Solving 2x2 Linear Systems (Graphing and Substitution)

A 2x2 system has 2 variables and 2 equations.

On a graph, the solution is where the two lines intersect.

Solve both equations to y = and graph.

Solve $\begin{cases} 2x - 4y = 8 \\ \frac{1}{2}y = 2x + 2.5 \end{cases}$ by graphing.

<u>Solve to y =</u>

2x – 4y = 8

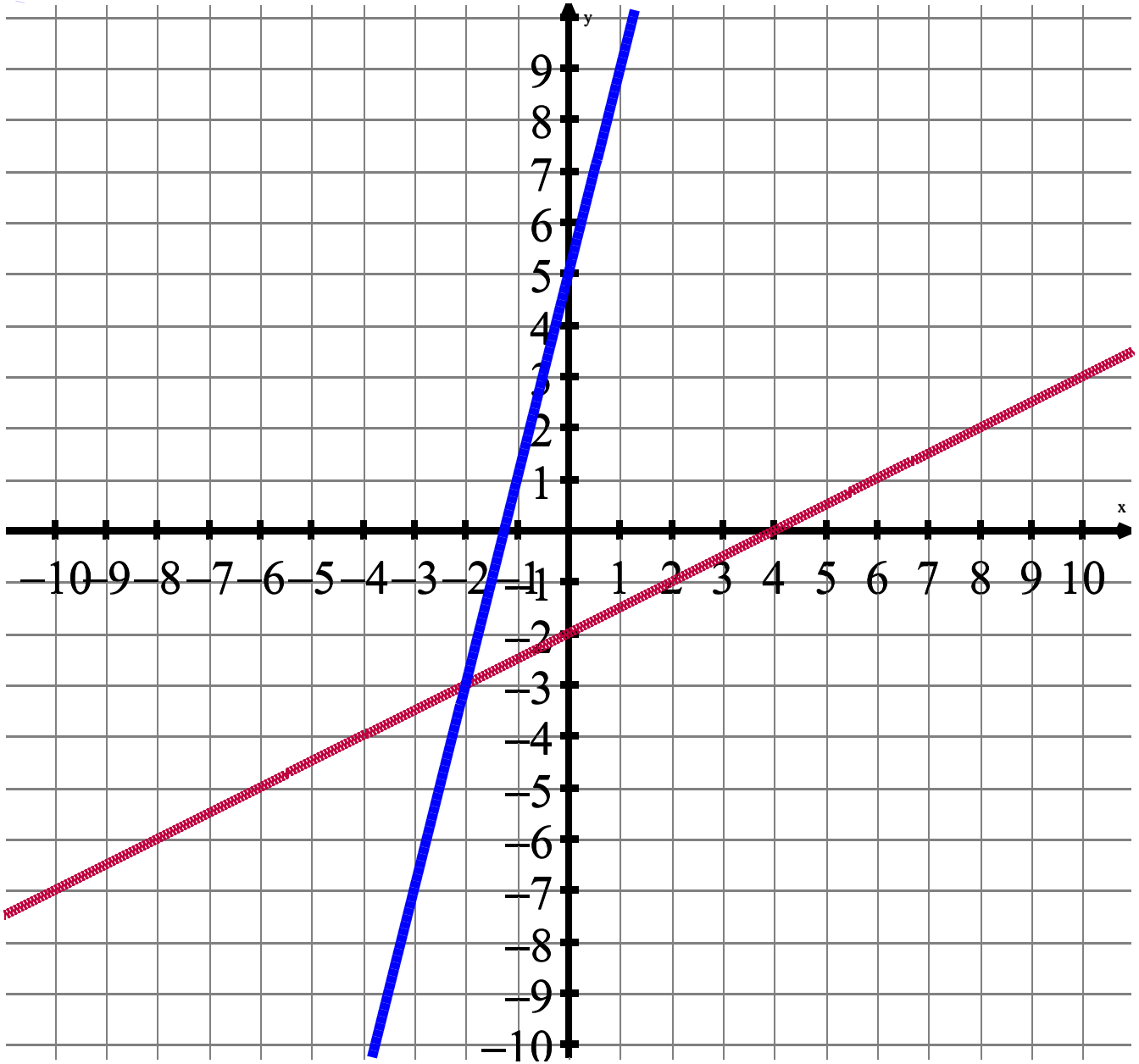
-4y = -2x + 8

y = 1/2x – 2

<u>Solve to y =</u>

½y = 2x + 2.5

y = 4x + 5



The solution is (-2, -3)

Solving by Substitution:

Solve one equation for one of its variables and then substitute that into the other equation.

Example)

Solve $\begin{cases} 2x - 4y = 8 \\ \frac{1}{2}y = 2x + 2.5 \end{cases}$

½y = 2x + 2.5

y = 4x + 5

Solve the 2nd equation for y because that looks like the easiest variable to solve for.

$2x - 4y = 8$

Substitute the equation $y = 4x + 5$ into y of the other equation.

$2x - 4(4x + 5) = 8$

$2x - 16x - 20 = 8$

Solve for x: distribute the -4

$-14x - 20 = 8$

Solve for x: combine like terms

$-14x = 28$

Solve for x: and 20 to both sides

$x = -2$

Solve for x: divide by -14

Substitute the x-value you find into the y = equation to get y.

$y = 4x + 5$ Substitute $x = -2$ to find y

$y = 4(-2) + 5$

$y = -8 + 5$

$y = -3$

The solution is the point (-2, -3)

Solve $\begin{cases} x - 2y = -3 \\ 3x - 7y = -14 \end{cases}$

x – 2y = -3	Solve the 1st equation for x because that looks like the easiest variable to solve for.
x = 2y – 3	
3x – 7y = -14	Substitute the equation x = 2y – 3 into x of the other equation.
3(2y – 3) – 7y = -14	
6y – 9 – 7y = -14	Solve for y: distribute the 3
-y – 9 = -14	Solve for y: combine like terms
-y = -5	Solve for y: and -9 to both sides
y = 5	Solve for y: divide by -1

Substitute the y-value you find into the x = equation to get x.

$x = 2y - 3$ Substitute $y = 5$ to find x

$x = 2(5) - 3$

$x = 10 - 3$

$x = 7$

The solution is the point (7, 5)

Solve $\begin{cases} 3x = y + 6 \\ 6x - 2y = 3 \end{cases}$

$3x = y + 6$

$y = 3x - 6$

Solve the 1st equation for y because that looks like the easiest variable to solve for.

$6x - 2y = 3$

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

Substitute the equation $y = 3x - 6$ into y of the other equation.

$6x - 6x + 12 = -3$

Solve for x: distribute the -2

$12 = -3$

Solve for x: combine like terms

12 = -3 is a false statement. This means that there is no solution to the system because we cannot choose values of x and y that would ever make 12 = -3 true. Graphically, these two lines must be parallel.

Solve $\begin{cases} -2x - 2y = -6 \\ x = 3 - y \end{cases}$

x = 3 – y	The 2nd equation is already solved for x.
-2x – 2y = -6 -2(3 – y) – 2y = -6	Substitute the equation x = 3 – y into x of the other equation.
-6 + 2y – 2y = -6	Solve for y: distribute the -2
-6 = -6	Solve for y: combine like terms

-6 = -6 is a true statement. This means that there are infinitely many solutions to the system because we cannot choose values of x and y that would ever make -6 = -6 false. Graphically, these two lines must coincide (one on top of the other; are the same).