Part 1 - Directions: Using Chart 1, answer the following questions.

1. How far will an S-wave travel in 14 minutes?
2. How far will a P-wave travel in 7 minutes?
3. How long will it take an S-wave to travel 4,000 km?
4. How long will it take a P-wave to travel 4,000 km?
5. Which waves always arrive first at a seismic station?
6. As a person gets father away from the epicenter of an Earthquake what happens to the difference in arrival time between the P and S waves?
7. If the time difference between the P and S-waves is 3 minutes and 10 seconds (3:10), what is the distance to the epicenter?
8. If the time difference between the arrival of P and S-waves is 6:40, what is the distance to the epicenter?
9. If the epicenter distance is 5,500 km, what would the difference in arrival time be between the P and S-waves?
10. An earthquake occurs at 12:00 noon. At what time would the P-wave reach a seismic station that is 4,000 km from the epicenter?
**Part 2:** Using Chart 1, find the distance to the epicenter for the following:

<table>
<thead>
<tr>
<th>Time difference between P &amp; S waves</th>
<th>Distance to Epicenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:8:20</td>
<td></td>
</tr>
<tr>
<td>00:4:30</td>
<td></td>
</tr>
<tr>
<td>00:6:00</td>
<td></td>
</tr>
<tr>
<td>00:7:20</td>
<td></td>
</tr>
<tr>
<td>00:5:40</td>
<td></td>
</tr>
<tr>
<td>00:2:20</td>
<td></td>
</tr>
</tbody>
</table>

**Part 3:** Complete the following tables.

<table>
<thead>
<tr>
<th>P Arrival</th>
<th>S Arrival</th>
<th>Time Difference</th>
<th>Distance to Epicenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:05:25</td>
<td>14:08:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:08:15</td>
<td>14:13:05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06:22:40</td>
<td>06:26:25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21:56:50</td>
<td>22:03:30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P Arrival Time</th>
<th>Distance (km)</th>
<th>P Travel Time</th>
<th>Time of Earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:10:10</td>
<td>4500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:35:05</td>
<td>7300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21:45:59</td>
<td>2000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part 4: Putting it ALL together to locate the epicenter!

The data below shows the P and S-wave arrival time difference determined from seismograms from three different cities, for 3 different earthquake events. Use your travel time curve to determine the distance to epicenter for each city/earthquake.

<table>
<thead>
<tr>
<th>Earthquake 1</th>
<th>City</th>
<th>Difference in arrival times of P and S waves</th>
<th>Distance to Epicenter (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seattle</td>
<td>1:50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Denver</td>
<td>2:30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Houston</td>
<td>4:00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earthquake 2</th>
<th>City</th>
<th>Difference in arrival times of P and S waves</th>
<th>Distance to Epicenter (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Denver</td>
<td>2:25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Houston</td>
<td>4:10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Miami</td>
<td>5:40</td>
<td></td>
</tr>
</tbody>
</table>

Part II: Using the distance to epicenter information above and the map on page 4, plot the location of each earthquake. This can be done by drawing circles with the appropriate radius around the cities of record, and identifying where the circles intersect. **Be sure to complete one earthquake entirely before moving on to the next!** Finally, record the epicenter location for each earthquake below by identifying the closest city, and describing the directions N, S, E or W of that city.

Earthquake 1: ____________________________________________
Earthquake 2: ____________________________________________