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Unit 4, 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.

A. $\begin{cases} y = -\frac{4}{3}x + 4 \\ y = -\frac{4}{3}x - 1 \end{cases}$

B. $\begin{cases} y = 4x - 5 \\ y = -2x + 7 \end{cases}$

C. $\begin{cases} 2x + 3y = 8 \\ 4x + 6y = 17 \end{cases}$

D. $\begin{cases} y = 5x - 15 \\ y = 5(x - 3) \end{cases}$

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.

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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: Solving Systems Practice

Here is a lot of systems of equations:

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

B. $\begin{cases} y = 5x - 4 \\ y = 4x + 12 \end{cases}$

C. $\begin{cases} y = \frac{2}{3}x - 4 \\ y = -\frac{4}{3}x + 9 \end{cases}$

D. $\begin{cases} 4y + 7x = 6 \\ 4y + 7x = -5 \end{cases}$

E. $\begin{cases} y = 0.24x \\ y = 0.18x + 0.9 \end{cases}$

F. $\begin{cases} y = 4.5x + 15 \\ y = 5x + 12.5 \end{cases}$

G. $\begin{cases} y = 3x \\ x + y = 52 \end{cases}$

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.

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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 then 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:

$y = 2\left(\frac{13}{5}\right) - 3$	substitute $x = \frac{13}{5}$ into the equation
$y = \frac{26}{5} - 3$	multiply $2\left(\frac{13}{5}\right)$ 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 $\begin{cases} y = x^2 + 1 \\ y = 2x + 3 \end{cases}$.

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Unit 4, Lesson 15: Writing Systems of Equations

1. Kiran and his cousin work during the summer for a landscaping company. Kiran's cousin has been working for the company longer, so his pay is 30% more than Kiran's. Last week his cousin worked 27 hours, and Kiran worked 23 hours. Together, they earned $493.85. What is Kiran's hourly pay? Explain or show your reasoning.

2. Decide which story can be represented by the system of equations $y = x + 6$ and $x + y = 100$. Explain your reasoning.

   a. Diego's teacher writes a test worth 100 points. There are 6 more multiple choice questions than short answer questions.
   b. Lin and her younger cousin measure their heights. They notice that Lin is 6 inches taller, and their heights add up to exactly 100 inches.

3. Clare and Noah play a game in which they earn the same number of points for each goal and lose the same number of points for each penalty. Clare makes 6 goals and 3 penalties, ending the game with 6 points. Noah earns 8 goals and 9 penalties and ends the game with -22 points.

   a. Write a system of equations that describes Clare and Noah's outcomes. Use x to represent the number of points for a goal and y to represent the number of points for a penalty.

   b. Solve the system. What does your solution mean?

4. Solve: $\begin{cases} y = 6x - 8 \\ y = -3x + 10 \end{cases}$

   (from Unit 4, Lesson 14)

5. a. Estimate the coordinates of the point where the two lines meet.

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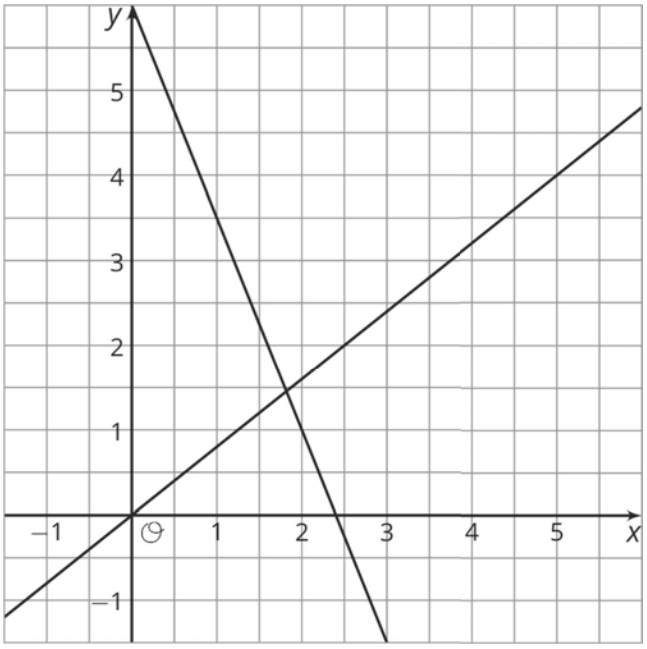

b. Choose two equations that make up the system represented by the graph.

i. $y = \frac{5}{4}x$
ii. $y = 6 - 2.5x$
iii. $y = 2.5x + 6$
iv. $y = 6 - 3x$
v. $y = 0.8x$

c. Solve the system of equations and confirm the accuracy of your estimate.

(from Unit 4, Lesson 13)