

Earthquakes and Crustal Movement

Predict the most likely location of earthquakes and volcanoes..

1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_

Locate an epicenter using isoseismic lines or triangulation.

4 \_\_\_\_\_ 5 \_\_\_\_\_ 6 \_\_\_\_\_

Know the characteristics and travel times of P and S waves.

7 \_\_\_\_\_ 8 \_\_\_\_\_ 9 \_\_\_\_\_ 10 \_\_\_\_\_

Use seismic information to determine the distance to an earthquake's epicenter.

11 \_\_\_\_\_ 12 \_\_\_\_\_ 13 \_\_\_\_\_

Use seismic information to determine the origin time of an earthquake.

14 \_\_\_\_\_ 15 \_\_\_\_\_ 16 \_\_\_\_\_

Use seismic information to infer the earth's interior conditions.

17 \_\_\_\_\_ 18 \_\_\_\_\_ 19 \_\_\_\_\_

Use the ESRTs to access data about the earth's interior.

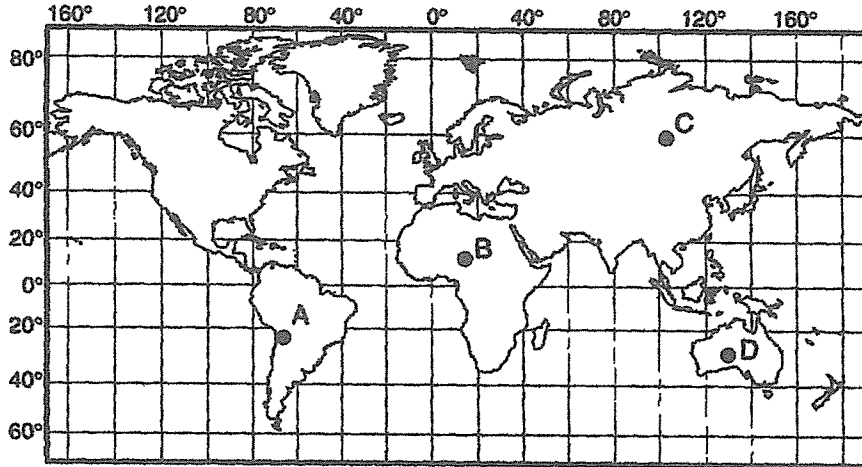
20 \_\_\_\_\_ 21 \_\_\_\_\_ 22 \_\_\_\_\_

Recognize evidence that exists for crustal movement.

23 \_\_\_\_\_ 24 \_\_\_\_\_ 25 \_\_\_\_\_

## Earthquakes and Crustal Movement

1. Letters *A* through *D* shown on the map below are locations on 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*

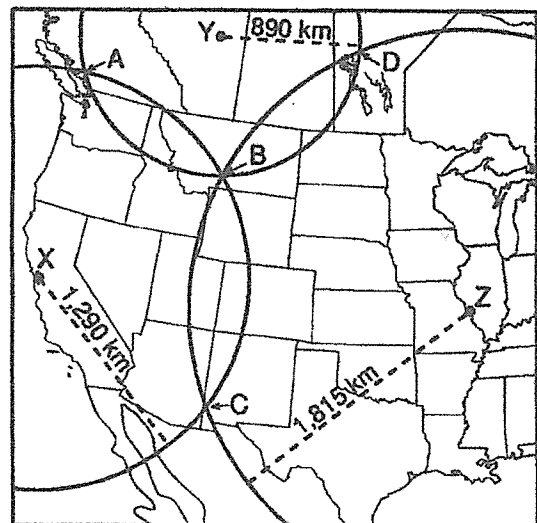
2. Which best describes a major characteristic of both volcanoes and earthquakes?

- (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.

3. Where have earthquakes occurred most frequently during the last one hundred years?

- (1) in the polar regions
- (2) in the interior of continental areas
- (3) along the Pacific Ocean coastlines
- (4) along the Atlantic Ocean coastlines

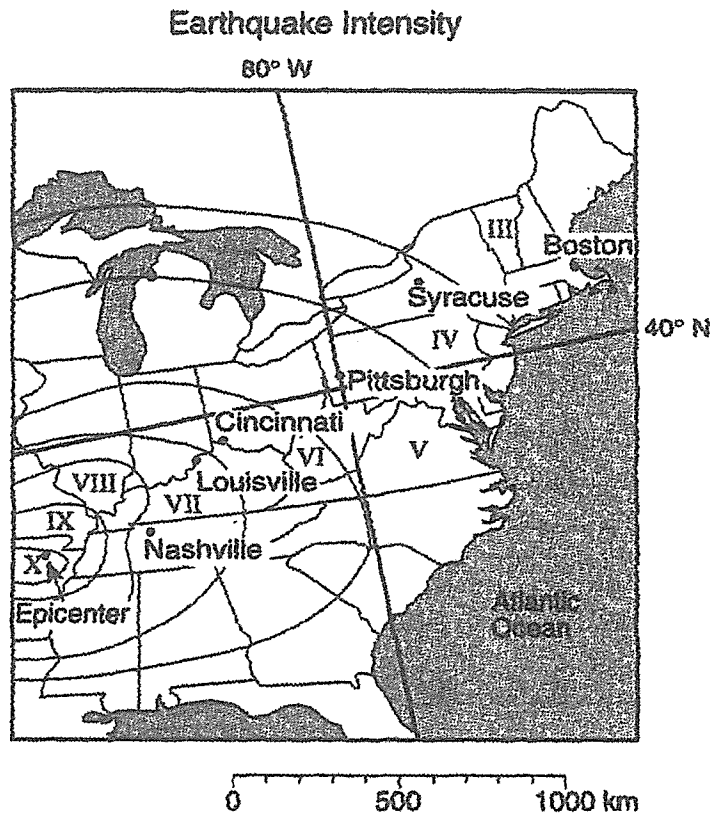
4. The circles on the map below show the distances from three seismic stations, *X*, *Y*, and *Z*, to the epicenter of an earthquake.



Which location is closest to the earthquake epicenter?

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

5. Base your answer on the *Earth Science Reference Tables*, the map and table of the Modified Mercalli Scale below, and your knowledge of Earth science. The map shows the intensities of the earthquake that occurred slightly southwest of New Madrid, Missouri, on December 16, 1811. The numbered areas on the map were determined from the Modified Mercalli Scale according to the observed effects of the earthquake.



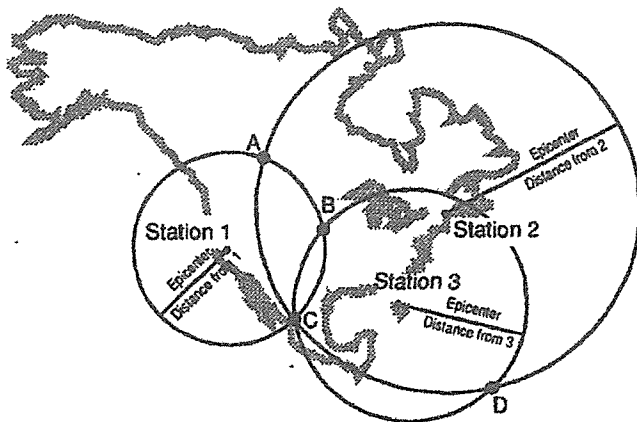
**Modified Mercalli Scale**

Intensity	Observed Effects
I	Felt by only a few people under very special circumstances
II	Felt by only a few people at rest, especially on the upper floors of buildings
III	Felt noticeably indoors, especially on upper floors of buildings
IV	Felt indoors by many people, outdoors by a few; some awaken
V	Felt by nearly everyone; many awaken; dishes and windows break; plaster cracks
VI	Felt by everyone; many frightened and run outdoors; heavy furniture moves
VII	Everyone runs outdoors; slight to moderate damage in ordinary structures
VIII	Considerable damage in ordinary structures; chimneys and monuments fall
IX	Considerable damage in all structures; ground cracks; underground pipes break
X	Most structures destroyed; rails bend; landslides occur; water splashes over banks
XI	Few structures left standing; bridges destroyed; broad fissures in the ground; underground pipes break
XII	Damage total; waves seen on ground surfaces; objects thrown in air

What is the approximate location of the earthquake's epicenter?

- (1) 36° N, 90° W      (2) 90° N, 36° W      (3) 36° N, 90° E      (4) 90° N, 36° E

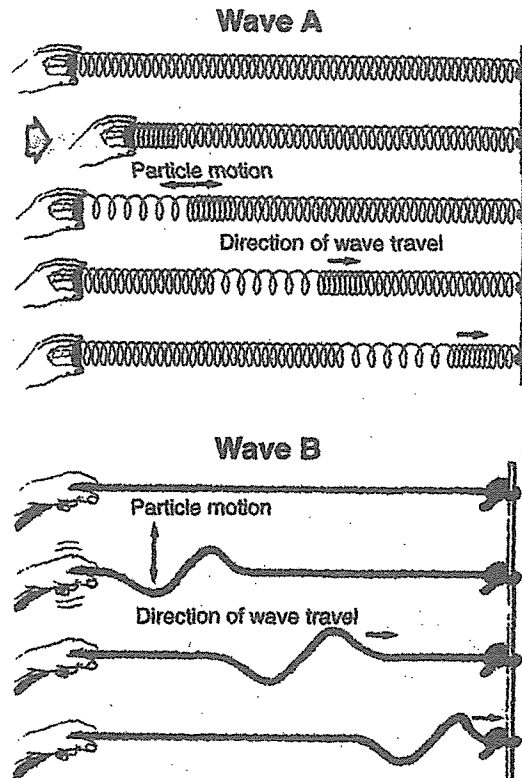
6. Base your answer on the *Earth Science Reference Tables* and the diagram below. The diagram shows a method used to locate the epicenter of an earthquake.



Which location represents the epicenter of the earthquake?

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

7. The diagrams below show demonstrations that represent the behavior of two seismic waves, A and B.



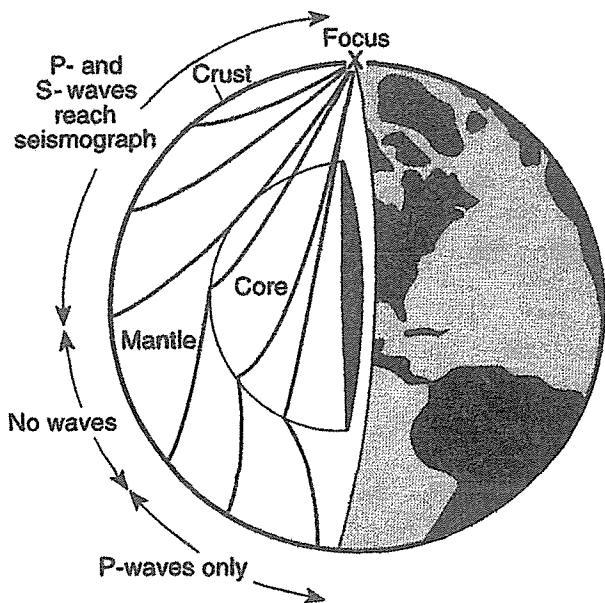
Which statement concerning the demonstrated waves is correct?

- (1) Wave A represents a compressional wave, and wave B represents a shear wave.
- (2) Wave A represents a shear wave, and wave B represents a compressional wave.
- (3) Wave A represents compressional waves in the crust, and wave B represents compressional waves in the mantle.
- (4) Wave A represents shear waves in the crust, and wave B represents shear waves in the mantle.

8. Which statement best describes the relationship between the travel rates and travel times of earthquake P-waves and S-waves from the focus of an earthquake to a seismograph station? [Refer to the *Earth Science Reference Tables*.]

- (1) P-waves travel at a slower rate and take less time.
- (2) P-waves travel at a faster rate and take less time.
- (3) S-waves travel at a slower rate and take less time.
- (4) S-waves travel at a faster rate and take less time.

9. The cutaway diagram below shows the paths of earthquake waves generated at point X.



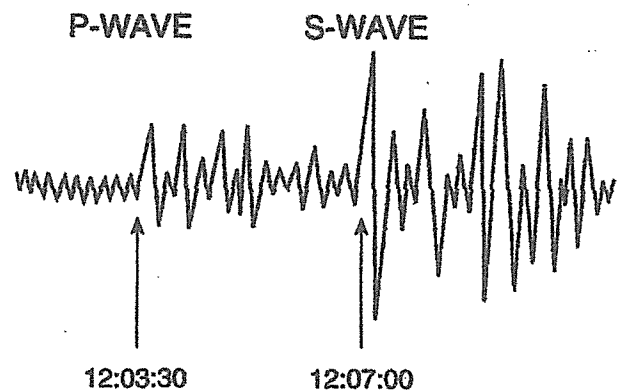
Only P-waves reach the side of Earth that is opposite the focus because P-waves

- (1) are stronger than S-waves
- (2) travel faster than S-waves
- (3) travel faster than S-waves
- (4) can travel through liquids and S-waves cannot

10. A seismic station is 2,000 kilometers from an earthquake epicenter. According to the *Earth Science Reference Tables*, how long does it take an S-wave to travel from the epicenter to the station?

- (1) 7 minutes 20 seconds
- (2) 5 minutes 10 seconds
- (3) 3 minutes 20 seconds
- (4) 4 minutes 10 seconds

11. The seismogram below shows the arrival times of P- and S-waves at a seismic station in hours, minutes, and seconds.



Approximately how far from the earthquake epicenter is this seismic station?

- (1) 1,650 km
- (2) 1,900 km
- (3) 2,200 km
- (4) 4,100 km

12. 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?

- (1) 1,100 km
- (2) 2,400 km
- (3) 3,100 km
- (4) 4,000 km

13. Based on the *Earth Science Reference Tables*, approximately how far away from the receiving station is the epicenter of an earthquake if the difference in arrival times of P- and S-waves at the station is 6 minutes and 30 seconds?

- (1) 3,000 km
- (2) 5,000 km
- (3) 6,300 km
- (4) 8,000 km

14. A P-wave reaches a seismograph station 2,600 kilometers from an earthquake epicenter at 12:10 p.m. According to the *Earth Science Reference Tables*, at what time did the earthquake occur?

- (1) 12:01 p.m.
- (2) 12:05 p.m.
- (3) 12:15 p.m.
- (4) 12:19 p.m.

15. An earthquake's P-wave traveled 4,800 kilometers and arrived at a seismic station at 5:10 p.m. At approximately what time did the earthquake occur?

- (1) 5:02 p.m.
- (2) 5:08 p.m.
- (3) 5:10 p.m.
- (4) 5:18 p.m.

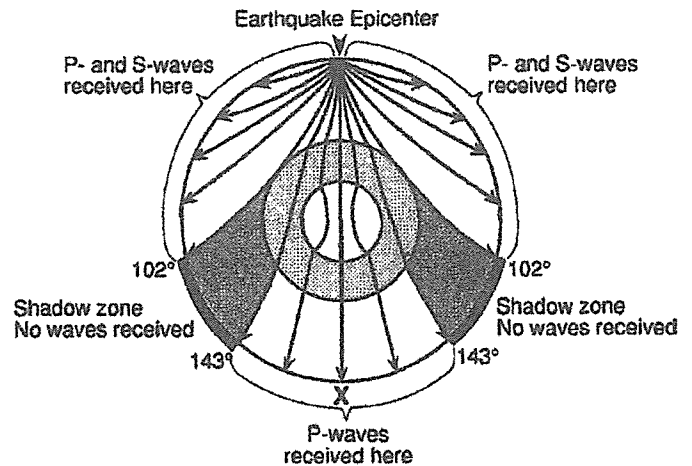
16. An earthquake's P-wave traveled 4,800 kilometers and arrived at a seismic station at 5:10 p.m. At approximately what time did the earthquake occur?

- (1) 5:02 p.m.
- (2) 5:08 p.m.
- (3) 5:10 p.m.
- (4) 5:18 p.m.

17. Earthquake S-waves do *not* travel through the Earth's

- (1) crust
- (2) moho
- (3) mantle
- (4) core

18. 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.

19. The analysis of seismic data from an earthquake shows that some locations received both P-waves and S-waves, but other locations received only P-waves. What is the best inference that can be made from these observations?

- (1) A zone of liquid rock exists within the Earth.
- (2) Iron in some rocks prevents S-waves from traveling.
- (3) Some seismographs are more sensitive than others.
- (4) S-waves are very weak.

20. According to the *Earth Science Reference Tables*, as depth within the Earth's interior increases, the

- (1) density, temperature, and pressure decrease
- (2) density, temperature, and pressure increase
- (3) density and temperature decrease, but pressure increases
- (4) density decreases, but temperature and pressure increase

21. According to the *Earth Science Reference Tables*, 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

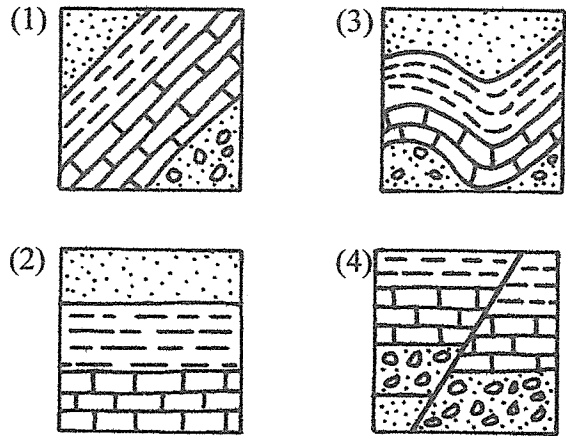
22. At a depth of 2,000 kilometers, the temperature of the stiffer mantle is inferred to be

- (1) 6,500°C
- (2) 4,200°C
- (3) 3,500°C
- (4) 1,800°C

23. A sandstone layer is found tilted at an angle of 75° from the horizontal. What probably caused this 75° tilt?

- (1) The sediments that formed this sandstone layer were originally deposited at a 75° tilt.
- (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.

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



25. Fossils of organisms that lived in shallow water can be found in horizontal sedimentary rock layers at great ocean depths. This fact is generally interpreted by most Earth scientists as evidence that

- (1) the cold water deep in the ocean kills shallow-water organisms
- (2) sunlight once penetrated to the deepest parts of the ocean
- (3) organisms that live in deep water evolved from species that once lived in shallow water
- (4) sections of the Earth's crust have changed their elevations relative to sea level