Warm-Up: Find the equation of the parabola. Then Graph it.

$focus: (2, 2)$

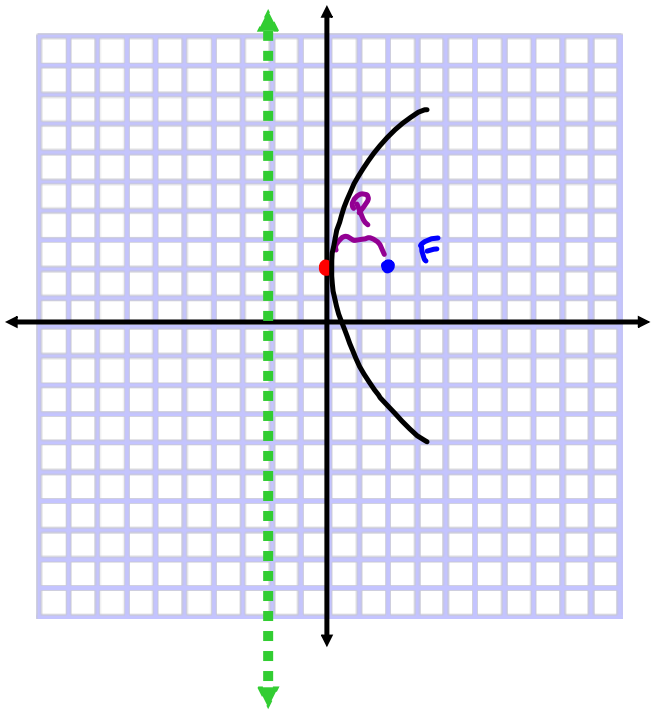
$directrix: x = -2$

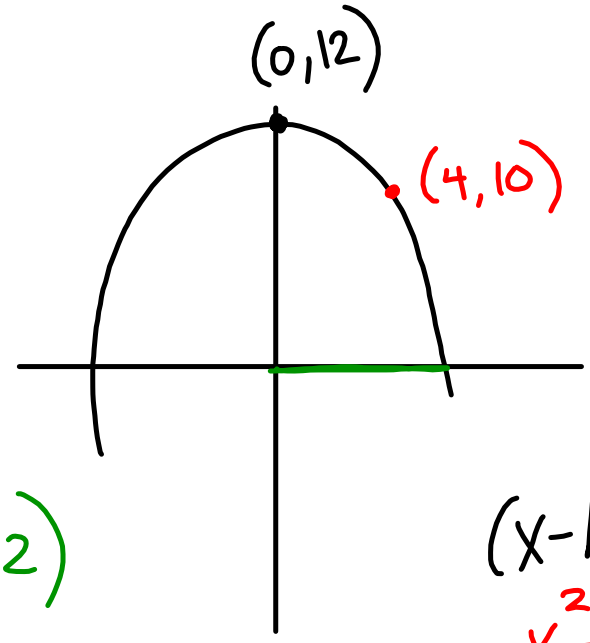
V: (0,2)

p = 2

$(y-k)^2 = 4p(x-h)$

$(y-2)^2 = 8x$





$x^2 = -8(y-12)$

$(x-h)^2 = -4p(y-k)$

$x^2 = -4p(y-12)$

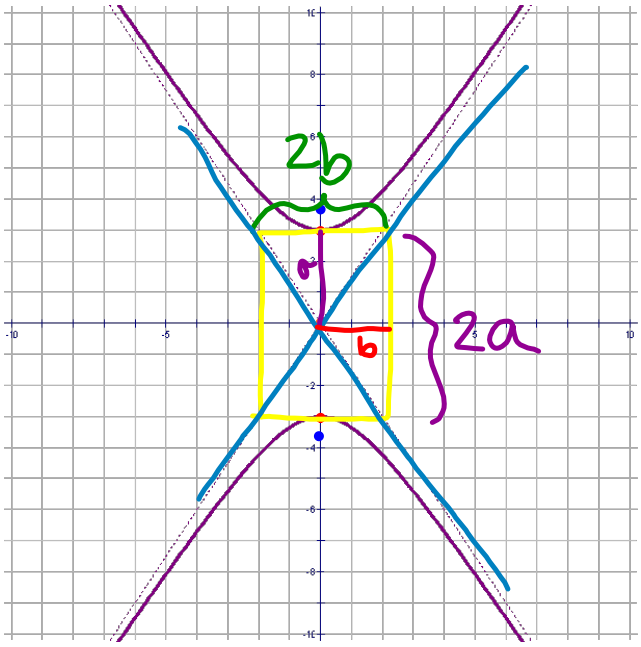
$p = -2$

$(4)^2 = -4p(10-12)$

$$\frac{(x)^2}{1/3} + \frac{(y)^2}{1/8} = 1$$

Lesson 9.3 - Hyperbolas

Hyperbolas



A hyperbola is the set of all points, the difference of whose distances from two fixed points called **foci** is a positive constant.

The line segment connecting the vertices is the **transverse axis**, and the midpoint of the transverse axis is the **center** of the hyperbola.

*The asymptotes cross at the center of the hyperbola.

The **standard form of the equation of a hyperbola** with center at (h,k) is:

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

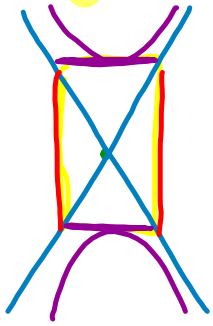
Transverse axis is horizontal

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

Transverse axis is vertical

*a is not always the bigger number, it is always first!

*The vertices are a units from the center, and the foci are c units from the center. $c^2 = a^2 + b^2$



* The transverse axis is 2a long

* The conjugate axis is 2b long

*Each hyperbola has two asymptotes that intersect at the center of the hyperbola.

How to find: $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$

$y = k \pm \frac{b}{a}(x-h)$ **horizontal**

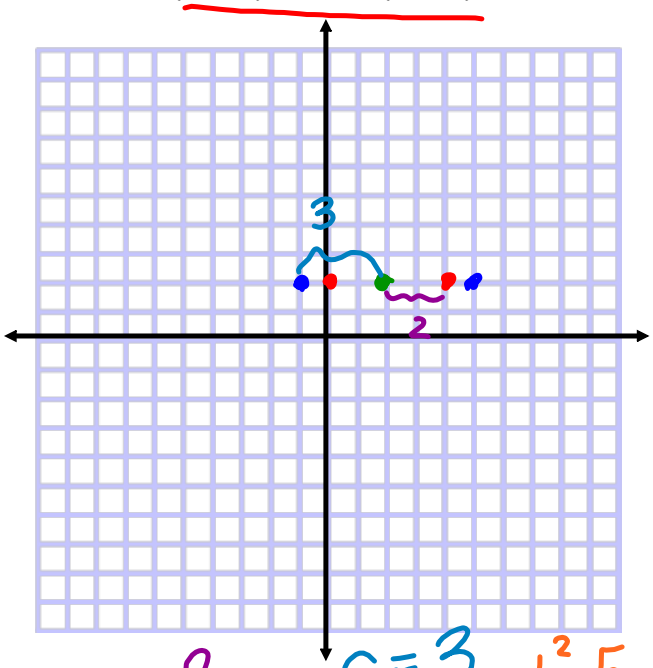
$y = k \pm \frac{a}{b}(x-h)$ **vertical**

Find the standard form of the equation of the hyperbola with foci (-1,2) and (5,2) and vertices (0,2) and (4,2)

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

center: (2,2)

$$\frac{(x-2)^2}{4} - \frac{(y-2)^2}{5} = 1$$

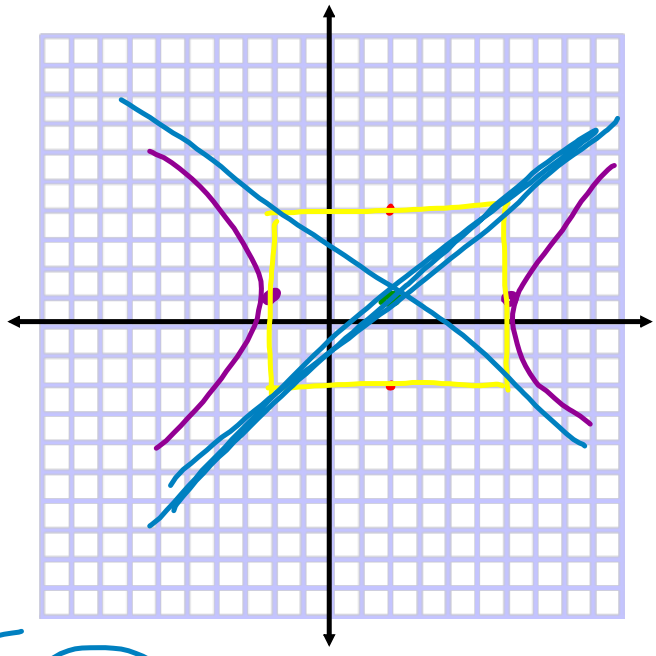


$a=2$ $c=3$ $b^2=5$

$9 = 4 + b^2$

Sketch the graph, find center, vertices, foci and asymptotes:

$$\frac{(x-2)^2}{16} - \frac{(y-1)^2}{9} = 1$$



Center: $(2,1)$

$a = 4 \quad b = 3$

$$y = k \pm \frac{b}{a}(x-h)$$

$y = 1 + \frac{3}{4}(x-2)$

$y = 1 + \frac{3}{4}x - \frac{3}{2}$

$y = \frac{3}{4}x - \frac{1}{2}$

$y = 1 - \frac{3}{4}(x-2)$

$y = 1 - \frac{3}{4}x + \frac{3}{2}$

$y = \frac{-3}{4}x + \frac{9}{2}$

Sketch the graph, find center, vertices, foci and asymptotes:

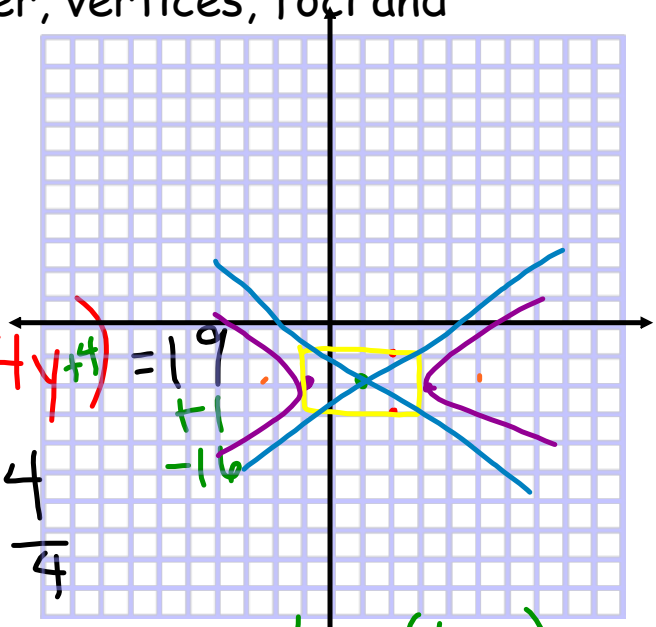
$$x^2 - 2x - 4y^2 - 16y = 19$$

$(x^2-2x+1) - 4(y^2+4y+4) = 19$

$+1 \quad -16$

$\frac{(x-1)^2}{4} - \frac{4(y+2)^2}{4} = \frac{4}{4}$

$\frac{(x-1)^2}{4} - \frac{(y+2)^2}{1} = 1$



center: $(1,-2)$

$a=2 \quad b=1 \quad c=\sqrt{5}$

$y = k \pm \frac{b}{a}(x-h)$

$y = -2 + \frac{1}{2}(x-1) \quad | \quad y = -2 - \frac{1}{2}(x-1)$