# **Lesson Objectives**

1. Greatest Common Factor
2. Factor Out a Greatest Common Factor
3. Factor a Quadratic Trinomial
4. Factor a Difference of Squares

# **Greatest Common Factor**

**Greatest:** the biggest **Common**: shared

**Factor:** numbers that “divide-into” (also called **divisors**)

Easiest way to see if a number is a factor is to **divide** it in your head or on a calculator.

For example, with , since there is no decimal part or remainder,

then both 2 and 4 are **factors** of 8.

* **EXAMPLE:** Find the greatest common factor for the list of terms: [\*Akst 16.1.9]

I recommend if necessary, use the calculator for the coefficients. Here’s how you do that:

Greatest Common Factor (GCF) on calculator (TI-84 Plus or TI-83 Plus)

is actually called the **Greatest Common Divisor** (abbreviated **gcd**)

The **gcd(** command on the calculator (TI-84 Plus or TI-83 Plus) has limitations:

* + - 1. only numbers, not variables
      2. only 2 numbers at a time
      3. only POSITIVE numbers

To access Greatest Common Divisor (gcd) on calculator:

press **MATH**, **→**(NUM), **9**:gcd( 

Here’s the problem again for reference:

* **EXAMPLE:** Find the greatest common factor for the list of terms:

To find the GCF of the coefficients 30, 110, 60, we will use calculator (TI-83/84 Plus):

gcd(30,110) = 10 then take that answer and do it again gcd(10,60) = 10

 

The GCF of the coefficients 30, 110, and 60 is **10**.

Here’s the problem again for reference:

* **EXAMPLE:** Find the greatest common factor for the list of terms:

For the variable part: *x*5, *x*7, *x*9

You can only include variables in GCF if ALL the terms include that same variable.

Since all 3 terms have *x*, use the **SMALLEST** listed (only what’s shared), which is ***x*5**.

The overall GCF for is **10*x*5**.

# **Factor Out the Greatest Common Factor**

Factoring out the GCF should always be tried FIRST, before trying other methods.

Factoring out the GCF is sort of like doing the **distributive property** in reverse.

* **EXAMPLE:** Factor out the greatest common factor.

[R.4.9]

* **STEP 1. Find GCF of coefficients.** \_\_GCF coeff. = **4**\_\_\_\_\_\_\_\_
* **STEP 2. Find GCF of variables.**
  + Do all terms have same variable? \_\_**YES**. All have an *x*\_\_\_\_\_\_
  + If YES, what is the **SMALLEST** of the ones listed? smallest of is ***x***.

(continued from the previous page … here is the problem again for reference)

* **EXAMPLE:** Factor out the greatest common factor.

[R.4.9]

* **STEP 3. Multiply the coefficient and variable GCF’s together.**
  + Coefficient GCF = 4, variable GCF = *x* Product =
  + The overall GCF is **4x**.
* **STEP 4. Skip a line** and **write the** **GCF** with a **“reverse-indent**.”

Open a set of **parentheses** the **SAME WIDTH** as the expression.

* **STEP 5.** To determine what goes INSIDE the parentheses, simply **divide** each term of the expression **by the GCF** and simplify. Write the simplified result in parentheses.

**(ANSWER)**

The entire expression is in “factored form.”

Original expression Factored expression

3 terms 1 term

Addition & Subtraction Multiplication

Factoring is a process that converts addition & subtraction into multiplication.

This allows the opportunity to SIMPLIFY – most common are fractions and roots.

# **Factor a trinomial of the form**

## Review of Multiplying Binomials – Use the FOIL method

* **EXAMPLE:** Multiply. [R.3.55]

|  |  |
| --- | --- |
| F: Firsts | Write all the terms connected together:  Simplify – combine like terms:  **ANSWER:** |
| O: Outers |
| I: Inners |
| L: Lasts |

## Factor a trinomial of the form

Factoring a trinomial in this form is sort of like doing FOIL in reverse.

* **EXAMPLE:** Find the binomial factors for the trinomial. [\*Akst \*16.2.7]

F O + I L

=

F (Firsts): Open up 2 sets of parentheses, with your variable in the **first** position.

Next, we need two integers whose **SUM** is 17 and whose **PRODUCT** is 16.

**O + I**

**(sum of Outers and Inners)**

**L**

**(Lasts)**

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need **2 numbers:** | | |
| **Product = 16** | **Sum = 17** | **Winner?** |
| 1(16) = 16 | 1 + 16 = 17 | **YES –**  **use + 1 and + 16** |
| 2(8) = 16 | 2 + 8 = 10 | NO |
| 4(4) = 16 | 4 + 4 = 8 | NO |

**ANSWER:** =  or

* **EXAMPLE:** Factor the expression. [R.4.81]

Open 2 sets of parentheses with variable in the **first** position:

=

Next, we need 2 integers whose **SUM**  is – 18 and whose **PRODUCT** is 81

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need **2 numbers:** | | |
| **Product = 81** | **Sum = -18** | **Winner?** |
| -1(-81) = 81 | -1 + (-81) = -81 | NO |
| -3(-27) = 81 | -3 + (-27) = -30 | NO |
| -9(-9) = 81 | -9 + (-9) = -18 | **YES –**  **Use -9 and -9** |

**ANSWER:** = or

* **EXAMPLE:** Factor the expression completely. [R.4.37]

Open 2 sets of parentheses with variable in the **first** position:

=

Next, we need 2 integers whose **SUM**  is +1 and whose **PRODUCT** is -72

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need **2 numbers:** | | |
| **Product = -72**  **(opposite signs)** | **Sum = +1**  **(opposite signs means SUBTRACT)** | **Winner?** |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  | or | **YES –**  **Use -8 and +9** |

**ANSWER:**  =  **or**

* **EXAMPLE:** Factor completely, if possible. [\*Akst 16.2-15)

Open 2 sets of parentheses with variable in the **first** position:

=

Next, we need 2 integers whose **SUM**  is -1 and whose **PRODUCT** is -48

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need **2 numbers:** | | |
| **Product = -48**  **(opposite signs)** | **Sum = -1**  **(opposite signs means SUBTRACT)** | **Winner?** |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  |  | NO |
| NONE of the pairs work – therefore, is **NOT FACTORABLE** or **PRIME**. | | |

# **Factor a Difference of Squares**

* **EXAMPLE:** Factor. [R.4.59]

It’s missing the middle term. Rewrite it with zero:

Open 2 sets of parentheses with variable in the **first** position:

=

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need **2 numbers:** | | |
| **Product = -81**  **(opposite signs)** | **Sum = 0**  **(opposite signs means SUBTRACT)** | **Winner?** |
|  |  | NO |
|  |  | NO |
|  | or (same thing) | **YES –**  **Use – 9 and +9** |

**ANSWER:** = or

**Square Root is 9**

**Square Root is *s***

**Opposite Signs**

**Opposite Signs**

## **FORMULA** for the Difference of Squares:

Works as long as the two terms are **PERFECT SQUARES** and they are **SUBTRACTED**.

* **EXAMPLE:** Factor the binomial completely. [R.4.61]

**Perfect Square**

**Perfect Square**

**Perfect Square**

**SUBTRACT**

**ANSWER:**  = or

* **EXAMPLE:** Factor the expression completely, if possible. [R.4-27]

**Perfect Square**

**ADD**

**(To factor, it MUST be SUBTRACT !!)**

**Perfect Square**

**Perfect Square**

The **SUM** (addition) of perfect squares is always **PRIME** – it **DOES NOT FACTOR !!**

Sources Used:

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2. MyLab Math for *College Algebra with Modeling and Visualization*, 6th Edition, Rockswold, Pearson Education Inc.
3. Wabbitemu calculator emulator version 1.9.5.21 by Revolution Software, BootFree ©2006-2014 Ben Moody, Rom8x ©2005-2014 Andree Chea. Website <https://archive.codeplex.com/?p=wabbit>