

### Discovering Completing the Square

Review: Factor the following trinomials and solve for zeros.

**a=1 x-method**

1.  $x^2 - 6x + 9 = 0$

~~9 (x) -3 -3 (-6) (+)~~

$(x-3)(x-3)$

$(x-3)^2$

$x-3=0$

$x=3$

**a=1 x-method**

2.  $x^2 + 10x + 25 = 0$

~~25 (x) +5 +5 (+)~~

$(x+5)(x+5)$

$(x+5)^2$

$x+5=0$

$-5 -5$

$x=-5$

**a=1 x-method**

3.  $x^2 + 10x - 6 = 0$

~~-6 (x) 10 (+)~~

not factorable

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

$\frac{-10 \pm \sqrt{100 - 4(-6)}}{2}$

$\frac{-10 \pm \sqrt{124}}{2}$

$\frac{-10 \pm 2\sqrt{31}}{2}$

$-5 \pm \sqrt{31}$

How can we solve for the zeros of a trinomial that is "non factorable"? One method is by completing the square

### Solving by Completing the Square

Non Factorable Methods		
Completing the Square	Finding Square Roots	Quadratic Formula
$ax^2 + bx + c = 0$ , when $a = 1$ and $b$ is an even #	$ax^2 - c = 0$ Parenthesis in equation	$ax^2 + bx + c = 0$ Any equation in standard form Large coefficients
<b>Examples</b> $x^2 - 6x + 11 = 0$ $x^2 - 2x - 20 = 0$	<b>Examples</b> $2x^2 + 5 = 9$ $5(x+3)^2 - 5 = 20$ $x^2 - 36 = 0$	<b>Examples</b> $3x^2 + 9x - 1 = 0$ $20x^2 + 36x - 17 = 0$

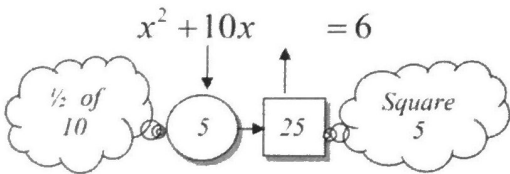
You can use the Completing the Square when factoring any trinomial, but the most common time we use this method is when our trinomial is not factorable. Below is a guided example, along with a video tutorial, on how to solve by completing the square.

#### Basic

Video Link: [goo.gl/hiGFt1](http://goo.gl/hiGFt1)

$$\boxed{x^2 + 10x - 6 = 0} \quad x^2 + 10x - 6 = 0$$

Move constant to the other side



$$x^2 + 10x + 25 = 6 + 25$$

Add 25 to both sides

$$x^2 + 10x + 25 = 31 \quad \text{Easily Factors}$$

$$(x+5)(x+5) = 31 \quad \text{Can be re-written}$$

$$(x+5)^2 = 31 \quad \text{Take the square root of both sides}$$

$$\sqrt{(x+5)^2} = \sqrt{31} \quad \text{Don't forget } \pm$$

$$x+5 = \pm\sqrt{31} \quad \text{Isolate } x$$

$$\underline{\quad -5 \quad -5 \quad}$$

$$x = -5 \pm \sqrt{31} \text{ OR } x \approx 0.5678 \text{ OR } -10.5678$$

Solve the following by completing the square.

1.  $x^2 + 10x - 19 = 0$

$$\frac{\quad}{+19 \quad +19}$$

$$x^2 + 10x + 25 = 19 + 25$$

$$\begin{array}{c} \div 2 \\ \hline 5 \end{array} \xrightarrow{5^2} \boxed{25}$$

$$x^2 + 10x + 25 = 44$$

$$(x+5)(x+5) = 44$$

$$\sqrt{(x+5)^2} = \sqrt{44}$$

$$\begin{array}{c} x+5 = \pm 2\sqrt{11} \\ \hline -5 \quad -5 \end{array}$$

$$\boxed{x = -5 \pm 2\sqrt{11}}$$

$$\begin{array}{c} \sqrt{44} \\ \wedge \\ \sqrt{4} \sqrt{11} \\ 2\sqrt{11} \end{array}$$

3.  $x^2 + 12x - 8 = 0$

$$\frac{\quad}{+8 \quad +8}$$

$$x^2 + 12x + 36 = 8 + 36$$

$$\begin{array}{c} \div 2 \\ \hline 6 \end{array} \xrightarrow{6^2} \boxed{36}$$

$$x^2 + 12x + 36 = 44$$

$$(x+6)(x+6) = 44$$

$$\sqrt{(x+6)^2} = \sqrt{44}$$

$$\begin{array}{c} x+6 = \pm 2\sqrt{11} \\ \hline -6 \quad -6 \end{array}$$

$$\boxed{x = -6 \pm 2\sqrt{11}}$$

2.  $x^2 - 12x + 2 = 0$

$$\frac{\quad}{-2 \quad -2}$$

$$x^2 - 12x + 36 = -2 + 36$$

$$\begin{array}{c} \div 2 \\ \hline -6 \end{array} \xrightarrow{6^2} \boxed{36}$$

$$x^2 - 12x + 36 = 34$$

$$(x-6)(x-6) = 34$$

$$\sqrt{(x-6)^2} = \sqrt{34}$$

$$\begin{array}{c} x-6 = \pm\sqrt{34} \\ \hline +6 \quad +6 \end{array}$$

$$\boxed{x = 6 \pm \sqrt{34}}$$

/  $x^2 - 5x - 4 = 0$

/  $2x^2 - 8x - 14 = 0$

/  $3x^2 - 18x - 5 = 0$