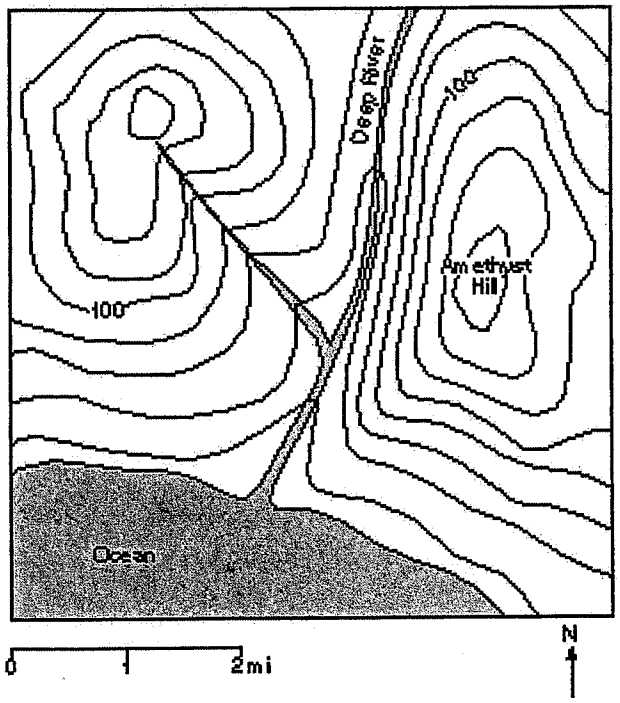
1 Measurements of gravity are greater at the poles than at the Equator. This evidence best supports the inference that Earth has a

1 perfectly spherical shape
2 slightly oblate shape
3 very elliptical orbit
4 slightly elliptical orbit

For questions 2 and 3 refer to the contour map as shown below. Elevations are shown in feet.



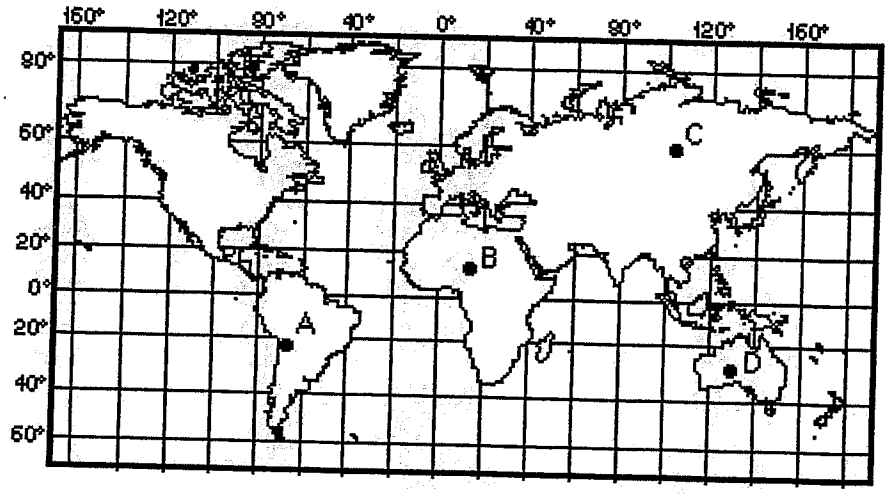
2 Which side of Amethyst hill has the steepest slope?

1 North
2 South
3 East
4 West

3 What is the elevation of the tallest point on the un-named hill shown on the map above?

1 130 feet
2 160 feet
3 165 feet
4 170 feet

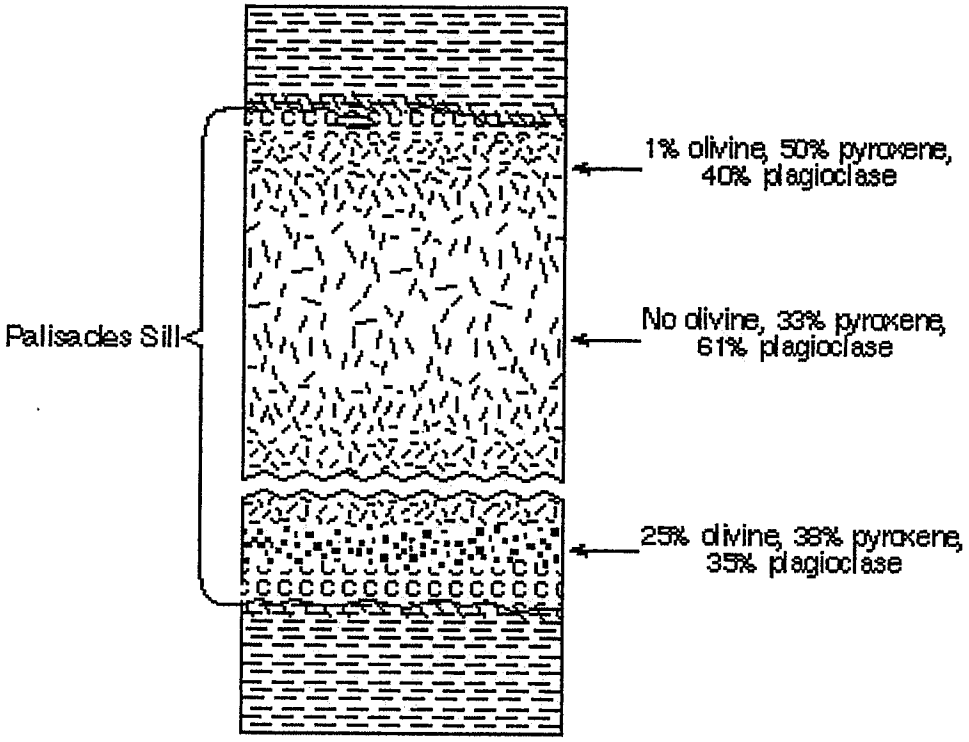
4 Letters A through D shown on the map below are locations on the Earth's surface



Which location is closest to a major zone of frequent earthquakes and volcanic activities?

1 A
2 B
3 C
4 D

For questions 5 and 6 Please refer to the cross 300 meter tall section below that shows variations of mineral composition that can be observed in the Palisades Sill clifs. The sill is an intrusive igneous rock called a diabase.



5 Which other igneous rock is closest to diabase in mineral composition?

1 andesite
2 granite
3 rhyolite
4 gabbro

6 What is the most likely causes of the different mineral compositions at different depths in the sill as observed above. More than one answer may apply.

1 Weathering of the exposed surface of the sill.

2 Settling of olivine crystals in the liquid magma because they are denser than the average composition of the melt.

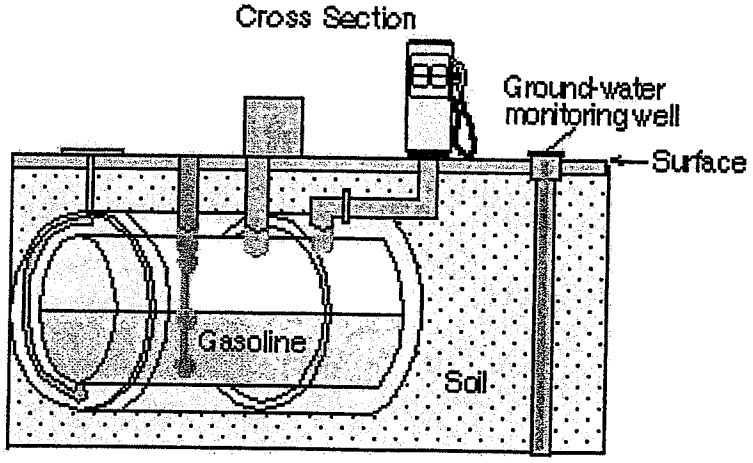
3 Settling of the olivine crystals in the liquid magma because they are less dense than the average composition of the liquid melt.

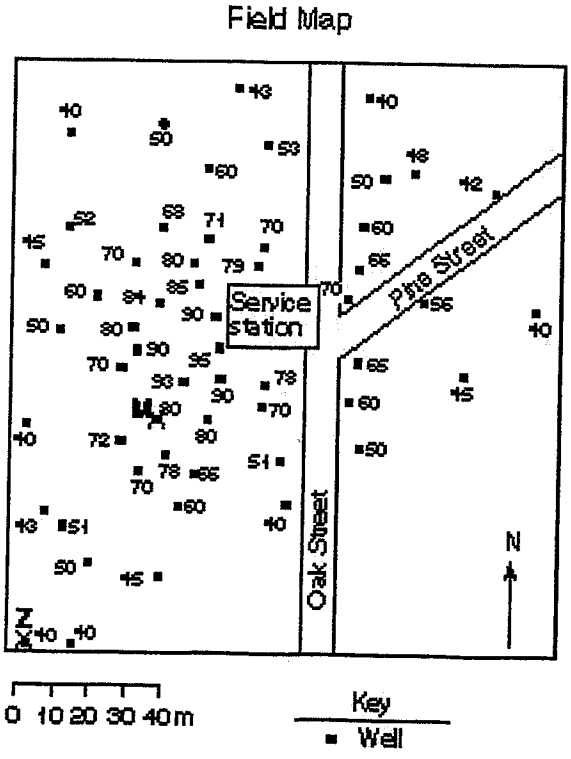
4 The olivine and plagioclase crystals formed from the melt prior to the formation of the pyroxene crystals.

5 The pyroxene crystals formed prior to the other crystals in the melt.

6 As the semi liquid magma was intruded into the host rock, the magma solidified first close to the the contact boundaries due to the thermal gradient.

Base your answers to questions 7 through 9 on the diagram and field map shown below. The diagram shows and underground storage tank at a service station that is leaking gasoline into the soil. Ground-water monitoring wells were drilled to show the pattern of leakage. The concentration of gasoline, in parts per million, at each well is indicated on the field map. 1 microgram per liter (µg/L) is considered unfit for human consumption.





7 Which expression shows the approximate gradient (rate of change in gasoline concentration per meter from point M to point Z?

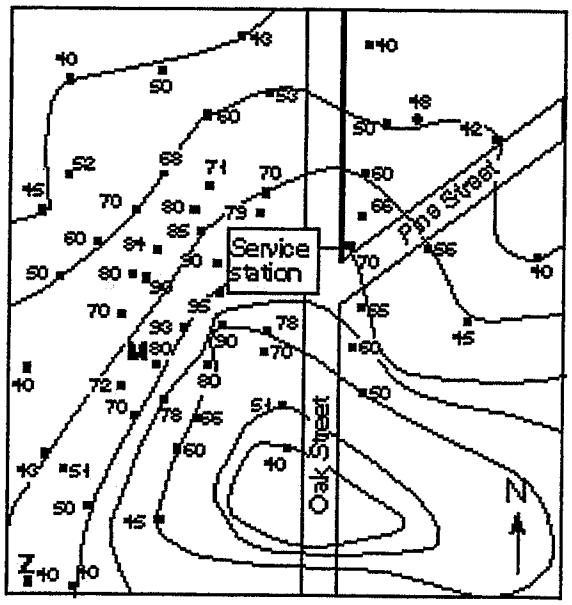
1 gradient = (80 ppm - 40 ppm) / 70 meters

2 gradient = 70 meters / (80 ppm - 40 ppm)

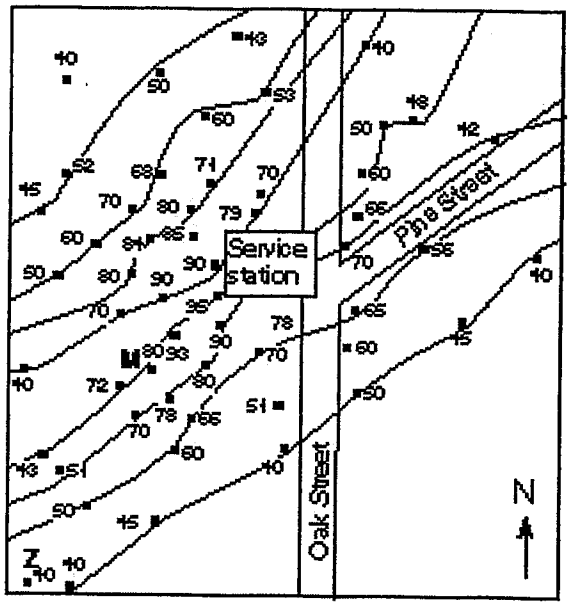
3 gradient = (80 ppm - 70 ppm) / 40 meters

4 gradient = 40 meters / (80 ppm - 70 ppm)

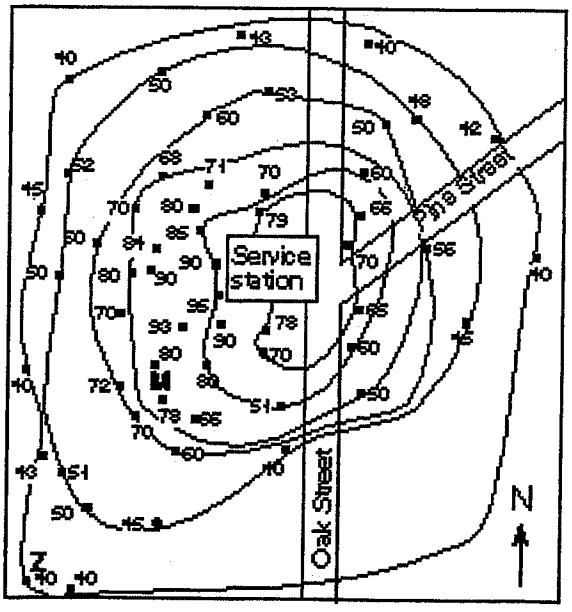
8 Which isoline map best represents the pattern of gasoline concentration as measured in the wells?



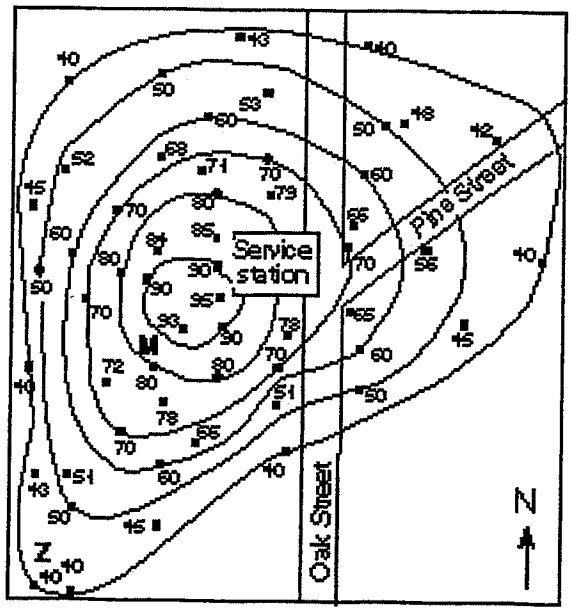
(1)



(3)



(2)



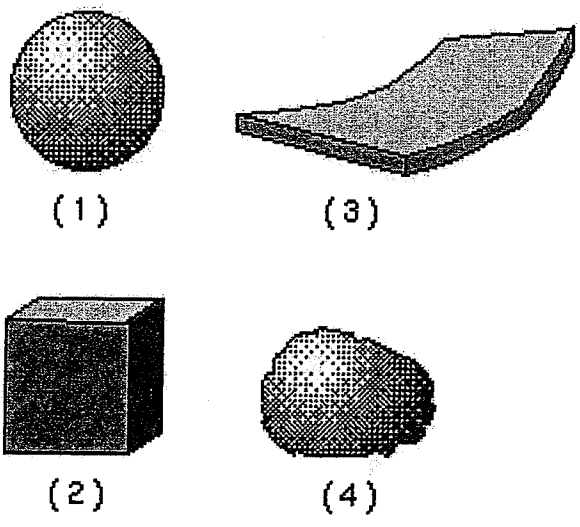
9 Which statement best describes the pollution field's size and concentration measurement if the gasoline continues to leak out of the tank?

1 The size of the pollution field will decrease and the concentration measurement will decrease.
2 The size of the pollution field will decrease and the concentration measurement will increase.
3 The size of the pollution field will increase and the concentration measurement will decrease.
4 The size of the pollution field will increase and the concentration measurement will increase.

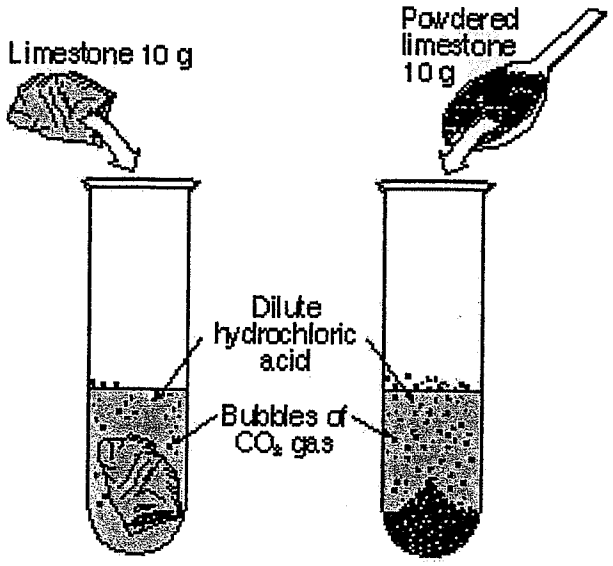
10 In a region that is being uplifted faster than it is being eroded, hills usually have

1 steep slopes and slow-moving streams
2 steep slopes and fast-moving streams
3 gentle slopes and slow-moving streams
4 gentle slopes and fast-moving streams

11 The four objects below are made of the same material and have the same mass. Which object will settle fastest in calm water?



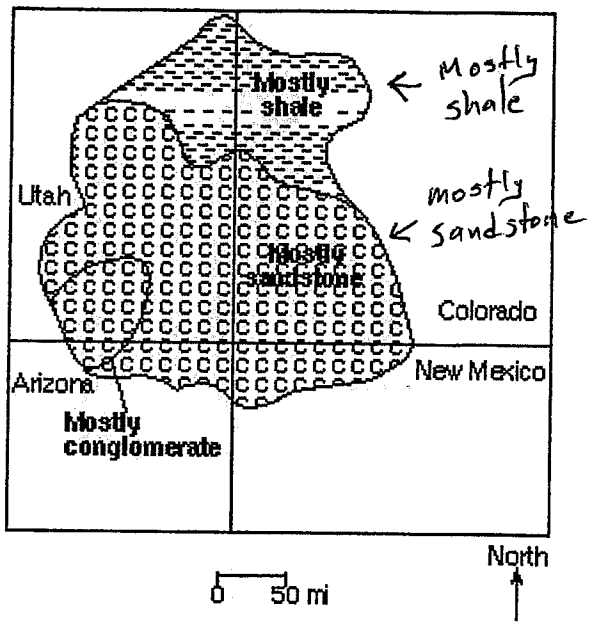
12 The demonstration shown in the diagram below indicates that powdered limestone reacts faster than a single large pieces of limestone of equal mass when both are placed in acid.



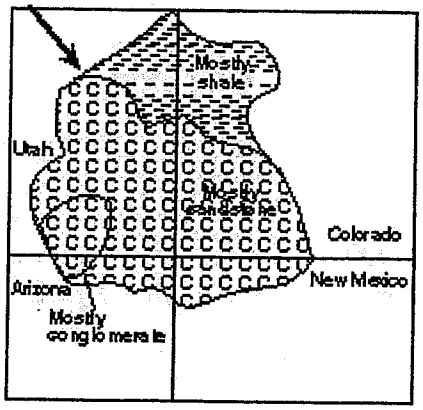
The most likely reason powdered limestone reacts faster is that it has

1 less total volume
2 more chemical bonds
3 more total surface area
4 lower density

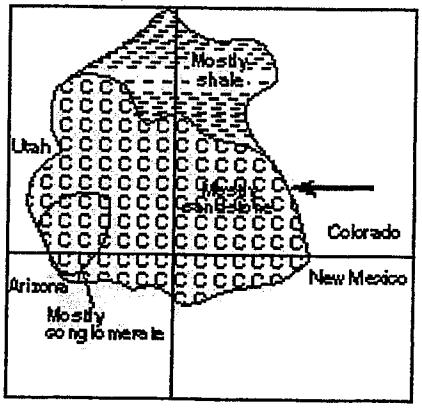
13 The map below shows the surface bedrock in an area of the southwestern United States that formed from sediments deposited in a shallow sea that formerly existed in that area. These sediments were transported by a river that flowed into that sea.



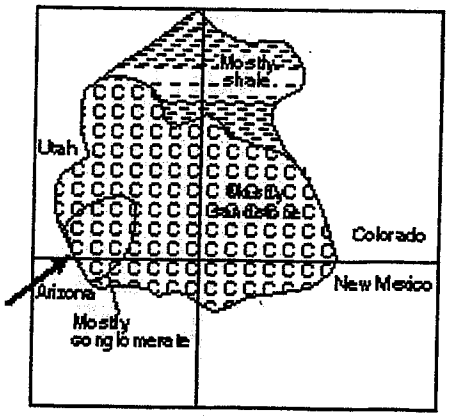
In which diagram does the arrow best show the direction of flow of the river that deposited these sediments and the point at which the river emptied into the sea?



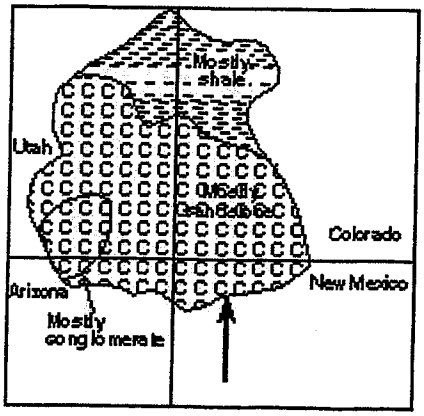
(1)



(3)

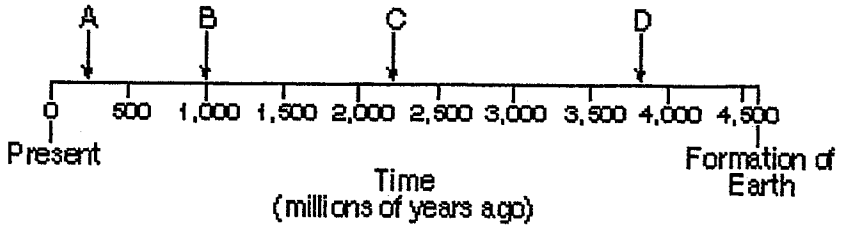


(2)



(4)

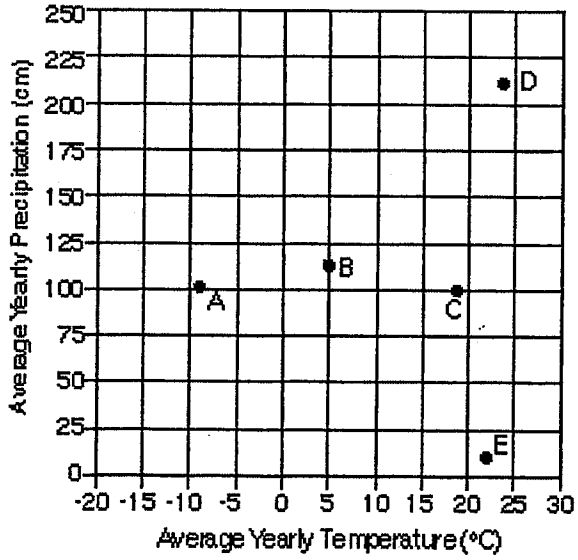
14 The timeline below represents the geological history of Earth. Letters A, B, C and D represent specific times in Earth's history.



Which letter best indicates when trilobites became extinct?

1 A
2 B
3 C
4 D

Base your answers to question 15 and 16 on the graph below, which shows the average yearly temperature and average yearly precipitation for Earth locations A through E



15 The climate indicated at location E on the graph would most likely be classified as

1 cold and dry
2 cold and humid
3 warm and dry
4 warm and humid

16 Which location has the climate conditions necessary for the greatest amount of chemical weathering to occur?

1 A
2 B
3 C
4 D

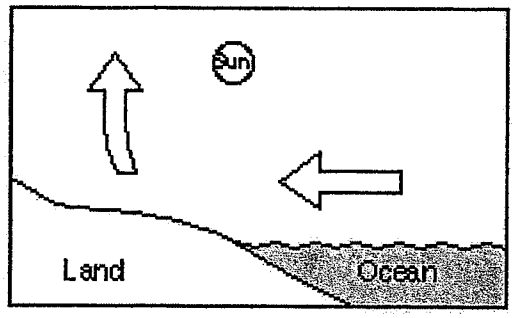
17 Which type of air mass would most likely have low humidity and high air temperature?

1 cT
2 cP
3 mT
4 mP

18 A student in New Zealand observed that the noon Sun increased in altitude each day during the first part of a certain month and then decreased in altitude each day later in the month. During which month were these observations made?

1 February
2 June
3 December
4 November

19 In the diagram below, arrows represent air movement near an ocean coastline on a summer afternoon.



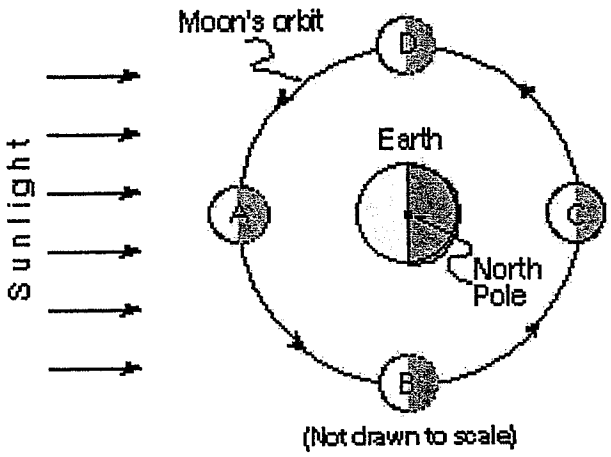
Compared to the air over the ocean, the air over the land has a

1 Lower temperature and a lower barometric pressure
2 Lower temperature and a higher barometric pressure
3 Higher temperature and a lower barometric pressure
4 Higher temperature and a higher barometric pressure

20 How do the metamorphic rocks schist and quartzite differ?

1 Quartzite contains the mineral quartz, and schist does not.
2 Quartzite forms from regional metamorphism, and schist does not.
3 Schist is organically formed, and quartzite is not.
4 Schist is foliated, and quartzite is not.

21 The diagram below shows a model of the moon's orbit around Earth. Letters A, B, C and D represent four positions in the moon's orbit.



What is the approximate length of time the Moon takes to travel from position A to position C?

1 1 day
2 15 days
3 30 days
4 365 days

22 The data table below compares the percentage of sunlight reflected from various types of Earth surfaces.

Surface	Percent of Sunlight Reflected
Fresh snow	80–85
Old snow	50–60
Sand	20–30
Grass	20–25
Dry soil	15–25
Wet soil	10
Forest	5–10
Water (Sun at sunset)	50–80
Water (Sun overhead)	3–5
Thick cloud	70–80
Thin cloud	25–50

Which statements are best supported by the table? More than one correct answer.

1 Light colored surfaces reflect more sunlight than dark-colored surfaces.

2 Rough surfaces reflect more sunlight than smooth surfaces.

3 Soil surfaces reflect more sunlight than cloud surfaces.

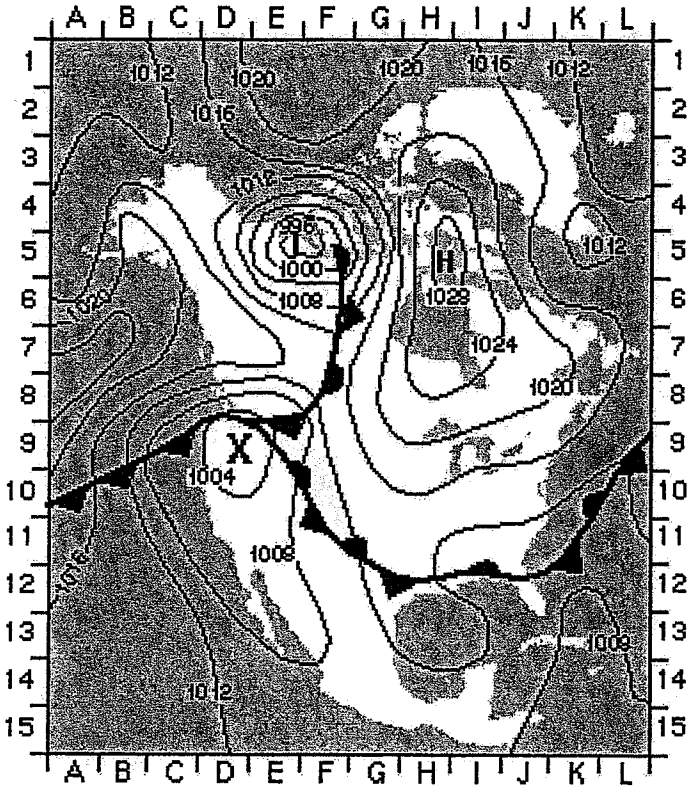
4 Vegetative surfaces reflect more sunlight than ice surfaces

5 As arctic ice melts, it leads to less sunlight energy being reflected.

6 When forests are cut down, exposing grass and soil, it leads to more sunlight energy being reflected.

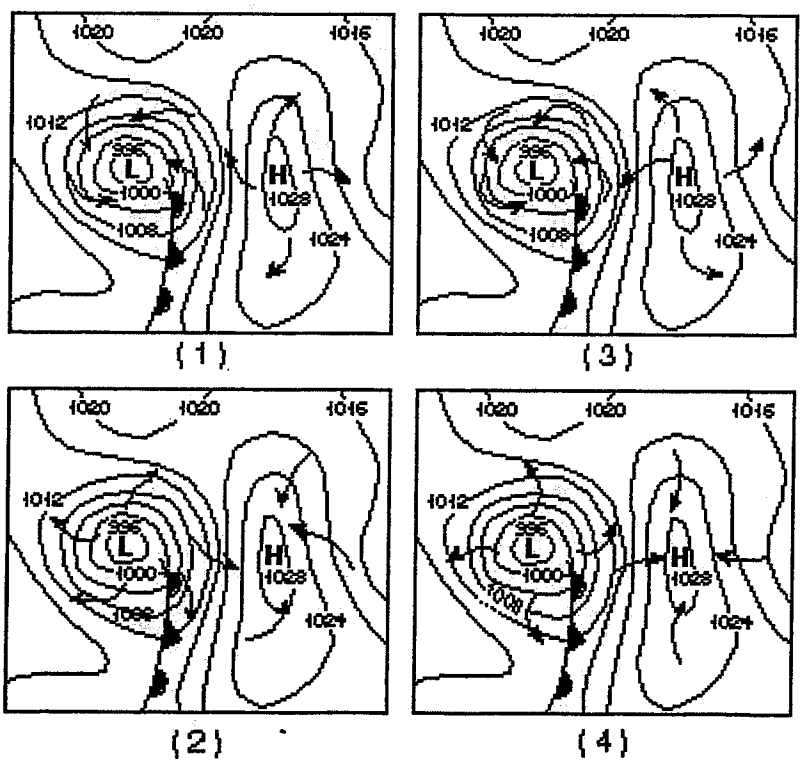
7 Clouds caused by the condensation trails of jets generally help to reflect more sunlight

Base your answers to questions 23 through 26 on the weather map of North America below. A grid system of letters and numbers is provided along the edges of the map to assist in finding locations. Isobars are labeled in millibars. Letter X represents the center of a second low-pressure system.



23 A

On which map do the arrows correctly show the surface wind pattern for the high- and low-pressure centers shown on the northern part of the weather map of North America?



23 B If the low pressure center labeled X follows the typical storm track from its present location, the low pressure center will move generally towards the

1 north
2 south
3 east
4 west

24 What type of front is shown at grid coordinates A-10

1 occluded
2 stationary
3 cold
4 warm

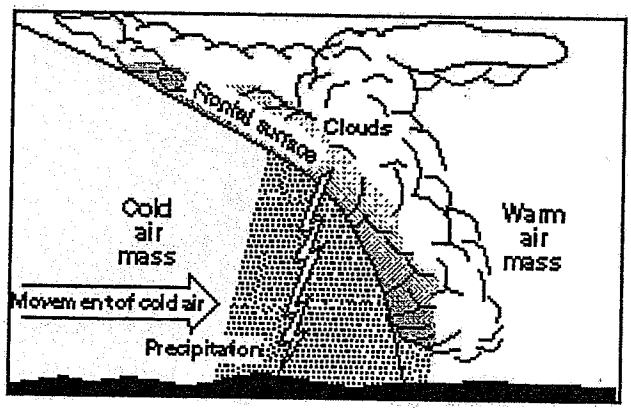
25 What type of front is shown at grid coordinates G-12

1 occluded
2 stationary
3 cold
4 warm

26 What type of front is shown at grid coordinates F-7

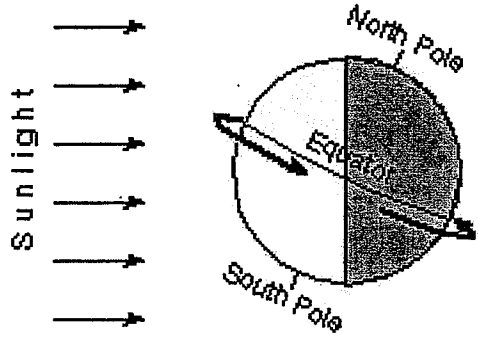
1 occluded
2 stationary
3 cold
4 warm

27 The diagram below shows a cross section of a front. What statements are true? More than one correct answer.



1 The front shown is a warm front
2 Sinking cold moist air causes precipitation.
3 Rising warm moist air causes precipitation.
4 Sinking warm moist air causes precipitation.
5 Some of the clouds shown are cumulonimbus.
6 This is a stationary front.
7 The tops of the clouds shown can go no further upwards

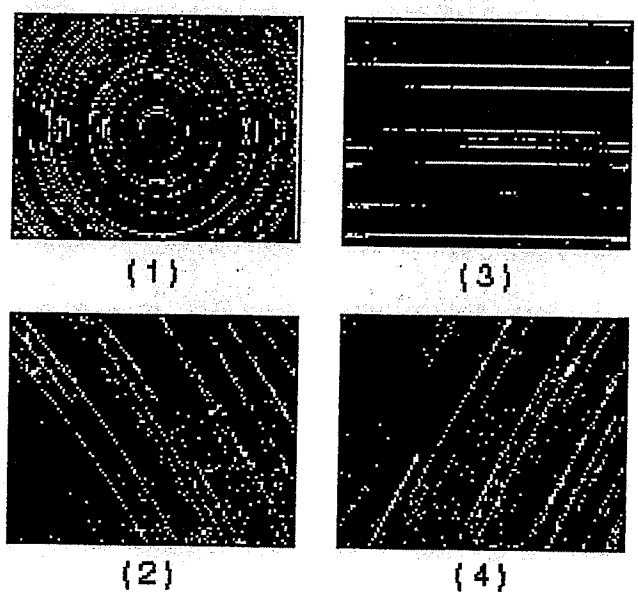
28 The diagram below shows a view of Earth as seen from space at a certain time of the year.



Compared to observers at 35° S latitude, observers at 35° N latitude are generally experiencing

1 fewer hours of daylight and warmer temperatures
2 fewer hours of daylight and cooler temperatures
3 more hours of daylight and warmer temperatures
4 more hours of daylight and cooler temperatures

29 Which photograph of star trails was taken by an observer facing directly up at the south pole?



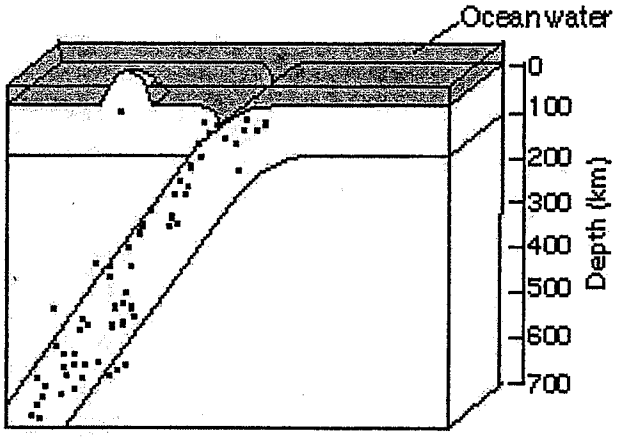
30 A mineral's crystal shape and cleavage are a direct result of the mineral's

1 hardness
2 abundance in nature
3 arrangement of atoms
4 exposure to the hydrosphere and atmosphere

31 Why is the Earth's outer core inferred to be a liquid? More than one answer

1 P-waves can pass through the outer core.
2 P-waves cannot pass through the outer core.
3 S-waves can pass through the outer core.
4 S-waves cannot pass through the outer core.
5 The location of zones where no S-waves are recorded.
6 The location of zones where no P-waves are recorded.

32 The cross section below shows the location of earthquakes and their depth More than one possible answer.

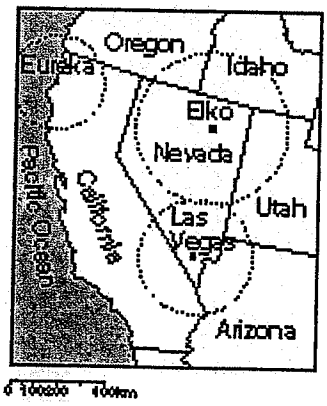


1 This shows a convergent plate boundary.
2 This shows a divergent plate boundary.
3 This shows a mantle hot spot.
4 This shows a transform fault.
5 Explosive volcanoes are often associated with this feature.
6 Non-explosive volcanoes are often associated with this feature.
7 Earthquakes located at this feature rarely exceed magnitude 6
8 Earthquakes located at this feature often exceed magnitude 6

33 The same earthquake was recorded by seismic stations in Eureka, California; Elko, Nevada; and las Vegas, Nevada. The distance to the earthquake epicenter for each station is shown below.

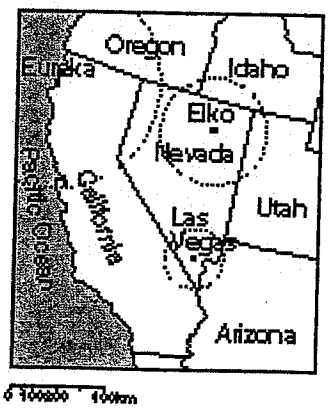
Seismic Station Location	Distance to Epicenter
Eureka, CA	485 km
Elko, NV	705 km
Las Vegas, NV	622 km

On which map do the circles correctly show the epicenter distance from each of the seismic stations?



(1)

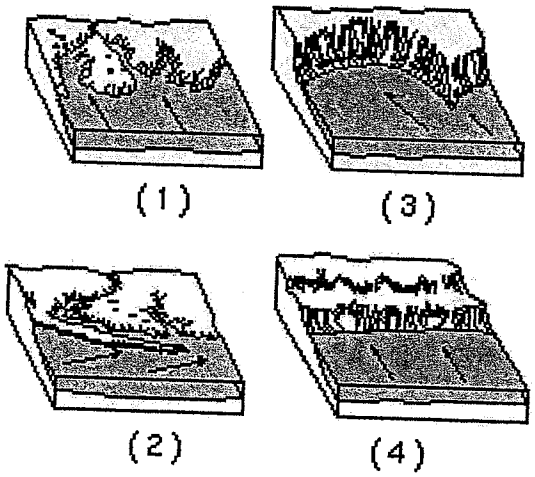
(3)



(2)

(4)

34 The diagrams below represent landscape features found along the seacoast. The arrows show ocean-wave direction. Which shoreline has been shaped more by deposition than erosion?



Which evidence causes scientists to conclude that seafloor spreading occurs at the mid-Atlantic ridge? More than one correct answer.

1 Ocean crust is oldest at the ridge.

2 Ocean crust on both sides of the ridge shows matching patterns of reversed and normal magnetic polarity.

3 The depth of accumulated sediment is greater near the ridge.

4 The depth of accumulated sediment is greater further away from the ridge.

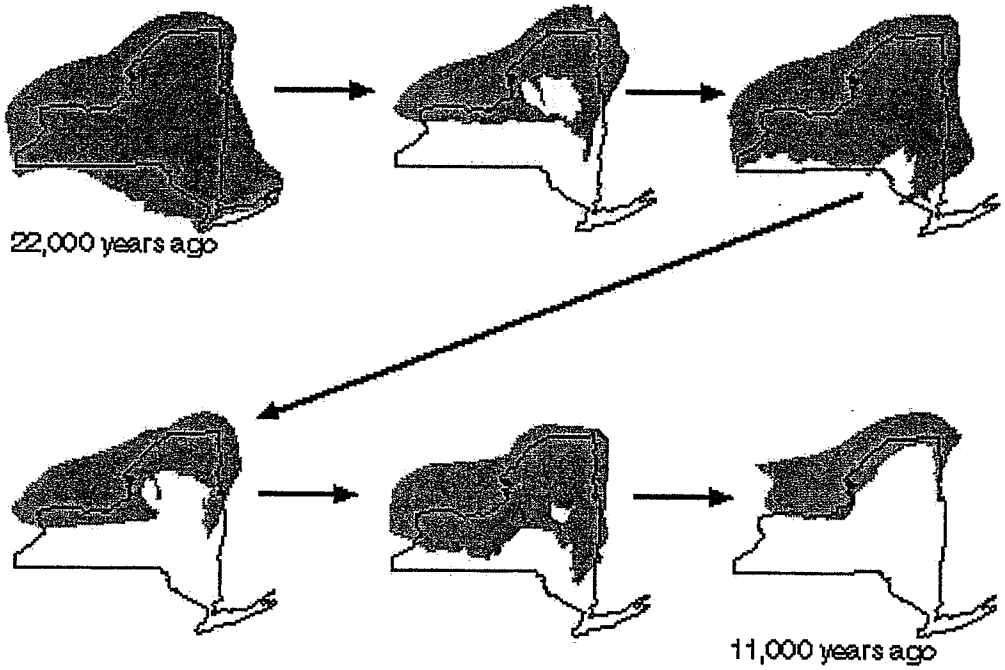
5 The density of the crust increases further away from the ridge causing the ocean to be of greater depth.

6 The rate of spreading has been directly measured at Iceland.

35 The curvature to the right by major ocean currents in the Northern Hemisphere is primarily due to

1 surface variations in ocean water salinity
2 differences in ocean water temperature
3 the gravitational attraction of the moon
4 the rotation of the Earth

36 Shaded areas on the diagram below show the part of New York State that was covered by glacial ice during the last ice age.



1 N.

What inferences can be made from these diagrams?

1 The glacial ice was over one km. thick in places.
2 The glacier advanced and retreated more than once.
3 The glaciers moved more slowly than glaciers of earlier ice ages.
4 The glaciers changed the shape of lake Ontario

37 What is the best evidence that a glacial erratic has been transported?

1 It is located at a high elevation in a mountainous area.
2 It is less than 25 cm. in diameter.
3 Its composition is different from that of the bedrock underneath it.
4 It appears to have been intensely metamorphosed.

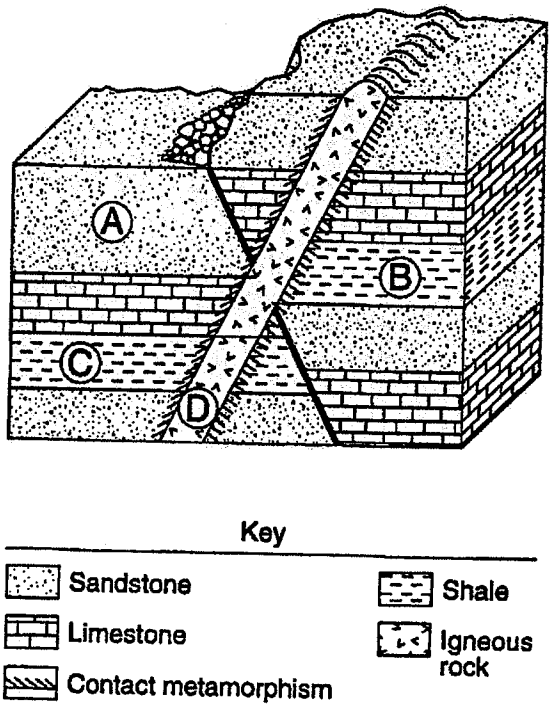
38 Which rocks generally have the mineral quartz as part of their composition?

1 conglomerate, gabbro, rock salt, and schist
2 breccia, fossil limestone, bituminous coal, and siltstone
3 shale, scoria, gneiss, and marble
4 granite, rhyolite, sandstone, and hornfels

39 Which features are commonly found at a plate boundary where the plates are neither converging or diverging? More than one answer.

1 a mid-ocean ridge
2 an ocean trench
3 a transform fault
4 new ocean crust
5 mostly shallow earthquakes
6 volcanism

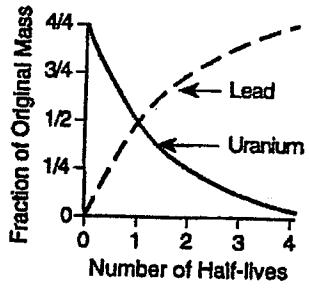
40 **A geologic cross section is shown below.**



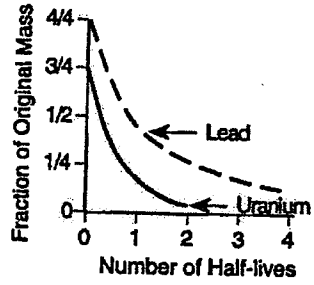
Select all statements that can be inferred from the section above.

1 A is the youngest rock formation.
2 D is the youngest rock formation.
3 D is the oldest rock formation
4 C and D are part of the same rock formation.
5 D is a fault structure.
6 D is metamorphic rock.
7 D is an igneous extrusive rock.
8 The marks in the other rocks next to D represent an unconformity
9 The marks in the other rocks next to D represent regional metamorphism.

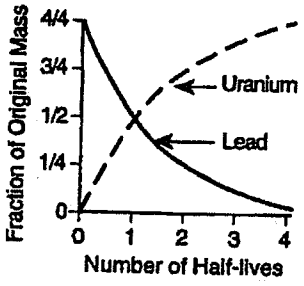
41 Which graph best represents the radioactive decay of uranium 238 into lead 206?



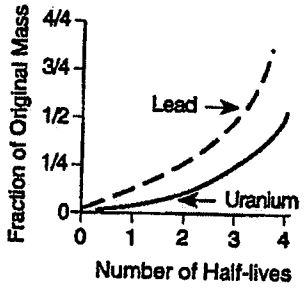
(1)



(3)

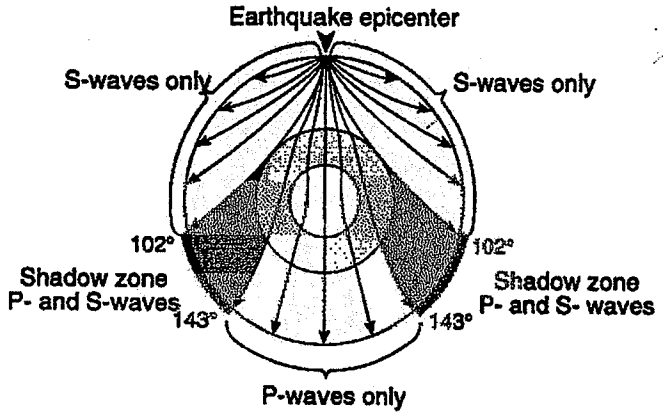


(2)

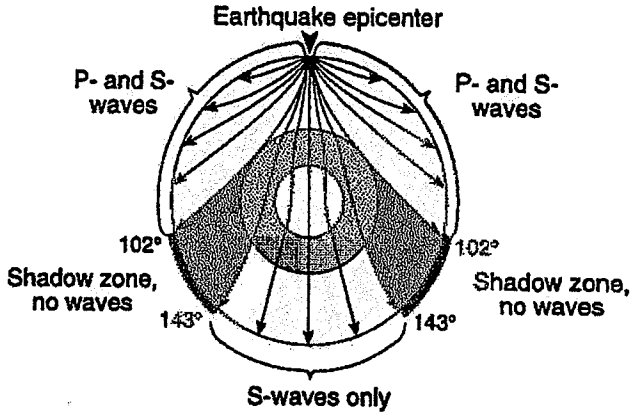


(4)

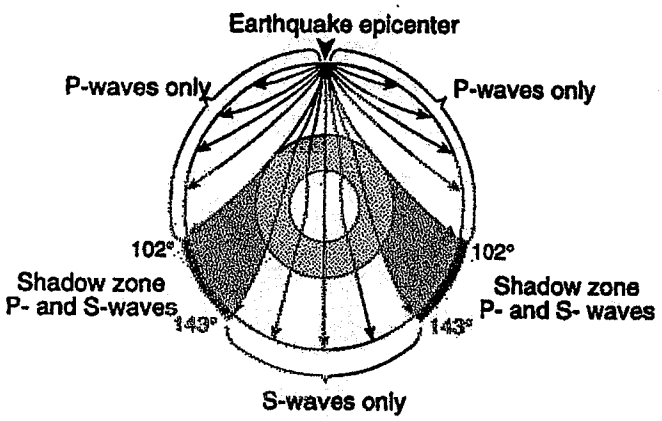
42 Which cross sectional diagram of Earth correctly shows the paths of seismic waves from an earthquake traveling through Earth's interior?



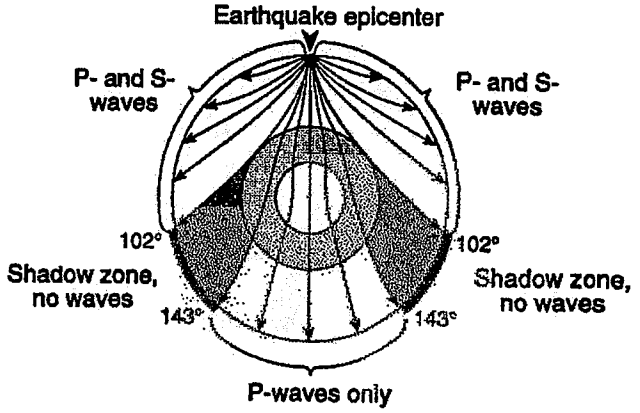
(1)



(3)



(2)

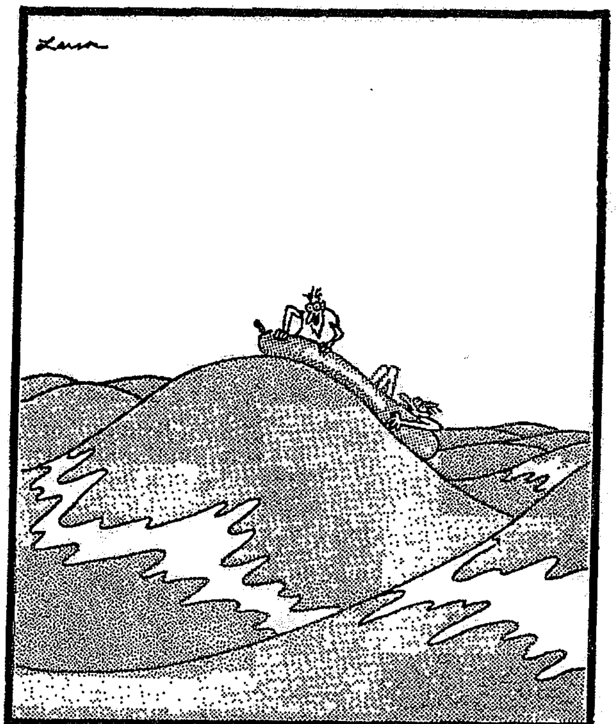


(4)

43 Compared to oceanic crust, continental crust is generally:
More than one answer.

1 older and thinner
2 older and thicker
3 younger and thinner
4 younger and thicker
5 denser
6 less dense
7 more mafic

44 The cartoon below presents a humorous look at deep ocean wave action with two Earth Science students adrift on an ocean of knowledge. Identify all of the following statements that are correct. More than one answer.



"Here comes another big one, Roy, and here — we — gooooooowheeeeeeeeooo!"

1 Waves are caused by an interaction between the hydrosphere and atmosphere.

2 Waves energy originates from differential absorption of the sun's energy in the atmosphere.

3 Waves slow down and become taller in shallower water.

4 Waves slow down and become taller in deeper water.

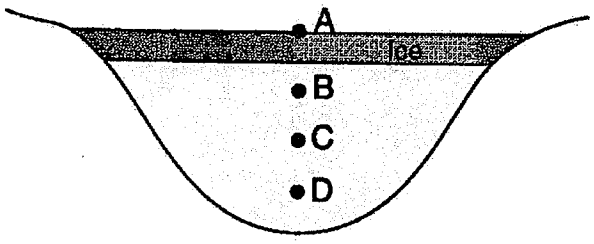
5 The motion of a water molecule on the surface of the ocean as a wave passes is circular.

6 The motion of a water molecule on the surface of the ocean as a wave passes is linear back and forth.

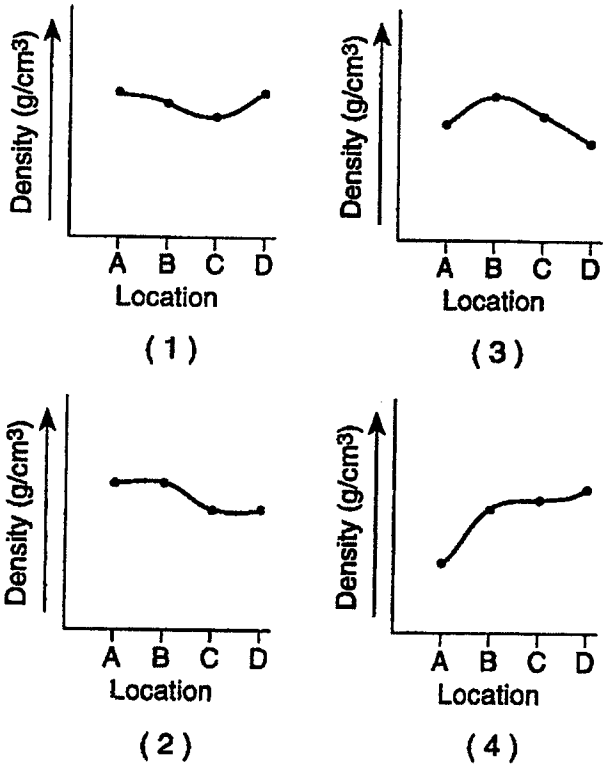
45 If the Earth's axis tilt were to increase from 23.5° to 33.5°, the result would be

1 shorter days and longer nights at the Equator.
2 less difference between winter and summer temperatures in Vermont
3 more difference between winter and summer temperatures in Vermont.
4 An increase in the amount of solar radiation received by Earth.

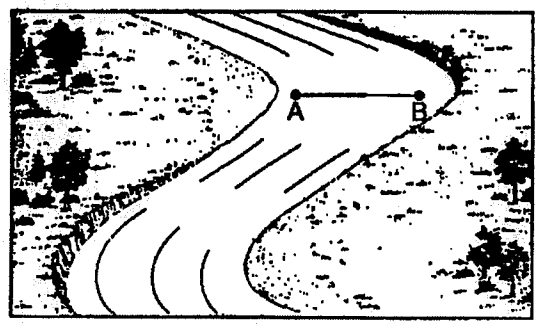
46 The diagram below is a cross section of an ice covered lake in Vermont during the month of January. Points A, B, C, and D are locations at various depths in the lake. The temperature of the water at location D is 4° C.



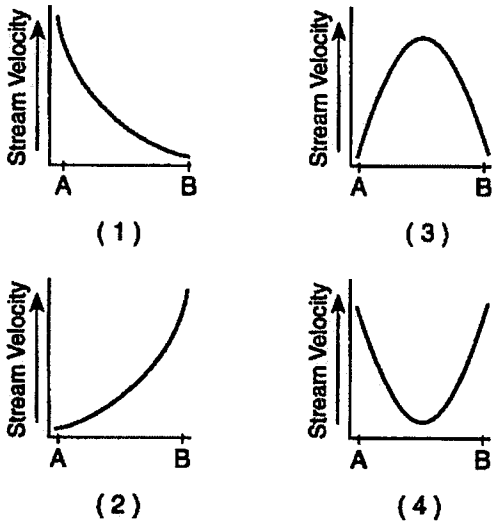
Which graph best represents the relationship between location and density of the ice or water?



47 The diagram below shows a meandering stream. Measurements of stream velocity were taken along straight line AB.



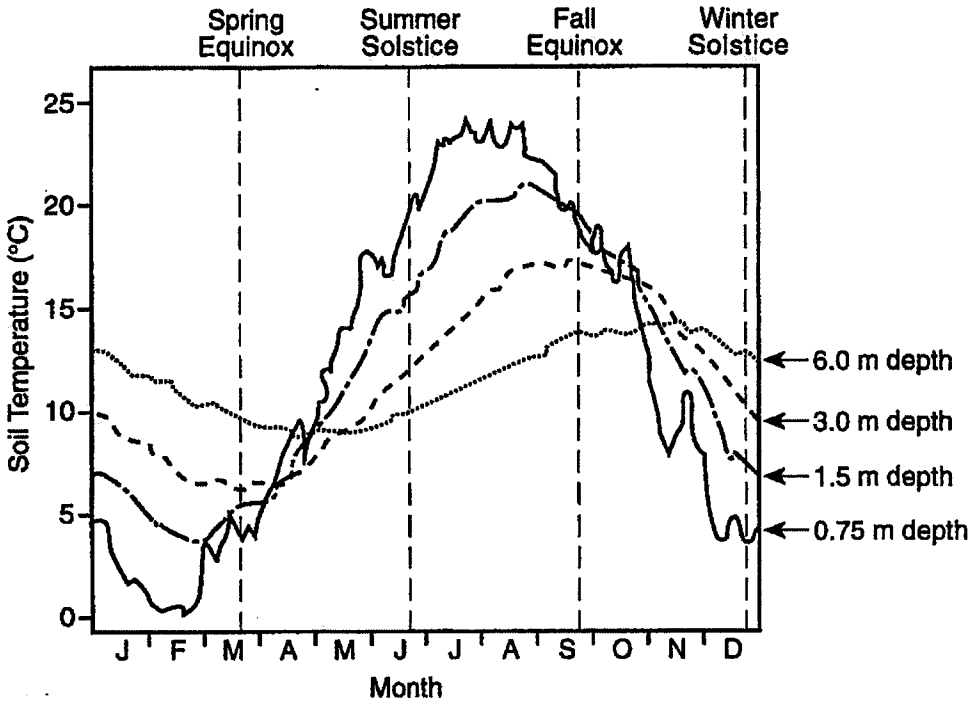
Which graph best shows the relative stream velocities across the stream from *A* to *B*?



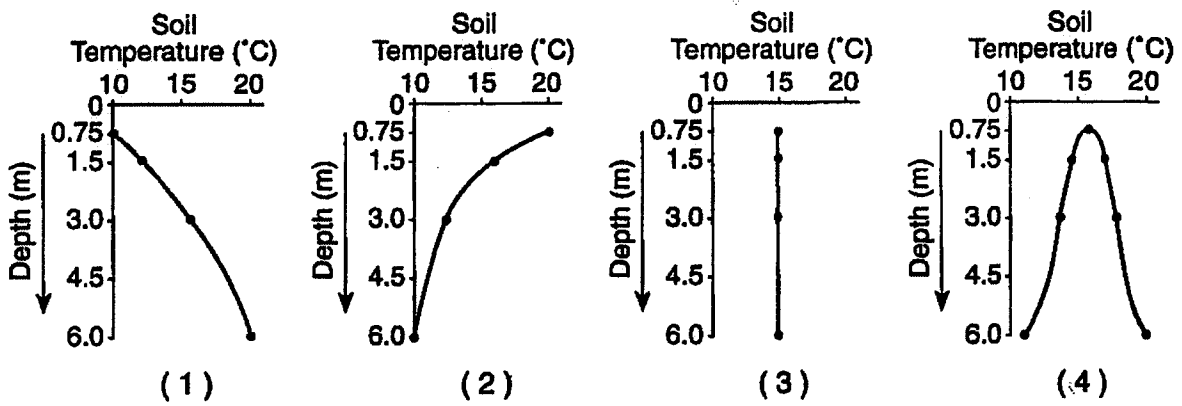
48 Which mineral property is illustrated by the peeling of muscovite into thin, flat sheets?

1 luster
2 streak
3 hardness
4 cleavage

Base your answers to questions 49 through 53 on the graph below and on your knowledge of Earth Science. The graph shows temperature data taken at four different depths in the soil at one location in Essex Vermont, for one year.



49 Which graph best represents the relationship between soil temperature and the depth in the soil on June 21?



50 On what date was the temperature at the 3 meter depth greater than the temperature at any other of the three depths?

1 July 11
2 August 31
3 November 1
4 December 21

51 When did the maximum soil temperature occur at depths in the soil of less than 5 meters?

1 at the spring equinox
2 between the spring equinox and the summer solstice
3 at the summer solstice
4 between the summer solstice and the fall equinox

52 Why are the temperatures different at different depths? More than one correct answer

1 The soil must absorb and give off energy to change temperature
2 The water in the soil has a much larger specific heat measured in cal/gram x °C than the bedrock.
3 The soil is being heated only from above by sunlight energy.
4 The shallowest depth shows the greatest short term fluctuation caused by short term weather swings.

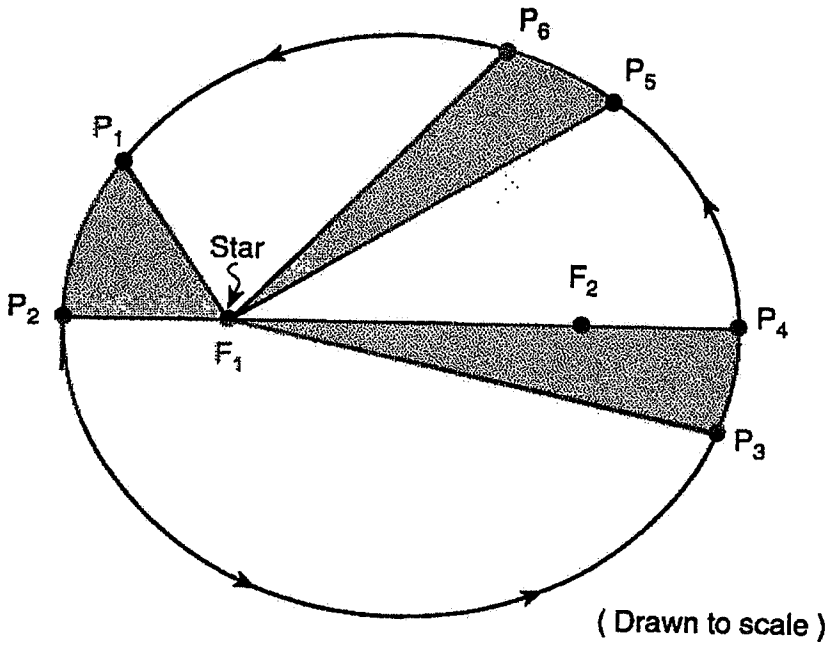
53 The graph shows that as the depth increases, the annual temperature range (Only three choices)

1 decreases
2 increases
3 remains the same

54 What can you infer about the temperature at a 10 m. depth? (More than one correct answer)

1 It has a temperature range each year of more than 10° C
2 It has a temperature range each year of less than 3° C
3 It has a temperature of about 5° C
4 It has a temperature of about 11.5° C

Base your answers to questions 55 through 60 on the diagram below and your knowledge of science. The diagram represents a planet, P, in an elliptical orbit around a star located af F1. The foci of the elliptical orbit are F1 and F2. Orbital locations are represented by P1 through P6.



(Drawn to scale)

55 The gravitational attraction between planet P and the star is greatest when the planet is located at position

1 P1
2 P2
3 P3
4 P4

56 When observed from the planet, the star would appear to have its least apparent angular diameter when the planet is located at position

1 P1
2 P2
3 p3
4 P4

57 If the shaded portions of the orbital plane are equal in area, the time between P1 and P2 will be equal to the time period between

1 P2 and P3
2 P3 and P4
3 P4 and P5
4 P6 and P1

58 If the mass of planet P were tripled, the gravitational force between the star and planet P would

1 remain the same
2 be two times greater
3 be three times greater
4 be nine times greater

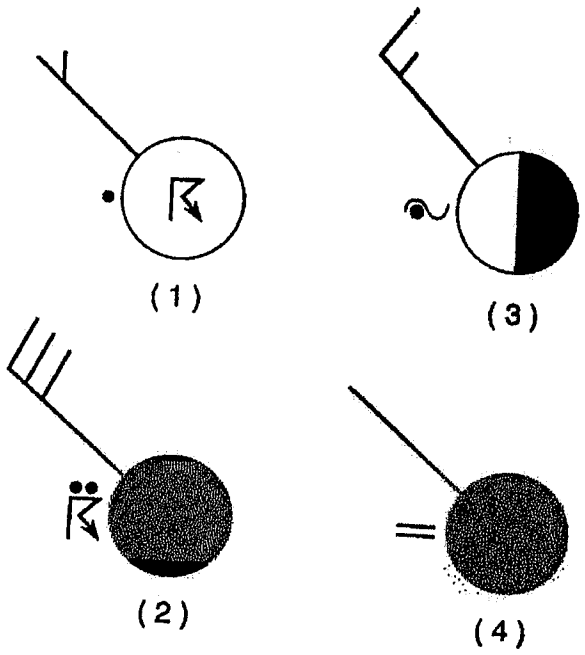
59 Regarding the planet's orbital speed around its star,

1 the speed is constant
2 the speed is greatest at point P1
3 the speed is greatest at point P2
4 the speed is greatest at point P4

60 When the planet is twice as far away from its star in its orbit, the gravitational attraction between planet P and the star is

1 the same
2 twice as much
3 four times as much
4 one quarter as much

Use the four answers below for questions 61 through 64



61 Which symbol shows clear sky and light rain?

1 2 3 4

62 Which symbol shows 15 mph winds with freezing rain?

1 2 3 4

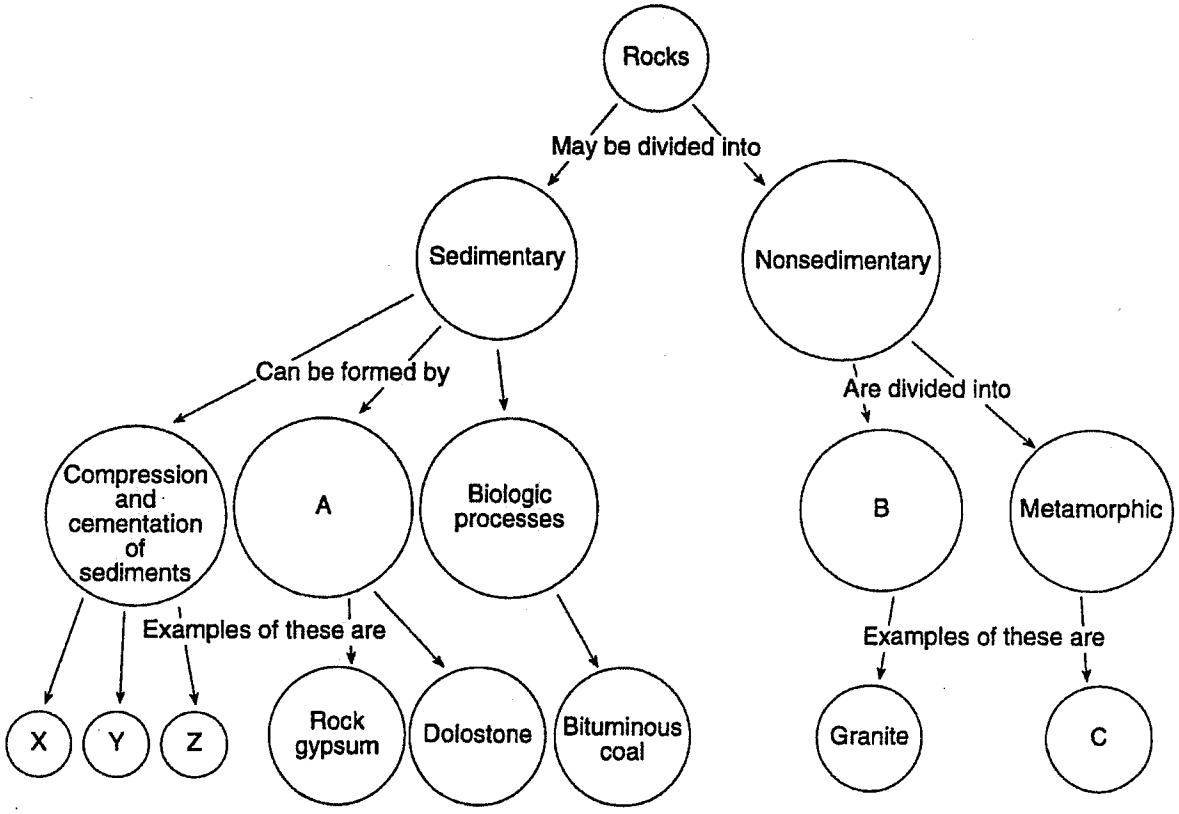
63 Which symbol shows 2 mph winds and fog?

1 2 3 4

64 Which symbol shows thunderstorm and rain.

1 2 3 4

Baee you answers to questions 65 through 68 on the diagram below. Letters A,B,C and X, Y, Z represent missing labels.



65 The classification of rocks into sedimentary or nonsedimentary is based primarily on the

1 origin
2 density
3 color
4 age

66 Which process would form the type of rock that is represented by circle B?

1 deposition and compaction
2 weathering and erosion
3 melting and solidification
4 faulting and folding

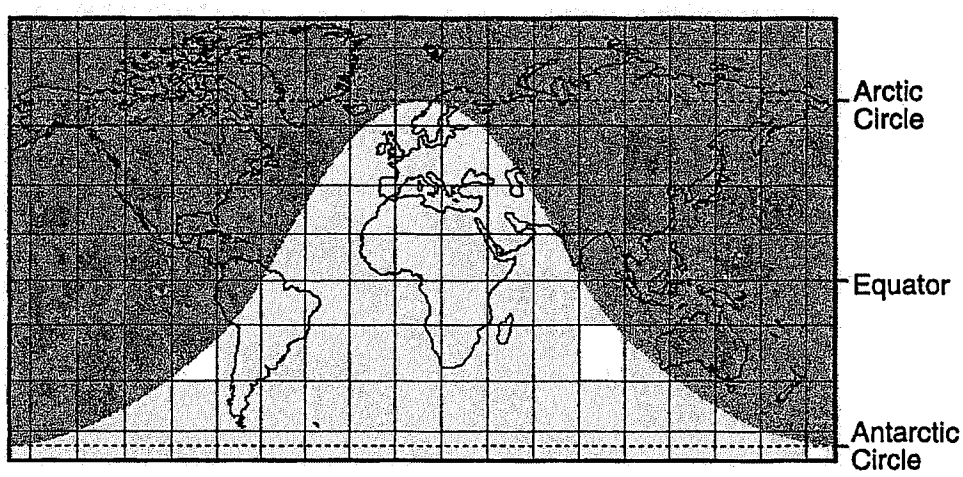
67 If the rock in circle C formed from limestone, it would be called

1 schist
2 anthracite coal
3 marble
4 slate

68 Which rocks could be represented by circles X,Y, and Z?

1 shale, slate, and schist
2 sandstone, shale, and siltstone
3 anthracite coal, metaconglomerate, and rock salt
4 breccia, gneiss, and rhyolite

69 The shaded portion of the map below indicates areas of night, and the unshaded portion indicates areas of daylight.



What day of the year is best represented by the map?

1 March 21
2 June 21
3 September 21
4 December 21

70 Ozone is important to life on Earth because ozone

1 cools refrigerators and air conditioners
2 absorbs energy that is reradiated by Earth
3 absorbs harmful ultraviolet radiation
4 destroys excess atmospheric carbon dioxide

71 Some Moon rock samples have coarse intergrown crystals composed of plagioclase feldspar, hornblende, and olivine. These Moon rock samples are most similar to Earth rock samples of

1 gabbro
2 marble
3 breccia
4 pumice

72 At what latitudes do currents of dry sinking air cause the dry conditions of Earth's major deserts?

1 0° and 30° N
2 60° N and 60°S
3 30° N and 30° S
4 60° S and 90° S

73 Why are impact structures more obvious on the Moon than on the Earth? More than one possible answer.

1 The Moon's gravity is stronger than the Earth's gravity
2 The moon has little or no atmosphere
3 The rocks on the moon are weaker than those on Earth
4 The moon rotates at a slower rate than the Earth does
5 The Earth has an active plate tectonic system