# Rational Expressions - Finding Domains, Simplifying, Mulitplying and Dividing

<u>Rational Expression</u>: an expression of the form $\frac{P}{Q}$ where P and Q are polynomials, $Q \neq 0$.

Rational Expressions are not necessarily defined for all values of x.

How to find the domain of a rational expression:

1) Factor the denominator
2) Set each factor of the denominator to zero
3) The domain will be all real numbers except the x-values that make the denominator zero.

**Find the domain of:**

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

$$\frac{6x-1}{x^2-4}$$

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

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

How to simplify rational expressions:

1) Completely factor the numerator and denominator
2) Cancel out common factors with a ONE and
   Cancel out opposite factors with a NEGATIVE ONE
3) The answer will be the product of the remaining factors

**Reduce to lowest terms:**

$$\frac{5s-25}{s^2-25}$$

$$\frac{6t^2-6t}{2t-2}$$

$$\frac{3x^2+8x+4}{3x^2-4x-4}$$

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

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

$$\frac{(a+b)^2}{a^2-2ab-3b^2}$$

$$\frac{8x+16-px-2p}{px-2p-8x+16}$$

**How to multiply or divide rational expressions:**

1) **If dividing, first change division to multiplication by the reciprocal**
2) **Completely factor all numerators and denominators**
3) **Cancel out common factors to ONE's**
   **Cancel our opposite factors to NEGATIVE ONE's**
4) **The answer is the product of the remaining factors**

**Multiply or divide:**

$$\frac{12x-20}{5x} \cdot \frac{6x^2}{9x-15}$$

$$\frac{z^2-3z+2}{z^2+4z+3} \div \frac{1-z}{z+1}$$

$$\frac{(x+1)^3(x+4)}{x^2+5x+4} \div \frac{x^2+2x+1}{x^2+3x+2}$$

$$\frac{x^3-125}{2x+1} \div \frac{x^2-25}{2x^2-9x-5}$$