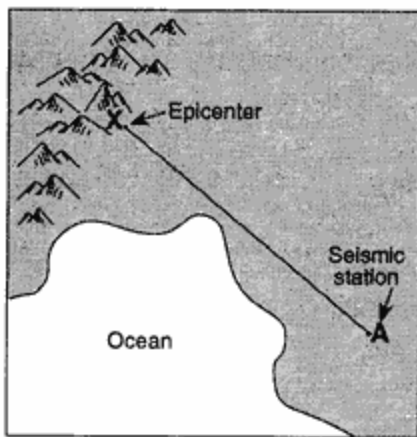

1. Which statement correctly compares seismic *P*-waves with seismic *S*-waves?

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

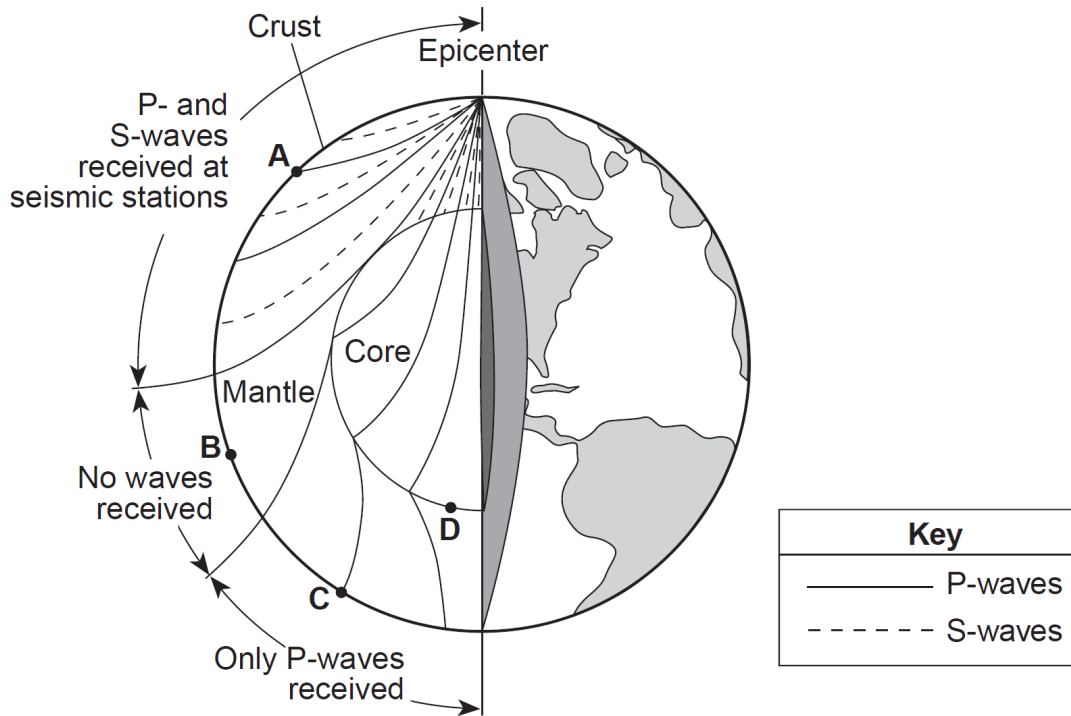
2. Base your answer to the following question on the map below. The map shows point *X*, which is the location of an earthquake epicenter, and point *A*, which is the location of a seismic station.



Which statement best describes the arrival of the initial *S*-wave at the seismic station?

- A) It arrived later than the *P*-wave because *S*-waves travel more slowly.
 - B) It arrived earlier than the *P*-wave because *S*-waves travel faster.
 - C) It arrived at the same time as the *P*-wave because *S*-waves and *P*-waves have the same velocity on Earth's surface.
 - D) It never reached location *A* because *S*-waves can travel only through a liquid medium.
-

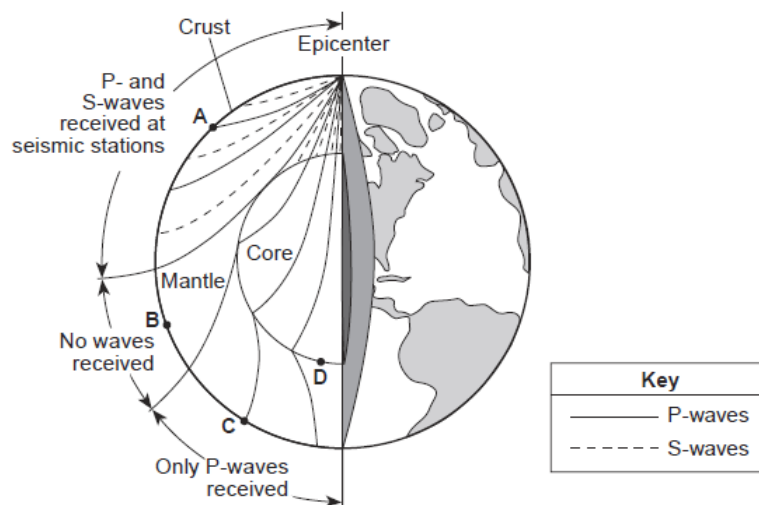
3. Base your answer to the following question on the diagram below and on your knowledge of Earth science. The diagram represents a cut-away view of Earth's interior and the paths of some of the seismic waves produced by an earthquake that originated below Earth's surface. Points *A*, *B*, and *C* represent seismic stations on Earth's surface. Point *D* represents a location at the boundary between the core and the mantle.



Only *P*-waves were recorded at seismic station *C* because *P*-waves travel

- A) only through Earth's interior, and *S*-waves travel only on Earth's surface
- B) fast enough to penetrate the core, and *S*-waves travel too slowly
- C) through iron and nickel, while *S*-waves cannot
- D) through liquids, while *S*-waves cannot

Base your answers to questions 4 and 5 on the diagram below and on your knowledge of Earth science. The diagram represents a cut-away view of Earth's interior and the paths of some of the seismic waves produced by an earthquake that originated below Earth's surface. Points *A*, *B*, and *C* represent seismic stations on Earth's surface. Point *D* represents a location at the boundary between the core and the mantle.



4. Only *P*-waves were recorded at seismic station *C* because *P*-waves travel
 - A) only through Earth's interior, and *S*-waves travel only on Earth's surface
 - B) fast enough to penetrate the core, and *S*-waves travel too slowly
 - C) through iron and nickel, while *S*-waves cannot
 - D) through liquids, while *S*-waves cannot

5. Seismic station *A* is 5000 kilometers from the epicenter. What is the difference between the arrival time of the first *P*-wave and the arrival time of the first *S*-wave recorded at this station?

A) 2 minutes 20 seconds	B) 6 minutes 40 seconds
C) 8 minutes 20 seconds	D) 15 minutes 00 second

- 6. The first *P*-wave of an earthquake took 11 minutes to travel to a seismic station from the epicenter of the earthquake. What is the seismic station's distance to the epicenter of the earthquake and how long did it take for the first *S*-wave to travel that distance?
 - A) Distance to epicenter: 3350 km
S-wave travel time: 4 min 50 sec
 - B) Distance to epicenter: 3350 km
S-wave travel time: 6 min 10 sec
 - C) Distance to epicenter: 7600 km
S-wave travel time: 9 min
 - D) Distance to epicenter: 7600 km
S-wave travel time: 20 min

- 7. What is the approximate *P*-wave travel time from an earthquake if the *P*-wave arrives at the seismic station 8 minutes before the *S*-wave?
 - A) 4 minutes 20 seconds
 - B) 6 minutes 30 seconds
 - C) 10 minutes 0 seconds
 - D) 11 minutes 20 seconds

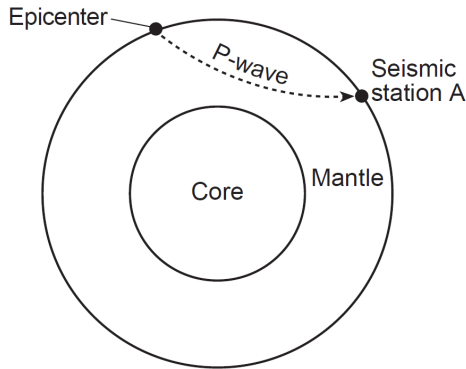
- 8. A *P*-wave takes 5 minutes to travel from the epicenter of an earthquake to a seismic station. Approximately how many minutes will it take an *S*-wave to travel that same distance?

A) 15 min	B) 12 min
C) 9 min	D) 4 min

9. The epicenter of an earthquake is located 6,500 kilometers away from a seismic station. If the first *S*-wave arrived at this seismic station at 1:30 p.m., at what time did the first *P*-wave arrive?

- A) 1:20 p.m. B) 1:22 p.m.
C) 1:38 p.m. D) 1:40 p.m.

10. The cross section of Earth below represents a *P*-wave moving away from an earthquake epicenter. Seismic station *A* is shown on Earth's surface.



At station *A*, the first *P*-wave arrives 11 minutes 40 seconds after the earthquake. How long after the first *P*-wave arrives will the first *S*-wave arrive?

- A) 5 minutes 00 second
B) 8 minutes 40 seconds
C) 9 minutes 40 seconds
D) 21 minutes 20 seconds

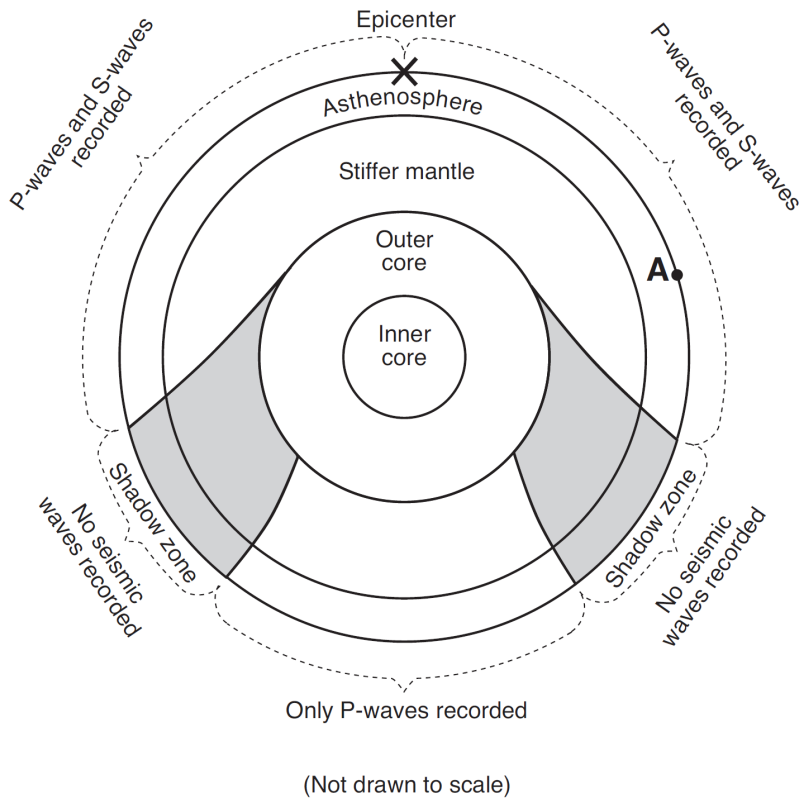
11. The arrival time of the first earthquake *P*-wave at a seismograph station was 10:11:20 (hours:minutes:seconds). If the epicenter of the earthquake is 8000 km away, what was the approximate arrival time of the first *S*-wave from this earthquake?

- A) 10:02:00 B) 10:09:20
C) 10:20:40 D) 10:32:00

12. What is the approximate time difference between the first *P*-wave and the first *S*-wave recorded at a seismic station located 8000 kilometers from an earthquake's epicenter?

- A) 8 minutes 40 seconds
B) 9 minutes 20 seconds
C) 11 minutes 20 seconds
D) 20 minutes 40 seconds
-

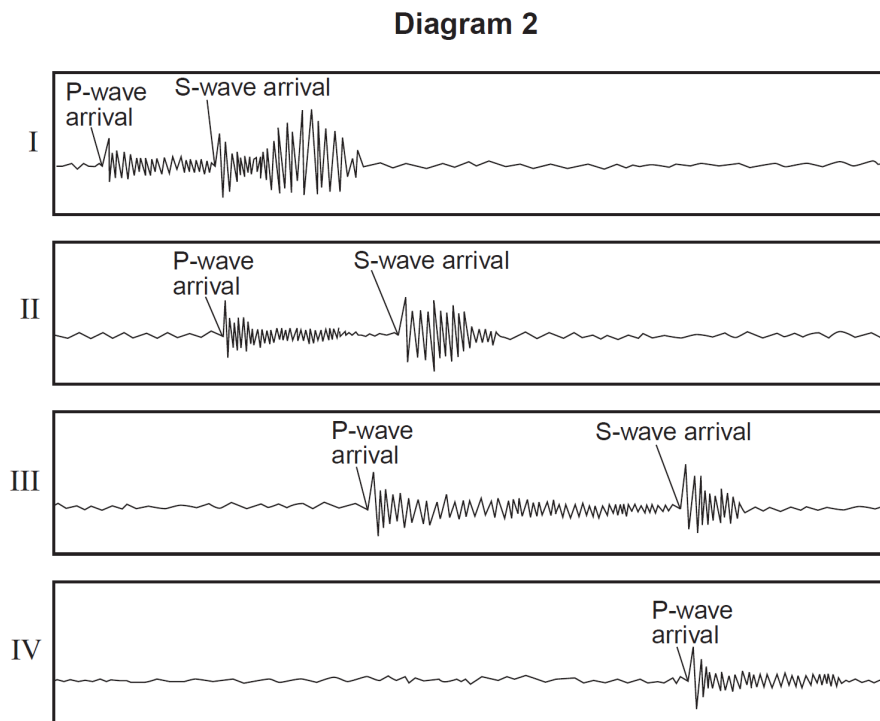
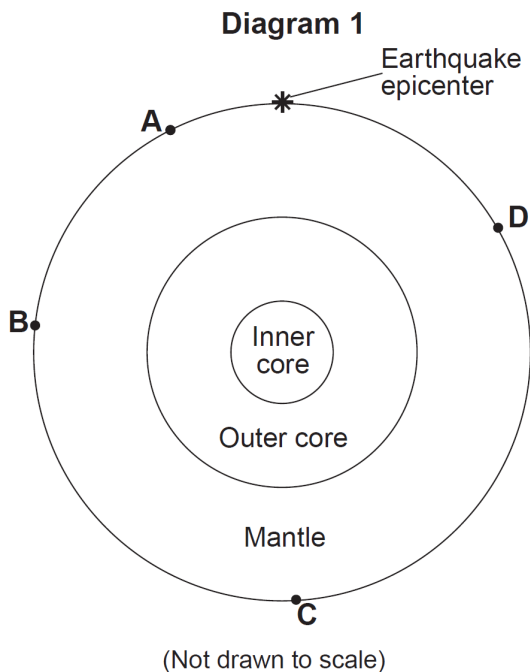
13. Base your answer to the following question on the cross section below, which shows the type of seismic waves recorded at various locations after an earthquake has occurred. Point *A* is a location on Earth's surface and *X* is the epicenter of the earthquake.



Point *A* is located 7600 kilometers from the epicenter of this earthquake. How many minutes did it take the first S-wave to reach point *A*?

- A) 9 min B) 11 min C) 16 min D) 20 min

Base your answers to questions 14 and 15 on the diagrams below. Diagram 1 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.



14. Station *D* is 8000 kilometers from the earthquake epicenter. How long did it take for the first *P*-wave to travel from the epicenter to station *D*?

- A) 9 minutes 20 seconds
- B) 11 minutes 20 seconds
- C) 20 minutes 40 seconds
- D) 4 minutes 20 seconds

15. Which list correctly matches the seismograms with the seismic stations where they were recorded?

A) seismogram I - station *A*

seismogram II - station *B*

seismogram III - station *C*

seismogram IV - station *D*

B) seismogram I - station *B*

seismogram II - station *D*

seismogram III - station *A*

seismogram IV - station *C*

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*

16. 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) 3 min 15 s B) 4 min 55 s

C) 6 min 05 s D) 9 min 00 s

17. An earthquake's first P-wave arrives at a seismic station at 12:00:00. This P-wave has traveled 6000 kilometers from the epicenter. At what time will the first S-wave from the same earthquake arrive at the seismic station?

A) 11:52:20 B) 12:07:40

C) 12:09:20 D) 12:17:00

18. A seismic station is recording the seismic waves produced by an earthquake that occurred 4200 kilometers away. Approximately how long after the arrival of the first P-wave will the first S-wave arrive?

A) 1 min 05 sec B) 5 min 50 sec

C) 7 min 20 sec D) 13 min 10 sec

19. 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?

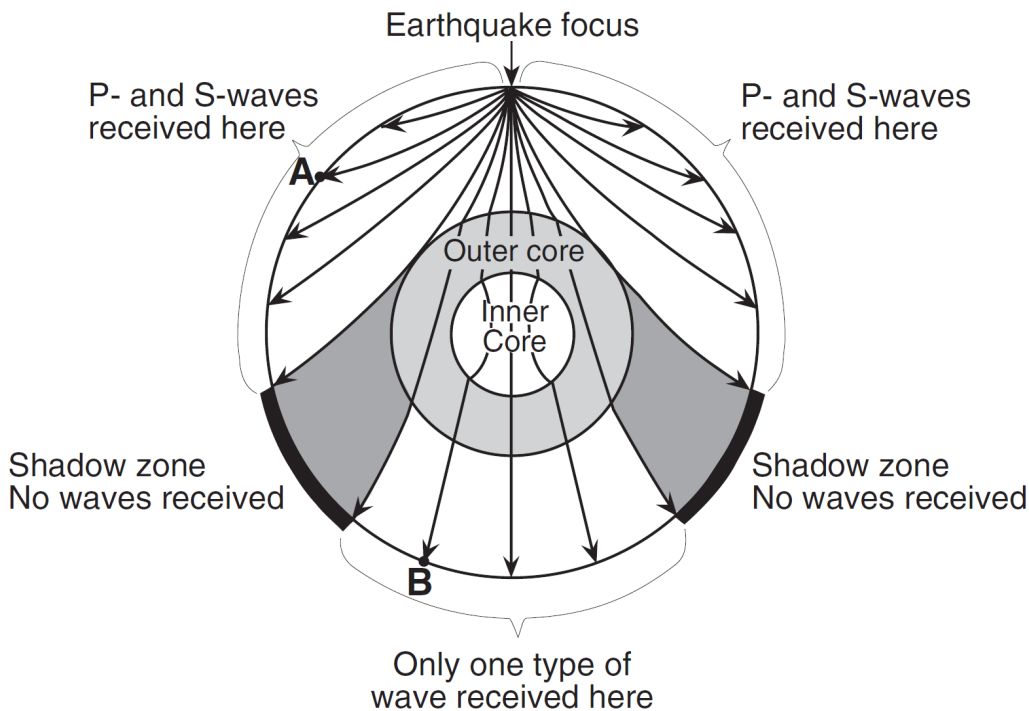
A) 6 mm 40 sec B) 9 mm 40 sec

C) 15 mm 00 sec D) 19 mm 00 sec

20. A seismic station 4000 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) 9:55:00 B) 10:05:40
 C) 10:07:05 D) 10:12:40

21. 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.



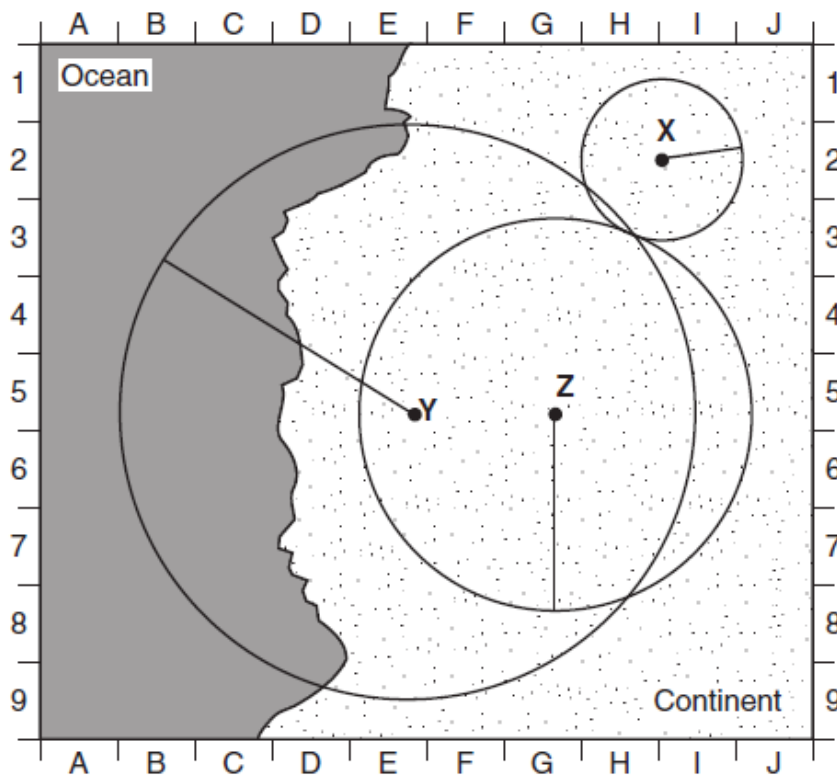
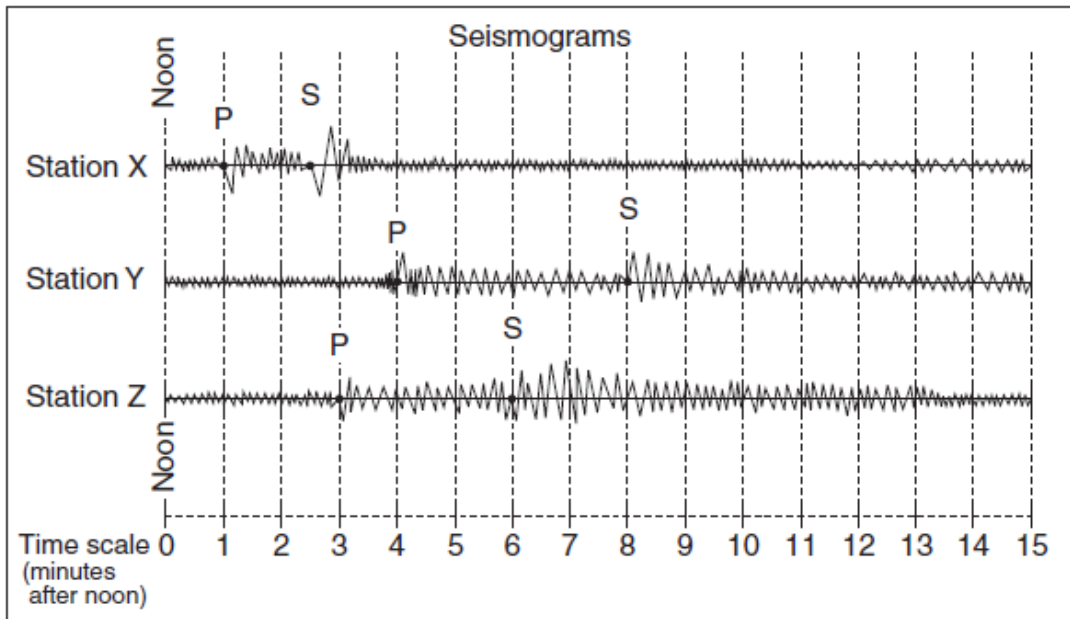
A seismic station located at point *A* is 5400 kilometers away from the epicenter of the earthquake. If the arrival time for the *P*-wave at point *A* was 2:00 p.m., the arrival time for the *S*-wave at point *A* was approximately

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

22. 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) 5 min 40 sec B) 7 min 0 sec
 C) 12 min 40 sec D) 13 min 20 sec

23. Base your answer to the following question on the diagram and map below. The diagram 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.



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

24. If a seismic station is 3200 km from an earthquake epicenter, which is the time needed for an *S*-wave to travel from the epicenter to the seismic station?

- A) 4 min 40 sec B) 6 min 0 sec
C) 10 min 40 sec D) 11 min 10 sec

25. The epicenter of an earthquake is located 2,800 kilometers from a seismic station. Approximately how long did the *S*-wave take to travel from the epicenter to the station?

- A) 11 min 15 sec B) 9 min 35 sec
C) 5 min 20 sec D) 4 min 20 sec
-