

Fix it 1 Make one side 0

The quadratic formula · ANSWERS

Do the same to both sides until one side is 0. Move every term to the side with the x^2 , so the x^2 term stays positive.

EXAMPLE

Make one side 0:

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

1. Take 6 from both sides.

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

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

YOUR TURN

- 1 Make one side 0:
 $x^2 = 5x + 1$

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

- 2 Make one side 0:
 $4x^2 + 1 = 9x$

$$4x^2 - 9x + 1 = 0$$

- 3 Make one side 0:
 $6 - x = 2x^2 + 4x$

$$2x^2 + 5x - 6 = 0$$

Check: Every term that moved has changed its sign, and the other side is now 0.

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Fix it 2 a , b and c

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Make it = 0 first. a goes with x^2 , b with x , and c is the number on its own. Each keeps the sign in front of it. No x term? Then $b = 0$.

EXAMPLE

What are a , b and c ?

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

1. a goes with x^2 : $a = 3$

2. b goes with x , sign and all: $b = -8$

3. c is the number: $c = 2$

YOUR TURN

- 1 What are a , b and c ?
 $x^2 + 6x - 5 = 0$

$$a = 1, b = 6, c = -5$$

- 2 What are a , b and c ?
 $2x^2 - 7 = 0$

$$a = 2, b = 0, c = -7$$

- 3 What are a , b and c ?
 $4 - 9x + 5x^2 = 0$

$$a = 5, b = -9, c = 4$$

Check: Put your a , b and c into $ax^2 + bx + c$. You get the equation back.

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Fix it 3 Substitute

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Write the formula down: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Then put each number in place of its letter. A negative number goes in brackets.

EXAMPLE

Substitute $a = 2$, $b = -4$, $c = 1$ into the formula.

1. Write the formula down.
2. b is negative, so it goes in brackets: $-(-4)$ and $(-4)^2$.
3. $x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \times 2 \times 1}}{2 \times 2}$

YOUR TURN

- 1 Substitute $a = 1$, $b = 3$, $c = -5$ into the formula.

$$x = \frac{-3 \pm \sqrt{3^2 - 4 \times 1 \times (-5)}}{2 \times 1}$$

- 2 Substitute $a = 3$, $b = -2$, $c = -4$ into the formula.

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \times 3 \times (-4)}}{2 \times 3}$$

- 3 Substitute $a = 5$, $b = -1$, $c = -3$ into the formula.

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times 5 \times (-3)}}{2 \times 5}$$

Check: Every negative number is in brackets, and the formula's own minus signs are all still there.

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Fix it 4 Work out $b^2 - 4ac$

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Square b first: a negative number squared is positive. Then work out $4 \times a \times c$ and take it away. a and c different signs? Then the $4ac$ adds on.

EXAMPLE

Work out $b^2 - 4ac$ when $a = 3$, $b = -4$, $c = -5$

1. $(-4)^2 - 4 \times 3 \times (-5)$
2. $(-4)^2 = 16$ and $4 \times 3 \times (-5) = -60$
3. $16 - (-60) = 16 + 60 = 76$

YOUR TURN

- 1 Work out $b^2 - 4ac$ when $a = 1$, $b = 7$, $c = 3$

37

- 2 Work out $b^2 - 4ac$ when $a = 2$, $b = -6$, $c = 1$

28

- 3 Work out $b^2 - 4ac$ when $a = 4$, $b = -3$, $c = -2$

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Check: a and c the same sign: your answer is less than b^2 . Different signs: it is more.

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Work it out once with + and once with −. The whole top is divided by $2a$, so on a calculator put the top in brackets. $-(-7)$ is 7.

EXAMPLE

$2x^2 - 5x + 2 = 0$ gives

$$x = \frac{-(-5) \pm \sqrt{9}}{2 \times 2}$$

1. $-(-5) = 5$ and $2 \times 2 = 4$

2. $\sqrt{9} = 3$

3. With +: $\frac{5+3}{4} = 2$

4. With −: $\frac{5-3}{4} = 0.5$

5. $x = 2$ or $x = 0.5$

YOUR TURN

1 $x^2 + 2x - 8 = 0$ gives $x = \frac{-2 \pm \sqrt{36}}{2 \times 1}$. Find both answers.

$$x = 2 \text{ or } -4$$

2 $4x^2 - 7x - 2 = 0$ gives $x = \frac{-(-7) \pm \sqrt{81}}{2 \times 4}$. Find both answers.

$$x = 2 \text{ or } -0.25$$

3 $2x^2 + x - 4 = 0$ gives $x = \frac{-1 \pm \sqrt{33}}{2 \times 2}$. Find both answers to 4 decimal places.

$$x = 1.1861 \text{ or } -1.6861$$

Check: Substitute each answer into the equation. Both give 0, or very close to 0.

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Fix it 6 Round

Give both answers to the accuracy asked for. Look at the next figure: 5 or more rounds up. Keep the minus sign, and keep a 0 at the end: 2.70, not 2.7.

EXAMPLE

The calculator shows

$$x = 4.192582404 \text{ or } -1.192582404$$

Give both to 2 decimal places.

1. The 3rd decimal place decides.

2. $4.19|2\dots$ rounds down: 4.19

3. $-1.19|2\dots$ rounds down: −1.19

4. $x = 4.19$ or -1.19

YOUR TURN

1 The calculator shows $x = 2.70325741$ or -0.3699240762 . Give both to 2 decimal places.

$$x = 2.70 \text{ or } -0.37$$

2 The calculator shows $x = -0.3625413912$ or -4.137458609 . Give both to 1 decimal place.

$$x = -0.4 \text{ or } -4.1$$

3 The calculator shows $x = 1.356107225$ or -1.106107225 . Give both to 3 significant figures.

$$x = 1.36 \text{ or } -1.11$$

Check: Count the decimal places or significant figures in each answer: exactly as many as the question asks for.

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