

Try this Warm-Up ... before the video

Simplify. State any restrictions on the variables.

$$\frac{x^2 - 1}{x - 2} \div \frac{x + 1}{12 - 6x}$$

Turn on the video

Let's have a look ...

Simplify. State any restrictions on the variables.

$$\begin{aligned} & \frac{x^2 - 1}{x - 2} \div \frac{x + 1}{12 - 6x} \\ &= \frac{(x+1)(x-1)}{x-2} \div \frac{x+1}{6(2-x)} \quad x \neq 2 \\ &= \frac{\cancel{(x+1)}(x-1)}{\cancel{(x-2)}} \times \frac{6\cancel{(2-x)}}{\cancel{x+1}} \quad x \neq -1 \\ &= \frac{(x-1)(6)\cancel{(-1)}\cancel{(-2+x)}}{\cancel{x-2}} \\ &= -6(x-1) \end{aligned}$$

Adding and Subtracting Rational Expressions

Learning Goals

- add / subtract rational expressions

Add the fractions

$$\frac{3}{5} + \frac{4}{5} = \frac{7}{5}$$

$$\frac{3}{5} + \frac{1}{7} = \frac{21 + 5}{35} = \frac{26}{35}$$

$$\frac{3}{5} + \frac{2}{15} =$$

$$= \frac{3}{5} + \frac{2}{3(5)} = \frac{9 + 2}{5(3)}$$

$$= \frac{11}{15}$$

Adding and Subtracting Rational Expressions

MUST HAVE A COMMON DENOMINATOR

Steps:

1. Factor numerator and denominator
2. State all restrictions
3. Determine lowest common denominator
4. Write equivalent expressions
5. Simplify

Find the lowest common denominator

$$\frac{1}{x+3} + \frac{1}{x+3} = \frac{2}{x+3}$$

$$\frac{1}{5x} + \frac{1}{2x^3} + \frac{1}{10x^2} = \frac{5x \cdot 2x^4}{10x^5}$$

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

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

Add the fractions

$$\rightarrow \frac{1}{x} + \frac{2}{y}$$

$$= \frac{y + 2x}{xy}$$

$$x \neq 0$$

$$y \neq 0$$

$$\frac{n}{m} + \frac{m}{n} + \frac{n}{1}$$

$$= \frac{n^2 + m^2 + mn^2}{mn}$$

$$m \neq 0$$

$$n \neq 0$$

$$\begin{aligned} & \frac{2}{x+2} + \frac{x}{x-3} \\ &= \frac{2(x-3) + x(x+2)}{(x+2)(x-3)} \\ &= \frac{2x - 6 + x^2 + 2x}{(x+2)(x-3)} \\ &= \frac{x^2 + 4x - 6}{(x+2)(x-3)} \quad \begin{array}{l} x \neq -2 \\ x \neq 3 \end{array} \end{aligned}$$

Pause the Video and try these ...

Example 1: Simplify

$$\frac{4x-1}{x+2} - \frac{x+3}{x+2} =$$

$$\frac{4}{5x} - \frac{3}{2x^2} + \frac{1}{x^3} =$$

Let's have a look ...

Example 1: Simplify

$$\frac{4x-1}{x+2} - \frac{x+3}{x+2} =$$

$$= \frac{4x-1-x-3}{x+2}$$

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

talk through each solution

$$\frac{4}{5x} - \frac{3}{2x^2} + \frac{1}{x^3} =$$

$$= \frac{4(2x^2) - 3(5x) + 10}{5(2)x^3}$$

$$= \frac{8x^2 - 15x + 10}{10x^3}$$

$$x \neq 0$$

Pause the Video and try ...

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

Let's have a look ...

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

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

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

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

$$= \frac{x^2+1}{(x+2)(x-2)} \quad x \neq 2, -2$$

Pause the Video and try ..

$$\frac{4}{y^2+5y+6} - \frac{5}{y^2-y-12}$$

Let's have a look ...

$$\begin{aligned} & \frac{4}{y^2+5y+6} - \frac{5}{y^2-y-12} \\ &= \frac{4}{(y+2)(\underline{y+3})} - \frac{5}{(\underline{y+3})(y-4)} \\ &= \frac{4(y-4) - 5(y+2)}{(y+2)(y+3)(y-4)} \\ &= \frac{4y-16-5y-10}{(y+2)(y+3)(y-4)} \quad y \neq -2, -3, 4 \\ &= \frac{-y-26}{(y+2)(y+3)(y-4)} \end{aligned}$$

Pause the Video and try ..

$$\frac{4x-7}{6x^2-17x+5} - \frac{3x+4}{2x^2-11x+15}$$

Let's have a look ...

$$\frac{4x-7}{6x^2-17x+5} - \frac{3x+4}{2x^2-11x+15}$$

$$= \frac{4x-7}{(2x-5)(3x-1)} - \frac{3x+4}{(2x-5)(x-3)}$$

$$= \frac{(4x-7)(x-3) - (3x+4)(3x-1)}{(2x-5)(3x-1)(x-3)}$$

$$= \frac{4x^2-12x-7x+21 - (9x^2-3x+12x-4)}{(2x-5)(3x-1)(x-3)}$$

$$= \frac{-5x^2-28x+25}{(2x-5)(3x-1)(x-3)}$$

$x \neq \frac{5}{2}$
 $x \neq \frac{1}{3}$
 $x \neq 3$

Try On Your Own

MCR 3U Adding and Subtracting Rational Expressions

MUST HAVE A COMMON DENOMINATOR

1. Factor numerator and denominator
2. State all restrictions
3. Determine LCD (lowest common denominator)
4. Write equivalent expressions
5. Simplify and state all restrictions

Simplify

1. $\frac{2x-1}{x+3} - \frac{x+5}{x+3}$

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

3. $\frac{x+1}{x^2-9} + \frac{x+2}{x+3}$

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

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

Try On Your Own

MCR 3U Adding and Subtracting Rational Expressions

MUST HAVE A COMMON DENOMINATOR

- Factor numerator and denominator
- State all restrictions
- Determine LCD (lowest common denominator)
- Write equivalent expressions
- Simplify and state all restrictions

Simplify

$$1. \frac{2x-1}{x+3} - \frac{x+5}{x+3} = \frac{2x-1-(x+5)}{x+3} = \frac{2x-1-x-5}{x+3} = \frac{x-6}{x+3}, x \neq -3$$

$$2. \frac{1}{7x} - \frac{3}{2x^2} + \frac{5}{x^3} \quad \text{LCD} = 14x^3$$

$$= \frac{(2x^2)1}{(7x)2x^2} - \frac{(7x)3}{(7x)2x^2} + \frac{(14)5}{14x^3}$$

$$= \frac{2x^2 - 21x + 70}{14x^3}, x \neq 0$$

$$3. \frac{x+1}{x^2-9} + \frac{x+2}{x+3} = \frac{(x+1)}{(x+3)(x-3)} + \frac{(x+2)(x-3)}{(x+3)(x-3)}$$

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

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

$$= \frac{x^2 - 5}{(x+3)(x-3)}, x \neq \pm 3$$

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

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

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

$$= \frac{-x - 10}{(x+4)(x+1)(x-2)}, x \neq -4, -1, 2$$

Optional Practice

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