Math 1111 – Rational Expressions

Objectives:

1. Simplify rational expressions

2. Multiply rational expressions

3. Divide rational expressions

4. Add and subtract rational expressions

5. Simplify complex rational expressions

The quotient of two polynomial expressions is called a rational expression.

**Objective 1:** Simplify rational expressions.

To simplify a rational expression, we can apply the properties of fractions, by canceling common factors from the numerator and the denominator. Before this can be done, the numerator and denominator need to be factored.

Using the rational expression:

Factor the numerator and denominator:

Cancel the common factor (x + 4):

To simplify a rational expression,

1. Factor the numerator and denominator.

2. Cancel out the common factors.

Example #1: Simplify the rational expressions.

A.

B.

C.

D.

**Objective 2:** Multiply rational expressions.

Multiplying with rational expressions is the same as multiplying with fractions. We must multiply the numerators and then multiply the denominators together. Before multiplying, it is helpful to factor the numerators and denominators.

To multiply a rational expression,

1. Factor the numerator and denominator.

2. Multiply the numerators.

3. Multiply the denominators.

4. Simplify

Example #2: Multiply the rational expressions and show the answer in simplest form.

A.

B.

C.

**Objective 3:** Dividing rational expressions.

Dividing with rational expressions is the same as dividing with fractions. To divide a rational expression, we will take the first expression and multiply by the reciprocal of the second expression. Then we will follow the rules of multiplication.

To divide a rational expression,

1. Rewrite the division as the product of the first rational expression and the reciprocal of the second.

2. Factor the numerators and denominators completely.

3. Multiply the numerators and denominators together.

4. Simplify by dividing out common factors.

Example #3: Divide the rational expressions and show the answer in simplest form.

A.

B.

C.

**Objective 4:** Add and subtract rational expressions.

Adding and subtracting with rational expressions is the same as dividing with fractions. We first must find a common denominator. The easiest common denominator to use will be the least common denominator (LCD). This is the smallest multiple that the denominator has in common.

For example, add the rational expressions after finding the least common denominator.

and .

* Factor each of the denominators and line up the common factors. Then bring down the columns. Do not include common factors twice.

x2 – 2x – 3 = (x + 1)(x – 3)

x2 + 4x + 3 = (x + 1) (x + 3)

LCD = (x + 1)(x – 3)(x + 3)

* Multiply each denominator by the “missing” LCD factor and multiple each numerator by the same factor.

= and =

* Simplify the numerators.

+

* Add and simplify the final expression.

To add or subtract a rational expression,

1. Factor the numerator and denominator.

2. Find the LCD of the expressions but do not include common factors twice.

3. Multiply the numerator and denominator by the missing factor(s).

4. Simplify the numerators.

5. Add or subtract the expressions. NOTE: When subtracting, the distribution property must be used to subtract the entire expression.

6. Simplify the numerators to determine if any more simplification can occur.

Example #4: Add or subtract the rational expressions and show the answer in simplest form.

A.

B.

C.

D.

**Objective 5:** Simplify complex rational expressions.

A complex rational expression is a rational expression in which the numerator and/or the denominator contains a rational expression.

There are two methods that can be used to simplify complex rational expressions.

Method 1: Make sure the complex fraction is in the form of a fraction over a fraction. Then we will rewrite the complex fraction as a division problem and use the procedure above for dividing fractions.

So, the complex fraction becomes (Example #3A)

Sometimes we must simplify the numerator and denominator, by using the addition or subtraction methods, before rewriting the complex fraction as a division problem.

So, the complex fraction is simplified to (using xy as the LCD), which becomes .

Now the problem can be written as a division problem .

Method 2: We can clear the fractions by find the LCD of all the rational expressions. Using the example above in Method 1, we will clear the fractions.

* Find the LCD of , which is xy.
* Multiply the numerator and denominator by xy.
* Distribute the LCD.
* Simplify.
* Factor.
* Simplify.

To simplify a complex rational expression,

1. Simplify the numerator and denominator.

2. Rewrite the complex rational expression as a division problem.

3. Divide the expressions.

4. Simplify

Example #5: Simplify the complex rational expressions and show the answer in simplest form, using either method.

A.

B.

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