# Solving Quadratic Equations by Completing the Square

$x^2 - 3x + 2 = 0$

Firstly, the coefficient of $x^2$ has to be 1. In this case it is. If this is not the case, divide entire equation, both LHS and RHS by the coefficient of $x^2$.

Next, move the constant term over to the RHS of the equation. Here, it is 2. Remember, when you move a term over to the other side of the equation, its sign changes. This gives us

$x^2 - 3x = -2$ .

Now take the coefficient of $x$, halve it and square the result. Add this result to both sides of the equation. Here, the coefficient of $x$ is -3. Half of -3 is -3/2. Square that and we get $(-3/2)^2$. Adding this to both sides of the equation, we get

$$x^2 - 3x + \left(\frac{-3}{2}\right)^2 = -2 + \left(\frac{-3}{2}\right)^2$$

$$x^2 - 3x + \left(\frac{-3}{2}\right)^2 = -2 + \frac{9}{4}$$

Now, $x^2 - 3x + \left(\frac{-3}{2}\right)^2 = \left(x - \frac{3}{2}\right)^2$

Use it on the LHS.

This gives us

$$\left(x - \frac{3}{2}\right)^2 = -2 + \frac{9}{4}$$

Add everything on the RHS together. This gives us

$\left(x - \frac{3}{2}\right)^2 = \frac{-8+9}{4}$ . Here, the LCD is 4.

$$\left(x - \frac{3}{2}\right)^2 = \frac{1}{4}$$

Now, take square roots on both sides. We then get

$$x - \frac{3}{2} = \pm\sqrt{\frac{1}{4}}$$

$$x - \frac{3}{2} = \frac{\pm 1}{2}$$

Now move the constant term on the LHS over to the RHS. Remember, the sign changes. We then get

$$x=\frac{\pm 1}{2}+\frac{3}{2}.$$

Thus, $x=\frac{1}{2}+\frac{3}{2}$ or $x=\frac{-1}{2}+\frac{3}{2}$

Final results: $x=\frac{4}{2}=2$ or $x=\frac{2}{2}=1$

Here's another example:

$$4x^2+32x+9=0$$

Firstly, the coefficient of $x^2$ has to be 1. In this case it is not. So, divide the entire equation, both LHS and RHS by the coefficient of $x^2$. This coefficient is 4.

We then get

$$x^2+8x+\frac{9}{4}=0$$

Next, move the constant term over to the RHS of the equation. Here, it is 9/4. Remember, when you move a term over to the other side of the equation, its sign changes. This gives us

$$x^2+8x=\frac{-9}{4}$$

Now take the coefficient of $x$, halve it and square the result. Add this result to both sides of the equation. Here, the coefficient of $x$ is 8. Half of 8 is 4. Square that and we get 16. Adding this to both sides of the equation, we get

$$x^2+8x+16=\frac{-9}{4}+16$$

Now, $x^2+8x+16=(x+4)^2$ ,

use it on the LHS

This gives us

$$(x+4)^2=\frac{-9}{4}+16$$

Add everything on the RHS together. This gives us

$(x+4)^2=\frac{-9+64}{4}$ , therefore, the LCD is 4.

$$(x+4)^2=\frac{55}{4}$$

Now, take square roots on both sides. We then get

$$x+4=\pm\sqrt{\frac{55}{4}}$$

$$x+4=\frac{\pm\sqrt{55}}{2}$$

Now move the constant term on the LHS over to the RHS. Remember, the sign changes. We then get

$$x=\frac{\pm\sqrt{55}}{2}-4$$

thus, $x=\frac{\sqrt{55}}{2}-4$ or $x=\frac{-\sqrt{55}}{2}-4$

Added together we get final result as $x=\frac{\sqrt{55}-8}{2}$ or $x=\frac{-\sqrt{55}-8}{2}$

Now that you have seen these two examples, try them yourself. You'll feel good if you succeed at it!

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