Stretching the Quads

About the Lesson

In this activity, students will use the Transformational Graphing Application to stretch and translate the parabola given by $y = x^2$. As a result, students will:

- Determine the effects of stretching and translation on a parabolic equation.
- Explore finding the vertex and zeros of a parabola and relate them to the equation.

Vocabulary

- transformations
- roots
- standard form of a quadratic equation
- intercept form of a quadratic equation

Teacher Preparation and Notes

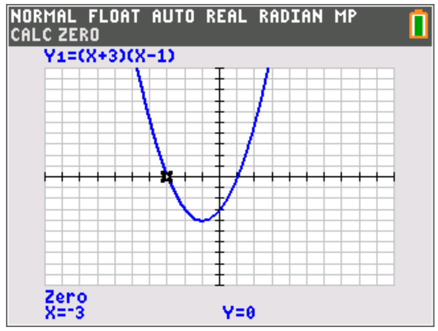
- This activity uses the **Transfrm** App. It is important to make sure the App is installed on each calculator before beginning.

Activity Materials

- Compatible TI Technologies:

  TI-84 Plus*
  TI-84 Plus Silver Edition*
  TI-84 Plus C Silver Edition
  TI-84 Plus CE

***** *with the latest operating system (2.55MP) featuring MathPrint™ functionality.*



Tech Tips:

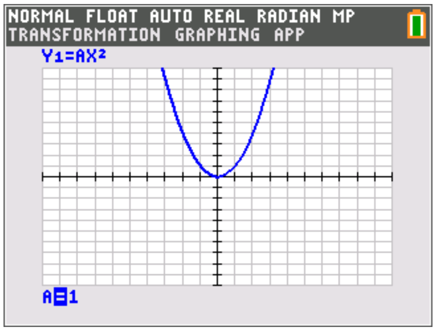
- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Lesson Files:

- Stretching_the_Quads_Student.pdf
- Stretching_the_Quads_Student.doc

Problem 1 – Stretching a Parabola

In this problem, students are told $y = x^2$ is the basic equation for the standard form a parabola. Students then change the value of **A** and observe how the graph equation changes. Students will make a connection between the curvature of the parabola and the equation. Several questions follow to determine if students have made a connection.



1. What effect does the **A** variable have on the graph of the equation?

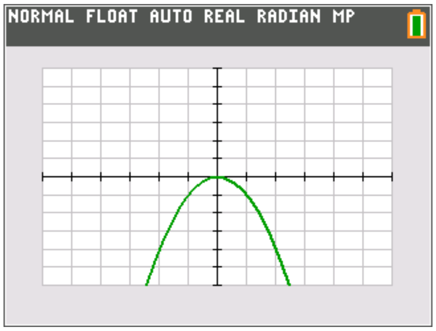
Answer: It vertically stretches or shrinks the graph.

2. When the coefficient of x^2 becomes negative, what happens to the graph?

Answer: The graph opens downward.

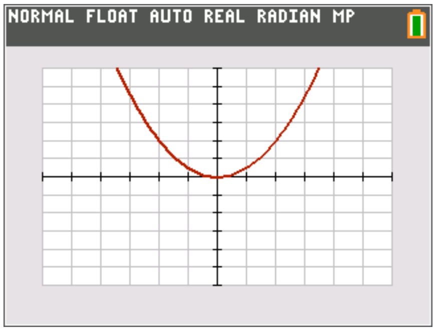
3. Is the coefficient of x^2 positive or negative for the equation of the graph to the right?

Answer: negative

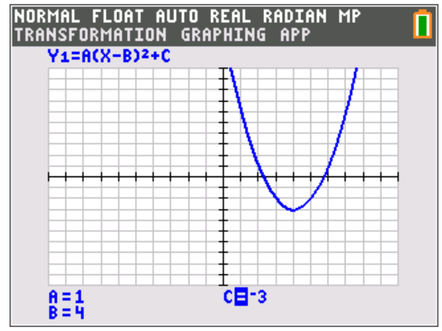


4. What is a possible coefficient of x^2 in the graph to the right? Is it 5 or 0.5?

Answer: 0.5



Problem 2 – Translating a Parabola



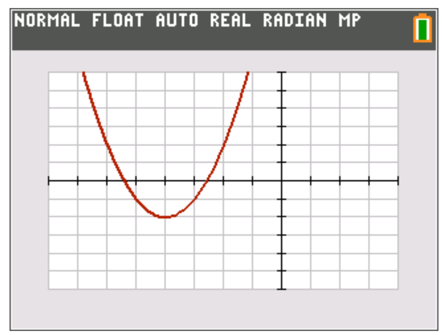
In this problem, students will translate the parabola $y = x^2$ by changing the values of **B** and **C**. Students will observe how the graph changes and make a connection between the vertex and equation. Several questions follow to determine if students have made a connection.

5. What effects do the variables, **A**, **B**, and **C** have on the graph of the equation?

<u>Answer</u>: **A** vertically stretches or shrinks the graph, **B** translates the graph horizontally, and **C** translates the graph vertically.

6. What does (**B**, **C**) represent?

<u>Answer</u>: The vertex of the parabola.



7. What is the vertex of the graph to the right?

<u>Answer</u>: (–4, –2)

8. What is the vertex of the function $f(x) = (x – 3)^2 + 1$?

<u>Answer</u>: (3, 1)

9. Which of the following functions has (have) a vertex at (–1, 1)?

$a(x) = 2(x – 1)^2 + 1$

$b(x) = –1(x + 1)^2 – 1$

$c(x) = –3(x + 1)^2 + 1$

<u>Answer</u>: *c(x)*

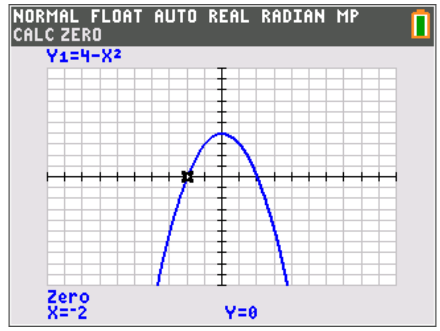
10. Write an equation with a vertex of (–2, 3). Check your work by graphing.

<u>Sample Answer</u>: $y = (x+2)^2 + 3$

11. Write a second equation with a vertex of (–2, 3), if possible. If it is not possible, explain why.

<u>Sample Answer</u>: $y = -(x+2)^2 + 3$

Problem 3 – Finding Zeros of Quadratic Graphically



In this problem, the students will find the zero(s) by using the Calculate menu of the graphing calculator.

Discussion Questions:

- *What is similar about the coordinates of the points representing the x-intercepts?*

  They have *y*-values of 0.

- *How does the x-coordinate of the vertex relate to the two x-intercepts?*

  It lies exactly in the middle of the two *x*-intercepts.

- *How can we algebraically find the zeros of the functions?*

  Set the quadratic equation equal to zero and solve it.

12. What is (are) the zero(s) of the function $y = 4 – x^2$?

Answer: –2 and 2

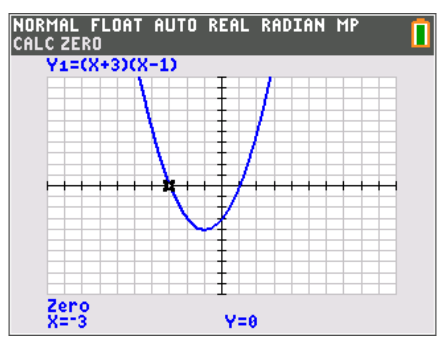
13. What is (are) the zero(s) of the function $y = x^2 – 3x – 4$?

Answer: –1 and 4

14. What is (are) the zero(s) of the function $y = –x^2 + 2x + 8$?

Answer: –2 and 4

Problem 4 – Connecting Zeros to the Equation



In this problem, students will find the zeros of the parabola. Students will see the factored form of the quadratic equation and draw a connection between the zeros and the factored form. Students will then view the intercept form of a quadratic equation to determine how to use this form to find the zeros of the function without a graph.

If students are having difficulties understanding the connection between the factored form of the equation and the zeros of the function, then have them use the *Transformation Graphing* application and enter **(X–A)(X–B)** in **Y1**. As they change the values of **A** and **B**, they will see the *x*-intercepts change.

Discussion Questions:

- *How can we use the factored form of the quadratic equation to find the zeros?*

  We can set the individual factors equal to zero and solve.

- *Is there an algebraic way to find the zeros?*

  Set the equation equal to zero and factor to solve to solve it.

- *How can you find the zeros of a quadratic without the graph?*

  Set the equation equal to zero and factor to solve to solve it.

- *How do we change the equation from intercept form to standard form?*

  Expand the binomial squared and combine like terms.

Find the zeros for the following functions. Be sure to observe how the factored form of the function could be used to find the zeros.

15. $y = (x - 1)(x + 3)$

Answer: –3 and 1

16. $y = (x - 3)(x - 2)$

Answer: 2 and 3

17. $y = (x + 2)^2$

Answer: –2

18. For the factored form equation $y = a(x - p)(x - q)$, what do *p* and *q* represent?

Answer: *p* and *q* represent the zeros or *x*-values of the *x*-intercepts.

19. What are the zeros of the function $y = (x - 4)(x + 2)$?

Answer: –2 and 4