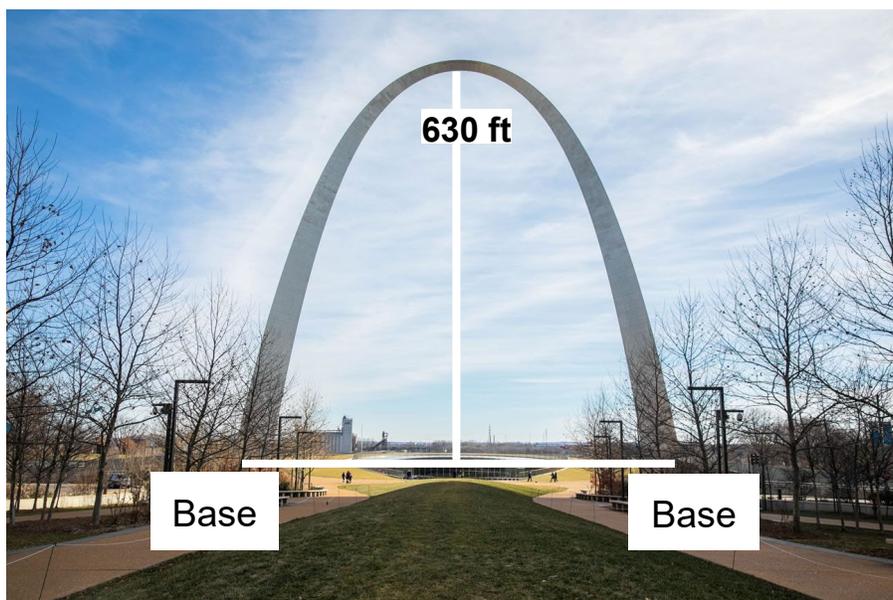


M103: Modeling with Functions of Quadratic Type Post-Badge Task

Reflecting on Badge Learning

Now that you have learned more about quadratic functions and their characteristics, respond to the questions that follow. These are the same questions you responded to before the start of this badge.

The Gateway Arch is a monument in St. Louis, Missouri. Use the information about the Gateway Arch to answer the following questions.



The following pages include sample student responses in **blue font**, as well as additional scoring comments in **red font**.

QUESTION 1 How does the image of the Gateway Arch relate to concepts you have learned about in math?



Answers will vary. Possible student responses:

- The arch looks like an upside down parabola.
- It is a function because no x values repeat.
- The equation of the graph of the arch would be quadratic because it has only one turning point.
- The vertex is a highest point along the arch and is at 630.
- The equation will have a negative a -value.

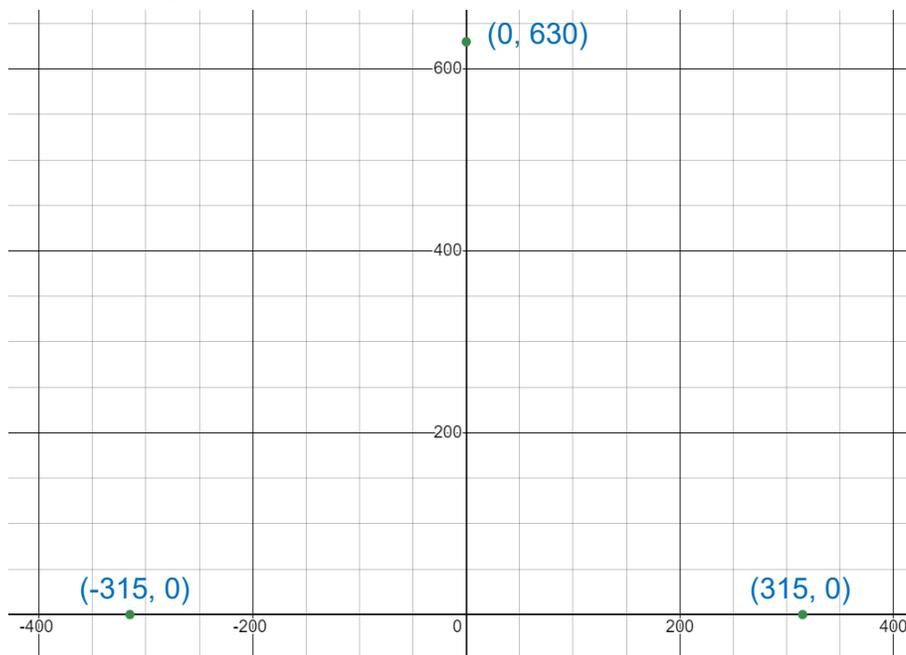
QUESTION 2 The height of the arch at its center is 630 feet. The distance from the bottom of one base to the bottom of the other base is 630 feet.

Use graph paper or technology to plot the three points described below, using an appropriate scale.

- Plot the first point on the vertical axis to represent the height of the center of the arch.
- Plot the second point on the horizontal axis to represent the left base of the arch relative to the center.
- Plot the third point on the horizontal axis to represent the right base of the arch relative to the center.
- Label the coordinates of each point.



[Attach a file with your work or describe how to find it if it is stored online.]



QUESTION 3

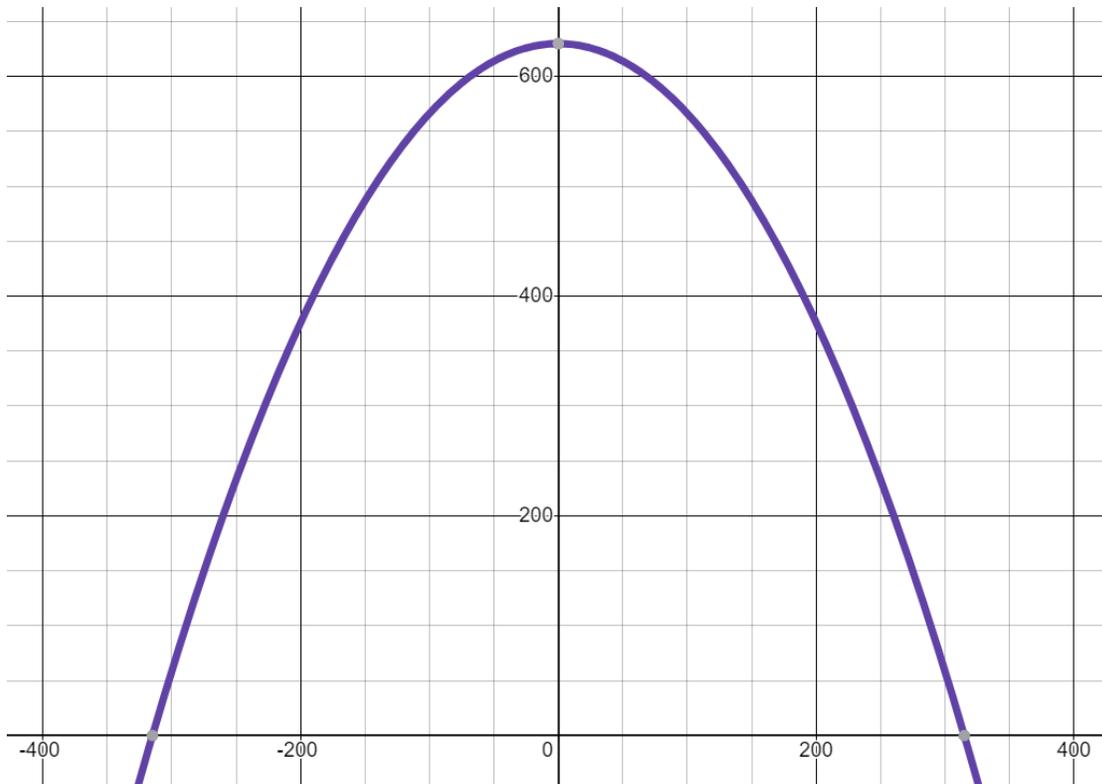
- Create an equation that models the shape of the curve through these 3 points.
- If you wrote an equation in part (a), explain how you came up with that equation.
- On your graph paper or using technology, graph the curve represented by your equation.



Possible student responses:

- $y = -0.00634921x^2 + 630$
- I used Desmos to come up with the equation and graph the curve.
- See graph below.

-
- $y = -\frac{630}{99225}x^2 + 630$
 - I used the vertex $(0, 630)$ and a point $(315, 0)$ and plugged it into $y = a(x - h)^2 + k$ to find a and the equation of the parabola.
 - See graph below.



QUESTION 4

- What is the height of the arch 100 feet from the center? How did you determine this?
- What is a reason why an architect or engineer might want to check the height of the arch 100 feet from its center on both sides?



Possible student response:

- The height of the arch 100 feet from the center is about 567 feet.
I plugged 100 into the equation for x and solved for y .
$$y = -0.00634921(100)^2 + 630$$
$$y = -0.00634921(10,000) + 630$$
$$y = -63.4921 + 630$$
$$y = 566.5079$$
 I looked at the graph and the number appears to be correct.
- They might be checking to be sure the arch is still equal on both side of the center. To check for safety reasons.

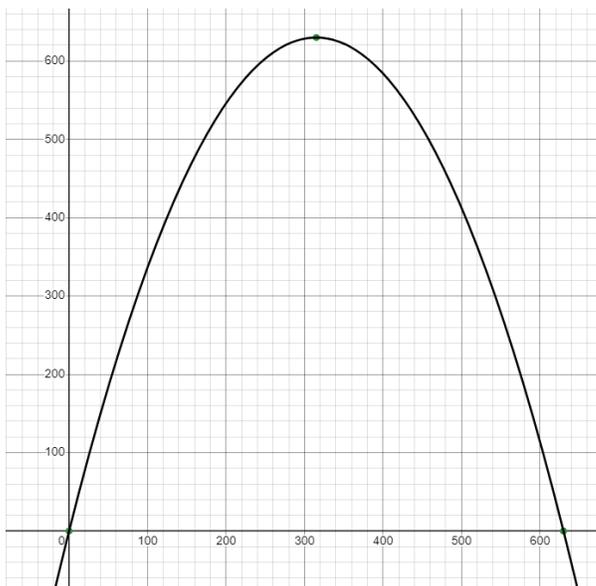
Question 5 You receive some feedback that the equation would be more useful if it models the arch such that the left base is at the point $(0, 0)$.

- Write a new equation for the arch that situates the leftmost point at $(0, 0)$.
- How does this compare to your original equation?



Possible student response:

- The new equation is $y = -0.00634921(x - 315)^2 + 630$ or $y = -\frac{630}{99225}(x - 315)^2 + 630$
- All it did was shift the graph to the right 315 units. So, the new vertex is $(315, 630)$. The shape is still the same, with the same a -value.



QUESTION 6 What else did you learn that was not reflected in Questions 1-5?



Answers will vary. Possible student response:

I learned how to use the Desmos Graphing calculator online to determine the equation of a parabola. I didn't know how to plot the points and use a table of x and y values to come up with the a-value of the equation before this task.

QUESTION 7 Compare your answers to these questions now to your answers from the earlier attempt. What do you notice about your progress?



Answers will vary. Look for students to explain what they know now compared to what they knew when responding to the pre-test.