Alternate Formulations Worksheet

Part 1 – Alternate Formulations

Consider these two examples, then answer the questions below.

	Function Formula	Formulation	Rules for graphing
Example 1	$f(x) = 6x^2 + 12$	$f(x) = ax^2 + c$	1. Stretch the parent function vertically by a factor of a. 2. Shift up c units.
Example 2	$f(x) = 6(x^2 + 2)$	$f(x) = a(x^2 + c)$	1. Shift the parent function up c units. 2. Stretch vertically by a factor of a.

1. Compare the function formulas for Examples 1 and 2. Are they the same function? ____
2. Compare the formulations for Examples 1 and 2. Are they the same? ____
3. In Example 1, what are the values for a and c? $a =$_____, $c =$_____
4. In Example 2, what are the values for a and c? $a =$_____, $c =$_____

Use Desmos to answer questions 5 and 6.

5. Do the rules for graphing in Example 1 result in the correct graph? _____
6. Do the rules for graphing in Example 2 result in the correct graph? _____
7. How do the rules for graphing differ between the two examples? _____
8. Why do the rules differ between the two examples? _____

Part 2 – Choose a Formulation

Each of the following formulations represents every possible parabola with its vertex on the y-axis. Some are formulated as functions (with $f(x)$ representing the dependent variable) and some as relations (with y representing the dependent variable.) All include x as the independent variable, and two randomly-selected letters as parameters.

$f(x) = a(x^2 - c)$ $\quad f(x) = q(x^2 + p)$ $\quad y = mx^2 + n$ $\quad x^2 = j(y - k)$

$f(x) = bx^2 - d$ $\quad f(x) = ex^2 + f$ $\quad y - g = hx^2$ $\quad x^2 = wy + r$

1. Choose a formulation from the list or create your own, and enter it into Desmos, making sliders for each of the two parameters. Make sure your sliders can take on both positive and negative values.
2. Using the sliders, convince yourself that your formulation can represent any possible parabola with its vertex on the y-axis. If this is not the case, adjust your formulation.
3. Choose a second formulation and do the same.
4. Select a formulation from the list that you want to work with, or create your own, testing it on Desmos. Write your selected formulation below at the start of Part 3.

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Part 3 – Determining Rules For My Formulation

The formulation I chose to work with is: _____

1. If you haven't done it yet, enter your formulation into Desmos with sliders for the two parameters.
2. Re-formulate each of the examples below to match your chosen formulation.
3. Graph each of the examples by adjusting the sliders on your Desmos graph.
4. As you do this, try to determine how your parameters translate into a correct graph.
5. Write down a set of rules for how to apply transformations to the parent function using your parameters. See the example rules given in Part 1.
6. Be sure to include as many details as are needed: What happens if a number is negative? What happens if a number is between zero and one?

Example Functions	Re-formulated Re-formulate each function using your chosen formulation.	For Example Reformulating the example functions using $f(x) = ax^2 + c$ would look like:
1. $f(x) = -(x^2 - 3)$		$f(x) = -x^2 + 3$
2. $f(x) = -2x^2 - 6$		$f(x) = -2x^2 - 6$
3. $f(x) = 3(x^2 - \frac{2}{3})$		$f(x) = 3x^2 - 2$
4. $f(x) = x^2 + 4$		$f(x) = x^2 + 4$
5. $y = \frac{1}{2}x^2 + 3$		$f(x) = \frac{1}{2}x^2 + 3$
6. $y + 4 = \frac{1}{4}x^2$		$f(x) = \frac{1}{4}x^2 - 4$
7. $x^2 = -\frac{4}{3}\left(y - \frac{1}{2}\right)$		$f(x) = -\frac{3}{4}x^2 + \frac{1}{2}$
8. $x^2 = -4y - 15$		$f(x) = -\frac{1}{4}x^2 - \frac{15}{4}$

My Set of Rules Is: