

Factoring Polynomials

Student Objectives:

Students will be able to factor quadratics with a leading coefficient of 1.

What is factoring?

Factoring is the process of rewriting a polynomial as a product (the multiplication) of two or more polynomials.

In other words, we rewrite this: $x^2 + 6x + 5$
as this: $(x + 5)(x + 1)$

Method 1: Factor by Greatest Common Factor (GCF)

Steps:

1. Identify the largest multiple ALL TERMS share (this can be a number or variable).

2. Divide out the multiple and add parenthesis around your new polynomial.

3. Write your multiple you divided outside the parenthesis.

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

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

Examples of Factoring by GCF:

$$\begin{aligned} \text{a) } & 3x^2 - x \\ & x(3x - 1) \end{aligned}$$

$$\begin{aligned} \text{c) } & 12x^3 + 4x \\ & = 4x(3x^2 + 1) \end{aligned}$$

$$\begin{aligned} \text{b) } & s^3 - s^2 + \frac{1}{2}s \\ & s\left(s^2 - s + \frac{1}{2}\right) \end{aligned}$$

$$\begin{aligned} \text{d) } & 7y^4 - 21y^2 \\ & 7y^2(y^2 - 3) \end{aligned}$$

Factoring Trinomials

$$x^2 + \underline{9}x + \underline{8}$$

Multi: 8

Add: 9

$$1 + 8 = 9$$

~~$$2 + 4 = 6$$~~

$$(x+1)(x+8)$$

1. Check to see if the polynomial is in descending order.

2. Find two numbers that add to the constant, but add to the middle term (list factors).

Those two numbers will be your factors.

multiply

Factoring Trinomials (Examples)

a) $x^2 + 12x - 13$

Multi: -13
Add: +12
- 1 * 13 = +12 ✓

$(x+13)(x-1)$

b) $x^2 + 10x + 21$

Multi: +21
Add: +10
~~1+21=22x~~
3+7=10 ✓

$(x+3)(x+7)$

c) $x^2 - 3x - 28$

$(x+4)(x-7)$

1 * 28 = -28
2 * -14 = -28
4 * -7 = -28 ✓

c) $x^2 + 8x - 48$

$(x+12)(x-4)$

Factoring TWO Terms

Form	Factor
$a^2 - b^2$ (1st squared) - (2nd squared)	$(a + b)(a - b)$
$a^2 + b^2$ (1st squared) + (2nd squared)	<u>NOT FACTORABLE</u>
$a^3 - b^3$ (1st cubed) - (2nd cubed)	$(a - b)(a^2 + ab + b^2)$
$a^3 + b^3$ (1st cubed) + (2nd cubed)	$(a + b)(a^2 - ab + b^2)$

Warm Up (9/7/18)

Factor completely (hint: factor the GCF first)

a) $12x^2 + 36x + 24$

b) $3x^3 - 33x^2 - 36x$

Factoring Method 3: Factor by Grouping

If there are more than 3 terms you will want to consider factoring by grouping.

$$\begin{aligned} & (x^3 + 7x^2) + (2x + 14) \\ & \underline{x^2(x+7) + 2(x+7)} \\ & (x+7)(x^2+2) \end{aligned}$$

1. Group the first two terms and last two terms together.

2. Factor out the GCF of each binomial.

3. Factor out the common binomial.

Factor by Grouping Examples

$$\text{a) } (a^3 - 2a^2) + (5a - 10)$$
$$\underline{a^2(a-2)} + \underline{5(a-2)}$$

$$(a-2)(a^2+5)$$

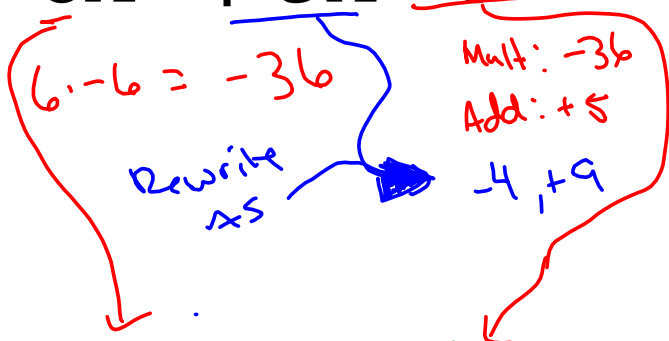
$$\text{b) } (2x^3 - 5x^2) - (6x - 15)$$
$$\underline{x^2(2x-5)} + \underline{(-3)(2x-5)}$$

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

Factoring Method 4: The "AC" Method

Use this method when the leading coefficient is not 1 and you cannot factor a GCF

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



$$(6x^2 - 4x) + (9x - 6)$$

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

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

1. Multiply the first and last terms together.
2. We want the terms, when multiplied together to give us our product, but when we add them will give us our second term.
3. Rewrite the middle term as a sum of our numbers we found.
4. Now we apply factor by grouping.