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Chapter 1: Analyze and Solve Linear Equations (3 weeks)

Utah Core Standard(s):

- Solve linear equations in one variable. (8.EE.7)
 - a) Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
 - b) Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Academic Vocabulary: linear expression, simplify, linear equation, solve, solution, like terms, distributive property, no solution, infinitely many solutions

Chapter Overview:

This chapter begins with a review of simplifying and writing expressions and then moves into solving multi-step linear equations in one variable. The chapter includes equations with one solution, no solution, and infinitely many solutions. Students use algebra tiles to model, simplify, and solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. While working with the concrete representation of an equation, students are simultaneously manipulating the symbolic representation of the equation. By the end of the chapter, students should be fluently solving multi-step equations represented symbolically. They should feel comfortable with the laws of algebra that allow them to simplify expressions and the properties of equality that allow them to transform a linear equation into its simplest form, thus revealing the solution if there is one. While solving, students will become comfortable with the inverse operations that allow them to transform a linear equation into its simplest form. An important feature of allowable operations on equations is that they can be reversed. This chapter utilizes error analysis to highlight common mistakes that are made when solving equations. In the last section of the chapter, students look at equations with infinitely many or no solutions. They analyze what it is about the structure of the equation and the solving outcome that results in one solution, infinitely many solutions, or no solution. Applications are interwoven throughout the chapter in order that students realize the power of being able to write and solve a linear equation to solve real world problems. The ability to be able to solve real world problems by writing and solving linear equations gives purpose to the skills students are learning in this chapter.

Connections to Content:






Prior Knowledge

In previous coursework, students used properties of operations to generate equivalent expressions, including those that require expansion using the distributive property. Students solved one- and two-step equations. Students have solved real-life mathematical problems using numerical and algebraic expressions and equations.

Future Knowledge

As students move on in this course, they will begin to study linear functions. They should understand that when working with linear equations in one variable, the variable takes on a specific value as studied here. As they move to the study of linear functions, they will see that functions can take on an infinite number of values. They will analyze and solve pairs of simultaneous linear equations, including systems with one solution, no solution, and infinitely many solutions. They will also write and solve linear equations in two-variables to solve real-world problems.

MATHEMATICAL PRACTICE STANDARDS (emphasized):

	<p>Make sense of problems and persevere in solving them</p>	<p>At Discovery Preschool, parents who have two students enrolled get a discount on the second child. The second child's tuition is 10 dollars less per day than the first child's. If Tess has her two children enrolled for 5 days and her total bill for both children is \$200, how much does she pay each day for her second child to attend daycare?</p> <p>Consider the following situation. Then answer the questions below. Include any pictures, tables, equations, or graphs that you used to solve the problem.</p> <p>Two students, Arthur and Oliver, each have some chocolates. They know that they each have the same number of chocolates. Arthur has two tubs of chocolates, one bag of chocolates, and twenty-five remaining chocolates. Oliver has two tubs of chocolates, two bags of chocolates, and seven remaining chocolates.</p> <p>Can you determine how many chocolates are in a tub? Can you determine how many chocolates are in a bag? To the extent possible, figure out how many chocolates are in a tub and how many chocolates are in a bag.</p>
	<p>Reason abstractly and quantitatively</p>	<p>Write the word problem that goes with the equation. Then solve for the unknown information and verify your answer.</p> <p><u>A Trip to the Fair</u> Cost of a pony ride: b Cost to ride the Ferris wheel: $\frac{1}{2}b$ Cost to bungee jump: $2b + 5$</p> $3b + 4\left(\frac{1}{2}b\right) + (2b + 5) = 33$
	<p>Construct viable arguments and critique the reasoning of others</p>	<p>Error Analysis: Ricardo solved the following equation incorrectly. Circle the mistake and describe the mistake in words. Then, solve the equation correctly.</p> $2x + x + 5x = 56$ $7x = 56$ $x = 8$ <p>Combine like terms ($2x$, x, and $5x$). Divide both sides by 7.</p> <p>What is it about the structure of an expression that leads to one solution, infinitely many solutions, or no solution? Provide examples to support your claim.</p>
	<p>Model with mathematics</p>	<p>You burn approximately 230 calories less per hour if you ride your bike versus go on a run. Lien went on a two-hour run plus burned an additional 150 calories in his warm-up and cool down. Theo went on a 4 hour bike ride. If Lien and Theo burned the same amount of calories on their workouts, approximately how many calories do you burn an hour for each type of exercise?</p> <p>Write the word problem that goes with the equation in the problem below. Then solve for the unknown information and verify your answer.</p> <p><u>Fast Food Calories</u> Calories in a Big Mac: c Calories in a Grilled Chicken Sandwich: $c - 200$</p> <p>Calories in a 6-piece chicken nugget: $\frac{c}{2}$</p> $c + (c - 200) + \frac{c}{2} = 1175$
	<p>Look for and make use of structure</p>	<p>Write an expression for the amount of money Peter earned last week. Peter is paid p dollars per hour he works. For every hour he works over 40 hours, he is paid an additional \$10 per hour. Peter worked 46 hours last week.</p> <p>Consider the expression $4a - 12$. Write 3 different expressions that if set equal to $4a - 12$ would result in the equation having infinite solutions.</p>

Section 1.1: Simplify and Solve Linear Equations in One Variable, Applications

Section Overview:

This section begins with a review of writing and simplifying algebraic expressions. Then students move into writing and solving linear equations in one variable. Students start with linear equations whose solutions require collecting like terms. They then move onto equations whose solution requires the use of the distributive property and collecting like terms. Following these lessons, students will write word problems to match equations and they will write equations to match word problems. The equations will be in the same form that students studied in prior lessons (those whose solutions require the use of the distributive property and collecting like terms). As students continue in this section, they will move to equations that contain variables on both sides of the equation. Finally, they will put everything together and fluently solve multi-step equations with rational coefficients and variables on both sides that require expanding expressions using the distributive property and collecting like terms. In the last lesson, students will again write word problems to match equations and they will write equations to match word problems. The equations can take on any form of equation studied in this chapter.

Concepts and Skills to Master:

By the end of this section, students should be able to:

1. Understand the meaning of linear expression and linear equation.
2. Simplify linear expressions, including those requiring expanding using the distributive property and collecting like terms.
3. Write and simplify linear expressions that model real world problems.
4. Translate between the concrete and symbolic representations of an expression and an equation.
5. Solve multistep linear equations with rational coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
6. Write and solve multistep linear equations that model real world problems.

1.1a Classwork: Review Simplify Linear Expressions

In this lesson, we will study **linear expressions**. A linear expression is a mathematical phrase consisting of numbers, variables (symbols that represent numbers), and arithmetic operations that describes a mathematical or real-world situation.

The following are all examples of linear expressions:

- $3x - 5$
- $2x - x - 17$
- $3x$
- $6(2x - 5) + 11$
- $3x + 7x - 3 + 2x$
- 25

It is often the case that different linear expressions have the same meaning. For example, $x + x$ and $2x$ have the same meaning. The linear expression $x + x$ has been simplified to $2x$.

If a linear expression is in the form $Ax + B$ where A and B are numbers and x represents an unknown, then the linear expression is **simplified**. In the following examples, we will simplify linear expressions to the form $Ax + B$.

We will start by using tiles to model and simplify linear expressions.

Key for Tiles:

$$\square = 1$$

$$\text{rectangle} = x$$

$$\blacksquare = -1$$

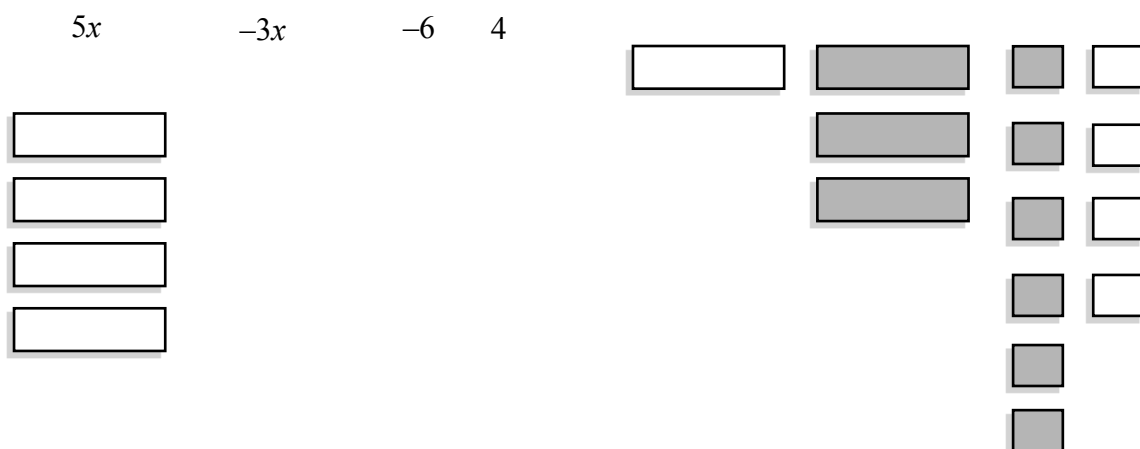
$$\text{shaded rectangle} = -x$$

Remember that a positive tile and a negative tile can be combined to create a **zero pair** or add to zero.

$$\square + \blacksquare = 0$$

$$\text{rectangle} + \text{shaded rectangle} = 0$$

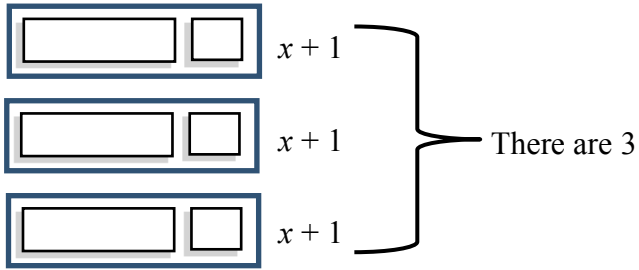
1. The following is a model of the expression $5x + -3x - 6 + 4$



Find zero pairs, and write the simplified form of this expression.

2. Model the expression $-4x + 3 + 5x + -1$. Then find zero pairs and simplify the expression.

3. The following is a model of the expression $3(x + 1)$



Write the simplified form of this expression.

Directions: Model and simplify each expression.

4. $2(x + 2) - x$

5. $3 - 3x + 4(x - 3)$

Directions: Simplify each expression.

6. $-4x + 3 + 5(2x - 1)$

7. $12 - (x - 2) + 4x$

8. $\frac{1}{2}a - 4.3 + a - 2.5$

9. $0.5(y - 1.5) + 2y + 5$

10. Write three expressions that are equivalent to $6x + 12$.

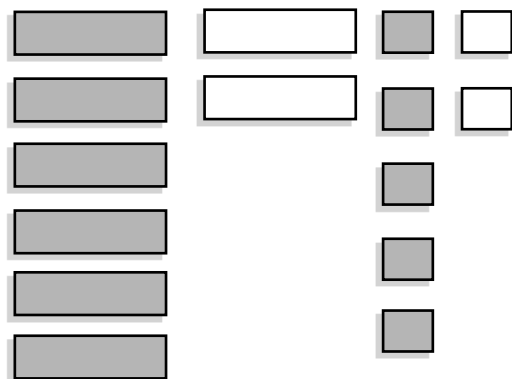
Linear expressions can be used to model many real world contexts. For example, if you buy 3 pieces of chicken that cost x dollars each, a slice of pie for \$3, and a drink for \$2, we can write an expression that represents the total amount you spent: $3x + 3 + 2$. The simplified form of this expression would be $3x + 5$.

Directions: Write a linear expression that models each of the following situations. Then, simplify the expression.

11. *An expression that represents the total amount made in one week.* A salesperson gets a base salary of \$300 per week plus \$20 for each item they sell. They sell x items in one week. The salesperson also spends \$40 a week on travel expenses.
12. *An expression that represents the total amount spent.* Sara bought 3 baby outfits and one bottle of baby lotion. The baby lotion costs x dollars. Each outfit costs \$2 more than the baby lotion.
13. *An expression that represents the amount of money remaining.* Tim took his friends to the movies. He started with \$40 and bought 3 movie tickets that each cost x dollars. He also bought one tub of popcorn that cost \$5.75.
14. *An expression that represents the perimeter of the basketball court.* In the NBA, the length of the basketball court is 44 feet longer than the width. The width of the court is w .
15. *An expression for the amount of money Peter earned last week.* Peter is paid p dollars per hour he works. For every hour he works over 40 hours, he is paid an additional \$10 per hour. Peter worked 46 hours last week.

1.1a Homework: Review Simplify Linear Expressions

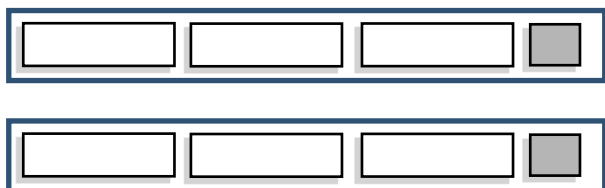
1. The following is a model of the expression $-6x + 2x - 5 + 2$



Find zero pairs, and write the simplified form of this expression.

2. Model the expression $5x + 2 - x - 4$. Then find zero pairs and simplify the expression.

3. The following is a model of the expression $2(3x - 1)$



Write the simplified form of this expression.

Directions: Model and simplify each expression.

4. $2(x + 3) + 4x$

5. $4 + 2(x - 2) - 4$

Directions: Simplify each expression.

6. $6(2x - 4) - 3x$

7. $4 - (2x + 3) + 5x$

8. $-6x - 4 + 5x + 7$

9. $\frac{1}{2}(4x + 12) + 2x$

10. Write three expressions that are equivalent to $3x + 15$.

Directions: Write a linear expression that models each of the following situations. Then, simplify the expression.

11. *An expression that represents the total cost of the concert tickets.* Master Tickets charges \$35 for each concert ticket, plus an additional \$2 service fee for each ticket sold. x tickets were purchased.
12. *The total number of baseball cards Jayant has.* Jayant bought 3 packs of baseball cards. He already has 35 baseball cards in his collection. Each pack of cards has x cards in it.
13. *An expression that represents the amount of money remaining.* Lisa went shopping for decorations for her birthday party. She started with \$20. She bought 4 bags of balloons that cost x dollars each, 2 rolls of streamers that cost \$2.25 each, and 1 pack of hats that cost \$4.50.
14. *An expression that represents the perimeter of the tennis court.* An official tennis court has a width that is 42 feet shorter than the length. The length of the court is l .
15. *An expression for the total amount spent.* At Six North Shoe Store, a pair of boots is \$30 more than a pair of shoes. Emily purchased 2 pairs of boots and 3 pairs of shoes. The cost of one pair of shoes is s .
16. *An expression for the amount of money Naja earned last week.* Naja is paid p dollars per hour she works. For every hour she works over 40 hours, she is paid time and a half which means she is paid 1.5 times her normal hourly rate. She worked 50 hours last week.

1.1b Anchor Problem: Chocolate Problem

Consider the following situation. Then answer the questions below. Include any pictures, tables, equations, or graphs that you used to solve the problem.

Two students, Theo and Lance, each have some chocolates. They know that they have the same number of chocolates. Theo has four full bags of chocolates and five loose chocolates. Lance has two full bags of chocolates and twenty-nine loose chocolates.

Can you determine how many chocolates are in a bag? Can you determine how many chocolates each child has?

1.1c Classwork: Solve Linear Equations in One Variable (simplify by combining terms)

In the previous section, we studied linear expressions. When we set two linear expressions equal to each other, we have created a **linear equation**. A **linear equation** is a statement that two linear expressions are equal to each other.

Let's look at an example from the previous section:

A salesperson gets a base salary of \$300 per week plus \$20 for each item they sell. They sell x items in one week. The salesperson also spends \$40 a week on travel expenses.

We can write an expression that represents the total amount made in one week: $300 + 20x - 40$

If we know that the salesperson made \$860 last week, we can set these two expressions equal to each other to create a **linear equation**:

$$300 + 20x - 40 = 860$$

We can then solve this equation to determine how many items the salesperson sold last week. When this equation is solved, the solution is $x = 30$, which means the salesperson sold 30 items last week. Verify this by plugging in 30 for x in the equation above.

It is important to note that when we create an equation, the two expressions on either side of the equal sign might not actually always be equal; that is, the equation might be true for some values of x and false for others. A **solution** to an equation is a number that makes the equation true when substituted for the variable. In the example of the salesperson, the linear equation is true for one value of x ($x = 30$) which represents the number of items the salesperson would have to sell to earn \$860. The solution to this equation is $x = 30$.

In the first section of this chapter, we will look at examples of linear equations that are true for one value of x as we saw in the sales example above. We will learn how to model and solve these types of linear equations.

It might also be the case that an equation has no solutions or an equation may have infinite solutions (every number is a solution). We will examine these two cases in section 1.2.

1. The following is a model of the equation $5x - 8 - 2x = 4$. Create this model with your tiles and solve the equation, showing your solving actions (steps) below.

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- a. Solving Actions:
 $5x - 8 - 2x = 4$

- b. Verify your solution in the space below.

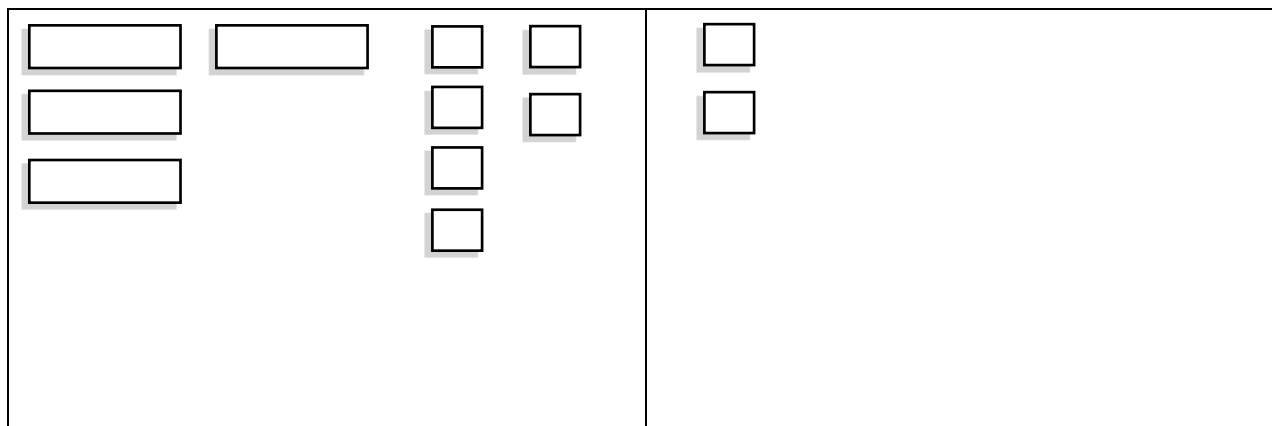
Directions: Model and solve the following equations. Show your solving actions and verify your solution.

2. $4x + 3x - 1 = 6$

3. $10 = -x + 3x + 4$

4. $10 = -2x - 3 + 4x + 5$

5. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

Directions: Solve the following equations without the use of the tiles.

6. $-7x + 5x + 3 = -9$

7. $17 = m + 5 - 3m$

8. $0.5b + 2b = -50$

9. $-\frac{2}{3} = -\frac{4}{3} + 6r$

10. Error Analysis: Ricardo solved the following equation incorrectly. Circle the mistake and describe the mistake in words. Then, solve the equation correctly.

$$2x + x + 5x = 56$$

$$7x = 56$$

Combine like terms.

$$x = 8$$

Divide both sides by 7.

11. Write an equation that contains like terms and has a solution of $x = 2$. Answers will vary.

1.1c Homework: Solve Linear Equations in One Variable (simplify by combining terms)

Directions: Solve the following equations. Verify your solutions.

1. $7x - 3x = 24$

2. $2x - 9x + 17 = -4$

3. $5a + 8 + (-2a) = -7$

4. $-2x - 7 - 4x = 17$

5. $6 = 4t - 3t - 2$

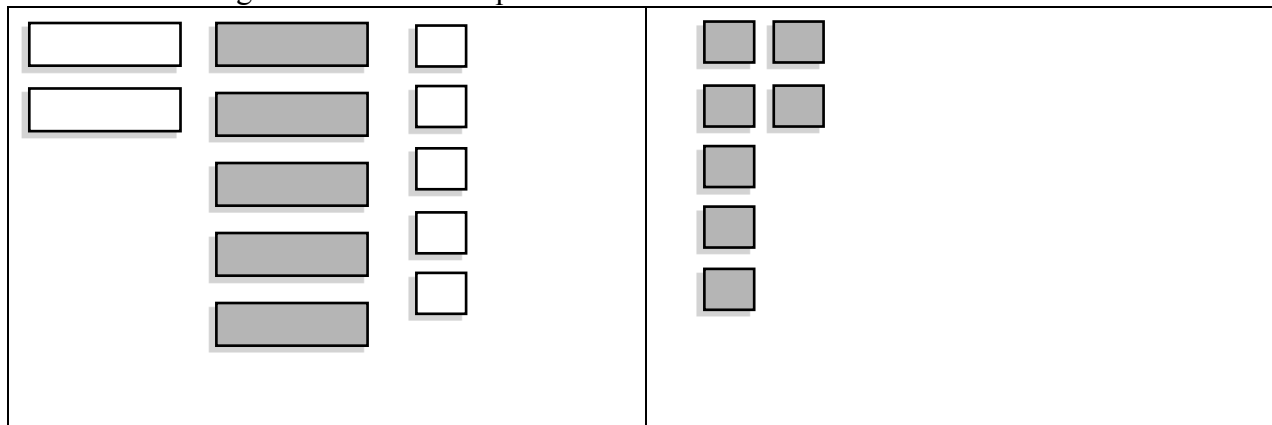
6. $\frac{2}{5}x - \frac{1}{5}x = 9$

7. $1.3b - 0.7b = 12$

8. $-2.5 = 0.4y + 0.1y$

9. $3\frac{1}{4} = r - 1\frac{1}{4} + \frac{1}{2}r$

10. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

Directions: In #11 – 12, a common mistake has been made. Circle the mistake and describe the mistake in words. Then, solve the equation correctly.

11. $2x + 4x - 2 = 20$

$$6x - 2 = 20$$

Combine like terms.

$$4x = 20$$

Combine like terms.

$$x = 5$$

Divide by 4.

Explanation of Mistake:

Solve Correctly:

12. $3x - 8x - 5 = 10$

$$5x - 5 = 10$$

Combine like terms.

$$5x = 15$$

Add 5 to both sides.

$$x = 3$$

Divide both sides by 5.

Explanation of Mistake:

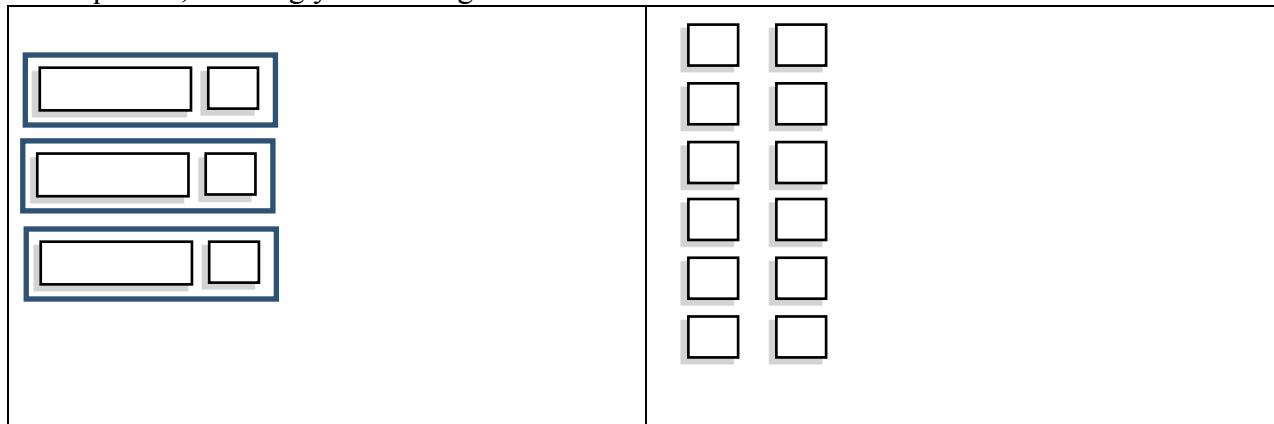
Solve Correctly:

13. Write an equation that contains like terms and has a solution of $x = 1$. Answers will vary.

14. Write an equation that contains like terms and has a solution of $x = -3$. Answers will vary.

1.1d Classwork: Solve Linear Equations in One Variable (simplify using distribution)

1. The following is a model of the equation $3(x+1)=12$. Create this model with your tiles and solve the equation, showing your solving actions below.



Solving Actions:

$$3(x+1)=12$$

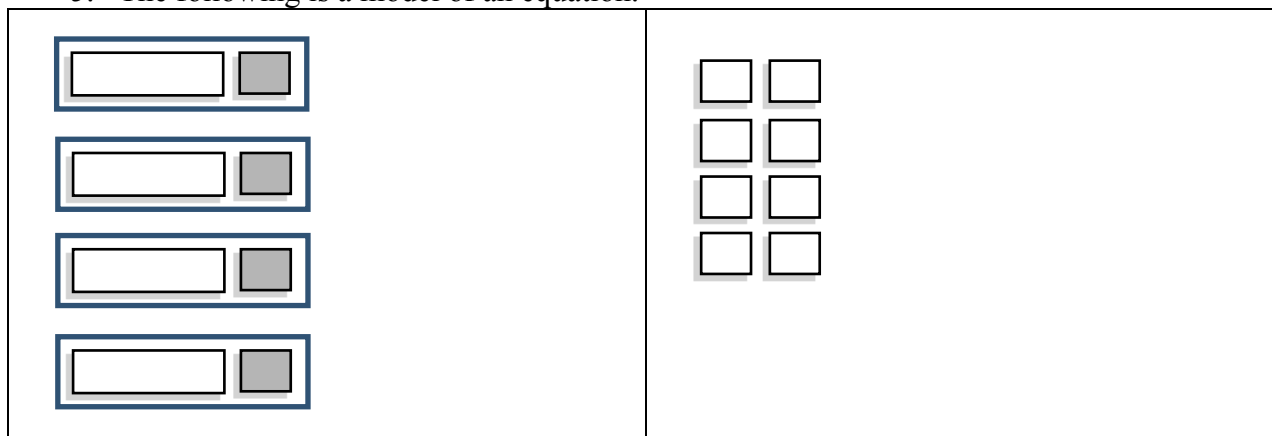
Directions: Model and solve the following equations.

2. $2(x+5)=14$

3. $2(3x+1)-2x=10$

4. $3(x-2)=-12$

5. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

Directions: Solve the following equations without the use of the tiles.

6. $-2(x+1) = 8$

7. $-3(x-4) - 8 = 13$

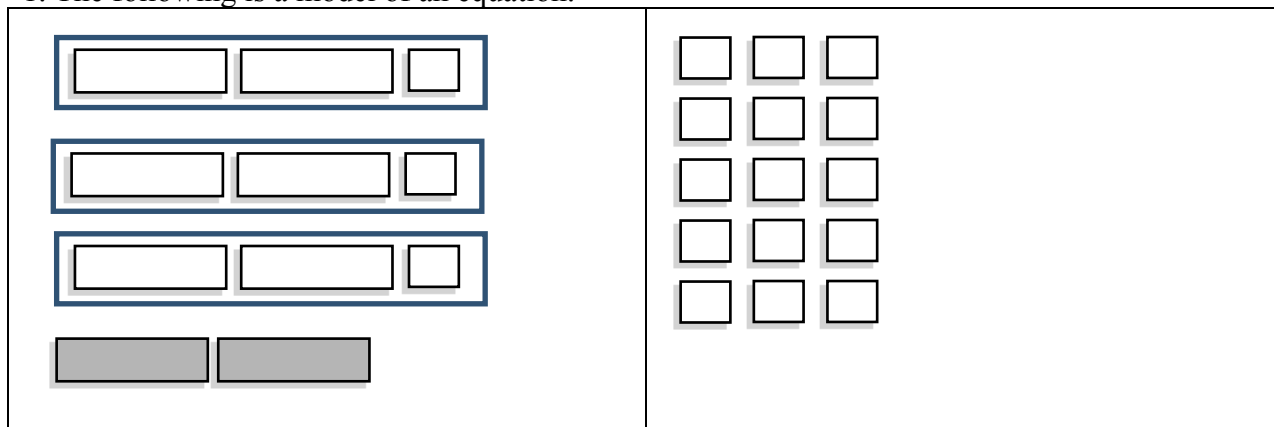
8. $5 + 2(3a - 1) = 15$

9. $\frac{1}{2}(2t + 4) = -8$

10. Write an equation that contains parentheses and has a solution of $x = 5$. Answers will vary.

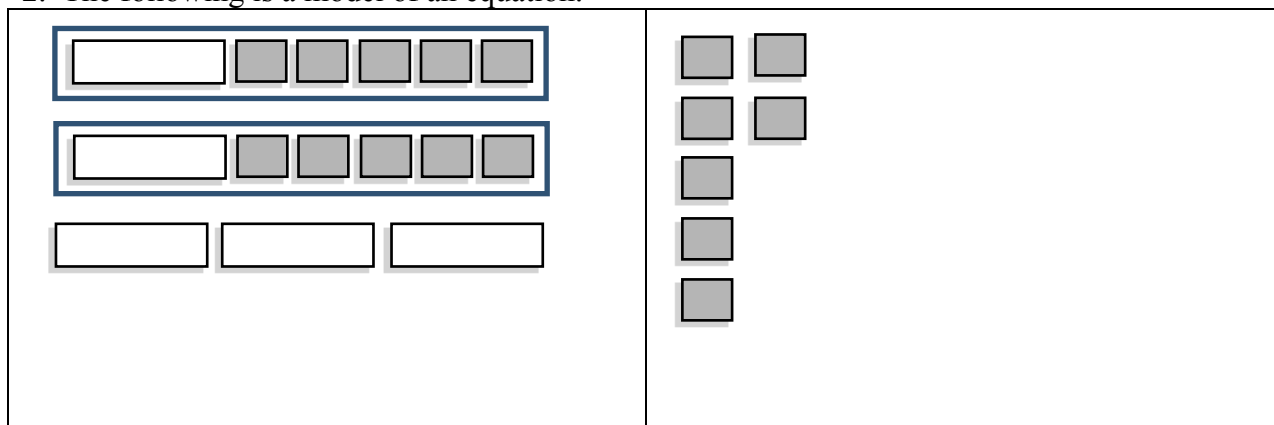
1.1d Homework: Solve Linear Equations in One Variable (simplify using distribution)

1. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

2. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

Directions: Solve the following equations. Verify your solutions.

1. $3(4x - 2) = 30$

2. $4(2 + 2x) = -24$

3. $-16 = 2(4x + 8)$

4. $3(x + 10) + 5 = 11$

5. $3t - 2 + t - 5t = -1$

6. $-24 = 2(1 - 5x) + 4$

7. $-2(a + 3) + 4a = 18$

8. $5x + 3(x + 4) = 28$

9. $4x - 3(x - 2) = 21$

10. $0 = -2(x + 5) + 3x$

11. $\frac{1}{3}(x + 6) = 1$

12. $5 - 4(2b - 5) + 3b = 15$

13. $10 = 3(x - 2) - 2(5x - 1)$

14. $0.2(10t - 4) - t = 1.2$

15. $26 = -\frac{1}{7}(-x - 7) + 22$

Directions: In the following problems, a common mistake has been made. Circle the mistake and describe the mistake in words. Then, solve the equation correctly.

16. $7 + 2(3x + 4) = 3$

$$7 + 6x + 4 = 3$$

Distribute the 2.

$$11 + 6x = 3$$

Combine like terms.

$$6x = -8$$

Subtract 11 from both sides.

$$x = \frac{-8}{6}$$

Divide both sides by 6.

$$x = \frac{-4}{3}$$

Simplify the fraction.

Explanation of Mistake:

Solve Correctly:

17. $-2(y - 3) + 5 = 3$

$$-2y - 6 + 5 = 3$$

Distribute the -2 .

$$-2y - 1 = 3$$

Combine like terms.

$$-2y = 4$$

Add 1 to both sides.

$$y = -2$$

Divide both sides by -2 .

Explanation of Mistake:

Solve Correctly:

18. $5 - (2x - 7) = 14$

$$5 - 2x - 7 = 14$$

Distribute the negative sign.

$$-2 - 2x = 14$$

Combine like terms.

$$-2x = 16$$

Add 2 to both sides.

$$x = -8$$

Divide both sides by -2 .

Explanation of Mistake:

Solve Correctly:

19. $\frac{1}{3}(x + 15) = 11$

$$\frac{1}{3}x + 5 = 11$$

Distribute the $\frac{1}{3}$

$$\frac{1}{3}x = 6$$

Subtract 5 from both sides.

$$x = 2$$

Divide both sides by 3.

Explanation of Mistake:

Solve Correctly:

20. Write an equation that contains parentheses and has a solution of $m = -6$. Answers will vary.

1.1e Classwork: Applications Part 1

Directions: Write the word problem that goes with the equation in each problem. Then solve for the unknown information and verify your answer.

1. The Cost of Lunch

Cost of a pear: x

Cost of juice: $1.5x$

Cost of a sandwich: $x + 1.40$

$$x + 1.5x + (x + 1.40) = 3.50$$

2. Ages

Talen's age now: t

Peter's age now: $8t + 3$

$$t + (8t + 3) = 39$$

3. Angles

$m\angle A$: a

$m\angle B$: $4a - 5$

$$a + (4a - 5) = 90$$

4. Rectangles

Width of a rectangle: $2w$

Length of a rectangle: $(w + 5)$

$$2w + (w + 5) + 2w + (w + 5) = 40$$

5. Triangles

$m\angle A: x$

$m\angle B: 3x$

$m\angle C: x - 20$

$$x + 3x + (x - 20) = 180$$

6. Making Lemonade

Cups of water to make a batch of lemonade: c

Cups of sugar to make a batch of lemonade: $\frac{1}{4}c$

Cups of lemon juice to make a batch of lemonade: $\frac{1}{2}c$

$$c + \frac{1}{4}c + \frac{1}{2}c = 14$$

7. Fast Food Calories

Calories in a Big Mac: c

Calories in a Grilled Chicken Sandwich: $c - 200$

Calories in a 6-piece chicken nugget: $\frac{c}{2}$

$$c + (c - 200) + \frac{c}{2} = 1175$$

Directions: Write an expression for each unknown quantity in the word problem. Then write an equation for each problem. Then solve your equation and answer the question in a complete sentence.

8. In a triangle, angle A is 3 times larger than angle B. Angle C is 20 degrees larger than Angle B. The sum of the angles is 180 degrees. What is the measure of each angle?
9. The width of a rectangle is five less than three times the length of the rectangle. If the perimeter of the rectangle is 70 ft., what are the dimensions of the rectangle?
10. The sum of three consecutive integers is 84. Find the three integers.
11. Afua got an 90% on her first math exam, a 76% on her second math exam, and a 92% on her third math exam. What must she score on her fourth exam to have an average of 88% in the class?
12. Kelly works 40 hours a week as a nurse practitioner. She makes time and a half for every hour she works over 40 hours. If she worked 60 hours one week and made \$2100, what is her hourly wage?

1.1e Homework: Applications Part 1

Directions: Write the word problem that goes with the equation in each problem. Then solve for the unknown information and verify your answer. For some of the problems, it may help to start by drawing a picture.

1. Angles

$$m\angle A: a$$

$$m\angle B: 2a$$

$$a + 2a = 180$$

2. Ages

$$\text{Felipe's age now: } f$$

$$\text{Felipe's sister's age: } f - 6$$

$$\text{Felipe's mom's age: } 3f - 9$$

$$f + (f - 6) + (3f - 9) = 60$$

3. A Trip to Disneyland

$$\text{Miles driven on the first day: } m$$

$$\text{Miles driven on the second day: } 2m$$

$$\text{Miles driven on the third day: } 2m + 50$$

$$m + 2m + (2m + 50) = 650$$

4. Triangles

$$m\angle X: x$$

$$m\angle Y: x$$

$$m\angle Z: 3x$$

$$x + x + (3x) = 180$$

5. The Cost of Clothes

Cost of a shirt: c

Cost of a pair of jeans: $c + 12$

$$3c + (c + 12) = 124$$

6. A Trip to the Fair

of tickets for a pony ride: b

of tickets to ride the Ferris wheel: $\frac{1}{2}b$

of tickets to bungee jump: $2b + 5$

$$3b + 4\left(\frac{1}{2}b\right) + (2b + 5) = 33$$

Directions: Write an expression for each unknown quantity in the word problem. Then write an equation for each problem. Then solve your equation and answer the question in a complete sentence.

7. At Shoes for Less, a pair of shoes is \$15 less than a pair of boots. Cho purchased three pairs of shoes and two pairs of boots for \$120. How much does a pair of boots cost?

8. The length of a rectangle is $4x$ and the width is 5 ft. If the perimeter of the rectangle is 34 ft., find the length of the rectangle.

9. Central Lewis High School has five times as many desktop computers as laptops. The school has a total of 360 computers. How many of each type of computer does the school have?

10. The sum of three consecutive integers is -36 . Find the three integers.

11. Hamir got a 98%, 87%, 92%, and 92% on his first four math tests. What score must he get on the fifth test to get a 93% in the class?

12. At Discovery Preschool, parents who have two students enrolled get a discount on the second child. The second child's tuition is 10 dollars less per day than the first child's. If Tess has her two children enrolled for 5 days and her total bill for both children is \$200, how much does she pay each day for her second child to attend daycare?

1.1f Classwork: Solve Linear Equations in One Variable (simplify with variables on both sides)

1. The following is a model of the equation: $5x + 2 = 3x + 12$. Create this model with your tiles and solve the equation, showing your solving actions below.

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- a. Solving Actions:
 $5x + 2 = 3x + 12$

- b. How can you verify your solution?

Directions: Model and solve the following equations.

2. $2x = x + 4$

3. $3x + 3 = 2x + 7$

4. $x + 10 = 2x + 5$

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

6. $4x = -2x + 12$

7. $2 - 5x = -6x + 5$

Directions: Solve the following equations without the use of the tiles.

8. $4x = 2x + 12$

9. $5x + 3 = x + 27$

10. $-4x + 6 = 3x - 36$

11. $0.7x - 0.6 = -0.2x - 0.42$

12. $8 - 4x = 4x$

13. $\frac{1}{3}x - 8 = 12 + \frac{4}{3}x$

14. Write an equation that contains variables on both sides and has a solution of $x = 3$. Answers will vary.

1.1f Homework: Solve Linear Equations in One Variable (simplify with variables on both sides)

Directions: Solve the following equations. Verify your solutions.

1. $3x = 2x + 2$

2. $3x + 5 = 4x + 1$

3. $6x + 3 = 3x + 12$

4. $3x + 8 = 2x + 10$

5. $5x + 3 = 3x + 7$

6. $5a - 5 = 7 + 2a$

7. $3b - 6 = 8 - 4b$

8. $-3y + 12 = 3y - 12$

9. $3 - \frac{1}{4}x = -\frac{1}{2}x + 9$

Directions: In the following problems, a common mistake has been made. Circle the mistake and describe the mistake in words. Then, solve the equation correctly.

10. $4x - 8 = -2x + 20$

$2x - 8 = 20$ Combine like terms ($4x$ and $-2x$)

$2x = 12$ Add 8 to both sides.

$x = 6$ Divide both sides by 2.

Explanation of Mistake:

Solve Correctly:

11. $6x + 4 = -2x$

$8x = 4$ Add $2x$ to both sides.

$x = \frac{4}{8}$ Divide both sides by 8.

$x = \frac{1}{2}$ Simplify the fraction.

Explanation of Mistake:

Solve Correctly:

14. Write an equation that contains variables on both sides and has a solution of $c = -4$. Answers will vary.

1.1g Classwork: Solve Linear Equations in One Variable (multi-step)

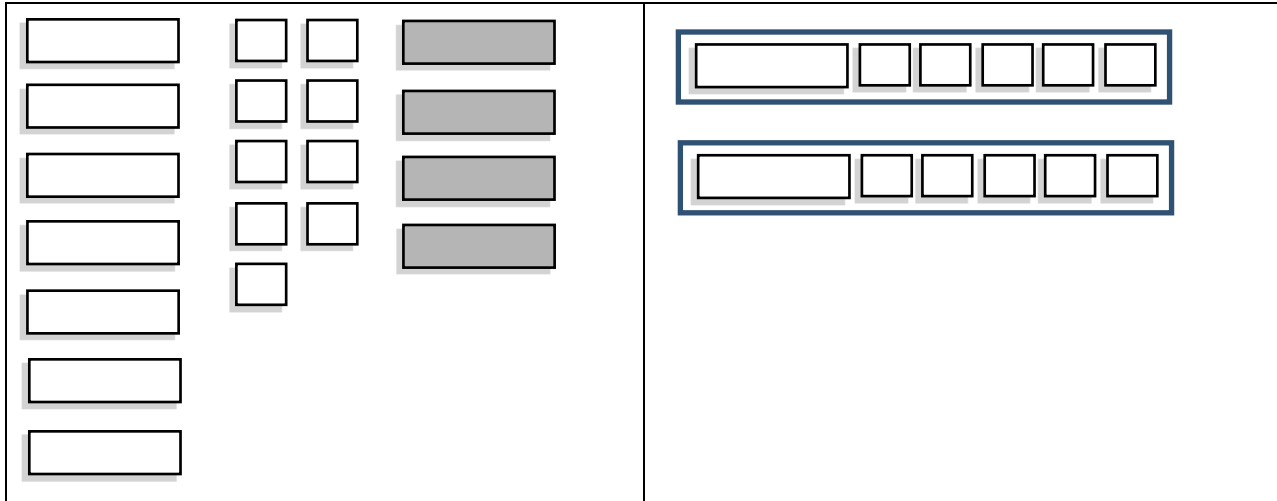
1. The following is a model of the equation $5x + 2 + x = 4x + 8$. Create this model with your tiles and solve the equation, showing your solving actions below.

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- a. Solving Actions:
 $5x + 2 + x = 4x + 8$

- b. How can you verify your solution?

2. The following is a model of the equation $7x + 9 - 4x = 2(x + 5)$. Create this model with your tiles and solve the equation, showing your solving actions below.



- a. Solving Actions:
 $7x + 9 - 4x = 2(x + 5)$

- b. How can you verify your solution?

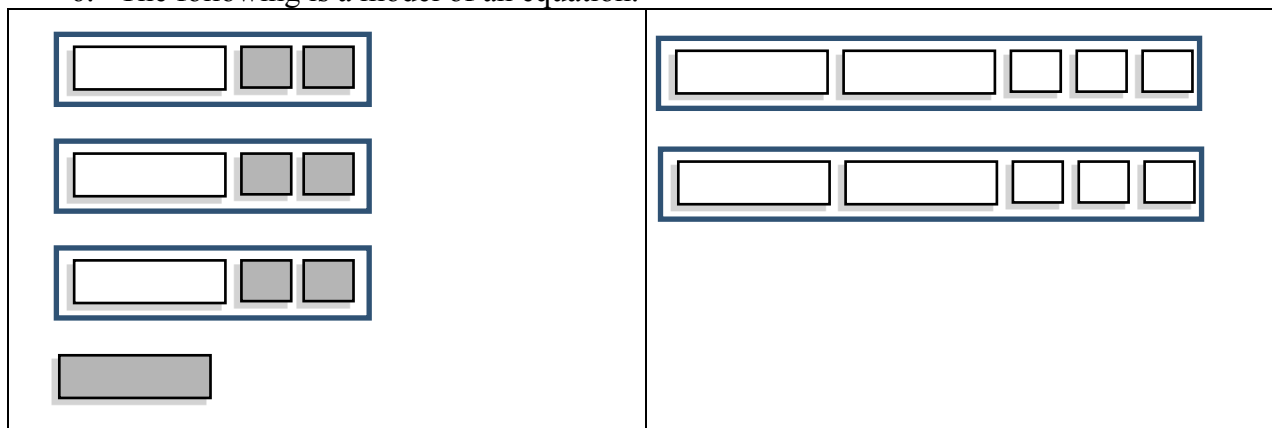
Model and solve the following equations.

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

4. $8x + 3 - 2x = 3x + 12$

5. $10x + 2 - 3x = 3(2x + 2)$

6. The following is a model of an equation.



Write the symbolic representation for this model. Solve the equation.

Directions: Solve the following equations without the use of the tiles.

7. $9x - 4 = 7 - 2x$

8. $2(a + 2) = 11 + a$

9. $5x - 4x + 18 = 3x + 2$

10. $2t + 21 = 3(t + 5)$

11. $7x + 2 - 4x = 7 + 2x + 4$

12. $4(1 - x) + 3x = -2(x + 1)$

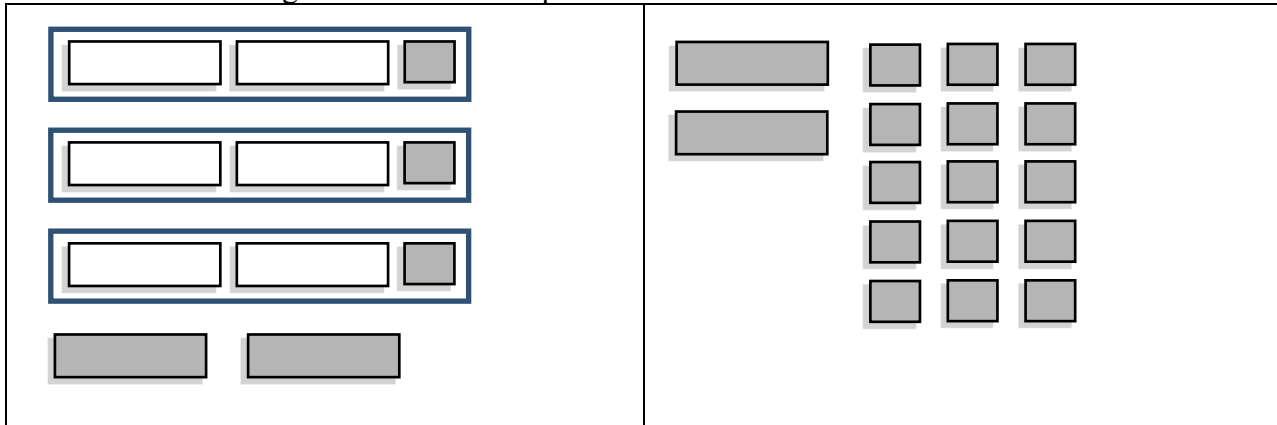
13. $\frac{1}{4}(12x + 16) = 10 - 3(x - 2)$

14. $\frac{2x - 4}{3x + 2} = \frac{2}{5}$

15. Write an equation that has parentheses on at least one side of the equation, variables on both sides of the equation, and a solution of $x = 4$. Answers will vary.

1.1g Homework: Solve Linear Equations in One Variable (multi-step)

1. The following is a model of an equation.



Write the symbolic representation of the equation for this model. Solve the equation.

Directions: Solve the following equations. Verify your solutions.

2. $x + 3x = 9 + x$

3. $4c + 4 = c + 10$

4. $3(4x - 1) = 2(5x - 7)$

5. $3x + 10 + 2x = 2(x + 8)$

6. $2(x + 8) = 2(2x + 1)$

7. $4(x + 3) = x + 26 + x$

8. $3a + 5(a - 2) = 6(a + 4)$

9. $13 - (2c + 2) = 2(c + 2) + 3c$

10. $2(4x + 1) - 2x = 9x - 1$

11. $2 - (2x + 2) = 2(x + 3) + x$

12. $3(x - 6) = 4(x + 2) - 21$

13. $3(y + 7) = 2(y + 9) - y$

14. $-4(x - 3) = 6(x + 5)$

15. $\frac{1}{2}(12 - 2x) - 4 = 5x + 2(x - 7)$

16. $\frac{1}{2}(12n - 4) = 14 - 10n$

17. Write an equation that has parentheses on at least one side of the equation, variables on both sides of the equation, and a solution of $x = 2$. Answers will vary.

1.1h Classwork: Applications Part 2

Directions: Write the word problem that goes with the equation in each problem. Then solve for the unknown information and verify your answer.

1. Birthday Parties

Number of friends at birthday party: f

Cost of party at Boondocks: $8f + 60$

Cost of party at Raging Waters: $20f$

$$8f + 60 = 20f$$

2. A Number Trick

Starting number: n

Lily's number: $3(n + 5)$

Kali's number: $n - 5$

$$3(n + 5) = n - 5$$

3. Savings

Number of weeks: w

Sophie's Money: $300 - 40w$

Raphael's Money: $180 + 20w$

$$300 - 40w = 180 + 20w$$

Directions: Write an expression for each unknown quantity in the word problem. Then write an equation for each problem. Then solve your equation and answer the question in a complete sentence.

4. Horizon Phone Company charges \$15 a month plus 10 cents per text. G-Mobile charges a flat rate of \$55 per month with unlimited texting. At how many texts would the two plans cost the same? Which plan is the better deal if you send 200 texts per month?

5. The enrollment in dance class is currently 80 students and is increasing at a rate of 4 students per term. The enrollment in choir is 120 students and is decreasing at a rate of 6 students per term. After how many terms will the number of students in dance equal the number of students in choir? How many students will be in each class?

6. You burn approximately 230 calories less per hour if you ride your bike versus go on a run. Lien went on a two-hour run plus burned an additional 150 calories in his warm-up and cool down. Theo went on a 4 hour bike ride. If Lien and Theo burned the same amount of calories on their workouts, approximately how many calories do you burn an hour for each type of exercise?

1.1h Homework: Applications Part 2

Directions: Write the word problem that goes with the equation in each problem. Then solve for the unknown information and verify your answer.

1. Fixing Your Car

Number of hours it takes to fix your car: h

Cost of Mike's Mechanics: $15h + 75$

Cost of Bubba's Body Shop: $25h$

$$15h + 75 = 25h$$

2. World Languages

Number of years: t

Number of Students Enrolled in French: $160 - 9t$

Number of Students Enrolled in Spanish: $85 + 6t$

$$160 - 9t = 85 + 6t$$

3. Downloading Music

Number of songs downloaded: s

Monthly cost of downloading songs at bTunes: $0.99s$

Monthly cost of downloading songs at iMusic: $10 + 0.79s$

$$0.99s = 10 + 0.79s$$

Directions: Write an expression for each unknown quantity in the word problem. Then write an equation for each problem. Then solve your equation and answer the question in a complete sentence.

4. Underground Floors charges \$8 per square foot of wood flooring plus \$150 for installation. Woody's Hardwood Flooring charges \$6 per square foot plus \$200 for installation. At how many square feet of flooring would the two companies charge the same amount for flooring? If you were going to put flooring on your kitchen floor that had an area of 120 square feet, which company would you choose?

5. Owen and Charlotte's mom give them the same amount of money to spend at the fair. They both spent all of their money. Owen goes on 8 rides and spends \$5 on pizza while Charlotte goes on 5 rides and spends \$6.50 on pizza and ice cream. How much does each ride cost?

6. Ashton and Kamir are arguing about how a number trick they heard goes. Ashton tells Andrew to think of a number, multiply it by five and subtract three from the result. Kamir tells Andrew to think of a number add five and multiply the result by three. Andrew says that whichever way he does the trick he gets the same answer. What was the number?

1.1i Self-Assessment: Section 1.1

Consider the following skills/concepts. Rate your comfort level with each skill/concept by checking the box that best describes your progress in mastering each skill/concept.

Skill/Concept	Beginning Understanding	Developing Skill and Understanding	Deep Understanding, Skill Mastery
1. Understand the meaning of linear expression and linear equation.			
2. Simplify linear expressions, including those requiring expanding using the distributive property and collecting like terms.			
3. Write and simplify linear expressions that model real world problems.			
4. Translate between the concrete and symbolic representations of an expression and an equation.			
5. Solve multistep linear equations with rational coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.			
6. Write and solve multistep linear equations that model real world problems.			

Section 1.2: Solve Linear Equations in One Variable (special cases)

Section Overview:

In this section students will extend their understanding of linear equations in one variable with unique solutions to linear equations in one variable with either no solution or infinitely many solutions (special cases). Students start the section with a problem that gives them an opportunity to explore these concepts. They will use models and skills developed and solidified in section 1.1 to recognize the structure and then solve special cases of linear equations. Students should come to understand that the structure of an equation as well as the solving outcome ($x = a$, $a = b$, or $a = a$ where a and b are different numbers) indicates if the equation has one, no, or infinitely many solutions (is true for a unique value, no value, or all values of the variable.)

Concepts and Skills to Master:

By the end of this section, students should be able to:

1. Solve multi-step linear equations that have one solution, infinitely many solutions, or no solution.
2. Understand what it is about the structure of a linear equation that results in equations with one solution, infinitely many solutions, or no solutions.
3. Identify and provide examples of equations that have one solution, infinitely many solutions, or no solutions.

1.2a Anchor Problem: Chocolate Problem

Consider the following situation. Then answer the questions below. Include any pictures, tables, equations, or graphs that you used to solve the problem.

Two students, Arthur and Oliver, each have some chocolates. They know that they have the same number of chocolates. Arthur has two tubs of chocolates, one bag of chocolates, and twenty-five loose chocolates. Oliver has two tubs of chocolates, two bags of chocolates, and seven loose chocolates.

Can you determine how many chocolates are in a tub? Can you determine how many chocolates are in a bag? To the extent possible, figure out how many chocolates are in a tub and how many chocolates are in a bag.

1.2a Homework: Review of Multi-step Solving

Directions: Solve the following equations. Show all your work.

1. $7(x-3) = 3x + 3(x-2)$

2. $8y - 19 = 5$

3. $8g + 9 = 4g + 1$

4. $2(-4d + 3) = -42$

5. $t + 0.5 = 0.25t + 2$

6. $7k - 2(k + 6) = -22$

7. $4\left(s + \frac{1}{2}\right) = 8\left(s + \frac{3}{4}\right)$

8. $\frac{20+x}{5} = 10$

9. $\frac{1}{2}(4x - 16) = 12$

10. Like Arthur and Oliver, Abby and Amy also say that they have the same number of chocolates. Abby has one full tub of chocolates and 21 remaining chocolates. Amy has one full tub of chocolates and 17 remaining chocolates. Each tub has the same number of chocolates. Can you determine how many chocolates are in a tub? Why or why not? If so, how many chocolates are a tub?

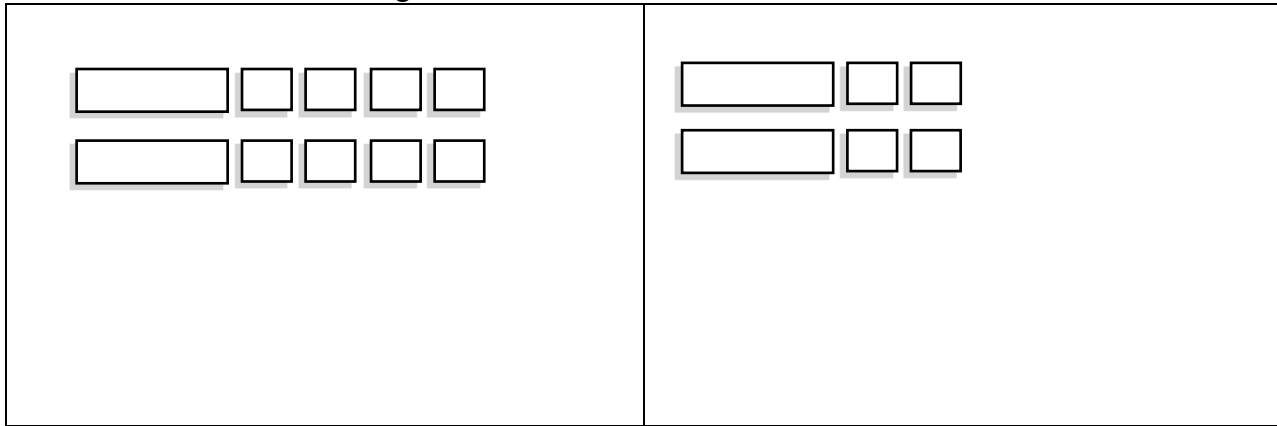
1.2b Classwork: Solve Linear Equations in One Variable (special cases)

1. Consider the following model:

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- Using the model, make some observations.
- Write the symbolic representation for this model and then solve the equation you wrote.
- What happened when you solved the equation?
- What is it about the structure of the equation that led to the solution?

2. Consider the following model:



- Using the model, make some observations.
- Write the symbolic representation for this model and then solve the equation you wrote.
- What happened when you solved the equation?
- What is it about the structure of the equation that led to the solution?

Directions: Solve the following equations. If there is one solution, state what the solution is. Otherwise, state if there are infinitely many solutions or no solution.

3. $x - 1 = x + 1$

4. $5x - 10 = 10 - 5x$

5. $4(m - 3) = 10m - 6(m + 2)$

6. $4(x - 4) = 4x - 16$

7. $2x - 5 = 2(x - 5)$

8. $3x = 3x - 4$

9. $3v + 5 + 2v = 5(2 + v)$

10. $5 - (4a + 8) = 5 - 4a - 8$

11. What is it about the structure of an expression that leads to one solution, infinitely many solutions, or no solution? Provide examples to support your claim.

Directions: Without solving completely, determine the number of solutions of each of the equations.

12. $6a - 3 = 3(2a - 1)$

13. $5x - 2 = 5x$

14. $8x - 2x + 4 = 6x - 1$

15. $5m + 2 = 3m - 8$

16. $2(3a - 12) = 3(2a - 8)$

17. Consider the expression $4a - 12$. Write 3 different expressions that if set equal to $4a - 12$ would result in the equation having infinite solutions.

18. Consider the expression $x + 1$. Write 3 different expressions that if set equal to $x + 1$ would result in the equation having no solution.

19. Consider the expression $2x + 6$. Write 3 different expressions that if set equal to $2x + 6$ would result in the equation having one solution.

20. Determine whether the equation $7x = 5x$ has one solution, infinitely many solutions, or no solution. If it has one solution, determine what the solution is.

1.2b Homework: Solve Linear Equations in One Variable (special cases)

Directions: Without solving completely, determine the number of solutions of each of the equations.

1. $x - 211 = x$

2. $3(m - 3) = 3m - 9$

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

4. $-4m + 12 = 4m + 12$

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

Directions: Solve the following equations. If there is one solution, state what the solution is. Otherwise, state if there are infinitely many solutions or no solution. Show all your work.

6. $3x + 1 - 3(x - 1) = 4$

7. $3(a + 6) - 2(a - 6) = 6$

8. $3(r - 4) = 3r - 4$

9. $2(x + 1) = 3x + 4$

10. $3 - (4b - 2) = 3 - 4b + 2$

11. $3 - (4b - 2) = 3 - 4b - 2$

$$12. 2y - 5y + 6 = -(3y - 6)$$

$$13. f + 1 = 7f + 12 - 11 - 6f$$

$$14. 12 + 8a = 6a - 6$$

$$15. \frac{1}{2}(6m - 10) = 3m - 5$$

Directions: Fill in the blanks of the following equations to meet the criteria given. In some cases, there may be more than one correct answer.

$$16. \text{An equation that yields one solution: } 8x + \underline{\hspace{1cm}} = \underline{\hspace{1cm}}x + 10$$

$$17. \text{An equation that yields no solution: } 8x + \underline{\hspace{1cm}} = \underline{\hspace{1cm}}x + 10$$

$$18. \text{An equation that yields infinitely many solutions: } 8x + 24 = \underline{\hspace{1cm}}(\underline{\hspace{1cm}}x + \underline{\hspace{1cm}})$$

Directions: Create your own equations to meet the following criteria.

19. An equation that yields one solution of $x = 5$.

20. An equation that yields no solution.

21. An equation that yields infinitely many solutions.

22. **Challenge:** Can you think of an equation with two solutions?

1.2c Self-Assessment: Section 1.2

Consider the following skills/concepts. Rate your comfort level with each skill/concept by checking the box that best describes your progress in mastering each skill/concept.

Skill/Concept	Beginning Understanding	Developing Skill and Understanding	Deep Understanding, Skill Mastery
1. Solve multi-step linear equations that have one solution, infinitely many solutions, or no solution.			
2. Understand what it is about the structure of a linear equation that results in equations with one solution, infinitely many solutions, or no solutions.			
3. Identify and provide examples of equations that have one solution, infinitely many solutions, or no solutions.			