

## Solving Simultaneous Linear Equations (Substitution Method)

We can solve simultaneous linear equations (2 equations and 2 unknowns) by solving one of the equations for one of the variables and substituting into the other.

Example:

$$\begin{aligned}2x + 3y &= 8 \\ x + 2y &= 5\end{aligned}$$

We can solve the second equation ( $x + 2y = 5$ ) for either  $x$  or  $y$ . It is simpler in this case to solve for  $x$ , so we get

$$x = 5 - 2y$$

Now we can substitute this value for  $x$  into the first equation ( $2x + 3y = 8$ ) and solve for  $y$

$$\begin{aligned}2(5-2y) + 3y &= 8 \\ 10 - 4y + 3y &= 8 \\ 10 - y &= 8 \\ 10 - y - 10 &= 8 - 10 \\ -y &= -2 \\ y &= 2\end{aligned}$$

Now, we know  $y = 2$ , we can substitute this back into either equation to get  $x$

$$\begin{aligned}2x + 3(2) &= 8 \\ 2x + 6 &= 8 \\ 2x + 6 - 6 &= 8 - 6 \\ 2x &= 2 \\ x &= 1\end{aligned}$$

Check:

$$2(1) + 3(2) = 2 + 6 = 8 \text{ and } 1 + 2(2) = 1 + 4 = 5$$

Therefore the point (1,2) is on both lines

Example:

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

Solve the bottom equation for  $y$  and get  $y = -5 - 3x$

Then substitute  $-5 - 3x$  in place of  $y$  in the top equation

$$\begin{aligned}5x + 2(-5 - 3x) &= -7 \\ 5x - 10 - 6x &= -7 \\ -10 - x &= -7 \\ -x &= 3 \\ x &= -3\end{aligned}$$

Now we can solve for  $y$ , in the equation that says  $y = -5 - 3x$  and get  $y = -5 - 3(-3) = -5 + 9 = 4$

So the point  $(-3,4)$  solve the system