

Solving Two-Step Equations with Rational Numbers

Grade 7 math · Lesson · Standards: 7.EE.B.3, 7.EE.B.4a

Quick answer: A two-step equation, such as $px + q = r$ or $p(x + q) = r$, is solved by undoing two operations in reverse order, always doing the same thing to both sides. Rational coefficients work the same way. Substituting the answer back and estimating first confirm that a solution is reasonable.

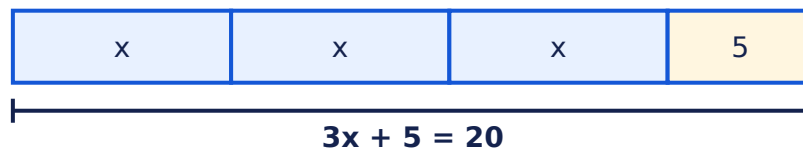
Standards: 7.EE.B.3, 7.EE.B.4a · **Level:** Grade 7

What is a two-step equation?

A two-step equation needs two inverse operations before the variable stands alone. Two forms appear in grade 7: $px + q = r$ and $p(x + q) = r$, where p , q and r are rational numbers.

Solution of an equation

A value of the variable that makes both sides equal. Substituting it back is the surest check.



The bar shows $3x + 5 = 20$: three equal parts and a 5.

How do you solve $px + q = r$?

Method

1. Undo the addition or subtraction by doing the opposite to both sides.
2. Undo the multiplication or division by doing the opposite to both sides.
3. Substitute the answer into the original equation.

Worked example

Solve $\frac{3}{4}x - 2 = 7$.

$$\frac{3}{4}x = 9 \quad \text{so} \quad x = 9 \times \frac{4}{3} = \mathbf{12}$$

Check: $\frac{3}{4}(12) - 2 = 9 - 2 = 7$.

Equation	Reason
$2.5x + 4 = 19$	original
$2.5x = 15$	subtract 4 from both sides
$x = 6$	divide both sides by 2.5
$2.5(6) + 4 = 19$	check

Each line of the solution has a reason.

How do you solve $p(x + q) = r$?

There are two valid paths. You can divide by p first, or distribute first and then solve a $px + q = r$ equation. Both lead to the same answer.

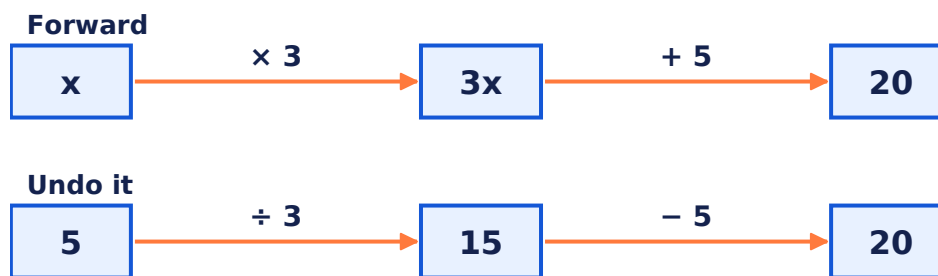
Divide first	Distribute first
$6(x - 2) = 42$	$6(x - 2) = 42$
$x - 2 = 7$	$6x - 12 = 42$
$x = 9$	$6x = 54$, so $x = 9$

Do it to both sides

Subtracting 12 from only one side breaks the balance. Each step must be done to both sides, and a negative coefficient divides to give a negative answer.

Why compare arithmetic and algebraic solutions?

An arithmetic solution works backward with numbers: "times 3, plus 5, gives 20," so $20 - 5 = 15$ and $15 \div 3 = 5$. The algebraic solution takes exactly the same steps on the equation $3x + 5 = 20$. Seeing both shows why the algebra works.



Solving reverses the operations in the opposite order: undo +5 first, then undo $\times 3$.

Estimate before solving, too. If $4.9x$ is about 30, then x is about 6, and an answer of 60 would be unreasonable.

Mathbot's tip

Write the order of operations the equation performs on x , then undo them in reverse, like taking off shoes before socks.

Key points to remember

- Undo addition or subtraction first in $px + q = r$, then undo multiplication or division.
- For $p(x + q) = r$, either divide by p first or distribute p first; both give the same solution.
- Dividing by a fraction means multiplying by its reciprocal.
- An arithmetic solution works backward with numbers and mirrors the algebraic steps.

Solving Two-Step Equations with Rational Numbers: frequently asked questions

Which step comes first in a two-step equation?

Undo the addition or subtraction first, then undo the multiplication or division. This reverses the order of operations that was applied to the variable.

How do I solve an equation with a fraction coefficient?

Multiply both sides by the reciprocal of the fraction. For $(\frac{3}{4})x = 9$, multiply by $\frac{4}{3}$ to get $x = 12$.

When should I distribute and when should I divide first?

Divide first when the number outside the parentheses divides the right side evenly, because it makes smaller numbers. Distribute first when it does not divide evenly.

How can I check my answer?

Replace the variable in the original equation with your solution and simplify both sides. If the two sides match, the solution is correct.

Can the solution be negative or a decimal?

Yes. With rational coefficients the solution may be negative, a fraction or a decimal. Keep the signs and place values carefully through each step.