5-4 Systems in the Real World

CONTENT STANDARDS
8.EE.8.b, 8.EE.8.c

What You'll Learn

To use systems of linear equations to solve real-world problems

Why Learn This?

Systems of linear equations can be used to model and solve real-world problems, such as those related to fees and purchases.

You can solve systems of linear equations using a graph, substitution, or elimination. The best method to use depends partly on how the given equations are written.

Methods for Solving Systems of Equations	
Method	**When to Use**
Graphing	When you want a visual display of the equations When you want to estimate a solution
Substitution	When one equation is solved for one of the variables When it is easy to solve for one of the variables
Elimination	When the coefficients of one variable are the same or additive inverses

Copy this table into your notes

EXAMPLE 1 Application: Fees

Taxi Company A charges a flat fee of \$8.50 plus \$2 per mile traveled. Taxi Company B charges a flat fee of \$5.50 plus \$4 per mile traveled. When would it be better to hire Company A? Company B? Explain your reasoning.

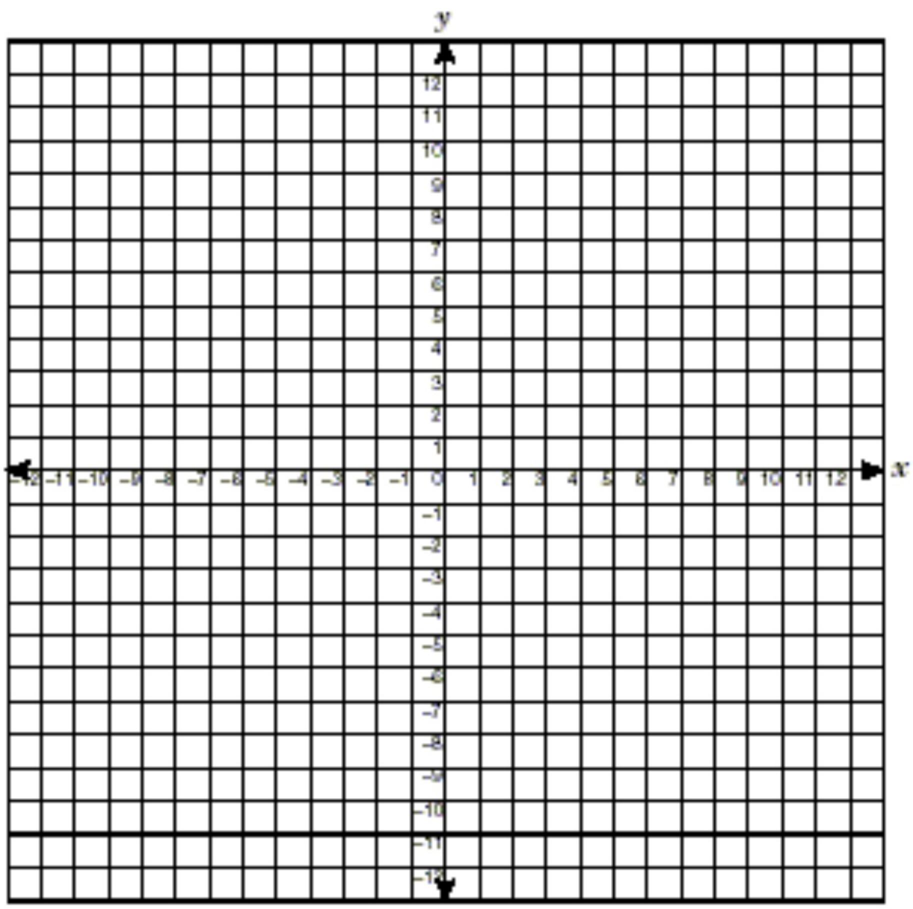
Step 1 Write a system of equations to represent the situation. Let x = the number of miles traveled, and let y = the total charge, in dollars.

$$y = 8.50 + 2.00x$$
$$y = 5.50 + 4.00x$$

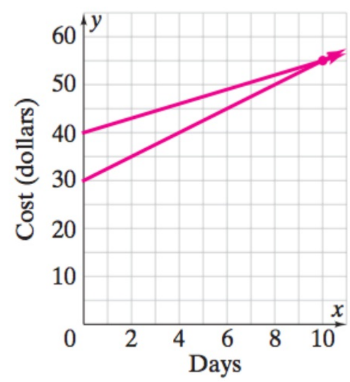
Step 2 Graph both equations in the same coordinate plane. The lines intersect at (1.5, 11.5).

Step 3 Analyze the graph. For a ride that is less than 1.5 miles, Company B is less expensive. For a ride that is greater than 1.5 miles, Company A is less expensive. The cost is the same for a ride of 1.5 miles.

$y = 8.50 + 2.00x$
$y = 5.50 + 4.00x$



1 **Application: Fees** The Main Street Parking Garage charges a \$30.00 monthly fee plus \$2.50 per day. The High Street Garage charges a \$40.00 monthly fee plus \$1.50 per day. Determine when it would be better to park in the Main Street garage, and when it would be better to park in the High Street garage.



Write a system of equations to represent the situation.

Let x = number of days and y = total cost.

Main Street: $y = 30 + 2.5x$

High Street: $y = 40 + 1.5x$

Graph both equations.

The lines appear to intersect at (10, 55).

Main Street Garage is less expensive for less than 10 days.

High Street Garage is less expensive for more than 10 days.

The cost is the same for 10 days.

EXAMPLE Application: Money

2 Matthew has 80 coins, all nickels and dimes. The value of the coins is \$6.75. Write and solve a system of equations to determine how many nickels and how many dimes Matthew has.

Step 1 Write a system of equations. Let n = the number of nickels. Let d = the number of dimes.

$n + d = 80$ ← **The total number of coins**

$0.05n + 0.10d = 6.75$ ← **The total value of the coins**

Step 2 $n + d = 80$ ← **Use the first equation to solve for *n*.**

$n = 80 - d$ ← **Subtract *d* from each side.**

Step 3 $0.05n + 0.10d = 6.75$ ← **Write the second equation.**

$0.05(80 - d) + 0.10d = 6.75$ ← **Substitute 80 − *d* for *n*.**

$4 - 0.05d + 0.10d = 6.75$ ← **Use the Distributive Property.**

$0.05d + 4 = 6.75$ ← **Simplify.**

$0.05d = 2.75$ ← **Subtract 4 from each side.**

$d = 55$ ← **Divide each side by 0.05.**

Step 4 $n + d = 80$ ← **Use either equation.**

$n + 55 = 80$ ← **Substitute 55 for *d*.**

$n = 25$ ← **Subtract 55 from each side.**

So Matthew has 25 nickels and 55 dimes.

You will want to put this example in your notes as your assignment is like this problem.

2 Application: Money Tina has 50 coins, all dimes and quarters. The value of the coins is \$7.10. Write a system of equations to determine how many dimes and how many quarters Tina has.

Write a system of equations to represent the situation.

Let d = number of dimes and d = number of quarters.

d + q = 50 ← **The number of dimes and quarters as an equation**

$0.10d$ + $0.25q$ = 7.10 ← **The values of the dimes and the quarters as an equation**

Use the substitution method to solve the system. Check your solution.

d = 36 q = 14

So, Tina has 36 dimes and 14 quarters.

$$0.10(50 - q) + 0.25q = 7.10$$
$$5 - 0.1q + 0.25q = 7.10$$
$$0.15q = 2.10$$
$$q = 14$$
$$d = 50 - q = 50 - 14 = 36$$

EXAMPLE Application: Dining

Multiple Choice Shanelle and Chris went to the coffee shop to buy breakfast for their office. Shanelle ordered 4 bagels and 3 muffins and paid \$10.86. Chris ordered 4 bagels and 6 muffins and paid \$14.16. What is the cost of one bagel?

Ⓐ \$1.10 Ⓒ \$3.30
Ⓑ \$1.89 Ⓓ \$7.56

Step 1 Write a system of equations. Let b = the cost of each bagel and let m = the cost of each muffin.

$4b + 3m = 10.86$ ← **Represent Shanelle's purchase.**
$4b + 6m = 14.16$ ← **Represent Chris's purchase.**

Step 2 Since the coefficients of b are the same, subtract to eliminate b.

$4b + 3m = 10.86$
$-(4b + 6m = 14.16)$
$-3m = -3.30$ ← **Subtract.**
$m = 1.10$ ← **Divide each side by −3.**

The cost of one muffin is \$1.10.

Step 3 Substitute 1.10 for m to solve for the eliminated variable.

$4b + 3m = 10.86$ ← **Use the first equation.**
$4b + 3(1.10) = 10.86$ ← **Substitute 1.10 for *m*.**
$4b + 3.30 = 10.86$ ← **Simplify.**
$4b = 7.56$ ← **Subtract 3.30 from each side.**
$b = 1.89$ ← **Divide each side by 4.**

The cost of one bagel is \$1.89. The correct answer is choice B.

3 **Application: Dining** Kevin and Rose went to a deli to have lunch with their friends. The people at Kevin's table ordered 3 salads and 2 cups of soup and paid $15.45. The people at Rose's table ordered 3 salads and 4 cups of soup and paid $21.03. Determine the cost of each salad and each cup of soup.

Write a system of equations to represent the situation.

Let s = cost of salad and c = cost of a cup of soup.

$3 \cdot$ [s] $+ 2 \cdot$ [c] $= 15.45$ ← **The order from Kevin's table as an equation**

[$3 \cdot s + 4 \cdot c = 21.03$] ← **The order from Rose's table as an equation**

Make additive inverses. Multiply each side of either equation by [−1].

Use the elimination method to solve the system of equations.

$s = 3.29$ $c =$ [2.79]

$$-3s - 2c = -15.45$$
$$3s + 4c = 21.03$$
$$2c = 5.58$$
$$c = 2.79$$
$$3s + 2(2.79) = 5.45$$
$$s = 3.29$$

So, each salad costs [$3.29] and each cup of soup costs [$2.79].

You have one problem to solve. Copy this on a blank sheet of notebook paper that you will hand in tomorrow with the answer and all of the work. (no work shown - no credit given.)

Alyssa has a collection of 35 character figures. Some of the figures cost $10 each and the others cost $25 each. The total value of her figures is $575. Write and solve a system of equations to find how many $10 figures and how many $25 figures she has.

HINT - use the substitution method. Make one variable "a" and the other "b". Set up your two equations, use substitution method to solve.