Please do these problems in your spiral

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

Find each product. Write in simplest form.

1. $\frac{7}{8}\cdot\frac{1}{2}$

$\frac{7\cdot1}{8\cdot2}=\frac{7}{16}$

$-\frac{9}{2}\left(-\frac{10}{9}\right)=\frac{\cancel{9}^{1}\cdot\cancel{10}^{5}}{\cancel{2}^{1}\cdot\cancel{9}_{1}}=\frac{5}{1}=5$

3. $-\frac{2}{3}\cdot\frac{3}{16}$

$\frac{\cancel{-2}^{-1}\cdot\cancel{3}^{1}}{\cancel{3}^{1}\cdot16_{8}}=-\frac{1}{8}$

5. $-4\frac{1}{2}\left(-1\frac{1}{9}\right)$

Evaluate each expression if $x=\frac{14}{15}$, $y=-1\frac{2}{5}$, and $z=-\frac{3}{7}$. Write the product in simplest form.

$-\frac{7}{5}$

7. xy

$\frac{14}{15}\left(-\frac{7}{5}\right)=-\frac{98}{75}$

$-1\frac{23}{75}$

9. xz

$\frac{14}{15}\left(-\frac{3}{7}\right)$

$\frac{\cancel{14}^{2}\cdot\cancel{-3}^{-1}}{\cancel{15}^{5}\cdot\cancel{7}_{1}}=-\frac{2}{5}$

11. $4y$

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

$4\left(-\frac{7}{5}\right)$

$-\frac{28}{5}=-5\frac{3}{5}$

Please do these problems in your spiral

Find each product. Write in simplest form.

2. $\frac{1}{3} \cdot \frac{2}{5}$

4. $-\frac{3}{5}\left(-\frac{10}{21}\right)$

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

Evaluate each expression if $x = \frac{14}{15}$, $y = -1\frac{2}{5}$, and $z = -\frac{3}{7}$. Write the product in simplest form.

8. $z \cdot z$

10. $\frac{3}{4}xz$

12. $\frac{7}{3}z$

Lesson 3-3
Multiplying Rational Numbers

Interactive Study Guide

See pages 55–56 for:
- Getting Started
- Real-World Link
- Notes

Essential Question

What happens when you add, subtract, multiply, and divide rational numbers?

Common Core State Standards

Content Standards
7.NS.2, 7.NS.2a, 7.NS.2c, 7.NS.3, 7.EE.3

Mathematical Practices
1, 3, 4, 5

What You'll Learn

- Multiply positive and negative fractions.
- Evaluate algebraic expressions with fractions.

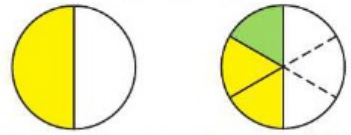
Real-World Link

Ice Cream A survey was taken to find the most popular ice cream flavors in the United States. Some of the top ten flavors contain chocolate, some contain fruit, and some contain both! You can use rational numbers to analyze the results of the survey.

Key Concept: Multiply Fractions

Words	To multiply fractions, multiply the numerators and multiply the denominators.
Symbols	$\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$, where $b, d \neq 0$
Example	$\frac{3}{4} \cdot \frac{1}{2} = \frac{3 \cdot 1}{4 \cdot 2}$ or $\frac{3}{8}$

The green area in the area model below shows the product of $\frac{1}{3}$ and $\frac{1}{2}$. One sixth of the second circle is shaded green. So, $\frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$.



Draw a circle and shade $\frac{1}{2}$ of it yellow.

Then shade $\frac{1}{3}$ of the yellow part green.

Example 1

Find $\frac{1}{6} \cdot \frac{2}{3}$. Write the product in simplest form.

$\frac{1}{6} \cdot \frac{2}{3} = \frac{1 \cdot 2}{6 \cdot 3}$ ◄··· Multiply the numerators. ◄··· Multiply the denominators.

$= \frac{2}{18}$ or $\frac{1}{9}$ Simplify. The GCF of 2 and 18 is 2.

Got It? Do these problems to find out.

Find each product. Write in simplest form.

1a. $\frac{1}{2} \cdot \frac{4}{10}$ **1b.** $\frac{5}{12} \cdot \frac{6}{10}$ **1c.** $\frac{3}{4} \cdot \frac{8}{21}$

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If the fractions have common factors in the numerators and denominators, you can simplify before you multiply.

Negative Signs
When working with negative fractions, assign the negative sign to the numerator.
Example: Write $-\frac{7}{9}$ as $\frac{-7}{9}$.

Example 2

Tutor

Find each product. Write in simplest form.

a. $\frac{3}{4}\left(-\frac{7}{9}\right)$

$\frac{3}{4}\left(-\frac{7}{9}\right) = \frac{\overset{1}{\cancel{3}}}{4}\left(\frac{-7}{\underset{3}{\cancel{9}}}\right)$ Divide 3 and 9 by their GCF, 3.

$= \frac{1 \cdot -7}{4 \cdot 3}$ Multiply the numerators and multiply the denominators.

$= -\frac{7}{12}$ Simplify.

b. $2\frac{1}{3} \cdot 2\frac{5}{7}$

Estimate $2 \cdot 3 = 6$

$2\frac{1}{3} \cdot 2\frac{5}{7} = \frac{7}{3} \cdot \frac{19}{7}$ Rename $2\frac{1}{3}$ as $\frac{7}{3}$ and $2\frac{5}{7}$ as $\frac{19}{7}$.

$= \frac{\overset{1}{\cancel{7}}}{3} \cdot \frac{19}{\underset{1}{\cancel{7}}}$ Divide by the GCF, 7.

$= \frac{1 \cdot 19}{3 \cdot 1}$ Multiply.

$= \frac{19}{3}$ or $6\frac{1}{3}$ Simplify.

Check for Reasonableness The solution is close to the estimate. ✓

Got It? **Do these problems to find out.**

2a. $-\frac{9}{12} \cdot -\frac{2}{3}$ **2b.** $\frac{6}{9} \cdot -\frac{3}{11}$ **2c.** $3\frac{3}{8} \cdot 2\frac{1}{3}$

Evaluate Expressions with Fractions

Variables can represent fractions in algebraic expressions.

Example 3

Tutor

Evaluate $\frac{1}{2}ab$ if $a = \frac{6}{7}$ and $b = -\frac{4}{9}$. Write in simplest form.

$\frac{1}{2}ab = \frac{1}{2}\left(\frac{6}{7}\right)\left(-\frac{4}{9}\right)$ Replace a with $\frac{6}{7}$ and b with $-\frac{4}{9}$.

$= \frac{1}{\underset{1}{\cancel{2}}}\left(\frac{\overset{2}{\cancel{6}}}{7}\right)\left(-\frac{\overset{2}{\cancel{4}}}{\underset{3}{\cancel{9}}}\right)$ The GCF of 6 and 9 is 3. The GCF of 2 and 4 is 2.

$= -\frac{4}{21}$ Simplify.

Got It? **Do these problems to find out.**

Evaluate each expression if $x = \frac{3}{8}$, $y = -2\frac{2}{9}$, and $z = -\frac{7}{10}$. Write in simplest form.

3a. xy **3b.** $5x$ **3c.** yz

Example 4

The first hill on a certain roller coaster is 255 feet tall. The first drop on another roller coaster is about $\frac{11}{20}$ as tall as the first coaster. Find the height of the hill on the second roller coaster.

To find the height of the hill on the second roller coaster, multiply $\frac{11}{20}$ by 255.

$\frac{11}{20} \cdot 255 = \frac{11}{20} \cdot \frac{255}{1}$ Rename 255 as $\frac{255}{1}$.

$= \frac{11}{\cancel{20}_{4}} \cdot \frac{\overset{51}{\cancel{255}}}{1}$ Divide by the GCF, 5.

$= \frac{11 \cdot 51}{4 \cdot 1}$ Multiply.

$= \frac{561}{4}$ or $140\frac{1}{4}$ Simplify.

So, the height of the drop is about 140 feet.

Got It? Do these problems to find out.

4a. The Willis Tower in Chicago is about 1450 feet tall. The Empire State Building in New York City is about $\frac{4}{5}$ as tall. About how tall is the Empire State Building?

4b. The longest suspension bridge in the United States is the 4260-foot Verrazano-Narrows Bridge in New York City. The Tacoma Narrows Bridge in Tacoma, Washington, is about $\frac{11}{12}$ of that length. About how long is the Tacoma Narrows Bridge?

Guided Practice

Find each product. Write in simplest form. (Examples 1 and 2)

1. $\frac{7}{8} \cdot \frac{1}{2}$
2. $\frac{1}{3} \cdot \frac{2}{5}$
3. $-\frac{2}{3} \cdot \frac{3}{16}$
4. $-\frac{3}{5}\left(-\frac{10}{21}\right)$
5. $-4\frac{1}{2}\left(-1\frac{1}{9}\right)$
6. $-2\frac{1}{2} \cdot 5\frac{2}{3}$

Evaluate each expression if $x = \frac{14}{15}$, $y = -1\frac{2}{5}$, and $z = -\frac{3}{7}$. Write the product in simplest form. (Example 3)

7. xy
8. $z \cdot z$
9. xz
10. $\frac{3}{4}xz$
11. $4y$
12. $\frac{7}{3}z$

13. "Midway" is the name of 252 towns in the United States. "Pleasant Hill" occurs $\frac{5}{9}$ as many times. How many towns named "Pleasant Hill" are there in the United States? (Example 4)

14. Of the 480 students at Pleasantview Middle School, $\frac{13}{20}$ play a school sport. How many students play a sport? (Example 4)

Independent Practice

Go online for Step-by-Step Solutions — eHelp

Find each product. Write in simplest form. (Examples 1 and 2)

15. $\frac{3}{4} \cdot \frac{1}{8}$
16. $\frac{3}{7} \cdot \frac{1}{6}$
17. $\frac{2}{3} \cdot \frac{4}{9}$
18. $\frac{1}{12} \cdot \frac{3}{8}$
19. $\frac{5}{10} \cdot \frac{2}{9}$
20. $\frac{4}{5} \cdot \frac{5}{8}$
21. $-\frac{1}{15}\left(-\frac{10}{13}\right)$
22. $-\frac{6}{10}\left(-\frac{1}{8}\right)$
23. $3\frac{1}{3}\left(-\frac{1}{5}\right)$
24. $\frac{12}{45}\left(-\frac{9}{16}\right)$
25. $-1\frac{1}{2} \cdot \frac{2}{3}$
26. $4\frac{3}{8}\left(-3\frac{3}{7}\right)$

Evaluate each expression if $a = \frac{10}{24}$, $b = -3\frac{1}{8}$, and $c = -\frac{4}{5}$. Write the product in simplest form. (Example 3)

27. bc
28. ab
29. $2c$
30. $\frac{2}{3}abc$
31. $-4bc$
32. $-\frac{19}{5}ac$

33. The average person living in Argentina consumes about 145 pounds of beef per year. The average person living in the United States consumes about $\frac{3}{5}$ as much. How many pounds of beef does the average American consume every year? (Example 4)

34. The Golden Gate Bridge in San Francisco is 4200 feet long. The Brooklyn Bridge in New York City is $\frac{19}{50}$ as long. How long is the Brooklyn Bridge? (Example 4)

Find each product. Write in simplest form.

35. $\frac{3}{5} \cdot \frac{10}{28} \cdot \frac{2}{9}$ $\frac{3 \cdot 10 \cdot 2}{5 \cdot 28 \cdot 9} = \frac{1}{21}$
36. $\frac{2}{3} \cdot \frac{1}{4} \cdot \frac{6}{13}$
37. $3\frac{1}{2} \cdot \left(-1\frac{1}{14}\right) \cdot \frac{4}{5}$
38. $4\frac{1}{5} \cdot \left(-1\frac{3}{7}\right) \cdot \frac{6}{11}$
39. $-\frac{6}{11} \cdot (-4) \cdot -2\frac{3}{4} \cdot \frac{1}{3}$
40. $\left(-\frac{9}{10}\right) \cdot 7 \cdot 2\frac{1}{3} \cdot \frac{1}{21}$

41. Dexter's lawn is $\frac{2}{3}$ of an acre. If $7\frac{1}{2}$ bags of fertilizer are needed for 1 acre, how much will he need to fertilize his lawn?

42. A certain hybrid car can travel $1\frac{4}{11}$ times as far as a similar nonhybrid car can, each on one gallon of gasoline. If the nonhybrid car can travel 33 miles per gallon of gasoline, how far can the hybrid travel on $\frac{4}{5}$ gallon of gasoline?

Complete each conversion.

43. ■ ounces $= \frac{3}{4}$ pound
(*Hint*: 1 pound = 16 ounces)
44. ■ feet $= \frac{2}{3}$ mile
(*Hint*: 1 mile = 5280 feet)
45. $\frac{5}{6}$ foot = ■ inches
46. $\frac{1}{4}$ minute = ■ seconds
47. ■ cups $= \frac{1}{4}$ gallon
(*Hint*: 1 gallon = 16 cups)
48. $\frac{3}{4}$ year = ■ weeks

49. Use a cookbook or the Internet to find a recipe for guacamole. Change the recipe to make $2\frac{1}{4}$ times the original amount.

50. The table shows the statistics from the last election for eighth grade class president. There are 540 students in the eighth grade.

Class Elections	
Fraction of class that voted	$\frac{3}{4}$
Fraction of votes for Hector	$\frac{3}{5}$
Fraction of votes for Nora	$\frac{1}{3}$

a. How many students voted for Hector?

b. How many students voted for Nora?

c. Were there other candidates for class president? How do you know? Explain your reasoning. If there were other candidates, what fraction of the student body voted for them?

51 CCSS **Use Math Tools** The expression $\frac{1}{2} \times 4$ means $\frac{1}{2}$ of 4. The number line shows that the product of $\frac{1}{2}$ and 4 is 2.

Find each product using a number line.

a. $\frac{2}{3}$ of 6 **b.** $\frac{3}{4}$ of 8 **c.** $\frac{1}{2}$ of $\frac{2}{3}$

d. $\frac{1}{2}$ of 2 **e.** $\frac{2}{3}$ of $\frac{3}{2}$ **f.** $\frac{3}{7}$ of $\frac{7}{3}$

g. Look back at the solutions for Exercises d–f. What pattern do you notice?

h. What is the product of $\frac{a}{b} \cdot \frac{b}{a}$ where $a, b \neq 0$?

$-\frac{3}{4}\left(-\frac{4}{3}\right) = \frac{12}{12} = 1$

$\frac{5}{8} \div \left(-\frac{3}{4}\right) = -\frac{a}{b}$

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

H.O.T. Problems Higher Order Thinking

52. CCSS **Justify Conclusions** Find two rational numbers greater than $\frac{1}{3}$ whose product is less than $\frac{1}{3}$. Explain your reasoning to a classmate.

$a \cdot 3 = 15$

$15 \div 3 = a$

53. CCSS **Find the Error** Kelly is finding $-4\frac{1}{6} \cdot 2\frac{2}{9}$. Find her mistake and correct it.

$-4\frac{1}{6} \cdot 2\frac{2}{9} = -4\frac{1}{6} \cdot 2\frac{2}{9}$

$= -8\frac{1}{27}$

55. $-\frac{20}{24} \cdot \left(-\frac{3}{4}\right) = \frac{60}{96} \div \frac{12}{12} = \frac{5}{8}$

$-\frac{4}{3}\left(\frac{5}{8}\right) = -\frac{20}{24} = -\frac{5}{6}$

CCSS **Persevere with Problems** **Find each missing fraction.**

54. $\frac{2}{3} \cdot \frac{x}{y} = -\frac{3}{8}$ **55.** $\frac{a}{b} \cdot \left(-\frac{3}{4}\right) = \frac{5}{8}$ **56.** $\frac{8}{9} \cdot \frac{m}{n} = \frac{14}{27}$

57. $-\frac{9}{10} \cdot \frac{c}{d} = -\frac{3}{5}$ **58.** $\frac{r}{s} \cdot \frac{4}{5} = \frac{1}{10}$ **59.** $\frac{1}{3} \cdot \frac{x}{y} = -\frac{1}{5}$

60. CCSS **Make a Conjecture** Investigate the product of a fraction between 0 and 1 and a whole number or mixed number. Is the product *always*, *sometimes*, or *never* less than the whole number or mixed number? Explain.

61. **Building on the Essential Question** Estimate $3\frac{3}{5} \cdot 4\frac{2}{3}$. Then find the actual product. Explain why the estimate and the product are different. What could you do to make your estimate closer to the actual product?

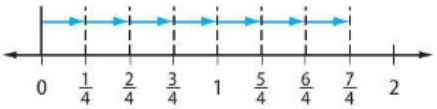
Standardized Test Practice

62. Of the students in Mr. Bogg's class, $\frac{3}{5}$ participate in an after-school sport. Of these, $\frac{1}{3}$ participate in track and field. What fraction of the students participates in track and field?

A $\frac{1}{5}$ **C** $\frac{3}{5}$

B $\frac{1}{3}$ **D** $\frac{14}{15}$

63. Which statement is shown on the number line below?



F $\frac{1}{4} + 7 = \frac{7}{4}$ **H** $\frac{7}{4} \cdot 7 = \frac{1}{4}$

G $\frac{1}{4} \cdot 7 = \frac{7}{4}$ **J** $\frac{7}{4} + 7 = \frac{1}{4}$

64. What is the value of the expression $2ab$ if $a = \frac{5}{7}$ and $b = -\frac{3}{8}$?

A $-2\frac{15}{56}$

B $-\frac{15}{28}$

C $\frac{15}{28}$

D $2\frac{15}{56}$

65. Short Response The length of one side of a square garden tile is $1\frac{2}{3}$ feet. Write mixed numbers to represent the perimeter and the area of the tile.

Common Core Review

Write each decimal as a fraction or mixed number in simplest form. 8.NS.1

66. 4.02 **67.** 0.215 **68.** −5.125

69. $-0.\overline{3}$ **70.** $4.\overline{5}$ **71.** $-2.\overline{05}$

Replace each ● with <, >, or = to make a true statement. 6.NS.7

72. 0.3 ● $\frac{1}{4}$ **73.** $\frac{5}{8}$ ● 0.65 **74.** $\frac{2}{5}$ ● 0.4

75. $\frac{7}{8}$ ● $\frac{8}{9}$ **76.** $\frac{1}{5}$ ● $0.\overline{5}$ **77.** $3\frac{4}{9}$ ● $3.\overline{4}$

78. In an online survey, about $\frac{1}{4}$ of teenagers go to sleep between 9 and 10 P.M., while $\frac{13}{50}$ of teenagers go to sleep at 12 A.M. or later. Which group is larger? 6.NS.7

Find each product. 7.NS.2

79. 14(−5) **80.** −8(−11) **81.** −7(−8)(−3) **82.** 2(−8)(−9)(10)

83. −50(−5) **84.** (12)(−2)(8) **85.** (−1)(16)(−2) **86.** 14(−2)(−3)

Find the greatest common factor for each set of numbers. 6.NS.4

87. 12, 20 **88.** 32, 14 **89.** 64, 48

90. 35, 9 **91.** 4, 8, 10 **92.** 18, 30, 42

93. 21, 45, 51 **94.** 24, 40, 64 **95.** 42, 63, 84

ISG Interactive Study Guide
See page 57 for:
• Mid-Chapter Check

MULTIPLICATION AND DIVISION ARE INVERSE OPERATIONS

$5 \times 3 = 15$

$15 \div 5 = 3$ OR $15 \div 3 = 5$

$$\frac{a}{b} \cdot \left(-\frac{3}{4}\right) = \frac{5}{8}$$

$$\frac{5}{8} \div \left(-\frac{3}{4}\right) = \frac{a}{b}$$

$$\frac{5}{8} \cdot \left(-\frac{4}{3}\right) = -\frac{20}{24} = -\frac{5}{6}$$

INVERT

$$\frac{2}{3} \cdot \frac{3}{2} = 1$$

$$-\frac{3}{4}\left(-\frac{4}{3}\right) = \frac{12}{12} = 1$$