

Warm-Up:

Multiplying and Dividing Rational Expressions

Example 1: Simplify the following.

$$a) \frac{(x+1)(x-5)}{(x-5)(x^2-1)} = \frac{\cancel{(x+1)}\cancel{(x-5)}}{\cancel{(x-5)}\cancel{(x+1)}(x-1)}$$

$$b) \frac{x^2+x-12}{x^2+7x+12} = \frac{\cancel{(x+4)}\cancel{(x-3)}}{\cancel{(x+4)}(x+3)}$$

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

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

You Try! Simplify the following.

$$a) \frac{x^2+6x+9}{x^2-9} = \frac{\cancel{(x+3)}\cancel{(x+3)}}{\cancel{(x+3)}(x-3)}$$

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

$$\frac{x+3}{x-3} \quad x \neq -3, 3$$

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

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.

STEPS

- ① Factor.
- ② Smush it together into 1 fraction!
- ③ Simplify! $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$

Example 2: Simplify completely.

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

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

$$x \neq -1, 2, -3$$

You Try! Multiply the following and state the restrictions.

c)

$$d) \frac{x^2-9}{x^2+5x+6} \cdot \frac{x+2}{3x-9} = \frac{1}{3}$$

$$x \neq 3, -3, -2$$

Example 3: Simplify Completely.

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

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

$$\frac{(t+12)}{2(t+2)} \quad x \neq -7, -2, 1$$

$$e) \frac{t^2+t-6}{x-5} \cdot \frac{t^2-25}{x^2+4x+3} = \frac{(x-2)(x+5)}{x+1}$$

$$x \neq 5, -3, -1$$

Dividing Rational Functions

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

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c} = \frac{ad}{bc}$$

Example 1: Simplify completely and state the restrictions.

$$\frac{a+2}{a+3} \div \frac{a^2+a-12}{a^2-9} \quad \text{KEEP CHANGE FLIP!}$$

$$\frac{a+2}{a+3} \cdot \frac{a^2-9}{a^2+a-12} = \frac{(a+2)(a+3)(a-3)}{(a+3)(a+4)(a-3)}$$

$$\frac{a+2}{a+4} \quad x \neq -3, 3, -4$$

Example 2: Simplify Completely. State all restrictions.

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

means divide!

$$\frac{b^2}{b^2-25} \cdot \frac{b+5}{b} = \frac{b \cdot \cancel{b} (b+5)}{(b-5)(b+5) \cancel{b}}$$

$$\frac{b}{b-5} \quad b \neq -5, 5, 0$$

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

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

$$a) \frac{\frac{12b+18}{b^2-25}}{\frac{4b+6}{b^2-3b-10}} = \frac{3(b+2)}{(b+5)}$$

$$b \neq 5, -5, -3/2$$

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

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

$$x \neq -2, -4, 4$$