Title: Graphing Quadratic Equations in Standard Form
Class: Math 100 or 107
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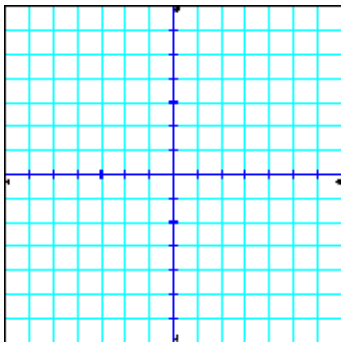
Instructions to tutor: Read instructions under “Activity” and follow all steps for each problem exactly as given.
Keywords/Tags: Parabola, quadratic, graphing, vertex

Objective: Before graphing an equation you should note the type and know what information you need in order to sketch an accurate graph. This activity will help you recognize a quadratic function in standard form and find the necessary information to graph the parabola.

Activity: Follow the given steps to graph each quadratic function. Take them to your tutor to make sure you're doing them correctly. Keep track of the steps listed in each example and use them to graph the equations at the end of this activity.

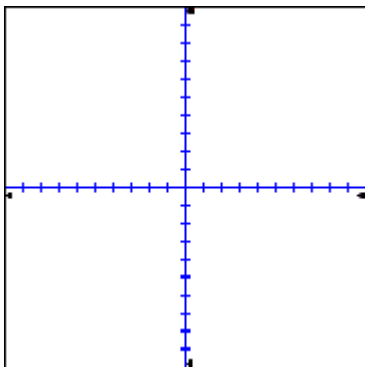


Example 1. Sketch a careful graph of the equation $y = 2x^2 - 4x + 6$.
Follow these steps:

1. Is this a quadratic function (polynomial of degree 2)?
2. Is it in standard form $y = ax^2 + bx + c$? If not put it in standard form.
3. What are values of a, b, and c? a = ____ b = _____ c = ____
4. Remember that you use the sign of a to determine whether the parabola opens upward or downward. If a is positive, the parabola opens up (smile), if a is negative, the parabola opens down (frown).
   Does this parabola open upward or downward?
5. The vertex of a parabola is the point where the graph "turns". To find the vertex we need its x-coordinate and y-coordinate. Remember that you can get the x-coordinate using the formula $\frac{-b}{2a}$. Refer to the values of a and b you found in #3 above to find the x of the vertex: x_{vertex} = ------- =

   Now to find the y of the vertex, you just plug in the above x value into the equation:
   $y_{vertex} = 2(\ \ )^2 - 4(\ \ ) + 6$
   =
   =
   So the vertex of this parabola is at : (_____, _____)
   Plot this point and make a little smile or frown based on your answer to #4.
6. The graph of every quadratic function is symmetric about the vertical line that goes through the vertex. This line is called the <u>axis of symmetry</u>. The axis of symmetry of this parabola is the vertical line :
   x = (since you know the x of the vertex, that's all you have to write down here.)
   Draw this vertical line through the vertex using dashes.
7. Now we just need one or two more points to sketch the graph. One point that we can always find easily is the y-intercept. Remember that to find the y-intercept of <u>any</u> equation, you must plug in 0 for x. So in this equation we get:
   $y = 2(0)^2 - 4(0) + 6$
   =
   So the y-intercept of this parabola is at : (0, _____) Plot this point on the y-axis.
8. Connect the vertex to the y-intercept with a "half-parabola" curve and then draw the mirror image of it on the other side of the axis of symmetry.
9. Does this parabola seem to have any x-intercepts?

Example 2. Sketch a careful graph of the equation $y = -x^2 + 4x - 9$.
Follow these steps:



1. Is this a quadratic function (polynomial of degree 2)?
2. Is it in standard form $\mathbf{y = ax^2 + bx + c}$? If not put it in standard form.
3. What are values of a, b, and c? a = ____ b = _____ c = _____
4. Remember that you use the sign of a to determine whether the parabola opens upward or downward. If a is positive, the parabola opens up (smile), if a is negative, the parabola opens down (frown). Does this parabola open upward or downward?
5. The vertex of a parabola is the point where the graph "turns". To find the vertex we need its x-coordinate and y-coordinate. Remember that you can get the x-coordinate using the formula $\frac{-b}{2a}$. Refer to the values of a and b you found in #3 above to find the x of the vertex: $\mathbf{x_{vertex}}$ = ------- =

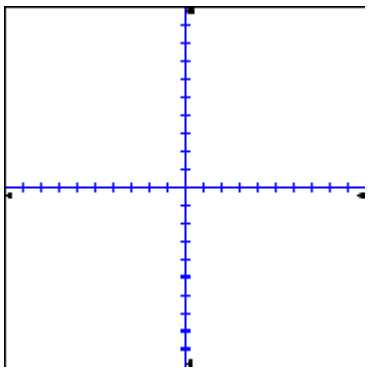
   Now to find the y of the vertex, you just plug in the above x value into the equation:

   $\mathbf{y_{vertex}} = -(\ \ )^2 + 4(\ \ ) - 9$
   $=$
   $=$

   So the vertex of this parabola is at : (_____, _____)
   Plot this point and make a little smile or frown based on your answer to #4.
6. The graph of every quadratic function is symmetric about the vertical line that goes through the vertex. This line is called the <u>axis of symmetry</u>. The axis of symmetry of this parabola is the vertical line :
   x = (since you know the x of the vertex, that's all you have to write down here.)

   Draw this vertical line through the vertex using dashes.
7. Now we just need one or two more points to sketch the graph. One point that we can always find easily is the y-intercept. Remember that to find the y-intercept of <u>any</u> equation, you must plug in 0 for x. So in this equation we get:
   $y = -(0)^2 + 4(0) - 9$
   $=$
   So the y-intercept of this parabola is at : (0, _____) Plot this point on the y-axis.
8. Connect the vertex to the y-intercept with a "half-parabola" curve and then draw the mirror image of it on the other side of the axis of symmetry.
9. Does this parabola seem to have any x-intercepts?

Example 3. Sketch a careful graph of the equation $y = 5 + x^2$.
Follow these steps:

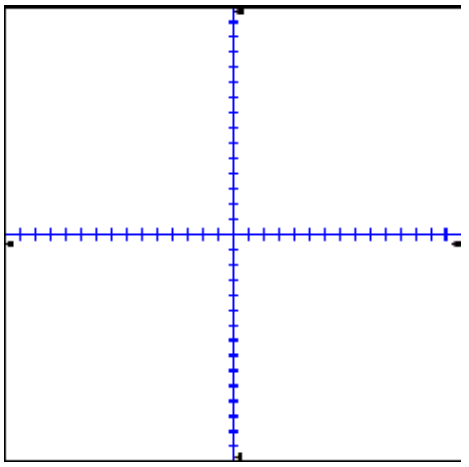


1. Is this a quadratic function (polynomial of degree 2)?
2. Is it in standard form $\mathbf{y = ax^2 + bx + c}$? If not put it in standard form.
3. What are values of a, b, and c? a = ____ b = _____ c = _____
4. Remember that you use the sign of a to determine whether the parabola opens upward or downward. If a is positive, the parabola opens up (smile), if a is negative, the parabola opens down (frown). Does this parabola open upward or downward?
5. The vertex of a parabola is the point where the graph "turns". To find the vertex we need its x-coordinate and y-coordinate. Remember that you can get the x-coordinate using the formula $\frac{-b}{2a}$. Refer to the values of a and b you found in #3 above to find the x of the vertex: $\mathbf{x_{vertex}}$ = ------- =

   Now to find the y of the vertex, you just plug in the above x value into the equation:
   $\mathbf{y_{vertex}}$ =
   =

   So the vertex of this parabola is at : (_____, _____)
   Plot this point and make a little smile or frown based on your answer to #4.
6. The graph of every quadratic function is symmetric about the vertical line that goes through the vertex. This line is called the axis of symmetry. The axis of symmetry of this parabola is the vertical line :
   x = (since you know the x of the vertex, that's all you have to write down here.)
   Draw this vertical line through the vertex using dashes.
7. Find the y-intercept of this graph by plugging in 0 for x in the equation.
   y =
   =
   The y-intercept of this parabola is at : (0, _____).
   Notice anything? The vertex and the y-intercept are the same point! So we definitely need another point.
8. Choose a number for x (something easy like 1 or 2) and plug it into the equation to find y.
   y =
   =
   Another point on this parabola is (_____, _____). Plot this point.
9. Connect this point to the vertex with a "half-parabola" curve and then draw the mirror image of it on the other side of the axis of symmetry.
10. Does this parabola seem to have any x-intercepts?

Example 4. Sketch a careful graph of the equation $y = 3x^2 + 12x + 12$.
Follow these steps:



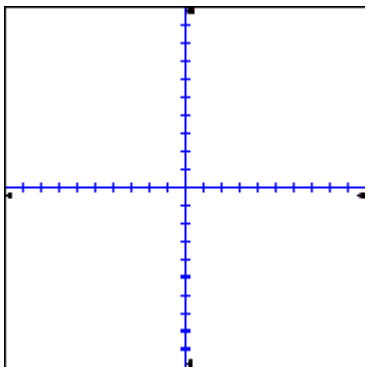
1. Is this a quadratic function (polynomial of degree 2)?
2. Is it in standard form $\mathbf{y = ax^2 + bx + c}$? If not put it in standard form.
3. What are values of a, b, and c? a = ____ b = _____ c = ____
4. Remember that you use the sign of a to determine whether the parabola opens upward or downward. If a is positive, the parabola opens up (smile), if a is negative, the parabola opens down (frown). Does this parabola open upward or downward?
5. The vertex of a parabola is the point where the graph "turns". To find the vertex we need its x-coordinate and y-coordinate. Remember that you can get the x-coordinate using the formula $\frac{-b}{2a}$. Refer to the values of a and b you found in #3 above to find the x of the vertex: $\mathbf{x_{vertex}}$ = ------- =

   Now to find the y of the vertex, you just plug in the above x value into the equation:
   $\mathbf{y_{vertex} = 3(\ \ )^2 + 12(\ \ ) + 12}$
   $\mathbf{=}$
   $=$
   So the vertex of this parabola is at : (_____, _____)
   Plot this point and make a little smile or frown based on your answer to #4.
6. The axis of symmetry of this parabola is the vertical line :
   x = (since you know the x of the vertex, that's all you have to write down here.)
   Draw this vertical line through the vertex using dashes.
7. Find the y-intercept of this graph by plugging in 0 for x in the equation.
   y =
   $\mathbf{=}$
   $\mathbf{=}$
   So the y-intercept of this parabola is at : (0, _____) Plot this point on the y-axis.
8. Connect the vertex to the y-intercept with a "half-parabola" curve and then draw the mirror image of it on the other side of the axis of symmetry.
9. Does this parabola seem to have any x-intercepts? How would you find it algebraically?

   Remember that to find the x-intercept of any graph, you plug in 0 for y. Find the x-intercept of this graph, i.e. solve
   $\mathbf{0 = 3x^2 + 12x + 12}$ (Use factoring or the quadratic formula.)

   The x-intercept is at (_____ , 0)
   Does your answer match what you see on the graph? (It better!)

Example 5. Sketch a careful graph of the equation $y = -3x^2 + 12x - 9$.
Follow these steps:



1. Is this a quadratic function (polynomial of degree 2)?
2. Is it in standard form $\mathbf{y = ax^2 + bx + c}$? If not put it in standard form.
3. What are values of a, b, and c? a = ____ b = _____ c = _____
4. Remember that you use the sign of a to determine whether the parabola opens upward or downward. If a is positive, the parabola opens up (smile), if a is negative, the parabola opens down (frown). Does this parabola open upward or downward?
5. Find the x of the vertex: $\mathbf{x_{vertex}}$ = ------- =

   Now to find the y of the vertex, plug in the above x value into the equation:

   $\mathbf{y_{vertex} = -3(\ \ )^2 + 12(\ \ ) - 9}$
   $\mathbf{=}$
   $=$

   So the vertex of this parabola is at : (_____, _____)
   Plot this point and make a little smile or frown based on your answer to #4.
6. The axis of symmetry of this parabola is the vertical line :
   x = (since you know the x of the vertex, that's all you have to write down here.)

   Draw this vertical line through the vertex using dashes.
7. Find the y-intercept of this graph by plugging in 0 for x in the equation.
   y =
   =
   =

   So the y-intercept of this parabola is at : (0, _____) Plot this point on the y-axis.
8. Connect the vertex to the y-intercept with a "half-parabola" curve and then draw the mirror image of it on the other side of the axis of symmetry.
9. Does this parabola seem to have any x-intercepts? How would you find them algebraically?

   Find the x-intercept of this graph, i.e. solve
   $\mathbf{0 = -3x^2 + 12x - 9}$ (Use factoring or the quadratic formula.)

   The x-intercepts are at (_____ , 0)
   Does your answer match what you see on the graph? (It better!)

After you go over the previous examples with a tutor, try the following on your own, then check with a tutor to make sure you did them correctly.

For each of the following equations, first verify that it is quadratic (hence the graph is a parabola) then sketch a graph by following the steps outlined in the examples. Specify the vertex, axis of symmetry, y-intercept, and x-intercept(s) (if any).

1. $y = 3x^2 + 6x - 4$

2. $y = -x^2 + 8x - 7$

3. $y = x^2 - 5x - 24$

4. $y = 3x^2 + 6x$

5. $y = x^2 - 9$

6. $y = -2x^2 + 12x - 9$

For tutor use: Please check the appropriate box.

- ☐ Student has completed worksheet but may need further assistance. Recommend a follow-up with instructor.
- ☐ Student has mastered topic.