SECTION 1.4 SOLVING LINEAR EQUATIONS

Name: Key **Date:** _____ **Period:** _____

Vocabulary

DEFINITION	EXAMPLE
Addition Property of Equality If you add the same amount to both sides of any equation, you get an equivalent equation	$x-5=7$ $x-5+5=7+5$ $x=12$
Subtraction Property of Equality If you subtract the same amount to both sides of any equation, you get an equivalent equation	$x+5=7$ $x+5-5=7-5$ $x=2$
Multiplication Property of Equality If you multiply both sides of any equation by the same non-zero number, you get an equivalent equation	$\frac{x}{5}=7$ $\frac{x}{5}\cdot 5=7\cdot 5$ $x=35$
Division Property of Equality If you divide both sides of any equation by the same non-zero number, you get an equivalent equation	$5x=35$ $\frac{5x}{5}=\frac{35}{5}$ $x=7$

EXAMPLE 1

Sue sells sandwiches at some price we don't know and candy bars for \$2 each. Mark buys only one candy bar and 4 sandwiches for a total cost of \$14. How much do the sandwiches cost?

Solution

Write an equation in words that describes the problem:

cost of 4 sandwiches + cost of one candy bar = total cost.

Translate words into mathematical symbols:

$$\$14 = \text{the total cost}$$
$$\$2 = \text{cost of the one candy bar Mark buys}$$
$$4 = \text{number of sandwiches Mark buys}$$

Define a variable:

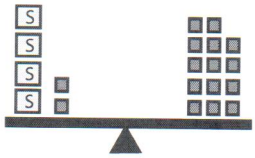
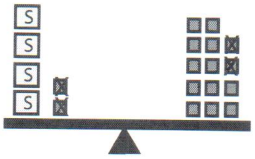
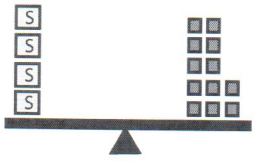
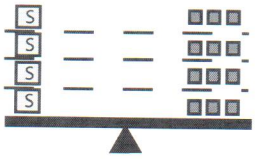
s = the price of a single sandwich in dollars.

Write an equation in symbols:

$$\text{cost of 4 sandwiches} + \text{cost of one candy bar} = \text{total cost}$$
$$\text{number of sandwiches} \cdot \text{price of a sandwich} + \$2 = \$14$$
$$4s + 2 = 14$$

To demonstrate different ways we can think about solving equations, look at the three different approaches to solve this problem shown below. What do you notice about the three methods? How are they similar?

Solve $4s + 2 = 14$

Balance Model	Algebraic Method	Number Line Model
	4s+2 = 14	
	Subtract 2 from both sides	
	4s+2-2 = 14-2	
	4s = 12	
	Divide both sides by 4	
	$\frac{4s}{4} = \frac{12}{4}$	
	s = 3	

Now we check our answer.

$$4 \cdot 3 + 2 = 14$$
$$14 = 14$$

EXPLORATION 1

Solve the following equations by performing the same operations to both sides of the equation: addition, subtraction, multiplication or division. Discuss which of these steps you should perform on each of the following equations. Some equations require two steps to solve for x. Does it matter in what order you perform these steps? Explain.

1. $x - 4 = 10$ $x = 14$
   addition prop. of eq.
2. $x + 4 = 10$ $x = 6$
   subtraction prop. of eq.
3. $3x = 15$ $x = 5$
   division prop. of eq.
4. $\frac{x}{4} = 3$ $x = 12$
   multiplication prop. of eq.
5. $15 = 2x + 7$ $x = 4$
   subtraction AND division prop. of eq.
6. $4x + 3 = 17$ $x = \frac{7}{2}$ or 3.5
   subtraction AND division prop. of eq.
7. $2x - 4 = 10$ $x = 7$
   addition AND division prop. of eq.

1. $x - 4 = 10$
   $x - 4 + 4 = 10 + 4$
   $x = 14$

2. $x + 4 = 10$
   $x + 4 - 4 = 10 - 4$
   $x = 6$

3. $3x = 15$
   $\frac{3x}{3} = \frac{15}{3}$
   $x = 5$

4. $\frac{x}{4} = 3$
   $\frac{x}{4} \cdot 4 = 3 \cdot 4$
   $x = 12$

5. $15 = 2x + 7$
   $15 - 7 = 2x + 7 - 7$
   $8 = 2x$
   $\frac{8}{2} = \frac{2x}{2}$
   $4 = x$

6. $4x + 3 = 17$
   $4x + 3 - 3 = 17 - 3$
   $4x = 14$
   $\frac{4x}{4} = \frac{14}{4}$
   $x = \frac{7}{2}$ or 3.5

7. $2x - 4 = 10$
   $2x - 4 + 4 = 10 + 4$
   $2x = 14$
   $\frac{2x}{2} = \frac{14}{2}$
   $x = 7$

Steps should be in the opposite order from Order of Operations, since you are undoing the process.

PROBLEM 1

Susan asks Fred to make some cookies for a party. Fred decides to make twice as many as Susan requested and, in addition, three extra cookies for his neighbor. Fred makes 57 cookies. How many cookies did Susan request?

r = number of cookies Susan requested

$2(\text{number requested}) + 3 = 57$

$2r + 3 = 57$

$2r + 3 - 3 = 57 - 3$ subtraction property of equality

$2r = 54$

$\frac{2r}{2} = \frac{54}{2}$ division property of equality

$r = 27$

Susan requested 27 cookies.

For the next three examples, use the properties of equality to solve equations.

EXAMPLE 2

Solve the equation: $x - 3 = 20$.

$x-3+3 = 20+3$ addition prop. of eq.

$x = 23$

EXAMPLE 3

Solve the equation: $4x = -8$.

$\frac{4x}{4} = \frac{-8}{4}$ division prop. of eq.

$x = -2$

EXAMPLE 4

Solve the equation: $3r + 5 = 17$.

$3r+5-5 = 17-5$ subtraction prop. of eq.

$3r = 12$

$\frac{3r}{3} = \frac{12}{3}$ division prop. of eq.

$r = 4$

Note: If you divide first, it will make the problem more difficult:

$3r+5 = 17$

$\frac{3r+5}{3} = \frac{17}{3}$

$\frac{3r}{3} + \frac{5}{3} = \frac{17}{3}$

$r + \frac{5}{3} = \frac{17}{3}$

$\Rightarrow r + \frac{5}{3} - \frac{5}{3} = \frac{17}{3} - \frac{5}{3}$

$r = \frac{12}{3}$

$r = 4$

SUMMARY (What I learned today)