PreCalc. Sect A.3 (2): Factoring

By the end of the lesson you will be able to:

~ Factor polynomials using these methods

- Sum of squares
- Difference/Sum of cubes
- Box method
- Grouping

PreCalc. Sect A.3 (2): Factoring

Remember what the Standard Polynomial looks like.

The Standard Polynomial is
where A, B, & C are real numbers.

$$Ax^2 + Bx + C$$

Remember, when factoring, we ALWAYS factor out the GCF first!

Sum of Squares

Now, we have another kind of polynomial that we can factor. It is called the **sum of squares**.

The polynomial looks like this:

$$(a^2x^2 + 2acx + c^2) = (ax + c)^2$$

Essentially, the middle term b=2ac.

Examples: Factor

1. $x^2 + 6x + 9$

$(x+3)^2$

2. $x^2 - 10x + 25$

$(x-5)^2$

PreCalc. Sect A.3 (2): Factoring

Examples: Factor

3. $16x^2 + 16x + 4$

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

$\boxed{4(2x+1)^2}$

4. $\boxed{4u^2 + 12x + 9v^2}$

$\cancel{(2u \quad 3v)^2}$

Factoring:

Sum and Difference of Cubes

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

Memorize!

Examples: Factor

1. $8x^3 - 27y^3$

$a = 2x$

$b = 3y$

$$\boxed{(2x - 3y)(4x^2 + 6xy + 9y^2)}$$

$(a-b)(a^2 + ab - b^2)$

Examples: Factor

2. $x^3 + 64y^3$

$a = x$

$b = 4y$

$$\boxed{(x+4y)(x^2-4xy+16y^2)}$$

Factoring:

If all else fails, we can always factor using the box method.

This will ALWAYS work!

PreCalc. Sect A.3 (2): Factoring

We will use this box to help us organize our work to figure out what two binomials multiply to be the polynomial given.

ax^2	$6x$
$5x$	c

$a \cdot c$

Essentially, we are trying to find two numbers that multiply to be A(C) and add to be B.

$$Ax^2 + Bx + C$$

PreCalc. Sect A.3 (2): Factoring

Box Method of Factoring:

Step 1: In the upper left box, put your first term, In the lower right box, put your last term.

ax^2	
	c

Step 2: Multiply *AxC* and factor the product to find factors that add up to B. Put these factors (with an x attached) into the other two boxes. Order doesn't matter.

Step 3: Find the *GCF* of each row and each column. Keep the sign of the upper right and lower left boxes as part of the *GCF*.

Step 4: Rewrite the *GCF*'s of the rows in one set of parentheses, and the *GCF*'s of the columns in one set of parentheses. This is your final factorization.

PreCalc. Sect A.3 (2): Factoring

Remember, factoring is essentially "undistributing". We are trying to write a ***second-degree*** polynomial as the product of ***2 first degree*** binomials. There is a pattern that always appears when we're factoring.

$$If\ x^2 + bx + c = (x+m)(x+n),$$
$$then\ \ b = m + n\ \ and\ \ c = m \cdot n$$

PreCalc. Sect A.3 (2): Factoring

Ex 1: Factor $y^2 + 11y + 28$

$$\begin{array}{c|c|c|c}
 & y & +7 & \\
\hline
 & y^2 & 7y & y \\
\hline
 & 4y & 28 & +4 \\
\end{array}$$

$\underline{7} \cdot \underline{4} = 28$

$\underline{7} + \underline{4} = 11$

$$\boxed{(y+7)(y+4)}$$

PreCalc. Sect A.3 (2): Factoring

Ex 2: Factor $a^2 - 11a + 18$

	a	-9
a	a^2	$-9a$
-2	$-2a$	18

$$\boxed{(a-2)(a-9)}$$

PreCalc. Sect A.3 (2): Factoring

Examples:

3. $4x^2 + 7x + 3$

$$\underline{4} \cdot \underline{3} = 12$$

$$\underline{4} + \underline{3} = 7$$

$$\begin{array}{c|c|c|} & 4x & +3 \\ \hline x & 4x^2 & 3x \\ \hline +1 & 4x & 3 \\ \hline \end{array}$$

$$(4x+3)(x+1)$$

Examples:

4. $2x^2 + 7x + 6$

$\underline{3} \cdot \underline{4} = 12$

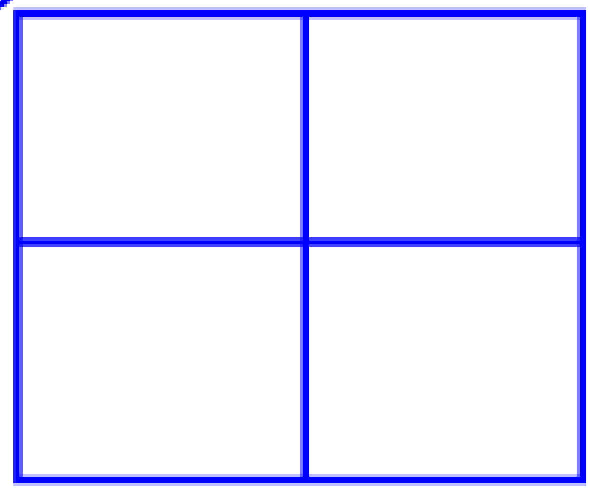
$\underline{3} + \underline{4} = 7$

	x	$+2$
$2x$	$2x^2$	$4x$
$+3$	$3x$	6

Examples: Let's just finish using the "Box".

$-3 \cdot 2 = -6$

$-3 + 2 = -1$



5. $4x^2 - 2x - 6$

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

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

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

$\boxed{2(2x-3)(x+1)}$

Factor by Grouping (4 terms)

Step 1: Group the terms with common factors. Sometimes it will be necessary to rearrange the terms.

Step 2: In each grouping, factor out the common factor.

Step 3: Factor out the common factor that remains (usually a Binomial).

Step 4: Check your answer.

PreCalc. Sect A.3 (2): Factoring

Factor by Grouping

Examples:

1. $\cancel{6+}\ x^3 + 3x^2 + 2x + 6$

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

$\boxed{(x+3)(x^2+2)}$

PreCalc. Sect A.3 (2): Factoring

Factor by Grouping

Examples:

2. $6x^2 + 9x - 10x - 15$

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

$\boxed{(2x+3)(3x-5)}$

PreCalc. Sect A.3 (2): Factoring

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- Box method
- Grouping

Can you?

Homework:

Section A.3: 113-151 odd, 159-169 odd, 173, 175, 183