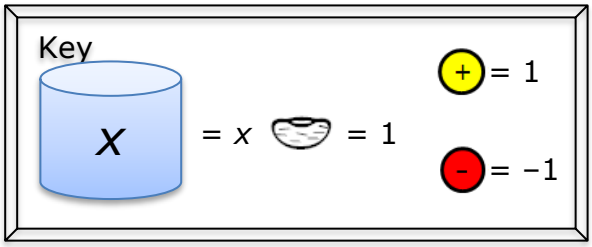
Name_____ Date _____

Modeling, Solving & Representing Solutions on Number Lines

Independent Practice

Directions: For each problem situation below, write an equation you can use to solve the problem. Use cups and counters to solve the equation. Represent the solution on a number line and use substitution to verify your solution.



1. Josh is thinking of a number. Five more than twice his number equals 17. What number is Josh thinking of?

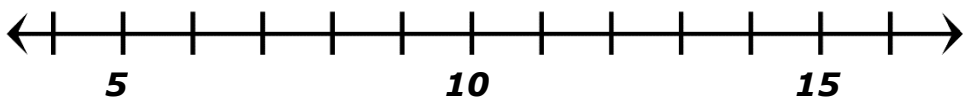
a) Write the equation.

b) Solve the equation using cups and counters. Sketch each step.

Model	Symbols

Name_____ Date _____

c) Represent the solution on a number line.



d) Use substitution to determine whether 4, 6, or 8 are solutions to the equation.

Name_____ Date _____

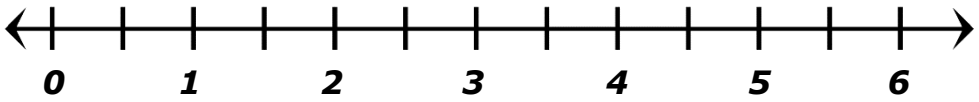
2. A rectangle has a length of 8 meters and a perimeter of 20 meters. What is the width, x, of the rectangle?

a) Write the equation.

b) Solve the equation using cups and counters. Sketch each step.

Model	Symbols

c) Represent the solution on a number line.



d) Use substitution to determine whether 2, 4, or 6 are solutions to the equation.

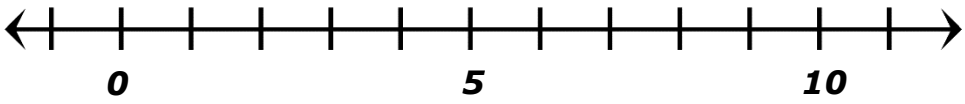
3. Maria's age is 4 years less than three times Jackson's age. Maria is 23 years old. How old is Jackson?

a) Write the equation.

b) Solve the equation using cups and two-color counters. Sketch each step.

Model	Symbols

c) Represent the solution on a number line.



d) Use substitution to determine whether 6, 9, or 12 are solutions to the equation.

Name_____ Date _____

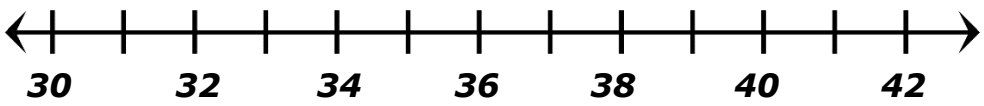
4. Amanda and two friends each earned the same amount of money from their combined garage sale. After Amanda spent $2 out of her earnings she had $12 left. How much money, x, did the combined garage sale earn?

a) Write the equation.

b) Solve the equation using cups and counters. Sketch each step.

Model	Symbols

c) Represent the solution on a number line.



d) Use substitution to determine whether 39, 42, or 45 are solutions to the equation.

Debriefing Questions

1. How did you use the model to represent each expression?

2. For equations with a sum or difference, how did you determine the value of x?

3. For equations with a product, how did you determine the value of x?

4. For equations with a quotient, how did you determine the value of x?

SOLVING TWO-STEP EQUATIONS

7.11A
7.10B

The student is expected to model and solve one-variable, two-step equations and inequalities.

The student is expected to represent solutions for one-variable, two-step equations and inequalities on number lines.

TELL ME MORE...

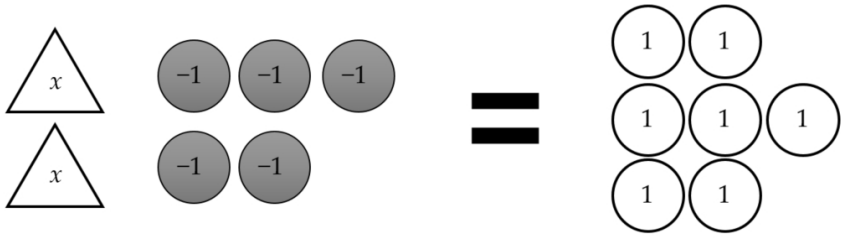
An **equation** is a relationship between two equivalent expressions. An equal sign (=) is used to indicate that the expression on the left has the same value as the expression on the right. If the expressions contain one variable, you can use the properties of algebra to solve the equation for the value of the variable.

Useful Properties of Algebra

Additive Inverse:	$a + (-a) = 0$
Multiplicative Inverse:	$a \div a = 1$
	$a \times \frac{1}{a} = 1$
Combine Like Terms:	$ax + bx = (a + b)x$
Distributive Property:	$a(b + c) = ab + ac$

Note: a, b, c, and x represent real numbers.

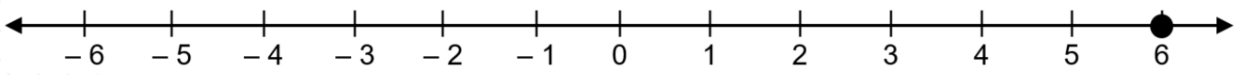
You can solve an equation using one of many different strategies. One strategy is to use models to represent the equation. Then, you can use the properties of algebra to manipulate the model until you determine the value of the object that represents the variable. For example, you can use models to represent the equation $2x - 5 = 7$. In this model, a triangle represents the variable, x, and a circle represents the unit constant, 1. Shaded triangles or circles indicate a negative value.



If the equation is presented or can be written symbolically, then you can use the properties of algebra to manipulate the constants and variable so that you can solve for the value of the variable. The solution to this equation is $x = 6$.

A number line is a line representing the set of all real numbers. The numbers are marked off in intervals.

The solution to the equation $2x - 5 = 7$ is represented on the number line below.



EXAMPLES

EXAMPLE 1: What value of x makes the equation $-3x + 4 = 13$ true?

$$-3x + 4 = 13$$

STEP 1 Isolate x on one side of the equal sign and a real number on the other.

$$-3x + 4 - 4 = 13 - 4$$

$$-3x = 9$$

- Use inverse operations to manipulate both sides of the equation.
- Apply the additive inverse to subtract 4 from both sides of the equation.

$-3x = 9$

STEP 2 Apply the multiplicative inverse.

$$-3x = 9$$

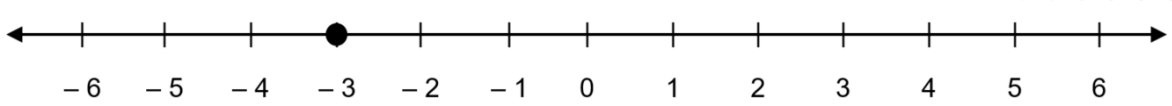
$$\frac{-3x}{-3} = \frac{9}{-3}$$

$$x = -3$$

- The variable, x, is being multiplied by -3.
- The inverse of multiplication is division, so divide both sides of the equation by -3.

$x = -3$

STEP 3 Represent the solution on a number line.



EXAMPLE 2: The measures of the three interior angles of a triangle are $(4x + 3)°$, $(6x - 5)°$, and $62°$. What is the value of x?

STEP 1 Write an equation relating the angle measures.

- The measures of the three interior angles of a triangle have a sum of 180°.
- Write an equation showing that the sum of the measures of the interior angles equals 180.

$(4x + 3) + (6x - 5) + (62) = 180$

STEP 2 Apply the associative property to combine like terms to simplify the equation.

- $4x + 3 + 6x - 5 + 62 = 180$
- $(4x + 6x) + (3 - 5 + 62) = 180$
- $10x + 60 = 180$

$10x + 60 = 180$

STEP 3 Apply the additive inverse to subtract 60 from both sides of the equation.

$$10x + 60 = 180$$

$$\underline{-60 \quad -60}$$

$$10x = 120$$

$10x = 120$

YOU TRY IT!

Fill in the missing blanks to solve for x.

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

$$\frac{x}{5} + 4 - \_\_\_\_ = -3 - \_\_\_\_$$

$$\frac{x}{5} = -7$$

$$\frac{x}{5} \bullet \_\_\_\_ = -7 \bullet \_\_\_\_$$

$$x = \_\_\_\_$$

STEP 4 Apply the multiplicative inverse to divide both sides of the equation by 10.

$$\frac{10x}{10} = \frac{120}{10}$$

$$10x = 12$$

***x* = 12**

STEP 5 Check the solution by substituting **12** for x in the original equation (Step 1) and simplify.

$4x + 3 + 6x - 5 + 62 = 180$

$4(\mathbf{12}) + 3 + 6(\mathbf{12}) - 5 + 62 = 180$

$48 + 3 + 72 - 5 + 62 = 180$

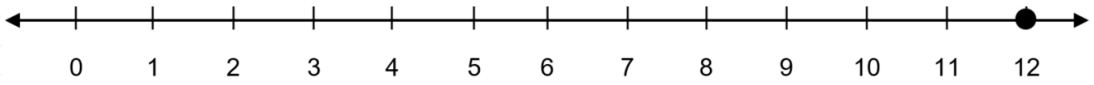
$51 + 72 - 5 + 62 = 180$

$123 - 5 + 62 = 180$

$118 + 62 = 180$

$180 = 180$

STEP 6 The solution is represented on the number line below.



EXAMPLE 3: Lisa has $125.00 on a gift card from *Coffee Hut*. Each morning she stops at *Coffee Hut* and purchases a medium cup of coffee. The medium cup of coffee costs $2.75 with tax. After many mornings, her card shows a balance of $111.25. How many medium cups of coffee has Lisa purchased? Record your answer and fill in the bubbles. Be sure to use the correct place value?

STEP 1 Write an equation to represent the situation. Let x represents number of medium cups of coffee.

$125 - 2.75x = 111.25$

STEP 2 Apply the additive inverse to subtract 125 from both sides of the equation.

$$125 - 2.75x = 111.25$$

$$\underline{-125 \qquad -125}$$

$$-2.75x = -13.75$$

$-2.75x = -13.75$

STEP 3 Apply the multiplicative inverse to divide both sides of the equation by – 2.75.

$$-2.75x = -13.75$$

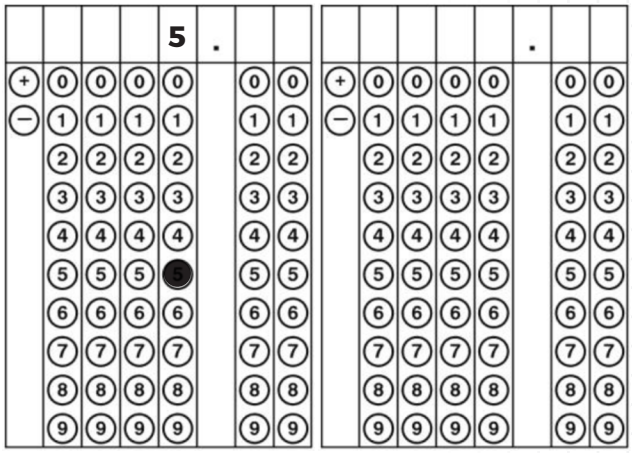
$$\frac{-2.75x}{-2.75} = \frac{-13.75}{-2.75}$$

$$x = 5$$

***x* = 5**

STEP 4 Since the question is a gridded response question, enter your response on the grid provided. Practice using the grid with the instructions.

1. Record a 5 in the ones column. Ignore the sign since the answer is a positive number.
2. Bubble **5** beneath the numeral 5.
3. It is not necessary to bubble extraneous zeroes.



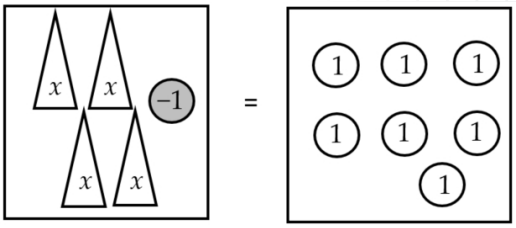
PRACTICE

For questions 1-3, determine the value of x that makes the equation true.

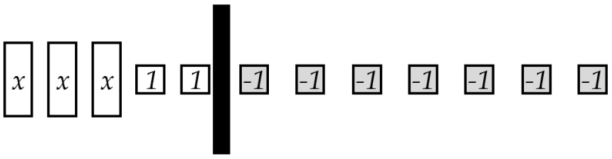
1. $5x - 7 = 23$

2. $\frac{x}{7} - 3 = -12$

3.

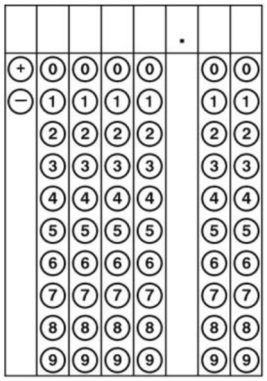


4. The equation $3x + 2 = -7$ is modeled below.



What value of x makes the equation true?

Record your answer and fill in the bubbles. Be sure to use the correct place value.



5. One angle in a triangle measures $(2x - 10)°$. A second angle measures $(100 - 3x)°$. If the third angle measures 115°, what is the value of x?

6. Lola wants to purchase several light bulbs and a lamp at a hardware store. The lamp cost $35, light bulbs cost $1.50 each, and she wants to spend exactly $50 before tax. How many light bulbs, x, can Lola purchase?

7. For any triangle, the sum of the measure of the three angles equals 180°. If two of the angles have the same measure, a, and the third angle measures 45°, what is the measure of a?

8. What value of x makes this equation true?

$$-2.5x + 8 = 1.25$$

A -2.7

B 2.7

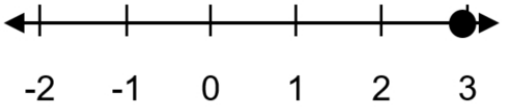
C 3.7

D -3.7

9. Which number line shows the solution to the equation below?

$$\frac{2}{3}x - \frac{1}{2} = -\frac{5}{2}$$

F



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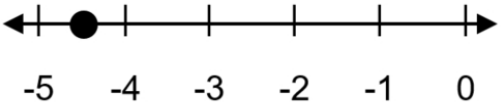

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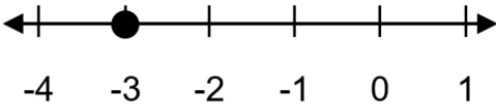

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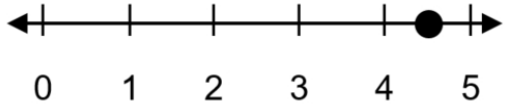


10. The model represents the equation.

$$4x - 3 = 5$$

What value of x makes the equation true?

A 2

B $\frac{1}{2}$

C -2

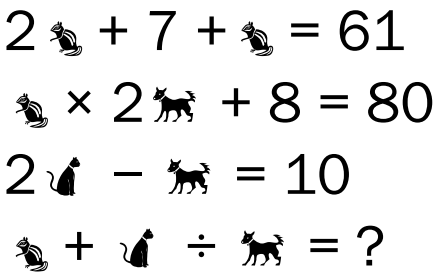
D $-\frac{1}{2}$

Name _____ Date _____

Performance Task: 7.11A

Equations and Inequalities: Marla's Picture Puzzle

Marla saw a math picture puzzle posted on her social media feed. She noticed that many people solved the puzzle and got different answers. After she solved the puzzle, she decided to create one of her own and do a survey with her friends to see how many of her friends could get the correct answer. Her puzzle is shown below.



- What is the value of each animal in Marla's puzzle?
- What answer does Marla expect from her friends?

Justify your reasoning.

Procedural	0	1	2
Conceptual	0	1	2
Communication	0	1	2

Total points:_____

Name _____ Date _____

Performance Task: 7.11A

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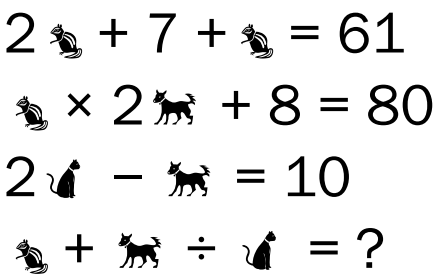

1. Using a variable letter to represent a squirrel, what equation can be used to solve the first line of the puzzle?

2. What is the value of a squirrel in the puzzle?

3. Using a variable letter to represent a dog, what equation can be used to solve the second line of the puzzle?

4. What is the value of a dog in the puzzle?

5. Using a variable letter to represent a cat, what equation can be used to solve the third line of the puzzle?

6. What is the value of a cat in the puzzle?

7. What is the answer to the last line of the puzzle based on the values for each animal?

Name _____ Date _____

Performance Task: 7.11A

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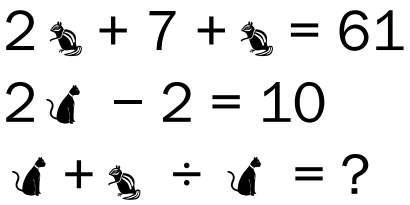

- What is the value of each animal in Marla's puzzle?
- What answer does Marla expect from her friends?

Justify your reasoning.

Procedural	0	1	2
Conceptual	0	1	2
Communication	0	1	2

Total points:_____

Name _____ Date _____

Performance Task: 7.11A

Equations and Inequalities: Marla's Picture Puzzle

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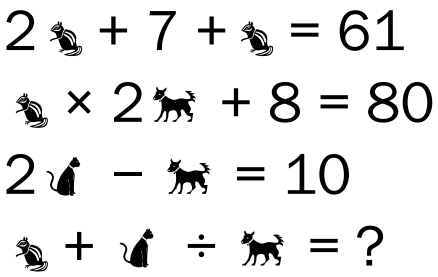

- What is the value of each animal in Marla's puzzle?
- What answer does Marla expect from her friends?
- What mistakes were made if some of the answers Marla got for the last line of the puzzle were 12 and 22.5?

Justify your reasoning.

Procedural	0	1	2
Conceptual	0	1	2
Communication	0	1	2

Total points:_____