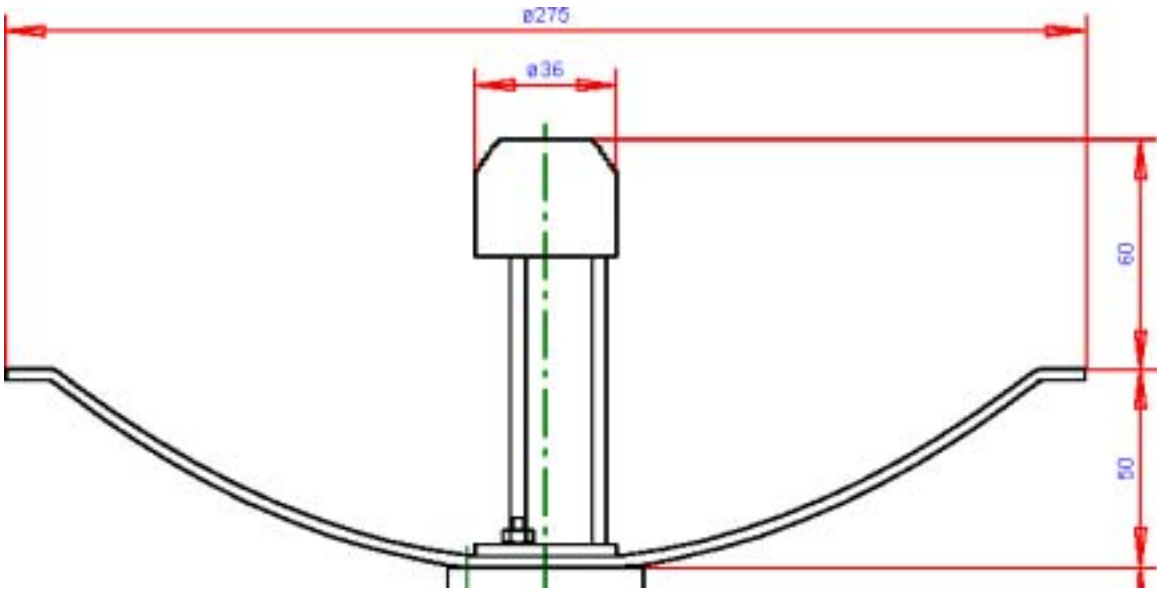
Chapter 8 Take Home | Math 116 | Name : _____
22 pts | College Algebra

1. SDT International in Brussels, Belgium, makes an Ultrasonic Transparent Parabolic Concentrator. The cross-section of the concentrator's dish is in the shape of a parabola with a nominal width of 250 mm (the drawing says 275 mm, but that includes a lip on each side). Use the technical drawing below to answer the questions about the parabolic concentrator. All dimensions are in millimeters.
http://www.sdt.be/04products/parabolicconcentrator.html



a. Find the focal length (2 pts)

b. Find the equation of the parabolic cross-section of the reflector. (2 pts)

2. The federal government has mandated that phone companies provide tracking capabilities for cellular phones to aid in emergency 911 calls, although certain people fear the government will use it for other purposes. One method of tracking a cell phone's location is to use a triangulation system where the signal strength is measured at three or more cellular towers and then used to triangulate the location to within a few hundred feet.

The signal strength is inversely proportional to the distance from the source. For example, if the signal strength is 1000 mW (milliWatts) one mile from the cellular phone, then it will be 250 mW (1/4 as much) two miles and 62.5 mW (1/16 as much) four miles from the phone. This can be modeled using the relationship $I = 1000/d^2$ where I is the signal intensity in mW and d is the distance from the cell phone in miles.

The Illinois SMSA Limited Partnership (doing business as Verizon Wireless) operates 4 cellular towers in Macon County: Decatur, Mt. Zion, Argenta, and Maroa. The Mt. Zion, Argenta, and Maroa towers are respectively located 7.11 miles, 14.02 miles, and 11.94 miles from the Decatur tower.

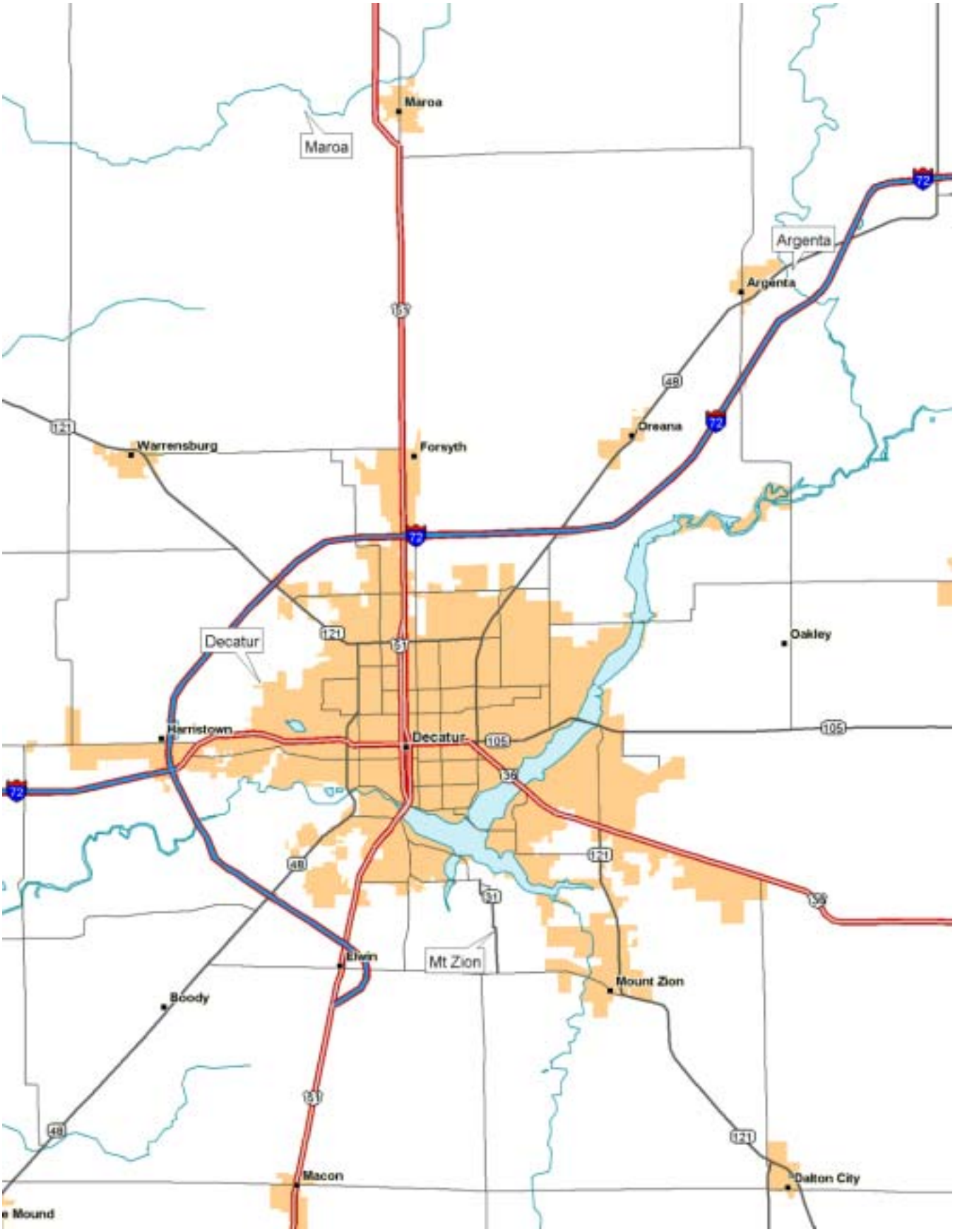
Roberta has had her cell phone stolen and the police ask Verizon to help trace it. Her phone has a signal intensity of 1000 mW one mile from the cell phone and its signal is detected at the Decatur, Argenta, and Maroa towers with the signal strengths indicated in the following table.

a. Complete the table to find the distances from each of the towers. (2 pts)

	Decatur	Argenta	Maroa
Signal intensity in milliWatts	46.85	10.78	14.11
Distance from phone in miles			

b. Draw three circles, centered at the towers and with the appropriate radius, on the map and triangulate the position of the cell phone. You should use a compass to draw your circles. (2 pts)

c. To within a few blocks, where is the stolen cell phone located? (1 pt)


Maroa
Maroa
Argenta
Argenta
Warrensburg
Forsyth
Oreana
Decatur
Decatur
Oakley
Harristown
Decatur
Mt Zion
Mount Zion
Boody
Macon
Dalton City
72
121
51
48
105
36
31
55

3. One of the events in Professional Rodeo is team roping in which both team members lasso the same calf. When the calf is finally roped and the event is over, Speed Williams and Rich Skelton are 20 feet apart and Speed has used 6 more feet of rope than Rich. Find the equation of the hyperbola on which the calf lies. (3 pts) http://www.prorodeo.com/

4. Loran-C is a low frequency hyperbolic radio-navigation system. The U.S. Department of Transportation has designated Loran-C as the government-provided radio-navigation system for the Costal Confluence Zone (CCZ). To obtain a line of position (LOP) the navigator measures the difference between the time arrival of a pulse from the master transmitter and a secondary transmitter of a particular chain. The measurement is plotted on a Loran-C chart. The crossing point of two or more LOP's, where each LOP is derived using the same master transmitter but a different secondary transmitter, fixes the receiver in latitude and longitude. http://www.nels.org/loran/loran_system.htm

The Loran-C stations for the 8970 Chain with master transmitter (M) at Dana, IN, are shown on the accompanying map. Secondary transmitters for the 8970 chain are denoted W, X, Y, and Z.

The radio waves used in Loran-C travel at the speed of light or 0.186 miles per microsecond (μs). The emission delay is the coding delay plus the time it takes for the secondary signal to reach the master transmitter. As an example, the coding delay for Seneca, NY, is 28,000.00 μs and the emission delay is 31,162.06 μs. This means that the Seneca secondary transmitter signal sends out its pulse 28,000.00 μs after the Dana transmitter and the signal arrives in Dana 31,162.06 μs after the Dana signal is sent. The time it takes for the signal to go from Seneca to Dana is 3,162.06 μs. Since the signal travels 0.186 miles/μs, the distance between Seneca and Dana is 3,162.06 (0.186) = 588.14316 miles.

Since the transmitters are located at the foci of a hyperbola, the distance between the foci for the Dana / Seneca hyperbola would be 588.14316 miles. The focal length *c*, the distance to the center, is half of that distance or 294.07158 miles.

The map has perpendicular bisectors drawn to the baselines. These are labeled as prime axes (W' is perpendicular to the line between stations M and W). These lines act as the conjugate axis for the hyperbolic curves. A navigator should avoid using transmitters with conjugate axes near his location when using Loran-C. Someone in Washington DC would not use transmitters X or Y and someone in New York would not use transmitter X.

Use the accompanying chart and map to answer the questions.

Transmitter	Location	Emission Delay (μs)	Coding Delay (μs)
8970-W	Malone, FL	14,355.11	11,000.00
8970-X	Seneca, NY	31,162.06	28,000.00
8970-Y	Baudette, MN	47,753.74	44,000.00
8970-Z	Boise City, OK	63,669.46	59,000.00

a. Complete the table of distances. (1 pt)

The distance from Dana to Seneca, NY is 588.14316 miles

The distance from Dana to Malone, FL is _____ miles

The distance from Dana to Baudette, MN is _____ miles

The distance from Dana to Boise City, OK is _____ miles

An airplane is flying over a state capital and samples the Loran-C dial readings given below. Use this information to locate the plane.

The reading for the Yankee (Y) transmitter is 50,104.44 μs.

The reading for the Zulu (Z) transmitter is 65,494.33 μs.

The time it takes for the signal to travel the length of the transverse axis is the time difference between the transmitters and is found by taking the difference between the dial readings and the Emission Delays. If the dial reading is less than the emission delay, then the craft is closer to the secondary transmitter and if the dial reading is more than the emission delay, then the craft is closer to the master transmitter. The navigator uses this information to select the proper branch of the hyperbola.

b. Consider the Yankee transmitter dial reading. (3 pts)

i. The craft is closer to the (master / secondary) transmitter.

ii. The time difference between transmitters is _____ μs

iii. The length of the transverse axis is _____ miles

iv. The value of *a* is _____ miles

v. The value of *c* is _____ miles (see part a)

vi. The value of *b* is _____ miles (Pythagorean)

vii. Write the equation of the hyperbola.

c. Consider the Zulu transmitter dial reading. (3 pts)

i. The craft is closer to the (master / secondary) transmitter.

ii. The time difference between transmitters is _____ μs

iii. The length of the transverse axis is _____ miles

iv. The value of *a* is _____ miles

v. The value of *c* is _____ miles (see part a)

vi. The value of *b* is _____ miles (Pythagorean)

vii. Write the equation of the hyperbola

d. Draw each hyperbola on the graph and find the intersection point of the two branches. (2 pts)

e. What capital city is the airplane flying over? (1 pt)