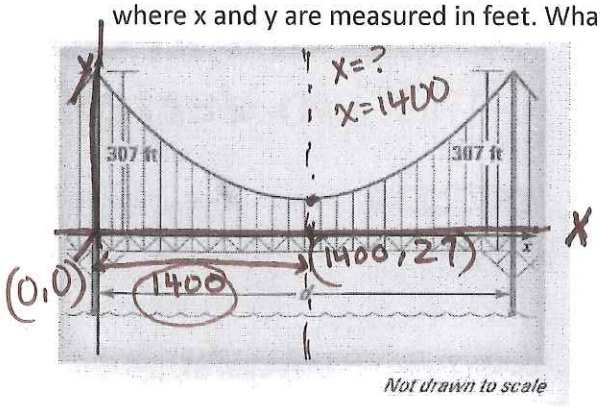
Integrated Math 2 Name: Key Period:

MODEL CARD Essential Skills 5: Quadratic Functions

Make a Model Card for the following word problem. Use pencil to show your work and colored pens to show the "why" for your execution. Pencil = calculations; RED = Questions that come to mind; BLUE = Use mathematical vocab to explain your reasoning (answer the questions). Use ACE-M

1. The Tacoma Narrows Bridge in Washington has 2 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 between the two towers?



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

What form is function written in?
Vertex form
$y = a(x-h)^2 + k$

$a = \frac{1}{7000}$

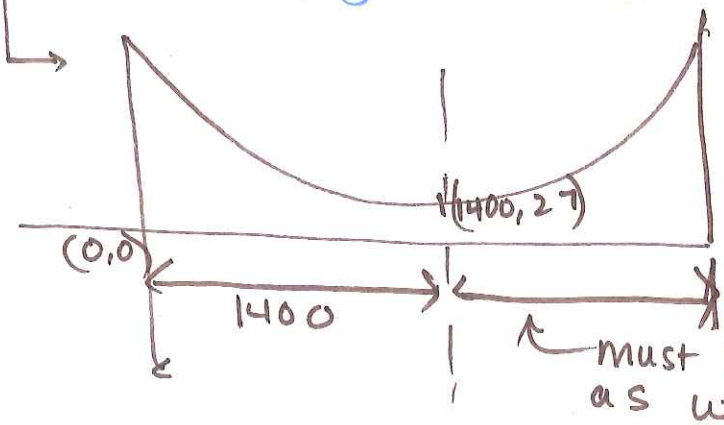
$h = 1400$

$K = 27$

What does the a, h, k values tell me about the key features of the graph?
a: + ↗↗
x=h : axis
(h,k): vertex

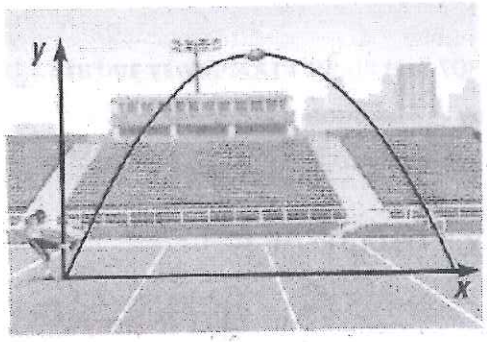
x = 1400
Vertex (1400, 27)

What do you know about axis of symmetry
Half way between 2 symmetrical pts on the graph



Total distance = 1400 + 1400 = 2800 ft

2. The path of a placekicked football can be modeled by the function $y = -0.026x(x - 46)$ where x is the horizontal distance (in yards) and y is the corresponding height (in yards).
   a. How far is the football kicked?
   b. What is the football's maximum height?



What is the given info?
$y = -0.026x(x - 46)$
↳ the path of the football

What form is this equation written in?
- looks like 3 things multiplied together
↳ intercept form.
$y = a(x - p)(x - q)$

The given function does not look exactly like intercept form
↳ how can I rewrite it?

$y = -0.026(x - 0)(x - 46)$

What values can I identify in intercept form?
a, p, q

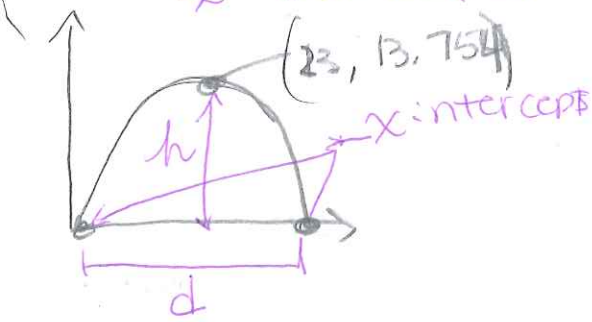
$a = 0.026$ $p = 0$ $q = 46$

What do these represent?
x-intercepts

$x = 0$ or $x - 46 = 0$
$+46 \quad +46$
$x = 46$

What is the goal?
- Maximum (vertex)
- distance between 2 x-intercepts

What are the x-intercepts?
(0, 0) & (0, 46)
↳ distance is 46 yds between



Vertex?
↳ find axis of symmetry first

$x = \frac{p+q}{2} = \frac{0+46}{2} = \frac{46}{2} = 23$ $\quad x = 23$

↳ Original function
$y = -0.026(23)(23 - 46)$
$= 13.754$

Vertex = (23, 13.754)

a) Football is kicked 46 yds
b) Max height is 13.754 yds.

2. The path of a placekicked football can be modeled by the function $y = -0.026x(x - 46)$ where x is the horizontal distance (in yards) and y is the corresponding height (in yards).
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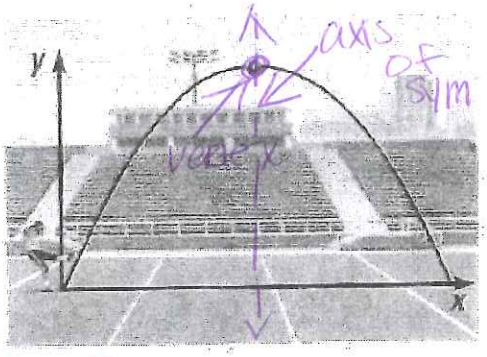


What form is the function written in?
- Does not really look like one of the forms we usually work with.

Can I make it look like a form I know?
- Multiply → standard form.

$y = -0.026x(x - 46)$ ← Distribute
$y = -0.026x^2 + 1.196x$

What form is this function in now?
Standard form $y = ax^2 + bx + c$
What info do you need to identify?
$a = ?$ $b = ?$ $c = ?$

Given?
- Graph of path of football?
- function

Goals?
- How far?
  - ↳ distance between x-intercepts
- Max height?
  - ↳ vertex (y-coordinate)

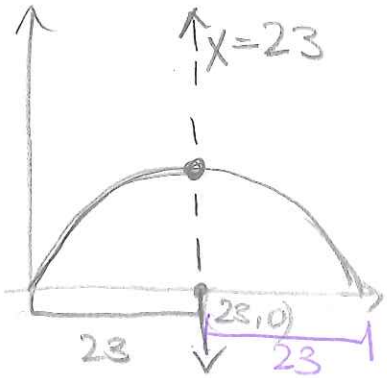
$a = -0.026$
$b = 1.196$
$c = 0$
} What info can you find? → Axis of symmetry $x = \frac{-b}{2a}$

Axis of symmetry
$x = \frac{-b}{2a} = \frac{-1.196}{2(-0.026)} = 23$

What do you know about the axis of symmetry? → How can you use this info to solve for the goals? → $x = 23$

- Plug in x into original function to find y-coordinate of vertex
- Use x-value to find distance

Where would this be in the graph?
↳ passes through vertex / max
- Middle
- Vertical line



Parabola is symmetrical
Distance from x-int to axis of symmetry is the same on both sides.

Distance between x intercepts
$23 + 23 = 46$ yds

Vertex (to find max height)
$x = 23$
$y = -0.026x(x - 46)$
$= -0.026(23)(23 - 46)$
$= 13.754$ yds

MAX height = 13.754 yds