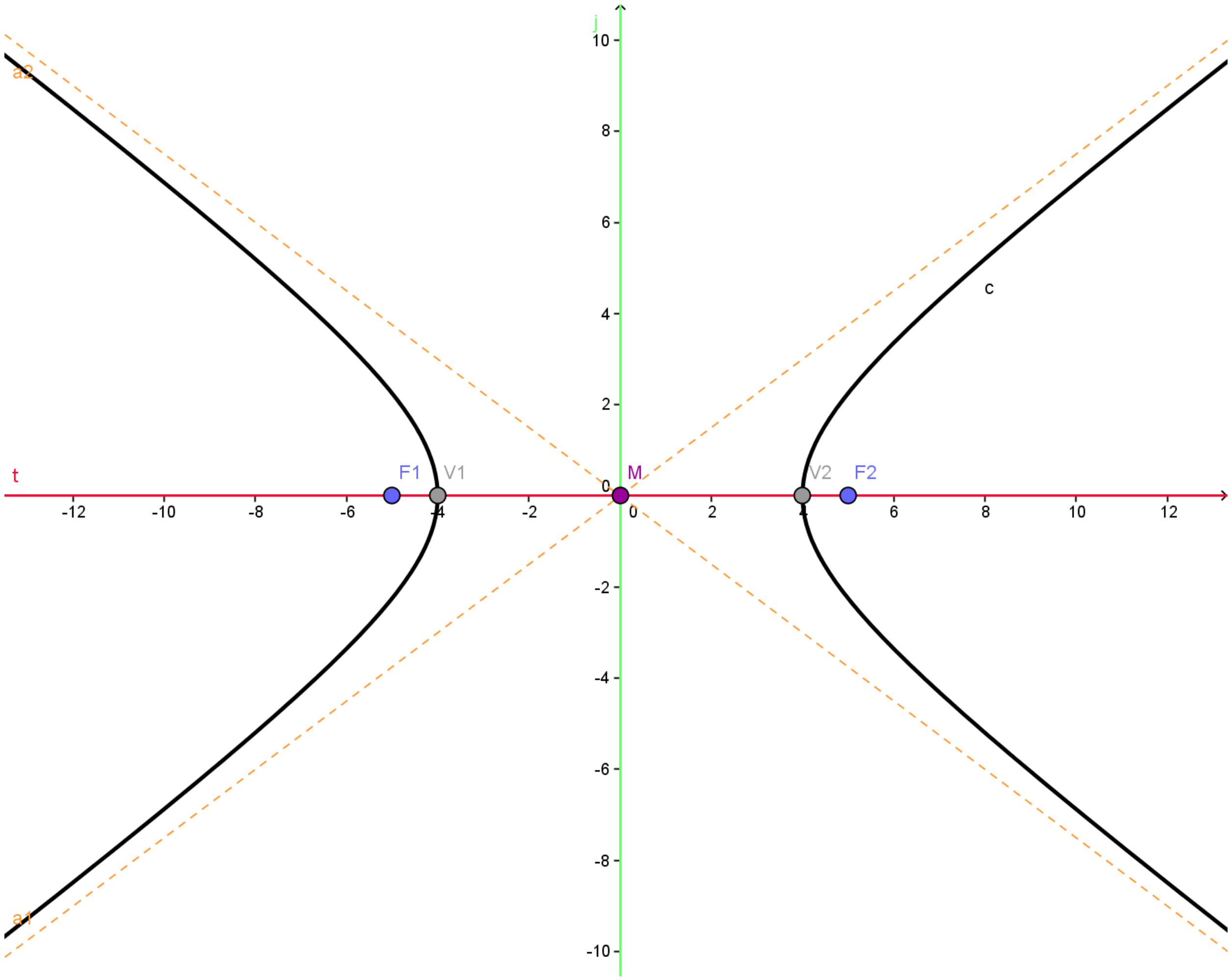
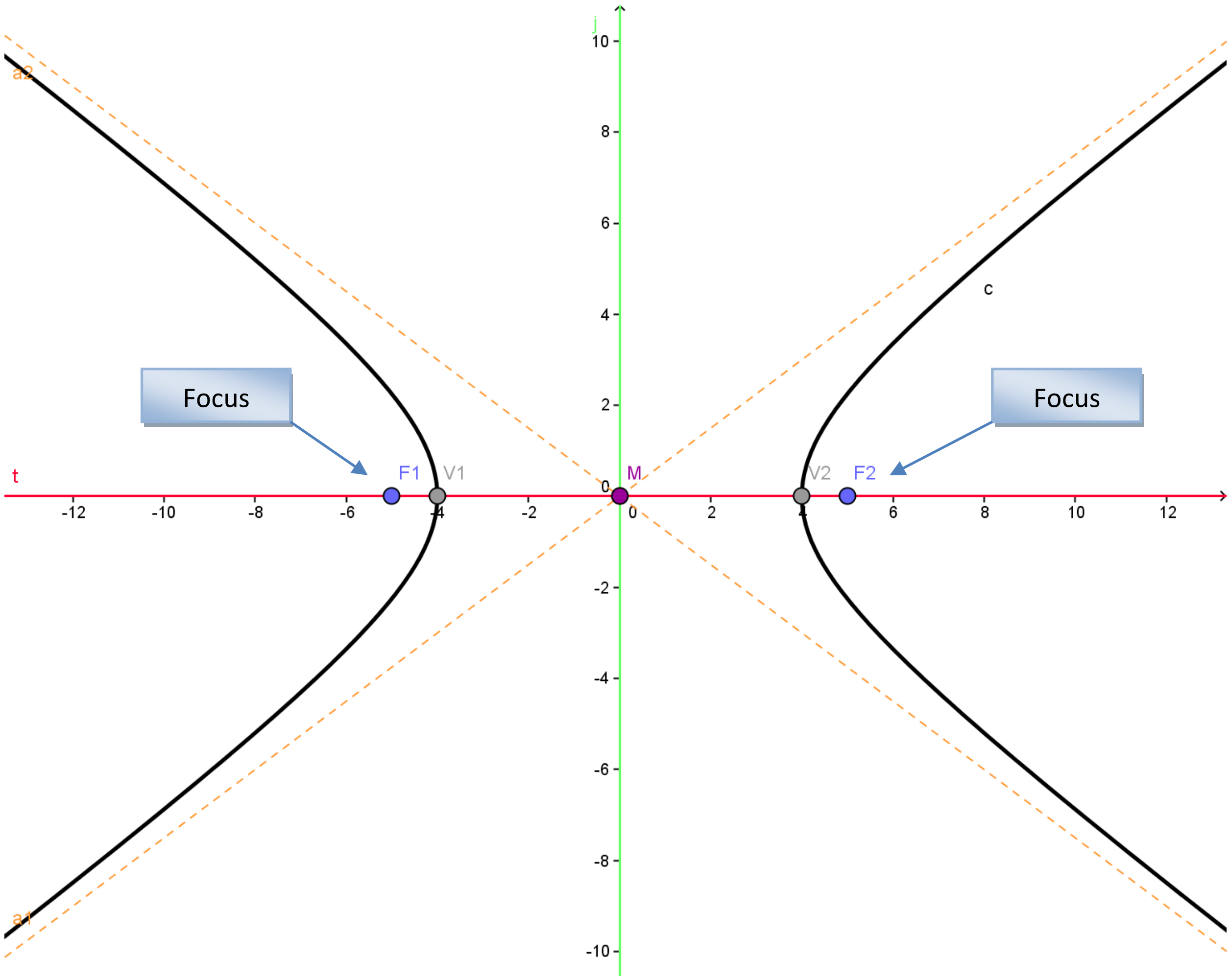
This is a diagram of a hyperbola (the graph counts by twos so we can see more of the hyperbola).



The black parts are the two branches of the hyperbola. This hyperbola opens LEFT & RIGHT.

Let's get a closer look at all the action in this graph!



A hyperbola has two **foci**. On this hyperbola, they are the points $(-5, 0)$ & $(5, 0)$.

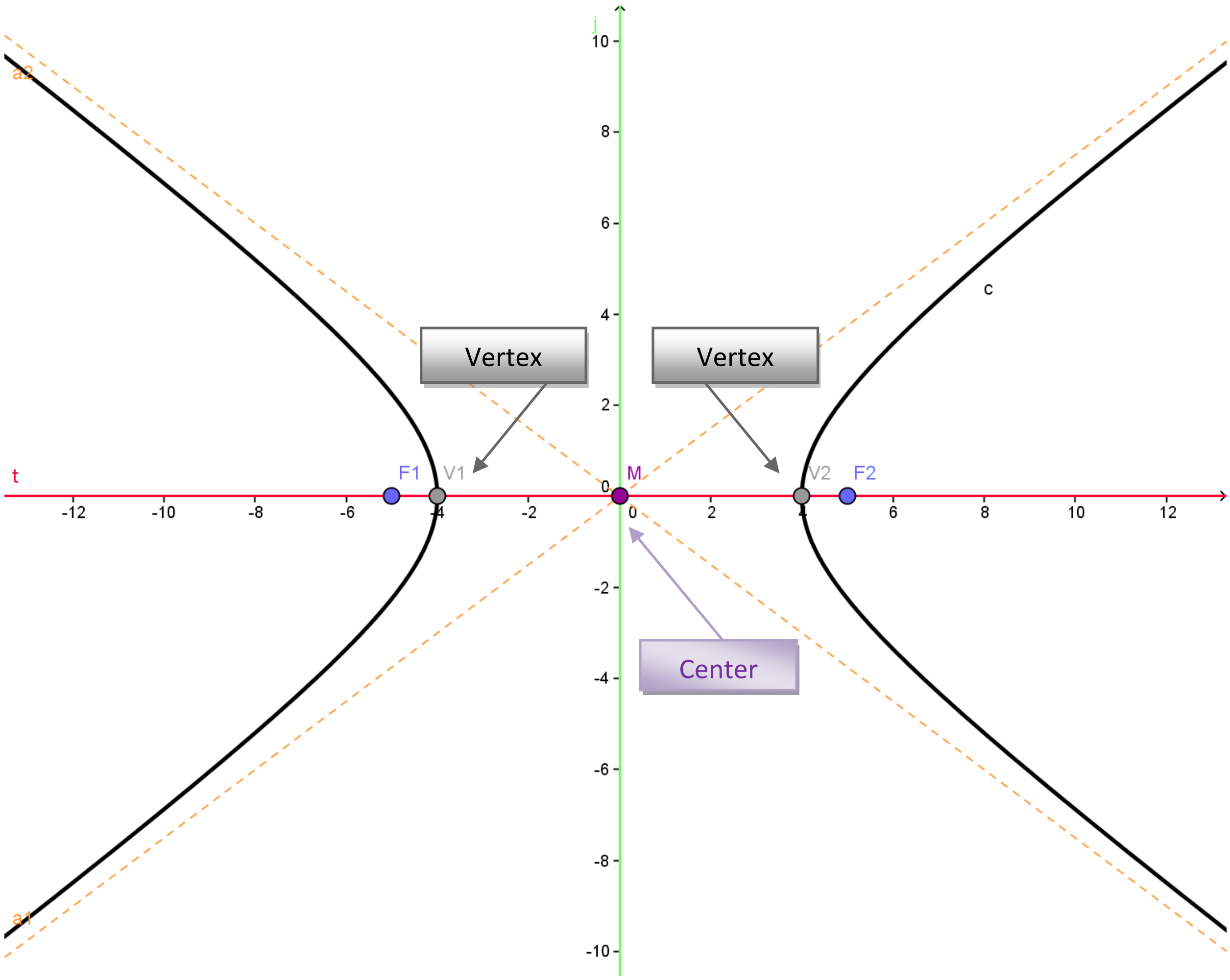
Put a point (*P*) on either black branch of the hyperbola. It will be far away from the opposite focus and closer to the focus of its branch.

Measure the distance (probably in mm) from *P* to the opposite focus. _______
Measure the distance (probably in mm) from *P* to the closer focus. _______
Subtract the two numbers _______

Put another point (*Q)* on either black branch of the hyperbola.

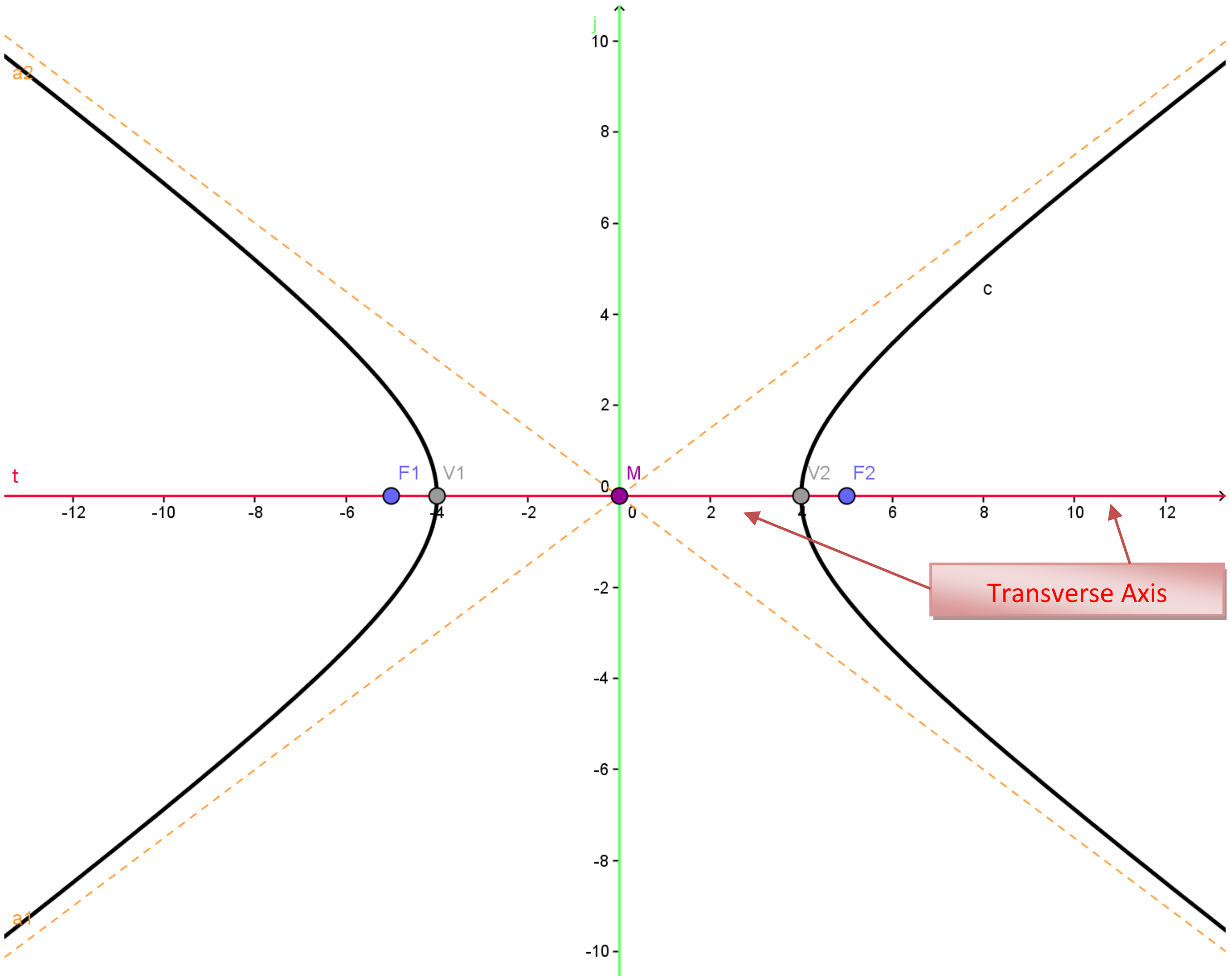
Measure the distance (probably in mm) from *Q* to the opposite focus. _______
Measure the distance (probably in mm) from *Q* to the closer focus. _______
Subtract the two numbers _______

What do you notice?



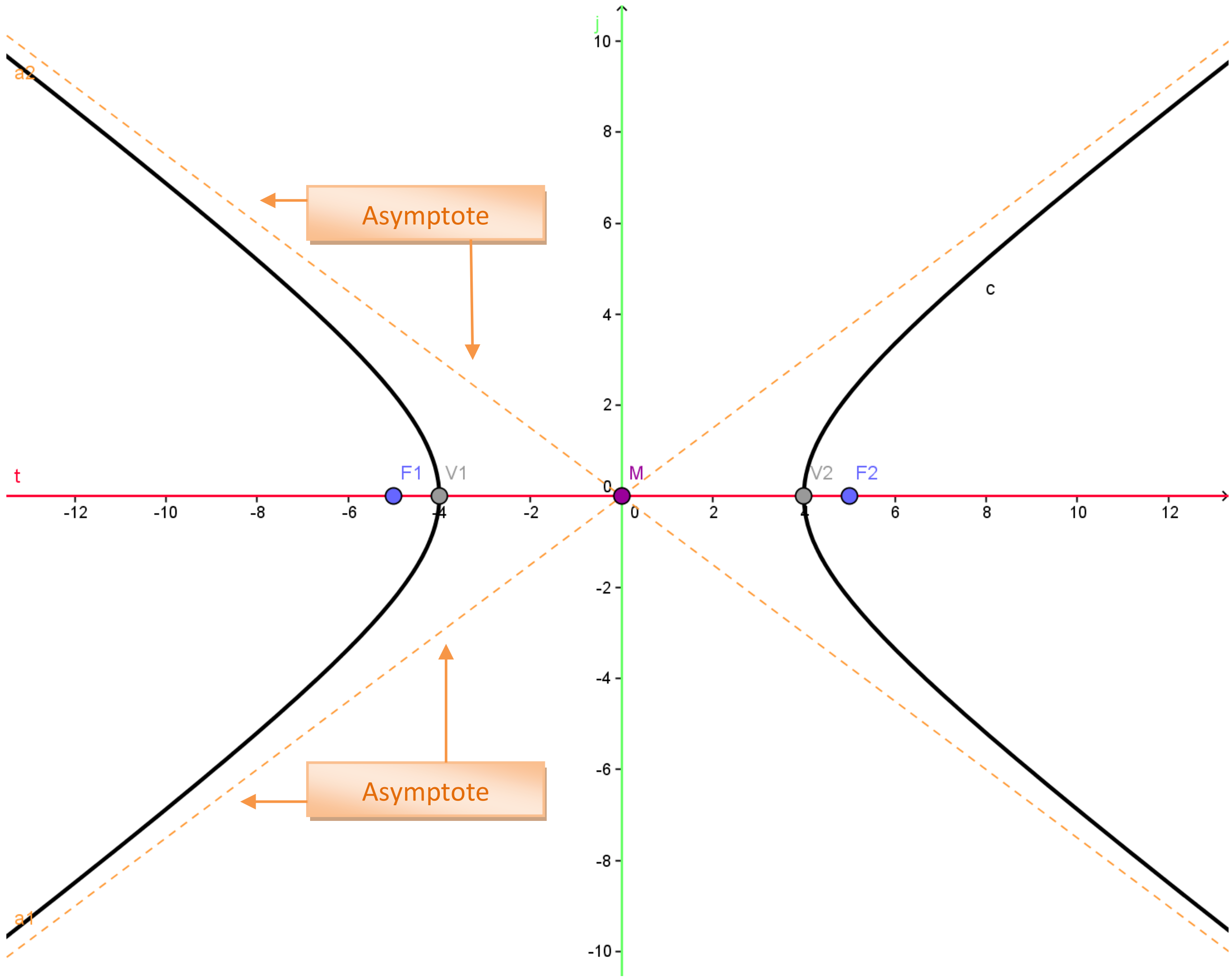
A hyperbola has two **verticies**. On this hyperbola, they are $(-4, 0)$ & $(4, 0)$.

A hyperbola has one **center**. On this hyperbola, it is $(0, 0)$.



There is a lot of action on the red line. It contains both foci, the center, and both verticies. This line is called the **transverse axis**.

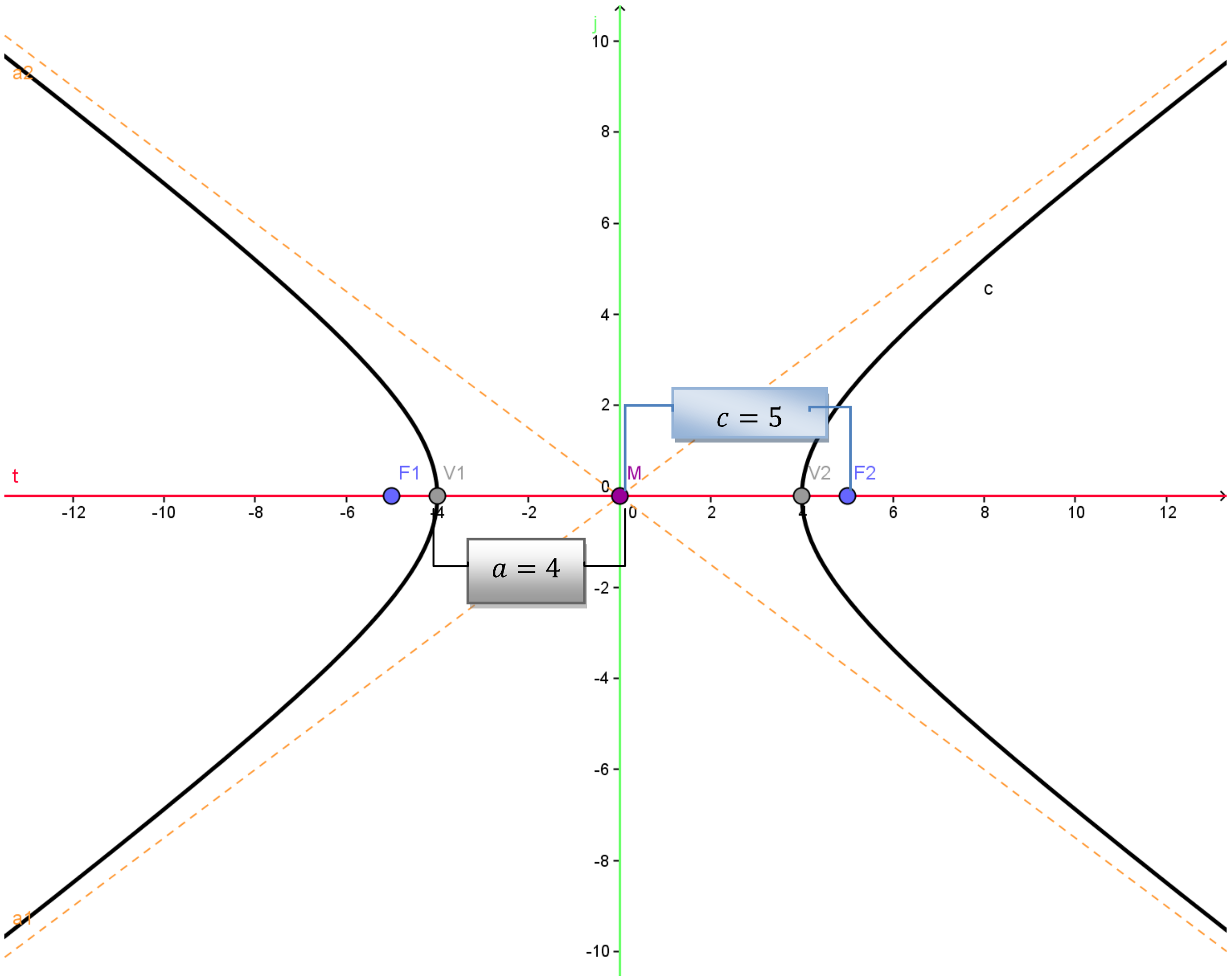
Because this hyperbola opens LEFT & RIGHT, the transverse axis is HORIZONTAL.



The black branches get closer and closer to the two orange dashed lines, but they will never quite reach them (they'll get really close, but never touch!). The orange dashed lines are called **asymptotes**.

The slopes of the asymptotes are always opposites. In this hyperbola, the slopes of the asymptotes $= \pm\frac{3}{4}$.

At what special point do the asymptotes intersect?



The distance from the center to either focus is called $\boldsymbol{c}$. In this hyperbola, $c = 5$.

The distance from the center to either vertex is called $\boldsymbol{a}$. In this hyperbola, $\boldsymbol{a = 4}$.

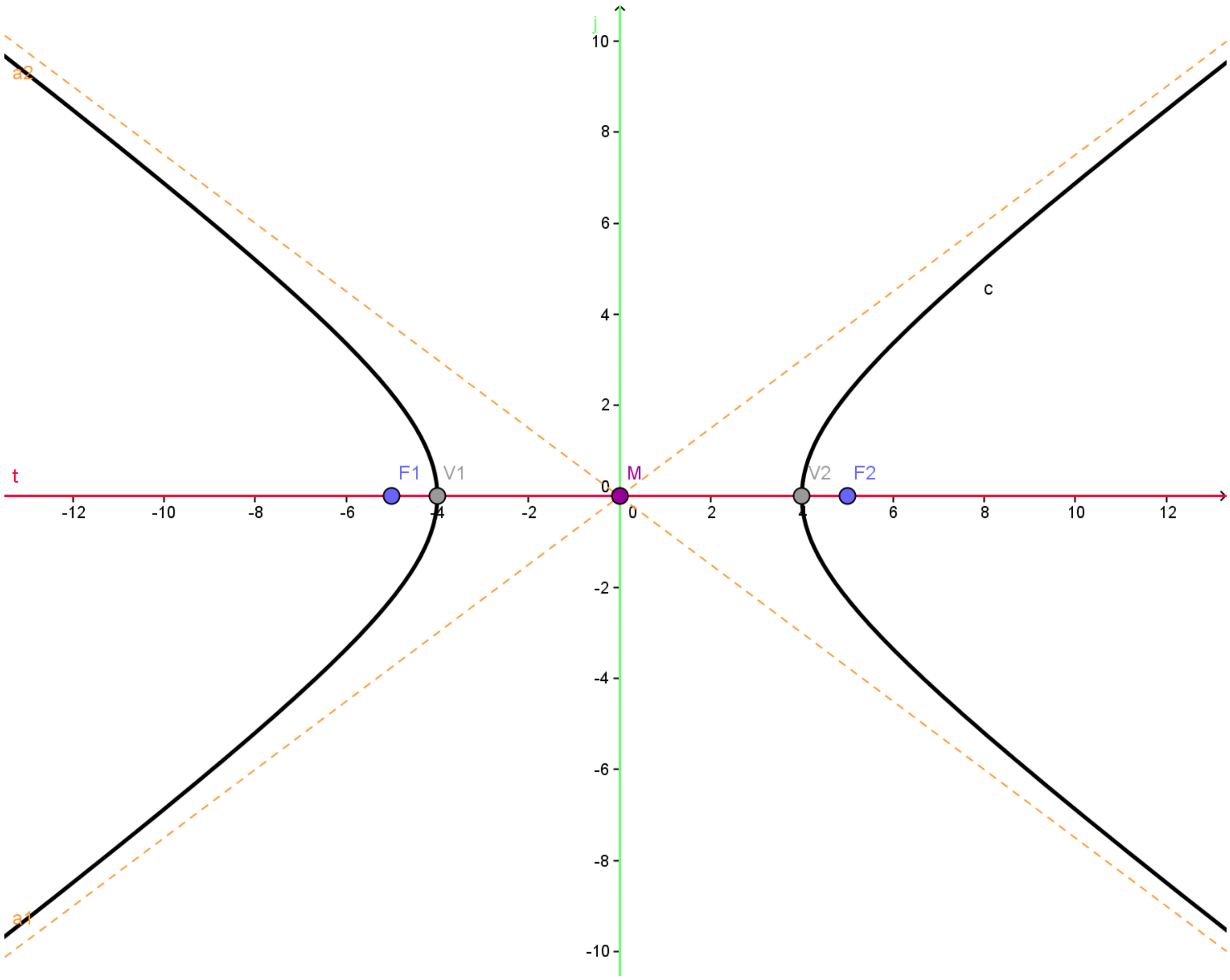
Equation of a LEFT & RIGHT hyperbola with center at $(0, 0)$

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

Direction of transverse axis: HORIZONTAL $c^2 = a^2 + b^2$

Slope of asymptotes: $\pm \frac{b}{a}$

(Tip: The square root of the number under y^2 will always go on top for the slope)



For this hyperbola…

Equation [center is $(0,0)$]:

$$\frac{\boldsymbol{x^2}}{4^2} - \frac{\boldsymbol{y^2}}{3^2} = \mathbf{1} \longrightarrow \boxed{\frac{\boldsymbol{x^2}}{\mathbf{16}} - \frac{\boldsymbol{y^2}}{\mathbf{9}} = \mathbf{1}}$$

Direction of transverse axis: HORIZONTAL

Slope of asymptotes: $\pm\frac{3}{4}$

$$c^2 = a^2 + b^2 \longrightarrow 25 = 4^2 + 3^2 \longrightarrow 5^2 = 4^2 + 3^2$$

Verticies: $(-4,0)$ & $(4,0)$ Foci: $(-5,0)$ & $(5,0)$