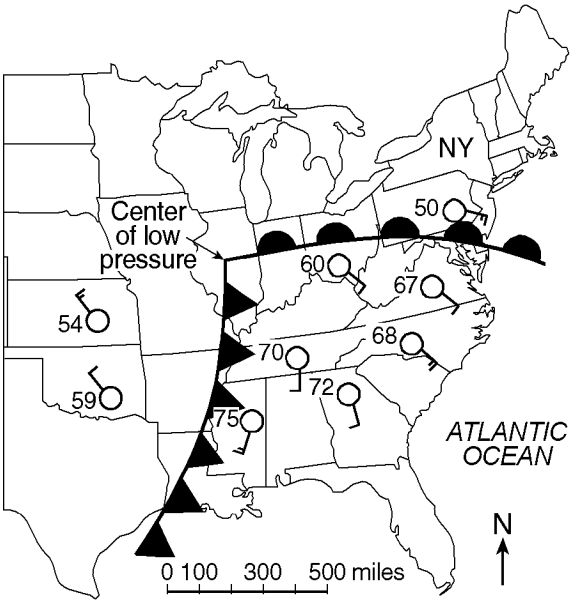


(a) On the map above, use smooth, curved solid lines to draw the 30°F, 40°F, and 50°F isotherms.

(b) What is the *most* probable air temperature at location *A*?

Questions 1015 through 1017 refer to the following:

The weather map below shows air temperature and winds for a few locations in the eastern half of the United States. A large low-pressure system is shown on the map.



1015) In the given diagram, which type of front extends eastward from the low-pressure center?

A) occluded B) cold C) stationary D) warm

1016) If the low-pressure center in the given diagram follows a typical storm track, it will move toward the

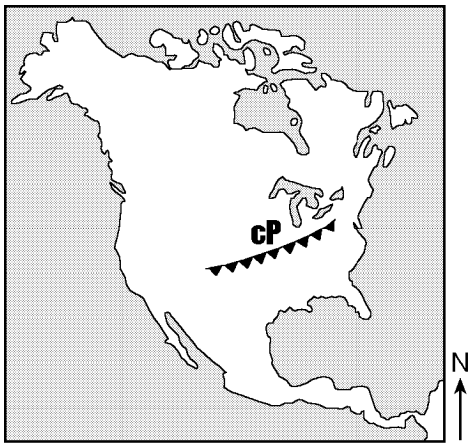
A) southwest B) northwest C) northeast D) southeast

1017) Surface winds within the low-pressure system shown generally flow

A) clockwise and toward the center of the system
B) counterclockwise and toward the center of the system
C) counterclockwise and away from the center of the system
D) clockwise and away from the center of the system

Questions 1018 through 1020 refer to the following:

The weather map of North America below shows the location of a front and the air mass influencing its movement.



1018) The **cP** air mass is identified on the basis of its temperature and

A) moisture content
B) windspeed
C) wind direction
D) cloud cover

1019) Which region is the probable source of the air mass labeled **cP** on the map?

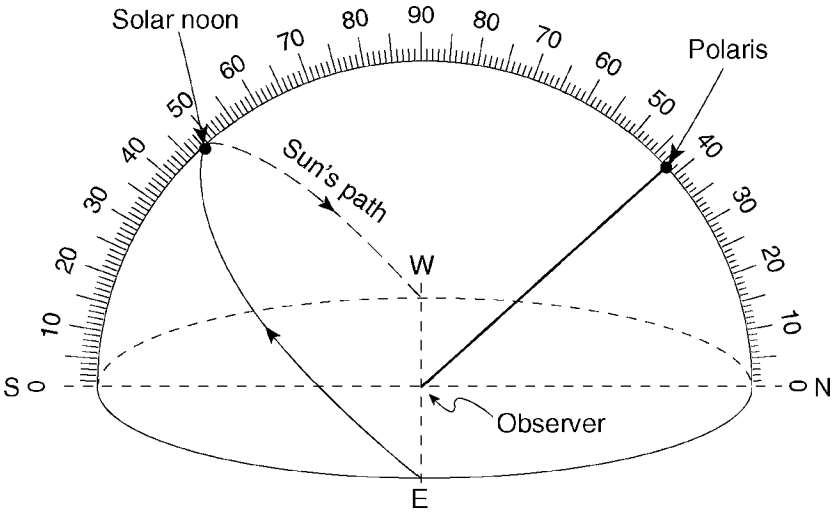
A) central Canada
B) North Atlantic Ocean
C) Gulf of Mexico
D) southwestern United States

1020) Which type of front and frontal movement is shown on the weather map?

A) warm front moving southeastward
B) cold front moving southeastward
C) cold front moving northwestward
D) warm front moving northwestward

Questions 1021 through 1023 refer to the following:

The diagram below represents a model of the sky (celestial sphere) for an observer in New York State. The curved arrow represents the Sun's apparent path for part of one day. The altitude of *Polaris* is also indicated.



1021) On which date could the observation of the Sun's apparent path in the diagram have been made?

A) March 21
B) October 21
C) July 21
D) December 21

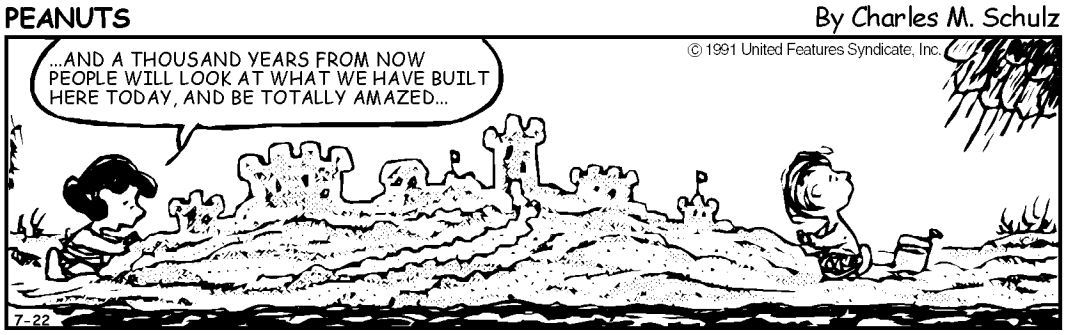
1022) According to the given diagram, what is the Sun's altitude at solar noon?

A) 42°
B) 48°
C) 90°
D) 23.5°

1023) Where is the observer in the diagram shown most likely located?

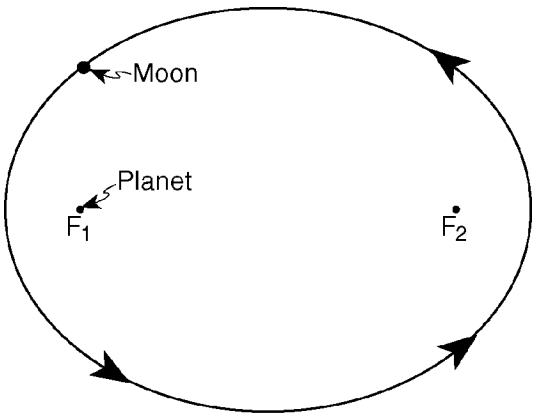
A) Mt. Marcy
B) Massena
C) Slide Mountain
D) Oswego

1024) The cartoon below shows characters building a sand castle on an ocean beach.



State *one* reason other than human activity that the sand castle will *not* exist a thousand years from now.

1025) The diagram below represents the elliptical orbit of a moon revolving around a planet. The foci of this orbit are the points labeled F_1 and F_2.



(Drawn to scale)

What is the approximate eccentricity of this elliptical orbit?

A) 0.3
B) 0.7
C) 0.5
D) 1.4

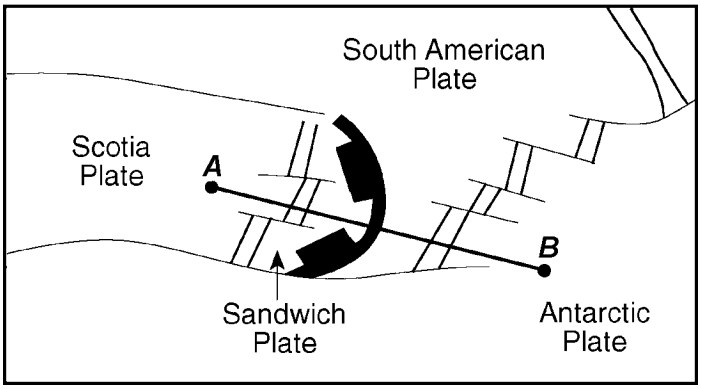
1026) The diagram below shows a fossil found in the surface bedrock of New York State.

Centroceras

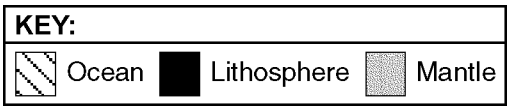
Which other fossil is most likely to be found in the same age bedrock?

A) *Phacops*
B) condor
C) *Coelophysis*
D) *Tetragraptus*

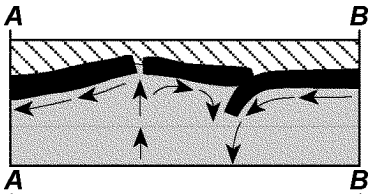
1027) On the map below, line *AB* is drawn across several of Earth's tectonic plates in the South Atlantic Ocean.



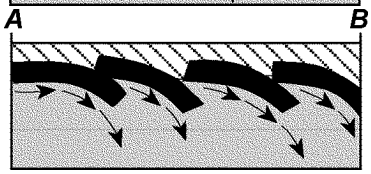
Which cross section *best* represents the plate boundaries and mantle movement beneath line *AB*?



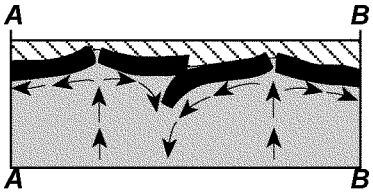
A)



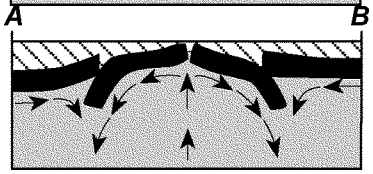
B)



C)



D)



1028) The Canaries Current along the west coast of Africa and the Peru Current along the west coast of South America are *both*

A) cool currents that flow away from the Equator
B) cool currents that flow toward the Equator
C) warm currents that flow toward the Equator
D) warm currents that flow away from the Equator

1029) Which factor has the *greatest* influence on the weathering rate of Earth's surface bedrock?

A) local air pressure
B) angle of insolation
C) regional climate
D) age of the bedrock

1030) Which star's surface temperature is *closest* to the temperature at the boundary between Earth's mantle and core?

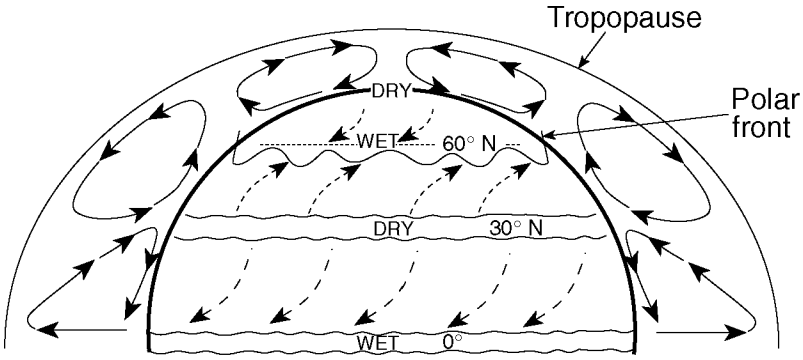
A) *Betelgeuse*
B) the Sun
C) *Rigel*
D) *Sirius*

1031) Using the *Luminosity and Temperature of Stars* graph in the Earth Science Reference Tables, list the five stars below in order of decreasing relative luminosity, with letter (*a*) being the brightest.

Aldebaran, Betelgeuse, Polaris, Sirius, the Sun

Questions 1032 and 1033 refer to the following:

The diagram below represents the planetary wind and moisture belts in Earth's Northern Hemisphere.



(Not drawn to scale)

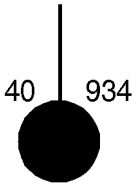
1032) The paths of the surface planetary winds are curved due to Earth's

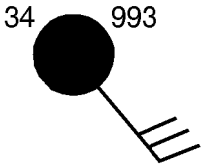
A) circumference
B) revolution
C) rotation
D) size

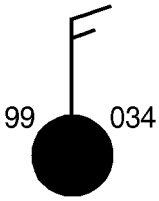
1033) The climate at 90° north latitude is dry because the air at that location is usually

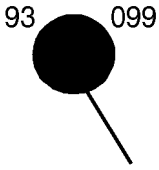
A) cool and rising
B) warm and rising
C) warm and sinking
D) cool and sinking

1034) Which weather-station model shows an air pressure of 993.4 millibars?

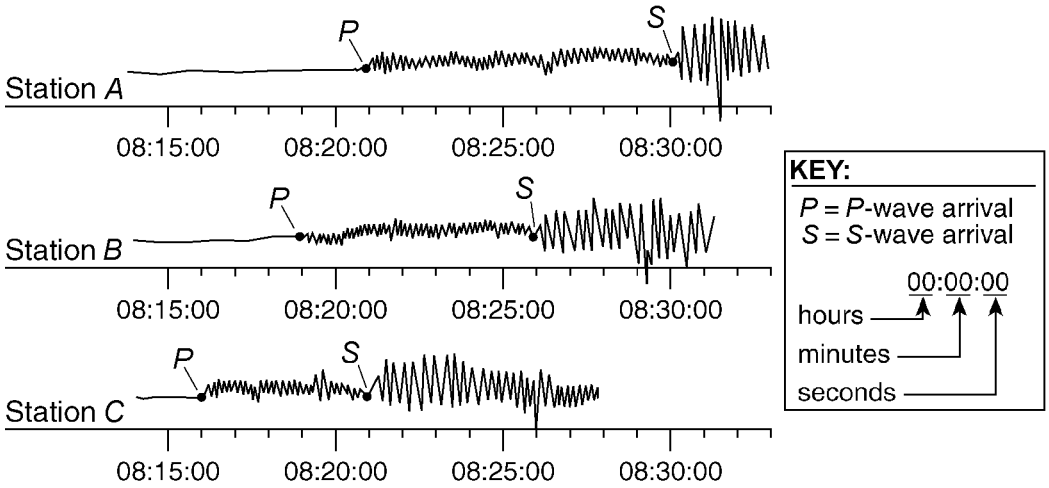
A) 

C) 

B) 

D) 

1035) The diagram below represents three seismograms showing the same earthquake as it was recorded at three different seismic stations, *A*, *B*, and *C*.



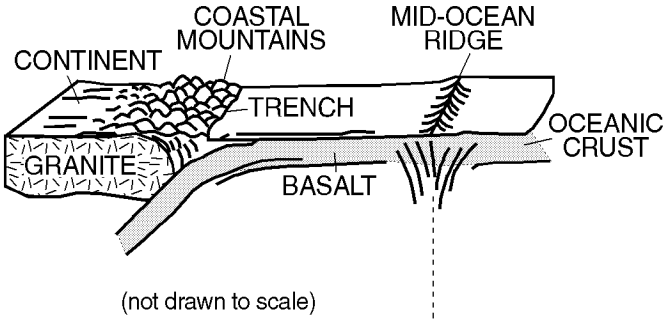
Which statement correctly describes the distance between the earthquake epicenter and these seismic stations?

A) *A* is closest to the epicenter, and *B* is farthest from the epicenter.
B) *C* is closest to the epicenter, and *A* is farthest from the epicenter.
C) *B* is closest to the epicenter, and *C* is farthest from the epicenter.
D) *A* is closest to the epicenter, and *C* is farthest from the epicenter.

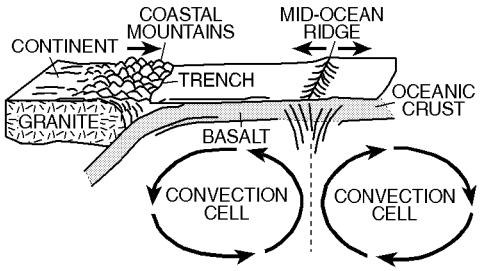
1036) Approximately how long does an earthquake *P*-wave take to travel the first 6,500 kilometers after the earthquake occurs?

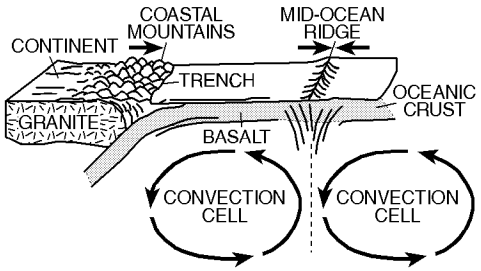
A) 10.0 min B) 6.5 min C) 18.5 min D) 8.0 min

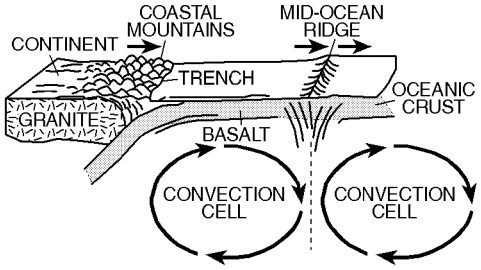
1037) The diagram below shows some features of Earth's crust and upper mantle.

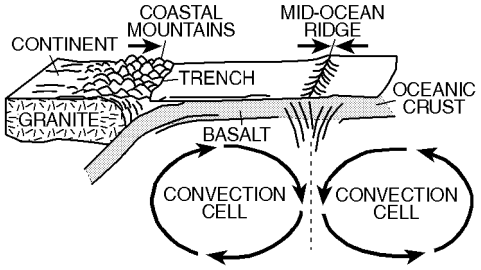


Which model most accurately shows the movements (arrows) associated with the surface features shown in the diagram?

A)


C)


B)


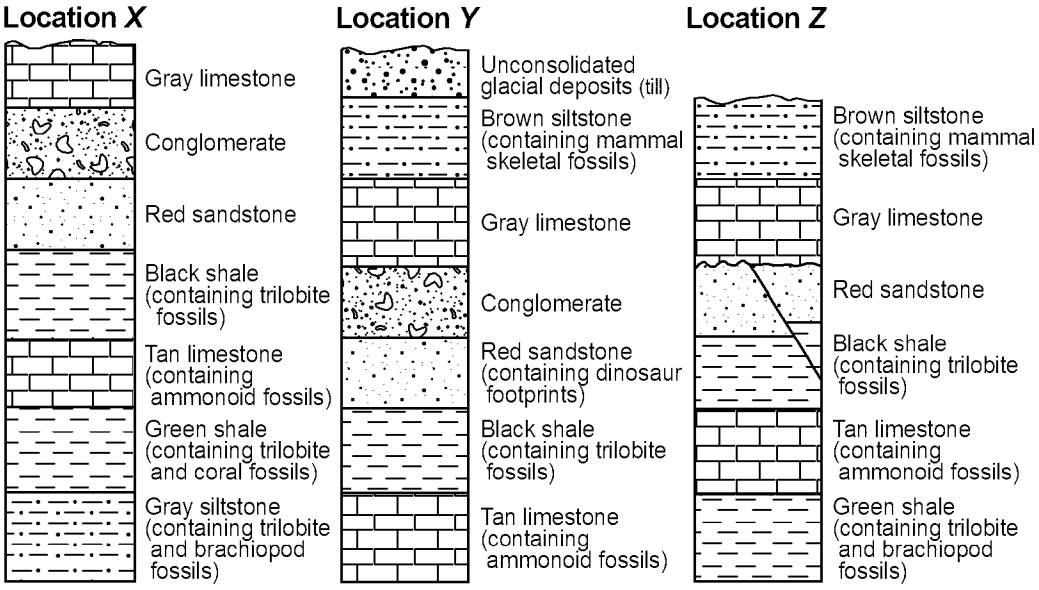
D)


1038) Rocks are classified as igneous, sedimentary, or metamorphic based primarily on their

A) texture
B) mineral composition
C) method of formation
D) crystal or grain size

Questions 1039 through 1043 refer to the following:

The cross sections below show widely separated outcrops at locations *X*, *Y*, and *Z*.



1039) Which rock layer was formed by the compaction and cementation of particles that were all less than 0.0004 centimeter in diameter?

A) brown siltstone
B) red sandstone
C) green shale
D) conglomerate

1040) An unconformity can be observed at location *Z*. Which rock layer was most probably removed by erosion during the time represented by the unconformity?

A) brown siltstone
B) conglomerate
C) gray siltstone
D) black shale

1041) The fossils in the rock formations at location *X* indicate that this area was often covered by

A) glacial ice
B) desert sand
C) tropical rain forests
D) seawater

1042) Which rock layer is *oldest*?

A) brown siltstone
B) gray siltstone
C) green shale
D) tan limestone

1043) At location *Y*, the boundary between the red sandstone and the black shale marks the

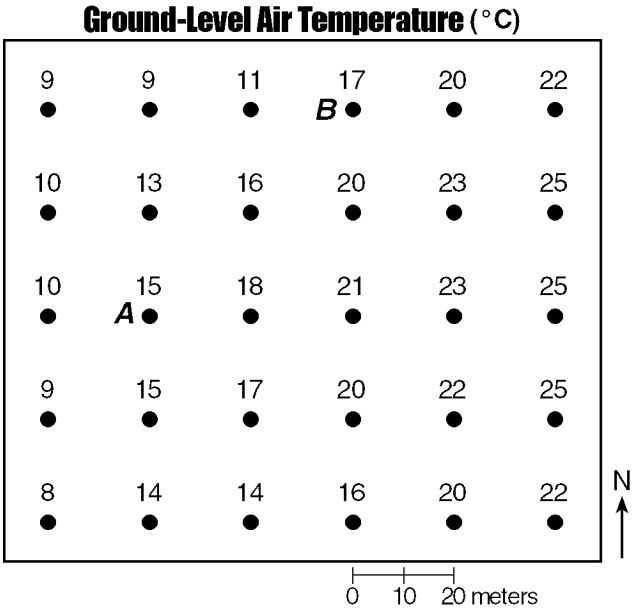
A) end of the Cenozoic Era
B) beginning of the Mesozoic Era
C) end of the Mesozoic Era
D) beginning of the Cenozoic Era

1044) Which celestial feature is *largest* in actual size?

A) Jupiter
B) the Moon
C) the Milky Way
D) the Sun

Questions 1045 through 1048 refer to the following:

The field map below shows air temperature at specific locations in an area near a school in New York State. Part of this area is a blacktop parking lot. Accurate temperature readings were taken by Earth Science students at 10 a.m. on June 1. Two reference points, *A* and *B*, are shown.



1045) On the given field map, draw only the 15°C and the 20°C isotherms. [*Isotherms must be extended to the edge of the map*.]

1046) Another Earth science class took accurate temperature readings at 12 noon on the same day and at the same locations. At each location, the temperature was warmer than it had been at 10 a.m. Explain why the temperature readings would normally increase between 10 a.m. and 12 noon.

1047) Surface temperatures are higher on the east side of the field map shown, where the parking lot is located. Explain how a characteristic of the parking lot surface could cause these higher temperatures.

1048) Calculate the temperature gradient along a straight line between point *A* and point *B* on the given map by following the directions below.

(a) Write the equation for determining the temperature gradient.

(b) Substitute the correct values into the equation.

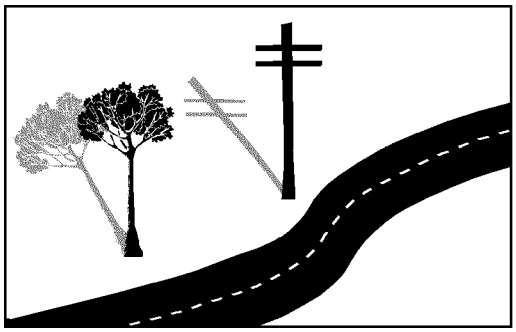
(c) Solve the equation and record your answer in decimal form. [*Label the answer with the correct units*.]

1049) Ozone is concentrated in Earth's atmosphere at an altitude of 20 to 35 kilometers. Which atmospheric layer contains the *greatest* concentration of ozone?

A) stratosphere
B) thermosphere
C) mesosphere
D) troposphere

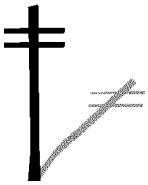
1050) The diagram below shows the shadow cast by a telephone pole on March 21 at solar noon at a location in New York State.

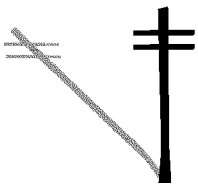
Shadow Cast on March 21

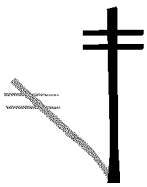


Which shadow was cast by the same telephone pole on June 21 at solar noon?

A) 

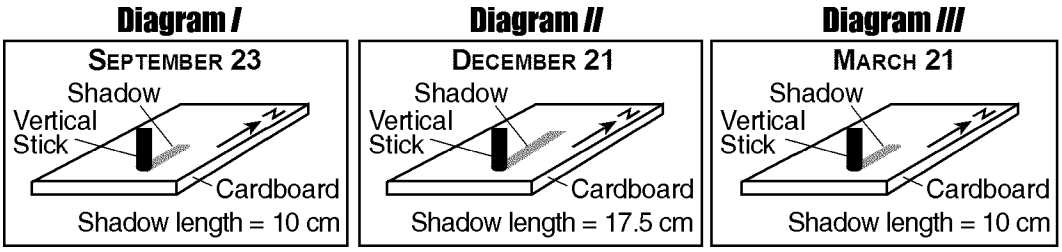
C) 

B) 

D) 

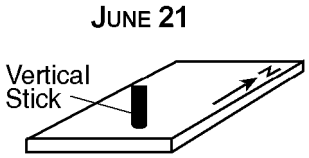
Questions 1051 and 1052 refer to the following:

Diagrams *I*, *II*, and *III* below represent the length and direction of the shadow of a vertical stick measured at noon on three different dates at 42° N latitude.



1051) Explain how the changing altitude (angle of incidence) of the noon Sun affects the length of the shadows shown in the diagrams.

1052) On the diagram below, draw the direction and length of the shadow at noon that will most likely be observed at 42° N latitude on June 21.



Questions 1053 through 1055 refer to the following:

The data table below gives information collected at seismic stations *A*, *B*, *C*, and *D* for the same earthquake. [*Some of the data has been deliberately omitted.*]

Seismic Station	*P*-Wave Arrival Time	*S*-Wave Arrival Time	Difference in Arrival Times	Distance to Epicenter
A	08:48:20	No *S*-waves arrived		
B	08:42:00		00:04:40	
C	08:39:20		00:02:40	
D	08:45:40			6,200 km

KEY: 08 : 48 : 20
seconds
minutes
hours

1053) How long did it take the *P*-wave to travel from the epicenter of the earthquake to seismic station *D*?

A) 00:39:20 B) 00:46:20 C) 00:09:40 D) 00:17:20

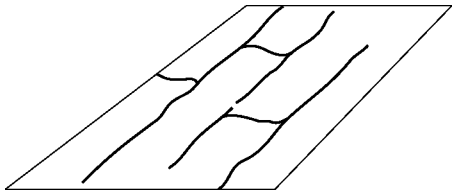
1054) What is the *most* probable reason for the absence of *S*-waves at station *A*?

A) Station *A* was located too close to the epicenter.
B) Station *A* was located on solid bedrock.
C) *S*-waves cannot travel through liquids.
D) *S*-waves were not generated at the epicenter.

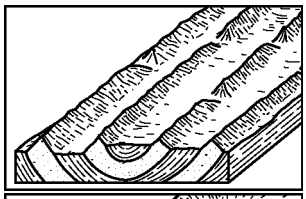
1055) What is the approximate distance from station *C* to the earthquake epicenter?

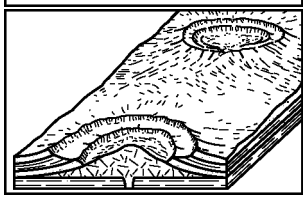
A) 1,600 km B) 3,200 km C) 1,000 km D) 2,400 km

1056) The diagram below represents a map view of a stream drainage pattern.

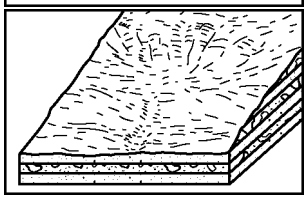


Which underlying bedrock structure most likely produced this stream drainage pattern?

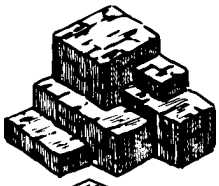
A) 

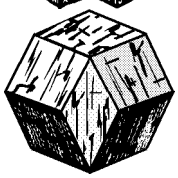
B) 

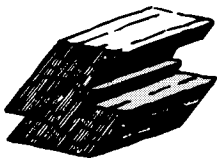
C) 

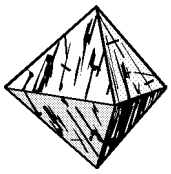
D) 

1057) Halite has three cleavage directions at 90° to each other. Which model *best* represents the shape of a broken sample of halite?

A) 

B) 

C) 

D) 

1058) The density of Earth's crust is

A) greater than the density of both the outer core and the mantle
B) less than the density of both the outer core and the mantle
C) less than the density of the outer core but greater than the density of the mantle
D) greater than the density of the outer core but less than the density of the mantle