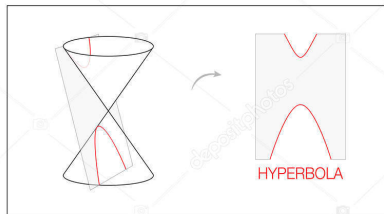
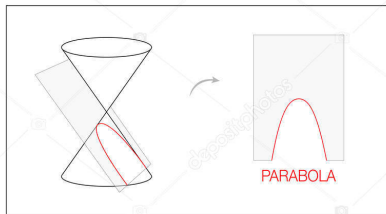
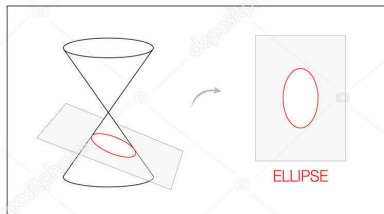
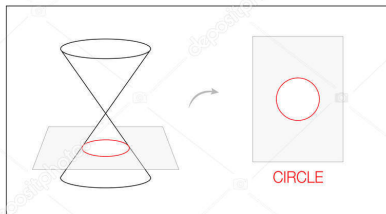


Hyperbolas



Objectives

- 1 Find the vertices and foci for a hyperbola in standard form.
- 2 Write the equation for a hyperbola in standard form.

Hyperbolas

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The set of points such that the **difference** of their distances from 2 fixed points (called **foci**) is constant.

Comparing Hyperbolas and Ellipses

Just like an ellipse, the midpoint joining the foci is the **center**.

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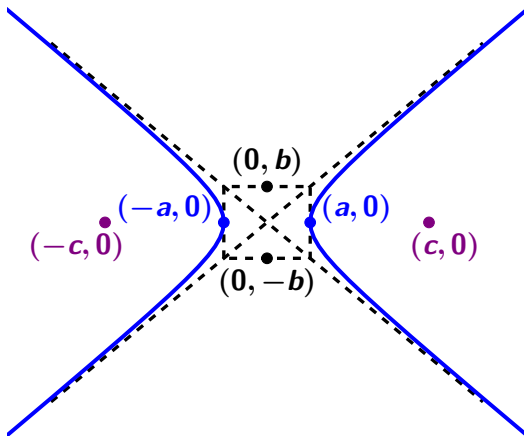
Comparing Hyperbolas and Ellipses

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Whereas ellipses could appear taller or wider, hyperbolas will open up and down, or left and right.

A key difference, however, is that hyperbolas will open left/right if the sign in front of x is positive, and will open up/down if the sign in front of y is positive; regardless of the values of a and b .

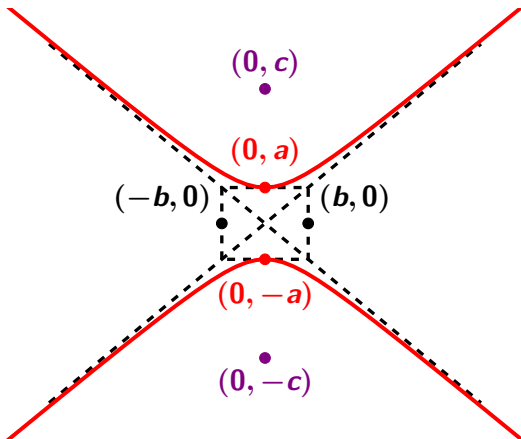
Opening Left and Right



Properties

Equation	$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$
Center	(h, k)
Vertices	$(h \pm a, 0)$
Foci	$(h \pm c, 0)$
Co-vertices	$(h, k \pm b)$
x-Axis	Transverse Axis
y-Axis	Conjugate Axis
c^2	$a^2 + b^2$

Opening Up and Down



Properties

Equation	$\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$
Center	(h, k)
Vertices	$(h, k \pm a)$
Foci	$(h, k \pm c)$
Co-vertices	$(h \pm a, k)$
x-Axis	Conjugate Axis
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Example 1

Find the exact coordinates for the vertices and foci for each of the following.

$$(a) \quad \frac{(y-3)^2}{4} - \frac{x^2}{16} = 1$$

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Center: $(0, 3)$

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$$a = \pm 2$$

Vertices: $(0, 3 \pm 2) \rightarrow (0, 1) \text{ and } (0, 5)$

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Foci: $(0, 3 \pm 2\sqrt{5})$

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