Help with Quadratics

After you enter your equation, here are some questions that may be asked and here are steps on your calculator for finding them!
Remember x = time and y = height

1. When it asks you when the **object falls to the ground**, or when the height is at 0, you need to use the "zero" option on your calculator. The "zero" option b/c there is "0" height (it is at the ground). Go to 2nd trace #2 (this is the "zero" option). It will ask you for left bound and a right bound. Just go to the left of where the graph is crossing the x-axis and press enter. Now scroll with your arrow key until you are to the right of the x-axis. Press enter. Press enter one more time. (Notice the 2 arrows up at the top of your screen, they should be pointing towards one another, not away from each other, if so, your left and right bounds are backwards). Notice it says zero at the bottom after you have pressed enter. X = number, y = 0. Again, b/c y = height and since it is at the ground, there is no height. X is the desired time it takes to reach the ground. That is your answer!

2. The **highest peak** at which the object is in the air is found under 2nd trace 4 (maximum). Again it will ask you the left and right bounds of the max. Just go to the left of the max, press enter, go to the right press enter and press enter again. The x = time it takes to reach the maximum height and y = the maximum height. (Same thing goes if you want to find the minimum, but it is 2nd trace # 3)

3. If it asks you when an object **will be at a certain height,** then you need to go back to y= and in y2, put the height in which you are referring to. If you go back to your graph, you will see the horizontal line going through your quadratic equation. You want to find the intersection. Go to 2nd trace #5 (intersect) and get your cursor right on the intersection of the two and press enter 3 times. The x again tells you the time and y = ht in which you put into y2. There may be 2 intersections. One for the height of the object on the way up in the air and other on the way back down.

Formulas to know:
Perimeter: P = 2l + 2w
Area of Rectangle: A = lw
Area of Triangle: A = ½ bh

Day 3: Quadratic Functions – Algebra

Key

- Standard Form:
- Graph:
- Ways to solve:

Example 1:

- The product of 2 consecutive *positive* integers is 110. Find the integers.

$x(x+1)=110 \Rightarrow x^2+x-110=0$
$(x+11)(x-10)=0$
$\cancel{x=-11}$ $x=10$
10 + 11

You Try!

- The product of two consecutive odd integers is 195. Find the integers.

$x(x+2)=195 \Rightarrow x^2+2x-195=0$
$(x+15)(x-13)=0$
$x=-15$ $x=13$
13 & 15

Example 2:

- The base of a triangle is 2 meters less than the altitude and the area of the triangle is 364 m². Find the altitude.

$b=h-2$
$\frac{1}{2}(h-2)(h)=364$
$\frac{1}{2}h^2-h=364$
$h^2-2h-728=0$
$(h-28)(h+26)=0$
$\boxed{h=28}$ $\cancel{h=-26}$
28 m

You Try!

- A rectangular building lot is 8 ft longer than it is wide and has an area of 2900 ft². Find the dimensions of the lot.

$L=w+8$
$Lw=2900$
$(w+8)w=2900$
$w^2+8w-2900=0$
$(w+58)(w-50)=0$
$\cancel{w=-58}$
$w=50$ ft
$L=58$ ft

Example 3:

- The perimeter of a rectangle is 24cm and the area is 32 cm². Find the dimensions.

$2L+2w=24 \Rightarrow L+w=12 \Rightarrow L=12-w$
$Lw=32$
$w(12-w)=32$
$12w-w^2=32$
$w^2-12w+32=0$
$(w-8)(w-4)=0$
$w=8$ $w=4$
8cm x 4cm

Example 4:

- The larger of two positive numbers is five less than twice the smaller. If their products is 63, find the smaller number.

$x=$ smaller
larger $=2x-5$
$x(2x-5)=63$
$2x^2-5x=63$
$2x^2-5x-63=0$
$(2x+9)(x-7)=0$
$x=-9/2$ $x=7$

Example 5:

- An object is thrown or fired straight upward at an initial speed of v_0 ft/s. It will reach a height of h feet after t sec, where h and t are related by the formula $h=-16t^2+v_0t$. Suppose that a bullet is show upward with an initial speed of 800 ft/s.

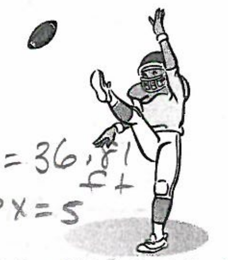
  $h=-16t^2+800t$

  When does bullet fall back to ground? 50 sec
  When does it reach a height of 6400? 10 sec + 40 sec
  When does it reach a height of 2 miles? It doesn't $\Rightarrow$ never
  How high is the highest point the ball reaches?
  10000 ft.

Key

Read each problem carefully and completely answer all questions. Solve algebraically or by using the calculator to graph each parabolic equation. Set your window so that the entire graph is shown in the view screen.

1. **Are You Ready For Some Football?** The height of a punted football can be modeled with the quadratic function $h = -0.01x^2 + 1.18x + 2$. The horizontal distance in feet from the point of impact with the kicker's foot is x, and h is the height of the ball in feet.



   a) What is the ball's height when it has traveled 30 ft downfield?
   28.4 ft
   b) What is the maximum height of the punt? How far downfield has the ball traveled when it reaches its maximum height? max height = 36.81 ft
   59 ft downfield
   c) The nearest defensive player is 5 ft horizontally from the point of impact. ⇒ x = 5
   How high must he get his hand to block the punt?
   7.65 ft high
   d) Suppose the punt was not blocked but continued on its path. How far down field would the ball go before it hit the ground? 119.67125 ft
   e) Why is the linear equation $h = 1.13x + 2$ not a good model for the path of the football? Explain.

2. **More Football** Although a football field appears to be flat, its surface is actually shaped like a parabola so that rain runs off to either side. The cross section of a field with synthetic turf can be modeled by $y = -0.000234(x-80)^2 + 1.5$ where x and y are measured in feet.
   a) What is the field's width? 160.064 ft
   b) What is the maximum height of the field's surface?
   1.5 ft

Source: Boston College

3. **Newspaper Circulation** The function $f(x) = -0.019x^2 + 3.04x - 58.87$ describes newspaper circulation (in millions) in the United States for 1920 to 1998 (where $x = 20$ is used for 1920). Identify periods of increasing and decreasing circulation.
   a) According to the function, when did newspaper circulation peak? 1980
   b) When will circulation approximate 45 million?
   in 1949 & in 2010

4. **Manufacturing** An electronics company has a new line of portable radios with CD players. Their research suggests that the daily sales s for the new product can be modeled by $s = -p^2 + 120p + 1400$, where p is the price of each unit.
   a) Find the maximum daily sales. $5000
   b) What price will result in that maximum? $60

5. **Architecture** The shape of the Gateway Arch in St. Louis, Missouri, is a catenary curve, which loosely resembles a parabola. The function $y = -\frac{2}{315}x^2 + 4x$ models the shape of the arch, where y is the height in feet and x is the horizontal distance from the base of the left side of the arch in feet.

   a) According to the model, what is the maximum height of the arch?
   630 ft
   b) What is the width of the arch at the base?
   630 ft

6. **Field Hockey** Suppose a player makes a scoop that releases the ball with an upward velocity of 34 ft/s. The function $h = -16t^2 + 34t$ models the height h in feet of the ball at time t in seconds. Will the ball ever reach a height of 20 ft? Explain. No, the max height is 18.06 ft

7. **Throwing A Ball** A player throws a ball up and toward a wall that is 17 feet high. The height h in feet of the ball t seconds after it leaves the player's hand is modeled by $h = -16t^2 + 25t + 6$. If the ball makes it to where the wall is, will it go over the wall or hit the wall? Explain.
   Hit the wall ⇒ the max height is 15.76 ft.

8. **Business** The weekly revenue, R, for a company is $R = -3p^2 + 60p + 1060$, where p is the price of the company's product. When will the weekly revenue reach $1500? Explain.
   Never, the max revenue is $1360

9. **Woodland Jumping Mouse** The woodland jumping mouse can hop surprisingly long distances given its small size. A relatively long hop can be modeled by $y = -\frac{2}{9}x^2 + \frac{4}{3}x$ where x and y are measured in feet.

   a) How far can a woodland jumping mouse hop? 6 ft.
   b) Can a woodland jumping mouse jump a tree stump that is 3.5 ft high?
   No, max height is 3 ft.

Source: University of Michigan Museum of Zoology