

Year 8 - Unit 3: Equations

Learning Journey:

Prior Learning

- Substitute values into expressions and simplify algebraic expressions, including collecting like terms.
- Use inverse operations and solve one-step equations



Next Steps

- Rearrange formulae and solve more complex algebraic equations.
- Apply equation-solving skills to graphs, inequalities & problem-solving contexts.

By the end of this unit, you should be able to:

- Solve multi-step linear equations, including brackets, fractions and variables on both sides.
- Construct and solve equations from worded problems and check their solutions.

Keywords:

- Equation** – A mathematical statement showing two expressions are equal.
- Variable** – A letter that represents an unknown value.
- Bracket** – A symbol used to group terms together.
- Denominator** – The bottom number in a fraction.
- Inverse** – The opposite operation used to undo a calculation.
- Balance method** – Solving equations by doing the same thing to both sides.

Solving two step equations

Example: $3x + 6 = 18$

Rearrange the equation so the unknown variable (x) is on its own on one side

Here the opposite of +6 is -6.

$$\begin{array}{r} 3x + 6 = 18 \\ -6 \quad -6 \end{array}$$

Work out what the unknown variable (x) is by using the opposite of what it says.

Here

$$3x = 3 \times x$$

so, we divide by 3.

$$\begin{array}{r} 3x = 12 \\ \div 3 \quad \div 3 \\ x = 4 \end{array}$$

Solving equations with brackets

Example: $4(x - 2) = 12$ $4x - 8 = 12$

$$\begin{array}{r} +8 \quad +8 \end{array}$$

Expand the brackets

$$4(x-2)=12$$

$$\begin{array}{r} 4x = 20 \\ \div 4 \quad \div 4 \end{array}$$

$$4x - 8 = 12$$

$$\begin{array}{r} x = 5 \end{array}$$

Here the opposite of -8 is +8.

Then $4x = 4 \times x$ so we divide by 4.

Top Tip:

We could have first divided both sides of the equation by 4 for this question as 4 is a factor of 12.

Equations with the unknown in denominator

Solve:

$$\frac{18}{x} - 6 = 3$$

Looking at the left-hand side of the equation, x is the denominator. 18 is divided by x and then 6 is subtracted.

First, we add 6 to both sides of the equation.

Then we need to multiply both sides of equation by x.

Then we can divide both sides by 9.

The final answer is:

$$x = 2$$

$$\begin{array}{r} \frac{18}{x} - 6 = 3 \\ +6 \quad +6 \\ \frac{18}{x} = 9 \\ \times x \quad \times x \\ 18 = 9x \\ \div 9 \quad \div 9 \\ 2 = x \end{array}$$

Solving equations with unknown on both sides

Solve: $5x + 6 = 2x + 9$

1 Rearrange the equation so x's are on the same side. (Top tip: eliminate the smallest variable).

Here 2x is smaller than 5x, so eliminate it by -2x.

2 Rearrange so the x is on its own on one side (here we are subtracting 6 from both sides of the equation).

3 Work out what the x is by doing the opposite of what it says.

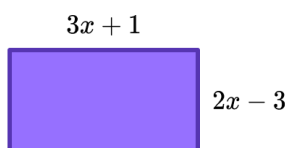
Here $3x = 3 \times x$ so we divide by 3.

$$\begin{array}{r} 5x + 6 = 2x + 9 \\ -2x \quad -2x \\ 3x + 6 = 9 \\ -6 \quad -6 \\ 3x = 3 \\ \div 3 \quad \div 3 \\ x = 1 \end{array}$$

Constructing and solving equations

Forming and solving equations is when we are given a mathematical situation which is, or can be, described using algebraic expressions. We can use the algebraic expressions and information about the situation to form an equation. We can then solve the equation to find the solution.

Example: The perimeter of the rectangle is 36



The perimeter is the sum of all the sides of the rectangle.

$$36 = 2(3x + 1) + 2(2x - 3)$$

$$36 = 6x + 2 + 4x - 6$$

$$36 = 10x - 4$$

$$40 = 10x$$

$$x = 4$$