

**Enrichment**  
**Objective 4.02**  
**Evaluating Quadratic Functions to Solve Problems**

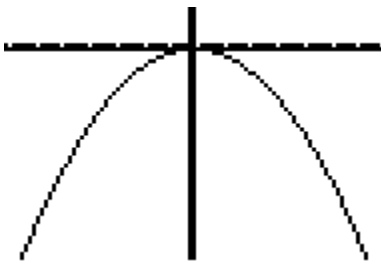
Quadratic Function Applications using the Graphing Calculator

**Example 1**

You are playing tennis and hit the ball over the net. The equation  $h(t) = -4.9t^2 + 5.8t + .5$  gives the ball's height  $h$  in meters at time  $t$  in seconds. When will the ball be at the highest point? What is the highest point?

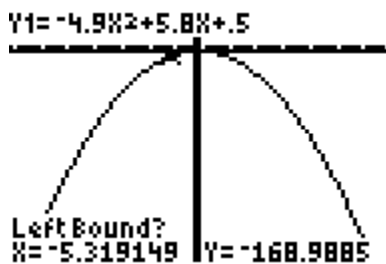
**1<sup>st</sup>:** Put the equation in Y= then press Zoom 0. You may have to Zoom 2 & 3 (in and out) a couple of times to get the graph just right.

Here is the graph of the function given.

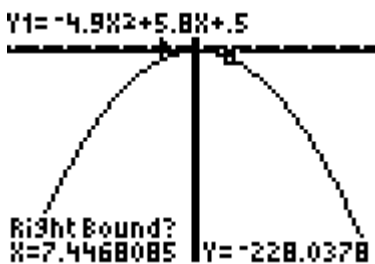


**2<sup>nd</sup>:** The question asks for the highest point of the tennis ball, so you are looking for the maximum. The x value is time, and the y value is meters. To find the maximum of the graph, go to 2<sup>nd</sup> Trace (calc) #4.

Left Bound? (cursor to the left of the maximum) Enter

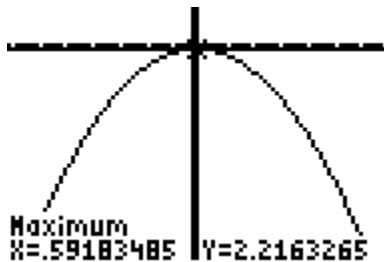


Right Bound?(cursor to the right of the maximum) Enter



Guess? Enter

The ball will be at its highest point in approximately 0.59 seconds. The highest point of the ball is about 2.2 meters.



*You try:*

1. Brian kicks a football in the air. It follows a path given by the equation  $y = -16x^2 + 25x + 4.5$  where  $x$  is time in seconds and  $y$  is in feet. What is the maximum height of the football? How long does it take to reach the highest point?
2. Sue has a new invention. She takes it to a company, and they agree to market it. Together, Sue and the company come up with the function  $S(p) = -64p^2 + 1600p$  to predict the total sales ( $S$ ) as a function of the price ( $p$ ) of the invention. What price for each item will produce the highest sales? How much money can they expect to make? If Sue gets 47% of the sales, how much money can she expect to make?

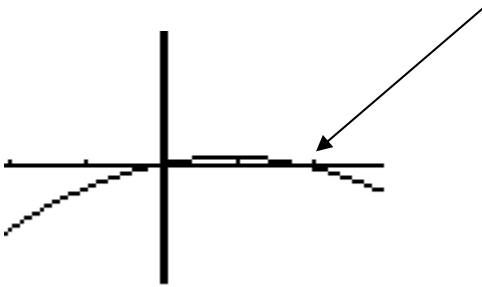
Answer: 1. The maximum height of the football is 14.27 feet. It takes 0.78 seconds to reach the maximum height. 2. \$12.50 will produce the maximum sales of \$10,000. Sue would make \$4700.

**Example 2:**

Jack and Jill are playing catch. Jack throws the ball into the air for Jill to catch. The formula can be represented by  $h(t) = -16t^2 + 29t + 6$  where  $h$  is the height in feet, and  $t$  is time in seconds. A) What if Jill misses the ball—how long does it take to hit the ground? B) Jill actually does catch the ball at 7 feet in the air. At what time/s could she have caught the ball?

Graph the function (you may want to get a zoomed in version of the graph to answer all of the questions given).

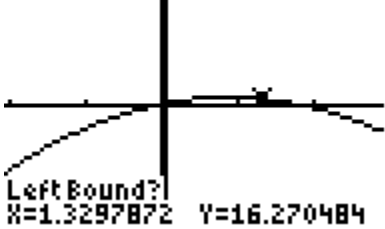
Where the ball hits the ground



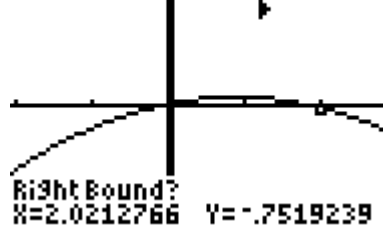
To find how long it takes for the ball to hit the ground, you need to find the x value when y is zero.

2<sup>nd</sup> Trace #2

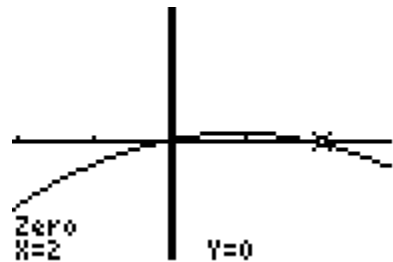
Left Bound? Enter  
Y1= -16X<sup>2</sup>+29X+6



Right Bound? Enter  
Y1= -16X<sup>2</sup>+29X+6

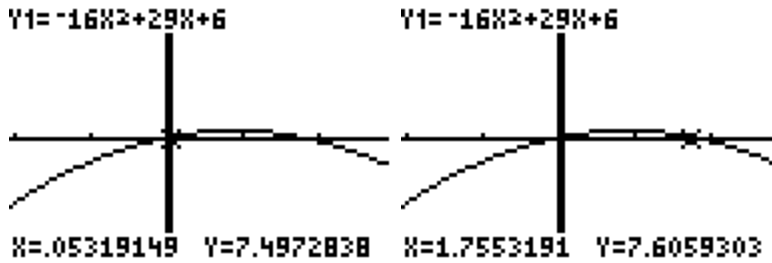


Guess? Enter



It takes 2 seconds for the ball to hit the ground.

B) At what time/s is the ball 7 feet in the air? 7 feet gives you the y value. You are looking for the x. On the graph use the TRACE key to bring the cursor on the function. Trace until you find the time/s that  $y = 7$ . You may not be able to get the graph on exactly 7, so just estimate.



Around 0.05 and 1.76 seconds are the times Jill could have caught the ball.

**You try:**

1. Mrs. Jones throws an Algebra I book in the air to watch it fly in a parabolic arc. The equation of the parabola that the book follows is  $h(t) = 6 + 48t - 16t^2$ , where  $h$  is the height of the book in inches and  $t$  is the time in seconds. Find the following:

- a) The maximum height of the book
- b) How long it takes the book to reach maximum height
- c) The approximate height of the book after 1 second
- d) At what time/s the book is 16 feet in the air

2. Joe Throw plays basketball for UNC. He is fouled, and stands at the line to shoot a free throw. The equation for the motion of the basketball is  $h(t) = 6 + 32t - 16t^2$ , where  $t$  is the time in seconds and  $h(t)$  represents the height of the basketball in feet. Poor Joe shoots an air ball (the ball does not hit anything at all), and the ball comes crashing down to the floor. Find the following:

- a) The height of the ball after 1 second
- b) The time it takes for the ball to hit the floor

Answers: 1. a) 42 inches b) 1.5 seconds c) 38 inches d) 0.22 seconds and 2.7 seconds

2. a) 22 feet b) 2.1 seconds