

## Lesson 15: Solving More Systems

Let's solve systems of equations.

### 15.1: Algebra Talk: Solving Systems Mentally

Solve these without writing anything down:

$$\begin{cases} x = 5 \\ y = x - 7 \end{cases}$$

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

$$\begin{cases} x = 8 \\ y = -11 \end{cases}$$

### 15.2: Challenge Yourself

Here are a lot of systems of equations:

$$A \begin{cases} y = 4 \\ x = -5y + 6 \end{cases}$$

$$E \begin{cases} y = -3x - 5 \\ y = 4x + 30 \end{cases}$$

$$I \begin{cases} 3x + 4y = 10 \\ x = 2y \end{cases}$$

$$B \begin{cases} y = 7 \\ x = 3y - 4 \end{cases}$$

$$F \begin{cases} y = 3x - 2 \\ y = -2x + 8 \end{cases}$$

$$J \begin{cases} y = 3x + 2 \\ 2x + y = 47 \end{cases}$$

$$C \begin{cases} y = \frac{3}{2}x + 7 \\ x = -4 \end{cases}$$

$$G \begin{cases} y = 3x \\ x = -2y + 56 \end{cases}$$

$$K \begin{cases} y = -2x + 5 \\ 2x + 3y = 31 \end{cases}$$

$$D \begin{cases} y = -3x + 10 \\ y = -2x + 6 \end{cases}$$

$$H \begin{cases} x = 2y - 15 \\ y = -2x \end{cases}$$

$$L \begin{cases} x + y = 10 \\ x = 2y + 1 \end{cases}$$

- Without solving, identify 3 systems that you think would be the least difficult to solve and 3 systems that you think would be the most difficult to solve. Be prepared to explain your reasoning.

2. Choose 4 systems to solve. At least one should be from your "least difficult" list and one should be from your "most difficult" list.

### 15.3: Five Does Not Equal Seven

Tyler was looking at this system of equations:

$$\begin{cases} x + y = 5 \\ x + y = 7 \end{cases}$$

He said, "Just looking at the system, I can see it has no solution. If you add two numbers, that sum can't be equal to two different numbers."

Do you agree with Tyler?

#### Are you ready for more?

In rectangle  $ABCD$ , side  $AB$  is 8 centimeters and side  $BC$  is 6 centimeters.  $F$  is a point on  $BC$  and  $E$  is a point on  $AB$ . The area of triangle  $DFC$  is 20 square centimeters, and the area of triangle  $DEF$  is 16 square centimeters. What is the area of triangle  $AED$ ?

## Lesson 15 Summary

When we have a system of linear equations where one of the equations is of the form  $y = [\text{stuff}]$  or  $x = [\text{stuff}]$ , we can solve it algebraically by using a technique called *substitution*. The basic idea is to replace a variable with an expression it is equal to (so the expression is like a substitute for the variable). For example, let's start with the system:

$$\begin{cases} y = 5x \\ 2x - y = 9 \end{cases}$$

Since we know that  $y = 5x$ , we can substitute  $5x$  for  $y$  in the equation  $2x - y = 9$ ,

$$2x - (5x) = 9,$$

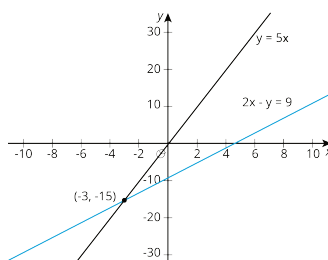
and then solve the equation for  $x$ ,

$$x = -3.$$

We can find  $y$  using either equation. Using the first one:  $y = 5 \cdot -3$ . So

$$(-3, -15)$$

is the solution to this system. We can verify this by looking at the graphs of the equations in the system:



Sure enough! They intersect at  $(-3, -15)$ .

We didn't know it at the time, but we were actually using substitution in the last lesson as well. In that lesson, we looked at the system

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

and we substituted  $2x + 6$  for  $y$  into the second equation to get  $2x + 6 = -3x - 4$ . Go back and check for yourself!