Exploring Hyperbolas
*ExploringHyperbolas.tns*

Name _____

Class _____

Problem 1 – Hyperbolas in the Real World

View the picture on page 1.2. You're in a dark room and you turn on a lamp. Have you ever noticed the shape the emmited light makes from the top of the lampshade?

Hyperbolic ripples are the concentric circles formed from two points repeatedly striking the water form hyperbolas where the two circles intersect.

On page 1.4, grab 🖐 (by pressing ⌃ ✳) a circle and move it toward the other circle until you see the hyperbolas that are formed.

*Move the circles together until hyperbolas form.*
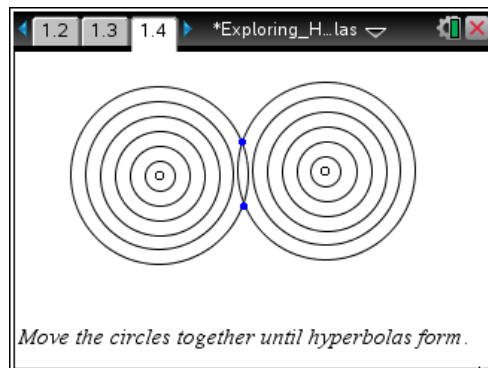
Problem 2 – The Hyperbola as a Conic Section

Like all conic sections, a hyperbola is formed when a plane slices the top and bottom section of the cone.

Unlike the three other conic sections, the hyperbola is formed when slicing two cones that are adjoined at their vertices.

On page 2.2, drag the sliders to view the conic section from different perspectives. You can auto rotate the 3D image at any time by pressing $\boxed{A}$, or you can use the arrows on the keypad.
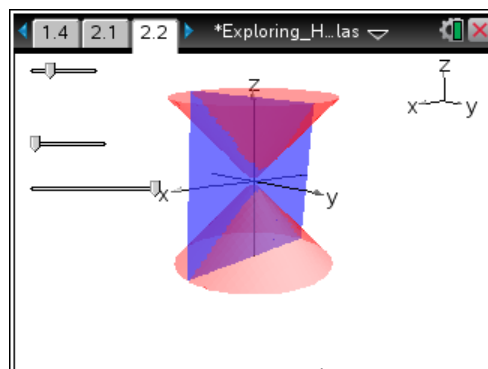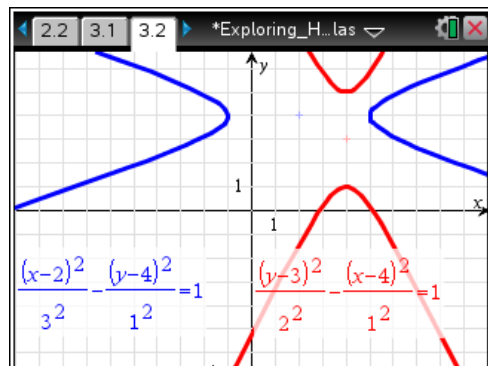
(Press esc to stop the automatic rotation.)

Problem 3 – The Standard Form of the Equations of a Hyperbola

On page 3.1, you will see the standard forms of the hyperbola:

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1 \quad and \quad \frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

On page 3.2, manipulate moveable points, one for each hyperbola with the different orientations, and observe the effects those changes have on the equation of each hyperbola.

![TI logo] **Exploring Hyperbolas**

Based on your observations from page 3.2, answer the questions on the following page.

1. When the center is moved to the left, what happens to the value of *h* in the equation $\dfrac{(x-h)^2}{a^2} - \dfrac{(y-k)^2}{b^2} = 1$?

The the value of *h* becomes _____.

   a. bigger

   b. smaller

2. A hyperbola of the form $\dfrac{(x-h)^2}{a^2} - \dfrac{(y-k)^2}{b^2} = 1$ opens _____.

   a. left and right

   b. up and down

Cooling Towers of Nuclear Power Plants

The hyperboloid is the design standard for all nuclear cooling towers. It is structurally sound and can be built with straight steel beams. The tower is approximately 500 feet tall.

On page 3.6, move the red point to model the cooling tower hyperbola. The focus and value of the vertex are given.
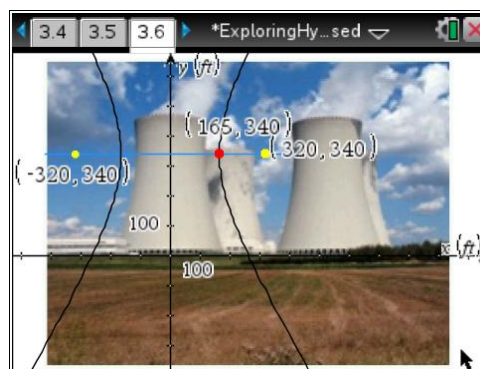
Use menu **> Graph Entry/Edit > Equation** to find an equation that models the hyperbola that forms the two sides of the cooling tower. Many of the values for the blanks will come from points that are shown. Explore various values until you are satisfied with the match.

(Tip: You may have to try several combinations of values until you arrive at a model that works best.)

3. Describe your equation by filling in the blanks below:

$$\frac{(x - \underline{\quad})^2}{\underline{\quad\quad}^2} - \frac{(y - \underline{\quad})^2}{\underline{\quad\quad}^2} = 1$$

Problem 4 – Focal Length of a Hyperbola

On page 4.1, manipulate the location of the point (*c*,0) and observe the effect it has on the lengths of *a* and *b*.

On page 4.2, you have the chance to manipulate two sliders, one for the value of *a* and one for the value of *b*.

4. What changes do you observe in the graph of the vertically-oriented hyperbola when *a* is increased?

5. What changes do you observe in the graph of the vertically-oriented hyperbola when *b* is increased?

Observe how both the equations and the graphs of the two diagonal lines called asymptoes change when the sliders for *a* and *b* are maniuplated. The graphs of the asymptotes will be very useful when you are sketching graphs of hyperbolas by hand.