

Solve & Discuss It!

Jaylon has a wrench labeled 0.1875 inch and bolts labeled in fractions of an inch. Which size bolt will fit best with the wrench? Explain.

Reasoning How can you write these numbers in the same form?

Lesson 2-1

Rational Numbers as Decimals

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I can...
write repeating decimals as fractions.

Focus on math practices

Reasoning Why is it useful to write a rational number as a fraction or as a decimal?

Essential Question

How can you write repeating decimals as fractions?

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EXAMPLE 1 Write Repeating Decimals as Fractions

The Sluggers baseball team ended the season with the highest win percentage in their division. What is the Slugger's winning percentage written as a fraction?

Team	PCT
Sluggers	.556
Crushers	.512
Bulldogs	.438
Crusaders	.414
Jaybirds	.389

Statistics are often rounded. Here, the decimal 0.555... or 0.5 is rounded to the thousandths place.

Locate 0.555... on a number line.

The decimal number 0.555... is between 0.5 and 0.6; so it is between $\frac{1}{2}$, or $\frac{5}{10}$, and $\frac{6}{10}$.

Reasoning How do you know that the repeating decimal 0.555... can be written as a fraction?

Write the repeating decimal as a fraction.

Assign a variable to represent the repeating decimal.

$$\begin{aligned} \text{Let } x &= 0.5 \\ 10 \cdot x &= 10 \cdot 0.5 \\ 10x &= 5.\overline{5} \\ 10x - x &= 5.\overline{5} - 0.5 \\ 9x &= 5 \\ 9x &= \frac{5}{1} \\ x &= \frac{5}{9} \end{aligned}$$

The Sluggers won $\frac{5}{9}$ of their games.

Try It!

In another baseball division, one team had a winning percentage of 0.444... What fraction of their games did this team win?


The team won of their games.

Convince Me! How do you know what power of ten to multiply by in the second step at the right?

$$\begin{aligned} \text{Let } x &= 0.\overline{4} \\ \square \cdot x &= \square \cdot 0.4 \\ \square \cdot x &= \square \\ \square - x &= \square - 0.4 \\ \square \cdot x &= \square \\ x &= \square \end{aligned}$$

EXAMPLE 2 Write Repeating Decimals with Nonrepeating Digits as Fractions

Sabine entered a division expression into her calculator. The quotient is shown on the calculator screen. What expression could Sabine have entered?



Let $x = 0.2\overline{6}$.

$10x = 2.\overline{6}$ Multiply by 10^1 , or 10, because the decimal has 1 repeating digit.

$10x - x = 2.\overline{6} - 0.2\overline{6}$ Subtract $0.2\overline{6}$ from each side of the equation, and then solve for x . Because $x = 0.2\overline{6}$, you can subtract x from one side and $0.2\overline{6}$ from the other side.

$9x = 2.4$

$\frac{9x}{9} = \frac{2.4}{9}$ Write an equivalent fraction so that the numerator and denominator are integers.

$x = \frac{24}{90}$

Sabine could have entered $24 \div 90$, or an equivalent expression such as $8 \div 30$.

Try It!

Write the repeating decimal $0.63333\dots$ as a fraction.

EXAMPLE 3 Write Decimals with Multiple Repeating Digits as Fractions

Write $2.0\overline{9}$ as a mixed number.

Let $x = 2.0\overline{9}$.

$100 \cdot x = 100 \cdot 2.0\overline{9}$ The repeating decimal has 2 repeating digits, so multiply each side of the equation by 10^2 , or 100.

$100x - x = 209.\overline{09} - 2.0\overline{9}$ Subtract x from one side of the equation and its equivalent $2.0\overline{9}$ from the other side of the equation.

$99x = 207$

$x = \frac{207}{99}$ or $2\frac{1}{11}$

Use Structure How do you know that subtracting x from one side of the equation and subtracting $2.0\overline{9}$ from the other side results in an equivalent equation?

Try It!

Write the repeating decimal $4.1363636\dots$ as a fraction.

KEY CONCEPT ↪ can be written as a fraction

Because repeating decimals are rational numbers, you can write them in fraction form.

STEP 1 Assign a variable to represent the repeating decimal.

STEP 2 Write an equation: *variable = decimal*.

STEP 3 Multiply each side of the equation by 10^d , where d is the number of repeating digits in the repeating decimal.

STEP 4 Subtract equivalent expressions of the variable and the repeating decimal from each side of the equation.

STEP 5 Solve for the variable. Write an equivalent fraction so that the numerator and denominator are integers, if necessary.

Do You Understand?

1. **Essential Question** How can you write repeating decimals as fractions?
2. **Use Structure** Why do you multiply by a power of 10 when writing a repeating decimal as a rational number?
3. **Be Precise** How do you decide by which power of 10 to multiply an equation when writing a decimal with repeating digits as a fraction?

Do You Know How?

4. A survey reported that 63.63% of moviegoers prefer action films. This percent represents a repeating decimal. Write it as a fraction.
5. A student estimates the weight of astronauts on the Moon by multiplying their weight by the decimal $0.16666\dots$. What fraction can be used for the same estimation?
6. Write $2.3181818\dots$ as a mixed number.




Name: _____

Practice & Problem Solving

Leveled Practice In 7 and 8, write the decimal as a fraction or mixed number.

7. Write the number 0.21212121... as a fraction.
 Let $x =$
 $100x =$
 $100x - x =$ -
 $99x =$
 $x =$
 So 0.2121... is equal to .

8. Write $3.\overline{7}$ as a mixed number.
 Let $x =$
 $10x =$
 $9x =$
 $x =$
 So $3.\overline{7}$ is equal to .

9. Write the number shown on the scale as a fraction.


10. Tomas asked 15 students whether summer break should be longer. He used his calculator to divide the number of students who said yes by the total number of students. His calculator showed the result as 0.9333...
 a. Write this number as a fraction.
 b. How many students said that summer break should be longer?

11. Write 0.87 as a fraction.
see notes similar to #7

12. Write 0.8 as a fraction.
see notes similar to #8

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2-1 Rational Numbers as Decimals 89

11)

$$x = 0.\overline{87}$$

$$x = 0.878787\dots$$

subtract

$$100 \cdot x = (0.878787\dots) \cdot 100$$

$$100x = 87.878787\dots$$

$$-1x = -0.878787\dots$$

$$99x = 87.000000\dots$$

$$\frac{99x}{99} = \frac{87}{99}$$

$$x = \frac{87}{99}$$

12)

$$x = 0.\overline{8}$$

$$x = 0.888\dots$$

Subtract x

$$10 \cdot x = (0.888\dots) \cdot 10$$

$$10x = 8.888\dots$$

$$-1x = -0.888\dots$$

$$9x = 8.000\dots$$

$$9x = 8$$

$$\frac{9x}{9} = \frac{8}{9}$$

$$x = \frac{8}{9}$$

13. Write 1.48 as a mixed number.

$$1\frac{48}{100} \div 4 = 1\frac{12}{25}$$

14. Write $0.\overline{6}$ as a fraction.

15. A manufacturer determines that the cost of making a computer component is \$2.161616. Write the cost as a fraction and as a mixed number.

$$2\frac{16}{99}$$

$$\frac{214}{99}$$

$$x = 0.161616\dots$$

$$100x = (0.161616\dots) \cdot 100$$

$$100x = 16.161616\dots$$

$$-1x = -0.161616\dots$$

$$99x = 16.00000\dots$$

$$99x = 16$$

$$x = \frac{16}{99}$$

16. Reasoning When writing a repeating decimal as a fraction, does the number of repeating digits you use matter? Explain.

17. Higher Order Thinking When writing a repeating decimal as a fraction, why does the fraction always have only 9s or 9s and 0s as digits in the denominator?

Assessment Practice

18. Which decimal is equivalent to $\frac{188}{11}$?

- Ⓐ 17.09
- Ⓑ 17.009
- Ⓒ 17.1709
- Ⓓ 17.17090

19. Draw lines to connect each repeating decimal on the left with an equivalent fraction on the right.

0.17	$\frac{348}{990}$	$\frac{58}{165}$
0.351	$\frac{316}{900}$	$\frac{79}{225}$
0.17	$\frac{351}{999}$	$\frac{13}{37}$
0.351	$\frac{16}{90}$	$\frac{8}{45}$
0.351	$\frac{17}{99}$	

