Mr. Ward Answer Key

Factoring!

Factoring using a Common Monomial

This is something you should be familiar with, you've just probably never heard it called this. Basically what this means is you'll be given a polynomial and you will simplify it by taking out something that all the terms have in common.

Example #1 $12x^3 + 4x^2 + 2x$

When you look at that polynomial you hopefully see something that all three terms have in common. The math jargon for this is Greatest Common Factor or GCF.

If you don't see it in your head yet let's go through some steps you should be thinking about.

First Step: Look at the coefficients. (12, 4, and 2)
What is the Greatest Common Factor of these three numbers? 2

Second Step: Look at the variables. (x^3, x^2, and x) What is the GCF? x

Hopefully through those two steps you got that the GCF of the polynomial was 2x.

You would then reverse distribute and factor 2x out of each of the three terms.

** It should then look like this: $2x(6x^2 + 2x + 1)$ **

Practice Problem #1 Factor by finding the common monomial: $9x^3 - 27x^2 + 3x$

Write your answer below.

$3x(3x^2 - 9x + 1)$

Assignment: Common Monomial Worksheet

Factor Theorem

Quick question. What is 16/4? 4 Alright, so you got 4 and no remainder right. This is because 4 is a factor of 16.
What I'm getting at here is that when you divide a number by one of its factors you get no remainder (or another way to say it, a remainder of 0).

This same concept will apply to polynomials. If we divide a polynomial by one of its factors we should get a remainder of 0.

Example #1

Determine whether the given binomial is a factor of the polynomial P(x).

(x-3); $P(x) = x^2 + 2x - 3$

If you remember synthetic division you will be golden here. If not review your notes over synthetic division.

Step 1: Identifying "a"

To do this look at the binomial we were given, (x-3). Just like you did when solving synthetic division problems, what is a? 3

Hopefully you said 3. To solve this problem we're going to use Synthetic Substitution. Pretend that you are doing synthetic division. Solve it out below.

$$\begin{array}{r|rrr} 3 & 1 & 2 & -3 \\ & \downarrow & 3 & 15 \\ \hline & 1 & 5 & 12 \end{array}$$

When you are all done look at your remainder. What was it? 12

- IF your remainder is zero, then you know that the linear binomial is a factor of the polynomial.
- IF your remainder is something other than zero, then you know that the linear binomial is not a factor of the polynomial.

Was (x-3) a factor of $x^2 + 2x - 3$? Yes or No? NO!

Assignment: pg 433 #1-3, 17-19

Factor by Grouping

Another method you'll use to factor polynomials is called grouping. This happens when you break down the polynomial into two different groups and factor each group individually.

Here's how to tell when to use grouping or not. If the polynomial you are trying to factor has 4 or more terms, you want to factor by grouping.

Example #1

$x^3 + 5x^2 - 4x - 20$

How many terms are there? 4
Therefore we're going to want to factor by grouping. To solve this we're going to split those 4 terms into 2 different groups, the 2 terms on the left and the 2 terms on the right. So our two groups will be:

$x^3 + 5x^2$ and $-4x - 20$

Now just factor each of these things individually. Do this by finding the GCF and factoring it out just like you did on the first page of this packet.

What is the greatest common factor for the left group? x^2

What is the greatest common factor for the right group? -4

Finish factoring below. Be sure to show all your work and steps.

$x^2(x+5)$ | $-4(x+5)$

Answer: $x^2(x+5)$ on the right and $-4(x+5)$ on the left.

What do you notice about the two things in the parenthesis? they're the same

That's right they are the exact same. This is a good check to make sure you're doing things right. The two things in the parenthesis should always be the same.

Now the last step is to write the two factors out next to each other. One factor is the (x+5) and the other factor are the two individual terms you had factored out. Which in this case is x^2 and -4.

Final answer then is $(x^2 - 4)(x + 5)$.

Practice Problem #1

Factor $x^3 - 2x^2 - 9x + 18$

$x^3 - 2x^2$ | $-9x + 18$

$x^2(x-2)$ $\quad -9(x-2)$ $\quad = (x^2-9)(x-2)$

Assignment: **pg 433 #4-9, 20-25**

Factoring Trinomials

A trinomial has how many terms? 3

When factoring a trinomial you will use reverse FOIL.

Example #1 Factor $x^2 + 4x + 3$

Step 1: Create 2 Parenthesis → ( )( )

Step 2: Fill in the first terms. → $(x \quad)(x \quad)$

Step 3: Look at the factors of the third term. Write them out!

In this case it is 3. What are the factors of the number 3? 1 and 3

Put them into the parenthesis. → $(x \quad 1)(x \quad 3)$

Step 4: Decide what the signs need to be in order to get to the middle term.

In this case we need them to both be + signs in order to get to 4x.

Answer: $(x+1)(x+3)$

*** *Hint:* You can **always** check to see if you answer is correct by FOILing your answer and seeing if you get back to what the original problem was. ***

Practice Problem #1 Factor $x^2 + 3x - 10$

1, 10
2, 5

(x)(x)

(x 2)(x 5)

(x-2)(x+5)

Show all your work and steps! Check with me or my key to see if your answer is correct when you're done!!

Assignment: Trinomial Worksheet

Mr. Ward Answer Key

Common Monomial Worksheet

$2x^6 - 4x^5 + 20x^4$

$2x^4(x^2 - 2x + 10)$

$-5x^3 - 7x$

$-x(5x^2 + 7)$

$-3x^6 + 15x^4$

$3x^4(-x^2 + 5)$

$14x^5 - 24x^4$

$2x^4(7x - 12)$

$19x^3 - 19x$

$19x(x^2 - 1)$

$160x^3 + 100x^2 - 180x$

$20x(8x^2 + 5x - 9)$

$-3x^3 - 33x$

$-3x(x^2 + 11)$

$-16x^4 - 32x^3 - 80x^2$

$-16x^2(x^2 + 2x + 5)$

$4x^2 + 9x$

$x(4x + 9)$

$-6x^5 + 3x^3$

$3x^3(-2x^2 + 1)$

$24x^3 + 168x$

$24x(x^2 + 7)$

$4x^3 - 28x$

$4x(x^2 - 7)$

Mr. Ward Answer Key

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4. $x^3 + x^2 - x - 1$

$x^2(x+1) \quad -1(x+1)$

$= (x^2-1)(x+1)$

5. $x^3 + 5x^2 - 4x - 20$

$x^2(x+5) \quad -4(x+5)$

$= (x^2-4)(x+5)$

6. $8x^3 + 4x^2 - 2x - 1$

$4x^2(2x+1) \quad -1(2x+1)$

$= (4x^2-1)(2x+1)$

7. $2x^3 - 2x^2 - 8x + 8$

$2x^2(x-1) \quad -8(x-1)$

$= (2x^2-8)(x-1)$

8. $2x^3 - 3x^2 - 2x + 3$

$x^2(2x-3) \quad -1(2x-3)$

$= (x^2-1)(2x-3)$

9. $12x^2 + 3x - 24x - 6$

$3x(4x+1) \quad -6(4x+1)$

$= (3x-6)(4x+1)$

20. $8y^3 - 4y^2 - 50y + 25$

$4y^2(2y-1) \quad -25(2y-1)$

$= (4y^2-25)(2y-1)$

21. $4b^3 + 3b^2 - 16b - 12$

$b^2(4b+3) \quad -4(4b+3)$

$= (b^2-4)(4b+3)$

22. $3p^3 - 21p^2 - p + 7$

$3p^2(p-7) \quad -1(p-7)$

$= (3p^2-1)(p-7)$

23. $3x^3 + x^2 - 27x - 9$

$x^2(3x+1) \quad -9(3x+1)$

$= (x^2-9)(3x+1)$

24. $8z^2 - 4z + 10z - 5$

$4z(2z-1) \quad +5(2z-1)$

$= (4z+5)(2z-1)$

25. $5x^3 - x^2 - 20x + 4$

$x^2(5x-1) \quad -4(5x-1)$

$= (x^2-4)(5x-1)$

Mr. Ward Answer Key

Factoring Trinomials

$x^2 + 9x + 18$

1, 18
3, 6
2, 9

$(x+3)(x+6)$

$x^2 + 7x + 12$

1, 12
2, 6
3, 4

$(x+3)(x+4)$

$x^2 + 11x + 18$

1, 18
3, 6
2, 9

$(x+2)(x+9)$

$x^2 + 14x + 24$

1, 24
2, 12
4, 6
3, 8

$(x+2)(x+12)$

$x^2 + 17x + 30$

1, 30
2, 15
3, 10
6, 5

$(x+2)(x+15)$

$x^2 - 2x - 15$

-1, 15 -15, 1
-3, 5 -5, 3

$(x-5)(x+3)$

$x^2 + 3x - 18$

-1, 18 -18, 1
-3, 6 -6, 3
-2, 9 -9, 2

$(x-3)(x+6)$

$x^2 - 7x + 12$

1, 12
2, 6
3, 4

$(x-3)(x-4)$

$x^2 - 17x + 72$

1, 72
2, 36
4, 18
6, 12
3, 24
8, 9

$(x-8)(x-9)$

$x^2 - 8x + 16$

1, 16
2, 8
4, 4

$(x-4)(x-4)$