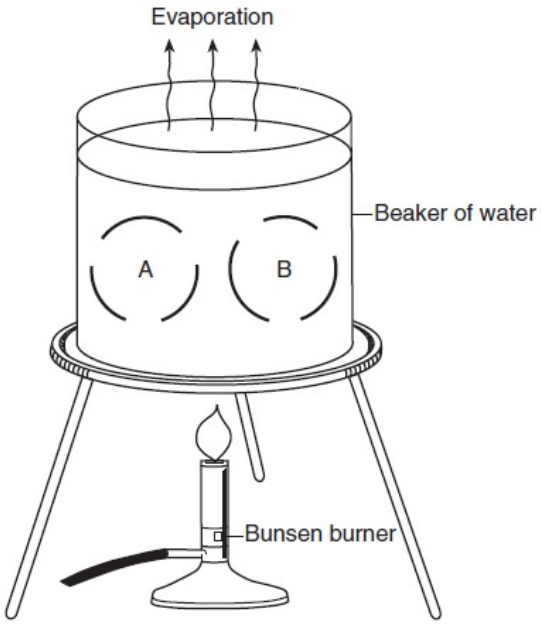
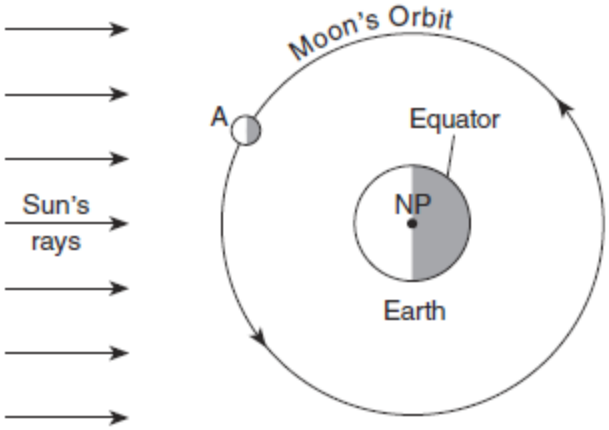
1. Base your answer to the following question on the diagram and on your knowledge of Earth science. The diagram represents a beaker of water being heated. The curved lines around letters *A* and *B* represent convection cells that have developed in the water.

   On the diagram, draw six arrowheads, one on *each* of the curved lines of the convection cells, to indicate the direction of water movement around letters *A* and *B*.



Base your answers to questions **2** through **5** on the diagram below and on your knowledge of Earth science. The diagram represents the Moon's orbit around Earth as viewed from space above Earth's North Pole (NP). Letter *A* represents one position of the Moon in its orbit.

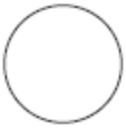


(Not drawn to scale)

2. On the diagram above, place an **X** on the Moon's orbit to indicate the position of the Moon when a solar eclipse would be observed from Earth.

3. State the number of days that it takes the Moon to orbit Earth once.

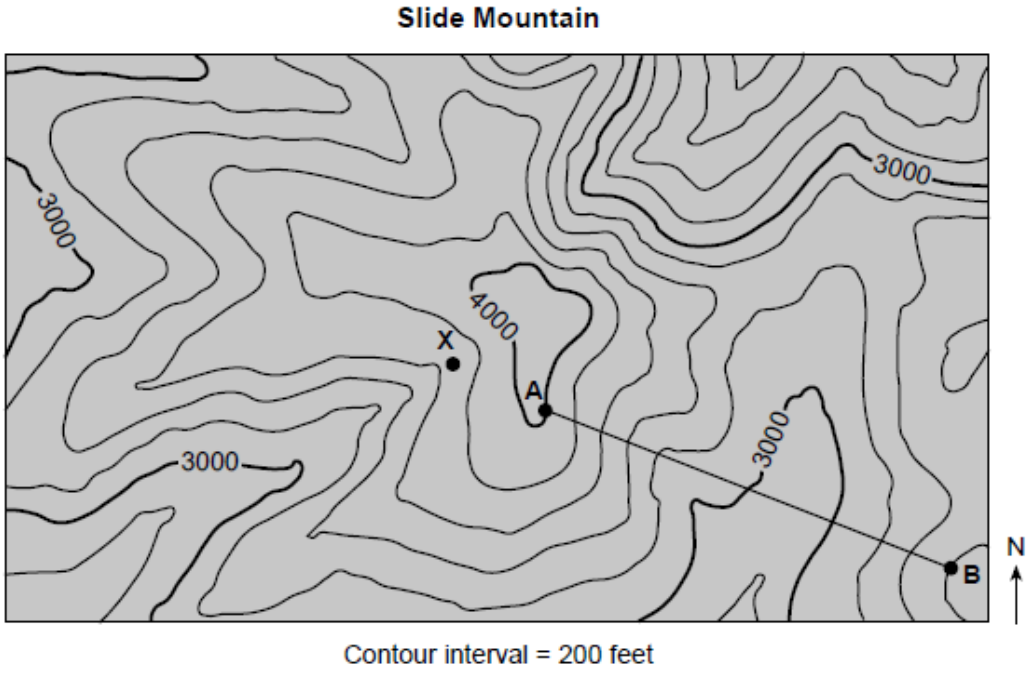
4. On the diagram below, shade the portion of the Moon that is in darkness as viewed from New York State when the Moon is at position *A*.



5. Describe the actual shape of the Moon's orbit.

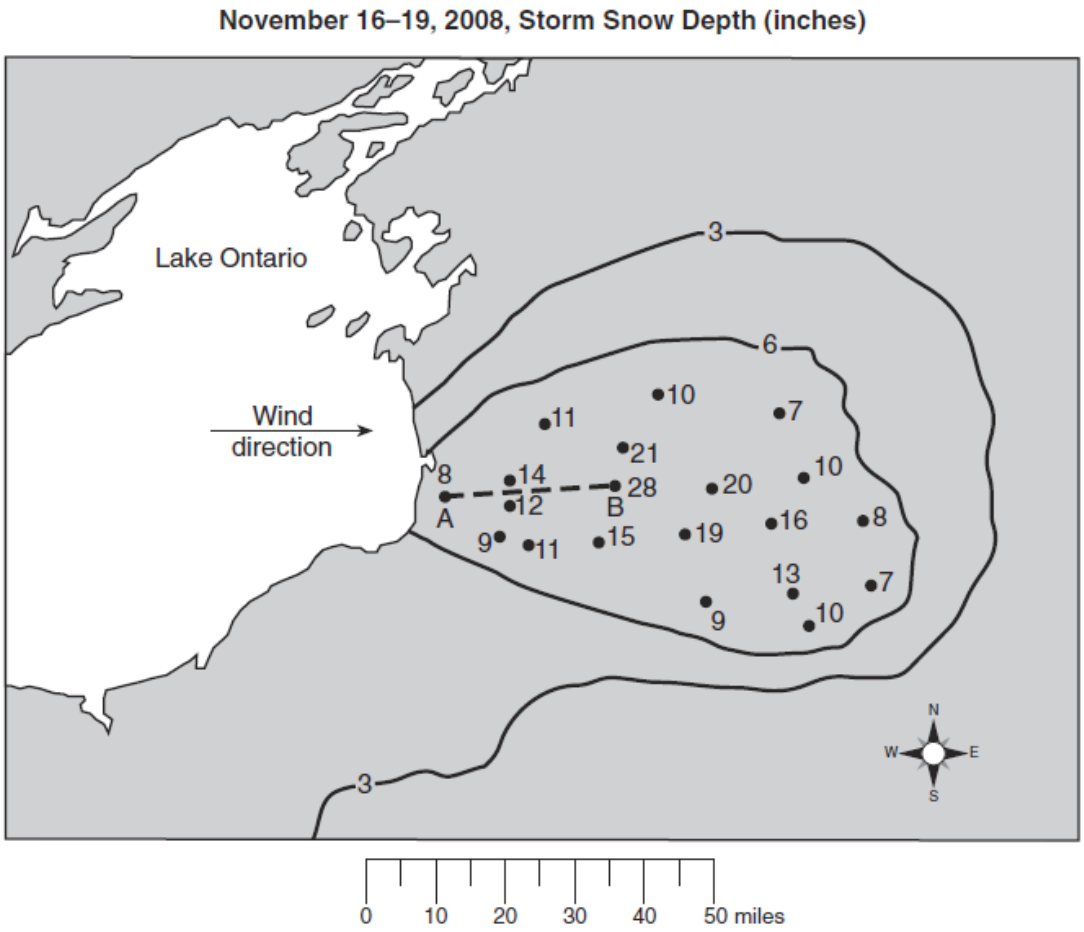
_____

6. Base your answer to the following question on the topographic map below and on your knowledge of Earth science. The map is centered on the peak of New York State's Slide Mountain at 42° North. Points *A*, *B*, and *X* represent locations on the map. Line *AB* is a reference line on the map. Elevations are shown in feet.



On the map, draw a line showing the most likely path of a stream that begins at point *X* and flows to the edge of the map.

Base your answers to questions **7** through **9** on the snowfall map of the Tug Hill Plateau region of New York State and your knowledge of Earth science. A lake-effect snowstorm occurred on November 16-19, 2008. Snow depths are indicated in inches at several points and by two labeled isoline. Dashed line *AB* is a reference line on the map between two recorded snow depths.

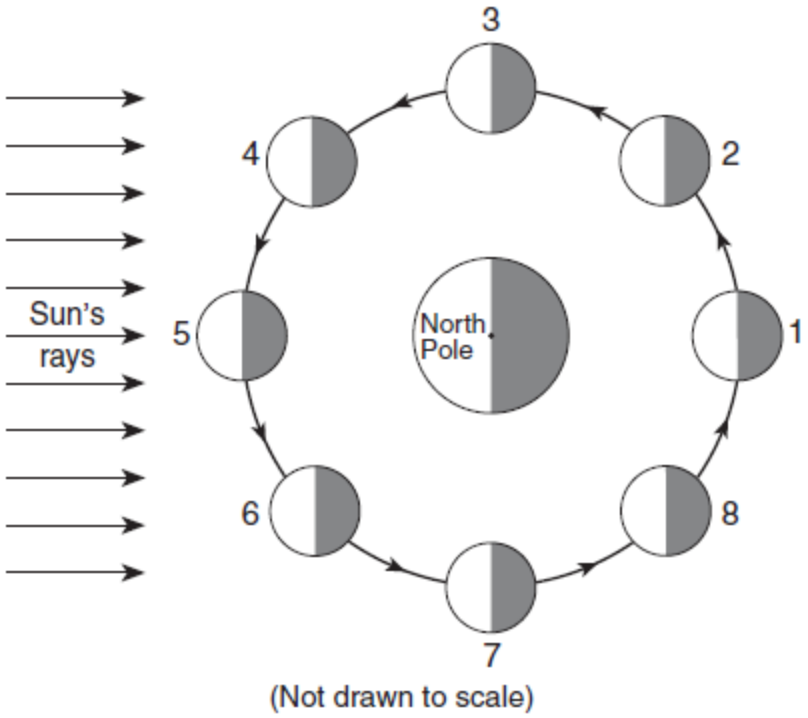


7. On the map, draw the 9-inch and 12-inch snow depth isolines.

8. Calculate the snow depth gradient between point *A* and point *B*, in inches per mile.

9. This snow occurred while Lake Ontario was *not* frozen. Explain why snowfall amounts would have been *less* if the lake had had significant ice over.

Base your answers to questions **10** through **12** on the diagram below and on your knowledge of Earth science. The diagram represents Earth as viewed from above the North Pole. The nighttime side of Earth and the Moon have been shaded. The Moon is represented in eight positions in its orbit around Earth.



(Not drawn to scale)

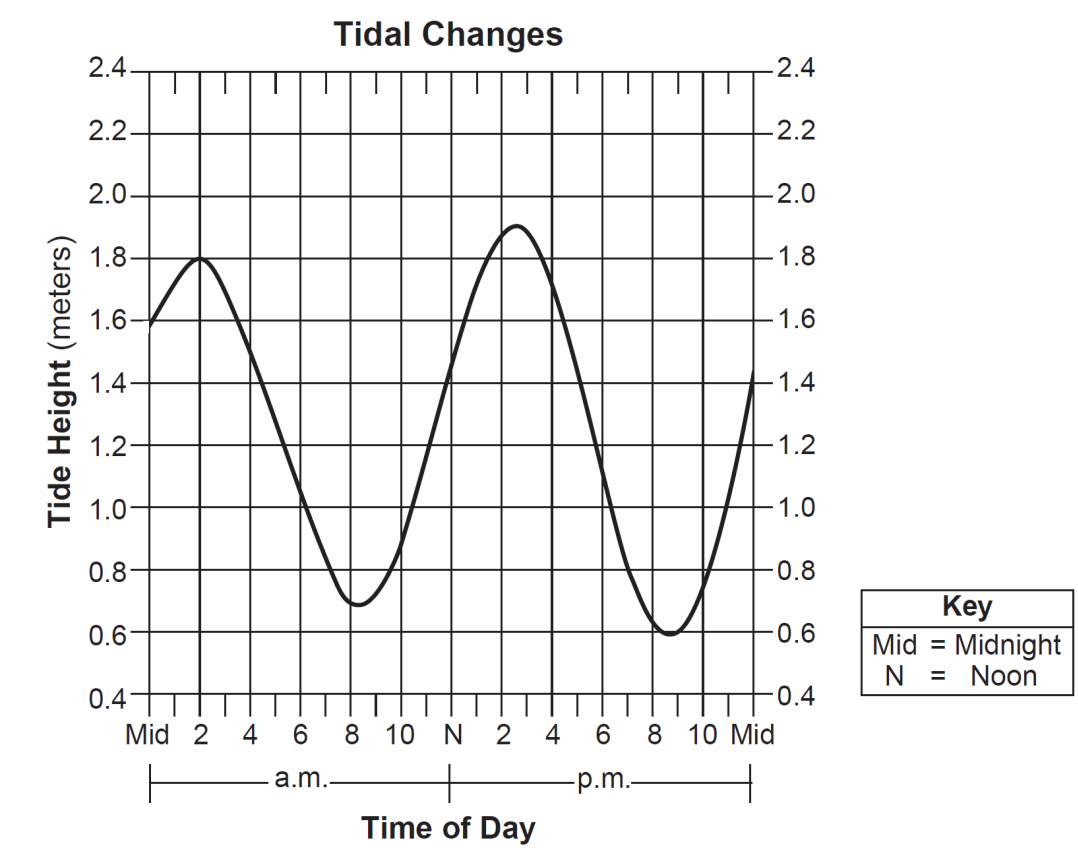
10 Identify by number the Moon's position where a solar eclipse might be observed from Earth.

11 The photographs below show the changing appearance of the Moon as viewed from New York State during three consecutive Moon phases. In the space below each photograph, identify the number of the Moon position that matches each of these phases.

Position:_____ → Position:_____ → Position:_____

12 Explain how the Moon's rotation and revolution cause the same side of the Moon to always face Earth.

Base your answers to questions **13** and **14** on the graph below and on your knowledge of Earth science. The graph shows the changes in ocean tide height at a New York State location during 1 day.



13. Determine the tide height and time of day for the *lowest* tide shown on the graph. Include a.m. or p.m. in your answer for the time of day

14. Explain why the Moon has a greater influence on Earth tides than the Sun.

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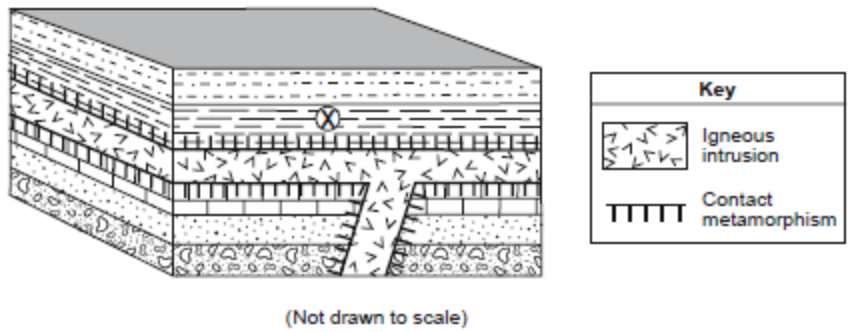
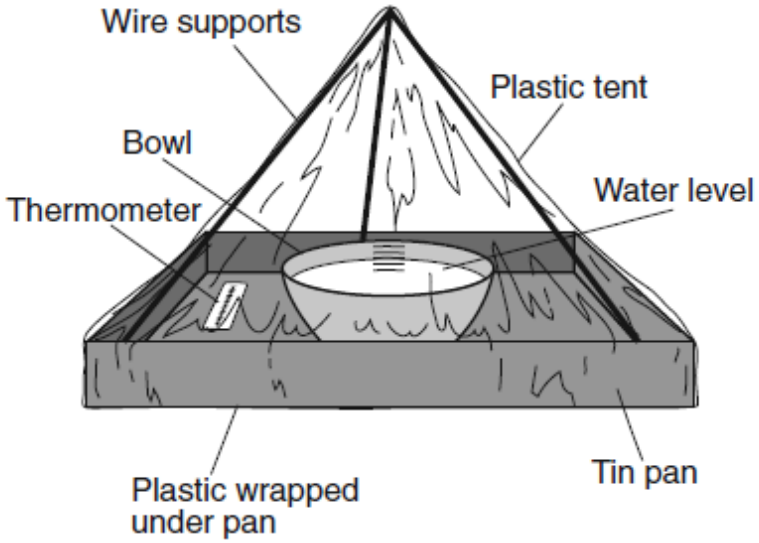
15. Base your answer to the following question on the block diagram below and on your knowledge of Earth science. The diagram represents an igneous intrusion that solidified between some layers of sedimentary rock. Letter *X* represents an index fossil in a sedimentary rock layer. The rock layers have not been overturned.



(Not drawn to scale)

Describe *one* characteristic of fossil *X* that makes it a good index fossil.

Base your answers to questions **16** through **19** on the model and data table shown below. A student constructed a model to demonstrate how water is recycled by natural processes on Earth. The model consisted of a clear plastic tent over a pan containing a bowl of water. The model was sealed so no air could enter or leave the tent. The data table shows the observations recorded when the model was placed in direct sunlight for 60 minutes.



Data Table

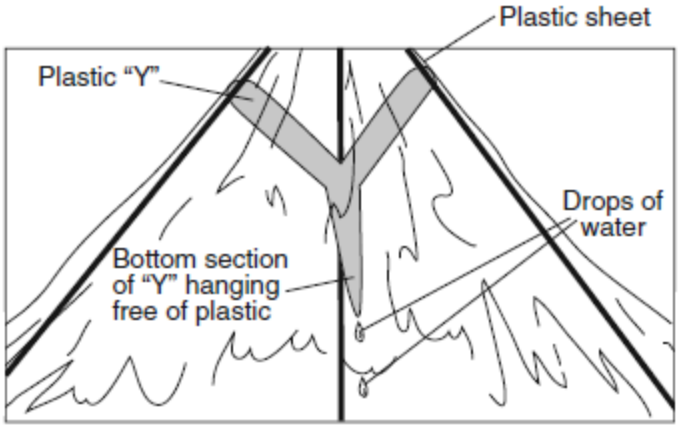
Time (min)	**Observations**
0	Water level in bowl = 10 cm Inside walls of the plastic tent are dry. Inside air temperature = 20°C
30	Water level in bowl = 9.9 cm Small drops of water form on the inside walls of the tent. Inside air temperature = 23°C
60	Water level in bowl = 9.8 cm Large drops of water form on the inside walls of the tent. Inside air temperature = 26°C

16. Identify the process that caused the water level in the bowl to decrease.

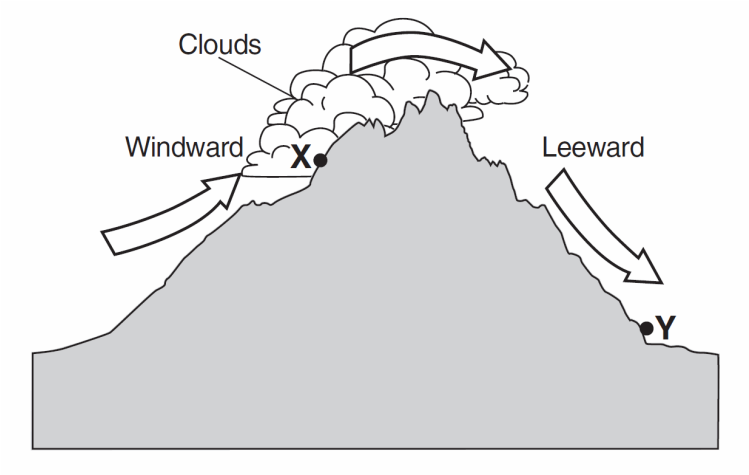
17. How much heat energy, in joules per gram, is released as water droplets are formed on the inside walls of the tent?

18. If the model is changed and the bowl of water is replaced with a green plant, by which process would the plant supply water vapor to the air inside the tent?

19. A student glues a Y-shaped piece of plastic, as shown below, near the top of the inside of the tent and repeats the demonstration. Drops of water are seen dripping from the bottom of the Y after 60 minutes. Which process of the water cycle is represented by the dripping water?

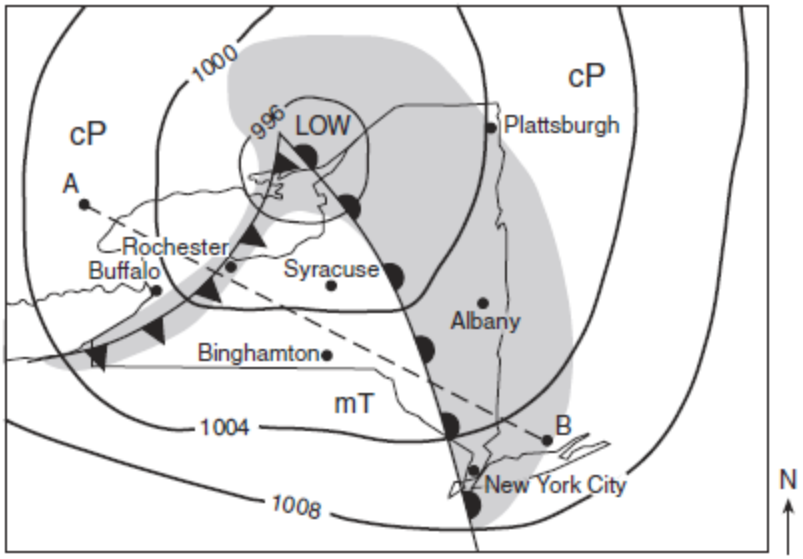


20. The cross section below represents the windward and leeward sides of a mountain range. Arrows show the movement of air over a mountain. Points *X* and *Y* represent locations on Earth's surface.



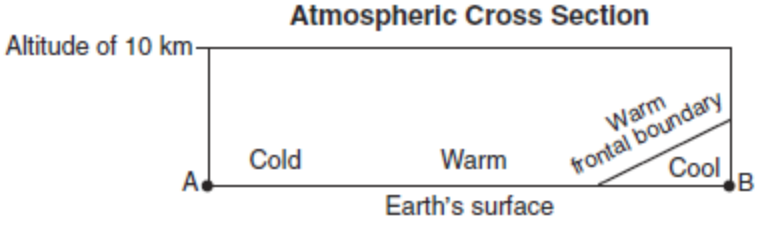
Describe how the air's temperature and water vapor content at point *X* is different from the air's temperature and water vapor content at point *Y*.

Base your answers to questions **21** and **22** on the weather map below and on your knowledge of Earth science. The map indicates the location of a low-pressure system over New York State during late summer. Isobar values are recorded in millibars. Shading indicates regions receiving precipitation. The air masses are labeled mT and cP. The locations of some New York State cities are shown. Points *A* and *B* represent other locations on Earth's surface.

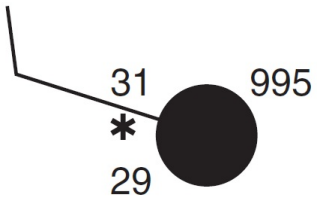


21. An air mass acquires the characteristics of the surface over which it forms. Above, circle the type of Earth surface (land or ocean) and describe the relative temperature of the surface over which the mT air mass most likely formed.

22. The cross section *below* represents the atmosphere along the dashed line from *A* to *B* on the map. The warm frontal boundary is already shown on the cross section. Draw a curved line to represent the shape and location of the cold frontal boundary.



Base your answers to questions **23** through **25** on the weather station model below and on your knowledge of Earth science. The model shows atmospheric conditions at Oswego, New York.



23. Fill in the correct information for *each* weather variable listed for this station model.

    Air temperature: _____ °F

    Dewpoint: _____ °F

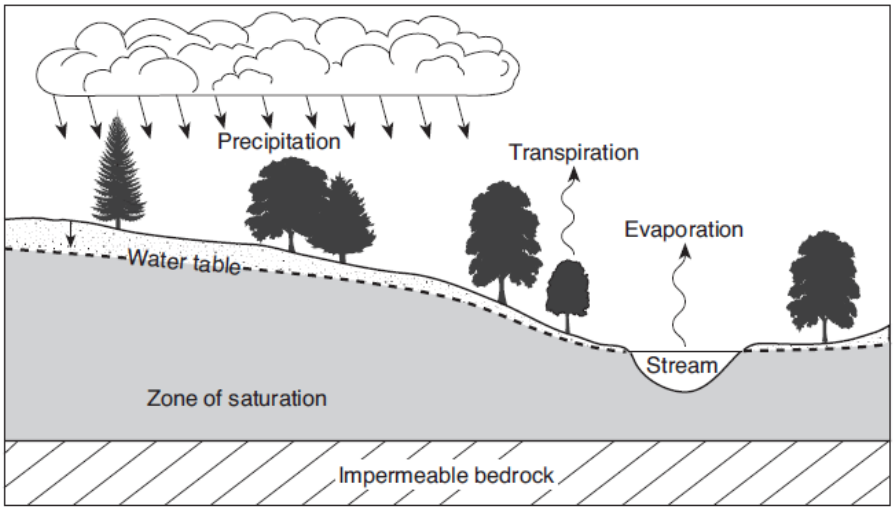
    Wind speed: _____ knots

    Cloud cover: _____ %

24. Explain how the data on the station model indicate a high relative humidity.

25. Convert the coded air pressure shown on the station model into the actual millibars of air pressure.

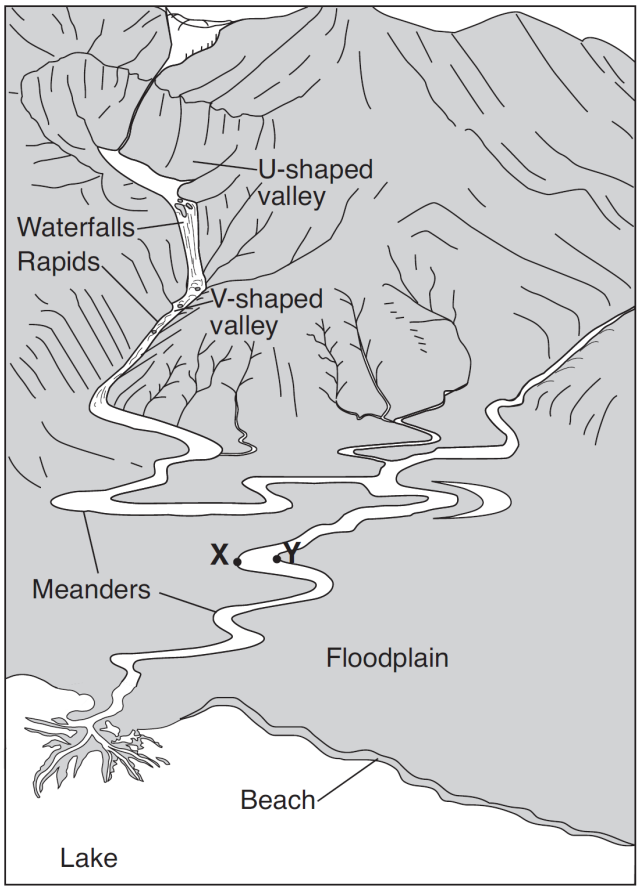
Base your answers to questions **26** and **27** on the diagram below, which shows some processes in the water cycle.



26. State the relationship between the amount of precipitation in this area and the height of the water table above the impermeable bedrock.

27. Describe *one* change that would cause more water to evaporate from this stream.

Base your answers to questions **28** through **31** on the diagram below, which shows several different landscape features. Points *X* and *Y* indicate locations on the streambank.



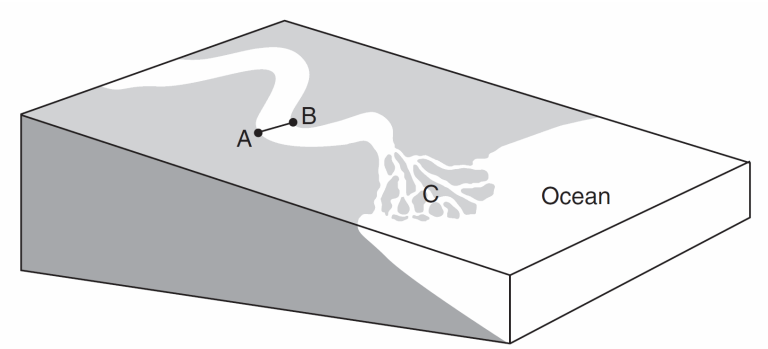
28. Explain why the upper valley in the mountains is U-shaped and the lower valley is V-shaped.

29. Identify which point, *X* or *Y,* has more stream erosion and explain why the amounts of erosion are different.

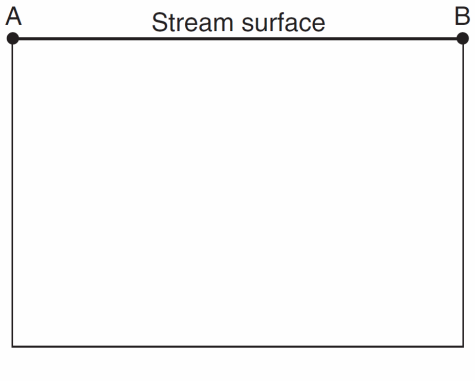
30. Explain why the stream meanders on the floodplain, but *not* in the mountains.

31. The beach consists of particles with diameters from 0.01 cm to 0.1 cm. Identify the sedimentary rock that will form when burial and cementation of these sediments occur.

Base your answers to questions **32** through **35** on the block diagram below and on your knowledge of Earth science. The diagram represents a meandering stream flowing into the ocean. Points *A* and *B* represent locations along the streambanks. Letter *C* indicates a triangular-shaped depositional feature where the stream enters the ocean.



32. The top of the box below represents the stream surface between points *A* and *B*. In the box, draw a line from point *A* to point *B* to represent a cross-sectional view of the shape of the bottom of the stream channel.



33. Explain how sediments eroded by the water in this stream become smoother and rounder in shape.

34. Identify the triangular-shaped depositional feature indicated by letter *C*.

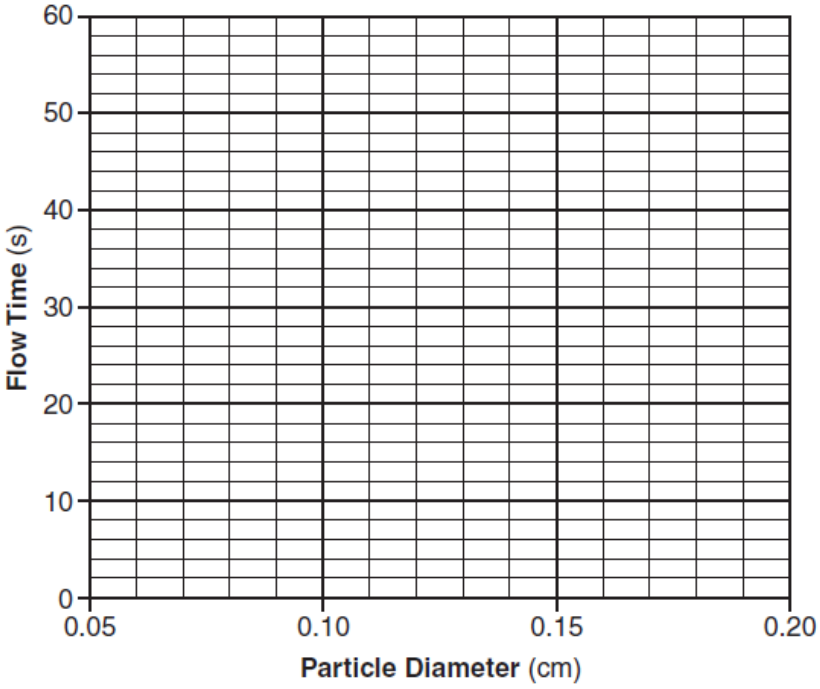
35. Identify *two* factors that determine the rate of stream erosion.

Base your answers to questions **36** through **38** on the data table below. Six identical cylinders, *A* through *F*, were filled with equal volumes of sorted spherical particles. The data table shows the particle diameters, in centimeters, and the amount of time, in seconds, for water to flow equal distances through each cylinder.

Data Table

Cylinder	Particle Diameter (cm)	Flow Time (s)
A	0.07	51
B	0.08	39
C	0.10	25
D	0.14	13
E	0.16	10
F	0.18	8

36. Use the information in the data table to construct a line graph. On the grid below,plot the data for the flow time for each of the particle sizes given in the data table. Connect the plotted data with a smooth, curved line.



37. Determine the flow time in a cylinder containing particles with a diameter of 0.13 centimeter.

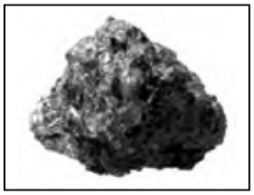
38. State *one* reason why the water flows faster through the cylinders containing larger particles than through the cylinders containing smaller particles.

Base your answers to questions **39** through **42** on the photographs below and on your knowledge of Earth science. The photographs show eight common rock-forming minerals.

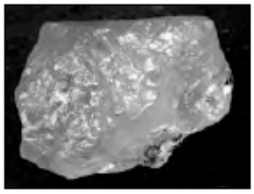
Biotite mica

Potassium feldspar

Olivine

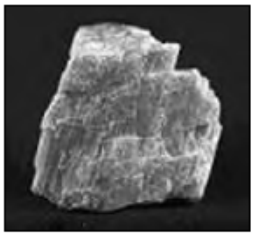


Quartz



Muscovite mica

Plagioclase feldspar



Amphibole

Pyroxene

39. Identify the mineral shown that can scratch all of the other minerals shown.

40. In the table below, place an **X** in the appropriate box to indicate whether each mineral is found mainly in felsic or mafic igneous rock.

Mineral Name	Felsic	Mafic
Potassium feldspar		
Olivine		
Quartz		
Pyroxene		

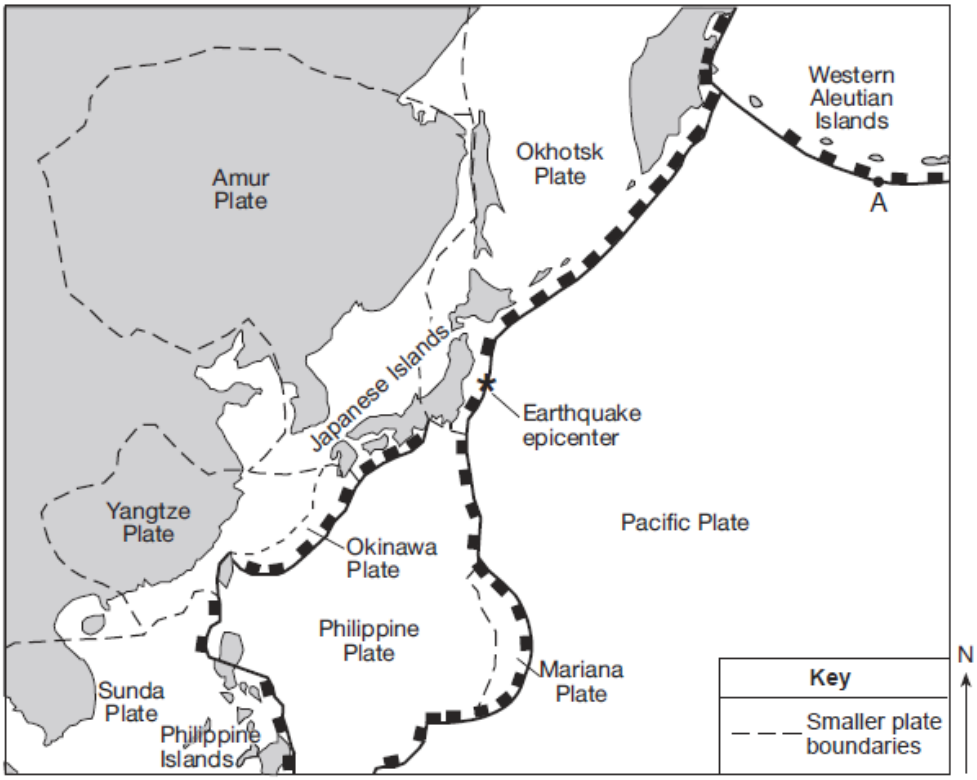
41. Identify the two most abundant elements, by mass, in Earth's crust that are part of the composition of all eight of these minerals.

42. Identify the two minerals shown that exhibit fracture as a dominant form of breakage.

Base your answers to questions **43** through **46** on the passage and the map below and on your knowledge of Earth science. The map indicates the epicenter **(*)** of a major earthquake that occurred at 38° N 142° E. This map also shows some smaller plates believed to be part of the major tectonic plates shown in the *Earth Science Reference Tables*. Letter *A* represents a location on a plate boundary.

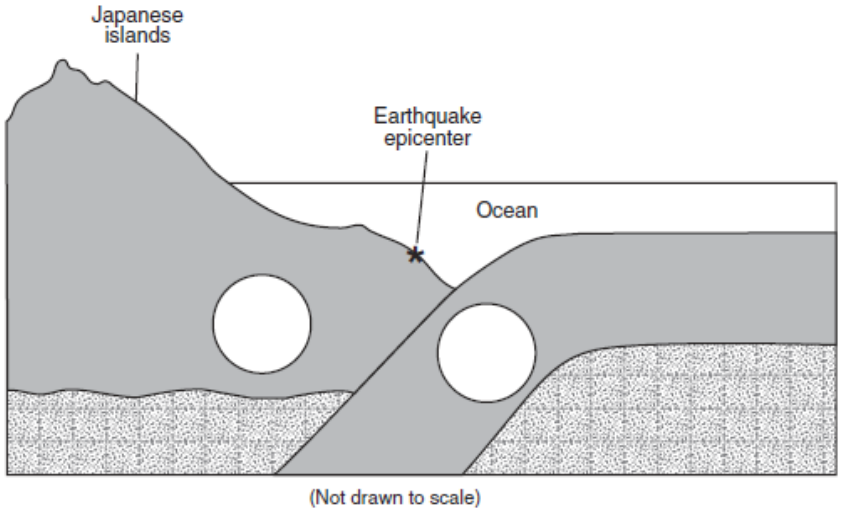
Devastating Tsunami

On March 11, 2011, one of the largest earthquakes ever recorded (magnitude 9.0) produced a 7-meter-high tsunami that devastated Japan's eastern coast. Thousands of people died and billions of dollars in damage occurred. Several hours after the earthquake, the tsunami reached the Hawaiian Islands and parts of North America's west coast.



43. Identify by name the *two* tectonic plates labeled on the map above that are located directly on each side of the earthquake epicenter.

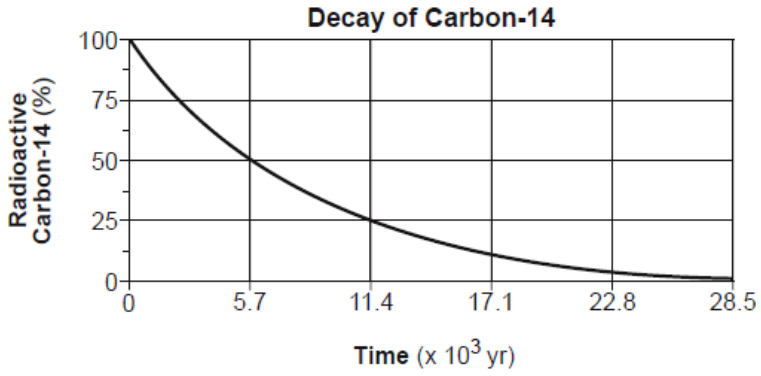
44. On the cross section of the tectonic plate boundary, draw *one* arrow in *each* circle to indicate the general direction of plate motion near the earthquake epicenter.



45. Describe *one* immediate action that was most likely taken in the Hawaiian Island to prevent the loss of life as the tsunami approached.

46. Identify *one* geologic feature that was most likely produced by plate interaction at point *A*.

Base your answers to questions **47** through **49** on the graph below and on your knowledge of Earth science. The graph shows the rate of decay of the radioactive isotope carbon-14 (^{14}C).

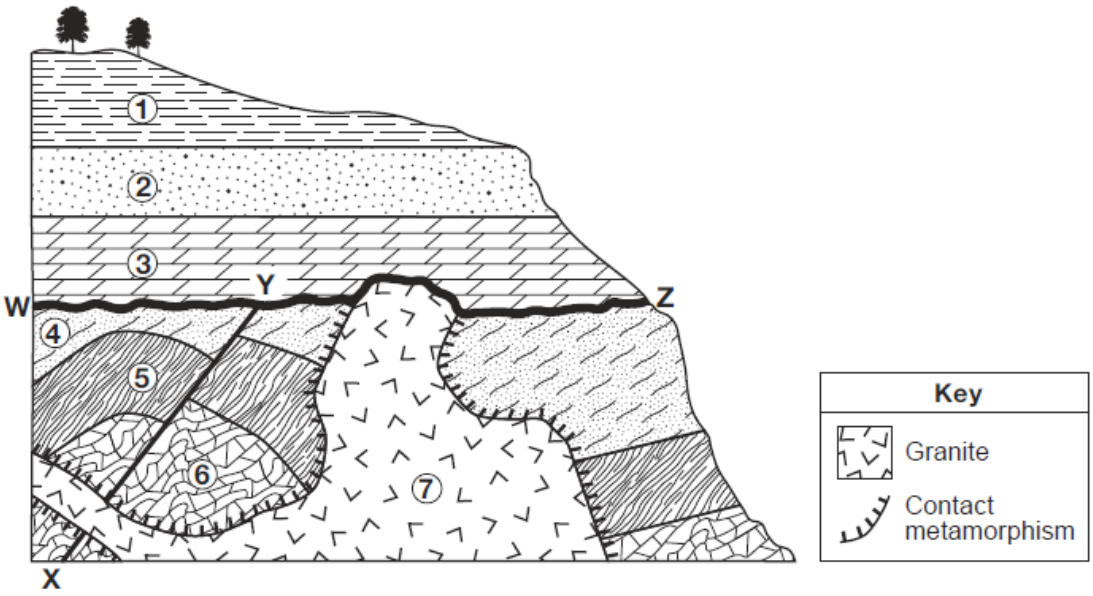


47. Identify the decay product formed by the disintegration of carbon-14.

48. Explain why carbon-14 *cannot* be used to accurately determine the age of organic remains that are 1,000,000 years old.

49. State the name of the radioactive isotope that has a half-life that is approximately the same as the estimated time of the origin of Earth.

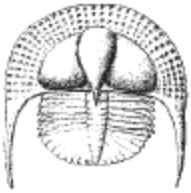
50. Base your answer to the following question on the cross section below and on your knowledge of Earth science. On the cross section, numbers 1 through 7 represent rock units in which overturning has *not* occurred. Line *XY* represents a fault and line *WZ* represents the location of an unconformity.



The three index fossils below are found within rock units 1, 2, and 3. Since the rock units were deposited during different geologic time periods, each fossil is found in a different rock unit.

Hexameroceras

Centroceras



Cryptolithus

Write the name of each of these index fossils next to the rock unit where the fossil is most likely found.

Rock Unit	Fossil Name
1	
2	
3	