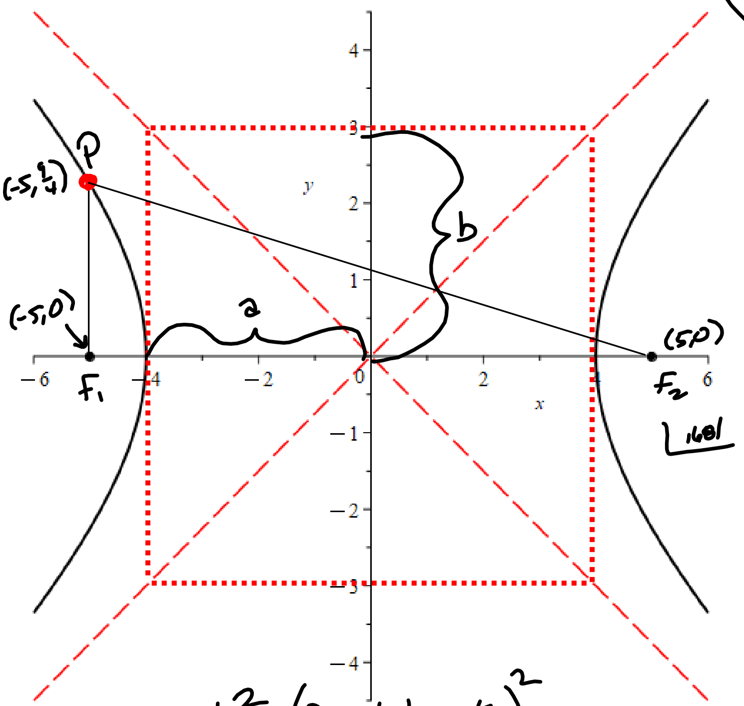
1 A hyperbola is the set of all points in the plane for which the ---Select--- of the distances from two fixed points F_1 and F_2 is constant. The points F_1 and F_2 are called the ---Select--- of the hyperbola.

difference

Foci



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

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

$$d\left(\left(-5, \tfrac{9}{4}\right), (5,0)\right) = d(P, F_2)$$

$$= \sqrt{10^2 + \left(\tfrac{9}{4}\right)^2} = \sqrt{\frac{1600 + 81}{16}}$$

$$= \frac{\sqrt{1681}}{4} = \frac{41}{4} = d(P, F_2)$$

Subtract: $d(P, F_2) - d(P, F_1)$

$$\frac{41}{4} - \frac{9}{4} = \frac{32}{4} = 8$$

= common difference

$$c^2 = a^2 + b^2 = (\text{focal length})^2$$

As before, e = eccentricity = $\frac{c}{a} > 1$

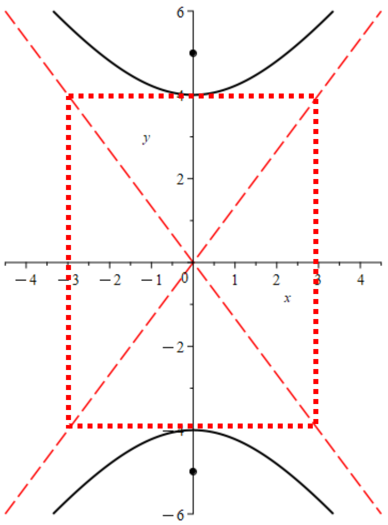
(For ellipse $\frac{c}{a} < 1$)

(For parabola $\frac{c}{a} = 1$)

2 The graph of the equation $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ with $a > 0$, $b > 0$ is a hyperbola with ---Select--- ($y=0$) transverse axis, vertices $(x, y) = ($ a,0 $)$ and $(-a, 0)$ and foci $(\pm c, 0)$, where $c = \sqrt{a^2+b^2}$. So the graph of $\frac{x^2}{4^2} - \frac{y^2}{3^2} = 1$ is a hyperbola with vertices $(x, y) = ($ 4,0 $)$ (larger x-value) and $(x, y) = ($ -4,0 $)$ (smaller x-value) and foci $(x, y) = ($ 5,0 $)$ (larger x-value) and $(x, y) = ($ -5,0 $)$ (smaller x-value).

$$c = \sqrt{a^2+b^2} = \sqrt{16+9} = \sqrt{25} = 5$$

3 The graph of the equation $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$ with $a > 0$, $b > 0$ is a hyperbola with ---Select--- vertical transverse axis, vertices $(x, y) = (\boxed{0, a})$ and $(0, -a)$ and foci $(0, \pm c)$, where $c = \boxed{\sqrt{a^2+b^2}}$. So the graph of $\frac{y^2}{8^2} - \frac{x^2}{6^2} = 1$ is a hyperbola with vertices $(x, y) = (\boxed{0,8})$ (larger y-value) and $(x, y) = (\boxed{0,-8})$ (smaller y-value) and foci $(x, y) = (\boxed{0,10})$ (larger y-value) and $(x, y) = (\boxed{0,-10})$ (smaller y-value).

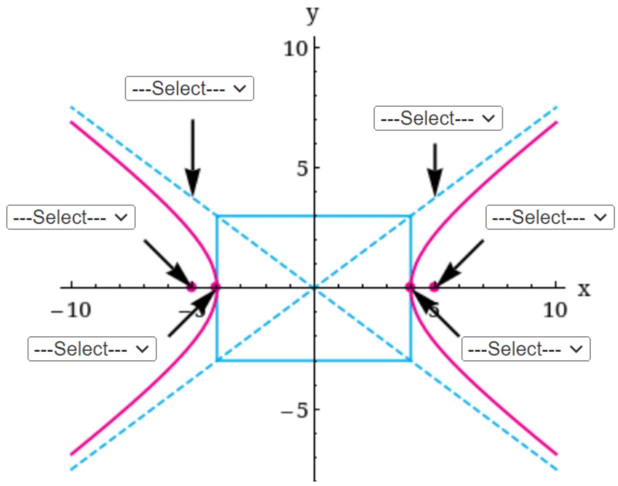


$c = \sqrt{a^2+b^2} = \sqrt{64+36} = \sqrt{100} = 10$

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

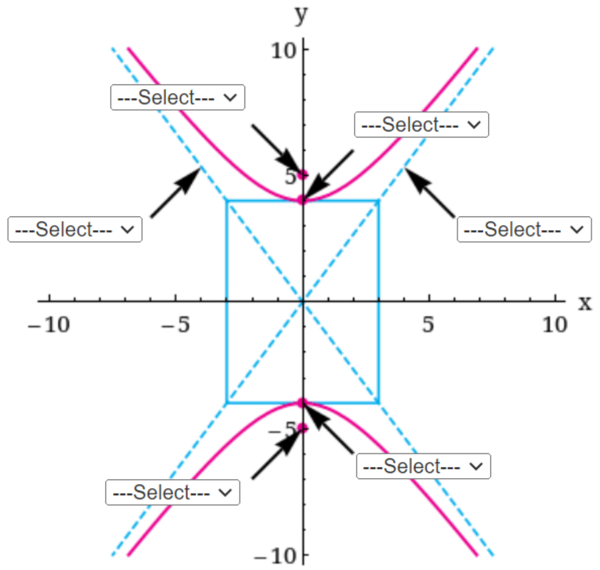
4 Label the vertices, foci, and asymptotes of the graphed hyperbolas.

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



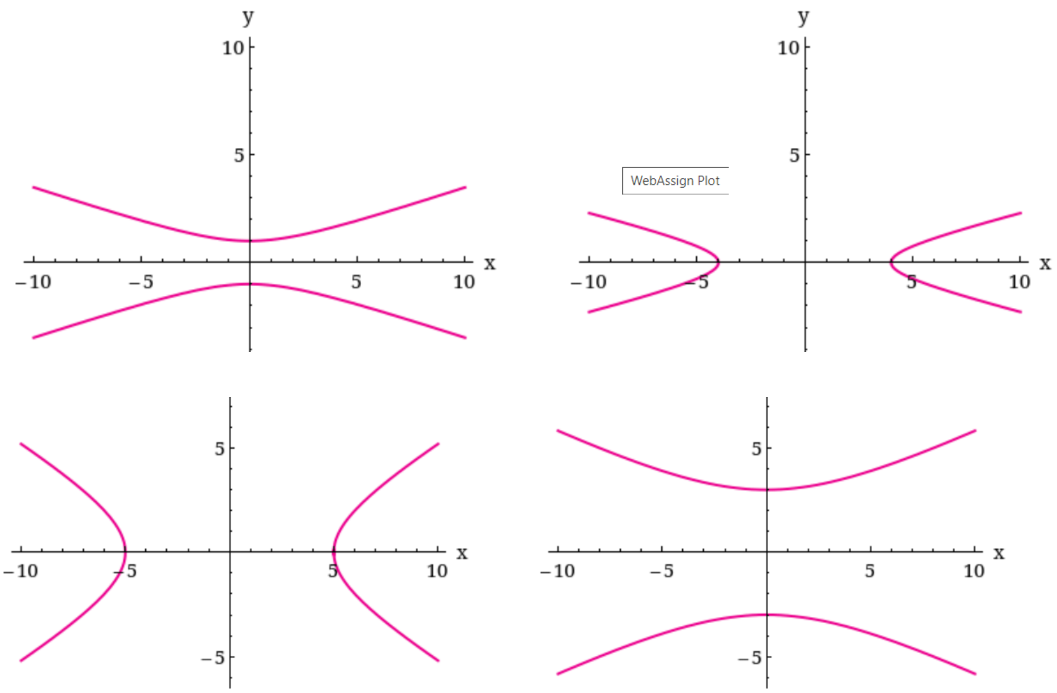
Click here to watch video

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



5 Match the equation with the graph.

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



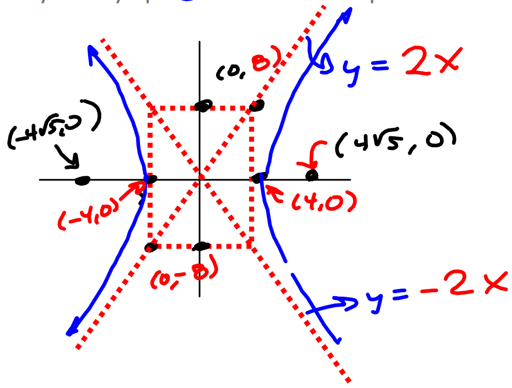
7 An equation of a hyperbola is given.

$$\frac{x^2}{16} - \frac{y^2}{64} = 1$$

$\sqrt{64+16} = \sqrt{80} = 4\sqrt{5} = c$

(a) Find the vertices, foci, and asymptotes of the hyperbola. (Enter your asymptotes as a comma-separated list of equations.)

vertex	$(x, y) = ($ $-3, 0$ $)$	(smaller x-value)
vertex	$(x, y) = ($ $3, 0$ $)$	(larger x-value)
focus	$(x, y) = ($ $-4\sqrt{5}, 0$ $)$	(smaller x-value)
focus	$(x, y) = ($ $4\sqrt{5}, 0$ $)$	(larger x-value)
asymptotes	$y=-2x, y=2x$	



(b) Determine the length of the transverse axis.

8

$a = 4$

$2a = 8$

(c) Sketch a graph of the hyperbola.

Done

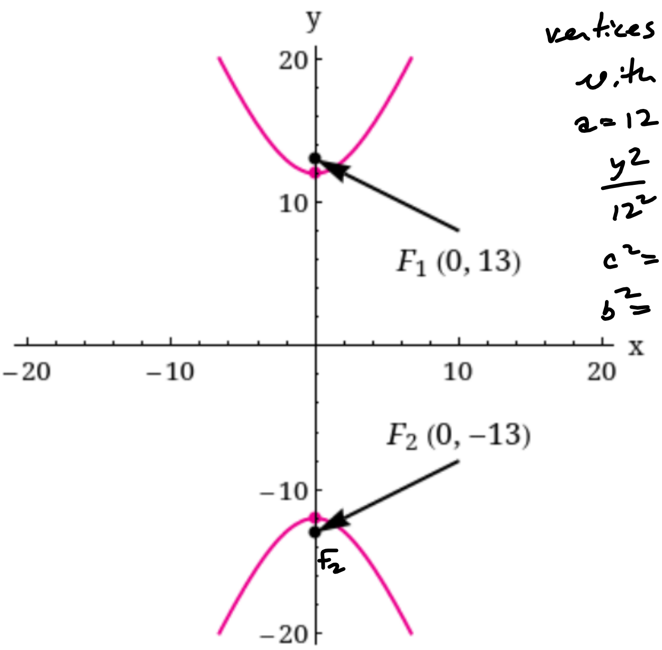
An equation of a hyperbola is given.

9 $9x^2 - 4y^2 = 36$

(a) Find the vertices, foci, and asymptotes of the hyperbola. (Enter your asymptotes as a comma-separated list of equations.)

$\Rightarrow \frac{9x^2}{36} - \frac{4y^2}{36} = 1 \longrightarrow \frac{x^2}{4} - \frac{y^2}{9} = 1$, etc.

10 Find the equation for the hyperbola whose graph is shown.



I THINK the vertices are $(0,\pm 12)$ with that, we're good

$a=12$

$\frac{y^2}{12^2}-\frac{x^2}{5^2}=1$

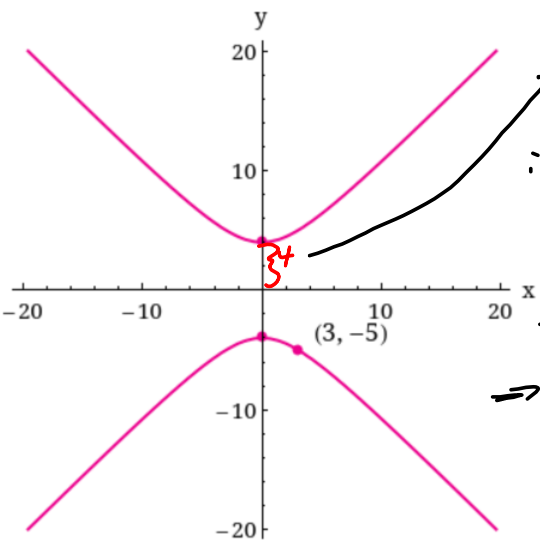
$c^2=a^2+b^2 \Rightarrow$

$b^2=c^2-a^2=13^2-12^2$

$=169-144=25=b^2$

Find the equation for the hyperbola whose graph is shown.

11



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

& we know $(3,-5)$ is on its graph $\Rightarrow$

$\frac{(-5)^2}{4^2}-\frac{3^2}{b^2}=1$ TIMES $16b^2$

$\Rightarrow 25b^2-16\cdot 9=16\cdot b^2$

$\Rightarrow 9b^2=144$

$b^2=\frac{144}{9}=16$

$\boxed{\frac{y^2}{16}-\frac{x^2}{16}=1}$

12 Find an equation for the hyperbola that satisfies the given conditions.

Foci: $(\pm 5, 0)$, vertices: $(\pm 3, 0)$

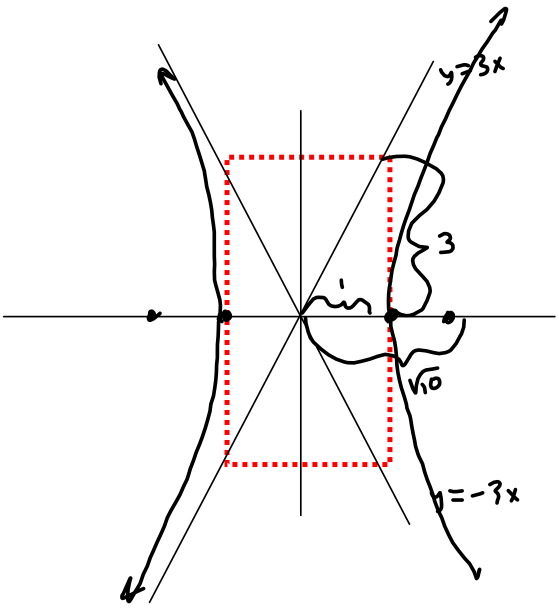
$c = 5,\ a = 3$

$c^2 - a^2 = 5^2 - 3^2 = 25 - 9 = 16 = b^2$

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

14 Find an equation for the hyperbola that satisfies the given conditions.

Vertices: $(\pm 1, 0)$, asymptotes: $y = \pm 3x$



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

$c^2 = a^2 + b^2 = 3^2 + 1^2 = 10$

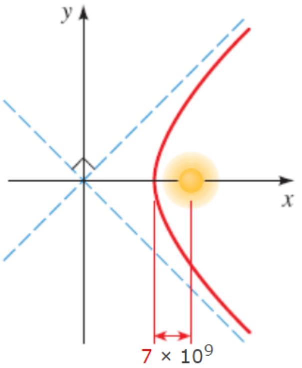
$\Rightarrow c = +\sqrt{10}$ = focal length.

16 Find an equation for the hyperbola that satisfies the given conditions.

Vertices: $(0, \pm 12)$, hyperbola passes through $(-5, 18)$

See #11.

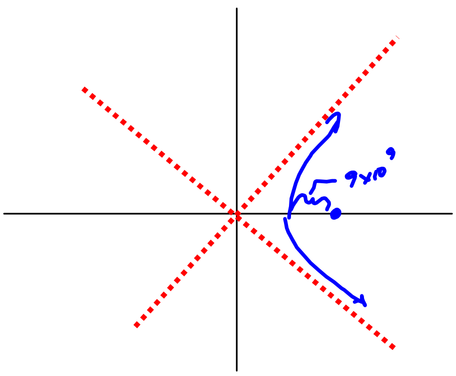
18 Some comets, such as Halley's comet, are a permanent part of the solar system, traveling in elliptical orbits around the sun. Other comets pass through the solar system only once, following a hyperbolic path with the sun at a focus. The figure shows the path of such a comet.



Find an equation for the path, assuming that the closest the comet comes to the sun is 7×10^9 mi and that the path the comet was taking before it neared the solar system is at a right angle to the path it continues on after leaving the solar system. (Round your answers to two decimal places.)

$x^2 - y^2 =$ ______ $\times 10$ ___

#18



$c^2 = a^2 + b^2 = 2a^2$

$c^2 - a^2 = a^2$

$(c-a)(c+a) = a^2$

$9\times10^9 c + 9\times10^9 a = a^2$

$\frac{x^2}{a^2} - \frac{y^2}{a^2} = 1 \rightarrow$

$x^2 - y^2 = a^2$

$c^2 = 2a^2$

$c = \pm\sqrt{2}a$

$\sqrt{2}a$

$c - a = \sqrt{2}a - a = (\sqrt{2}-1)a = 9\times10^9$

$a = \frac{9\times10^9}{\sqrt{2}-1} =$