Simplifying Rational Expressions

Undefined Rational Expressions

- A rational expression is undefined when values in the denominator give us 0.
  - To determine if a rational expression is undefined, you will set just the denominator equal to 0 and solve it.
  - Take the answer that you get and plug it into the denominator and you will see that you get 0 in the denominator which makes the rational expression undefined.

For what value of x will make the expression undefined:

$$\frac{x}{x-3}$$

$$x - 3 = 0$$
$$x = 3$$

This means that I cannot have the x value equal 3 because 3 – 3 gives me zero in the denominator making the rational expression undefined.

Simplifying Rational Expressions

Factor Everything First!

- Make sure you follow your factoring guidelines when simplifying rational expressions.
  - Greatest Common Factor first. If you forget to take out the GCF first, your factors will be wrong, and then your answer will be wrong.
  - Grouping if there are four terms
  - Trinomials factor into binomials
- A binomial cannot be reduced by a single term. Binomials can only be reduced by other exact binomials.

The following slides have lots of examples for you to work on and follow.

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

Factor the common factors first. Then cancel the like binomials.

$$\frac{x+9}{x^2-81}=\frac{x+9}{(x-9)(x+9)}=\frac{1}{x-9}$$

The numerator is already factored. The denominator is a difference of squares so it needs to be factored. Then cancel the like binomials.

$$\frac{-5a-5b}{a+b}=\frac{-5(a+b)}{a+b}=-5$$

The numerator contains GCF of 5 and since both are negative we can factor out a -5. Then cancel the like binomials.

$$\frac{7x+35}{x^2+5x}=\frac{7(x+5)}{x(x+5)}=\frac{7}{x}$$

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

$$\frac{2x-10}{3x-30}=\frac{2(x-5)}{3(x-10)}$$

Even though we could factor the numerator and denominator, we cannot cancel anything out. This means that it cannot be simplified. You should leave your answer in factored form.

$$\frac{x^2 + xy + 2x + 2y}{x+2} = \frac{(x^2 + xy)(2x + 2y)}{x+2} =$$

$$\frac{x(x+y) + 2(x+y)}{x+2} =$$

$$\frac{(x+2)(x+y)}{x+2} = x + y$$

The numerator contains a polynomial with four terms which means we need to group terms together, then factor each of those terms by factoring out the GCF and then factor out the next GCF. Then cancel the like binomials.

This problem becomes a little trickier to do. Once you have factored both the numerator and denominator you will notice that nothing drops out; it is close but not the same thing.

We will need to factor out a -1 from the denominator , rewrite the denominator so it is in the same order as the one in the numerator, and cancel the like terms.

Be careful that you do not lose sight of the negative that you factored out.

$$\frac{100-x^2}{x-10}=\frac{(10-x)(10+x)}{x-10}=$$

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

$$-(10+x)$$