7.5 Complex Rational Expressions

Complex rational expressions have numerators or denominators containing one or more rational expressions.

Simplifying a Complex Rational Expression by Dividing:

Follow these steps to simplify a complex rational expression by dividing:

1. If necessary, add or subtract to get a single rational expression in the numerator.
2. If necessary, add or subtract to get a single rational expression in the denominator.
3. Perform the division indicated by the main fraction bar: invert the denominator of the complex rational expression and multiply.
4. If possible, simplify.

Example 1: Simplify each complex rational expression by using the division method.

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

b. $\dfrac{4-\dfrac{7}{y}}{3-\dfrac{2}{y}}$

c. $\dfrac{\dfrac{8}{x^2}-\dfrac{2}{x}}{\dfrac{10}{x}-\dfrac{6}{x^2}}$

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

Note: Portions of this document are excerpted from the textbook *Introductory and Intermediate Algebra for College Students* by Robert Blitzer.

Simplifying a Complex Rational Expression by Multiplying by the LCD:

Follow these steps to simplify a complex rational expression by multiplying by the LCD:

1. Find the LCD of all rational expressions within the complex rational expression.
2. Multiply both the numerator and the denominator of the complex rational expression by this LCD.
3. Use the distributive property and multiply each term in the numerator and each term in the denominator by the LCD. Simplify. No fractional expressions should remain (that is, the numerator should be a polynomial and the denominator should be a polynomial.) This process is called clearing fractions.
4. If possible, factor and simplify.

Example 2: Simplify by multiplying by the LCD.

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

b. $\dfrac{4-\dfrac{7}{y}}{3-\dfrac{2}{y}}$

c. $\dfrac{\dfrac{8}{x^2}-\dfrac{2}{x}}{\dfrac{10}{x}-\dfrac{6}{x^2}}$

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

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Answers Section 7.5

Example 1:

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

b. $\frac{4y-7}{3y-2}$

c. $\frac{4-x}{5x-3}$

d. $\frac{-12}{5}$ or $-\frac{12}{5}$

Example 2: The answers are the same as for example 1.