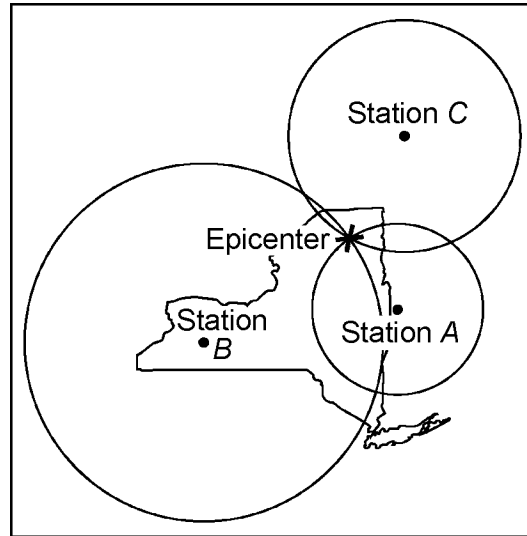Name: _____
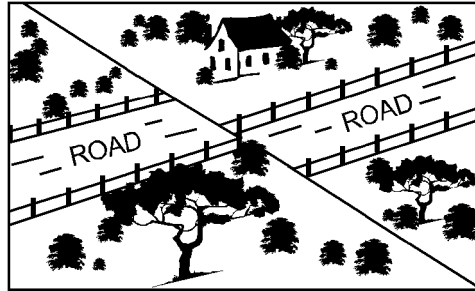
1) Which statement correctly compares seismic *P*-waves with seismic *S*-waves?

A) *P*-waves travel faster than *S*-waves and pass through Earth's liquid zones.
B) *P*-waves travel slower than *S*-waves and pass through Earth's liquid zones.
C) *P*-waves travel faster than *S*-waves and do not pass through Earth's liquid zones.
D) *P*-waves travel slower than *S*-waves and do not pass through Earth's liquid zones.

2) The map below shows the location of an earthquake epicenter in New York State. Seismic stations *A*, *B*, and, *C* received the data used to locate the earthquake epicenter.
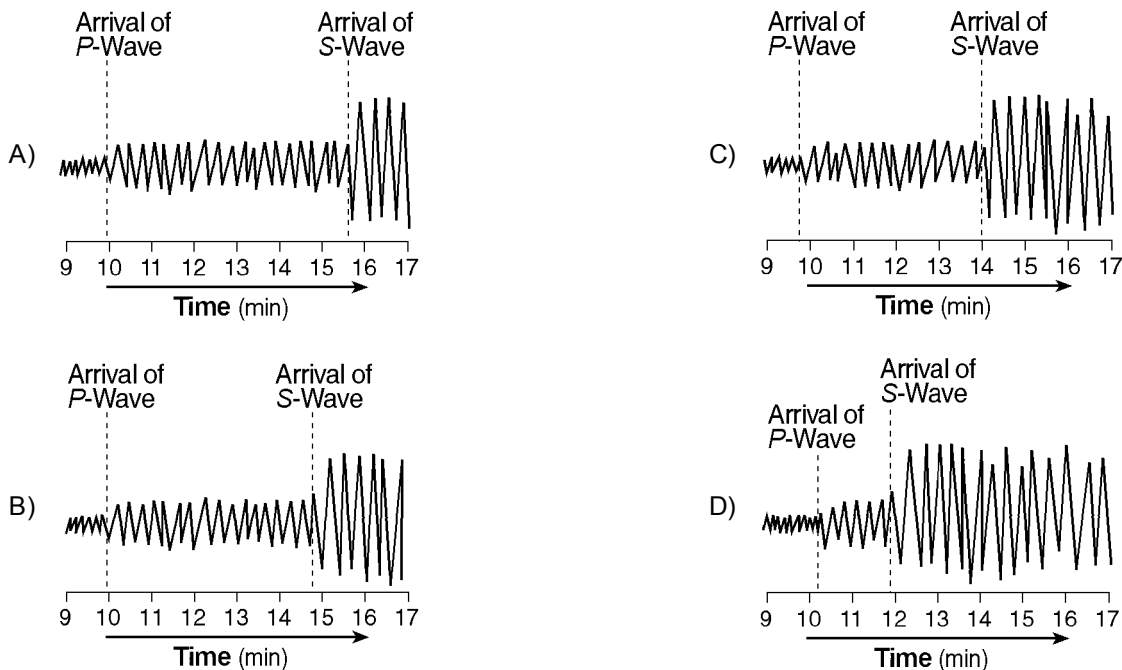

The seismogram recorded at station *A* would show the

A) arrival of *P*-waves, only
B) greatest difference in the arrival times of *P*-waves and *S*-waves
C) earliest arrival time of *P*-waves
D) arrival of *S*-waves before the arrival of *P*-waves

3) An earthquake's first *P*-wave arrives at a seismic station at 12:00:00. This *P*-wave has traveled 6,000 kilometers from the epicenter. At what time will the *first S*-wave from the same earthquake arrive at the seismic station?

A) 12:17:00   B) 12:09:20   C) 11:52:20   D) 12:07:40

4) An earthquake's magnitude can be determined by

A) calculating the time the earthquake occurred
B) analyzing the seismic waves recorded by a seismograph
C) comparing the speed of *P*-waves and *S*-waves
D) calculating the depth of the earthquake faulting

5) The first *S*-wave arrived at a seismograph station 11 minutes after an earthquake occurred. How long after the arrival of the first *P*-wave did this first *S*-wave arrive?

A) 9 min 00 s   B) 3 min 15 s   C) 4 min 55 s   D) 6 min 05 s

6) A *P*-wave takes 8 minutes and 20 seconds to travel from the epicenter of an earthquake to a seismic station. Approximately how long will an *S*-wave take to travel from the epicenter of the same earthquake to this seismic station?

A) 15 min 00 sec   B) 9 min 40 sec   C) 6 min 40 sec   D) 19 min 00 sec

7) A seismograph station recorded the arrival of the first *P*-wave at 7:32 p.m. from an earthquake that occurred 4,000 kilometers away. What time was it at the station when the earthquake occurred?

A) 7:25 p.m.   B) 7:20 p.m.   C) 7:39 p.m.   D) 7:32 p.m.

8) A seismic station is recording the seismic waves produced by an earthquake that occurred 4,200 kilometers away. Approximately how long after the arrival of the first *P*-wave will the first *S*-wave arrive?

A) 13 min 10 sec   B) 5 min 50 sec   C) 7 min 20 sec   D) 1 min 05 sec

9) A seismic station 4,000 kilometers from the epicenter of an earthquake records the arrival time of the first *P*-wave at 10:00:00. At what time did the *first S*-wave arrive at this station?

A) 10:05:40   B) 9:55:00   C) 10:12:40   D) 10:07:05

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

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

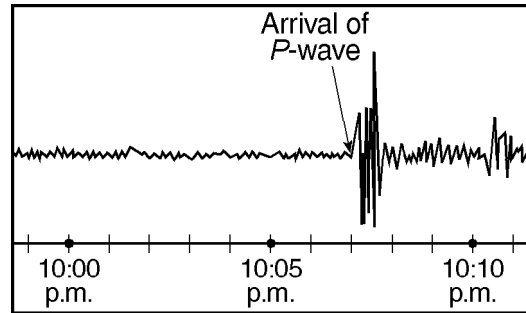11) The diagram below shows land features that have been disrupted by an earthquake.

Which type of crustal movement most likely caused the displacement of features in this area?

A) down-warping of the crust   C) folding of surface rock
B) vertical lifting of surface rock   D) movement along a transform fault

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

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

13) How long would it take for the first *S*-wave to arrive at a seismic station 4,000 kilometers away from the epicenter of an earthquake?

A) 7 min 0 sec   B) 13 min 20 sec   C) 5 min 40 sec   D) 12 min 40 sec

14) An earthquake's *P*-wave arrived at a seismograph station at 02 hours 40 minutes 00 seconds. The earthquake's *S*-wave arrived at the same station 2 minutes later. What is the approximate distance from the seismograph station to the epicenter of the earthquake?

A) 4,000 km   B) 3,100 km   C) 1,100 km   D) 2,400 km

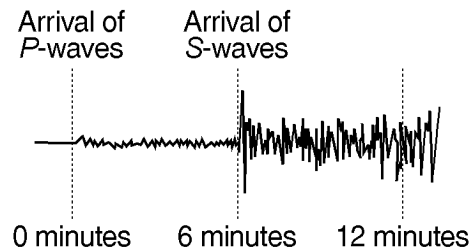15) Which seismogram was recorded approximately 4,000 kilometers from an earthquake epicenter?

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

If the earthquake occurred at exactly 10:00 p.m., approximately how far from the earthquake epicenter was Albany, New York?
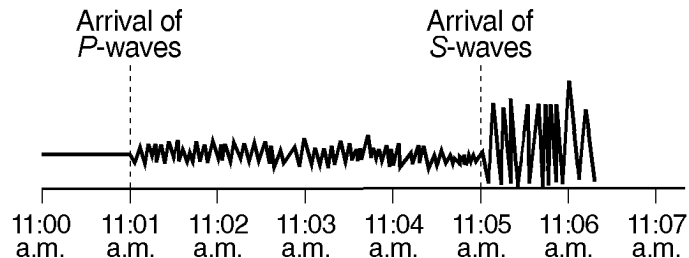
A) 3,200 km   B) 1,900 km   C) 5,200 km   D) 4,000 km

17) Approximately how long does an earthquake *P*-wave take to travel the first 6,500 kilometers after the earthquake occurs?

A) 6.5 min   B) 18.5 min   C) 10.0 min   D) 8.0 min

18) The seismogram below shows *P*-wave and *S*-wave arrival times at a seismic station following an earthquake.

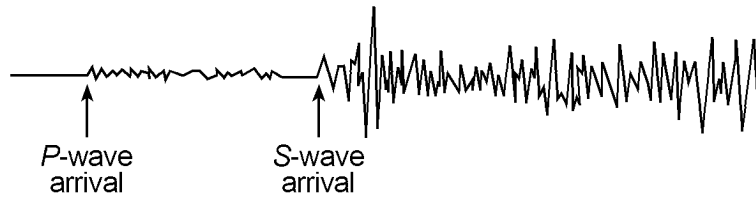The distance from this seismic station to the epicenter of the earthquake is approximately

A) 5,600 km   B) 3,200 km   C) 4,400 km   D) 1,600 km

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

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

Questions 20 and 21 refer to the following:

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

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

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

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

22) The diagram below is a seismogram of the famous San Francisco earthquake of 1906, recorded at a seismic station located 6,400 kilometers from San Francisco.
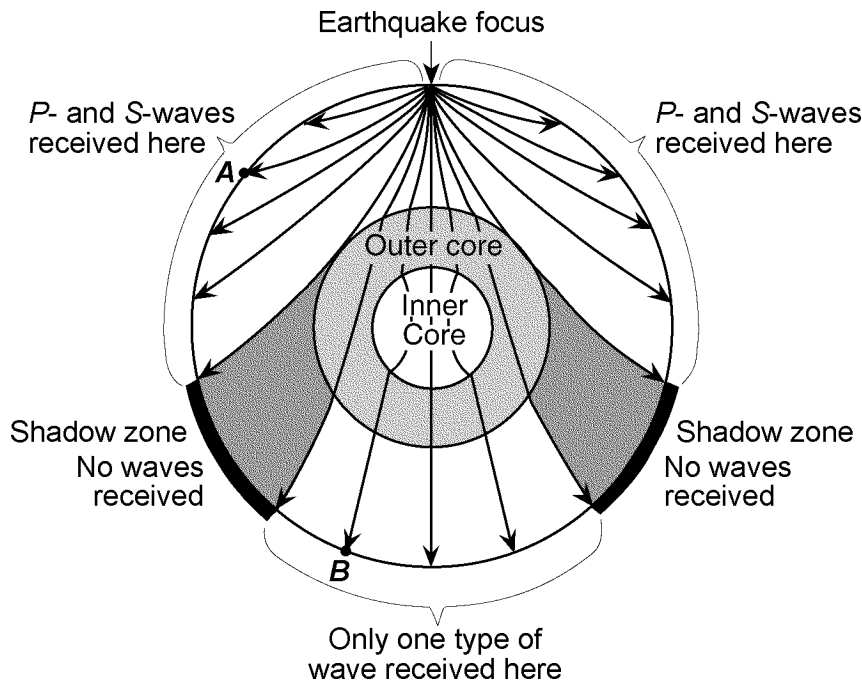

P-wave arrival   *S*-wave arrival

Which time scale *best* represents the arrival-time difference between *P*-waves and *S*-waves at this station?

A)

0	5

Time (min)

P-wave arrival   *S*-wave arrival

C)

0	5	10

Time (min)

P-wave arrival   *S*-wave arrival

B)

0	4

Time (min)

P-wave arrival   *S*-wave arrival

D)

0	5

Time (min)

P-wave arrival   *S*-wave arrival

Questions 23 through 26 refer to the following:

The cross-sectional view of Earth below shows seismic waves traveling from the focus of an earthquake. Points *A* and *B* are locations on Earth's surface.

Earthquake focus

P- and *S*-waves received here

P- and *S*-waves received here

Outer core

Inner Core

Shadow zone
No waves received

Shadow zone
No waves received

Only one type of wave received here

23) The distance from Albany, New York, to the epicenter of the earthquake represented by the given diagram is 5,600 km. Approximately how much longer did it take for the *S*-wave to arrive at Albany than the *P*-wave?

A) 7 minutes and 10 seconds
B) 16 minutes and 10 seconds
C) 9 minutes and 0 seconds
D) 4 minutes and 20 seconds

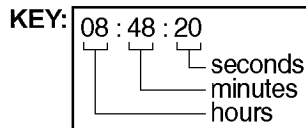24) Which statement *best* explains why only one type of seismic wave was recorded at location *B* on the diagram?

A) *P*-waves cannot travel through the solid inner core.
B) *S*-waves cannot travel through the liquid outer core.
C) *P*-waves cannot travel through the solid outer core.
D) *S*-waves cannot travel through the liquid inner core.

25) A seismic station located at point *A* is 5,400 kilometers away from the epicenter of the earthquake. If the arrival time for the *P*-wave at point *A* was 2:00 p.m., the arrival time for the *S*-wave at point *A* was approximately

A) 1:53 p.m.   B) 2:09 p.m.   C) 2:07 p.m.   D) 2:16 p.m.

26) No *P*-waves or *S*-waves are received in the shadow zone in the given diagram because

A) *P*-waves are refracted and *S*-waves are absorbed by Earth's outer core
B) both the *P*-waves and *S*-waves are absorbed by Earth's outer core
C) both the *P*-waves and *S*-waves are refracted by Earth's outer core
D) *P*-waves are absorbed and *S*-waves are refracted by Earth's outer core

Questions 27 through 29 refer to the following:

The data table below gives information collected at seismic stations *A*, *B*, *C*, and *D* for the same earthquake. [*Some of the data has been deliberately omitted.*]

Seismic Station	*P*-Wave Arrival Time	*S*-Wave Arrival Time	Difference in Arrival Times	Distance to Epicenter
A	08:48:20	No *S*-waves arrived		
B	08:42:00		00:04:40	
C	08:39:20		00:02:40	
D	08:45:40			6,200 km

KEY:
```
08 : 48 : 20
        └ seconds
    └ minutes
└ hours
```
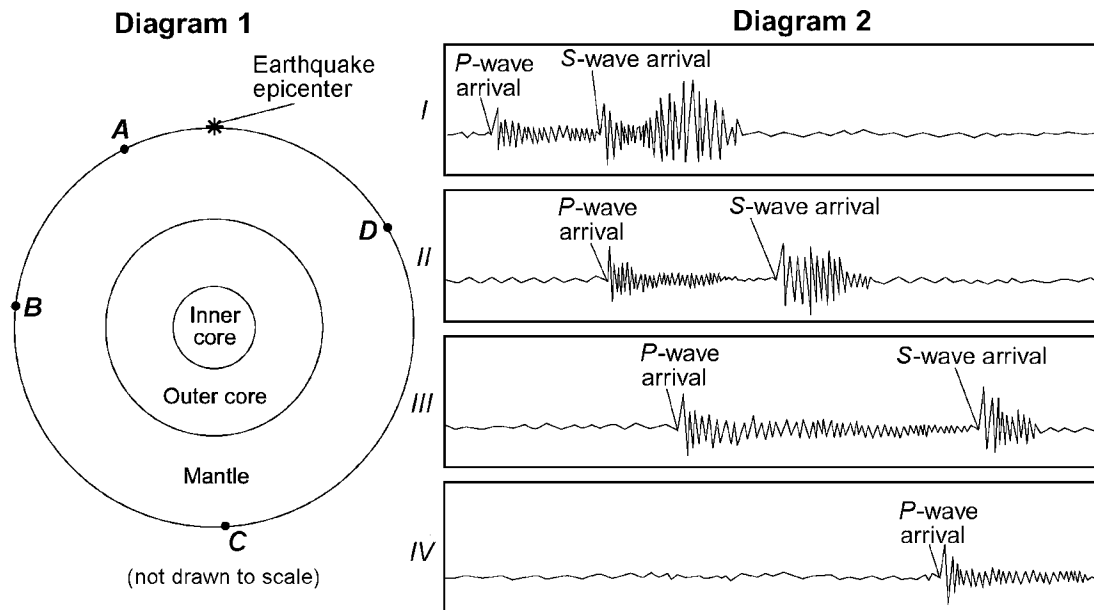
27) How long did it take the *P*-wave to travel from the epicenter of the earthquake to seismic station *D*?

A) 00:17:20   B) 00:39:20   C) 00:46:20   D) 00:09:40

28) What is the *most* probable reason for the absence of *S*-waves at station *A*?

A) Station *A* was located too close to the epicenter.
B) *S*-waves cannot travel through liquids.
C) *S*-waves were not generated at the epicenter.
D) Station *A* was located on solid bedrock.

29) What is the approximate distance from station *C* to the earthquake epicenter?

A) 1,600 km   B) 2,400 km   C) 1,000 km   D) 3,200 km

Questions 30 and 31 refer to the following:

Diagram 1 below represents a cross section of Earth and its interior layers. The asterisk (✳) shows the location of an earthquake epicenter. Letters *A* through *D* are seismic stations on Earth's surface.

Diagram 2 shows four seismograms labeled *I*, *II*, *III*, and *IV*, which were recorded at seismic stations *A*, *B*, *C*, and *D* during the same time interval.
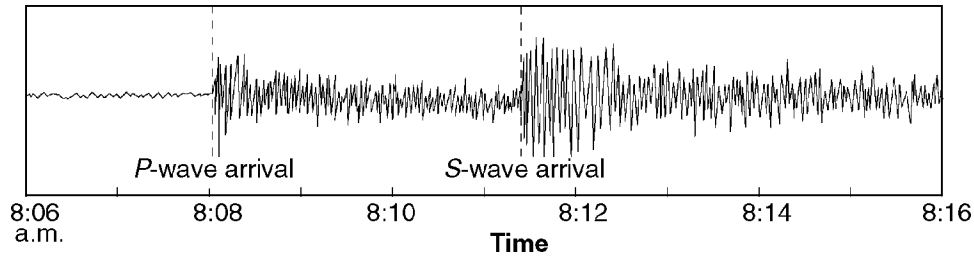
Diagram 1

(not drawn to scale)

Diagram 2

30) Which list correctly matches the given seismograms with the seismic stations where they were recorded?

A) seismogram *I* — station *B*
   seismogram *II* — station *D*
   seismogram *III* — station *A*
   seismogram *IV* — station *C*

B) seismogram *I* — station *A*
   seismogram *II* — station *B*
   seismogram *III* — station *C*
   seismogram *IV* — station *D*

C) seismogram *I* — station *C*
   seismogram *II* — station *B*
   seismogram *III* — station *D*
   seismogram *IV* — station *A*

D) seismogram *I* — station *A*
   seismogram *II* — station *D*
   seismogram *III* — station *B*
   seismogram *IV* — station *C*

31) Station *D* in the given diagram is 8,000 kilometers from the earthquake epicenter. How long did it take for the first P-wave to travel from the epicenter to station *D*?

A) 4 minutes 20 seconds

B) 20 minutes 40 seconds

C) 11 minutes 20 seconds

D) 9 minutes 20 seconds

32) The seismogram below was recorded at a seismic station and shows the arrival times of the first *P*-wave and *S*-wave from an earthquake.
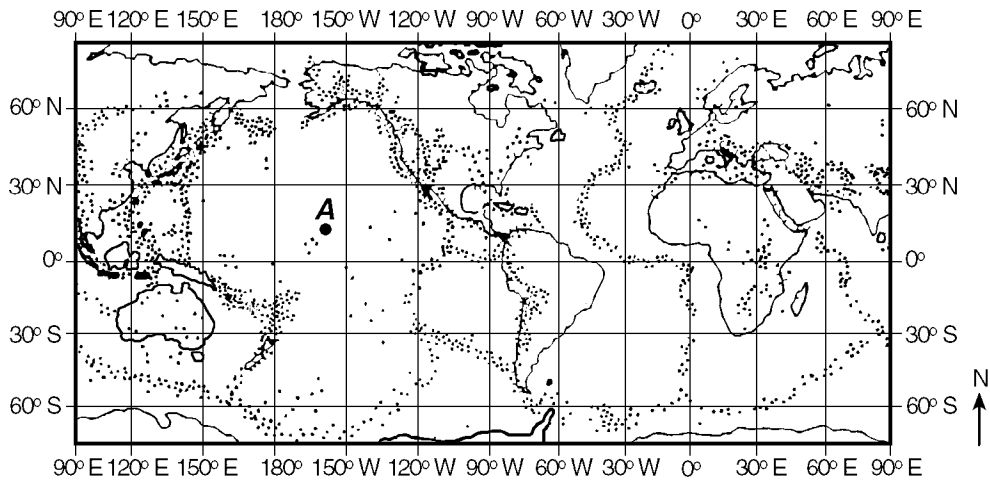

Which part of this seismogram is used to find the distance to the epicenter of the earthquake?

A) difference in the height of the *P*-wave and *S*-wave
B) difference in the arrival time of the *P*-wave and *S*-wave
C) *P*-wave arrival time, only
D) *S*-wave arrival time, only

Questions 33 and 34 refer to the following:

The dots on the map below show the distribution of major earthquake epicenters. The shaded circle labeled *A* represents a location on Earth's surface.
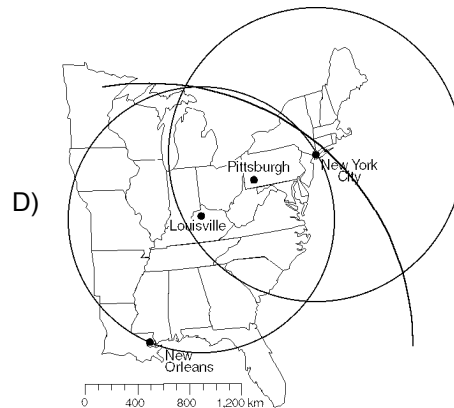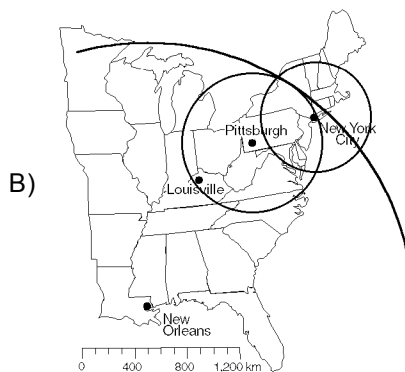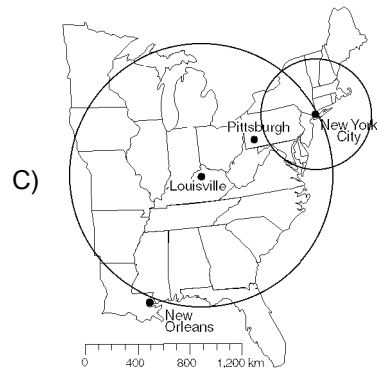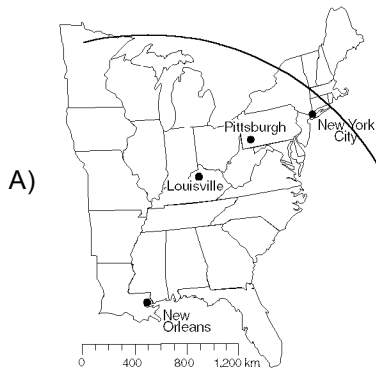

33) Which one of the following conclusions can *best* be inferred from the data shown on the given map?

A) Most earthquakes occur on continents.
B) Most earthquakes are concentrated in zones along plate boundaries.
C) Most earthquakes occur west of the Prime Meridian and north of the Equator.
D) Earthquakes generally are evenly distributed over the surface of Earth.

34) Location *A* in the given diagram is *best* described as an area that is

A) above a mantle hot spot near the center of a crustal plate
B) at the boundary between two diverging plates
C) within a rift valley at a mid-ocean ridge
D) within a deep-sea trench between two converging plates

Questions 35 and 36 refer to the following:

Seismic stations are located at the four cities shown on the map below. Letter *X* represents the epicenter of an earthquake determined from seismic waves recorded at all four cities.

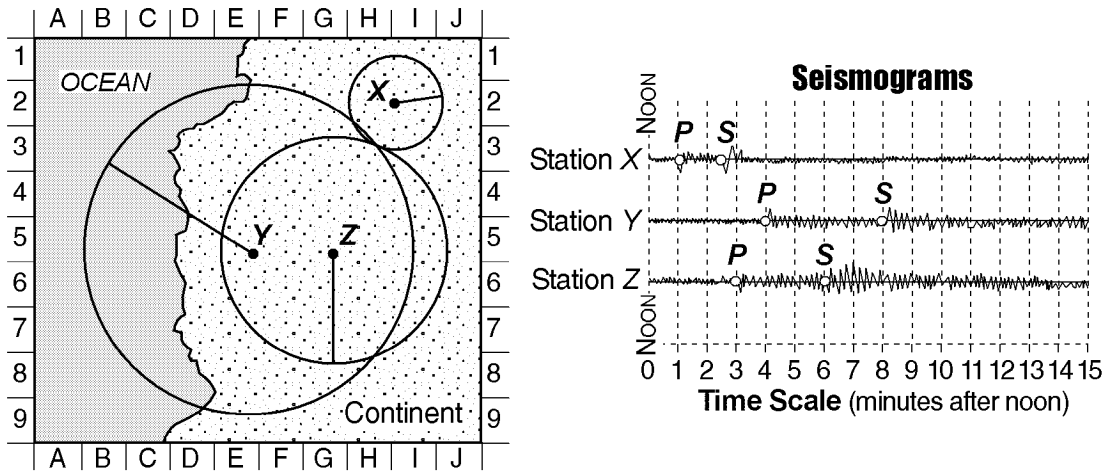35) Which map correctly shows how the location of the epicenter was determined?

A)

C)

B)

D)

36) At which city is there a difference of approximately 3 minutes and 20 seconds between the arrival times of the *P*-waves and the *S*-waves?
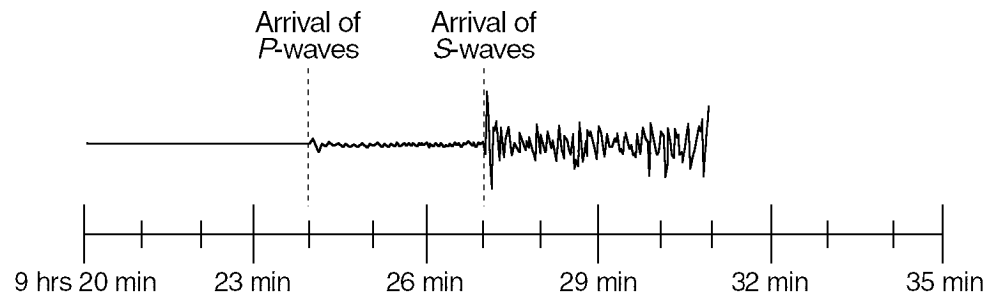
A) New Orleans   B) New York City   C) Louisville   D) Pittsburgh

Questions 37 through 40 refer to the following:

The diagram below shows three seismograms of the same earthquake recorded at three different seismic stations, *X, Y,* and *Z.* The distances from each seismic station to the earthquake epicenter have been drawn on the map. A coordinate system has been placed on the map to describe locations. [*The map scale has not been included.*]
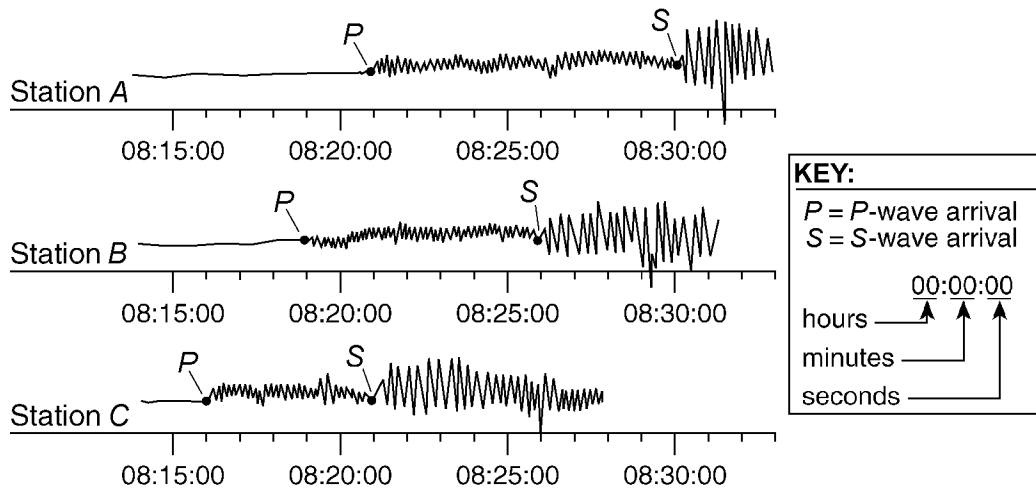

37) Seismic station *Z* is 1,700 kilometers from the epicenter. Approximately how long did it take the *P*-wave to travel to station *Z*?

A) 2 min 50 sec   B) 3 min 30 sec   C) 6 min 30 sec   D) 1 min 50 sec

38) The *S*-waves from this earthquake that travel toward Earth's center will

A) reach the other side of Earth faster than those that travel around Earth in the crust
B) be deflected by Earth's magnetic field
C) be totally reflected off the crust-mantle interface
D) be absorbed by the liquid outer core

39) Approximately how far away from station *Y* is the epicenter?

A) 5,200 km   B) 1,300 km   C) 2,600 km   D) 3,900 km

40) On the map, which location is *closest* to the epicenter of the earthquake?

A) *H*-8   B) *G*-1   C) *E*-5   D) *H*-3

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

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

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

42) The diagram below represents three seismograms showing the same earthquake as it was recorded at three different seismic stations, *A*, *B*, and *C*.
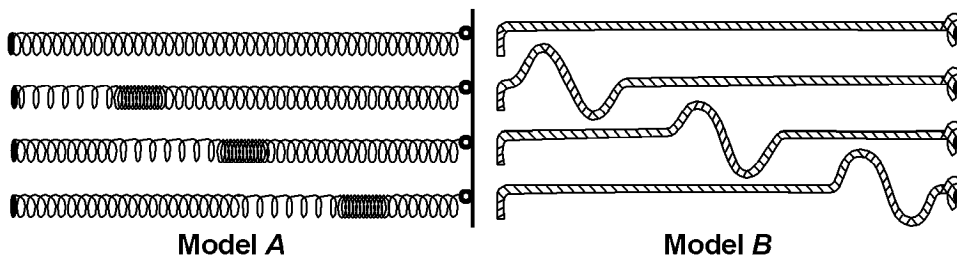

Which statement correctly describes the distance between the earthquake epicenter and these seismic stations?

A) *C* is closest to the epicenter, and *A* is farthest from the epicenter.
B) *A* is closest to the epicenter, and *B* is farthest from the epicenter.
C) *A* is closest to the epicenter, and *C* is farthest from the epicenter.
D) *B* is closest to the epicenter, and *C* is farthest from the epicenter.

Questions 43 and 44 refer to the following:

The diagram below shows models of two types of earthquake waves.

43) The difference in seismic station arrival times of the two waves represented by the models in the given diagram helps scientists determine the

A) time of occurrence of the next earthquake   C) amount of damage caused by an earthquake
B) distance to the epicenter of an earthquake   D) intensity of an earthquake

44) In the given diagram, model *A best* represents the motion of earthquake waves called

A) *S*-waves (shear waves) that travel slower than *P*-waves (compressional waves) shown in model *B*
B) *S*-waves (shear waves) that travel faster than *P*-waves (compressional waves) shown in model *B*
C) *P*-waves (compressional waves) that travel faster than *S*-waves (shear waves) shown in model *B*
D) *P*-waves (compressional waves) that travel slower than *S*-waves (shear waves) shown in model *B*