Lesson 6.1: Multiplying and Dividing Rational Expressions

By the end of the lesson, we will be able to:

- Determine the domain of rational expressions and functions
- Simplify, multiply, and divide rational expressions and functions

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A RATIONAL EXPRESSION is the quotient of two polynomials.

Examples:

$$\frac{x-5}{2x+1} \qquad \frac{x^2-7x-18}{x^2-4}$$

$$\frac{1}{x-3} \qquad \frac{2a^2+5ab+2b^2}{a^2-6ab+8b^2}$$

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A RATIONAL FUNCTION

is a function of the form $R(x) = \frac{p(x)}{q(x)}$

where $p(x)$ and $q(x)$ are polynomials and q is not a zero polynomial.

The domain consists of all real numbers except those for which the denominator $q(x)$ is 0.

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Remember?

The Domain of an expression is all values of x that result in a defined value for y. This means that if we have a fraction, the denominator can never equal 0!

To find the domain of a rational expression, it is easier to determine what values *x* can't be.

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Examples: Determine the domain for each of the following rational expressions or functions.

a.) $\frac{-3z}{z+5}$

b.) $\frac{n^2-2n-8}{n^2-n-12}$

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Examples: Determine the domain for each of the following rational expressions or functions.

c.) $R(x) = \dfrac{x-3}{x^2-2x-8}$

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SIMPLIFYING RATIONAL EXPRESSIONS/FUNCTIONS:

We simplify rational expressions and functions by dividing out any common factors.

NOTE!!! "Factors" means that we are dealing with a multiplication problem! If two terms are connected by a + or –, you CAN NOT reduce just one of the terms. You can only reduce sets of terms if the whole set is identical in both the numerator *and* the denominator.

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SIMPLIFYING RATIONAL EXPRESSIONS/FUNCTIONS:

Examples: Simplify

a.) $\dfrac{x^2+x-6}{2x^2-5x+2}$

b.) $\dfrac{y^3+27}{2y^2+6y}$

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MULTIPLYING RATIONAL EXPRESSIONS/FUNCTIONS:

Step 1: Completely factor each polynomial in the numerator and the denominator.

Step 2: Divide out common factors in the numerators and denominator.

Step 3: Multiply the remaining terms in the numerator together, and the remaining terms in the denominator together.

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Multiply Examples:

a.) $\dfrac{n^2-9}{n^2+5n+6} \cdot \dfrac{n+2}{6-2n}$

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Multiply Examples:

b.) $\dfrac{a^2-b^2}{10a^2-10ab} \cdot \dfrac{10a+5b}{2a^2+3ab+b^2}$

DIVIDING RATIONAL EXPRESSIONS or FUNCTIONS:

To divide rational expressions, follow the rules for dividing regular fractions: Invert the second (or bottom) fraction, then multiply.

$$\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{a}{b} \cdot \frac{d}{c}$$

DIVIDING RATIONAL EXPRESSIONS

Examples:

a.) $\dfrac{\dfrac{45z^4}{7y}}{\dfrac{5z}{21y^2}}$

DIVIDING RATIONAL EXPRESSIONS

Examples:

b.) $\dfrac{\dfrac{p^3-8}{5p^2+15p}}{\dfrac{p^2-4}{p^2+3p}}$

WORKING WITH FUNCTIONS:

Sometimes we are given two or more functions and told to combine and simplify them.

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$$f(x) = \frac{x^2 - 9}{2x^2 - 8x} \qquad g(x) = \frac{x - 4}{x^2 + 4x + 3} \qquad h(x) = \frac{x^2 + 6x + 9}{x^2 - 5x}$$

Example: *find the given function and state the domain of each function.*

$$R(x) = f(x) \cdot g(x)$$

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$$f(x) = \frac{x^2 - 9}{2x^2 - 8x} \qquad g(x) = \frac{x - 4}{x^2 + 4x + 3} \qquad h(x) = \frac{x^2 + 6x + 9}{x^2 - 5x}$$

Example: *find the given function and state the domain of each function.*

$$A(x) = \frac{f(x)}{h(x)}$$

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Can you?

Homework:

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(22 problems)