

Mathematics in this Lesson

Lesson 10

Lesson Description

Given the equation of a parabola in any form, Sasha and Keoni find geometric information (such as the focus, directrix, p -value, and vertex) about the parabola.

Targeted Understandings

This lesson can help students:

- Understand that when the equation representing a parabola is written in vertex form [$y = \frac{(x-h)^2}{4p} + k$], then the vertex can be easily determined as (h, k) and the p -value can be located in the denominator and can be used, along with the vertex, to determine the focus and directrix of the parabola.
- Understand that geometric information (e.g., the vertex, p -value, focus, and directrix) can also be located from a parabola that is given in a different form, by first re-expressing the equation in an equivalent vertex form.

Common Core Math Standards

CCSS.M.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

In this lesson, Sasha and Keoni re-express quadratic functions like $y = 2(x - 3)^2 + 1$ and $y = x^2 - 4x + 4$ in vertex form [$y = \frac{(x-h)^2}{4p} + k$] in order to locate geometric information about the graphs (such as the vertex, p -value, focus and directrix). To rewrite the function $y = 2(x - 3)^2 + 1$ in vertex form, they think of 2 as 1 divided by $\frac{1}{2}$ [see 2:20 – 2:31 in Episode 3] and $\frac{1}{2}$ as 4 multiplied by $\frac{1}{8}$ [3:21 – 3:43, Episode 3]. To rewrite the function $y = x^2 - 4x + 4$ in vertex form, Sasha and Keoni figure out that they need to factor, but that not every way of factoring is helpful. For example, factoring out the x from $x^2 - 4x$ yields $y = x(x - 4) + 4$ [1:06 – 1:30, Episode 4], which doesn't help them. However, factoring the entire trinomial yields $y = (x - 2)^2$, which is very close to being in vertex form [1:50 – 2:05, Episode 4].

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Common Core Math Practices

CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them.

An important aspect of Math Practice 1 is not giving up, even when several attempts have not been fruitful. In Episode 5, Sasha and Keoni face a challenging task of rewriting $y = x^2 - 4x + 5$ in vertex form. They begin with a false start, as Keoni incorrectly factors $x^2 - 4x + 5$ as $(x - 5)(x + 1)$ [1:08 – 1:44 , Episode 5]. Instead of getting discouraged, Keoni tells Sasha, “Let’s not give up” [2:19 – 2:26]. And they don’t! Sasha tries factoring out the x [2:53 – 3:07], which doesn’t end up helping. However, when they explain the correspondences between $y = x^2 - 4x + 5$ and the function they worked with in Episode 4 [$y = x^2 - 4x + 4$], they are able to successfully rewrite the given equation as $y = (x - 2)^2 + 1$ [4:25 – 4:46].

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