

Simplifying Rational Expressions

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A rational expression is an algebraic expression that can be written as the quotient of 2 polynomials written as a fraction

A polynomial is a mathematical expression with 1 or more terms whose exponents are whole numbers and coefficients are real numbers

Polynomials

$$3x^2 + 7x + 5$$

$$4x^2y^3$$

$$\sqrt{3}x + 5$$

Not Polynomials

$$3x^{-2} \rightarrow \frac{3}{x^2}$$

$$4x^{\frac{1}{2}} \rightarrow 4\sqrt{x}$$

$$3^x$$

Examples of Rational Expressions

$$\frac{2x}{5y}, \quad x^2 - 5, \quad \frac{2x+3}{x-1}, \quad \frac{6x^2+2x+5}{4x^2+3}$$

$\frac{2}{x}$, $x \neq 0$ because division by zero is undefined.
 $x=0$ is called a non-permissible value (n.p.v.)

For the following state the

non-permissible values:

① $\frac{x+3}{2x} \quad x \neq 0$

② $\frac{x^2-5}{x+4} \quad x \neq -4$

$x+4=0$
 $x=-4$

③ $\frac{x^2+4}{2x-5} \quad x \neq \frac{5}{2} \quad 2x-5=0$
 $\frac{2x=5}{2} \quad \frac{5}{2}$

④ $\frac{x+7}{x^2+9}$ This expression $x^2+9=0$
is defined for all values of x $x^2=-9$ not possible!

⑤ $\frac{2x}{x^2+7x+12} \quad x^2+7x+12=0 \quad x \neq -3, -4$
 $(x+3)(x+4)=0$

To simplify a rational expression means to make it in lowest terms by dividing common factors of the numerator & denominator.

$\frac{15 \div 5}{20 \div 5} = \frac{3}{4}$

$\frac{3x^2y^3}{4xy^2} = 3xy, \quad x \neq 0, y \neq 0$

$\frac{2x^2+8x}{4x} = \frac{\cancel{2}x^{\cancel{1}}(x+4)}{\cancel{4}x} \quad x \neq 0$

$= \frac{x+4}{2}, \quad x \neq 0$

$\frac{5+4}{2} = \frac{9}{2}$

... ..

$$\frac{x+4}{2} - \frac{1}{2}$$
~~$$\frac{5+x^2}{2}$$~~

- ① Factor First!!
- ② Look for n.p.v.'s :
- ③ Divide out common factors
- ④ Write your answer with n. . v.'s

Try: Simplify $\frac{x^2+9x+20}{x^2+x-12} = \frac{\cancel{(x+4)}(x+5)}{\cancel{(x+4)}(x-3)}$

$$= \frac{x+5}{x-3} \quad x \neq -4, 3$$

$$\frac{-12x^2 - 8x}{9x^2 + 12x + 4} = \frac{-4x(3x+2)}{(3x+2)(3x+2)}$$

$$3x+2=0$$

$$3x = -2$$

$$x = -\frac{2}{3}$$

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

$$\frac{x^2-3x-40}{\sqrt{25-x^2}} = \frac{(x-8)(x+5)}{(5+x)(5-x)}$$

$$x^2-25$$

$$= \frac{x-8}{5-x}$$

$$x \neq \pm 5$$

$$p = -30$$

$$s = -1$$

$$-6, 5$$

$$x = 5$$

$$\frac{2x^2 - x - 15}{9 - x^2}$$

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

$$x-3$$

$$5-3=2$$

$$= \frac{2x+5}{3-x}$$

$$3-x$$

$$2x^2 - x - 15$$

$$\boxed{2x^2 - 6x + 5x - 15}$$

$$2x(x-3) + 5(x-3)$$

$$(x-3)(2x+5)$$

$$\frac{(3+x) \cancel{(3-x)}}{\cancel{3-x} - 5} \quad 3-5=-2$$

$$= \frac{-2x-5}{3+x}$$

$$x \neq \pm 3$$

$$\begin{array}{l} x-3 \\ -1(-x+3) \\ -1(3-x) \end{array}$$

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