



Graphing Calculator

A Preview of Lesson 6-6

Casio Algebra FX 2.0

Families of Parabolas

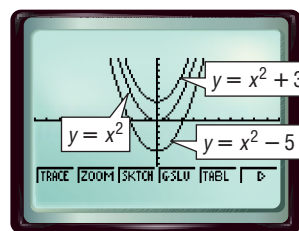
The general form of a quadratic equation is $y = a(x - h)^2 + k$. Changing the values of a , h , and k results in a different parabola in the family of quadratic functions. You can use a Casio Algebra FX 2.0 graphing calculator to analyze the effects that result from changing each of these parameters.

Example 1

Graph each set of equations on the same screen in the standard viewing window. Describe any similarities and differences among the graphs.

$$y = x^2, y = x^2 + 3, y = x^2 - 5$$

The graphs have the same shape, and all open up. The vertex of each graph is on the y -axis. However, the graphs have different vertical positions.



Example 1 shows how changing the value of k in the equation $y = a(x - h)^2 + k$ translates the parabola along the y -axis. If $k > 0$, the parabola is translated k units up, and if $k < 0$, it is translated k units down.

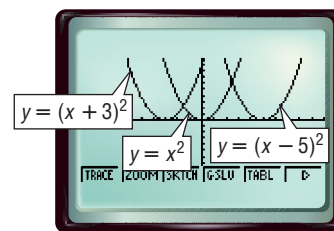
How do you think changing the value of h will affect the graph of $y = x^2$?

Example 2

Graph each set of equations on the same screen in the standard viewing window. Describe any similarities and differences among the graphs.

$$y = x^2, y = (x + 3)^2, y = (x - 5)^2$$

These three graphs all open up and have the same shape. The vertex of each graph is on the x -axis. However, the graphs have different horizontal positions.



Example 2 shows how changing the value of h in the equation $y = a(x - h)^2 + k$ translates the graph horizontally. If $h > 0$, the graph translates to the right h units. If $h < 0$, the graph translates to the left h units.



www.algebra2.com/other_calculator_keystrokes

Investigation

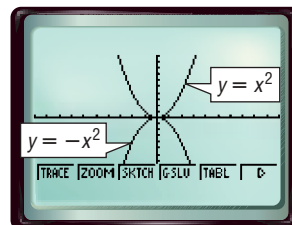
How does the value a affect the graph of $y = x^2$?

Example 3

Graph each set of equations on the same screen in the standard viewing window. Describe any similarities and differences among the graphs.

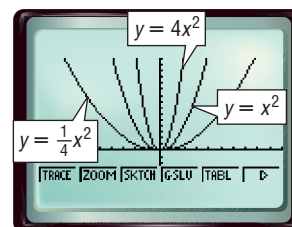
a. $y = x^2, y = -x^2$

The graphs have the same vertex and the same shape. However, the graph of $y = x^2$ opens up and the graph of $y = -x^2$ opens down.



b. $y = x^2, y = 4x^2, y = \frac{1}{4}x^2$

The graphs have the same vertex, $(0, 0)$, but each has a different shape. The graph of $y = 4x^2$ is narrower than the graph of $y = x^2$. The graph of $y = \frac{1}{4}x^2$ is wider than the graph of $y = x^2$.



Changing the value of a in the equation $y = a(x - h)^2 + k$ can affect the direction of the opening and the shape of the graph. If $a > 0$, the graph opens up, and if $a < 0$, the graph opens down or is *reflected* over the x -axis. If $|a| > 1$, the graph is narrower than the graph of $y = x^2$. If $|a| < 1$, the graph is wider than the graph of $y = x^2$. Thus, a change in the absolute value of a results in a *dilation* of the graph of $y = x^2$.

Exercises 1–3. See margin.

Consider $y = a(x - h)^2 - k$.

1. How does changing the value of h affect the graph? Give an example.
2. How does changing the value of k affect the graph? Give an example.
3. How does using $-a$ instead of a affect the graph? Give an example.

Examine each pair of equations and predict the similarities and differences in their graphs. Use a graphing calculator to confirm your predictions. Write a sentence or two comparing the two graphs. **4–15. See pp. 343A–343F.**

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|---|---|
| 4. $y = x^2, y = x^2 + 2.5$ | 5. $y = -x^2, y = x^2 - 9$ |
| 6. $y = x^2, y = 3x^2$ | 7. $y = x^2, y = -6x^2$ |
| 8. $y = x^2, y = (x + 3)^2$ | 9. $y = -\frac{1}{3}x^2, y = -\frac{1}{3}x^2 + 2$ |
| 10. $y = x^2, y = (x - 7)^2$ | 11. $y = x^2, y = 3(x + 4)^2 - 7$ |
| 12. $y = x^2, y = -\frac{1}{4}x^2 + 1$ | 13. $y = (x + 3)^2 - 2, y = (x + 3)^2 + 5$ |
| 14. $y = 3(x + 2)^2 - 1,$
$y = 6(x + 2)^2 - 1$ | 15. $y = 4(x - 2)^2 - 3,$
$y = \frac{1}{4}(x - 2)^2 - 1$ |