MRS. HORN – GEOMETRY

DISTANCE LEARNING – ASSIGNMENT #3

This packet is a review of factoring by grouping, and using factoring to solve. It is very important that you attend class on Tuesday and/or Thursday to help you understand the material, as well as give you the chance to ask any questions.

PART ONE – FACTORING BY GROUPING

- **Factoring by grouping is a method used to factor an expression with four terms**
- **It is done by grouping the first two terms together, and the last two terms together**
- **You then factor out the GCF of each group**
- **You pull down the numbers in front, group them together**
- **Pull down one of the sets of parenthesis, and this is your final factorization**
- **See the examples below for more clarification**

EXAMPLE 1:

Factor the expression by grouping.

$12x^3 - 21x^2 + 28x - 49$

FIRST: Group the first two terms together in parenthesis, and the last two terms together in parenthesis.

$(12x^3 - 21x^2) + (28x - 49)$

The + in the middle of the two parenthesis comes from the + that is between the $21x^2$ and $28x$.

SECOND: Look at each group individually. Establish the GCF of the group, and factor it out.

FIRST GROUP: GCF is $3x^2$, factored out is $3x^2(4x - 7)$*

SECOND GROUP: GCF is 7, factored out is $7(4x - 7)$*

NOTE: What remains in each set of parenthesis is a match. This is the goal of factoring by grouping. If they do not match, you have done something wrong.

THIRD: Your expression now looks like the one below, after you have taken out the GCF of each group.

$3x^2(4x - 7) + 7(4x - 7)$

FOURTH: You will now pull out the "GCFs" and put them together in one set of parenthesis, and then "pull down" one set of the matching parenthesis to get your final factorization.

$3x^2(4x - 7) + 7(4x - 7)$

$(3x^2 + 7)(4x - 7)$ → ***This is your final answer.***

EXAMPLE 2:

Factor the expression by grouping.

$$12x^3 - 2x^2 - 30x - 5$$

Although the process for this problem will be the exact same as example 1, there is one thing we will have to fix before we proceed. The subtraction sign between the terms $2x^2$ and $30x$ will cause you a problem. You must change it to addition, AND CHANGE THE SIGNS OF ALL TERMS TO THE LEFT OF IT. It will then look like this, and you can proceed with the rest of the steps.

$$12x^3 - 2x^2 + -30x + 5$$

FIRST: Group the first two terms together in parenthesis, and the last two terms together in parenthesis.

$$(12x^3 - 2x^2) + (-30x + 5)$$

The + in the middle of the two parenthesis comes from the + that is between the $2x^2$ and $-30x$.

SECOND: Look at each group individually. Establish the GCF of the group, and factor it out.

FIRST GROUP: GCF is $2x^2$, factored out is $2x^2(6x - 1)$*

SECOND GROUP: GCF is -5 (when the leading term is negative, you take a negative out with the GCF), factored out is $-5(6x - 1)$*

NOTE: What remains in each set of parenthesis is a match. This is the goal of factoring by grouping. If they do not match, you have done something wrong.

THIRD: Your expression now looks like the one below, after you have taken out the GCF of each group.

$$2x^2(6x - 1) - 5(6x - 1)$$

FOURTH: You will now pull out the "GCFs" and put them together in one set of parenthesis, and then "pull down" one set of the matching parenthesis to get your final factorization.

$$2x^2(6x - 1) - 5(6x - 1)$$

$(2x^2 - 5)(6x - 1)$ → ***This is your final answer.***

ASSIGNMENT: ***Factor each expression using the factor by grouping method.***

1. $49x^3 - 35x^2 + 56x - 40$

2. $96x^3 - 84x^2 + 112x - 98$

3. $4x^3 - 12x^2 - 5x + 15$

4. $24x^3 + 15x^2 - 56x - 35$

PART TWO – SOLVING BY FACTORING

- **Solving by factoring means that we will now add "= 0" to the factoring work we have done the last two weeks. You will have to select a method of factoring, THEN you will have to solve for x as your final step.**
- **IN MOST PROBLEMS, there will be two answers for x.**
- **IMPORTANT THINGS TO REMEMBER:**
  - **The equation MUST be equal to zero BEFORE you can do any factoring.**
  - **The equation MUST also be in standard form.**
  - **You use the method of factoring when you have an equation involving multiple x-terms (x^3 or x^2 AND x).**

EXAMPLE 1:

Solve for x.

$$x^2 + 4x - 12 = 0$$

NOTE: The equation is already equal to zero AND in standard form. Since it is a quadratic trinomial, we will try to factor it in order to solve for x.

When factoring a trinomial, all your answers will be two binomials. You are basically trying to "fill in the blanks" of (_ +/- _)(_ +/- _).

FIRST: Check for a GCF.

In this problem, there is no number or variable that ALL THREE terms have in common.

SECOND: Establish the leading coefficient.

IN THIS CASE, IT IS 1 (the number in front of the x^2 term).

This means you can fill in the first "blank space" in each set of your factors

$(x$ +/- _$)(x$ +/- _$)$

THIRD: Look at the constant and the coefficient of the middle term.
The constant is -12, and the coefficient of the middle term is 4.

ASK YOURSELF: What two numbers MULTIPLY to -12, but also ADD to 4?
ANSWER: 6 and -2
This means you can fill in the second "blank space" in each set of your factors

$(x + 6)(x - 2)$

Now that you have factored the left side (trinomial), you are ready to solve.

Your equation is now $(x + 6)(x - 2) = 0$

TO SOLVE: You set each set of parenthesis equal to zero SEPARATELY and solve.

$x + 6 = 0$	$x - 2 = 0$
(subtract 6 from both sides)	(add 2 to both sides)
$x = -6$	$x = 2$

ANSWERS: $x = -6$ AND 2

EXAMPLE 2:

Solve for x.

$2x^2 + 3x - 9 = 0$

NOTE: The equation is already equal to zero AND in standard form. Since it is a quadratic trinomial, we will try to factor it in order to solve for x.

When factoring a trinomial, all your answers will be two binomials. You are basically trying to "fill in the blanks" of (_ +/- _)(_ +/- _).

FIRST: Check for a GCF.

In this problem, there is no number or variable that ALL THREE terms have in common.

SECOND: Establish the leading coefficient.

IN THIS CASE, IT IS 2 (the number in front of the x^2 term).

This means your process is a little different from example one. You will be using BOTH the factors of your first term and last term to fill in your binomials.

Factors of first term: 2x and x

Factors of last term: 3, -3

THIRD: You are now going to try to fill in your binomials, like we did in example 1, using this information.

ATTEMPT #1: $(2x + 3)(x - 3)$ – doesn't work, it will FOIL out to $2x^2 - 3x - 9$

Try switching the placement of the +3 and -3

ATTEMPT #2: $(2x - 3)(x + 3)$ – IT WORKS! It will FOIL to $2x^2 + 3x - 9$

$(2x - 3)(x + 3)$

<u>Now that you have factored the left side (trinomial), you are ready to solve.</u>

Your equation is now $(2x - 3)(x + 3) = 0$

TO SOLVE: You set each set of parenthesis equal to zero SEPARATELY and solve.

$2x - 3 = 0$	$x + 3 = 0$
(add 3 to both sides)	(subtract 3 from both sides)
(divide both sides by 2)	$x = -3$
$x = 3/2$	

ANSWERS: $x = 3/2$ AND -3

EXAMPLE 3:

Solve for x.

$$12x^3 - 21x^2 = -28x + 49$$

NOTE: The equation is NOT equal to zero OR in standard form. We must rearrange it before we can factor. Always move the terms to the side of the equation where the leading term is POSITIVE. In this example, we will move the terms on the left to the right to keep the $12x^3$ term POSITIVE.

$12x^3 - 21x^2 = -28x + 49$
(add $28x$ to both sides)
(subtract 49 from both sides)

NEW EQUATION: $12x^3 - 21x^2 + 28x - 49 = 0$

Since this equation has four terms, our method of factoring is factoring by grouping.

FIRST: Group the first two terms together in parenthesis, and the last two terms together in parenthesis.

$(12x^3 - 21x^2) + (28x - 49)$

The + in the middle of the two parenthesis comes from the + that is between the $21x^2$ and $28x$.

SECOND: Look at each group individually. Establish the GCF of the group, and factor it out.

FIRST GROUP: GCF is $3x^2$, factored out is $3x^2(4x - 7)$*

SECOND GROUP: GCF is 7, factored out is $7(4x - 7)$*

NOTE: What remains in each set of parenthesis is a match. This is the goal of factoring by grouping. If they do not match, you have done something wrong.

THIRD: Your expression now looks like the one below, after you have taken out the GCF of each group.

$3x^2(4x - 7) + 7(4x - 7)$

FOURTH: You will now pull out the "GCFs" and put them together in one set of parenthesis, and then "pull down" one set of the matching parenthesis to get your final factorization.

$3x^2(4x - 7) + 7(4x - 7)$

$(3x^2 + 7)(4x - 7)$ → ***This is your factorization.***

Your equation is now $(3x^2 + 7)(4x - 7) = 0$

TO SOLVE: You set each set of parenthesis equal to zero SEPARATELY and solve.

$3x^2 + 7 = 0$
(subtract 7 from both sides)
(divide both sides by 3)
(take the square root of -7/3)
x = no solution

$4x - 7 = 0$
(add 7 to both sides)
(divide both sides by 4)
$x = 7/4$

ANSWER: $x = 7/4$

ASSIGNMENT: ***Solve for x by factoring.***

1. $x^2 - 11x + 24 = 0$

2. $x^2 - 10x + 22 = -2$

3. $6x^2 - 13x + 6 = 0$

4. $10x^2 = 27x - 18$

5. $2x^3 + 5x^2 + 6x + 15 = 0$

6. $12x^3 + 3x = -4x^2 - 1$