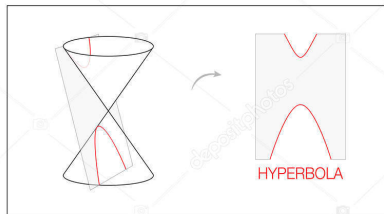
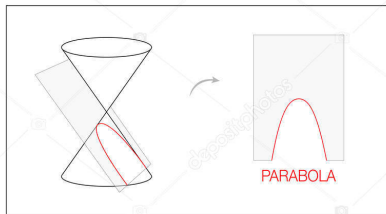
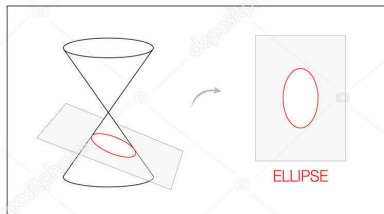
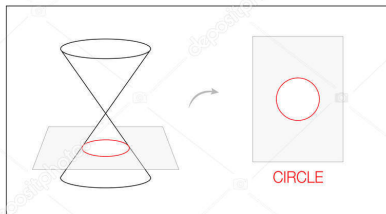


# Hyperbolas



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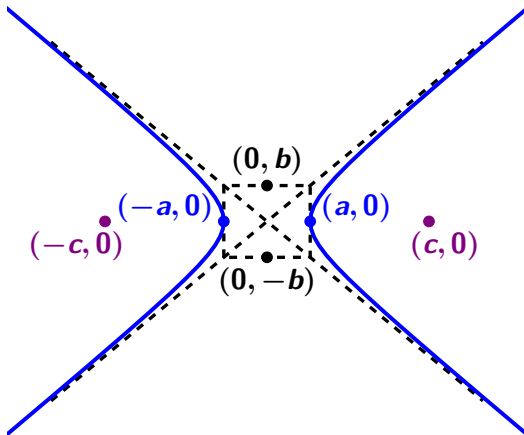
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Whereas ellipses could appear taller or wider, hyperbolas will open up and down, or left and right.

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  $b$ .



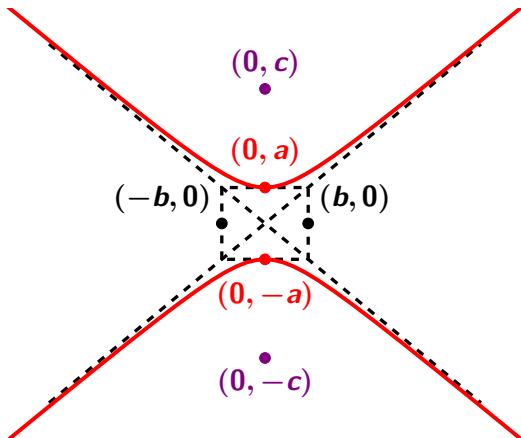
# Opening Left and Right



# Properties

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

# Opening Up and Down



# Properties

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<b>Center</b>	$(h, k)$
<b>Vertices</b>	$(h, k \pm a)$
<b>Foci</b>	$(h, k \pm c)$
<b>Co-vertices</b>	$(h \pm a, k)$
<b>x-Axis</b>	Conjugate Axis
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## Example 1

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

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Center:  $(0, 3)$

$$a^2 = 4$$

$$a = \pm 2$$

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

## Example 1a

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

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