CHAPTER

Applying Rational Numbers

• Add, subtract, multiply and

divide rational numbers.

Solve equations containing

fractions.

Chapter

3A Decimal Operations and Applications

- 3-1 Estimating with Decimals
- **3-2** Adding and Subtracting Decimals
- LAB Model Decimal Multiplication
- 3-3 Multiplying Decimals
- LAB Model Decimal Division
- 3-4 Dividing Decimals
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- LAB Model Fraction Addition and Subtraction
- **3-7** Adding and Subtracting Fractions
- **3-8** Adding and Subtracting Mixed Numbers
- LAB Model Fraction Multiplication and Division
- **3-9** Multiplying Fractions and Mixed Numbers
- **3-10** Dividing Fractions and Mixed Numbers
- **3-11** Solving Equations Containing Fractions

Why Learn This?

By using operations with decimals, you can determine statistics for football players and teams.

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simplest form

Vocabulary

Choose the best term from the list to complete each sentence.

1. $A(n) \stackrel{?}{_}$ is a number that is written using the	decimal
base-ten place value system.	fraction
2. An example of $a(n) = \frac{?}{16}$ is $\frac{14}{5}$.	improper fraction
3. $A(n) \stackrel{?}{_}$ is a number that represents a part of	mixed number

3. A(n) <u>?</u> is a number that represents a part of a whole.

Complete these exercises to review the skills you will need for this chapter.

Simplify Fractions

Write each fraction in simplest form.

4. $\frac{24}{40}$	5. $\frac{64}{84}$	6. $\frac{66}{78}$	7. $\frac{64}{192}$
8. $\frac{21}{35}$	9. $\frac{11}{99}$	10. $\frac{16}{36}$	11. $\frac{20}{30}$

🧭 Write Mixed Numbers as Fractions

Write each mixed number as an improper fraction.

12. $7\frac{1}{2}$	13. $2\frac{5}{6}$	14. $1\frac{14}{15}$	15. $3\frac{2}{11}$
16. $3\frac{7}{8}$	17. $8\frac{4}{9}$	18. $4\frac{1}{7}$	19. $5\frac{9}{10}$

🧭 Write Fractions as Mixed Numbers

Write each improper fraction as a mixed number.

20. $\frac{23}{6}$	21. $\frac{17}{3}$	22. $\frac{29}{7}$	23. $\frac{39}{4}$
24. $\frac{48}{5}$	25. $\frac{82}{9}$	26. $\frac{69}{4}$	27. $\frac{35}{8}$

🧭 Add, Subtract, Multiply, or Divide Integers

Find each sum, difference, product, or quotient.

28. -11 + (-24)	29. -11 - 7	30. −4 • (−10)
31. −22 ÷ (−11)	32. 23 + (-30)	33. -33 - 74
34. −62 • (−34)	35. 84 ÷ (−12)	36. -26 - 18

CHAPTER

Study Guide: Preview

Where You've Been

Previously, you

- added, subtracted, multiplied, and divided whole numbers.
- used models to solve equations with whole numbers.

In This Chapter

You will study

- using models to represent multiplication and division situations involving fractions and decimals.
- using addition, subtraction, multiplication, and division to solve problems involving fractions and decimals.
- solving equations with rational numbers.

Where You're Going

You can use the skills learned in this chapter

- to estimate total cost when purchasing several items at the grocery store.
- to find measurements in fields such as carpentry.

Key Vocabulary/Vocabulario

compatible numbers	números compatibles
reciprocal	recíproco

Vocabulary Connections

To become familiar with some of the vocabulary terms in the chapter, consider the following. You may refer to the chapter, the glossary, or a dictionary if you like.

- When two things are compatible, they make a good match. You can match a fraction with a number that is easier to work with, such as 1, ¹/₂, or 0, by rounding up or down. How could you use these compatible numbers to estimate the sums and differences of fractions?
- **2.** When fractions are **reciprocals** of each other, they have a special relationship. The fractions $\frac{3}{5}$ and $\frac{5}{3}$ are reciprocals of each other. What do you think the relationship between reciprocals is?





Study Strategy: Use Your Notes Effectively

Taking notes helps you understand and remember information from your textbook and lessons in class. Listed below are some steps for effectively using your notes before and after class.



Reading and Writing Math

Try This

- **1.** Look at the next lesson in your textbook. Think about how the new vocabulary terms relate to previous lessons. Write down any questions you have.
- **2.** With a classmate, compare the notes you took during the last class. Are there differences in the main points that you each recorded? Then brainstorm two ways you can improve your note-taking skills.

3-1

Estimating with Decimals

Learn to estimate decimal sums, differences, products, and quotients.

compatible numbers

Vocabulary

Jessie earned \$26.00 for baby-sitting. She wants to use the money to buy a ticket to an aquarium for \$14.75 and a souvenir T-shirt for \$13.20.

To find out if Jessie has enough money to buy both items, you can use estimation. To estimate the total cost of the ticket and the T-shirt, round each price to the nearest dollar, or integer. Then add the rounded values.



The Georgia Aquarium in Atlanta, GA, is the world's largest aquarium, with more than 8.1 million gallons of water.

\$14. 7 5	7 > 5, so round to \$15.	\$15
\$13. <mark>2</mark> 0	2 < 5, so round to \$13.	+ \$13
		\$28

The estimated cost is \$28, so Jessie does not have enough money to buy both items.

To estimate decimal sums and differences, round each decimal to the nearest integer and then add or subtract.

EXAMPLE	Estimating Sums and Differences of Decimals		
Remember!	A $86.9 + 58.4$ $86.9 \longrightarrow 87$ $9 > 5$, so round to 87. $+ 58.4 \longrightarrow + 58$ $4 < 5$, so round to 58.		
To round to the nearest integer, look at the digit in the tenths place. If it is greater than or equal to 5, round to the next integer. If it is less than 5, keep the same integer.	$\begin{array}{c} 1 & 3011 \\ \hline 145 \end{array} \xrightarrow{1} 10 \\ 145 \end{array} \xrightarrow{1} 10 \\ 10.38 \\ \hline 10.38 \\ \hline -6.721 \\ \hline -7 \\ 3 \end{array} \xrightarrow{1} 5, so round to 10. \\ \hline 3 \\ \hline 5 \\ 5 \\ 5 \\ 7 \\ \hline 3 \\ \hline 5 \\ 5 \\ 7 \\ \hline 5 \\ 5 \\ 7 \\ \hline 5 \\ 5 \\ 7 \\ 7 \\ \hline 5 \\ 5 \\ 7 \\ 7 \\ \hline 5 \\ 7 \\ 7 \\ 7 \\ \hline 5 \\ 7 \\ 7 \\ 7 \\ 7 \\ 7 \\ 7 \\ 7 \\ 7 \\ 7 \\$		
See Skills Bank p. SB1.	-26.3 + 15.195		
	$\begin{array}{rcl} -26.3 & \longrightarrow & -26 & 3 < 5, \text{ so round to } -26. \\ + 15.195 & \longrightarrow & +15 & 1 < 5, \text{ so round to } 15. \\ \hline & -11 & \longleftarrow & \textit{Estimate} \end{array}$		

You can use *compatible numbers* when estimating. Compatible numbers are numbers that are close to the given numbers that make estimation easier.

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Guidelines for Using Compatible Numbers

When multiplying . . .

round numbers to the nearest nonzero integer or to numbers that are easy to multiply.

When dividing . . .

round numbers so that they divide without leaving a remainder.

EXAMPLE 2	Estimating Products and Quotients of Decimals	
	Use compatible numbers to estimate.	
	A 32.66 ⋅ 7.69	
Remember!	$\begin{array}{rcl} 32.66 & \longrightarrow & 30 & \text{Round to the nearest multiple of 10.} \\ \underline{\times 7.69} & \longrightarrow & \underline{\times 8} & 6 > 5, \text{ so round to 8.} \\ \hline \underline{240} & \longleftarrow & \underline{\textit{Estimate}} \end{array}$	
A prime number has exactly two factors, 1 and itself. So the factors of 37 are 1 and 37.	B $36.5 \div (-8.241)$ $36.5 \longrightarrow 36$ $-8.241 \longrightarrow -9$ $36 \div (-9) = -4$ B 37 is a prime number, so round to 36. -9 divides into 36 without a remainder. Estimate	

When you solve problems, using an estimate can help you decide whether your answer is reasonable.

EXAMPLE

School Application

On a math test, a student worked the problem $6.2)\overline{55.9}$ and got the answer 0.9. Use estimation to check whether the answer is reasonable.

6. 2 → 6	2 < 5, so round to 6.
55.9 → 60	6 divides into 60 without a remainder.
$60 \div 6 = 10$	← Estimate

The estimate is more than ten times the student's answer, so 0.9 is not a reasonable answer.

Think and Discuss

- **1. Explain** whether your estimate will be greater than or less than the actual answer when you round both numbers down in an addition or multiplication problem.
- **2. Describe** a situation in which you would want your estimate to be greater than the actual amount.







Ringette is a team sport originally developed to be played by girls. Players wear ice skates and use straight sticks to pass, carry, and shoot a rubber ring to score goals.

- **39.** Transportation Kayla stopped for gasoline at a station that was charging \$2.719 per gallon. If Kayla had \$14.75 in cash, approximately how many gallons of gas could she buy?
- **40. Social Studies** The circle graph shows the languages spoken in Canada.
 - **a.** Which language do approximately 60% of Canadians speak?
 - **b.** What is the approximate difference between the percent of people who speak English and the percent who speak French?



41. Astronomy Jupiter is 5.20 astronomical units (AU) from the Sun. Neptune is almost 6 times as far from the Sun as Jupiter is. Estimate Neptune's distance from the Sun in astronomical units.

Sports Scott must earn a total of 27 points to advance to the final round in an ice-skating competition. He earns scores of 5.9, 5.8, 6.0, 5.8, and 6.0. Scott estimates that his total score will allow him to advance. Is his estimate reasonable? Explain.

- **43. Write a Problem** Write a problem that can be solved by estimating with decimals.
 - 44. Write About It Explain how an estimate helps you decide whether an answer is reasonable.
- **45.** Challenge Estimate. 6.35 15.512 + 8.744 4.19 72.7 + 25.008

Drop and Chiral Daviau

iest Prep al	iu Spiral Review		
46. Multiple Choic	e Which is the best estim	mate for 24.976 ÷ (-	-4.893)?
A 20	B -6	© -5	D 2
47. Multiple Choic buy a printer tha weeks he will have	• Steve is saving \$10.50 t costs \$150. Which is the ze to save his money unt	from his allowance e best estimate of th il he can buy the pri	each week to le number of inter?
(F) 5 weeks	G 10 weeks	(H) 12 weeks	① 15 weeks
48. Short Response wallet. Explain he money to leave a	 Joe's restaurant bill wa ow to use rounding to es \$2.75 tip. 	s \$16.84. He had \$2 timate whether Joe	0 in his had enough
Simplify each expres	sion. (Lessons 2-3 and 2-4	4)	
49. −5 + 4 − 2	50. 16 · (-3	5) + 12 5	51. $28 - (-2) \cdot (-3)$
52. $-90 - (-6) \cdot (-6)$	53. −7 − 3	-1 5	54. $-10 \cdot (-5) + 2$

Adding and Subtracting Decimals

Learn to add and subtract decimals.

3-2

One of the coolest summers on record in the Midwest was in 1992. The average summertime temperature that year was 66.8 °F. Normally, the average temperature is 4 °F higher than it was in 1992.

To find the normal average summertime temperature in the Midwest, you can add 66.8 °F and 4 °F.



Interactivities Online 🕨



Line up the decimal points.

The normal average summertime temperature in the Midwest is 70.8 °F.

EXAMPLE

Adding Decimals

Add. Estimate to check whether each answer is reasonable.

A 3.62 + 18.57	
3.62	Line up the decimal points.
+ 18.57	
22.19	Add.
Estimate	
4 + 19 = 23	22.19 is a reasonable answer.
$\begin{array}{r} \textbf{B} \textbf{9} + \textbf{3.245} \\ 9.000 \\ \underline{+ \ \textbf{3.245}} \\ 12.245 \end{array}$	Use zeros as placeholders. Line up the decimal points. Add.
Estimate	
9 + 3 = 12	12.245 is a reasonable answer.

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Remember!	Add. Estimate to ch	eck whether	each answer is reasonable.				
When adding numbers with the same sign, find the sum of their absolute values. Then use the sign of the numbers.	$\begin{array}{c} \textbf{C} -5.78 + (-18.3) \\ -5.78 + (-18.3) \\ 5.78 \\ + 18.30 \\ \hline 24.08 \\ -5.78 + (-18.3) \end{array}$	0 = -24.08	Think: 5.78 + 18.3. Line up the decimal points. Use zero as a placeholder. Add. Use the sign of the two numbers.				
	-6 + (-18) = -	24	-24.08 is a reasonable answer.				
EXAMPLE 2	Subtracting Decin Subtract.	nals					
		Line up ti Subtract	he decimal points.				
Caution! You will need to regroup numbers in order to subtract in Example 2B.	$\begin{array}{r} \textbf{B} 14 - 7.32 \\ 13 & 910 \\ 14.00 \\ - 7.32 \\ \hline 6.68 \end{array}$	Use zeros Line up ti Subtract.	as placeholders. he decimal points.				

EXAMPLE 3

Transportation Application

During one month in the United States, 492.23 million commuter trips were taken on buses, and 26.331 million commuter trips were taken on light rail. How many more trips were taken on buses than on light rail? Estimate to check whether your answer is reasonable.

492.23 0 - 26.331 465.899	<i>Use zero as a placeholder. Line up the decimal points. Subtract.</i>
Estimate	
490 - 30 = 460	465.899 is a reasonable answer.

465.899 million more trips were taken on buses than on light rail.

12.3

Think and Discuss

- **1. Tell** whether the addition is correct. If it is not,
explain why not.+ 4.68
5.91
- **2. Describe** how you can check an answer when adding and subtracting decimals.





Egg-drop competitions challenge students to build devices that will protect eggs when they are dropped from as high as 100 ft.

Weather The graph shows the five coolest summers recorded in the Midwest. The average summertime temperature in the Midwest is 70.8 °F.

- **42.** How much warmer was the average summertime temperature in 1950 than in 1915?
- **43.** In what year was the temperature 4.4 °F cooler than the average summertime temperature in the Midwest?
- Physical Science To float in water, an object must have a density of less than 1 gram per milliliter. The density of a

Summers When the Midwest Was Coolest 69 68.0° 68.0° 68 67.6° 66.8° 67 66.4° 66 65



Source: Midwestern Regional Climate Center

fresh egg is about 1.2 grams per milliliter. If the density of a spoiled egg is about 0.3 grams per milliliter less than that of a fresh egg, what is the density of a spoiled egg? How can you use water to tell whether an egg is spoiled?

- **45.** Choose a Strategy How much larger in area is Agua Fria than Pompeys Pillar?
 - (\mathbf{A}) 6.6 thousand acres
 - (B) 20.1 thousand acres
 - \bigcirc 70.59 thousand acres
 - \bigcirc 71.049 thousand acres

46. Write About It Explain how to find the sum or difference of two decimals.

47. Challenge Find the missing number. 5.11 + 6.9 - 15.3 + 20

Test Prep and Spiral Review

48. Multiple Choice In the 1900 Olympic Games, the 200-meter dash was won in 22.20 seconds. In 2000, the 200-meter dash was won in 20.09 seconds. How many seconds faster was the winning time in the 2000 Olympics?

(A) 1.10 seconds (B) 2.11 seconds	C 2.29 seconds	D 4.83 seconds
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49. Multiple Choice John left school with \$2.38. He found a quarter on his way home and then stopped to buy a banana for \$0.89. How much money did he have when he got home?

F	\$1.24	G	\$1.74	H	\$3.02	\bigcirc	\$3.52

Solve each equation. Check your answer. (Lesson 2-5)

52. $\frac{z}{2} = -8$ **50.** x - 8 = -22**51.** -3v = -45**53.** 29 = -10 + pEstimate. (Lesson 3-1) **54.** 15.85 ÷ 4.01 **55.** 18.95 + 3.21 **56.** 44.217 – 19.876 **57.** 21.43 • 1.57

National Monument	Area (thousand acres)
Agua Fria	71.1
Pompeys Pillar	0.051

Model Decimal Multiplication



You can use base-ten blocks to model multiplying decimals by whole numbers.

Activity 1

Hands-On

1 Use base-ten blocks to find $3 \cdot 0.1$.

Multiplication is repeated addition, so $3 \cdot 0.1 = 0.1 + 0.1 + 0.1$.

									2																			
									/																			
									r																			
									1																			
									/																			
									1																			
									2																			
									1																			
_	_	_	_	_	_	_	-	-		_	-	_	 _	_	_	_	_	_	-	_	_	_	_	_	_	_	_	_
										2		. (1		_	1	ſ١	-2										
3 - 0.1 - 0.3																												

2 Use base-ten blocks to find $5 \cdot 0.03$.

 $5 \cdot 0.03 = 0.03 + 0.03 + 0.03 + 0.03 + 0.03$



Think and Discuss

- **1.** Why can't you use base-ten blocks to model multiplying a decimal by a decimal?
- **2.** Is the product of a decimal between 0 and 1 and a whole number less than or greater than the whole number? Explain.

Try This

Use base-ten blocks to find each product.

1. 4 • 0.5	2. 2 • 0.04	3. 3 • 0.16	4. 6 • 0.2
5. 3 • 0.33	6. 0.25 • 5	7. 0.42 • 3	8. 1.1 • 4

You can use decimal grids to model multiplying decimals by decimals.

Activity 2

1 Use a decimal grid to find 0. $4 \cdot 0.7$.

×

×

Shade **0.4** horizontally.





0.7

Shade **0.7** vertically.

The area where the shaded regions overlap is the answer.



=

=

Think and Discuss

- **1.** Explain the steps you would take to model 0.5 0.5 with a decimal grid.
- **2.** How could you use decimal grids to model multiplying a decimal by a whole number?

Try This

Use decimal grids to find each product.

1. 0.6 • 0.6	2. 0.5 • 0.4	3. 0.3 • 0.8
4. 0.2 • 0.8	5. 3 • 0.3	6. 0.8 • 0.8
7. 2 • 0.5	8. 0.1 • 0.9	9. 0.1 • 0.1

Multiplying Decimals

Learn to multiply decimals.

3 - 3

You can use decimal grids to model multiplication of decimals. Each large square represents 1. Each row and column represents 0.1. Each small square represents 0.01. The area where the shading overlaps shows the product of the two decimals.



Interactivities Online

To multiply decimals, multiply as you would with integers. To place the decimal point in the product, count the number of decimal places in each factor. The product should have the same number of decimal places as the sum of the decimal places in the factors.



EXAMPLE 1	Multiplying I	ntegers by Decimals
	Multiply.	
	A 6 · 0.1	
	6	0 decimal places
	× 0.1	1 decimal place
	0.6	0 + 1 = 1 decimal place
	<mark>■</mark> -2・0.04	
	-2	0 decimal places
	× 0.04	2 decimal places
	-0. 0 8	0 + 2 = 2 decimal places. Use zero as a placeholder.
	C 1.25 · 23	
	1.25	2 decimal places
	<u>× 23</u>	0 decimal places
	3 75	
	+ 25 00	
	28.75	2 + 0 = 2 decimal places

EXAMPLE

Multiplying Decimals by Decimals

Multiply. Estimate to check whether each answer is reasonable.

A 1.2 · 1.6	
1.2	1 decimal place
× 1.6	1 decimal place
72	
<u>120</u>	
1.92	1 + 1 = 2 decimal places
Estimate	
$1 \cdot 2 = 2$	1.92 is a reasonable answer.
<mark>B</mark> −2.78・0.8	
-2.78	2 decimal places
× 0.8	1 decimal place
-2.224	2 + 1 = 3 decimal places
Estimate	
$-3 \cdot 1 = -3$	-2.224 is a reasonable answer.

EXAMPLE **3** Nutrition Application

On average, Americans eat 0.25 lb of peanut butter per month. How many pounds of peanut butter are eaten by the approximately 302 million Americans living in the United States per month?

302	0 decimal places
× 0.25	2 decimal places
1510	
6040	
75.50	0 + 2 = 2 decimal



0 + 2 = 2 decimal places

Estimate

 $300 \cdot 0.3 = 90$ 75.50 is a reasonable answer.

Approximately 75.50 million (75,500,000) pounds of peanut butter are eaten by Americans each month.

Think and Discuss

- **1. Explain** whether the multiplication $2.1 \cdot 3.3 = 69.3$ is correct.
- **2.** Compare multiplying integers with multiplying decimals.



- **42. Estimation** The graph shows the results of a survey about river recreation activities.
 - a. A report claimed that about 3 times as many people enjoyed canoeing in 1999–2000 than in 1994–1995. According to the graph, is this claim reasonable?
 - **b.** Suppose a future survey shows that 6 times as many people enjoyed kayaking in 2016–2017 than in 1999–2000. About how source: USA many people reported that they enjoyed kayaking in 2016–2017?



Multiply. Estimate to check whether each answer is reasonable.

43. 0.3 • 2.8 • (-10.6)	44. 1.3 • (-4.2) • (-3.94)
45. 0.6 ⋅ (−0.9) ⋅ 0.05	46. -6.5 • (-1.02) • (-12.6)
47. $-22.08 \cdot (-5.6) \cdot 9.9$	48. -63.75 • 13.46 • 7.8

- **49. What's the Question?** In a collection, each rock sample has a mass of 4.35 kilograms. There are a dozen rocks in the collection. If the answer is 52.2 kilograms, what is the question?
- **50. Write About It** How do the products 4.3 0.56 and 0.43 5.6 compare? Explain.
- $\mathbf{\mathbf{5}}$ 51. Challenge Evaluate (0.2)⁵.

Test Prep and Spiral Review

- **52.** Multiple Choice Which expression is equal to -4.3?
 - (A) $0.8 \cdot (-5.375)$ (B) $-1.2 \cdot (-3.6)$ (C) $-0.75 \cdot 5.6$ (D) $2.2 \cdot (-1.9)$
- **53. Gridded Response** Julia walked 1.8 mi each day from Monday through Friday. On Saturday, she walked 2.3 mi. How many miles did she walk in all?

Write the prime fac	torization of each numbe	er. (Lesson 2-6)	
54. 20	55. 35	56. 120	57. 64
Add or subtract. Est	imate to check whether o	each answer is reasonal	ole. (Lesson 3-2)
58. -4.875 + 3.62	59. 5.83 – (-2.74)	60. 6.32 + (-3.62)	61. -8.34 - (-4.6)
62. 9.3 + 5.88	63. 32.08 – 12.37	64. 19 – 6.92	65. -75.25 + 6.382



You can use decimal grids to model dividing decimals by integers and by decimals.

Activity

Use a decimal grid to find 0.6 ÷ 2. Shade 6 columns to represent 0.6.

Divide the 6 columns into 2 equal groups.

_
_
_

There are 3 columns, or 30 squares, in each group. 3 columns = 0.3 $0.6 \div 2 = 0.3$

Use decimal grids to find 2.25 ÷ 5. Shade 2 grids and 25 squares of a third grid to represent 2.25.



Divide the grids and squares into 5 equal groups. Use scissors to cut apart the grids. Think: 225 squares \div 5 = 45 squares.

There are 45 squares, or 4.5 columns, in each group. 4.5 columns = 0.45 $2.25 \div 5 = 0.45$



3 Use decimal grids to find 0.8 \div 0.4. Shade 8 columns to represent 0.8.

_	_	_	_	_	_	_	_	_

Divide the 8 columns into groups that each contain 0.4 of a decimal grid, or 4 columns.

	_	_	_						
_	_	_	_	_	_	_			
-	_	_	_	_	_	_	_		
	-	-	-	-	-	-		-	-

There are 2 groups that each contain 0.4 of a grid. $0.8 \div 0.4 = 2$

4 Use decimal grids to find $3.9 \div 1.3$. Shade 3 grids and 90 squares of a fourth grid to represent 3.9.



Divide the grids and squares into groups that each contain 1.3 of a decimal grid, or 13 columns.





There are 3 groups that each contain 1.3 grids. $3.9 \div 1.3 = 3$

Think and Discuss

- **1.** Explain why you think division is or is not commutative.
- **2.** How is dividing a decimal by a whole number different from dividing a decimal by another decimal?

Try This

Use decimal grids to find each quotient.

1. 0.8 ÷ 4	2. 0.6 ÷ 4	3. 0.9 ÷ 0.3	4. 0.6 ÷ 0.4
5. 4.5 ÷ 9	6. 1.35 ÷ 3	7. 3.6 ÷ 1.2	8. 4.2 ÷ 2.1

3-4

Dividing Decimals

Learn to divide decimals.

EXAMPLE

Sandy and her family traveled from Columbus, Ohio, to Chicago, Illinois, to visit Millennium Park. They used 14.95 gallons of gas for their 358.8-mile drive.

To find the number of miles per gallon the car got, you will need to divide a decimal by a decimal.



When you divide two numbers, you can multiply *both numbers* by the same power of ten without changing the final answer.

Multiply both 0.6 and 0.3 by 10: $0.6 \cdot 10 = 6$ and $0.3 \cdot 10 = 3$

 $0.6 \div 0.3 = 2$ and $6 \div 3 = 2$

By multiplying both numbers by the same power of ten, you can make the divisor an integer. Dividing by an integer is much easier than dividing by a decimal.

1 Dividing Decimals by Decimals

Divide. Helpful Hint **A** 4.32 ÷ 3.6 Multiply both $4.32 \div 3.6 = 43.2 \div 36$ Multiply both numbers by 10 numbers by the least to make the divisor an integer. 1.2 power of ten that Divide as with whole numbers. 36)43.2 will make the divisor an integer. -36 72 -720 **B** 12.95 \div (-1.25) $12.95 \div (-1.25) = 1295 \div (-125)$ Multiply both numbers by 100 to make the divisor an integer. 10.36 125)1,295.00 Use zeros as placeholders. -125Divide as with whole numbers. 450 -375 7 50 -7500 $12.95 \div (-1.25) = -10.36$ The signs are different.

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EXAMPLE 2

Dividing Integers by Decimals

Divide. Estimate to check whether each answer is reasonable.

A 9 ÷ 1.25	
$9.00 \div 1.25 = 900 \div 125$ 7.2 125)900.0	Multiply both numbers by 100 to make the divisor an integer. Use zero as a placeholder.
$ \frac{-875}{250} \\ -250}{0} $	Divide as with whole numbers.
Estimate $9 \div 1 = 9$	7.2 is a reasonable answer.
B $-12 \div (-1.6)$	
$-12.0 \div (-1.6) = -120 \div (-16)$	Multiply both numbers by 10
7.5	to make the divisor an integer.
16)120.0	Divide as with whole numbers
$\frac{-112}{80}$	
$\frac{-80}{0}$	
$-12 \div (-1.6) = 7.5$	The signs are the same.
Estimate $-12 \div (-2) = 6$	7.5 is a reasonable answer.

EXAMPLE 3

Transportation Application

If Sandy and her family used 14.95 gallons of gas to drive 358.8 miles, how many miles per gallon did the car get?

Helpful Hint

To calculate miles per gallon, divide the number of miles driven by the number of gallons of gas used.

```
358.80 \div 14.95 = 35,880 \div 1,495
24
1,495)35,880
-29.90
5.980
-5.980
0
```

Multiply both numbers by 100 to make the divisor an integer.

Divide as with whole numbers.

The car got 24 miles per gallon.

Think and Discuss

- **1. Explain** whether $4.27 \div 0.7$ is the same as $427 \div 7$.
- **2. Explain** how to divide an integer by a decimal.





The Blue Ridge Parkway is the longest, narrowest national park in the world. Starting in Virginia, it covers 469 miles and ends at the entrance of the Great Smoky Mountains NP in North Carolina.

- **39. Earth Science** Glaciers form when snow accumulates faster than it melts and thus becomes compacted into ice under the weight of more snow. Once the ice reaches a thickness of about 18 m, it begins to flow. If ice were to accumulate at a rate of 0.0072 m per year, how long would it take to start flowing?
- **40.** Critical Thinking Explain why using estimation to check the answer to $56.21457 \div 7$ is useful.

41. **Recreation** The graph shows the approximate number of total visits to the three most visited U.S. national parks in 2006. What was the average number of visits to these three parks? Round your answer to the nearest hundredth.



- **42. Write a Problem** Find some supermarket advertisements. Use the ads to write a problem that can be solved by dividing a decimal by a whole number.
- **43.** Write About It Can you use the Commutative Property when dividing decimals? Explain.
- **44. Challenge** Use a calculator to simplify the expression $(2^3 \cdot 7.5 + 3.69) \div 48.25 \div [1.04 - (0.08 \cdot 2)].$

Test Prep and Spiral Review

- **45.** Multiple Choice Which expression is NOT equal to -1.34?
 - \bigcirc -12.06 ÷ (-9) (A) $-6.7 \div 5$ **B** 16.08 ÷ (−12) **(D)** $-22.78 \div 17$
- **46.** Multiple Choice A deli is selling 5 sandwiches for \$5.55, including tax. A school spent \$83.25 on roast beef sandwiches for its 25 football players. How many sandwiches did each player get?
 - **(F)** 1 **G** 2 **H** 3 $\bigcirc 5$
- **47. Gridded Response** Rujuta spent a total of \$49.65 on 5 CDs. What was the average cost in dollars for each CD?

Simplify each expression. (Lesson 1-4)					
48. 2 + 6 • 2	49. $3^2 - 8 \cdot 0$	50. $(2-1)^5 + 3$			
51. $10 - (5 - 3)^2 + 4 \div 2$	52. $2^5 \div (7 + 1)$	53. $6 - 2 \cdot 3 + 5$			

Mul	tiply. Estimate to check whe	ther	each answer is reasonable	e. (Le	esson 3-3)
54.	$-2.75 \cdot 6.34$	55.	0.2 · (-4.6) · (-2.3)	56.	1.3 · (-6.7)
57.	-6.87 · (-2.65)	58.	9 • 4.26	59 .	7.13 · (-14)

 $+3 \cdot 2^2$

Solving Equations Containing Decimals

Learn to solve one-step equations that contain decimals.

3-5

Students in a physical education class were running 40-yard dashes as part of a fitness test. The slowest time in the class was 3.84 seconds slower than the fastest time of 7.2 seconds.

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EXAMPLE

You can write an equation to represent this situation. The slowest time *s* minus 3.84 is equal to the fastest time of 7.2 seconds.

s - 3.84 = 7.2

Solving Equations by Adding or Subtracting

Solve. Justify your steps.

A s - 3.84 = 7.2

y

11-	-		-	
	-	 -	-	-

You can solve an equation by performing the same operation on both sides of the equation to isolate the variable. s - 3.84 = 7.20 $\frac{+ 3.84}{s} = \frac{+ 3.84}{11.04}$ y + 20.51 = 26 y + 20.51 = 26.00 - 20.51 = -20.51

Use the Addition Property of Equality. Add 3.84 to both sides.

Use the Subtraction Property of Equality. Subtract 20.51 from both sides.

EXAMPLE

Solving Equations by Multiplying or Dividing

5.49

Solve. Justify your steps.

=

A $\frac{w}{3.9} = 1.2$ $\frac{w}{3.9} = 1.2$ $\frac{w}{3.9} \cdot 3.9 = 1.2 \cdot 3.9$ w = 4.68B 4 = 1.6c 4 = 1.6c $\frac{4}{1.6} = \frac{1.6c}{1.6}$ $\frac{4}{1.6} = c$

2.5 = c

Use the Multiplication Property of Equality. Multiply by 3.9 on both sides.

Use the Division Property of Equality. Divide by 1.6 on both sides. Think: $4 \div 1.6 = 40 \div 16$.

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PROBLEM SOLVING APPLICATION

Yancey wants to buy a new snowboard that costs \$396.00. If she earns \$8.25 per hour at work, how many hours must she work to earn enough money to buy the snowboard?

Understand the Problem

Rewrite the question as a statement.

• Find the number of hours Yancey must work to earn \$396.00.

List the **important information**:

- Yancey earns \$8.25 per hour.
- Yancey needs \$396.00 to buy a snowboard.



2 Make a Plan

Yancey's pay is equal to her hourly pay times the number

of hours she works. Since you know how much money she needs to earn, you can write an equation with *h* being the number of hours.

8.25h = 396

Solve

8.25h = 396 $\frac{8.25h}{8.25} = \frac{396}{8.25}$

Use the Division Property of Equality.

h = 48

Yancey must work 48 hours.

4 Look Back

You can round 8.25 to 8 and 396 to 400 to estimate how many hours Yancey needs to work.

 $400 \div 8 = 50$

So 48 hours is a reasonable answer.

Think and Discuss

- **1. Describe** how to solve the equation -1.25 + x = 1.25. Then solve.
- **2. Explain** how you can tell if 1.01 is a solution of 10s = -10.1 without solving the equation.





From 1892 to 1924, more than 22 million immigrants came to Ellis Island, New York. **44. Physical Science** Pennies minted, or created, before 1982 are made mostly of copper and have a density of 8.85 g/cm³. Because of an increase in the cost of copper, the density of pennies made after 1982 is 1.71 g/cm³ less. What is the density of pennies minted today?

Social Studies The table shows the most common European ancestral origins of Americans (in millions), according to a Census 2000 supplementary survey. In addition, 19.6 million people stated that their ancestry was "American."

a. How many people claimed ancestry from the countries listed, according to the survey?

Ancestral Origins of Americans					
European Ancestry	Number (millions)				
English	28.3				
French	9.8				
German	46.5				
Irish	33.1				
Italian	15.9				
Polish	9.1				
Scottish	5.4				

b. If the data were placed in order

from greatest to least, between which two nationalities would "American" ancestry be placed?

- **46.** What's the Error? A student's solution to the equation m + 0.63 = 5 was m = 5.63. What is the error? What is the correct solution?
- **47. Write About It** Compare the process of solving equations containing integers with the process of solving equations containing decimals.
- **48.** Challenge Solve the equation $-2.8 + (b 1.7) = -0.6 \cdot 9.4$.

Test Prep and Spiral Review

49. M	49. Multiple Choice What is the solution to the equation $-4.55 + x = 6.32$?				
A	x = -1.39	(B) $x = 1.77$	\bigcirc <i>x</i> = 10.87	D $x = 28.76$	
50. Multiple Choice The pep squad is selling tickets for a raffle. The tickets are \$0.25 each or 5 for \$1.00. Julie bought a pack of 5 tickets. Which equation can be used to find how much Julie paid per ticket?					
Œ	5x = 0.25	(G) $0.25x = 1.00$	(H) $5x = 1.00$	\bigcirc 1.00 <i>x</i> = 0.25	
51. Extended Response Write a word problem that the equation $6.25x = 125$ can be used to solve. Solve the problem and explain what the solution means.					
Write	each number in sci	entific notation. (Lesso	on 1-3)		
52. 34	0,000	53. 6,000,000	54. 3	$2.4 \cdot 10^2$	
Simplify each expression. (Lesson 3-4)					
55. 6.3	$3 \div 2.1 - 1.5$	56. 4 • 5.1 ÷ 2	+ 3.6 57. (1.6 + 3.8) ÷ 1.8	
58. (–	·5.4 + 3.6) ÷ 0.9	59. −4.5 ÷ 0.6	• (-1.2) 60. 5	$5.8 + 3.2 \div (-6.4)$	



Quiz for Lessons 3-1 Through 3-5

3-1 Estimating with Decimals

Estimate.

- **1.** 163.2 5.4 **2.** 37.19 + 100.94 **3.** 376.82 139.28 **4.** 33.19 ÷ 8.18
- **5.** Brad worked the homework problem 119.67 m \div 10.43 m. His answer was 11.47 m. Use estimation to check whether this answer is reasonable.

Or State Adding and	l Subtracting Decimals		
Add or subtract.			
6. 4.73 + 29.68	7. -6.89 - (-29.4)	8. 23.58 – 8.36	9. -15 + (-9.44)
3-3 Multiplying	y Decimals		
Multiply.			
10. 3.4 • 9.6	11. $-2.66 \cdot 0.9$	12. $-7 \cdot (-0.06)$	13. 6.94 ⋅ (−24)
14. Cami can run 7 1.75 hours? Rot	7.02 miles per hour. How a und your answer to the n	many miles can she earest hundredth.	run in
O 3-4 Dividing Do	ecimals		
Divide.			
15. 55 ÷ 12.5	16. −126.45 ÷ (−4.5)	17. −3.3 ÷ 0.11	18. −36 ÷ (−0.9)

- **19.** $10.4 \div (-0.8)$ **20.** $18 \div 2.4$ **21.** $-45.6 \div 12$ **22.** $-99.36 \div (-4)$
- **23.** Cynthia ran 17.5 laps in 38.5 minutes. If she ran each lap at the same pace, how long did it take her to run one full lap?
- **24.** A jewelry store sold a 7.4-gram gold necklace for \$162.18. How much was the necklace worth per gram? Round your answer to the nearest tenth.

3-5 Solving Equations Containing Decimals

Solve.

25. 3.4 + n = 8 **26.** x - 1.75 = -19 **27.** -3.5 = -5x **28.** $10.1 = \frac{s}{8}$

29. Pablo earns \$5.50 per hour. His friend Raymond earns 1.2 times as much. How much does Raymond earn per hour?

Focus on Problem Solving



Look Back

• Does your solution answer the question in the problem?

Sometimes, before you solve a problem, you first need to use the given data to find additional information. Any time you find a solution for a problem, you should ask yourself if your solution answers the question being asked, or if it just gives you the information you need to find the final answer.

Read each problem, and determine whether the given solution answers the question in the problem. Explain your answer.

1 At one store, a new CD costs \$15.99. At a second store, the same CD costs 0.75 as much. About how much does the second store charge?

Solution: The second store charges about \$12.00.

2 Bobbie is 1.4 feet shorter than

her older sister. If Bobbie's

sister is 5.5 feet tall, how

Bobbie is 4.1 feet tall.

tall is Bobbie?

Solution:

Juanita ran the 100-yard dash
 1.12 seconds faster than Kellie. Kellie's time was 0.8 seconds faster than Rachel's. If Rachel's time was 15.3 seconds, what was Juanita's time?

Solution: Kellie's time was 14.5 seconds.

The playscape at a local park is located in a triangular sandpit. Side A of the sandpit is 2 meters longer than side B. Side B is twice as long as side C. If side C is 6 meters long, how long is side A?

Solution: Side B is 12 meters long.

Both Tyrone and Albert walk to and from school every day. Albert has to walk 1.25 miles farther than Tyrone does each way. If Tyrone's house is 0.6 mi from school, how far do the two boys walk altogether?

Solution: Albert lives 1.85 mi from school.

3-6 Estimating with Fractions

Learn to estimate sums, differences, products, and quotients of fractions and mixed numbers. One of the largest cheese wheels ever produced was made in Alkmaar, Netherlands, and weighed about $1,250\frac{1}{50}$ lb. About how much heavier was this than the average cheese wheel, which may weigh about 6 lb?

Sometimes, when solving problems, you may not need an exact answer. To estimate sums and differences of



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fractions and mixed numbers, round each fraction to 0, $\frac{1}{2}$, or 1. You can use a number line to help.



You can also round fractions by comparing numerators with denominators.

Benchmarks for Rounding Fractions				
Round to 0 if the numerator is much smaller than the denominator.	Round to $\frac{1}{2}$ if the numerator is about half the denominator.	Round to 1 if the numerator is nearly equal to the denominator.		
Examples: $\frac{1}{9}$, $\frac{3}{20}$, $\frac{2}{11}$	Examples: $\frac{2}{5}$, $\frac{5}{12}$, $\frac{7}{13}$	Examples: $\frac{8}{9}$, $\frac{23}{25}$, $\frac{97}{100}$		

EXAMPLE 1

Measurement Application

One of the largest wheels of cheese ever made weighed about $1,250\frac{1}{50}$ lb. Estimate how much more this wheel of cheese weighed than an average 6 lb wheel.



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You can estimate products and quotients of mixed numbers by rounding to the nearest whole number. If the fraction in a mixed number is greater than or equal to $\frac{1}{2}$, round the mixed number up to the next whole number. If the fraction is less than $\frac{1}{2}$, round down to a whole number by dropping the fraction.

Estimating Products and Quotients

Estimate each product or quotient.



Think and Discuss

- **1. Demonstrate** how to round $\frac{5}{12}$ and $5\frac{1}{5}$.
- **2. Explain** how you know that $25\frac{5}{8} \cdot 5\frac{1}{10} > 125$.

EXAMPLE



Life Science The diagram shows the wingspans of different species of birds. Use the diagram for Exercises 42 and 43.



- **42.** Approximately how much longer is the wingspan of an albatross than the wingspan of a gull?
- **43.** Approximately how much longer is the wingspan of a golden eagle than the wingspan of a blue jay?

44. Write a Problem Using mixed numbers, write a problem in which an estimate is enough to solve the problem.

- **45. Write About It** How is estimating fractions or mixed numbers similar to rounding whole numbers?
- **46.** Challenge Suppose you had bought 10 shares of Xerox stock on October 16, 1987, for \$73 per share and sold them at the end of the day on October 19, 1987, for $56\frac{1}{4}$ per share. Approximately how much money would you have lost?

Test Prep and Spiral Review

47. Multiple Choice For which of the following would 2 be the best estimate?

(A) $8\frac{7}{9} \cdot 4\frac{2}{5}$	B $4\frac{1}{5} \div 2\frac{5}{9}$	$\bigcirc 8\frac{7}{9} \cdot 2\frac{1}{5}$	D $8\frac{1}{9} \div 4\frac{2}{5}$

48. Multiple Choice The table shows the distance Maria biked each day last week.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Distance (mi)	12 <u>3</u>	9 <u>11</u> 15	3 <u>1</u>	8 <u>1</u>	0	$4\frac{3}{4}$	5 <u>2</u> 5

Which is the best estimate for the total distance Maria biked last week?

(F) 40 mi(G) 44 mi(H) 48 mi(D) 52 miSolve each equation. Check your answer. (Lessons 1-10 and 1-11)49. x + 16 = 4350. y - 32 = 1451. 5m = 6552. $\frac{n}{3} = 18$ Solve. (Lesson 3-5)53. -7.1x = -46.1554. 8.7 = y + (-4.6)55. $\frac{q}{-5.4} = 3.6$ 56. r - 4 = -31.2

^{🧭 44}

Model Fraction Addition and Subtraction

Use with Lesson 3-7



Fraction bars can be used to model addition and subtraction of fractions.

Activity

tands-or

You can use fraction bars to find $\frac{3}{8} + \frac{2}{8}$.

Use fraction bars to represent both fractions. Place the fraction bars side by side.

$$\frac{1}{8} \quad \frac{1}{8} \quad \frac{1}{8} \quad \frac{1}{8} \quad \frac{1}{8} \quad \frac{1}{8} \quad \frac{3}{8} + \frac{2}{8} = \frac{5}{8}$$

1 Use fraction bars to find each sum.

a. $\frac{1}{3} + \frac{1}{3}$ **b.** $\frac{2}{4} + \frac{1}{4}$ **c.** $\frac{3}{12} + \frac{2}{12}$ **d.** $\frac{1}{5} + \frac{2}{5}$

You can use fraction bars to find $\frac{1}{3} + \frac{1}{4}$.

Use fraction bars to represent both fractions. Place the fraction bars side by side. Which kind of fraction bar placed side by side will fit below $\frac{1}{3}$ and $\frac{1}{4}$? (*Hint:* What is the LCM of 3 and 4?)

$$\begin{array}{c|c} \frac{1}{3} & \frac{1}{4} \\ \frac{1}{12} & \frac{1}{12} & \frac{1}{12} & \frac{1}{12} & \frac{1}{12} & \frac{1}{12} & \frac{1}{12} \\ \end{array} & \begin{array}{c} \frac{1}{3} + \frac{1}{4} = \frac{7}{12} \\ \frac{1}{3} + \frac{1}{4} = \frac{7}{12} \\ \end{array}$$

2 Use fraction bars to find each sum.

a. $\frac{1}{2} + \frac{1}{3}$ **b.** $\frac{1}{2} + \frac{1}{4}$ **c.** $\frac{1}{3} + \frac{1}{6}$ **d.** $\frac{1}{4} + \frac{1}{6}$

 $\frac{7}{6}$

You can use fraction bars to find $\frac{1}{3} + \frac{5}{6}$.

Use fraction bars to represent both fractions. Place the fraction bars side by side. Which kind of fraction bar placed side by side will fit below $\frac{1}{3}$ and $\frac{5}{6}$? (*Hint:* What is the LCM of 3 and 6?)

<u>1</u>		<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	1.5
3		6	6	6	6	6	
<u>1</u>	$\frac{1}{3} + \frac{1}{6} =$						
6	6	6	6	6	6	6	

When the sum is an improper fraction, you can use the 1 bar along with fraction bars to find the mixed-number equivalent.



3 Use fraction bars to find each sum.

a. $\frac{3}{4} + \frac{3}{4}$ **b.** $\frac{2}{3} + \frac{1}{2}$ **c.** $\frac{5}{6} + \frac{1}{4}$ **d.** $\frac{3}{8} + \frac{3}{4}$

You can use fraction bars to find $\frac{2}{3} - \frac{1}{2}$.

Place a $\frac{1}{2}$ bar beneath bars that show $\frac{2}{3}$, and find which fraction fills in the remaining space.



4 Use fraction bars to find each difference.

a. $\frac{2}{3} - \frac{1}{3}$ b. $\frac{1}{4} - \frac{1}{6}$ c. $\frac{1}{2} - \frac{1}{3}$ d.	$\frac{3}{4}$	- 4	$\frac{2}{3}$
---	---------------	-----	---------------

Think and Discuss

- **1.** Model and solve $\frac{3}{4} \frac{1}{6}$. Explain your steps.
- **2.** Two students solved $\frac{1}{4} + \frac{1}{3}$ in different ways. One got $\frac{7}{12}$ for the answer, and the other got $\frac{2}{7}$. Use models to show which student is correct.
- **3.** Find three different ways to model $\frac{1}{2} + \frac{1}{4}$.
- **4.** If you add two proper fractions, do you always get a sum that is greater than one? Explain.

Try This

Use fraction bars to find each sum or difference.

1.	$\frac{1}{2} + \frac{1}{2}$	2. $\frac{2}{3} + \frac{1}{6}$	3. $\frac{1}{4} + \frac{1}{6}$	4.	$\frac{1}{3}$ +	$\frac{7}{12}$
5.	$\frac{5}{12} - \frac{1}{3}$	6. $\frac{1}{2} - \frac{1}{4}$	7. $\frac{3}{4} - \frac{1}{6}$	8.	$\frac{2}{3}$ –	$\frac{1}{4}$

- **9.** You ate $\frac{1}{4}$ of a pizza for lunch and $\frac{5}{8}$ of the pizza for dinner. How much of the pizza did you eat in all?
- **10.** It is $\frac{5}{6}$ mile from your home to the library. After walking $\frac{3}{4}$ mile, you stop to visit a friend. How much farther must you walk to reach the library?

Adding and Subtracting Fractions

Learn to add and subtract fractions.

EXAMPLE

3-7

From January 1 to March 14 of any given year, Earth completes approximately $\frac{1}{5}$ of its circular orbit around the Sun, while Venus completes approximately $\frac{1}{3}$ of its orbit. To find out how much more of its orbit Venus completes



than Earth, you need to subtract fractions.

Adding and Subtracting Fractions with Like Denominators

Add or subtract. Write each answer in simplest form.

A $\frac{3}{10} + \frac{1}{10}$	
$\frac{3}{10} + \frac{1}{10} = \frac{3+1}{10}$	Add the numerators and keep the common denominator.
$=\frac{4}{10}=\frac{2}{5}$	Simplify.
B $\frac{7}{9} - \frac{4}{9}$	
$\frac{7}{9} - \frac{4}{9} = \frac{7-4}{9}$	Subtract the numerators and keep the common denominator.
$=\frac{3}{9}=\frac{1}{3}$	Simplify.

To add or subtract fractions with different denominators, you must rewrite the fractions with a common denominator.

Two Ways to Find a Common Denominator				
Method 1: Find the LCM (least common multiple) of the denominators.	Method 2: Multiply the denominators.			
$\frac{1}{2} + \frac{1}{4} = \frac{1 \cdot 2}{2 \cdot 2} + \frac{1}{4}$ The LCM of the denominators is 4	$\frac{1}{2} + \frac{1}{4} = \frac{1 \cdot 4}{2 \cdot 4} + \frac{1 \cdot 2}{4 \cdot 2}$ Multiply the denominators			
$\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$	$\frac{4}{8} + \frac{2}{8} = \frac{6}{8} = \frac{3}{4}$			

Helpful Hint

The LCM of two denominators is the lowest common denominator (LCD) of the fractions.



EXAMPLE

Adding and Subtracting Fractions with Unlike Denominators

Add or subtract. Write each answer in simplest form.

EXAMPLE

Astronomy Application

From January 1 to March 14, Earth completes about $\frac{1}{5}$ of its orbit, while Venus completes about $\frac{1}{3}$ of its orbit. How much more of its orbit does Venus complete than Earth?

$$\frac{1}{3} - \frac{1}{5} = \frac{1 \cdot 5}{3 \cdot 5} - \frac{1 \cdot 3}{5 \cdot 3}$$

$$= \frac{5}{15} - \frac{3}{15}$$

$$= \frac{2}{15}$$
Write equivalent fractions.
$$= \frac{2}{15}$$
Subtract.
Venus completes $\frac{2}{15}$ more of its orbit than Earth does.

Think and Discuss

- **1. Describe** the process for subtracting fractions with different denominators.
- **2. Explain** whether $\frac{3}{4} + \frac{2}{3} = \frac{5}{7}$ is correct.



Fitness Four friends had a competition to see how far they could walk while spinning a hoop around their waists. The table shows how far each friend walked. Use the table for Exercises 51–53.

- 51. How much farther did Lauren walk than Rosalyn?
- **52.** What is the combined distance that Cai and Rosalyn walked?
- 53. Who walked farther, Janna or Cai?
- **54.** Measurement A shrew weighs $\frac{3}{16}$ lb. A hamster weighs $\frac{1}{4}$ lb.
 - **a.** How many more pounds does a hamster weigh than a shrew?
 - **b.** There are 16 oz in 1 lb. How many more ounces does the hamster weigh than the shrew?
- **55.** Multi-Step To make $\frac{3}{4}$ lb of mixed nuts, how many pounds of cashews would you add to $\frac{1}{8}$ lb of almonds and $\frac{1}{4}$ lb of peanuts?
- **56.** Make a Conjecture Suppose the pattern $1, \frac{7}{8}, \frac{3}{4}, \frac{5}{8}, \frac{1}{2} \dots$ is continued forever. Make a conjecture about the rest of the numbers in the pattern.
- **57. Write a Problem** Use facts you find in a newspaper or magazine to write a problem that can be solved using addition or subtraction of fractions.
- **58.** Write About It Explain the steps you use to add or subtract fractions that have different denominators.
- **59.** Challenge The sum of two fractions is 1. If one fraction is $\frac{3}{8}$ greater than the other, what are the two fractions?

Test Prep and Spiral Review

60.	Multiple Choice What	at is the value of the e	xpression $\frac{3}{7} + \frac{1}{5}$?	
	(A) $\frac{1}{3}$ (B) $\frac{22}{35}$	$\bigcirc \frac{2}{3}$	D $\frac{26}{35}$
61. Ein	Gridded Response G apples. They want to co 1 pound of apples. How	Trace has $\frac{1}{2}$ pound of a symbol of a problem their apples to many more pounds	pples. Julie has $\frac{2}{5}$ pour o use in a recipe that ca of apples do they need	ıd of alls for l?
ГШ	u the greatest common.	lactor (GCF). (Lesson	2-7)	
62.	5, 9 63 .	6, 54	64. 18, 24	65. 12, 36, 50
Esti 66.	imate each sum or differ $\frac{4}{7} + \frac{1}{9}$ 67.	rence. (Lesson 3-6) $4\frac{2}{3} - 2\frac{3}{5}$	68. $7\frac{5}{9} - (-3\frac{2}{7})$	69. $6\frac{1}{8} + 2\frac{4}{7}$







3-8 Adding and Subtracting Mixed Numbers

Learn to add and subtract mixed numbers.

Beetles can be found all over the world in a fabulous variety of shapes, sizes, and colors. The giraffe beetle from Madagascar can grow about $6\frac{2}{5}$ centimeters longer than the giant green fruit beetle can. The giant green fruit beetle can grow up to $1\frac{1}{5}$ centimeters long. To find the maximum length of the giraffe beetle, you can add $6\frac{2}{5}$ and $1\frac{1}{5}$.



EXAMPLE

Measurement Application

The giraffe beetle can grow about $6\frac{2}{5}$ centimeters longer than the giant green fruit beetle can. The giant green fruit beetle can grow up to $1\frac{1}{5}$ centimeters long. What is the maximum length of the giraffe beetle?

$$6\frac{2}{5} + 1\frac{1}{5} = 7 + \frac{3}{5}$$
$$= 7\frac{3}{5}$$

Add the fractions, and then add the integers.

The maximum length of the giraffe beetle is $7\frac{3}{5}$ centimeters.

Add.

EXAMPLE

Helpful Hint

Add the fractions first in case an improper fraction needs to be rewritten.

Adding Mixed Numbers

Add. Write each answer in simplest form.

A $3\frac{4}{5} + 4\frac{2}{5}$	
$3\frac{4}{5} + 4\frac{2}{5} = 7 + \frac{6}{5}$	Add the fractions, and then add the integers.
$= 7 + 1\frac{1}{5}$ $= 8\frac{1}{5}$	Rewrite the improper fraction as a mixed number. Add.
B $1\frac{2}{15} + 7\frac{1}{6}$	
$1\frac{2}{15} + 7\frac{1}{6} = 1\frac{4}{30} + 7\frac{5}{30}$	Find a common denominator.
$= 8 + \frac{9}{30}$	Add the fractions, and then add the integers.
$= 8\frac{9}{30} = 8\frac{3}{10}$	Add. Then simplify.

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Sometimes, when you subtract mixed numbers, the fraction portion of the first number is less than the fraction portion of the second number. In these cases, you must regroup before subtracting.

	REGROUPING MIXED NUMBERS		
	Words	Numbers	
Remember! Any fraction in which the numerator and denominator are the same is equal to 1.	Regroup. Rewrite 1 as a fraction with a common denominator. Add.	$7\frac{1}{8} = 6 + 1 + \frac{1}{8}$ $= 6 + \frac{8}{8} + \frac{1}{8}$ $= 6\frac{9}{8}$	

EXAMPLE

Subtracting Mixed Numbers

Subtract. Write each answer in simplest form.

A
$$10\frac{7}{9} - 4\frac{2}{9}$$

 $10\frac{7}{9} - 4\frac{2}{9} = 6\frac{5}{9}$
B $12\frac{7}{8} - 5\frac{17}{24}$
 $12\frac{7}{8} - 5\frac{17}{24} = 12\frac{21}{24} - 5\frac{17}{24}$
 $= 7\frac{4}{24}$

C $72\frac{3}{5} - 63\frac{4}{5}$ $72\frac{3}{5} - 63\frac{4}{5} = 71\frac{8}{5} - 63\frac{4}{5}$ Regroup. $72\frac{3}{5} = 71 + \frac{5}{5} + \frac{3}{5}$ $= 8\frac{4}{5}$

 $= 7\frac{1}{6}$

Subtract the fractions, and then subtract the integers.

Find a common denominator.

Subtract the fractions, and then subtract the integers.

Simplify.

Subtract the fractions, and then subtract the integers.

Think and Discuss

- **1. Explain** whether it is possible for the sum of two mixed numbers to be a whole number.
- **2. Explain** whether $2\frac{3}{5} + 1\frac{3}{5} = 3\frac{6}{5}$ is correct. Is there another way to write the answer?
- **3. Demonstrate** how to regroup to simplify $6\frac{2}{5} 4\frac{3}{5}$.





New Zealand is made of two main islands in the southwestern Pacific Ocean. The native Māori people refer to New Zealand as *Aoetearoa*, or "The Land of the Long White Cloud."

Travel The table shows the distances in miles between four cities. To find the distance between two cities, locate the square where the row for one city and the column for the other city intersect.

- **44.** How much farther is it from Charleston to Dixon than from Atherton to Baily?
- **45.** If you drove from Charleston to Atherton and then from Atherton to Dixon, how far would you drive?

les ween or	Ather	Baily	Charl	Diton	
Atherton	\times	40 <u>2</u> 3	100 <u>5</u>	16 <u>1</u>	
Baily	$40\frac{2}{3}$	\boxtimes	210 ³ /8	$30\frac{2}{3}$	
Charleston	$100\frac{5}{6}$	210 ³ /8	\times	$98\frac{3}{4}$	
Dixon	16 <u>1</u>	30 ² / ₃	98 <u>3</u>	\mathbf{X}	

46. Agriculture In 2003, the United

States imported $\frac{97}{100}$ of its tulip bulbs from the Netherlands and $\frac{1}{50}$ of its tulip bulbs from New Zealand. What fraction more of tulip imports came from the Netherlands?

- **47. Recreation** Kathy wants to hike to Candle Lake. The waterfall trail is $1\frac{2}{3}$ miles long, and the meadow trail is $1\frac{5}{6}$ miles long. Which route is shorter and by how much?
- **48.** Choose a Strategy Spiro needs to draw a 6-inch-long line. He does not have a ruler, but he has sheets of notebook paper that are $8\frac{1}{2}$ in. wide and 11 in. long. Describe how Spiro can use the notebook paper to measure 6 in.
- **49. Write About It** Explain why it is sometimes necessary to regroup a mixed number when subtracting.
- **50.** Challenge Todd had *d* pounds of nails. He sold $3\frac{1}{2}$ pounds on Monday and $5\frac{2}{3}$ pounds on Tuesday. Write an expression to show how many pounds he had left and then simplify it.

Test Prep and Spiral Review 51. Multiple Choice Which expression is NOT equal to $2\frac{7}{8}$? **B** $5\frac{15}{16} - 3\frac{1}{16}$ **C** $6 - 3\frac{1}{8}$ (A) $1\frac{1}{2} + 1\frac{3}{9}$ **D** $l_{0}^{1} + l_{4}^{1}$ **52.** Short Response Where Maddie lives, there is a $5\frac{1}{2}$ -cent state sales tax, a $1\frac{3}{4}$ -cent county sales tax, and a $\frac{3}{4}$ -cent city sales tax. The total sales tax is the sum of the state, county, and city sales taxes. What is the total sales tax where Maddie lives? Show your work. Find each sum. (Lesson 2-2) **53.** -3 + 9 55. -4 + (-8)**56.** -11 + 5 **54.** 6 + (-15) Find each sum or difference. Write your answer in simplest form. (Lesson 3-7) **58.** $\frac{3}{7} - \frac{1}{3}$ **60.** $\frac{1}{3} - \frac{4}{5}$ **59.** $\frac{3}{4} + \frac{7}{18}$ **57.** $\frac{2}{5} + \frac{7}{20}$

Use with Lessons 3-9 and 3-10



You can use grids to model fraction multiplication and division.

Activity 1 Use a grid to model $\frac{3}{4} \cdot \frac{1}{2}$. Think of $\frac{3}{4} \cdot \frac{1}{2}$ as $\frac{3}{4}$ of $\frac{1}{2}$. Model $\frac{1}{2}$ by shading half of a grid.

The denominator tells you to divide the grid into 2 parts. The numerator tells you how many parts to shade.

Divide the grid into 4 equal horizontal sections.



Use a different color to shade $\frac{3}{4}$ of the same grid.



The denominator tells you to divide the grid into 4 parts. The numerator tells you how many parts to shade.

What fraction of the whole is shaded?

$$\frac{3}{4} \cdot \frac{1}{2} = \frac{3}{8}$$

To find the numerator, think: How many parts overlap? To find the denominator, think: How many total parts are there?

Think and Discuss

- **1.** Are $\frac{2}{3} \cdot \frac{1}{5}$ and $\frac{1}{5} \cdot \frac{2}{3}$ modeled the same way? Explain.
- **2.** When you multiply a positive fraction by a positive fraction, the product is less than either factor. Why?

Try This

Use a grid to find each product.

1.
$$\frac{1}{2} \cdot \frac{1}{2}$$
 2. $\frac{3}{4} \cdot \frac{2}{3}$ **3.** $\frac{5}{8} \cdot \frac{1}{3}$ **4.** $\frac{2}{5} \cdot \frac{5}{6}$

Activity 2

Use grids to model $4\frac{1}{3} \div \frac{2}{3}$.

Divide 5 grids into thirds. Shade 4 grids and $\frac{1}{3}$ of a fifth grid to represent $4\frac{1}{3}$.



Think: How many groups of $\frac{2}{3}$ are in $4\frac{1}{3}$?

Divide the shaded grids into equal groups of 2.



There are 6 groups of $\frac{2}{3}$, with $\frac{1}{3}$ left over. This piece is $\frac{1}{2}$ of a group of $\frac{2}{3}$. Thus there are 6 + $\frac{1}{2}$ groups of $\frac{2}{3}$ in $4\frac{1}{3}$.

$$4\frac{1}{3} \div \frac{2}{3} = 6\frac{1}{2}$$

Think and Discuss

1. Are $\frac{3}{4} \div \frac{1}{6}$ and $\frac{1}{6} \div \frac{3}{4}$ modeled the same way? Explain.

2. When you divide fractions, is the quotient greater than or less than the dividend and the divisor? Explain.

Try This

Use grids to find each quotient.

1. $\frac{7}{12} \div \frac{1}{6}$ **2.** $\frac{4}{5} \div \frac{3}{10}$ **3.** $\frac{2}{3} \div \frac{4}{9}$ **4.** $3\frac{2}{5} \div \frac{3}{5}$

Multiplying Fractions and Mixed Numbers

Learn to multiply fractions and mixed numbers.

3-9

The original Sunshine Skyway Bridge connecting St. Petersburg and Palmetto, Florida, opened in 1954 and had a toll of \$1.75. The current Sunshine Skyway Bridge opened in 1987, replacing the original. In 2007, the toll for a car crossing the bridge was $\frac{4}{7}$ of the toll in 1954. To find the toll in 2007, you will need to multiply the toll in 1954 by a fraction.



To multiply fractions, multiply the numerators to find the product's numerator. Then multiply the denominators to find the product's denominator.



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Multiplying Mixed Numbers



EXAMPLE

Transportation Application

In 1954, the Sunshine Skyway Bridge toll for a car was \$1.75. In 2007, the toll was $\frac{4}{7}$ of the toll in 1954. What was the toll in 2007?

$$1.75 \cdot \frac{4}{7} = 1\frac{75}{100} = 1\frac{3}{4} \cdot \frac{4}{7}$$
Write the decimal as a fraction.

$$= \frac{7}{4} \cdot \frac{4}{7}$$
Write the mixed number as an improper
fraction.

$$= \frac{1}{7} \cdot \frac{1}{4}$$
Simplify.

$$= \frac{1}{1} = 1$$
Multiply numerators. Multiply denominators.

The Sunshine Skyway Bridge toll for a car was \$1.00 in 2007.

Think and Discuss

- **1. Describe** how to multiply a mixed number and a fraction.
- **2. Explain** why $\frac{1}{2} \cdot \frac{1}{3} \cdot \frac{1}{4} = \frac{1}{24}$ is or is not correct.
- **3. Explain** why you may want to simplify before multiplying $\frac{2}{3} \cdot \frac{3}{4}$ What answer will you get if you don't simplify first?



- **53.** Physical Science The weight of an object on the moon is $\frac{1}{6}$ its weight on Earth. If a bowling ball weighs $12\frac{1}{2}$ pounds on Earth, how much would it weigh on the moon?
- **54.** In a survey, 200 students were asked what most influenced them to download songs. The results are shown in the circle graph.
 - **a.** How many students said radio most influenced them?
 - **b.** How many more students were influenced by radio than by a music video channel?
 - **c.** How many said a friend or relative influenced them or they heard the song in a store?
- **55.** The Mississippi River flows at a rate of 2 miles per hour. If Eduardo floats down the river in a boat for $5\frac{2}{3}$ hours, how far will he travel?



56. Choose a Strategy What is the product of $\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{4} \cdot \frac{4}{5}$?

- (A) $\frac{1}{5}$ (B) 5 (C) $\frac{1}{20}$ (D) $\frac{3}{5}$
- **57. Write About It** Two positive proper fractions are multiplied. Is the product less than or greater than one? Explain.
- **58.** Challenge Write three multiplication problems to show that the product of two fractions can be less than, equal to, or greater than 1.

Test Prep and Spiral Review

59. Multiple Choice Which expression is greater than $5\frac{5}{9}$?

(A) $8 \cdot \frac{9}{16}$ (B) $-\frac{7}{9} \cdot \left(-8\frac{2}{7}\right)$ (C) $3\frac{1}{2} \cdot \frac{5}{7}$ (D) $-\frac{3}{7} \cdot \frac{14}{27}$ 60. Multiple Choice The weight of an object on Mars is about $\frac{3}{8}$ its weight on Earth. If Sam weighs 85 pounds on Earth, how much would he weigh on Mars?

(F) 11 pounds (G) $31\frac{7}{8}$ pounds (H) $120\frac{4}{5}$ pounds (D) $226\frac{2}{3}$ pounds

Use a number line to order the integers from least to greatest. (Lesson 2-1)

61. -7, 5, -3, 0, 4 **62.** -5, -10, -15, -20, 0 **63.** 9, -9, -4, 1, -1

Add or subtract. Write each answer in simplest form. (Lesson 3-8)

64. $4\frac{3}{5} + 2\frac{1}{5}$ **65.** $2\frac{3}{4} - 1\frac{1}{3}$ **66.** $5\frac{1}{7} + 3\frac{5}{14}$ **67.** $4\frac{5}{6} + 2\frac{5}{8}$

3-10 Dividing Fractions and Mixed Numbers

Learn to divide fractions and mixed numbers.

Reciprocals can help you divide by fractions. Two numbers are **reciprocals** or **multiplicative inverses** if their product is 1. The reciprocal of $\frac{1}{3}$ is 3 because

$$\frac{1}{3} \cdot 3 = \frac{1}{3} \cdot \frac{3}{1} = \frac{3}{3} = 1.$$

Dividing by a number is the same as multiplying by its reciprocal.

Vocabulary reciprocal multiplicative inverse



Interactivities Online You can use this rule to divide by fractions.

EXAMPLE 1 Dividing Fractions Divide. Write each answer in simplest form. **A** $\frac{2}{3} \div \frac{1}{5}$ $\frac{2}{3} \div \frac{1}{5} = \frac{2}{3} \cdot \frac{5}{1}$ $= \frac{2 \cdot 5}{3 \cdot 1}$ $= \frac{10}{3} \text{ or } 3\frac{1}{3}$ **B** $\frac{3}{5} \div 6$ $\frac{3}{5} \div 6 = \frac{3}{5} \cdot \frac{1}{6}$ $= \frac{13 \cdot 1}{5 \cdot 6_2}$ $= \frac{1}{10}$ Multiply by the reciprocal of 6.

EXAMPLE2Dividing Mixed NumbersDivide. Write each answer in simplest form.**A** $4\frac{1}{3} \div 2\frac{1}{2}$ $4\frac{1}{3} \div 2\frac{1}{2} = \frac{13}{3} \div \frac{5}{2}$ $4\frac{1}{3} \div 2\frac{1}{2} = \frac{13}{3} \div \frac{5}{2}$ Write mixed numbers as improper fractions. $= \frac{13}{3} \cdot \frac{2}{5}$ $= \frac{26}{15}$ or $1\frac{11}{15}$

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EXAMPLE

Social Studies Application

Use the bar graph to determine how many times longer a \$100 bill is expected to stay in circulation than a \$1 bill.

The life span of a \$1 bill is $1\frac{1}{2}$ years. The life span of a \$100 bill is 9 years.

Think: How many $1\frac{1}{2}$'s are there in 9?

$$9 \div 1\frac{1}{2} = \frac{9}{1} \div \frac{3}{2}$$
$$= \frac{9}{1} \cdot \frac{2}{3}$$

\$5 \$1 \$10 \$20 \$50 \$100 Write both numbers as improper fractions. Multiply by the reciprocal of $\frac{3}{2}$.

Life Spans of Bills

Simplify.

A \$100 bill is expected to stay in circulation 6 times longer than a \$1 bill.

9

8

7

6 Years

5

3

2

1

0

Think and Discuss

- **1. Explain** whether $\frac{1}{2} \div \frac{2}{3}$ is the same as $2 \cdot \frac{2}{3}$.
- **2.** Compare the steps used in multiplying mixed numbers with those used in dividing mixed numbers.



Industrial Arts

- **45. Multi-Step** The students in Mr. Park's woodworking class are making birdhouses. The plans call for the side pieces of the birdhouses to be $7\frac{1}{4}$ inches long. If Mr. Park has 6 boards that are $50\frac{3}{4}$ inches long, how many side pieces can be cut?
- **46. Critical Thinking** Brandy is stamping circles from a strip of aluminum. If each circle is $1\frac{1}{4}$ inches tall, how many circles can she get from an $8\frac{3}{4}$ -inch by $1\frac{1}{4}$ -inch strip of aluminum?



- **48.** The table shows the total number of hours that the students in each of Mrs. Anwar's 5 industrial arts classes took to complete their final projects. If the third-period class has 17 students, how many hours did each student in that class work on average?
- **49. Challenge** Alexandra is cutting wood stencils to spell her first name with capital letters. Her first step is to cut a square of wood that is $3\frac{1}{2}$ in. long on a side for each letter in her name. Will

Alexandra be able to make all of the letters of her name from a single piece of wood that is $7\frac{1}{2}$ in. wide and 18 in. long? Explain your answer.

Period	Hours
1st	200 <u>1</u>
2nd	179 <u>2</u>
3rd	199 <u>3</u>
5th	190 <u>3</u>
6th	180 <u>1</u>

Test Prep and Spiral Review

50. Multiple Choice Which expression is NOT equivalent to $2\frac{2}{3} \div 1\frac{5}{8}$?			
(A) $\frac{8}{3} \cdot \frac{8}{13}$	B $2\frac{2}{3} \div \frac{13}{8}$	$\textcircled{C} \frac{8}{3} \div \frac{13}{8}$	D $\frac{8}{3} \cdot 1\frac{5}{8}$
51. Multiple Choice V	What is the value of the	expression $\frac{3}{5} \cdot \frac{1}{6} \div \frac{2}{5}$?	
(F) $\frac{1}{25}$	$\bigcirc \frac{1}{4}$	$\textcircled{H} \frac{15}{22}$	J 25
52. Gridded Response Each cat at the animal shelter gets $\frac{3}{4}$ c of food every day. If Alysse has $16\frac{1}{2}$ c of cat food, how many cats can she feed?			
Find the least common	multiple (LCM). (Lessor	ר 2-8)	
53. 2, 15	54. 6, 8	55. 4, 6, 18	56. 3, 4, 8
Multiply. Write each an 57 . $-\frac{2}{15} \cdot \frac{5}{8}$	swer in simplest form. 58. $1\frac{7}{20} \cdot 6$	(Lesson 3-9) 59. $1\frac{2}{7} \cdot 2\frac{3}{4}$	60. $\frac{1}{8} \cdot 6 \cdot 2\frac{5}{9}$

Solving Equations Containing Fractions

Learn to solve one-step equations that contain fractions.

EXAMPLE

3-11

Gold classified as 24 karat is pure gold, while gold classified as 18 karat is only $\frac{3}{4}$ pure. The remaining $\frac{1}{4}$ of 18-karat gold is made up of one or more different metals, such as silver, copper, or zinc.

Equations can help you determine the amounts of metals in different kinds of gold. The goal when solving equations that contain fractions is the same as when working with other kinds of numbers—*to isolate the variable* on one side of the equation.



Solving Equations by Adding or Subtracting



Recall that the product of a nonzero number and its reciprocal is 1. This is called the Multiplicative Inverse Property.

Multiplicative Inverse Property			
Words	Numbers	Algebra	
The product of a nonzero number and its reciprocal, or multiplicative inverse, is one.	$\frac{4}{5} \cdot \frac{5}{4} = 1$	$\frac{a}{b} \cdot \frac{b}{a} = 1$	

You can use the Multiplicative Inverse Property to solve multiplication equations that contain fractions and whole numbers.

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Solving Equations by Multiplying

Solve. Write each answer in simplest form.

Caution!

To undo multiplying by $\frac{2}{3}$, you must divide by $\frac{2}{3}$ or multiply by its reciprocal, $\frac{3}{2}$.



 $\frac{2}{3}x = \frac{4}{5}$ Use the Multiplicative Inverse Property. $\frac{2}{3}x \cdot \frac{3}{2} = \frac{24}{5} \cdot \frac{3}{2'_1}$ Multiply by the reciprocal of $\frac{2}{3}$. Then simplify.

> Use the Multiplicative Inverse Property. Multiply by the reciprocal of 3. Then simplify.

EXAMPLE

Physical Science Application

Pink gold is made of pure gold, silver, and copper. There is $\frac{11}{20}$ more pure gold than copper in pink gold. If pink gold is $\frac{3}{4}$ pure gold, what portion of pink gold is copper?



Let *c* represent the amount of copper in pink gold.

$$c + \frac{11}{20} = \frac{3}{4}$$

$$c + \frac{11}{20} - \frac{11}{20} = \frac{3}{4} - \frac{11}{20}$$

$$c = \frac{15}{20} - \frac{11}{20}$$

$$c = \frac{4}{20}$$

$$c = \frac{1}{5}$$
Pink gold is $\frac{1}{5}$ copper.

Write an equation. Subtract to isolate c. Find a common denominator. Subtract. Simplify.

Think and Discuss

- **1.** Show the first step you would use to solve $m + 3\frac{5}{8} = 12\frac{1}{2}$.
- **2. Describe** how to decide whether $\frac{2}{3}$ is a solution of $\frac{7}{8}y = \frac{3}{5}$.
- **3. Explain** why solving $\frac{2}{5}c = \frac{8}{9}$ by multiplying both sides by $\frac{5}{2}$ is the same as solving it by dividing both sides by $\frac{2}{5}$.

3-11 Exe	rcises		Learn It Online Homework Help Online go.hrw.com, keyword MS7 3-11 Go Exercises 1–20, 27, 31, 33, 35,
			39, 41, 43
	GUIDED PRACTICE		
See Example 1	Solve. Write each answer i	n simplest form.	
	1. $a - \frac{1}{2} = \frac{1}{4}$	2. $m + \frac{1}{6} = \frac{5}{6}$	3. $p - \frac{2}{3} = \frac{5}{6}$
See Example 2	4. $\frac{1}{5}x = 8$	5. $\frac{2}{3}r = \frac{3}{5}$	6. $3w = \frac{3}{7}$
See Example 3	7. Kara has $\frac{3}{8}$ cup less oat $\frac{3}{4}$ cup of oatmeal, how	meal than she needs for a co much oatmeal does she need	okie recipe. If she has l?
	INDEPENDENT PRACTIC		
See Example 1	Solve. Write each answer i	n simplest form.	
	8. $n - \frac{1}{5} = \frac{3}{5}$	9. $t - \frac{3}{8} = \frac{1}{4}$	10. $s - \frac{7}{24} = \frac{1}{3}$
	11. $x + \frac{2}{3} = 2\frac{7}{8}$	12. $h + \frac{7}{10} = \frac{7}{10}$	13. $y + \frac{5}{6} = \frac{19}{20}$
See Example 2	14. $\frac{1}{5}x = 4$	15. $\frac{1}{4}w = \frac{1}{8}$	16. $5y = \frac{3}{10}$
	17. $6z = \frac{1}{2}$	18. $\frac{5}{8}x = \frac{2}{5}$	19. $\frac{5}{8}n = 1\frac{1}{5}$
See Example <u>3</u>	20. Earth Science Carbonyears, $\frac{1}{8}$ of the carbon- are left after 17,190 years	n-14 has a half-life of 5,730 ye 14 in a sample will be left. If 5 ırs, how much was in the orig	ears. After 17,190 5 grams of carbon-14 ginal sample?
	PRACTICE AND PROBLE	M SOLVING	
Extra Practice	Solve. Write each answer i	n simplest form.	
See page EP10.	21. $\frac{4}{5}t = \frac{1}{5}$	22. $m - \frac{1}{2} = \frac{2}{3}$	23. $\frac{1}{8}w = \frac{3}{4}$
:	24. $\frac{8}{9} + t = \frac{17}{18}$	25. $\frac{5}{3}x = 1$	26. $j + \frac{5}{8} = \frac{11}{16}$
:	27. $\frac{4}{3}n = 3\frac{1}{5}$	28. $z + \frac{1}{6} = 3\frac{9}{15}$	29. $\frac{3}{4}y = \frac{3}{8}$
:	30. $-\frac{5}{26} + m = -\frac{7}{13}$	31. $-\frac{8}{77} + r = -\frac{1}{11}$	32. $y - \frac{3}{4} = -\frac{9}{20}$
	33. $h - \frac{3}{8} = -\frac{11}{24}$	34. $-\frac{5}{36}t = -\frac{5}{16}$	35. $-\frac{8}{13}v = -\frac{6}{13}$
:	36. $4\frac{6}{7} + p = 5\frac{1}{4}$	37. $d - 5\frac{1}{8} = 9\frac{3}{10}$	38. $6\frac{8}{21}k = 13\frac{1}{3}$
	39. Food Each person in F This is $13\frac{1}{16}$ lb more tha how much coffee does	Finland drinks an average of 24 In the average person in Italy an Italian drink each year?	$4\frac{1}{4}$ lb of coffee per year. consumes. On average,
	40. Weather Yuma, Arizo than Quillayute, Washi National Weather Serv	ona, receives $102\frac{1}{100}$ fewer incongrammed ngton, which receives $105\frac{9}{50}$ in ice). How much rain does Yu	hes of rain each year nches per year. (<i>Source:</i> 1ma get in one year?

- **41.** Life Science Scientists have discovered $1\frac{1}{2}$ million species of animals. This is estimated to be $\frac{1}{10}$ the total number of species thought to exist. About how many species do scientists think exist?
- **42. History** The circle graph shows the birthplaces of the United States' presidents who were in office between 1789 and 1845.
 - a. If six of the presidents represented in the graph were born in Virginia, how many presidents are represented in the graph?
 - **b.** Based on your answer to **a**, how many of the presidents were born in Massachusetts?



43. Architecture In Indianapolis,

the Market Tower has $\frac{2}{3}$ as many

stories as the Chase Tower. If the Market Tower has 32 stories, how many stories does the Chase Tower have?

- **44. Multi-Step** Each week, Jennifer saves $\frac{1}{5}$ of her allowance and spends some of the rest on lunches. This week, she had $\frac{2}{15}$ of her allowance left after buying her lunch each day. What fraction of her allowance did she spend on lunches?
- **45.** What's the Error? A student solved $\frac{3}{5}x = \frac{2}{3}$ and got $x = \frac{2}{5}$. Find the error.
- **46.** Write About It Solve $3\frac{1}{3}z = 1\frac{1}{2}$. Explain why you need to write mixed numbers as improper fractions when multiplying and dividing.

37 Challenge Solve $\frac{3}{5}w = 0.9$. Write your answer as a fraction and as a decimal.

Test Prep and Spiral Review

48.	Multiple Choice Whit $y - \frac{7}{8} = \frac{3}{5}$?	ch value of <i>y</i> is the sc	olution to the equation	n
		B $y = \frac{10}{13}$	$\bigcirc y = 1\frac{19}{40}$	(D $y = 2$
49.	Multiple Choice Wh	ich equation has the	solution $x = -\frac{2}{5}$?	
	(F) $\frac{2}{5}x = -1$	G $-\frac{3}{4}x = \frac{6}{20}$	(H) $-\frac{4}{7} + x = \frac{2}{3}$	
Orc	ler the numbers from le	east to greatest. (Less	on 2-11)	
50.	$-0.61, -\frac{3}{5}, -\frac{4}{3}, -1.25$	51. 3.25, 3 ² / ₁₀ , 3	3, 3.02 52. $\frac{1}{2}$	$\frac{1}{2}$, -0.2, $-\frac{7}{10}$, 0.04
Esti	imate. (Lesson 3-1)			
53.	5.87 - 7.01	54. 4.0387 + (- 2.13) 55. 6	6.785 · 3.01



The Chase Tower is the tallest skyscraper in Indiana. The two spires bring the building's height to 830 feet. One of the spires functions as a communications antenna, while the other is simply decorative.



Quiz for Lessons 3-6 Through 3-11

3-6 Estimating with Fractions

Estimate each sum, difference, product, or quotient.

1. $\frac{3}{4} - \frac{2}{9}$ **2.** $-\frac{2}{7} + 5\frac{6}{11}$ **3.** $4\frac{9}{15} \cdot 3\frac{1}{4}$ **4.** $9\frac{7}{9} \div 4\frac{3}{5}$

3-7 Adding and Subtracting Fractions

Add or subtract. Write each answer in simplest form.

5. $\frac{5}{8} + \frac{1}{8}$ **6.** $\frac{14}{15} - \frac{11}{15}$ **7.** $-\frac{1}{3} + \frac{6}{9}$ **8.** $\frac{5}{8} - \frac{2}{3}$

🧭 3-8 Adding and Subtracting Mixed Numbers

Add or subtract. Write each answer in simplest form.

- **9.** $6\frac{1}{9} + 2\frac{2}{9}$ **10.** $1\frac{3}{6} + 7\frac{2}{3}$ **11.** $5\frac{5}{8} 3\frac{1}{8}$ **12.** $8\frac{1}{12} 3\frac{1}{4}$
- **13.** A mother giraffe is $13\frac{7}{10}$ ft tall. She is $5\frac{1}{2}$ ft taller than her young giraffe. How tall is the young giraffe?

3-9 Multiplying Fractions and Mixed Numbers

Multiply. Write each answer in simplest form.

- **14.** $-12 \cdot \frac{5}{6}$ **15.** $\frac{5}{14} \cdot \frac{7}{10}$ **16.** $8\frac{4}{5} \cdot \frac{10}{11}$ **17.** $10\frac{5}{12} \cdot 1\frac{3}{5}$
- **18.** A recipe calls for $1\frac{1}{3}$ cups flour. Tom is making $2\frac{1}{2}$ times the recipe for his family reunion. How much flour does he need? Write your answer in simplest form.

3-10 Dividing Fractions and Mixed Numbers

Divide. Write each answer in simplest form.

19.
$$\frac{1}{6} \div \frac{5}{6}$$
 20. $\frac{2}{3} \div 4$ **21.** $5\frac{3}{5} \div \frac{4}{5}$ **22.** $4\frac{2}{7} \div 1\frac{1}{5}$

23. Nina has $9\frac{3}{7}$ yards of material. She needs $1\frac{4}{7}$ yards to make a pillow case. How many pillow cases can Nina make with the material?

3-11 Solving Equations Containing Fractions

Solve. Write each answer in simplest form.

24. $x - \frac{2}{3} = \frac{2}{15}$ **25.** $\frac{4}{9} = -2q$ **26.** $\frac{1}{6}m = \frac{1}{9}$ **27.** $\frac{3}{8} + p = -\frac{1}{6}$

28. A recipe for Uncle Frank's homemade hush puppies calls for $\frac{1}{8}$ teaspoon of cayenne pepper. The recipe calls for 6 times as much salt as it does cayenne pepper. How much salt does Uncle Frank's recipe require?

Ready to Go On?





Civil Rights in Education Heritage Trail The roots of free public education in the United States can be traced to southern Virginia. A self-guided driving tour of the area takes visitors to more than 40 schools, libraries, and other sites that played a key role in the story of civil rights in education.



The Wilson family is driving the Civil Rights in Education Heritage Trail. Use the map to solve these problems about their trip.

- The Wilsons drive from Appomattox to Petersburg on the first day of their trip. How many miles do they drive?
- 2. On the second day of the trip, they drive from Petersburg to South Hill. How much farther do they drive on the first day than on the second day?
- **3.** The distance from South Boston to Halifax is $\frac{1}{6}$ of the distance from Farmville to Nottoway. What is the distance from South Boston to Halifax?



- **4.** The entire trip from Appomattox to Halifax is 202.1 miles. The Wilsons' car gets 21.5 miles to the gallon. How many gallons of gas will they use for the trip?
- **5.** Gas costs \$3.65 per gallon. How much will gas cost for the entire trip?





Other interesting number patterns involve cyclic numbers. Cyclic numbers sometimes occur when a fraction converts to a repeating nonterminating decimal. One of the most interesting cyclic numbers is produced by converting the fraction $\frac{1}{7}$ to a decimal.

 $\frac{1}{7} = 0.142857142857142\ldots$

Multiplying 142857 by the numbers 1–6 produces the same digits in a different order.

$1 \cdot 142857 = 142857$	$3 \cdot 142857 = 428571$	$5 \cdot 142857 = 714285$
$2 \cdot 142857 = 285714$	4 • 142857 = 571428	6 ⋅ 142857 = 857142

Fraction Action

Roll four number cubes and use the numbers to form two fractions. Add the fractions and try to get a sum as close to 1 as possible. To determine your score on each turn, find the difference between the sum of your fractions and 1. Keep a running total of your score as you play. The winner is the player with the lowest score at the end of the game.

A complete copy of the rules are available online.





PROJECT Operation Slide Through

Slide notes through the frame to review key concepts about operations with rational numbers.

Directions

- Keep the file folder closed throughout the project. Cut off a $3\frac{1}{2}$ -inch strip from the bottom of the folder. Trim the remaining folder so that is has no tabs and measures 8 inches by 8 inches. **Figure A**
- Cut out a thin notch about 4 inches long along the middle of the folded edge. Figure B
- Cut a $3\frac{3}{4}$ -inch slit about 2 inches to the right of the notch. Make another slit, also $3\frac{3}{4}$ inches long, about 3 inches to the right of the first slit. **Figure C**
- Weave the 3¹/₂-inch strip of the folder into the notch, through the first slit, and into the second slit. Figure D

Taking Note of the Math

As you pull the strip through the frame, divide the strip into several sections. Use each section to record vocabulary and practice problems from the chapter.









OPERATIONS WITH RATIONAL NUMBERS

Study Guide: Review

Vocabulary

compatible numbers	 144
multiplicative inverse	 190

reciprocal 190

EXERCISES

Complete the sentences below with vocabulary words from the list above.

- 1. When estimating products or quotients, you can use ___? that are close to the original numbers and easy to use.
- **2.** The fractions $\frac{3}{8}$ and $\frac{8}{3}$ are ____? because they multiply to give 1.

EXAMPLES

Estimating with Decimals (pp. 144-147)

Estimate.		Estimate.	
63. <mark>2</mark> 8 → 63	Round each decimal to	3. 54.4 + 55.99	4. 11.48 - 5.6
$+ 16.52 \longrightarrow + 17$	the nearest integer.	5. 24.77 • 3.45	6. 37.8 ÷ 9.3
$43.55 \longrightarrow 40$ $\underline{\times \ 8.65} \longrightarrow \underline{\times \ 9}{360}$	Use compatible numbers.	7. Helen saves \$7.85 to buy a TV that how many weeks her money befor	5 each week. She wants costs \$163.15. For about s will Helen have to save e she can buy the TV?

Adding and Subtracting Decimals (pp. 148–151)

Add.	Add or subtract.	
5.67 + 22.44	8. 4.99 + 22.89	9. -6.7 + (-44.5)
5.67 Line up the decimal points.	10. 18.09 – 11.87	11. 47 + 5.902
$\frac{+22.44}{28.11}$ Add.	12. 23 – 8.905	13. 4.68 + 31.2

Multiplying Decimals (pp. 154–157)

Multiply.	Multiply.	
1.44 • 0.6	14. 7 • 0.5	15. −4.3 • 9
1.44 2 decimal places	16. 4.55 • 8.9	17. 7.88 • 7.65
$\frac{x \ 0.6}{0.864} \qquad 2+1=3 \ decimal places$	18. 63.4 • 1.22	19 . −9.9 • 1.9
	20. Fred buys 4 shirts How much did Fi	s at \$9.52 per shirt. red spend?

EXAMPLES

3-4 Dividing Decir	mals (pp. 160–163)		
Divide. $7 \div 2.8$ 2.5 28)70.0 56 140	Multiply both numbers by 10 to make the divisior an integer.	 Divide. 21. 16 ÷ 3.2 23. 48 ÷ 0.06 25. 78 ÷ (−12.5) 27. 7.65 ÷ 1.7 	 22. 50 ÷ (-1.25) 24. 31 ÷ (-6.2) 26. 816 ÷ 2.4 28. 9.483 ÷ (-8.7)
$\frac{140}{0}$ Divide. $0.96 \div 1.6$ $\frac{0.6}{16)9.6}$ $\frac{-96}{0}$	Multiply both numbers by 10 to make the divisor an integer.	 29. 126.28 ÷ (−8.2) 31. 9 ÷ 4.5 33. In qualifying for a one driver had la of 195.3 mi/h, 19 193.557 mi/h, an What was the dri speed for these for the fo	30. 2.5 ÷ (−0.005) 32. 13 ÷ 3.25 an auto race, p speeds 0.456 mi/h, d 192.757 mi/h. ver's average bur laps?

EXERCISES

3-5 Solving Equations Containing Decimals (pp. 164–167)

Solve.	Solve.
n - 4.77 = 8.60 Add to isolate n.	34. $x + 40.44 = 30$ 35. $\frac{s}{1.07} = 100$
$\frac{+4.77}{n} = \frac{+4.77}{13.37}$	36. $0.8n = 0.0056$ 37. $k - 8 = 0.64$
	38. $3.65 + e = -1.4$ 39. $\frac{w}{-0.2} = 15.4$
	40. Sam wants to buy a new wakeboard that costs \$434. If he makes \$7.75 per hour, how many hours must he work to
	earn enough money for the wakeboards

3-6 Estimating with Fractions (pp. 170–173) **•** Estimate. $7\frac{3}{4} - 4\frac{1}{3}$ $7\frac{3}{4} \longrightarrow 8$ $4\frac{1}{3} \longrightarrow 4\frac{1}{2}$ $8 - 4\frac{1}{2} = 3\frac{1}{2}$ $11\frac{7}{12} \div 3\frac{2}{5}$ $11\frac{7}{12} \longrightarrow 12$ $3\frac{2}{5} \longrightarrow 3$ $12 \div 3 = 4$

Estimate each sum, difference, product, or quotient.

41. $11\frac{1}{7} + 12\frac{3}{4}$	42. $5\frac{5}{7} - 13\frac{10}{17}$
43. $9\frac{7}{8} + \left(-7\frac{1}{13}\right)$	44. $11\frac{8}{9} - 11\frac{1}{20}$
45. $5\frac{13}{20} \cdot 4\frac{1}{2}$	46. $-6\frac{1}{4} \div \left(-1\frac{5}{8}\right)$

47. Sara ran $2\frac{1}{3}$ laps on Monday and $7\frac{3}{4}$ laps on Friday. About how many more laps did Sara run on Friday?

EXAMPLES

EXERCISES

3-7 Adding and Subtracting Fractions (pp. 176–179)

Add.		Add or subtract. Wri	ite each answer in
$\frac{1}{2} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15}$	Write equivalent	simplest form.	
3 + 5 + 15 + 15 = $\frac{11}{15}$	fractions using a common denominator.	48. $\frac{3}{4} - \frac{1}{3}$	49. $\frac{1}{4} + \frac{3}{5}$
15		50. $\frac{4}{11} + \frac{4}{44}$	51. $\frac{4}{9} - \frac{1}{3}$

3-8 Adding and Subtracting Mixed Numbers (pp. 180–183)

Add.	Add or subtract. V	Add or subtract. Write each answer in		
$1\frac{1}{2} + 2\frac{1}{2} = 1\frac{2}{6} + 2\frac{3}{6}$ Add the integer	rs, simplest form.			
$= 3 + \frac{5}{6}$ and then add the	52. $3\frac{7}{8} + 2\frac{1}{3}$	53. $2\frac{1}{4} + 1\frac{1}{12}$		
$= 3\frac{5}{6}$	54. $8\frac{1}{2} - 2\frac{1}{4}$	55. $11\frac{3}{4} - 10\frac{1}{3}$		

3-9 Multiplying Fractions and Mixed Numbers (pp. 186–189)

Multiply. Write the answer in	Multiply. Write each answer in		
simplest form.	simplest form.		
$4\frac{1}{2} \cdot 5\frac{3}{4} = \frac{9}{2} \cdot \frac{23}{4}$	56. $1\frac{2}{3} \cdot 4\frac{1}{2}$ 57. $\frac{4}{5} \cdot 2\frac{3}{10}$		
$=\frac{207}{8}$ or $25\frac{7}{8}$	58. $4\frac{6}{7} \cdot 3\frac{5}{9}$ 59. $3\frac{4}{7} \cdot 1\frac{3}{4}$		

3-10 Dividing Fractions and Mixed Numbers (pp. 190–193)

Divide.	Divide. Write each answer in simplest form		
$\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \cdot \frac{5}{2}$ Multiply by the	60. $\frac{1}{3} \div 6\frac{1}{4}$ 61. $\frac{1}{2} \div 3\frac{3}{4}$		
$=\frac{15}{8} \text{ or } 1\frac{7}{8}$	62. $\frac{11}{13} \div \frac{11}{13}$ 63. $2\frac{7}{8} \div 1\frac{1}{2}$		
	64. A 21-inch long loaf of bread is cu	ıt into	
	$\frac{3}{4}$ -inch slices. How many slices will		
	there be?		

3-11 Solving Equations Containing Fractions (pp. 194–197)

Solve. Write the answer in simplest form.

$\frac{1}{4}x = \frac{1}{6}$	
$\frac{4}{1} \cdot \frac{1}{4}x = \frac{1}{6} \cdot \frac{4}{1}$	Multiply by the reciprocal of $\frac{1}{4}$.
$x = \frac{4}{6} = \frac{2}{3}$	' 4

Sol	Solve. Write each answer in simplest form.				
65.	$\frac{1}{5}x = \frac{1}{3}$	66.	$\frac{1}{3} + y = \frac{2}{5}$		
67.	$\frac{1}{6}x = \frac{2}{7}$	68.	$\frac{2}{7} + x = \frac{3}{4}$		
69.	Ty had $2\frac{1}{2}$	cups of oil an	d used $\frac{3}{4}$ cup for		
	a recipe. H	How many cuj	os of oil are left?		





Esti 1.	mate. 19.95 + 21.36	2.	49.17 - 5.88	3.	3.21 • 16.78	4.	49.1 ÷ 5.6
Add	l or subtract.						
5.	3.086 + 6.152	6.	5.91 + 12.8	7.	3.1 – 2.076	8.	14.75 - 6.926
Mu	ltiply or divide.						
9.	3.25 • 24	10.	$-3.79 \cdot 0.9$	11.	32 ÷ 1.6	12.	$3.57 \div (-0.7)$
Sol	ve.						
13.	w - 5.3 = 7.6	14.	4.9 = c + 3.7	15.	$b \div 1.8 = 2.1$	16.	4.3h = 81.7
Esti	mate each sum, d	liffer	ence, product, or q	uoti	ent.		
17.	$\frac{3}{4} + \frac{3}{8}$	18.	$5\frac{7}{8} - 3\frac{1}{4}$	19.	$6\frac{5}{7} \cdot 2\frac{2}{9}$	20.	$8\frac{1}{5} \div 3\frac{9}{10}$
Add	l or subtract. Write	e eac	ch answer in simple	est fo	orm.		
21.	$\frac{3}{10} + \frac{2}{5}$	22.	$\frac{11}{16} - \frac{7}{8}$	23.	$7\frac{1}{3} + 5\frac{11}{12}$	24.	$9 - 3\frac{2}{5}$
Mu	ltiply or divide. W	rite e	each answer in sim	plest	form.		
25.	$5 \cdot 4\frac{1}{3}$	26.	$2\frac{7}{10} \cdot 2\frac{2}{3}$	27.	$\frac{3}{10} \div \frac{4}{5}$	28.	$2\frac{1}{5} \div 1\frac{5}{6}$
29.	A recipe calls for his soccer team. I simplest form.	4 <u>4</u> tb How	osp of butter. Nasim much butter does l	is n ne ne	naking 3 <u>1</u> times the re eed? Write your answ	ecipe er in	for
30.	Brianna has $11\frac{2}{3}$ c hot cocoa. How n	cups nany	of milk. She needs i pots of hot cocoa c	1 <u>6</u> cı can H	ips of milk to make a Brianna make?	pot	of
Sol	ve. Write each ans	wer	in simplest form.				
31.	$\frac{1}{5}a = \frac{1}{8}$	32.	$\frac{1}{4}c = 980$	33.	$-\frac{7}{9} + w = \frac{2}{3}$	34.	$z - \frac{5}{13} = \frac{6}{7}$
35.	Alan finished his h than Alan to finis his homework?	nome h his	work in $1\frac{1}{2}$ hours. It homework. How lo	tool ong c	$\frac{3}{4}$ of an hour $\frac{3}{4}$ if an hour $\frac{3}{4}$ lid it take Jimmy to find	longe nish	er

36. Mya played in two softball games one afternoon. The first game lasted 42 min. The second game lasted $1\frac{2}{3}$ times longer than the first game. How long did Mya's second game last?

Chapter Test



Gridded Response: Write Gridded Responses

When responding to a test item that requires you to place your answer in a grid, you must fill in the grid on your answer sheet correctly, or the item will be marked as incorrect.

EXAMPLE

1	•	1	9	
\oslash	\oslash	\oslash	\oslash	0
ullet		\odot	\odot	\bullet
0	0	0	0	0
	1		1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
1	7	\bigcirc	7	7
8	8	8	8	8
9	(9)	9		9

Gridded Response: Solve the equation 0.23 + r = 1.42.

 $\begin{array}{c} 0.23 + r = 1.42 \\ \underline{-0.23} \\ r = \underline{-0.23} \\ 1.19 \end{array}$

- Using a pencil, write your answer in the answer boxes at the top of the grid. Put the first digit of your answer in the leftmost box, or put the last digit of your answer in the rightmost box. On some grids, the fraction bar and the decimal point have a designated box.
- Put only one digit or symbol in each box. Do not leave a blank box in the middle of an answer.
- Shade the bubble for each digit or symbol in the same column as in the answer box.

EXAMPLE

		5	/	3
\oslash	\oslash	\oslash		\oslash
ullet	\odot	ullet	\odot	\odot
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	
4	4	4	4	4
5	5		5	5
6	6	6	6	6
7	7	\bigcirc	7	1
8	8	8	8	8
9	9	9	9	9

Gridded Response: Divide. $3 \div 1\frac{4}{5}$

$$3 \div 1\frac{4}{5} = \frac{3}{1} \div \frac{9}{5}$$
$$= \frac{3}{1} \cdot \frac{5}{9}$$
$$= \frac{15}{9} = \frac{5}{3} = 1\frac{2}{3} = 1.\overline{6}$$

The answer simplifies to $\frac{5}{3}$, $1\frac{2}{3}$, or $1.\overline{6}$.

- Mixed numbers and repeating decimals cannot be gridded, so you must grid the answer as $\frac{5}{3}$.
- Write your answer in the answer boxes at the top of the grid.
- Put only one digit or symbol in each box. Do not leave a blank box in the middle of an answer.
- Shade the bubble for each digit or symbol in the same column as in the answer box.



If you get a negative answer to a gridded response item, rework the problem carefully. Response grids do not include negative signs, so if you get a negative answer, you probably made a math error.

Read each statement, and then answer the questions that follow.

Sample A

A student correctly solved an equation for *x* and got 42 as a result. Then the student filled in the grid as shown.

			4	2	
\oslash	\oslash	\oslash	\oslash	\oslash	
$oldsymbol{igstar}$	\odot	$oldsymbol{igstar}$	$oldsymbol{igstar}$	$oldsymbol{eta}$	
0	0	0	0	0	
1	1	1	1	\bigcirc	
2	2	2	2	2	
3	3	3	3	3	
4	4	4	4	4	
5	5	5	5	5	
6	6	6	6	6	
\mathcal{D}	\mathcal{D}	D	\mathcal{D}	D	
8	8	8	8	8	
9	9	9	9	9	

- 1. What error did the student make when filling in the grid?
- **2.** Explain a second method of filling in the answer correctly.

Sample B

A student correctly multiplied 0.16 and 0.07. Then the student filled in the grid as shown.

	0	1	1	2	
\oslash	\oslash	\oslash	\oslash	\oslash	
Ó	۲	ullet	۲	ullet	
0	Ó	0	0	0	
Ĩ	1		1	1	
2	2	2	Ó	2	
3	3	3	3	3	
4	4	4	4	4	
5	5	5	5	5	
6	6	6	6	6	
Ō	$\overline{\mathcal{O}}$	$\overline{\mathcal{O}}$	$\overline{\mathcal{O}}$	$\overline{\mathcal{O}}$	
8	8	8	8	8	
9	9	9	9	9	

- **3.** What error did the student make when filling in the grid?
- **4.** Explain how to fill in the answer correctly.

Sample C

A student subtracted -12 from 5 and got an answer of -17. Then the student filled in the grid as shown.



- **5.** What error did the student make when finding the answer?
- 6. Explain why you cannot fill in a negative number on a grid.
- 7. Explain how to fill in the answer to 5 (-12) correctly.

Sample D

A student correctly simplified $\frac{5}{6} + \frac{11}{12}$ and got $1\frac{9}{12}$ as a result. Then the student filled in the grid as shown.



- 8. What answer is shown in the grid?
- **9.** Explain why you cannot show a mixed number in a grid.
- 10. Write two equivalent forms of the answer $1\frac{9}{12}$ that could be filled in the grid correctly.



Cumulative Assessment, Chapters 1–3

Multiple Choice

 A cell phone company charges \$0.05 per text message. Which expression represents the cost of t text messages?

A 0.05 <i>t</i>	○ 0.05 – <i>t</i>

- **B** 0.05 + t **D** $0.05 \div t$
- 2. Ahmed had \$7.50 in his bank account on Sunday. The table shows his account activity for each day last week. What was the balance in Ahmed's account on Friday?

Day	Deposit	Withdrawal
Monday	\$25.25	none
Tuesday	none	-\$108.13
Wednesday	\$65.25	none
Thursday	\$32.17	none
Friday	none	-\$101.50

(F) −\$86.96	(H) \$0
ⓑ −\$79.46	J \$96.46

3. Natasha is designing a doghouse. She wants the front of the doghouse to be $3\frac{1}{2}$ feet wide, and she wants the side of the doghouse to be $2\frac{3}{4}$ feet wider than the front. Which equation can be used to find *x*, the length of the side of the doghouse?

(A) $3\frac{1}{2} + 2\frac{3}{4} = x$	$\bigcirc 3\frac{1}{2} \cdot 2\frac{3}{4} = x$
B $3\frac{1}{2} - 2\frac{3}{4} = x$	(D) $3\frac{1}{2} \div 2\frac{3}{4} = x$

4. What is the value of $5\frac{2}{3} \div \frac{3}{9}$?

(F) 17	H 10
---------------	-------------

(G) $\frac{17}{9}$ (J) $5\frac{1}{3}$

5. Mrs. Herold has $5\frac{1}{4}$ yards of material to make two dresses. The larger dress requires $3\frac{3}{4}$ yards of material. Which equation can be used to find *t*, the number of yards of material remaining to make the smaller dress?

(A)
$$3\frac{3}{4} - t = 5\frac{1}{4}$$
 (C) $3\frac{3}{4} \div t = 5\frac{1}{4}$
(B) $3\frac{3}{4} \cdot t = 5\frac{1}{4}$ (D) $3\frac{3}{4} + t = 5\frac{1}{4}$

6. Carl is building a picket fence. The first picket in the fence is 1 m long, the second picket is $1\frac{1}{4}$ m long, and the third picket is $1\frac{1}{2}$ m long. If the pattern continues, how long is the seventh picket?

(F)
$$1\frac{3}{4}$$
 m (H) $2\frac{1}{4}$ m

G 2 m **J**
$$2\frac{1}{2}$$
 m

- 7. Daisy the bulldog weighs $45\frac{13}{16}$ pounds. Henry the beagle weighs $21\frac{3}{4}$ pounds. How many more pounds does Daisy weigh than Henry?
 - (A) $23\frac{15}{16}$ pounds (C) $24\frac{1}{16}$ pounds (B) $24\frac{5}{6}$ pounds (D) $67\frac{9}{16}$ pounds
- 8. What is the prime factorization of 110?

(F) 55 · 2	⊕ 11 · 5 · 2
G 22 • 5 • 2	J 110 · 1

9. Joel threw a ball $24\frac{2}{9}$ yards. Jamil threw the ball $33\frac{10}{11}$ yards. Estimate how much farther Jamil threw the ball than Joel did.

A 8 yards	C 12 yards
(B) 10 vards	(D) 15 vards



When possible, use logic to eliminate at least two answer choices.

10. Which model best represents the expression $\frac{6}{8} \times \frac{1}{2}$?



11. The table shows the different types of pets owned by the 15 students in Mrs. Sizer's Spanish class. What fraction of the students listed own a dog?

	Type of Pet	Number of Students
	Cat	5
	Dog	9
	Hamster	1
(A) $\frac{3}{5}$		$\bigcirc \frac{1}{15}$

 $\bigcirc \frac{1}{9}$

Gridded Response

 $\mathbb{B}\frac{1}{5}$

- 12. Frieda earns \$5.85 per hour. To find the amount of money Frieda earns working x hours, use the equation y = 5.85x. How many dollars does Frieda earn if she works 2.4 hours?
- **13.** Solve the equation $\frac{5}{12}x = \frac{1}{4}$ for *x*.
- **14.** What is the value of the expression $2(3.1) + 1.02(-4) 8 + 3^2$?

Short Response

- **S1.** Louise is staying on the 22nd floor of a hotel. Her mother is staying on the 43rd floor. Louise wants to visit her mother, but the elevator is temporarily out of service. Write and solve an equation to find the number of floors that Louise must climb if she takes the stairs.
- **52.** Mari bought 3 packages of colored paper. She used $\frac{3}{4}$ of a package to make greeting cards and used $1\frac{1}{6}$ packages for an art project. She gave $\frac{2}{3}$ of a package to her brother. How much colored paper does Mari have left? Show the steps you used to find the answer.
- **S3.** A building proposal calls for 6 acres of land to be divided into $\frac{3}{4}$ -acre lots. How many lots can be made? Explain your answer.

Extended Response

- **E1.** A high school is hosting a triple-jump competition. In this event, athletes make three leaps in a row to try to cover the greatest distance.
 - a. Tony's first two jumps were $11\frac{2}{3}$ ft and $11\frac{1}{2}$ ft. His total distance was 44 ft. Write and solve an equation to find the length of his final jump.
 - b. Candice's three jumps were all the same length. Her total distance was 38 ft. What was the length of each of her jumps?
 - c. The lengths of Davis's jumps were 11.6 ft, $11\frac{1}{4}$ ft, and $11\frac{2}{3}$ ft. Plot these lengths on a number line. What was the farthest distance he jumped? How much farther was this distance than the shortest distance Davis jumped?