1. 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

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

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

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

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

2. 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.

3. 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

4. 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
5. Base your answer to the following question on the data table below, which gives information collected at seismic stations W, X, Y, and Z for the same earthquake. Some of the data have been omitted.

<table>
<thead>
<tr>
<th>Seismic Station</th>
<th>P-Wave Arrival Time (h:min:s)</th>
<th>S-Wave Arrival Time (h:min:s)</th>
<th>Difference in Arrival Times (h:min:s)</th>
<th>Distance to Epicenter (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>10:50:00</td>
<td>no S-waves arrived</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>10:42:00</td>
<td>10:46:40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>10:39:20</td>
<td>10:46:40</td>
<td>00:02:40</td>
<td>6200</td>
</tr>
<tr>
<td>Z</td>
<td>10:45:40</td>
<td>10:46:40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At what time did the S-wave arrive at station Y?
A) 10:36:40  B) 10:39:20  C) 10:42:00  D) 10:45:20

6. 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

7. 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.

8. 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

9. 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) **earliest arrival time of P-waves**
C) greatest difference in the arrival times of P-waves and S-waves
D) arrival of S-waves before the arrival of P-waves
10. 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

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

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

Base your answers to questions 12 and 13 on the map below, which shows seismograph recording stations at locations A, B, and C. Location D is an earthquake epicenter. The distances from locations A and B to this epicenter are given in kilometers.

12. At which location is the arrival-time difference between the P-wave and the S-wave greatest?

A) A  
B) B  
C) C  
D) D

13. Approximately how long did the S-wave take to travel from the epicenter to location A?

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

14. In 8 minutes, an earthquake P-wave travels a total distance of

A) 2,100 km  
B) 4,700 km  
C) 6,600 km  
D) 11,300 km

15. An earthquake’s magnitude can be determined by

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

16. A huge undersea earthquake off the Alaskan coastline could produce a

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

17. 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

A) are stronger than S-waves  
B) travel faster than S-waves  
C) travel faster than S-waves  
D) can travel through liquids and S-waves cannot
18. When the seafloor moves as a result of an underwater earthquake and a large tsunami develops, what will most likely occur?

A) Deep-ocean sediments will be transported over great distances.
B) No destruction will occur near the origin of the earthquake.
C) The direction of the tsunami will be determined by the magnitude of the earthquake.
D) Severe destruction will occur in coastal areas.

19. An earthquake occurs at 12:02 p.m. A seismic station records the first S-wave at 12:19 p.m. Which set of data shows the approximate arrival time of the first P-wave and the distance to the epicenter?

A) 12:11:25 p.m. and 4000 km
B) 12:11:25 p.m. and 6000 km
C) 12:19:40 p.m. and 4000 km
D) 12:19:40 p.m. and 6000 km

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

<table>
<thead>
<tr>
<th>Arrival of P-waves</th>
<th>Arrival of S-waves</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 minutes</td>
<td>6 minutes</td>
</tr>
<tr>
<td>6 minutes</td>
<td>12 minutes</td>
</tr>
</tbody>
</table>

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

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

21. 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) **1,100 km**
B) 2,400 km
C) 3,100 km
D) 4,000 km

22. 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

A) D  B) E  C) F  D) G

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

Which information can be determined by using this seismogram?

A) the depth of the earthquake's focus
B) the direction to the earthquake's focus
C) the location of the earthquake's epicenter
D) **the distance to the earthquake's epicenter**

24. A seismic station recorded the arrival of a P-wave at 10:00:00 a.m. The S-wave arrival was recorded at 10:04:20 a.m. What is the approximate distance between the earthquake epicenter and the seismic station?

A) **1.1 \times 10^3 km**
B) **2.2 \times 10^3 km**
C) **2.9 \times 10^3 km**
D) **7.2 \times 10^3 km**

25. A P-wave reaches a seismograph station 2,600 kilometers from an earthquake epicenter at 12:10 p.m. At what time did the earthquake occur?

A) 12:01 p.m.  B) **12:05 p.m.**
C) 12:15 p.m.  D) 12:19 p.m.
26. An earthquake $P$-wave arrived at a seismograph station at 01 hour 21 minutes 40 seconds. The distance from the station to the epicenter is 3,000 kilometers. The earthquake's origin time was

A) 01 h 11 min 40 sec  
B) **01 h 16 min 00 sec**  
C) 01 h 20 min 20 sec  
D) 01 h 27 min 20 sec

27. If a seismograph recording station located 5,700 kilometers from an epicenter receives a $P$-wave at 4:45 p.m., at which time did the earthquake actually occur at the epicenter?

A) 4:24 p.m.  
B) 4:29 p.m.  
C) **4:36 p.m.**  
D) 4:56 p.m.

28. The arrival of $P$-waves and $S$-waves at a seismic station indicated that an earthquake occurred 4,000 kilometers from the station. The $P$-wave arrived at 3:32:30 p.m. When did the earthquake occur?

A) 3:25:30 p.m.  
B) 3:32:23 p.m.  
C) 3:27:00 p.m.  
D) 3:39:30 p.m.

29. 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?

A) 10:53 a.m.  
B) 11:05 a.m.  
C) **11:07 a.m.**  
D) 11:12 a.m.

30. Base your answer to the following question on the diagram below, which represents zones of Earth’s interior, identified by letters $A$ through $E$. The scale shows depths below Earth’s surface, measured in kilometers.

![Zones of Earth’s Interior Diagram](image)  

The Moho is a boundary located in zone

A) $A$  
B) $B$  
C) $E$  
D) $D$
1. A
2. B
3. C
4. B
5. C
6. B
7. A
8. B
9. B
10. B
11. B
12. C
13. B
14. B
15. A
16. A
17. D
18. D
19. B
20. C
21. A
22. A
23. D
24. C
25. B
26. B
27. C
28. A
29. C
30. A