12.4 Simplify Rational Expressions
(FRACTIONS WITH VARIABLES)

Goal • Simplify rational expressions.

Your Notes

VOCABULARY

Rational expression CAN BE WRITTEN AS A RATIO OF 2 POLYNOMIALS EX] $\dfrac{x^2}{(x+2)(x-1)}$ ← Simplified FACTOR FORM!

Excluded value IS ANY NUMBER THAT MAKES THE DENOMINATOR "0". WHY? You cannot divide by 0!

Simplest form of a rational expression HAS NO COMMON FACTORS IN THE NUMERATOR AND DENOMINATOR (EXAMPLES BELOW)

I. REVIEW ARITHMETIC EXAMPLES:

Simplify:

multiplication you can cancel COMMON FACTORS

(A) $\dfrac{2 \cdot 5}{2 \cdot 6} = \boxed{\dfrac{5}{6}}$

Addition – You can NOT cancel

(B) $\dfrac{1+2}{1+3}$ $\boxed{\dfrac{3}{4}}$

NO!!

DO NOT DO: $\dfrac{1+2}{1+3}$ 6

II. TRY SIMPLIFYING THESE RATIONAL EXPRESSIONS:

(C) $\dfrac{(x+1)(x-1)}{(x+1)(x+5)} = \boxed{\dfrac{x-1}{x+5}}$

COMMON FACTOR (x+1) can cancel

(D) $\boxed{\dfrac{x+3}{x-3}}$ ← ALL READY SIMPLIFIE

You can NOT cancel the x's!!

Simplify Fractions

① Completely Factor both the num. and denominator.

② Cancel all comm factors

③ Simplify and leave in factor form.

SIMPLIFYING RATIONAL EXPRESSIONS

Let a, b, and c be polynomials where $b \neq 0$ and $c \neq 0$.

Algebra

$$\frac{ac}{bc} = \frac{a \cdot \cancel{c}^{1}}{b \cdot \cancel{c}} = \boxed{\frac{a}{b}}$$

Example

$$\frac{3x - 9}{4x - 12} = \frac{3(\cancel{x-3})^{1}}{4(\cancel{x-3})} = \boxed{\frac{3}{4}}$$

Example 2   *Simplify expressions by dividing out monomials*

① Simplify the rational expression, if possible. ② State the excluded values.

a. $\dfrac{18x}{6x^2} = \dfrac{\cancel{6x}(3)}{\cancel{6x}(x)}$

$= \boxed{\dfrac{3}{x}}$

The excluded value is ___. $\longrightarrow$ $\boxed{x \neq 0}$

EXAMPLE
① Divide out common factors.
② USE RULES OF EXPONEN

Simplify.

b. $\dfrac{12x^2 - 6x}{24x} = \dfrac{6x(2x-1)}{6x(4)}$

① Factor numerator and denominator.

$=$

② Divide out common factors.

$= \boxed{\dfrac{2x-1}{4}}$

③ Simplify. — KEEP AS A SIMPLIFIED FRACTION IN FACTOR FORM

The excluded value is ___.

$\rightarrow$ $\left(x \neq 0\right)$

④ IDENTIFY EXCLUDED VALUES

✔ **Checkpoint** Simplify the rational expression, if possible. State the excluded values.

① Simplify the fraction

② State excluded values

3. $\dfrac{7}{5x + 3}$

↗
(Simplified)

$5x + 3 = 0$
$\quad -3 \quad -3$
$\dfrac{5x}{5} = \dfrac{-3}{5}$

$\left(x \neq -3/5\right)$

4. $\dfrac{5x}{5x^2 - 125}$

$\dfrac{5x}{5(x^2 - 25)} =$

$\dfrac{\cancel{5}x}{\cancel{5}(x-5)(x+5)}$

$\boxed{\dfrac{x}{(x-5)(x+5)}}$

$\left(x \neq 5, -5\right)$

5. $\dfrac{6x^3}{2x + 4}$

$\dfrac{\cancel{2}(3x^3)}{\cancel{2}(x+2)}$

$\boxed{\dfrac{3x^3}{x+2}}$

$x + 2 = 0$

$\left(x \neq -2\right)$