Linear Equations

Inverse operations are key in solving linear equations.

Inverse means 'opposite'

The **inverse** operation of **addition** is **subtraction**.
The inverse operation of **multiplication** is **division**.

One and two step equations

Work backwards using the inverse operations. Remember to perform the inverse on both sides of the equation to keep it balanced. Keep taking the inverses until you arrive at the answer.

Example one-step

$$\begin{array}{ll} & a + 5 = 11 \\ -5 & \\ & a = 6 \end{array} \quad -5$$

Example two-step

$$\begin{array}{ll} & 4 = 3b - 7 \\ +7 & \\ & 11 = 3b \\ \div 3 & \\ & \frac{11}{3} = b \end{array} \quad \begin{array}{l} \\ +7 \\ \\ \div 3 \end{array}$$

Equations with unknowns both sides

You need to balance the unknowns first so you are left with just one instance of the unknown in your equation.

Example:

$$\begin{array}{ll} & 5f + 2 = 2f - 2 \\ -2f & \\ & 3f + 2 = -2 \\ -2 & \\ & 3f = -4 \\ \div 3 & \\ & f = -\frac{4}{3} \end{array} \quad \begin{array}{l} \\ -2f \\ \\ -2 \\ \\ \div 3 \end{array}$$

Subtract 2f from both sides then subtract 2 from each side and finally divide both sides by 3 to obtain the final answer.

Fractional equations

To solve equations with fractions you will need to multiply both sides of the equation by the denominator at some stage. It is important to do the inverse operation in the right order.

Solve

$\frac{t-2}{5} = 3$

$t - 2 = 15$ (multiply both sides by 5)

$t = 17$ (add 2 to both sides)

Equations with brackets

Two different methods for single brackets.

Method 1: divide by the number in front of the bracket first.

$$\begin{array}{ll} & 3(2p + 1) = 12 \\ \div 3 & \\ & 2p + 1 = 4 \\ -1 & \\ & 2p = 3 \\ \div 2 & \\ & p = 1.5 \end{array} \quad \begin{array}{l} \\ \div 3 \\ \\ -1 \\ \\ \div 2 \end{array}$$

Method 2: multiply out the brackets first.

$$\begin{array}{ll} & 3(2p + 1) = 12 \\ & 6p + 3 = 12 \\ -3 & \\ & 6p = 9 \\ \div 6 & \\ & p = 1.5 \end{array} \quad \begin{array}{l} \\ \\ -3 \\ \\ \div 6 \end{array}$$

Setting up and solving an equation

Read the text carefully and pick out the relevant parts.

A milkman sets off from the dairy with **eight** crates of milk, each containing *b* bottles.
He delivers **92 bottles** to a large factory and finds that he has **exactly 100 bottles** left on his float. How many bottles were in each crate?

The equation is: $8b - 92 = 100$

$8b = 192$ (add 92 to both sides)

$b = 24$ (divide both sides by 8)

There were 24 bottles in each crate.