Simultaneous Equations

Unknowns

To work out the unique values of the unknowns in equations, you need at least as many *different* pieces of information as there are unknown values.

The substitution method

$$x + 2y = 5$$
$$2x - 3y = -4$$

To use this method, just pick one of the equations: $x + 2y = 5$.

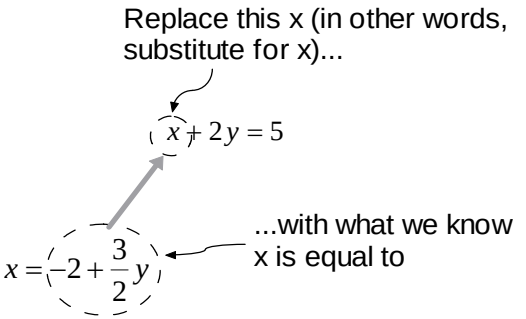
Pick one of the two unknowns and substitute something else for it.

Say we pick 'x'. We want to replace the 'x' with what it is equal to.

We can rearrange our second equation, so that it is in the form of "x = …":

$$\begin{aligned} 2x - 3y &= -4 \\ 2x - 3y + 3y &= -4 + 3y \\ 2x &= -4 + 3y \\ x &= \frac{-4 + 3y}{2} \\ x &= -2 + \frac{3}{2}y \end{aligned}$$

So now we have an expression that says what x is equal to. We can substitute this into our first equation:



To get this: $-2 + \frac{3}{2}y + 2y = 5$

Now we've only got *one* unknown in this equation, so we can solve for the value of y:

$$\begin{aligned} -2 + \frac{3}{2}y + 2y &= 5 \\ -2 + 3\frac{1}{2}y &= 5 \\ 3\frac{1}{2}y &= 7 \\ \frac{7}{2}y &= 7 \\ 7y &= 14 \\ y &= 2 \end{aligned}$$

Use our x = equation from earlier:

$$\begin{aligned} x &= -2 + \frac{3}{2}y \\ x &= -2 + \frac{3}{2} \times 2 \\ x &= -2 + 3 \\ x &= 1 \end{aligned}$$

The Elimination Method

The elimination method is all about *getting rid* of one of the unknowns in the equations, by *adding* or *subtracting* the equations.

$$3a + 2b = 3$$
$$2a + b = 1$$

To get rid of one of the unknowns, you need to change one of the equations so that it has exactly the same unknown term in it as the other. Can multiply the 2nd equation by 2:

	$2a + b = 1$
×	2
	$4a + 2b = 2$

Now subtract the 2nd equation from the first:

	$3a + 2b = 3$
−	$4a + 2b = 2$
	$-a = 1$

If –a is equal to 1, this must mean a = –1. Now easy to solve for the value of 'b' using the first equation:

$$\begin{aligned} 3a + 2b &= 3 \\ 3 \times -1 + 2b &= 3 \\ -3 + 2b &= 3 \\ 2b &= 6 \\ b &= 3 \end{aligned}$$