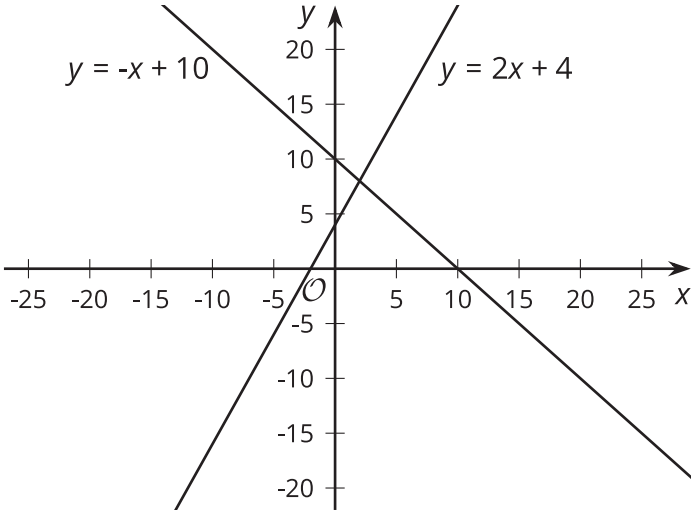
Solving Systems of Equations

Let's solve systems of equations.

15.1 Ask about This Graph



CC BY NC Illustrative Mathematics, based on IM 6–8 Math, CC BY Open Up Resources.

15.2 Matching Graphs to Systems

Here are three **systems of equations.** Find the solution to each system.

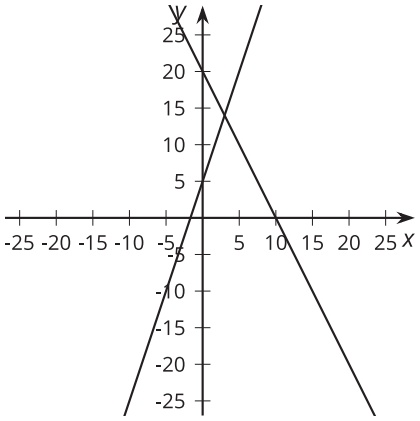
$$\begin{cases} y = 3x + 5 \\ y = -2x + 20 \end{cases}$$

$$\begin{cases} y = 2x - 10 \\ y = 4x - 1 \end{cases}$$

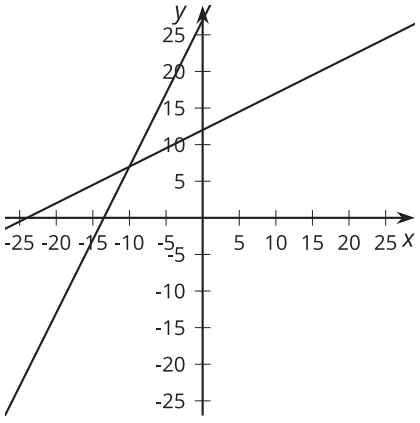
$$\begin{cases} y = 0.5x + 12 \\ y = 2x + 27 \end{cases}$$

Match each graph to one of the systems of equations, then use the graphs to check that your solutions are reasonable.

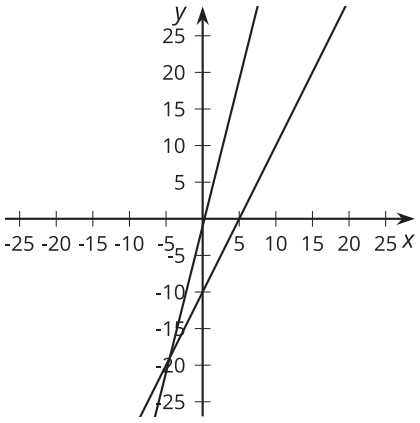
A



B



C



15.3 Different Types of Systems

Your teacher will give you a page with some systems of equations.

1. Graph each system of equations carefully on the provided coordinate plane.
2. Describe what the graph of a system of equations looks like when it has
   a. 1 solution.

   b. 0 solutions.

   c. Infinitely many solutions.

Are you ready for more?

The graphs of the equations $Ax + By = 15$ and $Ax - By = 9$ intersect at $(2, 1)$. Find A and B. Show or explain your reasoning.

Lesson 15 Summary

Sometimes it is easier to solve a system of equations without having to graph the equations and look for an intersection point. In general, whenever we are solving a system of equations written as

$$\begin{cases} y = [\text{some stuff}] \\ y = [\text{some other stuff}] \end{cases}$$

we know that we are looking for a pair of values (x, y) that makes both equations true. In particular, we know that the value for y will be the same in both equations. That means that

$$[\text{some stuff}] = [\text{some other stuff}]$$

For example, look at this system of equations:

$$\begin{cases} y = 2x + 6 \\ y = -3x - 4 \end{cases}$$

Since the y value of the solution is the same in both equations, then we know that:

$$2x + 6 = -3x - 4$$

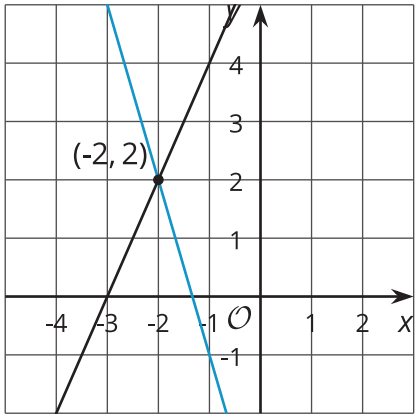
We can solve this equation for x:

$$\begin{aligned} 2x + 6 &= -3x - 4 & \\ 5x + 6 &= -4 & \text{add } 3x \text{ to each side} \\ 5x &= -10 & \text{subtract 6 from each side} \\ x &= -2 & \text{divide each side by 5} \end{aligned}$$

But this is only half of what we are looking for: we know the value for x, but we need the corresponding value for y.

Since both equations have the same y value, we can use either equation to find the y-value: $2(-2) + 6$ or $y = -3(-2) - 4$.

In both cases, we find that $y = 2$. So the solution to the system is $(-2, 2)$. We can verify this by graphing both equations in the coordinate plane.



In general, a system of linear equations can have:

- No solutions. In this case, the lines that correspond to each equation never intersect. They have the same slope and different y-intercepts.
- Exactly one solution. The lines that correspond to each equation intersect in exactly one point. They have different slopes.
- An infinite number of solutions. The graphs of the two equations are the same line! They have the same slope and the same y-intercept.