6.1 Rational Expressions and Functions: Multiplying and Dividing

6.2 Rational Expressions and Functions: Adding and Subtracting

6.3 puts it all together into one problem.

What is an example of a Complex Rational number?

How did we deal with them?

Ex: $\frac{\frac{1}{2}}{\frac{3}{5}}$

Def: A **complex rational expression** is a rational expression where the numerator and/or denominator is/are themselves rational expressions.

So how will we deal with them?

Ex:$\frac{\frac{1}{x^{2}}}{1+\frac{1}{x}}$

Two ways to simplify a complex rational expression:

1. Use a “magic one” to clear the denominators of the numerator and denominator. Then simplify.
2. Cary out any simplifications of the numerators and denominators first, then treat the division as multiplication with the divisors reciprocal.

## Method 1: Multiplying by a “magic one”

Consider the complex rational expression:

Ex:$\frac{1+\frac{2}{x}}{1-\frac{4}{x^{2}}}$

Our goal is to eliminate all of the denominators individually from both the numerator and the denominator.

In the past when we try to clear the fractions in an equation, we would try to multiply by the LCD. Since we do not have an equation we can not use a property of equality, but since we have fractions on top and bottom we can use a “magic one” to multiply the numerator fraction by AND the denominator fraction by. This will allow us to clear out the denominators from the numerator fraction and the denominator fraction.

The LCD for this example is: \_\_\_\_\_\_\_\_\_\_\_\_\_

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

## Method 2: Simplify, then simplify again

This method is a great summary of the previous two sections.

The first thing you do is simplify the numerator until it is a single fraction. Then you simplify the denominator until it too is a single fraction.

Then you treat the fraction bar/division as multiplication with by the denominators reciprocal. And you simplify again.

Ex: $\frac{\frac{1}{a}+\frac{1}{b}}{\frac{1}{a^{2}}-\frac{1}{b^{2}}}$

Simplify the numerator:

Simplify the denominator:

Treat the fraction bar/division as multiplication by the reciprocal and simplify again.

Ex: $\frac{\frac{x}{x^{2}+5x-6}-\frac{6}{x^{2}+5x-6}}{\frac{x}{x^{2}-5x+4}-\frac{2}{x^{2}-5x+4}}$

Ex: $\frac{\frac{2}{y-3}+\frac{1}{y+1}}{\frac{3}{y+1}+\frac{4}{y-3}}$

Ex: $\frac{\frac{a}{a+2}+\frac{5}{a}}{\frac{a}{2a+4}+\frac{1}{3a}}$

Ex: $\frac{\frac{y}{y^{2}-4}-\frac{2y}{y^{2}+y-6}}{\frac{2y}{y^{2}+y-6}-\frac{y}{y^{2}-4}}$

Ex: For $g\left(x\right)=\frac{x+3}{x-1}$ find $g(g\left(a\right))$