COMPOSITION BOOK

Ms. Forbes'

Math 7 Journal

Unit 4: Proportional Relationships and Percentages

80 Sheets • 160 pages
4½ in x 3¼ in/11.4 cm x 8.2 cm

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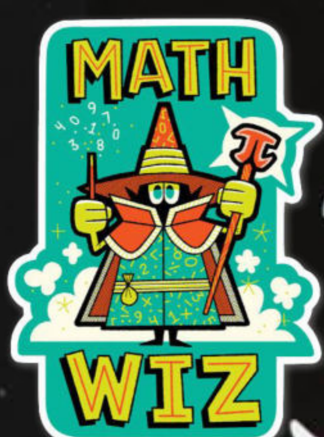

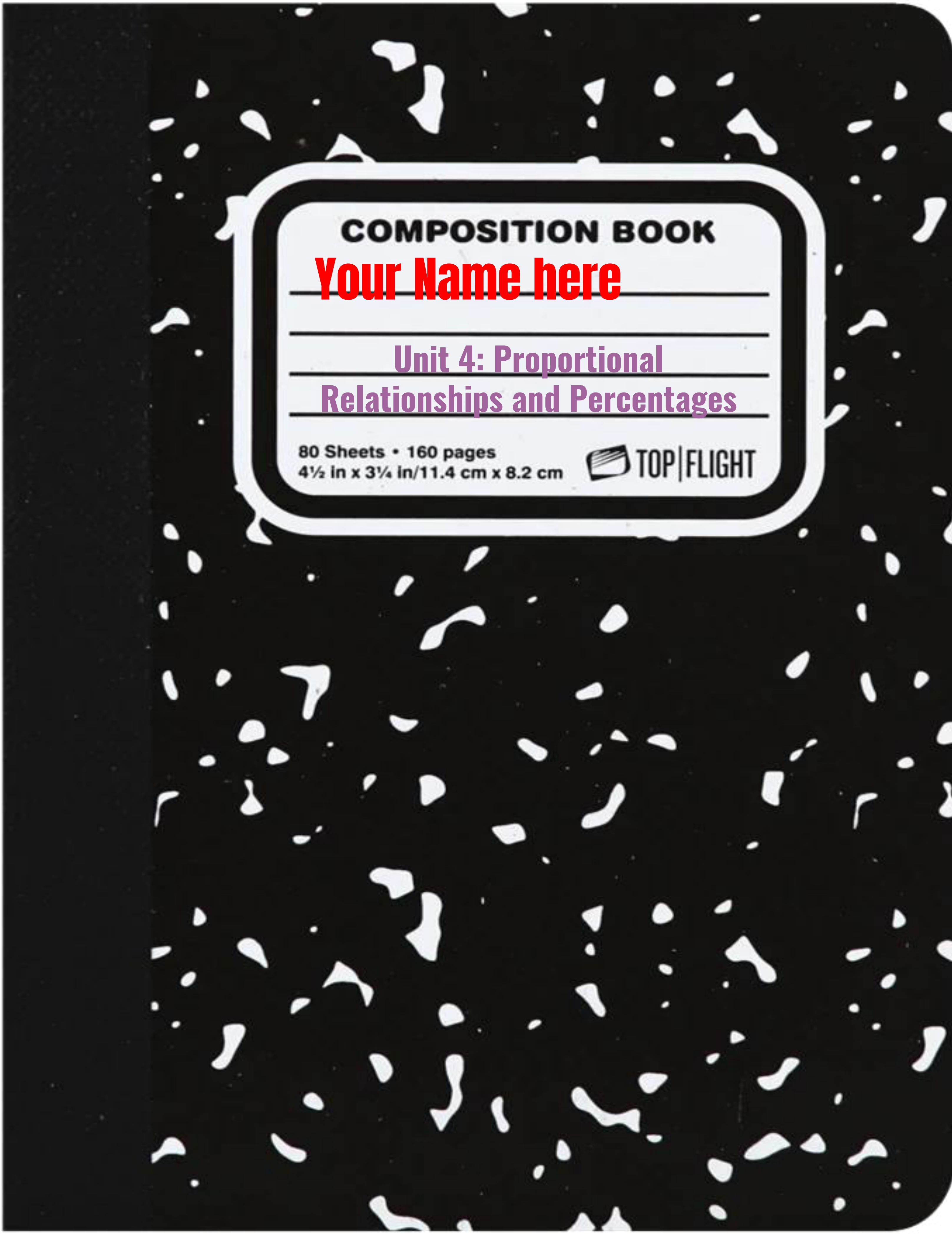
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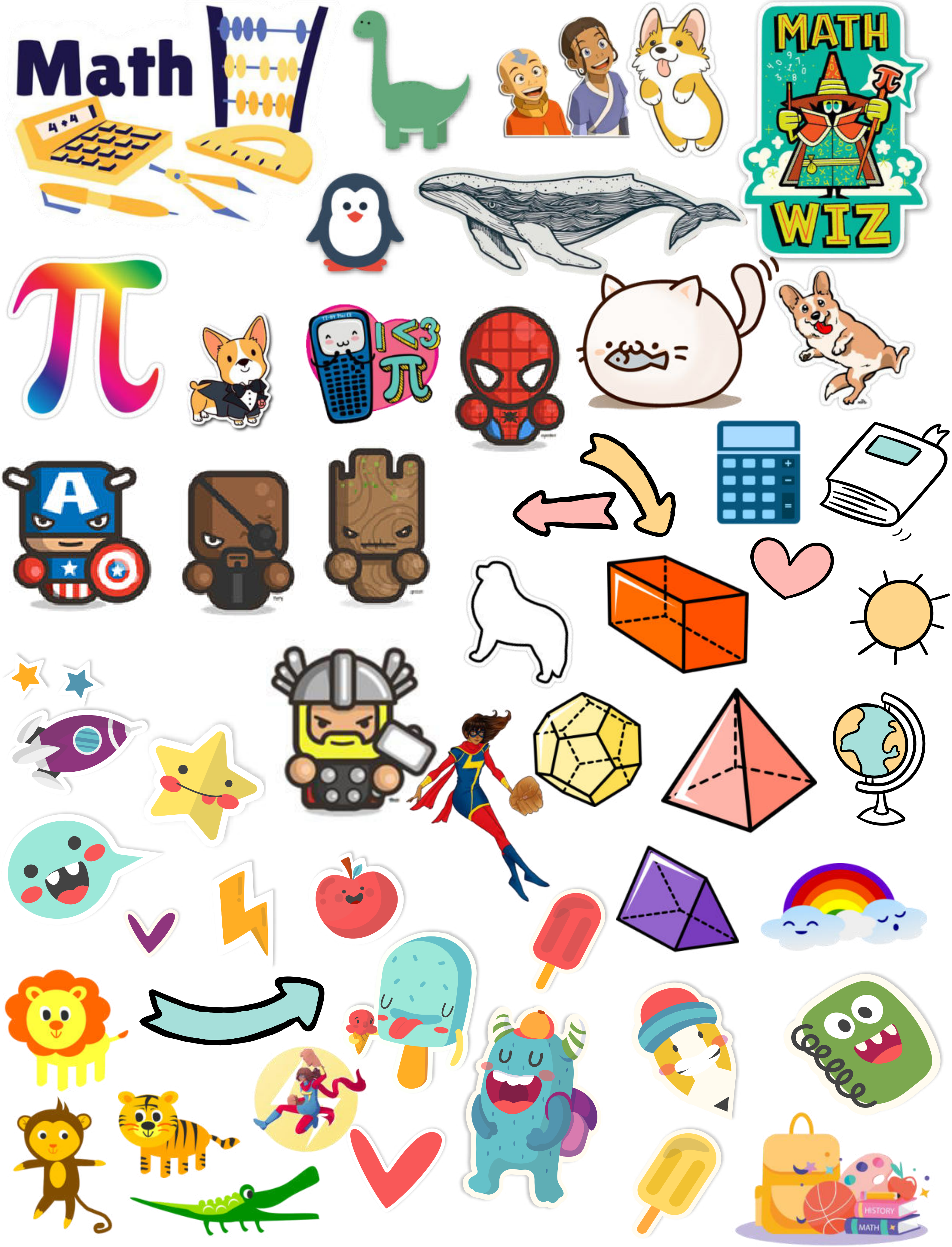
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OK!
STRANGER THINGS
NOPE
COMPOSITION
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STAR WARS

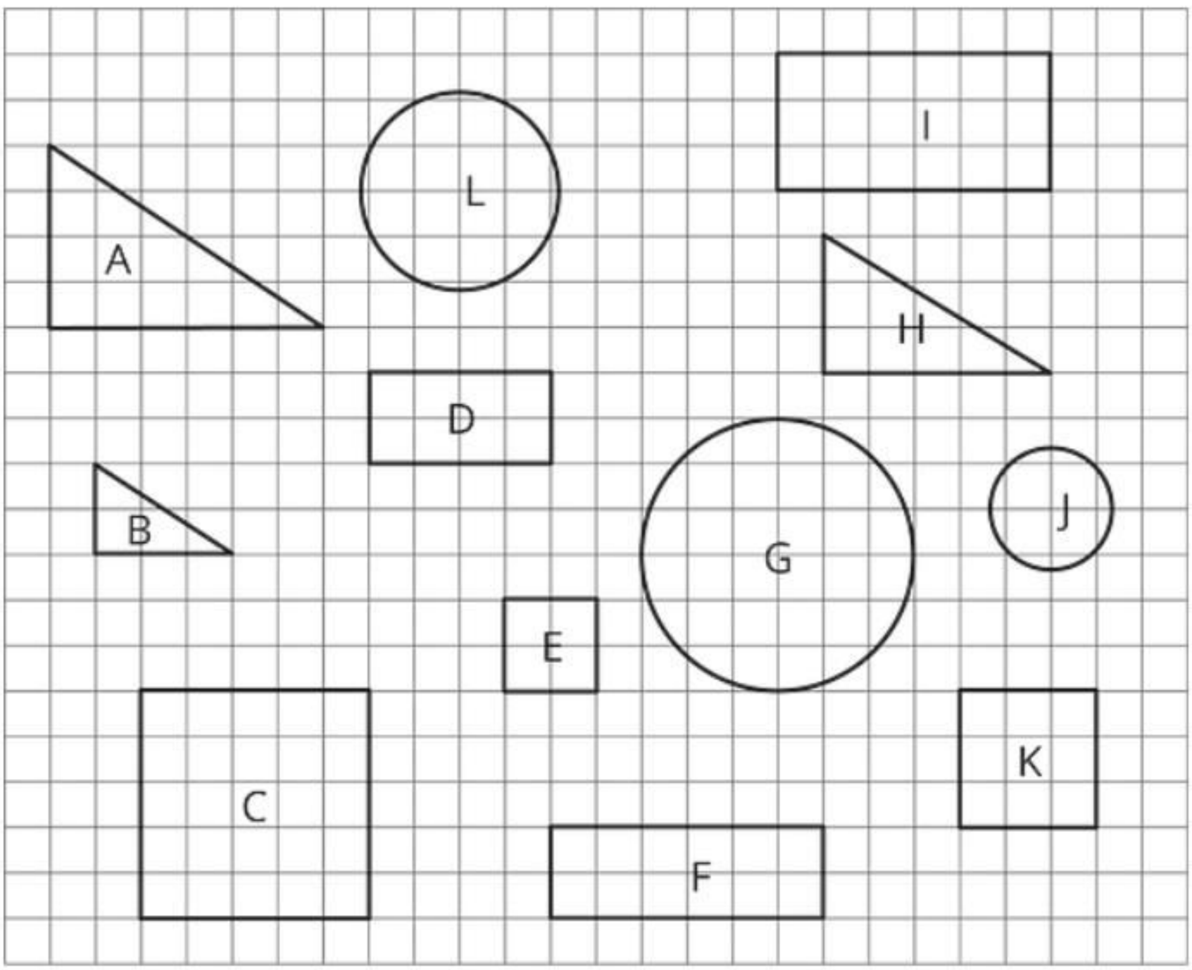
Table of Contents

Lesson 1

Lesson 1: Lots of Flags

Scaled or Not?

Which of the geometric objects are scaled versions of each other?



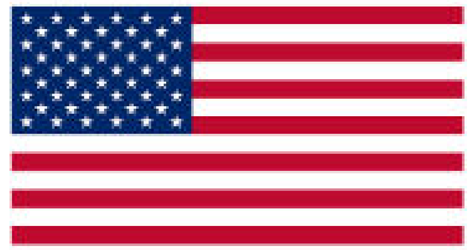
Pick two of the objects that are scaled copies and find the scale factor.

Flags Are Many Sizes

One standard size for the United States flag is 19 feet by 10 feet. On a flag of this size, the union (the blue rectangle in the top-left corner) is $7\frac{5}{8}$ feet by $5\frac{3}{8}$ feet.

There are many places that display flags of different sizes.

- Many classrooms display a U.S. flag.
- Flags are often displayed on stamps.
- There was a flag on the space shuttle.
- Astronauts on the Apollo missions had a flag on a shoulder patch.



"US flag clip art" via OpenClipArt. Public Domain.

Choose one of the four options and decide on a size that would be appropriate for this flag. Find the size of the union.

Share your answer with another group that used a different option. What do your dimensions have in common?

What Percentage IS the Union?

On a U.S. flag that is 19 feet by 10 feet, the union is $7\frac{5}{8}$ feet by $5\frac{3}{8}$ feet. For each question, first estimate the answer and then compute the actual percentage.

What percentage of the flag is taken up by the union?

What percentage of the flag is red? Be prepared to share your reasoning.

Lesson 1 Summary

width	height
15	5
2	h

Imagine you have a painting that is 15 feet wide and 5 feet high. To sketch a scaled copy of the painting, the ratio of the width and height of a scaled copy must be equivalent to $15 : 5$. What is the height of a scaled copy that is 2 feet across?

We know that the height is $\frac{1}{3}$ the width, so $h = \frac{1}{3} \cdot 2$ or $\frac{2}{3}$.

Sometimes ratios include fractions and decimals. We will be working with these kinds of ratios in the next few lessons.

Lesson 2

Lesson 2: Ratios and Rates with Fractions

A Train Traveling at ...

A train is traveling at a constant speed and goes 7.5 kilometers in 6 minutes. At that rate:

How far does the train go in 1 minute?

"Freight train photo" by hpgruesen via Pixabay. Public Domain.

How far does the train go in 100 minutes?

Comparing Running Speeds

Lin ran $2\frac{3}{4}$ miles in $\frac{2}{5}$ of an hour. Noah ran $8\frac{2}{3}$ miles in $\frac{4}{3}$ of an hour.

What do you notice? What do wonder?

We came up with some questions that can be answered with the information.
Choose one of the questions and find the answer.

Share your answer with your partner and see if they can guess what question you answered.

Then, switch and see if you can guess what question they answered.

Lesson 2 Summary

There are 12 inches in a foot, so we can say that for every 1 foot, there are 12 inches, or the ratio of feet to inches is $1 : 12$. We can find the unit rates by dividing the numbers in the ratio:

$1 \div 12 = \frac{1}{12}$
so there is $\frac{1}{12}$ foot per inch.

$12 \div 1 = 12$
so there are 12 inches per foot.

The numbers in a ratio can be fractions, and we calculate the unit rates the same way: by dividing the numbers in the ratio. For example, if someone runs $\frac{3}{4}$ mile in $\frac{11}{2}$ minutes, the ratio of minutes to miles is $\frac{11}{2} : \frac{3}{4}$.

$\frac{11}{2} \div \frac{3}{4} = \frac{22}{3}$, so the person's pace is $\frac{22}{3}$ minutes per mile.

$\frac{3}{4} \div \frac{11}{2} = \frac{3}{22}$, so the person's speed is $\frac{3}{22}$ miles per minute.

Lesson 3

Lesson 3: Revisiting Proportional Relationships

Recipe Ratios

A recipe calls for $\frac{1}{2}$ cup sugar and 1 cup flour. Complete the table to show how much sugar and flour to use in different numbers of batches of the recipe.

sugar (cups)	flour (cups)
$\frac{1}{2}$	1
$\frac{3}{4}$	
	$1\frac{3}{4}$
1	
	$2\frac{1}{2}$

The Price of Rope

Two students are solving the same problems: At a hardware store, they can cut a length of rope off a big roll, so you can buy any length you like. The cost for 6 feet of rope is $7.50. How much would you pay for 50 feet of rope, at this rate?

Kiran knows he can solve the problem this way.

	length of rope (feet)	price of rope (dollars)	
	6	7.50	
$\cdot \frac{1}{6}$	1	1.25	$\cdot \frac{1}{6}$
$\cdot 50$	50		$\cdot 50$

What would be Kiran's answer?

Kiran wants to know if there is a more efficient way of solving the problem. Priya says she can solve the problem with only 2 rows in the table.

length of rope (feet)	**price of rope (dollars)**
6	7.50
50	

What do you think Priya's method is?

Swimming, Manufacturing, and Painting

Tyler swims at a constant speed, 5 meters every 4 seconds. How long does it take him to swim 114 meters?

distance (meters)	time (seconds)
5	4
114	

A factory produces 3 bottles of sparkling water for every 8 bottles of plain water. How many bottles of sparkling water does the company produce when it produces 600 bottles of plain water?

number of bottles of sparkling water	number of bottles of plain water

A certain shade of light blue paint is made by mixing 1 ½ quarts of blue paint with 5 quarts of white paint. How much white paint would you need to mix with 4 quarts of blue paint?

For each oif the previous three situations, write an equation to represent the proportional relationship.

Lesson 3 Summary

If we identify two quantities in a problem and one is proportional to the other, then we can calculate the constant of proportionality and use it to answer other questions about the situation. For example, Andre runs at a constant speed, 5 meters every 2 seconds. How long does it take him to run 91 meters at this rate?

In this problem there are two quantities, time (in seconds) and distance (in meters). Since Andre is running at a constant speed, time is proportional to distance. We can make a table with distance and time as column headers and fill in the given information.

distance (meters)	time (seconds)
5	2
91	

To find the value in the right column, we multiply the value in the left column by $\frac{2}{5}$ because $\frac{2}{5} \cdot 5 = 2$. This means that it takes Andre $\frac{2}{5}$ seconds to run one meter.

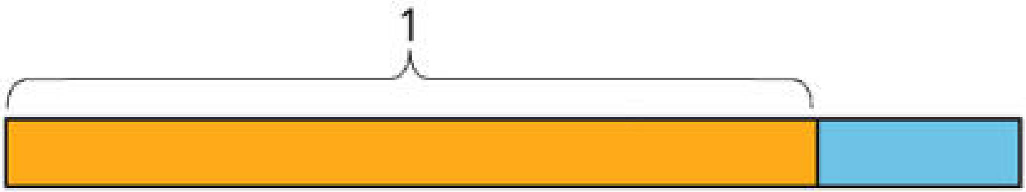
At this rate, it would take Andre $\frac{2}{5} \cdot 91 = \frac{182}{5}$, or 36.4 seconds to walk 91 meters. In general, if t is the time it takes to walk d meters at that pace, then $t = \frac{2}{5}d$.

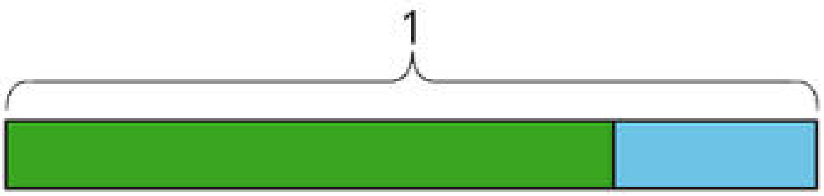
Lesson 4

Lesson 4: Half as Much Again

Notice and Wonder: Tape Diagrams

What do you notice? What do you wonder?





Walking Half as Much Again

Complete the table to show the total distance walked in each case.

a. Jada's pet turtle walked 10 feet, and then half that length again.

a. Jada's baby brother walked 3 yards, and then half that length again.

a. Jada's hamster walked 4.5 km, and then half that length again.

a. Jada's robot walked 1 mile, and then half that length again.

a. A person walked x meters and then half that length again.

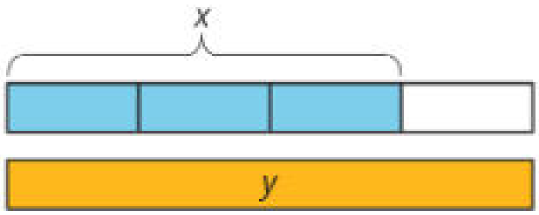
initial distance	total distance
10	
3	
4.5	
1	
x	

Explain how you computed the total distance in each case.

More and Less

Match each situation with a diagram. A diagram may not have a match.

A



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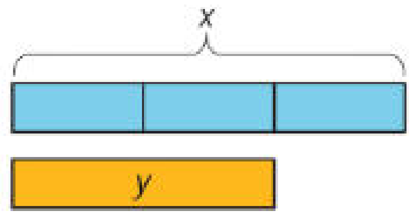
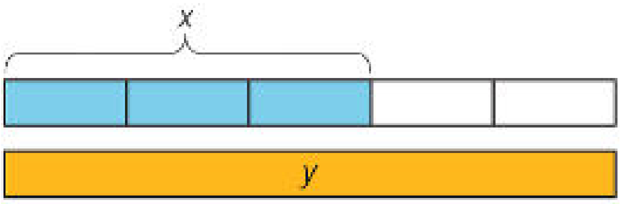


B



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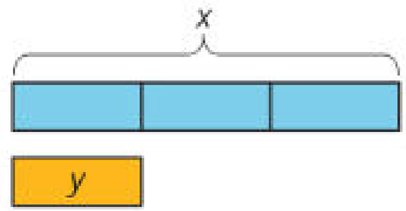


a. Han ate x ounces of blueberries. Mai ate $\frac{1}{3}$ less than that.

____

b. Mai biked x miles. Han biked $\frac{2}{3}$ more than that.

____

c. Han bought x pounds of apples. Mai bought $\frac{2}{3}$ of that.

____

For each diagram, write an equation that represents the relationship between x and y.

a. Diagram A:

b. Diagram B:

c. Diagram C:

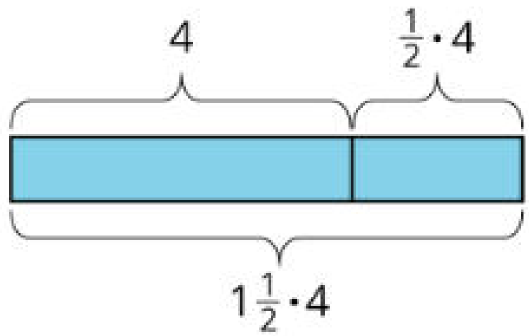
d. Diagram D:

Write a story for one of the diagrams that doesn’t have a match.

Lesson 4 Summary

Using the distributive property provides a shortcut for calculating the final amount in situations that involve adding or subtracting a fraction of the original amount.

For example, one day Clare runs 4 miles. The next day, she plans to run that same distance plus half as much again. How far does she plan to run the next day?



Tomorrow she will run 4 miles plus $\frac{1}{2}$ of 4 miles. We can use the distributive property to find this in one step:
$1 \cdot 4 + \frac{1}{2} \cdot 4 = \left(1 + \frac{1}{2}\right) \cdot 4$

Clare plans to run $1\frac{1}{2} \cdot 4$, or 6 miles.

This works when we decrease by a fraction, too. If Tyler spent x dollars on a new shirt, and Noah spent $\frac{1}{3}$ less than Tyler, then Noah spent $\frac{2}{3}x$ dollars since $x - \frac{1}{3}x = \frac{2}{3}x$.

Lesson 5

Lesson 5: Say It with Decimals

Notice and Wonder: Fractions to Decimals

A calculator gives the following decimal representations for some unit fractions:

$\frac{1}{2} = 0.5$

$\frac{1}{3} = 0.3333333$

$\frac{1}{4} = 0.25$

$\frac{1}{5} = 0.2$

$\frac{1}{6} = 0.1666667$

$\frac{1}{7} = 0.142857143$

$\frac{1}{8} = 0.125$

$\frac{1}{9} = 0.1111111$

$\frac{1}{10} = 0.1$

$\frac{1}{11} = 0.0909091$

What do you notice? What do you wonder?

Repeating Decimals

Use long to express each fraction as a decimal.

$\frac{9}{25}$ $\frac{11}{30}$ $\frac{4}{11}$

What is similar about your answers to the previous question? What is different?

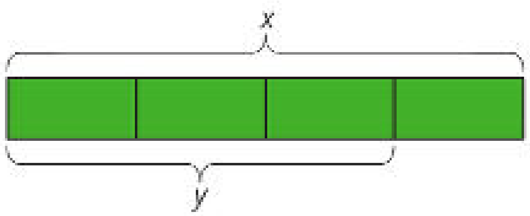
Use the decimal representations to decide which of these fractions has the greatest value. Explain your reasoning.

More and Less with Decimals

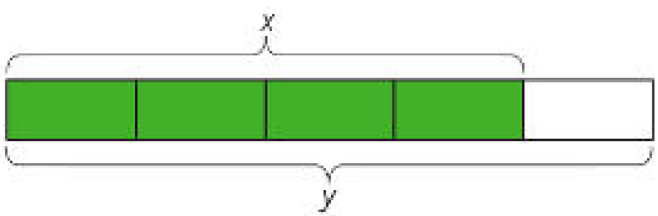
Match each diagram with a description and equation.

Diagrams:

A



B



Descriptions:

An increase by $\frac{1}{4}$

An increase by $\frac{1}{3}$

An increase by $\frac{2}{3}$

A decrease by $\frac{1}{5}$

A decrease by $\frac{1}{4}$

Equations:

$y = 1.\overline{6}x$

$y = 1.\overline{3}x$

$y = 0.75x$

$y = 0.4x$

$y = 1.25x$

Draw a diagram for one of the unmatched equations.

Lesson 5 Summary

Long division gives us a way of finding decimal representations for fractions.

For example, to find a decimal representation for $\frac{9}{8}$, we can divide 9 by 8.

So $\frac{9}{8} = 1.125$.

```
    1.125
 8)9.000
   8
   1 0
     8
    20
    16
     40
     40
      0
```

Sometimes it is easier to work with the decimal representation of a number, and sometimes it is easier to work with its fraction representation. It is important to be able to work with both. For example, consider the following pair of problems:

- Priya earned x dollars doing chores, and Kiran earned $\frac{6}{5}$ as much as Priya. How much did Kiran earn?

- Priya earned x dollars doing chores, and Kiran earned 1.2 times as much as Priya. How much did Kiran earn?

Since $\frac{6}{5} = 1.2$, these are both exactly the same problem, and the answer is $\frac{6}{5}x$ or $1.2x$.

When we work with percentages in later lessons, the decimal representation will come in especially handy.

Lesson 6

Lesson 6: Increasing and Decreasing

Improving Their Game

Here are the scores from 3 different sports teams from their last 2 games.

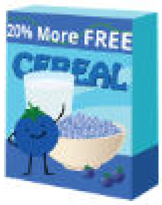
sports team	total points in game 1	total points in game 2
football team	22	30
basketball team	100	108
baseball team	4	12

What do you notice about the teams' scores? What do you wonder?

Which team improved the most? Explain your reasoning.

More Cereal and a Discounted Shirt

A cereal box says that now it contains 20% more. Originally, it came with 18.5 ounces of cereal. How much cereal does the box come with now?



The price of a shirt is $18.50, but you have a coupon that lowers the price by 20%. What is the price of the shirt after using the coupon?

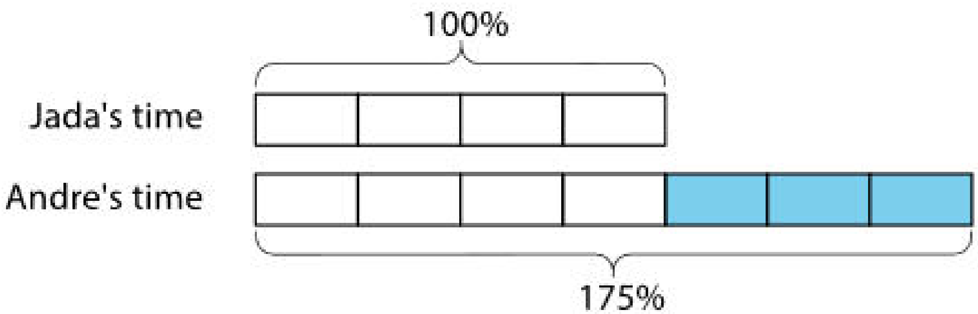
Draw a diagram to represent these situations.

a. The number of ducks living at the pond increased by 40%

a. The number of mosquitoes decreased by 80%

Lesson 6 Summary

Imagine that it takes Andre $\frac{3}{4}$ more than the time it takes Jada to get to school. Then we know that Andre's time is $1\frac{3}{4}$ or 1.75 times Jada's time. We can also describe this in terms of percentages:

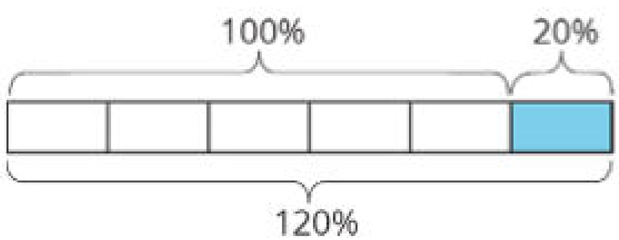


We say that Andre's time is 75% more than Jada's time. We can also see that Andre's time is 175% of Jada's time. In general, the terms **percent increase** and **percent decrease** describe an increase or decrease in a quantity as a percentage of the starting amount.

For example, if there were 500 grams of cereal in the original package, then "20% more" means that 20% of 500 grams has been added to the initial amount, $500 + (0.2) \cdot 500 = 600$, so there are 600 grams of cereal in the new package.

We can see that the new amount is 120% of the initial amount because

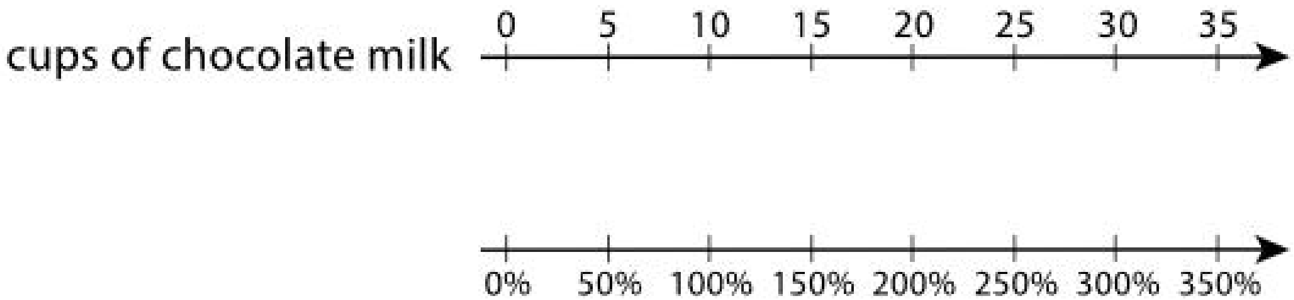
$$500 + (0.2) \cdot 500 = (1 + 0.2)500$$



Lesson 7

Lesson 7: One Hundred Percent

Double Number Line

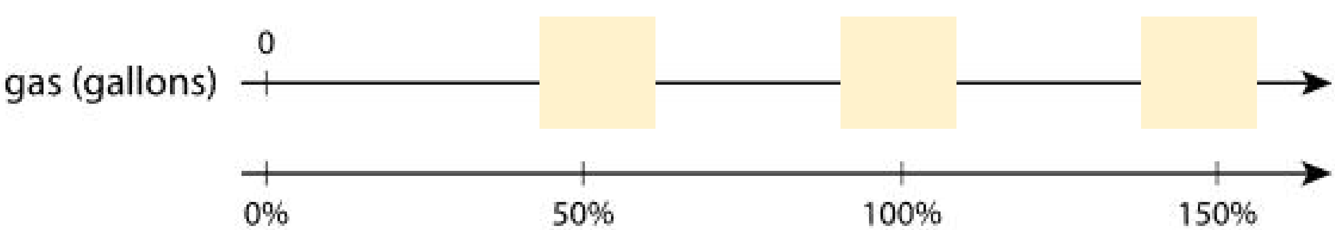


What do you notice? What do you wonder?

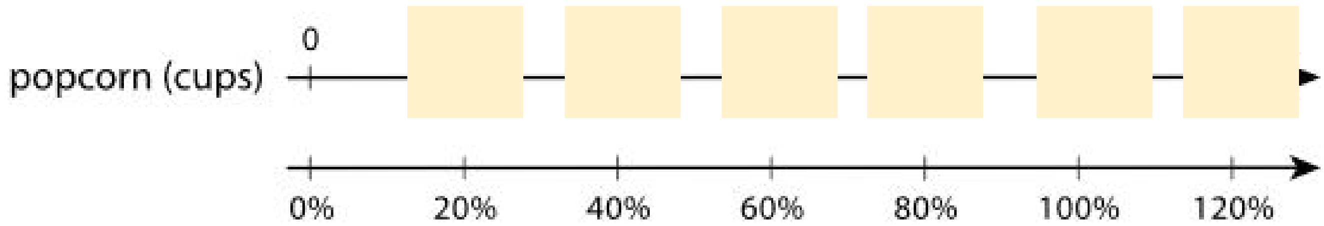
Double Number Lines

For each problem, complete the double number line diagram to show the percentages that correspond to the original amount and the new amount.

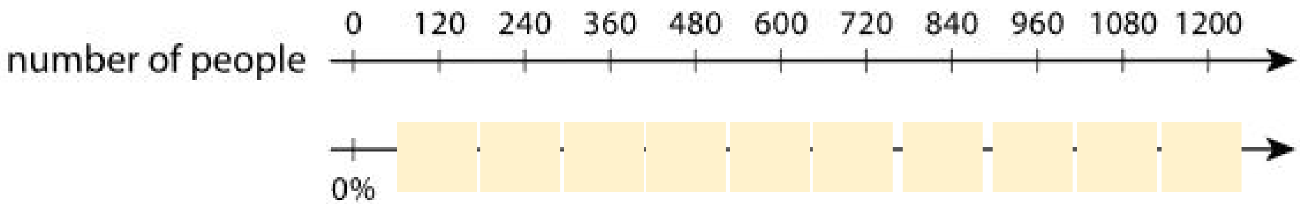
1. The gas tank in dad's car holds 12 gallons. The gas tank in mom's truck holds 50% more than that. How much gas does the truck's tank hold?



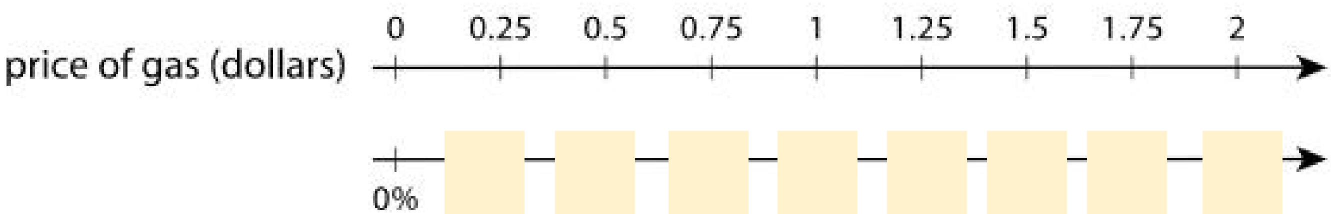
2. At a movie theater, the size of popcorn bags decreased 20%. If the old bags held 15 cups of popcorn, how much do the new bags hold?



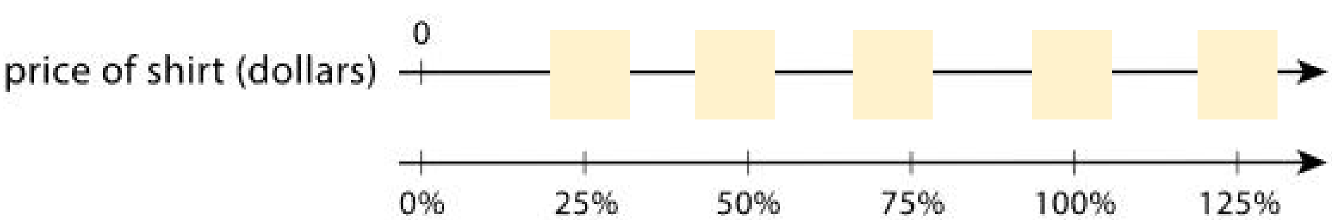
3. A school had 1,200 students last year and only 1,080 students this year. What was the percentage decrease in the number of students?



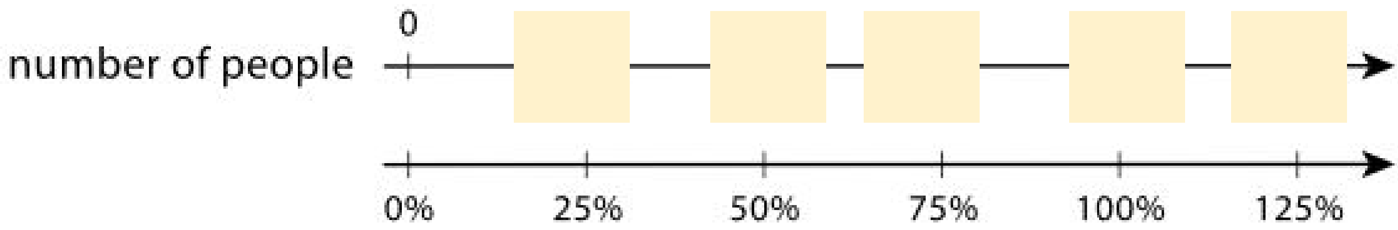
4. One week gas was $1.25 per gallon. The next week gas was $1.50 per gallon. By what percentage did the price increase?



5. After a 25% discount, the price of a T-shirt was $12. What was the price before the discount?



6. Compared to last year, the population of Boom Town has increased 25%.The population is now 6,600. What was the population last year?

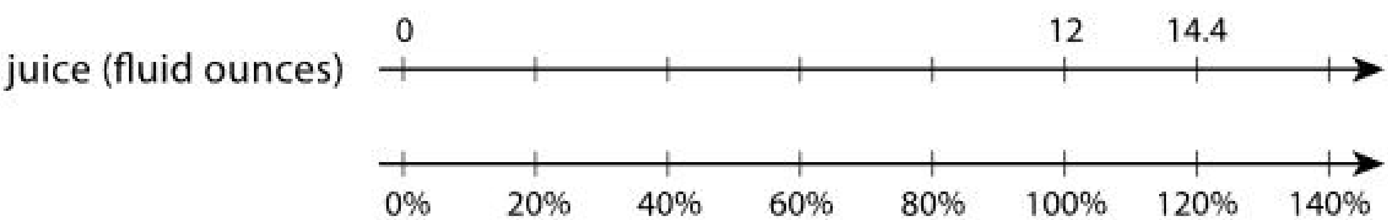


Representing More Juice

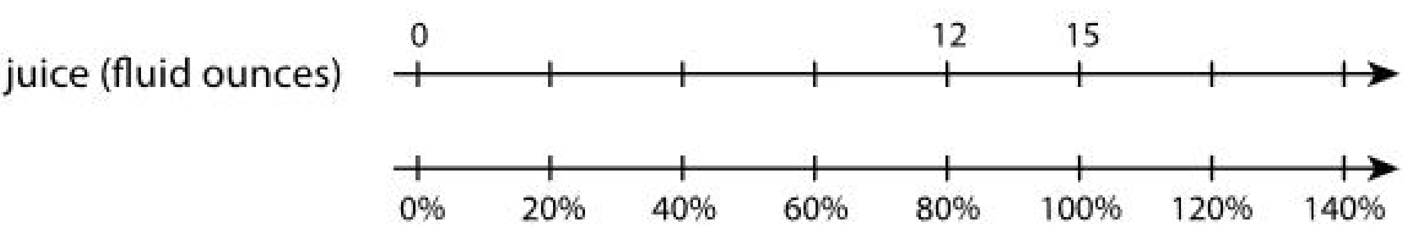
Two students are working on the same problem:

A juice box has 20% more juice in its new packaging. The original packaging held 12 fluid ounces. How much juice does the new packaging hold?

- Here is how Priya set up her double number line.



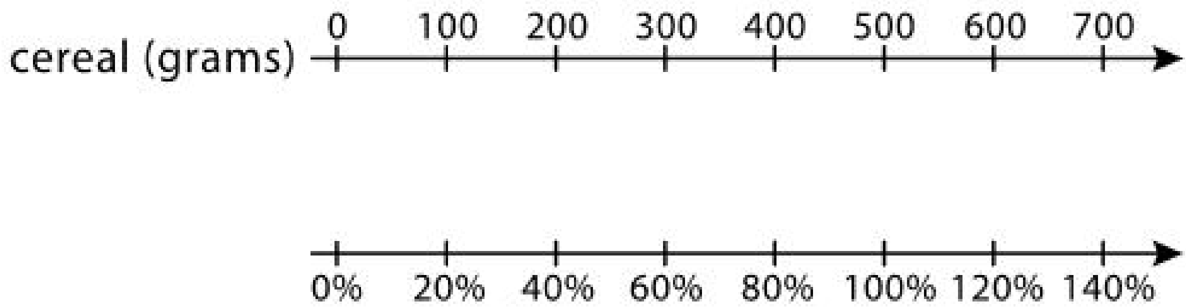
- Here is how Clare set up her double number line.



Do you agree with either of them? Explain or show your reasoning.

Lesson 7 Summary

We can use a double number line diagram to show information about percent increase and percent decrease:



The initial amount of cereal is 500 grams, which is lined up with 100% in the diagram. We can find a 20% *increase* to 500 by adding 20% of 500:

$$\begin{aligned} 500 + (0.2) \cdot 500 &= (1.20) \cdot 500 \\ &= 600 \end{aligned}$$

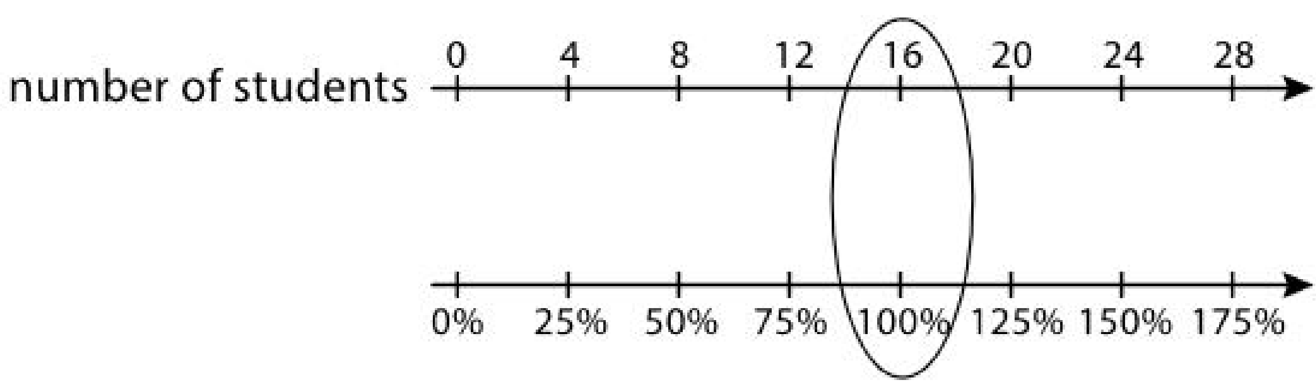
In the diagram, we can see that 600 corresponds to 120%.

If the initial amount of 500 grams is *decreased* by 40%, we can find how much cereal there is by subtracting 40% of the 500 grams:

$$\begin{aligned} 500 - (0.4) \cdot 500 &= (0.6) \cdot 500 \\ &= 300 \end{aligned}$$

So a 40% decrease is the same as 60% of the initial amount. In the diagram, we can see that 300 is lined up with 60%.

To solve percentage problems, we need to be clear about what corresponds to 100%. For example, suppose there are 20 students in a class, and we know this is an increase of 25% from last year. In this case, the number of students in the class *last* year corresponds to 100%. So the initial amount (100%) is unknown and the final amount (125%) is 20 students.



Looking at the double number line, if 20 students is a 25% increase from the previous year, then there were 16 students in the class last year.

Lesson 8

Lesson 8: Percent Increase and Decrease with Equations

Interest and Depreciation

Money in a particular savings account increases by about 6% after a year. How much money will be in the account after one year if the initial amount is $100, $50, $200? $125? x dollars?

The value of a new car decreased by abouth 15% in the first year. How much will a car be worth after one year if its initial value was $1,000? $5,000? $5,020? x dollars?

Matching Equations

Match an equation to each of these situation. Be prepared to share your reasoning.

The water level in a reservoir is now 52 meters. If this was a 23% increase, what was the initial depth?

____

The snow is now 52 inches deep. If this was a 77 decrease, what was the initial depth?

____

$0.23x = 52$

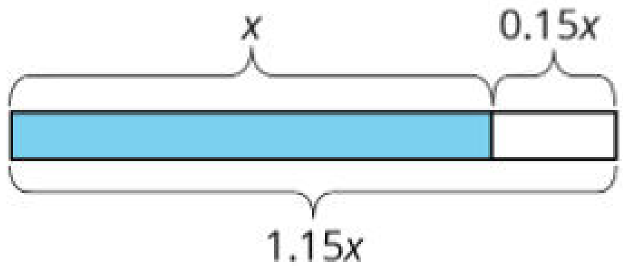
$1.23x = 52$

$0.77x = 52$

$1.77x = 52$

Lesson 8 Summary

We can use equations to express percent increase and percent decrease. For example, if y is 15% more than x,

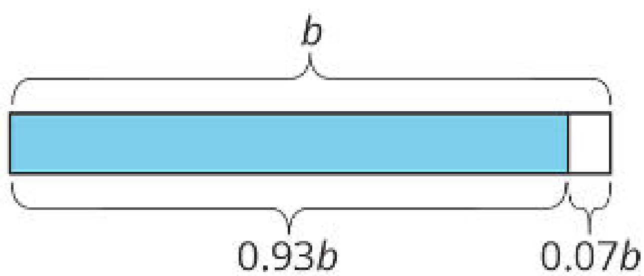


we can represent this using any of these equations:

$y = x + 0.15x$ $\qquad$ $y = (1 + 0.15)x$ $\qquad$ $y = 1.15x$

So if someone makes an investment of x dollars, and its value increases by 15% to $1250, then we can write and solve the equation $1.15x = 1250$ to find the value of the initial investment.

Here is another example: if a is 7% less than b,



we can represent this using any of these equations:

$a = b - 0.07b$ $\qquad$ $a = (1 - 0.07)b$ $\qquad$ $a = 0.93b$

So if the amount of water in a tank decreased 7% from its starting value of b to its ending value of 348 gallons, then you can write $0.93b = 348$.

Often, an equation is the most efficient way to solve a problem involving percent increase or percent decrease.

Lesson 9

Lesson 9: More and Less than 1%

Waiting Tables

During one waiter's shift, he delivered 13 appetizers, 17 entrees, and 10 desserts.

What percentage of the dishes he delivered were:

a. desserts?

a. appetizers?

a. entrees?

What do your percentages add up to?

Fractions of a Percent

Find each percentage of 60. What do you notice about your answers?

30% of 60 | 3% of 60 | 0.3% of 60 | 0.03% of 60

20% of 5,000 is 1,000 and 21% of 5,000 is 1,050. Find each percentage of 5,000 and be prepared to explain your reasoning.

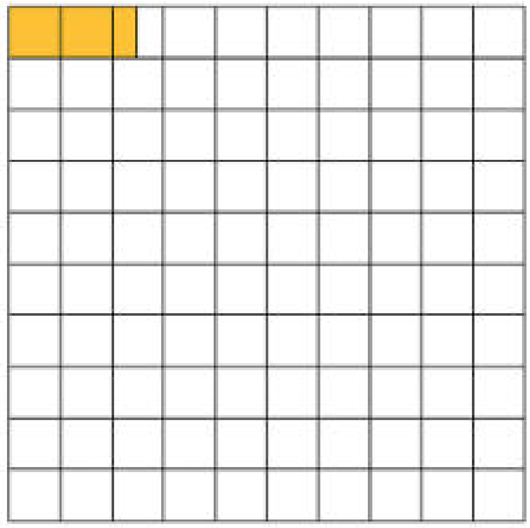
a. 1% of 5,000
b. 0.1% of 5000
c. 20.1% of 5,000
d. 20.4% of 5,000

15% of 80 is 12 and 16% of 80 is 12.8. Find the percentage of 80 and be prepared to explain your reasoning.

a. 15.1% of 80
b. 15.7$ of 80

Lesson 9 Summary

A percentage, such as 30%, is a rate per 100. To find 30% of a quantity, we multiply it by $30 \div 100$, or 0.3.



The same method works for percentages that are not whole numbers, like 7.8% or 2.5%.
To find 2.5% of a quantity, we multiply it by $2.5 \div 100$, or 0.025.
In the square, 2.5% of the area is shaded.

- For example, to calculate 2.5% interest on a bank balance of $80, we multiply $(0.025) \cdot 80 = 2$, so the interest is $2.

We can sometimes find percentages like 2.5% mentally by using convenient whole number percents. For example, 25% of 80 is one fourth of 80, which is 20. Since 2.5 is one tenth of 25, we know that 2.5% of 80 is one tenth of 20, which is 2.

Lesson 10

Lesson 10: Tax and Tip

The Price of Sunglasses

You are on vacation and want to buy a pair of sunglasses for $10 or less. You find a pair with a price tag of $10. The cashier says the total will be $10.45.

What do you notice? What do you wonder?

Shopping in Two Different Cities

Different cities have different sales tax rates. Here are the sales tax charges on the same items in two different cities. Complete the tables.

City 1

item	price (dollars)	sales tax (dollars)	total cost (dollars)
paper towels	8.00	0.48	8.48
lamp	25.00	1.50	
pack of gum	1.00		
laundry soap	12.00		
	x		

City 2

item	price (dollars)	sales tax (dollars)	total cost (dollars)
paper towels	8.00	0.64	8.64
lamp	25.00	2.00	
pack of gum	1.00		
laundry soap	12.00		
	x		

Dining at a Restaurant

Jada has a meal in a restaurant. She adds up the prices listed on the menu for everything they ordered and gets a subtotal of $42.00.

Date: Sep. 12th
Time: 6:55 PM
Server: #27

Bread Stix	9.50
Chicken Parm	15.50
Chef Salad	12.00
Lemon Soda	2.00
Tea	3.00
Subtotal	42.00
Sales Tax	3.99
Total	45.99

a. When the check comes, it says they also need to pay $3.99 in sales tax. What percentage of the subtotal is the sales tax?

b. After tax, the total is $45.99. What percentage of the subtotal is the total?

c. They actually pay $52.99. The additional $7 is a tip for the server. What percentage of the subtotal is the tip?

Lesson 10 Summary

Many places have *sales tax*. A sales tax is an amount of money that a government agency collects on the sale of certain items. For example, a state might charge a tax on all cars purchased in the state. Often the tax rate is given as a percentage of the cost. For example,

a state's tax rate on car sales might be 2%, which means that for every car sold in that state, the buyer has to pay a tax that is 2% of the sales price of the car.

Fractional percentages often arise when a state or city charges a sales tax on a purchase. For example, the sales tax in Arizona is 7.5%. This means that when someone buys something, they have to add 0.075 times the amount on the price tag to determine the total cost of the item.

For example, if the price tag on a T-shirt in Arizona says $11.50, then the sales tax is $(0.075) \cdot 11.5 = 0.8625$, which rounds to 86 cents. The customer pays $11.50 + 0.86$, or $12.36 for the shirt.

The total cost to the customer is the item price plus the sales tax. We can think of this as a percent increase. For example, in Arizona, the total cost to a customer is 107.5% of the price listed on the tag.

A *tip* is an amount of money that a person gives someone who provides a service. It is customary in many restaurants to give a tip to the server that is between 10% and 20% of the cost of the meal. If a person plans to leave a 15% tip on a meal, then the total cost will be 115% of the cost of the meal.

Lesson 11

Lesson 11: Percentage Contexts

A Car Dealership

A car dealership pays a wholesale price of $12,000 to purchase a vehicle.

The car dealership wants to make a 32% profit.

a. By how much will they mark up the price of the vehicle?

a. After the markup, what is the retail price of the vehicle?

During a special sales event, the dealership offers a 10% discount off of the retail price. After the discount, how much will a customer pay for this vehicle?

Commission at a Gym

For each gym membership sold, the gym keeps $42 and the employee who sold it gets $8. What is the commission the employee earned as a percentage of the total cost of the gym membership?

If an employee sells a family pass for $135, what is the amount of the commission they get to keep?

Lesson 11 Summary

There are many everyday situations where a percentage of an amount of money is added to or subtracted from that amount, in order to be paid to some other person or organization:

	goes to	how it works
sales tax	the government	added to the price of the item
gratuity (tip)	the server	added to the cost of the meal
interest	the lender (or account holder)	added to the balance of the loan, credit card, or bank account
markup	the seller	added to the price of an item so the seller can make a profit
markdown (discount)	the customer	subtracted from the price of an item to encourage the customer to buy it
commission	the salesperson	subtracted from the payment that is collected

For example,

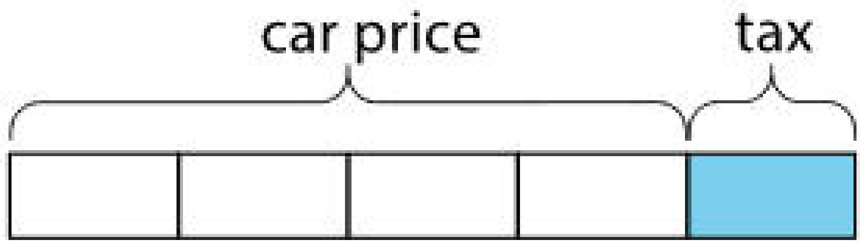
- If a restaurant bill is \$34 and the customer pays \$40, they left \$6 dollars as a tip for the server. That is 18% of \$34, so they left an 18% tip. From the customer's perspective, we can think of this as an 18% increase of the restaurant bill.
- If a realtor helps a family sell their home for \$200,000 and earns a 3% commission, then the realtor makes \$6,000, because $(0.03) \cdot 200{,}000 = 6{,}000$, and the family gets \$194,000, because $200{,}000 - 6{,}000 = 194{,}000$. From the family's perspective, we can think of this as a 3% decrease on the sale price of the home.

Lesson 12

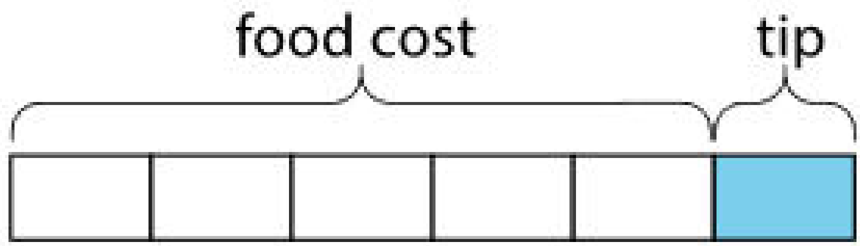
Lesson 12: Finding the Percentage

Tax, Tip, and Discount

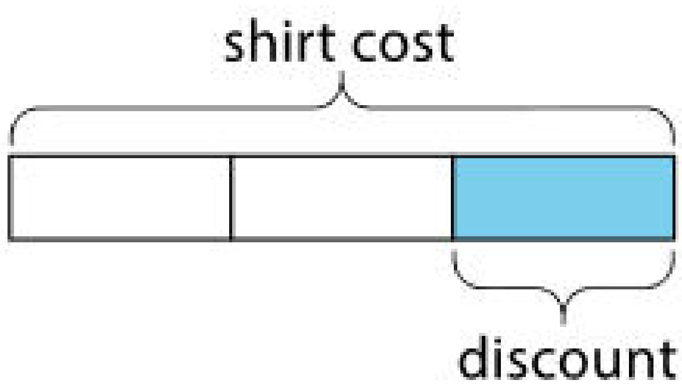
What percentage of the car price is the tax?



What percentage of the food cost is the tip?



What percentage of the shirt cost is the discount?



What is the Percentage?

A salesperson sold a car for $18,250 and their commission is $693.50. What percentage of the sale price is their commission?

The bill for a meal was $33.75. The customer left $40.00. What percentage of the bill as the tip?

The original price of a bicycle was $375. Now it is on sale for $295. What percentage of the original price was the markdown?

Sporting Goods

You are being shown a problem card. You need to think about the information you need to answer the question.

Ask your teacher specific information that you need.

Solve the problem and explain your reasoning.

Info Gap: Sporting Goods

Problem Card 1

Elena went to a sporting goods store that was having a sale. She bought a tennis racket and 3 cans of tennis balls. How much will she pay for everything, including tax?

Info Gap: Sporting Goods

Problem Card 2

Andre went to a sporting goods store that was having a different sale. He bought a baseball glove and 2 packages of socks. What percentage of the total regular price (before tax) was his savings?

Lesson 12 Summary

To find a 30% increase over 50, we can find 130% of 50. $1.3 \cdot 50 = 65$

To find a 30% decrease from 50, we can find 70% of 50. $0.7 \cdot 50 = 35$

If we know the initial amount and the final amount, we can also find the percent increase or percent decrease. For example, a plant was 12 inches tall and grew to be 15 inches tall. What percent increase is this? Here are two ways to solve this problem:

The plant grew 3 inches, because $15 - 12 = 3$. We can divide this growth by the original height, $3 \div 12 = 0.25$. So the height of the plant increased by 25%.

The plant's new height is 125% of the original height, because $15 \div 12 = 1.25$. This means the height increased by 25%, because $125 - 100 = 25$.

Here are two ways to solve the problem: A rope was 2.4 meters long. Someone cut it down to 1.9 meters. What percent decrease is this?

The rope is now $2.4 - 1.9$, or 0.5 meters shorter. We can divide this decrease by the original length, $0.5 \div 2.4 = 0.208\overline{3}$. So the length of the rope decreased by approximately 20.8%.

The rope's new length is about 79.2% of the original length, because $1.9 \div 2.4 = 0.791\overline{6}$. The length decreased by approximately 20.8%, because $100 - 79.2 = 20.8$.

Lesson 13

Lesson 13: Measurement Error

Measuring a Soccer Field

A soccer field is 120 yards long. Han measures the length of the field using a 30-foot-long tape measure and gets a measurement of 358 feet, 10 inches.

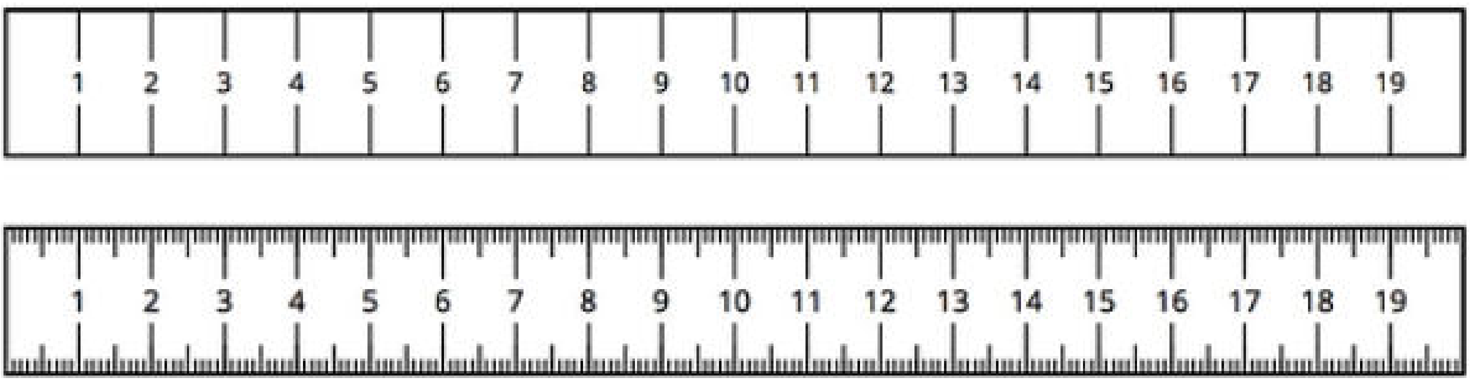
What is the amount of error?

Express the error as a percentage of the actual length of the field.

Lesson 13 Summary

When we are measuring a length using a ruler or measuring tape, we can get a measurement that is different from the actual length. This could be because we positioned the ruler incorrectly, or it could be because the ruler is not very precise. There is always at least a small difference between the actual length and a measured length, even if it is a microscopic difference!

Here are two rulers with different markings.



The second ruler is marked in millimeters, so it is easier to get a measurement to the nearest tenth of a centimeter with this ruler than with the first. For example, a line that is actually 6.2 cm long might be measured to be 6 cm long by the first ruler, because we measure to the nearest centimeter.

The **measurement error** is the positive difference between the measurement and the actual value. Measurement error is often expressed as a percentage of the actual value. We always use a positive number to express measurement error and, when appropriate, use words to describe whether the measurement is greater than or less than the actual value.

For example, if we get 6 cm when we measure a line that is actually 6.2 cm long, then the measurement error is 0.2 cm, or about 3.2%, because $0.2 \div 6.2 \approx 0.032$.

Lesson 14

Lesson 14: Percent Error

Plants, Bicycles, and Crowds

Instructions to care for a plant say to water it with ¾ cup of water every day. The plant has been getting 25% too much water. How much water is the plant been getting?

The pressure on a bicycle tire is 63 psi. This is 5% higher than what the manual says is the correct pressure. What is the correct pressure?

The crowd at a sporting event is estimated to be 2,500 people. The exact attendance is 2,486 people. What is the percent error?

Measuring in the Heat

A metal measuring tape expands when the temperature goes above 50°F. For every degree Fahrenheit above 50, its length increases by 0.00064%.

The temperature is 100 degrees Fahrenheit. How much longer is a 30-foot measuring tape than its correct length?

What is the percent error?

Lesson 14 Summary

Percent error can be used to describe any situation where there is a correct value and an incorrect value, and we want to describe the relative difference between them. For example, if a milk carton is supposed to contain 16 fluid ounces and it only contains 15 fluid ounces:

- the measurement error is 1 oz, and
- the percent error is 6.25% because $1 \div 16 = 0.0625$.

We can also use percent error when talking about estimates. For example, a teacher estimates there are about 600 students at their school. If there are actually 625 students, then the percent error for this estimate was 4%, because $625 - 600 = 25$ and $25 \div 625 = 0.04$.