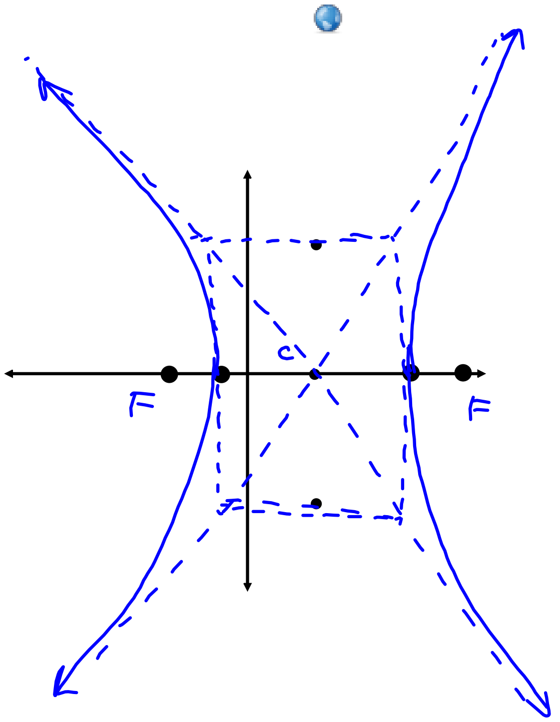
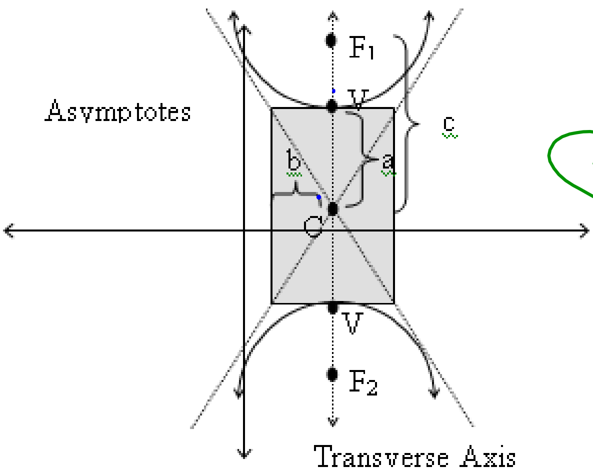
10.4 Hyperbolas



Horizontal

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

a^2 is with positive squared term



Vertical

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

a^2 is with positive squared term

Differences between Hyperbolas & Ellipses

- *Hyperbolas:* Equal One & have a MINUS sign between x^2 & y^2
- *Ellipses:* Equal One & have a PLUS sign between x^2 & y^2

- *Hyperbolas:* a^2 is with positive squared term
- *Ellipses:* a^2 is the BIGGER denominator

a^2 is bigger (positives are bigger than negatives)

- *Hyperbolas:* $a^2 + b^2 = c^2$
- *Ellipses:* $a^2 - b^2 = c^2$

opposite of what's in your given equation

- *Hyperbolas:* Horizontal/Vertical--whichever squared term is positive
- *Ellipses:* Horizontal/Vertical--whichever squared term has a^2 under it

Transverse Axis - Contains Center, Foci & Vertices.

Center (h, k)

a - distance from center to vertex

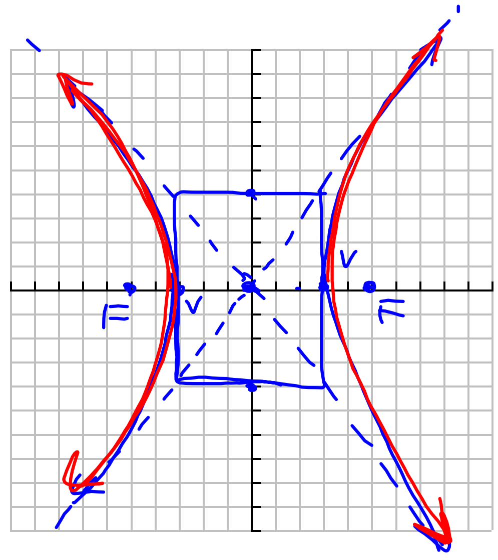
c - distance from center to foci

Asymptotes - lines the hyperbola approach but never reach. Diagonals of the rectangle.

Rectangle - lengths of 2a and 2b (Helps draw theasymptotes)

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

Ex 1: $\frac{x^2}{9} - \frac{y^2}{16} = 1$ $\quad (x-0)^2 \quad (y-0)^2$



$a^2 = 9$ $\quad b^2 = 16$ $\quad c^2 = 9+16 = 25$

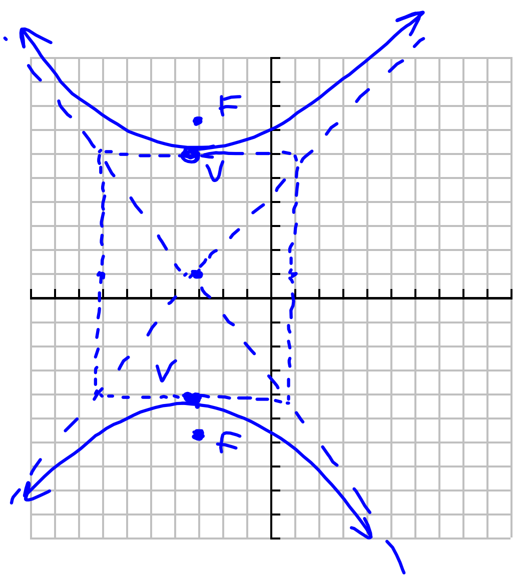
$a = 3$ $\quad b = 4$ $\quad c = 5$

Center: $(0,0)$

Foci: $(-5, 0)$ $(5, 0)$

Vertices: $(3, 0)$ $(-3, 0)$

Ex 2: $\frac{(y-1)^2}{25} - \frac{(x+3)^2}{16} = 1$



$a^2 = 25$ $\quad b^2 = 16$ $\quad c^2 = 25+16 = 41$

$a = 5$ $\quad b = 4$ $\quad c = \sqrt{41}$

≈ 6.4

Center: $(-3, 1)$

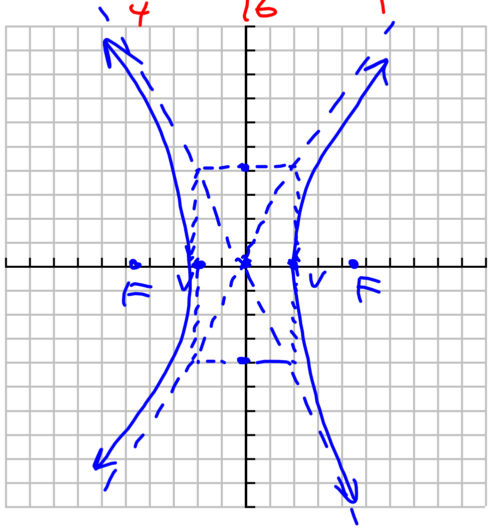
Foci: $(-3, 1+\sqrt{41})$ $(-3, 1-\sqrt{41})$

Vertices: $(-3, 6)$ $(-3, -4)$

Ex 3: $4x^2 - y^2 - 16 = 0$
$+16 \quad +16$

$\frac{4x^2}{16} - \frac{y^2}{16} = \frac{16}{16}$

$\frac{x^2}{4} - \frac{y^2}{16} = 1$



$a^2 = 4$ $\quad b^2 = 16$ $\quad c^2 = \overset{4+16}{20}$

$a = 2$ $\quad b = 4$ $\quad c = \sqrt{20}$
$= 2\sqrt{5}$
≈ 4.5

Center: $(0,0)$

Foci: $(\sqrt{20}, 0)$ $(-\sqrt{20}, 0)$

Vertices: $(2, 0)$ $(-2, 0)$