Consider the function $f(x) = x^2 + 3x - 4$.

1. Factor this polynomial and use that to sketch a graph of the function.

2. This function is not linear, so the 'slope' of it changes as we change the x value. We will investigate that here. Find the slope of the line that connects the two points on the graph of f that lie at $x_1 = 1$ and $x_2 = 4$. (Hint: What are the x and y coordinates of these points?)

3. We are going to define a new function $g_1(x)$ which finds the slope of the line between points on the graph of f above 1 and x. Thus, you found $g_1(4)$ in the last step. Find $g_1(2)$, $g_1(1.5)$, $g_1(1.1)$ and $g_1(1.01)$.

4. It doesn't make sense to evaluate $g_1(1)$. Why not? If you had to make a guess for $g_1(1)$ based on your previous calculations, what would it be?

5. Write out a piecewise definition for $g_1(x)$.

6. Figure out the equation of the line through $(1, f(1))$ with slope $g_1(1)$. Draw this along with a graph of f. You may want to use a calculator for this part. What do you notice about how the line relates to the parabola?

7. Say I was going to have you do all of the previous steps again, but with $x_1 = 3$. (You don't actually have to do this.) Do you think the value of $g_3(3)$ would be larger or smaller than $g_1(1)$? Why? What could you say about the value of $g_{-4}(-4)$?