

Lesson Objectives

You will be able to

- Understand decimals as part of the place-value system
- Use strategies for rounding decimals
- Compare and order decimal numbers

Skills

- **Core Practice:** Model with Mathematics
- **Core Skill:** Apply Number Sense Concepts

Vocabulary

cent
compare
decimal
decimal point
hundredth
tenth

MATH LINK



More precise values can be described by splitting the whole into smaller and smaller parts. Decimals are wholes split into ten parts or multiples of ten parts (100, 1, 000, 10, 000, and so on).

An example using money is that a quarter is written as 25 cents or \$0. 25, so 25 hundredths written in the form of a decimal is 0. 25.

KEY CONCEPT: Decimals represent a part of a number. They are an extension of the place-value system.

Identify the value of the underlined digit.

1. 1, 734

2. 20, 015

3. 18

4. 2, 986, 123

Round each number to the nearest ten.

5. 57

6. 189

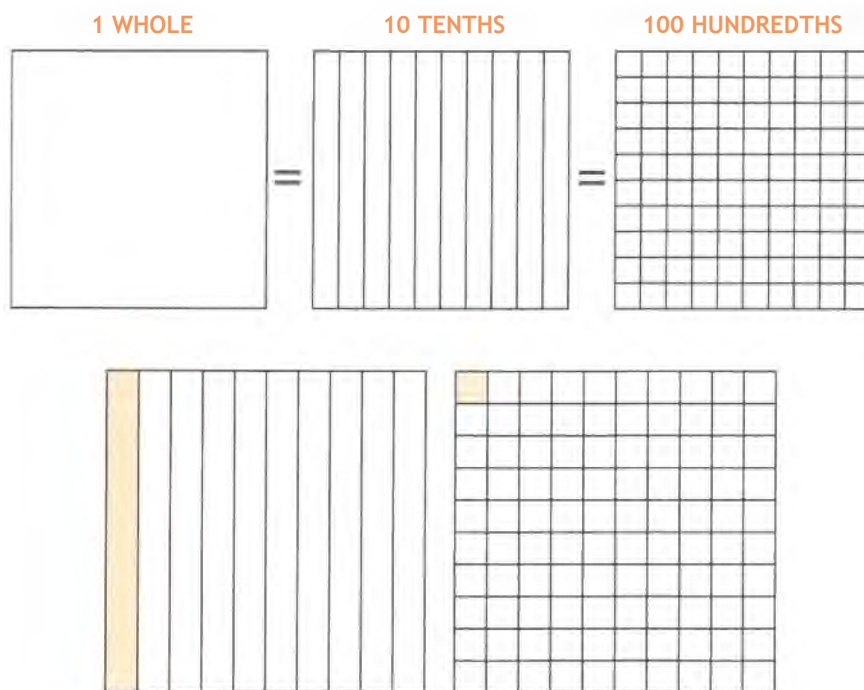
7. 296

8. 6, 382

Understand Decimals

The U. S. monetary system is based on the **decimal** system. Decimals are based on a whole being split into ten equal parts one or more times. Start by thinking of dollars as whole numbers. For decimals less than 1, think about money values less than a dollar.

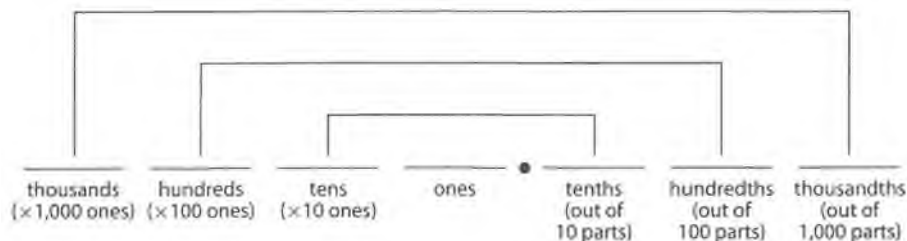
1 dollar = 10 dimes = 100 pennies or **cents**, so 1 dime = 1 tenth of a dollar and 1 cent = 1 hundredth of a dollar.



1 **tenth** = $\frac{1}{10}$ of a whole and 1 **hundredth** = $\frac{1}{100}$ of a whole.

Place Value in Decimals

The whole number place-value chart can be extended to include decimal values. The **decimal point** is read as *and*.



Remember that each decimal part stands for part of a whole.

Example	Value	Meaning
0. 1	1 tenth	1 out of 10 parts
0. 01	1 hundredth	1 out of 100 parts
0. 001	1 thousandth	1 out of 1, 000 parts
0. 0001	1 ten-thousandth	1 out of 10, 000 parts
0. 00001	1 hundred-thousandth	1 out of 100, 000 parts
0. 000001	1 millionth	1 out of 1, 000, 000 parts

Compare Decimals

When you **compare** decimals, you decide which has the greater value. Comparing decimals is similar to comparing whole numbers. First, line the decimals up by their decimal points. Start from the left, and compare each place value until there is one that is different.

Example 1 Compare 1. 145 and 1. 17

Step 1 Align the numbers by decimal point.

Add zeros to the end of a decimal if needed.

$$\begin{array}{r} 1.145 \\ 1.17 \end{array}$$

$$\begin{array}{r} 1.145 \\ 1.170 \end{array}$$

Step 2 Starting from the left, look at each place value until you find one that is different.

$$\begin{array}{r} 1.1\boxed{4}5 \\ 1.1\boxed{7}0 \end{array}$$

Step 3 Compare the digits.

$7 > 4$, so $1.17 > 1.145$

Core Practice

Model with
Mathematics

Charts are handy tools for demonstrating ideas that are central to mathematics. You have used place-value charts to show the values of whole numbers. You can extend such place-value charts to the right to show the values of decimal numbers. In this extended chart, a decimal point, or a period between whole numbers and decimal numbers, is added.

You can interpret the data in the chart on this page by determining the place value for each digit in the number. Note the location of the decimal point.

In a notebook, write how the place-value chart for decimal numbers is similar to and different from the place-value chart for whole numbers.

THINK ABOUT MATH

Directions: Write $<$, $>$, or $=$ to compare the numbers.

1. 1.45 $\underline{\hspace{1cm}}$ 1.045

2. 4.52 $\underline{\hspace{1cm}}$ 4.273

3. 2.75 $\underline{\hspace{1cm}}$ 2.750

4. 2.81 $\underline{\hspace{1cm}}$ 6.81

5. 0.23 $\underline{\hspace{1cm}}$ 0.2300

MATH LINK



Annexing, or adding zeros to the end of a decimal, does not change its value. $0.1 = 0.10 = 0.100 = 0.1000$, and so on. It may be helpful to add zeros to the end of a decimal when comparing numbers with different amounts of decimal places, such as 0.1 and 0.051 ; 0.100 and 0.051 .

Core Skill

Apply Number Sense Concepts

Amelia and Rory are discussing how the number 7.48 should be rounded to the nearest whole number. Rory claims that 7.48 rounds to 7.5 , which rounds to 8 . Amelia believes that Rory is incorrect. She says that 7.48 rounds to 7 . In a notebook, write the process for rounding 7.48 to the nearest whole number to find out who rounded correctly.

Round Decimals

In most cases, decimals are rounded just as whole numbers are rounded. When an amount of money is rounded, the value is usually rounded up to the next nearest cent.

Example 2 Round Decimals

Round 1.537 to the nearest whole number, tenth, and hundredth.

Step 1 Identify the place-value digit to be rounded.



Step 2 Look at the digit immediately to the right of the value to be rounded. If this digit is 5 or greater, round up to the next higher digit. If this digit is less than 5, round down and keep the digit the same. The digits to the right of the rounded digit become 0 (if they are part of the whole number) or are eliminated (if they are part of the decimal).



Example 3 Round Money

Eric computed the sales tax on the items he bought. His calculator displayed the figure 2.0860 . How much tax did he pay?

When rounding with money, round to the hundredth (or cent). Look at the first digit to the right of the hundredths place. If it is greater than five, round the decimal to the next higher hundredth (or cent).



THINK ABOUT MATH

Directions: Round each number to the specified place.

- | | | |
|-----------------|-------------------------|----------------------|
| 1. 6.145, tenth | 3. 15.876, whole number | 5. 4.235, hundredth |
| 2. 2.952, tenth | 4. 5.009, hundredth | 6. 12.366, hundredth |

Vocabulary Review

Directions: Fill in each blank with the correct word.

cent decimal point decimals hundredths tenth

- _____ is/are based on a whole being split into ten equal parts one or more times.
- The first number to the right of the decimal point is a_____.
- The_____ separates the whole numbers from the decimal numbers.
- In 2. 34, the 4 is in the_____ place.
- One hundredth of a dollar is one_____ or one penny.

Skill Review

Directions: Study the chart. Write the value of each digit.

Thousands	Hundreds	Tens	Ones	.	Tenths	Hundredths
2	4	6	1	.	8	5

- 2 _____
- 4 _____
- 6 _____
- 1 _____
- 8 _____
- 5 _____

Directions: Create a place-value chart for each number.

1. 45
8. 32. 091
9. twenty-four and 31 hundredths
10. one hundred and two hundredths

Skill Practice

Directions: Choose the best answer to each question.

1. Which number rounds 5412. 8367 to the nearest thousandth?

A. 5000
B. 5400
C. 5412. 836
D. 5412. 837

2. Which drink costs the most?

HOT DRINKS MENU

Latte	\$2. 45
Espresso	\$2. 39
Mocha	\$2. 99
Black Coffee	\$1. 89

- A. black coffee C. mocha
B. latte D. espresso

Add and Subtract Decimals

Lesson Objectives

You will be able to

- Add decimals
- Subtract decimals

Skills

- **Core Skill:** Perform Operations
- **Core Practice:** Attend to Precision

Vocabulary

align
annexed
organize
place value
topic
vertically

Core Skill

Perform Operations

Evariste and Sophie are counting money they made by doing chores. Evariste has 2 quarters, 7 dimes, and 12 pennies. Sophie has 3 quarters, 5 dimes, and 7 pennies. Evariste believes he has more money than Sophie because he has more coins. In a notebook, determine how much each person made. Is Evariste correct? If not, what was wrong with his thinking?

KEY CONCEPT: Decimals are added and subtracted by using place value much as whole numbers are added and subtracted.

Add or subtract.

1. $41 + 29$ 2. $325 - 149$ 3. $6,009 + 932$ 4. $6,108 - 42$

Compare each pair of numbers. Write an expression using $<$, $>$, or $=$ when comparing.

5. $7.5 \square 2.19$ 6. $9.88 \square 19.1$ 7. $3.1 \square 0.85$ 8. $17.9 \square 17.90$

Add Decimals

Add decimals the same way you add whole numbers. Look at the following examples.

Example 1 Add Money Amounts

Add three quarters and six dimes.

Step 1 Change each amount of money to cents.

$$\begin{array}{l} 3 \text{ quarters} \longrightarrow 3 \times 25 \longrightarrow 75 \text{ cents or } \$0.75 \\ 6 \text{ dimes} \longrightarrow 6 \times 10 \longrightarrow 60 \text{ cents or } \$0.60 \end{array}$$

Step 2 Add the cents.

$$\begin{array}{r} 75 \text{ cents} \\ + 60 \text{ cents} \\ \hline 135 \text{ cents} \end{array} \quad \text{or} \quad \begin{array}{r} 1 \\ \$0.75 \\ + \$0.60 \\ \hline \$1.35 \end{array}$$

Example 2 Column Addition

Add $3.40 + 17.062 + 0.85$.

Step 1 Write the numbers vertically, aligning the decimal points and each place value (tens, ones, tenths, hundredths, thousandths).

Step 2 Starting at the right, add as you do whole numbers. Insert zeros to help you align places as necessary. Bring the decimal point straight down.

$$\begin{array}{r} 111 \\ 3.400 \\ 17.062 \\ + 0.850 \\ \hline 21.312 \end{array}$$

Move the decimal point straight down.

tens	ones	tenths	hundredths	thousandths
	3	4	0	
1	7	0	6	2
	0	8	5	

IDENTIFY TOPIC SENTENCES

The **topic** sentence is usually one sentence in a well-organized paragraph; it states the main idea of the paragraph. Although the topic sentence may appear anywhere in a paragraph, it can usually be found at the beginning. All other sentences in a paragraph are related to the topic sentence. Their purpose is to explain or support the main idea.

To find the topic sentence, ask: *Which sentence tells what this paragraph is about?*

Read the following paragraph, and underline the topic sentence.

- (1) Adding decimals is very much like adding whole numbers. (2) For example, when adding 2.3 and 1.5, you first write the numbers vertically, aligning by place value. (3) You also align the decimal points. (4) Start at the right. (5) Add 3 and 5 to get 8. (6) Then add 2 and 1 to get 3. (7) The decimal point is brought straight down to get the answer 3.8.

Sentence 1 makes a general statement about how adding decimals is like adding whole numbers. Sentences 2 through 7 provide an example of adding two decimals, showing how the steps are very much the same as for adding whole numbers. Only sentence 1 is general enough to include the ideas of the other sentences. Sentence 1 is the topic sentence.

Core Practice Attend to Precision

In most ways, calculating with decimals resembles performing operations with whole numbers—for example, the digits must be aligned (lined up) vertically (up and down) by place value, the decimal point must be correctly positioned, and the answer must extend the correct number of decimal places (whole numbers need zero decimal places). However, there are differences. Zeroes can be written at the far right of a number, or annexed, as needed for decimal numbers, but not for whole numbers.

As shown below, vertical lines can be drawn through the decimal points and the place values of the numbers so that the digits are organized, or placed in order, and ready to add or subtract. In a notebook, write down how many decimal places will be needed for the final answer before solving the problem. Then, find the sum.

$$\begin{array}{r} 3.4 \\ 17.062 \\ + 0.85 \\ \hline \end{array}$$


21st Century Skill

Productivity and Accountability

Just as some math problems must be completed in a series of steps that lead to a final solution, some assigned school projects must likewise be completed in steps. It is important, therefore, to set up a schedule before you begin your work. In this way, you can budget your time. You will complete the project by the due date if you finish each step on time.

Make a plan for what you will do between the end of the school day today and the time you go to bed. Choose no more than three or four activities, including dinner and homework. Make a schedule. At the end of the evening, see if you were successful in meeting all of your goals. If not, consider what you could have done differently to achieve what you set out to do.

MATH LINK

If your display shows a sum or difference as attraction, press  to have it show the sum or difference as a decimal.

Example 3 Add Decimals on a Calculator



Use a calculator to find the sum of $1.79 + 8.03$.

Press 

Press          

The display will read



Press   to have it show the sum as a decimal.

The display will read



THINK ABOUT MATH

Directions: Solve each problem.

1. Three dimes and six nickels is the same as \$_____
2. $2.8 + 5.1 =$ _____ 3. $1.54 + 0.165 + 0.3 =$ _____

Subtract Decimals

Subtract decimals the same way you subtract whole numbers. Look at the following examples.

Example 4 Subtract Decimals

Subtract 2.13 from 12.6.

Step 1 Write the subtraction problem vertically.

$$\begin{array}{r} 12.6 \\ - 2.13 \\ \hline \end{array}$$

Step 2 Insert zeros, if necessary, at the far right of a number. Subtract. Bring the decimal point straight down.

$$\begin{array}{r} 12.60 \\ - 2.13 \\ \hline \end{array} \quad \begin{array}{r} 12.60 \\ - 2.13 \\ \hline 10.47 \end{array}$$

Example 5 Subtract Decimals from Whole Numbers

Subtract 3.87 from 10.

Step 1 Write the subtraction problem vertically.

$$\begin{array}{r} 10 \\ - 3.87 \\ \hline \end{array}$$

Remember to align the digits by place value.

Step 2 Insert a decimal point and zeros, if necessary, after a whole number. Subtract.

$$\begin{array}{r} 10.00 \\ - 3.87 \\ \hline 6.13 \end{array} \longrightarrow \begin{array}{r} \overset{9}{1} \overset{9}{0} \overset{10}{0} \\ - 3.87 \\ \hline 6.13 \end{array}$$

Think of 10 ones as 9 ones, 9 tenths, and 10 hundredths.

Example 6 Subtract Whole Numbers from Decimals

Subtract 3 from 5.36.

Step 1 Write the subtraction problem vertically. Remember to align the digits and decimal point appropriately.

$$\begin{array}{r} 5.36 \\ - 3.00 \\ \hline 2.36 \end{array}$$

Step 2 Solve the subtraction problem. Note that because 3 had no decimals, the decimal portion of 5.36 was left unchanged.

Add and Subtract Decimals Summary

Write the numbers to be subtracted or added vertically. Align by place values and by decimal points. Insert any necessary zeros or missing decimal points. Subtract or add the digits from right to left as you would when subtracting or adding whole numbers.

THINK ABOUT MATH

Directions: Solve each problem.

1. $5.6 - 2.3$

2. $12 - 3.47$

3. $2.165 - 0.18$

Vocabulary Review

Directions: Fill in each blank with the correct word.

align annexed organize place value vertically

- The digits in the number 4.29 each have their own_____.
- When numbers are written one under the other, they are arranged_____.
- Before adding two decimals, be sure to_____the decimal points.
- To_____ an addition or subtraction problem means to write it in a way that makes calculating its sum or difference easier.
- Zeros can be_____to the right of the digits in a decimal.

Skill Review

Directions: Draw vertical lines through each problem to show that the digits have been aligned vertically, that decimal points and zeros have been added, and that the problem is organized in a way that is useful for finding the sum or difference.

1.
$$\begin{array}{r} 17.350 \\ + 50.927 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 3.890 \\ - 1.426 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 42.000 \\ - 36.498 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 0.180 \\ 8.921 \\ + 39.600 \\ \hline \end{array}$$

Directions: Rewrite the problems below so that they are organized in a way that is useful for finding the sum or difference.

5. $1.563 + 8.03$

7. $7.5 - 1.004$

6. $29 - 0.25$

8. $0.234 - 1.006 + 80$

Directions: Identify which person is incorrect and why.

9. Marco and Olivia are working together to solve a subtraction problem. When Marco subtracted .57 from 4.28, he got 4.31, because $8 - 7 = 1$ and $5 - 2 = 3$. Olivia subtracted .57 from 4.28 and got 3.71, because $8 - 7 = 1$ and $12 - 7 = 5$.
10. While training for a race, Charlie and Lucy ran 3.56 miles one day and 5.87 miles the next day. Charlie claims that they ran a total of 9.43 miles, while Lucy claims they ran 8.33 miles.

Skill Practice

Directions: Choose the best answer to each question.

- Calvino drew line segments to show the length of each section of a sidewalk he will be pouring. The lengths of each section were: 1. 5 m, 1. 8 m, 2. 75 m, and 2. 9 m. How many meters long is the sidewalk?
A. 3. 37 m
B. 6. 2 m
C. 6. 95 m
D. 8. 95 m
- Fatima subtracted 0. 35 from 2. 4 and got the correct answer. Which could have been Fatima's calculations?
A.
$$\begin{array}{r} 0.35 \\ - 2.4 \\ \hline 0.11 \end{array}$$

B.
$$\begin{array}{r} 1\ 14\ 10 \\ 2.\cancel{4}0 \\ - 0.35 \\ \hline 2.15 \end{array}$$

C.
$$\begin{array}{r} 3\ 10 \\ 2.\cancel{4}0 \\ - 0.35 \\ \hline 2.05 \end{array}$$

D.
$$\begin{array}{r} 2.40 \\ + 0.35 \\ \hline 2.75 \end{array}$$
- The unemployment rate for single men who are 16 years of age is 13. 1 percent in Chi's hometown this month. If the unemployment rate for single women is 2. 4 percent lower, what is that rate?
A. 13. 6percent
B. 15. 5percent
C. 10. 7percent
D. 18. 4percent
- Mia has two dogs. Brutus weighs 12 kg and Buckeye weighs 15. 25 kg. How many kilograms do Brutus and Buckeye weigh together?
A. 27. 25 kg
B. 3. 25 kg
C. 15. 37 kg
D. 16. 45 kg

Multiply Decimals

Lesson Objective

You will be able to

- Multiply decimals

Skills

- **Core Skill:** Apply Number Sense Concepts
- **Core Skill:** Represent Real-World Problems

Vocabulary

factor
multiplication
product

MATH LINK

Apply the same process for multiplying decimals to multiplying **monetary units** (currency) or money amounts by a whole number. For example, to find the value of 13 quarters, multiply \$0.25 by 13.

$$\begin{array}{r} 0.25 \\ \times 13 \\ \hline 75 \\ + 25 \\ \hline 3.25 \end{array}$$

The value of 13 quarters is \$3.25.

KEY CONCEPT: Multiplying decimals is a process that is similar to multiplying whole numbers.

Multiply.

$1. 4 \times 9$

$2. 32 \times 5$

$3. 19 \times 24$

$4. 628 \times 317$

Add.

$5. 1.2 + 1.2 + 1.2 + 1.2 + 1.2$

$6. 3.15 + 3.15 + 3.15 + 3.15$

Multiply Decimals

Multiplying decimals is done the same way you multiply whole numbers. You must be careful to put the decimal point in the correct place in the **product**— the answer in a multiplication problem. To do this, add the number of decimal places in each number being multiplied. Start at the far right of the product, count that number of decimal places to the left, and insert the decimal point. Look at the following examples.

Example 1 Multiply Decimals

Multiply 2.3 and 1.2.

Step 1 Count the number of decimal places in the original numbers.

2.3 has 1 digit to the right of the decimal point.

1.2 has 1 digit to the right of the decimal point.

The product should have $1 + 1 = 2$ decimal places.

$$\begin{array}{r} 2.3 \\ \times 1.2 \\ \hline 46 \\ 23 \\ \hline 2.76 \end{array}$$

Step 2 Write the problem and multiply as whole numbers.

Step 3 Start at the far right of the product. Move 2 places to the left. Insert the decimal point between the 2 and the 7.

Step 4 Check the answer by estimating the product.

2.3 is about 2.

1.2 is about 1.

$2 \times 1 = 2$

The product of 2.3 and 1.2 should be slightly greater than 2, so 2.76 seems reasonable.

Example 2 Write Zeros in the Product

Multiply 3.9 and 0.025.

Step 1 Count the number of decimal places in the original numbers. 3.9 has 1 digit to the right of the decimal point. 0.025 has 3 digits to the right of the decimal point. The product should have $1 + 3 = 4$ decimal places.

Step 2 Write the problem and multiply as whole numbers.

Step 3 Start at the far right of the product. Move 4 places to the left. A zero will need to be written to the left of 9 in the product.

$$3.9 \times 0.025 = 0.0975 \text{ or } .0975$$

Step 4 Check your answer by estimating the product. 3.9 is about 4. Since multiplication is repeated addition, add 0.025 four times. Since 0.100 (the sum) is close to 0.0975 (the product), the product seems reasonable.

$$\begin{array}{r} 3.9 \\ \times 0.025 \\ \hline 195 \\ 78 \\ \hline 0.0975 \end{array}$$

$$\begin{array}{r} 0.025 \\ 0.025 \\ 0.025 \\ + 0.025 \\ \hline 0.100 \end{array}$$

Example 3 Multiply Decimals on a Calculator

Use a calculator to find the product of 0.985×2.1 .

Press **on**

Press **0** **.** **9** **8** **5** **×** **2** **.** **1** **enter**

The display will show

4137
2000

Press **2nd**

The display will read

2.0685

THINK ABOUT MATH

Directions: Apply the process for multiplying decimals to find the value of the following amounts.

1. 23 dimes 2. 40 quarters 3. 75 nickels 4. 350 pennies

Directions: Find each product.

5. 0.5×0.3 6. 3×6.8 7. 0.025×1.3 8. 7.4×0.31

Core Skill

Apply Number
Sense Concepts

Multiplication with decimals, like multiplication with whole numbers, is repeated addition.

Nina's math teacher announces a pop quiz. "There will be eight questions," he says, "and each one is worth 2.5 points. I'll give extra credit to anyone who can show me on the board two ways to determine how many points you'll get if you answer every question correctly." Nina is called on, and first she writes the number 2.5 eight times and adds the column of numbers. Then she multiplies 2.5×8 . Each time, her answer is 20. "Twenty points," she says.

With a partner, write the product 2.3×3.2 as a repeated addition problem. (Hint: You can write a number as the sum of two other numbers, so the second factor, or number that gets multiplied, in this problem, 3.2, can be changed to $3 + 0.2$.) When you finish, check your answer using the method you learned for multiplying decimals to other decimals.

MATH LINK



A zero written before a decimal point can be dropped as long as there is no number to the left of it (0.025 can be written simply as .025, but 10.3 cannot be simplified).

Core Skill

Represent Real-World Problems

There are many real-world scenarios that would require you to multiply decimals. That's because many real-world measurements aren't exactly equal to a whole number. For example, think of the last time you bought something by weight, such as fruit at the grocery store.

Consider the following problem. Jaqueline has a rectangular garden that needs to be covered for the winter to protect it from the weather. The length of the garden is 4.7 feet and the width is 3.56 feet. The amount of cloth she would need would be the area of the garden, which would be a multiplication of decimals problem. In a notebook, determine how much cloth Jaqueline would need to purchase to cover her garden.

Example 4 Multiplying Decimals with Extra Zeroes

Find the product of 1.350 and 6.9.

Step 1 Write the multiplication problem by aligning everything to the right-most space, ignoring place value.

Step 2 Perform the multiplication as you would using whole numbers. Determine the number of places needed after the decimal point. (4)

$$\begin{array}{r} 1.350 \\ \times 6.9 \\ \hline 12150 \\ 8100 \\ \hline 93150 \end{array}$$

Looking at the furthest most digit in the multiplication problem, you may have noticed that it is a zero and is not needed. Therefore, the problem only needed 3 decimal places. Why is this? The number of decimal places needed for the problem was the total of decimal places in each factor. After closer inspection, you should notice that one of the factors, 1.350, wasn't written using the least amount of decimal places. It could have been simplified to 1.35 and therefore only 3 decimal places would have been determined.

Multiply Decimals Summary

Count the total number of decimal places in the original problem. Multiply as you would with whole numbers. Starting at the far right of the product, count the required number of places to the left and insert the decimal point. Insert zeros to the left as needed.

Vocabulary Review

Directions: Fill in the blank with the word that makes the sentence true.

factor multiplication product

- The number 0.4 is a _____ in the problem $0.4 \times 0.2 = 0.08$.
- The _____ of 4×0.6 is 2.4.
- Repeated addition is more commonly known as _____.

Skill Review

Directions: Write the number of decimal places each product will have.

1.
$$\begin{array}{r} 17.3 \\ \times 5.92 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 42.556 \\ \times 6.293 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 3.89 \\ \times 1.4 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 3.18 \\ \times 92 \\ \hline \end{array}$$

Directions: Find the product of the whole numbers. Then use that product to find the product of the decimal numbers.

5. 15×12

1. 5×1.2

7. 7×9

0. 7×9

6. 123×8

1. 23×0.8

8. 47×31

0. 47×0.031

Skill Practice

Directions: You may use a calculator with these questions. Choose the best answer to each question,

1. Ralf knows the product of 12 and 3 is 36. Which best explains why Ralf knows for sure that 1.2×0.03 equals 0.036 and not 0.36?
 - A. 1.2 has one decimal place, so the product should have one zero.
 - B. There is one zero in .03, so the product should have only one zero.
 - C. The product has three decimal places. A zero needs to be inserted to place the decimal point three places to the left of 6 in the product.
 - D. 1.2 has one decimal place, and .03 has two decimal places. $2-1 = 1$, so the product should have one zero.
2. Jana wants to purchase 6 new towels. Each towel costs \$5.39. She multiplies 539 by 6. Where should she place the decimal point?
 - A. two places from the far right of the product
 - B. three places from the far right of the product
 - C. four places from the far right of the product
 - D. six places from the far right of the product
3. Chen wants to buy 2.5 pounds of ground meat. If the cost is \$2.38 per pound, what amount will he pay for 2.5 pounds?
 - A. \$4.88
 - B. \$5.95
 - C. \$14.75
 - D. \$11.90

Divide Decimals

Lesson Objective

You will be able to

- Divide decimals

Skills

- **Core Skill:** Apply Number Sense Concepts
- **Core Skill:** Evaluate Reasoning

Vocabulary

dividend
divisor
evaluate
quotient
reasoning
summarize

Core Skill

Apply Number Sense Concepts

When dividing decimals, it is important to keep track of the number of places the decimal point was moved in the divisor and move the same number of places in the dividend. If not, the answer you get will be off by a power of ten.

If you and a friend earned \$27.36 raking leaves, how much would each of you receive if you split the money evenly?

KEY CONCEPT: Dividing decimals is similar to dividing whole numbers. The key difference is the placement of the decimal point in the quotient, or answer.

Find each quotient.

1. $5 \overline{)835}$ 3. $59,344 \div 16$ 5. $5,000 \div 1,000$ 7. $5,000 \div 10$
2. $30 \overline{)510}$ 4. $16,000 \div 40$ 6. $5,000 \div 100$ 8. $5,000 \div 1$

Divide Decimals

Divide decimals the same way you divide whole numbers. When the **divisor** (the number being divided into another number) is a decimal, however, move the decimal point to the right, and write the divisor as a whole number. Next, move the decimal point in the **dividend** (the number being divided) the same number of places as in the divisor. Put a decimal point in the **quotient** (the answer) directly above the dividend's decimal point, and divide. Look at the following examples.

Example 1 Divide a Decimal by a Whole Number

Divide 23.7 by 3.

Step 1 The divisor, 3, is already a whole number, so place the decimal point in the quotient above the decimal point in the dividend.

Step 2 Divide as you would with whole numbers.

$$\begin{array}{r} 3 \overline{)23.7} \\ 7.9 \\ 3 \overline{)23.7} \\ \underline{21} \downarrow \\ 27 \\ \underline{27} \\ 0 \end{array}$$

Example 2 Divide a Whole Number by a Decimal

Divide 18 by 2.4.

Step 1 The divisor, 2.4, is not a whole number, so move the decimal point in both the divisor and dividend to the right 1 place. Place the decimal point in the quotient above the new dividend.

Step 2 Divide as you would with whole numbers.

$$\begin{array}{r} 2.4 \overline{)18} \\ 7.5 \\ 24 \overline{)180.} \\ \underline{168} \downarrow \\ 120 \\ \underline{120} \\ 0 \end{array}$$

Example 3 Divide a Decimal by a Decimal

Divide 17.5 by 1.25.

Step 1 Move the decimal point in the divisor in order to make it a whole number. In this case, move the decimal point 2 places to the right.

Step 2 Move the decimal point in the dividend the same number of places as in Step 1. Insert zeros if necessary.

Step 3 Insert a decimal point in the quotient directly above the decimal point of the dividend.

Step 4 Divide as with whole numbers.

Step 5 Check your answer by multiplying the quotient by the original divisor. The product should be the dividend.

$$1.25 \overline{)17.50}$$

$$\begin{array}{r} 14. \\ 125 \overline{)1750} \\ \underline{125} \\ 500 \\ \underline{500} \\ 0 \end{array}$$

$$\begin{array}{rcl} 14 & \leftarrow & \text{quotient} \\ \times 1.25 & \leftarrow & \text{original divisor} \\ \hline 17.50 & \leftarrow & \text{original dividend} \end{array}$$

SUMMARIZE IDEAS

When you summarize a passage of text, you read the entire passage, separate the most important from the less important information, and then restate that important information in your own words.

One way to summarize a passage is to follow these three steps: Identify the main ideas, note some of the details about those main ideas, and then write your summary using those main ideas.

Read the following paragraph, and then summarize the ideas.

There is a close relationship between division of whole numbers and division of decimals. When dividing decimals, count the number of decimal places in the divisor that the decimal point would have to be moved to the right to make the divisor a whole number. Move the decimal points in the divisor and in the dividend that number of places to the right. Then place the decimal point into the quotient straight up above the decimal point in the dividend. For example, $0.2 \overline{)4.28}$ becomes $2 \overline{)42.8}$.

Main Ideas: dividing whole numbers; dividing decimals; moving the decimal point in the divisor, dividend, and quotient

Summary: To divide a decimal by a decimal, move the decimal points in the divisor and in the dividend, and then place a decimal in the quotient.

Core Skill

Evaluate Reasoning

Sometimes, when learning procedures in mathematics, you might make an error in **reasoning**, or the process of thinking and finding a solution. So it is important to **evaluate**, or make a judgment about, your reasoning to see if you have introduced any errors into a procedure.

Suppose a student quickly looks at Example 3 and draws a conclusion about how to move the decimal point in all division problems involving decimals. In the problem below, the student took a second look at what he had done and realized the error in reasoning. He used a mathematical skill called *checking the answer*.

$$\begin{array}{r} 41. \\ 1.2 \overline{)4.92} \end{array} \rightarrow \begin{array}{r} 41. \\ \times 1.2 \\ \hline 82 \\ 41 \\ \hline 49.2 \end{array}$$

$$4.92 \neq 49.2$$

In a notebook, explain the error in reasoning made in the problem above. Then show how to find the quotient of $4.92 \div 1.2$.

21st Century Skill

Communication and Collaboration

You have probably heard the term *brainstorming*. Brainstorming is a way of addressing a problem that involves a group of people sharing all ideas that come to them as they try to find a solution to the problem. Studies have found that groups can stumble upon creative solutions when there is a free exchange of ideas. One person may contribute an idea that sparks other ideas, and eventually, the group effort leads to a solution that no single individual may have come up with on his or her own.

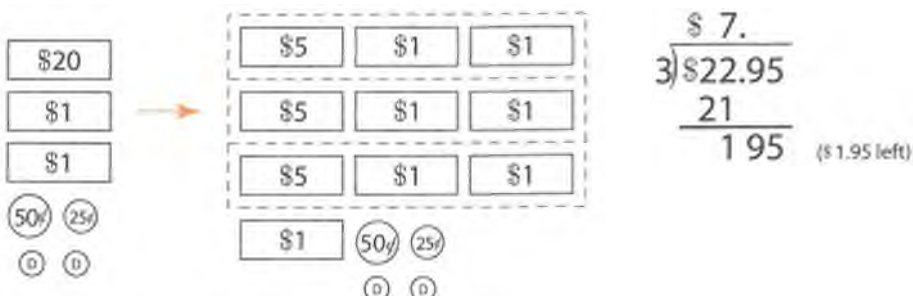
While working in groups, one person can draw pictures to help illustrate the problem, one person could write out expressions that could represent the problem, while another could try to help the entire group find a solution.

Working with a partner, brainstorm and try to find another solution for Example 4, one that involves a different combination of paper currency and coins.

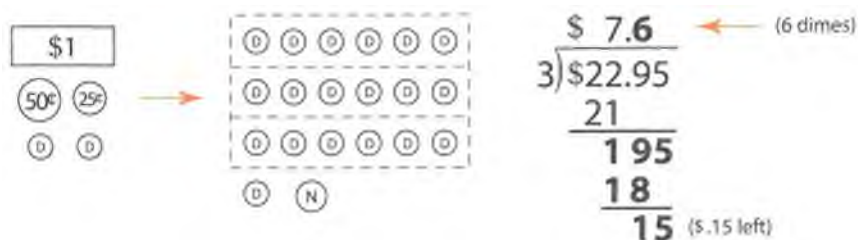
Example 4 Divide with Money

Yumi and 2 of her friends earned \$22.95 one Saturday washing cars. If they split the money equally, how much did each person receive?

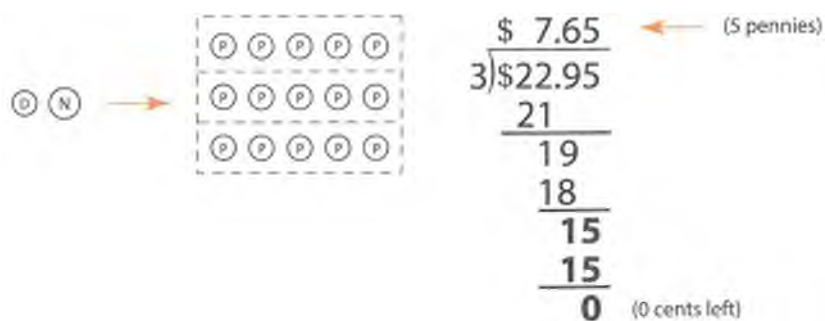
Step 1 Divide the dollars equally. Each friend receives \$7 with \$1 plus the original 95 cents left over.



Step 2 The \$1.95 left over can be changed into 19 dimes and 1 nickel. Now divide 19 by 3. Each friend receives 6 dimes, or 60 cents, with 1 dime and the nickel left over.



Step 3 Change the dime and nickel to 15 pennies and divide by 3. Each friend receives 5 pennies plus the 7 dollars and 6 dimes they received earlier. Each friend receives \$7.65.



Step 4 Check the answer by finding an estimate using comparable numbers.

Since \$24 divided by 3 is \$8, the three friends should each receive about \$8. The quotient, \$7.65, rounded to the nearest dollar is \$8, so the answer is reasonable.

Example 5 Divide Decimals on a Calculator

Use a calculator to find the quotient of $9.72 \div 1.2$.

Press 

Press         

The display will show

81



18

Press  

The display will read

8.1

MATH LINK

The division symbol \div is not the same as the   key, which is used when finding the square root of a number.

Divide Decimals Summary

When dividing decimals, if the divisor is a decimal, follow these steps: Move the decimal point to the right to rewrite the divisor as a whole number, and move the decimal point in the dividend the same number of places. Add zeros as needed. Then insert a decimal point in the quotient directly above the new decimal point in the dividend. Finally, divide as with whole numbers.

THINK ABOUT MATH

Directions: Divide.

1. $0.72 \div 8$

3. $42 \div 0.7$

5. $1.44 \div 0.3$

7. $57.5 \div 2.5$

2. $1.6 \overline{)48}$

4. $1.6 \overline{)1.44}$

6. $0.9 \overline{)5.4}$

8. $6 \overline{)54.80}$

Vocabulary Review

Directions: Complete each of the sentences below using one the following words.

dividend divisor evaluate quotient reasoning

- The _____ in the problem $5 \overline{)7.5}$ is 7.5.
- The _____ in the problem $5 \overline{)7.5}$ is 1.5.
- The _____ in the problem $5 \overline{)7.5}$ is 5.
- If you place the decimal point in the wrong place when you are dividing, you will have to _____ the steps you took to find your answer.
- You can use math _____ to determine that a \$24 lunch can be divided evenly among 5 friends.

Skill Review

Directions: Next to each problem is the number of places the decimal point should be moved in both the dividend and the divisor. Evaluate whether this is correct or if it shows an error in reasoning. Then tell the correct number of places to move the decimal point.

- | | | | |
|-----------------------------|-----------------------|--------------------------|-----------------------|
| 1. $8.9 \overline{)36.223}$ | 1 place to the right | 5. $5 \overline{)21.15}$ | 2 places to the right |
| 2. $0.35 \overline{)1.127}$ | 2 places to the right | 6. $53.9 \overline{)60}$ | 0 places to the right |
| 3. $26.35 \div 0.5$ | 2 places to the right | 7. $3.92 \div 7$ | 0 places to the right |
| 4. $18 \div 0.02$ | 2 places to the right | 8. $146.72 \div 0.16$ | 1 place to the right |

Directions: Write a summary of the ideas in each passage.

- It is easy to understand how to divide a decimal by a whole number. Since the divisor is already a whole number, there is no need to move the decimal point(s). You do, however, need to write the decimal in the quotient directly above the decimal point in the dividend. Then divide as you would with whole numbers.
- Just as subtraction is the opposite of addition, division is the opposite of multiplication. Thus, checking a division problem is a matter of solving a related multiplication problem. First, turn the division problem into a multiplication problem. Check that the quotient \times the divisor = the dividend. For example, to check that $3.4 \div 0.2 = 17$, show that $17 \times 0.2 = 3.4$.

Skill Practice

Directions: You may use a calculator with these questions. Choose the best answer to each question.

1. During each of the 8 days Zuri was camping, it rained. If the total rainfall was 5.44 inches, what was the average daily rainfall in inches?
A. 0.068
B. 0.68
C. 1.47
D. 6.8
3. Elvio paid \$2.34 for 6 pounds of bananas. What was his cost, in dollars, for each pound?
A. \$0.39
B. \$2.56
C. \$2.28
D. \$3.66

2. Malik divided 16.56 by 0.9 and got the correct answer. Which calculation could have been Malik's?
A.
$$\begin{array}{r} 18.4 \\ 9 \overline{)165.6} \end{array}$$

B.
$$\begin{array}{r} 1.84 \\ .9 \overline{)16.56} \end{array}$$

C.
$$\begin{array}{r} .184 \\ 9 \overline{)1.656} \end{array}$$

D.
$$\begin{array}{r} 184. \\ 9 \overline{)1656.} \end{array}$$
4. Lomasi took 4.5 hours to travel 227.25 miles. How many miles per hour did she average?
A. 50.5
B. 5.05
C. 3.79
D. 45

Directions: You may use a calculator with these questions. Choose the best answer to each question.

- In the number 2. 707, what is the difference in value between the underlined digits?
 0. 007 is 100 times greater than 0. 7.
 0. 7 is 10 times greater than 0. 007.
 0. 7 is 100 times greater than 0. 007.
 0. 7 is 70 more than 0. 007.
- What is $5.43 \div 1.2$?
 0. 4525
 4. 525
 45. 25
 452. 5
- Ashaki bought 3 pounds of bananas for \$0. 69 per pound. She also bought 1. 2 pounds of cherries for \$3. 95 per pound and 2. 5 pounds of grapes for \$4. 50 per pound. How much did she spend altogether?
 - \$15. 84
 - \$17. 96
 - \$18. 06
 - \$22. 80
- Two baseball players had batting averages at the end of the season of. 206 and. 315. What was the difference between them?
 - . 521
 - . 111
 - . 109
 - . 019
- What is the value of the expression $2.5 + (0.1 \times 56) \div (3 + 5)$?
 0. 9
 3. 2
 8. 7
 27. 267
- What is the sum of $1.3 + 12.502 + 0.045$?
 3. 0002
 12. 56
 13. 252
 13. 847
- What is one reason zeros might be added to the end of a decimal?
 - Zeros are added to increase its value.
 - Zeros are added to make it easier to align addition and subtraction.
 - Zeros are added to give the quotient the correct number of decimal places.
 - Zeros should never be added to the end of a decimal.
- What is the quotient?

$$\begin{array}{r} 0.42 \overline{)4.41} \\ \underline{0.84} \\ 0.57 \\ \underline{0.84} \\ 0.73 \\ \underline{0.84} \\ 0.87 \\ \underline{0.84} \\ 0.27 \end{array}$$

 1. 5
 1. 8522
 3. 99
 10. 5
- What is the value of the digit 7 in 12. 372?
 - 7 tenths
 - 7 hundredths
 - 7 hundreds
 - 7 tens
- Rami multiplied 4. 52 times 0. 95 and got 429. 4. What mistake did he make?
 - He did not align the decimal places when he multiplied.
 - He did not annex zeros to the end of the decimal.
 - He did not count the decimal places in both factors.
 - He did not move the decimal before multiplying.

Review

Directions: Questions 11 and 13 refer to the following chart.

Felipe's Electric Bill	
Month	Amount (\$)
April	65. 97
May	64. 54
June	71. 90
July	90. 15

11. Which month did Felipe pay the least amount for electricity?
 - A. April
 - C. May
 - B. June
 - D. July
12. What is 67. 142 rounded to the nearest tenth?
 - A. 70
 - C. 67. 1
 - B. 67
 - D. 67. 14
13. How much more did Felipe pay in July than in April?
 - A. \$26. 61
 - C. \$24. 18
 - B. \$18. 25
 - D. \$5. 93
14. Aponee gets paid by the hour for freelance work. She charges \$22. 00 per hour. On Friday, she worked 7. 25 hours. How much should she charge for the work?
 - A. \$29. 25
 - C. \$159. 50
 - B. \$308
 - D. \$1, 595

Check Your Understanding

On the following chart, circle the number of any item you answered incorrectly. Near each lesson title, you will see the pages you can review to learn the content covered in the question. Pay particular attention to reviewing these lessons in which you missed half or more of the questions.

Chapter 2: Decimals	Procedural	Conceptual	Application/ Modeling/ Problem Solving
Introduction to Decimals pp. 50-53		1, 9	11, 12
Add and Subtract Decimals pp. 54-59	6	7	4, 13
Multiply Decimals pp. 60-63	10		3, 14
Divide Decimals pp. 64-69	2, 5, 8		