Lesson 15: Writing Systems of Equations

Let's write systems of equations from real-world situations.

15.1: How Many Solutions? Matching

Match each system of equations with the number of solutions the system has.

1. $\begin{cases} y = -\frac{4}{3}x + 4 \\ y = -\frac{4}{3}x - 1 \end{cases}$
2. $\begin{cases} y = 4x - 5 \\ y = -2x + 7 \end{cases}$
3. $\begin{cases} 2x + 3y = 8 \\ 4x + 6y = 17 \end{cases}$
4. $\begin{cases} y = 5x - 15 \\ y = 5(x - 3) \end{cases}$

1. No solutions
2. One solution
3. Infinitely many solutions

15.2: Situations and Systems

For each situation:

- Create a system of equations.
- Then, without solving, interpret what the solution to the system would tell you about the situation.

1. Lin's family is out for a bike ride when her dad stops to take a picture of the scenery. He tells the rest of the family to keep going and that he'll catch up. Lin's dad spends 5 minutes taking the photo and then rides at 0.24 miles per minute until he meets up with the rest of the family further along the bike path. Lin and the rest were riding at 0.18 miles per minute.

2. Noah is planning a kayaking trip. Kayak Rental A charges a base fee of $15 plus $4.50 per hour. Kayak Rental B charges a base fee of $12.50 plus $5 per hour.

3. Diego is making a large batch of pastries. The recipe calls for 3 strawberries for every apple. Diego used 52 fruits all together.

4. Flour costs $0.80 per pound and sugar costs $0.50 per pound. An order of flour and sugar weighs 15 pounds and costs $9.00.

15.3: Info Gap: Racing and Play Tickets

Your teacher will give you either a *problem card* or a *data card*. Do not show or read your card to your partner.

If your teacher gives you the *problem card*:

1. Silently read your card and think about what information you need to be able to answer the question.
2. Ask your partner for the specific information that you need.
3. Explain how you are using the information to solve the problem.

   Continue to ask questions until you have enough information to solve the problem.
4. Share the *problem card* and solve the problem independently.
5. Read the *data card* and discuss your reasoning.

If your teacher gives you the *data card*:

1. Silently read your card.
2. Ask your partner *"What specific information do you need?"* and wait for them to *ask* for information.

   If your partner asks for information that is not on the card, do not do the calculations for them. Tell them you don't have that information.
3. Before sharing the information, ask "*Why do you need that information?*" Listen to your partner's reasoning and ask clarifying questions.
4. Read the *problem card* and solve the problem independently.
5. Share the *data card* and discuss your reasoning.

15.4: Solving Systems Practice

Here are a lot of systems of equations:

- $\begin{cases} y = -2x + 6 \\ y = x - 3 \end{cases}$
- $\begin{cases} y = 5x - 4 \\ y = 4x + 12 \end{cases}$
- $\begin{cases} y = \frac{2}{3}x - 4 \\ y = -\frac{4}{3}x + 9 \end{cases}$
- $\begin{cases} 4y + 7x = 6 \\ 4y + 7x = -5 \end{cases}$
- $\begin{cases} y = x - 6 \\ x = 6 + y \end{cases}$
- $\begin{cases} y = 0.24x \\ y = 0.18x + 0.9 \end{cases}$
- $\begin{cases} y = 4.5x + 15 \\ y = 5x + 12.5 \end{cases}$
- $\begin{cases} y = 3x \\ x + y = 52 \end{cases}$

1. Without solving, identify 3 systems that you think would be the least difficult for you to solve and 3 systems you think would be the most difficult. 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.

Lesson 15 Summary

We have learned how to solve many kinds of systems of equations using algebra that would be difficult to solve by graphing. For example, look at

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

The first equation says that $y = 2x - 3$, so wherever we see y, we can substitute the expression $2x - 3$ instead. So the second equation becomes $x + 2(2x - 3) = 7$.

We can solve for x:

$x + 4x - 6 = 7$	distributive property
$5x - 6 = 7$	combine like terms
$5x = 13$	add 6 to each side
$x = \frac{13}{5}$	multiply each side by $\frac{1}{5}$

We know that the y value for the solution is the same for either equation, so we can use either equation to solve for it. Using the first equation, we get:

$y = 2(\frac{13}{5}) - 3$	substitute $x = \frac{13}{5}$ into the equation
$y = \frac{26}{5} - 3$	multiply $2(\frac{13}{5})$ to make $\frac{26}{5}$
$y = \frac{26}{5} - \frac{15}{5}$	rewrite 3 as $\frac{15}{5}$
$y = \frac{11}{5}$	

If we substitute $x = \frac{13}{5}$ into the other equation, $x + 2y = 7$, we get the same y value. So the solution to the system is $\left(\frac{13}{5}, \frac{11}{5}\right)$.

There are many kinds of systems of equations that we will learn how to solve in future grades, like $\begin{cases} 2x + 3y = 6 \\ -x + 2y = 3 \end{cases}$.

Or even $\begin{cases} y = x^2 + 1 \\ y = 2x + 3 \end{cases}$.