

## Homework 6

1-4. **Recovering Geometric Information.** For each parabola below determine:

- the vertex
- the line of symmetry
- $p$  (the distance from the focus to the vertex)
- the focus
- the directrix

**Note that for Questions 2-4, you will need to complete the square** (which you should do by reasoning informally, rather than using a formula or procedure).

1.  $y = \frac{1}{12}(x + 5)^2 + 6$

2.  $y = x^2 - 4x + 5$

If you would like to see how Sasha and Keoni did this task, go to [www.mathtalk.org](http://www.mathtalk.org). Select Students. Select Parabolas. Select Lesson 10. Watch Episode 5. Note that in Episode 4, they figured out that they could rewrite  $y = x^2 - 4x + 4$  as  $(x-2)^2$

3.  $y = 2x^2 - 12x + 21$

4.  $y = 4x^2 + 8x - 3$

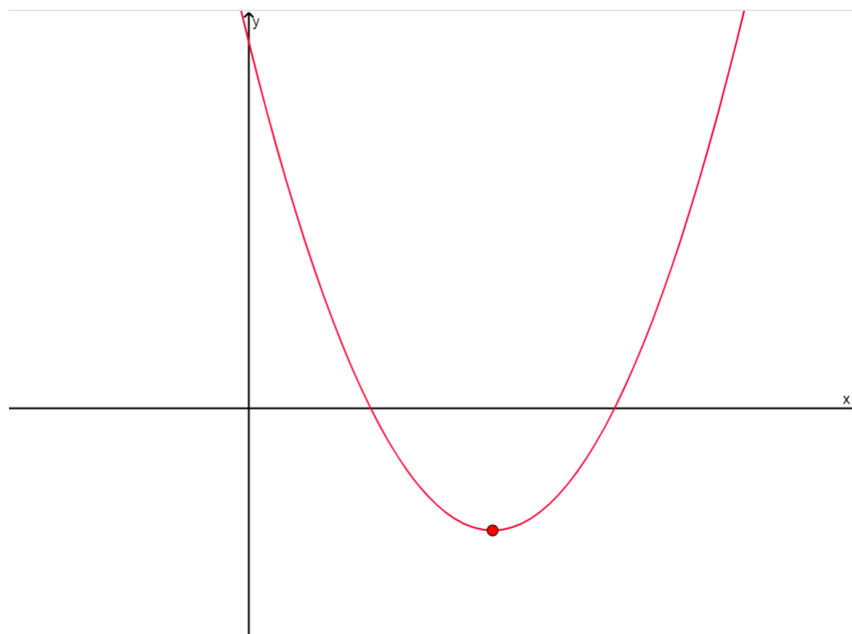
### 5. Geometric Meaning of Standard Form of a Parabola and for the Quadratic Equation.

This question goes over and extends the material from our whole class discussion at the end of Lesson 6. Then Question 6 takes you through this activity for a specific parabola, which may help you deepen connections. The standard form of the equation of a general parabola,

$y = ax^2 + bx + c$ , can be written in vertex form:  $y = a\left(x + \frac{b}{2a}\right)^2 + c - \frac{b^2}{4a}$

- What is the vertex of a general parabola?
- What is the equation for its line of symmetry?
- What is  $p$  (written in terms of  $a$ )?
- Assuming a parabola with two real roots, label the vertex and line of symmetry on the parabola below:

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The root of a parabola is the value(s) of  $x$  when the  $y = 0$ . If we take the vertex form of a general parabola and solve for  $x$  when  $y = 0$ , we get the quadratic equation:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \text{ which means that } x = \frac{-b}{2a} + \frac{\sqrt{b^2 - 4ac}}{2a} \text{ and } x = \frac{-b}{2a} - \frac{\sqrt{b^2 - 4ac}}{2a}$$

- What does  $\frac{\sqrt{b^2 - 4ac}}{2a}$  tell you about the graph of  $y = ax^2 + bx + c$ ? Label it on the graph
- Label each root in a coordinate pair on the graph

### 6. Reconsidering Question 5 for a Specific Parabola

Consider the parabola represented by  $y = x^2 - 12x + 27$

- Rewrite the equation in vertex form (by completing the square using informal reasoning)
- What is the vertex of the parabola?
- What is the line of symmetry?
- Now use your answer to Question 5a to find the vertex of the parabola
- Let's now find the roots of the equation two different ways. First let  $y = 0$ , factor  $x^2 - 12x + 27$ , and solve for  $x$ .
- How do the roots you found relate to the line of symmetry of the parabola?
- Now use the quadratic equation  $x = \frac{-b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$  to find the two roots.
- How does your response to Item 6g compare to your answer to 6e-f?