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
3-5 Solving Equations Containing Decimals

3B Fraction Operations and Applications
3-6 Estimating with Fractions
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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## Are You Ready?

## Vocabulary

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

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

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. $-4 \cdot(-10)$
31. $-22 \div(-11)$
32. $23+(-30)$
33. $-33-74$
34. $-62 \cdot(-34)$
35. $84 \div(-12)$
36. $-26-18$

## 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 <br> 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.

1. 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 $1, \frac{1}{2}$, 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.

Step 1: Before Class

- Read through your notes from the last class.
- Then look ahead to the the next lesson. Write down any questions you have.

10/2/07 Lesson 2-6 Prime Factorization

How do I know when I have found the prime factorization of a number?

Prime number - whole number $>1$ that has exactly 2 factors: 1 and itself. Ex. 2, 3.7 Composite number-whole num. that has more than 2 factors. Ex. 4, 6,9

The number 1 has exactly one factor.
Step 2: During Class

- Write down main points that your teacher Not prime and not composite

Step 3: After Class

- Fill in any information you may have missed. - Highlight or circle the most important ideas, such as vocabulary, formulas and rules, or steps.
- Use your notes to quiz a friend or yourself.


## 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.

## Vocabulary

 compatible numbersJessie 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.
$\$ 14.75 \quad 7>5$, so round to $\$ 15$. \$15

$$
\$ 13.20 \quad 2<5 \text {, so round to } \$ 13 . \quad \frac{+\$ 13}{\$ 28}
$$



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

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.

## E X A M PLE 1 Estimating Sums and Differences of Decimals

Estimate by rounding to the nearest integer.
(A) $86.9+58.4$

$$
\begin{array}{rll}
86.9 \\
+58.4
\end{array} \longrightarrow \begin{array}{r}
87 \\
\hline+58 \\
\hline 145 \\
\longleftrightarrow
\end{array} \quad \begin{aligned}
& 9>5 \text {, so round to } 87 . \\
& 4<5 \text { Estimate round to } 58 .
\end{aligned}
$$

B $10.38-6.721$

$$
\begin{aligned}
10.38 \\
-6.721
\end{aligned} \longrightarrow \begin{array}{r}
10 \\
\hline
\end{array} \quad \begin{aligned}
& 3<5 \text {, so round to } 10 . \\
& 7>5 \text {, so round to } 7 . \\
& \text { Estimate }
\end{aligned}
$$

C $-26.3+15.195$

$$
\begin{array}{lll}
-26.3 \\
+15.195 & \longrightarrow-26 & \begin{array}{l}
3<5, \text { so round to }-26 . \\
1
\end{array} \\
\hline-11 \\
\hline & \text { Estimate so round to } 15 .
\end{array}
$$

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

## 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.

## E X A M P E 2 Estimating Products and Quotients of Decimals

## Use compatible numbers to estimate.

A $32.66 \cdot 7.69$

| 32.66 | $\longrightarrow$ |
| ---: | :--- | | 30 |
| :--- |
| $\times 7.69$ |$\longrightarrow$| Round to the nearest multiple of 10. |
| :--- |
| $6>8$ |
| 640 |
|  |
| 6stimate |


| Guidelines for Using Compatible Numbers |  |
| :--- | :--- |
| When multiplying ... | When dividing ... |
| round numbers to the nearest <br> nonzero integer or to numbers <br> that are easy to multiply. | round numbers so that they <br> divide without leaving a remainder. |

A prime number has exactly two factors, 1 exactly two factors, factors of 37 are 1 and 37. and 37.

## Remember!

$$
\begin{aligned}
& \mathbf{3 6 . 5} \div(-\mathbf{8 . 2 4 1}) \\
& 36.5 \\
& -8.241 \longrightarrow 36 \\
& 36 \div(-9)=-4
\end{aligned} \quad \begin{aligned}
& \text { 37 is a prime number, so round to } 36 . \\
& \text {-9 divides into } 36 \text { without a remainder. }
\end{aligned}
$$

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

## EXAMPLE 3 School Application

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

$6.2 \longrightarrow 6$$\quad$| $2<5$, so round to 6. |
| :--- |
| $55.9 \longrightarrow 60$ |
| $60 \div 6=10$ |$\quad$| 6 divides into 60 without a remainder. |
| :--- |

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.

## GUIDED PRACTICE

See Example 1 Estimate by rounding to the nearest integer.

1. $37.2+25.83$
2. $18.256-5.71$
3. $-9.916+12.4$

See Example 2 Use compatible numbers to estimate.
4. $8.09 \cdot 28.32$
5. $-3.45 \cdot 73.6$
6. $41.9 \div 6.391$

See Example 3 7. School A student worked the problem 35.8•9.3. The student's answer was $3,329.4$. Use estimation to check whether this answer is reasonable.

## INDEPENDENT PRACTICE

See Example 1
Estimate by rounding to the nearest integer.
8. $5.982+37.1$
9. $68.2+23.67$
10. $-36.8+14.217$
11. $15.23-6.835$
12. $6.88+(-8.1)$
13. $80.38-24.592$

## See Example 2 Use compatible numbers to estimate.

14. $51.38 \cdot 4.33$
15. $46.72 \div 9.24$
16. $32.91 \cdot 6.28$
17. $-3.45 \cdot 43.91$
18. $2.81 \cdot(-79.2)$
19. $28.22 \div 3.156$

See Example 3 20. Ann has a piece of rope that is 12.35 m long. She wants to cut it into smaller pieces that are each 3.6 m long. She thinks she will get about 3 smaller pieces of rope. Use estimation to check whether her assumption is reasonable.

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP8.

## Estimate.

21. 5.921 - 13.2
22. $-7.98-8.1$
23. $-42.25+(-17.091)$
24. $98.6+43.921$
25. $4.69 \cdot(-18.33)$
26. $62.84-35.169$
27. $-48.28+11.901$
28. $31.53 \div(-4.12)$
29. $35.9-24.71$
30. $69.7-7.81$
31. $-6.56 \cdot 14.2$
32. $4.513+72.45$
33. $-8.9 \cdot(-24.1)$
34. $6.92 \cdot(-3.714)$
35. $-78.3 \div(-6.25)$
36. Jo needs 10 lb of ground beef for a party. She has packages that weigh 4.23 lb and 5.09 lb . Does she have enough?
37. Consumer Math Ramón saves $\$ 8.35$ each week. He wants to buy a video game that costs $\$ 61.95$. For about how many weeks will Ramón have to save his money before he can buy the video game?
38. Multi-Step Tickets at a local movie theater cost $\$ 7.50$ each. A large bucket of popcorn at the theater costs $\$ 4.19$, and a large soda costs $\$ 3.74$. Estimate the amount that 3 friends spent at the theater when they saw one movie, shared one large bucket of popcorn, and had one large soda each.


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.
42. 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 lt Explain how an estimate helps you decide whether an answer is reasonable.
45. Challenge Estimate. $6.35-15.512+8.744-4.19-72.7+25.008$

## Test Prep and Spiral Review

46. Multiple Choice Which is the best estimate for $24.976 \div(-4.893)$ ?
(A) 20
(B) -6
(C) -5
(D) 2
47. Multiple Choice Steve is saving $\$ 10.50$ from his allowance each week to buy a printer that costs $\$ 150$. Which is the best estimate of the number of weeks he will have to save his money until he can buy the printer?
(F) 5 weeks
(G) 10 weeks
(H) 12 weeks
(J) 15 weeks
48. Short Response Joe's restaurant bill was $\$ 16.84$. He had $\$ 20$ in his wallet. Explain how to use rounding to estimate whether Joe had enough money to leave a $\$ 2.75$ tip.

Simplify each expression. (Lessons 2-3 and 2-4)
49. $-5+4-2$
50. $16 \cdot(-3)+12$
51. $28-(-2) \cdot(-3)$
52. $-90-(-6) \cdot(-8)$
53. $-7-3-1$
54. $-10 \cdot(-5)+2$

## 3-2

## Adding and Subtracting Decimals

Learn to add and subtract decimals.

One of the coolest summers on record in the Midwest was in 1992. The average summertime temperature that year was $66.8^{\circ} \mathrm{F}$. Normally, the average temperature is $4^{\circ} \mathrm{F}$ higher than it was in 1992.

To find the normal average summertime temperature in the Midwest, you can add $66.8^{\circ} \mathrm{F}$ and $4^{\circ} \mathrm{F}$.


The normal average summertime temperature in the Midwest is $70.8^{\circ} \mathrm{F}$.

## E X A MPLE 1 Adding Decimals

Add. Estimate to check whether each answer is reasonable.
A $3.62+18.57$
3.62 Line up the decimal points.
$\begin{array}{r}18.57 \\ \hline\end{array}$
22.19 Add.

Estimate

$$
4+19=23 \quad 22.19 \text { is a reasonable answer. }
$$

(B) $9+3.245$
9.000 Use zeros as placeholders.
+3.245 Line up the decimal points.
12.245 Add.

## Estimate

$9+3=12 \quad 12.245$ is a reasonable answer.

## Remember!

When adding numbers with the same sign, find the sum of their absolute values. Then use the sign of the numbers.

Add. Estimate to check whether each answer is reasonable.
C $-5.78+(-18.3)$
$-5.78+(-18.3) \quad$ Think: $5.78+18.3$.
5.78
$\begin{array}{r}+18.30 \\ \hline 24.08\end{array}$
$-5.78+(-18.3)=-24.08$

## Estimate

$-6+(-18)=-24 \quad-24.08$ is a reasonable answer.

## EXAMPLE 2 Subtracting Decimals

Subtract.
A $12.49-7.25$
12.49 Line up the decimal points.
$\begin{array}{r}-7.25 \\ \hline 5.24\end{array}$
Subtract.

## Caution!

You will need to regroup numbers in order to subtract in Example 2B.

B $14-7.32$
$13 \quad 910$

$$
14.00
$$

$\begin{array}{r}-7.32 \\ \hline 6.68\end{array}$

Use zeros as placeholders. Line up the decimal points. Subtract.

## E X A M P L E 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.

| 492.230 |
| ---: |
| -26.331 |
| 465.899 |

Use zero as a placeholder. Line up the decimal points. Subtract.

## Estimate

$$
490-30=460 \quad 465.899 \text { is a reasonable answer. }
$$

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

## Think and Discuss

12.3

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

## GUIDED PRACTICE

See Example 1 Add. Estimate to check whether each answer is reasonable.

1. $5.37+16.45$
2. $2.46+11.99$
3. $7+5.826$
4. $-5.62+(-12.9)$

See Example 2 Subtract.
5. $7.89-5.91$
6. $17-4.12$
7. $4.97-3.2$
8. $9-1.03$

See Example 3
9. In 1990, international visitors to the United States spent $\$ 58.3$ billion. In 1999, international visitors spent $\$ 95.5$ billion. By how much did spending by international visitors increase from 1990 to 1999?

## INDEPENDENT PRACTICE

See Example 1 Add. Estimate to check whether each answer is reasonable.
10. $7.82+31.23$
11. $5.98+12.99$
12. $4.917+12$
13. $-9.82+(-15.7)$
14. $6+9.33$
15. $10.022+0.11$
16. $8+1.071$
17. $-3.29+(-12.6)$

See Example 2 Subtract.
18. $5.45-3.21$
19. $12.87-3.86$
20. $15.39-2.6$
21. $21.04-4.99$
22. $5-0.53$
23. $14-8.9$
24. $41-9.85$
25. $33-10.23$

See Example 3 26. Angela runs her first lap around the track in 4.35 minutes and her second lap in 3.9 minutes. What is her total time for the two laps?
27. A jeweler has 122.83 grams of silver. He uses 45.7 grams of the silver to make a necklace and earrings. How much silver does he have left?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP8.

Add or subtract. Estimate to check whether each answer is reasonable.
28. $-7.238+6.9$
29. $4.16-9.043$
30. $-2.09-15.271$
31. $5.23-(-9.1)$
32. $-123-2.55$
33. $5.29-3.37$
34. $32.6-(-15.86)$
35. $-32.7+62.82$
36. $-51+81.623$
37. $5.9-10+2.84$
38. $-4.2+2.3-0.7$
39. $-8.3+5.38-0.537$
40. Multi-Step Students at Hill Middle School plan to run a total of $2,462 \mathrm{mi}$, which is the distance from Los Angeles to New York City. So far, the sixth grade has run 273.5 mi , the seventh grade has run 275.8 mi , and the eighth grade has run 270.2 mi . How many more miles must the students run to reach their goal?
41. Critical Thinking Why must you line up the decimal points when adding and subtracting decimals?

Weather The graph shows the five coolest summers recorded in the Midwest. The average summertime temperature in the Midwest is $70.8^{\circ} \mathrm{F}$.


Egg-drop competitions challenge students to build devices that will protect eggs when they are dropped from as high as 100 ft .
42. How much warmer was the average summertime temperature in 1950 than in 1915?
43. In what year was the temperature $4.4^{\circ} \mathrm{F}$ cooler than the average summertime temperature in the Midwest?
44. 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


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?
(A) 6.6 thousand acres
(B) 20.1 thousand acres
(C) 70.59 thousand acres

| National <br> Monument | Area <br> (thousand acres) |
| :--- | :---: |
| Agua Fria | 71.1 |
| Pompeys Pillar | 0.051 |

(D) 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. $5.11+6.9-15.3+\square=20$

## 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
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) $\$ 3.02$
(J) $\$ 3.52$

Solve each equation. Check your answer. (Lesson 2-5)
50. $x-8=-22$
51. $-3 y=-45$
52. $\frac{z}{2}=-8$
53. $29=-10+p$
Estimate. (Lesson 3-1)
54. $15.85 \div 4.01$
55. $18.95+3.21$
56. $44.217-19.876$
57. $21.43 \cdot 1.57$

## Hands-on

## LAB

## Model Decimal Multiplication

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

## Activity 1

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

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


$$
3 \cdot 0.1=0.3
$$

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

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



$$
5 \cdot 0.03=0.15
$$

## 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. $4 \cdot 0.5$
2. $2 \cdot 0.04$
3. $3 \cdot 0.16$
4. $6 \cdot 0.2$
5. $3 \cdot 0.33$
6. $0.25 \cdot 5$
7. $0.42 \cdot 3$
8. $1.1 \cdot 4$

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.

0.4

Shade 0.7 vertically.

0.7

The area where the shaded regions overlap is the answer.
$\times$
$=$

0.28

## Think and Discuss

1. Explain the steps you would take to model $0.5 \cdot 0.5$ 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. $0.6 \cdot 0.6$
2. $0.5 \cdot 0.4$
3. $0.3 \cdot 0.8$
4. $0.2 \cdot 0.8$
5. $3 \cdot 0.3$
6. $0.8 \cdot 0.8$
7. $2 \cdot 0.5$
8. $0.1 \cdot 0.9$
9. $0.1 \cdot 0.1$

## 3-3

## Multiplying Decimals

## Learn to multiply decimals.

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.


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 Integers by Decimals

## Multiply.

A $6 \cdot 0.1$

| 6 | 0 decimal places |
| ---: | :--- |
| $\times 0.1$ | 1 decimal place |
| 0.6 | $0+1=1$ decimal place |

B $-2 \cdot 0.04$
-2 0 decimal places
$\begin{array}{ll}\times 0.04 & 2 \text { decimal places } \\ -0.08 & 0+2=2 \text { decimal places. Use zero as a placeholder. }\end{array}$

C $1.25 \cdot 23$
1.252 decimal places
$\times 230$ decimal places
375
$+2500$
$28.75 \quad 2+0=2$ decimal places

## EXAMPLE 2 Multiplying Decimals by Decimals

Multiply. Estimate to check whether each answer is reasonable.
A $1.2 \cdot 1.6$

| 1.2 | 1 decimal place |
| ---: | ---: |
| $\times 1.6$ | 1 decimal place |

120
$1.92 \quad 1+1=2$ decimal places
Estimate
$1 \cdot 2=2 \quad 1.92$ is a reasonable answer.
B $-2.78 \cdot 0.8$
-2.78 2 decimal places
$\begin{array}{ll}\times 0.8 & 1 \text { decimal place } \\ -2.224 & 2+1=3 \text { decimal places }\end{array}$
Estimate
$-3 \cdot 1=-3 \quad-2.224$ is a reasonable answer.

## E X A M P L E 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 |
| ---: | :--- |
| $\times 0.25$ | 2 decimal places |
| 1510 |  |
| 6040 | $0+2=2$ decimal places |



## Estimate

$300 \cdot 0.3=90 \quad 75.50$ 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.

## GUIDED PRACTICE

See Example 1 Multiply.

1. $-9 \cdot 0.4$
2. $3 \cdot 0.2$
3. $0.06 \cdot 3$
4. $-0.5 \cdot 2$

See Example 2 Multiply. Estimate to check whether each answer is reasonable.
5. $1.7 \cdot 1.2$
6. $2.6 \cdot 0.4$
7. $1.5 \cdot(-0.21)$
8. $-0.4 \cdot 1.17$

See Example 3 9. If Carla is able to drive her car 24.03 miles on one gallon of gas, how far could she drive on 13.93 gallons of gas?

## INDEPENDENT PRACTICE

See Example 1 Multiply.
10. $8 \cdot 0.6$
11. $5 \cdot 0.07$
12. $-3 \cdot 2.7$
13. $0.8 \cdot 4$
14. $6 \cdot 4.9$
15. $1.7 \cdot(-12)$
16. $43 \cdot 2.11$
17. $-7 \cdot(-1.3)$

See Example 2 Multiply. Estimate to check whether each answer is reasonable.
18. $2.4 \cdot 3.2$
19. $2.8 \cdot 1.6$
20. $5.3 \cdot 4.6$
21. $4.02 \cdot 0.7$
22. $-5.14 \cdot 0.03$
23. $1.04 \cdot(-8.9)$
24. $4.31 \cdot(-9.5)$
25. $-6.1 \cdot(-1.01)$

See Example 3 26. Nicholas bicycled 15.8 kilometers each day for 18 days last month. How many kilometers did he bicycle last month?
27. While walking, Lara averaged 3.63 miles per hour. How far did she walk in 1.5 hours?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP8.

Multiply. Estimate to check whether each answer is reasonable.
28. $-9.6 \cdot 2.05$
31. $-1.08 \cdot(-0.4)$
34. $-325.9 \cdot 1.5$
37. $-7.02 \cdot(-0.05)$
29. $0.07 \cdot 0.03$
30. $4 \cdot 4.15$
32. $1.46 \cdot(-0.06)$
33. $-3.2 \cdot 0.9$
35. $14.7 \cdot 0.13$
36. $-28.5 \cdot(-1.07)$
38. $1.104 \cdot(-0.7)$
39. $0.072 \cdot 0.12$
40. Multi-Step Bo earns $\$ 8.95$ per hour plus commission. Last week, he worked 32.5 hours and earned $\$ 28.75$ in commission. How much money did Bo earn last week?
41. Weather As a hurricane increases in intensity, the air pressure within its eye decreases. In a Category 5 hurricane, which is the most intense, the air pressure measures approximately 27.16 inches of mercury. In a Category 1 hurricane, which is the least intense, the air pressure is about 1.066 times that of a Category 5 hurricane. What is the air pressure within the eye of a Category 1 hurricane? Round your answer to the nearest hundredth.
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
 many people reported that they enjoyed kayaking in 2016-2017?

Multiply. Estimate to check whether each answer is reasonable.
43. $0.3 \cdot 2.8 \cdot(-10.6)$
44. $1.3 \cdot(-4.2) \cdot(-3.94)$
45. $0.6 \cdot(-0.9) \cdot 0.05$
46. $-6.5 \cdot(-1.02) \cdot(-12.6)$
47. $-22.08 \cdot(-5.6) \cdot 9.9$
48. $-63.75 \cdot 13.46 \cdot 7.8$

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 $4.3 \cdot 0.56$ and $0.43 \cdot 5.6$ compare? Explain.
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 factorization of each number. (Lesson 2-6)
54. 20
55. 35
56. 120
57. 64

Add or subtract. Estimate to check whether each answer is reasonable. (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

(1) Use a decimal grid to find $0.6 \div 2$.

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 $=0.3$

$$
0.6 \div 2=0.3
$$

(2) Use decimal grids to find $2.25 \div 5$.

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

## Learn to divide decimals.

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 $0.3 \cdot \mathbf{1 0}=3$

$$
0.6 \div 0.3=2 \quad \text { and } \quad 6 \div 3=2
$$

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.

## EXAMPLE 1 Dividing Decimals by Decimals

## Helpful Hint

Multiply both numbers by the least power of ten that will make the divisor an integer.

## Divide.



## EXAMPLE

2 Dividing Integers by Decimals
Divide. Estimate to check whether each answer is reasonable.
A $9 \div 1.25$
$9.00 \div 1.25=900 \div 125 \quad$ Multiply both numbers by 100

$$
\begin{array}{r}
7.2 \\
\begin{array}{r}
725 \\
-870.0 \\
250 \\
-250 \\
0
\end{array}
\end{array}
$$

Estimate $9 \div 1=9 \quad 7.2$ is a reasonable answer.

| B $-12 \div(-1.6)$ |  |
| :--- | :--- |
| $-12.0 \div(-1.6)=-120 \div(-16)$ | Multiply both numbers by 10 <br> to make the divisor an integer. |
| $1 6 \longdiv { 1 2 0 . 0 }$ Divide as with whole numbers. <br> $\frac{-112}{8} 0$  <br> $\frac{-80}{0}$  |  |

$-12 \div(-1.6)=7.5 \quad$ The signs are the same.
Estimate $-12 \div(-2)=6 \quad 7.5$ is a reasonable answer.

## EXAMPLE <br> 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.
$358.80 \div 14.95=35,880 \div 1,495$
$1,4 9 5 \longdiv { 3 5 , 8 8 0 }$
$\begin{array}{r}-2990 \\ \hline 5980\end{array}$
-5980
0
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.

## GUIDED PRACTICE

See Example 1 Divide.

1. $3.78 \div 4.2$
2. $13.3 \div(-0.38)$
3. $14.49 \div 3.15$
4. $1.06 \div 0.2$
5. $-9.76 \div 3.05$
6. $263.16 \div(-21.5)$

See Example 2 Divide. Estimate to check whether each answer is reasonable.
7. $3 \div 1.2$
8. $84 \div 2.4$
9. $36 \div(-2.25)$
10. $24 \div(-1.2)$
11. $-18 \div 3.75$
12. $189 \div 8.4$

See Example 3 13. Transportation Samuel used 14.35 gallons of gas to drive his car 401.8 miles. How many miles per gallon did he get?

## INDEPENDENT PRACTICE

See Example 1 Divide.
14. $81.27 \div 0.03$
15. $-0.408 \div 3.4$
16. $38.5 \div(-5.5)$
17. $-1.12 \div 0.08$
18. $27.82 \div 2.6$
19. $14.7 \div 3.5$

See Example 2 Divide. Estimate to check whether each answer is reasonable.
20. $35 \div(-2.5)$
21. $361 \div 7.6$
22. $63 \div(-4.2)$
23. $5 \div 1.25$
24. $14 \div 2.5$
25. $-78 \div 1.6$

See Example 3 26. Transportation Lonnie used 26.75 gallons of gas to drive his truck 508.25 miles. How many miles per gallon did he get?
27. Mitchell walked 8.5 laps in 20.4 minutes. If he walked each lap at the same pace, how long did it take him to walk one full lap?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP8.

Divide. Estimate to check whether each answer is reasonable.
28. $-24 \div 0.32$
29. $153 \div 6.8$
30. $-2.58 \div(-4.3)$
31. $4.12 \div(-10.3)$
32. $-17.85 \div 17$
33. $64 \div 2.56$

Simplify each expression. Justify your steps using the Commutative, Associative, and Distributive Properties when neccessary.
34. $2^{2} \cdot(6.8 \div 3.4) \cdot 5$
35. $11.7 \div(0.7+0.6) \cdot 2$
36. $4 \cdot 5(0.6+0.2) \cdot 0.25$
37. $(1.6 \div 3.2) \cdot(4.2+8.6)$
38. Critical Thinking A car loan totaling $\$ 13,456.44$ is to be paid off in 36 equal monthly payments. Lin Yao can afford no more than $\$ 350$ per month. Can she afford the loan? Explain.


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.

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 $\left(2^{3} \cdot 7.5+3.69\right) \div 48.25 \div[1.04-(0.08 \cdot 2)]$.

## Test Prep and Spiral Review

45. Multiple Choice Which expression is NOT equal to -1.34 ?
(A) $-6.7 \div 5$
(B) $16.08 \div(-12)$
(C) $-12.06 \div(-9)$
(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
(J) 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. $2+6 \cdot 2$
49. $3^{2}-8 \cdot 0$
50. $(2-1)^{5}+3 \cdot 2^{2}$
51. $10-(5-3)^{2}+4 \div 2$
52. $2^{5} \div(7+1)$
53. $6-2 \cdot 3+5$

Multiply. Estimate to check whether each answer is reasonable. (Lesson 3-3)
54. $-2.75 \cdot 6.34$
55. $0.2 \cdot(-4.6) \cdot(-2.3)$
56. $1.3 \cdot(-6.7)$
57. $-6.87 \cdot(-2.65)$
58. $9 \cdot 4.26$
59. $7.13 \cdot(-14)$

## 3-5 Solving Equations Containing Decimals

Learn to solve one-step equations that contain decimals.

Interactivities Online

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.

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.

$$
s-3.84=7.2
$$



E X A M P L E 1 Solving Equations by Adding or Subtracting
Solve. Justify your steps.

## Remember!

You can solve an equation by performing the same operation on both sides of the equation to isolate the variable.

A $s-3.84=7.2$
$s-3.84=\quad 7.20 \quad$ Use the Addition Property of Equality. $\underline{+3.84}+3.84$ Add 3.84 to both sides.
(B) $y+20.51=26$
$y+20.51=2 .{ }^{5} . .^{10} \varnothing^{10} \quad$ Use the Subtraction Property of Equality.

- 20.51 - 20.51 Subtract 20.51 from both sides.


## EXAMPLE 2 Solving Equations by Multiplying or Dividing

Solve. Justify your steps.
A $\frac{w}{3.9}=1.2$

$$
\begin{aligned}
\frac{w}{3.9} & =1.2 & & \\
\frac{w}{3.9} \cdot 3.9 & =1.2 \cdot 3.9 & & \text { Use the Multiplication Property of Equality. } \\
w & =4.68 & & \text { Multiply by 3.9 on both sides. }
\end{aligned}
$$

B $4=1.6 c$
$4=1.6 c$
$\frac{4}{1.6}=\frac{1.6 c}{1.6}$
Use the Division Property of Equality. Divide by 1.6 on both sides.
$\frac{4}{1.6}=c$
Think: $4 \div 1.6=40 \div 16$.
$2.5=c$

## EXAMPLE

PROBLEM SOLVING

3 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?

## 1 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.


## 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.

$$
8.25 h=396
$$

## - 3 Solve

$$
\begin{aligned}
8.25 h & =396 \\
\frac{8.25 h}{8.25} & =\frac{396}{8.25} \quad \text { Use the Division Property of Equality. } \\
h & =48
\end{aligned}
$$

Yancey must work 48 hours.

## 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 $10 s=-10.1$ without solving the equation.

## GUIDED PRACTICE

See Example 1
Solve. Justify your steps.

1. $w-5.8=1.2$
2. $x+9.15=17$
3. $k+3.91=28$
4. $n-1.35=19.9$
5. $\frac{b}{1.4}=3.6$
6. $\frac{x}{0.8}=7.2$
7. $3.1 t=27.9$
8. $7.5=5 y$

See Example 2

See Example 3
9. Consumer Math Jeff bought a sandwich and a salad for lunch. His total bill was $\$ 7.10$. The salad cost $\$ 2.85$. How much did the sandwich cost?

## INDEPENDENT PRACTICE

See Example 1
Solve. Justify your steps.
10. $v+0.84=6$
11. $c-32.56=12$
12. $d-14.25=-23.9$
13. $3.52+a=8.6$
14. $w-9.01=12.6$
15. $p+30.34=-22.87$
16. $3.2 c=8$
17. $72=4.5 z$
18. $21.8 x=-124.26$
19. $\frac{w}{2.8}=4.2$
20. $\frac{m}{0.19}=12$
21. $\frac{a}{21.23}=-3.5$

See Example 2

See Example 3
22. At the fair, 25 food tickets cost $\$ 31.25$. What is the cost of each ticket?
23. To climb the rock wall at the fair, you must have 5 ride tickets. If each ticket costs $\$ 1.50$, how much does it cost to climb the rock wall?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP9.

Solve. Justify your steps.
24. $1.2 y=-1.44$
25. $\frac{n}{8.2}=-0.6$
26. $w-4.1=-5$
27. $r+0.48=1.2$
28. $x-5.2=-7.3$
29. $1.05=-7 m$
30. $a+0.81=-6.3$
31. $60 k=54$
32. $\frac{h}{-7.1}=0.62$
33. $\frac{t}{-0.18}=-5.2$
34. $7.9=d+12.7$
35. $-1.8+v=-3.8$
36. $-k=287.658$
37. $-n=-12.254$
38. $0.64 f=12.8$
39. $15.217-j=4.11$
40. $-2.1=p+(-9.3)$
41. $\frac{27.3}{g}=54.6$
42. The Drama Club at Smith Valley Middle School is selling cookie dough in order to raise money for costumes. If each tub of cookie dough costs $\$ 4.75$, how many tubs must members sell to make $\$ 570.00$ ?
43. Consumer Math Gregory bought a computer desk at a thrift store for $\$ 38$. The regular price of a similar desk at a furniture store is 4.5 times as much. What is the regular price of the desk at the furniture store?


Social Studies


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 $8.85 \mathrm{~g} / \mathrm{cm}^{3}$. Because of an increase in the cost of copper, the density of pennies made after 1982 is $1.71 \mathrm{~g} / \mathrm{cm}^{3}$ 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. Multiple Choice What is the solution to the equation $-4.55+x=6.32$ ?
(A) $x=-1.39$
(B) $x=1.77$
(C) $x=10.87$
(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?
(F) $5 x=0.25$
(G) $0.25 x=1.00$
(H) $5 x=1.00$
(J) $1.00 x=0.25$
51. Extended Response Write a word problem that the equation $6.25 x=125$ can be used to solve. Solve the problem and explain what the solution means.

Write each number in scientific notation. (Lesson 1-3)
52. 340,000
53. 6,000,000
54. $32.4 \cdot 10^{2}$

Simplify each expression. (Lesson 3-4)
55. $6.3 \div 2.1-1.5$
56. $4 \cdot 5.1 \div 2+3.6$
57. $(1.6+3.8) \div 1.8$
58. $(-5.4+3.6) \div 0.9$
59. $-4.5 \div 0.6 \cdot(-1.2)$
60. $5.8+3.2 \div(-6.4)$

## Quiz for Lessons 3-1 Through 3-5

## 3-1 Estimating with Decimals

Estimate.

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

## 3-2 Adding and 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 Decimals

Multiply.
10. $3.4 \cdot 9.6$
11. $-2.66 \cdot 0.9$
12. $-7 \cdot(-0.06)$
13. $6.94 \cdot(-24)$
14. Cami can run 7.02 miles per hour. How many miles can she run in 1.75 hours? Round your answer to the nearest hundredth.

## 3-4 Dividing Decimals

Divide.
15. $55 \div 12.5$
16. $-126.45 \div(-4.5)$
17. $-3.3 \div 0.11$
18. $-36 \div(-0.9)$
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. $-3.5=-5 x$
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.

$\checkmark$Read each problem, and determine whether the given solution answers the question in the problem. Explain your answer.
(1) At one store, a new $C D$ 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 tall is Bobbie?
Solution:
Bobbie is 4.1 feet tall.

(3) 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.
(4) 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.
5 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 $1,250 \frac{1}{50} \mathrm{lb}$. 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.
Interactivities Online To estimate sums and differences of 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 <br> numerator is much <br> smaller than the <br> denominator. | Round to $\frac{1}{2}$ if the <br> numerator is about half <br> the denominator. | Round to 1 if the <br> numerator is nearly <br> equal to the <br> 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

## Measurement Application

One of the largest wheels of cheese ever made weighed about $1,250 \frac{1}{50} \mathrm{lb}$. Estimate how much more this wheel of cheese weighed than an average 6 lb wheel.
$1,250 \frac{1}{50}-6$
$1,250 \frac{1}{50} \longrightarrow 1,250 \quad$ Round the mixed number.
$1,250-6=1,244$ Subtract.
The cheese wheel weighed about $1,244 \mathrm{lb}$ more than an average cheese wheel.

## EXAMPLE

2
Estimating Sums and Differences
Estimate each sum or difference.
(A) $\frac{4}{7}-\frac{13}{16}$
$\frac{4}{7} \longrightarrow \frac{1}{2} \quad \frac{13}{16} \longrightarrow 1 \quad$ Round each fraction.
$\frac{1}{2}-1=-\frac{1}{2} \quad$ Subtract.
B $3 \frac{3}{8}+3 \frac{1}{3}$
$3 \frac{3}{8} \longrightarrow 3 \frac{1}{2} \quad 3 \frac{1}{3} \longrightarrow 3 \frac{1}{2} \quad$ Round each mixed number.
$3 \frac{1}{2}+3 \frac{1}{2}=7 \quad$ Add.
C $5 \frac{7}{8}+\left(-\frac{2}{5}\right)$
$5 \frac{7}{8} \longrightarrow 6 \quad-\frac{2}{5} \longrightarrow-\frac{1}{2} \quad$ Round each number.
$6+\left(-\frac{1}{2}\right)=5 \frac{1}{2} \quad$ Add.

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.

## EXAMPLE 3 Estimating Products and Quotients

Estimate each product or quotient.
A $4 \frac{2}{7} \cdot 6 \frac{9}{10}$
$4 \frac{2}{7} \longrightarrow 4 \quad 6 \frac{9}{10} \longrightarrow 7$
$4 \cdot 7=28$
B $11 \frac{3}{4} \div 2 \frac{1}{5}$
$11 \frac{3}{4} \longrightarrow 12 \quad 2 \frac{1}{5} \longrightarrow 2$
$12 \div 2=6$

Round each mixed number to the nearest whole number. Multiply.

Round each mixed number to the nearest whole number. Divide.

## Think and Discuss

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

## GUIDED PRACTICE



1. The length of a large SUV is $18 \frac{9}{10}$ feet, and the length of a small SUV is $15 \frac{1}{8}$ feet. Estimate how much longer the large SUV is than the small SUV.

See Example 2 Estimate each sum or difference.
2. $\frac{5}{6}+\frac{5}{12}$
3. $\frac{15}{16}-\frac{4}{5}$
4. $2 \frac{1}{6}+3 \frac{6}{11}$
5. $5 \frac{2}{7}-2 \frac{7}{9}$

See Example 3 Estimate each product or quotient.
6. $1 \frac{3}{25} \cdot 9 \frac{6}{7}$
7. $21 \frac{2}{7} \div 7 \frac{1}{3}$
8. $31 \frac{7}{8} \div 4 \frac{1}{5}$
9. $12 \frac{2}{5} \cdot 3 \frac{6}{9}$

## INDEPENDENT PRACTICE

See Example 1
10. Measurement Sarah's bedroom is $14 \frac{5}{6}$ feet long and $12 \frac{1}{4}$ feet wide. Estimate the difference between the length and width of Sarah's bedroom.

See Example 2 Estimate each sum or difference.
11. $\frac{4}{9}+\frac{3}{5}$
12. $2 \frac{5}{9}+1 \frac{7}{8}$
13. $8 \frac{3}{4}-6 \frac{2}{5}$
14. $6 \frac{1}{3}+\left(-\frac{5}{6}\right)$
15. $\frac{7}{8}-\frac{2}{5}$
16. $15 \frac{1}{7}-10 \frac{8}{9}$
17. $8 \frac{7}{15}+2 \frac{7}{8}$
18. $\frac{4}{5}+7 \frac{1}{8}$

See Example 3 Estimate each product or quotient.
19. $23 \frac{5}{7} \div 3 \frac{6}{9}$
20. $10 \frac{2}{5} \div 4 \frac{5}{8}$
21. $2 \frac{1}{8} \cdot 14 \frac{5}{6}$
22. $7 \frac{9}{10} \cdot 11 \frac{3}{4}$
23. $5 \frac{3}{5} \div 2 \frac{2}{3}$
24. $12 \frac{4}{6} \cdot 3 \frac{2}{7}$
25. $8 \frac{1}{4} \div 1 \frac{7}{8}$
26. $15 \frac{12}{15} \cdot 1 \frac{5}{7}$

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP9.

Estimate each sum, difference, product, or quotient.
27. $\frac{7}{9}-\frac{3}{8}$
28. $\frac{3}{5}+\frac{6}{7}$
29. $2 \frac{5}{7} \cdot 8 \frac{3}{11}$
30. $16 \frac{7}{20} \div 3 \frac{8}{9}$
31. $-1 \frac{3}{5} \cdot 4 \frac{6}{13}$
32. $5 \frac{3}{5}-4 \frac{1}{3}$
33. $3 \frac{7}{8}+\frac{2}{15}$
34. $19 \frac{5}{7} \div\left(-5 \frac{2}{5}\right)$
35. $\frac{3}{8}+3 \frac{5}{7}+6 \frac{7}{8}$
36. $8 \frac{4}{5}+6 \frac{1}{12}+3 \frac{2}{5}$
37. $14 \frac{2}{3}+1 \frac{7}{9}-11 \frac{14}{29}$
38. Kevin has $3 \frac{3}{4}$ pounds of pecans and $6 \frac{2}{3}$ pounds of walnuts. About how many more pounds of walnuts than pecans does Kevin have?
39. Business October 19, 1987, is known as Black Monday because the stock market fell 508 points. Xerox stock began the day at $\$ 70 \frac{1}{8}$ and finished at $\$ 56 \frac{1}{4}$. Approximately how far did Xerox's stock price fall during the day?
40. Recreation Monica and Paul hiked $5 \frac{3}{8}$ miles on Saturday and $4 \frac{9}{10}$ miles on Sunday. Estimate the number of miles Monica and Paul hiked.
41. Critical Thinking If you round a divisor down, is the quotient going to be less than or greater than the actual quotient? Explain.

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 lt 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) $4 \frac{1}{5} \div 2 \frac{5}{9}$
(C) $8 \frac{7}{9} \cdot 2 \frac{1}{5}$
(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) | $12 \frac{3}{8}$ | $9 \frac{11}{15}$ | $3 \frac{1}{4}$ | $8 \frac{1}{2}$ | 0 | $4 \frac{3}{4}$ | $5 \frac{2}{5}$ |

Which is the best estimate for the total distance Maria biked last week?
(F) 40 mi
(G) 44 mi
(H) 48 mi
(J) 52 mi

Solve each equation. Check your answer. (Lessons 1-10 and 1-11)
49. $x+16=43$
50. $y-32=14$
51. $5 m=65$
52. $\frac{n}{3}=18$

Solve. (Lesson 3-5)
53. $-7.1 x=-46.15$
54. $8.7=y+(-4.6)$
55. $\frac{q}{-5.4}=3.6$
56. $r-4=-31.2$

## Hands-on

Model Fraction Addition and Subtraction

## 3-7

Use with Lesson 3-7

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

## Activity

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.

| $\frac{1}{8}$ | $\frac{1}{8}$ | $\frac{1}{8}$ | $\frac{1}{8}$ | $\frac{1}{8}$ | $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$ |
| :--- | :---: | :---: | :---: | :---: | :---: |

(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?)


$$
\frac{1}{3}+\frac{1}{4}=\frac{7}{12}
$$

(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. $\frac{1}{4}+\frac{1}{6}$

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 ?)

| $\frac{1}{3}$ |  | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ |

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

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

| $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ | $\frac{1}{6}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 |  |  |  |  |  |  | $\frac{7}{6}=1 \frac{1}{6}$ |
|  |  |  |  |  |  |  |  |

(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.

| $\frac{1}{3}$ | $\frac{1}{3}$ |  |
| :---: | :---: | :---: |
| $\frac{1}{2}$ | $\frac{1}{6}$ |  |

(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. $\frac{3}{4}-\frac{2}{3}$

## 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?

## 3-7 Adding and Subtracting Fractions

Learn to add and subtract fractions.

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.

## E X A M P L E 1 Adding and Subtracting Fractions with Like Denominators

 Add or subtract. Write each answer in simplest form.A $\frac{3}{10}+\frac{1}{10}$

$$
\begin{aligned}
\frac{3}{10}+\frac{1}{10} & =\frac{3+1}{10} & & \text { Add the numerators and } \\
& =\frac{4}{10}=\frac{2}{5} & & \text { seep the common denominator. }
\end{aligned}
$$

B $\frac{7}{9}-\frac{4}{9}$

$$
\begin{aligned}
\frac{7}{9}-\frac{4}{9} & =\frac{7-4}{9} & & \begin{array}{l}
\text { Subtract the numerators and } \\
\text { keep the common denominator. }
\end{array} \\
& =\frac{3}{9}=\frac{1}{3} & & \text { Simplify. }
\end{aligned}
$$

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

## Helpful Hint

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

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

## EXAMPLE

2
Adding and Subtracting Fractions with Unlike Denominators Add or subtract. Write each answer in simplest form.
A $\frac{3}{8}+\frac{5}{12}$
$\frac{3}{8}+\frac{5}{12}=\frac{3 \cdot 3}{8 \cdot 3}+\frac{5 \cdot 2}{12 \cdot 2} \quad$ The LCM of the denominators is 24. $=\frac{9}{24}+\frac{10}{24}=\frac{19}{24} \quad$ Write equivalent fractions. Add.
Estimate $\quad \frac{1}{2}+\frac{1}{2}=1 \quad \frac{19}{24}$ is a reasonable answer.
B $\frac{1}{10}-\frac{5}{8}$
$\frac{1}{10}-\frac{5}{8}=\frac{1 \cdot 4}{10 \cdot 4}-\frac{5 \cdot 5}{8 \cdot 5} \quad$ The LCM of the denominators is 40. $=\frac{4}{40}-\frac{25}{40}=-\frac{21}{40} \quad$ Write equivalent fractions. Subtract.
Estimate $\quad 0-\frac{1}{2}=-\frac{1}{2} \quad-\frac{21}{40}$ is a reasonable answer.
(C) $-\frac{2}{3}+\frac{7}{8}$

$$
\begin{aligned}
-\frac{2}{3}+\frac{7}{8} & =-\frac{2 \cdot 8}{3 \cdot 8}+\frac{7 \cdot 3}{8 \cdot 3} & & \text { Multiply the denominators. } \\
& =-\frac{16}{24}+\frac{21}{24}=\frac{5}{24} & & \text { Write equivalent fractions. Add. }
\end{aligned}
$$

Estimate $-1+1=0 \quad \frac{5}{24}$ is a reasonable answer.

## E X A M P LE 3 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?

$$
\begin{aligned}
\frac{1}{3}-\frac{1}{5} & =\frac{1 \cdot 5}{3 \cdot 5}-\frac{1 \cdot 3}{5 \cdot 3} & & \text { The LCM of the denominators is } 15 . \\
& =\frac{5}{15}-\frac{3}{15} & & \text { Write equivalent fractions. } \\
& =\frac{2}{15} & & \text { Subtract. }
\end{aligned}
$$

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.

## GUIDED PRACTICE

See Example 1
Add or subtract. Write each answer in simplest form.

1. $\frac{2}{3}-\frac{1}{3}$
2. $\frac{1}{12}+\frac{1}{12}$
3. $\frac{16}{21}-\frac{7}{21}$
4. $\frac{4}{17}+\frac{11}{17}$
5. $\frac{1}{6}+\frac{1}{3}$
6. $\frac{9}{10}-\frac{3}{4}$
7. $\frac{2}{3}+\frac{1}{8}$
8. $\frac{5}{8}-\frac{3}{10}$

See Example 2
See Example 3 9. Parker spends $\frac{1}{4}$ of his earnings on rent and $\frac{1}{6}$ on entertainment. How much more of his earnings does Parker spend on rent than on entertainment?

## INDEPENDENT PRACTICE

See Example 1 Add or subtract. Write each answer in simplest form.
10. $\frac{2}{3}+\frac{1}{3}$
11. $\frac{3}{20}+\frac{7}{20}$
12. $\frac{5}{8}+\frac{7}{8}$
13. $\frac{6}{15}+\frac{3}{15}$
14. $\frac{7}{12}-\frac{5}{12}$
15. $\frac{5}{6}-\frac{1}{6}$
16. $\frac{8}{9}-\frac{5}{9}$
17. $\frac{9}{25}-\frac{4}{25}$
18. $\frac{1}{5}+\frac{2}{3}$
19. $\frac{1}{6}+\frac{1}{12}$
20. $\frac{5}{6}+\frac{3}{4}$
21. $\frac{1}{2}+\frac{2}{8}$
22. $\frac{21}{24}-\frac{1}{2}$
23. $\frac{3}{4}-\frac{11}{12}$
24. $\frac{1}{2}-\frac{2}{7}$
25. $\frac{7}{10}-\frac{1}{6}$

See Example 2

See Example 26. Seana picked $\frac{3}{4}$ quart of blackberries. She ate $\frac{1}{12}$ quart. How much was left?
27. Armando lives $\frac{2}{3}$ mi from his school. If he has walked $\frac{1}{2}$ mi already this morning, how much farther must he walk to get to his school?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP9.

Find each sum or difference. Write your answer in simplest form.
28. $\frac{4}{5}+\frac{6}{7}$
29. $\frac{5}{6}-\frac{1}{9}$
30. $\frac{1}{2}-\frac{3}{4}$
31. $\frac{2}{3}+\frac{2}{15}$
32. $\frac{5}{7}+\frac{1}{3}$
33. $\frac{1}{2}-\frac{7}{12}$
34. $\frac{3}{4}+\frac{2}{5}$
35. $\frac{9}{14}-\frac{1}{7}$
36. $\frac{7}{8}+\frac{2}{3}+\frac{5}{6}$
37. $\frac{3}{5}+\frac{1}{10}-\frac{3}{4}$
38. $\frac{3}{10}+\frac{5}{8}+\frac{1}{5}$
39. $\frac{2}{5}-\frac{1}{6}+\frac{7}{10}$
40. $-\frac{1}{2}+\frac{3}{8}+\frac{2}{7}$
41. $\frac{1}{3}+\frac{3}{7}-\frac{1}{9}$
42. $\frac{2}{9}-\frac{7}{18}+\frac{1}{6}$
43. $\frac{2}{15}+\frac{4}{9}+\frac{1}{3}$
44. $\frac{9}{35}-\frac{4}{7}-\frac{5}{14}$
45. $\frac{1}{3}-\frac{5}{7}+\frac{8}{21}$
46. $-\frac{2}{9}-\frac{1}{12}-\frac{7}{18}$
47. $-\frac{2}{3}+\frac{4}{5}+\frac{5}{8}$
48. Cooking One fruit salad recipe calls for $\frac{1}{2}$ cup of sugar. Another recipe calls for 2 tablespoons of sugar. Since 1 tablespoon is $\frac{1}{16}$ cup, how much more sugar does the first recipe require?
49. It took Earl $\frac{1}{2}$ hour to do his science homework and $\frac{1}{3}$ hour to do his math homework. How long did Earl work on homework?
50. Music In music written in $4 / 4$ time, a half note lasts for $\frac{1}{2}$ measure and an eighth note lasts for $\frac{1}{8}$ measure. In terms of a musical measure, what is the difference in the duration of the two notes?

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?

| Person | Distance (mi) |
| :--- | :---: |
| Rosalyn | $\frac{1}{8}$ |
| Cai | $\frac{3}{4}$ |
| Lauren | $\frac{2}{3}$ |
| Janna | $\frac{7}{10}$ |

53. Who walked farther, Janna or Cai?
54. Measurement A shrew weighs $\frac{3}{16} \mathrm{lb}$. A hamster weighs $\frac{1}{4} \mathrm{lb}$.
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 $\frac{3}{4} \mathrm{lb}$ of mixed nuts, how many pounds of cashews would you add to $\frac{1}{8} \mathrm{lb}$ of almonds and $\frac{1}{4} \mathrm{lb}$ of peanuts?
56. Make a Conjecture Suppose the pattern $1, \frac{7}{8}, \frac{3}{4}, \frac{5}{8}, \frac{1}{2} \ldots$ 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 is the value of the expression $\frac{3}{7}+\frac{1}{5}$ ?
(A) $\frac{1}{3}$
(B) $\frac{22}{35}$
(C) $\frac{2}{3}$
(D) $\frac{26}{35}$
61. Gridded Response Grace has $\frac{1}{2}$ pound of apples. Julie has $\frac{2}{5}$ pound of apples. They want to combine their apples to use in a recipe that calls for 1 pound of apples. How many more pounds of apples do they need?

Find the greatest common factor (GCF). (Lesson 2-7)
62. 5, 9
63. 6, 54
64. 18, 24
65. $12,36,50$

Estimate each sum or difference. (Lesson 3-6)
66. $\frac{4}{7}+\frac{1}{9}$
67. $4 \frac{2}{3}-2 \frac{3}{5}$
68. $7 \frac{5}{9}-\left(-3 \frac{2}{7}\right)$
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 $1 \frac{1}{5}$.

## E X A M P LE 1 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?

$$
\begin{aligned}
6 \frac{2}{5}+1 \frac{1}{5} & =7+\frac{3}{5} & & \text { Add the fractions, and then add the integers. } \\
& =7 \frac{3}{5} & & \text { Add. }
\end{aligned}
$$

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

## EXAMPLE 2 Adding Mixed Numbers

## Helpful Hint

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

Add. Write each answer in simplest form.
A $3 \frac{4}{5}+4 \frac{2}{5}$

$$
\begin{aligned}
3 \frac{4}{5}+4 \frac{2}{5} & =7+\frac{6}{5} & & \text { Add the fractions, and then add the integers. } \\
& =7+1 \frac{1}{5} & & \text { Rewrite the improper fraction } \\
& =8 \frac{1}{5} & & \text { as a mixed number. }
\end{aligned}
$$

B $1 \frac{2}{15}+7 \frac{1}{6}$

$$
\begin{aligned}
1 \frac{2}{15}+7 \frac{1}{6} & =1 \frac{4}{30}+7 \frac{5}{30} & & \text { Find a common denominator. } \\
& =8+\frac{9}{30} & & \text { Add the fractions, and then add the integers. } \\
& =8 \frac{9}{30}=8 \frac{3}{10} & & \text { Add. Then simplify. }
\end{aligned}
$$

## Remember!

Any fraction in which the numerator and denominator are the same is equal to 1 .

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.

## EXAMPLE

## 3 Subtracting Mixed Numbers

Subtract. Write each answer in simplest form.
A $10 \frac{7}{9}-4 \frac{2}{9}$

$$
10 \frac{7}{9}-4 \frac{2}{9}=6 \frac{5}{9}
$$

Subtract the fractions, and then subtract the integers.

B $12 \frac{7}{8}-5 \frac{17}{24}$

$$
\begin{array}{rlrl}
12 \frac{7}{8}-5 \frac{17}{24} & =12 \frac{21}{24}-5 \frac{17}{24} & & \text { Find a common denominator. } \\
& =7 \frac{4}{24} & & \text { Subtract the fractions, and then } \\
& =7 \frac{1}{6} & & \text { subtract the integers. } \\
\text { Simplify. }
\end{array}
$$

C $72 \frac{3}{5}-63 \frac{4}{5}$

$$
\begin{array}{rlrl}
72 \frac{3}{5}-63 \frac{4}{5} & =71 \frac{8}{5}-63 \frac{4}{5} & & \text { Regroup. } 72 \frac{3}{5}=71+\frac{5}{5}+\frac{3}{5} \\
& =8 \frac{4}{5} & & \text { Subtract the fractions, and then } \\
\text { subtract the integers. }
\end{array}
$$

## 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 $6 \frac{2}{5}-4 \frac{3}{5}$.

## GUIDED PRACTICE

See Example 1

1. Measurement Chrystelle's mother is $1 \frac{2}{3} \mathrm{ft}$ taller than Chrystelle. If Chrystelle is $3 \frac{1}{2} \mathrm{ft}$ tall, how tall is her mother?

See Example 2 Add. Write each answer in simplest form.
2. $3 \frac{2}{5}+4 \frac{1}{5}$
3. $2 \frac{7}{8}+3 \frac{3}{4}$
4. $1 \frac{8}{9}+4 \frac{4}{9}$
5. $5 \frac{1}{2}+2 \frac{1}{4}$

See Example 3 Subtract. Write each answer in simplest form.
6. $6 \frac{2}{3}-5 \frac{1}{3}$
7. $8 \frac{1}{6}-2 \frac{5}{6}$
8. $3 \frac{2}{3}-2 \frac{3}{4}$
9. $7 \frac{5}{8}-3 \frac{2}{5}$

## INDEPENDENT PRACTICE

See Example 1
10. Sports The track at Daytona International Speedway is $\frac{24}{25} \mathrm{mi}$ longer than the track at Atlanta Motor Speedway. If the track at Atlanta is $1 \frac{27}{50} \mathrm{mi}$ long, how long is the track at Daytona?

See Example 2 Add. Write each answer in simplest form.
11. $6 \frac{1}{4}+8 \frac{3}{4}$
12. $3 \frac{3}{5}+7 \frac{4}{5}$
13. $3 \frac{5}{6}+1 \frac{5}{6}$
14. $2 \frac{3}{5}+4 \frac{1}{3}$
15. $2 \frac{3}{10}+4 \frac{1}{2}$
16. $6 \frac{1}{8}+8 \frac{9}{10}$
17. $6 \frac{1}{6}+5 \frac{3}{10}$
18. $1 \frac{2}{5}+9 \frac{1}{4}$

See Example 3 Subtract. Write each answer in simplest form.
19. $2 \frac{1}{14}-1 \frac{3}{14}$
20. $4 \frac{5}{12}-1 \frac{7}{12}$
21. $8-2 \frac{3}{4}$
22. $7 \frac{3}{4}-5 \frac{2}{3}$
23. $8 \frac{3}{4}-6 \frac{2}{5}$
24. $3 \frac{1}{3}-2 \frac{5}{8}$
25. $4 \frac{2}{5}-3 \frac{1}{2}$
26. $11-6 \frac{5}{9}$

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP9.

Add or subtract. Write each answer in simplest form.
27. $7 \frac{1}{3}+8 \frac{1}{5}$
28. $14 \frac{3}{5}-8 \frac{1}{2}$
29. $9 \frac{1}{6}+4 \frac{6}{9}$
30. $21 \frac{8}{12}-3 \frac{1}{2}$
31. $3 \frac{5}{8}+2 \frac{7}{12}$
32. $25 \frac{1}{3}+3 \frac{5}{6}$
33. $1 \frac{7}{9}-\frac{17}{18}$
34. $3 \frac{1}{2}+5 \frac{1}{4}$
35. $1 \frac{7}{15}+2 \frac{7}{10}$
36. $12 \frac{4}{6}-\frac{2}{5}$
37. $4 \frac{2}{3}+1 \frac{7}{8}+3 \frac{1}{2}$
38. $5 \frac{1}{6}+8 \frac{2}{3}-9 \frac{1}{2}$

Compare. Write $<,>$, or $=$.
39. $12 \frac{1}{4}-10 \frac{3}{4} \square 5 \frac{1}{2}-3 \frac{7}{10}$
40. $4 \frac{1}{2}+3 \frac{4}{5} \square 4 \frac{5}{7}+3 \frac{1}{2}$
41. $13 \frac{3}{4}-2 \frac{3}{8} \square 5 \frac{5}{6}+4 \frac{2}{9}$
42. $4 \frac{1}{3}-2 \frac{1}{4} \square 3 \frac{1}{4}-1 \frac{1}{6}$
43. The liquid ingredients in a recipe are water and olive oil. The recipe calls for $3 \frac{1}{2}$ cups of water and $1 \frac{1}{8}$ cups of olive oil. How many cups of liquid ingredients are included in the recipe?


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?
46. Agriculture In 2003, the United

| Atherton | $40 \frac{2}{3}$ | $100 \frac{5}{6}$ | $16 \frac{1}{2}$ |  |
| :--- | :--- | :--- | :--- | :--- |
| Baily | $40 \frac{2}{3}$ |  | $210 \frac{3}{8}$ | $30 \frac{2}{3}$ |
| Charleston | $100 \frac{5}{6}$ | $210 \frac{3}{8}$ |  | $98 \frac{3}{4}$ |
| Dixon | $16 \frac{1}{2}$ | $30 \frac{2}{3}$ | $98 \frac{3}{4}$ |  | 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 $8 \frac{1}{2} \mathrm{in}$. 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 $2 \frac{7}{8}$ ?
(A) $1 \frac{1}{2}+1 \frac{3}{8}$
(B) $5 \frac{15}{16}-3 \frac{1}{16}$
(C) $6-3 \frac{1}{8}$
(D) $1 \frac{1}{8}+1 \frac{1}{4}$
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. $-3+9$
54. $6+(-15)$
55. $-4+(-8)$
56. $-11+5$

Find each sum or difference. Write your answer in simplest form. (Lesson 3-7)
57. $\frac{2}{5}+\frac{7}{20}$
58. $\frac{3}{7}-\frac{1}{3}$
59. $\frac{3}{4}+\frac{7}{18}$
60. $\frac{1}{3}-\frac{4}{5}$

## Hands-on

## Model Fraction Multiplication and Division

## 3-9

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.


What fraction of the whole is shaded?
$\frac{3}{4} \cdot \frac{1}{2}=\frac{3}{8}$

## 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. $3 \frac{2}{5} \div \frac{3}{5}$

## 3-9 Multiplying Fractions and Mixed Numbers

Learn to multiply fractions and mixed numbers.

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.

## EXAMPLE

## Helpful Hint

The product of two positive proper fractions is less than either fraction.

## Multiplying Fractions

## Multiply. Write each answer in simplest form.

$$
\begin{aligned}
& \text { A }-15 \cdot \frac{2}{3} \\
& -15 \cdot \frac{2}{3}=-\frac{15}{1} \cdot \frac{2}{3} \quad \text { Write }-15 \text { as a fraction. } \\
& =-\frac{515 \cdot 2}{1 \cdot z_{1}} \quad \text { Simplify. } \\
& =-\frac{10}{1} \quad \text { Multiply numerators. Multiply denominators. } \\
& =-10 \\
& \text { B } \frac{1}{4} \cdot \frac{4}{5} \\
& \frac{1}{4} \cdot \frac{4}{5}=\frac{1 \cdot \not A^{1}}{14 \cdot 5} \\
& =\frac{1}{5} \\
& \text { Simplify. } \\
& \text { Multiply numerators. Multiply denominators. } \\
& \text { (C) } \frac{3}{4} \cdot\left(-\frac{1}{2}\right) \\
& \frac{3}{4} \cdot\left(-\frac{1}{2}\right)=-\frac{3 \cdot 1}{4 \cdot 2} \quad \text { The signs are different, so the answer will } \\
& \text { be negative. } \\
& =-\frac{3}{8} \quad \text { Multiply numerators. Multiply denominators. }
\end{aligned}
$$

## E X A M PLE 2 Multiplying Mixed Numbers

Multiply. Write each answer in simplest form.
(A) $8 \cdot 2 \frac{3}{4}$

$$
\begin{aligned}
8 \cdot 2 \frac{3}{4} & =\frac{8}{1} \cdot \frac{11}{4} & & \text { Write mixed numbers as improper fractions. } \\
& =\frac{{ }^{2} \cdot 11}{1 \cdot A_{1}} & & \text { Simplify. } \\
& =\frac{22}{1}=22 & & \text { Multiply numerators. Multiply denominators. }
\end{aligned}
$$

(B) $\frac{1}{3} \cdot 4 \frac{1}{2}$
$\frac{1}{3} \cdot 4 \frac{1}{2}=\frac{1}{3} \cdot \frac{9}{2} \quad$ Write the mixed number as an improper fraction. $=\frac{1 \cdot g^{3}}{\not \partial \cdot 2} \quad$ Simplify.
$=\frac{3}{2}$ or $1 \frac{1}{2} \quad$ Multiply numerators. Multiply denominators.
C $3 \frac{3}{5} \cdot 1 \frac{1}{12}$

$$
\begin{aligned}
3 \frac{3}{5} \cdot 1 \frac{1}{12} & =\frac{18}{5} \cdot \frac{13}{12} & & \text { Write mixed numbers as improper fractions. } \\
& =\frac{38 \cdot 13}{5 \cdot 12} & & \text { Simplify. } \\
& =\frac{39}{10} \text { or } 3 \frac{9}{10} & & \text { Multiply numerators. Multiply denominators. }
\end{aligned}
$$

## E X A M P L E 3 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?

$$
\begin{aligned}
1.75 \cdot \frac{4}{7} & =1 \frac{75}{100}=1 \frac{3}{4} \cdot \frac{4}{7} & & \text { Write the decimal as a fraction. } \\
& =\frac{7}{4} \cdot \frac{4}{7} & & \text { Write the mixed number as an improper } \\
& =\frac{1}{1} \cdot \frac{4}{4 \cdot 7} & & \text { fraction. } \\
& =\frac{1}{1}=1 & & \text { Simplify. }
\end{aligned}
$$

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?

## GUIDED PRACTICE

See Example 1
Multiply. Write each answer in simplest form.

1. $-8 \cdot \frac{3}{4}$
2. $\frac{2}{3} \cdot \frac{3}{5}$
3. $\frac{1}{4} \cdot\left(-\frac{2}{3}\right)$
4. $\frac{3}{5} \cdot(-15)$
5. $4 \cdot 3 \frac{1}{2}$
6. $\frac{4}{9} \cdot 5 \frac{2}{5}$
7. $1 \frac{1}{2} \cdot 1 \frac{5}{9}$
8. $2 \frac{6}{7} \cdot(-7)$

See Example 2
See Example 3
9. On average, people spend $\frac{1}{4}$ of the time they sleep in a dream state. If Maxwell slept 10 hours last night, how much time did he spend dreaming? Write your answer in simplest form.

## INDEPENDENT PRACTICE

See Example 1 Multiply. Write each answer in simplest form.
10. $5 \cdot \frac{1}{8}$
11. $4 \cdot \frac{1}{8}$
12. $3 \cdot \frac{5}{8}$
13. $6 \cdot \frac{2}{3}$
14. $\frac{2}{5} \cdot \frac{5}{7}$
15. $\frac{3}{8} \cdot \frac{2}{3}$
16. $\frac{1}{2} \cdot\left(-\frac{4}{9}\right)$
17. $-\frac{5}{6} \cdot \frac{2}{3}$
18. $7 \frac{1}{2} \cdot 2 \frac{2}{5}$
19. $6 \cdot 7 \frac{2}{5}$
20. $2 \frac{4}{7} \cdot \frac{1}{6}$
21. $2 \frac{5}{8} \cdot 6 \frac{2}{3}$
22. $\frac{2}{3} \cdot 2 \frac{91}{4}$
23. $1 \frac{1}{2} \cdot 1 \frac{5}{9}$
24. $7 \cdot 5 \frac{1}{8}$
25. $3 \frac{3}{4} \cdot 2 \frac{1}{5}$

See Example 2

See Example 3 26. Sherry spent 4 hours exercising last week. If $\frac{5}{6}$ of the time was spent jogging, how much time did she spend jogging? Write your answer in simplest form.
27. Measurement A cookie recipe calls for $\frac{1}{3}$ tsp of salt for 1 batch. Doreen is making cookies for a school bake sale and wants to bake 5 batches. How much salt does she need? Write your answer in simplest form.

## PRACTICE AND PROBLEM SOLVING

Extra Practice
See page EP10.

Multiply. Write each answer in simplest form.
28. $\frac{5}{8} \cdot \frac{4}{5}$
29. $4 \frac{3}{7} \cdot \frac{5}{6}$
30. $-\frac{2}{3} \cdot 6$
31. $2 \cdot \frac{1}{6}$
32. $\frac{1}{8} \cdot 5$
33. $-\frac{3}{4} \cdot \frac{2}{9}$
34. $4 \frac{2}{3} \cdot 2 \frac{4}{7}$
35. $-\frac{4}{9} \cdot\left(-\frac{3}{16}\right)$
36. $3 \frac{1}{2} \cdot 5$
37. $\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{5}$
38. $\frac{6}{7} \cdot 5$
39. $1 \frac{1}{2} \cdot \frac{3}{5} \cdot \frac{7}{9}$
40. $-\frac{2}{3} \cdot 1 \frac{1}{2} \cdot \frac{2}{3}$
41. $\frac{8}{9} \cdot \frac{3}{11} \cdot \frac{33}{40}$
42. $\frac{1}{6} \cdot 6 \cdot 8 \frac{2}{3}$
43. $-\frac{8}{9} \cdot\left(-1 \frac{1}{8}\right)$

Complete each multiplication sentence.
44. $\frac{1}{2} \cdot \frac{\square}{8}=\frac{3}{16}$
45. $\frac{2}{3} \cdot \frac{\square}{4}=\frac{1}{2}$
46. $\frac{-}{3} \cdot \frac{5}{8}=\frac{5}{12}$
47. $\frac{3}{5} \cdot \frac{\square}{7}=\frac{3}{7}$
48. $\frac{5}{6} \cdot \frac{3}{-}=\frac{1}{4}$
49. $\frac{4}{-} \cdot \frac{4}{5}=\frac{8}{15}$
50. $\frac{2}{3} \cdot \frac{9}{-}=\frac{3}{11}$
51. $\frac{\square}{15} \cdot \frac{3}{5}=\frac{1}{25}$
52. Measurement A standard paper clip is $1 \frac{1}{4} \mathrm{in}$. long. If you laid 75 paper clips end to end, how long would the line of paper clips be?
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 $5 \frac{5}{8}$ ?
(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
(J) $226 \frac{2}{3}$ 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.

## Vocabulary

reciprocal
multiplicative inverse

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.

$$
\mathbf{6} \div \mathbf{3}=\underbrace{\text { Reciproals }}_{\uparrow} \quad 6 \cdot \frac{1}{3}=\mathbf{2}
$$

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

## E X A M PLE 1 Dividing Fractions

Divide. Write each answer in simplest form.
A $\frac{2}{3} \div \frac{1}{5}$

$$
\begin{aligned}
\frac{2}{3} \div \frac{1}{5} & =\frac{2}{3} \cdot \frac{5}{1} \quad \quad \text { Multiply by the reciprocal of } \frac{1}{5} . \\
& =\frac{2 \cdot 5}{3 \cdot 1} \\
& =\frac{10}{3} \text { or } 3 \frac{1}{3}
\end{aligned}
$$

(B) $\frac{3}{5} \div 6$

$$
\begin{aligned}
\frac{3}{5} \div 6 & =\frac{3}{5} \cdot \frac{1}{6} & & \text { Multiply by the reciprocal of } 6 . \\
& =\frac{13 \cdot 1}{5 \cdot 6_{2}} & & \text { Simplify. } \\
& =\frac{1}{10} & &
\end{aligned}
$$

## E X A MPLE 2 Dividing Mixed Numbers

Divide. Write each answer in simplest form.
A $4 \frac{1}{3} \div 2 \frac{1}{2}$

$$
\begin{array}{rlrl}
4 \frac{1}{3} \div 2 \frac{1}{2} & =\frac{13}{3} \div \frac{5}{2} & & \text { Write mixed numbers as improper fractions. } \\
& =\frac{13}{3} \cdot \frac{2}{5} & & \text { Multiply by the reciprocal of } \frac{5}{2} . \\
& =\frac{26}{15} \text { or } 1 \frac{11}{15} &
\end{array}
$$

## Divide. Write each answer in simplest form.

B
$\frac{5}{6} \div 7 \frac{1}{7}$

$$
\begin{aligned}
\frac{5}{6} \div 7 \frac{1}{7} & =\frac{5}{6} \div \frac{50}{7} & & \text { Write } 7 \frac{1}{7} \text { as an improper fraction. } \\
& =\frac{5}{6} \cdot \frac{7}{50} & & \text { Multiply by the reciprocal of } \frac{50}{7} . \\
& =\frac{15 \cdot 7}{6 \cdot 5 \theta_{10}} & & \text { Simplify. } \\
& =\frac{7}{60} & &
\end{aligned}
$$

C $4 \frac{4}{5} \div \frac{6}{7}$

$$
\begin{aligned}
4 \frac{4}{5} \div \frac{6}{7} & =\frac{24}{5} \div \frac{6}{7} & & \text { Write } 4 \frac{4}{5} \text { as an improper fraction. } \\
& =\frac{24}{5} \cdot \frac{7}{6} & & \text { Multiply by the reciprocal of } \frac{6}{7} . \\
& =\frac{24 \cdot 7}{5 \cdot 6_{1}} & & \text { Simplify. } \\
& =\frac{28}{5} \text { or } 5 \frac{3}{5} & &
\end{aligned}
$$

3 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

Life Spans of Bills

in 9?

$$
\begin{aligned}
9 \div 1 \frac{1}{2} & =\frac{9}{1} \div \frac{3}{2} & & \text { Write both numbers as improper fractions. } \\
& =\frac{9}{1} \cdot \frac{2}{3} & & \text { Multiply by the reciprocal of } \frac{3}{2} . \\
& =\frac{3}{1 \cdot 2} & & \text { Simplify. } \\
& =\frac{6}{1} \text { or } 6 & &
\end{aligned}
$$

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

## 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.

## GUIDED PRACTICE

See Example 1
Divide. Write each answer in simplest form.

1. $6 \div \frac{1}{3}$
2. $\frac{3}{5} \div \frac{3}{4}$
3. $\frac{3}{4} \div 8$
4. $-\frac{5}{9} \div \frac{2}{5}$
5. $\frac{5}{6} \div 3 \frac{1}{3}$
6. $5 \frac{5}{8} \div 4 \frac{1}{2}$
7. $10 \frac{4}{5} \div 5 \frac{2}{5}$
8. $2 \frac{1}{10} \div \frac{3}{5}$

See Example 2
See Example 3 9. Kareem has $12 \frac{1}{2}$ yards of material. A cape for a play takes $3 \frac{5}{6}$ yards. How many capes can Kareem make with the material?

## INDEPENDENT PRACTICE

See Example 1
Divide. Write each answer in simplest form.
10. $2 \div \frac{7}{8}$
11. $10 \div \frac{5}{9}$
12. $\frac{3}{4} \div \frac{6}{7}$
13. $\frac{7}{8} \div \frac{1}{5}$
14. $\frac{8}{9} \div \frac{1}{4}$
15. $\frac{4}{9} \div 12$
16. $\frac{9}{10} \div 6$
17. $-16 \div \frac{2}{5}$
18. $\frac{7}{11} \div 4 \frac{1}{5}$
19. $\frac{3}{4} \div 2 \frac{1}{10}$
20. $22 \frac{1}{2} \div 4 \frac{2}{7}$
21. $-10 \frac{1}{2} \div \frac{3}{4}$
22. $3 \frac{5}{7} \div 9 \frac{1}{7}$
23. $14 \frac{2}{3} \div 1 \frac{1}{6}$
24. $7 \frac{7}{10} \div 2 \frac{2}{5}$
25. $8 \frac{2}{5} \div \frac{7}{8}$

See Example 2

See Example 3
26. A juicer holds $43 \frac{3}{4}$ pints of juice. How many $2 \frac{1}{2}$-pint bottles can be filled with that much juice?
27. Measurement How many $24 \frac{1}{2}$ in. pieces of ribbon can be cut from a roll of ribbon that is 147 in . long?

## PRACTICE AND PROBLEM SOLVING

## Extra Practice

See page EP10.

## Evaluate. Write each answer in simplest form.

28. $6 \frac{2}{3} \div \frac{7}{9}$
29. $-1 \frac{7}{11} \div\left(\frac{9}{11}\right)$
30. $\frac{2}{3} \div \frac{8}{9}$
31. $-1 \frac{3}{5} \div 2 \frac{1}{2}$
32. $\frac{1}{2} \div 4 \frac{3}{4}$
33. $\left(2 \frac{3}{4}+3 \frac{2}{3}\right) \div \frac{11}{18}$
34. $\left(\frac{1}{2}+\frac{2}{3}\right) \div 1 \frac{1}{2}$
35. $\frac{4}{5} \cdot \frac{3}{8} \div \frac{9}{10}$
36. $\frac{1}{2}\left(\frac{3}{5}-\frac{2}{15}\right)+\frac{2}{9} \div \frac{1}{3}$
37. $\frac{3}{7} \div \frac{15}{28} \div\left(-\frac{4}{5}\right)$
38. $\frac{7}{8} \div 2 \frac{1}{10}$
39. $\frac{2}{3} \div\left(\frac{5}{6}+\frac{1}{12}\right)-2 \cdot \frac{1}{2}$
40. $\frac{3}{4}+\frac{3}{20} \div \frac{2}{5} \cdot \frac{7}{8}-1$
41. $\left(\frac{1}{2}\right)^{2}+\frac{1}{3} \div \frac{1}{6}-\frac{1}{4}$
42. Three friends will be driving to an amusement park that is $226 \frac{4}{5}$ mi from their town. If each friend drives the same distance, how far will each drive? Explain how you decided which operation to use to solve this problem.
43. Multi-Step How many $\frac{1}{4} \mathrm{lb}$ hamburger patties can be made from a $10 \frac{1}{4} \mathrm{lb}$ package and an $11 \frac{1}{2} \mathrm{lb}$ package of ground meat?
44. Write About It Explain what it means to divide $\frac{2}{3}$ by $\frac{1}{3}$. Use a model in your explanation.

## 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?
47. For his drafting class, Manuel is drawing plans for a bookcase. Because he wants his drawing to be $\frac{1}{4}$ the actual size of the bookcase, Manuel must divide each measurement of the bookcase by 4 . If the bookcase will be $3 \frac{2}{3}$ feet wide, how wide will Manuel's drawing be?
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

| Period | Hours |
| :--- | :--- |
| 1st | $200 \frac{1}{2}$ |
| 2nd | $179 \frac{2}{5}$ |
| 3rd | $199 \frac{3}{4}$ |
| 5th | $190 \frac{3}{4}$ |
| 6th | $180 \frac{1}{4}$ | 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 $7 \frac{1}{2} \mathrm{in}$. wide and 18 in . long? Explain your answer.

## 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) $2 \frac{2}{3} \div \frac{13}{8}$
(C) $\frac{8}{3} \div \frac{13}{8}$
(D) $\frac{8}{3} \cdot 1 \frac{5}{8}$
51. Multiple Choice What is the value of the expression $\frac{3}{5} \cdot \frac{1}{6} \div \frac{2}{5}$ ?
(F) $\frac{1}{25}$
(G) $\frac{1}{4}$
(H) $\frac{15}{22}$
(J) 25
52. Gridded Response Each cat at the animal shelter gets $\frac{3}{4} \mathrm{c}$ of food every day. If Alysse has $16 \frac{1}{2} \mathrm{c}$ of cat food, how many cats can she feed?

Find the least common multiple (LCM). (Lesson 2-8)
53. 2,15
54. 6, 8
55. 4, 6, 18
56. $3,4,8$

Multiply. Write each answer in simplest form. (Lesson 3-9)
57. $-\frac{2}{15} \cdot \frac{5}{8}$
58. $1 \frac{7}{20} \cdot 6$
59. $1 \frac{2}{7} \cdot 2 \frac{3}{4}$
60. $\frac{1}{8} \cdot 6 \cdot 2 \frac{5}{9}$

## 3-11 Solving Equations Containing Fractions

Learn to solve one-step equations that contain fractions.

## E X A M PLE 1 Solving Equations by Adding or Subtracting

## Solve. Write each answer in simplest form.

A $x-\frac{1}{5}=\frac{3}{5}$

$$
\begin{array}{rlr}
x-\frac{1}{5} & =\frac{3}{5} \\
x-\frac{1}{5}+\frac{1}{5} & =\frac{3}{5}+\frac{1}{5} \\
x & =\frac{4}{5} & \text { Use the Addition Property of Equality. }
\end{array}
$$

(B) $\frac{7}{18}+u=-\frac{14}{27}$

$$
\begin{aligned}
\frac{7}{18}+u & =-\frac{14}{27} & & \\
\frac{7}{18}+u-\frac{7}{18} & =-\frac{14}{27}-\frac{7}{18} & & \text { Use the Subtraction Property of Equality. } \\
u & =-\frac{28}{54}-\frac{21}{54} & & \text { Find a common denominator. } \\
u & =-\frac{49}{54} & & \text { Subtract. }
\end{aligned}
$$

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 <br> and its reciprocal, or multiplicative <br> 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.

## Caution!

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

## EXAMPLE

Solving Equations by Multiplying
Solve. Write each answer in simplest form.
A $\frac{2}{3} x=\frac{4}{5}$

$$
\begin{array}{rlrl}
\frac{2}{3} x & =\frac{4}{5} & & \text { Use the Multiplicative Inverse Property. } \\
\frac{2}{3} x \cdot \frac{3}{2} & =\frac{{ }^{2}}{5} \cdot \frac{3}{2} 2_{1} & & \text { Multiply by the reciprocal of } \frac{2}{3} . \text { Then simplify. } \\
x & =\frac{6}{5} \text { or } 1 \frac{1}{5} &
\end{array}
$$

B $3 y=\frac{6}{7}$

$$
\begin{array}{rlrl}
3 y & =\frac{6}{7} & \text { Use the Multiplicative Inverse Property. } \\
3 y \cdot \frac{1}{3} & =\frac{6}{7} \cdot \frac{1}{Z_{1}} & & \text { Multiply by the reciprocal of 3. Then sim } \\
y & =\frac{2}{7} & &
\end{array}
$$

## 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.

$$
\begin{aligned}
c+\frac{11}{20} & =\frac{3}{4} & & \text { Write an equation. } \\
c+\frac{11}{20}-\frac{11}{20} & =\frac{3}{4}-\frac{11}{20} & & \text { Subtract to isolate } c . \\
c & =\frac{15}{20}-\frac{11}{20} & & \text { Find a common denominator. } \\
c & =\frac{4}{20} & & \text { Subtract. } \\
c & =\frac{1}{5} & & \text { Simplify. }
\end{aligned}
$$

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

## 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 $\frac{2}{5}$.

## GUIDED PRACTICE

See Example 1 Solve. Write each answer in simplest form.

1. $a-\frac{1}{2}=\frac{1}{4}$
2. $m+\frac{1}{6}=\frac{5}{6}$
3. $p-\frac{2}{3}=\frac{5}{6}$
4. $\frac{1}{5} x=8$
5. $\frac{2}{3} r=\frac{3}{5}$
6. $3 w=\frac{3}{7}$

See Example 2
See Example 3
7. Kara has $\frac{3}{8}$ cup less oatmeal than she needs for a cookie recipe. If she has $\frac{3}{4}$ cup of oatmeal, how much oatmeal does she need?

## INDEPENDENT PRACTICE

See Example 1 Solve. Write each answer in 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. $y+\frac{5}{6}=\frac{19}{20}$
14. $\frac{1}{5} x=4$
15. $\frac{1}{4} w=\frac{1}{8}$
16. $5 y=\frac{3}{10}$
17. $6 z=\frac{1}{2}$
18. $\frac{5}{8} x=\frac{2}{5}$
19. $\frac{5}{8} n=1 \frac{1}{5}$

See Example 2

See Example 3 20. Earth Science Carbon-14 has a half-life of 5,730 years. After 17,190 years, $\frac{1}{8}$ of the carbon-14 in a sample will be left. If 5 grams of carbon- 14 are left after 17,190 years, how much was in the original sample?

## PRACTICE AND PROBLEM SOLVING

Extra Practice
See page EP10.

Solve. Write each answer in simplest form.
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 Finland drinks an average of $24 \frac{1}{4} \mathrm{lb}$ of coffee per year. This is $13 \frac{1}{16} \mathrm{lb}$ more than the average person in Italy consumes. On average, how much coffee does an Italian drink each year?
40. Weather Yuma, Arizona, receives $102 \frac{1}{100}$ fewer inches of rain each year than Quillayute, Washington, which receives $105 \frac{9}{50}$ inches per year. (Source: National Weather Service). How much rain does Yuma get in one year?


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.
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?

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

## Test Prep and Spiral Review

48. Multiple Choice Which value of $y$ is the solution to the equation $y-\frac{7}{8}=\frac{3}{5}$ ?
(A) $y=-\frac{11}{40}$
(B) $y=\frac{10}{13}$
(C) $y=1 \frac{19}{40}$
(D) $y=2$
49. Multiple Choice Which equation has the solution $x=-\frac{2}{5}$ ?
(F) $\frac{2}{5} x=-1$
(G) $-\frac{3}{4} x=\frac{6}{20}$
(H) $-\frac{4}{7}+x=\frac{2}{3}$
(J) $x-3 \frac{5}{7}=3 \frac{1}{2}$

Order the numbers from least to greatest. (Lesson 2-11)
50. $-0.61,-\frac{3}{5},-\frac{4}{3},-1.25$
51. $3.25,3 \frac{2}{10}, 3,3.02$
52. $\frac{1}{2},-0.2,-\frac{7}{10}, 0.04$

Estimate. (Lesson 3-1)
53. $5.87-7.01$
54. $4.0387+(-2.13)$
55. $6.785 \cdot 3.01$

## 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 $13 \frac{7}{10} \mathrm{ft}$ tall. She is $5 \frac{1}{2} \mathrm{ft}$ 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. $\frac{4}{9}=-2 q$
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?

# Realluloric C O N NECTIONS 

## Civil Rights in Education Heritage Trail The roots of free

VIRGINIA
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.

1. 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?

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

## 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.


[^0]

## PROJECT <br> Operation Slide Through

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

## Directions

(1) 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 $\mathbf{A}$

Cut out a thin notch about 4 inches long along the middle of the folded edge. Figure B
(3) 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 $\mathbf{C}$Weave the $3 \frac{1}{2}$-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.


## Study Guide: Review

## Vocabulary

compatible numbers .................. 144 reciprocal ............................... 190
multiplicative inverse .................. 190
Complete the sentences below with vocabulary words from the list above.

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

## EXAMPLES

## EXERCISES

3-1 Estimating with Decimals (pp. 144-147)

Estimate.

| 63.28 | $\longrightarrow$63 Round each decimal to <br> +16.52 $\longrightarrow \frac{17}{80}$ |
| ---: | :--- |
| the nearest integer. |  |
| 43.55 | $\longrightarrow 40$ |
| $\times 8.65$ | $\longrightarrow \frac{\times 9}{360}$ | | Use compatible |
| :--- |
| numbers. |

Estimate.
3. $54.4+55.99$
4. $11.48-5.6$
5. $24.77 \cdot 3.45$
6. $37.8 \div 9.3$
7. Helen saves $\$ 7.85$ each week. She wants to buy a TV that costs $\$ 163.15$. For about how many weeks will Helen have to save her money before she can buy the TV?

3-2 Adding and Subtracting Decimals (pp. 148-151)
Add.
$5.67+22.44$
5.67 Line up the decimal points.
28.44
+28.11
Add.
Add or subtract.
8. $4.99+22.89$
9. $-6.7+(-44.5)$
10. $18.09-11.87$
11. $47+5.902$
12. $23-8.905$
13. $4.68+31.2$

3-3 Multiplying Decimals (pp. 154-157)

- Multiply.


## Multiply.

| $1.44 \cdot 0.6$ |  |
| :---: | :--- |
| 1.44 | 2 decimal places |
| $\times 0.6$ | 1 decimal place |
| 0.864 | $2+1=3$ decimal places |

14. $7 \cdot 0.5$
15. $-4.3 \cdot 9$
16. $4.55 \cdot 8.9$
17. $7.88 \cdot 7.65$
18. $63.4 \cdot 1.22$
19. $-9.9 \cdot 1.9$
20. Fred buys 4 shirts at $\$ 9.52$ per shirt. How much did Fred spend?

## EXAMPLES

3-4 Dividing Decimals (pp. 160-163)

## ■ Divide.

$7 \div 2.8$
2.5
2870.0 $\quad$ Multiply both numbers by
$\frac{56}{140}$ integer.
$\frac{140}{0}$

## ■ Divide.

$0.96 \div 1.6$

$$
\begin{aligned}
\begin{array}{rl}
0.6 & \text { Multiply both numbers by } \\
1 6 \longdiv { 9 . 6 } & 10 \text { to make the divisor an } \\
-96 & \text { integer. }
\end{array} .
\end{aligned}
$$

## EXERCISES

Divide.
21. $16 \div 3.2$
22. $50 \div(-1.25)$
23. $48 \div 0.06$
24. $31 \div(-6.2)$
25. $78 \div(-12.5)$
26. $816 \div 2.4$
27. $7.65 \div 1.7$
28. $9.483 \div(-8.7)$
29. $126.28 \div(-8.2)$
30. $2.5 \div(-0.005)$
31. $9 \div 4.5$
32. $13 \div 3.25$
33. In qualifying for an auto race, one driver had lap speeds of $195.3 \mathrm{mi} / \mathrm{h}, 190.456 \mathrm{mi} / \mathrm{h}$, $193.557 \mathrm{mi} / \mathrm{h}$, and $192.757 \mathrm{mi} / \mathrm{h}$. What was the driver's average speed for these four laps?

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

■ Solve.

$$
\begin{aligned}
& n-4.77=8.60 \\
& \frac{+4.77}{n}=\begin{array}{r}
+4.77 \\
13.37
\end{array} \quad \text { Add to isolate } n .
\end{aligned}
$$

Solve.
34. $x+40.44=30 \quad$ 35. $\frac{s}{1.07}=100$
36. $0.8 n=0.0056$
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 wakeboard?

3-6 Estimating with Fractions (pp. 170-173)

## ■ Estimate.

$$
\begin{aligned}
& \begin{array}{l}
7 \frac{3}{4}-4 \frac{1}{3} \\
7 \frac{3}{4} \longrightarrow 8
\end{array} \\
& 8-4 \frac{1}{2}=3 \frac{1}{2}
\end{aligned} \begin{aligned}
& 4 \frac{1}{3} \\
& 11 \frac{7}{12} \div 3 \frac{2}{5} \\
& 11 \frac{7}{12} \longrightarrow 12 \quad 3 \frac{2}{5} \longrightarrow 3 \\
& 12 \div 3=4
\end{aligned}
$$

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.

$$
\begin{array}{rlrl}
\frac{1}{3}+\frac{2}{5} & =\frac{5}{15}+\frac{6}{15} & & \text { Write equivalent } \\
& =\frac{11}{15} & & \text { fractions using a } \\
& \text { common denominator. }
\end{array}
$$

Add or subtract. Write each answer in simplest form.
48. $\frac{3}{4}-\frac{1}{3}$
49. $\frac{1}{4}+\frac{3}{5}$
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.

$$
\begin{array}{rlrl}
1 \frac{1}{3}+2 \frac{1}{2} & =1 \frac{2}{6}+2 \frac{3}{6} & & \text { Add the integers, } \\
& =3+\frac{5}{6} & & \text { and then add the } \\
\text { fractions. }
\end{array}
$$

Add or subtract. Write each answer in simplest form.
52. $3 \frac{7}{8}+2 \frac{1}{3}$
53. $2 \frac{1}{4}+1 \frac{1}{12}$
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 simplest form.
$4 \frac{1}{2} \cdot 5 \frac{3}{4}=\frac{9}{2} \cdot \frac{23}{4}$
$=\frac{207}{8}$ or $25 \frac{7}{8}$
56. $1 \frac{2}{3} \cdot 4 \frac{1}{2}$
57. $\frac{4}{5} \cdot 2 \frac{3}{10}$
58. $4 \frac{6}{7} \cdot 3 \frac{5}{9}$
59. $3 \frac{4}{7} \cdot 1 \frac{3}{4}$

Multiply. Write each answer in simplest form.

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

- Divide.

$$
\begin{aligned}
\frac{3}{4} \div \frac{2}{5} & =\frac{3}{4} \cdot \frac{5}{2} & & \text { Multiply by the } \\
& =\frac{15}{8} \text { or } 1 \frac{7}{8} & & \text { reciprocal of } \frac{2}{5} .
\end{aligned}
$$

Divide. Write each answer in simplest form.
60. $\frac{1}{3} \div 6 \frac{1}{4}$
61. $\frac{1}{2} \div 3 \frac{3}{4}$
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 cut 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.
$\frac{1}{4} x=\frac{1}{6}$
$\begin{aligned} \frac{4}{1} \cdot \frac{1}{4} x & =\frac{1}{6} \cdot \frac{4}{1} \\ x & =\frac{4}{6}=\frac{2}{3}\end{aligned}$
$\begin{aligned} \frac{4}{1} \cdot \frac{1}{4} x & =\frac{1}{6} \cdot \frac{4}{1} \\ x & =\frac{4}{6}=\frac{2}{3}\end{aligned}$
Multiply by the reciprocal of $\frac{1}{4}$.

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 and used $\frac{3}{4}$ cup for a recipe. How many cups of oil are left?

## Chapter Test

## Estimate.

1. $19.95+21.36$
2. $49.17-5.88$
3. $3.21 \cdot 16.78$
4. $49.1 \div 5.6$

## Add or subtract.

5. $3.086+6.152$
6. $5.91+12.8$
7. $3.1-2.076$
8. $14.75-6.926$

Multiply or divide.
9. $3.25 \cdot 24$
10. $-3.79 \cdot 0.9$
11. $32 \div 1.6$
12. $3.57 \div(-0.7)$

Solve.
13. $w-5.3=7.6$
14. $4.9=c+3.7$
15. $b \div 1.8=2.1$
16. $4.3 h=81.7$

Estimate each sum, difference, product, or quotient.
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 or subtract. Write each answer in simplest form.
21. $\frac{3}{10}+\frac{2}{5}$
22. $\frac{11}{16}-\frac{7}{8}$
23. $7 \frac{1}{3}+5 \frac{11}{12}$
24. $9-3 \frac{2}{5}$

Multiply or divide. Write each answer in simplest 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 $4 \frac{4}{5}$ tbsp of butter. Nasim is making $3 \frac{1}{3}$ times the recipe for his soccer team. How much butter does he need? Write your answer in simplest form.
30. Brianna has $11 \frac{2}{3}$ cups of milk. She needs $1 \frac{1}{6}$ cups of milk to make a pot of hot cocoa. How many pots of hot cocoa can Brianna make?

Solve. Write each answer 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 homework in $1 \frac{1}{2}$ hours. It took Jimmy $\frac{3}{4}$ of an hour longer than Alan to finish his homework. How long did it take Jimmy to finish his homework?
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?

## 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



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

$$
\begin{array}{r}
0.23+r= \\
-0.23 \quad 1.42 \\
r=\frac{-0.23}{1.19}
\end{array}
$$

- 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 2



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

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

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.


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.

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

1. A cell phone company charges $\$ 0.05$ per text message. Which expression represents the cost of $t$ text messages?
(A) $0.05 t$
(C) $0.05-t$
(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) $\$ 0$
(G) $-\$ 79.46$
(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) $3 \frac{1}{2}+2 \frac{3}{4}=x$
(C) $3 \frac{1}{2} \cdot 2 \frac{3}{4}=x$
(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 $1 \frac{1}{4} \mathrm{~m}$ long, and the third picket is $1 \frac{1}{2} \mathrm{~m}$ long. If the pattern continues, how long is the seventh picket?
(F) $1 \frac{3}{4} \mathrm{~m}$
(H) $2 \frac{1}{4} \mathrm{~m}$
(G) 2 m
(J) $2 \frac{1}{2} \mathrm{~m}$
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) $55 \cdot 2$
(H) $11 \cdot 5 \cdot 2$
(G) $22 \cdot 5 \cdot 2$
(J) $110 \cdot 1$
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 yards
(D) 15 yards

When possible, use logic to eliminate at least two answer choices.
10. Which model best represents the expression $\frac{6}{8} \times \frac{1}{2}$ ?
(F)

(G)

(H)


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) $\frac{3}{5}$
(C) $\frac{1}{15}$
(B) $\frac{1}{5}$
(D) $\frac{1}{9}$

## Gridded Response

12. Frieda earns $\$ 5.85$ per hour. To find the amount of money Frieda earns working $x$ hours, use the equation $y=5.85 x$. 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.

S2. 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 $11 \frac{2}{3} \mathrm{ft}$ and $11 \frac{1}{2} \mathrm{ft}$. 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 $11.6 \mathrm{ft}, 11 \frac{1}{4} \mathrm{ft}$, and $11 \frac{2}{3} \mathrm{ft}$. 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?


[^0]:    Learn It Online
    Game Time Extra go.hrw.com, keyword MS10 Games Go

