

9.5 Adding and Subtracting Rational Expressions

To add or subtract rational expressions with different denominators, you must write all the expressions with a common denominator. It is easiest to use the least common multiple (LCM) of the denominators.

Simplify the sum.

$$\frac{1}{x^2-4x-12} + \frac{3x}{4x+8}$$

$$\frac{1}{(x-6)(x+2) \cdot 4} + \frac{3x}{4(x+2) (x-6)}$$

$$\frac{4 + 3x^2 - 18x}{4(x-6)(x+2)} = \frac{3x^2 - 18x + 4}{4(x-6)(x+2)}$$

$x \neq 6 \quad x \neq -2$

Simplify the sum.

$$\frac{1}{3x^2+2x+30} + \frac{4x}{3x+15}$$

$$\frac{1}{3(x^2+7x+10)} + \frac{4x}{3(x+5)}$$

$$\frac{1}{3(x+5)(x+2)} + \frac{4x}{3(x+5) (x+2)}$$

$$\frac{1}{3(x+5)(x+2)} + \frac{4x^2+8x}{3(x+5)(x+2)} = \frac{4x^2+8x+1}{3(x+5)(x+2)}$$

$x \neq -5 \quad x \neq -2$

Simplify the difference.

$$\frac{-2}{3x^2+36x+105} - \frac{3x}{6x+30}$$

$$\frac{-2}{3(x^2+12x+35)} - \frac{3x}{6(x+5)}$$

$$\frac{-2}{3(x+5)(x+7)^2} - \frac{3x}{2 \cdot 6(x+5)} \cdot \frac{3}{3} \cdot \frac{(x+7)}{(x+7)}$$

$$\frac{-2 \cdot 2}{6(x+5)(x+7)} - \frac{3x(x+7)}{6(x+5)(x+7)} = \frac{-3x^2-21x-4}{6(x+5)(x+7)}$$

$x \neq -5$
 $x \neq -7$

Simplify the difference.

$$\frac{x}{3x^2-9x+6} - \left(\frac{2x+1}{3x^2+3x-6} \right)$$

$$\frac{x}{3(x^2-3x+2)} - \left(\frac{2x+1}{3(x^2+x-2)} \right)$$

$$\frac{x \cdot \overbrace{(x+2)}^{(x+2)}}{3(x-2)(x-1)\overbrace{(x+2)}^{(x+2)}} - \left(\frac{2x+1}{3(x+2)(x-1)} \right) \frac{(x-2)}{(x-2)}$$

	$x-2$
$2x$	$2x^2-4x$
1	$x-2$

$$\frac{x^2+2x}{3(x+2)(x-2)(x-1)} + \left(\frac{-2x^2+3x+2}{3(x+2)(x-2)(x-1)} \right) = \frac{-x^2+5x+2}{3(x+2)(x-2)(x-1)}$$

$x \neq -2 \quad x \neq 1$

Complex Fractions: fractions that have a fraction in its numerator or denominator or both.

examples: $\frac{1}{x} \quad 1 - \frac{1}{2y} \quad \frac{\frac{x-2}{x} - \frac{2}{x+1}}{\frac{3}{x-1} - \frac{1}{x+1}}$

To simplify a complex fraction such as $\frac{\frac{a}{b}}{\frac{c}{d}}$ you can multiply the numerator and denominator by their LCM bd . Or you can divide $\frac{a}{b}$ by $\frac{c}{d}$

Simplify the complex fraction.

$$\frac{\frac{1}{x}}{y} \quad \frac{1}{x} \div y$$

$$y \quad \frac{1}{x} \cdot \frac{1}{y} = \frac{1}{xy}$$

$x \neq 0$
 $y \neq 0$

Simplify the complex fraction.

$$\frac{3}{\frac{1}{2y} - \frac{1}{2y}}$$

$$\frac{3}{\frac{2y}{2y} - \frac{1}{2y}} = \frac{3}{\frac{2y-1}{2y}}$$

$$3 \div \frac{2y-1}{2y} \quad \frac{3 \cdot 2y}{1 \cdot 2y-1} = \frac{6y}{2y-1} \quad y \neq \frac{1}{2}$$

Simplify the complex fraction.

$$\frac{\frac{1 \cdot y}{x \cdot y} + \frac{1 \cdot x}{y \cdot x}}{\frac{2 \cdot x}{y \cdot x} - \frac{1 \cdot y}{x \cdot y}} \longrightarrow \frac{\frac{y}{xy} + \frac{x}{xy}}{\frac{2x}{xy} - \frac{y}{xy}} \longrightarrow \frac{\frac{x+y}{xy}}{\frac{2x-y}{xy}}$$

$$\frac{x+y}{xy} \div \frac{2x-y}{xy}$$

$$\frac{x+y}{xy} \cdot \frac{xy}{2x-y} = \frac{(x+y)\cancel{xy}}{\cancel{xy}(2x-y)} = \frac{x+y}{2x-y}$$

$x \neq 0 \quad y \neq 0$

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Simplify the complex fraction.

$$\frac{\frac{2}{x+4}}{2 \frac{x+4}{x+4} - \frac{3}{x+4}} \longrightarrow \frac{\frac{2}{x+4}}{\frac{2x+8}{x+4} - \frac{3}{x+4}} \longrightarrow \frac{\frac{2}{x+4}}{\frac{2x+5}{x+4}}$$

$$\frac{2}{x+4} \div \frac{2x+5}{x+4}$$

$$\frac{2}{\cancel{x+4}} \cdot \frac{\cancel{x+4}}{2x+5} = \frac{2}{2x+5}$$

$$x \neq -4$$

$$x \neq -\frac{5}{2}$$

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homework.

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