

## Rational Expressions

**Rational Expression:** a quotient of two polynomials

- Rational expressions are **undefined** at values that make the denominator equal to 0

Example #1:

**Determine what values of  $x$  make the expression undefined.**

$$\frac{x^2 - 6x + 5}{x^2 - 3x - 10}$$

**Now simplify the expression in example #1.**

Example #2: Simplify and identify any restrictions for  $x$ .

$$\frac{2x^2 + 7x + 3}{x^2 + 7x + 12}$$

You try: Simplify and identify any restrictions for  $x$ .

a.  $\frac{x^2 + 20x + 36}{x^3 - 4x}$

b.  $\frac{x^2 - 2x - 15}{2x^2 + 3x - 9}$

Example #3: Multiply and identify any restrictions for x

$$\frac{x-3}{4x+20} \cdot \frac{x+5}{x^2-9}$$

Example #4: Multiply and identify any restrictions for x

$$\frac{2x+4}{x^2-25} \cdot \frac{x^2-5x-50}{4x^2-16}$$

You try:

$$\frac{10x-40}{x^2-6x+8} \cdot \frac{x+3}{5x+15}$$

Example #5: Divide. Assume all variables are defined.

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

You try: Divide. Assume all variables are defined.

$$\frac{x^2-25}{x^2+6x-7} \div \frac{x^2+13x+40}{x^2+7x-8}$$

## Adding/Subtracting Rational Expressions

Example #1:

**Add or subtract. Identify any  $x$ -values for which the expression is undefined.**

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

You try:

$$\frac{3x^2 - 5}{3x - 1} - \frac{2x^2 - 3x - 2}{3x - 1}$$

To add or subtract rational expressions with unlike denominators, first find the **least common denominator** (LCD). The LCD is the least common multiple of the polynomials in the denominators.

- Factor each polynomial completely to identify the LCD

**Example:**  $x^2 - 2x - 3$  and  $x^2 - x - 6$

Example #2:

**Add the rational expressions and identify where the expression is undefined.**

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

Example #3:

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

You try: Also, identify any restriction.

**Subtract**  $\frac{2x^2 + 64}{x^2 - 64} - \frac{x - 4}{x + 8}$

Add:  $\frac{x}{x+2} + \frac{4}{x-3}$

Example #4: Complex Fractions

Simplify and assume that all variables are defined.

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

You try: **Assume all variables are defined**

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

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