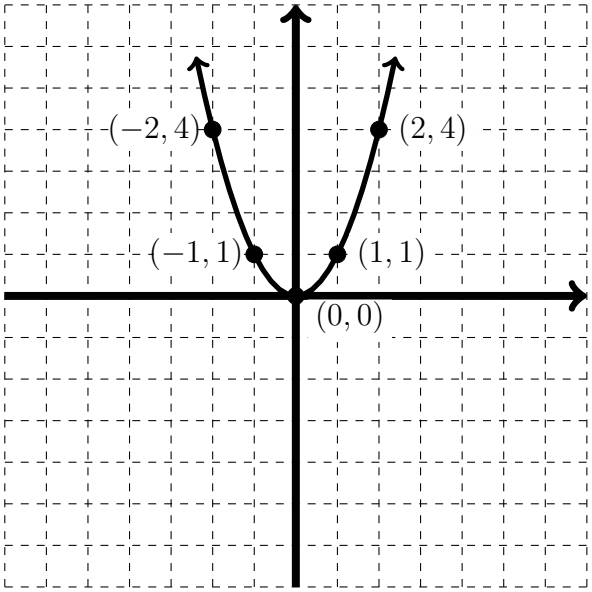
Algebra
Activity 5b - Parabolas: General, Standard and Graphical Forms

Recall the standard parabola $y = x^2$



The goal of this activity is to find connections between the graph of any parabola, the standard form

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

and the general form

$$y = ax^2 + bx + c$$

1. Given the standard form $y = a(x - h)^2 + k$, describe how to draw the graph.

   (a) Draw the graph of $y = 2(x - 3)^2 - 1$

2. Given the graph, write the standard form $y = a(x - h)^2 + k$.

   Hints:

   - Explore desmos.com graphs https://www.desmos.com/calculator/obgrwkmfmb and https://www.desmos.com/calculator/foione276h

     In each case, you are given the coordinates of the vertex and one other point on the parabola. The vertex is black and the other point is blue.
   - What does the slider bar for a do? What does the slider bar for h do? What does the slider bar for k do?
   - In what order did you use the slider bars?
   - How can you figure out the values of a, h and k from the two given points?

3. Given the standard form $y = a(x-h)^2 + k$, describe how to find the general form $y = ax^2 + bx + c$.

   (a) Write $y = 3(x+1)^2 - 2$ in general form.

   (b) Write $y = -\frac{2}{3}(x+3)^2 + 5$ in general form.

   - To prepare for future problems, you may wish to actually do this general conversion, and write out formulas for a, b and c, as functions of a, h and k. In other words, write $y = a(x-h)^2 + k$ in general form.
   - You may also wish to then solve those equations for a, h and k and write them as functions of a, b and c.

4. Given the graph, write the general form $y = ax^2 + bx + c$.

   Hints:

   - Explore desmos.com graphs https://www.desmos.com/calculator/oyqahm8hsq and https://www.desmos.com/calculator/kx6ehh5wvr
     In each case, you are given the coordinates of the vertex and one other point on the parabola. The vertex is blue and the other point is black.
   - What does the slider bar for a do? What does the slider bar for b do? What does the slider bar for c do?
   - In what order did you use the slider bars?
   - How can you figure out the values of a, b and c from the two given points? (Do the formulas from the previous problem help you?)
   - Can you answer this question by combining problems 2 and 3?

5. Given the general form $y = ax^2 + bx + c$, describe how to draw the graph?

   Hint: Use the formulas from problem 3 to get started.

6. Given the general form $y = ax^2 + bx + c$, describe how to find the standard form $y = a(x-h)^2 + k$.

   One method is called completing the square, and will be discussed in class later. You may have some ideas based on the formulas in problem 3.

   (a) Write $y = x^2 + 4x + 1$ in standard form.

   (b) Write $y = 2x^2 - 8x + 18$ in standard form.