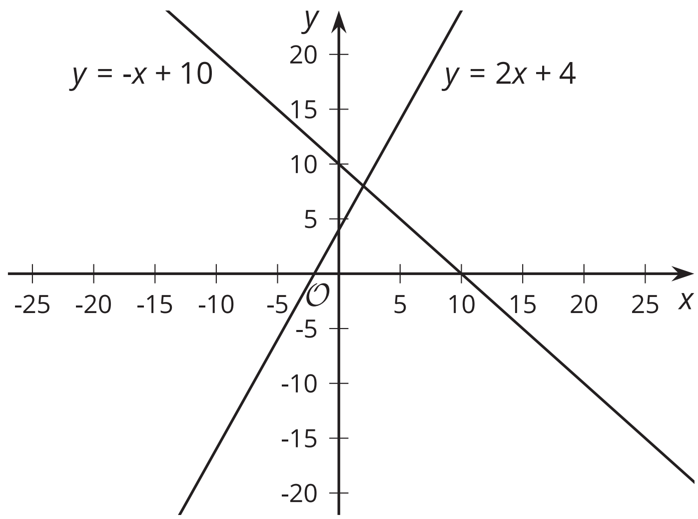
Solving Systems of Equations

Let’s solve systems of equations.

13.1 Ask about This Graph



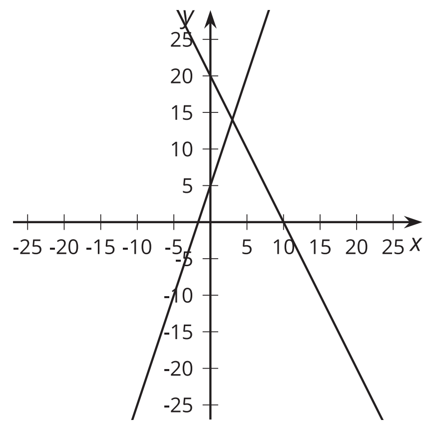
13.2 Matching Graphs to Systems

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

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

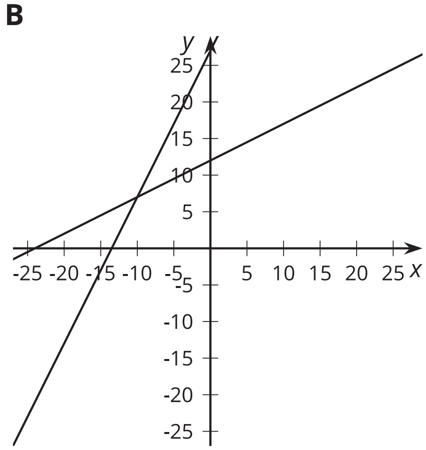
$$\begin{cases} y = 3x + 5 \\ y = -2x + 20 \end{cases}$$

A



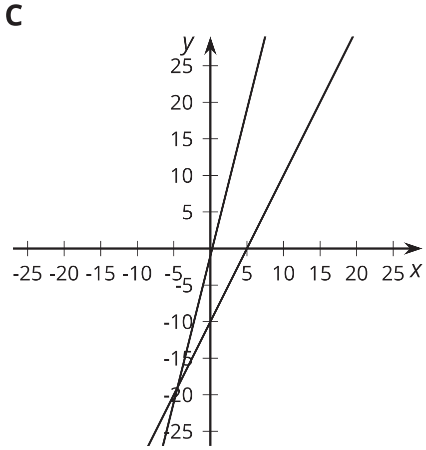
$$\begin{cases} y = 2x - 10 \\ y = 4x - 1 \end{cases}$$

B



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

C



13.3 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 13 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:

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

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

$$2x + 6 = \text{-}3x - 4$$

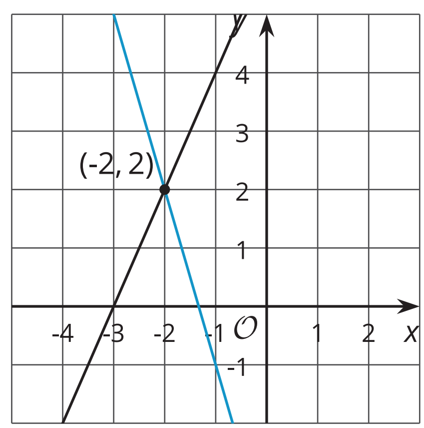
We can solve this equation for x:

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

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: $2(\text{-}2) + 6$ or $y = \text{-}3(\text{-}2) - 4$.

In both cases, we find that $y = 2$. So the solution to the system is $(\text{-}2, 2)$. 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.