GRADE ALG

MULTIPLY RATIONAL EXPRESSIONS

By DataWORKS Educational Research

Learning Objective

We will multiply rational expressions.

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What are we going to learn?

Activate Prior Knowledge

A **polynomial** is a monomial or a sum of monomials .

Factor the polynomials.

1 $x^2 + 3x - 28$

$(x + 7)(x - 4)$

-28

28 – 1 = 27

14 – 2 = 12

7 – 4 = 3

2 $x^2 + 3x - 18$

$(x + 6)(x - 3)$

-18

18 – 1 = 17

9 – 2 = 7

6 – 3 = 3

Multiply the fractions.

3 $\frac{\cancel{12}^{1}}{\cancel{25}_{5}} \times \frac{\cancel{5}^{1}}{\cancel{24}_{2}} = \frac{1}{10}$

4 $\frac{\cancel{18}^{1}}{\cancel{49}_{7}} \times \frac{\cancel{7}^{1}}{\cancel{36}_{2}} = \frac{1}{14}$

Make Connection

Students, you already know how to factor polynomials and multiply fractions. Now, we will learn how to multiply rational expressions.

A **rational expression** contains fractions with polynomials.

- *Common factors can be reduced before multiplying rational expressions.*

Multiply Rational Expressions

WITHOUT common factors

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

$$= \frac{x^2+5x+6}{x^2-5x+4}$$

WITH common factors

$$\frac{\cancel{x+3}}{x-1}\bullet\frac{x+2}{\cancel{x+3}} = \frac{x+2}{x-1}$$

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On your whiteboard, write a rational expression using the following polynomials:
$5x-2$ $x^2+3x-18$
Which of the following multiplication problems has rational expressions with common factors? How do you know?

A $\frac{x+5}{x-2}*\frac{x+4}{x-3}$

B $\frac{x+5}{x-2}*\frac{x+4}{x+5}$

In your own words, what is a rational expression?
"A rational expression is _____."

A **rational expression** contains fractions with polynomials.

- *Common factors can be reduced before multiplying rational expressions.*

Multiply rational expressions.

1. Factor the polynomial in the numerator and denominator.
2. Reduce common factors if possible.
3. Multiply the rational expressions.

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2. How did I/you reduce common factors?
3. How did I/you multiply the rational expressions?

1. $\frac{x+5}{x-3} \cdot \frac{x-2}{x+1} = \frac{x^2+3x-10}{x^2-2x-3}$

$\frac{(x+5)(x-2)}{(x-3)(x+1)}$

$\frac{x^2-2x+5x-10}{x^2-3x+x-3}$

2. $\frac{x+4}{x-6} \cdot \frac{x+2}{x-2} = \frac{x^2+6x+8}{x^2-8x+12}$

$\frac{(x+4)(x+2)}{(x-6)(x-2)}$

$\frac{x^2+2x+4x+8}{x^2-2x-6x+12}$

3. $\frac{x^2+2x-3}{x^2+5x+6} \cdot \frac{x+5}{x-1} = \frac{x+5}{x+2}$

$\frac{\cancel{(x-1)}\cancel{(x+3)}}{\cancel{(x+3)}(x+2)} \cdot \frac{x+5}{\cancel{x-1}}$

4. $\frac{x^2+3x+2}{x^2+5x+6} \cdot \frac{x+4}{x+1} = \frac{x+4}{x+3}$

$\frac{\cancel{(x+1)}\cancel{(x+2)}}{(x+3)\cancel{(x+2)}} \cdot \frac{x+4}{\cancel{x+1}}$

5. $\frac{x^2+x-2}{x^2+7x+10} \cdot \frac{1}{x-1} = \frac{1}{x+5}$

$\frac{\cancel{(x-1)}\cancel{(x+2)}}{(x+5)\cancel{(x+2)}} \cdot \frac{1}{\cancel{x-1}}$

6. $\frac{x^2+5x+4}{x^2+4x+3} \cdot \frac{1}{x+4} = \frac{1}{x+3}$

$\frac{\cancel{(x+1)}\cancel{(x+4)}}{(x+3)\cancel{(x+1)}} \cdot \frac{1}{\cancel{x+4}}$

A **rational expression** contains fractions with polynomials.

- *Common factors can be reduced before multiplying rational expressions.*

1. *Multiplying rational expressions will help you add and subtract rational expressions.*

Add rational expressions:

$$\frac{x-1}{x-1}\cdot\frac{7}{x+3}+\frac{1}{x-1}\cdot\frac{x+3}{x+3}=\frac{7x-7}{(x+3)(x-1)}+\frac{x+3}{(x+3)(x-1)}=\frac{8x-4}{(x+3)(x-1)}$$

2. *Multiplying rational expressions will help you do well on tests.*

Sample Test Question:

82 $\frac{7z^3+7z}{4z+8}\cdot\frac{z^2-4}{z^3+2z^2+z}=$

A $\frac{7(z-2)}{4(z+1)}$

B $\frac{7(z+2)}{4(z-1)}$

C $\frac{7z(z+1)}{4(z+2)}$

D $\frac{7z(z-1)}{4(z+2)}$

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Does anyone else have another reason why it is relevant to multiply rational expressions? (Pair-Share) Why is it relevant to multiply rational expressions? You may give one of my reasons or one of your own. Which reason is more relevant to you? Why?

A **rational expression** contains fractions with polynomials.

- *Common factors can be reduced before multiplying rational expressions.*

Skill Closure

Multiply rational expressions.

1. Factor the polynomial in the numerator and denominator.
2. Reduce common factors if possible.
3. Multiply the rational expressions.

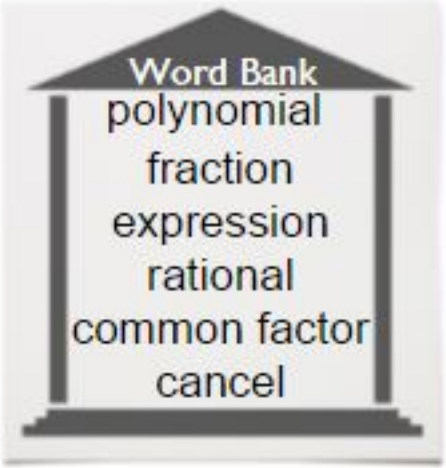
1. $\frac{x+7}{x-3} \cdot \frac{x+1}{x-2} = \frac{x^2+8x+7}{x^2-5x+6}$

$\frac{(x+7)(x+1)}{(x-3)(x-2)}$

$\frac{x^2+x+7x+7}{x^2-2x-3x+6}$

2. $\frac{x^2+2x-3}{x^2+3x+2} \cdot \frac{x+1}{x+3} = \frac{x-1}{x+2}$

$\frac{(x-1)(x+3)}{(x+1)(x+2)} \cdot \frac{x+1}{x+3}$



Constructed Response Closure

Mitchel multiplied the rational expression $\frac{x+7}{x-3} \cdot \frac{x+3}{x+1}$. Explain the error Mitchel made and find the correct answer.

$$\frac{x+7}{\cancel{x-3}} \cdot \frac{\cancel{x+3}}{x+1} = \frac{x+7}{x+1}$$

Mitchell incorrectly canceled the factors x-3 and x+3. They are not common factors.

$$\frac{x+7}{x-3} \times \frac{x+3}{x+1} = \frac{x^2+10x+21}{x^2-2x-3}$$

Summary Closure

What did you learn today about multiplying rational expressions? (Pair-Share)
Use words from the word bank.

A **rational expression** contains fractions with polynomials.

- *Common factors can be reduced before multiplying rational expressions.*

Multiply rational expressions.

1. Factor the polynomial in the numerator and denominator.
2. Reduce common factors if possible.
3. Multiply the rational expressions.

1. $\frac{x+2}{x-3} \cdot \frac{x+2}{x-4}$ $= \frac{x^2+4x+4}{x^2-7x+12}$

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

$\frac{x^2+2x+2x+4}{x^2-4x-3x+12}$

2. $\frac{x^2+x-2}{x^2+2x-3} \cdot \frac{x+3}{x+5}$ $= \frac{x+2}{x+5}$

$\frac{(x-1)(x+2)}{(x-1)(x+3)} \cdot \frac{x+3}{x+5}$

3. $\frac{x^2+5x+6}{x^2+3x+2} \cdot \frac{x+1}{x+4}$ $= \frac{x+3}{x+4}$

$\frac{(x+3)(x+2)}{(x+1)(x+2)} \cdot \frac{x+1}{x+4}$

4. $\frac{x^2+4x+3}{x^2+6x+5} \cdot \frac{1}{x+3}$ $= \frac{1}{x+5}$

$\frac{(x+1)(x+3)}{(x+5)(x+1)} \cdot \frac{1}{x+3}$

1.

$$\frac{x+1}{x-5} \bullet \frac{x+2}{x-2} = \frac{x^2+3x+2}{x^2-7x+10}$$

$$\frac{(x+1)(x+2)}{(x-5)(x-2)}$$

$$\frac{x^2+2x+x+2}{x^2-5x-2x+10}$$

2.

$$\frac{x^2+7x+10}{x^2-9x+14} \bullet \frac{x-2}{x+5} = \frac{x+2}{x-7}$$

$$\frac{\cancel{(x+5)}(x+2)}{\cancel{(x-2)}(x-7)} \bullet \frac{\cancel{x-2}}{\cancel{x+5}}$$

3.

$$\frac{x^2+8x+16}{x^2+x-12} \bullet \frac{x+2}{x+4} = \frac{x+2}{x-3}$$

$$\frac{\cancel{(x+4)}(x+4)}{(x-3)\cancel{(x+4)}} \bullet \frac{x+2}{\cancel{x+4}}$$

4.

$$\frac{x^2+8x+7}{x^2-x-2} \bullet \frac{1}{x+7} = \frac{1}{x-2}$$

$$\frac{\cancel{(x+1)}\cancel{(x+7)}}{(x-2)\cancel{(x+1)}} \bullet \frac{1}{\cancel{x+7}}$$

1.

$$\frac{x^2+4x+3}{x^2+6x+5}\cdot\frac{1}{x+3}$$

$$\frac{(x+1)(x+3)}{(x+5)(x+1)}\cdot\frac{1}{x+3}$$

$$=\frac{1}{x+5}$$

2.

$$\frac{x^2-x-2}{x^2+3x-10}\cdot\frac{x+7}{x+1}$$

$$\frac{(x+1)(x-2)}{(x-2)(x+5)}\cdot\frac{x+7}{x+1}$$

$$=\frac{x+7}{x+5}$$

3.

$$\frac{x^2-2x+1}{x^2+x-2}\cdot\frac{x+2}{x-1}$$

$$\frac{(x-1)(x-1)}{(x-1)(x+2)}\cdot\frac{x+2}{x-1}$$

$$=1$$

4.

$$\frac{x-9}{x+3}\cdot\frac{x+1}{x-4}$$

$$\frac{(x-9)(x+1)}{(x+3)(x-4)}$$

$$\frac{x^2+x-9x-9}{x^2-4x+3x-12}$$

$$=\frac{x^2-8x-9}{x^2-x-12}$$

1. $\frac{x^2+2x-3}{x^2+3x+2} \cdot \frac{x+1}{x+3}$

$\frac{(x-1)(x+3)}{(x+1)(x+2)} \cdot \frac{x+1}{x+3}$

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

2. $\frac{x+2}{x-3} \cdot \frac{x+2}{x-4}$

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

$\frac{x^2+2x+2x+4}{x^2-4x-3x+12}$

$= \frac{x^2+4x+4}{x^2-7x+12}$

3. $\frac{x^2+8x+16}{x^2+x-12} \cdot \frac{x+2}{x+4}$

$\frac{(x+4)(x+4)}{(x-3)(x+4)} \cdot \frac{x+2}{x+4}$

$= \frac{x+2}{x-3}$

4. $\frac{x^2+5x+4}{x^2+4x+3} \cdot \frac{1}{x+4}$

$\frac{(x+1)(x+4)}{(x+3)(x+1)} \cdot \frac{1}{x+4}$

$= \frac{1}{x+3}$