Lesson 17 Part 1: Introduction Solve Problems Using Systems of Equations

CCLS 8.EE.C.8c

You know how to solve systems of linear equations. Take a look at this problem.

Mr. Torres spent \$30.00 to buy $9\frac{1}{2}$ pounds of ground beef and chicken for a family cookout. If the price of ground beef was \$3.50 per pound and chicken was \$3.00 per pound, how many pounds of each did he buy?

्र Explore It

- Let b = pounds of ground beef and c = pounds of chicken.
 Write an equation that represents the weight of the ground beef and chicken together.
- What other information is given in the problem?
- How can you express the cost of the beef in terms of b and the cost of the chicken in terms of c?
- Write a second equation to represent the total cost.
- Now write and solve a system of equations to solve the problem.



Q Find Out More

The key to solving real-world problems with systems of equations is to use the information given in the problem to write two related equations.

You know the total weight:

lb of beef + **lb of chicken** = total weight
$$(9.5)$$

$$b + c = 9.5$$

You know the total cost:

$$3.5b + 3c = 30$$

Both equations contain the same unknowns (*b* and *c*), and these unknowns must have the same value in each equation. That's why you can solve a system of equations to solve the problem.

Let's look at the ordered pair (3, 6.5), and verify that it solves both equations.

$$b + c = 9.5$$

$$3.5b + 3c = 30$$

$$3 + 6.5 = 9.5$$

$$3.5(3) + 3(6.5) = 30$$

$$10.5 + 19.5 = 30$$

Reflect

- 1 Dan stocked up on batteries.
 - He bought 10 packages of AA and AAA batteries for a total of 72 batteries.
 - The AA batteries are sold in packages of 6, and the AAA batteries are sold in packages of 8.

Write a system of equations that can be solved to find how many packages of each type of battery Dan bought. Remember to define your variables.



Read the problem below. Then explore different ways to solve a problem that can be represented by a system of equations.

Bill and Brandon are downhill mountain-biking. Bill starts 500 feet ahead of Brandon and bikes at a rate of 42 feet per second. Brandon bikes at a rate of 50 feet per second. How long will it take Brandon to catch up to Bill?

(Q) Model It

You can write a system of equations to model the problem.

Bill and Brandon are biking at different rates. They started at the same time but at different locations. You need to find the time that corresponds to the point where they meet.

You can think of this as traveling equal distances, but you need to account for the fact that one biker started a certain distance ahead of the other.

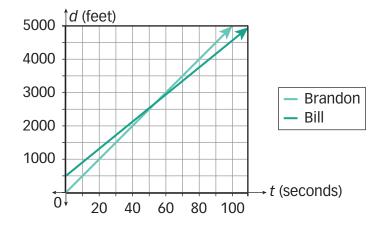
Use this formula: rate • time = distance

Brandon: 50 • t = d

Bill: $42 \cdot t = d - 500$

् Graph It

You can graph the equations to estimate the solution.





Connect It

Now you solve a system of equations to solve the problem.

2 Use the graph to estimate the point where Bill and Brandon meet. Will their times be the same at the meeting point? Will the distances they travelled be the same? Explain.

Fill in the blanks to explain what the two equations represent.

Brandon bikes at ______ feet per second for a certain amount of ______ and travels a certain _____.

Bill bikes at _____ feet per second for the same amount of _____ and travels _____ feet ____ than Brandon does.

Describe how the graph represents the problem situation.

5 Solve the system of equations algebraically. Then, describe what the solution means in the context of the problem.

Try It

Use what you just learned to solve this problem. Show your work on a separate sheet of paper.

Membership at Ace Gym is \$30 per month plus a one-time registration fee of \$100.

Membership at Bold's Gym is \$50 per month, and there is no registration fee. After how many months will the membership costs be the same at both gyms?



Study the model below. Then solve problems 7–9.

Student Model

The student uses the slope formula to find the slope of each line.



Line a passes through the points (2, 1) and (1, -1). Line b passes through the points (-3, -2) and (-1, 0). Do lines a and b intersect? Justify your answer.

Look at how you could show your work.

Find the slope of each line.

Line a:
$$\frac{-1-1}{1-2} = \frac{-2}{-1}$$
 or 2

Line b:
$$\frac{0-(-2)}{-1-(-3)} = \frac{2}{2}$$
 or 1

The lines have different slopes, so they will intersect at exactly one point.

Solution: Lines a and b intersect.



What would the student have needed to do if the slopes were equal? Why?

Writing equations for the plans might help you compare them.



- Nicky is considering two different companies for textbook rentals. For what number of months will Company B cost less?
 - Company A charges a one-time account fee of \$20 and a rental fee of \$15 per month.
 - Company B charges \$20 per month with no other fees.

Show your work.

Pair/Share

Describe the situation in which Company A would be a better deal.

Solution:



8 Gina visited the aquarium with some of her cousins, aunts, and uncles. The group bought 20 admission tickets for \$340. Adult tickets cost \$20, and children's tickets cost \$15. How many adult and children's tickets did the group buy?

Show your work.

What do the two given totals represents?



Solution: _

9 A telephone plan costs \$42 per month plus \$0.08 per minute of calls made. Another plan costs \$50 per month plus \$0.05 per minute of calls made. Which system of equations could you use to compare the monthly cost of the plans?

A
$$c = 42 - 0.08m$$

$$c = 50 - 0.05m$$

B
$$c = 42m + 0.08$$

$$c = 50m + 0.05$$

c
$$c = 42 + 0.05m$$

$$c = 50 + 0.08m$$

D
$$c = 42 + 0.08m$$

$$c = 50 + 0.05m$$

Casey chose **B** as the correct answer. How did he get that answer?

Pair/Share

How can you check that your answer is correct? Check your partner's answer.

What part of the monthly bill changes? What part stays the same?



Pair/Share

How would you explain to Casey why his answer is incorrect?



Solve the problems.

- One number is 16 more than another number. The two numbers have a sum of 120. Which system of equations could you use to find the two numbers?
 - **A** y = x 16 y = x + 120
 - **B** y = x + 16 y = x + 120
 - **C** y = x 16 y = x 120
 - **D** y = x 16 y = -x + 120
- Which point lies on the line 2y 3x = 4? Select Yes or No for each point.
 - **A** (4, 8)

Yes

Yes

Yes

B (12, 24)

 \square_{No}

C (6, 11)

∐ No

D (-2, -1)

∐ No

- **E** (-4, -2)
- Yes No
- **3** Line *a* passes through (2, 3) and (6, 5) on a coordinate plane. Lines *b*, *c*, and *d* are defined by the ordered pairs below.
 - Line *b* passes through (-2, 1) and (4, 4).
 - Line c passes through (8, 6) and (-1, -3).
 - Line *d* passes through (-4, 2) and (2, 5).

Determine whether lines b, c, and d form lines that intersect line a at no points, one point, or infinitely many points. Write the name of the line in the appropriate box.

No points of intersection with line <i>a</i> .	Infinitely many points of intersection with line <i>a</i> .



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Two taxi companies charge different rates.

Metro Taxi: \$3.00 for the first mile and \$2.50 for each additional mile

City Taxi: \$5.00 for the first mile and \$2.25 for each additional mile

Part A

For how many additional miles and how many total miles would the charge be the same at each company?

Show your work.

Answer		

Part B

Use the table below to describe a situation in which it would make more sense to use Metro Taxi. Then, describe a different situation in which it would make more sense to use City Taxi. Explain your answer.

Show your work.

Miles	1	2	3	4	5	6	7	8	9	10
Metro Taxi	3	5.5	8	10.5	13	15.5	18	20.5	23	25.5
City Taxi	5	7.25	9.5	11.75	14	16.25	18.5	20.75	23	25.25



Self Check Go back and see what you can check off on the Self Check on page 99.