Quadratic equations

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

The three methods are:

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

The three methods are:

- factorization,

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

The three methods are:

- factorization,
- completing the square,

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

The three methods are:

- factorization,
- completing the square,
- quadratic formula.

We've discussed 3 methods for solving quadratic equations, i.e. equations of the form:

$$ax^2 + bx + c = 0$$

The three methods are:

- factorization,
- completing the square,
- quadratic formula.

We will now review these methods.

Factorization

Factorization should always be your first choice. If you can factorize a given expression quickly, then you will save lots of time. Only if you can't factorize the given quadratic, should you move on to a different method.

Factorization

Factorization should always be your first choice. If you can factorize a given expression quickly, then you will save lots of time. Only if you can't factorize the given quadratic, should you move on to a different method.

Solve

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

Factorization

Factorization should always be your first choice. If you can factorize a given expression quickly, then you will save lots of time. Only if you can't factorize the given quadratic, should you move on to a different method.

Solve

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

We factorize the left hand side to get:

Factorization

Factorization should always be your first choice. If you can factorize a given expression quickly, then you will save lots of time. Only if you can't factorize the given quadratic, should you move on to a different method.

Solve

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

We factorize the left hand side to get:

$$(x-6)(x+3) = 0$$

So $x - 6 = 0$ or $x + 3 = 0$. Which gives $x = 6$ or $x = -3$.

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

$$(x + 5)(x - 3) = 0$$

which gives $x + 5 = 0$ or $x - 3 = 0$,

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

$$(x+5)(x-3) = 0$$

which gives $x + 5 = 0$ or $x - 3 = 0$, so $x = -5$ or $x = 3$.

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

$$(x+5)(x-3) = 0$$

which gives $x + 5 = 0$ or $x - 3 = 0$, so $x = -5$ or $x = 3$.

b) Solve

$$2x^2 + 11x = 0$$

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

$$(x + 5)(x - 3) = 0$$

which gives $x + 5 = 0$ or $x - 3 = 0$, so $x = -5$ or $x = 3$.

b) Solve

$$2x^2 + 11x = 0$$

We factor out x and get:

$$x(2x + 11) = 0$$

which gives $x = 0$ or $2x + 11 = 0$,

Factorization - examples

a) Solve:

$$x^2 + 2x - 15 = 0$$

We factorize and get:

$$(x + 5)(x - 3) = 0$$

which gives $x + 5 = 0$ or $x - 3 = 0$, so $x = -5$ or $x = 3$.

b) Solve

$$2x^2 + 11x = 0$$

We factor out x and get:

$$x(2x + 11) = 0$$

which gives $x = 0$ or $2x + 11 = 0$, so $x = 0$ or $x = -5.5$.

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

$$(2x - 9)(2x + 9) = 0$$

which gives $2x - 9 = 0$ or $2x + 9 = 0$,

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

$$(2x - 9)(2x + 9) = 0$$

which gives $2x - 9 = 0$ or $2x + 9 = 0$, so $x = 4.5$ or $x = -4.5$.

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

$$(2x-9)(2x+9) = 0$$

which gives $2x - 9 = 0$ or $2x + 9 = 0$, so $x = 4.5$ or $x = -4.5$.

d) Solve

$$x^2 - 6x + 8 = 0$$

Factorization - examples

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

$$(2x - 9)(2x + 9) = 0$$

which gives $2x - 9 = 0$ or $2x + 9 = 0$, so $x = 4.5$ or $x = -4.5$.

d) Solve

$$x^2 - 6x + 8 = 0$$

We factorize and get:

$$(x - 4)(x - 2) = 0$$

which gives $x - 4 = 0$ or $x - 2 = 0$,

c) Solve:

$$4x^2 - 81 = 0$$

We factorize and get:

$$(2x - 9)(2x + 9) = 0$$

which gives $2x - 9 = 0$ or $2x + 9 = 0$, so $x = 4.5$ or $x = -4.5$.

d) Solve

$$x^2 - 6x + 8 = 0$$

We factorize and get:

$$(x - 4)(x - 2) = 0$$

which gives $x - 4 = 0$ or $x - 2 = 0$, so $x = 4$ or $x = 2$.

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

$$(x - 2)^2 = 0$$

which gives $x - 2 = 0$,

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

$$(x-2)^2 = 0$$

which gives $x - 2 = 0$, so $x = 2$.

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

$$(x-2)^2 = 0$$

which gives $x - 2 = 0$, so $x = 2$.

f) Solve

$$3x^2 - 10x - 8 = 0$$

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

$$(x-2)^2 = 0$$

which gives $x - 2 = 0$, so $x = 2$.

f) Solve

$$3x^2 - 10x - 8 = 0$$

We factorize and get:

$$(3x+2)(x-4) = 0$$

which gives $3x + 2 = 0$ or $x - 4 = 0$,

Factorization - examples

e) Solve:

$$x^2 - 4x + 4 = 0$$

We factorize and get:

$$(x-2)^2 = 0$$

which gives $x - 2 = 0$, so $x = 2$.

f) Solve

$$3x^2 - 10x - 8 = 0$$

We factorize and get:

$$(3x+2)(x-4) = 0$$

which gives $3x + 2 = 0$ or $x - 4 = 0$, so $x = -\frac{2}{3}$ or $x = 4$.

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

We first move all terms to one side:

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

We first move all terms to one side:

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

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

We first move all terms to one side:

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

Now we factorize and get:

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

We first move all terms to one side:

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

Now we factorize and get:

$$(x - 4)(x + 3) = 0$$

which gives $x - 4 = 0$ or $x + 3 = 0$,

Factorization - examples

g) Solve:

$$x^2 = x + 12$$

We first move all terms to one side:

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

Now we factorize and get:

$$(x - 4)(x + 3) = 0$$

which gives $x - 4 = 0$ or $x + 3 = 0$, so $x = 4$ or $x = -3$.

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

We move all terms to one side:

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

We move all terms to one side:

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

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

We move all terms to one side:

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

Now we factorize and get:

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

We move all terms to one side:

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

Now we factorize and get:

$$(2x + 1)(x - 3) = 0$$

which gives $2x + 1 = 0$ or $x - 3 = 0$,

Factorization - examples

h) Solve

$$2x^2 = 5x + 3$$

We move all terms to one side:

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

Now we factorize and get:

$$(2x + 1)(x - 3) = 0$$

which gives $2x + 1 = 0$ or $x - 3 = 0$, so $x = -\frac{1}{2}$ or $x = 3$.

Factorization

Remember that we constantly use the fact that if a product of two numbers is 0, then one of the numbers must be 0.

Important property

If $a \times b = 0$, then $a = 0$ or $b = 0$.

Factorization

Remember that we constantly use the fact that if a product of two numbers is 0, then one of the numbers must be 0.

Important property

If $a \times b = 0$, then $a = 0$ or $b = 0$.

This is why it's crucial to always have 0 on one side of the equation.

Factorization

Remember that we constantly use the fact that if a product of two numbers is 0, then one of the numbers must be 0.

Important property

If $a \times b = 0$, then $a = 0$ or $b = 0$.

This is why it's crucial to always have 0 on one side of the equation. Note that if a product of two numbers is equal to number other than 0, then we can't deduce anything about the two numbers.

Factorization

Remember that we constantly use the fact that if a product of two numbers is 0, then one of the numbers must be 0.

Important property

If $a \times b = 0$, then $a = 0$ or $b = 0$.

This is why it's crucial to always have 0 on one side of the equation. Note that if a product of two numbers is equal to number other than 0, then we can't deduce anything about the two numbers.

Useless property

If $a \times b = 7$ (or any other non-zero number), then we don't know much about a or b.

Factorization doesn't always work and if after a few seconds we cannot factorize the given expression, then we should try a different approach.

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$.

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$. We "complete the square and change $x^2 + 4x$ to $(x + 2)^2$.

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$. We "complete the square and change $x^2 + 4x$ to $(x+2)^2$. Of course $x^2 + 4x \neq (x+2)^2$, but at least the first two terms are fine. In order for the two expression to be equal we need to subtract 4.

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$. We "complete the square and change $x^2 + 4x$ to $(x + 2)^2$. Of course $x^2 + 4x \neq (x + 2)^2$, but at least the first two terms are fine. In order for the two expression to be equal we need to subtract 4.
We have $x^2 + 4x = (x + 2)^2 - 4$

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$. We "complete the square and change $x^2 + 4x$ to $(x+2)^2$. Of course $x^2 + 4x \neq (x+2)^2$, but at least the first two terms are fine. In order for the two expression to be equal we need to subtract 4.
We have $x^2 + 4x = (x+2)^2 - 4$
So we are solving:

$$(x+2)^2 - 4 - 12 = 0$$

Completing the square

Let's solve the following equation

$$x^2 + 4x - 12 = 0$$

We could've factorized it and get the following solutions: $x = -6$ or $x = 2$.

Let's try a different method We will focus on $x^2 + 4x$. We "complete the square and change $x^2 + 4x$ to $(x + 2)^2$. Of course $x^2 + 4x \neq (x + 2)^2$, but at least the first two terms are fine. In order for the two expression to be equal we need to subtract 4.
We have $x^2 + 4x = (x + 2)^2 - 4$
So we are solving:

$$(x + 2)^2 - 4 - 12 = 0$$

czyli:

$$(x + 2)^2 - 16 = 0$$

Completing the square

We have:

$$(x+2)^2 - 16 = 0$$

Completing the square

We have:

$$(x+2)^2 - 16 = 0$$

$$(x+2)^2 = 16$$

Completing the square

We have:

$$(x+2)^2 - 16 = 0$$

$$(x+2)^2 = 16$$

$x+2$ squared gives 16, so $x+2=4$ or $x+2=-4$, which gives $x=2$ or $x=-6$.

Completing the square

The method is fairly simple:

$$x^2 + 4x - 12 = 0$$

We want to change the left hand side to the form

$$(x \;\; ...)^2 - ... = 0$$

We just need to put appropraite numbers in place of dots.

Completing the square

The method is fairly simple:

$$x^2 + 4x - 12 = 0$$

We want to change the left hand side to the form

$$(x \;\; ...)^2 - ... = 0$$

We just need to put appropraite numbers in place of dots. The bracket is easy, we choose the number so that the first two terms are ok, so we want to get $x^2 + 4x$.

Completing the square

The method is fairly simple:

$$x^2 + 4x - 12 = 0$$

We want to change the left hand side to the form

$$(x \ \ ...)^2 - ... = 0$$

We just need to put appropraite numbers in place of dots. The bracket is easy, we choose the number so that the first two terms are ok, so we want to get $x^2 + 4x$. So the bracket has to be $(x + 2)^2$.

Completing the square

The method is fairly simple:

$$x^2 + 4x - 12 = 0$$

We want to change the left hand side to the form

$$(x \ \ ...)^2 - ... = 0$$

We just need to put appropraite numbers in place of dots. The bracket is easy, we choose the number so that the first two terms are ok, so we want to get $x^2 + 4x$. So the bracket has to be $(x + 2)^2$. Now we need to add/subtract something to make the expressions equal

Completing the square

The method is fairly simple:

$$x^2 + 4x - 12 = 0$$

We want to change the left hand side to the form

$$(x \ \ ...)^2 - ... = 0$$

We just need to put appropraite numbers in place of dots. The bracket is easy, we choose the number so that the first two terms are ok, so we want to get $x^2 + 4x$. So the bracket has to be $(x + 2)^2$. Now we need to add/subtract something to make the expressions equal $(x + 2)^2 = x^2 + 4x + 4$. the first two terms agree, we need to change the last one. We want -12 and we have 4, so we need to subtract 16. Finally we have $x^2 + 4x - 12 = (x + 2)^2 - 16$.

Names

Let's look at the equation once more:

$$x^2 + 4x - 12 = 0$$

The left hand side of the equation is a quadratic in a **standard form**.

Names

Let's look at the equation once more:

$$x^2 + 4x - 12 = 0$$

The left hand side of the equation is a quadratic in a **standard form**. We can factorize it and turn it into:

$$(x - 2)(x + 6) = 0$$

This form is called a **factored form**.

Names

Let's look at the equation once more:

$$x^2 + 4x - 12 = 0$$

The left hand side of the equation is a quadratic in a **standard form**.
We can factorize it and turn it into:

$$(x-2)(x+6) = 0$$

This form is called a **factored form**.
Now we turned it into:

$$(x+2)^2 - 16 = 0$$

This is called a **vertex form**.

Names

Let's look at the equation once more:

$$x^2 + 4x - 12 = 0$$

The left hand side of the equation is a quadratic in a **standard form**.
We can factorize it and turn it into:

$$(x - 2)(x + 6) = 0$$

This form is called a **factored form**.
Now we turned it into:

$$(x + 2)^2 - 16 = 0$$

This is called a **vertex form**.

We will talk more about these forms when we will be covering quadratic functions.

Completing the square - example

Turn $x^2 + 6x - 2$ into vertex form. Hence solve $x^2 + 6x - 2 = 0$.

Completing the square - example

Turn $x^2 + 6x - 2$ into vertex form. Hence solve $x^2 + 6x - 2 = 0$.

We want $x^2 + 6x - 2$ in the form $(x\ ...)^2$ .... We need $+3$ in the bracket to get $6x$.

Completing the square - example

Turn $x^2 + 6x - 2$ into vertex form. Hence solve $x^2 + 6x - 2 = 0$.

We want $x^2 + 6x - 2$ in the form $(x \ldots)^2 \ldots$. We need $+3$ in the bracket to get $6x$.
So we have $(x+3)^2$, which gives $(x+3)^2 = x^2 + 6x + 9$, but instead of 9 we want -2, so we need to subtract 11.

Completing the square - example

Turn $x^2 + 6x - 2$ into vertex form. Hence solve $x^2 + 6x - 2 = 0$.

We want $x^2 + 6x - 2$ in the form $(x \,...)^2$ .... We need $+3$ in the bracket to get $6x$.
So we have $(x+3)^2$, which gives $(x+3)^2 = x^2 + 6x + 9$, but instead of 9 we want -2, so we need to subtract 11. Finally:

$$x^2 + 6x - 2 = (x+3)^2 - 11$$

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

We turn the left hand side into vertex form:

$$(x+3)^2 - 11 = 0$$

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

We turn the left hand side into vertex form:

$$(x + 3)^2 - 11 = 0$$

so:

$$(x + 3)^2 = 11$$

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

We turn the left hand side into vertex form:

$$(x + 3)^2 - 11 = 0$$

so:

$$(x + 3)^2 = 11$$

so $x + 3 = \sqrt{11}$ or $x + 3 = -\sqrt{11}$.

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

We turn the left hand side into vertex form:

$$(x+3)^2 - 11 = 0$$

so:

$$(x+3)^2 = 11$$

so $x + 3 = \sqrt{11}$ or $x + 3 = -\sqrt{11}$.
This gives $x = -3 + \sqrt{11}$ or $x = -3 - \sqrt{11}$.

Completing the square - example

Now we want to solve:

$$x^2 + 6x - 2 = 0$$

We turn the left hand side into vertex form:

$$(x + 3)^2 - 11 = 0$$

so:

$$(x + 3)^2 = 11$$

so $x + 3 = \sqrt{11}$ or $x + 3 = -\sqrt{11}$.
This gives $x = -3 + \sqrt{11}$ or $x = -3 - \sqrt{11}$.

Note that we wouldn't be able to solve the equation $x^2 + 6x - 2 = 0$ by factorizing it, or at least it would be very hard.

Completing the square - example

If we want to solve an equation like:

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

We will first divide both sides by 2, this gives:

Completing the square - example

If we want to solve an equation like:

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

We will first divide both sides by 2, this gives:

$$x^2 + 3x - \frac{3}{2} = 0$$

Completing the square - example

If we want to solve an equation like:

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

We will first divide both sides by 2, this gives:

$$x^2 + 3x - \frac{3}{2} = 0$$

Now we complete the square:

$$\left(x + \frac{3}{2}\right)^2 - \frac{15}{4} = 0$$

Completing the square - example

If we want to solve an equation like:

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

We will first divide both sides by 2, this gives:

$$x^2 + 3x - \frac{3}{2} = 0$$

Now we complete the square:

$$\left(x + \frac{3}{2}\right)^2 - \frac{15}{4} = 0$$

So

$$\left(x + \frac{3}{2}\right)^2 = \frac{15}{4}$$

which gives $x + \frac{3}{2} = \pm\frac{\sqrt{15}}{2}$, so $x = -\frac{3}{2} \pm \frac{\sqrt{15}}{2}$.

Completing the square - example

If we want to solve an equation like:

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

We will first divide both sides by 2, this gives:

$$x^2 + 3x - \frac{3}{2} = 0$$

Now we complete the square:

$$\left(x + \frac{3}{2}\right)^2 - \frac{15}{4} = 0$$

So

$$\left(x + \frac{3}{2}\right)^2 = \frac{15}{4}$$

which gives $x + \frac{3}{2} = \pm\frac{\sqrt{15}}{2}$, so $x = -\frac{3}{2} \pm \frac{\sqrt{15}}{2}$. Note $\pm$ means that there are two solutions, one when we add the given number, the other when we subtract.

Quadratic formula

The method of completing the square led us to a formula for solving quadratic equations:

$$ax^2 + bx + c = 0$$

Quadratic formula

The method of completing the square led us to a formula for solving quadratic equations:

$$ax^2 + bx + c = 0$$

The formula we derived is $x = \dfrac{-b \pm \sqrt{\Delta}}{2a}$, where $\Delta = b^2 - 4ac$.

Quadratic formula

If we want to solve:

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

then we have $a = 2$, $b = 6$ and $c = -3$.

Quadratic formula

If we want to solve:

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

then we have $a = 2$, $b = 6$ and $c = -3$.

We first calculate Δ:

$$\Delta = 6^2 - 4(2)(-3) = 60$$

Quadratic formula

If we want to solve:

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

then we have $a = 2$, $b = 6$ and $c = -3$.

We first calculate Δ:

$$\Delta = 6^2 - 4(2)(-3) = 60$$

So $x = \dfrac{-6 \pm \sqrt{60}}{4} = \dfrac{-6 \pm 2\sqrt{15}}{4} = \dfrac{-3 \pm \sqrt{15}}{2}$

Practice

When you solve a quadratic equation, you should start by trying factorization, then if it doesn't work use the quadratic formula. The completing the square method is still important and we will use it when we will be dealing with quadratic functions.

Practice

Solve:

$$x^2 - 6x - 7 = 0$$

Practice

Solve:

$$x^2 - 6x - 7 = 0$$

Method:

Practice

Solve:

$$x^2 - 6x - 7 = 0$$

Method: factorization!

Practice

Solve:

$$x^2 - 6x - 7 = 0$$

Method: factorization!

$$(x-7)(x+1) = 0$$

so $x = 7$ oraz $x = -1$.

Practice

Solve:

$$2x^2 - x - 15 = 0$$

Practice

Solve:

$$2x^2 - x - 15 = 0$$

Method:

Practice

Solve:

$$2x^2 - x - 15 = 0$$

Method: factorization!

Practice

Solve:

$$2x^2 - x - 15 = 0$$

Method: factorization!

$$(2x+5)(x-3) = 0$$

so $x = -2.5$ oraz $x = 3$.

Practice

Solve:

$$x^2 + 5x + 1 = 0$$

Practice

Solve:

$$x^2 + 5x + 1 = 0$$

Method:

Practice

Solve:

$$x^2 + 5x + 1 = 0$$

Method: quadratic formula (factorization doesn't work nicely)

Practice

Solve:

$$x^2 + 5x + 1 = 0$$

Method: quadratic formula (factorization doesn't work nicely)
$a = 1$, $b = 5$, $c = 1$, so

$$\Delta = 25 - 4(1)(1) = 21$$

Practice

Solve:

$$x^2 + 5x + 1 = 0$$

Method: quadratic formula (factorization doesn't work nicely)
$a = 1$, $b = 5$, $c = 1$, so

$$\Delta = 25 - 4(1)(1) = 21$$

So we have:

$$x = \frac{-5 \pm \sqrt{21}}{2}$$

Practice

Solve:

$$3x^2 + 5x = 0$$

Practice

Solve:

$$3x^2 + 5x = 0$$

Method:

Practice

Solve:

$$3x^2 + 5x = 0$$

Method: factorization!

Practice

Solve:

$$3x^2 + 5x = 0$$

Method: factorization!

$$x(3x + 5) = 0$$

so $x = 0$ oraz $x = -\frac{5}{3}$.

Practice

Solve:

$$2x^2 + 3x - 1 = 0$$

Practice

Solve:

$$2x^2 + 3x - 1 = 0$$

Method:

Practice

Solve:

$$2x^2 + 3x - 1 = 0$$

Method: quadratic formula (factorization doesn't work)

Practice

Solve:

$$2x^2 + 3x - 1 = 0$$

Method: quadratic formula (factorization doesn't work)
$a = 2,\ b = 3,\ c = -1$, so

$$\Delta = 9 - 4(2)(-1) = 17$$

Practice

Solve:

$$2x^2 + 3x - 1 = 0$$

Method: quadratic formula (factorization doesn't work)
$a = 2,\ b = 3,\ c = -1$, so

$$\Delta = 9 - 4(2)(-1) = 17$$

So we have:

$$x = \frac{-3 \pm \sqrt{17}}{4}$$

Practice

Solve:

$$9x^2 - 4 = 0$$

Practice

Solve:

$$9x^2 - 4 = 0$$

Method:

Practice

Solve:

$$9x^2 - 4 = 0$$

Method: factorization!

Practice

Solve:

$$9x^2 - 4 = 0$$

Method: factorization!

$$(3x - 2)(3x + 2) = 0$$

so $x = \frac{2}{3}$ oraz $x = -\frac{2}{3}$.

Practice

Solve:

$$3x^2 + 14x + 8 = 0$$

Practice

Solve:

$$3x^2 + 14x + 8 = 0$$

Method:

Practice

Solve:

$$3x^2 + 14x + 8 = 0$$

Method: factorization!

Practice

Solve:

$$3x^2 + 14x + 8 = 0$$

Method: factorization!

$$(3x + 2)(x + 4) = 0$$

so $x = -\frac{2}{3}$ oraz $x = -4$.

Practice

Solve:

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

Practice

Solve:

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

Method:

Practice

Solve:

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

Method: quadratic formula (factorization doesn't work)

Practice

Solve:

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

Method: quadratic formula (factorization doesn't work)
$a = 2,\ b = -6,\ c = 3$, so

$$\Delta = 36 - 4(2)(3) = 12$$

Practice

Solve:

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

Method: quadratic formula (factorization doesn't work)
$a = 2,\ b = -6,\ c = 3$, so

$$\Delta = 36 - 4(2)(3) = 12$$

So we have:

$$x = \frac{6 \pm \sqrt{12}}{4} = \frac{6 \pm 2\sqrt{3}}{4} = \frac{3 \pm \sqrt{3}}{2}$$

There will be a test on this on Monday!