Algebra Cue Cards

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ADVICE TUITION ASSESSMENT

Foundations

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Algebra Tiles

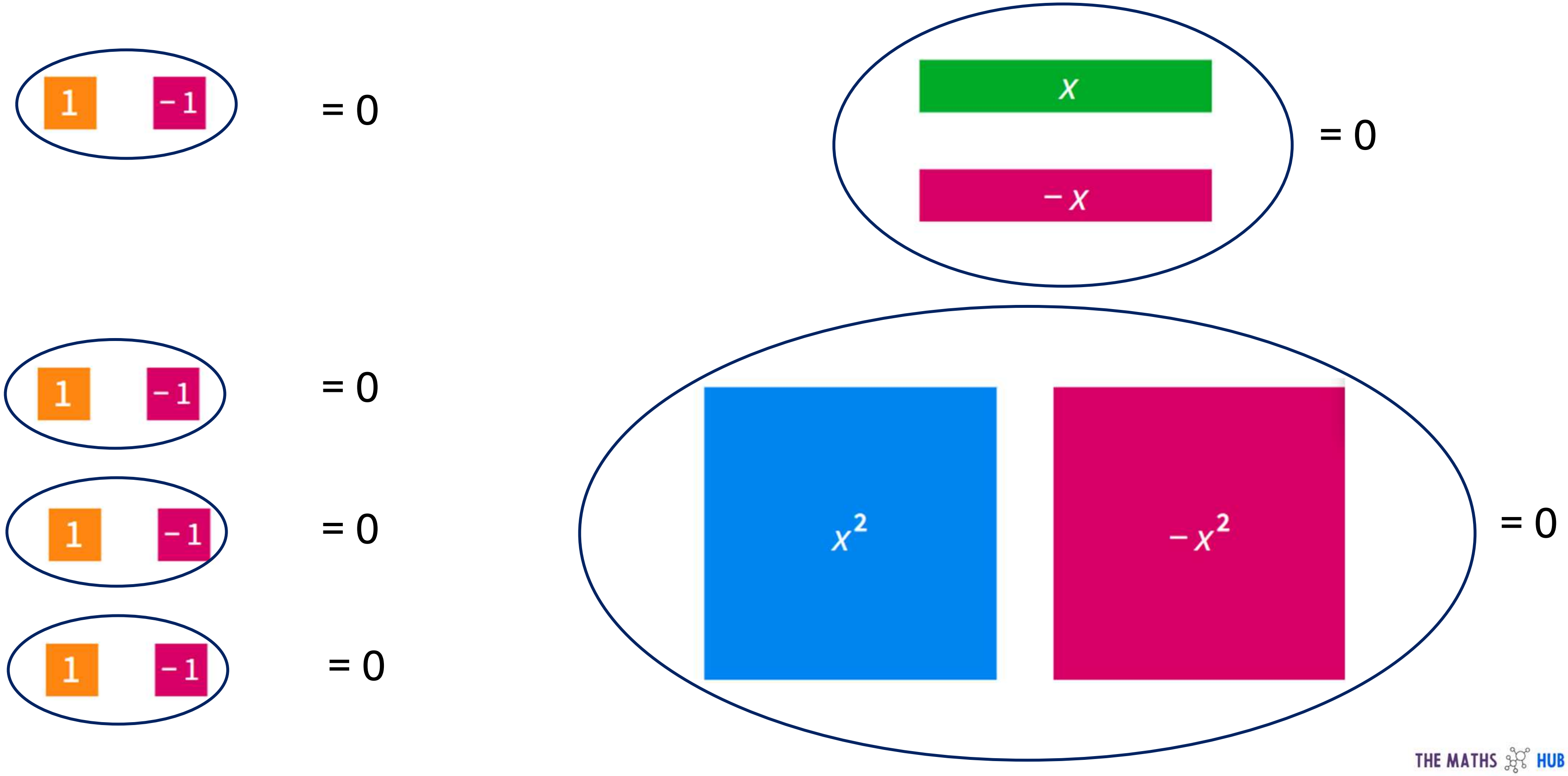
What are Algebra Tiles?

Algebra tiles are models used to represent integers, variables, expressions and equations. Algebra tiles are based on the area model of multiplication, where the dimensions of each tile represents factors, and the area is the product.

Positive quantities	1	x	x^2	y	xy
	Positive integer +1	Same width as +1 tiles Unknown length of x Used to represent variable x	x by x in dimension Used to model x^2	Same width as +1 tiles Unknown length of y Used to represent variable y	Same height as x Same length as y Use to model the product of x by y
Negative quantities	-1	$-x$	$-x^2$	$-y$	$-xy$
	Negative integer -1	$-x$	$-x^2$	$-y$	$-xy$

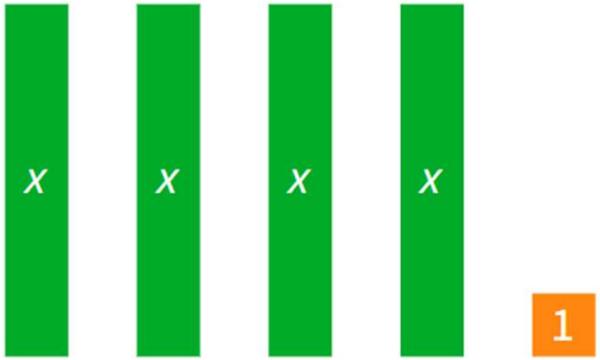
Modelling Zero with Algebra Tiles

To model zero with algebra tiles means showing that equal and opposite tiles cancel each other out.

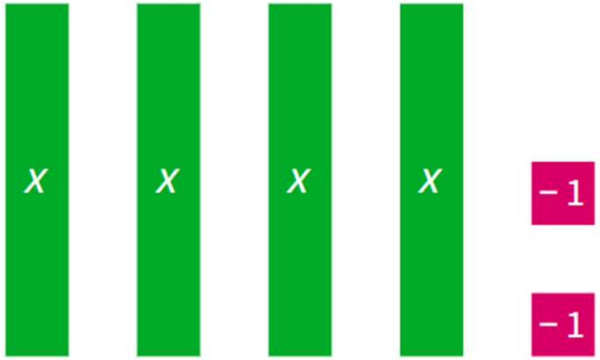


Modelling Expressions with Algebra Tiles

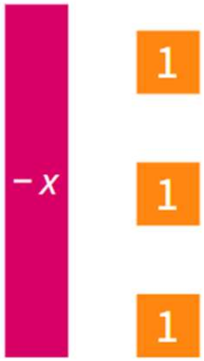
Algebra tiles can be used to model expressions.



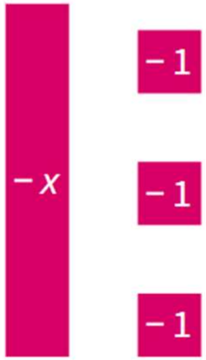
$4x + 1$



$4x - 2$



$-x + 3$



$-x - 3$

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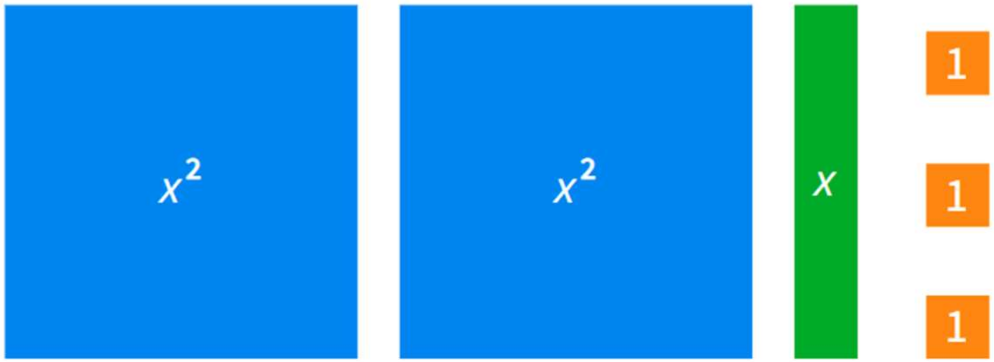
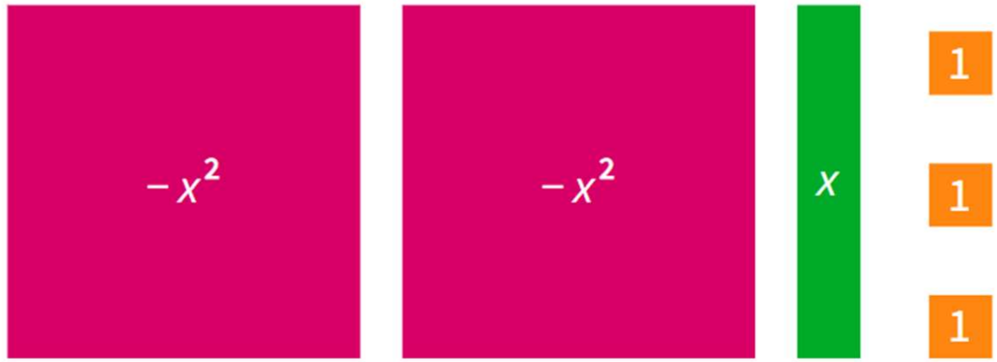
Modelling Expressions with Algebra Tiles

$$2x^2 + x + 3$$



$$-2x^2 + x + 3$$



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Collecting Like Terms

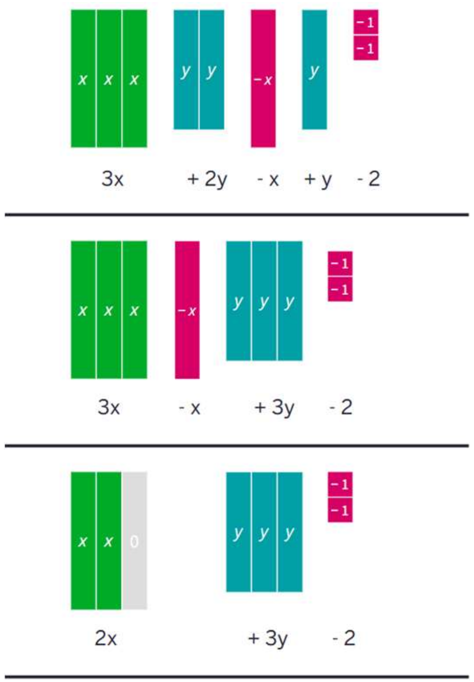
Collecting Like Terms with Algebra Tiles

Collecting like terms means combining all the parts of an expression that share the same variable or constant, so the expression is written in its simplest form. Algebra tiles can make this process visible and concrete.

How to collect like terms with algebra tiles:

- **Build the expression.** Use algebra tiles to represent each term. Write the expression underneath. (*No tiles? Draw or imagine them instead.*)
- **Sort tiles by type.** Move all x-tiles into one group, y-tiles into another, integer tiles into a third.
- **Make zero pairs.** Within each group, pair one positive tile with one negative tile. Remove both as they cancel out.
- **Count what's left.** The number of tiles in each group gives the coefficient of x, y, and the constant.
- **Write the simplified expression.** Combine the counts into a single simplified expression.

Simplify the expression 3x + 2y – x + y - 2



Answer: 2x + 3 y - 2

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Substitution

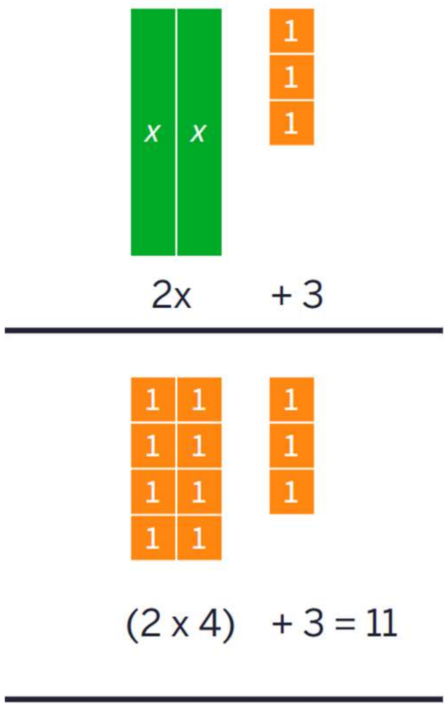
Substitution with Algebra Tiles

Substitution means replacing a variable with a specific value. Algebra tiles can help by making this replacement visible and concrete.

How to substitute with algebra tiles:

- **Build the expression.** Use algebra tiles to represent each term. Write the expression underneath. (*No tiles? Draw or imagine them instead*.)
- **Replace variable tiles.** Swap each variable tile for the correct number of integer tiles based on the given value. Write the new expression below the tiles.
- **Solve.** Count all the integer tiles to carry out the calculation or solve using BIDMAS.
- **State the final answer.**

Evaluate 2x + 3 when x = 4



Answer: 11

Equations and Inequalities

Expanding Single Brackets

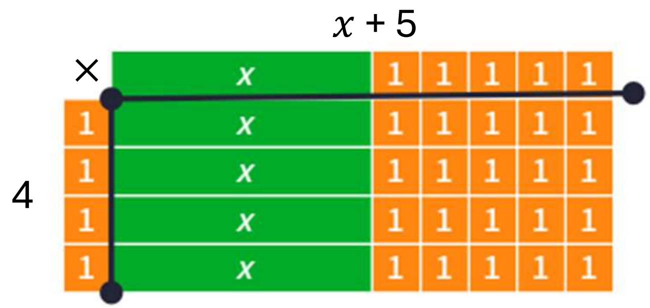
Expanding Single Brackets with Algebra Tiles

To **expand a single bracket,** multiply the term outside of the bracket by each term inside. Algebra tiles can make this visible and concrete, while using the grid method alongside the tiles reinforces the link between the visual model and the written expansion.

To expand a single bracket with algebra tiles:

- **Represent the problem.** Model the expression using algebra tiles and a multiplication grid. (*No tiles? Sketch or imagine them instead*.)
- **Multiply each term.** Use the tiles to multiply the term outside the bracket by each term inside the bracket. Terms may be numbers, variables, or a mix – positive or negative.
- **Show your work.** Lay out your multiplication clearly with the grid method, using numbers and letters for constants and variables.
- **State the answer.** Combine the results and write the simplified answer.

Expand $4(x + 5)$

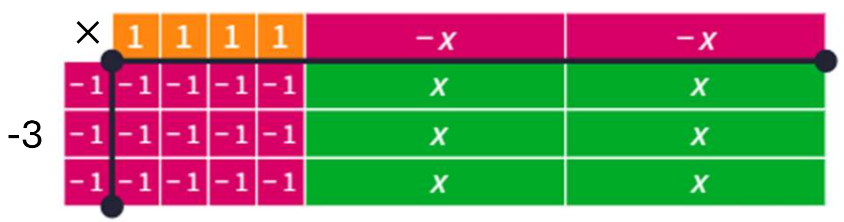


×	x	5
4	$4x$	20

$$4 \times x = 4x$$
$$4 \times 5 = 20$$
$$4x + 20$$

Expanding Single Brackets with Algebra Tiles

Expand $-3(4 - 2x)$



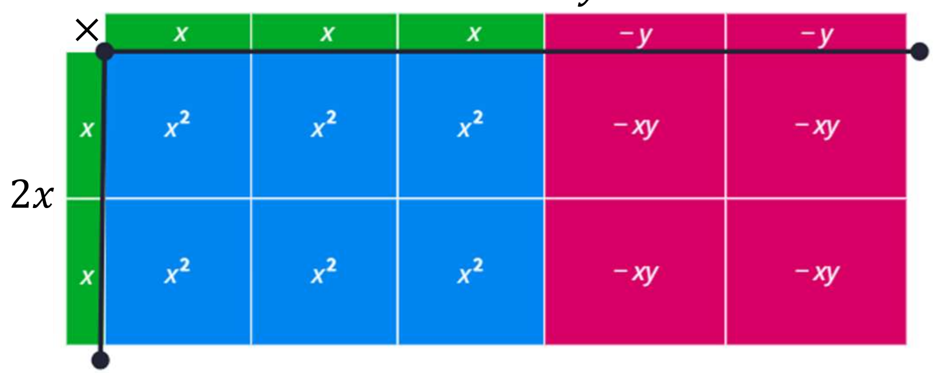
x	4	$-2x$
-3	-12	$6x$

$-3 \times 4 = -12$

$-3 \times -2x = 6x$

$-12 + 6x$

Expand $2x(3x - 2y)$



x	$3x$	$-2y$
$2x$	$6x^2$	$-4xy$

$2x \times 3x = 6x^2$

$2x \times -2y = -4xy$

$6x^2 - 4xy$

Factorising Single Brackets

Coming soon

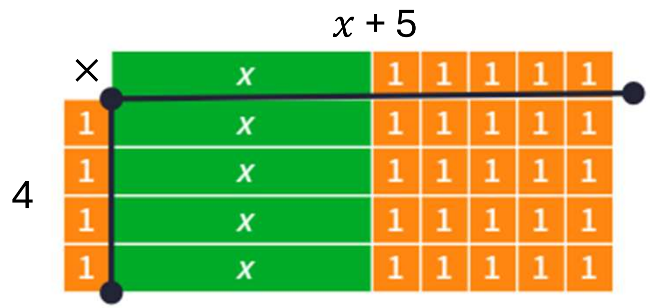
Factorising Single Brackets with Algebra Tiles

To **expand a single bracket,** multiply the term outside of the bracket by each term inside. Algebra tiles can make this visible and concrete, while using the grid method alongside the tiles reinforces the link between the visual model and the written expansion.

To expand a single bracket with algebra tiles:

- **Represent the problem.** Model the expression using algebra tiles and a multiplication grid. (*No tiles? Sketch or imagine them instead*.)
- **Multiply each term.** Use the tiles to multiply the term outside the bracket by each term inside the bracket. Terms may be numbers, variables, or a mix – positive or negative.
- **Show your work.** Lay out your multiplication clearly with the grid method, using numbers and letters for constants and variables.
- **State the answer.** Combine the results and write the simplified answer.

Factorise 6x + 12



×	x	5
4	$4x$	20

$$4 \times x = 4x$$
$$4 \times 5 = 20$$
$$4x + 20$$

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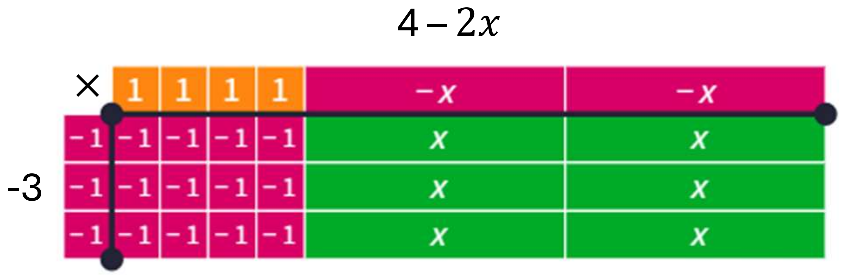
Factorising Single Brackets with Algebra Tiles

Factorise 4x - 8



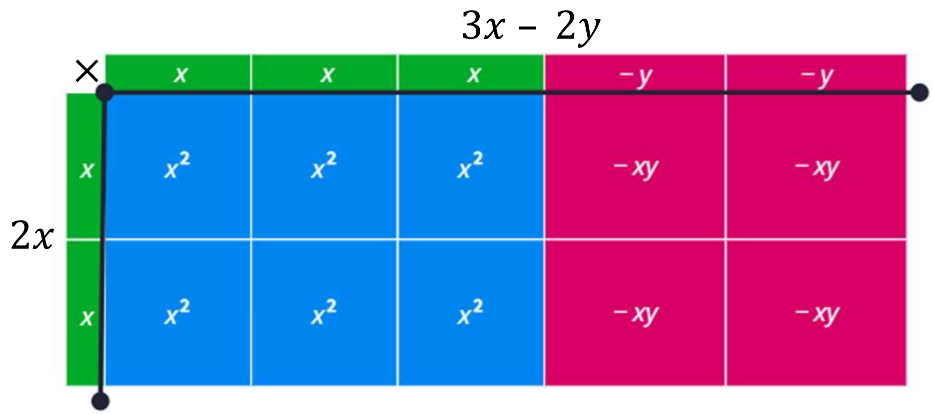
x	4	$-2x$
-3	-12	$6x$

$-3 \times 4 = -12$

$-3 \times -2x = 6x$

$-12 + 6x$

Factorise 2x + 4y



x	$3x$	$-2y$
$2x$	$6x^2$	$-4xy$

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

$2x$ x $-2y = -4xy$

$6x^2 - 4xy$

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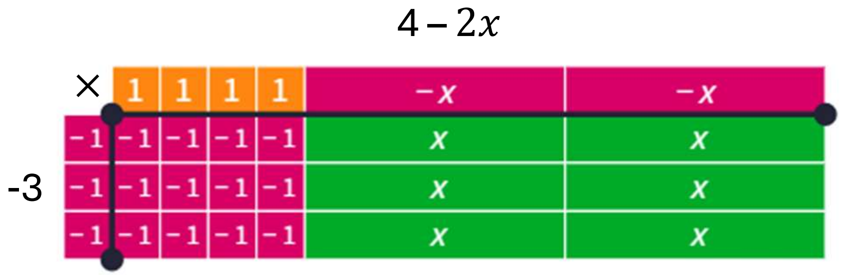
Factorising Single Brackets with Algebra Tiles

Factorise 6y – 9y



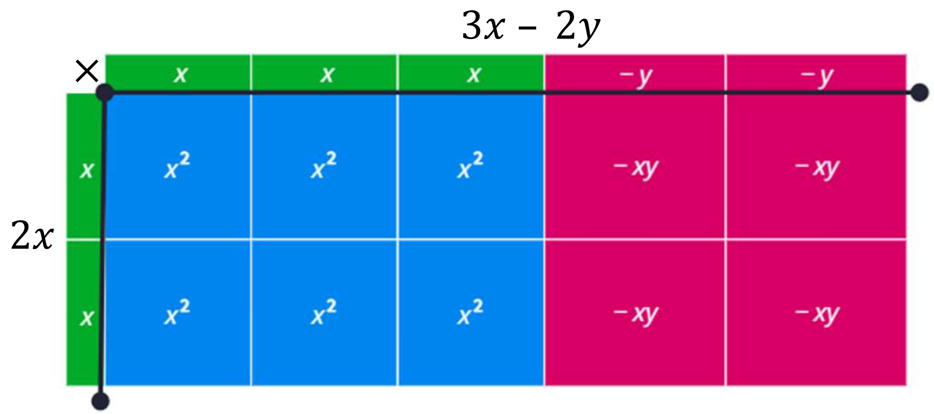
x	4	$-2x$
-3	-12	$6x$

$-3 \times 4 = -12$

$-3 \times -2x = 6x$

$-12 + 6x$

Factorise 3x + 6y + 9



x	$3x$	$-2y$
$2x$	$6x^2$	$-4xy$

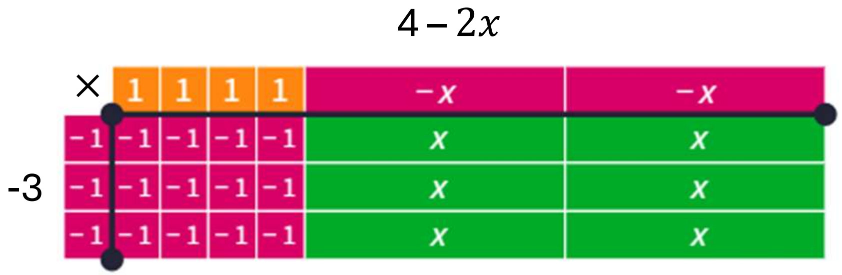
$2x \times 3x = 6x^2$

$2x \times -2y = -4xy$

$6x^2 - 4xy$

Factorising Single Brackets with Algebra Tiles

Factorise 5a – 10b



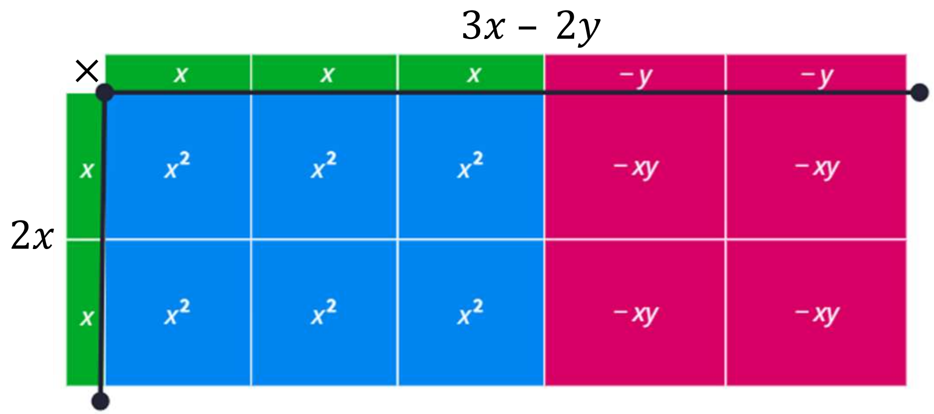
x	4	$-2x$
-3	-12	$6x$

$-3 \times 4 = -12$

$-3 \times -2x = 6x$

$-12 + 6x$

Factorise -6x + 9



x	$3x$	$-2y$
$2x$	$6x^2$	$-4xy$

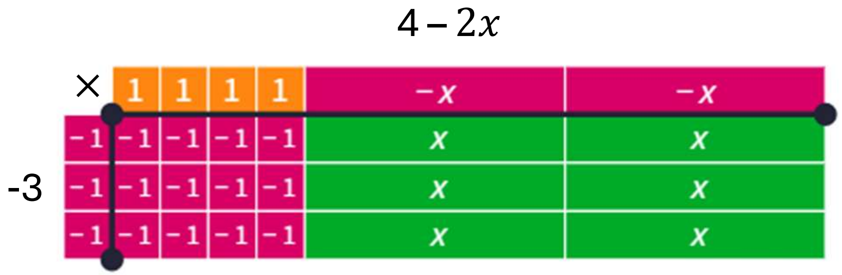
$2x \times 3x = 6x^2$

$2x \times -2y = -4xy$

$6x^2 - 4xy$

Factorising Single Brackets with Algebra Tiles

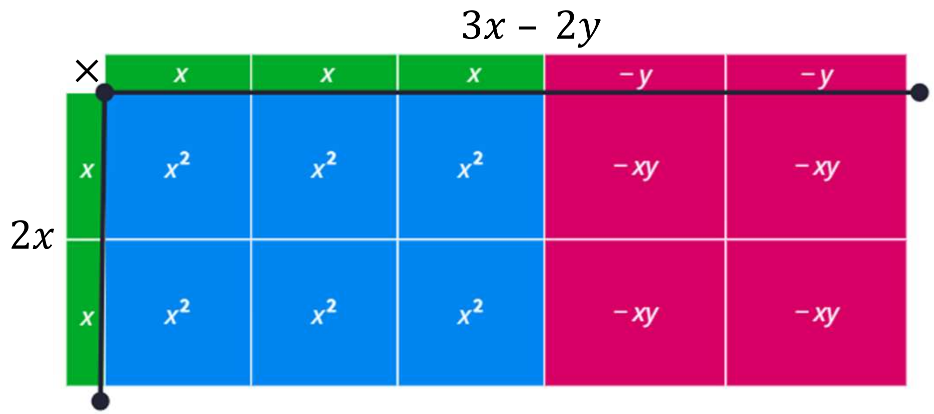
Factorise x^2 + 2x



x	4	-2x
-3	-12	6x

$$-3 \times 4 = -12$$
$$-3 \times -2x = 6x$$
$$-12 + 6x$$

Factorise -6x + 9



x	3x	-2y
2x	6x^2	-4xy

$$2x \text{ x } 3x = 6x^2$$
$$2x \text{ x } -2y = -4xy$$
$$6x^2 - 4xy$$

Rearranging Formulae

Changing the Subject of a Formula Using Function Machines

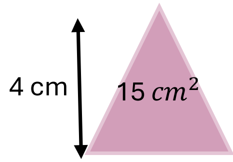
A formula shows how variables are related in a given context. A formula can be rearranged so that a different variable stands alone on one side of the equation. This is called changing the subject. There are different methods to do this. The following examples use function machines.

To change the subject of a formula:

- **Identify the new subject.** Write the formula and circle the variable you want as the new subject.
- **Map the operations.** Start from the new subject and sketch a function machine showing each operation in order.
- **Use inverse operations.** Undo each step using the appropriate inverse operation.
- **Rewrite the formula.** Write the new subject on the left, equal to the rearranged formula.

Find the base of a triangle given the area and the height.

$$A = \frac{bh}{2}$$



h → [x b] → [÷ 2] → A

h ← [÷ b] ← [x 2] ← A

$$h = \frac{2A}{b}$$

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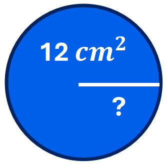
Changing the Subject of a Formula Using Function Machines

Find the radius of a circle given the area.

Area = πr^2



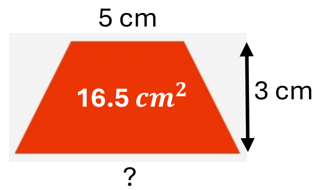
r → [^{2}] → [x π] → A

r ← [√] ← [÷ π] ← A

$$r = \sqrt{\frac{A}{\pi}}$$

Find the missing side length of a trapezium given the area and the given side length.

$$A = \frac{a+b}{2}h$$



a → [+ b] → [÷ 2] → [x h] → A

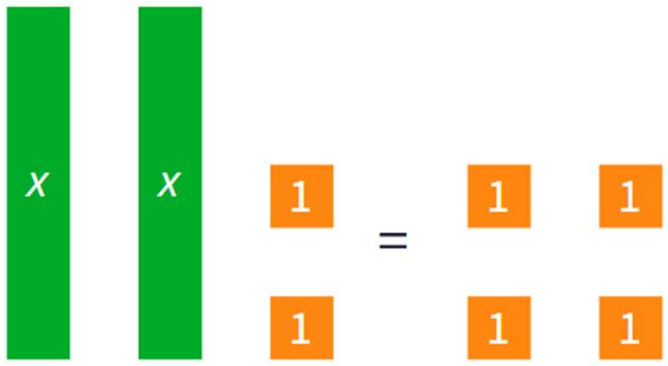
a ← [- b] ← [x 2] ← [÷ h] ← A

$$2\left(\frac{A}{h}\right) - b = a$$

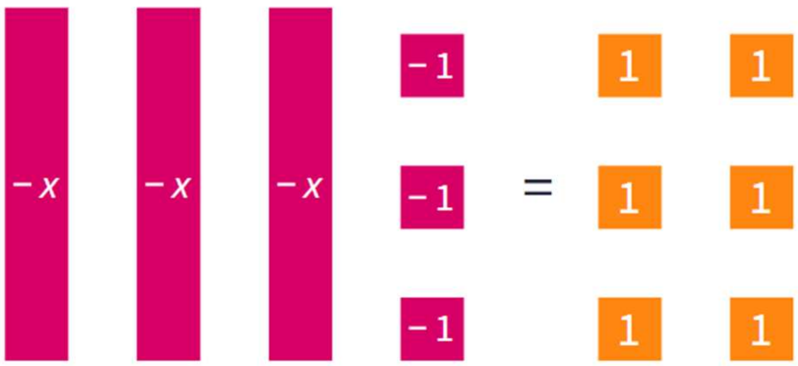
Solving Linear Equations

Modelling Equations with Algebra Tiles

Algebra tiles can be used to model equations.



$2x + 2 = 4$



$-3x + -3 = 6$

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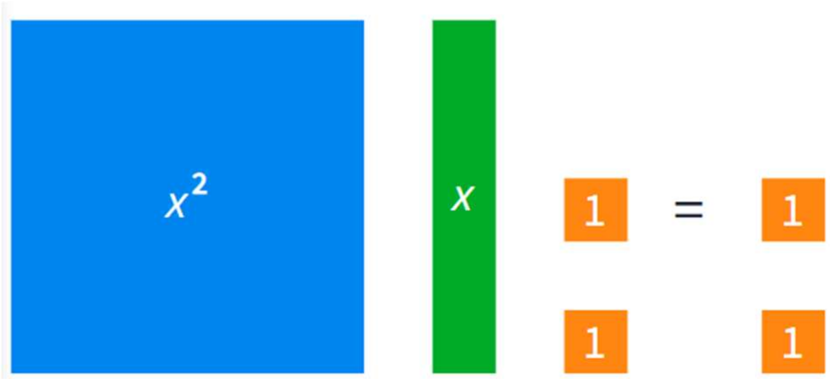
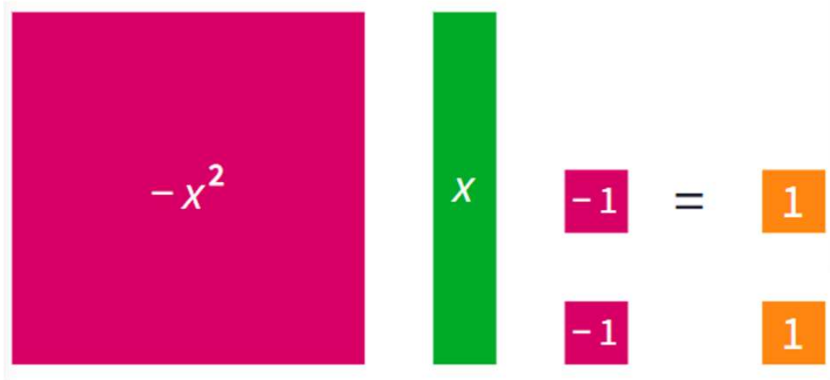
Modelling Equations with Algebra Tiles



$$x^2 + x + 2 = 2$$



$$-x^2 + x + -2 = 2$$

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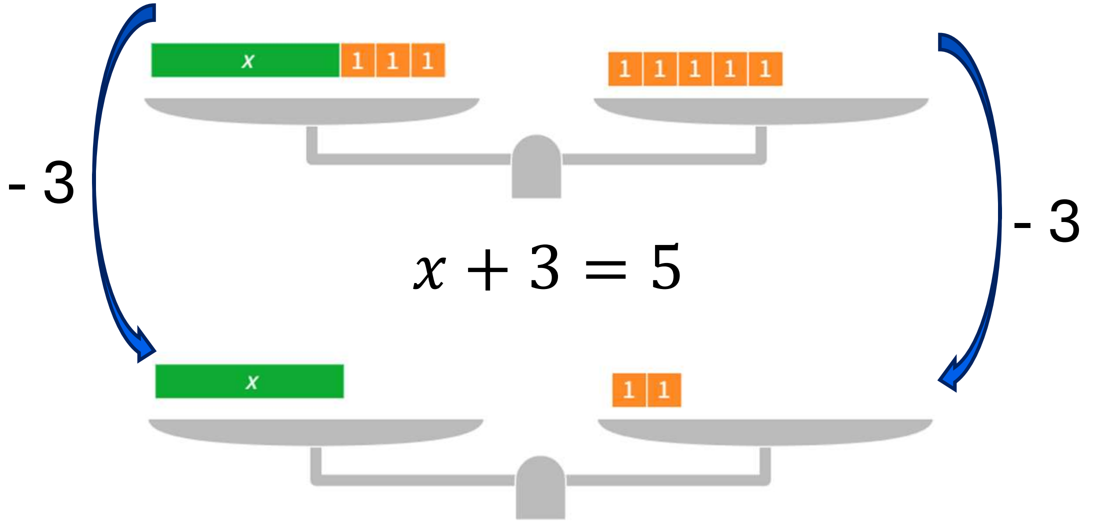
Solving One-Step Equations On a Balance Scale with Algebra Tiles

Solving an equation means finding the value of the unknown variable (e.g., x). One way to understand this process is by using a balance scale model. Working with algebra tiles shows how each side stays equal, while writing the steps in notation reinforces the connection between the visual model and the formal written method.

To solve a one-step equation on a balance scale with algebra tiles:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead.*)
- **Use the inverse operation.** To isolate x on one side of the scale, use the inverse operation. Keep the scale balanced by doing the same step on both sides. Record your work alongside the scales.
- **Check your answer.** Substitute your value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $x + 3 = 5$



$x + 3 = 5$

$x = 2$

$2 + 3 = 5$ ✓

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Solving One-Step Equations On a Balance Scale with Algebra Tiles

Solve x - 2 = 4

+ 2

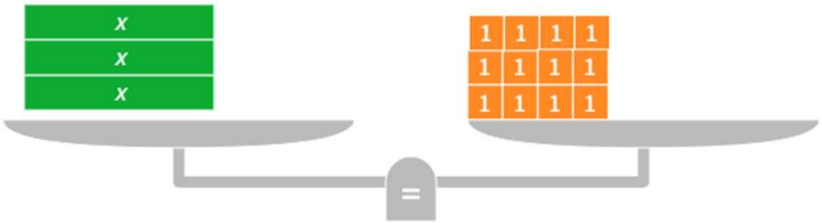
$$x - 2 = 4$$

+ 2

$$x = 6$$

6 – 2 = 4✓

Solve $3x$ = 12



÷ 3

$$3x = 12$$

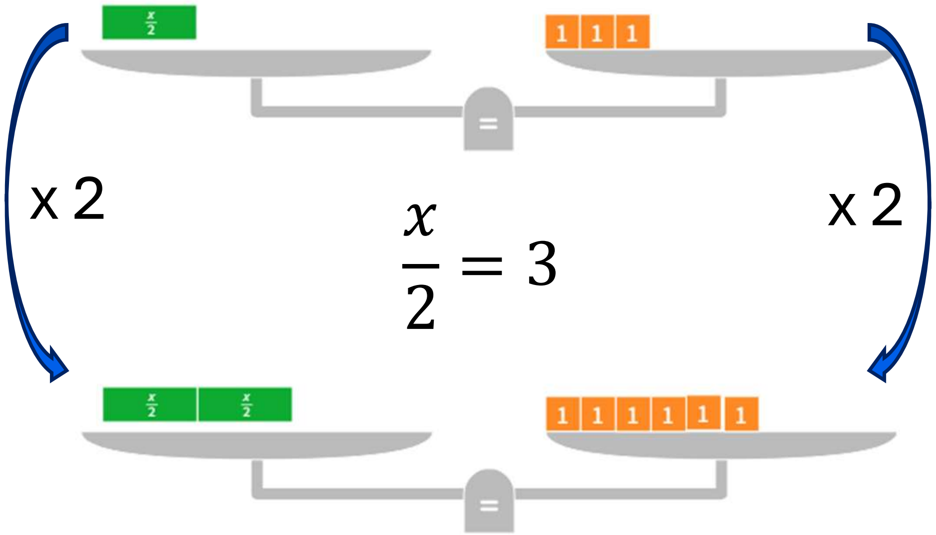
÷ 3

$$x = 4$$

3 x 4 = 12✓

Solving One-Step Equations On a Balance Scale with Algebra Tiles

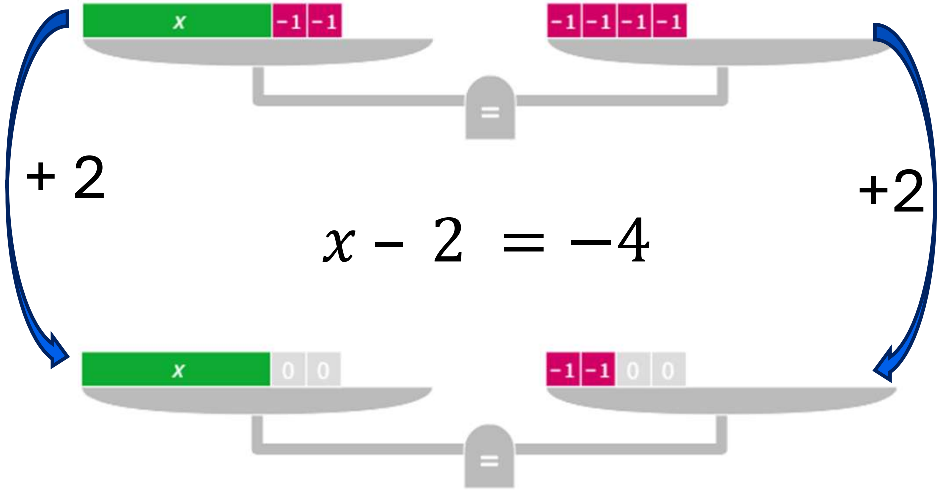
Solve $\frac{x}{2} = 3$



$x = 6$

$\frac{6}{2} = 3$✓

Solve x - 2 = -4



$x = -2$

-2 – 2 = -4✓

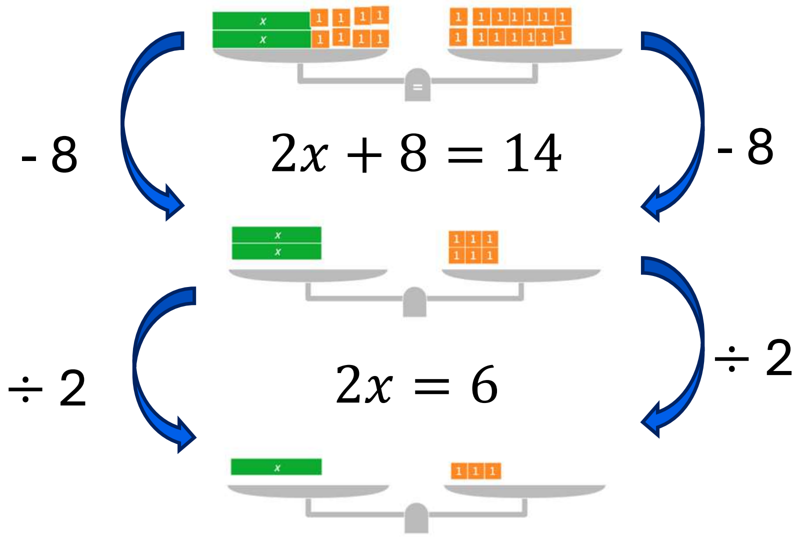
Solving Two-Step Equations On a Balance Scale with Algebra Tiles

Solving an equation means finding the value of the unknown variable (e.g., x). One way to understand this process is by using a balance scale model. Working with algebra tiles shows how each side stays equal, while writing the steps in notation reinforces the connection between the visual model and the formal written method.

To solve a two-step equation on a balance scale with algebra tiles:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead*.)
- **Use the inverse operation.** To isolate x on one side of the scale, use the inverse operations. Keep the scale balanced by doing the same steps on both sides. Record your work alongside the scales.
- **Check your answer.** Substitute your value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $2x + 8 = 14$

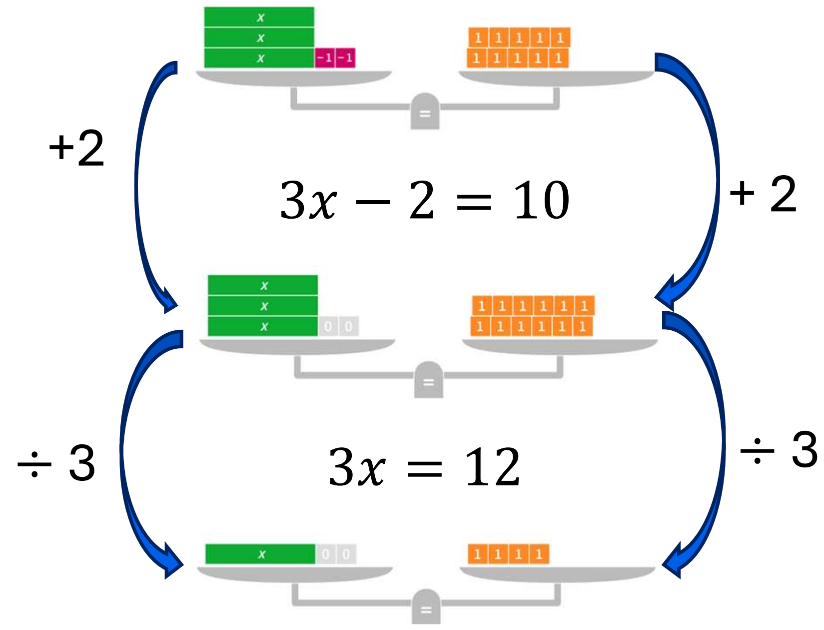


$x = 3$

(2 x 3) + 8 = 14✓

Solving Two-Step Equations On a Balance Scale with Algebra Tiles

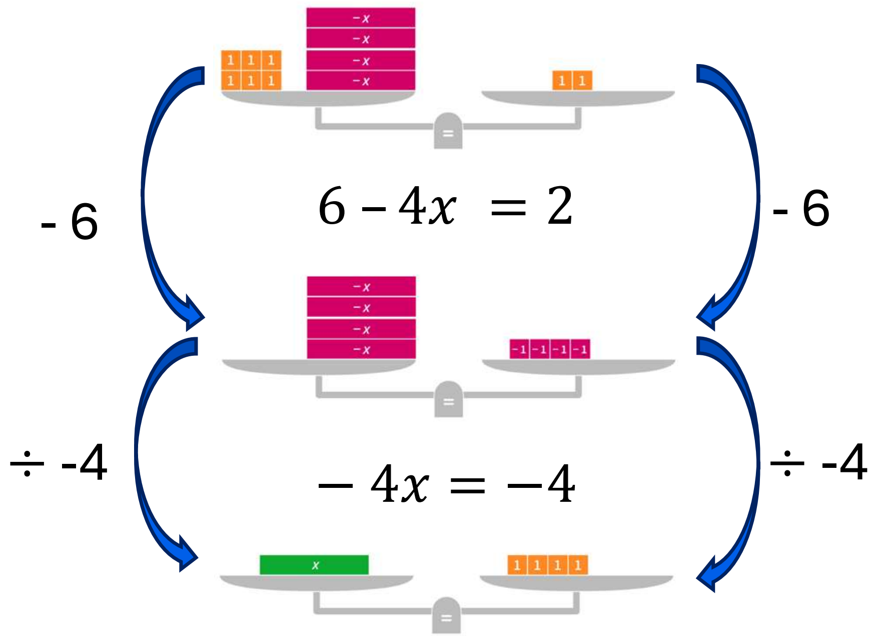
Solve $3x - 2 = 10$



$x = 4$

$(3 \times 4) - 2 = 10$ ✓

Solve $6 - 4x = 2$



$x = 1$

$6 - (4 \times 1) = 2$ ✓

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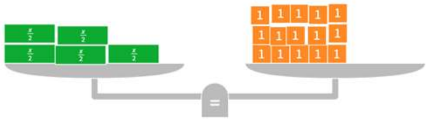
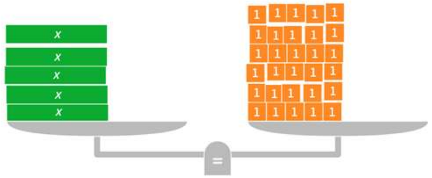
Solving Two-Step Equations On a Balance Scale with Algebra Tiles

Solve $\frac{5x}{2} = 15$



x 2 $\frac{5x}{2} = 15$ x 2



÷ 5 $5x = 30$ ÷ 5

$x = 6$

$\frac{(5 \times 6)}{2} = 15$ ✓

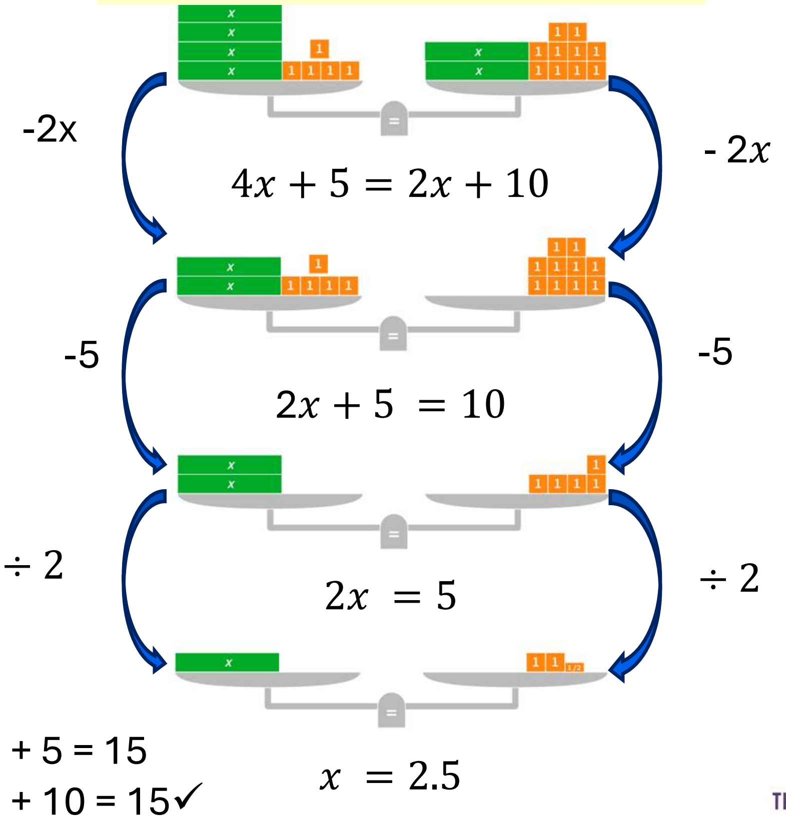
Solving Equations With an Unknown on Both Sides

When you have an **unknown variable on both sides** of an equation, start by removing the variable from one side. Typically, it's easiest to get rid of the smaller or negative variable first. This makes solving the equation easier.

To solve an equation with an unknown on both sides:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead*.)
- **Identify the smallest or negative x.** Remove it using the inverse operation. Keep the scale balanced by doing the same operation on both sides.
- **Use the inverse operation.** Now use the inverse operations to isolate x on one side of the scale.
- **Check your answer.** Substitute the value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $4x + 5 = 2x + 10$



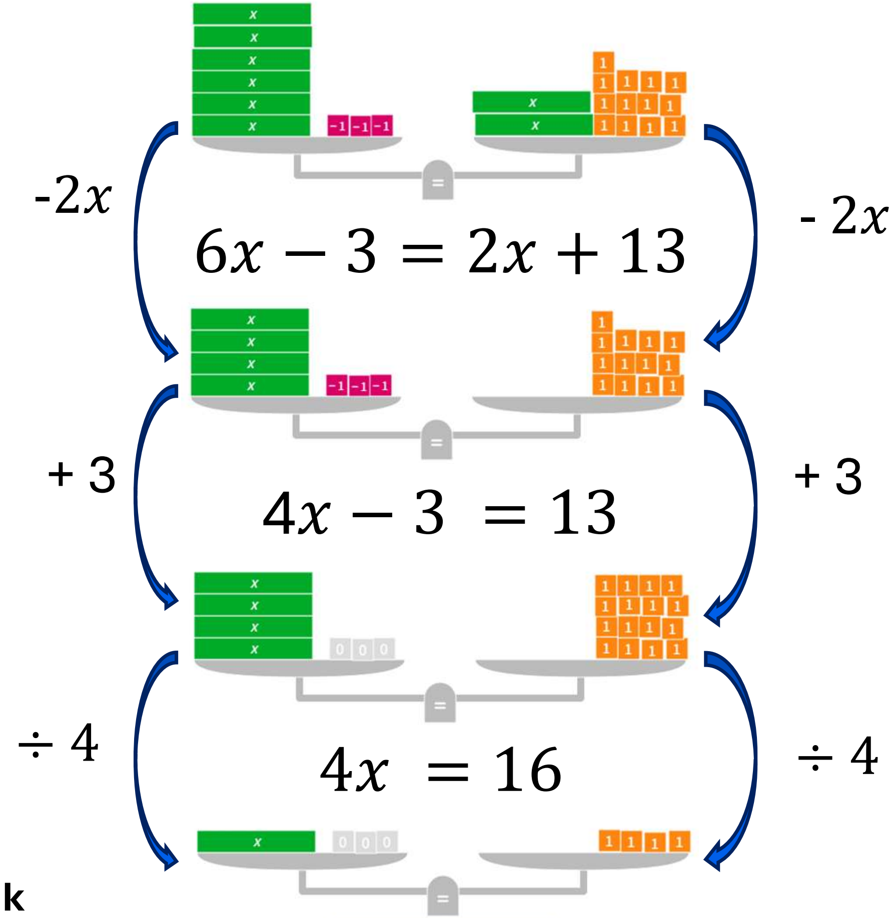
Check

(4 x 2.5) + 5 = 15

(2 x 2.5) + 10 = 15✓

Solving Equations With an Unknown on Both Sides

Solve $6x - 3 = 2x + 13$



$$6x - 3 = 2x + 13$$

$$4x - 3 = 13$$

$$4x = 16$$

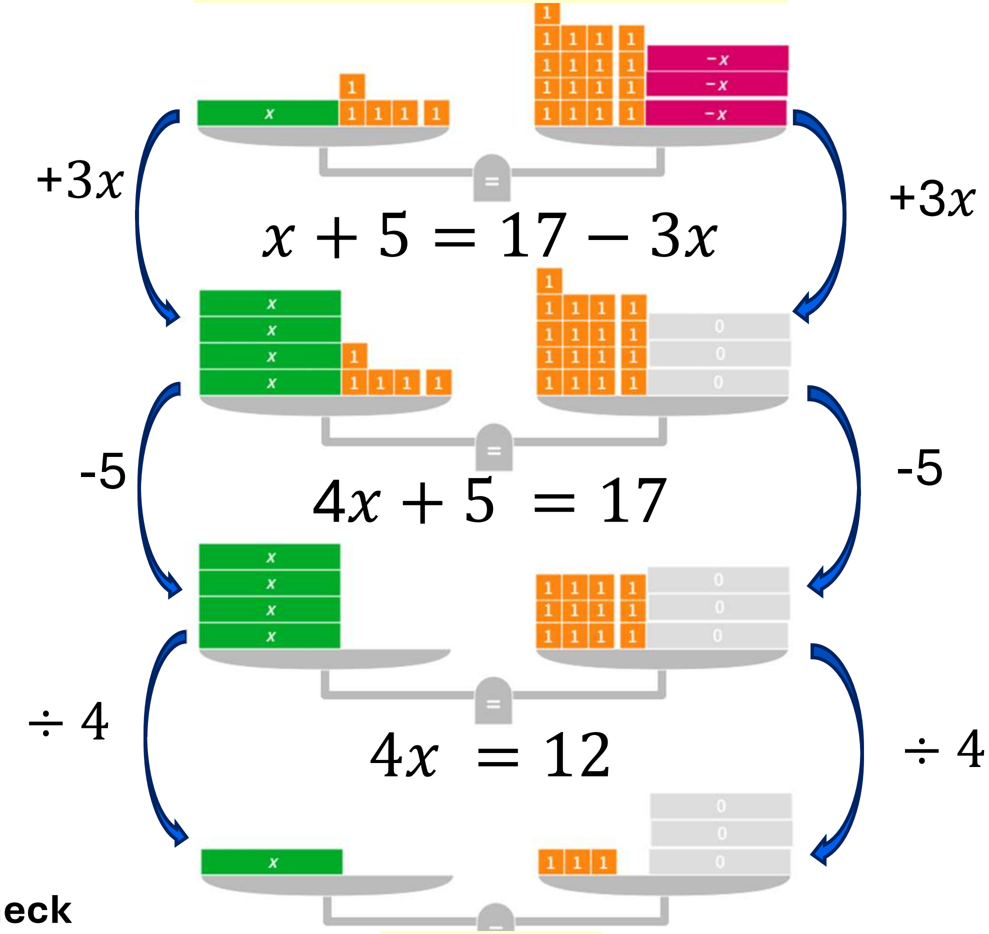
Check

(6 x 4) – 3 = 21

(2 x 4) + 13 = 21✓

$$x = 4$$

Solve $x + 5 = 17 - 3x$



$$x + 5 = 17 - 3x$$

$$4x + 5 = 17$$

$$4x = 12$$

Check

(3 +1) = 4

10 – (2 x 3) = 10 – 6 = 4✓

$$x = 3$$

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Solving Equations With Brackets

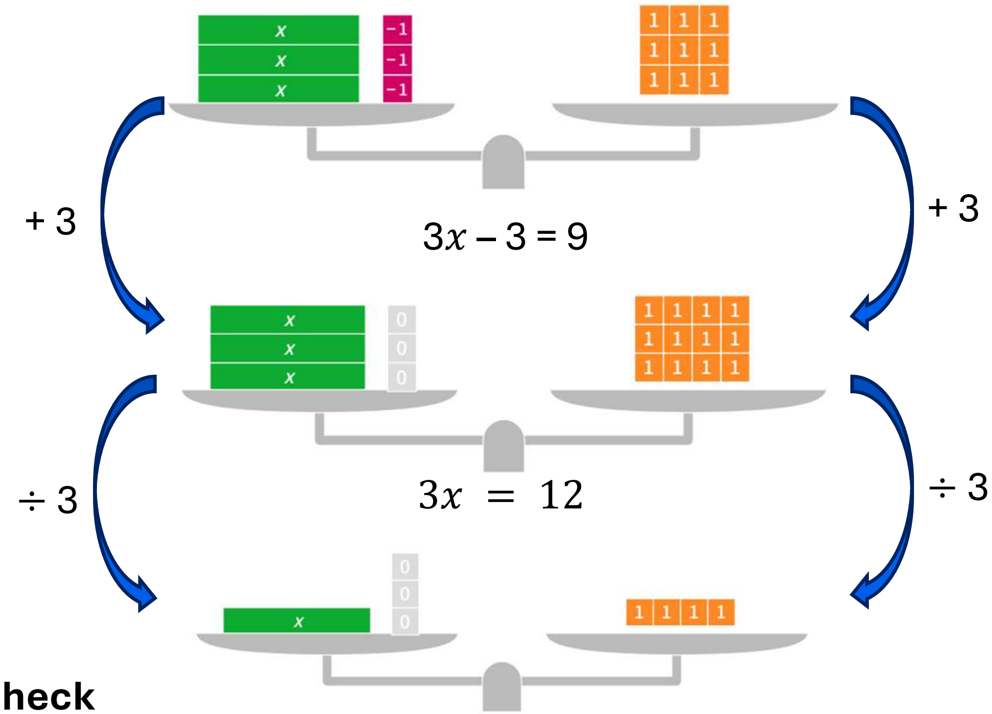
When **solving equations with brackets**, start by expanding the brackets.

To solve an equation with brackets:

- **Multiply each term.** Use a multiplication grid or algebra tiles to multiply the term outside the bracket by each term inside the bracket.
- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead.*)
- **Use the inverse operation.** Now use the inverse operations to isolate x on one side of the scale.
- **Check your answer.** Substitute the value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $3(x - 1) = 9$

	x	- 1
3	$3x$	- 3



Check
$3(4 - 1) = 9$ ✓

$x = 4$

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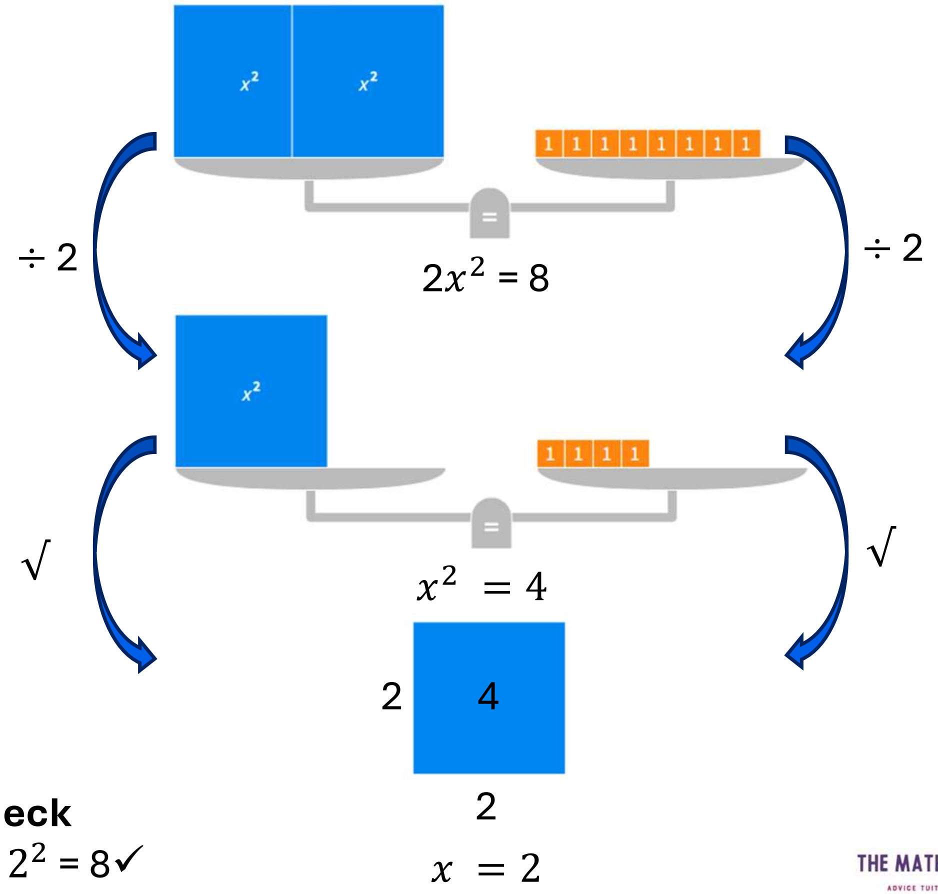
Solving Equations With Roots and Powers

Roots and powers are inverse operations. Use this fact when solving equations on a balance scale with algebra tiles.

To solve an equation with roots and powers:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead*.)
- **Use the inverse operation.** Apply the inverse operations to isolate x on one side of the scale.
- **Check your answer.** Substitute the value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $2x^2 = 8$



Check
$2 \times 2^2 = 8$ ✓

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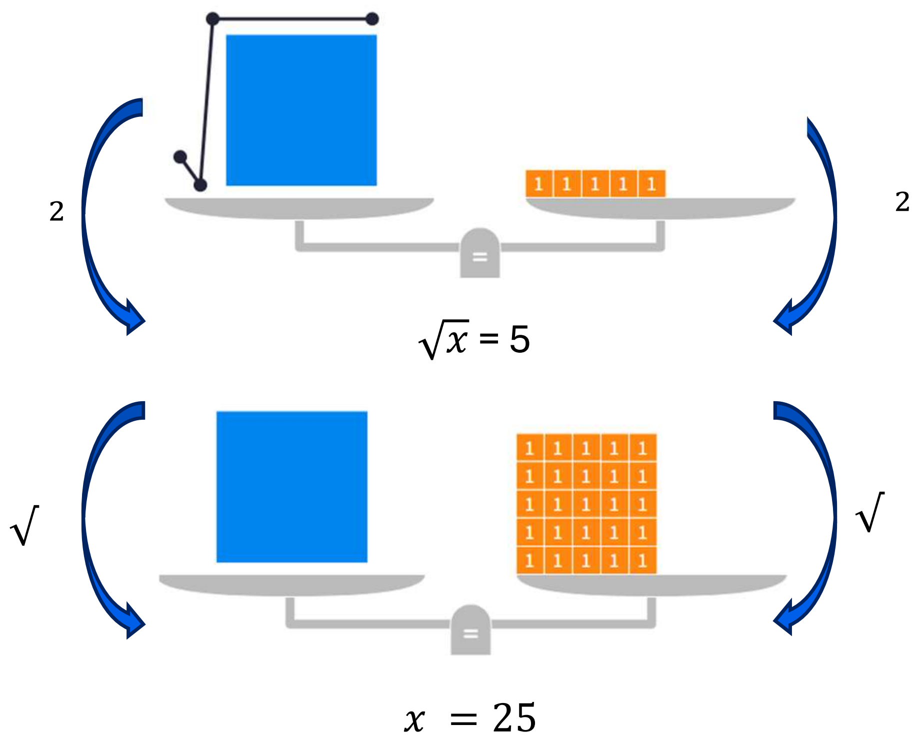
Solving Equations With Roots and Powers

Roots and powers are inverse operations. Use this fact when solving equations on a balance scale with algebra tiles.

To solve an equation with roots and powers:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead*.)
- **Use the inverse operation.** Apply the inverse operations to isolate x on one side of the scale.
- **Check your answer.** Substitute the value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $\sqrt{x} = 5$



Check

$\sqrt{25} = 5$ ✓

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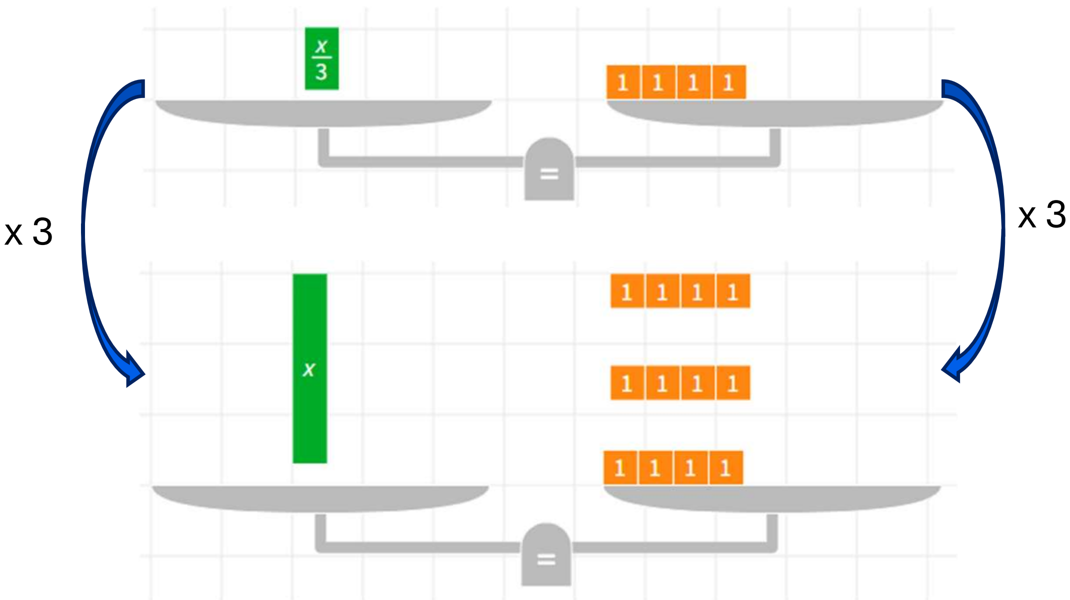
Solving Equations with Fractions

Fractions mean division, so solving these equations is about undoing division with multiplication.

To solve an equation with fractions:

- **Represent the problem.** Model the equation using algebra tiles on a balance scale. Write the equation underneath. (*No tiles? Sketch or imagine them instead*.)
- **Use the inverse operation.** Multiply to undo division. Keep the balance by doing the same operation on both sides of the scale. Isolate x on one side of the scale.
- **Check your answer.** Substitute the value of x back into the original equation. If both sides are equal, it's correct.
- **State your final answer.**

Solve $\frac{x}{3} = 4$



$x = 12$

Check

$12 \div 3 = 4$ ✓

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Forming Equations

Coming soon

Solving Inequalities and Representing Them on Number Lines

Coming soon

Sequences

Finding the nth Term

Coming soon

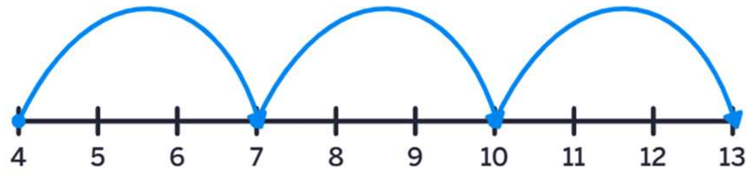
Finding the nth Term of an Arithmetic Sequence

An arithmetic sequence is a list of numbers made by adding (or subtracting) the same number each time. The nth term is a rule or formula that tells you how to find any number in that sequence, no matter how far along it is. Instead of writing out the whole sequence, the nth term gives you a shortcut.

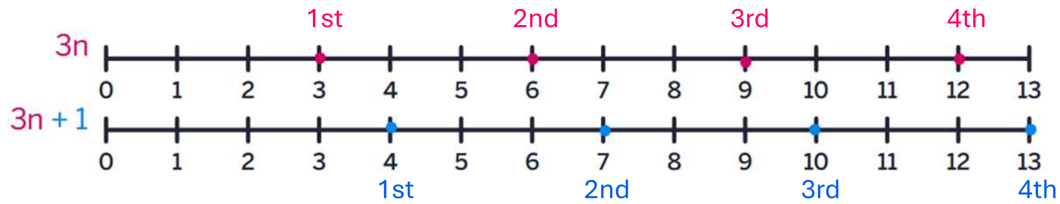
How to find the nth term:

- **Draw the sequence on a number line.** Write the numbers spaced out. Place each term at the correct position.
- **Spot the step size.** Draw arrows between the numbers. Each arrow shows the common difference (the jump).
- **Use the times tables.** Choose the times table that matches the jump size. Write these numbers spaced out on a number line above the sequence.
- **Spot the relationship.** Compare the times table with the sequence. Ask: “How do I get from the times tables to the number in the same position in the sequence? Do I add or subtract?” This is the adjustment.
- **Put the numbers in a table.**
- **Build the rule.** Rule = (times table) + or – (adjustment). This is the nth term.

Find the nth term of 4, 7, 10, 13...



Common difference is 3

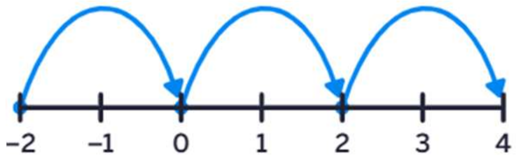


The sequence is one more than the three times tables

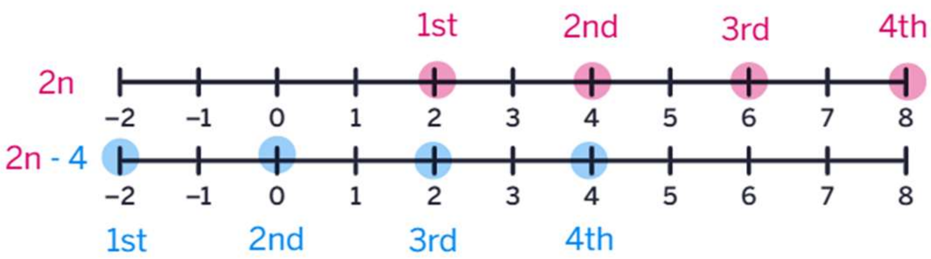
Position	1	2	3	4
Term	4	7	10	13
3n	3 x 1 = 3	3 x 2 = 6	3 x 3 = 9	3 x 4 = 12
3n + 1	3 + 1	6 + 1	9 + 1	12 + 1

Finding the nth Term of an Arithmetic Sequence

Find the nth term of -2, 0, 2, 4...



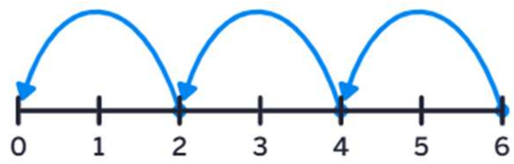
The common difference is 2



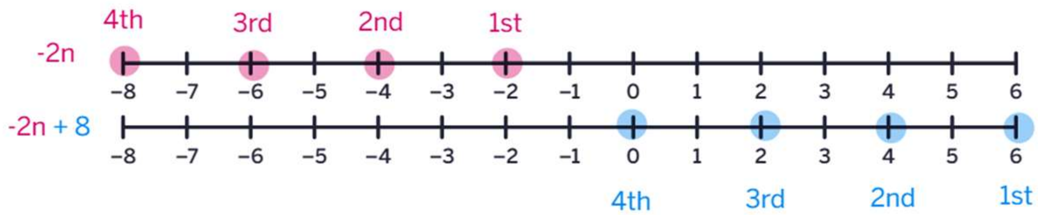
The sequence is the 2 times tables minus 4

Position	1	2	3	4
Term	-2	0	2	4
2n	2 x 1 = 2	2 x 2 = 4	2 x 3 = 6	2 x 4 = 8
2n - 4	2 – 4 = -2	4 – 4 = 0	6 – 4 = 2	8 – 4 = 4

Find the nth term of 6, 4, 2, 0



The common difference is -2

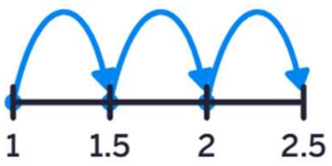


The sequence is the -2 times tables plus 8

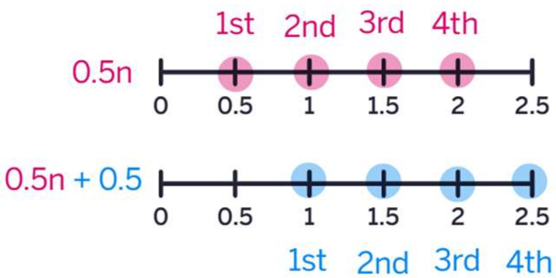
Position	1	2	3	4
Term	6	4	2	0
-2n	-2 x 1 = -2	-2 x 2 = -4	-2 x 3 = -6	-2 x 4 = -8
-2n + 8	-2 + 8 = 6	-4 + 8 = 4	-6 + 8 = 2	-8 + 8 = 0

Finding the nth Term of an Arithmetic Sequence

Find the nth term of 1, 1.5, 2, 2.5...



The common difference is 0.5



The sequence is the 0.5 times tables add 0.5

Position	1	2	3	4
Term	1	1.5	2	2.5
0.5n	0.5 x 1 = 0.5	0.5 x 2 = 1	0.5 x 3 = 1.5	0.5 x 4 = 2
0.5n + 0.5	0.5 + 0.5	1 + 0.5	1.5 + 0.5	2 + 0.5 = 2.5

Polynomials

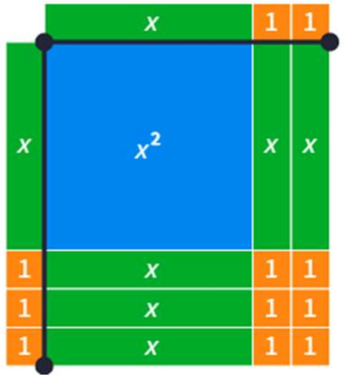
Expanding Double Brackets with Algebra Tiles

To **expand double brackets,** multiply each term in the first bracket by each term inside the second bracket. Algebra tiles can make this visible and concrete, while using the grid method alongside the tiles reinforces the link between the visual model and the written expansion.

To expand double brackets with algebra tiles:

- **Represent the problem.** Model the expression with algebra tiles and a multiplication grid. (*No tiles? Sketch or imagine them instead*.)
- **Multiply each term.** Use the tiles to multiply each term in the first bracket by each term in the second bracket. Terms may be numbers, variables, or a mix –positive or negative.
- **Show your work.** Lay out your multiplication clearly with the grid method, using numbers and letters for constants and variables.
- **State the answer.** Combine the results and write the simplified answer.

Expand and simplify $(x + 2)(x + 3)$



X	x	2
x	x^2	$2x$
3	$3x$	6

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

$x^2 + 5x + 6$

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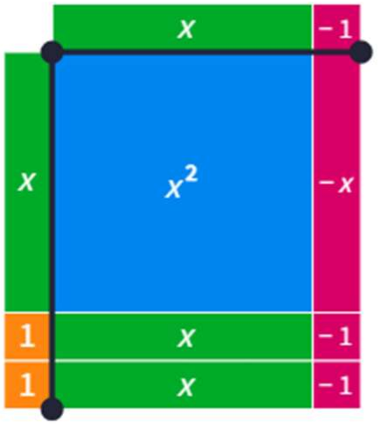
Expanding Double Brackets with Algebra Tiles

Expand and simplify $(x + 2)(x - 1)$

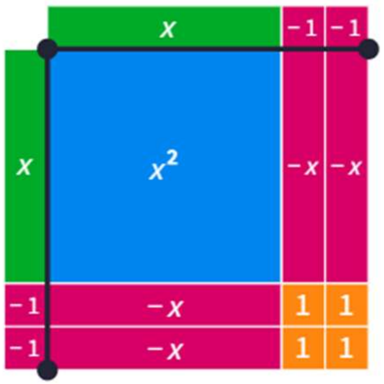


x	x	2
x	x^2	$2x$
-1	- x	- 2

x^2 + $2x$ - x - 2

x^2 + x - 2

Expand and simplify $(x - 2)^2$



x	x	-2
x	x^2	$-2x$
- 2	$-2x$	-4

$x^2 - 2x - 2x$ + 4

$x^2 - 4x$ + 4

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Acknowledgements

- Images were created using free virtual manipulatives by Amplify available at Polypad.com

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