

Simplifying Fractions

What You'll Learn

- To find equivalent fractions
- To write fractions in simplest form

... And Why

To solve real-world problems involving statistics

 Check Skills You'll Need

Find each GCF.

1. 14, 21 2. 48, 60

3. $5mn$, $15m^2n$

4. $63r^2$, $48s^3$


 **GO for Help**
Lesson 4-3

 **New Vocabulary**

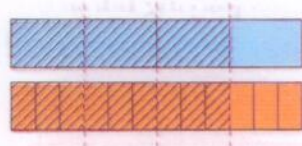
- equivalent fractions
- simplest form

Vocabulary Tip

Most fraction names are made by adding *th* or *ths* to the denominator. You read $\frac{1}{4}$ as "one fourth," $\frac{2}{5}$ as "two fifths," and $\frac{8}{10}$ as "eight tenths." Halves and thirds are two exceptions.

 **1 Finding Equivalent Fractions**

Each fraction model below represents one whole. The blue model is divided into four equal parts. The orange model is divided into twelve equal parts.




$\frac{3}{4}$ of the model is shaded.

$\frac{9}{12}$ of the model is shaded.

$$\frac{3}{4} = \frac{3 \cdot 3}{4 \cdot 3} = \frac{9}{12}$$

The fraction models show that $\frac{3}{4} = \frac{9}{12}$. The fractions $\frac{3}{4}$ and $\frac{9}{12}$ are **equivalent fractions** because they describe the same part of a whole.

You can find equivalent fractions by multiplying or dividing the numerator and denominator by the same nonzero factor.

 **1 EXAMPLE** Finding an Equivalent Fraction

Find two fractions equivalent to $\frac{4}{12}$.

$$\begin{aligned} \text{a. } \frac{4}{12} &= \frac{4 \cdot 3}{12 \cdot 3} \\ &= \frac{12}{36} \end{aligned}$$

$$\begin{aligned} \text{b. } \frac{4}{12} &= \frac{4 \div 4}{12 \div 4} \\ &= \frac{1}{3} \end{aligned}$$

The fractions $\frac{12}{36}$ and $\frac{1}{3}$ are both equivalent to $\frac{4}{12}$.


 **Quick Check**

1. Find two fractions equivalent to each fraction.

a. $\frac{5}{15}$

b. $\frac{10}{12}$

c. $\frac{14}{20}$

 **2 Writing Fractions in Simplest Form**

A fraction is in **simplest form** when the numerator and the denominator have no common factors other than 1. You can use the GCF to write a fraction in simplest form. In some situations, you may need to choose between simplest form and an equivalent fraction.

2 EXAMPLE Real-World Problem Solving

Statistics You survey your friends about their favorite sandwich and find that 8 out of 12, or $\frac{8}{12}$, prefer peanut butter. Write this fraction in simplest form. Which fraction best communicates the survey results? Why?

The GCF of 8 and 12 is 4.

$$\begin{aligned} \frac{8}{12} &= \frac{8 \div 4}{12 \div 4} && \text{Divide the numerator and denominator} \\ &= \frac{2}{3} && \text{by the GCF, 4.} \\ & && \text{Simplify.} \end{aligned}$$

The favorite sandwich of $\frac{2}{3}$ of your friends is peanut butter. The fraction $\frac{2}{3}$ best communicates the survey results because most people have a mental picture of $\frac{2}{3}$ but not of $\frac{8}{12}$.

Quick Check

2. Write each fraction in simplest form.

a. $\frac{6}{8}$ b. $\frac{9}{12}$ c. $\frac{28}{35}$

You can often simplify a fraction that contains a variable. In this book, you may assume that no expression for a denominator equals zero.

3 EXAMPLE Simplifying a Fraction

Write in simplest form.

a. $\frac{y}{xy}$

$$\begin{aligned} \frac{y}{xy} &= \frac{y^1}{xy^1} && \text{Divide the numerator and denominator} \\ &= \frac{1}{x} && \text{by the common factor, } y. \\ & && \text{Simplify.} \end{aligned}$$

b. $\frac{3ab^2}{12ac}$

$$\begin{aligned} \frac{3ab^2}{12ac} &= \frac{3 \cdot a \cdot b \cdot b}{2 \cdot 2 \cdot 3 \cdot a \cdot c} && \text{Write as a product of prime factors.} \\ &= \frac{3^1 \cdot a^1 \cdot b \cdot b}{2 \cdot 2 \cdot 1 \cdot 3 \cdot 1 \cdot a \cdot c} && \text{Divide the numerator and} \\ &= \frac{b \cdot b}{2 \cdot 2 \cdot c} && \text{denominator by the common factors.} \\ &= \frac{b \cdot b}{4 \cdot c} && \text{Simplify.} \\ &= \frac{b^2}{4c} \end{aligned}$$

Quick Check

3. Write in simplest form. a. $\frac{b}{abc}$ b. $\frac{2mn}{6m}$ c. $\frac{24x^2y}{8xy}$



Real-World Connection

The average American child will eat 1,500 peanut butter and jelly sandwiches by the time she or he graduates from high school.



Test-Taking Tip

You will see the directions *write in lowest terms* on some tests. This is another way of saying "write in simplest form."

EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice*.

Practice and Problem Solving

A Practice by Example

Example 1
(page 196)

Example 2
(page 197)



Example 3
(page 197)

B Apply Your Skills

GO for Help

For a guide to reading and solving Exercise 27, see page 200.

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C Challenge

PC and On-Line Households
in the U.S. (millions)

Households	2000	2001
Total households	105	109
Households with PCs	54	60
Households with Internet access	44	55

SOURCE: U.S. Census Bureau

Find two fractions equivalent to each fraction.

1. $\frac{2}{8}$ 2. $\frac{8}{10}$ 3. $\frac{3}{9}$ 4. $\frac{8}{36}$ 5. $\frac{6}{18}$ 6. $\frac{20}{22}$

Write each fraction in simplest form.

7. $\frac{3}{9}$ 8. $\frac{4}{10}$ 9. $\frac{12}{48}$ 10. $\frac{2}{10}$ 11. $\frac{4}{12}$ 12. $\frac{6}{15}$

13. **Health** Doctors suggest that most people need about 8 h of sleep each night to stay healthy. What fraction of the day is this? Write your answer in simplest form.

Write in simplest form.

14. $\frac{2x}{3x}$ 15. $\frac{4km^2}{12k}$ 16. $\frac{b}{bc}$ 17. $\frac{24x}{16}$
18. $\frac{8pr}{12p}$ 19. $\frac{14a^2}{24a}$ 20. $\frac{4bc}{16b}$ 21. $\frac{40ab^2}{5ab}$

Find two fractions equivalent to each fraction.

22. $\frac{4}{8}$ 23. $\frac{4}{10}$ 24. $\frac{5}{20}$ 25. $\frac{10}{16}$ 26. $\frac{25}{100}$

27. **Error Analysis** A student claims $\frac{65}{91}$ is in simplest form. Do you agree? Explain.

Write in simplest form.

28. $\frac{8}{14}$ 29. $\frac{18}{32}$ 30. $\frac{20}{30}$ 31. $\frac{12}{16}$ 32. $\frac{15^3}{15^2}$ 33. $\frac{56pq}{7pq}$
34. $\frac{5c^2d}{15c}$ 35. $\frac{4r^3st}{36st^2}$ 36. $\frac{5t}{10r^2}$ 37. $\frac{x^2y}{3yz}$ 38. $\frac{12gh}{8g^2h^2}$ 39. $\frac{6m^2n^2}{9mn^2}$

40. In a survey, 27 out of 45 students say that chocolate is their favorite flavor of frozen yogurt.

a. Write the fraction $\frac{27}{45}$ in simplest form.

b. **Reasoning** When might you want to use the fraction $\frac{27}{45}$?

41. **Open-Ended** Write two fractions whose simplest form is $\frac{3x}{5}$.

42. **Writing in Math** Does $\frac{1}{2}$ of one pizza represent the same amount as $\frac{1}{2}$ of another pizza? Justify your answer.

Data Analysis The table shows the number of personal computers (PCs) and households with Internet access in the United States. For Exercises 43–45, write each fraction in simplest form.

43. In 2000, what fraction of U.S. households had PCs?
44. In 2000, what fraction of U.S. households with PCs had Internet access? (Assume that a household with Internet access had a PC.)
45. a. In 2001, what fraction of U.S. households with PCs had Internet access? (*Hint*: See Exercise 44.)
b. Was the fraction greater in 2000 or 2001? Explain.