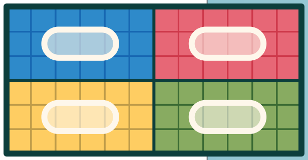
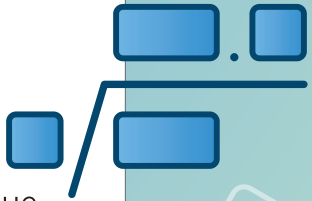
Caregiver Support | Grade 6 Unit 5

Unit 5

Decimal Arithmetic

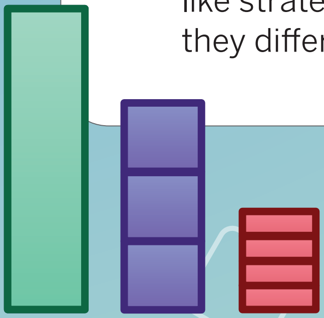


When you add, subtract, multiply, and divide numbers with decimal places, instead of just estimating, you can get far more precise answers. Doing so can help you make sense of all sorts of real-world situations — like working with money, comparing grocery prices, and even buying a car!



Essential Questions

- How do the place values in each decimal number in a calculation affect the place value of the result?
- How are strategies for multiplying decimals like strategies for dividing decimals? How are they different?



Summary | Lesson 1

One of the most common, everyday places you might see decimals is at the grocery store. While you can use all sorts of strategies to calculate exact decimal values, estimation and rounding can help you do quick calculations in your daily life.

Let's see how estimation and rounding can help Adnan shop within his budget.

Adnan has $15.00 to spend on groceries and wants to know if he can afford all of the ingredients for his favorite recipe.

- Spaghetti: $1.34
- Diced tomatoes: $0.79
- Chicken thighs: $4.99
- Parmesan cheese: $4.38

First, Adnan can round each price to a value that is easier to add using mental math.

- Spaghetti: $1.50
- Chicken thighs: $5
- Diced tomatoes: $1
- Parmesan cheese: $4.50

Then Adnan can add the rounded values to determine an estimate for the total cost.

$1.5 + 5 + 1 + 4.5 = \$12$

The ingredients will cost about $12, so Adnan knows he can make his favorite recipe tonight!

Try This

Fatima is making cheesy potatoes.

She needs 5 russet potatoes and 1 container of Parmesan cheese.

Ingredient	Cost
Russet potato	$0.94
Parmesan cheese	$4.38

a About how much will it cost to buy these ingredients?

b If Fatima pays with $10.00, will she have money left over? Show or explain your thinking.

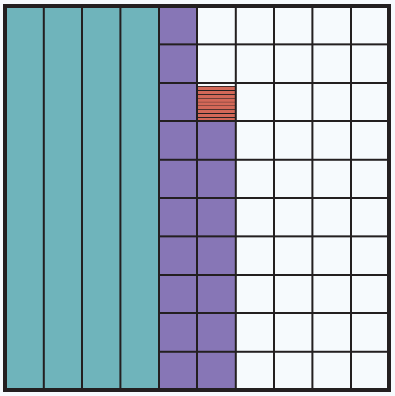
Summary | Lesson 2

You can represent decimals in more than one way using words, diagrams, and decimal points. For example, six tenths, 0.6, sixty hundredths, and 0.60 all represent the same quantity.

Using multiple representations can help when you're adding or subtracting decimals.

Let's say we're calculating $0.189 + 0.39$.

Hundredths Chart



Vertical Calculation

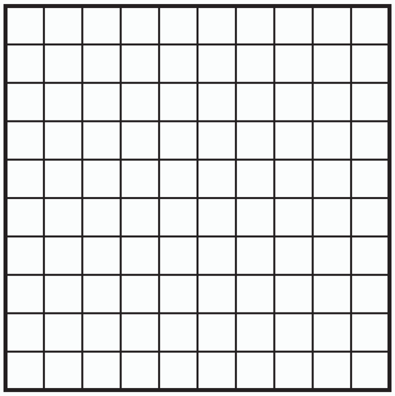
$$\begin{array}{cccccc} & & & 1 & & \\ & 0 & . & 1 & 8 & 9 \\ + & 0 & . & 3 & 9 & 0 \\ \hline & 0 & . & 5 & 7 & 9 \end{array}$$

Both the hundredths chart and vertical calculation show a total of 4 tenths, 17 hundredths, and 9 thousandths. 10 hundredths equals 1 tenth, so the final answer is 5 tenths, 7 hundredths, and 9 thousandths, or 0.579.

Try This

Calculate the value of $0.472 - 0.081$.

Use the diagram or a vertical calculation if it helps to show your thinking.



Summary | Lesson 3

When you're adding and subtracting decimals, it's helpful to rewrite them in different ways.

Let's say a lemon and a strawberry together weigh 0.35 pounds, and the lemon on its own weighs 0.235 pounds.

How much does the strawberry weigh?

$$\begin{array}{rcccc} & 0\,. & 3 & \overset{4}{\cancel{5}} & \overset{10}{\cancel{0}} \\ - & 0\,. & 2 & 3 & 5 \\ \hline & 0\,. & 1 & 1 & 5 \end{array}$$

You can use vertical calculations to rewrite the total weight, 0.35, as 3 tenths, 4 hundredths, and 10 thousandths. Now you can subtract the weight of the lemon from the total to determine the weight of the strawberry.

Try This

Calculate the value of $3.725 - 1.14$.

Use a vertical calculation if it helps to show your thinking.

Summary | Lesson 4

One strategy that can help you make sense of decimal addition and subtraction is vertical calculations.

To use a vertical calculation, you just align numbers by place value so that you're adding or subtracting ones with ones, tenths with tenths, hundredths with hundredths, and thousandths with thousandths.

Here's a vertical calculation. To check if the calculation is correct, you could either estimate or use the opposite operation (addition).

$$\begin{array}{r} 6.2 \\ -\boxed{2}.5 \\ \hline 3.\boxed{7} \end{array}$$

You could estimate that $6.2 - 3 = 3.2$, so your difference should be larger than 3.2.

You could also use addition to check your work, adding 2.5 to 3.7 to get 6.2.

Try This

Here is a subtraction problem.

$$\begin{array}{r} 8.8 \\ -\boxed{}.2\boxed{} \\ \hline 4.\boxed{}4 \end{array}$$

a Determine the missing digits.

b Use addition to check your work.

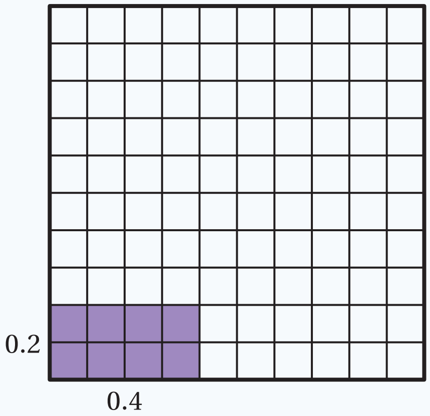
Two strategies for multiplying decimals are:

- Using an area model.
- Writing the decimals as equivalent fractions.

One advantage to using an area model is that you can visualize the product. For example, you can represent $0.4 \cdot 0.2$ as a rectangle with a length of 0.4 and a width of 0.2. On a hundredths chart, you can count the shaded boxes, each representing $\frac{1}{100}$, to determine the product.

It can, however, be challenging to use an area model to represent decimals smaller than tenths or hundredths.

Your other option is to convert decimals to equivalent fractions. $0.4 \cdot 0.2$ can be written as $\frac{4}{10} \cdot \frac{2}{10}$, which equals $\frac{8}{100}$ or 0.08.

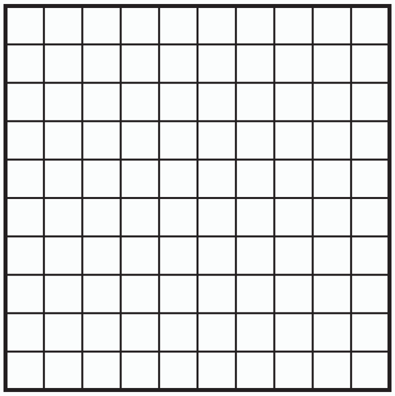


$$\begin{aligned} \text{Area} &= \text{length} \cdot \text{width} \\ &= 0.4 \cdot 0.2 \\ &= 0.08 \end{aligned}$$

Try This

Calculate the value of $0.8 \cdot 0.05$.

Use the hundredths chart or equivalent fractions if it helps to show your thinking



Summary | Lesson 6

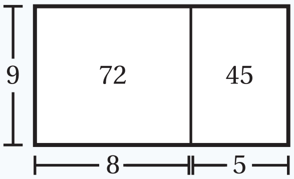
We can use common factors to create equivalent expressions.

For example, since 7 is a common factor of each term in the expression $21 + 14$, you can create the equivalent expression $7(3 + 2)$. This is an example of the **distributive property**.

The distributive property tells us that $a(b + c) = ab + ac$. This means that multiplying a number by the sum of two or more terms is equal to multiplying the number by each term separately before adding the products together.

We can use area models to determine equivalent expressions.

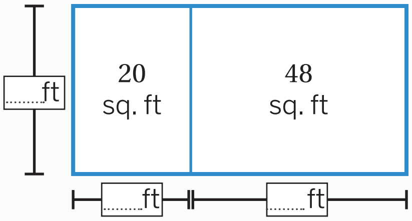
Let's write two expressions for this area model.



- $72 + 45$ represents the sum of the areas of the smaller rectangles.
- $9(8 + 5)$ represents the length of the whole rectangle multiplied by the width. This expression shows us that 9 is a common factor of 72 and 45.

Try This

Here is an area model.



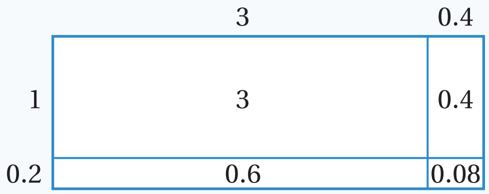
a Determine the missing lengths and width.

b Write two other expressions to represent the total area of $20 + 48$.

Summary | Lesson 7

One way to multiply two decimals is to use an area model.

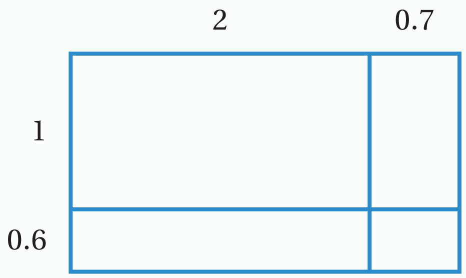
To use an area model, separate the decimals into parts. This rectangle has side lengths measuring 3.4 and 1.2 units. Each side length has been split apart by place value: 3.4 has been split into $3 + 0.4$ and 1.2 has been split into $1 + 0.2$.



The total area of the rectangle is equal to the sum of the areas of the four smaller rectangles: $3.4 \cdot 1.2 = 3 + 0.4 + 0.6 + 0.08 = 4.08$.

Try This

Here is an area model for $2.7 \cdot 1.6$, split into parts.



a Calculate the area of each part.

b Use your area model to calculate $2.7 \cdot 1.6$.

Summary | Lesson 8

There are several different strategies you can use to multiply decimals, such as area models and fractions. You can even convert the decimals to whole numbers and then use place value reasoning. Depending on the problem, one strategy might be more helpful than another.

Let's solve $2.4 \cdot 0.03$ using two strategies: converting fractions and using whole numbers with place value reasoning.

Strategy 1: Converting Fractions

Rewrite each value as an equivalent fraction.

$$2.4 \cdot 0.03 = \frac{24}{10} \cdot \frac{3}{100}$$

Multiply the fractions.

$$\frac{24}{10} \cdot \frac{3}{100} = \frac{72}{1000}$$

Use the denominator to determine the place value.

$\frac{72}{1000}$ is 72 thousandths.

$$\frac{72}{1000} = 0.072$$

Strategy 2: Whole Numbers With Place Value Reasoning

Think of each term as a whole number, then multiply.

$$2.4 \cdot 0.03 \longrightarrow 24 \cdot 3$$

$$24 \cdot 3 = 72$$

Think about the place value of each term.

2.4 is 24 tenths.

0.03 is 3 hundredths.

Determine the appropriate place value of the product.

tenths times hundredths = thousandths

$2.4 \cdot 0.03 = 72$ thousandths

$$2.4 \cdot 0.03 = 0.072$$

Try This

Calculate the value of $1.5 \cdot 0.023$.

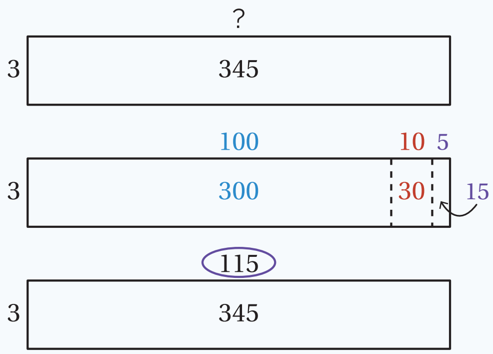
Use any strategy to show your thinking.

Summary | Lesson 9

There are many ways you can divide numbers. Here are two strategies you can use to calculate $345 \div 3$.

Area Model

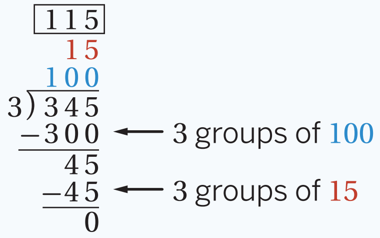
Draw a diagram with a width of 3 and an area of 345. Cut the diagram into smaller areas, such as 300, 30 and 15, to help find the missing lengths. Determine the sum of the missing lengths to determine the total quotient.



$345 \div 3 = 115$

Partial Quotients

Starting with the hundreds place, determine the size of each group if 300 is divided by 3. Then subtract 300 from 345 to find out how much is remaining in the tens place, and determine the size of each group if it's divided by 3. Repeat with the ones place.



$345 \div 3 = 115$

Try This

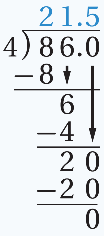
Calculate the value of $723 \div 6$.

Use any strategy to show your thinking.

Summary | Lesson 10

When you get a remainder in a division expression, you can just continue to divide.

Here is how you can calculate $86 \div 4$ using **long division**.



In this strategy, you break down the remaining 2 ones into 20 tenths by writing the dividend of 86 as 86.0.

This allows you to bring a 0 down to the right of the remaining 2 ones.

Then you add a decimal point to the right of the 1 in the quotient, to show that the resulting 5 is in the tenths place.

So $86 \div 4 = 21.5$.

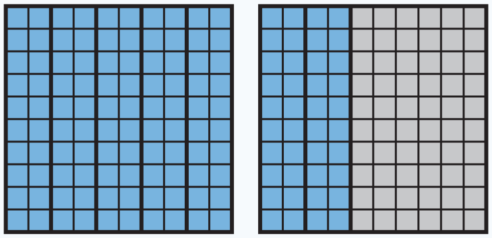
Try This

Use long division to calculate the value of $855 \div 6$.

Summary | Lesson 11

We can use hundredths charts, thousandths charts, and fractions to help us visualize and divide decimals.

This diagram represents the expression $1.4 \div 0.2$.



- Using the hundredths chart, you can count the number of groups of 2 tenths needed to fill the 1 whole and 4 tenths. It takes 7 groups, so $1.4 \div 0.2 = 7$.
- You can rewrite each decimal as an equivalent fraction, so 1.4 becomes $\frac{14}{10}$ and 0.2 becomes $\frac{2}{10}$. Now you can use your knowledge of fraction division to calculate the quotient.

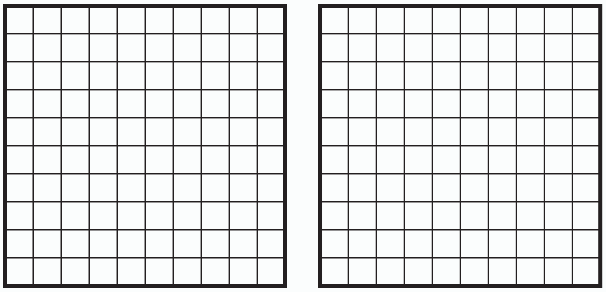
$$\begin{aligned} 1.4 \div 0.2 &= \frac{14}{10} \div \frac{2}{10} \\ &= 14 \div 2 \\ &= 7 \end{aligned}$$

Sometimes you will need to use common denominators to solve expressions with fractions. For example, $1.5 \div 0.03 = \frac{15}{10} \div \frac{3}{100} = \frac{150}{100} \div \frac{3}{100} = 150 \div 3 = 50$.

Try This

Calculate $1.08 \div 0.09$.

Use the diagram if it helps to show your thinking.



Summary | Lesson 12

When dividing by a decimal, it can be helpful to rewrite the expression using whole numbers by multiplying by a power of 10.

For example, you can rewrite $7.65 \div 1.2$ as $765 \div 120$.

$$\begin{aligned} 7.65 \div 1.2 &= \frac{765}{100} \div \frac{12}{10} \\ &= \frac{765}{100} \div \frac{120}{100} \\ &= 765 \div 120 \end{aligned}$$

Once you have an expression with whole numbers, you can use long division to calculate the quotient.

$$\begin{array}{r}
6.375 \\
120\overline{)\,765.000} \\
\underline{-720\downarrow\downarrow\downarrow} \\
450 \\
\underline{-360\downarrow} \\
900 \\
\underline{-840\downarrow} \\
600 \\
\underline{-600} \\
0
\end{array}$$

Try This

Calculate $5.62 \div 0.05$.

Use any strategy to show your thinking.

Summary | Lesson 13

To determine how long it will take to play a movie at a certain speed, you can divide the length of the original movie by the playback speed.

Let’s say a movie is 5.6 minutes long.

- When the playing speed is doubled, it will take 2.8 minutes to watch the movie: $5.6 \div 2 = 2.8$.
- When the playing speed is halved, it will take 11.2 minutes to watch the movie: $5.6 \div 0.5 = 11.2$.

Try This

Ichiro wants to play a 20-second movie at different speeds.

a Write an expression he could use to calculate how long it would take to play the movie at 4x.

b How long would it take to play the movie at 0.8x?

Summary | Lesson 14

Decimals show up in all sorts of real-world problems. We can use decimal operations to make well-informed decisions in these situations.

You might start by writing an equation to represent the situation, then determine its solution.

Problem	Equations
Apples cost $0.75 per pound. I have $4.00 to spend on apples. I need to know how many pounds of apples I can buy.	$4.00 \div 0.75 = 5\frac{1}{3}$ $5\frac{1}{3}$ pounds of apples
Callen is measuring wood for a wheelchair ramp. The ramp is 5.7 feet long, and Callen will place a nail every 6 inches. How many nails will they use?	$5.7 \cdot 12 = 68.4$ $68.4 \div 6 = 11.4$ 11 or 12 nails
Marc works at the grocery store and earns $11.50 per hour. Jaylene works at a pet store and earns $12.85 per hour. How much more money will Jaylene earn than Marc for a 5.5-hour shift?	$12.85 - 11.50 = 1.35$ $1.35 \cdot 5.5 = 7.425$ $7.43

Try This

Zoe's family is planning to buy a DesMobile.

Here is some information they used to help make their decision.

- The DesMobile can hold 12.5 gallons of gas.
- The DesMobile can travel 500 miles on a full tank of gas.
- Zoe's family drives about 12,000 miles a year.
- Gas in Zoe's town costs $3.20 per gallon.

a How much would it cost to fill a tank of gas in the DesMobile?

b How much would it cost to drive 1 mile based on the cost of gas and the range of the DesMobile?

c If Zoe's family drives the DesMobile, about how much would they spend on gas each year?

Summary | Lesson 15

We can convert between percentages, decimals, and fractions to solve problems, including problems related to money.

We've learned that percent means "out of 100." This means that:

- We can write percentages as fractions with a denominator of 100. For example, 13% is equivalent to $\frac{13}{100}$.
- We can think of percentages as a number of hundredths, then determine an equivalent decimal value. For example, 13% is 13 hundredths, or 0.13.

It's important to think about place value when converting percentages into fractions and decimals. For example, 2.5% is equivalent to 2.5 hundredths $\left(\frac{2.5}{100}\right)$ or 25 thousandths $\left(\frac{25}{1000}\right)$, both of which can be represented by the decimal 0.025.

Try This

Determine the missing values in each row.

Percent (%)	Decimal	Fraction
6		
170		
	0.24	
		$\frac{300}{100}$

You've used ratios, double number lines, and tape diagrams to model and solve percent problems. Another strategy you can use is to convert the percent to a decimal, then multiply or divide.

Let's say Isaiah's family spent 4% of their monthly income on groceries last week. Their monthly income is $\$4{,}000.00$. How much money did they spend on one week's worth of groceries?

To determine the answer, first write 4% as a decimal: $4\% = 0.04$.

Then multiply by the total monthly income: $0.04 \cdot 4000 = 160$.

That means Isaiah's family spent $\$160.00$ on their groceries last week.

Try This

In the United States, the cost of food for one person is about $\$340$ per month.

a Tyler spends around $\$68$ on salad ingredients each month.

What percent of the average monthly food cost is this?

b Fruit makes up 6% of Tyler's monthly food cost.

How much money is that?

Try This | Answer Key

Lesson 1

a *Responses vary.* $1 + 1 + 1 + 1 + 1 + 4.50 = \$9.50$

b Yes. *Explanations vary.* I estimated Fatima's cost by rounding up each cost and determining the sum. The actual items will cost less than the sum of $9.50.

Lesson 2

0.391

Lesson 3

2.585

Lesson 4

a

$$\begin{array}{r} 8.8 \\ -\,\boxed{4}.2\boxed{6} \\ \hline 4.\boxed{5}4 \end{array}$$

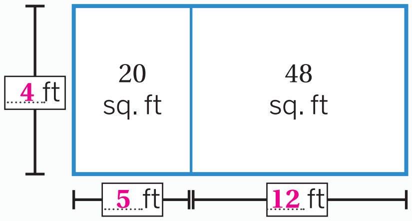
b $4.26 + 4.54 = 8.8$

Lesson 5

0.04

Lesson 6

a *Responses vary.*



b *Responses vary.* $4(5 + 12)$, $4(5) + 4(12)$, $2(10 + 24)$, $2(10) + 2(24)$, 68 (or equivalent)

Lesson 7

a

	2	0.7
1	2	0.7
0.6	1.2	0.42

b 4.32

Lesson 8

0.0345

Explanation: One strategy is to use the converting fractions model to calculate $1.5 \cdot 0.023$.

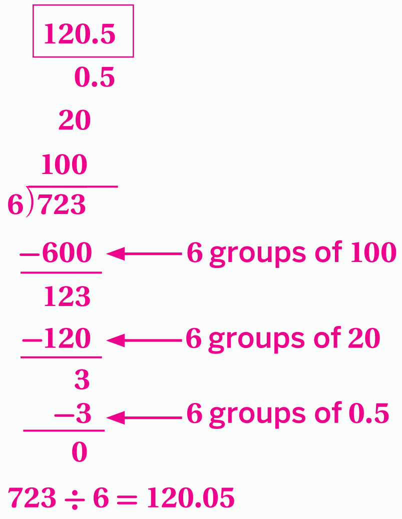
- *Rewrite each value as an equivalent fraction.* $1.5 \cdot 0.023 = \frac{15}{10} \cdot \frac{23}{1000}$
- *Multiply the fractions.* $\frac{15}{10} \cdot \frac{23}{1000} = \frac{345}{10000}$
- *Use the denominator to determine the place value.* $\frac{345}{10000}$ *is 345 ten-thousandths, which is written as 0.0345 in decimal form.*

Lesson 9

120.5

Explanation: One strategy is to use the partial quotients model to calculate 723 ÷ 6.

- *Start with the hundreds place. There are 6 groups of 100 in 700.*
- *Then subtract 600 from 723 to determine that 123 remains.*
- *Next go to the tens place to determine that there are 6 groups of 20 in 120.*
- *Subtract 120 from 123 to determine that 3 remains.*
- *There are 6 groups of 0.5 in 3.*
- *Add all the partial quotients to determine that 723 ÷ 6 = 120.5.*



Lesson 10

142.5

Explanation: To use the long division model to calculate $855 \div 6$, determine the quotient one digit at a time, from left to right. Use place value to determine where to put each digit in the quotient.

- *There are 6 groups of 1 (hundreds).*
- *There are 6 groups of 4 (tens).*
- *There are 6 groups of 2 (ones).*

You can write a remainder using decimals by adding a decimal point and a zero to the right of the ones digit in the dividend, then continuing long division until there is no remainder.

- *There are 6 groups of 5 (tenths).*

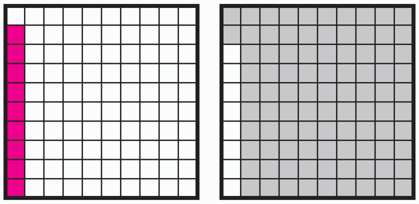
$$\begin{array}{rl} 142.5 & \\ 6\overline{)855.0} & \\ -6 & \text{6 groups of 1 (hundreds)} \\ \hline 255 & \\ -24 & \text{6 groups of 4 (tens)} \\ \hline 15 & \\ -12 & \text{6 groups of 2 (ones)} \\ \hline 3 & \\ -3 & \text{6 groups of 5 (tenths)} \\ \hline 0 & \end{array}$$

Lesson 11

12

Explanation: Here are two strategies to divide $1.08 \div 0.09$.

- *Using the hundredths chart, count how many groups of 9 hundredths are needed to fill the 1 whole and 8 hundredths. It takes 12 groups, so $1.08 \div 0.09 = 12$.*
- *Rewrite each decimal as an equivalent fraction, so 1.08 becomes $\frac{108}{100}$ and 0.09 becomes $\frac{9}{100}$.*
  $\frac{108}{100} \div \frac{9}{100} = 108 \div 9 = 12$



Lesson 12

112.4

Explanation: One strategy is to rewrite the expression using whole numbers by multiplying by a power of 10.

- *First rewrite $5.62 \div 0.05$ using equivalent fractions.*
- *Then use long division to calculate the quotient.*

$$\frac{562}{100} \div \frac{5}{100} = 562 \div 5$$

$$\begin{array}{r} 112.4 \\ 5\overline{)562.0} \\ -500 \\ \hline 62 \\ -50 \\ \hline 12 \\ -10 \\ \hline 2 \\ -2 \\ \hline 0 \end{array}$$

Try This | Answer Key

Lesson 13

- **a** $20 \div 4$ (or equivalent)
- **b** 25 seconds

  Explanation: One strategy is to divide the length of the movie by the playback speed.
  $20 \div 0.8 = 25$

Lesson 14

- **a** \$40
- **b** \$0.08

  Explanation: One strategy is to divide \$40 by 500 to determine the unit rate.
  $40 \div 500 = 0.08$

- **c** \$960

  Explanation: One strategy is to multiply the cost per mile by the number of miles.
  $0.08 \cdot 12000 = 960$

Lesson 15

Percent (%)	Decimal	Fraction
6	0.06	$\frac{6}{100}$ (or equivalent)
170	1.7	$\frac{170}{100}$ (or equivalent)
24	0.24	$\frac{24}{100}$ (or equivalent)
300	3.0	$\frac{300}{100}$

Lesson 16

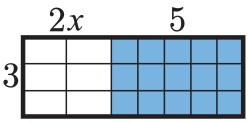
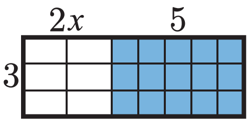
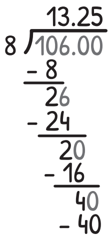
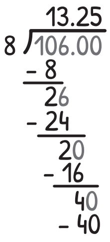
- **a** 20%

  Explanation: One strategy is to divide the part by the whole. $68 \div 340 = 0.2 = 20\%$

- **b** \$20.40

  Explanation: One strategy is to change the percent to a decimal, then multiply.
  6% of \$340 is $0.06 \cdot 340 = 20.40$.

Grade 6 Unit 5 Glossary/6.º grado Unidad 5 Glosario

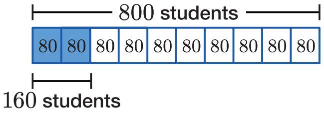
English	Español
A	**A**
algorithm A procedure used for solving a problem or performing a calculation.	**algoritmo** Un procedimiento que se emplea para resolver un problema o realizar un cálculo.
D	**D**
 Area as a Product $3(2x+5)$ **distributive property** The property that says $a(b+c)=ab+ac$. This means that multiplying a number by the sum of two or more terms is equal to multiplying the number by each term separately before adding the products together. For example, $3(2x+5)=3 \cdot 2x+3 \cdot 5=6x+15$.	 El área como un producto $3(2x+5)$ **propiedad distributiva** La propiedad que indica que $a(b+c)=ab+ac$. Significa que multiplicar un número por la suma de dos o más términos equivale a multiplicar el número por cada término individualmente y luego sumar los productos. Por ejemplo, $3(2x+5)=3 \cdot 2x+3 \cdot 5=6x+15$.
dividend The number in a division statement that is being divided. For example, in the equation $12 \div 3=4$, the dividend is 12.	**dividendo** El número que se está dividiendo en un enunciado de división. Por ejemplo, en la ecuación $12 \div 3=4$, el dividendo es 12.
divisor In a division statement, the divisor describes the number of equal-sized groups or the size of each group being created. For example, in the equation $12 \div 3=4$, the divisor is 3.	**divisor** En un enunciado de división, el divisor describe la cantidad de grupos de igual tamaño o el tamaño de cada grupo que se produce. Por ejemplo, esta ecuación $12 \div 3=4$, el divisor es 3.
L	**L**
long division A way to divide numbers. When we use long division, we determine the quotient one digit at a time, from left to right. For example, here is the long division for $\frac{106}{8}$. 	**división larga** Una forma de dividir números. Al usar la división larga, determinamos el cociente de izquierda a derecha, un dígito a la vez. Por ejemplo, esta es la división larga der $\frac{106}{8}$. 

English

Español

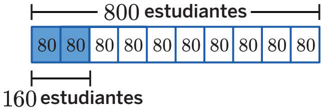
P

percent (percentage) Percent means “for every 100.” It is represented by the percent symbol, %. We use percentages to represent ratios and fractions.



For example, 20% means 20 for every 100. 20% of a number means $\frac{20}{100}$ or $\frac{1}{5}$ of that number. Let’s say there are 800 students in a school. If 20% of them are on a field trip, that means 160 students because 20 students are on the trip for every 100 students total.

por ciento (porcentaje) Por ciento significa “por cada 100”. Se representa con el símbolo de porcentaje, %. Usamos porcentajes para representar razones y fracciones.



Por ejemplo, 20% significa 20 por cada 100. 20% de un número significa $\frac{20}{100}$ o $\frac{1}{5}$ de dicho número. Supongamos que hay 800 estudiantes en una escuela. Si el 20% de ellos está en una excursión, eso significa 160 estudiantes porque 20 están de viaje por cada 100 estudiantes.

Q

quotient The result of dividing two numbers is called the quotient.

For example, in the equation $12 \div 3 = 4$, the quotient is 4.

cociente Se denomina cociente al resultado de dividir dos números.

Por ejemplo, en la ecuación $12 \div 3 = 4$, el cociente es 4.

R

remainder The leftover amount in a division problem when another whole group cannot be formed. The remainder should be smaller than the divisor in a division problem.

For the problem $\frac{15}{6}$, there are 2 groups of 6 in 15 and a remainder of 3.

resto La cantidad que sobra en un problema de división cuando no se puede formar otro grupo completo. El resto debe ser menor que el divisor en un problema de división.

En el problema $\frac{15}{6}$, hay 2 grupos de 6 en 15 y un resto de 3.