/20 Earthquakes and Faults Assignment (Counts as Assessment)

Locating an Earthquake

Q1.

/10 a) On the graph paper provided in Figure 1, plot points to show the travel time of each main seismic wave in relation to its distance from the epicenter.

/3 b) For each discrete path of points, draw a line or curve that starts at the origin (where time and distance equals zero) and connect all the points in the path. Label the lines that represent P waves, S waves and L waves. Hint: Which wave is fastest? Slowest?

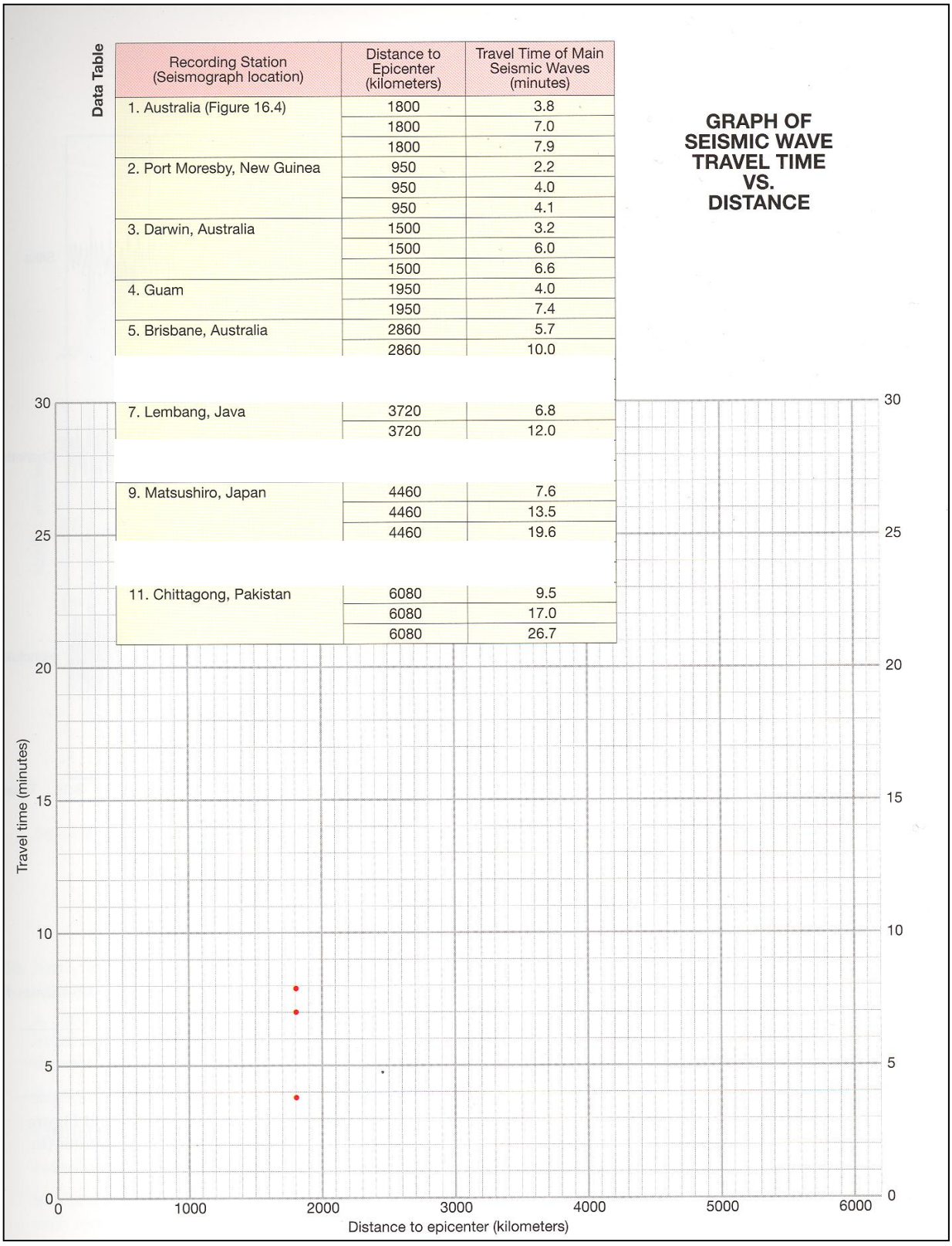
/2 c) Why is the S wave curve steeper than the P wave curve?

/2 d) Point zero on the graph represents time zero (start of seismic waves) and the epicenter of the Earthquake. The difference in time between the P waves and S waves at the same recording station is called the **S-P time interval**. How is the S-P time interval related to distance from the epicenter? Why?

/2 e) Imagine that an Earthquake occurred last night, and the fastest P wave of the Earthquake was recorded at a station in Nanaimo at 6:11.6 pm and the first S wave arrived at the same station at 6:16.1 pm.

What is the S minus P time interval? _____

Approximately how far from the epicenter is the Sudbury recording station located?
(hint: check on your graph to see were the S-P time interval fits and project it down to x-axis, where you'll find the distance)



Data Table

Recording Station (Seismograph location)	Distance to Epicenter (kilometers)	Travel Time of Main Seismic Waves (minutes)
1. Australia (Figure 16.4)	1800	3.8
	1800	7.0
	1800	7.9
2. Port Moresby, New Guinea	950	2.2
	950	4.0
	950	4.1
3. Darwin, Australia	1500	3.2
	1500	6.0
	1500	6.6
4. Guam	1950	4.0
	1950	7.4
5. Brisbane, Australia	2860	5.7
	2860	10.0
7. Lembang, Java	3720	6.8
	3720	12.0
9. Matsushiro, Japan	4460	7.6
	4460	13.5
	4460	19.6
11. Chittagong, Pakistan	6080	9.5
	6080	17.0
	6080	26.7

Figure 1: Seismic wave data for the New Guinea (3° North latitude and 140° East longitude Earthquake that occurred at Greenwich Mean Time of 7hrs, 10 mins, 23 secs. This graph is for plotting the points that represent the arrival times of each seismic wave (P, S and L, where applicable) at stations located at different distances from the epicenter of the Earthquake. (From Laboratory Manual in Physical Geology, 2003, AGI-NAGT, p.265)

Q2.

/9 a) Figure 2 are seismograms recorded at stations in Alaska, North Carolina and Hawaii. Label the following on all three diagrams: background noise, arrival of P wave, arrival of S wave, and draw the S-P interval.

/9 b) Estimate **(to the nearest <u>tenth</u> of a minute eg: 7:08.90)** the times of arrival for P and S waves, then calculate the S minus P time interval for the three station stations.

	P wave arrival	S wave arrival	S-P time interval
Sitka, AK			
Charlotte, NC			
Honolulu, HI			

/6 c) Use the S-P time intervals, and Figure 1 to determine the distance from the epicenter (in km) to the three stations. To do this you will need to measure, using Fig. 1, how long the S-P time interval (calculated in Q2b) is in cm. Then use this length (in cm) to determine where it fits between the S and P curves on Fig.1. Draw a line representing these distances in on Fig.1. Then project this line down to the x-axis, where you can determine the distance in km.

	S-P time interval	Distance on Fig. 1 (cm)	Distance (km)
Sitka, AK			
Charlotte, NC			
Honolulu, HI			

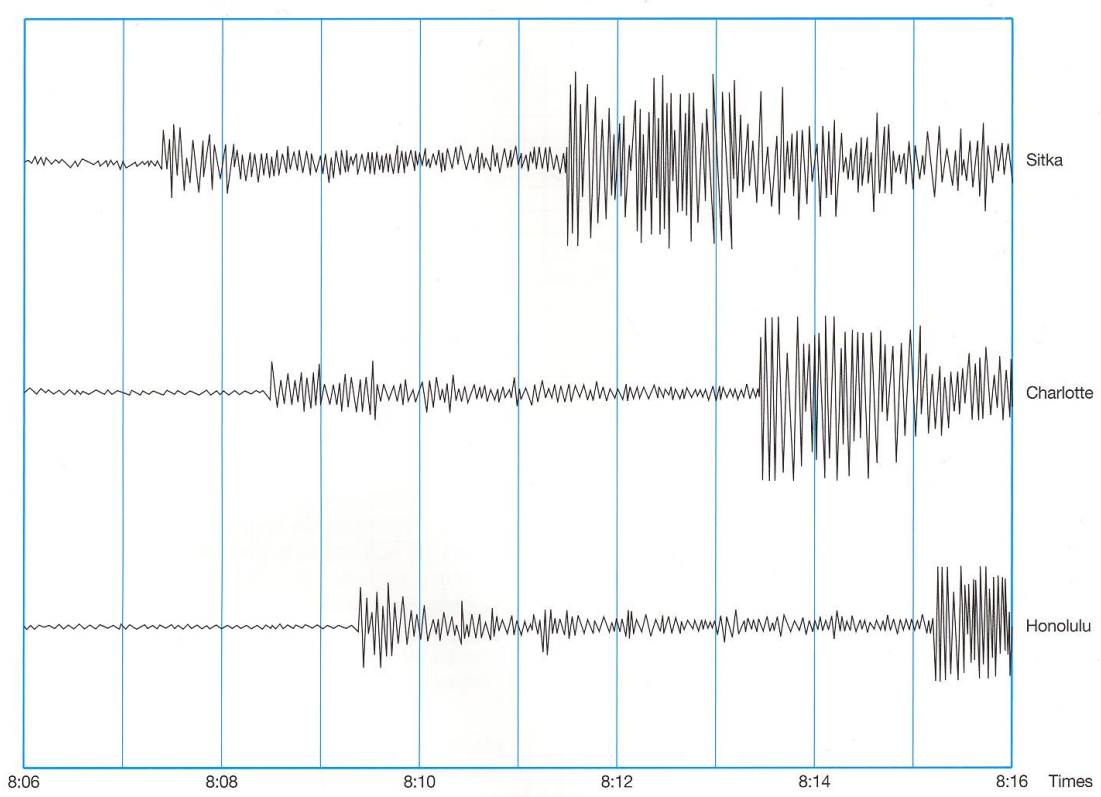


Figure 2: Seismograms for an Earthquake recorded at three locations: Alaska, North Carolina and Hawaii. (from Laboratory Manual in Physical Geology, AGI-NAGT, 2003, p.266)

Q3.

To find the Earthquakes epicenter, you will use the distances that you just recorded.

/9 First, mark and label the three stations below onto Figure 3 using the following information:

	Latitude	Longitude
Sitka, AK	**57°N**	**135°W**
Charlotte, NC	**35°N**	**81°W**
Honolulu, HI	**21°N**	**158°W**

Use a compass or string to draw a circle around each recording station. Make the radius equal to the distance from the epicenter, which you determined in question 2c. (Make sure you use the scale on Figure 3 to set your compass to the proper scale!).

Once the three circles are drawn, they should pretty much intersect at one point. This is the epicenter. If the points do not exactly intersect, then find the point that is at the same distance from the edges of the circles and use this as your epicenter.

Where is the epicenter? Give N latitude _____

W Longitude_____

What is the name of the major fault that occurs near this epicenter? ***San Andreas Fault***

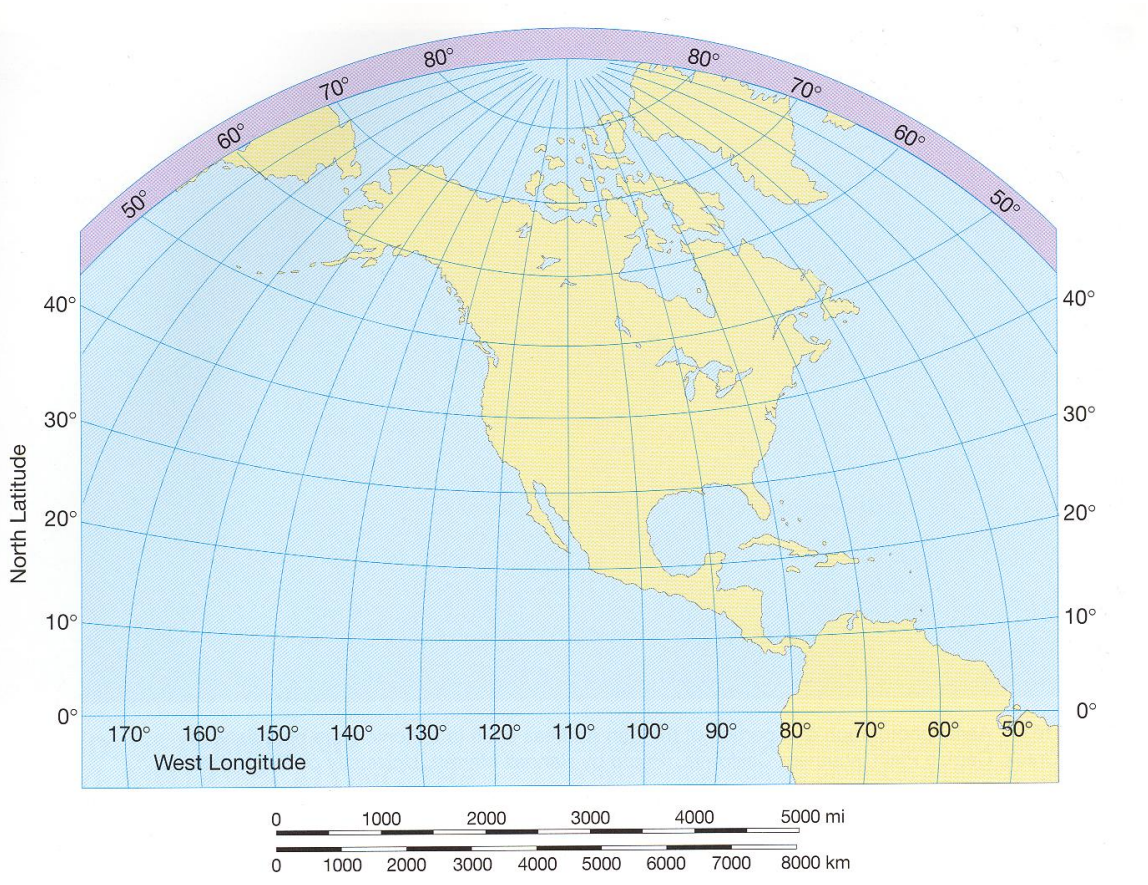


Figure 3: Map of Earth, for use in plotting data and locating the Earthquake's epicenter. (from Laboratory Manual in Physical Geology, AGI-NAGT, 2003, p. 267)

Magnitude of an Earthquake

Q4. Using Figure 4, you will determine the magnitude of this southern California Earthquake.

/2 a) On Figure 4, label: arrival time of P-wave, arrival time of S-wave, and the S-P interval.

/2 b) Determine S minus P to the nearest second and place a mark on the lower left hand scale at the corresponding time. S-P = _____

/2 c) Measure the amplitude (This is the point on the waveform where the trace is at its greatest distance from the position of rest -- a horizontal line running across the center of the seismogram) of the quake in millimeters.

Amplitude =_____mm Mark the amplitude on the lower right hand scale.

/2 d) Draw a straight line (use a ruler) from the mark on the left scale to the mark on the right scale. What is the Richter scale magnitude of this Earthquake? _____

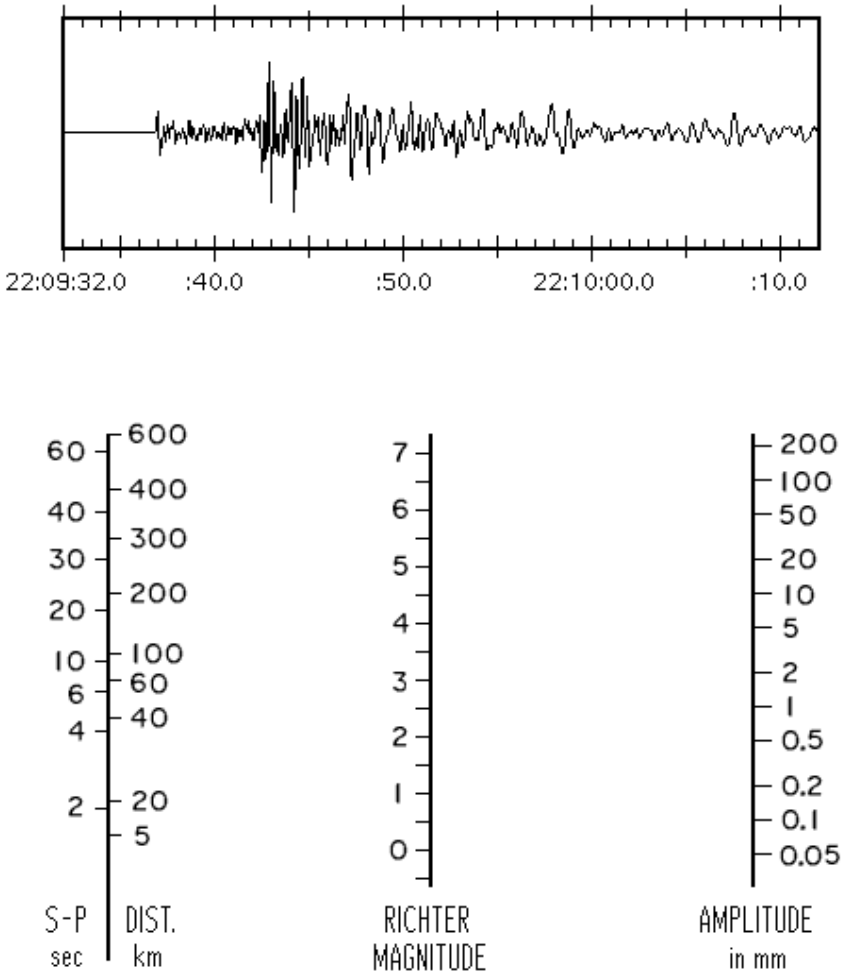


Figure 4: The rectangular area contains a portion of a seismogram of a real Earthquake recorded in southern California. The time scale of this seismogram is given directly beneath the rectangle; marks on the rectangles borders correspond to these numbers, which give hours, minutes, and seconds. Below the seismogram is the Richter Scale nomograph. This graph is made up of three scale bars, labeled below each. The nomograph allows you to find the Richter magnitude of an Earthquake by connecting the points that represent two other values (arrival-time difference and maximum amplitude) with a straight line. The point where that line intersects the third and middle scale corresponds to the Richter magnitude of the Earthquake.
(from: www. scec.org).