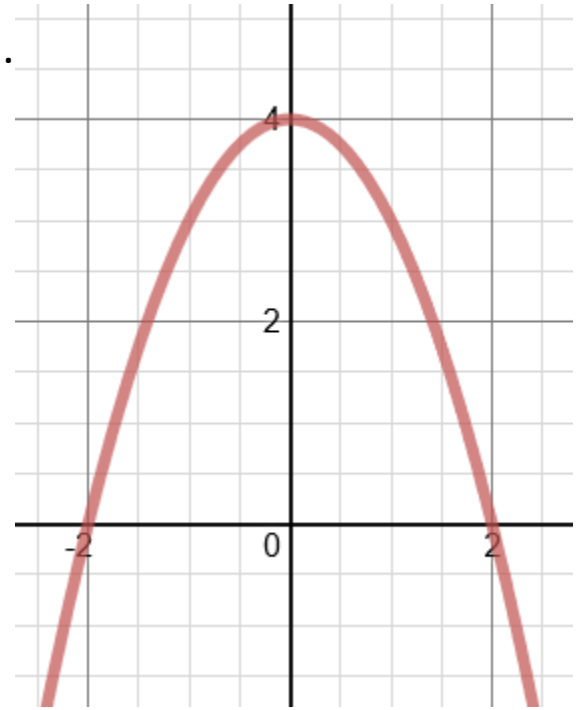
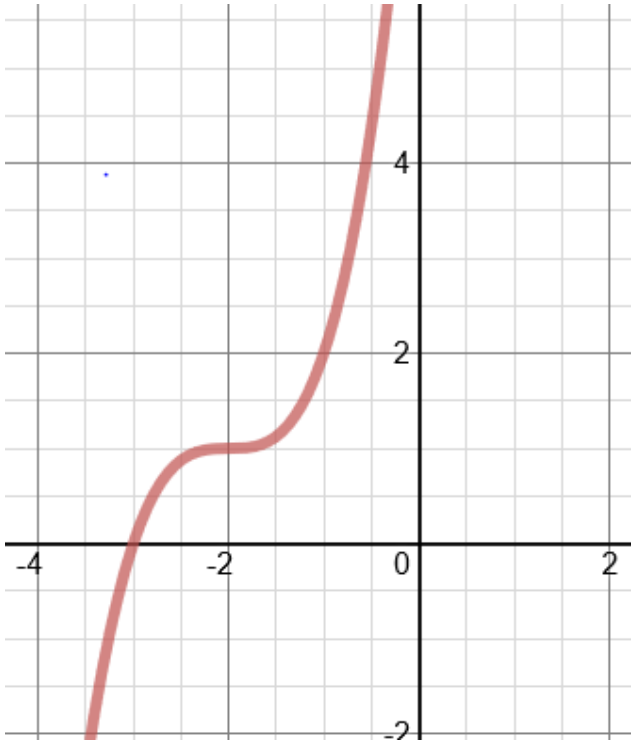
Warm-up

Write the function equation for the graphs pictured below.

1.



2.



3. Write the equation for a cubic function that has been shifted left 2 units and down 3 units.

4. Write the equation for a radical function that been flipped over the x axis and stretched by a factor of 7.

5. Write the equation for a quadratic function that shifted right 1 units and up 84 units.

Homework questions?

Objectives for today

Describe the transformations that are applied to functions that have already been transformed from a parent function.

Write equations from descriptions of transformations of transformed functions.

In other words, TRANSFORMATIONS OF TRANSFORMATIONS!

Use function equations to model real world applications.

Transformations

Vertical Transformations

Function Notation	Description of Transformation
$g(x) = f(x) \pm c$	Vertical shift **up** C units if C is **positive**
	Vertical shift **down** C units if C is **negative**

Horizontal Translations

Function Notation	Description of Transformation
$g(x) = f(x \pm c)$	Horizontal shift **left** C units if C is **positive**.
	Horizontal shift **right** C units if C is negative

Reflections

Function Notation	Description of Transformation
$g(x) = -f(x)$	Reflected over the **x-axis**
$g(x) = f(-x)$	Reflected over the **y-axis**

Vertical Stretches and Compressions

Function Notation	Description of Transformation
$f(x) = cf(x)$	Vertical **Stretch** if $c > 1$
	Vertical **Compression** if $0 < c < 1$

Transformations

How do we transform a function that has already been transformed from the parent function?

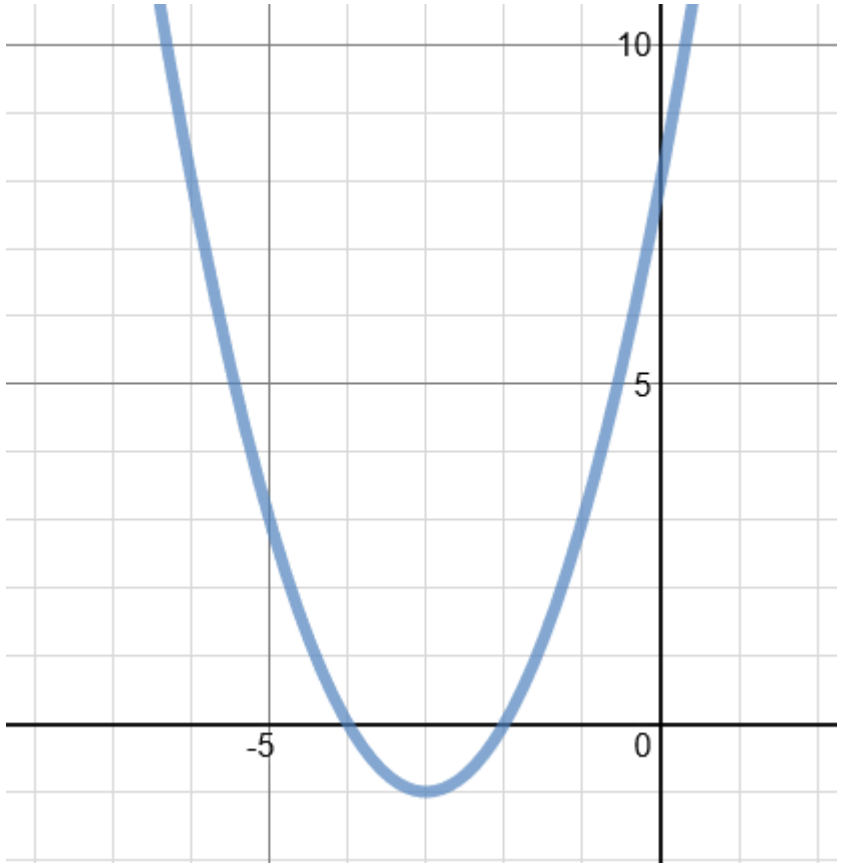
The function pictured is $f(x) = (x+3)^2 - 1$

What would the equation be if the entire function is shifted up two units?

What part of the equation represents a vertical shift?

Add the number of units we want to shift the graph up to -1.

The resulting function is $g(x) = (x+3)^2 + 1$



Transformations

How do we transform a function that has already been transformed from the parent function?

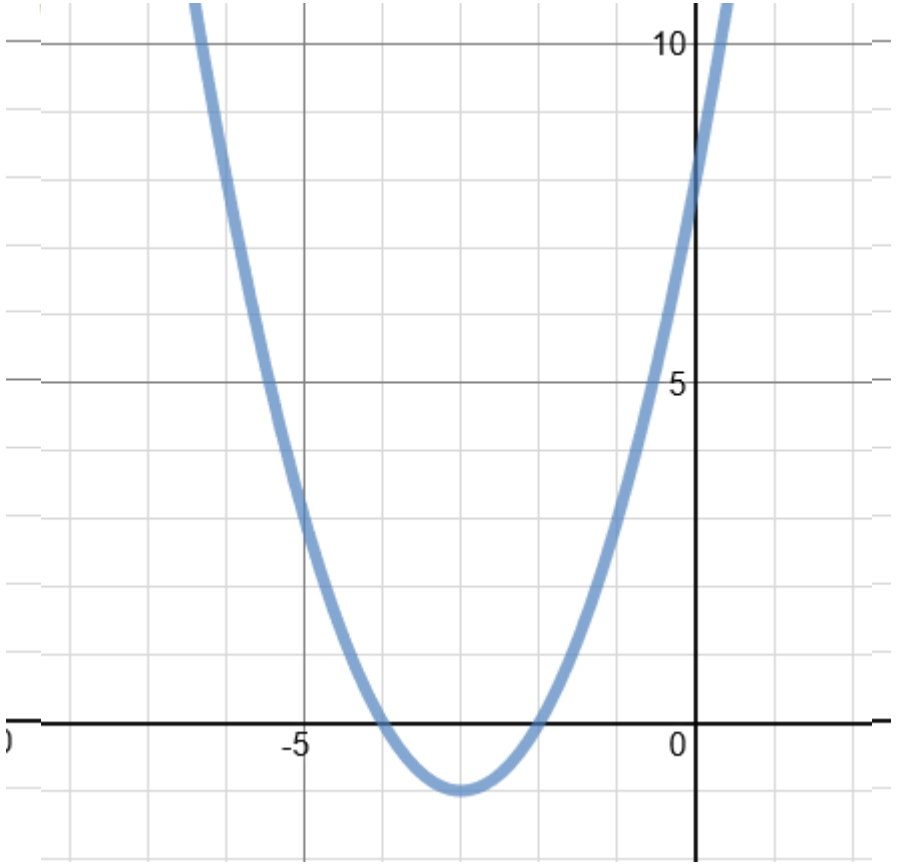
The function pictured is $f(x) = (x+3)^2 - 1$

What would the equation be if the entire function is shifted left 3 units?

What part of the equation represents a horizontal shift?

Add the number of units we want to shift the graph left to 3.

The resulting function is $g(x) = (x+6)^2 - 1$



Transformations

How do we transform a function that has already been transformed from the parent function?

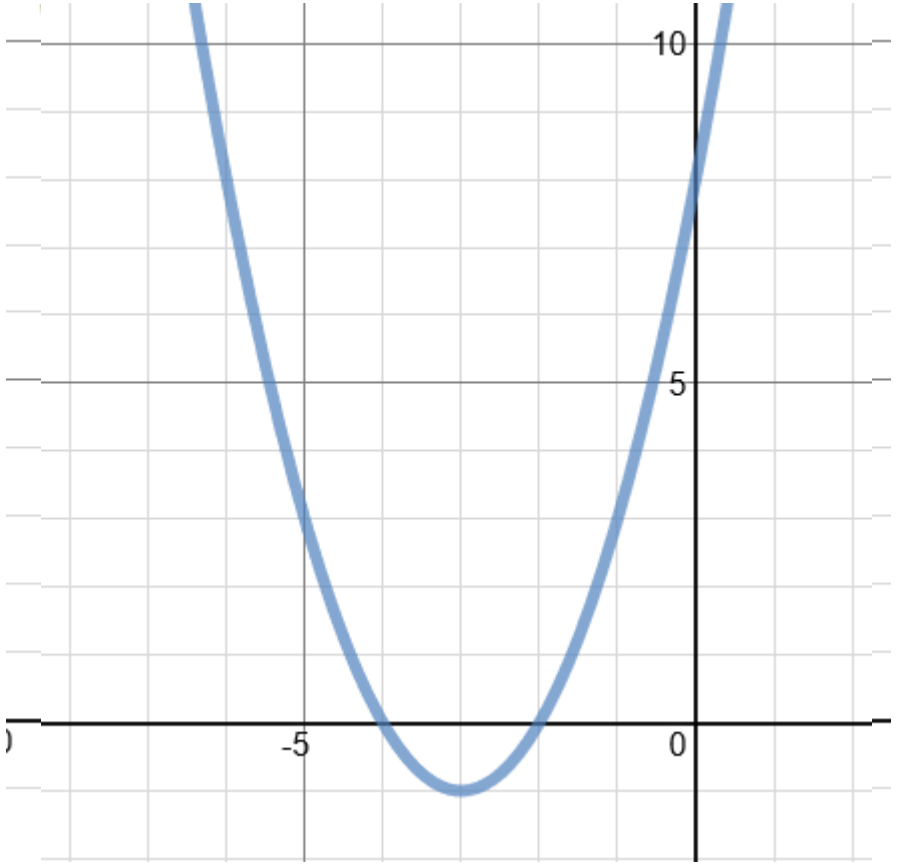
The function pictured is $f(x) = (x+3)^2 - 1$

What would the equation be if the entire function is shifted left 3 units?

What part of the equation represents a horizontal shift?

Add the number of units we want to shift the graph left to 3.

The resulting function is $g(x) = (x+6)^2 - 1$



Transformations

If I start with this function…

$$f(x) = -\frac{1}{2}(x-6)^3 + 2$$

And then I shift it left 3 and down 1 what do I end up with?

$$f(x) = -\frac{1}{2}(x \boxed{-6}\ )^3 \boxed{+2}$$
$$\boxed{+3} \quad \boxed{-1}$$

$$g(x) = -\frac{1}{2}(x-3)^3 + 1$$

Add 3 to send left
Subtract 1 to send down

Transformations

If I start with this function…

$$f(x) = -\frac{1}{2}(x-6)^3 + 2$$

And then I shift it right 2, up 1 and stretch by a factor of 2 what do I end up with?

$$f(x) = -\frac{1}{2}(x-6)^3 + 2$$

$$\times 2 \qquad -2 \quad +1$$

Multiply by 2 to stretch
Subtract 2 to send right
Add 1 to send left

$$g(x) = -(x-8)^3 + 1$$

Transformations

On the Transformations – Pulling it all together worksheet...

The following are transformations of the functions you graphed in problems 14-17.

14.a. Write the new function that would be created if the function $y = (x + 2)^2 - 3$ is shifted right 1 unit and up 3?

15.a. Write the new function that would be created if the function $y = -2|x - 3| + 2$ is vertically stretched by a factor of 3 shifted down 1 unit?

16.a. What transformations would change the function $y = 4x + 5$ to $y = -x$?

17.a. What transformations of $y = (x + 2)^2 - 3$ yield the function $y = -\frac{1}{2}(x - 1)^2 + 9$?

Quiz time!

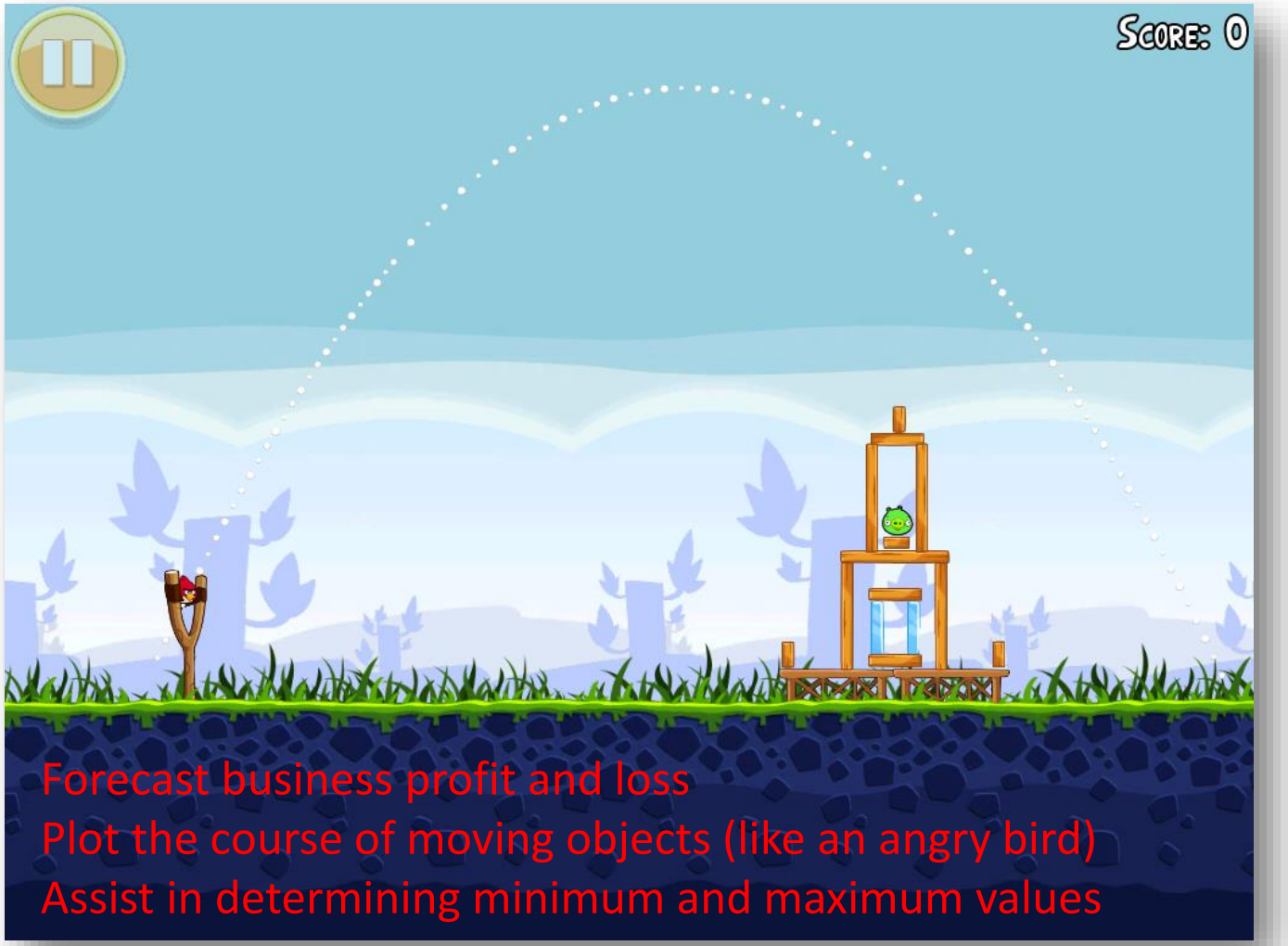
What do all these pictures have in common?

A celebration of Quadratic Functions

Widely used in science, business, and engineering

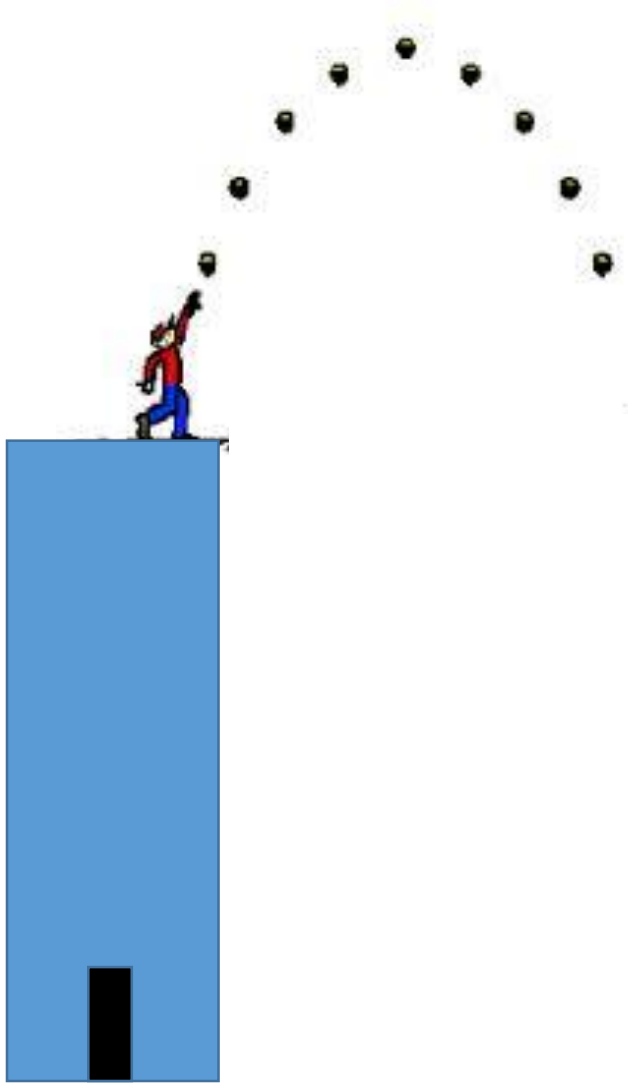
U-shape can describe the trajectories of water jets in a fountain, a bouncing ball, and angry birds

On a more serious note…



A celebration of Quadratic Functions

#1 on your worksheet



A ball is thrown vertically upward from the top of a building with an initial speed of 80 feet per second.

The height in feet above the starting point after t seconds is given by the equation

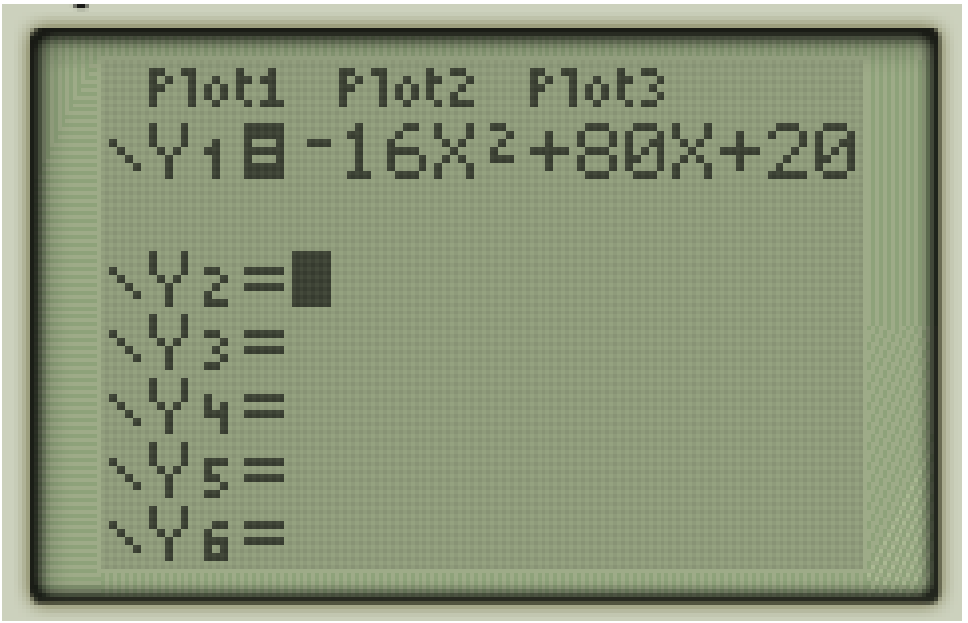
$$h(t)=-16t^2+80t+20$$

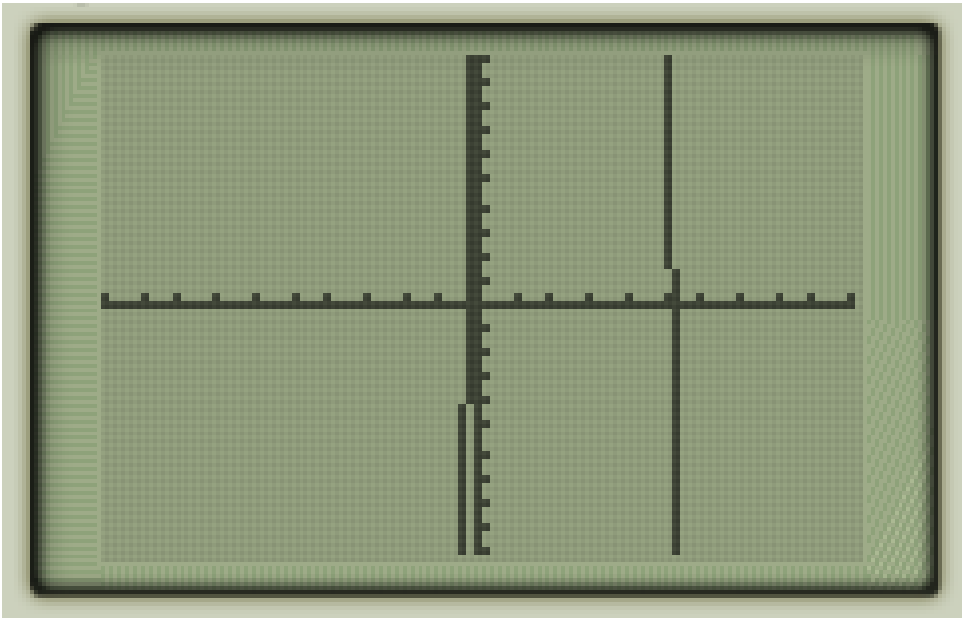
What is the maximum height reached by the ball?

Step 1: Turn on your calculator

Step 2: press [Y=] and enter the equation given.

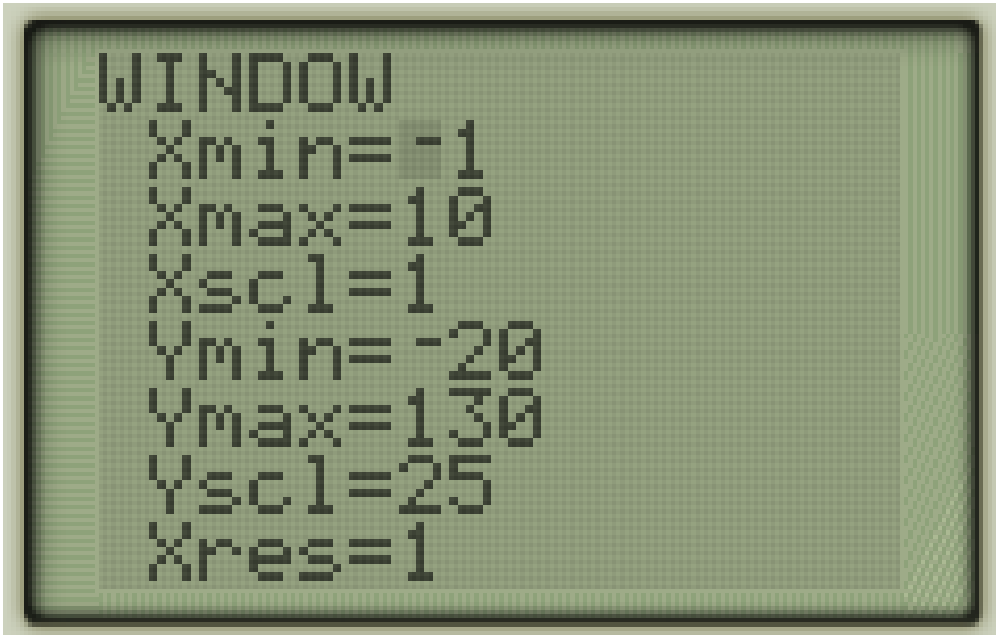
Step 3: press [GRAPH]



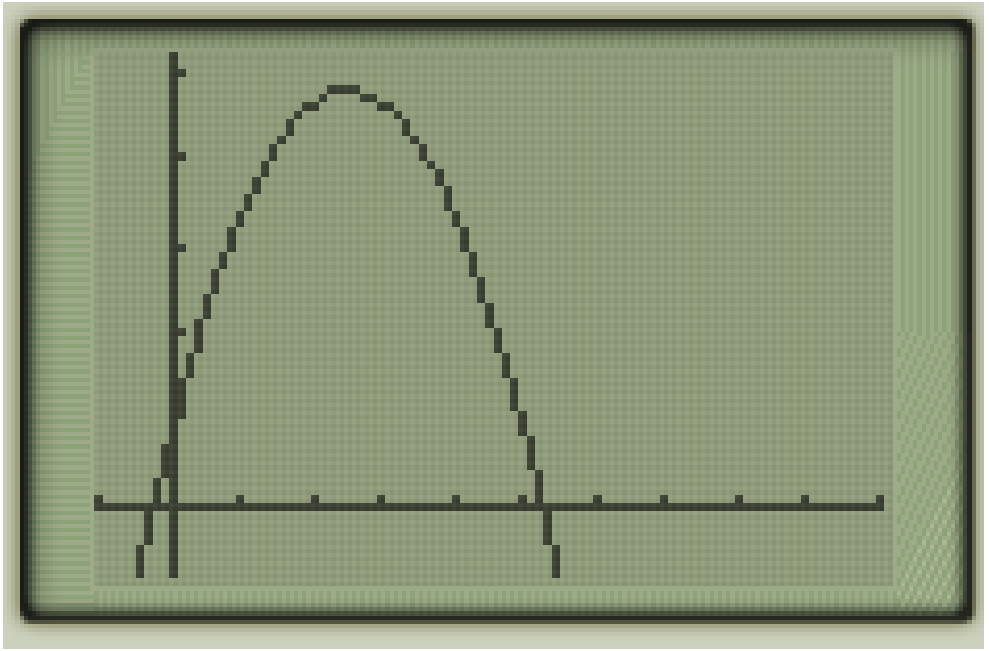


Not helpful!

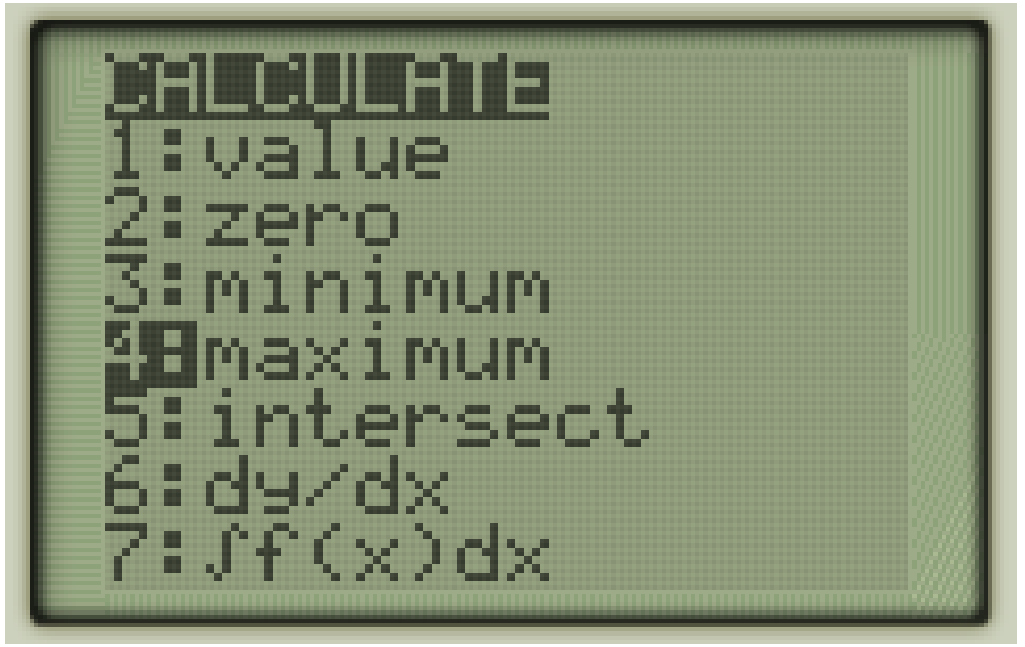
Step 4: press [WINDOW] and change the settings as indicated here.



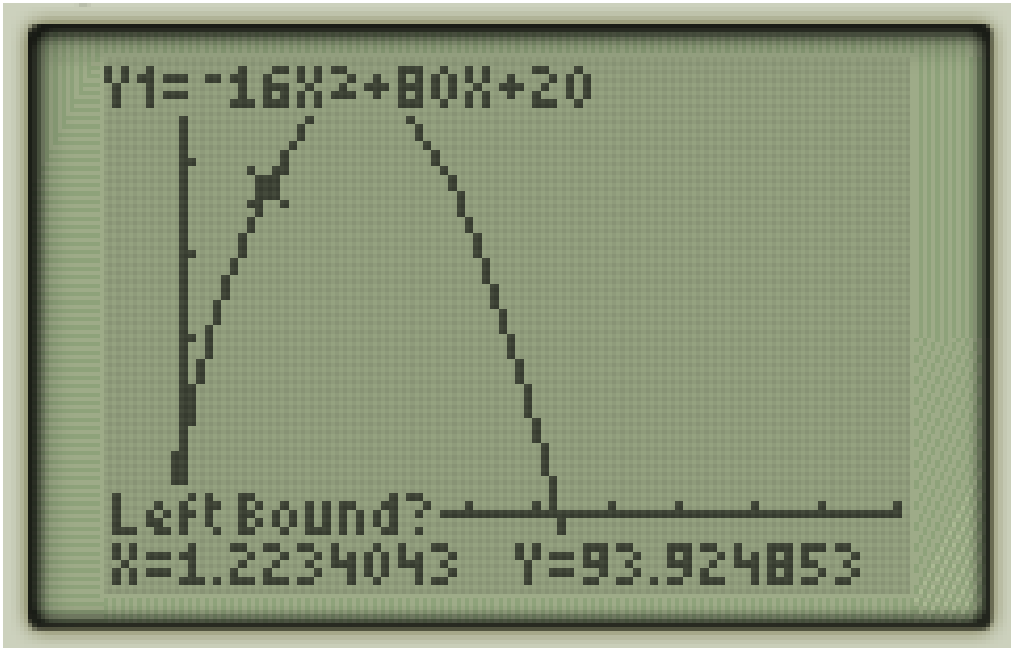
Step 5: press [GRAPH]



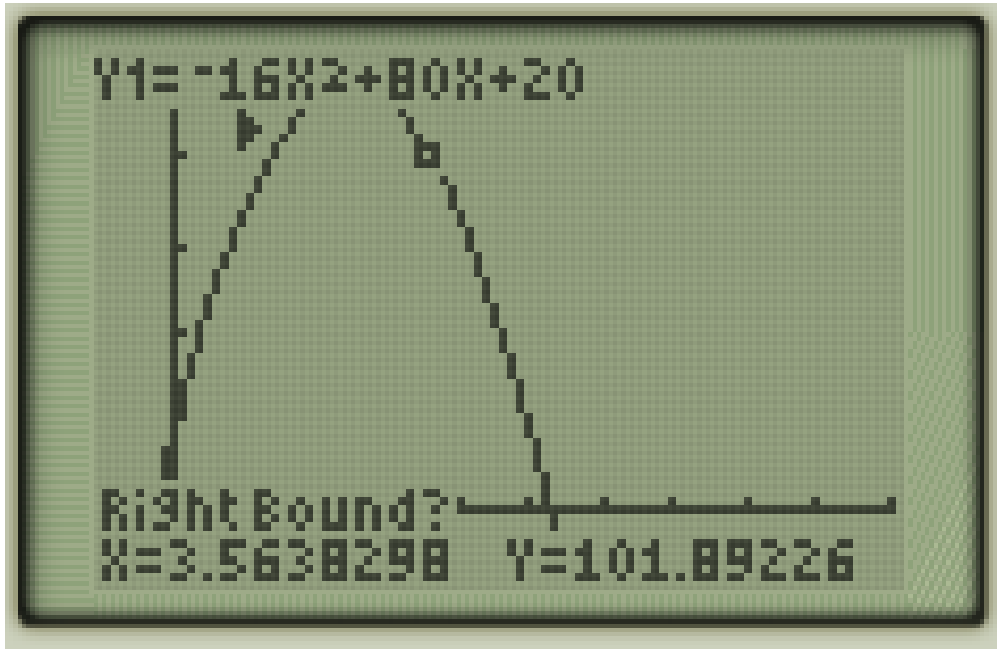
Step 6: press [2nd][TRACE] and select option [4:maximum]



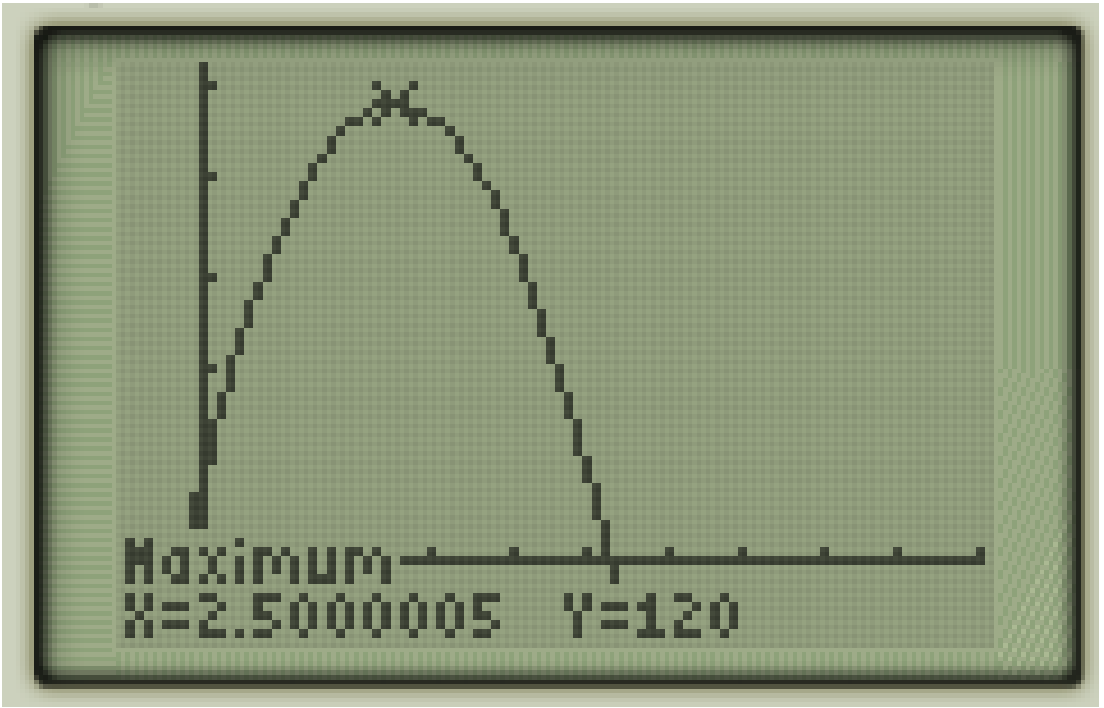
Step 7: Move the cursor using the arrow keys to the left of the maximum point on the graph and press [ENTER].

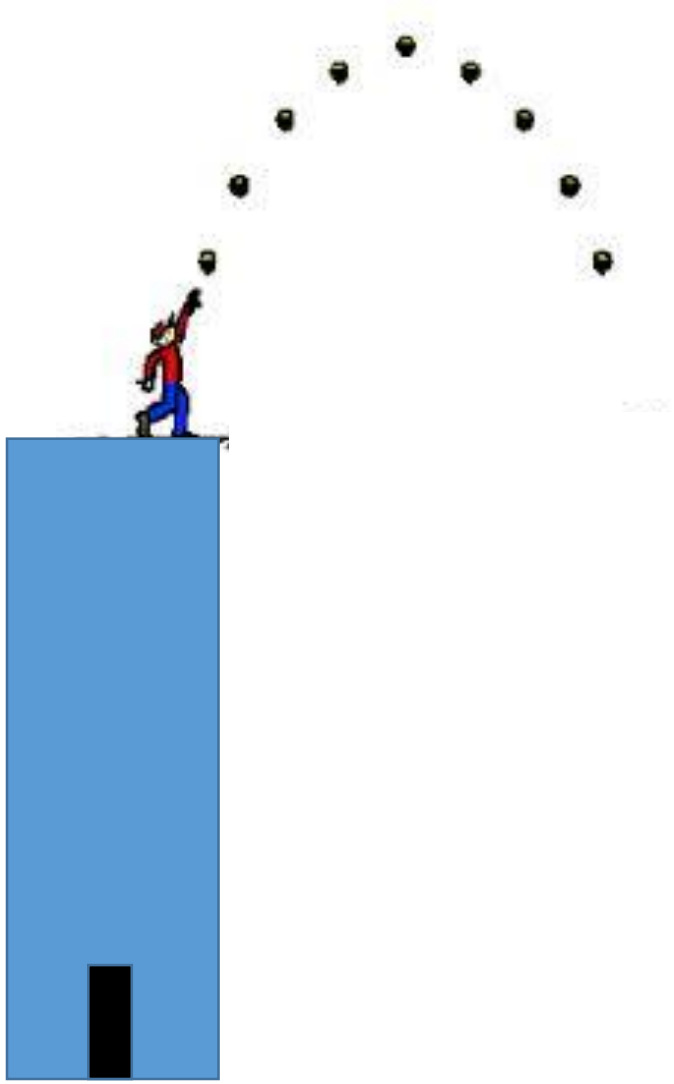


Step 8: Then move the cursor to the right of the maximum point and press [ENTER].



Step 9: Verify your maximum is between the two arrows. Then press [ENTER] again.



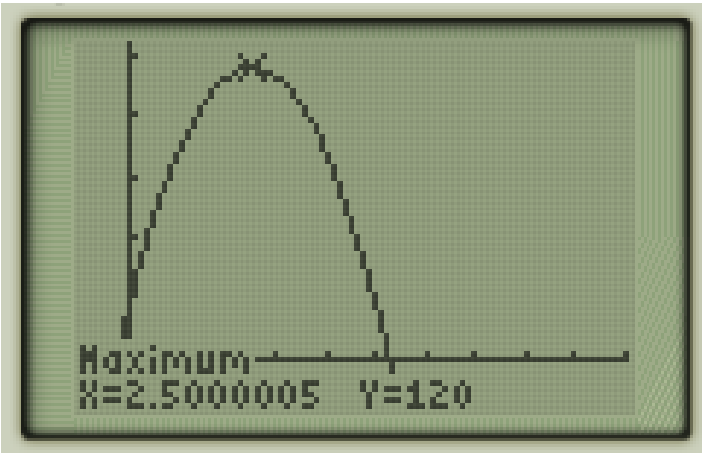


A ball is thrown vertically upward from the top of a building with an initial speed of 80 feet per second.

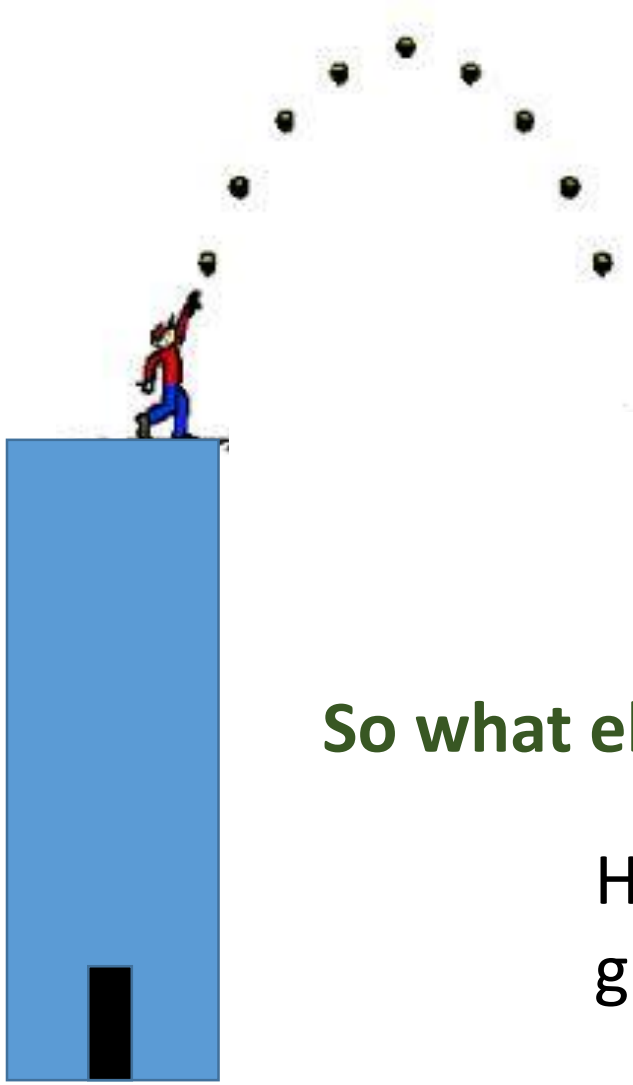
The height in feet above the starting point after t seconds is given by the equation

$$h(t)=-16t^2+80t+20$$

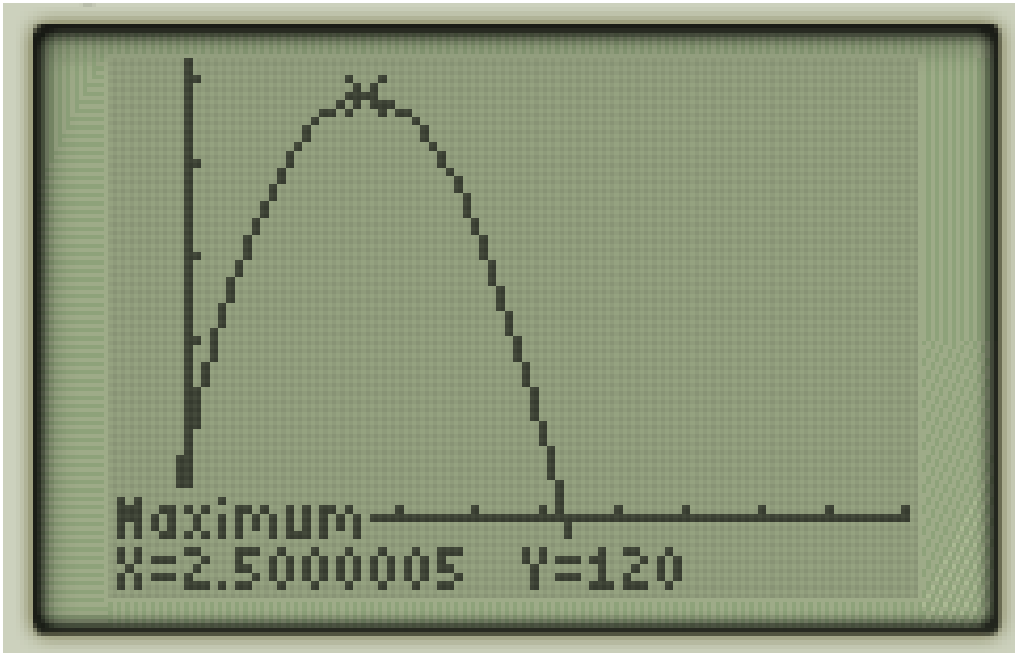
What is the maximum height reached by the ball?



The **height** in feet above the starting point after **t seconds** is given by the equation $h(t)=-16t^2+80t+20$.



Y: HEIGHT

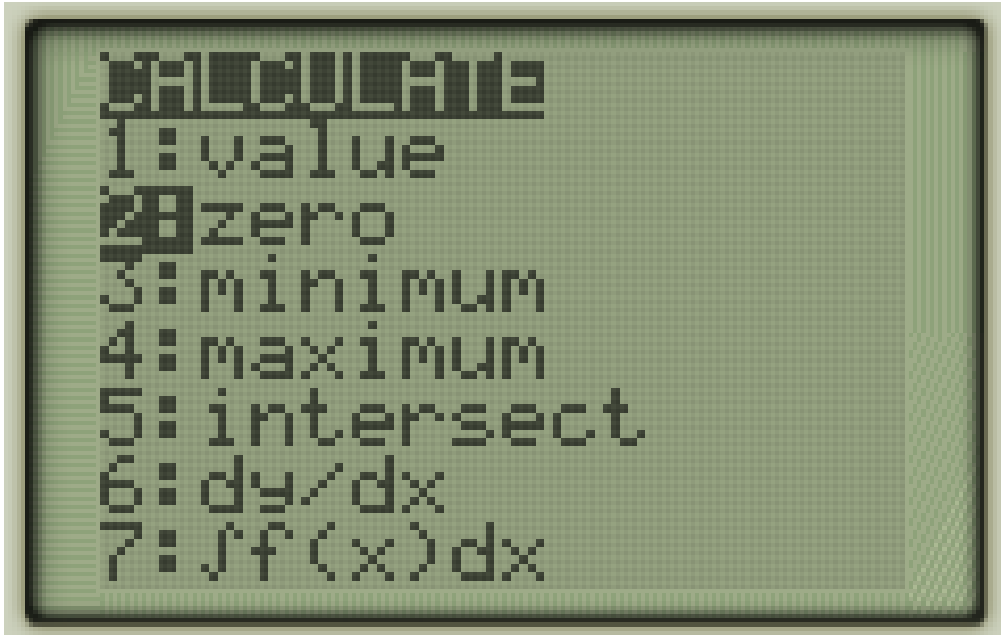


X: TIME in seconds

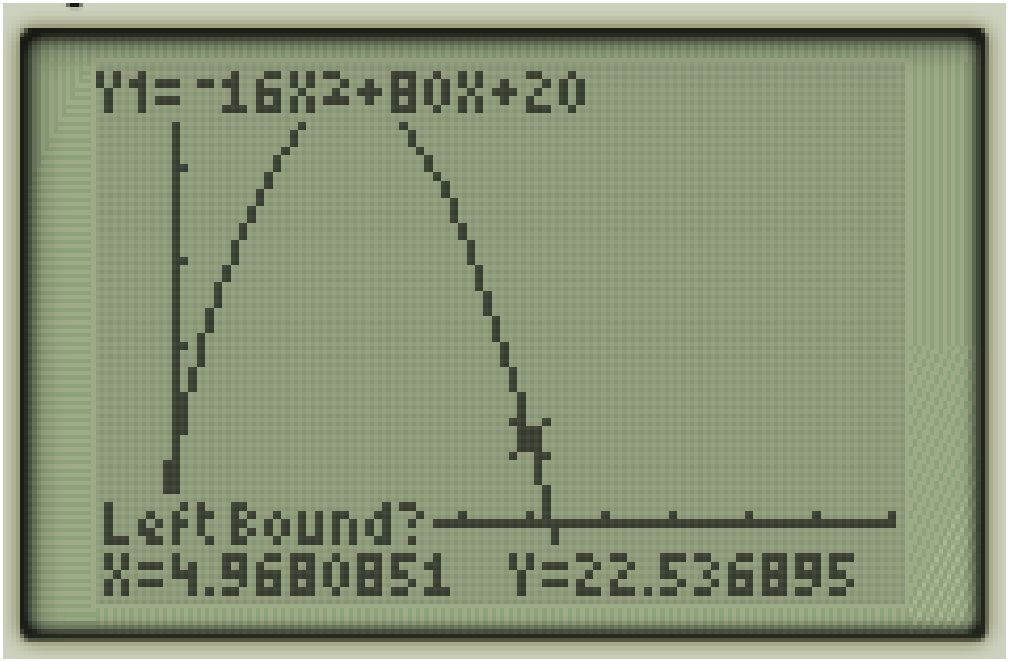
So what else can we tell from this graph?

How many seconds will have elapsed when the ball hits the ground?

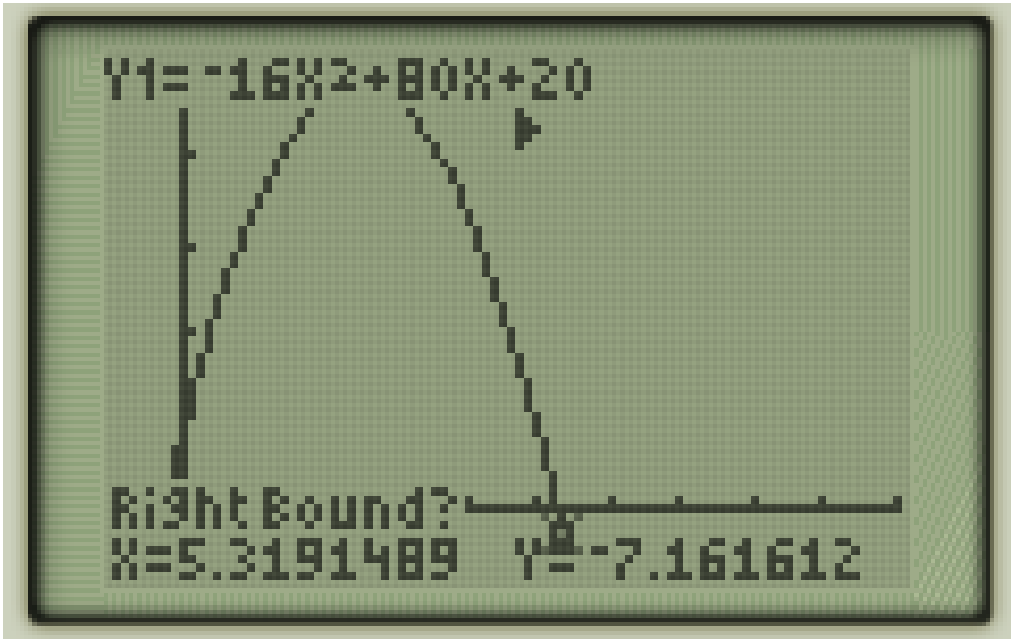
Press [2nd][TRACE] and select option [2:zero]



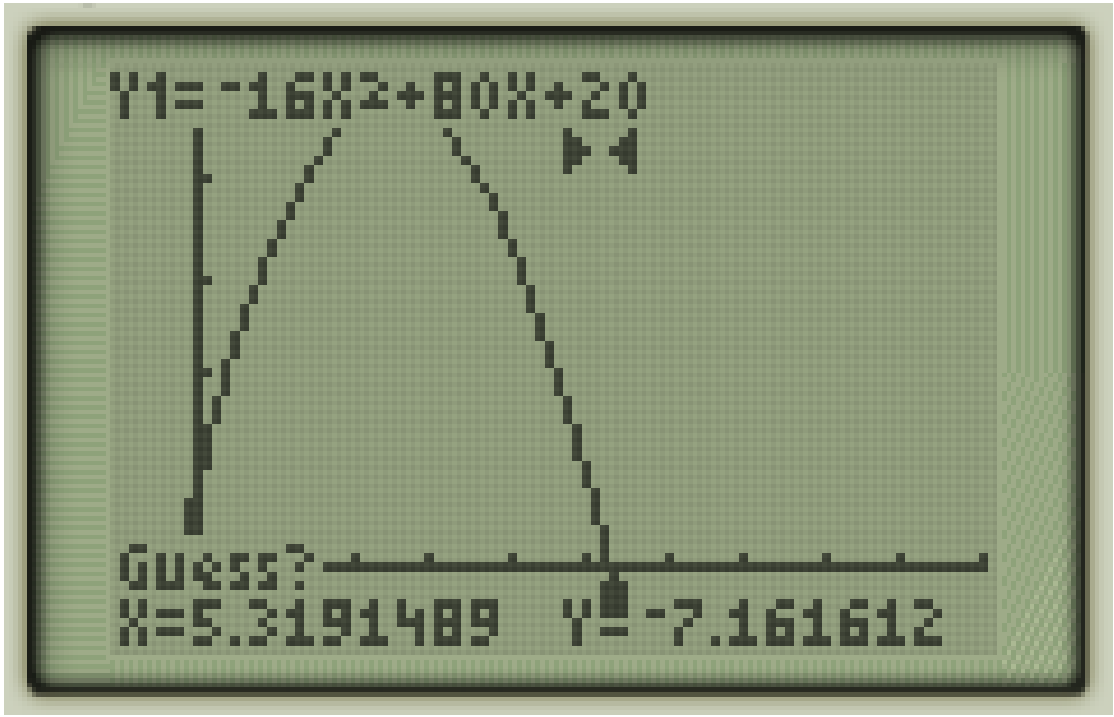
Move the cursor using left/right arrow keys above x-intercept on the graph and press [ENTER].



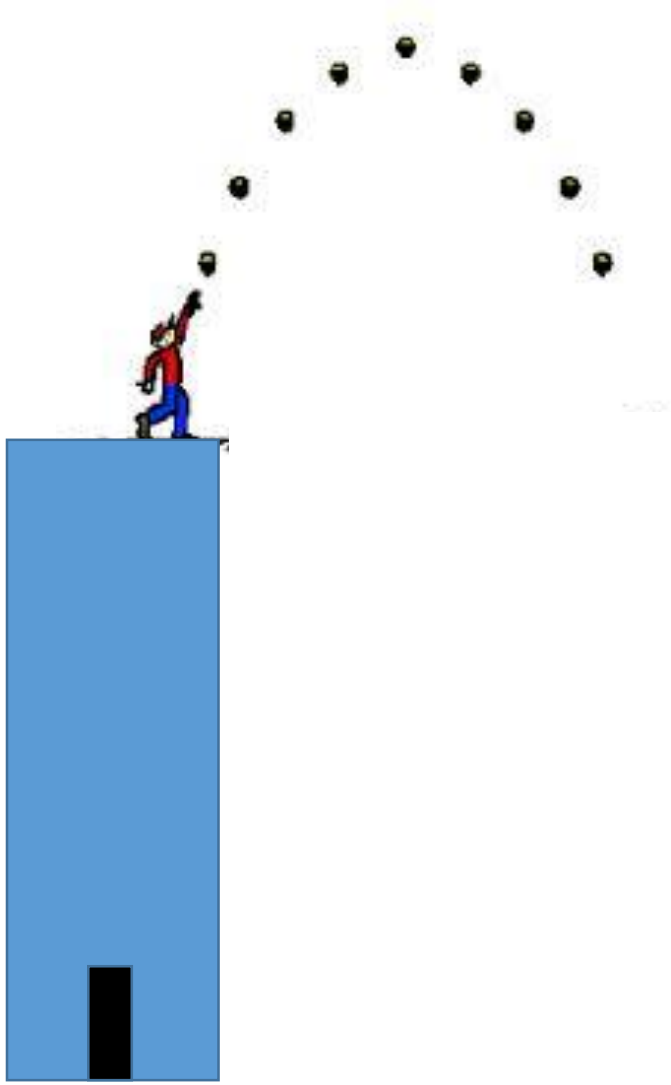
Then move the cursor below the x-intercept and press [ENTER].

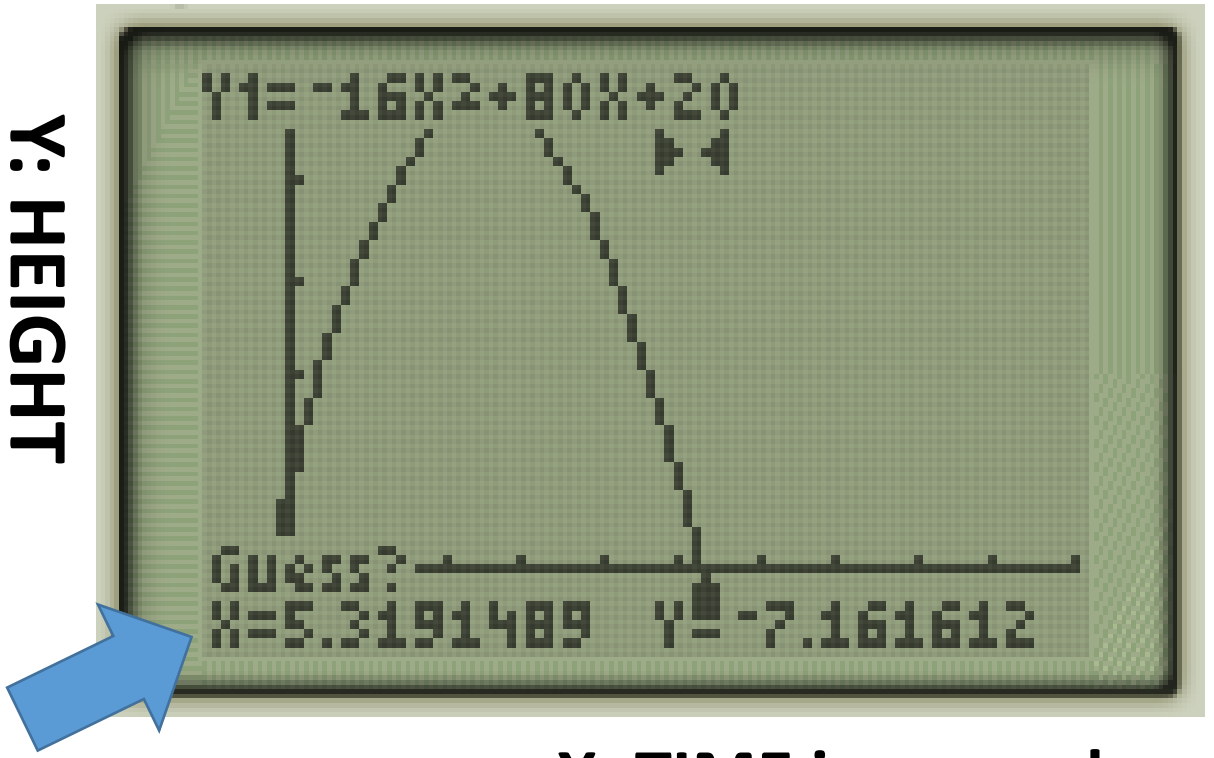


Step 9: Then press [ENTER] again.



How many seconds will have elapsed when the ball hits the ground?





Y: HEIGHT

X: TIME in seconds

A shot-put throw can be modeled using the equation

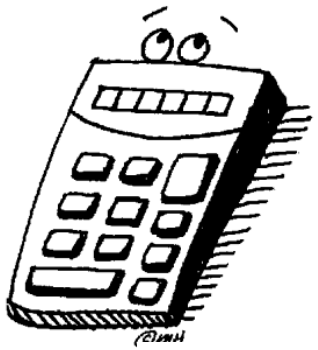
$$h(t)=-0.0241x^2+x+5.5$$

where **x** is the **distance** traveled in feet and **h(t)** is the **height** in feet.

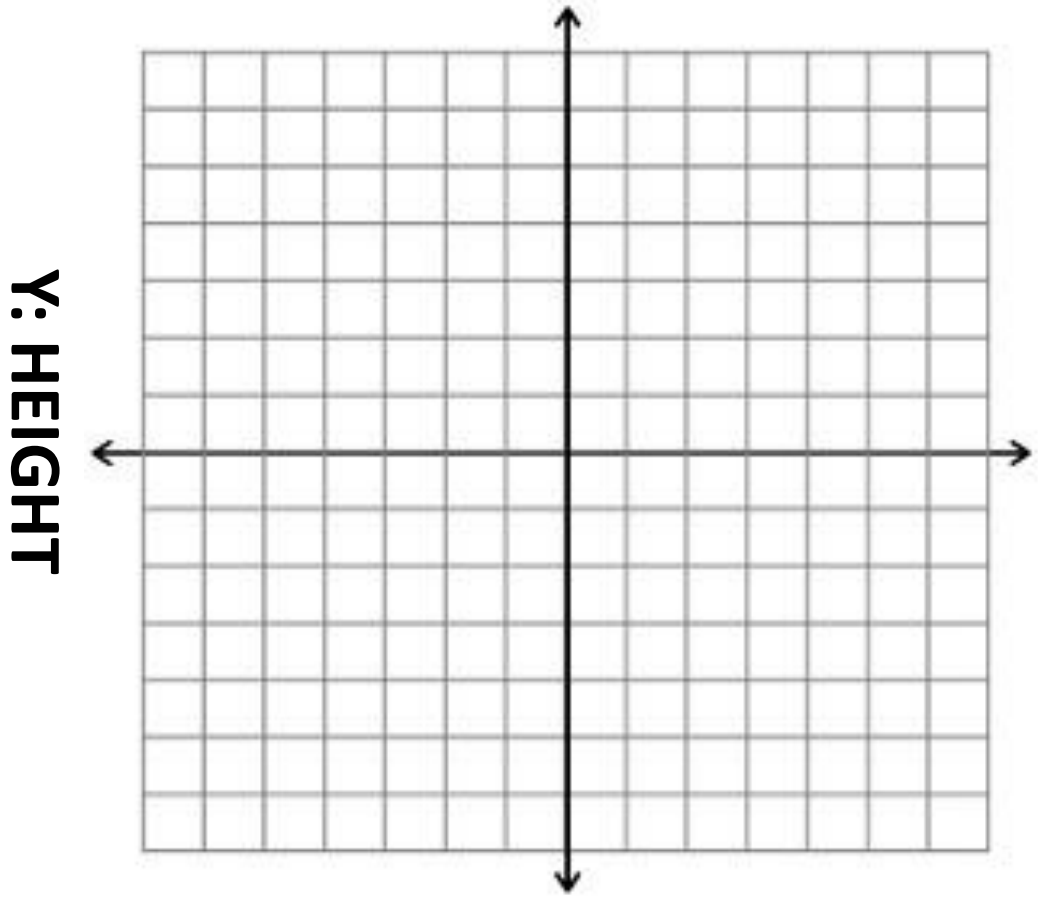
#2 on your worksheet

1. How long was the throw?

2. How high did the shot get put?

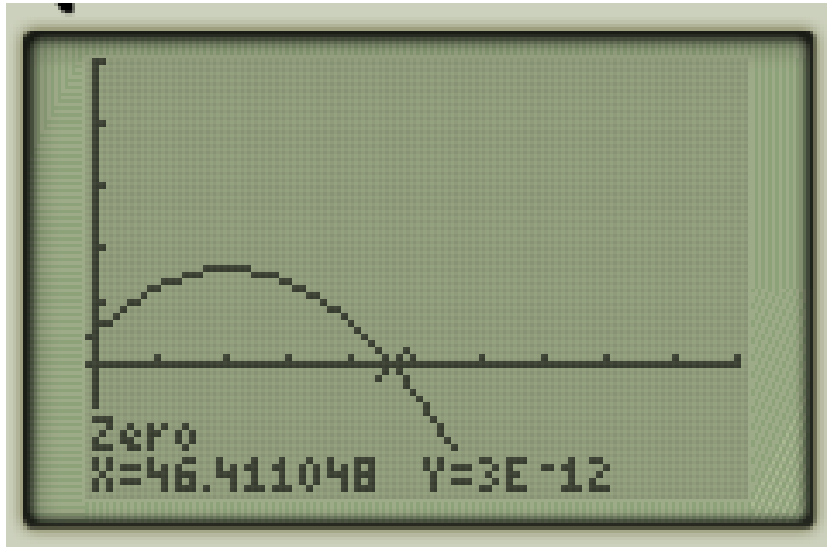


Press [Y=] and enter the function

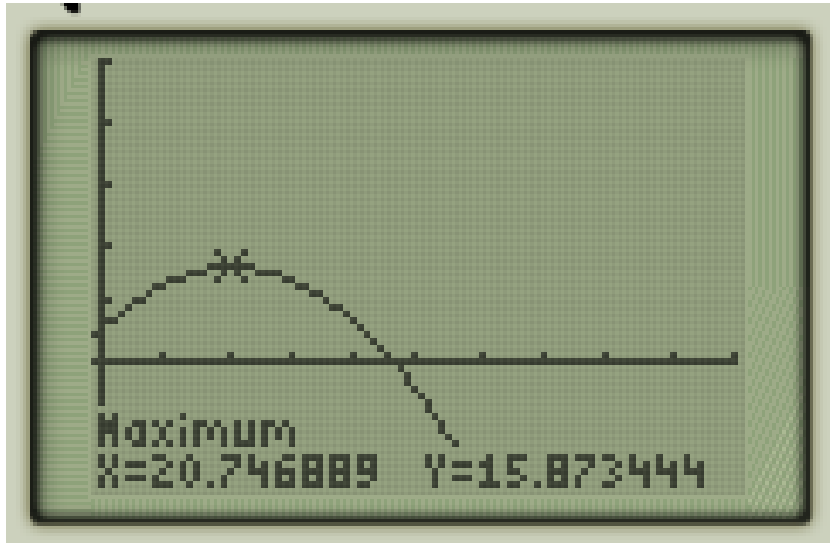


What's a realistic viewing window?

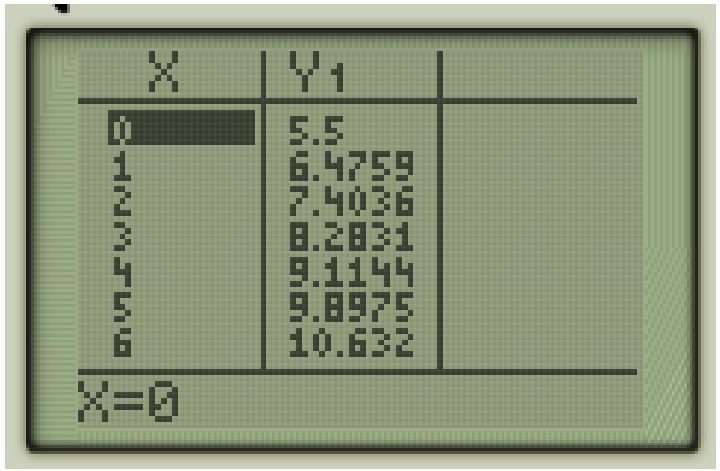
1. How long was the throw?



2. How high did the shot get put?

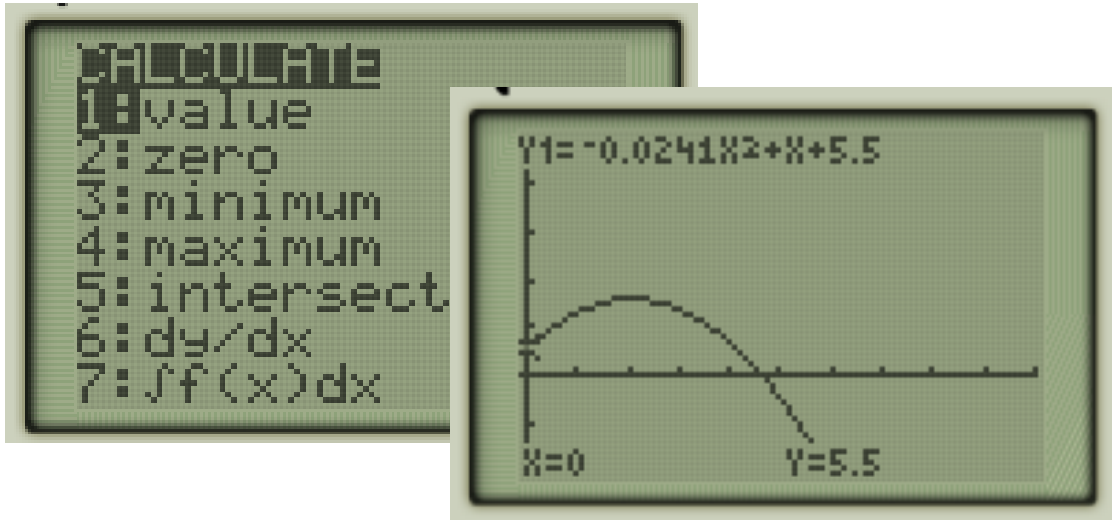


Bonus: How tall is the shot putter?



X	Y1
0	5.5
1	6.4759
2	7.4036
3	8.2831
4	9.1144
5	9.8975
6	10.632

X=0



#3 on your worksheet

A farmer has 1000 feet of fencing and a very big field. She can enclose a rectangular area with dimensions **x** feet and **500-X** feet. What is the largest rectangular area she can create?

Area = Length times Width

Area = (x)(500-x)
$=500x-x^2$

What are realistic values for x?

A farmer has 1000 feet of fencing and a very big field. She can enclose a rectangular area with dimensions **x** feet and **500-X** feet. What is the largest rectangular area she can create?

Realistic X… $0<x<500$

Can length or wide be negative? Zero?

Realistic Y…

Pick a number halfway between 0 and 500. Plug that into your area function. Use the answer to determine the Y saettings.

Area = Length times Width

Area = (x)(500-x)
$=500x-x^2$

What is the maximum area that can be fenced?

What are the dimensions of the rectangle?

Exit Slip

List three things you know how to do on the calculator when solving Quadratic Word Problems.

What did you struggle most with today?

What do you remember about…

Create graphs for functions that have been transformed and are in the form

$$g(x) = a \cdot f(x + h) - k$$

Interpret function equations that are in the above form and identify the transformations that have been applied to the parent function $f(x)$.

Describe the transformations that are applied to functions that have already been transformed from a parent function.

I spy functions!