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Chapter 4 Lesson 3

MULTIPLY & DIVIDE MIXED NUMBERS & COMPLEX FRACTIONS

Lesson Objectives:

- Multiply and divide mixed numbers
- Translate phrases to expressions with fractions
- Simplify complex fractions
- Simplify expressions written with a fraction bar

Multiply & Divide Mixed Numbers notes

Multiply & Divide Mixed Numbers

In the last section we talked about how to multiply and divide fractions. In this section, we will learn how to multiply and divide mixed numbers.

Lucky for us, it's super easy and almost the same as multiplying and dividing regular fractions. The only difference is that first you must convert your mixed numbers to improper fractions.

HOW TO MULTPLY OR DIVIDE MIXED NUMBERS
Step 1: Convert the mixed numbers to improper fractions.
Step 2: Follow the rules for fraction multiplication or division.
Step 3: Simplify if possible.

Example Problems

$2\frac{4}{5}\left(1\frac{7}{8}\right)$	$3\frac{4}{7} \div 5$	$2\frac{1}{2} \div 1\frac{1}{4}$

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Multiply & Divide Mixed Numbers *your turn*

Multiply or divide and write your answer in simplified form.

$5\frac{4}{5}\left(-2\frac{3}{8}\right)$	$-4\frac{4}{5}\left(4\frac{1}{6}\right)$
$4\frac{3}{8} \div 6$	$2\frac{3}{8} \div 4$
$3\frac{2}{3} \div 1\frac{1}{3}$	$4\frac{3}{4} \div 1\frac{1}{2}$

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Translate Phrases to Expressions with Fractions notes

Translate Phrases to Expressions with Fractions

There are two words that are often used to describe fractions: *ratio* and *quotient*. A quotient is the result of division, and we say "the quotient of a and b is the result you get from dividing a by b, or $\frac{a}{b}$.

Let's practice translating some phrases into algebraic expressions using these terms.

Example Problems

Translate each phrase into an algebraic expression.	
The quotient of 4x and 8	The quotient of the sum of a and b, and c.
Your Turn	
The quotient of 10s and 15	The quotient of 5h and 8
The quotient of the difference of x and y, and zw.	The quotient of the difference of a and b, and c.

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Simplify Complex Fractions notes

Simplify Complex Fractions

We've talked about proper fractions, improper fractions, and mixed numbers. There's one more type of fraction we will talk about: complex fractions!

A complex fraction is a fraction in which the numerator or the denominator contain a fraction.

Here are some examples: $\frac{\frac{6}{7}}{3}$ $\frac{\frac{3}{4}}{\frac{5}{8}}$

They look scary, but they are rather easy to solve! Just remember that the fraction bar means division. That means that $\frac{\frac{3}{4}}{\frac{5}{8}} = \frac{3}{4} \div \frac{5}{8}$, and you already know how to solve those!

Example Problems

Simplify.	
$\frac{\frac{3}{4}}{\frac{5}{8}}$	$-\frac{\frac{6}{7}}{3}$
$\frac{\frac{x}{2}}{\frac{xy}{4}}$	$\frac{2\frac{3}{4}}{\frac{1}{8}}$

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Simplify a Complex Fraction *your turn*

Multiply or divide and write your answer in simplified form.

$\dfrac{\frac{2}{5}}{\frac{6}{5}}$

$\dfrac{\frac{3}{7}}{\frac{5}{11}}$

$-\dfrac{\frac{7}{8}}{4}$

$-\dfrac{3}{\frac{9}{10}}$

$\dfrac{\frac{a}{10}}{\frac{ab}{5}}$

$\dfrac{\frac{x}{2}}{\frac{xy}{10}}$

$\dfrac{\frac{5}{8}}{1\frac{2}{3}}$

$\dfrac{\frac{8}{5}}{3\frac{2}{5}}$

Simplify Expressions with a Fraction Bar notes

Where Does the Negative Go?

One thing that often comes up when talking about fractions is the negative. Where does it go? What if there is more than one negative?

Remember that fractions represent division. The fraction $-\frac{6}{7}$ could be the result of dividing $\frac{-6}{7}$ or $\frac{6}{-7}$. When the numerator and denominator have different signs, the quotient (entire fraction) is negative because fractions are division! If the numerator AND the

denominator have the same sign, then the fraction itself is positive because you are

essentially dividing a negative by a negative.

Pretty cool, right?

$$\frac{-1}{4} = -\frac{1}{4} \qquad \frac{1}{-4} = -\frac{1}{4} \qquad \frac{-1}{-4} = \frac{1}{4}$$

Expressions with a Fraction Bar

When simplifying expressions with a fraction bar, the fraction bars act as grouping symbols. Imagine that everything in the numerator is in parentheses and everything in the denominator is in parentheses, and simplify the numerator, then simplify the denominator.

$\frac{4+8}{5-3}$ is the same as $(4+8) \div (5-3)$.

Let's try some!

Example Problems

Simplify.	
$\frac{4 - 2(3)}{2^2 + 2}$	$\frac{(8-4)^2}{8^2 - 4^2}$

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Simplify Expressions with a Fraction Bar *your turn*

Simplify.

$\frac{4+6}{11-3}$

$\frac{6-3(5)}{3^2-3}$

$\frac{(11-6)^2}{11^2-7^2}$

$\frac{(6-2)^2}{6^2-2^2}$

EXAMPLE:

$\frac{[4(-3)+6(-2)]}{3(2)-2}$

$\frac{-8(2)+4(-3)}{2(-5)-(-3)}$

$\frac{-7(1)-(-9)(-3)}{3(-5)-2}$

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Multiply & Divide Mixed Numbers & Complex Fractions Practice

Simplify.

1. $4\frac{5}{8} \cdot \frac{4}{15}$

2. $\frac{15}{22} \cdot 3\frac{4}{5}$

3. $5\frac{1}{3} \div 8$

4. $-12 \div \left(-3\frac{3}{11}\right)$

5. $-9\frac{3}{5} \div 1\frac{2}{5}$

6. $-18\frac{3}{4} \div 3\frac{3}{4}$

Multiply & Divide Mixed Numbers & Complex Fractions Practice

Translate each phrase into an algebraic expression.

7. The quotient of 6x and 11

8. The quotient of r and the sum of b and 9

Simplify.

8. $\frac{\frac{2}{3}}{\frac{4}{9}}$

9. $\frac{\frac{8}{12}}{\frac{-12}{35}}$

10. $\frac{\frac{4}{5}}{\frac{1}{8}}$

11. $\frac{\frac{m}{6}}{\frac{x}{3}}$

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Multiply & Divide Mixed Numbers & Complex Fractions Practice

Simplify.

12. $\frac{4 + 11}{8}$

13. $\frac{22 + 8}{10}$

14. $\frac{15 - (-9)}{18 + 12}$

15. $\frac{6 \cdot 2}{4 \cdot 8}$

16. $\frac{12 \cdot 9 - 3^2}{6 \cdot 9}$

17. $\frac{9(8 - 2) - 3(15 - 7)}{6(4 + 2) - 3(17 - 9)}$

Answer Key

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Multiply & Divide Mixed Numbers notes

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Step 1: Convert the mixed numbers to improper fractions.
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Step 3: Simplify if possible.

Example Problems

$2\frac{4}{5}\left(1\frac{7}{8}\right)$

$\frac{\cancel{7}^{1}}{\cancel{14}^{2}/\cancel{5}_{1}} \cdot \frac{3}{\cancel{15}^{5}/\cancel{8}_{4}}$

$\frac{21}{4} = 5\frac{1}{4}$

$3\frac{4}{7} \div 5$

$\frac{25}{7} \div 5$

$\frac{\cancel{25}^{5}}{7} \cdot \frac{1}{\cancel{5}_{1}} = \frac{5}{7}$

$2\frac{1}{2} \div 1\frac{1}{4}$

$\frac{5}{2} \div \frac{5}{4}$

$\frac{\cancel{5}^{1}}{\cancel{2}_{1}} \cdot \frac{\cancel{4}^{2}}{\cancel{5}_{1}} = 2$

 Name: Answer Key Date: _____ Period: _____

Multiply & Divide Mixed Numbers your turn

Multiply or divide and write your answer in simplified form.

$5\frac{4}{5}\left(-2\frac{3}{8}\right)$

$\frac{29}{5} \cdot -\frac{19}{8} = -\frac{551}{40}$

$-4\frac{4}{5}\left(4\frac{1}{6}\right)$

$-\frac{24}{5} \cdot \frac{25}{6} = -20$

$4\frac{3}{8} \div 6$

$\frac{27}{8} \cdot \frac{1}{6} = \frac{9}{16}$

$2\frac{3}{8} \div 4$

$\frac{19}{8} \cdot \frac{1}{4}$

$\frac{19}{32}$

$3\frac{2}{3} \div 1\frac{1}{3}$

$\frac{11}{3} \div \frac{4}{3}$

$\frac{11}{3} \cdot \frac{3}{4} = \frac{11}{4}$

$4\frac{3}{4} \div 1\frac{1}{2}$

$\frac{19}{4} \div \frac{3}{2}$

$\frac{19}{4} \cdot \frac{2}{3} = \frac{19}{6}$

 Name: Answer Key Date: _____ Period: _____

Translate Phrases to Expressions with Fractions notes

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Let's practice translating some phrases into algebraic expressions using these terms.

Example Problems

Translate each phrase into an algebraic expression.

The quotient of 4x and 8 $\frac{4x}{8} = \frac{x}{2}$	The quotient of the sum of a, b, and c. $\frac{a+b}{c}$
your turn	
The quotient of 10s and 15 $\frac{10s}{15} = \frac{2}{3}s$	The quotient of 5h and 8 $\frac{5h}{8}$
The quotient of the difference of x, y, and zw. $\frac{x-y}{zw}$	The quotient of the difference of a, b, and c. $\frac{a-b}{c}$

 Name: Answer Key Date: _____ Period: _____

Simplify Complex Fractions notes

Simplify Complex Fractions

We've talked about proper fractions, improper fractions, and mixed numbers. There's one more type of fraction we will talk about: complex fractions!

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They look scary, but they are rather easy to solve! Just remember that the fraction bar means division. That means that $\frac{\frac{3}{4}}{\frac{5}{8}} = \frac{3}{4} \div \frac{5}{8}$, and you already know how to solve those!

Example Problems

Simplify.

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

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

$\frac{3}{\cancel{4}_1} \cdot \frac{\cancel{8}^2}{5}$

$\frac{6}{5}$

$-\frac{\frac{6}{7}}{3}$

$-\frac{6}{7} \div 3$

$-\frac{\cancel{6}^2}{7} \cdot \frac{1}{\cancel{3}_1} = -\frac{2}{7}$

$\frac{\frac{x}{2}}{\frac{xy}{4}}$

$\frac{x}{2} \div \frac{xy}{4}$

$\frac{x}{\cancel{2}} \cdot \frac{\cancel{4}^2}{xy} = \frac{2}{y}$

$2\frac{\frac{3}{4}}{\frac{1}{8}}$

$\frac{11}{4} \div \frac{1}{8}$

$\frac{11}{\cancel{4}_1} \cdot \frac{\cancel{8}^2}{1} = 22$

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Simplify a Complex Fraction your turn

Multiply or divide and write your answer in simplified form.

$\frac{\frac{2}{5}}{\frac{6}{5}}$

$\frac{2}{5} \div \frac{6}{5}$

$\frac{2}{5} \cdot \frac{5}{6} = \frac{1}{3}$

$\frac{\frac{3}{7}}{\frac{5}{11}}$

$\frac{3}{7} \div \frac{5}{11}$

$\frac{3}{7} \cdot \frac{11}{5}$

$\frac{33}{35}$

$-\frac{\frac{7}{8}}{4}$

$\frac{7}{8} \div -4$

$\frac{7}{8} \cdot \frac{1}{-4} = -\frac{7}{32}$

$-\frac{\frac{3}{9}}{10}$

$\frac{-3}{9} \div \frac{10}{1}$

$\frac{-3}{9} \cdot \frac{1}{10} = \frac{-3}{90} = -\frac{1}{30}$

$\frac{\frac{a}{10}}{\frac{ab}{5}}$

$\frac{a}{10} \div \frac{ab}{5}$

$\frac{a}{10} \cdot \frac{5}{ab} = \frac{1}{26}$

$\frac{\frac{x}{2}}{\frac{xy}{10}}$

$\frac{x}{2} \div \frac{xy}{10}$

$\frac{x}{2} \cdot \frac{10}{xy} = \frac{5}{y}$

$\frac{\frac{5}{8}}{1\frac{2}{3}}$

$\frac{5}{8} \div \frac{5}{3}$

$\frac{5}{8} \cdot \frac{3}{5} = \frac{3}{8}$

$\frac{\frac{8}{5}}{3\frac{2}{5}}$

$\frac{8}{5} \div \frac{17}{5}$

$\frac{8}{5} \cdot \frac{5}{17} = \frac{8}{17}$

 Name: Answer Key Date: _____ Period: _____

Simplify Expressions with a Fraction Bar notes

Where Does the Negative Go?

One thing that often comes up when talking about fractions is the negative. Where does it go? What if there is more than one negative?

Remember that fractions represent division. The fraction $-\frac{6}{7}$ could be the result of dividing $\frac{-6}{7}$ or $\frac{6}{-7}$. When the numerator and denominator have different signs, the quotient (entire fraction) is negative because fractions are division! If the numerator AND the

denominator have the same sign, then the fraction itself is positive because you are

essentially dividing a negative by a negative.

Pretty cool, right?

$$\frac{-1}{4} = -\frac{1}{4} \qquad \frac{1}{-4} = -\frac{1}{4} \qquad \frac{-1}{-4} = \frac{1}{4}$$

Expressions with a Fraction Bar

When simplifying expressions with a fraction bar, the fraction bars act as grouping symbols. Imagine that everything in the numerator is in parentheses and everything in the denominator is in parentheses, and simplify the numerator, then simplify the denominator.

$\frac{4+8}{5-3}$ is the same as $(4+8) \div (5-3)$.

Let's try some!

Example Problems

Simplify.

$\frac{4-2(3)}{2^2+2}$ $\frac{4-6}{4+2} = \frac{-2}{6} = \left(\frac{-1}{3}\right)$

$\frac{(8-4)^2}{8^2-4^2}$ $\frac{4^2}{64-16}$ $\frac{16}{48} = \left(\frac{1}{3}\right)$

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Simplify Expressions with a Fraction Bar your turn

Simplify.

$\frac{4+6}{11-3}$

$\frac{10}{8} = \frac{5}{4}$

$\frac{6-3(5)}{3^2-3}$

$\frac{6-15}{9-3} = \frac{-9}{6} = -\frac{3}{2}$

$\frac{(11-6)^2}{11^2-7^2}$ $\frac{5^2}{121-49}$

$\frac{25}{72}$

$\frac{(6-2)^2}{6^2-2^2}$

$\frac{4^2}{36-4} = \frac{16}{32} = \frac{1}{2}$

EXAMPLE:

$\frac{[4(-3)+6(-2)]}{3(2)-2}$ $\frac{-12+(-12)}{6-2}$

$\frac{-24}{4} = -6$

$\frac{-8(2)+4(-3)}{2(-5)-(-3)}$

$\frac{-16-12}{-10+3} = \frac{-28}{-7} = 4$

$\frac{-7(1)-(-9)(-3)}{3(-5)-2}$

$\frac{-7-27}{-15-2} = \frac{-34}{-17} = 2$

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Multiply & Divide Mixed Numbers & Complex Fractions Practice

Simplify.

1. $4\frac{5}{8} \cdot \frac{4}{15}$

$\frac{37}{8} \cdot \frac{4}{15}$

$\frac{37}{30}$

2. $\frac{15}{22} \cdot 3\frac{4}{5}$

$\frac{15}{22} \cdot \frac{19}{5} = \frac{57}{22}$

3. $5\frac{1}{3} \div 8$

$\frac{16}{3} \cdot \frac{1}{8}$

$\frac{2}{3}$

4. $-12 \div \left(-3\frac{3}{11}\right)$

$-12 \div \frac{-36}{11}$

$12 \cdot \frac{11}{36} = \frac{11}{3}$

5. $-9\frac{3}{5} \div 1\frac{2}{5}$

$-\frac{48}{5} \div \frac{7}{5} = -\frac{48}{5} \cdot \frac{5}{7}$

$-\frac{48}{7}$

6. $-18\frac{3}{4} \div 3\frac{3}{4}$

$-\frac{75}{4} \div \frac{15}{4}$

$-\frac{75}{4} \cdot \frac{4}{15}$

-5

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Multiply & Divide Mixed Numbers & Complex Fractions Practice

Translate each phrase into an algebraic expression.

7. The quotient of 6x and 11

$\frac{6x}{11}$

8. The quotient of r and the sum of b and 9

$\frac{r}{b+9}$

Simplify.

8. $\frac{\frac{2}{3}}{\frac{4}{9}}$

$\frac{2}{3} \div \frac{4}{9}$

$\frac{1}{2}{3} \cdot \frac{3}{4}{2} = \frac{3}{2}$

9. $\frac{\frac{8}{12}}{\frac{-12}{35}}$

$\frac{8}{12} \div -\frac{12}{35}$

$\frac{1}{2}{3} \cdot \frac{-35}{12}{6} = \frac{-35}{18}$

10. $\frac{\frac{4}{5}}{8}$

$\frac{4}{5} \div 8$

$\frac{1}{2}{4} \cdot \frac{1}{8} = \frac{1}{10}$

11. $\frac{\frac{m}{6}}{\frac{x}{3}}$

$\frac{m}{6} \div \frac{x}{3}$

$\frac{m}{2}{6} \left(\frac{1}{x}\right) = \frac{m}{2x}$

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Multiply & Divide Mixed Numbers & Complex Fractions Practice

Simplify.

12. $\frac{4+11}{8}$ $\frac{15}{8}$

13. $\frac{22+8}{10}$

$\frac{30}{10} = 3$

14. $\frac{15-(-9)}{18+12}$

$\frac{15+9}{30} = \frac{24}{30} \overset{\div 6}{\underset{\div 6}{=}} \frac{4}{5}$

15. $\frac{\overset{3}{\cancel{6}} \cdot \overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}} \cdot \underset{4}{\cancel{8}}}$ $\frac{3}{8}$

16. $\frac{12 \cdot 9 - 3^2}{6 \cdot 9}$

$\frac{108-9}{54} = \frac{99 \div 9}{54 \div 9} = \frac{11}{6}$

17. $\frac{9(8-2)-3(15-7)}{6(4+2)-3(17-9)}$

$\frac{9(6)-3(8)}{6(6)-3(8)} = \frac{54-24}{36-24} = \frac{30}{12}$

$\frac{30}{12} \div \frac{2}{2} = \frac{15}{6}$