Algebra II
Semester Exam: Applied Problem #2

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Chapter 4: Civil Engineering Applications of the Quadratic Function

Part 1 – Background Information

Before you work with specific examples within the Civil Engineering field, first take some time to learn about the origins and applications of quadratic equations. Go to the Algebra II moodle page to find the links to the documents below. You will receive points for reading through both articles.

- 101 Uses of a Quadratic Equation: Part 1 −3
- 101 Uses of a Quadratic Equation: Part 2 −3

Part 2 – Applied Problems for Bridges and Arches

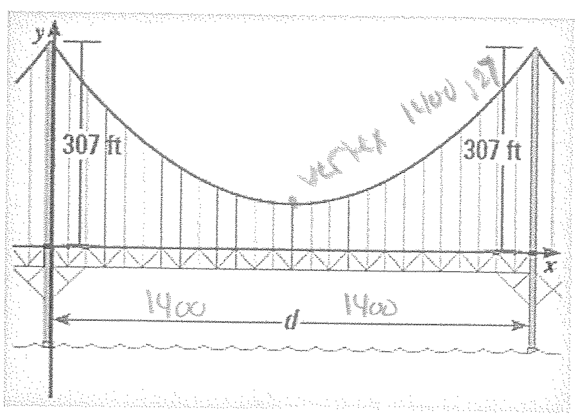
Please complete each problem thoroughly, showing all work and giving explanations about your strategies used to solve the problem.

Tacoma Narrows Bridge

The Tacoma Narrows Bridge in Washington has two towers that each rise 307 feet above the roadway and are connected by suspension cables as shown. Each cable can be modeled by the function

$$y = \frac{1}{7000}(x - 1400)^2 + 27$$

where x and y are measured in feet. What is the distance d between the two towers?



Not drawn to scale

$y = \frac{1}{7000}(x - 1400)^2 + 27$

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

vertex = (h, k)

vertex $(1400, 27)$

D = 2800 vertex is shown on diagram to find distance you have to realize vertex is 1/2 distance between towers so you would have to double 1400 ft from each side to vertex to find total distance as shown above

Distance between towers is D = 2800 ft

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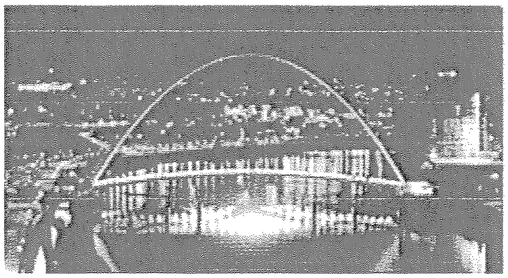
Arch of the Gateshead Millennium Bridge



Please go to the Gateshead Millennium Bridge link on the Algebra 2 moodle page to learn more about the design of the world's first and only tilting bridge. Click on the virtual tour and read about the design.

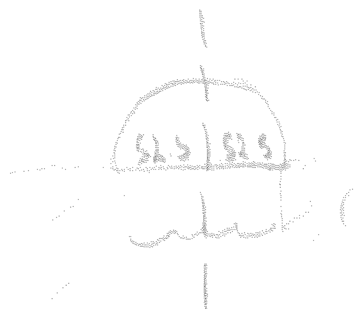
The arch of the Gateshead Millennium Bridge, in Europe, forms a parabola with equation $y = -0.016(x - 52.5)^2 + 45$ where x is the horizontal distance (in meters) from the arch's left end and y is the distance (in meters) from the base of the arch. What is the width of the arch?

$y = -0.016(x-52.5)^2 + 45$ is vertex form

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

vertex $= (h, k)$

vertex $= (52.5, 45)$



$x = 105$ m Because vertex is half the distance so you double it to get whole distance $x = 105$ m

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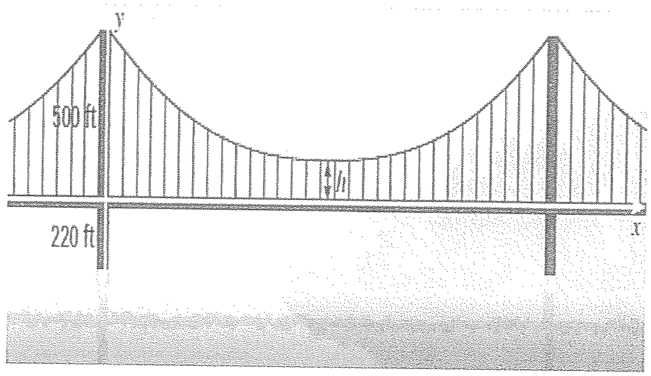
Golden Gate Bridge

Each cable joining the two towers on the Golden Gate Bridge in San Fransico, California can be modeled by the function

$$y = \frac{1}{9000}x^2 - \frac{7}{15}x + 500$$

form?

where x and y are measured in feet. What is the height h above the road of a cable at its lowest point?



The equation is in Standard form and were looking for the lowest point or the vertex. to find the vertex you use $x = \frac{-b}{2a}$ and that gives you an x value of 2100 So to find y insert x(2100) and solve

$$Y = \frac{1}{9000}x^2 - \frac{7}{15}x + 500$$

$$x = \frac{-b}{2a}$$

$$X = \frac{7/15}{\frac{2}{9000}} = 2100$$

$$Y = \frac{1}{9000}(2100) - \frac{7}{15}(2100) + 500$$

$Y = 10$ ft.

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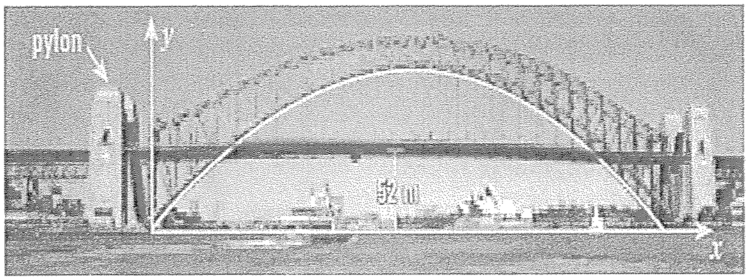
Arch of Sydney Harbor Bridge

The arch of the Sydney Harbor Bridge in Sydney, Australia can be modeled by $y = -0.00211x^2 + 1.06x$ where x is the distance (in meters) from the left pylons and **y** is the height (in meters) of the arch above the water, as shown below. For what distance x is the arch above the road?



A = -0.00211
B = 1.06
C = -52

was asked to find the values of x of the road for the points where the arch intercepts the road. This is where the arch meets the road

I used a quadratic formula because it gives $\frac{-B \pm \sqrt{B^2 - 4ac}}{2a}$ two values. If you look at the equation it gives you your A and B values. for your C value you see x axis is 52 m below road so you have to -52 which is your C plug in values and solve

$$\boxed{55.1 \le x \le \cancel{207}.85}$$

Need units (-1)

(-4) Need verbal explanation
- what were you asked to do?
- why did you use y=52?

$$\frac{-1.06 \pm \sqrt{1.1236 - 0.43888}}{0.00422}$$

$$\frac{-1.06 \pm 0.827478}{0.00422}$$

-1 calc error?

$x = \cancel{207}.85$ $\quad x = 55.1$

-6