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Get the 4.5 Mult. & Div. Rational expression notes from the brown table.

Algebra 2 – Section 4.5

Simplify, Multiply, and Divide Rational Expressions

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EXAMPLE 1 Simplify a rational

Simplify: $\frac{x^2 - 2x - 15}{x^2 - 9}$

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

Factor numerator and
Divide out common
Simplified

GUIDED PRACTICE

Simplify the expression, if

- $\frac{2(x+1)}{(x+1)(x+3)} = \frac{2}{x+3}$
- $\frac{40x+20}{10x+30} = \frac{2(2x+1)}{10(x+3)} = \frac{2(2x+1)}{2(2x+1) \cdot 5} = \frac{1}{5}$
- $\frac{4}{x(x+2)}$
- $\frac{x+4}{x^2-16} = \frac{x+4}{(x-4)(x+4)} = \frac{1}{x-4}$

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Simplifying Rational Expressions

- **Factor** the numerator, if possible
- **Factor** the denominator, if possible
- Divide out common factors
- Binomial factors like $x+3$ or $2x-1$
- Opposite binomials, like $x-3$ and $3-x$ can be cancelled by putting a (-1) in the numerator
- Variables that are not involved in $+$ or $-$
- Constants that are reducible
- A rational expression is in simplified form if its numerator and denominator have no common factors other than 1

Handwritten notes: "Multi you go" with arrows pointing to the binomial factors.

EXAMPLE 4 Multiply rational

Multiply: $\frac{3x-3x^2}{x^2+4x-5} \cdot \frac{x^2+x-20}{3x}$

Handwritten work:

$$\frac{-1 \cancel{3x} (1-x)}{(x+5)(x-1)} \cdot \frac{(x+5)(x-4)}{\cancel{3x}}$$

$$\frac{-1(x-4)}{(x-1)}$$

$$\frac{-x+4}{4-x}$$

Blue annotations:

- Factor numerators and
- Multiply numerators and
- Rewrite $1-x$ as (-1)
- Divide out common

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$$\frac{2x^2 \cdot 5x^2 y}{10x^2 \cdot 4y^2} = \frac{10x^3 y^3}{40x^2 y^2} = \frac{xy}{4}$$

Handwritten work showing prime factorization of coefficients and cancellation of variables.

$$\frac{2x^2 y^2}{10x^2 y^2} \cdot \frac{5x^2 y}{4y^2} = \frac{10x^3 y^3}{40x^2 y^2} = \frac{xy}{4}$$

Handwritten work showing cancellation of common factors in the first fraction.

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GUIDED PRACTICE

Multiply the expressions.

8. $\frac{3x^5y^2}{8xy} \cdot \frac{6xy^2}{9x^3y} = \frac{18x^6y^4}{72x^4y^2} = \frac{x^2y^2}{4}$

9. $\frac{2x^2-10x}{x^2-25} \cdot \frac{x+3}{2x^2}$

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

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

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ANSWER?
What is the simplified form of $\frac{8x^3y}{2xy^2} \cdot \frac{7x^4y^3}{4y}$?

(A) $\frac{5}{2}x^6y$ (B) $7x^6y$ (C) $7x^{11}y$ (D) $7x^7y^{4/3}$

$\frac{56x^7y^4}{8xy^3}$

$\frac{7x^3}{y^4}$

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Multiplying and Dividing Rational Expressions

- If it is **division**, rewrite as multiplication by using the **reciprocal**. *Flip the Second Fraction*
- **Factor** all of the numerators and denominators that factor. *mult.*
- It must be two or more pieces to factor
- Divide out common factors (binomials, variables, and constants)
- You may cancel anything on the top with anything on the bottom
- Multiply the remaining factors by writing them next to each other
- Remember: top x top and bottom x bottom

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EXAMPLE 6 Divide rational expressions

Divide: $\frac{7x}{2x-10} \div \frac{x^2-6x}{x^2-11x+30}$

Multiply by reciprocal.

$\frac{7x}{2(x-5)} \cdot \frac{(x-5)(x-6)}{x(x-6)}$

Factor.

Divide out common factors.

$\frac{7}{2} = 3\frac{1}{2}$

Simplified form

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EXAMPLE 7 Divide a rational expression by a

Divide: $\frac{6x^2 + x - 15}{4x^2} \div (3x^2 + 5x)$

~~$\frac{-90}{-9 \cdot 10}$~~
 $\frac{-9 \div 3 \quad 10 \div 2}{6 \cdot 3 \quad 6 \div 2} = \frac{-3 \quad 5}{2x \quad 3x}$

$\frac{(2x-3)(3x+5)}{4x^2} \cdot \frac{1}{x(3x+5)} = \frac{2x \cdot 3}{4x^3}$

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GUIDED PRACTICE

Divide the expressions. Simplify the result.

11. $\frac{4x}{5x-20} \div \frac{x^2-2x}{x^2-6x+8}$

$\frac{4x}{5(x-4)} \cdot \frac{(x-4)(x-2)}{x(x-2)} = \frac{4}{5}$

12. $\frac{2x^2+3x-5}{6x} \div (2x^2+5x)$

~~$\frac{5}{-20x} \cdot \frac{(x+5)(x-1)}{6x} \cdot \frac{1}{x(2x+5)} = \frac{x-1}{6x^2}$~~

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① 4.4-4.5 w.s

② Ch. 4 Review

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