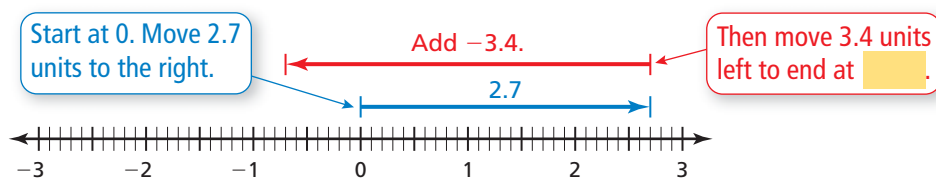# 2.2 Adding Rational Numbers

Essential Question How can you use what you know about adding integers to add rational numbers?

1 ACTIVITY: Adding Rational Numbers

Work with a partner. Use a number line to find the sum.

a. $2.7 + (-3.4)$

| Start at 0. Move 2.7 units to the right. | Add -3.4. | Then move 3.4 units left to end at ☐. |

2.7

$$-3 \qquad -2 \qquad -1 \qquad 0 \qquad 1 \qquad 2 \qquad 3$$

So, $2.7 + (-3.4) = $ ☐.

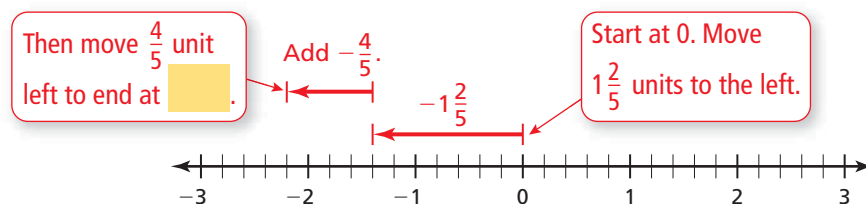**b.** $1.3 + (-1.5)$

c. $-2.1 + 0.8$

d. $-1\frac{1}{4} + \frac{3}{4}$

e. $\frac{3}{10} + \left(-\frac{3}{10}\right)$

2 ACTIVITY: Adding Rational Numbers

Work with a partner. Use a number line to find the sum.

a. $-1\frac{2}{5} + \left(-\frac{4}{5}\right)$

| Then move $\frac{4}{5}$ unit left to end at ☐. | Add $-\frac{4}{5}$. | Start at 0. Move $1\frac{2}{5}$ units to the left. |

$-1\frac{2}{5}$

$$-3 \qquad -2 \qquad -1 \qquad 0 \qquad 1 \qquad 2 \qquad 3$$

So, $-1\frac{2}{5} + \left(-\frac{4}{5}\right) = $ ☐.

b. $-\frac{7}{10} + \left(-1\frac{7}{10}\right)$

c. $-1\frac{2}{3} + \left(-1\frac{1}{3}\right)$

d. $-0.4 + (-1.9)$

e. $-2.3 + (-0.6)$

Rational Numbers

In this lesson, you will
- add rational numbers.
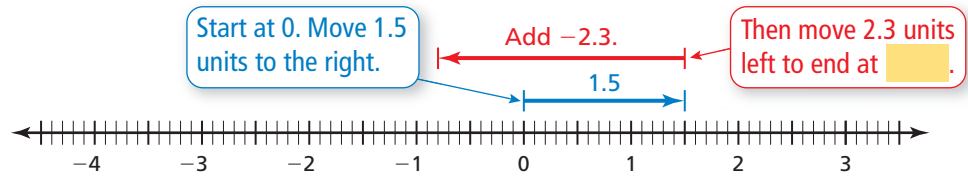- solve real-life problems.

ACTIVITY: Writing Expressions

Work with a partner. Write the addition expression shown. Then find the sum.
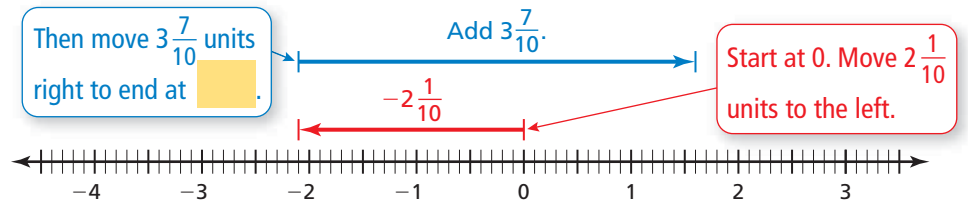
Math Practice

Use Operations
What operation is represented in each number line? How does this help you write an expression?

a.

Start at 0. Move 1.5 units to the right.

Add −2.3.

Then move 2.3 units left to end at [ ].

1.5

-4   -3   -2   -1   0   1   2   3

b.

Then move $3\frac{7}{10}$ units right to end at [ ].

Add $3\frac{7}{10}$.

Start at 0. Move $2\frac{1}{10}$ units to the left.

$-2\frac{1}{10}$

-4   -3   -2   -1   0   1   2   3

c.

Then move 0.7 unit left to end at [ ].

Add −0.7.

Start at 0. Move 1.1 units to the left.

−1.1

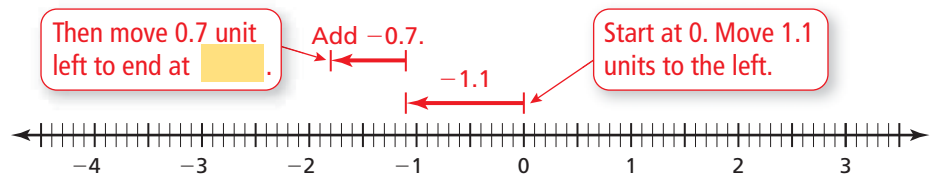-4   -3   -2   -1   0   1   2   3

What Is Your Answer?

4. IN YOUR OWN WORDS How can you use what you know about adding integers to add rational numbers?

PUZZLE Find a path through the table so that the numbers add up to the sum. You can move horizontally or vertically.

5. Sum: $\frac{3}{4}$

Start →

$\frac{1}{2}$	$\frac{2}{3}$	$-\frac{5}{7}$
$-\frac{1}{8}$	$-\frac{3}{4}$	$\frac{1}{3}$

← End

6. Sum: −0.07

Start →

2.43	1.75	−0.98
−1.09	3.47	−4.88

← End

Practice Use what you learned about adding rational numbers to complete Exercises 4–6 on page 54.

Check It Out
Lesson Tutorials
BigIdeasMath ✓com

🔑 Key Idea

Adding Rational Numbers

Words To add rational numbers, use the same rules for signs as you used for integers.

Numbers $-\dfrac{1}{3} + \dfrac{1}{6} = \dfrac{-2}{6} + \dfrac{1}{6} = \dfrac{-2+1}{6} = \dfrac{-1}{6} = -\dfrac{1}{6}$

EXAMPLE 1 Adding Rational Numbers

Study Tip

In Example 1, notice how $-\dfrac{8}{3}$ is written as $-\dfrac{8}{3} = \dfrac{-8}{3} = \dfrac{-16}{6}$.

Find $-\dfrac{8}{3} + \dfrac{5}{6}$.

Estimate $-3 + 1 = -2$

$$-\dfrac{8}{3} + \dfrac{5}{6} = \dfrac{-16}{6} + \dfrac{5}{6}$$ Rewrite using the LCD (least common denominator).

$$= \dfrac{-16+5}{6}$$ Write the sum of the numerators over the common denominator.

$$= \dfrac{-11}{6}$$ Add.

$$= -1\dfrac{5}{6}$$ Write the improper fraction as a mixed number.

∴ The sum is $-1\dfrac{5}{6}$.   **Reasonable?** $-1\dfrac{5}{6} \approx -2$ ✓

EXAMPLE 2 Adding Rational Numbers

Find $-4.05 + 7.62$.

$$-4.05 + 7.62 = 3.57$$ $|7.62| > |-4.05|$. So, subtract $|-4.05|$ from $|7.62|$.

Use the sign of 7.62.

∴ The sum is 3.57.

🔴 On Your Own

Now You're Ready
Exercises 4–12

Add.

1. $-\dfrac{7}{8} + \dfrac{1}{4}$

2. $-6\dfrac{1}{3} + \dfrac{20}{3}$

3. $2 + \left(-\dfrac{7}{2}\right)$

4. $-12.5 + 15.3$

5. $-8.15 + (-4.3)$

6. $0.65 + (-2.75)$

EXAMPLE ③ Evaluating Expressions

Evaluate $2x + y$ when $x = \frac{1}{4}$ and $y = -\frac{3}{2}$.

$$2x + y = 2\left(\frac{1}{4}\right) + \left(-\frac{3}{2}\right) \qquad \text{Substitute } \frac{1}{4} \text{ for } x \text{ and } -\frac{3}{2} \text{ for } y.$$

$$= \frac{1}{2} + \left(\frac{-3}{2}\right) \qquad \text{Multiply.}$$

$$= \frac{1 + (-3)}{2} \qquad \text{Write the sum of the numerators over the common denominator.}$$

$$= -1 \qquad \text{Simplify.}$$

EXAMPLE ④ Real-Life Application

Year	Profit (billions of dollars)
2008	−1.7
2009	−4.75
2010	1.7
2011	0.85
2012	3.6

The table shows the annual profits (in billions of dollars) of a financial company from 2008 to 2012. Positive numbers represent *gains*, and negative numbers represent *losses*. Which statement describes the profit over the five-year period?

Ⓐ gain of $0.3 billion   Ⓑ gain of $30 million

Ⓒ loss of $3 million   Ⓓ loss of $300 million

To determine whether there was a gain or a loss, find the sum of the profits.

five-year profit $= -1.7 + (-4.75) + 1.7 + 0.85 + 3.6$	Write the sum.
$= -1.7 + 1.7 + (-4.75) + 0.85 + 3.6$	Comm. Prop. of Add.
$= 0 + (-4.75) + 0.85 + 3.6$	Additive Inv. Prop.
$= -4.75 + 0.85 + 3.6$	Add. Prop. of Zero
$= -3.9 + 3.6$	Add -4.75 and 0.85.
$= -0.3$	Add -3.9 and 3.6.

The five-year profit is −$0.3 billion. So, the company has a five-year loss of $0.3 billion, or $300 million.

∴ The correct answer is Ⓓ.

On Your Own

Now You're Ready
Exercises 15–17

Evaluate the expression when $a = \frac{1}{2}$ and $b = -\frac{5}{2}$.

7. $b + 4a$ **8.** $|a + b|$

9. WHAT IF? In Example 4, the 2013 profit is $1.07 billion. State the company's gain or loss over the six-year period in millions of dollars.

✓ Vocabulary and Concept Check

1. **WRITING** Explain how to find the sum $-8.46 + 5.31$.

2. **OPEN-ENDED** Write an addition expression using fractions that equals $-\dfrac{1}{2}$.

3. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

Add -4.5 and 3.5.	What is the distance between -4.5 and 3.5?
What is -4.5 increased by 3.5?	Find the sum of -4.5 and 3.5.

📝 Practice and Problem Solving

Add. Write fractions in simplest form.

① ②   **4.** $\dfrac{11}{12} + \left(-\dfrac{7}{12}\right)$ **5.** $-1\dfrac{1}{5} + \left(-\dfrac{3}{5}\right)$ **6.** $-4.2 + 3.3$

7. $-\dfrac{9}{14} + \dfrac{2}{7}$ **8.** $4 + \left(-1\dfrac{2}{3}\right)$ **9.** $\dfrac{15}{4} + \left(-4\dfrac{1}{3}\right)$

10. $-3.1 + (-0.35)$ **11.** $12.48 + (-10.636)$ **12.** $20.25 + (-15.711)$

ERROR ANALYSIS Describe and correct the error in finding the sum.

13.

✗
$$\begin{aligned} -3.7 \\ + (-0.25) \\ \hline -0.62 \end{aligned}$$

14.

✗
$$-\dfrac{5}{8} + \dfrac{1}{8} = \dfrac{-5 + 1}{8} = \dfrac{-6}{8} = -\dfrac{3}{4}$$

Evaluate the expression when $x = \dfrac{1}{3}$ and $y = -\dfrac{7}{4}$.

③ **15.** $x + y$ **16.** $3x + y$ **17.** $-x + |y|$

18. **BANKING** Your bank account balance is –$20.85. You deposit $15.50. What is your new balance?

19. **HOT DOGS** You eat $\dfrac{3}{10}$ of a pack of hot dogs. Your friend eats $\dfrac{1}{5}$ of the pack of hot dogs. What fraction of the pack of hot dogs do you and your friend eat?

Add. Write fractions in simplest form.

20. $6 + \left(-4\frac{3}{4}\right) + \left(-2\frac{1}{8}\right)$ 　　　 **21.** $-5\frac{2}{3} + 3\frac{1}{4} + \left(-7\frac{1}{3}\right)$ 　　　 **22.** $10.9 + (-15.6) + 2.1$

23. NUMBER SENSE When is the sum of two negative mixed numbers an integer?

24. WRITING You are adding two rational numbers with different signs. How can you tell if the sum will be *positive*, *negative*, or *zero*?

25. RESERVOIR The table at the left shows the water level (in inches) of a reservoir for three months compared to the yearly average. Is the water level for the three-month period greater than or less than the yearly average? Explain.

June	July	August
$-2\frac{1}{8}$	$1\frac{1}{4}$	$-\frac{9}{16}$

26. BREAK EVEN The table at the right shows the annual profits (in thousands of dollars) of a county fair from 2008 to 2012. What must the 2012 profit be (in hundreds of dollars) to break even over the five-year period?

Year	Profit (thousands of dollars)
2008	2.5
2009	1.75
2010	−3.3
2011	−1.4
2012	?

27. REASONING Is $|a + b| = |a| + |b|$ for all rational numbers a and b? Explain.

28. 🟥 **Repeated Reasoning** Evaluate the expression.

$$\frac{19}{20} + \left(\frac{-18}{20}\right) + \frac{17}{20} + \left(\frac{-16}{20}\right) + \cdots + \left(\frac{-4}{20}\right) + \frac{3}{20} + \left(\frac{-2}{20}\right) + \frac{1}{20}$$

Fair Game Review What you learned in previous grades & lessons

Identify the property. Then simplify. *(Skills Review Handbook)*

29. $8 + (-3) + 2 = 8 + 2 + (-3)$ 　　　　　 **30.** $2 \cdot (4.5 \cdot 9) = (2 \cdot 4.5) \cdot 9$

31. $\frac{1}{4} + \left(\frac{3}{4} + \frac{1}{8}\right) = \left(\frac{1}{4} + \frac{3}{4}\right) + \frac{1}{8}$ 　　　 **32.** $\frac{3}{7} \cdot \frac{4}{5} \cdot \frac{14}{27} = \frac{3}{7} \cdot \frac{14}{27} \cdot \frac{4}{5}$

33. MULTIPLE CHOICE The regular price of a photo album is $18. You have a coupon for 15% off. How much is the discount? *(Skills Review Handbook)*

Ⓐ $2.70　　　　　　Ⓑ $3　　　　　　Ⓒ $15　　　　　　Ⓓ $15.30