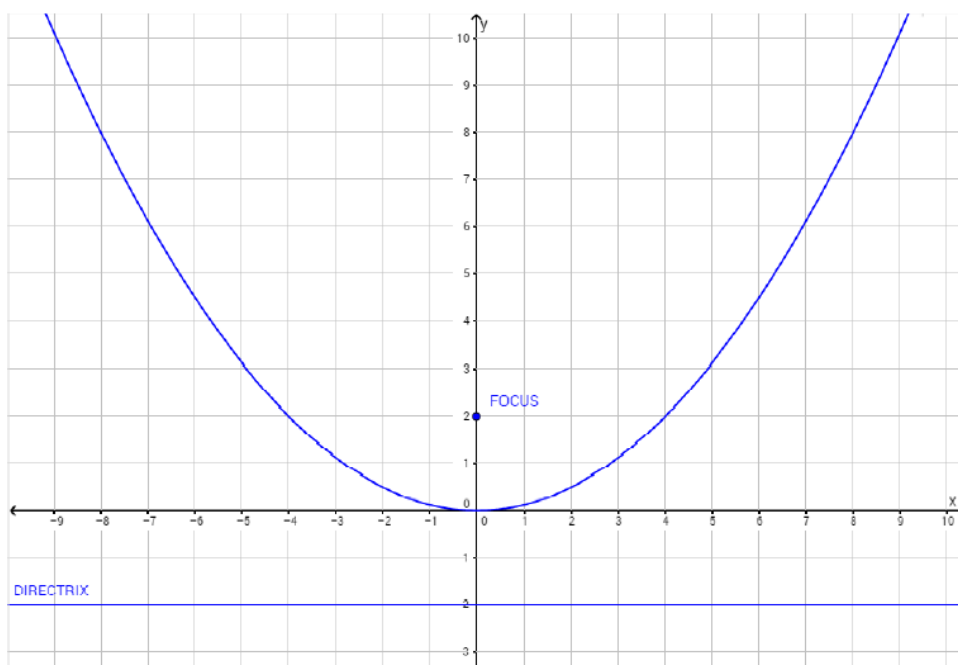# Homework 3

In class, you derived an equation for a parabola with vertex of (0,0) and a distance of 1 between the vertex and focus. Then we compared your equation to the equation that Sasha and Keoni derived, which was $b = \sqrt{4y}$. Later (in a part of the Project MathTalk videos, Lesson 3, which we didn't watch), Keoni and Sasha make it clear that $b = x$. Then they rewrite their equation of the parabola as $x = \sqrt{4y}$. In Project MathTalk's Lesson 4 videos (which we will not watch), Sasha and Keoni come up with another version of the equation, namely $y = \frac{x^2}{4}$. For your homework, we are going to skip ahead to Lesson 5 of the Project MathTalk videos. In the Lesson 5 videos, we vary the distance between the focus and the vertex. Sasha and Keoni explore what effect that has on the equation of a parabola.

For Questions 1-4 below, you'll need access to the Project MathTalk videos. Go to www.mathtalk.org. Select "Students" from the main menu at the top; then select "Parabolas"; click on "Lesson 5"; select "Episode 1"

1.   Watch Lesson 5, Episode 1, 0:00 to 6:06. Then answer this question:

At 1:34, Keoni wonders if a single equation ($y = \frac{x^2}{4}$) could represent two different parabolas. Explain how Sasha and Keoni tested Keoni's conjecture, and describe what they figured out in the process.

2a.   Find the equation of the blue parabola below, which is a parabola with vertex at the origin and focus at (0,2), using the definition of a parabola and the Pythagorean theorem.

b. Then watch Lesson 5, Episode 2, 0:00 – 5:22. At 1:04, why do you think Keoni initially thought the distance from the general point (x, y) to the directrix would be y + 1?

c. Sasha expressed the distance of the vertical side of the right triangle as y – 2.
   - What does the y represent?
   - What does 2 represent?
   - Why does she subtract the 2?
   - What does y – 2 represent as an entity or whole (i.e., describe the distance the y - 2 represents – it is the distance between what two points)?

d. How does your solution method compare to Sasha and Keoni's?

3. Watch Lesson 5, Episode 3, 0:00 – 2:03

a. What is Sasha's conjecture, and what is her reasoning?

b. What is Keoni's conjecture, and what is his reasoning?

4a. Find the equation of the orange parabola below, which is a parabola with its vertex at the origin and focus at (0,3), using the definition of a parabola and the Pythagorean theorem.
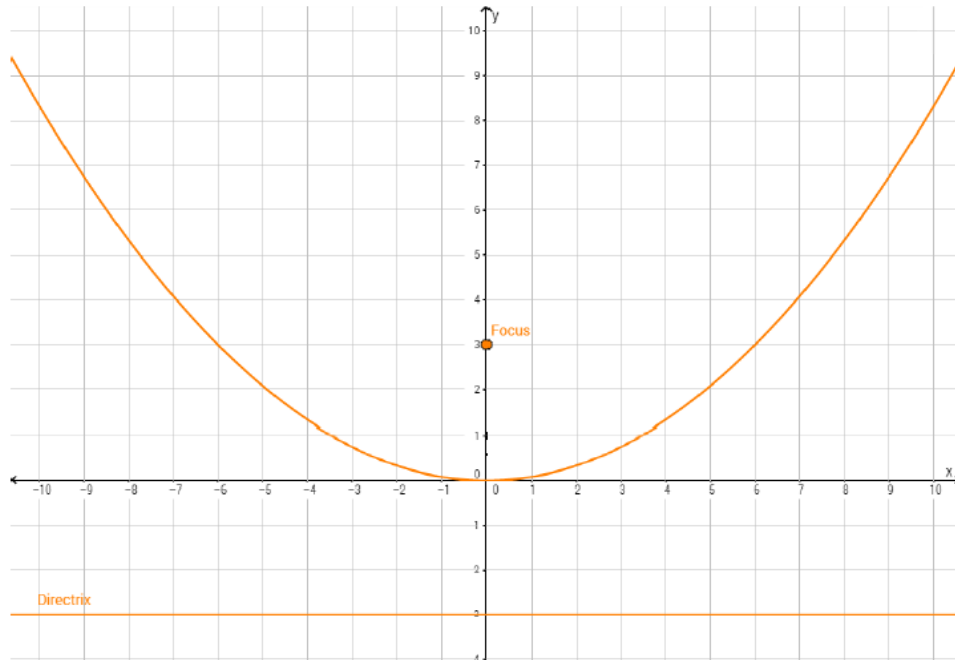
b. Then watch Lesson 5, Episode 4, 1:15 - 4:10. What do you think Sasha and Keoni figured out?

c. What do you think Sasha and Keoni will predict the equation to be for a parabola that has a distance of 4 units between its vertex (the origin) and its focus? Explain why.