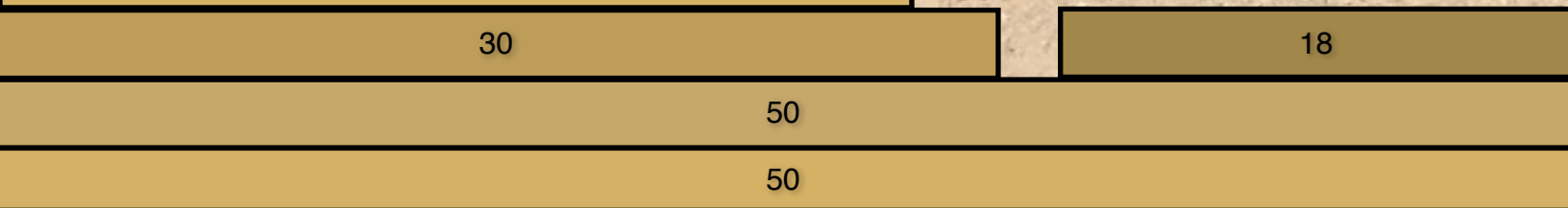
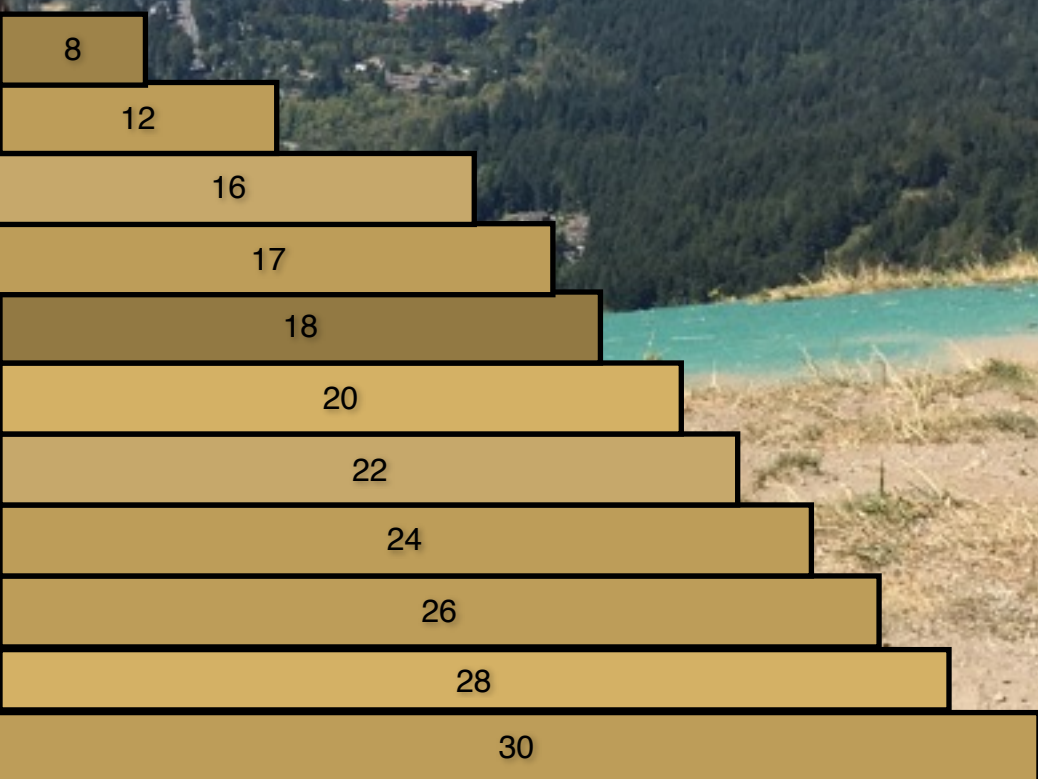
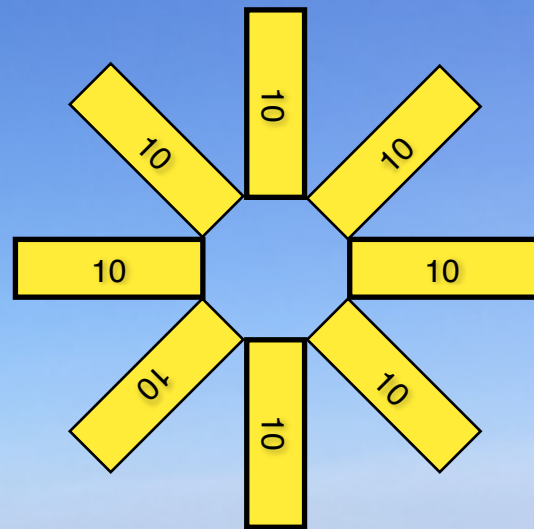


# Bar Modeling: Adventures in Algebra



A Carleton College Comps Project  
Department of Mathematics and Statistics  
Fall/Winter 2016-2017

Thank you to our advisor, Deanna Haunsperger  
and to Dan Meyers and his students at Northfield Middle School

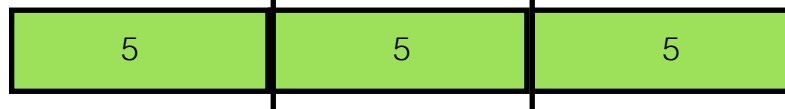
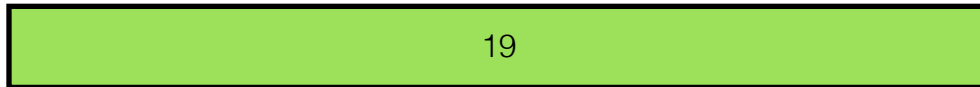
## Table of Contents

Introduction.....	3
Bar Modeling Tutorials.....	5
Equality.....	6
Variables.....	7
Addition.....	9
Subtraction.....	12
Multiplication.....	15
Division.....	17
Simplifying.....	22
Solving a Word Problem.....	25
Algebra Concepts.....	28
Associative Property.....	29
Commutative Property.....	31
Distributive Property.....	34
Problems.....	38
Level 1 (One Step Equations).....	39
Level 2 (Two Step Equations).....	58
Level 3 (Equations Requiring Simplifying).....	80
Level 4 (Equations with Variables on Both Sides of Equality).....	98
Solutions.....	112
Addition.....	113
Subtraction.....	115
Multiplication.....	117
Division.....	118
Simplifying.....	121
Distributive Property.....	123
Level 1.....	126
Level 2.....	143
Level 3.....	164
Level 4.....	179

Hi there! We're so excited that you're starting our workbook, "Bar Modeling: Adventures in Algebra".

*So what is bar modeling?* Bar modeling is a way of drawing pictures to help solve math problems. The best way to explain is through an example. This example might not make sense right now, but soon you'll have the tools to solve problems this way too!

Question: Leon bought three boxes of pizza rolls and a \$4 carton of juice. In total he spent \$19. How much does one box of pizza rolls cost?



So  $p = \$5$ !

Bar modeling helps you see the rules of algebra in action!

This workbook will begin with some concepts you might have already seen, but this time you'll learn how to model them with bars.

Now it's time to get started!



Scan here for a video introduction!

### How to use this workbook:

- This book starts with **tutorials** to help you learn all the tools you will need to solve problems using bar modeling!
- Before you start on the problems, read all of the tutorials and do the **practice problems**. There are **answers to the practice problems** in the back of the book. It may be more fun to read the tutorials with a partner!
- After you have done all of the tutorials, you are ready to start the **problems!**
- They may be tricky or confusing at first, but there are examples of solutions throughout the book and **answers in the back of the book.**

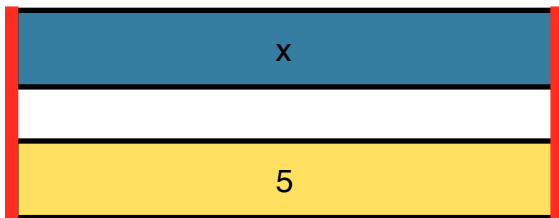
# Bar Modeling Tutorials

## How do we show values are equal?

Imagine that you have been told that  $x = 5$ . How could we show this information with blocks?



In the above model the equals sign shows that the two blocks are equal. However, it's hard to really see they are equal. What if instead we use the *length* of the blocks to show equality?



Now we can see that these two blocks are the exact same length! This indicates that in this example  $x$  and  $5$  are equal.

## Units

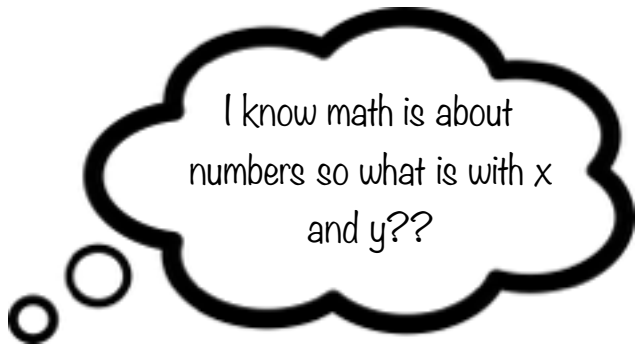
If both  $x$  and  $5$  are counting the same thing, say the number of cows, then this equality makes sense. But what if  $x$  is counting cows and  $5$  is counting shoes?



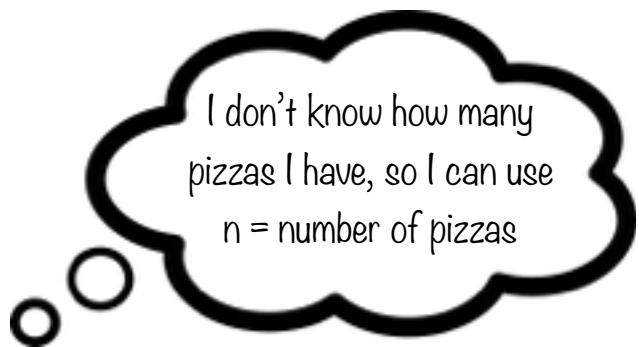
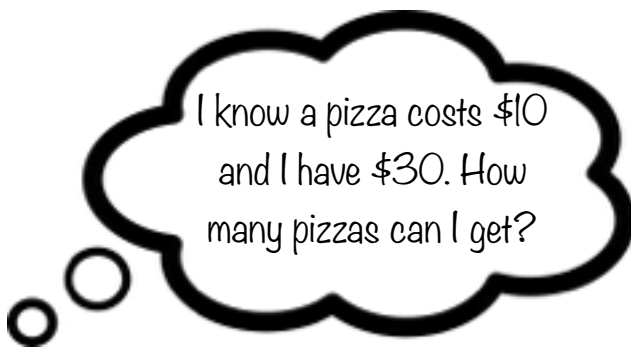
5 cows aren't the same as 5 shoes!

Make sure that when you show equality, you are always comparing the same type of things. Both bars need to have the same **units**.

## What's a Variable?



In algebra, we use letters, like x and y, as **variables** to represent numbers that we don't know the value of yet. They are just like numbers, we just don't know what they mean until we solve for them! This is what algebra is all about!

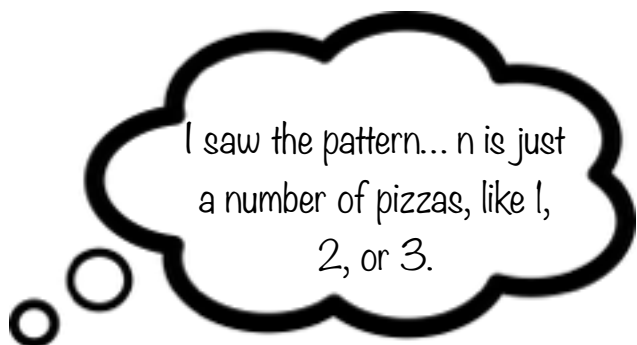


In this case, since we don't know how many pizzas you can get, we can use the variable  $n = \text{number of pizzas}$  to represent this number we don't know yet.

How much does my pizza order cost?

Number of Pizzas	Cost (in dollars)
1	$1 \times 10 = 10$
2	$2 \times 10 = 20$
$n$	$n \times 10 = 10n$

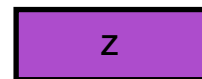
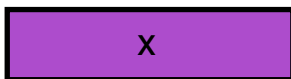




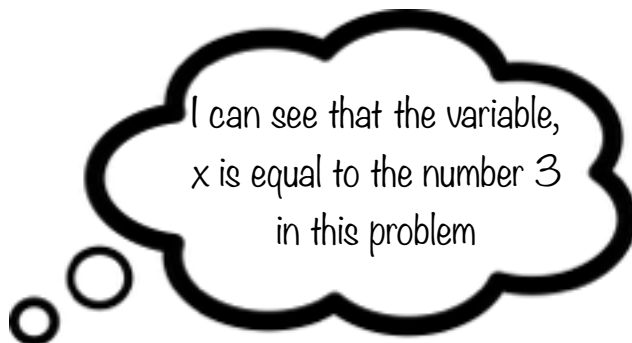
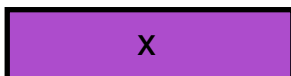
**Variables can take on many values.** Like  $l$  can replace  $n$  with 1, 2, or 3 to represent different sized pizza orders.

We use variables in bar modeling in the same way, to represent a number. Then we can use bar modeling to figure out the value of the variable!

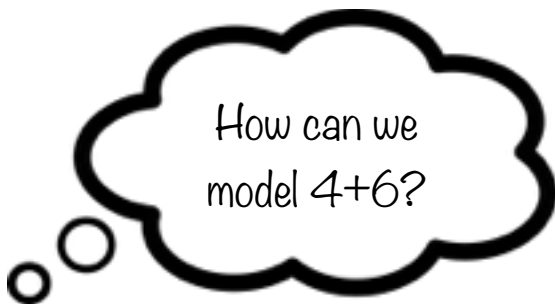
Since a variable is just standing in for a number we don't know, we use bars to show variables the same way we use bars to show numbers, like this:



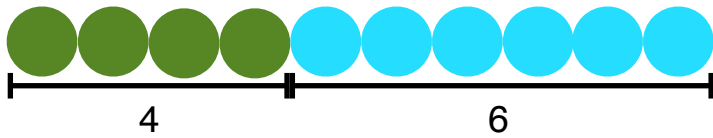
It is a good idea to make your number and variable blocks different colors to keep track of what you know and what you want to find out!



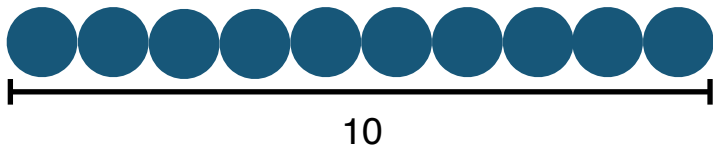
# Addition



$$4 + 6$$




When we add 4 circles and 6 circles...

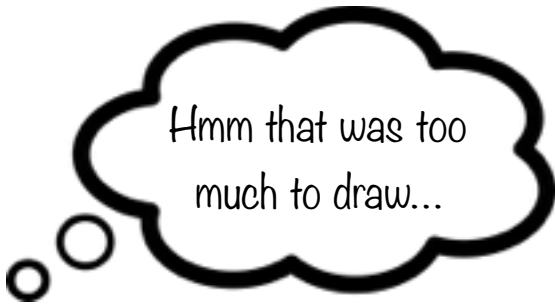


... that's 10 circles!

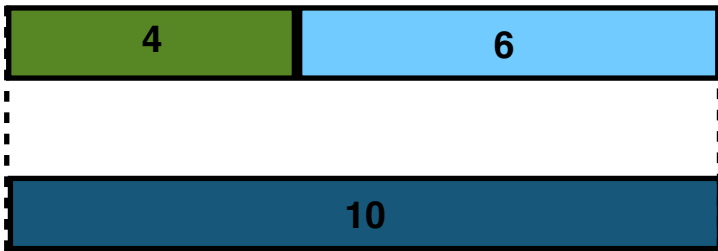
**Circles next to each other show addition.**

Practice: Model using circles

$3 + 5$ 	$1 + 2$
$7 + 9$	$28 + 5$



$$4 + 6$$

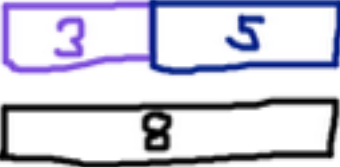


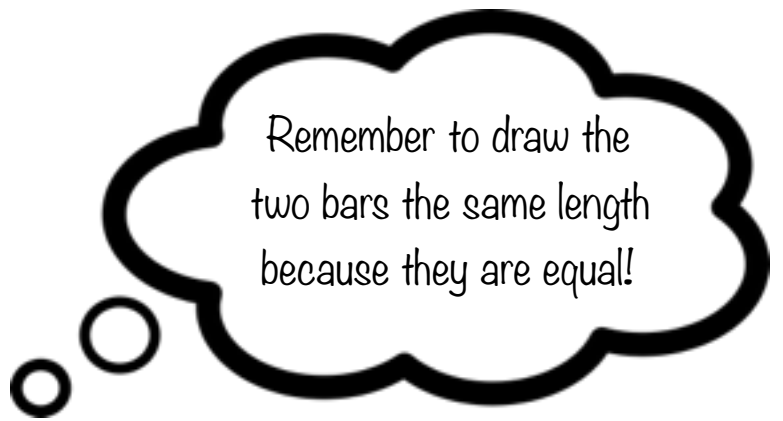
When we draw a 4 block next to a 6 block


That's the same as one 10 block

**Blocks next to each other show addition.**

Practice: Model using blocks

<p style="text-align: center;"><math>3 + 5</math></p> 	<p style="text-align: center;"><math>1 + 2</math></p>
<p style="text-align: center;"><math>7 + 9</math></p>	<p style="text-align: center;"><math>28 + 5</math></p>



$100 + 50$	$1 + 2 + 3 + 4$
$10 + 5$	$10 + 10$
$x + 10$ 	$y + z + 10$
$a + a + 5$	$b + 1 + 2$

# Subtraction

$$8 - 3$$



We start with 8 circles



Then we take away 3



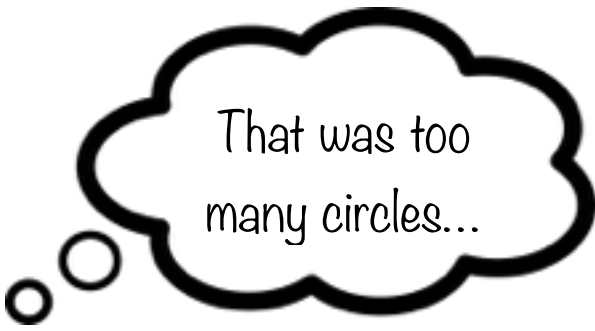
And we are left with 5 circles

Note: Always remove the farthest right circle!



Practice: Model using circles

<p style="text-align: center;"><math>7 - 4</math></p>	<p style="text-align: center;"><math>9 - 2</math></p>
<p style="text-align: center;"><math>13 - 7</math></p>	<p style="text-align: center;"><math>25 - 17</math></p>



$$8 - 3$$



We start with an 8 block



Then we draw a subtract 3 block



And we are left with a 5 block

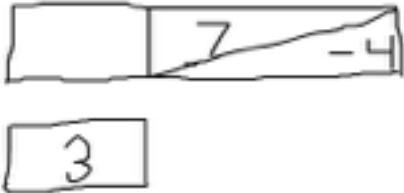

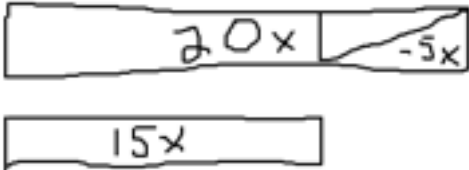
Note: Always line up the right side of a subtraction block with the right side of a regular block



Scan here for tutorial video!

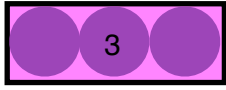
I helped you get started, now  
you finish the problem!

Practice: Model using bars

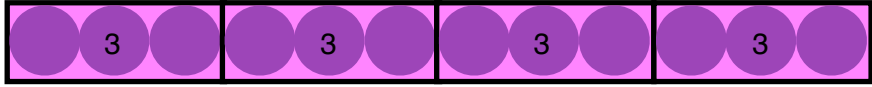
$7 - 4$ 	$9 - 2$ 
$13 - 7$	$25 - 17$
$18 - 2$	$20x - 5x$ 
$8y - 4y$	$30a - 10a$

# Multiplication

$3 \times 4$



← We start with a 3 bar



← Then repeat it 4 times



← I can see that's 12

$2 \times 3$



← We start with a 2 bar



← Then repeat it 3 times



← I can see combined that's 6

$5y$



← We start with a y bar

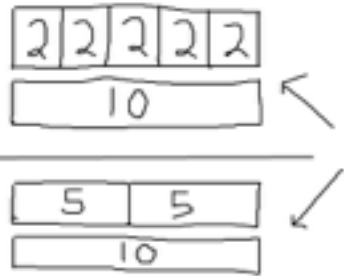


← Then repeat it 5 times and combine to show  $5y$





Practice: Model using bars

<p style="text-align: center;"><math>2 \times 5</math></p>  <p style="text-align: center;">Either way works!</p>	<p style="text-align: center;"><math>8 \times 6</math></p>
<p style="text-align: center;"><math>7 \times 3</math></p>	<p style="text-align: center;"><math>4 \times 9</math></p>
<p style="text-align: center;"><math>29 \times 3</math></p>	<p style="text-align: center;"><math>45 \times 6</math></p>
<p style="text-align: center;"><math>7y</math></p>	<p style="text-align: center;"><math>3z</math></p>

# Division

$$6 \div 3$$

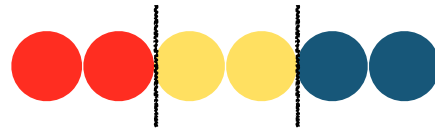
We start with 6 circles



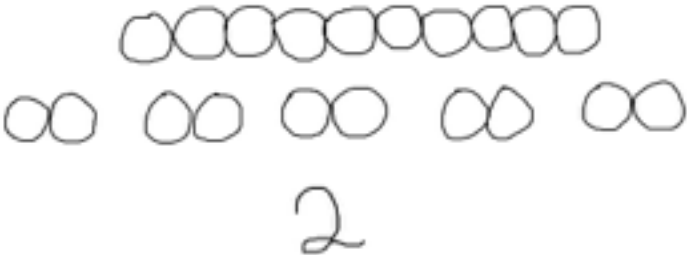
We divide them into 3 piles



There are two circles in each pile,  
so our answer is 2



Practice: Model using circles

$10 \div 5$  $2$	$8 \div 4$
$12 \div 4$	$12 \div 3$

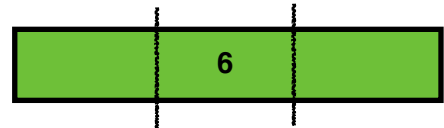
$$6 \div 3$$

We start with a 6 bar

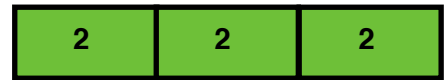


We divide the bar into 3 parts

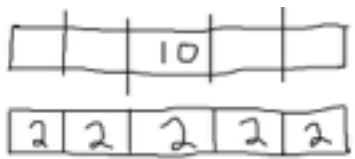
We figure out how big each section is



In this problem, each bar is of size 2. So our answer is 2!



Practice: Model using bars

$10 \div 5$  $2$	$8 \div 4$
$12 \div 4$	$12 \div 3$

$24 \div 6$

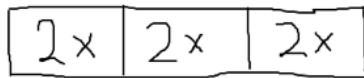
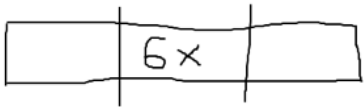
$20 \div 5$

$40 \div 10$

$100 \div 4$

$6x \div 3$

$15y \div 5$



$2x$

$100a \div 10$

$20x \div 2$

## Another Way of Viewing Division!

$$10 \div 2 = ?$$



What is 10 divided by 2?

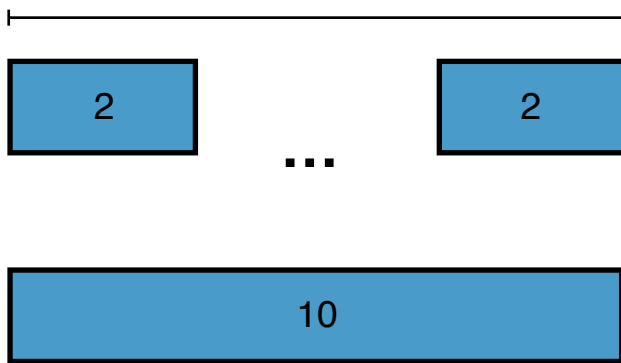
$$2 \times ? = 10$$



How many 2's do we add to have 10?

These two equations are asking the same question!

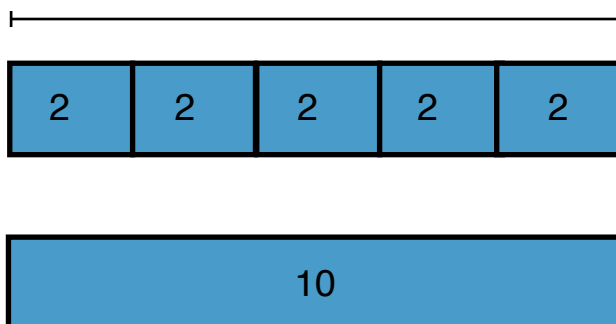
?



Let's model  $2 \times ? = 10$

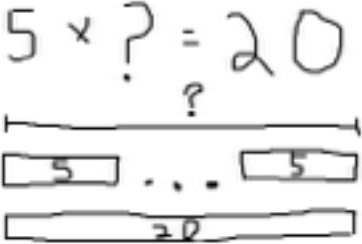
We use ... to show that we are adding up an unknown number of 2 blocks

5



Ahhh the ? is 5!  
It takes five 2 blocks to make 10.

Practice: Model using bars

<p><math>20 \div 5</math></p> <p><math>5 \times ? = 20</math></p> <p>?</p>  <p>4</p>	<p><math>8 \div 4</math></p>
<p><math>12 \div 4</math></p>	<p><math>12 \div 3</math></p>
<p><math>40 \div 10</math></p>	<p><math>100 \div 4</math></p>

## Simplifying with Bars

We now know how to add, subtract, multiply, and divide using bar modeling! And we know what variables are and how to show equality with bar modeling.

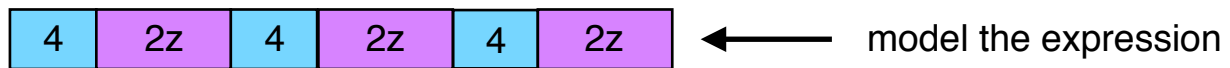
Now it's time to . . .

put it all together!!



## Combining Like Terms

**Example 1:** Simplify  $3(4+2z)$



**Example 2:** Simplify  $2(5+3x)+4+x$



Practice: Simplify using modeling and combining like terms

<p style="text-align: center;"><math>4 + 2z + 3z + 1</math></p> <table border="1" style="margin: 5px auto; width: 80%; text-align: center;"> <tr> <td style="width: 20%;">4</td> <td style="width: 20%;">2z</td> <td style="width: 20%;">3z</td> <td style="width: 20%;">1</td> </tr> </table> <table border="1" style="margin: 5px auto; width: 80%; text-align: center;"> <tr> <td style="width: 20%;">2z</td> <td style="width: 20%;">3z</td> <td style="width: 20%;">4</td> <td style="width: 20%;">1</td> </tr> </table> <table border="1" style="margin: 5px auto; width: 80%; text-align: center;"> <tr> <td style="width: 60%;">5z</td> <td style="width: 20%;">5</td> </tr> </table>	4	2z	3z	1	2z	3z	4	1	5z	5	<p style="text-align: center;"><math>x + x + 2 + x + 2</math></p> <table border="1" style="margin: 5px auto; width: 80%; text-align: center;"> <tr> <td style="width: 20%;">x</td> <td style="width: 20%;">x</td> <td style="width: 20%;">2</td> <td style="width: 20%;">x</td> <td style="width: 20%;">2</td> </tr> </table>	x	x	2	x	2
4	2z	3z	1													
2z	3z	4	1													
5z	5															
x	x	2	x	2												

$2(x + 3) + 4 + x$ <table border="1" data-bbox="272 262 690 325"> <tr> <td>x</td><td>3</td><td>x</td><td>3</td><td>4</td><td>x</td> </tr> </table>	x	3	x	3	4	x	$4(a + 1) + 2a$ <table border="1" data-bbox="828 262 1312 325"> <tr> <td>a</td><td>1</td><td>a</td><td>1</td><td>a</td><td>1</td><td>a</td><td>1</td><td>2a</td> </tr> </table>	a	1	a	1	a	1	a	1	2a
x	3	x	3	4	x											
a	1	a	1	a	1	a	1	2a								
$2a + a + 3 + 2a$ <table border="1" data-bbox="289 655 738 865"> <tr> <td>2a</td><td>a</td><td>3</td><td>2a</td> </tr> <tr> <td>2a</td><td>a</td><td>2a</td><td>3</td> </tr> <tr> <td colspan="3">5a</td><td>3</td> </tr> </table>	2a	a	3	2a	2a	a	2a	3	5a			3	$2x + 2(x + 3)$			
2a	a	3	2a													
2a	a	2a	3													
5a			3													
$2 + 4b + 1 + b$	$4(2b + 2) + b$															
$3a + b + 2 + a + 2b$	$x + z + 2y + 2z + y$															



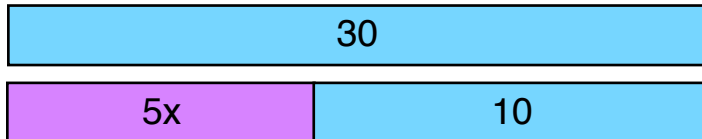
## Modeling Equations with Equality

When you're given any equation to solve, you first want to **model** the entire equation.

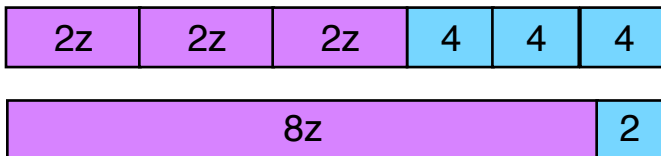
You'll build **two** bars made up of blocks: one bar for each side of the equals sign.

After drawing your model, you want to **check** (✓) to make sure your bars are **equal (=)** in size.

**Modeling Example 1:**  $30=5x+10$



**Modeling Example 2:**  $8z+2=3(4+2z)$



**Practice:** Now it's your turn to practice this first step. Model the equation, and then check that your two bars are equal in size.

<p style="text-align: center;"><math>4y = y + 12</math></p> <p>Check: Are your two bars equal in size? ✓</p>	<p style="text-align: center;"><math>20 = 2(q+5)</math></p> <p>Check: Are your two bars equal in size? ____</p>
<p style="text-align: center;"><math>a = 2(10)+7</math></p> <p>Check: Are your two bars equal in size? ____</p>	<p style="text-align: center;"><math>4(a+4) = 8(a+1)</math></p> <p>Check: Are your two bars equal in size? ____</p>

## Word Problems

Let's move onto another type of problem: a problem with lots of words and numbers. You may not know where to start, and that's okay. Modeling can help you!

Suppose you are given the following word problem:

Zoe and Meg really like basketball. Meg has 8 basketballs, and Zoe has 5 basketballs. How many basketballs do they have total?



We want to solve this problem by modeling it. Let's see how someone might think about this problem.

1)

First I need to read the whole problem. Do I understand all parts of the problem?

2)

What am I asked to find?  
I am asked to find the number of basketballs they have total. Let's define a variable.

Workspace

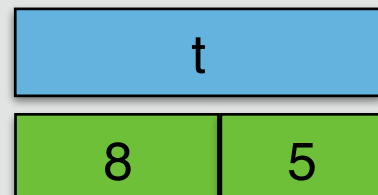
$t$  = total number of basketballs

3)

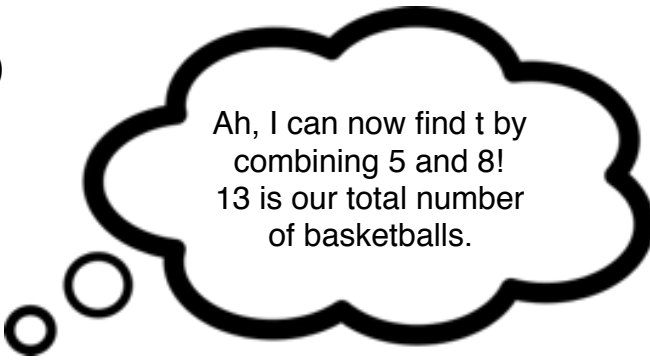
I don't know what  $t$  is, but I do know Zoe's basketballs added to Meg's basketballs equals  $t$ .

Workspace

$t$  = total number of basketballs



4)

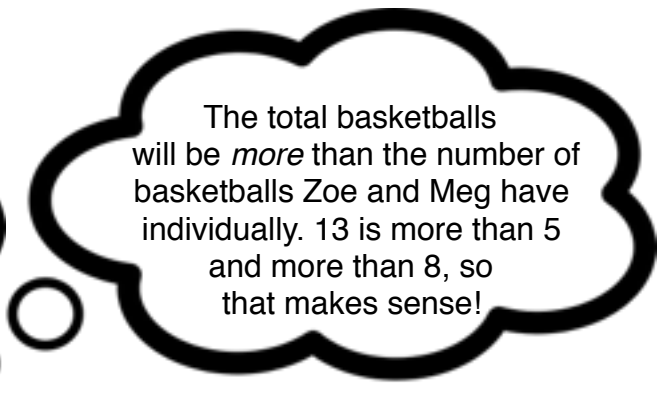
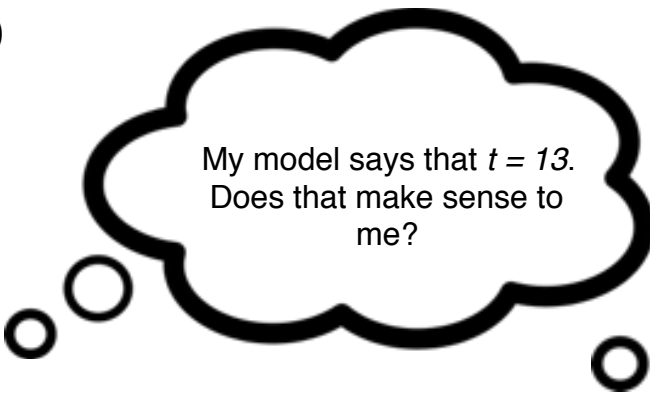


Workspace

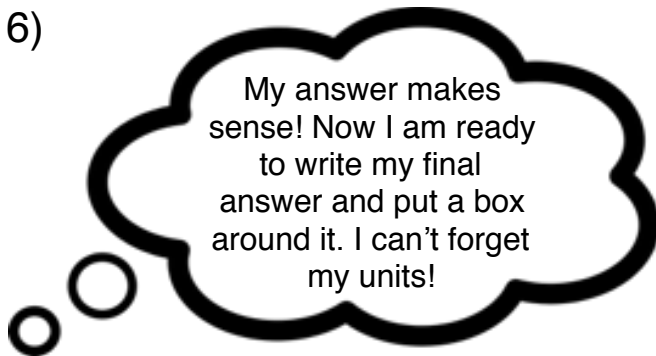
$t$  = total number of basketballs

$t$
13

5)



6)



Workspace

$t$  = total number of basketballs

$t$
13
13 Basketballs

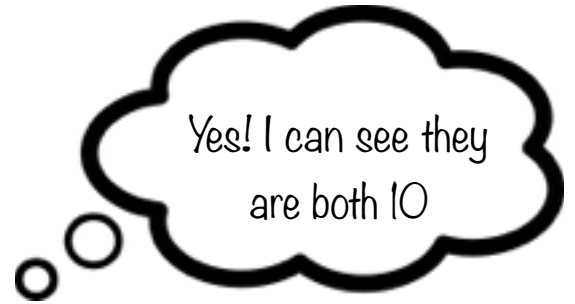
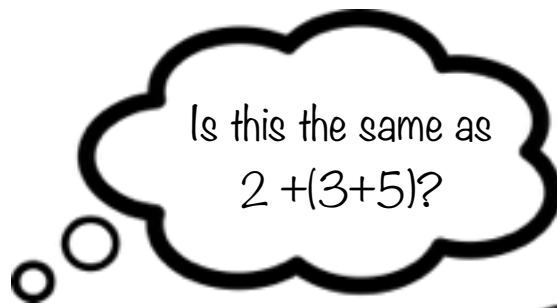
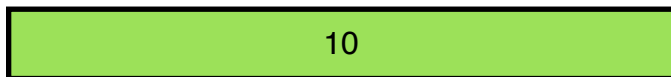
## What steps did this student go through to solve this problem?

1. **Read** the entire problem and make sure you understand the situation.
2. **Define**: Decide what you're trying to find and define a variable.
3. **Draw** the model for the situation. You will need to decide what parts are equal.
4. **Solve**: Use the model and your tools of addition, subtraction, multiplication, and division to solve the problem.
5. **Check** if your answer makes sense. If it does not, go back and find your mistake.
6. **Write** and box your answer. Don't forget the units!

# Algebra Concepts

## The Associative Property

$$(2+3)+5$$



It doesn't matter where the parentheses are, the sum of the numbers is the same.  $(2+3)+5 = 2+(3+5) = 10$ .

This is called the **Associative Property** in Algebra. You might see it like this:

$$(a+b)+c = a+(b+c)$$

The Associative Property also works for multiplication, so

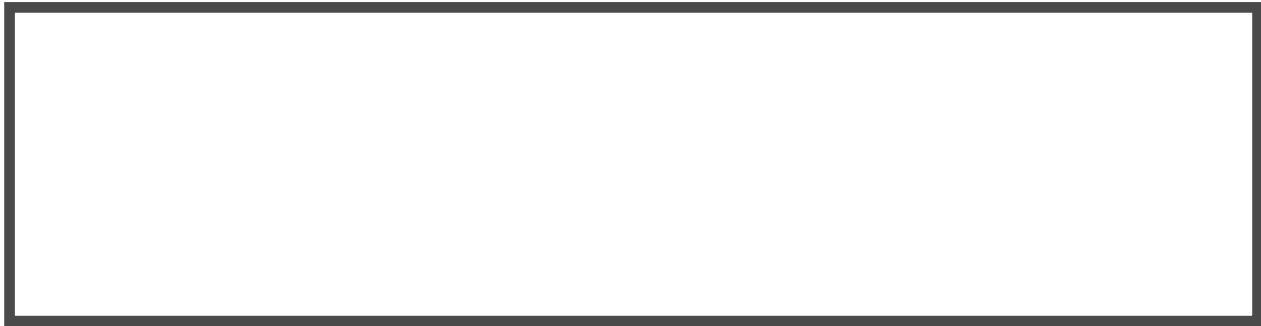
$$(axb)xc = ax(bxc)$$

Lets take a look at that together...

Model  $2 \times (1 \times 3)$  below:



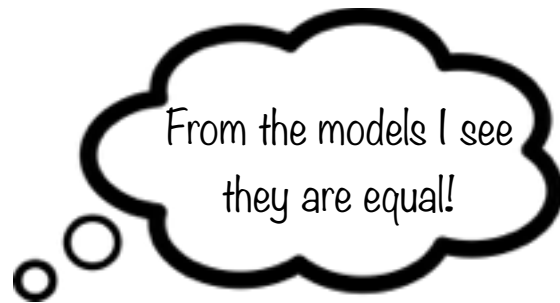
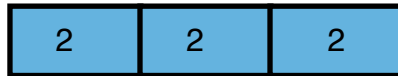
Now model  $(2 \times 1) \times 3$ :



$2 \times (1 \times 3)$ :



$(2 \times 1) \times 3$ :



## Commutative Property of Addition

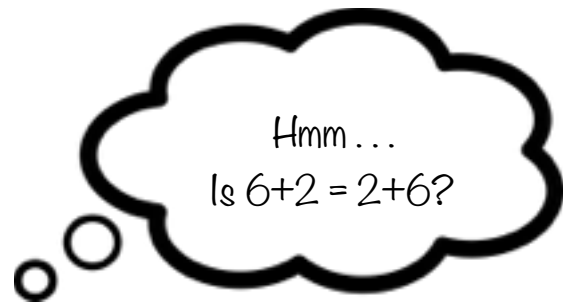
Let's model  $6+2$ .



Adding like terms together, we can see that the total is 8.



What if we modeled  $2+6$  instead?



Surprise! The total is again 8!



The models above demonstrate the **commutative property of addition**: the order in which numbers are added together does not change the sum! In other words:

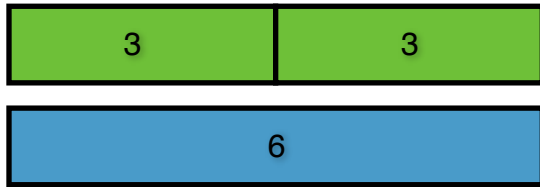
$$\mathbf{a + b = b + a.}$$

Model  $3+5$  and  $5+3$ , and show that you get the same result!

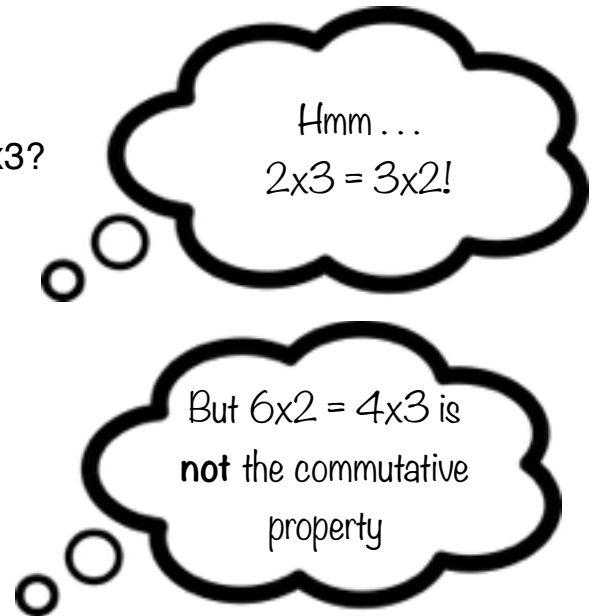


## Commutative Property of Multiplication

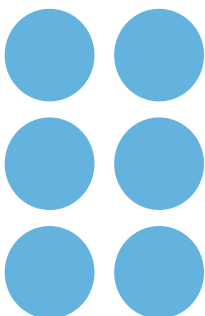
Let's consider the expression  $3 \times 2$ . As we saw in the multiplication section, this can be modeled as two groups of three:



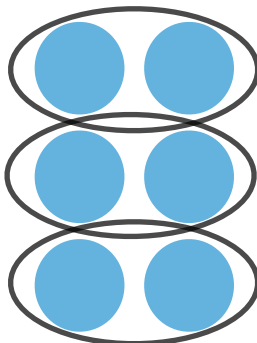
Now what if the expression was written as  $2 \times 3$ ?



The commutative property applies when you want to **change the order of the numbers** that you are multiplying. Check out the relationship:

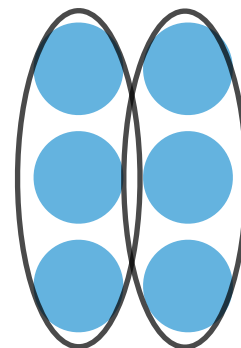


$$3 \times 2 = 2 \times 3$$



$$3 \times 2 =$$

Three groups  
of two




$$2 \times 3 =$$

Two groups  
of three

The models on the previous page demonstrate **the commutative property of multiplication**: the order in which numbers are multiplied does not change the product. In other words:

$$a \times$$

Model  $2 \times 4$ , using either circles or bars.

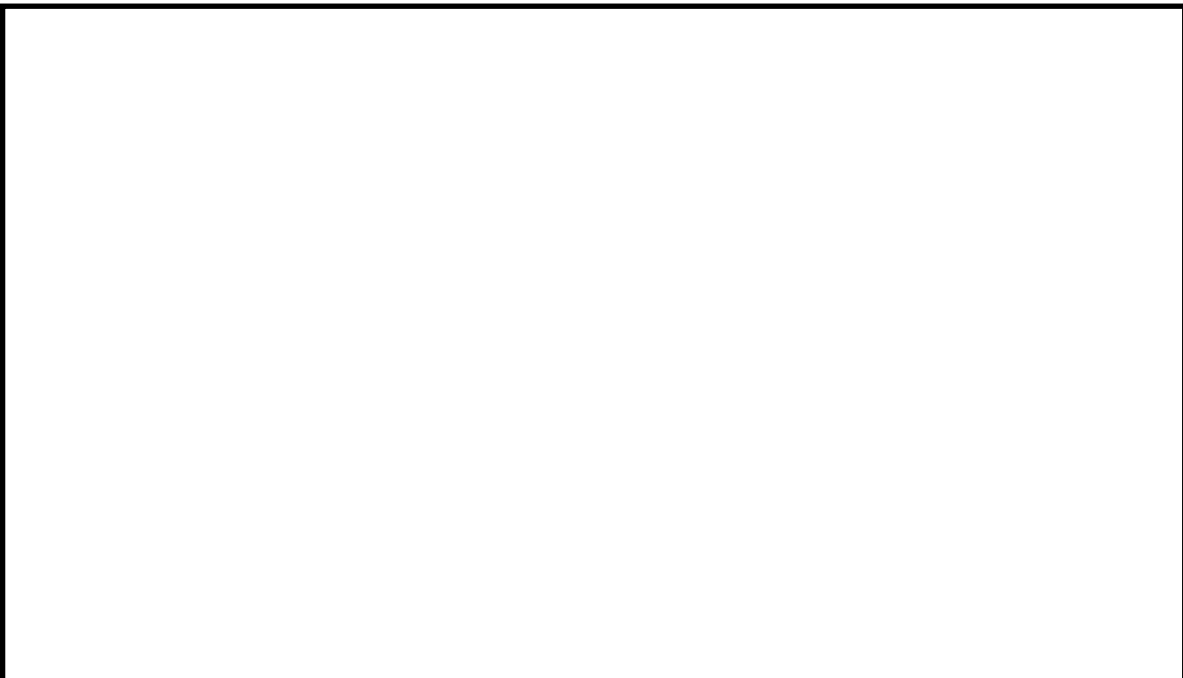


Now model  $4 \times 2$ , using either circles or bars.



Show that the models of  $2 \times 4$  and  $4 \times 2$  are related.

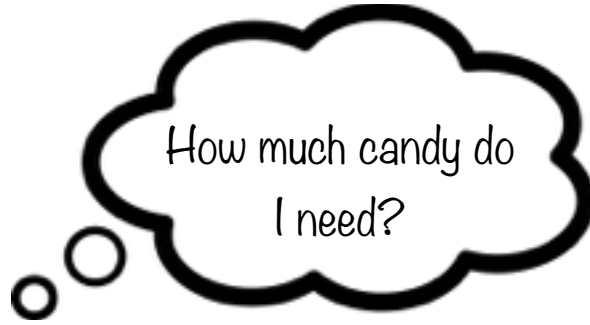
*Hint: you can use the strategies on the previous page!*



# The Distributive Property



I want to give this candy to each of my three friends



$$3(\text{candy items}) = ?$$

Let's start by drawing out all of the candy I need

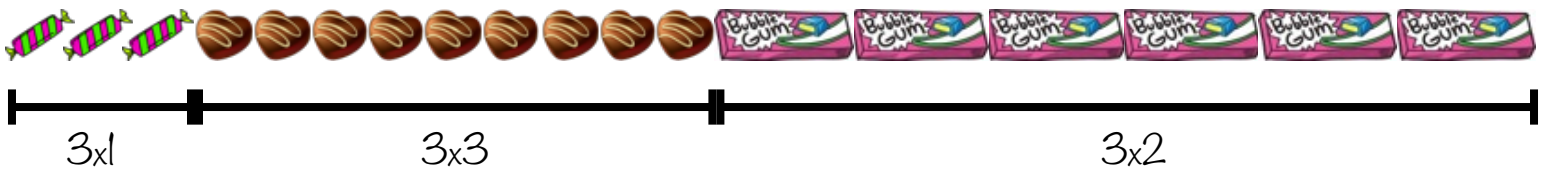


Now let's sort the candy by type



## The Distributive Property: Candy

$$3 \left( \text{candy} + \text{chocolate} + \text{chocolate} + \text{chocolate} + \text{Bubble Gum} + \text{Bubble Gum} \right) =$$



Okay! So I need:

$3 \times 1 = 3$  wrapped candies

$3 \times 3 = 9$  chocolates

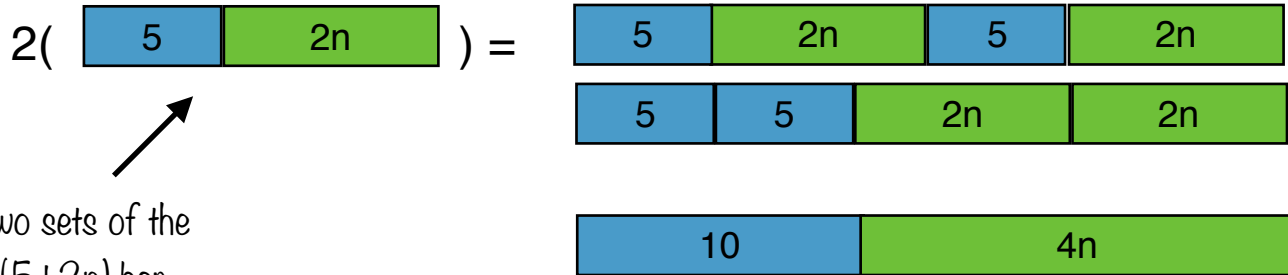
$3 \times 2 = 6$  packs of bubble gum

## The Distributive Property: Algebra

$$n (a + b + c) = n \times a + n \times b + n \times c$$

## The Long Way

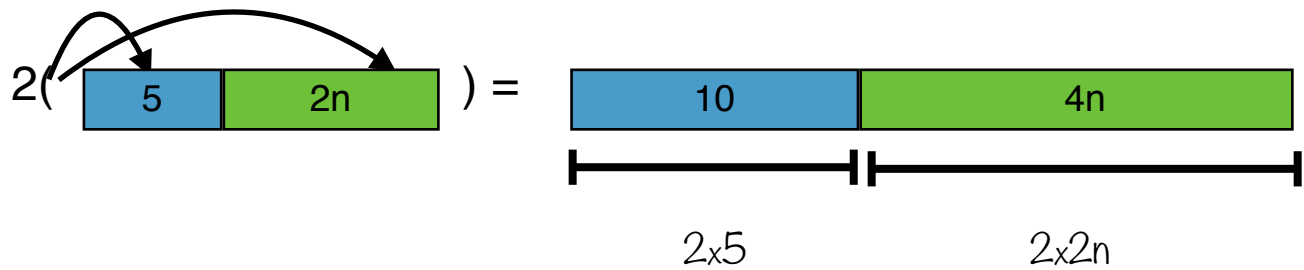
$$2(5+2n) = 10 + 4n$$



Two sets of the  
(5+2n) bar

## Using the Distributive Property Shortcut

$$2(5+2n) = 10 + 4n$$



Practice: Model The Long Way

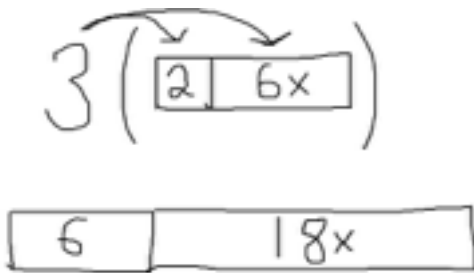
<p style="text-align: center;"><math>3(2+6x)</math></p> <p style="text-align: center;"><math>3(\boxed{2} \boxed{6x})</math></p> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 5px;"> <span>2</span> <span>6x</span> <span>2</span> <span>6x</span> <span>2</span> <span>6x</span> </div> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 5px; margin-top: 5px;"> <span>2</span> <span>2</span> <span>2</span> <span>6x</span> <span>6x</span> <span>6x</span> </div> <div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 5px; margin-top: 5px;"> <span>6</span> <span>18x</span> </div>	<p style="text-align: center;"><math>2(7+d)</math></p>
---	--

$$3(2+2d)$$

$$2(b+3)$$

Practice: Model using the Distributive Property

$$3(2+6x)$$

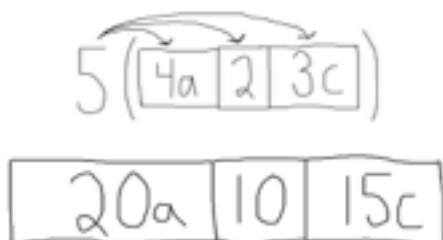


$$2(7+d)$$

$$5(4+3a)$$

$$6(4a+2)$$

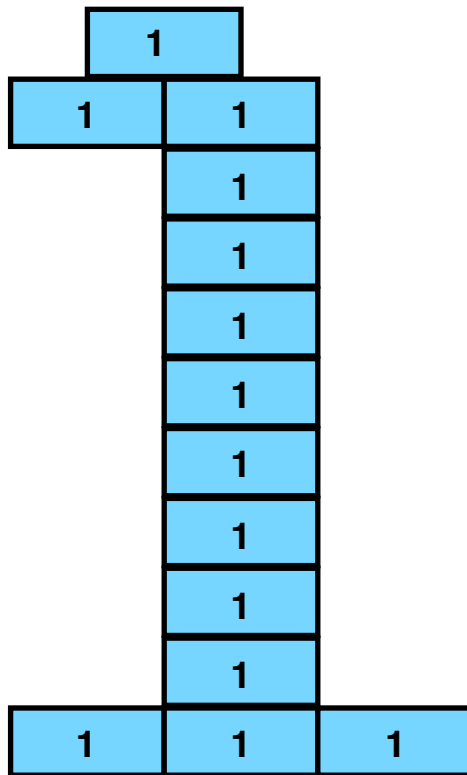
$$5(4a+2+3c)$$



$$3(5x+2y+4)$$

# Problems

# Level





Problem:  $7x=49$

$7x$

$49$

$7x$

$49$

$x$   $x$   $x$   $x$   $x$   $x$   $x$

$7$   $7$   $7$   $7$   $7$   $7$   $7$

$x$

$7$

When I divide  $7x$  and  $49$   
into 7 equal parts, I get  
 $x$  and  $7$ .  $x=7$

Final Answer:  $7$

**Problem:**  $x+13=27$

A large empty rectangular box with a thick black border, intended for the student to show their work. In the bottom right corner of this box, there is a smaller, horizontally-oriented rectangular box with a thick black border, containing the text "Final Answer:".

Final Answer:

**Problem:** James and Melissa have a reading assignment to complete. Melissa has read 75 pages. Together they have read a total of 200 pages. How many pages did James read?

Variable:  
 $n$  = number of pages James read

pages James read      pages Melissa read

$n$                       75

200                      ← total pages

---

$n$                       75    -75

200                      -75

---

$n$

125

Final Answer: 125 pages

**Problem:** Jake's class is selling boxes of candy for a fundraiser. Their goal is to raise 500 dollars. If they make \$2 for each box of candy they sell, how many boxes do they need to sell to reach their goal?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Jimmy loves christmas lights! He knows he has 550 total light bulbs. He has 5 strands of lights with the same number of bulbs on each strand. How many lights are on each strand that Jimmy has?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Mark bought three notebooks. In total he spent \$18. How much did he spend on each notebook?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Alicia wants to buy a new scooter for \$30. She knows she can earn \$5 each time she mows a neighbor's yard. How many yards will she have to mow to afford the scooter?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Abdul and Maria are planning a surprise party for their friend. Together they have \$12 to spend on balloons. If they buy 4 packages of balloons and spend all their money, how much does a package of balloons cost?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:** Izzy collects marbles. She currently has 12. Her older sister, Adela, tells her that if they combined their collections, they would have 37 marbles total. How many marbles does Adela have?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Landon and Chantel are buying supplies for school. Landon spent \$3 less than Chantel. Chantel spent \$12. How much did Landon spend on school supplies?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Christina has to finish a book before her class tomorrow. She has 100 pages left. If Christina knows that she can read twenty pages in a half an hour, how long (in hours) will it take her to finish her reading?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Mrs. Dunn's class decides that they want to buy her an end of the year gift. There are 24 students in the class. They want to buy Mrs. Dunn a picture frame that costs \$12, how much will each student contribute to split the cost evenly?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Felicity has 30 minutes before her bus will come to pick her up. If it takes 9 nine minutes to eat breakfast, how much more time does she have to get ready for school?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Ray has to go to soccer practice in an hour. He wants to watch some of his favorite cartoons before leaving. If each episode is twelve minutes, how many episodes can he watch before he needs to leave?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Sean's class is going on a field trip with a small participation fee. There are 10 students in his class, who all paid the same amount. All together, they paid \$25.00. How much did Sean have to pay?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Yolanda is in charge of gathering s'mores supplies for a family camping trip. There are 5 people in Yolanda's family and the package has 15 segments of chocolate. How many segments of chocolate does each person get to make s'mores?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:** Hernando can't remember how much money he had in his wallet before lunch. He knows he spent \$8 on lunch at Chipotle, and he has \$13 left in his wallet now. How much money did he have before lunch?

Variable:

= \_\_\_\_\_

Final Answer:

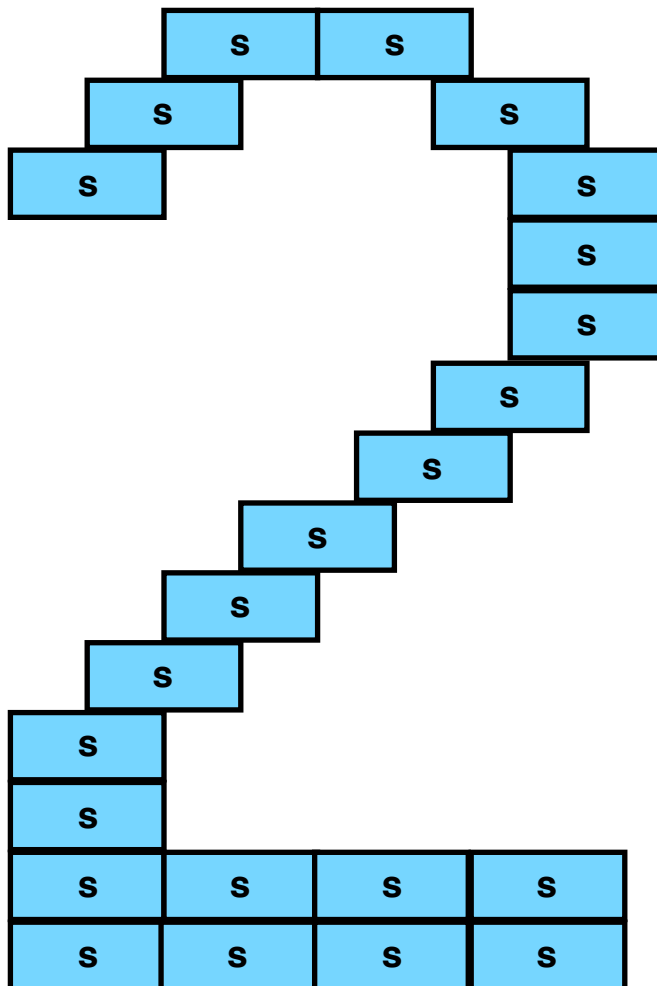
**Problem:** Jason had 131 dollars to spend on 6 books. After buying the books he had 11 dollars. Each book costs the same amount. How much did each book cost?

Variable:

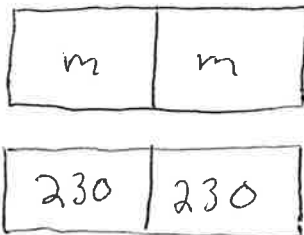
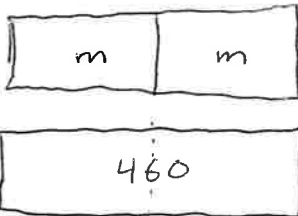
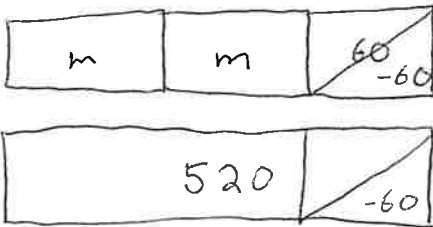
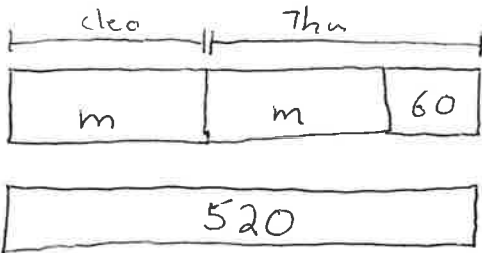
= \_\_\_\_\_

Final Answer:

# Level



**Problem:** Thu and Cleo are sharing the driving on a 520 mile trip. If Thu drives 60 miles more than Cleo, how far did each of them drive?



Variable:

$m$  = miles driven  
by Cleo

$230 + 60 =$  miles driven  
by Thu

**Final Answer:** Cleo drove 230 miles  
Thu drove 290 miles

**Problem:** Linnea is planning on cooking dinner with three of her friends. Linnea's mom agrees to contribute \$12 towards the cost of ingredients, and Linnea and each of her friends agree to split the remaining cost equally. If the ingredients cost \$24, how much will Linnea end up spending?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $75 = 8x + 11$

Final Answer:

**Problem:** You ride a taxi for 17 minutes, and you know that they charge a base fee (an amount charged before any minutes have gone by) and \$2 per minute. After the trip, \$40 dollars total is charged. How much was the base fee?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** The sum of two numbers is 12. One number is 4 more than the other number. What is the value of the larger number?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:**  $23 = 5x - 7$

A large empty rectangular box with a thick black border, intended for the student to show their work in solving the equation  $23 = 5x - 7$ .

Final Answer:

**Problem:** The school is putting in a new row of lockers! You have 100 feet of space, and each locker is  $1\frac{1}{2}$  feet wide. There needs to be 5 feet of extra space at each end of the row. How many lockers can you put in?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** You are at a school assembly and getting bored. You know the next class is supposed to start in 40 minutes, and the teachers usually allow 10 minutes after assembly for you to get back to class. You estimate each speaker is about 6 minutes. If there are only speakers remaining in assembly, how many more speakers are there?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $4x + 7 = 19$

A large empty rectangular box with a thick black border, intended for the student to show their work in solving the equation. In the bottom right corner of this box, there is a smaller, horizontally-oriented rectangular box with a thick black border, containing the text "Final Answer:".

Final Answer:

**Problem:** I am some number. Multiply me by 6, and then add 4 and you get 10. What number am I?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Last week Javier had twice as many stickers as Daniel. Then Daniel received 12 stickers for his birthday. Together they now have 90 stickers. How many stickers did Daniel have last week?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $131 = 6x + 11$

Final Answer:

**Problem:** Sunny Hill Farms and Babbling Brooks Farms both raise hens. Sunny Hill Farms has 35 hens. Babbling Brooks Farms has 15 hens. If together the farms have 500 eggs at the end of the week, and each hen laid the same number of eggs, how many eggs did each hen lay last week?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:** Felix wants to buy a new pair of shoes that cost \$30. He has \$15 now, and knows he can earn \$5 a week helping his grandma with yard work. In how many weeks can Felix afford the shoes?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $520 = x + (x + 60)$

Final Answer:

**Problem:** Jason had 131 dollars to spend. After buying 5 books he had 11 dollars left. Each book cost the same amount. How much did each book cost?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $36 = 12 + 4x$

Final Answer:

**Problem:**  $50 = 10 + 4x$

Final Answer:

**Problem:**  $12x^3 + x = 43$

Final Answer:

**Problem:**  $12 = x + (x - 4)$

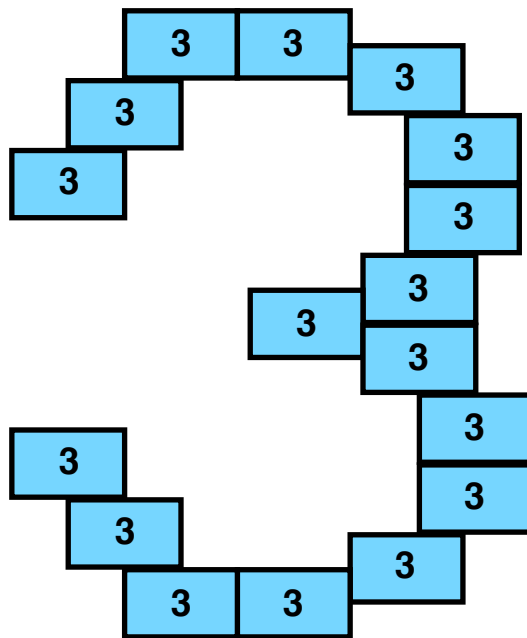
Final Answer:

**Problem:**  $6x + 4 = 10$

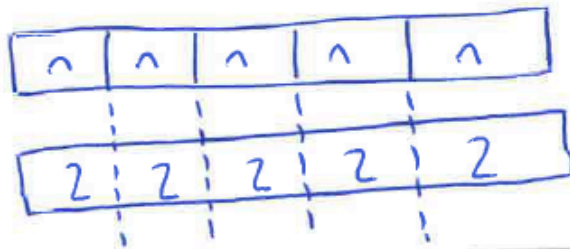
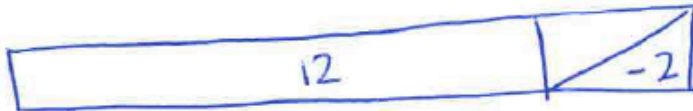
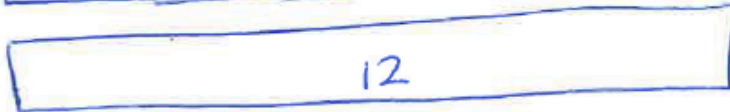
Final Answer:



# Level



**Problem:** Alicia bought 3 notebooks and 2 binders, and her sister agreed to pay for the notebooks. Unfortunately, Alicia can't remember the cost of the notebooks! She does remember that each binder cost \$1 more than each notebook and that she spent \$10 total. How much does Alicia's sister need to pay Alicia?



So each notebook is \$2. Then her sister pays for 3, meaning she pays \$6!

Variable:

$$\square = \frac{\text{cost of one notebook}}{\text{notebook}}$$

Final Answer: 6 dollars

**Problem:** Philippe and Finn go to see a movie. Each buys a ticket for \$7 and a slushie, spending \$18 together. How much does one slushie cost?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $3(x + 2) + 4x = 27$

Final Answer:

**Problem:**  $4x + 2x = 24$

A large empty rectangular box with a thick black border, intended for the student to show their work. In the bottom right corner of this box, there is a smaller, horizontally-oriented rectangular box with a thick black border, containing the text "Final Answer:".

Final Answer:

**Problem:** Jordan goes to the grocery store and buys one bag of chocolate, one bag of caramel, and one bag of lollipops. A bag of chocolate costs two dollars more than three times as much as a bag of caramel, and a bag of lollipops costs as much as buying a bag of caramel and a bag of chocolate. If Jordan spends 20 dollars for the three bags, how much does a bag of chocolate cost?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Kim is three years older than her sister Jess and half as old as her cousin Lexi. If they add their ages together, they get 37. How old is Jess?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Jeremiah had a busy Saturday morning! Starting at 9:00am, he cleaned his bedroom for a while. Then he helped his mom clean the garage for four times as long as he had spent cleaning his room. Finally he cooked breakfast with his sister for ten minutes fewer than the time he had spent cleaning his room, until 9:56 am. How many minutes did Jeremiah spend cleaning his room this morning?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:** Izumi is running the mile (4 laps) at a track meet. She knows that she can run her first lap in 75 seconds. Izumi also knows that her second and third laps are the same speed, while her final lap is normally 9 seconds faster than her third lap. If she wants to finish in 6 minutes, how fast should her second lap be? (Note: there are 60 seconds in 1 minute)

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $5(x+5) - 2(2x+4) = 18$

Final Answer:

**Problem:** Jamal has three reading assignments to complete. In total he has to read 70 pages. Assignment 2 is twice as long as assignment 1, and assignment 3 is four times long as assignment 1. How many pages is his shortest assignment?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Malia and Megan ordered 3 pizzas and each pizza had 8 slices. Their friend Nilver ate 4 slices of pizza, their friend Shayna ate twice as many pieces as Nilver. Malia and Megan ate all of the remaining slices. How many slices did Malia and Megan eat?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $2(2x + 5 + x) + 10 - x = 60$

Final Answer:

**Problem:** Shailee and Sofia are on a road trip to see their grandparents. They drive for a while before stopping for lunch. After that, they drive again for 3 hours before getting gas. Before reaching their grandparents house, they drive 1 hour less than twice as long as they drove before the first stop. In total, they drove 14 hours on their trip. How long did they drive before the first stop, for lunch?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Marcos picked up three books from the library. *The Uglies* is twice as long as *A Wrinkle In Time*, and *A Wrinkle In Time* has forty pages more pages than *The BFG*. Altogether, the three books have 960 pages. How many pages long is *The BFG*?

Variable:

= \_\_\_\_\_

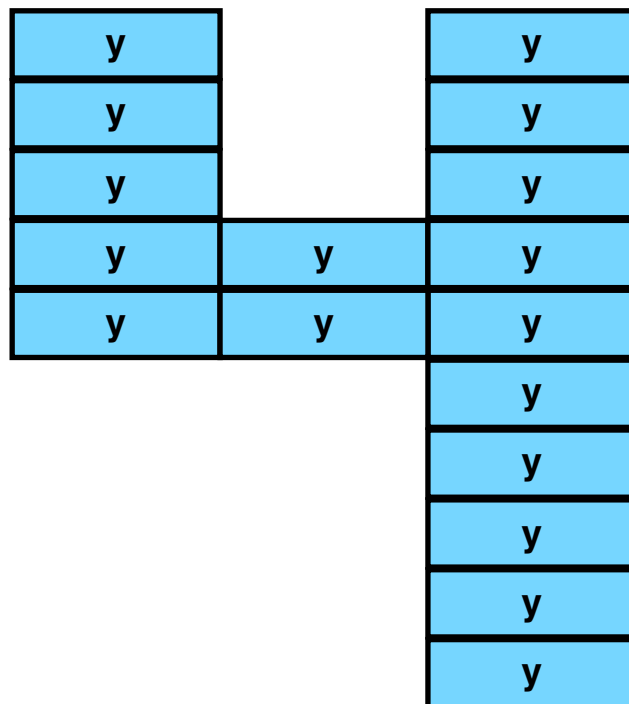
Final Answer:

**Problem:**  $3(x + 8) + 2(x + 1) = 36$

Final Answer:



# Level



**Problem:** Frankie and Lana are both selling candy for a school fundraiser. Frankie sells three boxes of chocolate in addition to \$12 worth of hard candies. Lana sells seven boxes of chocolate and brags that she has earned \$4 more than Frankie. How much does each box of chocolates cost?

① I want to know the cost of one box of chocolates, so I define a variable

Variable:  
 $C$  = cost of one box of chocolates

② Frankie 3C | 12 4 ← 12+4 = 16

Lana 7C

③ ~~3C~~ -3C | 16 ← 7C - 3C = 4C

~~-3C~~ | 7C

④ 16

4C

⑤ 16

C | C | C | C

⑥ 4  
C C=4

Final Answer: \$4.00

**Problem:** Monica and Bridget bought the same binders for school, and after filling them with school supplies, they weigh the same amount! Monica's binder contains a pencil pouch that weighs 2 pounds and 3 notebooks. Bridget's binder contains a stapler that weighs 1 pound, a pack of crayons that weighs 2 pounds, and 2 notebooks. How much does 1 notebook weigh?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $3x+1=x+9$

Final Answer:

**Problem:** Jimmy always goes on runs that are the same distance. Last week he went on a run where he ran his favorite trail 2 times and then ran 3 miles to the park. Today, he ran his favorite trail 3 times and then ran 1 more mile. How many miles is his favorite trail?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Samantha and Carlos wore braces for the same number of years. Samantha can't remember how many years her doctor said she would need braces for, but she knows she had braces for 3 years longer than the doctor expected. Carlos had braces for twice as long as Samantha was supposed to. How long was Samantha supposed to have braces for?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $2t + 15 = 4t + 5$

Final Answer:

**Problem:** In middle school, Frank and AJ went to the same number of dances. Frank went to 2 dances in 6th grade, and 3 dances in 7th grade. AJ didn't go to any dances 6th grade, and went to to 1 dance in 7th grade. In 8th grade AJ went to three times as many dances as Frank. How many dances did Frank go to in 8th grade?

Variable:

= \_\_\_\_\_

Final Answer:



**Problem:** Samantha and Elsa have the same number of photos on their phones, and all of their pictures are either selfies or pictures of their pet. Samantha's phone has 5 times as many selfies as Elsa's. Elsa's phone has 20 pictures of her dog, and Samantha's phone has 4 pictures of her cat. How many selfies does Elsa have on her phone?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $3(p + 3) + 1 = p + 24$

Final Answer:

**Problem:** Every Friday, Lola has her friends over and they eat pizza rolls. Last week her friends made 3 boxes of pizza rolls and ate 5 pizza rolls that were leftover in the fridge. This week they ate 4 boxes of pizza rolls and ate 3 more rolls than they ate last week. How many pizza rolls are there in one box?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:** Frank has eleven siblings, and they all like to eat cheese sticks. Their dad buys the same number of cheese sticks every week. Last week, Frank ate many cheese sticks, and each of his siblings ate three cheese sticks. This week, Frank and his sister Sofia *each* ate one more than Frank had eaten the week before, and each of their *other* siblings ate two cheese sticks. How many cheese sticks did Frank eat last week?

Variable:

= \_\_\_\_\_

Final Answer:

**Problem:**  $y + 3 = 10y - 15$

Final Answer:

**Problem:** Gretchen plays the clarinet, and her teacher has a required amount of time that a practice session is supposed to last. Last week she practiced the required amount of time 6 times, and practiced for 30 extra minutes on Thursday. This week she practiced the required amount 5 times and practiced 90 minutes less this week than last week. How long does Gretchen's teacher require that a practice session last?

Variable:

=

Final Answer:

**Problem:** Ron and Harry love to tell jokes. On Tuesday Ron told 3 jokes in each class period and Harry told 5 jokes in each class period. Ron also told 8 jokes during lunch, and Harry told 2 jokes during lunch. If they only told jokes during class and at lunch, and they both told the same number of jokes on Tuesday, how many class periods were there on Tuesday?

Variable:

=

Final Answer:




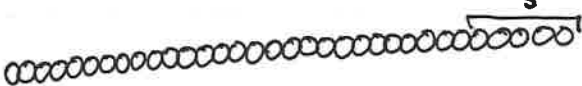
**Problem:**  $7(x+1) = 4x + 43$

Final Answer:

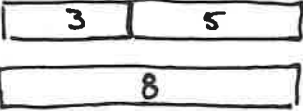
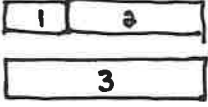

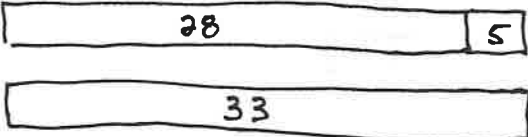


# Tutorial Solutions

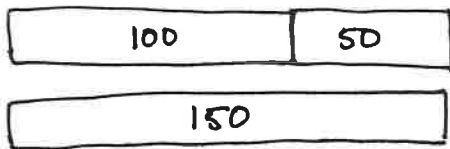
Addition page 9

<p><math>3 + 5</math></p> 	<p><math>1 + 2</math></p> 
<p><math>7 + 9</math></p> 	<p><math>28 + 5</math></p> 

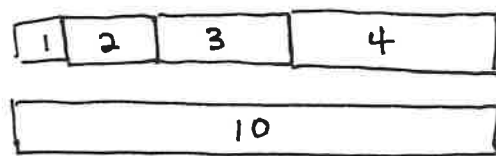
Addition page 10

<p><math>3 + 5</math></p> 	<p><math>1 + 2</math></p> 
<p><math>7 + 9</math></p> 	<p><math>28 + 5</math></p> 

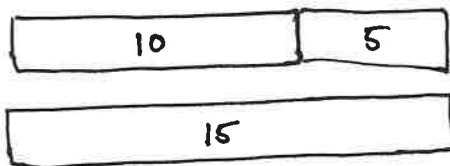
$$100 + 50$$



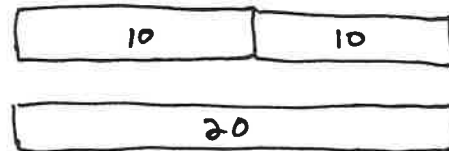
$$1 + 2 + 3 + 4$$



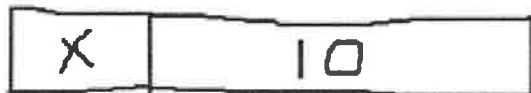
$$10 + 5$$



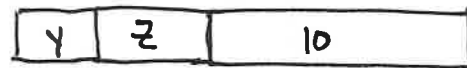
$$10 + 10$$



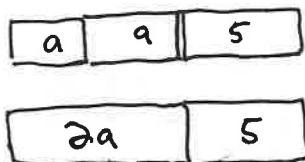
$$x + 10$$



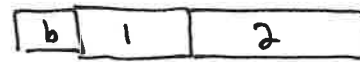
$$y + z + 10$$










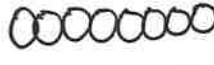
$$a + a + 5$$



$$b + 1 + 2$$



Subtraction page 12

<p style="text-align: center;"><math>7 - 4</math></p>  <p style="text-align: center;"></p>	<p style="text-align: center;"><math>9 - 2</math></p>  <p style="text-align: center;"></p>
<p style="text-align: center;"><math>13 - 7</math></p>  <p style="text-align: center;"></p>	<p style="text-align: center;"><math>25 - 17</math></p>  <p style="text-align: center;"></p>

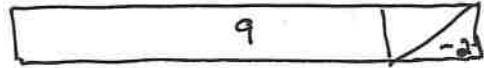
Subtraction page 14

$7 - 4$



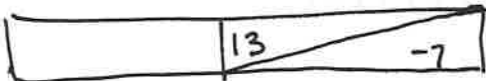
$3$

$9 - 2$



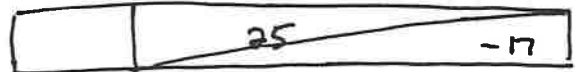
$7$

$13 - 7$



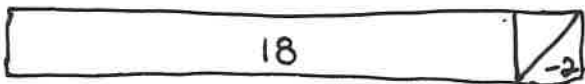
$6$

$25 - 17$



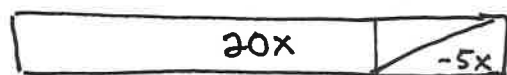
$8$

$18 - 2$



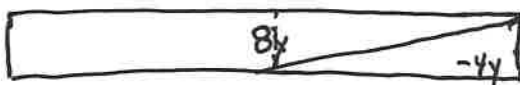
$16$

$20x - 5x$



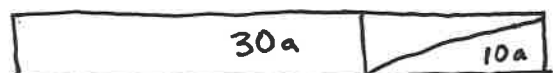
$15x$

$8y - 4y$



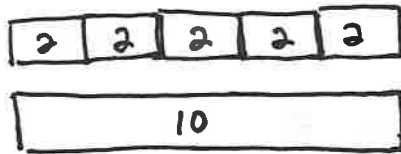
$4y$

$30a - 10a$

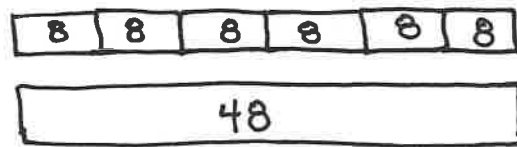


$20a$

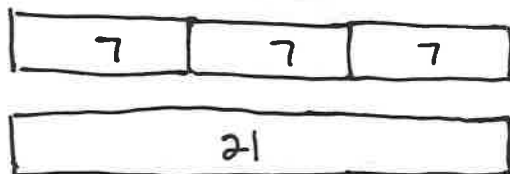
$2 \times 5$



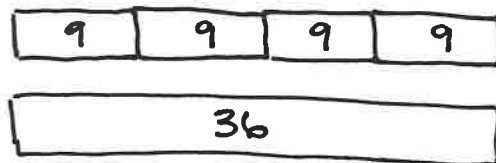
$8 \times 6$



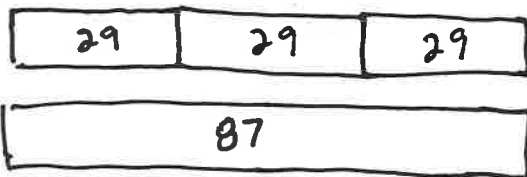
$7 \times 3$



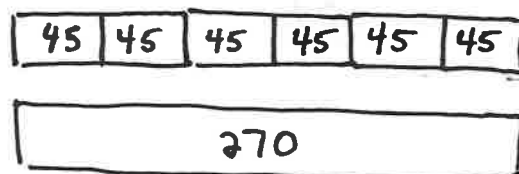
$4 \times 9$



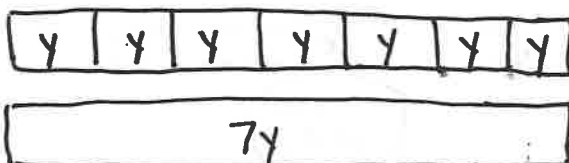
$29 \times 3$



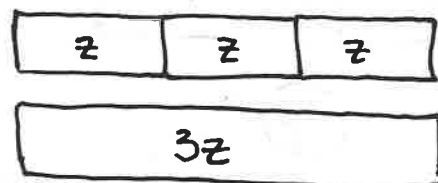
$45 \times 6$



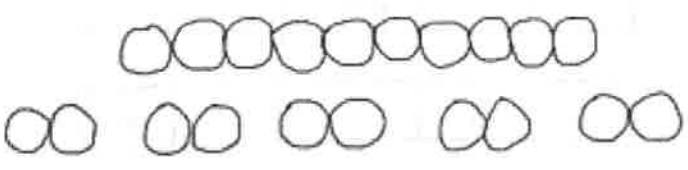
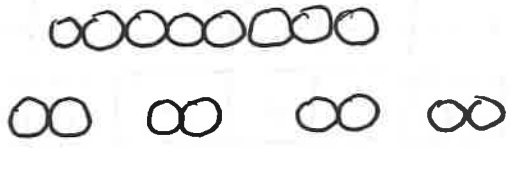
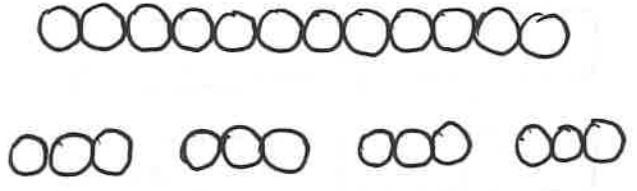
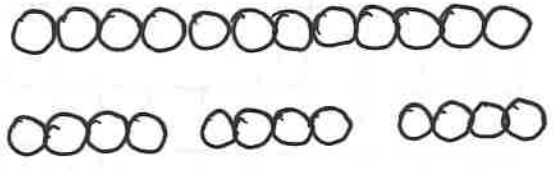
$7y$



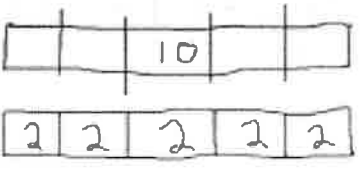
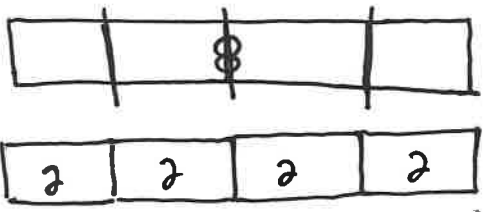
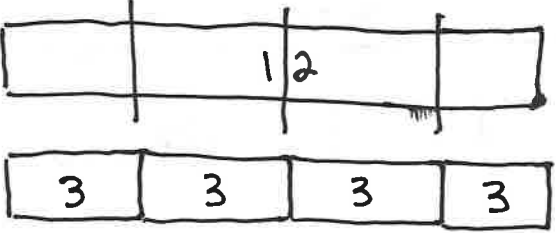
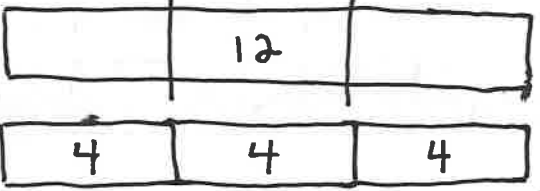
$3z$



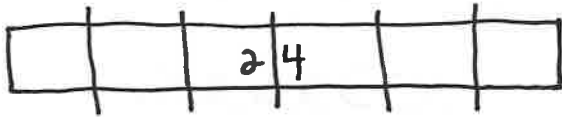
Division page 17

<p style="text-align: center;"><math>10 \div 5</math></p> 	<p style="text-align: center;"><math>8 \div 4</math></p> 
<p style="text-align: center;"><math>12 \div 4</math></p> 	<p style="text-align: center;"><math>12 \div 3</math></p> 

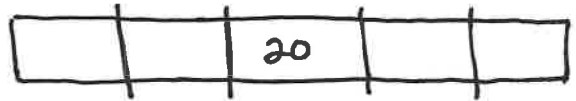
Division page 18

<p style="text-align: center;"><math>10 \div 5</math></p>  <p style="text-align: center; font-size: 2em;">2</p>	<p style="text-align: center;"><math>8 \div 4</math></p> 
<p style="text-align: center;"><math>12 \div 4</math></p> 	<p style="text-align: center;"><math>12 \div 3</math></p> 

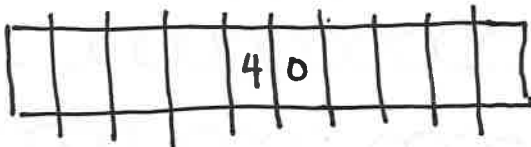
$$24 \div 6$$



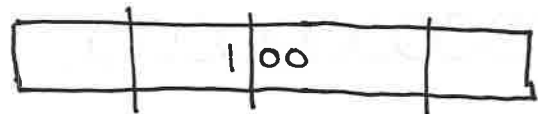
$$20 \div 5$$



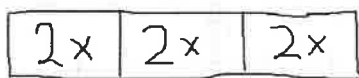
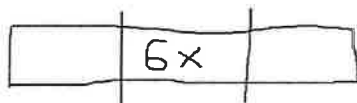
$$40 \div 10$$



$$100 \div 4$$

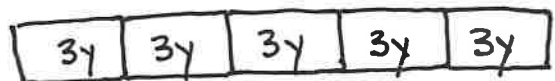


$$6x \div 3$$

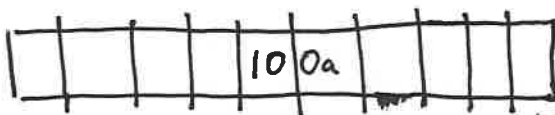


$$2x$$

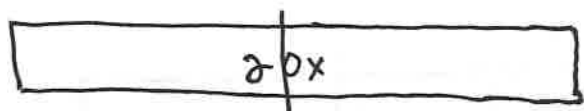
$$15y \div 5$$



$$100a \div 10$$



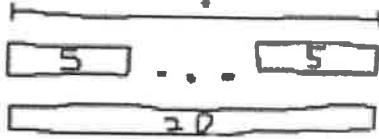
$$20x \div 2$$





$$20 \div 5$$

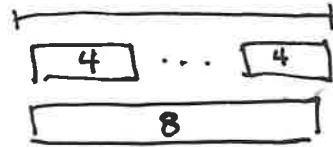
$$5 \times ? = 20$$



4

$$8 \div 4$$

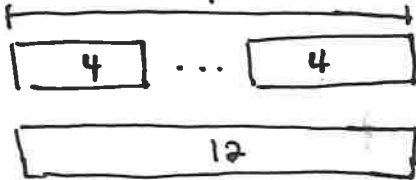
$$4 \times ? = 8$$



2

$$12 \div 4$$

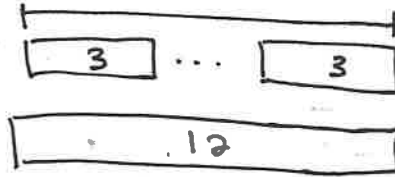
$$4 \times ? = 12$$



3

$$12 \div 3$$

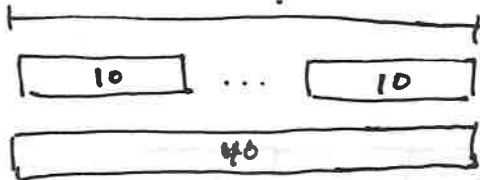
$$3 \times ? = 12$$



4

$$40 \div 10$$

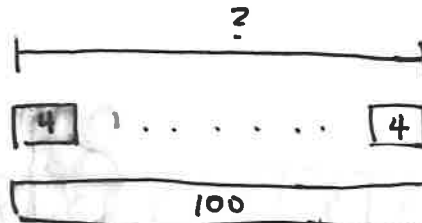
$$10 \times ? = 40$$



4

$$100 \div 4$$

$$4 \times ? = 100$$



25

Simplifying page 22

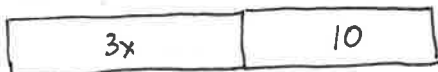
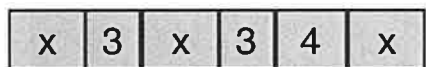
$4 + 2z + 3z + 1$	$x + x + 2 + x + 2$									
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">4</td> <td style="padding: 5px;">2z</td> <td style="padding: 5px;">3z</td> <td style="padding: 5px;">1</td> </tr> </table>	4	2z	3z	1	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">x</td> <td style="padding: 5px;">x</td> <td style="padding: 5px;">2</td> <td style="padding: 5px;">x</td> <td style="padding: 5px;">2</td> </tr> </table>	x	x	2	x	2
4	2z	3z	1							
x	x	2	x	2						
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">2z</td> <td style="padding: 5px;">3z</td> <td style="padding: 5px;">4</td> <td style="padding: 5px;">1</td> </tr> </table>	2z	3z	4	1	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">x</td> <td style="padding: 5px;">x</td> <td style="padding: 5px;">x</td> <td style="padding: 5px;">2</td> <td style="padding: 5px;">2</td> </tr> </table>	x	x	x	2	2
2z	3z	4	1							
x	x	x	2	2						
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">5z</td> <td style="padding: 5px;">5</td> </tr> </table>	5z	5	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">3x</td> <td style="padding: 5px;">4</td> </tr> </table>	3x	4					
5z	5									
3x	4									

Simplifying page 24

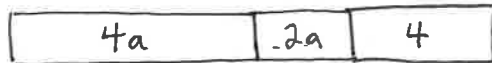
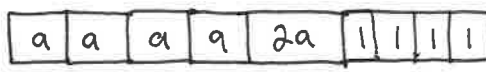
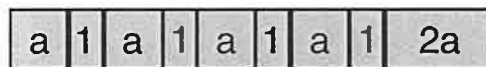
$4y = y + 12$	$20 = 2(q+5)$																										
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">4y</td> </tr> <tr> <td style="padding: 5px;">y</td> <td style="padding: 5px;">12</td> </tr> </table>	4y	y	12	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">20</td> </tr> <tr> <td style="padding: 5px;">q</td> <td style="padding: 5px;">5</td> <td style="padding: 5px;">q</td> <td style="padding: 5px;">5</td> </tr> </table> <hr style="border-top: 1px dashed black;"/> <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">20</td> </tr> <tr> <td style="padding: 5px;">2q</td> <td style="padding: 5px;">10</td> </tr> </table>	20	q	5	q	5	20	2q	10															
4y																											
y	12																										
20																											
q	5	q	5																								
20																											
2q	10																										
$a = 2(10)+7$	$4(a+4) = 8(a+1)$																										
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">a</td> </tr> <tr> <td style="padding: 5px;">10</td> <td style="padding: 5px;">10</td> <td style="padding: 5px;">7</td> </tr> </table> <hr style="border-top: 1px dashed black;"/> <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">a</td> </tr> <tr> <td style="padding: 5px;">27</td> </tr> </table>	a	10	10	7	a	27	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">a</td> <td style="padding: 5px;">4</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">4</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">4</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">4</td> </tr> <tr> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> <td style="padding: 5px;">a</td> </tr> </table> <hr style="border-top: 1px dashed black;"/> <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">4a</td> <td style="padding: 5px;">16</td> </tr> <tr> <td style="padding: 5px;">8a</td> <td style="padding: 5px;">8</td> </tr> </table>	a	4	a	4	a	4	a	4	a	a	a	a	a	a	a	a	4a	16	8a	8
a																											
10	10	7																									
a																											
27																											
a	4	a	4	a	4	a	4																				
a	a	a	a	a	a	a	a																				
4a	16																										
8a	8																										

Simplifying page 23

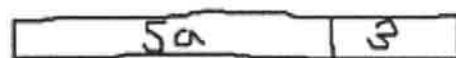
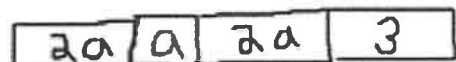
$$2(x + 3) + 4 + x$$



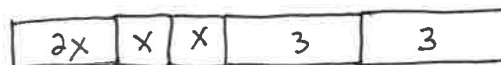
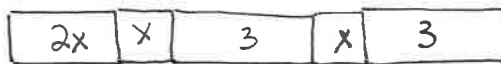
$$4(a + 1) + 2a$$



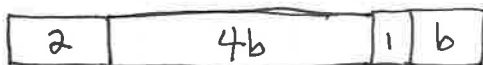
$$2a + a + 3 + 2a$$



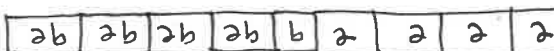
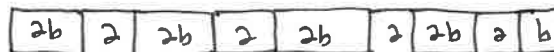
$$2x + 2(x + 3)$$



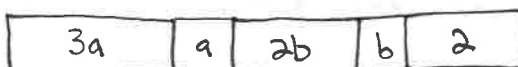
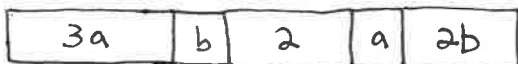
$$2 + 4b + 1 + b$$



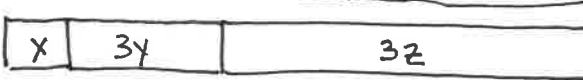
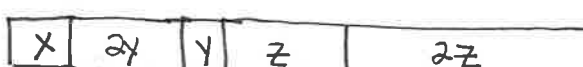
$$4(2b + 2) + b$$



$$3a + b + 2 + a + 2b$$



$$x + z + 2y + 2z + y$$



Distributive Property pages 36-37

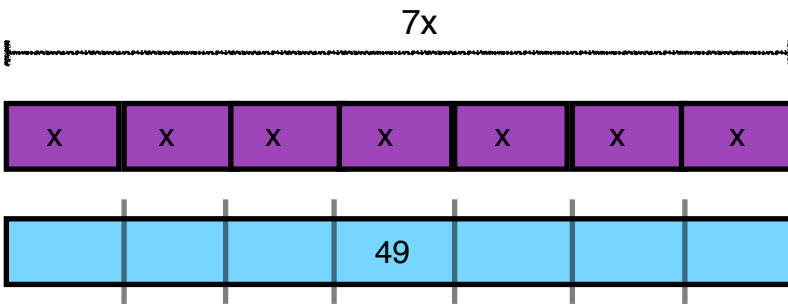
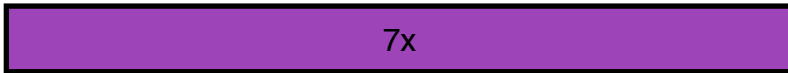
<p style="text-align: center;"><math>3(2+2d)</math></p> <p style="text-align: center;"><math>3(\boxed{2d} \mid \boxed{2})</math></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">6d</td><td style="padding: 2px 5px;">6</td> </tr> </table>	2d	2	2d	2	2d	2	2d	2d	2d	2	2	2	6d	6	<p style="text-align: center;"><math>2(b+3)</math></p> <p style="text-align: center;"><math>2(\boxed{b} \mid \boxed{3})</math></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">b</td><td style="padding: 2px 5px;">3</td><td style="padding: 2px 5px;">b</td><td style="padding: 2px 5px;">3</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">b</td><td style="padding: 2px 5px;">b</td><td style="padding: 2px 5px;">3</td><td style="padding: 2px 5px;">3</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">2b</td><td style="padding: 2px 5px;">6</td> </tr> </table>	b	3	b	3	b	b	3	3	2b	6
2d	2	2d	2	2d	2																				
2d	2d	2d	2	2	2																				
6d	6																								
b	3	b	3																						
b	b	3	3																						
2b	6																								

<p style="text-align: center;"><math>3(2+6x)</math></p> <p style="text-align: center;"><math>3(\boxed{2} \mid \boxed{6x})</math></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">6x</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">6x</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">6x</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">6x</td><td style="padding: 2px 5px;">6x</td><td style="padding: 2px 5px;">6x</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">6</td><td style="padding: 2px 5px;">18x</td> </tr> </table>	2	6x	2	6x	2	6x	2	2	2	6x	6x	6x	6	18x	<p style="text-align: center;"><math>2(7+d)</math></p> <p style="text-align: center;"><math>2(\boxed{d} \mid \boxed{7})</math></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">d</td><td style="padding: 2px 5px;">7</td><td style="padding: 2px 5px;">d</td><td style="padding: 2px 5px;">7</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td style="padding: 2px 5px;">d</td><td style="padding: 2px 5px;">d</td><td style="padding: 2px 5px;">7</td><td style="padding: 2px 5px;">7</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">2d</td><td style="padding: 2px 5px;">14</td> </tr> </table>	d	7	d	7	d	d	7	7	2d	14
2	6x	2	6x	2	6x																				
2	2	2	6x	6x	6x																				
6	18x																								
d	7	d	7																						
d	d	7	7																						
2d	14																								

<p style="text-align: center;"><math>3(2+6x)</math></p> <p style="text-align: center;"> </p>	<p style="text-align: center;"><math>2(7+d)</math></p> <p style="text-align: center;"> </p>
<p style="text-align: center;"><math>5(4+3a)</math></p> <p style="text-align: center;"> </p>	<p style="text-align: center;"><math>6(4a+2)</math></p> <p style="text-align: center;"> </p>
<p style="text-align: center;"><math>5(4a+2+3c)</math></p> <p style="text-align: center;"> </p>	<p style="text-align: center;"><math>3(5x+2y+4)</math></p> <p style="text-align: center;"> </p>

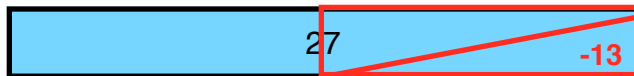
# Solutions

Problem:  $7x=49$



Final Answer: 7

**Problem:**  $x + 13 = 27$

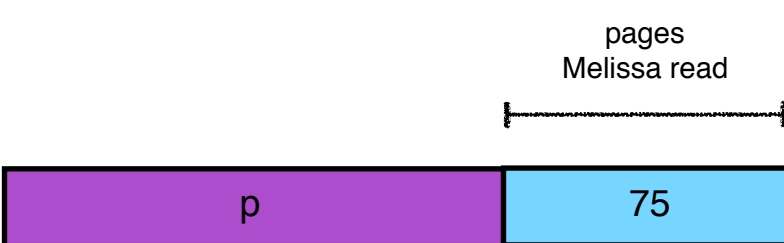



Final Answer:  $x = 14$

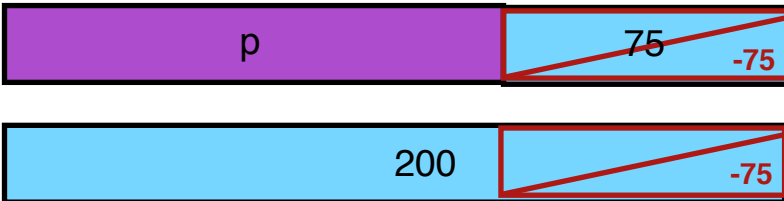


**Problem:** James and Melissa have a reading assignment to complete. Melissa has read 75 pages. Together they have read a total of 200 pages. How many pages did James read?

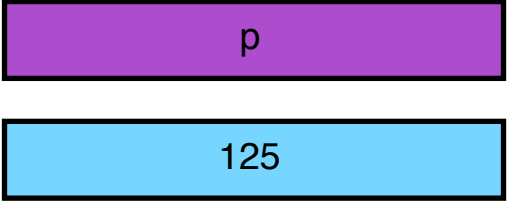
pages  
Melissa read


---




---



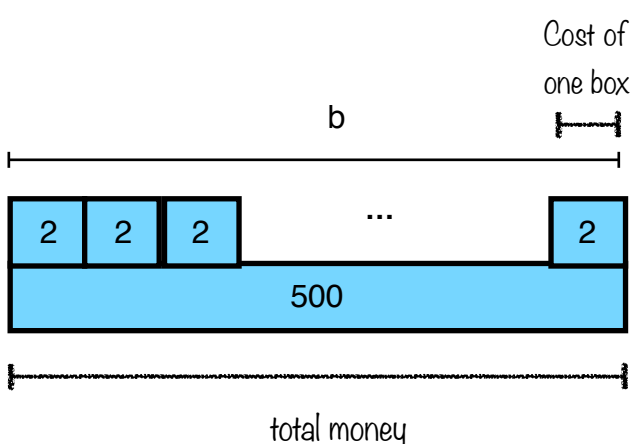
**Variable:**

p

 = pages James read

Final Answer: 125 pages

**Problem:** Jake's class is selling boxes of candy for a fundraiser. Their goal is to raise 500 dollars. If they make \$2 for each box of candy they sell, how many boxes do they need to sell to reach their goal?



Variable:

$b$  = number of boxes

From the model we can see that we now have to divide 500 by 2 in order to find the answer!

$$500 \div 2 = 250$$

Final Answer: 250 boxes

**Problem:** Jimmy loves Christmas lights! He knows he has 550 total light bulbs and he has 5 strands of lights with the same number of bulbs on each. How many lights are on each strand that Jimmy has?

**Variable:**

L

= number of lights on one strand

---

---

---

L

110

Final Answer: 110 bulbs

**Problem:** Mark bought three notebooks. In total he spent \$18. How much did he spend on each notebook?

Variable:  
 $n$  = Cost of one notebook

3n

n n n

18

n n n

18

n n n

6 6 6

Final Answer: 6 dollars

**Problem:** Alicia wants to buy a new scooter for \$30. She knows she can earn \$5 each time she mows a neighbor's yard. How many yards will she have to mow to afford the scooter?

Looking at this model, we can see that we must divide 30 by 5 in order to find the answer:

$$30 \div 5 = 6$$

Let's check:  
\$5 x 6 yards = \$30

She has enough for the scooter!

Variable:

y = number of yards

Final Answer: 6 yards

**Problem:** Abdul and Maria are planning a surprise party for their friend. Together they have \$12 to spend on balloons. If they buy 4 packages of balloons and spend all their money, how much does a package of balloons cost?

Variable:

b = cost of a package of balloons

---

---

---

Final Answer: \$3/package

**Problem:** Izzy collects marbles. She currently has 12. Her older sister, Adela, tells her that if they combined their collections, they would have 37 marbles total. How many marbles does Adela have?

Variable:

m = number of marbles Adela has

Initial state:  $m$  (purple) + 12 (light blue) = 37 (light blue)

---

Adjustment:  $m$  (purple) and 37 (light blue) both have  $-12$  subtracted from them.

---

Final state:  $m$  (purple) and 25 (light blue)

Final Answer: 25 marbles

**Problem:** Landon and Chantel are buying supplies for school. Landon spends \$3 less than Chantel. Chantel spends \$12. How much did Landon spend on school supplies?

**Variable:**

s

 = money spent on Landon's school supplies

---

s

9

Final Answer: \$9.00



**Problem:** Christina has to finish a book before her class tomorrow. She has 100 pages left. If Christina knows that she can read twenty pages in a half an hour, how long (in hours) will it take her to finish her reading?

Variable:  
h = number of 1/2-hour blocks

h half hour blocks

20    20    ...    20

100

Looking at the model we see we need to divide 100 by 20 to find how many half-hour blocks she needs to finish.

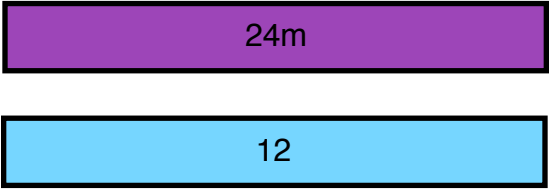
$$100 \div 20 = 5$$

Let's check,  
5 half-hour blocks \* 20 pages = 100 pages.

But we want the answer in hours, so  
5 1/2-hour blocks = 2.5 hours

Final Answer: 2.5 hours

**Problem:** Mrs. Dunn’s class decides that they want to buy her an end of the year gift. There are 24 students in the class. They want to buy Mrs. Dunn a picture frame that costs \$12, how much will each student contribute to split the cost evenly?

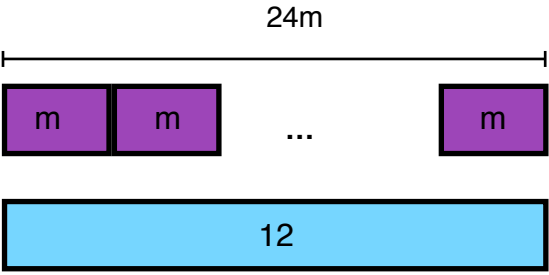


**Variable:**

m

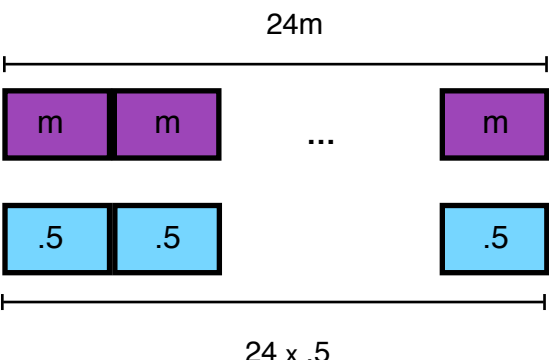
 = money each student contributes

---



It's too much to draw 25 m blocks, so we can show it this way

---



$12 \div 24 = .5$

**Final Answer:** \$0.50

**Problem:** Ray has to go to soccer practice in an hour. He wants to watch some of his favorite cartoons before leaving. If each episode is twelve minutes, how many can he watch before he needs to leave?

Variable:

$r$  = number of episodes

I can see from the model that I need to divide 60 by 12 to find the number of episodes

$$60 \div 12 = 5$$

Let's check:

5 episodes x 12 minutes per episode = 60 minutes of TV

Final Answer: 5 episodes

**Problem:** Felicity has 30 minutes before her bus will come to pick her up. If it takes 9 nine minutes to eat breakfast, how much more time does she have to get ready for school?

Variable:

t

= time to get ready

t

9

30

---

t

~~9~~ -9

~~30~~ -9

---

t

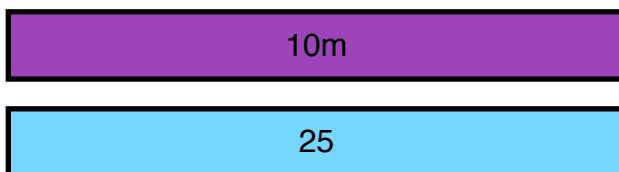
21

Final Answer: 21 minutes

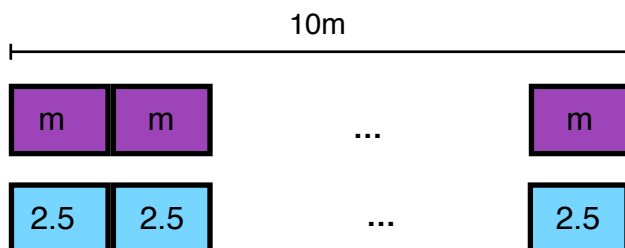
**Problem:** Sean's class is going on a field trip with a small participation fee. There are 10 students in his class, who all paid the same amount. All together, they paid \$25.00. How much did Sean have to pay?

Variable:

$m$  = money Sean pays  
(each student pays)



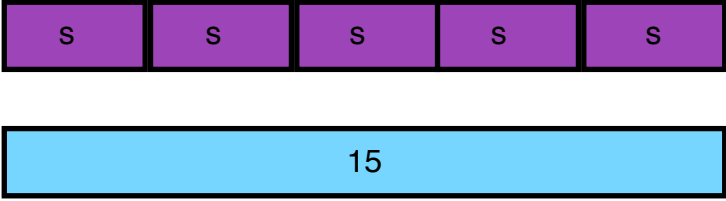
$$25 \div 10 = 2.5$$



It's too much to draw 10  $m$  blocks and 10 2.5 blocks, so we can show it this way.

Final Answer: \$2.50

**Problem:** Yolanda is in charge of gathering supplies s'mores supplies for a family camping trip. There are five people in Yolanda's family and Yolanda has a package with 15 segments of chocolate. How many segments of chocolate does each person get to make s'mores?

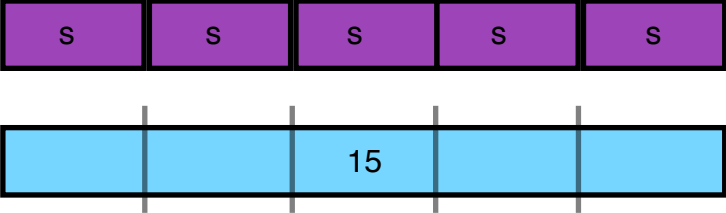


**Variable:**

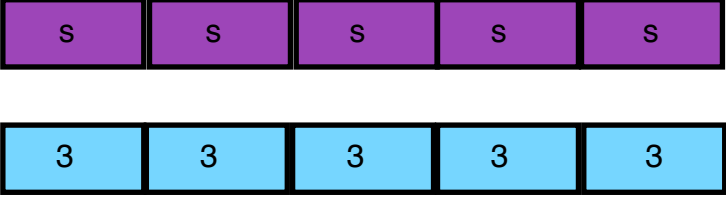
s

 = number of segments  
each person gets

---



---



Final Answer: 3 segments

**Problem:** Hernando can't remember how much money he had in his wallet before lunch. He knows he spent \$8 on lunch at Chipotle, and he has \$13 left in his wallet now. How much money did he have before lunch?

Variable:

$m$  = money before lunch

13

+8


---

m

21

Final Answer: \$21

**Problem:** Thu and Cleo are sharing the driving on a 520 mile trip. If Thu drives 60 miles more than Cleo, how far did each of them drive?

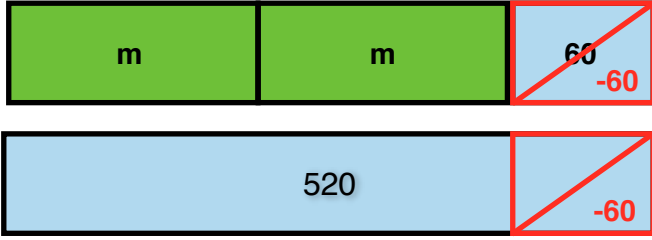


Variable:

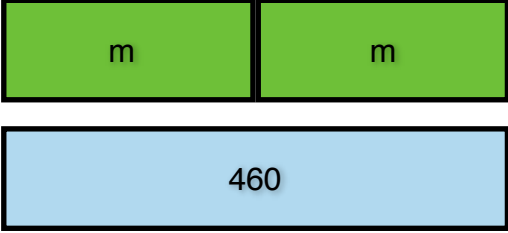
m

 = miles driven by Cleo

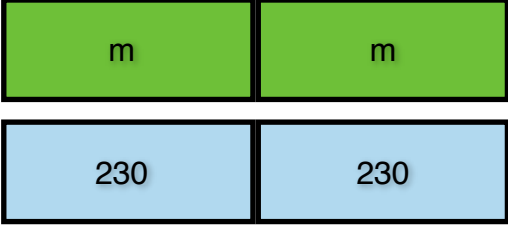
---



---



---

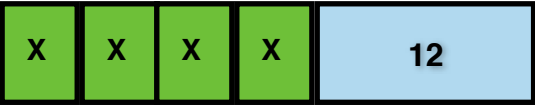



$230 + 60 =$  miles driven by Thu

**Final Answer:** Cleo drove 230 miles, The drove 290



**Problem:** Linnea is planning on cooking dinner with three of her friends. Linnea’s mom agrees to contribute \$12 towards the cost of ingredients, and Linnea and each of her friends agree to split remaining cost equally. If the ingredients cost \$24, how much will Linnea end up spending?

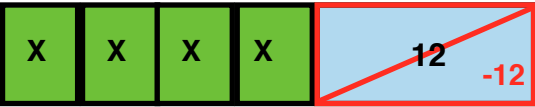




Variable:



X

 = dollars one friend contributed

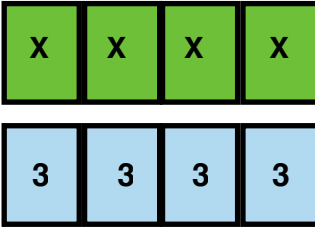
---

---

---



**Final Answer: \$3**

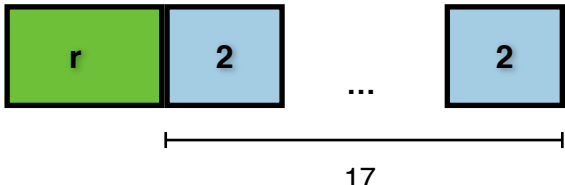
**Problem:**  $75 = 8x + 11$

The diagram illustrates the algebraic process of solving the equation  $75 = 8x + 11$  in four stages, separated by dashed lines:

- Stage 1:** Shows the equation  $75 = 8x + 11$ . The term  $8x$  is represented by 8 green blocks labeled 'X'. The constant term 11 is represented by a blue block labeled '11'. A bracket above the 'X' blocks is labeled  $8X$ . Below the blocks is a long blue bar labeled '75', representing the total value.
- Stage 2:** Shows the subtraction of 11 from both sides. A red box highlights the '11' block in the top row and a '-11' in the bottom row. The '11' block in the top row is crossed out with a red diagonal line.
- Stage 3:** Shows the simplified equation  $64 = 8x$ . The '11' block has been removed from the top row, leaving only the 8 green 'X' blocks. The blue bar below is now labeled '64'.
- Stage 4:** Shows the final solution  $x = 8$ . The 8 green 'X' blocks are replaced by 8 blue blocks labeled '8'. A bracket above the 'X' blocks is still labeled  $8X$ .

**Final Answer:**  $X=8$

**Problem:** You ride a taxi for 17 minutes, and you know that they charge a base fee (an amount charged before any minutes have gone by) and \$2 per minute. After the trip, \$40 dollars total is charged. How much was the base fee?




17


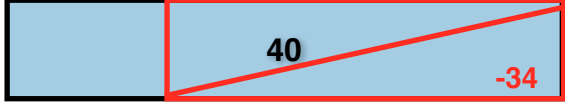
Variable:

r = base fee in dollars

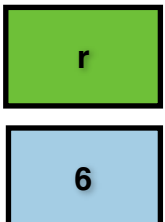
---



---

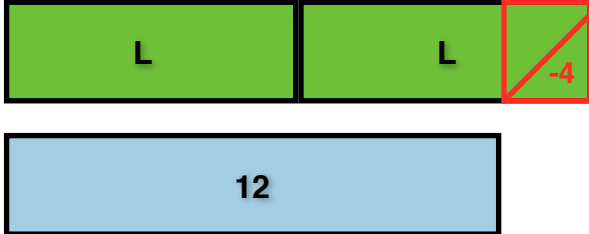



---

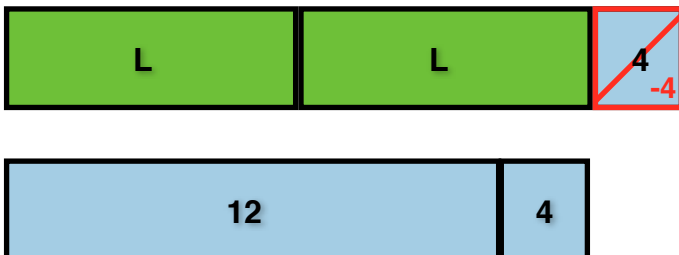


**Final Answer: \$6**

**Problem:** The sum of two numbers is 12. One number is 4 more than the other. What is the value of the larger number?

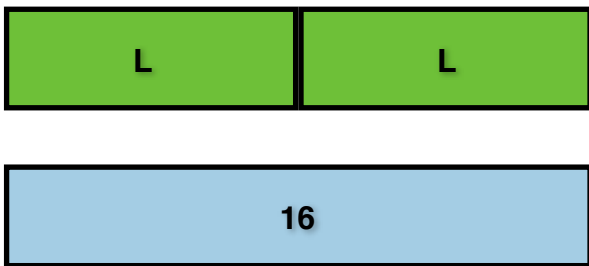



---

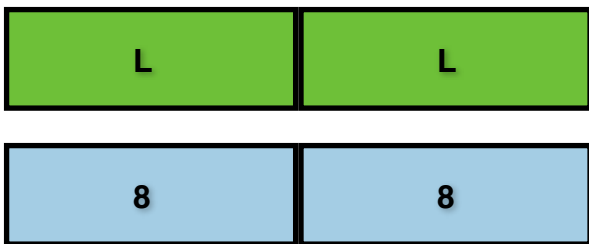


I added 4 to both sides of my equation

---




---



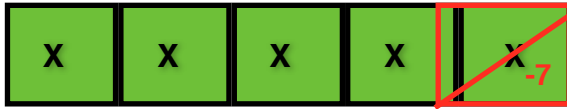
Variables:

L

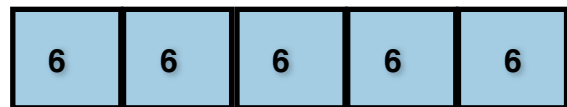
 = the larger number

**Final Answer:** The larger number is 8

**Problem:**  $23 = 5x - 7$



I added 7 to both sides  
of my equation



**Final Answer:**  $X=6$

**Problem:** The school is putting in a new row of lockers! You have 100 feet of space, and each locker is 1 ½ feet wide. There needs to be 5 feet of extra space at each end of the row. How many lockers can you put in?

L

5

1.5

...

1.5

5

100

Variables:

L

 = Number of lockers

---

L

1.5

...

1.5

5

5

100

-10

---

L

1.5

...

1.5

90

**Final Answer:** 60 lockers

149

**Problem:** You are at school assembly and getting bored. You know the next class is supposed to start in 40 minutes, and the teachers usually allow 10 minutes after assembly for you to get back to class. You estimate each speaker is about 6 minutes. If there are only speakers remaining in assembly, how many more speakers are there?

Variables:

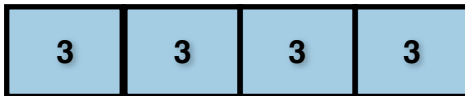
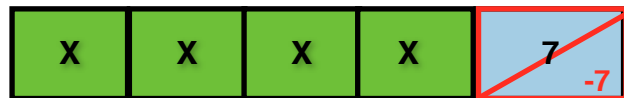
s = number of speakers

---

---

**Final Answer:** 5 speakers

**Problem:**  $4x + 7 = 19$

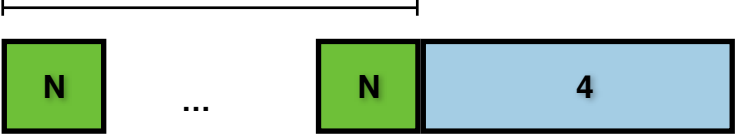


**Final Answer:**  $X=3$




**Problem:** I am some number. Multiply me by 6, and add 4 and you get 10.  
What number am I?

$6N$



...




Variables:

N


 = The number

---

$6N$




...




---

$6N$





...



**Final Answer:** The number is 1

**Problem:** Last week Javier had twice as many stickers as Daniel. Then Daniel received 12 stickers for his birthday. Together they now have 90 stickers. How many stickers did Daniel have last week?

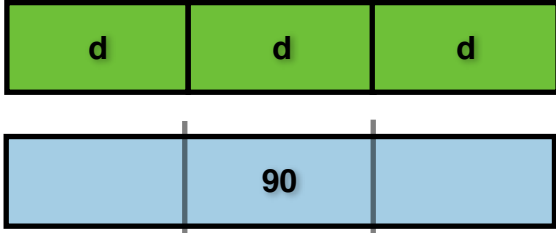



Variables:

d

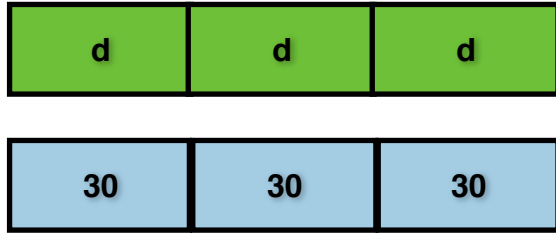
 = The number of stickers Daniel had last week

---



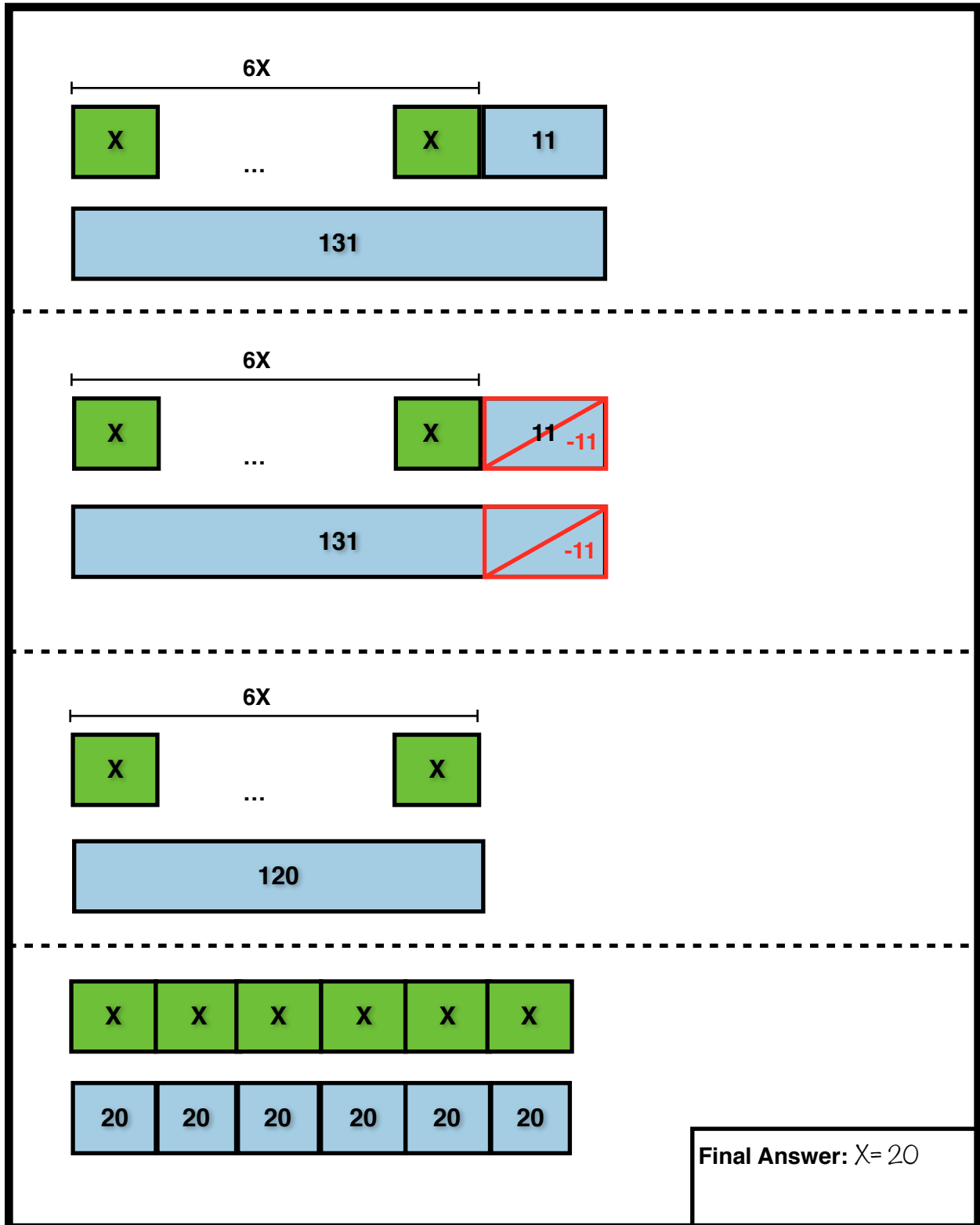
Modeling the stickers Javier and Daniel have now

---



**Final Answer:** 30 stickers

**Problem:**  $131 = 6x + 11$



**Problem:** Sunny Hill Farms and Babbling Brooks Farms both raise hens. Sunny Hill Farms has 35 hens. Babbling Brooks Farms has 15 hens. If together the farms have 500 eggs at the end of the week, and each hen laid the same number of eggs, how many eggs did each hen lay last week?

$35 + 15$

|-----|

E

...

E

500

Variables:

E

 = The number of eggs one hen lays in a week

---

50

|-----|

E

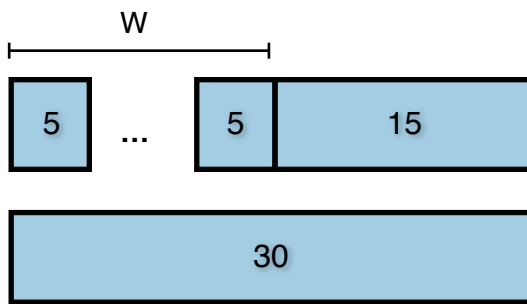
...

E

500

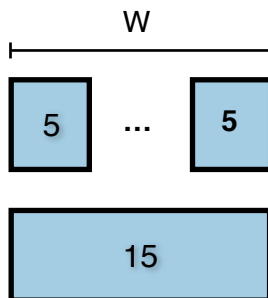
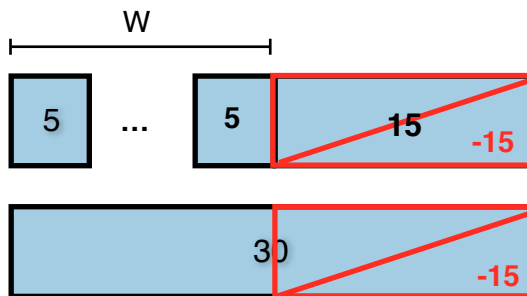
**Final Answer:** One hen lays 10 eggs in a week

**Problem:** Felix wants to buy a new pair of shoes that cost \$30. He has \$15 now, and knows he can earn \$5 a week helping his grandma with yard work. How many weeks will it take Felix to be able to afford the shoes?



Variables:

$W$  = weeks until Felix can afford the shoes



**Final Answer:** 3 weeks

**Problem:**  $520 = x + (x + 60)$

Diagram illustrating the solution to the equation  $520 = x + (x + 60)$  using a bar model.

The diagram is divided into four horizontal sections by dashed lines.

**Section 1:** A bar model with three segments: two green segments labeled  $x$  and one blue segment labeled  $60$ . Below it is a single blue bar labeled  $520$ .

**Section 2:** The same bar model as in Section 1, but the blue segment  $60$  is crossed out with a red diagonal line and labeled  $-60$  in red. Below it is a blue bar labeled  $520$  with a red diagonal line and  $-60$  in red at its right end.

**Section 3:** A bar model with two green segments labeled  $x$ . Below it is a blue bar labeled  $460$ .

**Section 4:** A bar model with two green segments labeled  $x$ . Below it is a blue bar divided into two equal segments, each labeled  $230$ .

**Final Answer:**  $X=230$

**Problem:** Jason had 111 dollars to spend. After buying 5 books he had 11 dollars left. Each book costs the same amount. How much did each book cost?

$5b$

b ... b 11

111

Variables:

b = the price of one book

---

$5b$

b ... b ~~11~~  
~~-11~~

~~111~~  
~~-11~~

---

$5b$

b ... b

100

**Final Answer:** \$20

**Problem:**  $36 = 12 + 4x$

The diagram illustrates the solution to the equation  $36 = 12 + 4x$  through several steps:

- Step 1:** Shows the equation  $36 = 12 + 4x$  represented by a bar model. Four green boxes labeled  $x$  and one blue box labeled  $12$  are placed above a long blue bar labeled  $36$ .
- Step 2:** Shows the subtraction of  $12$  from both sides. A red diagonal line is drawn through the  $12$  box in the top row, and a red  $-12$  is written at the bottom right. Below, the long blue bar is also shown with a red diagonal line and a red  $-12$ .
- Step 3:** Shows the simplified equation  $24 = 4x$ . Four green boxes labeled  $x$  are above a blue bar labeled  $24$ .
- Step 4:** Shows the final solution. Four green boxes labeled  $x$  are above four blue boxes, each labeled  $6$ .
- Final Answer:** A box in the bottom right corner contains the text "Final Answer:  $X=6$ ".



Problem:  $50 = 10 + 4x$



Final Answer:  $X = 10$

**Problem:**  $12x + 3 = 43$

12

x 3 ... 3

43

---

x 36

43

---

x 36 -36

43 -36

---

x

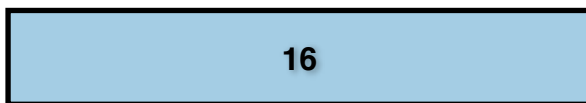
7

**Final Answer:**  $X = 7$

**Problem:**  $12 = x + (x-4)$



I added 4 to both sides  
of the equation



**Final Answer:**  $x = 8$

**Problem:**  $6x + 4 = 10$

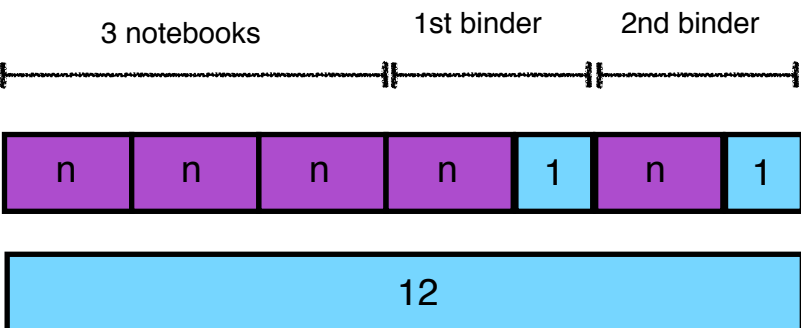
The diagram illustrates the steps to solve the equation  $6x + 4 = 10$  using algebra tiles:

- Step 1:** The equation is represented by six green tiles labeled  $x$  and one blue tile labeled  $4$ , with a bracket above labeled  $6x$ . Below is a blue bar representing the constant term  $10$ .
- Step 2:** To isolate the variable term,  $4$  is subtracted from both sides. This is shown by a red box around the  $4$  tile and a  $-4$  being added to it. Similarly, a red box around the  $10$  bar and a  $-4$  being added to it.
- Step 3:** The equation is now  $6x = 6$ . The  $4$  and  $-4$  tiles are removed, leaving six green  $x$  tiles. Below is a blue bar representing the constant term  $6$ .
- Step 4:** The equation is  $6x = 6$ . The six green  $x$  tiles are shown above six blue  $1$  tiles, indicating that  $x = 1$ .

**Final Answer:**  $x = 1$

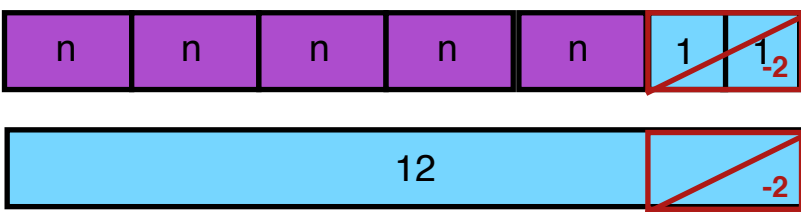
**Problem:** Alicia bought 3 notebooks and 2 binders, and her sister agreed to pay for the notebooks. Unfortunately, Alicia can't remember the cost of the notebooks! She does remember that each binder cost \$1 more than each notebook and that she spent \$12 total. How much does Alicia's sister need to pay Alicia?

3 notebooks
1st binder
2nd binder

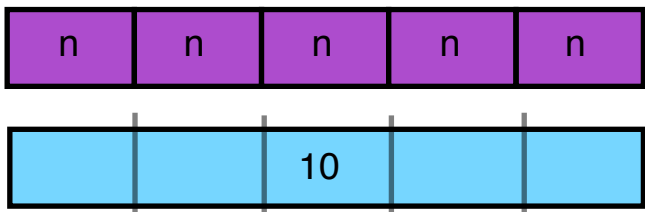


**Variable:**  
n = cost of one notebook

---

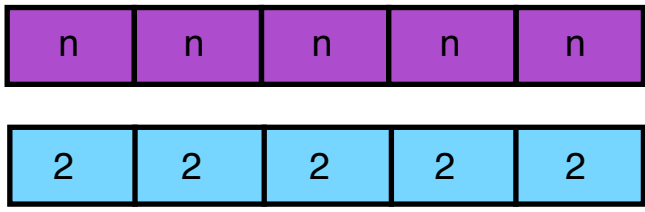



---



Each notebook costs 2 dollars, but her sister is paying for 3 notebooks...

---



$2 \times 3 = 6$

**Final Answer:** 6 dollars

**Problem:** Philippe and Finn go to see a movie. Each buys a ticket for \$7 and a slushie, spending \$18 together. How much does one slushie cost?

Philippe's Ticket      Philippe's Slushie      Finn's Ticket      Finn's Slushie

Variable:

s = cost of one slushie

---

7      s      7      s

20

---

s      s      7      7

20

---

s      s      14      -14

20      -14

---

s      s

6

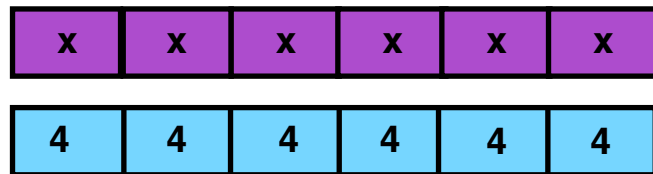
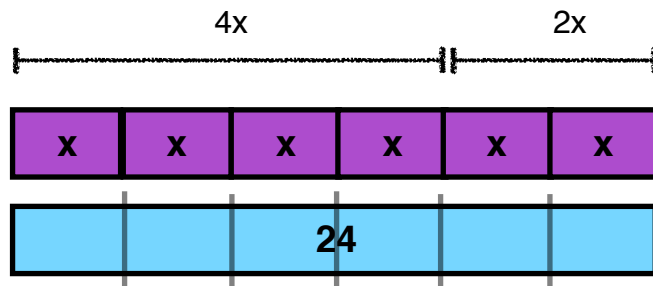
---

s      s

3      3

Final Answer: 3 dollars

**Problem:**  $4x + 2x = 24$



Final Answer:  $x = 4$

**Problem:** Jordan goes to the grocery store and buys one bag of chocolate, one bag of caramel, and one bag of lollipops. A bag of chocolate costs two dollars more than three times as much as a bag of caramel, and a bag of lollipops costs as much as buying a bag of caramel and a bag of chocolate. If Jordan spends 20 dollars for the three bags, how much does a bag of chocolate cost?

Variable:  
c = cost of one bag of caramel

chocolate
caramel
lollipops

The diagram illustrates the problem-solving process. It starts with a total cost of 20 dollars for three items: chocolate, caramel, and lollipops. The cost of chocolate is represented as  $3c + 2$  (three bags of caramel plus two dollars), the cost of caramel is  $c$ , and the cost of lollipops is  $c + 2$ . The total cost equation is  $3c + 2 + c + c + 2 = 20$ , which simplifies to  $5c + 4 = 20$ . The diagram shows that  $5c = 16$ , which is not a multiple of 5, indicating an error in the initial setup. The correct setup is  $3c + 2 + c + c + 2 = 20$ , which simplifies to  $5c + 4 = 20$ , leading to  $5c = 16$ . The diagram shows that the cost of chocolate is 2 dollars, the cost of caramel is 2 dollars, and the cost of lollipops is 4 dollars, totaling 20 dollars.

Final Answer: 2 dollars



**Problem:** Kim is three years older than her sister Jess and half as old as her cousin Lexi. If they add their ages together, they get 37. How old is Jess?

Variable:  
j = Jess' age

Jess                      Kim                      Lexi

---

---

---

---

Final Answer: 7 years old

**Problem:**  $3(x+2) + 4x = 27$

Diagram illustrating the algebraic equation  $3(x+2) + 4x = 27$  using algebra tiles. The tiles are arranged in rows, with labels above them indicating their dimensions:  $x+2$ ,  $x+2$ ,  $x+2$ , and  $4x$ .

The first row shows three  $(x+2)$  terms and one  $4x$  term. The second row shows a total of 27. The third row shows seven  $x$  tiles and three  $2$  tiles. The fourth row shows a total of 27. The fifth row shows seven  $x$  tiles and a triangle with a base of 6 and a height of -6. The sixth row shows a total of 27. The seventh row shows seven  $x$  tiles. The eighth row shows a total of 21. The ninth row shows seven  $x$  tiles. The tenth row shows seven  $3$  tiles.

Final Answer:  $x = 3$

**Problem:** Jeremiah had a busy Saturday morning! Starting at 9:00 am, he cleaned his bedroom for a while. Then he helped his mom clean the garage for four times as long as he had spent cleaning his room. Finally he cooked breakfast with his sister for ten minutes fewer than the time he had spent cleaning his room, until 9:56am. How many minutes did Jeremiah spend cleaning his room in the morning?

**Variable:**

t

 = time spent cleaning bedroom

Cleaning Bedroom                      Cleaning Garage                      Cooking Breakfast

t	t	t	t	t	t	<del>t</del>
56						

---

t	t	t	t	t	t	<del>t</del>
56						10

---

t	t	t	t	t	t
66					

---

t	t	t	t	t	t
11	11	11	11	11	11

Final Answer: 11 minutes

170

**Problem:** Izumi is running the mile (4 laps) at a track meet. She knows that she can run her first lap in 75 seconds. Izumi also knows that her second and third laps are the same speed, while her final lap is normally 9 seconds faster than her third lap. If she wants to finish in 6 minutes, how fast should her second lap be? (Note: there are 60 seconds in 1 minute)

First Lap
Second Lap
Third Lap
Fourth Lap

75	s	s	s	<del>9</del>
----	---	---	---	--------------

Variable:

s = time it takes to run the second lap

360
-----

6 x 60 = 360

---

s	s	s	75	<del>9</del>
---	---	---	----	--------------

360
-----

---

s	s	s	<del>66</del>	<del>66</del>
---	---	---	---------------	---------------

360		<del>66</del>
-----	--	---------------

---

s	s	s
---	---	---

	294	
--	-----	--

---

s	s	s
---	---	---

98	98	98
----	----	----

Final Answer: 98 seconds

**Problem:**  $5(x+5) - 2(2x+4) = 18$

The diagram illustrates the algebraic process of solving the equation  $5(x+5) - 2(2x+4) = 18$  using a block model.

- Step 1:** The expression  $5(x+5)$  is represented by five blocks, each containing  $x$  and  $5$ . The expression  $-2(2x+4)$  is represented by two blocks, each containing  $-x$ ,  $-x$ , and  $-4$ . A bracket below these two blocks is labeled  $-(2x+4)$ .
- Step 2:** The blocks are rearranged to show cancellation. The  $x$  blocks from the first term and the  $-x$  blocks from the second term are crossed out. The  $5$  blocks from the first term and the  $-4$  blocks from the second term are also crossed out. A blue box labeled  $18$  is shown below the remaining blocks.
- Step 3:** The remaining blocks are simplified. The  $x$  blocks are crossed out, leaving one  $x$  block. The  $5$  blocks and  $-4$  blocks are simplified to a single  $5$  block and a  $-4$  block. A blue box labeled  $18$  is shown below.
- Step 4:** The equation is further simplified. The  $x$  block is moved to the left, and the  $5$  and  $-4$  blocks are combined to form  $1$ . A blue box labeled  $18$  is shown below.
- Step 5:** The final simplified equation is shown:  $x + 1 = 18$ . The  $x$  block is in a purple box, and the  $1$  block is in a blue box.
- Final Answer:** A box labeled "Final Answer:  $x = 1$ " is shown at the bottom right.

**Problem:** Jamal has three reading assignments to complete. In total he has to read 70 pages. Assignment 2 is twice as long as assignment 1, and assignment 3 is four times long as assignment 1. How many pages is his shortest assignment?

**Variable:**

s = Length of the shortest assignment (Assignment 1)

Assignment 1
Assignment 2
Assignment 3

---

---

Final Answer: 10 pages

**Problem:** Malia and Megan ordered 3 pizzas and each pizza had 8 slices. Their friend Niver ate 4 slices of pizza, their friend Shayna ate twice as many pieces as Niver. Malia and Megan ate all of the remaining slices. How many slices did Malia and Megan eat?

Niver
Shayna
Malia and Megan

S

= number of slices  
Malia and Megan ate

4

4

4

s

24

s

4

4

4

24

s

12

24

s

12

-12

24

s

12

12

Final Answer: 12 slices

$3 \times 8 = 24$

**Problem:**  $2(2x + 5 + x) + 10 - x = 60$

The diagram illustrates the solution to the equation  $2(2x + 5 + x) + 10 - x = 60$  through several steps:

- Step 1:** The equation is represented by a row of blocks: two purple blocks labeled  $x$ , a light blue block labeled  $5$ , another two purple blocks labeled  $x$ , a second light blue block labeled  $5$ , a third purple block labeled  $x$ , and a light blue block labeled  $10$ . A red box with a diagonal line and  $-x$  is attached to the right end. Above the row, two brackets each labeled  $2x + 5 + x$  span the first six blocks. Below the row is a light blue bar labeled  $60$ .
- Step 2:** The row of blocks is rearranged: five purple blocks labeled  $x$ , two light blue blocks labeled  $5$ , and a light blue block labeled  $10$ . A red box with a diagonal line and  $-x$  is attached to the right end. Below the row is a light blue bar labeled  $60$ .
- Step 3:** The row of blocks is rearranged: five purple blocks labeled  $x$ , a light blue bar labeled  $20$ , and a red box with a diagonal line and  $-20$  attached to the right end. Below the row is a light blue bar labeled  $60$ .
- Step 4:** The row of blocks is simplified to five purple blocks labeled  $x$ . Below the row is a light blue bar labeled  $40$ .
- Step 5:** The row of blocks is simplified to five light blue blocks labeled  $8$ .

**Final Answer:**  $x = 8$



**Problem:** Shailee and Sofia are on a roadtrip to see their grandparents. They drive for a while before stopping for lunch. After that, they drive again for 3 hours before getting gas. Before reaching their grandparents house, they drive 1 hour less than twice as long as they drove before the first stop. In total, they drove 14 hours on their trip. How long did they drive before the first stop, for lunch?

before first stop
before stopping for gas
before reaching their grandparent's house

Variable:

t = time spent driving before first

---

t

3

t

t

~~-1~~

14

---

t

t

t

3

~~-1~~

14

---

t

t

t

~~2-2~~

14

14

---

t

t

t

12

---

t

t

t

4

4

4

Final Answer: 4 hours

176

**Problem:** Marcos picked up three books from the library. *The Uglies* is twice as long as *A Wrinkle In Time*, and *A Wrinkle In Time* is forty pages longer than *The BFG*. Altogether, the three books have 960 pages. How many pages long is *The BFG*?

The BFG
A Wrinkle In Time
The Uglies

Variable:  
p = number of pages in *The BFG*

---



---



---



---

Final Answer: 210 pages

**Problem:**  $3(x + 8) + 2(x + 1) = 36$

The diagram illustrates the solution to the equation  $3(x + 8) + 2(x + 1) = 36$  through several steps:

- Step 1:** A number line shows three segments of length  $x + 8$  and two segments of length  $x + 1$ . Below it, a bar model shows three blocks of  $x$  and  $8$ , and two blocks of  $x$  and  $1$ .
- Step 2:** A single bar model shows the total value of 36.
- Step 3:** A dashed line separates the next step, where the terms are grouped into five  $x$ 's, three  $8$ 's, and two  $1$ 's.
- Step 4:** A bar model shows the total value of 36.
- Step 5:** A dashed line separates the next step, where a red triangle is drawn to show the cancellation of 26 from both sides. The top bar has five  $x$ 's and a value of 26, while the bottom bar has a value of 36 and a value of -26.
- Step 6:** A dashed line separates the next step, where the remaining terms are shown: five  $x$ 's and a value of 10.
- Step 7:** A dashed line separates the final step, where the terms are simplified to five  $x$ 's and five 2's.
- Final Answer:** A box contains the text "Final Answer:  $x = 2$ ".

**Problem:** Frankie and Lana are both selling candy for a school fundraiser. Frankie sells three boxes of chocolate in addition to \$12 worth of hard candies. Lana sells seven boxes of chocolate and brags that she has earned \$4 more than Frankie. How much does each box of chocolates cost?

$3b$

Frankie made \$4 less than Lana

**Variable:**

$b$  = cost of one box of chocolate

---

---

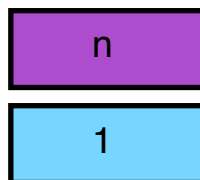
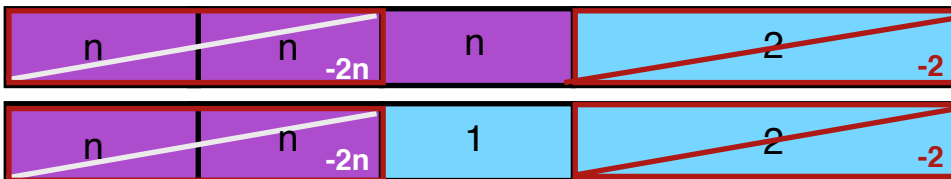
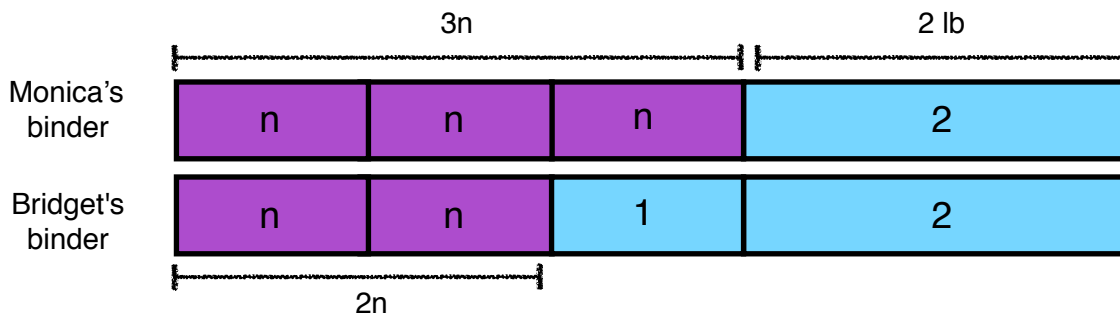
---

Final Answer: 4 dollars

**Problem:** Monica and Bridget bought the same binders for school, and after filling them with school supplies, they weigh the same amount! Monica's binder contains a pencil pouch that weighs 2 pounds and 3 notebooks. Bridget's binder contains a stapler that weighs 1 pound, a pack of crayons that weighs 2 pounds, and 2 notebooks. How much does 1 notebook weigh?

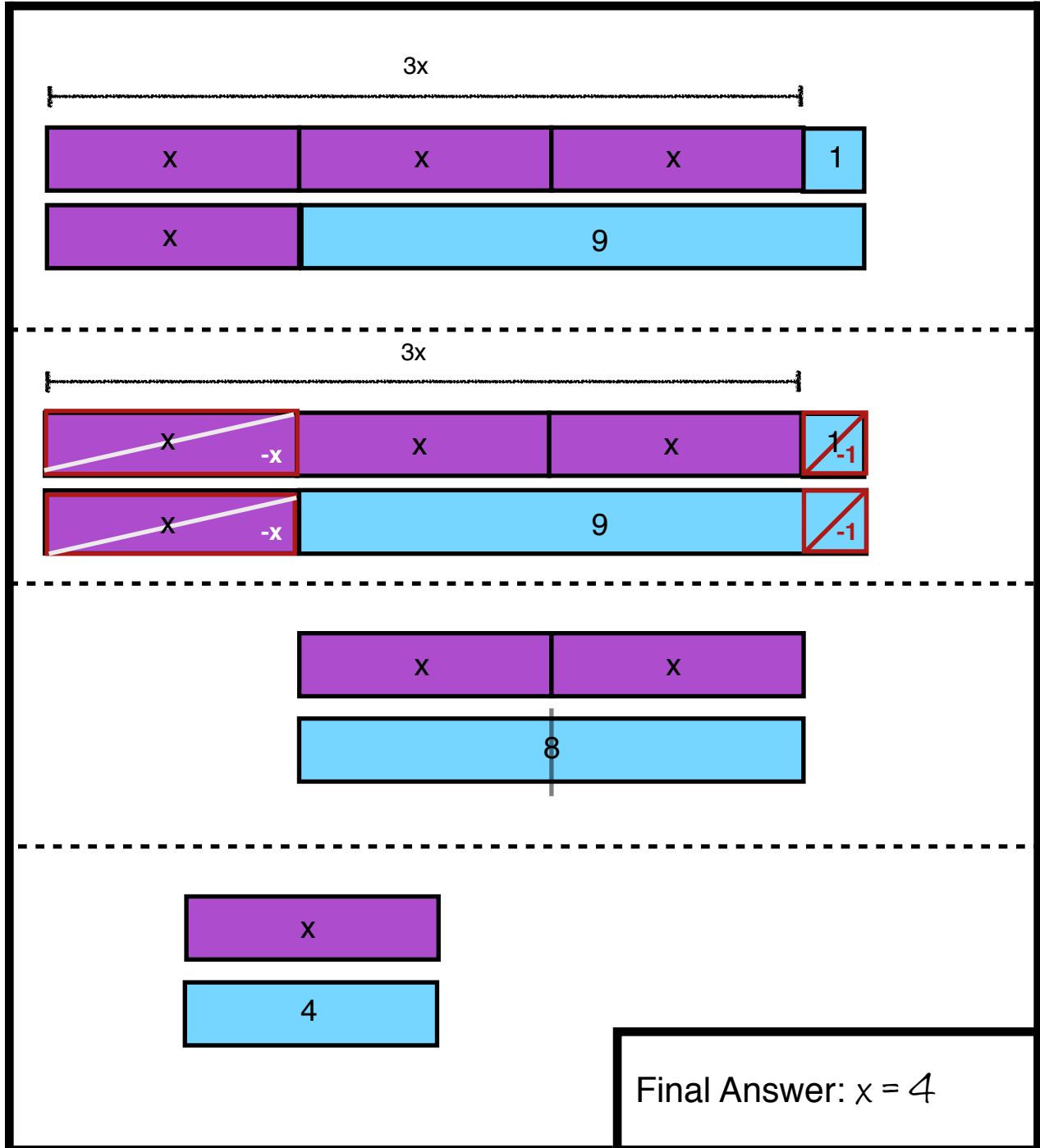
Variable:

$n$  = weight of one notebook



Final Answer: 1 pound

**Problem:**  $3x+1=x+9$



**Problem:** Jimmy always goes on runs that are the same distance. Last week he went on a run where he ran his favorite trail 2 times and then ran 3 miles to the park. Today, he ran his favorite trail 3 times and then ran 1 more mile. How many miles is his favorite trail?

Variable:

f

 = miles of favorite trail

$2f$

Last week's run:

Today's run:

$3f$

---

f
f
 $-2f$ 
3
 $-1$

f
f
 $-2f$ 
f
1
 $-1$

---

Final Answer: 2 miles

**Problem:** Samantha and Carlos wore braces for the same number of years. Samantha can't remember how many years her doctor said she would need braces for, but she knows she had braces for 3 years longer than the doctor expected. Carlos had braces for twice as long as Samantha was supposed to. How long was Samantha supposed to have braces for?

**Variable:**

s

 = time Samantha was supposed to have braces

Samantha

s

3

Carlos

s

s

s

3

s

s

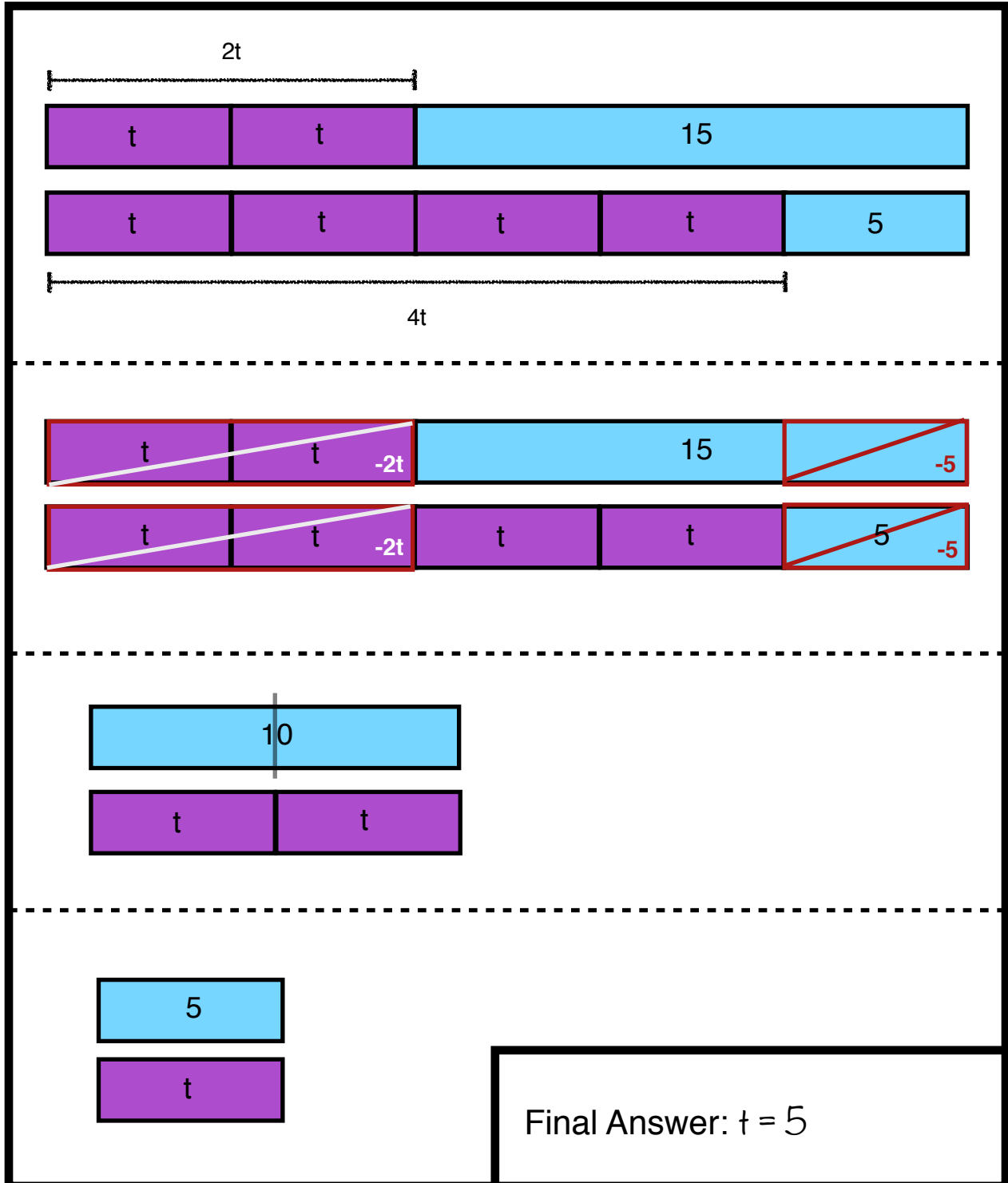
3

s

Final Answer: 3 years



**Problem:**  $2t + 15 = 4t + 5$



**Problem:** In middle school, Frank and AJ went to the same number of dances. Frank went to 2 dances in 6th grade, and 3 dances in 7th grade. AJ didn't go to any dances 6th grade, and went to to 1 dance in 7th grade. In 8th grade AJ went to three times as many dances as Frank. How many dances did Frank go to in 8th grade?

**Variable:**  
 $x$  = dances Frank went to in 8th grade

Frank	$x$	2	3	
AJ	$x$	$x$	$x$	1
	$\underbrace{\hspace{15em}}_{3x}$			

---

Frank	$x$	5
AJ	$3x$	
	$x$	5
	$3x$	1

---

$x$	$-x$	5	$-1$
$x$	$-x$	$3x$	1

---

4		2
$2x$		$x$

Final Answer: 2 dances

**Problem:** Samantha and Elsa have the same number of photos on their phones, and all of their pictures are either selfies or pictures of their pet. Samantha’s phone has 5 times as many selfies as Elsa’s. Elsa’s phone has 20 pictures of her dog, and Samantha’s phone has 4 pictures of her cat. How many selfies does Elsa have on her phone?

Variable:

s = number of selfies Elsa has

$5s$

Samantha	s	s	s	s	s	4
Elsa	s	20				

---

<del>s</del>	<del>-s</del>	s	s	s	s	s	<del>4</del>	<del>-4</del>
<del>s</del>	<del>-s</del>	20					<del>-4</del>	

---

s	s	s	s
<div style="display: flex; justify-content: space-between; width: 100%;"> <span style="width: 25%;"></span> <span style="width: 25%; text-align: center;">16</span> <span style="width: 25%;"></span> </div>			

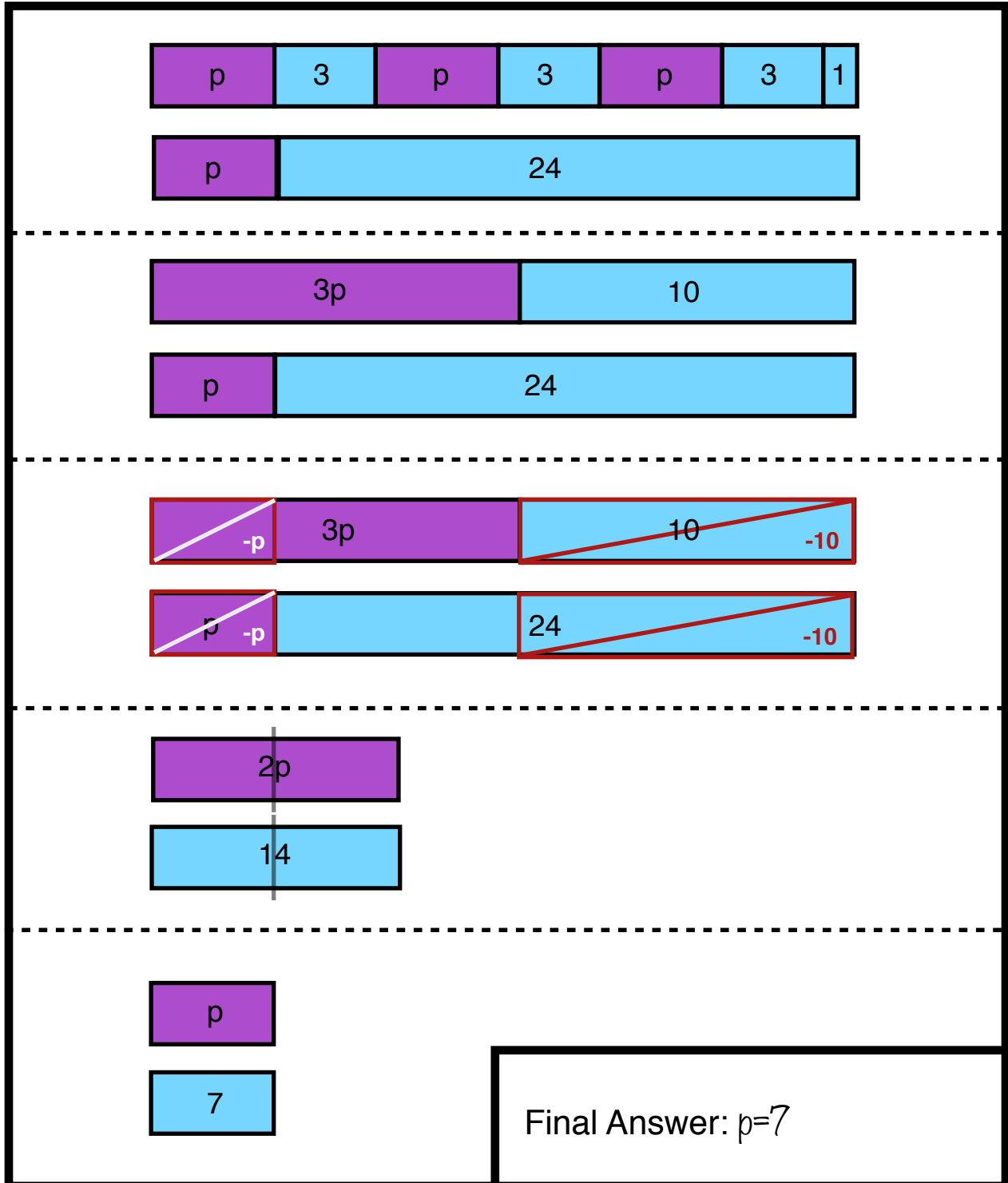
---

s
4

Final Answer: 4 selfies

186


**Problem:**  $3(p + 3) + 1 = p + 24$

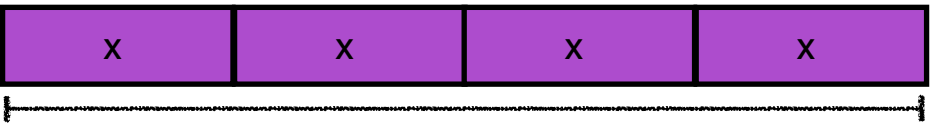


**Problem:** Every Friday, Lola has her friends over and they eat pizza rolls. Last week her friends made 3 boxes of pizza rolls and ate 5 pizza rolls that were leftover in the fridge. This week they ate 4 boxes of pizza rolls and ate 3 more rolls than they ate last week. How many pizza rolls are there in one box?

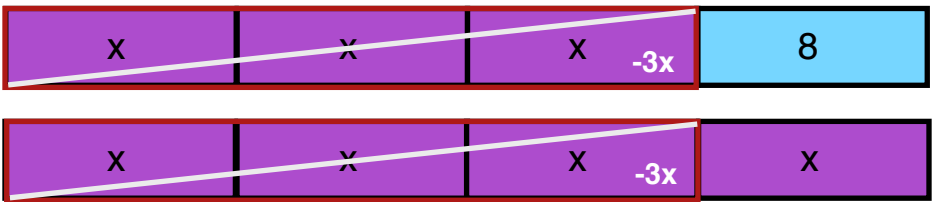
**Variable:**  
 $x$  = # pizza rolls in one box

$3x$   $+3$

Last week 

This week 

---



8

x

Final Answer: 8 pizza rolls in one box

**Problem:** Frank has eleven siblings, and they all like to eat cheese sticks. Their dad buys the same number of cheese sticks every week. Last week, Frank ate many cheese sticks, and each of his siblings ate three cheese sticks. This week, Frank and his sister Sofia *each* ate one more than Frank had eaten the week before, and each of their *other* siblings ate two cheese sticks. How many cheese sticks did Frank eat last week?

Variable:

s = # string cheeses Frank ate last week

3x11= string cheese eaten by siblings

Last week  33

This week  1  1 20

2x10= string cheese eaten by siblings

---

33

22

---

33  -22

22  -22

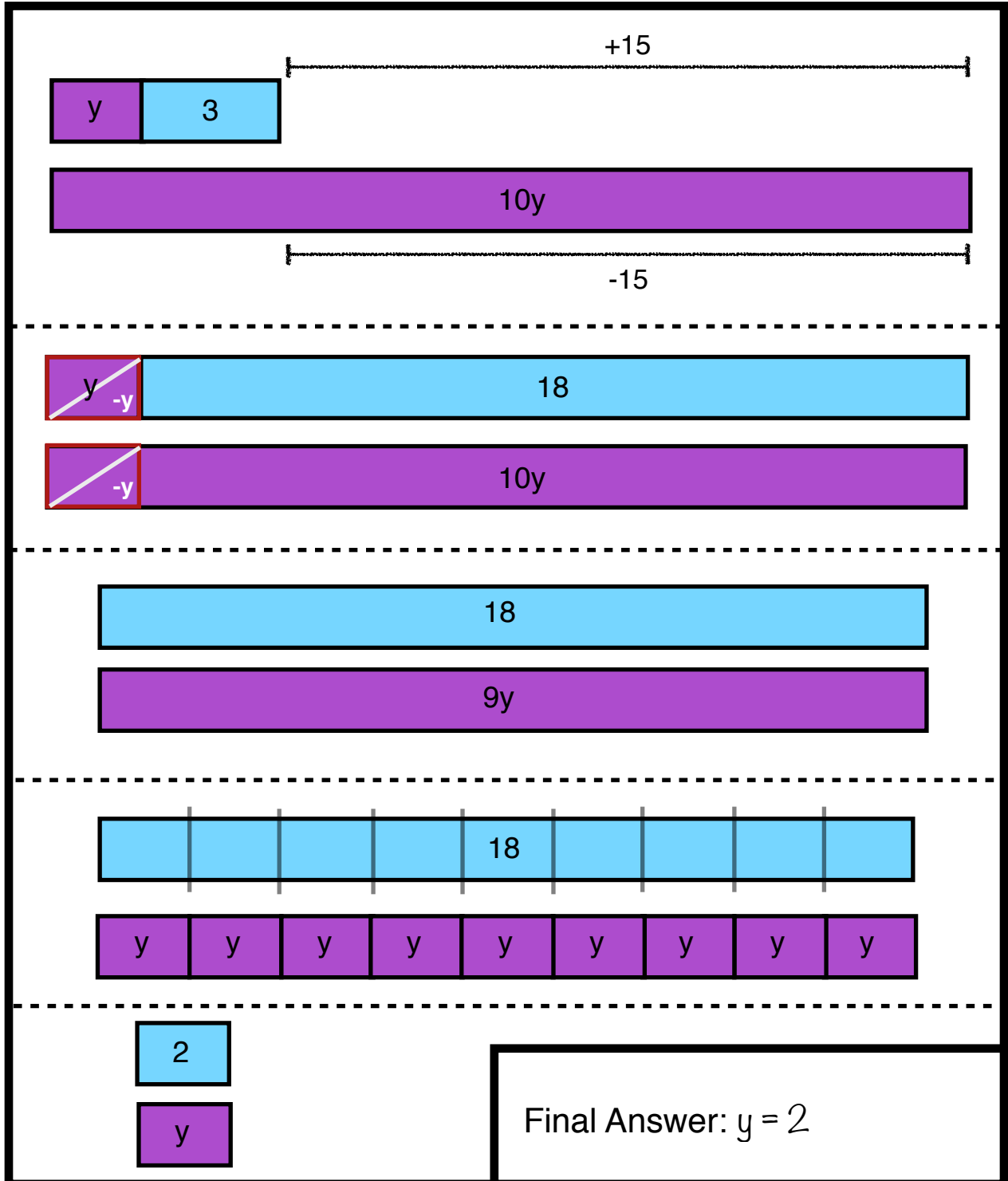
---

11

s

Final Answer: 11 string cheeses

**Problem:**  $y + 3 = 10y - 15$



**Problem:** Gretchen plays the clarinet, and her teacher has a required amount of time that a practice session is supposed to last. Last week she practiced the required amount of time 6 times, and practiced for 30 extra minutes on Thursday. This week she practiced the required amount 5 times and practiced 90 minutes less this week than last week. How long does Gretchen’s teacher require that a practice session last?

**Variable:**  
x = minutes required for practice session

$6x$

Last week: x x x x x x 30

This week: x x x x x

$5x$   $+90$

---

$6x$

$30$

$5x$

$90$

---

$6x$

$-5x$

~~$30$~~

~~$-30$~~

$5x$

$-5x$

$90$

~~$-30$~~

---

x

60

Final Answer: 60 minutes

101



**Problem:** Ron and Harry love to tell jokes. On Tuesday Ron told 3 jokes in each class period and Harry told 5 jokes in each class period. Ron also told 8 jokes during lunch, and Harry told 2 jokes during lunch. If they only told jokes during class and at lunch, and they both told the same number of jokes on Tuesday, how many class periods were there on Tuesday?

Variable:

x = # class periods Tuesday

x times

Ron ... 3 8

Harry 5 ... 5 2

x times

---

In every class period, Ron tells 3 jokes for Harry's 5 jokes. So Harry tells 2 more jokes every class period. I can use that to simplify the model!

8 -2

2 ... 2 2 -2

x times

---

6

2 ... 2

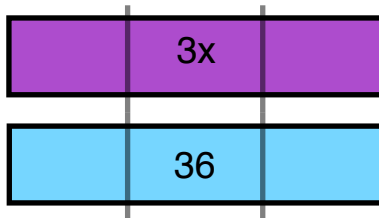
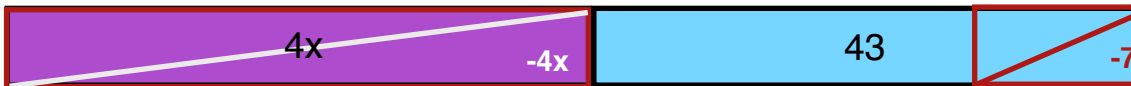
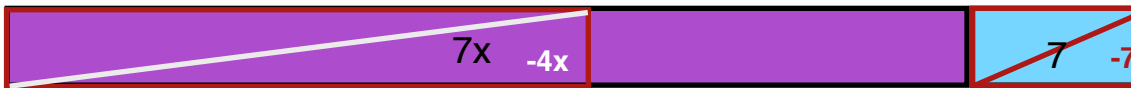
x times

Final Answer: 3 periods

**Problem:**  $7(x+1) = 4x + 43$

drawing 7 “x” blocks and 7 “1” blocks is too much work, so I will use the distributive property to make it easier.

$$7(x+1) = 7x + 7$$



Final Answer:  $x = 12$