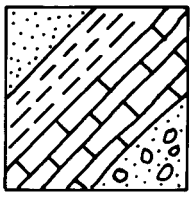
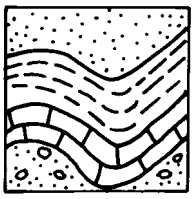
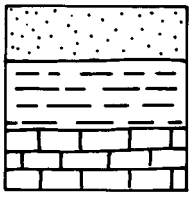
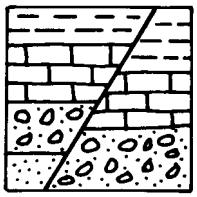
The Dynamic Crust

? The diagrams below show cross sections of exposed bedrock. Which cross section shows the *least* evidence of crustal movement?

1) 

3) 

2) 

4) 

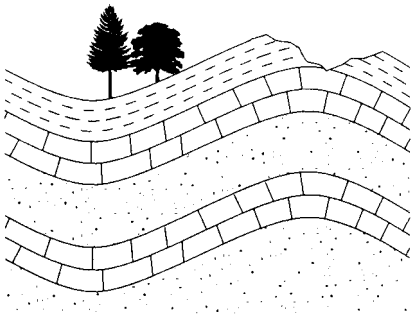
HINT

? A sandstone layer is tilted at a steep angle. What probably caused this tilting?

1) The sediments that formed this sandstone layer were originally deposited at a steep angle.
2) This sandstone layer has changed position due to crustal movement
3) This sandstone layer has recrystallized due to contact metamorphism.
4) Nearly all sandstone layers are formed from wind deposited sands.

HINT

? The diagram below shows a cross section of sedimentary rock layers.

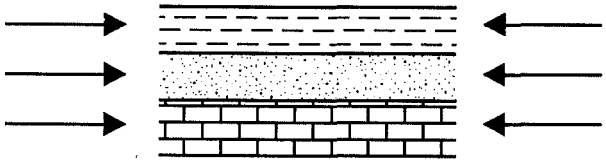


Which statement about the deposition of the sediments best explains why these layers have the curved shape shown?

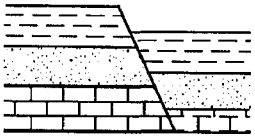
1) Sediments were deposited in horizontal layers and later disturbed by crustal activity.
2) Sediments were deposited on an uneven curving seafloor.
3) Sediments were deposited after widespread volcanic eruptions.
4) Sediments were deposited between two diverging oceanic plates.

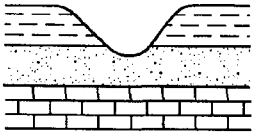
HINT

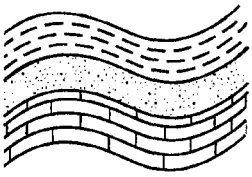
? The diagram below represents a section of the Earth's bedrock. The arrows show the direction of forces that are gradually compressing this section.

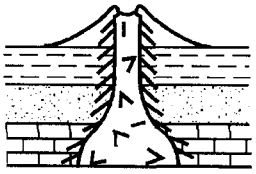


Which diagram represents the most probable result of these forces?

1) 

2) 

3) 

4) 

HINT

? Rock strata containing fossils of shark's teeth are found at an elevation of 5,000 meters. Which process most likely caused the shark's teeth to be located at this elevation?

1) crustal subsidence
2) ocean floor spreading
3) crustal uplift
4) continental glaciation

HINT

? Shallow-water fossils are found in rock layers that are deep beneath the ocean floor. This suggests that

1) shallow-water organisms always migrate to the deeper waters to die
2) parts of the ocean floor have been uplifted
3) parts of the ocean floor have subsided
4) the surface water cooled off, killing the organisms

HINT

The Dynamic Crust

? Fossils of marine plants and animals are found in the bedrock of mountains many thousands of feet above sea level. The most likely reason for this observation is that

1) the mountains were part of a mid-ocean ridge
2) the ocean level has dropped several thousand feet
3) forces within the Earth caused uplift
4) transported materials were deposited at high elevations

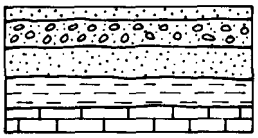
HINT

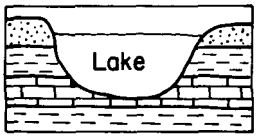
? Which statement about the Earth's crust in California is best supported by the many faults found in the crust?

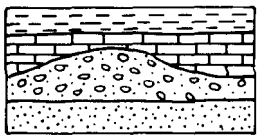
1) The crust has moved in the geologic past.
2) The crust has been inactive throughout the geologic past.
3) New faults will probably not develop in the crust.
4) An earthquake epicenter has not been located in the crust.

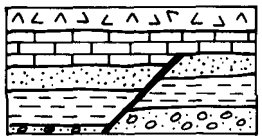
HINT

? Which diagram of rock layers represents the best evidence of crustal movement?

1) 

2) 

3) 

4) 

HINT

? Where are earthquakes most likely to take place?

1) along the core-mantle interface
2) where the composition of the Earth tends to be uniform
3) near the Earth's Equator
4) near a fault zone

?

11. Compared to the continental crust, the oceanic crust is

1) thicker
2) more dense
3) more granitic
4) more felsic

HINT #1

HINT #2

? Which best describes a major characteristic of both volcanoes and earthquakes?

1) They are centered at the poles.
2) They are located in the same geographic areas.
3) They are related to the formation of glaciers.
4) They are restricted to the Southern Hemisphere.

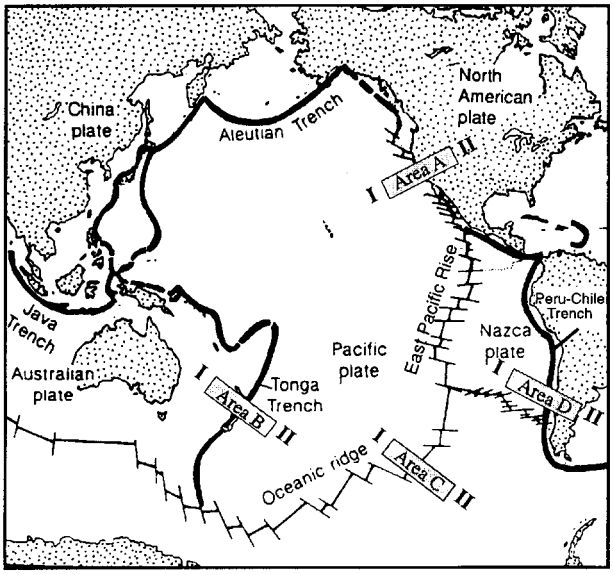
HINT

? Contact zones between tectonic plates may produce trenches. One of these trenches is located at the boundary between which plates?

1) Australian and Pacific
2) South American and African
3) Australian and Antarctic
4) North American and Eurasian

HINT

? Base your answer to the following question on the map below which shows mid-ocean ridges and trenches in the Pacific Ocean. Specific areas *A*, *B*, *C*, and *D* are indicated by shaded rectangles.



Movement of the crustal plates shown in the diagram is most likely caused by

1) the revolution of the Earth
2) the erosion of the Earth's crust
3) shifting of the Earth's magnetic poles
4) convection currents in the Earth's mantle

HINT

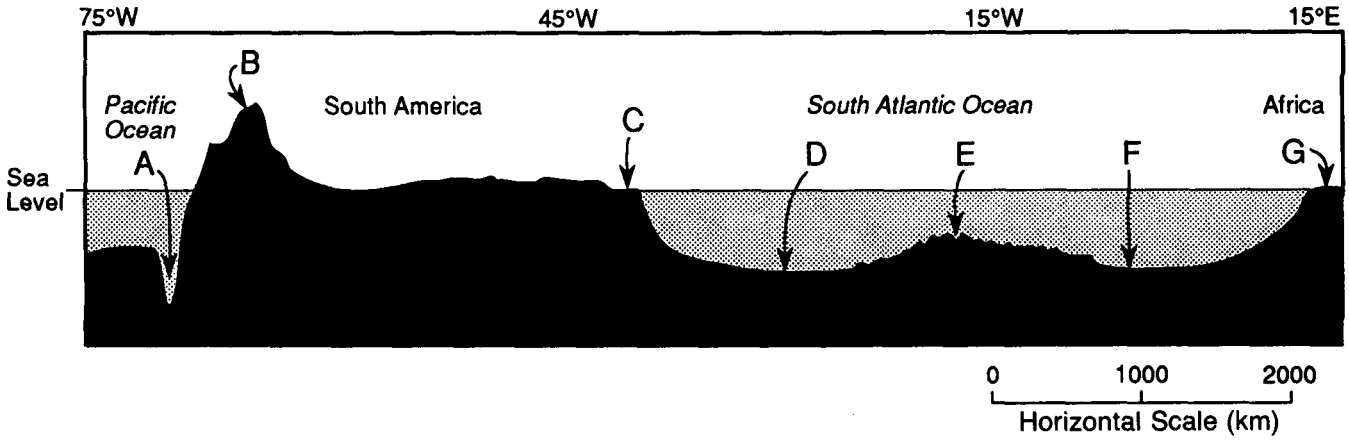
? The border between the South American plate and the African plate is best described as

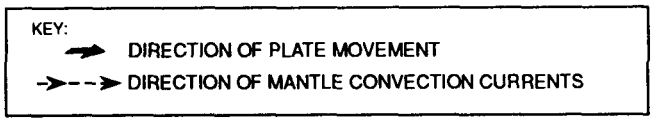
1) converging and located at an oceanic ridge
2) converging and located at an oceanic trench
3) diverging and located at an oceanic ridge
4) diverging and located at an oceanic trench

HINT

The Dynamic Crust

Base your answers to questions **16** and **17** on the diagram below which is a cross section of the major surface features of the Earth along the Tropic of Capricorn (23½° S) between 75° W and 15° E longitude. Letters *A* through *G* represent locations on the Earth's crust.





?

A mid-ocean ridge is located near position

1) *A* 2) *E* 3) *C* 4) *D*

HINT

?

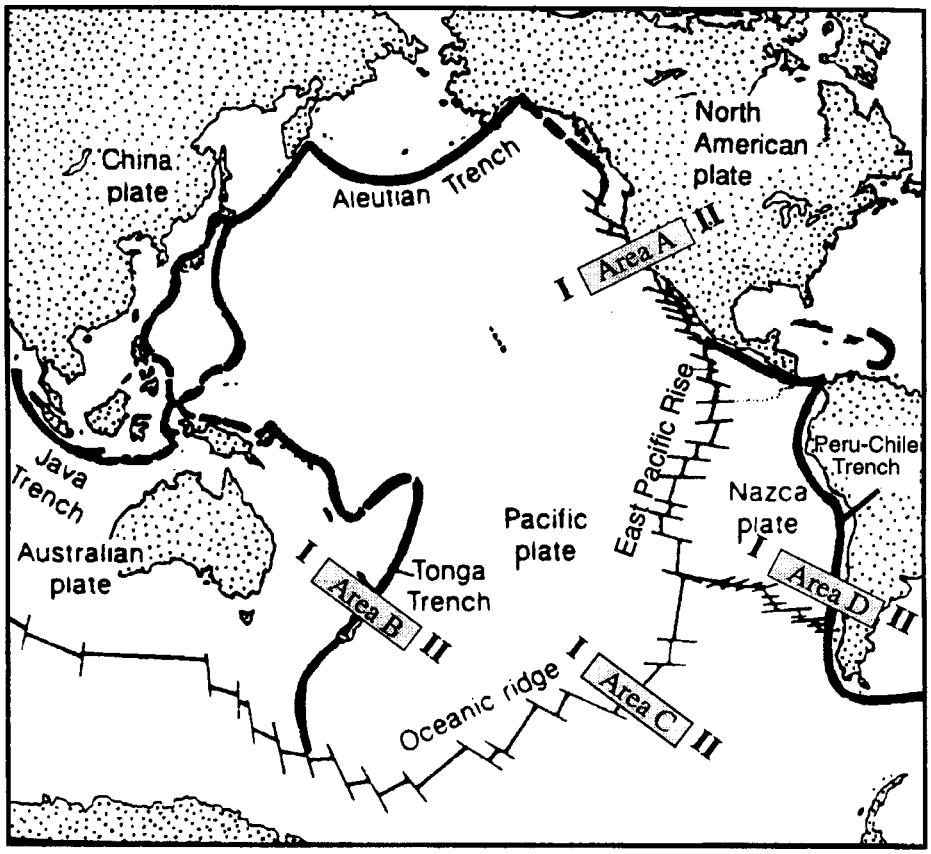
Which two locations in the diagram have bedrock of approximately the same age, which has been separated by seafloor spreading?

1) *A* and *C* 2) *C* and *E* 3) *D* and *F* 4) *E* and *F*

HINT

The Dynamic Crust

Base your answers to questions **18** and **19** on the map below which shows mid-ocean ridges and trenches in the Pacific Ocean. Specific areas A, B. C, and D are indicated by shaded rectangles.



? The crust at the mid-ocean ridges is composed mainly of

1) granite 2) shale 3) basalt 4) limestone

HINT

? Mid-ocean ridges such as the East Pacific Rise and the Oceanic Ridge are best described as

1) mountains containing folded sedimentary rocks
2) mountains containing fossils of present-day marine life
3) sections of the ocean floor that contain the youngest oceanic crust
4) sections of the ocean floor that are the remains of a submerged continent

HINT

? Which statement best supports the theory that all the continents were once a single landmass?

1) Rocks of the ocean ridges are older than those of the adjacent sea floor.
2) Rock and fossil correlation can be made where the continents appear to fit together.
3) Marine fossils can be found at high elevations above sea level on all continents.
4) Great thicknesses of shallow-water sediments are found at interior locations on some continents.

HINT

? Which statement best supports the theory of continental drift?

1) Basaltic rock is found to be progressively younger at increasing distances from a mid-ocean ridge.
2) Marine fossils are often found in deep-well drill cores.
3) The present continents appear to fit together as pieces of a larger landmass.
4) Areas of shallow-water seas tend to accumulate sediment, which gradually sinks.

HINT

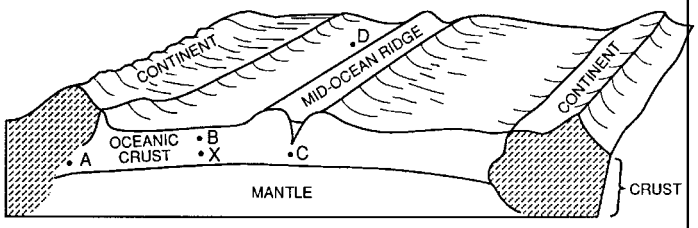
? The Earth's core is believed to be composed primarily of

1) oxygen and silicon 3) iron and nickel
2) aluminum and silicon 4) carbon and iron

HINT

The Dynamic Crust

? The diagram below represents a cross section of a portion of the Earth's crust and mantle. Letters *A*, *B*, *C*, *D* and *X* identify locations within the crust.

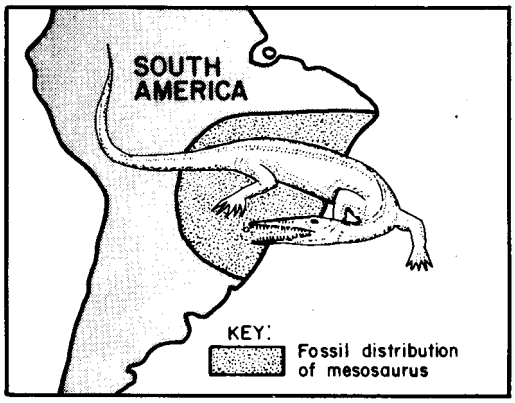


The age of oceanic crust increases along a line between location *X* and location

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

HINT

? On what other landmass would you most likely find fossil remains of the late Paleozoic reptile called Mesosaurus shown below?



1) North America 
2) Africa 
3) Antarctica 
4) Eurasia 

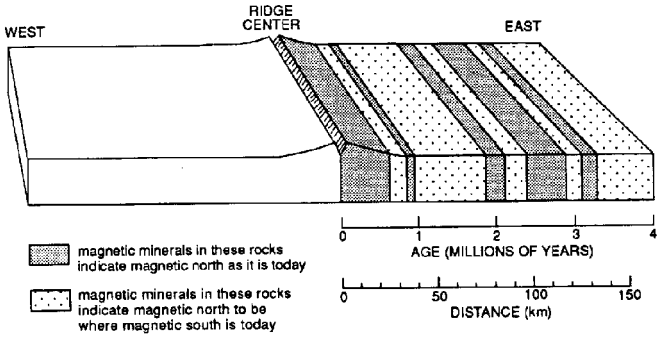
HINT

? What is the approximate total distance traveled by an earthquake's *P*-wave in its first 9 minutes?

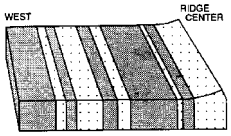
1) 2,600 km
2) 5,600 km
3) 7,600 km
4) 12,100 km

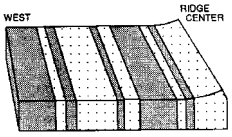
HINT

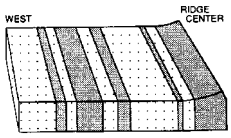
Base your answers to questions **26** and **27** on the diagram below which shows the magnetic orientation of igneous rock on the seafloor on the east (right) side of a mid-ocean ridge. The pattern on the west (left) side of the ridge has been omitted. The age of the igneous rock and its distance from the ridge center are shown.

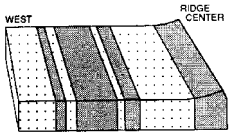


? Which diagram below best represents the pattern of magnetic orientation in the seafloor on the west (left) side of the ocean ridge?

1) 

3) 

2) 

4) 

HINT

? As distance from the center of the ridge increases, the age of the rocks

1) decreases
2) increases
3) remains the same

HINT

? Living corals are found in warm, shallow seas. Coral fossils have been found in the sedimentary rocks of Alaska. These findings suggest that

1) Alaska once had a tropical marine environment
2) Alaska's cold climate fossilized the coral
3) coral usually develops in cold climates
4) ocean currents carried the coral to Alaska

HINT

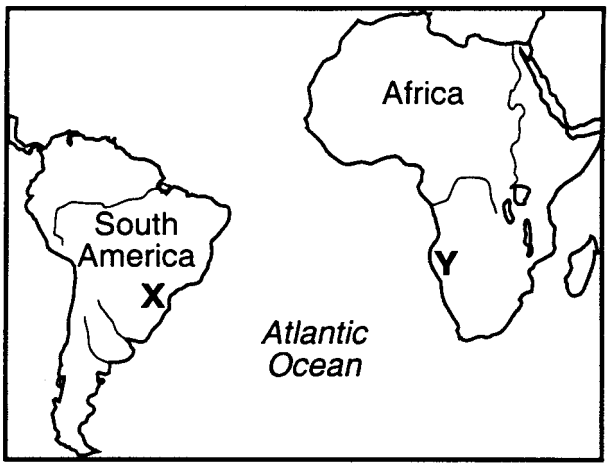
? Compared to the velocity of an earthquake's *P*-waves, the velocity of the *S*-waves in the same material is

1) less
2) greater
3) the same

HINT

The Dynamic Crust

? 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 statement represents the most logical conclusion to draw from this evidence?

1) *Mesosaurus* migrated across the ocean from location *X* to location *Y*.
2) *Mesosaurus* came into existence on several widely separated continents at different times.
3) The continents of South America and Africa were joined when *Mesosaurus* lived.
4) The present climates at locations *X* and *Y* are similar.

HINT

? Which inference is supported by a study of the Earth's magnetic rock record?

1) The Earth's magnetic field is only 2 million years old.
2) The Earth's magnetic field is 50 times stronger now than in the past.
3) The Earth's magnetic poles are usually located at 0 latitude.
4) The Earth's magnetic poles appear to have changed location over time.

HINT

? A seismic station recorded an earthquake with an epicenter distance of 4,000 kilometers. If the origin time of the earthquake was 11:00 a.m., what time did the *P*-wave arrive at the seismic station?

1) 10:53 a.m.
2) 11:05 a.m.
3) 11:07 a.m.
4) 11:12 a.m.

HINT #1

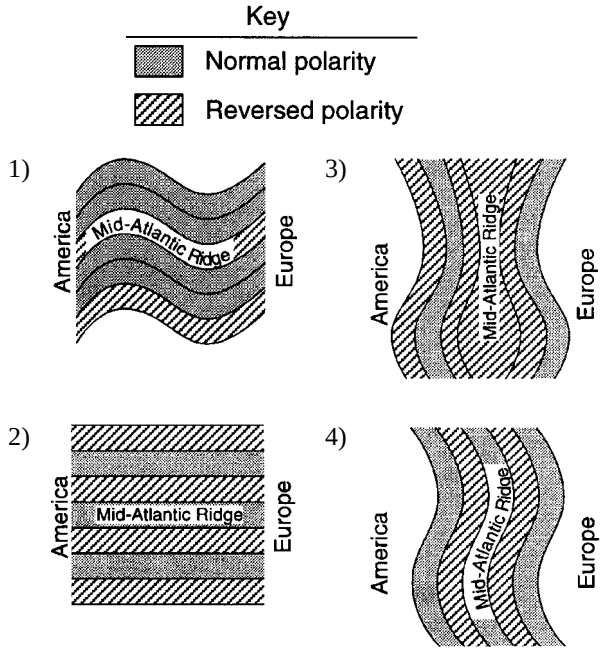
HINT #2

? A huge undersea earthquake off the Alaskan coastline could produce a

1) tsunami
2) cyclone
3) hurricane
4) thunderstorm

HINT

? Which map best represents the general pattern of magnetism in the oceanic bedrock near the mid-Atlantic Ridge?



HINT

? Which conclusion based on the analysis of seismic data supports the inference that the Earth's outer core is liquid?

1) *S*-waves are *not* transmitted through the outer core.
2) *S*-waves are transmitted through the outer core.
3) *P*-waves are *not* transmitted through the outer core.
4) *P*-waves are transmitted through the outer core.

HINT

? Which statement best describes the materials through which earthquake waves are transmitted?

1) *P*-waves are transmitted through solids, only.
2) *P*-waves are transmitted through liquids, only.
3) *S*-waves are transmitted through solids, only.
4) *S*-waves are transmitted through solids and liquids.

HINT

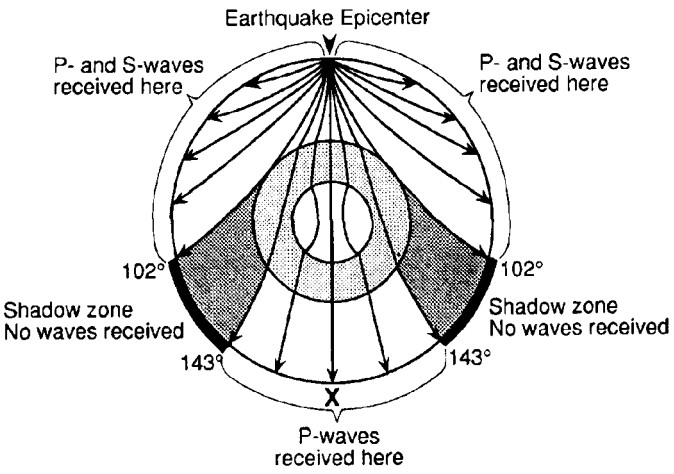
? Which seismic information is needed to find the distance from an observer to an earthquake epicenter?

1) origin time of the earthquake
2) depth of the earthquake focus
3) *P*-wave and *S*-wave refractions
4) *P*-wave and *S*-wave arrival times

HINT

The Dynamic Crust

? The cross-sectional diagram below of the Earth shows the paths of seismic waves from an earthquake. Letter *X* represents the location of a seismic station.

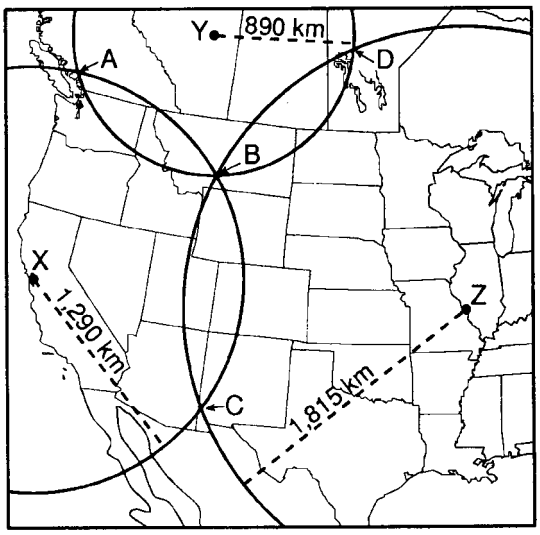


Which statement best explains why station *X* received only *P*-waves?

1) *S*-waves traveled too slowly for seismographs to detect them.
2) Station *X* is too far from the focus for *S*-waves to reach.
3) A liquid zone within the Earth stops *S*-waves.
4) *P*-waves and *S*-waves are refracted by the Earth's core.

HINT

? The circles on the map below show the distances from three seismic stations, *X*, *Y*, and *Z*, to the epicenter of an earthquake.

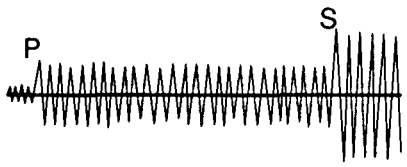


Which location is closest to the earthquake epicenter?

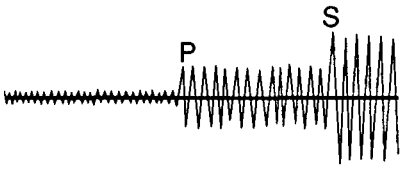
1) *A*
2) *B*
3) *C*
4) *D*

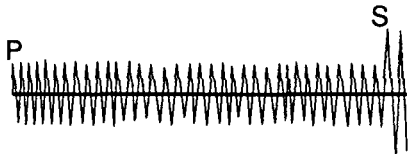
HINT

? The diagrams below represent seismograms of the same earthquake recorded in four different locations. Which seismogram was recorded closest to the epicenter of the earthquake?

1)


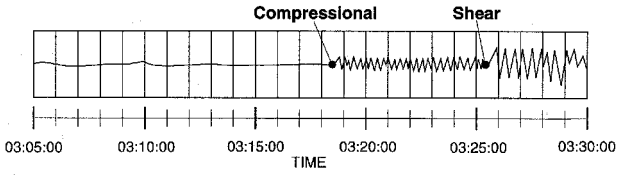
2)


3)


4)


HINT

? A seismogram recorded at a seismic station is shown below.



Which information can be determined by using this seismogram?

1) depth of the earthquake's focus
2) direction to the earthquake's focus
3) location of the earthquake's epicenter
4) distance to the earthquake's epicenter

HINT

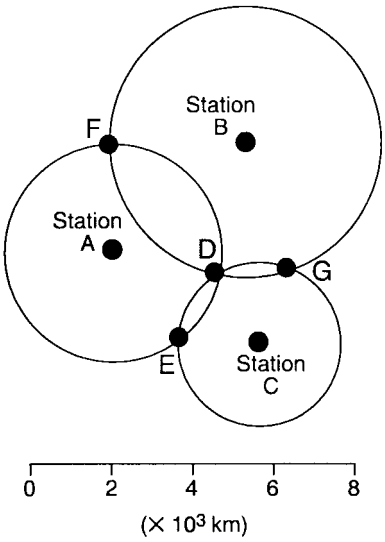
? At which epicenter distance is the difference in arrival times between *P*-waves and *S*-waves greatest?

1) 1,000 km
2) 3,000 km
3) 5,000 km
4) 7,000 km

HINT

The Dynamic Crust

? Base your answer to the following question on the diagram below, which represents seismic stations *A*, *B*, and *C*. The distance from each station to an earthquake's epicenter is plotted.



The epicenter is closest to point

1) *D*
2) *E*
3) *F*
4) *G*

HINT

? Seismic studies of the Moon have helped scientists to make inferences about

1) water erosion on the Moon
2) weathering on the Moon's surface
3) radioactivity of the Moon's surface rocks
4) the Moon's interior

HINT

? In the Earth's interior, which zone has a temperature higher than its melting point?

1) crust
2) stiffer mantle
3) inner core
4) outer core

HINT

? The rock between 2,900 kilometers and 5,200 kilometers below the Earth's surface is inferred to be

1) an iron-rich solid
2) an iron-rich liquid
3) a silicate-rich solid
4) a silicate-rich liquid

HINT

? Which part of Earth's interior is inferred to have convection currents that cause tectonic plates to move?

1) rigid mantle
2) asthenosphere
3) outer core
4) inner core

HINT

? Earth's outer core is best inferred to be

1) liquid, with an average density of approximately 4 g/cm^3
2) liquid, with an average density of approximately 11 g/cm^3
3) solid, with an average density of approximately 4 g/cm^3
4) solid, with an average density of approximately 11 g/cm^3

HINT

? To get sample material from the mantle, drilling will be done through the oceanic crust rather than through the continental crust because oceanic crust is

1) more dense than continental crust
2) softer than continental crust
3) thinner than continental crust
4) younger than continental crust

HINT

? What are the four most abundant elements, by volume, in the Earth's crust?

1) oxygen, potassium, sodium, and calcium
2) hydrogen, oxygen, nitrogen, and potassium
3) aluminum, iron, silicon, and magnesium
4) aluminum, calcium, hydrogen, and iron

? How does the oceanic crust compare to the continental crust?

1) The oceanic crust is thinner and contains less basalt.
2) The oceanic crust is thinner and contains more basalt.
3) The oceanic crust is thicker and contains less basalt.
4) The oceanic crust is thicker and contains more basalt.

HINT

? Compared to the continental crust of central North America, the oceanic crust of the Mid-Atlantic Ridge is

1) younger
2) thicker
3) less dense
4) more felsic

HINT

? The *rate* of temperature increase below the Earth's surface is greatest between depths of

1) 250 and 500 km
2) 1500 and 2500 km
3) 2500 and 3500 km
4) 3500 and 4000 km

HINT

? In which zone of the Earth's interior is the melting point of the rock inferred to be lower than the actual temperature of the rock?

1) outer core
2) inner core
3) crust
4) mantle

The Dynamic Crust

? What is the relationship between density, temperature, and pressure inside the Earth?

1) As depth increases, density, temperature, and pressure decrease.
2) As depth increases, density and temperature increase, but pressure decreases.
3) As depth increases, density increases, but temperature and pressure decrease.
4) As depth increases, density, temperature, and pressure increase.

HINT

? Which statement about the Earth's mantle is correct?

1) The density of the mantle is greatest 300 km below the Earth's surface.
2) The highest temperatures within the Earth occur in the mantle.
3) The greatest pressures within the Earth exist in the mantle.
4) The temperature of the mantle 300 km below the Earth's surface is very near its melting point.

HINT

? At 4,500 kilometers below the surface of the Earth, the pressure is estimated to be

1) 1.4 million atmospheres
2) 2.0 million atmospheres
3) 2.8 million atmospheres
4) 3.1 million atmospheres

HINT

? Theories about the composition of the Earth's core are supported by meteorites that are composed primarily of

1) oxygen and silicon
2) aluminum and iron
3) aluminum and oxygen
4) iron and nickel

HINT

? 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

1) landscape boundaries
2) continental coastlines
3) erosional surfaces
4) seismic waves

HINT

? The source of energy for the high temperatures found deep within the Earth is

1) tidal friction
2) incoming solar radiation
3) decay of radioactive materials
4) meteorite bombardment of the Earth

HINT

? Approximately how far below the Earth's surface is the interface between the mantle and the outer core?

1) 5 to 30 km
2) 700 to 900 km
3) 2,900 to 3,000 km
4) 5,000 to 5,200 km

HINT

? In which part of the Earth is a rock temperature of 2,000ºC most likely to occur?

1) continental crust
2) asthenosphere (plastic mantle)
3) stiffer mantle
4) outer core

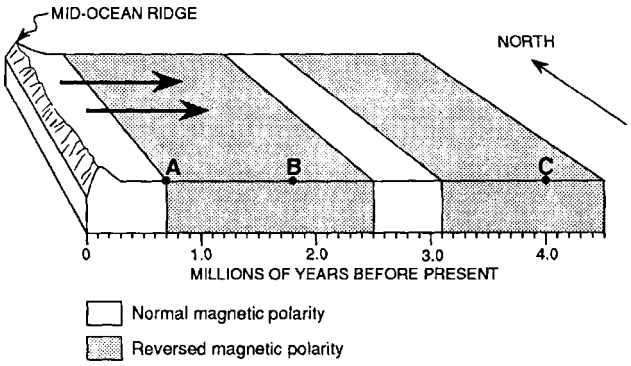
HINT

The Dynamic Crust

Base your answers to questions **63** and **64** on the information and diagram below.

At intervals in the past, the Earth's magnetic field has reversed. The present North magnetic pole was once the South magnetic pole, and the present South magnetic pole was once the North magnetic pole. A record of these changes is preserved in the igneous rocks that formed at mid-ocean ridges and moved away from the ridges.

The diagram below represents the pattern of normal and reversed magnetic polarity in the igneous rocks composing the ocean crust on the east side of a mid-ocean ridge.

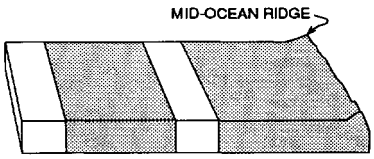


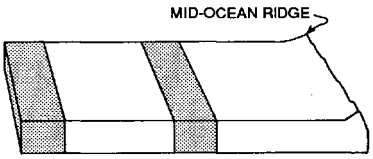
? The igneous material along this mid-ocean ridge was found to be younger than the igneous material farther from the ridge. This fact supports the theory of

1) crustal subsidence
2) seafloor spreading
3) superposition
4) dynamic equilibrium

HINT

? Which diagram below best shows the pattern of normal and reversed polarity on the west side of the mid-ocean ridge?

1)


2)


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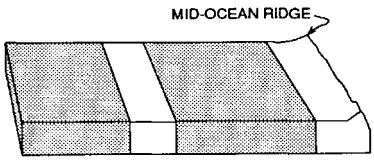

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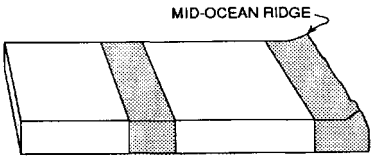
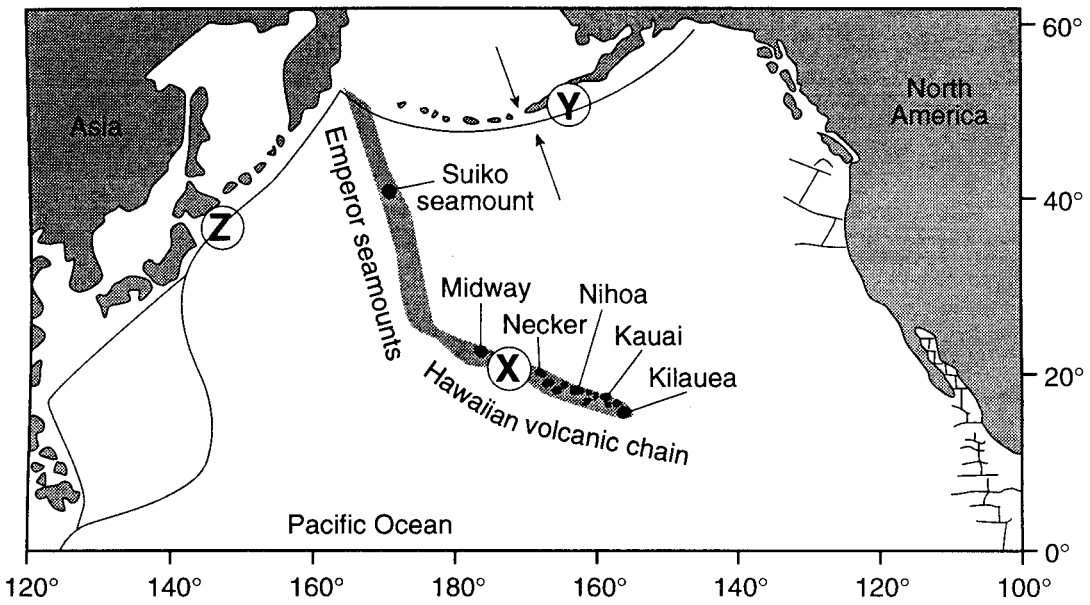


HINT

The Dynamic Crust

Base your answers to questions **65** and **66** on the map and data table below. The map 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

? Approximately how far has location *X* moved from its original location over the hotspot?

1) 3,600 km 2) 2,500 km 3) 1,800 km 4) 20 km

HINT

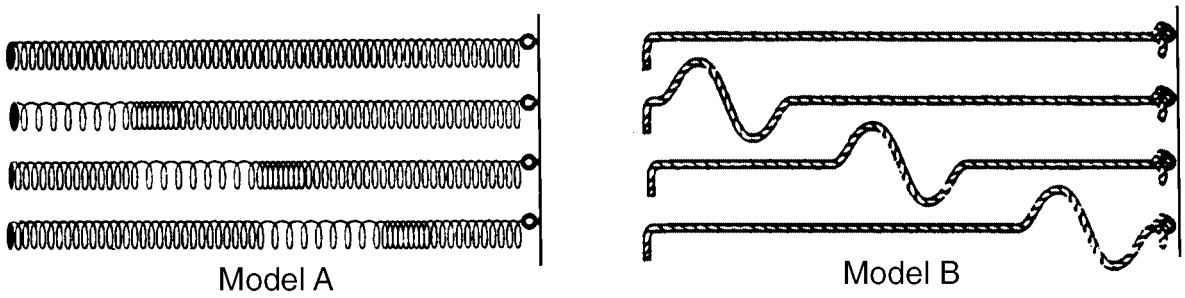
? According to the data table, what is the approximate speed at which the island of Kauai has been moving away from the mantle hotspot, in kilometers per million years?

1) 1 2) 10 3) 100 4) 1,000

HINT

The Dynamic Crust

? Base your answer to the following question on the diagram below, which shows models of two types of earthquake waves.

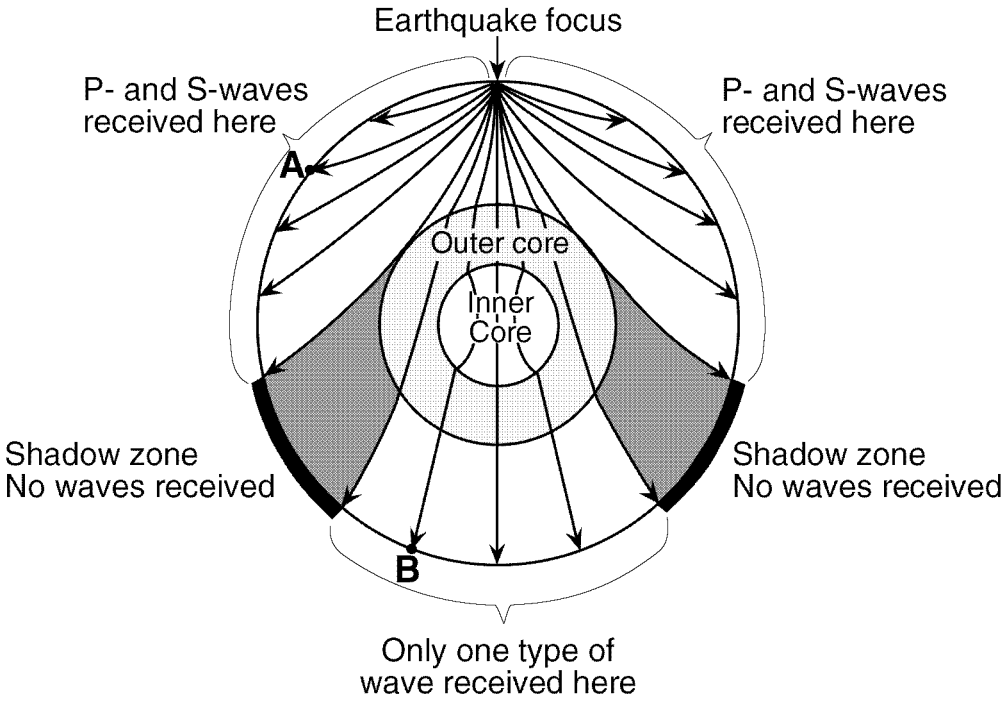


Model *A* best represents the motion of earthquake waves called

1) *P*-waves (compressional waves) that travel faster than *S*-waves (shear waves) shown in model *B*
2) *P*-waves (compressional waves) that travel slower than *S*-waves (shear waves) shown in model *B*
3) *S*-waves (shear waves) that travel faster than *P*-waves (compressional waves) shown in model *B*
4) *S*-waves (shear waves) that travel slower than *P*-waves (compressional waves) shown in model *B*

HINT

? Base your answer to the following question on the cross-sectional view of Earth below, which shows seismic waves traveling from the focus of an earthquake. Points A and B are locations on Earth's surface.



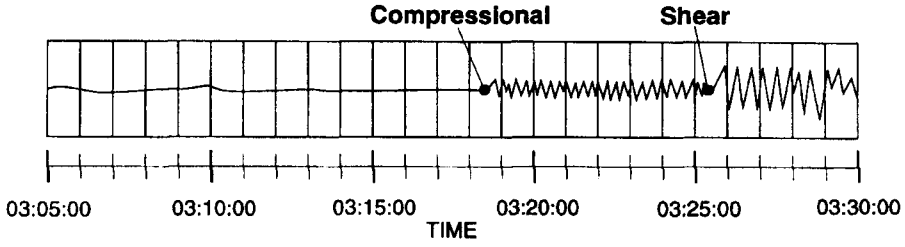
Which statement best explains why only one type of seismic wave was recorded at location *B*?

1) *S*-waves cannot travel through the liquid outer core.
2) *S*-waves cannot travel through the liquid inner core.
3) *P*-waves cannot travel through the solid outer core.
4) *P*-waves cannot travel through the solid inner core.

HINT

The Dynamic Crust

? A seismogram recorded at a seismic station is shown below.

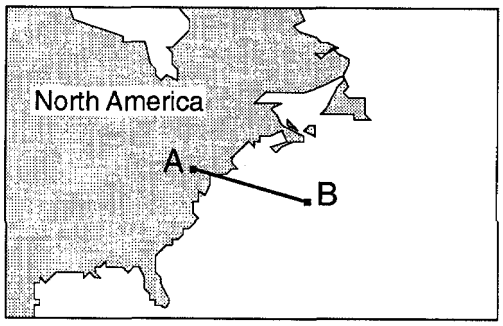


Which information can be determined by using this seismogram?

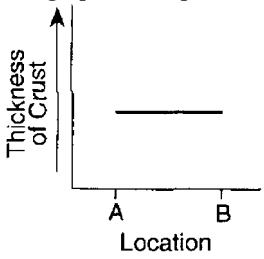
1) the depth of the earthquake's focus
2) the direction to the earthquake's focus
3) the location of the earthquake's epicenter
4) the distance to the earthquake's epicenter

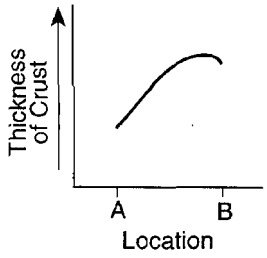
HINT

? On the map below, locations *A* and *B* are reference points on the Earth's surface. Crustal thickness was measured beneath a line from *A* to *B*.



Which graph best represents the thickness of the Earth's crust from location A to location B?

1)


2)


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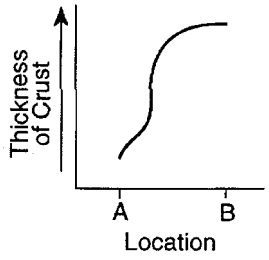

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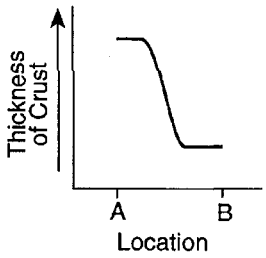

HINT