

2.1 Rational Numbers

Essential Question How can you use a number line to order rational numbers?

The Meaning of a Word ● Rational

The word **rational** comes from the word *ratio*. Recall that you can write a ratio using fraction notation.

If you sleep for 8 hours in a day, then the ratio of your sleeping time to the total hours in a day can be written as $\frac{8 \text{ h}}{24 \text{ h}}$.



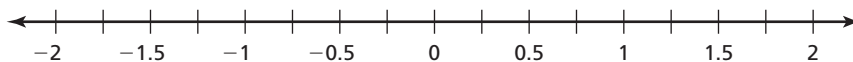
A **rational number** is a number that can be written as the ratio of two integers.

$$2 = \frac{2}{1} \quad -3 = \frac{-3}{1} \quad -\frac{1}{2} = \frac{-1}{2} \quad 0.25 = \frac{1}{4}$$

1 ACTIVITY: Ordering Rational Numbers

Work in groups of five. Order the numbers from least to greatest.

- Use masking tape and a marker to make a number line on the floor similar to the one shown.



- Write the numbers on pieces of paper. Then each person should choose one.
- Stand on the location of your number on the number line.
- Use your positions to order the numbers from least to greatest.



Rational Numbers

In this lesson, you will

- understand that a rational number is an integer divided by an integer.
- convert rational numbers to decimals.

Learning Standards

7.NS.2b
7.NS.2d

a. $-0.5, 1.25, -\frac{1}{3}, 0.5, -\frac{5}{3}$

b. $-\frac{7}{4}, 1.1, \frac{1}{2}, -\frac{1}{10}, -1.3$

c. $-1.4, -\frac{3}{5}, \frac{9}{2}, \frac{1}{4}, 0.9$

d. $\frac{5}{4}, 0.75, -\frac{5}{4}, -0.8, -1.1$

2 ACTIVITY: The Game of Math Card War

Math Practice 1

Consider Similar Problems

What are some ways to determine which number is greater?

Preparation:

- Cut index cards to make 40 playing cards.
- Write each number in the table on a card.



To Play:

- Play with a partner.
- Deal 20 cards to each player facedown.
- Each player turns one card faceup. The player with the greater number wins. The winner collects both cards and places them at the bottom of his or her cards.
- Suppose there is a tie. Each player lays three cards facedown, then a new card faceup. The player with the greater of these new cards wins. The winner collects all ten cards and places them at the bottom of his or her cards.
- Continue playing until one player has all the cards. This player wins the game.

$-\frac{3}{2}$	$\frac{3}{10}$	$-\frac{3}{4}$	-0.6	1.25	-0.15	$\frac{5}{4}$	$\frac{3}{5}$	-1.6	-0.3
$\frac{3}{20}$	$\frac{8}{5}$	-1.2	$\frac{19}{10}$	0.75	-1.5	$-\frac{6}{5}$	$-\frac{3}{5}$	1.2	0.3
1.5	1.9	-0.75	-0.4	$\frac{3}{4}$	$-\frac{5}{4}$	-1.9	$\frac{2}{5}$	$-\frac{3}{20}$	$-\frac{19}{10}$
$\frac{6}{5}$	$-\frac{3}{10}$	1.6	$-\frac{2}{5}$	0.6	0.15	$\frac{3}{2}$	-1.25	0.4	$-\frac{8}{5}$

What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you use a number line to order rational numbers? Give an example.

The numbers are in order from least to greatest. Fill in the blank spaces with rational numbers.

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

5. $-\frac{5}{2}$, , -1.9 , , $-\frac{2}{3}$,

6. $-\frac{1}{3}$, , -0.1 , , $\frac{4}{5}$,

7. -3.4 , , -1.5 , , 2.2 ,

Practice

Use what you learned about ordering rational numbers to complete Exercises 28–30 on page 48.

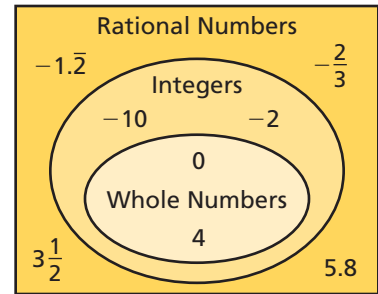
Key Vocabulary

rational number,
p. 46
terminating decimal,
p. 46
repeating decimal,
p. 46

Key Idea

Rational Numbers

A **rational number** is a number that can be written as $\frac{a}{b}$ where a and b are integers and $b \neq 0$.



Because you can divide any integer by any nonzero integer, you can use long division to write fractions and mixed numbers as decimals. These decimals are also rational numbers and will either *terminate* or *repeat*.

A **terminating decimal** is a decimal that ends.

1.5, -0.25, 10.625

A **repeating decimal** is a decimal that has a pattern that repeats.

$-1.333\dots = -1.\overline{3}$

$0.151515\dots = 0.1\overline{5}$

Use bar notation to show which of the digits repeat.

EXAMPLE 1 Writing Rational Numbers as Decimals

a. Write $-2\frac{1}{4}$ as a decimal.

Notice that $-2\frac{1}{4} = -\frac{9}{4}$.

Divide 9 by 4.

$$\begin{array}{r} 2.25 \\ 4 \overline{)9.00} \\ \underline{-8} \\ 10 \\ \underline{-8} \\ 20 \\ \underline{-20} \\ 0 \end{array}$$

The remainder is 0. So, it is a terminating decimal.

∴ So, $-2\frac{1}{4} = -2.25$.

b. Write $\frac{5}{11}$ as a decimal.

Divide 5 by 11.

$$\begin{array}{r} 0.4545 \\ 11 \overline{)5.0000} \\ \underline{-44} \\ 60 \\ \underline{-55} \\ 50 \\ \underline{-44} \\ 60 \\ \underline{-55} \\ 5 \end{array}$$

The remainder repeats. So, it is a repeating decimal.

∴ So, $\frac{5}{11} = 0.\overline{45}$.

On Your Own

Write the rational number as a decimal.

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

2. $-7\frac{3}{8}$

3. $-\frac{3}{11}$

4. $1\frac{5}{27}$

Now You're Ready
Exercises 11–18

EXAMPLE 2 Writing a Decimal as a Fraction

Write -0.26 as a fraction in simplest form.

Study Tip

If p and q are integers, then $-\frac{p}{q} = \frac{-p}{q} = \frac{p}{-q}$.

$$\begin{aligned}
 -0.26 &= -\frac{26}{100} \\
 &= -\frac{13}{50}
 \end{aligned}$$

Write the digits after the decimal point in the numerator.

The last digit is in the hundredths place. So, use 100 in the denominator.

Simplify.

On Your Own

Now You're Ready
Exercises 20–27

Write the decimal as a fraction or a mixed number in simplest form.

5. -0.7

6. 0.125

7. -3.1

8. -10.25

EXAMPLE 3 Ordering Rational Numbers

Creature	Elevation (kilometers)
Anglerfish	$-\frac{13}{10}$
Squid	$-2\frac{1}{5}$
Shark	$-\frac{2}{11}$
Whale	-0.8

The table shows the elevations of four sea creatures relative to sea level. Which of the sea creatures are deeper than the whale? Explain.

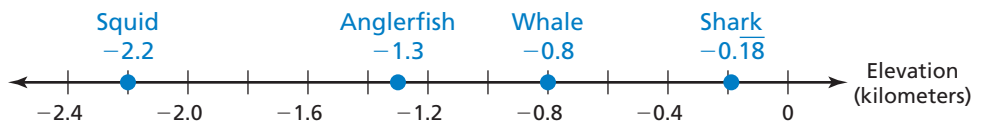
Write each rational number as a decimal.

$$-\frac{13}{10} = -1.3$$

$$-2\frac{1}{5} = -2.2$$

$$-\frac{2}{11} = -0.\overline{18}$$

Then graph each decimal on a number line.



Both -2.2 and -1.3 are less than -0.8 . So, the squid and the anglerfish are deeper than the whale.

On Your Own

Now You're Ready
Exercises 28–33

9. **WHAT IF?** The elevation of a dolphin is $-\frac{1}{10}$ kilometer. Which of the sea creatures in Example 3 are deeper than the dolphin? Explain.


Vocabulary and Concept Check

- VOCABULARY** Is the quotient of two integers always a rational number? Explain.
- WRITING** Are all terminating and repeating decimals rational numbers? Explain.

Tell whether the number belongs to each of the following number sets:
rational numbers, integers, whole numbers.

3. -5 4. $-2.1\overline{6}$ 5. 12 6. 0

Tell whether the decimal is *terminating* or *repeating*.


7. $-0.4848\dots$ 8. -0.151 9. 72.72 10. $-5.2\overline{36}$


Practice and Problem Solving

Write the rational number as a decimal.

11. $\frac{7}{8}$ 12. $\frac{1}{11}$ 13. $-\frac{7}{9}$ 14. $-\frac{17}{40}$
 15. $1\frac{5}{6}$ 16. $-2\frac{17}{18}$ 17. $-5\frac{7}{12}$ 18. $8\frac{15}{22}$

19. **ERROR ANALYSIS** Describe and correct the error in writing the rational number as a decimal.

 $-\frac{7}{11} = -0.6\overline{3}$

Write the decimal as a fraction or a mixed number in simplest form.

20. -0.9 21. 0.45 22. -0.258 23. -0.312
 24. -2.32 25. -1.64 26. 6.012 27. -12.405

Order the numbers from least to greatest.

28. $-\frac{3}{4}, 0.5, \frac{2}{3}, -\frac{7}{3}, 1.2$ 29. $\frac{9}{5}, -2.5, -1.1, -\frac{4}{5}, 0.8$ 30. $-1.4, -\frac{8}{5}, 0.6, -0.9, \frac{1}{4}$
 31. $2.1, -\frac{6}{10}, -\frac{9}{4}, -0.75, \frac{5}{3}$ 32. $-\frac{7}{2}, -2.8, -\frac{5}{4}, \frac{4}{3}, 1.3$ 33. $-\frac{11}{5}, -2.4, 1.6, \frac{15}{10}, -2.25$

34. **COINS** You lose one quarter, two dimes, and two nickels.

- Write the amount as a decimal.
- Write the amount as a fraction in simplest form.

35. **HIBERNATION** A box turtle hibernates in sand at $-1\frac{5}{8}$ feet. A spotted turtle hibernates at $-1\frac{16}{25}$ feet. Which turtle is deeper?

Copy and complete the statement using $<$, $>$, or $=$.

36. -2.2 -2.42

37. -1.82 -1.81

38. $\frac{15}{8}$ $1\frac{7}{8}$

39. $-4\frac{6}{10}$ -4.65

40. $-5\frac{3}{11}$ $-5.\bar{2}$

41. $-2\frac{13}{16}$ $-2\frac{11}{14}$

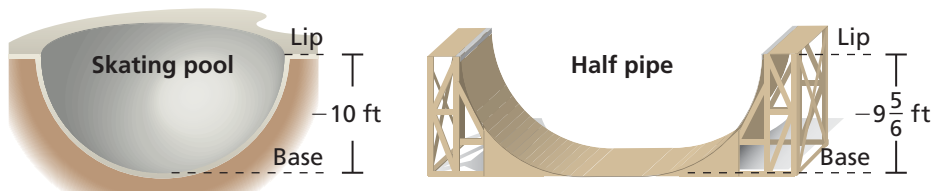
42. **OPEN-ENDED** Find one terminating decimal and one repeating decimal between $-\frac{1}{2}$ and $-\frac{1}{3}$.

Player	Hits	At Bats
Eva	42	90
Michelle	38	80

43. **SOFTBALL** In softball, a batting average is the number of hits divided by the number of times at bat. Does Eva or Michelle have the higher batting average?

44. **PROBLEM SOLVING** You miss 3 out of 10 questions on a science quiz and 4 out of 15 questions on a math quiz. Which quiz has a higher percent of correct answers?

45. **SKATING** Is the half pipe deeper than the skating pool? Explain.



46. **ENVIRONMENT** The table shows the changes from the average water level of a pond over several weeks. Order the numbers from least to greatest.

Week	1	2	3	4
Change (inches)	$-\frac{7}{5}$	$-1\frac{5}{11}$	-1.45	$-1\frac{91}{200}$

47. **Critical Thinking** Given: a and b are integers.

a. When is $-\frac{1}{a}$ positive?

b. When is $\frac{1}{ab}$ positive?



Fair Game Review what you learned in previous grades & lessons

Add or subtract. (*Skills Review Handbook*)

48. $\frac{3}{5} + \frac{2}{7}$

49. $\frac{9}{10} - \frac{2}{3}$

50. $8.79 - 4.07$

51. $11.81 + 9.34$

52. **MULTIPLE CHOICE** In one year, a company has a profit of $-\$2$ million. In the next year, the company has a profit of $\$7$ million. How much more profit did the company make the second year? (*Section 1.3*)

(A) \$2 million

(B) \$5 million

(C) \$7 million

(D) \$9 million