

## MULTIPLYING & DIVIDING RATIONAL EXPRESSIONS

A rational expression  
in **simplest form**  
is one that has  
**no common factors** in the  
numerator and denominator.

Example 1

Simplify:  $\frac{x^2 - 4x - 12}{x^2 - 4}$

$$\begin{array}{r|l} 5 & -4 \\ -6 & +2 \\ \hline & -6 \cdot 2 \end{array} \quad \begin{array}{l} \text{p. } -12 \\ \text{p. } -6 \cdot 2 \end{array}$$

difference  
of  
squares

$$\frac{(x-6)(\cancel{x+2})}{(x-2)(\cancel{x+2})}$$

$$\boxed{\frac{x-6}{x-2}}$$

Example 2

Simplify:  $\frac{x^2 - 5x - 6}{x^2 - 1}$

$$\begin{array}{r|l} 5 & -6 \\ -6 & +1 \\ \hline & -6 \cdot 1 \end{array} \quad \begin{array}{l} \text{p. } -6 \\ \text{p. } -6 \cdot 1 \end{array}$$

diff. of  
squares

$$\frac{(\cancel{x+1})(x-6)}{(\cancel{x+1})(x-1)}$$

$$\boxed{\frac{x-6}{x-1}}$$

Example 3

Simplify:  $\frac{5x^2y \cdot 6x^3y^2}{2xy^3 \cdot 10y}$

$$\frac{30x^5y^3}{20xy^4}$$

$$\frac{3x^4}{2y}$$

Example 4

Simplify:  $\frac{6x^2y^3 \cdot 10x^3y^4}{2x^2y^2 \cdot 18y^2}$

$$\frac{60x^5y^7}{36x^2y^4}$$

$$\frac{5x^3y^3}{3}$$

Example 5

Simplify:  $\frac{4x - 4x^2}{x^2 + 2x - 3} \cdot \frac{x^2 + 1x - 6}{4x}$

$\frac{\text{sum } 2 \mid \text{p. } -3}{3 + -1 \mid 3 \cdot -1}$  (blue arrows pointing to  $x^2 + 2x - 3$ )  
 $\frac{\text{sum } 1 \mid \text{p. } -6}{3 + -2 \mid 3 \cdot -2}$  (orange arrows pointing to  $x^2 + 1x - 6$ )

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

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

$$\cancel{-1} \cdot (x-2) = \boxed{-x+2}$$

**Example 6**  $3x(1 - 9x^2)$

Simplify:  $\frac{3x - 27x^3}{3x^2 - 2x - 1} \cdot \frac{3x^2 - 4x + 1}{3x}$

$$\begin{array}{r|l} s-2 & p-3 \\ -3+1 & -3 \cdot 1 \\ \hline \cancel{3} & \frac{1}{3} \\ -1 & \end{array}$$

$$\begin{array}{r|l} s-4 & p-3 \\ -3+1 & -3 \cdot -1 \\ \hline \cancel{3} & \frac{-1}{3} \\ -1 & \end{array}$$

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

$$\frac{\cancel{3x}(1-3x)\overset{3x+1}{\cancel{(1+3x)}}\cancel{(x-1)}(3x-1)}{\cancel{3x}\cancel{(x-1)}\cancel{(3x+1)}}$$

$$(1-3x)(3x-1)$$

$$3x - 1 - 9x^2 + 3x$$

$$\boxed{-9x^2 + 6x - 1}$$