Name: Date: Pd:

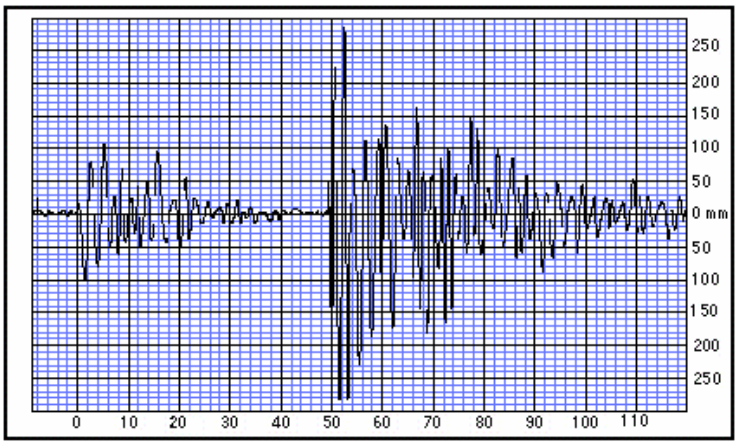
Unit 2: Earthquakes

Seismologist For A Day

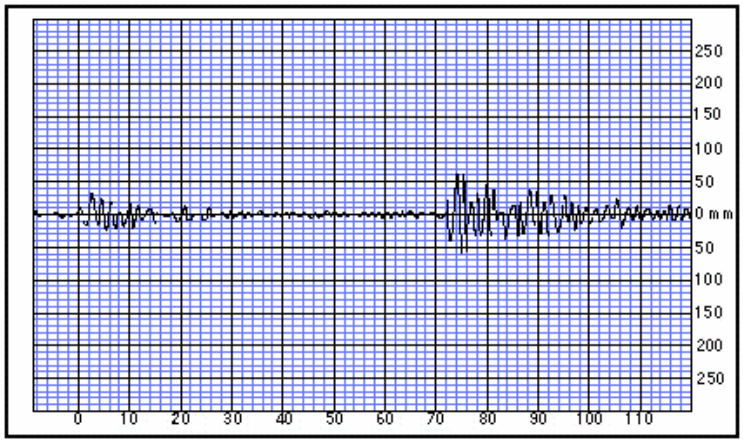
Purpose:
In this activity, you will analyze actual seismographic data to determine the epicenter of an earthquake, as well as its magnitude on the Richter Scale.

Three seismograph stations detect an earthquake. Below are the seismograms that each station measured. Time is on the x-axis and wave amplitude is on the y-axis.

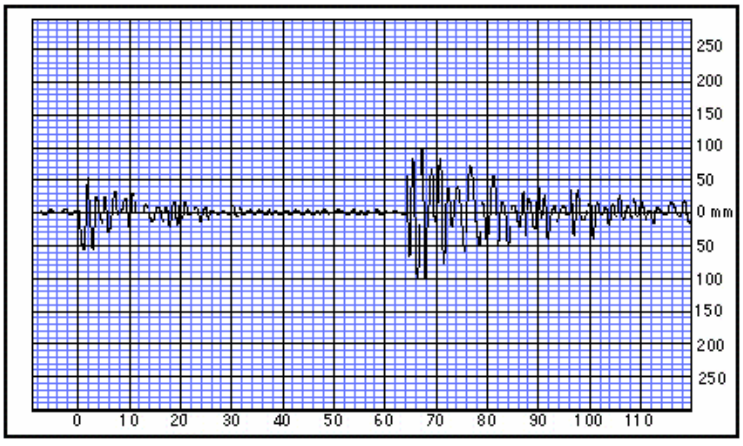
Seismograph Station #1: Eureka, *CA*



Seismograph Station #2: Elko, NV



Seismograph Station #3: Las Vegas, NV



Predictions:
Based only on the seismograms above, which city do you think the earthquake's epicenter was closest to? Explain your reasoning.

Locating the Epicenter:

- On the data above, label the P-waves and S-waves for all 3 seismograms.

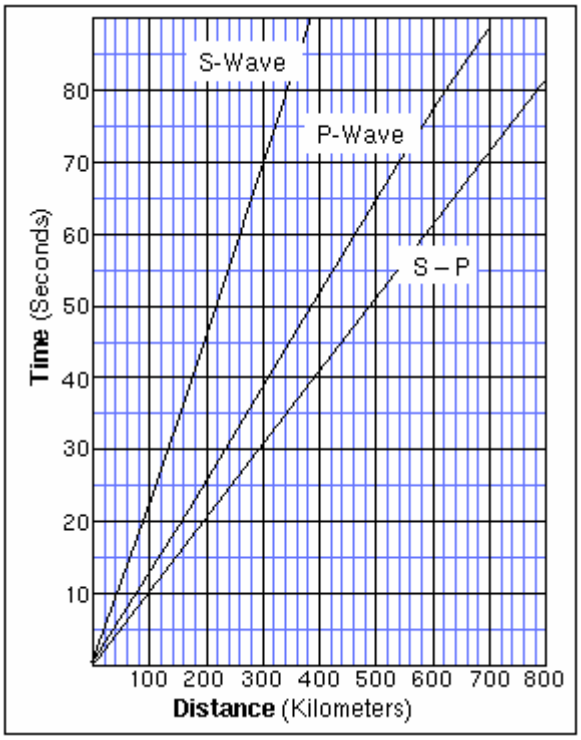
- Using the graphs above, measure the time delay between the when the P-waves were detected and when the S-waves were detected. Record your data in the table below.

City	S-P Time Difference (s)	Kilometers from Epicenter (km)	Maximum Amplitude of S-Waves (mm)
Eureka, CA			
Elko, NV			
Las Vegas, NV			

P-waves and S-waves from hundreds of earthquakes have been studied and it was found that the waves travel at predictable speeds through the earth. The graph below shows the travel speed of P and S-waves, as well as a graph of the time delay between the waves, S-P.

- Using the graph to the right, how many kilometers can an S-wave travel in 70 seconds?

- Using your answer from above and the graph, how many seconds does it take a P-wave to travel the same distance?



The line on this graph that will give us the most information is the S-P line. This line tells us how far away the epicenter of an earthquake is located from the seismograph station based on the time delay.

- Determine the distance from each seismic recording station to the earthquake's epicenter using the the S-P time differences that you calculated above. Record your values in the data table above.

- Seismic waves leave the epicenter of an earthquake in what direction?

- On the following page is a map of the Western United States. Develop a procedure for locating the epicenter of the earthquake.

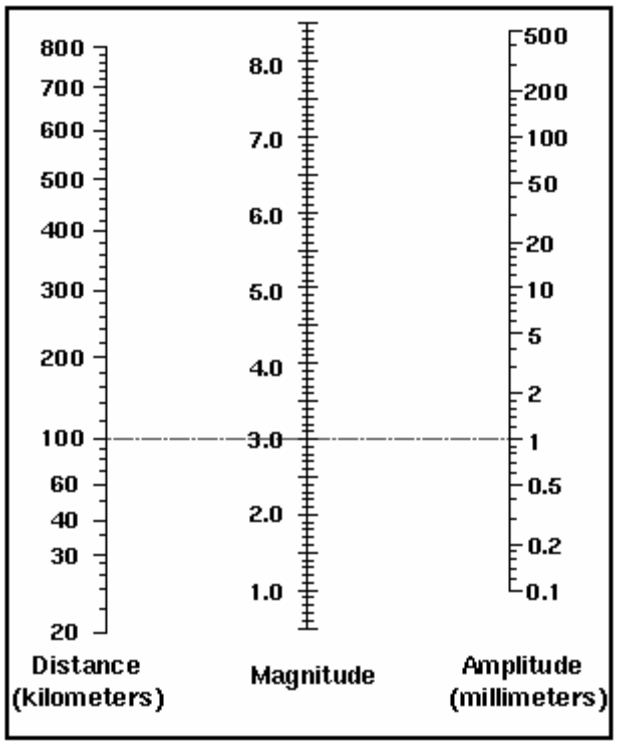
- Mark the epicenter of the earthquake with an "X" on the map to the right.
- The epicenter is closest to which major city?

Determining the Magnitude on the Richter Scale: The Richter magnitude determination is based on measurements made on seismograms. Two measurements are needed: the S-P time interval and the Maximum Amplitude of the S-waves.

- Use the seismograms and determine the maximum altitude of the S-waves and record your data in the table on the previous page.

The calculation for finding the magnitude on the Richter Scale is complex, but a special graph called a nomogram, can be used to simplify the process.

Nomogram



- Use your data from your data table to plot your points on the nomogram to the left.
- First plot the distance value for the Eureka data on the Distance scale.
- Then plot the amplitude for the S-waves measured at the Eureka station on the Amplitude scale.
- Using a ruler, draw a line connecting these two points.
- Repeat this process for the Elko and Las Vegas data.
- Where do your lines cross? This is the magnitude of the earthquake.
- The nomogram shows us that a 3.0 earthquake with an epicenter 100 km from a seismograph station will have S-waves with an amplitude of 1 mm. What amplitude would a 4.0 earthquake at the same distance produce?

- You just calculated the epicenter and magnitude of the 1989 Loma Prieta earthquake that occurred south of San Francisco. It was estimated to have a magnitude of 7.1 on the Richter Scale. Were you close? What were some possible sources of error?