# Section 2.8: Using the Quadratic Formula to Solve Problems

The quadratic formula is used to find the x-intercepts (roots or zeros) of a quadratic equation. We can use the x-intercepts to solve word problems.

Use the quadratic formula when you are asked the following types of questions:

- Find the width.
- Find the time to hit the ground.
- Find the time it takes to travel a certain distance or reach a certain height.

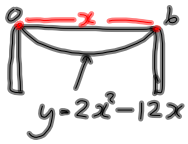
**Examples:**

1. A plane flies according to the equation $h = 5000 + 55.5t - 4.9t^2$ where $h$ is the height in meters and $t$ is the time in minutes.

   A) When will the plane land?

   B) When will the plane be at a height of 4000 m?

2. A falcon flies under a bridge and follows a path defined by $y = 2x^2 - 12x$ where $y$ is the height below the bridge and $x$ is the width of the bridge. Find the width of the bridge.




Set $y = 0$ & solve for $x$.

$y = 2x^2 - 12x$

$0 = 2x^2 - 12x \quad c = 0$ ($a = 2$, $b = -12$)

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{12 \pm \sqrt{(-12)^2 - 4(2)(0)}}{2(2)}$

$x = \frac{12 \pm \sqrt{144}}{4}$

$x = \frac{12 \pm 12}{4}$

$x = \frac{12+12}{4}$

$x = \frac{24}{4}$

$x = 6$

$x = \frac{12-12}{4}$

$x = \frac{0}{4}$

$x = 0$

∴ width of bridge is 6m

3. A geyser spurts water vertically into the air. The height of the water $h$ ( in meters) at time $t$ (in seconds) is given by $h = 4.9t - t^2$.

When will the water hit the ground?

$h = 0$

$0 = 4.9t - t^2$

$0 = -t^2 + 4.9t$ ($a = -1$, $b = 4.9$)

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-4.9 \pm \sqrt{(4.9)^2 - 4(-1)(0)}}{2(-1)}$

$x = \frac{-4.9 \pm \sqrt{24.01}}{-2}$

$x = \frac{-4.9 \pm 4.9}{-2}$

$x = \frac{-4.9+4.9}{-2}$

$x = \frac{0}{-2}$

$x = 0$

$x = \frac{-4.9-4.9}{-2}$

$x = \frac{-9.8}{-2}$

$x = 4.9$

Test - Assign - Worksample → Final

4. A toy rocket is fired into the air from the top of a house. Its height above the ground in meters after t seconds is given by the equation $h = 20 + 10t - 5t^2$ where $h$ is the height in meters and $t$ is the time in seconds.

A) What was the initial height of the rocket? "c"
B) When did the rocket reach maximum height? → $x = \frac{-b}{2a}$
C) What was the maximum height of the rocket? $y =$
D) How long was the rocket in ther air before it hit the ground?
E) At what time(s) will the rocket be at a height of 22 m?

→ quadratic formula.

A) 20 m

B) $x = \frac{-b}{2a} = \frac{-10}{2(-5)} = \frac{-10}{-10} = 1s$

C) $y = 20 + 10t - 5t^2$
$y = 20 + 10(1) - 5(1)^2$
$y = 20 + 10 - 5(1)$
$y = 20 + 10 - 5$
$y = 25$ m