

4-1 Multiplying and Dividing Rational Expressions

I can multiply and divide rational expression and simplify using factoring.
I can simplify a rational expression.

Multiply Rational Numbers

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

$$-\frac{4}{5} \cdot \frac{5}{2}$$

$$\frac{3}{7} \cdot 2$$

Multiply Rational Expressions

$$\frac{1}{x} \cdot \frac{x}{4}$$

$$\frac{x^2}{2} \cdot \frac{3}{x}$$

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

To multiply rational expressions:

1. Find the excluded values of the product, which are values of the variable for which the expression is undefined
2. Factor and terms that need to be factored
3. Multiply straight across (numerator times numerator, denominator times denominator)
4. Simplify the product by canceling common factors.

Find the product and any excluded values

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

Find the product and any excluded values

$$\frac{(x+3)(x-3)}{(x-8)(x+3)} \cdot \frac{(x-8)}{2x^2-18x}$$

Find the product and any excluded values

$$\frac{x}{(x-9)} \cdot \frac{(3x-27)}{(x+1)}$$

Find the product and any excluded values

$$\frac{(x+3)(x+11)}{4x} \cdot \frac{x^2-3x}{(x+3)} \cdot \frac{(8x-56)}{(x-7)(x+11)}$$

Dividing Rational Numbers

Keep, Change, Flip

$$\frac{2}{3} \div \frac{4}{3} \quad \frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \left(\frac{1}{2}\right)$$

$$\left(\frac{4}{5}\right) \div \frac{5}{2} \quad \overset{\text{Flip}}{-\frac{4}{5}} \times \frac{2}{5} = \left(\frac{-8}{25}\right)$$

$$\frac{3}{7} \div \frac{3}{1} \quad \frac{3}{7} \times \frac{1}{3} = \frac{3}{21} = \left(\frac{1}{7}\right)$$

Dividing Rational Expressions

$$\frac{1}{x} \div \frac{x}{4} \quad \frac{1}{x} \cdot \frac{4}{x} = \left(\frac{4}{x^2}\right)$$

$$\frac{x^2}{2} \div \frac{x}{3} \quad \frac{x^2}{2} \cdot \frac{3}{x} = \frac{3x^2}{2x} = \frac{3 \cdot \cancel{x}}{2 \cdot \cancel{x}} = \left(\frac{3x}{2}\right)$$

$$\frac{(x+1)}{3} \div \frac{(x+1)}{4} \quad \frac{(x+1)}{3} \cdot \frac{4}{(x+1)} = \frac{4 \cdot \cancel{(x+1)}}{3 \cdot \cancel{(x+1)}} = \left(\frac{4}{3}\right)$$

To divide rational expressions

1. Find the excluded values of the product, which are values of the variable for which the expression is undefined (You must now look in the numerator of the second expression as well!)
2. Factor terms that need to be factored
3. Find the reciprocal of the second expression (flip it.)
3. Multiply straight across (numerator times numerator, denominator times denominator)
4. Simplify the product by canceling common factors.

Divide and find any excluded values

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

$x \neq 0, -2, 1, -7$

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

Divide and find any excluded values

$$\frac{6x}{9(x+1)(x-4)} \div \frac{3(x-10)}{x(x-10)}$$

$x \neq 10, 0, -1, 4$

$$\frac{2 \cdot 3 \cdot \cancel{3} \cdot x}{\cancel{3} \cdot (x+1) \cdot (x-4)} = \frac{6x^2}{27(x+1)(x-4)}$$

$$\frac{2x^2}{9(x+1)(x-4)}$$

Divide and find any excluded values

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

$x \neq 0, 1, -3$

$$\frac{(x+1)}{2 \cdot 2 \cdot x} \cdot \frac{(x-1)(x+3)}{2(x+3)} = \frac{(x+1)(x-1)}{8x}$$

Divide and find any excluded values

$$\frac{(x-1)(x-9)}{3x} \div \frac{(x-9)(x+2)}{x(x+2)}$$

$x \neq 0, -2, 9$

$$\frac{(x-1)(x-9)}{3x} \cdot \frac{x(x+2)}{(x-9)(x+2)} = \frac{(x-1)}{3}$$

#12 $x^2 - 25 = (x+5)(x-5)$