

Solving Multi-Step Equations

Field Trip Fundraiser

ACTIVITY

1.5

SUGGESTED LEARNING STRATEGIES: KWL, Question the Text, Create Representations, Quickwrite

The Future Engineers of America Club (FEA) wants to raise money for a field trip to the science museum. They will make and sell custom photo buttons and will sell them for two dollars. They have found two companies to make the buttons, but the production costs are different.

Picture Buttons will charge \$125 for set-up and \$0.15 per button. Buttons for You will charge \$75 for set-up and \$0.40 per button.

Cost of x buttons produced by Picture Buttons
 $125 + 0.15x$

Cost of x buttons produced by Buttons for You
 $75 + 0.40x$

To help decide which company to use, club members want to determine how many buttons they would have to sell for the production costs to be the same.

1. Write an equation that makes the production costs of the two companies equal.
2. The numbers in the equation from Item 1 make it difficult to solve by modeling or mental math. Solve the equation showing each step. Provide an explanation for each step.

Equations	Explanation
	original equation
	Multiply each side by 100.

3. What is the meaning of the value you got for x in the equation above?

My Notes



MATH TIP

The Multiplication Property of Equality states that an equation is still true after both sides are multiplied by the same number.

For example:

$$0.2 = 0.2$$

$$0.2 \cdot 100 \stackrel{?}{=} 0.2 \cdot 100$$

Both sides are still equal.

Solving Multi-Step Equations

Field Trip Fundraiser

SUGGESTED LEARNING STRATEGIES: Create Representations, Quickwrite

My Notes

CONNECT TO BUSINESS

Revenue is the amount of money made selling a product. *Profit* is earnings after costs are subtracted from the revenue.

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

The *break even point* occurs when revenue equals cost.

$$\text{Revenue} = \text{Cost}$$

MATH TIP

The formula for finding profit is $P = R - C$, where P represents the profit, R represents the revenue, and C represents the cost.

This formula is an example of a literal equation. You can solve the literal equation for R to get a formula for finding revenue:

$$P = R - C$$

$$P + C = R - C + C$$

$$P + C = R$$

$$R = P + C$$

4. The FEA club estimates they will sell more than 200 buttons. Make a recommendation to the club explaining which company would be the better choice.
5. Each button will sell for \$2.00. The revenue for selling x buttons at \$2.00 each is $2x$. Write and solve an equation to find the break even point for the button fundraiser using the company you recommended to the FEA club.
6. How much profit will the FEA club earn on sales of 250 buttons if they use the company you recommended?
7. The Future Engineers of America Club treasurer was going back through the fundraising records. On Monday, the club made revenue of \$90 selling buttons at \$2.00 each. One person sold 20 buttons, but the other person selling that day forgot to write down how many she sold. How many buttons did the other person sell?

Solving Multi-Step Equations

Field Trip Fundraiser

ACTIVITY 1.5

continued

SUGGESTED LEARNING STRATEGIES: Close Reading, Shared Reading, Questioning the Text, Marking the Text, Create Representations, Group Presentation

My Notes

8. On the day of the FEA field trip, two other school clubs, the Environmental Club and the Drama Club, are also planning field trips. Each group had to report the number of people going on their field trip so the cafeteria would know how many meals to make that day. The cafeteria manager knows 105 students will be absent for field trips. The principal knows that there are twice as many students in the Drama Club as in the FEA club and 10 more students in the Environmental Club than in the Drama Club. Write and solve an equation to find out how many students will be on the FEA field trip.

9. At the museum, the FEA students want to see the show at the planetarium. Tickets cost \$11 for each student who is a member of the museum's frequent visitor program and \$13 for each student who is not a member. If all of the students (use your answer from the previous problem) see the show, it will cost \$209. Write and solve an equation to find out how many of the FEA club members are also members of the museum's frequent visitor program.

10. Betsy is a member of the FEA club. She read a book for the entire time that the bus was on the highway on the way to and from the museum. She has a deal with her mother that if she reads for 4 hours every week, then she can use the Internet for that same amount of time on the weekend. On the way to the museum there was fog, so the bus driver had to reduce his speed on the highway to 45 miles per hour, but the fog had cleared by the time they drove back so he was able to go 55 miles per hour on the way back. The fog caused the highway portion of trip to the museum to take 12 minutes longer on the way there than it took on the way back. If the highway route was exactly the same on both parts of the trip and they did not hit any traffic, for how long can Betsy tell her mother that she was reading?

MATH TIP

If the total number of people in a room is 25, and the number of males in the room is x , the number of females in the room can be expressed in terms of x with the expression $25 - x$.

My Notes

MATH TIP

Solving equations using symbols is the same as using the balancing method.

CONNECT TO AP

The process of solving multi-step equations is applied to literal equations in calculus and AP Statistics.

MATH TIP

Equations can have no solutions, one solution, or more than one solution.

SUGGESTED LEARNING STRATEGIES: Note Taking, Think/Pair/Share

Some equations require multiple steps to solve them efficiently.

EXAMPLE

Solve the following equation using symbols.

$$3x - 2(x + 3) = 5 - 2x$$

The Explanation column shows the steps.

Equations	Explanation
$3x - 2(x + 3) = 5 - 2x$	Original equation
$3x - 2x - 6 = 5 - 2x$	Distributive property.
$x - 6 = 5 - 2x$	Combine like terms.
$x + 2x - 6 = 5 - 2x + 2x$	Add $2x$ to both sides.
$3x - 6 = 5$	Combine like terms.
$3x - 6 + 6 = 5 + 6$	Add 6 to both sides.
$3x = 11$	Combine like terms.
$\frac{3x}{3} = \frac{11}{3}$	Divide both sides by 3.
$x = 3\frac{2}{3}$	

Solution: $x = 3\frac{2}{3}$

TRY THESE

Solve the following equations using symbols. Check your answers using a different method that you have learned.

a. $-(5x + 3) - 4x = 8 + 6x$

b. $4(x - 3) = 2(x + 2)$

c. $6x - 2(x + 3) = 5x - 1(x + 2)$

SUGGESTED LEARNING STRATEGIES: Group Presentation

My Notes

- 11.** There are many different methods to solve any given equation. Solve the following equations and compare your method to the method of other students in the class.

a. $5x + 8 = 3x - 3$

b. $2(4y + 3) = 16$

c. $\frac{2}{3}p + \frac{1}{5} = \frac{4}{5}$

d. $\frac{3}{4}a - \frac{1}{6} = \frac{2}{3}a + \frac{1}{4}$

- 12.** Find solutions to each of the following three equations.

a. $3(2z + 4) = 6(5z + 2)$

b. $3(x + 1) + 1 + 2x = 2(2x + 2) + x$

c. $8b + 3 - 10b = -2(b - 2) + 3$

You should have had some surprising results to the equations in Item 12. Some equations cannot be solved (they will never be true) while others have infinitely many solutions (they are true for all numbers).

- 13.** Which of the following equations will have no solutions and which will be true for all real numbers? Explain.

a. $3x + 5 = 3x$

b. $4r - 2 = 4r - 2$

My Notes

SUGGESTED LEARNING STRATEGIES: Predict and Confirm, Look for a Pattern, Think/Pair/Share, Graphic Organizer

14. Create another equation that will have each of the following as its solution:

- a. One solution
- b. No solution
- c. Infinitely many solutions
- d. A solution of zero

Some equations may have one or more extra letters in addition to the variable for which you are solving. Treat such extra letters as numbers when solving.

15. Solve for x .

- a. $ax + 7 = 9$
- b. $nx - 4 = 6$

CHECK YOUR UNDERSTANDING

Use notebook paper to write your answers.
Show your work.

Solve the following equations using symbols.
Check your answer using a different method.

1. $6x + 3 = 5x + 10$
2. $6 + 0.10x = 0.15x + 8$
3. $5 - 4x = 6 + 2x$
4. $9 - 2x = 7x$
5. $2(x - 4) + 2x = 4x - 1$
6. $\frac{1}{2}x - 3 = \frac{3}{2}x + 4$

On-the-Go Phone Company has two monthly plans for their customers. The table shows the cost in dollars for x minutes on each plan.

EZ PAY Plan	$0.15x$
40 TO GO Plan	$40 + 0.05x$

7. Determine the number of minutes that will make the two plans equal.
8. Which plan should you choose if you only want 200 minutes per month? Explain.
9. Solve for x .
 - a. $nx + 8 = 5$
 - b. $ax - 15 = 15$
10. **MATHEMATICAL REFLECTION** What have you learned about solving equations as a result of this activity?