

Example 1: Simplify the following.

a)  $\frac{(x+1)(x-5)}{(x-5)(x^2-1)}$  Difference of Squares (DAS)

$$\frac{(x+1)(x-5)}{(x-5)(x+1)(x-1)}$$

Restrictions: what makes the bottom equal to zero.  
 $x-1=0 \Rightarrow x=1$   
 $x+1 \neq 0 \Rightarrow x \neq -1$   
 $x \neq 1$

b)  $\frac{x^2+x-12}{x^2+7x+12}$

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

$$\frac{(x-3)}{(x+3)} \quad x \neq -3$$

You Try! Simplify the following.

a)  $\frac{x^2+6x+9}{x^2-9}$  (DAS)

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

$$\frac{(x+3)}{(x-3)} \quad x \neq 3$$

b)  $\frac{4x^2+8x}{x^2+6x+8}$  (GCF)

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

$$\frac{4x}{(x+4)} \quad x \neq -4$$

### Multiplying Rational Functions

When multiplying rational functions, meaning you are multiplying two fractions together, you multiply straight across the top and straight across the bottom, simplifying where you can.

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

Example 2: Simplify completely.

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

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

$$\frac{3(x+4)}{(x+3)} \quad x \neq -3$$

Example 3: Simplify Completely.

(DAS)  $\frac{x^2-9}{x^2+5x+6} \cdot \frac{x+2}{3x-9}$  (GCF)

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

$$\frac{1}{3}$$

You Try!

Multiply the following & state the restrictions.

a)  $\frac{t^2+19t+84}{4t-4} \cdot \frac{2t-2}{t^2+9t+14}$

$$\frac{(t+12)(t+7)}{4(t-1)} \cdot \frac{2(t-1)}{(t+2)(t+7)}$$

$$\frac{2(t+12)}{4(t+2)}$$

$$\frac{(t+12)}{2(t+2)} \quad x \neq -2$$

b)  $\frac{x^2+x-6}{x-5} \cdot \frac{x^2-25}{x^2+4x+3}$

$$\frac{(x+3)(x-2)}{(x-5)} \cdot \frac{(x+5)(x-5)}{(x+1)(x+3)}$$

$$\frac{(x-2)(x+5)}{(x+1)} \quad x \neq -1$$

## Dividing Rational Functions

When dividing rational functions, you multiply the first fraction by the **reciprocal** of the second fraction, simplifying where you can. **SAME-CHANGE-FLIP!**

$$\frac{\overset{K}{a}}{\underset{b}{c}} \div \frac{\overset{F}{c}}{\underset{d}{b}} = \frac{\overset{K}{a} \cdot \overset{d}{d}}{\underset{b}{b} \cdot \underset{c}{c}} = \frac{ad}{bc}$$

**Example 1:** Simplify completely and state the restrictions.

$$\frac{\overset{K}{a+2}}{\overset{c}{a+3}} \div \frac{\overset{F}{a^2+a-12}}{a^2-9} \rightarrow \frac{(x+2)}{(x+3)} \cdot \frac{x^2-9}{x^2+x-12} \quad (\text{OOS})$$

$$\frac{(x+2)}{(x+3)} \cdot \frac{(x-3)(x+3)}{(x+4)(x-3)} \quad \begin{matrix} -12 \\ 4 \\ -3 \end{matrix}$$

$$\frac{(x+2)}{(x+4)} \quad x \neq -4$$

**Example 2:** Simplify Completely. State all restrictions.

$$\frac{b^2}{25a^2 - b^2} \div \frac{b}{5a - b}$$

divide  $\rightarrow \frac{\overset{K}{b^2}}{25a^2 - b^2} \div \frac{\overset{F}{b}}{5a - b}$

$$\rightarrow \frac{\overset{K}{b^2}}{\overset{OOS}{25a^2 - b^2}} \cdot \frac{5a - b}{b}$$

$$\frac{b^2}{(5a+b)(5a-b)} \cdot \frac{(5a-b)}{b}$$

$$\frac{b}{(5a+b)} \quad \begin{matrix} a \neq 0 + b \neq 0 \\ @ \text{ the same time} \end{matrix}$$

**You Try!** Divide the following. Be sure to state all restrictions.

a)  $\frac{-12b+18}{\frac{b^2-25}{4b-6}} \div \frac{b^2-3b-10}{b^2-25}$

$$\frac{-12b+18}{b^2-25} \cdot \frac{4b-6}{b^2-3b-10} \quad \begin{matrix} -10 \\ -5 \end{matrix}$$

$$\frac{-6(2b-3)}{(b+5)(b-5)} \cdot \frac{(b-5)(b+2)}{2(2b-5)}$$

$$\frac{-6(b+2)}{2(b+5)} \quad b \neq -5$$

b)  $\frac{3x+12}{2x+4} \div \frac{x^2-16}{x+2}$

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

$$\frac{3}{2(x-4)} \quad x \neq 4$$