

When finding the sums and/or differences of Rational Expressions, there are essentially **two cases**:

1) When the denominators are the same

- a) Add or subtract the numerators
- b) Keep the denominator (don't change it)
- c) Simplify the result

2) When the denominators are NOT the same

- a) Find the Least Common Denominator (LCD) of the fractions.
- b) Write each fraction as an equivalent fraction with the LCD as the denominator
- c) Add or subtract the equivalent numerators
- d) Simplify the result

Ex 1a) Simplify: $\frac{4}{15} + \frac{2}{15} - \frac{1}{15}$

$$= \frac{4 + 2 - 1}{15}$$

$$= \frac{5}{15}$$

$$= \frac{5}{3 \cdot 5} \rightarrow \frac{\cancel{5}}{3 \cdot \cancel{5}} \rightarrow \left(\frac{1}{3}\right)$$

Ex 1b) Simplify: $\frac{4x+5}{x+3} - \frac{x-2}{x+3}$

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

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

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

$$= \left(\frac{3x+7}{x+3}\right)$$

Ex 2) Simplify: $\frac{7x}{8} + \frac{5y}{12x}$

Find the LCM of 8 and $12x$

$$\begin{array}{l} 2^3 \qquad 2^2 \cdot 3 \cdot x \\ \text{LCM } 2^3 \cdot 3 \cdot x \\ = 24x \end{array}$$

$$= \frac{7x \cdot \frac{3x}{3x}}{2^3 \cdot 3x} + \frac{5y}{2^2 \cdot 3x} \cdot \frac{2}{2}$$
$$= \frac{21x^2}{2^3 \cdot 3 \cdot x} + \frac{10y}{2^3 \cdot 3 \cdot x}$$

$$= \frac{21x^2 + 10y}{24x}$$

Ex 3) Simplify: $\frac{1}{2x} + \frac{5x}{x^2 - 1} + \frac{3}{x+1}$

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

LCM: $2x(x+1)(x-1)$

$= \frac{(x+1)(x-1)}{2x(x+1)(x-1)} + \frac{10x^2}{2x(x+1)(x-1)} + \frac{6x(x-1)}{2x(x+1)(x-1)}$

multiply the numerators!

$\frac{x^2 - 1}{2x(x+1)(x-1)} + \frac{10x^2}{2x(x+1)(x-1)} + \frac{6x^2 - 6x}{2x(x+1)(x-1)}$

$\frac{17x^2 - 6x - 1}{2x(x+1)(x-1)}$

← doesn't factor, doesn't simplify

Ex 4) Simplify:

$$\frac{2x+1}{x^2-7x+6} - \frac{x+3}{x^2-5x-6}$$

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

LCM: $(x-6)(x-1)(x+1)$

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

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

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