- 1. If two stations that are 2 miles apart receive a sound signal issued from a source located at point P(x,y). The station located at point (0,-1) gets the signal 4 seconds earlier than the station located (0,1). Use 1100 ft/sec as the speed of sound and find an equation of the hyperbola containing point P.
- 2. Long distance radio navigation for aircraft and ships uses synchronized pulses transmitted by widely separated transmitting stations. These pulses travel at the speed of light (186,000 miles per second). The difference in the times of arrival of these pulses at an aircraft or ship is constant on a hyperbola having the transmitting stations as foci. Assume that two stations, 300 miles apart, are positioned on a rectangular coordinate system at coordinates (-150, 0) and (150, 0), and that a ship is traveling on a hyperbolic path with coordinates (x, 75).

a) Find the x-coordinate of the position of the ship if the time difference between the pulses from the transmitting stations is 1000 microseconds (0.001 second). (Round your answer to one decimal place.)

b) Determine the distance between the ship and station 1 when the ship reaches the shore. (Round your answer to one decimal place.)

c) The captain of the ship wants to enter a bay located between the two stations. The bay is 28 miles from station 1. What should the time difference be between the pulses? (Round your answer to five decimal places.)

d) The ship is 60 miles offshore when the time difference in part (c) is obtained. What is the position of the ship? (Round your answers to one decimal place.)

3. A comet's path (as it approaches the sun) can be modeled by one branch of the hyperbola  $\frac{x^2}{1096} - \frac{y^2}{41,334} = 1$ , where the sun is at the focus of that part of the hyperbola. Each unit of the coordinate system is 1 million miles.

a) Find the coordinates of the sun (assuming it is at the focus with non-negative coordinates). Round to the nearest hundredth.

- b) How close does the comet come to the sun?
- 4. Two buildings in a shopping complex are shaped like a branches of the hyperbola  $729x^2 1,024y^2 746,496 = 0$ , where x and y are in feet. How far apart are the buildings at their closest part?
- 5. Two radar sites are tracking an airplane. The first radar site is located at (0, 0), and shows an airplane to be 200 miles away. The second radar site, located 160 miles east of the first, shows the airplane to be 100 miles away. Find the coordinates of all possible points where the airplane could be located. (Find the equation of the hyperbola where the plane could be located).
- 6. The equation  $\frac{1}{32}x^2$  models cross sections of parabolic mirrors that are used for solar energy. There is a heating tube located at the focus of each parabola. How high is this tube located above the vertex of its parabola?
- 7. A searchlight has a parabolic reflector (has a cross section that forms a "bowl"). The parabolic "bowl" is 16 inches wide from rim to rim and 12 inches deep. The filament of the light bulb is located at the focus.
  - a) What is the equation of the parabola used for the reflector?
  - b) How far from the vertex is the filament of the light bulb?
- 8. A rectangular barge is traveling under a bridge with a parabolic archway. The barge is 60 feet tall and 80 feet wide. The bridge is 80 feet tall and 200 feet wide. If the barge must travel down the right side of the river to allow two-way traffic, will it fit under the bridge? How do you know? What if the barge is allowed to travel down the center of the river? Provide thorough evidence to justify your conclusions.