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What's for Lunch?

Solving More Systems

LEARNING GOALS

In this lesson, you will:

- Write a linear system of equations to represent a problem context.
- Solve a linear system of equations using the linear combinations method.

In most large cities throughout the world, you can find people selling food out of mobile food carts. These food carts can have an advantage over permanent restaurants because sellers can move the cart from location to location to try and increase sales. While this mobility can be beneficial, some carts do become permanent restaurants. For example, in 1939, Paul and Betty Pink purchased a lunch cart and pushed it near the present day corner of Melrose and La Brea in Los Angeles. As business grew, so did Pink's and by 1946 it was located in a permanent building on North La Brea where it still stands. Now, Pink's Hot Dogs has opened other locations in California, Nevada, and even Ohio. Their success also has stemmed into being referenced or seen on-camera in dozens of television shows and films.

Which do you think would earn more money—a food cart or a permanent restaurant? Which would be cheaper to run?

PROBLEM 1 What's On the Menu Today?

Constance owns a small lunch cart. She changes her menu daily. Yesterday, she offered a chef salad for \$5.75 or a hoagie for \$5.00. She sold 85 lunches for a total of \$464. Determine how many chef salads and hoagies she sold.

1. Write an equation in standard form that represents the total number of lunches in terms of the number of chef salads sold and the number of hoagies sold. Let x represent the number of chef salads sold, and let y represent the number of hoagies sold.

$$x + y = 85$$

2. Write an equation in standard form that represents the amount of money collected. Use the same variables as those used in Question 1.

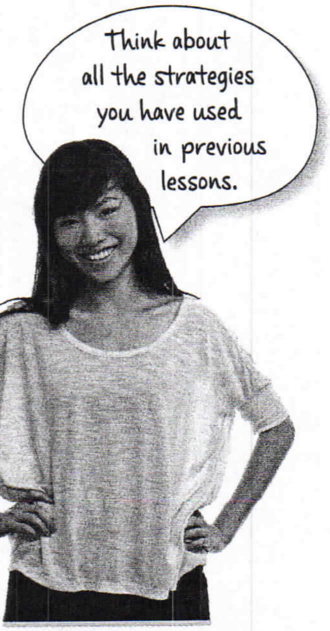
$$5.75x + 5.00y = 464$$

3. Write a system of linear equations to represent this problem situation.

$$x + y = 85$$
$$5.75x + 5y = 464$$

4. What methods can you use to solve this system of linear equations?

I could use either the substitution method, or I could use the linear combination method.



5. Determine the solution of this linear system of equations by using linear combinations. Then, check your answer.

$$-5\cdot(x + y) = (85)\cdot(-5)$$
$$5.75x + 5y = 464$$

$$-5x \cancel{-5y} = -425$$
$$+\quad 5.75x \cancel{+5y} = 464$$
$$0.75x = 39$$
$$\frac{0.75x}{0.75} = \frac{39}{0.75}$$
$$x = 52$$

* multiplying the top equation by -5 got opposite y coefficients ☺

$$x + y = 85$$
$$(52) + y = 85$$
$$-52 \qquad -52$$
$$y = 33$$

$$\boxed{(52, 33)}$$

6. Interpret your solution to the linear system in terms of this problem situation.

Constance sold 52 ~~hoagie~~ salads and 33 hoagies.

PROBLEM 2 You're My Best Buddy!

The School Spirit Club is making beaded friendship bracelets with the school colors to sell in the school store. The bracelets are black and orange and come in two lengths: 5 inches and 7 inches. The club has enough beads to make a total of 84 bracelets. So far, they have made 49 bracelets, which represents $\frac{1}{2}$ the number of 5-inch bracelets plus $\frac{3}{4}$ the number of 7-inch bracelets they plan to make and sell. Determine how many 5-inch and 7-inch bracelets the club plans to make.

1. Write an equation in standard form that represents the total number of bracelets the School Spirit Club can make out of the beads that they have. Let *x* represent the number of 5-inch bracelets, and let *y* represent the number of 7-inch bracelets.

$$x + y = 84$$

2. Write an equation in standard form that represents the number of bracelets the School Spirit Club has made so far. Use the same variables as those used in Question 1.

$$\frac{1}{2}x + \frac{3}{4}y = 49$$

3. Write a system of linear equations that represents this problem situation.

$$x + y = 84$$
$$\frac{1}{2}x + \frac{3}{4}y = 49$$

4. Karyn says that the first step she would take to solve this system would be to first multiply the second equation by the least common denominator (LCD) of the fractions. Is she correct? Explain your reasoning.

Multiplying the bottom equation by the LCD would cancel out the fractions. You do not need to do that step first, but I think it is a really good idea. ☺

5. Rewrite the equation containing fractions as an equivalent equation without fractions.

$$\frac{4}{1}\cdot\left(\frac{1}{2}x + \frac{3}{4}y\right) = (49)\cdot 4$$
$$\frac{4}{1}\cdot\frac{1}{2}x + \frac{4}{1}\cdot\frac{3}{4}y = 49\cdot 4$$
$$\frac{4}{2}x + \frac{12}{4}y = 196$$
$$2x + 3y = 196$$

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6. Determine the solution to the system of equations by using linear combinations and check your answer.

$-2 \cdot (x + y) = (84) \cdot (-2)$

$2x + 3y = 196$

$-2x - 2y = -168$

$+ \quad 2x + 3y = 196$

$y = 28$

$x + y = 84$

$x + (28) = 84$

$-28 \quad -28$

$x = 56$

$\boxed{(56, 28)}$

Check:

$2(56) + 3(28) = 196$

$112 + 84 = 196$

$196 = 196$ ✓

7. Interpret the solution of the linear system in terms of this problem situation.

The school spirit club can sell 56 5 inch bracelets and 28 7 inch bracelets.

Talk the Talk

1. Solve each linear system using linear combinations. Check all solutions.

a. $\begin{cases} x + 2y = 2 \\ 5x - 3y = -29 \end{cases}$

$-5 \cdot (x + 2y) = (2) \cdot (-5)$

$5x - 3y = -29$

$\cancel{-5x} - 10y = -10$

$+ \quad \cancel{5x} - 3y = -29$

$-13y = -39$

$\frac{-13y}{-13} = \frac{-39}{-13}$

$y = 3$

$x + 2y = 2$

$x + 2(3) = 2$

$x + 6 = 2$

$\quad -6 \quad -6$

$x = -4$

$\boxed{(-4, 3)}$

b. $\begin{cases} \frac{1}{2}x + \frac{1}{3}y = 3 \\ 3x + 5y = 36 \end{cases}$

$\frac{6}{1} \cdot \left(\frac{1}{2}x + \frac{1}{3}y\right) = (3) \cdot 6 \rightarrow \frac{6}{1} \cdot \frac{1}{2}x + \frac{6}{1} \cdot \frac{1}{3}y = 3 \cdot 6 \rightarrow \frac{6}{2}x + \frac{6}{3}y = 18$

$3x + 2y = 18$

$3x + 5y = 36$

$3x + 2y = 18$

$-1 \cdot (3x + 5y) = (36) \cdot (-1)$

$\cancel{3x} + 2y = 18$

$+ \quad \cancel{-3x} - 5y = -36$

$-3y = -18$

$\frac{-3y}{-3} = \frac{-18}{-3}$

$y = 6$

$3x + 5y = 36$

$3x + 5(6) = 36$

$3x + 30 = 36$

$\quad -30 \quad -30$

$\frac{3x}{3} = \frac{6}{3}$

$x = 2$

$\boxed{(2, 6)}$

c. $\begin{cases} 0.6x + \cancel{0.2y} = 2.2 \\ 0.5x - \cancel{0.2y} = 1.1 \end{cases}$

$$\frac{1.1x}{1.1} = \frac{3.3}{1.1}$$

$$x = 3$$

$$0.6x + 0.2y = 2.2$$
$$0.6(3) + 0.2y = 2.2$$
$$1.8 + 0.2y = 2.2$$
$$-1.8 \qquad -1.8$$
$$\frac{0.2y}{0.2} = \frac{0.4}{0.2}$$
$$y = 2$$

$$\boxed{(3,2)}$$

d. $\begin{cases} 10\cdot\left(\frac{1}{2}x + \frac{3}{5}y\right) = (17)\cdot 10 \rightarrow 5x + 6y = 170 \\ 20\cdot\left(\frac{1}{5}x + \frac{3}{4}y\right) = (17)\cdot 20 \rightarrow 4x + 15y = 340 \end{cases}$

$$-4\cdot(5x + 6y) = (170)\cdot(-4)$$
$$5\cdot(4x + 15y) = (340)\cdot(5)$$

$$+\begin{array}{l} \cancel{-20x} - 24y = -680 \\ \cancel{20x} + 75y = 1700 \end{array}$$

$$51y = 1020$$

$$y = 20$$

$$5x + 6y = 170$$
$$5x + 6(20) = 170$$
$$5x + 120 = 170$$
$$-120 \qquad -120$$
$$\frac{5x}{5} = \frac{50}{5}$$
$$x = 10$$

$$\boxed{(10,20)}$$

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