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3.2. Advanced Algebra

Solving Systems of Equations by Substitution

DATE: 10/25

Target 3B. Solve a system of equations graphically and algebraically.



Substitution Method: one equation is solved for one variable in terms of the other. Then, this expression is substituted for the variable in the other equation.

Solve each system of equations by the substitution method.

1. $2x + y = 6$

$y = x + 3$

Is one of the equations in the system solved for a variable?

Yes, the second equation is solved for y . This is desired when solving by substitution. Now, substitute the expression $x+3$ for y in 1st equation (see arrow top left).

$$2x + (x+3) = 6$$

$$2x + x + 3 = 6 \quad \text{"Drop parenthesis"}$$

$$3x + 3 = 6$$

$$\begin{array}{r} -3 -3 \\ \hline 3x = 3 \end{array}$$

$$x = 1$$

$x = 1$

To find y , substitute 1 for x in $y = x + 3$.

$$y = x + 3$$

$$y = 1 + 3$$

$$= 4$$

Solution:

$$\begin{pmatrix} 1 & 4 \\ x & y \end{pmatrix}$$

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2. $x = 3 - y$

$3x + 2y = 9$

Is one of the equations in the system solved for a variable?

Yes, the 1st equation is solved for x. Substitute the expression

$3 - y$ for x in 2nd equation.

multiply

$3(3 - y) + 2y = 9$

$9 - 3y + 2y = 9$

$9 - 1y = 9$

$-1y = 0$

$-1y = 0$

$-1y = 0$

$-1y = 0$

$-1y = 0$

$y = 0$

$x = 3 - y$

$= 3 - 0$

$= 3$

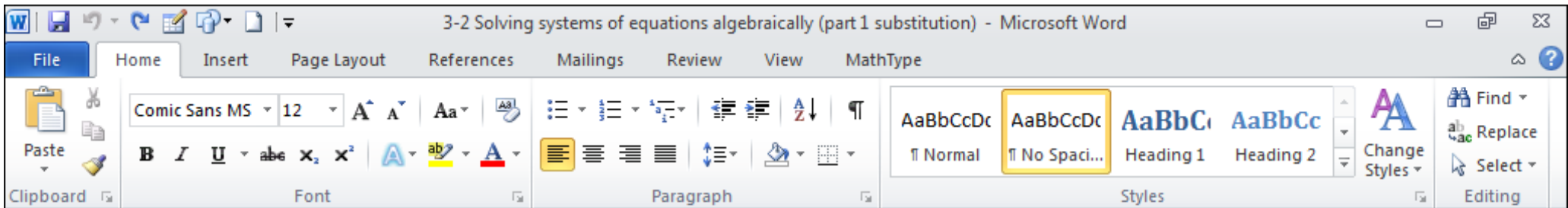
Solution:

$(3, 0)$

x y

3. $2x + y = 5$

Is one of the equations in the system solved for a variable?



3. $2x + y = 5$
 $x - y = 1$

Is one of the equations in the system solved for a variable?
 No. Must solve for x or y in 1st or 2nd equation. How do you choose which to solve for? It doesn't matter, but try to CHOOSE the easy one.
 I'll choose to solve for x in second equation.

$$\begin{array}{r} x - y = 1 \\ + y + y \\ \hline \end{array}$$

$x = y + 1$

$x = 1 + 1$
 $= 2$

$2(y + 1) + 1y = 5$

$2y + 2 + 1y = 5$

$3y + 2 = 5$
 $-2 \quad -2$

$\frac{3y}{3} = \frac{3}{3}$

$y = 1$

Solution:

$(2, 1)$

4. $x + 4y = 26$
 $x - 5y = -10$

Is one of the equations in the system solved for a variable?

3-2 Solving systems of equations algebraically (part 1 substitution) - Microsoft Word

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4. $x + 4y = 26$ Is one of the equations in the system solved for a variable?
 $x - 5y = -10$ Again, no. I'll choose easy and go with x in first equation.

$$\begin{array}{r} x + 4y = 26 \\ -4y - 4y \\ \hline x = -4y + 26 \end{array}$$

$$\begin{array}{r} (-4y + 26) - 5y = -10 \\ -4y + 26 - 5y = -10 \\ \hline -9y + 26 = -10 \\ -26 -26 \\ \hline -9y = -36 \\ \hline -9 -9 \\ \hline y = 4 \end{array}$$

$$\begin{array}{r} x = -4y + 26 \\ = -4(4) + 26 \\ = -16 + 26 \\ = 10 \end{array}$$

Solution:

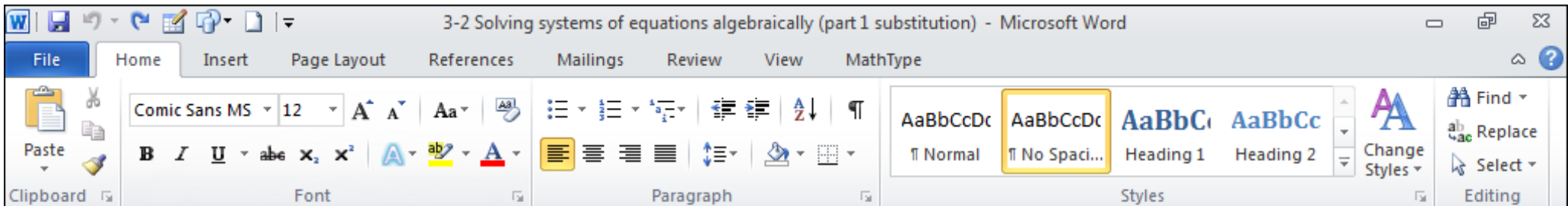
$$\begin{pmatrix} 10 \\ x \end{pmatrix}, \begin{pmatrix} 4 \\ y \end{pmatrix}$$

Extra Practice: Solve each system of equations by the substitution method.

5. $2x + y = 4$
 $3x + 2y = 1$

6. $x + 2y = 8$
 $\frac{1}{2}x - y = 18$

7. $a + 3b = 8$



Extra Practice: Solve each system of equations by the substitution method.

5. $2x + y = 4$
 $3x + 2y = 1$

$\begin{pmatrix} x & y \\ 22 & -7 \end{pmatrix}$

6. $x + 2y = 8$
 $\frac{1}{2}x - y = 18$

7. $g + 3h = 8$
 $\frac{1}{3}g + h = 9$

8. $2a - 4b = 6$
 $-a + 2b = -3$

#6 $x + 2y = 8$
 $\frac{-2y - 2y}{-2y - 2y}$
 $x = -2y + 8$

$\frac{1}{2}(-2y + 8) - y = 18$

$\frac{-y + 4 - y}{-y + 4 - y} = 18$

$\frac{-2y + 4}{-4 - 4} = 18$

$x = -2y + 8$
 $\frac{-2y = 14}{-2 - 2}$

$= -2(-7) + 8$
 $y = -7$

$= 14 + 8$
 $= 22$

#8 $2a - 4b = 6$
 $-a + 2b = -3$

$2(2b + 3) - 4b = 6$

$4b + 6 - 4b = 6$

$6 = 6$ True

Infininitely many solutions!



$-a + 2b = -3$
 $\frac{-2b - 2b}{-1 - 1} = \frac{-2b - 3}{-1 - 1}$
 $a = 2b + 3$