Systems of Equations and Substitution

One way that we can find out where two lines cross is by using substitution. This works on the premise that if we know a value for either “x” or “y”, then we can plug it in the second equation. For example:

Solve the system: \[
\begin{cases}
  x = 2 \\
  x + y = 9
\end{cases}
\]

Since we know that \(x = 2\), then we can substitute “2” in for “x” in the second equation like so:

\[
(2) + y = 9 \quad \text{← Now, solve for y…} \quad (y = 7)
\]

Once you get that \(y = 7\), and you know that \(x = 2\), put the numbers in ordered pair form: (2, 7). This is where the two lines cross!

Find where the following lines cross (solve the system):

1. \[
\begin{cases}
  y = 9 \\
  2x + y = 7
\end{cases}
\]
2. \[
\begin{cases}
  y = -5 \\
  8x + 2y = 6
\end{cases}
\]
3. \[
\begin{cases}
  x = 12 \\
  -5x + 2y = -4
\end{cases}
\]
4. \[
\begin{cases}
  2y = 8 \\
  3x - 7y = -1
\end{cases}
\]
5. \[
\begin{cases}
  4x = 4 \\
  -9x - 2y = 16
\end{cases}
\]
6. \[
\begin{cases}
  -3x = 15 \\
  6x - y = 17
\end{cases}
\]

In numbers 4-6 above, you had to solve for \(x\) or \(y\) first by dividing both sides by the coefficient of the variable. In the problems below, you’re going to have to put your skills to work by solving for either “\(x\)” or “\(y\)” in one equation and plugging that whole thing into the other. **It’s easiest to solve for a variable with a coefficient of “1”!** For example:

Solve the system: \[
\begin{cases}
  x + 2y = 7 \\
  3x + y = 11
\end{cases}
\]

← Solve for “\(x\)” in the top equation: \(x = 7 - 2y\). (Coefficient of \(x\) is “1”)

Now, plug \(7 - 2y\) in for “\(x\)” in the second equation (because that’s what \(x\) equals)!

\[
3x + y = 11 \quad \Rightarrow \quad 3(7 - 2y) + y = 11
\]

Now, solve for \(y\)!

\[
3(7 - 2y) + y = 11 \quad \Rightarrow \quad 21 - 6y + y = 11 \quad \Rightarrow \quad 21 - 5y = 11 \quad \Rightarrow \quad -5y = -10 \quad \Rightarrow \quad y = 2
\]

To get “\(x\)”, plug “\(y\)” into one of the above equations and solve for “\(x\)!”

\[
x = 7 - 2y \quad \Rightarrow \quad x = 7 - 2(2) \quad \Rightarrow \quad x = 7 - 4 \quad \Rightarrow \quad x = 3
\]

The point of intersection is (3, 2)!

Find where the following lines cross (solve the system):

7. \[
\begin{cases}
  x - y = 2 \\
  2x + 3y = -6
\end{cases}
\]
8. \[
\begin{cases}
  x + 2y = 2 \\
  7x + 10y = 2
\end{cases}
\]
9. \[
\begin{cases}
  3x + y = 4 \\
  -2x - 5y = 7
\end{cases}
\]