

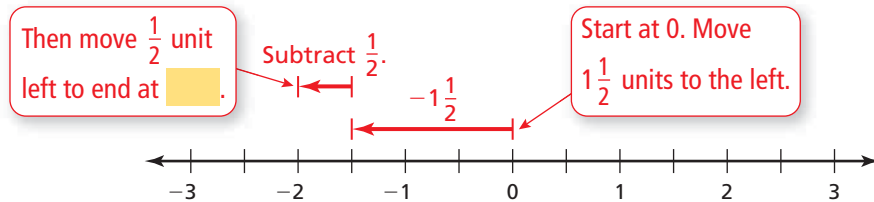
## 2.3 Subtracting Rational Numbers

**Essential Question** How can you use what you know about subtracting integers to subtract rational numbers?

### 1 ACTIVITY: Subtracting Rational Numbers

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

a.  $-1\frac{1}{2} - \frac{1}{2}$



∴ So,  $-1\frac{1}{2} - \frac{1}{2} =$  [yellow box].

b.  $\frac{6}{10} - 1\frac{3}{10}$

c.  $-1\frac{1}{4} - 1\frac{3}{4}$

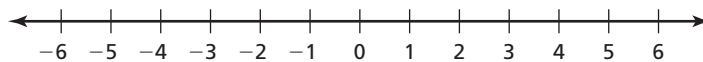
d.  $-1.9 - 0.8$

e.  $0.2 - 0.7$

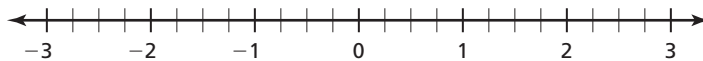
### 2 ACTIVITY: Finding Distances on a Number Line

Work with a partner.

- a. Plot  $-3$  and  $2$  on the number line. Then find  $-3 - 2$  and  $2 - (-3)$ . What do you notice about your results?



- b. Plot  $\frac{3}{4}$  and  $1$  on the number line. Then find  $\frac{3}{4} - 1$  and  $1 - \frac{3}{4}$ . What do you notice about your results?



- c. Choose any two points  $a$  and  $b$  on a number line. Find the values of  $a - b$  and  $b - a$ . What do the absolute values of these differences represent? Is this true for any pair of rational numbers? Explain.

#### Rational Numbers

In this lesson, you will

- subtract rational numbers.
- solve real-life problems.

### 3 ACTIVITY: Financial Literacy



Work with a partner. The table shows the balance in a checkbook.

- Black numbers are amounts added to the account.
- **Red numbers** are amounts taken from the account.

Date	Check #	Transaction	Amount	Balance
--	--	Previous balance	--	100.00
→ 1/02/2013	124	Groceries	34.57	
1/07/2013		Check deposit	875.50	
1/11/2013		ATM withdrawal	40.00	
1/14/2013	125	Electric company	78.43	
1/17/2013		Music store	10.55	
1/18/2013	126	Shoes	47.21	
1/22/2013		Check deposit	125.00	
1/24/2013		Interest	2.12	
1/25/2013	127	Cell phone	59.99	
1/26/2013	128	Clothes	65.54	
→ 1/30/2013	129	Cable company	75.00	

#### Math Practice

##### Interpret Results

What does your answer represent? Does your answer make sense?

You can find the balance in the **second row** two different ways.

$$100.00 - 34.57 = 65.43 \quad \text{Subtract 34.57 from 100.00.}$$

$$100.00 + (-34.57) = 65.43 \quad \text{Add } -34.57 \text{ to } 100.00.$$

- Copy the table. Then complete the balance column.
- How did you find the balance in the **twelfth row**?
- Use a different way to find the balance in part (b).

### What Is Your Answer?

- IN YOUR OWN WORDS** How can you use what you know about subtracting integers to subtract rational numbers?
- Give two real-life examples of subtracting rational numbers that are not integers.

#### Practice

Use what you learned about subtracting rational numbers to complete Exercises 3–5 on page 62.

**Key Idea**
**Subtracting Rational Numbers**

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

**Numbers**  $\frac{2}{5} - \left(-\frac{1}{5}\right) = \frac{2}{5} + \frac{1}{5} = \frac{2+1}{5} = \frac{3}{5}$

**EXAMPLE 1 Subtracting Rational Numbers**

Find  $-4\frac{1}{7} - \left(-\frac{6}{7}\right)$ .

**Estimate**  $-4 - (-1) = -3$

$$\begin{aligned} -4\frac{1}{7} - \left(-\frac{6}{7}\right) &= -4\frac{1}{7} + \frac{6}{7} \\ &= -\frac{29}{7} + \frac{6}{7} \\ &= \frac{-29 + 6}{7} \\ &= \frac{-23}{7} \\ &= -3\frac{2}{7} \end{aligned}$$

Add the opposite of  $-\frac{6}{7}$ .

Write the mixed number as an improper fraction.

Write the sum of the numerators over the common denominator.

Add.

Write the improper fraction as a mixed number.

∴ The difference is  $-3\frac{2}{7}$ .

**Reasonable?**  $-3\frac{2}{7} \approx -3$  ✓

**EXAMPLE 2 Subtracting Rational Numbers**

Find  $12.8 - 21.6$ .

$12.8 - 21.6 = 12.8 + (-21.6)$  Add the opposite of 21.6.

$= -8.8$

$|-21.6| > |12.8|$ . So, subtract  $|12.8|$  from  $|-21.6|$ .

∴ The difference is  $-8.8$ .

Use the sign of  $-21.6$ .

**On Your Own**

**Now You're Ready**  
Exercises 3–11

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

2.  $-3\frac{1}{3} - \frac{5}{6}$

3.  $4\frac{1}{2} - 5\frac{1}{4}$

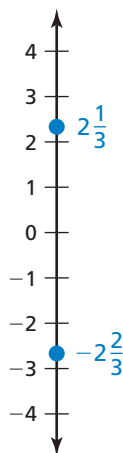
4.  $-8.4 - 6.7$

5.  $-20.5 - (-20.5)$

6.  $0.41 - (-0.07)$

The distance between any two numbers on a number line is the absolute value of the difference of the numbers.

### EXAMPLE 3 Finding Distances Between Numbers on a Number Line



**Find the distance between the two numbers on the number line.**

To find the distance between the numbers, first find the difference of the numbers.

$$\begin{aligned}
 -2\frac{2}{3} - 2\frac{1}{3} &= -2\frac{2}{3} + \left(-2\frac{1}{3}\right) && \text{Add the opposite of } 2\frac{1}{3}. \\
 &= -\frac{8}{3} + \left(-\frac{7}{3}\right) && \text{Write the mixed numbers as improper fractions.} \\
 &= \frac{-15}{3} && \text{Add.} \\
 &= -5 && \text{Simplify.}
 \end{aligned}$$

Because  $|-5| = 5$ , the distance between  $-2\frac{2}{3}$  and  $2\frac{1}{3}$  is 5.

### EXAMPLE 4 Real-Life Application



Clearance: 11 ft 8 in.

**In the water, the bottom of a boat is 2.1 feet below the surface, and the top of the boat is 8.7 feet above it. Towed on a trailer, the bottom of the boat is 1.3 feet above the ground. Can the boat and trailer pass under the bridge?**

**Step 1:** Find the height  $h$  of the boat.

$$\begin{aligned}
 h &= 8.7 - (-2.1) && \text{Subtract the lowest point from the highest point.} \\
 &= 8.7 + 2.1 && \text{Add the opposite of } -2.1. \\
 &= 10.8 && \text{Add.}
 \end{aligned}$$

**Step 2:** Find the height  $t$  of the boat and trailer.

$$\begin{aligned}
 t &= 10.8 + 1.3 && \text{Add the trailer height to the boat height.} \\
 &= 12.1 && \text{Add.}
 \end{aligned}$$

Because 12.1 feet is greater than 11 feet 8 inches, the boat and trailer cannot pass under the bridge.

### On Your Own

**Now You're Ready**  
Exercises 13–15

- Find the distance between  $-7.5$  and  $-15.3$  on a number line.
- WHAT IF?** In Example 4, the clearance is 12 feet 1 inch. Can the boat and trailer pass under the bridge?

## Vocabulary and Concept Check

- WRITING** Explain how to find the difference  $-\frac{4}{5} - \frac{3}{5}$ .
- WHICH ONE DOESN'T BELONG?** Which expression does *not* belong with the other three? Explain your reasoning.

$$-\frac{5}{8} - \frac{3}{4}$$

$$-\frac{3}{4} + \frac{5}{8}$$

$$-\frac{5}{8} + \left(-\frac{3}{4}\right)$$

$$-\frac{3}{4} - \frac{5}{8}$$

## Practice and Problem Solving

**Subtract.** Write fractions in simplest form.

- $\frac{5}{8} - \left(-\frac{7}{8}\right)$
- $-1\frac{1}{3} - 1\frac{2}{3}$
- $-1 - 2.5$
- $-5 - \frac{5}{3}$
- $-8\frac{3}{8} - 10\frac{1}{6}$
- $-\frac{1}{2} - \left(-\frac{5}{9}\right)$
- $5.5 - 8.1$
- $-7.34 - (-5.51)$
- $6.673 - (-8.29)$

- ERROR ANALYSIS** Describe and correct the error in finding the difference.

$$\times \quad \frac{3}{4} - \frac{9}{2} = \frac{3-9}{4-2} = \frac{-6}{2} = -3$$

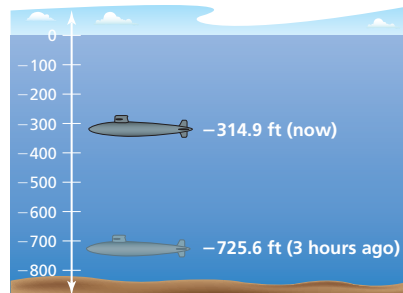
**Find the distance between the two numbers on a number line.**

- $-2\frac{1}{2}, -5\frac{3}{4}$
- $-2.2, 8.4$
- $-7, -3\frac{2}{3}$

- SPORTS DRINK** Your sports drink bottle is  $\frac{5}{6}$  full. After practice, the bottle is  $\frac{3}{8}$  full. Write the difference of the amounts after practice and before practice.

- SUBMARINE** The figure shows the depths of a submarine.

- Find the vertical distance traveled by the submarine.
- Find the mean hourly vertical distance traveled by the submarine.



**Evaluate.**

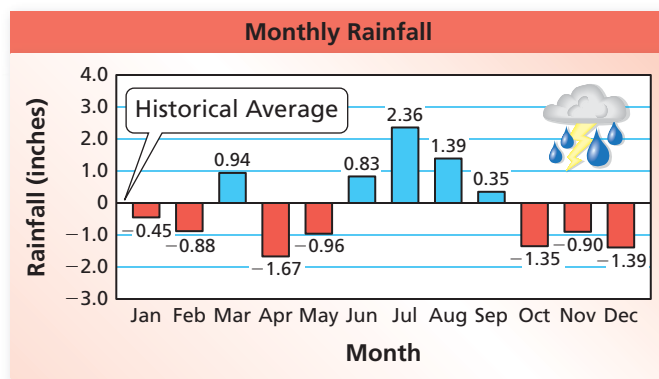
- $2\frac{1}{6} - \left(-\frac{8}{3}\right) + \left(-4\frac{7}{9}\right)$
- $6.59 + (-7.8) - (-2.41)$
- $-\frac{12}{5} + \left|-\frac{13}{6}\right| + \left(-3\frac{2}{3}\right)$

21. **REASONING** When is the difference of two decimals an integer? Explain.
22. **RECIPE** A cook has  $2\frac{2}{3}$  cups of flour. A recipe calls for  $2\frac{3}{4}$  cups of flour. Does the cook have enough flour? If not, how much more flour is needed?



23. **ROADWAY** A new road that connects Uniontown to Springville is  $4\frac{1}{3}$  miles long. What is the change in distance when using the new road instead of the dirt roads?

**RAINFALL** In Exercises 24–26, the bar graph shows the differences in a city’s rainfall from the historical average.



24. What is the difference in rainfall between the wettest and the driest months?
25. Find the sum of the differences for the year.
26. What does the sum in Exercise 25 tell you about the rainfall for the year?
27. **OPEN-ENDED** Write two different pairs of negative decimals,  $x$  and  $y$ , that make the statement  $x - y = 0.6$  true.

**REASONING** Tell whether the difference between the two numbers is *always*, *sometimes*, or *never* positive. Explain your reasoning.

28. two negative fractions
29. a positive decimal and a negative decimal
30. **Structure** Fill in the blanks to make the solution correct.

$$5. \quad \square 4 - (\square .8 \square) = -3.61$$



## Fair Game Review

what you learned in previous grades & lessons

**Evaluate.** (*Skills Review Handbook*)

31.  $5.2 \times 6.9$
32.  $7.2 \div 2.4$
33.  $2\frac{2}{3} \times 3\frac{1}{4}$
34.  $9\frac{4}{5} \div 3\frac{1}{2}$
35. **MULTIPLE CHOICE** A sports store has 116 soccer balls. Over 6 months, it sells 8 soccer balls per month. How many soccer balls are in inventory at the end of the 6 months? (*Section 1.3 and Section 1.4*)
- (A) -48
- (B) 48
- (C) 68
- (D) 108