IM3 - Lesson 1: Stretching & Reflecting Quadratic Functions | Unit 2 – Quadratic Functions

A. Lesson Context

BIG PICTURE of this UNIT:	• How & why do we build NEW knowledge in Mathematics? • What NEW IDEAS & NEW CONCEPTS can we now explore with specific references to QUADRATIC FUNCTIONS? • How can we extend our knowledge of FUNCTIONS, given our BASIC understanding of Functions?		
CONTEXT of this LESSON:	Where we've been In UNIT 1, you were introduced to & practiced with basic function concepts & applied them to Linear functions	Where we are WHY & HOW do we transform parent functions, specifically a quadratic function	Where we are heading How do we extend our knowledge & skills of quadratic functions, given the new ideas & concepts we now know about functions.

B. Lesson Objectives

a. Review KEY IDEAS in our parent function, $y = x^2$

b. Investigate the role of the parameter a in the equation $y = ax^2$ and relate that role to the concept of TRANSFORMATIONS

c. Apply the idea of transforming a parent function to (i) contextual applications & (ii) further functions

C. Fast Five (Skills Review Focus)

Given the quadratic function $f(x) = (x - 2)(x - 4)$:

(a) find the zeroes

(b) find the axis of symmetry

(c) find the vertex

(d) find the y-intercept

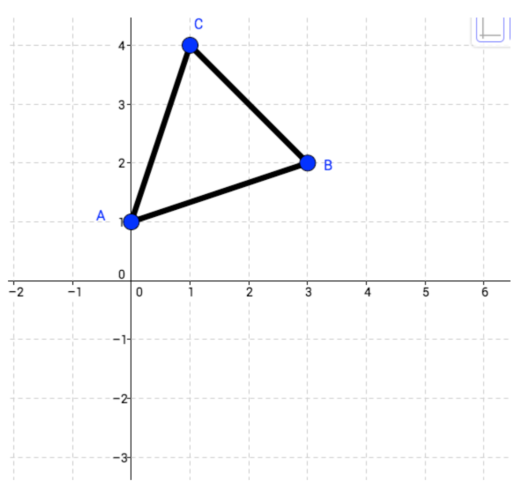
(e) write the equation in standard form

(f) Sketch the parabola, labelling key features

Given the triangle defined below:

(a) Translate the triangle 3 units right and 2 units down

(d) Reflect the triangle in the x-axis



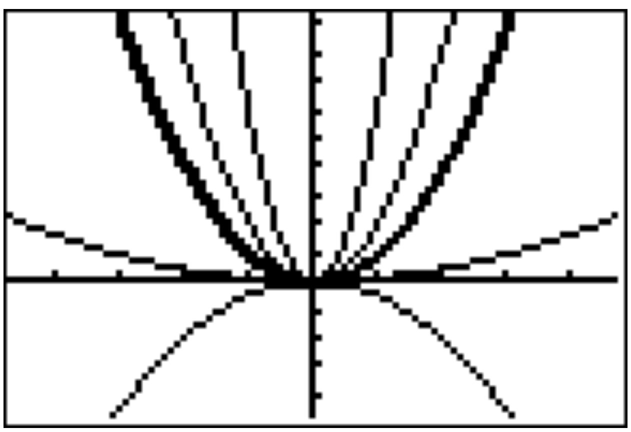
D. Observation Table for Exploration

What is the relationship between the value of the **parameter** ***a*** in the equation y = ***a***x^2 and the shape of the graph of the function. How do we DESCRIBE the change in the appearance of the graph?	
1. Enter y = x^2 into Y1 of the equation editor of your GDC	
2. Set your windows (-4.7 ≤ x ≤ 4.7 and then -3.1 ≤ y ≤ 9.3)	
3. Enter y = $2x^2$ into Y2 and y = $5x^2$ in Y3 and graph these. What appears to be happening to the **SHAPE** of the parabola as the value of ***a*** increases?	3.
4. Where would you expect the graph of y = $3x^2$ to appear, relative to the other 3 graphs? Test your conjecture by entering y = $3x^2$ into Y3. Was your conjecture true?	4.
5. Where would you expect the graphs y = ½x^2 and y = ¼x^2 to appear relative to the graph of y = x^2? Test your conjecture.	5.
6. Describe the effect of the parameter ***a*** when 0 < ***a*** < 1.	6.
7. Where would you expect the graph of y = ¾x^2 to appear, relative to the other three graphs? Check your conjecture.	7.
8. Enter y = -4x^2 into Y2 and y = -¼x^2 into Y3 and graph these functions. Describe the effect of ***a*** on the parabola when ***a*** < 0.	8.
9. How does changing the value of ***a*** in the equation affect the **SHAPE** of the graph.	9.
10. REFLECTING: What happens to the *x* coordinates of all the points on the graph of y = x^2 when the parameter ***a*** is changed in y = ***a***x^2?	10.
11. REFLECTING: What happens to the *y* coordinates of all the points on the graph of y = x^2 when the parameter ***a*** is changed in y = ***a***x^2?	11.

12. REFLECTING: State the values of ***a*** that cause the following **TRANSFORMATIONS** of y = x^2: (a) ***vertical stretch*** (b) ***vertical compression*** (c) ***reflection across the x-axis***	12.

E. Practicing with Transforming Quadratics

Example 1 (CI): You are given graphs of parabolas in the form of y = $\boldsymbol{a}x^2$. PREDICT the equations of each one & give a reason for your prediction. The parent function, y = x^2, is the thick curve.



(a)

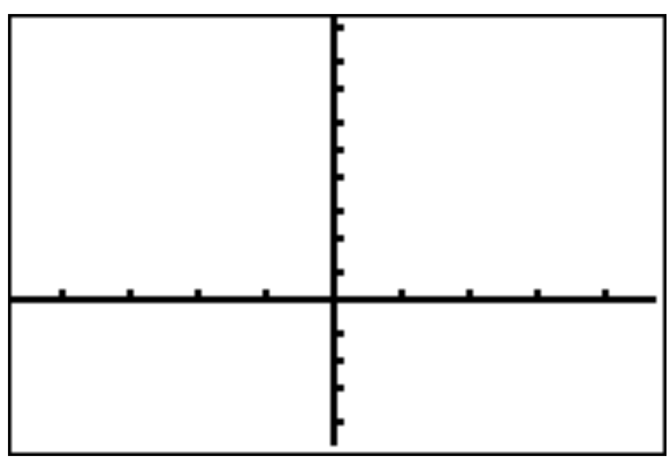
(b)

(c)

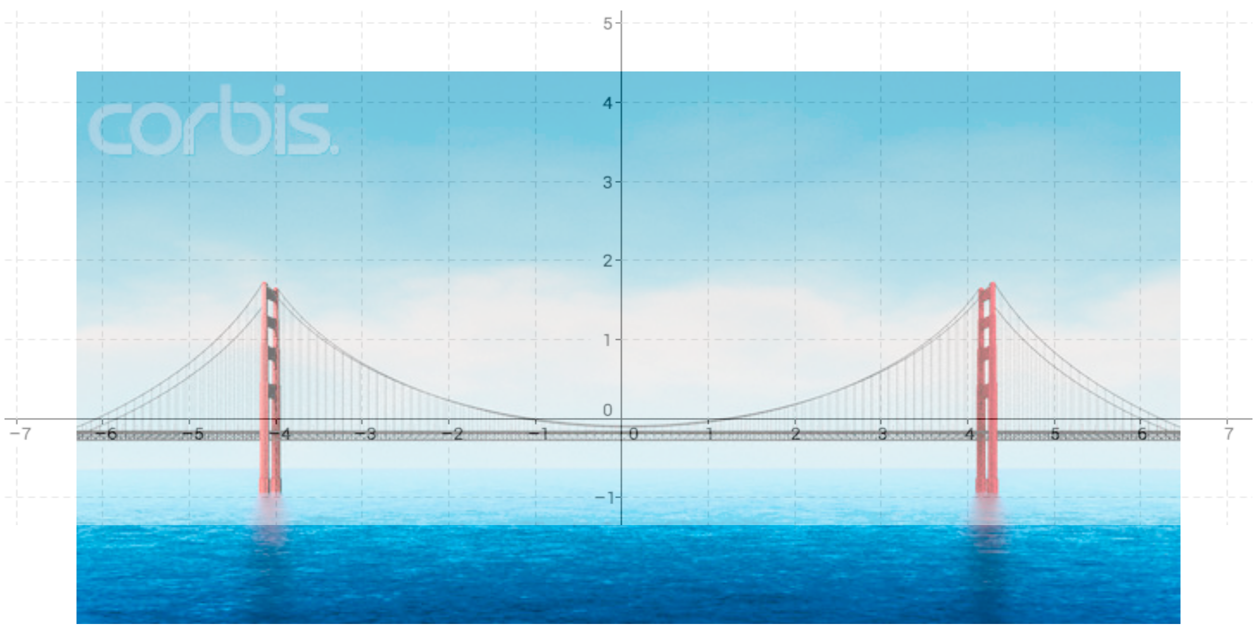
(d)

Example 2 (CI): Sketch the graph of y = $2.5x^2$ by transforming the graph of y = x^2. Sketch both graphs, label each graph.

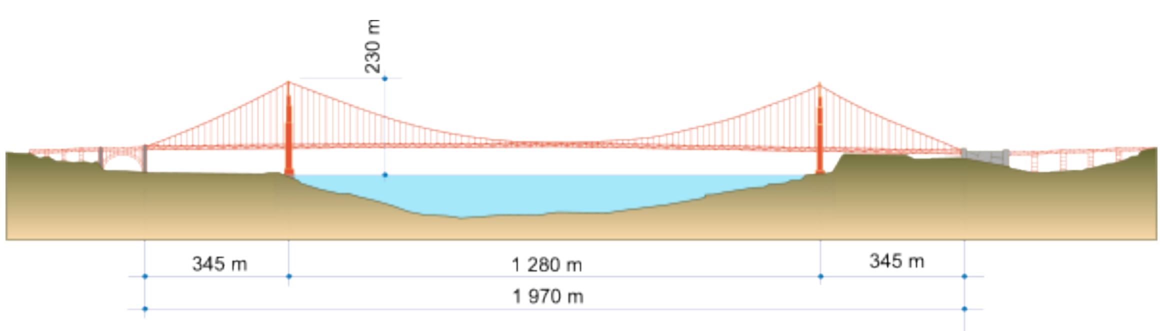
Label the points (1,1) and (-1,1) on the parent function. Then label the corresponding, transformed points (i.e. where do these two original points wind up, AFTER the transformation?)



Example 3: Modeling the Golden Gate Bridge ➔ Write an equation that models the Golden Gate bridge, given the superimposed grid on a side profile of the bridge

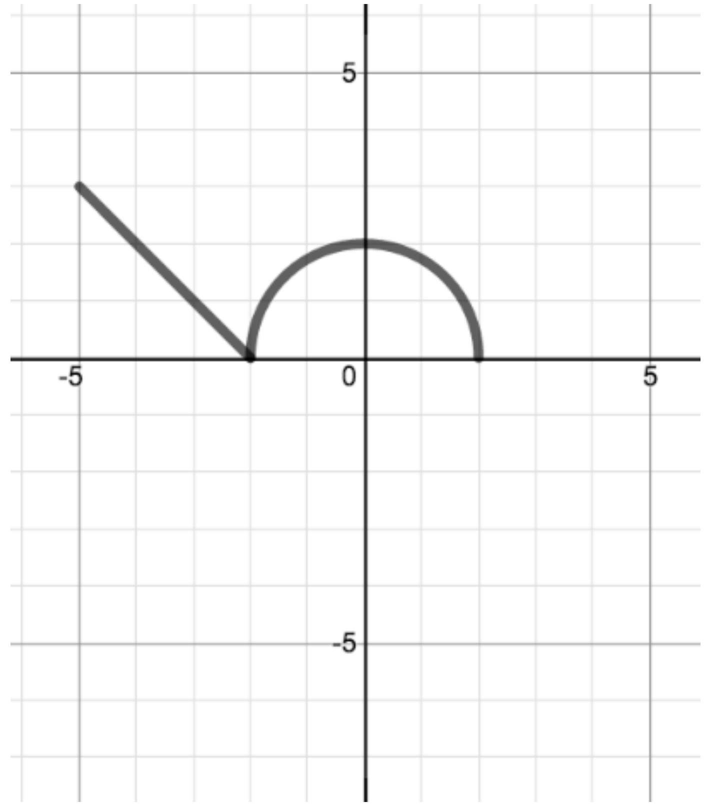


Example 3b: Here are the measurements of the bridge. Rewrite your equation, using the real data.



F. Extending the Concepts

Example 4: Working with a Piecewise defined function. A function, y = f(x) is illustrated on the grid.



You are required to produce a graph of a new function, called g(x), which is a TRANSFORMATION of f(x) as defined below:

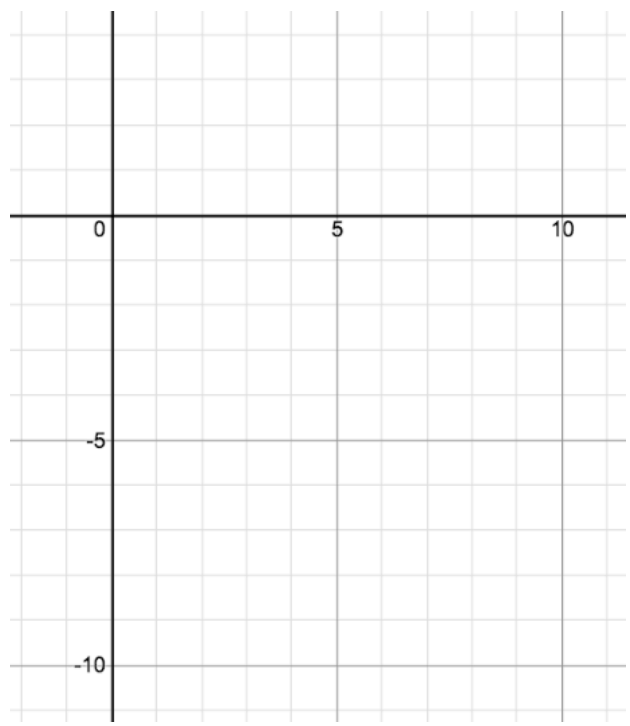
(a) g(x) = 2f(x)

(b) g(x) = -3f(x)

(c) g(x) = -½f(x)

In each sketch, label KEY points very clearly.

Example 5: Now let f(x) be one of our new parent functions, f(x) = √x. On the grid provided, sketch:



(a) the parent function, clearly labelling the key points (0,0) and (4,2) and (9,3)

(b) y = -3√x, clearly labelling the new locations for the original key points

(c) g(x) = ¼f(x), clearly labelling the new locations for the original key points