SOLVING SYSTEMS OF LINEAR EQUATIONS BY SUBSTITUTION

NOTE: A solution to a system of equations is an ordered pair that satisfies both equations. It is the point where the equations meet.

Example:  
\[ y = 2x - 5 \]  
\[ y = x + 2 \]

There are different ways to find the point of intersection

1) one way is by graphing

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-5</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
</tr>
<tr>
<td>-1</td>
<td>-7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>-1</td>
<td>1</td>
</tr>
</tbody>
</table>

The solution to the system of equations is (7,9)
2) a second way is by substitution

\[ y = 2x - 5 \]
\[ y = x + 2 \]

a) get one of your equations in slope intercept form if not already
\[ y = mx + b \]

**NOTE** you may also use \( x = my + b \) for this method

b) substitute the equivalent expression for the variable from the first equation into the second equation
since \( y = \) both \( 2x - 5 \) and \( x + 2 \)
we can substitute \( x + 2 \) for \( y \)

\[ y = 2x - 5 \]
\[ y = x + 2 \]

\[ 2x - 5 = x + 2 \]

\[ 2x - x - 5 = x - x + 2 \] get the variable on one side of the equation
\[ x - 5 = 2 \]
\[ x - 5 + 5 = 2 + 5 \] get the variable by itself
\[ x = 7 \]

d) choose one of the original equations and substitute the value of the variable (\( x = 7 \) in this case) and solve for the other variable.

\[ y = x + 2 \]
\[ y = (7) + 2 \]
\[ y = 9 \]

The solution is \( x = 7 \) and \( y \) equals 9
\( (7,9) \)
**LESSON 59 SOLVING SYSTEMS OF EQUATIONS BY SUBSTITUTION**

\[
\begin{align*}
2x + 3y &= 8 \\
y &= x - 4
\end{align*}
\]

**NOTE**

the second equation is in \( y = mx + b \) form

a) take the first equation and substitute for \( y \)

since \( 2x + 3y = 9 \) we can say

\[
2x + 3(x - 4) = 8
\]

substitute for \( y \) in equation 1

\[
2x + 3x - 12 = 8
\]

distribute the 3

\[
5x - 12 = 8
\]

simplify by adding the variables

\[
5x - 12 + 12 = 8 + 12
\]

add 12 to both sides

\[
5x = 20
\]

\[
\frac{5x}{5} = \frac{20}{5}
\]

divide both sides by 5

\[
x = 4
\]

Pick an equation and substitute 4 for \( x \).

\[
y = x - 4
\]

\[
y = (4) - 4
\]

\[
y = 0
\]

Since \( x = 4 \) and \( y = 0 \), the point of intersection is \((4,0)\)

Check the second equation substituting for \( x \) and \( y \)

\[
2x + 3y = 8
\]

\[
2(4) + 3(0) = 8
\]

\[
8 + 0 = 8
\]

\[
8 = 8
\]
YOU MAY ALSO GET YOUR EXAMPLE IN \( x = ym + b \) FORM

\[
\begin{align*}
2y + 3x &= 8 \\
x &= 3y - 1
\end{align*}
\]

Since \( x = 3y - 1 \) we can substitute in equation 1

\[
\begin{align*}
2y + 3x &= 8 \\
2y + 3(3y - 1) &= 8
\end{align*}
\]

\[
\begin{align*}
2y + 9y - 3 &= 8 \\
11y - 3 &= 8
\end{align*}
\]

\[
\begin{align*}
11y - 3 + 3 &= 8 + 3 \\
y &= 1
\end{align*}
\]

Choose an equation and find the value of the other variable

\[
\begin{align*}
x &= 3y - 1 \\
x &= 3(1) - 1 \\
x &= 3 - 1 \\
x &= 2
\end{align*}
\]

The solution (point of intersection) is (2,1)

check

\[
\begin{align*}
2y + 3x &= 8 \\
2(1) + 3(2) &= 8 \\
2 + 6 &= 8 \\
8 &= 8
\end{align*}
\]