

2.1 Factoring Part 1

Quadratic - x^2

Factoring - "undistributing", going backwards from distribution

Factoring is a way that can help us find solutions to equations. Today we will go over three strategies to help us factor.

- Greatest Common Factor

- what is the biggest multiple that each term has in common?
- this applies to coefficients and variables

★ Make sure everything is in standard form first - highest exponent to lowest exponent ★

$$\begin{array}{l} \text{1) a) } -5x^2 - 20x + 15x^3 + 5 \\ 15x^3 - 5x^2 - 20x + 5 \\ \boxed{5(3x^3 - x^2 - 4x + 1)} \end{array}$$

$$\begin{array}{l} \text{b) } 8m^6 + 2m^8 - 4m^4 \\ 2m^8 + 8m^6 - 4m^4 \\ \boxed{2m^4(m^4 + 4m^2 - 2)} \end{array}$$

$$\begin{array}{l} \text{c) } -x^2 + 3x - 4 \\ \boxed{-(x^2 - 3x + 4)} \end{array}$$

* If the first term is negative, you must factor it out

- Factoring by grouping - split expression into groups & factor out GCF from each group - use with 4 terms

$$\begin{array}{l} \text{2) a) } 4x^3 + 8x^2 + x + 2 \\ 4x^2(x+2) + 1(x+2) \\ \boxed{(4x^2+1)(x+2)} \end{array}$$

$$\begin{array}{l} \text{b) } 4x^2 + 20xy - 3xy - 15y \\ 4x(x+5) - 3y(x+5) \\ \boxed{(4x-3y)(x+5)} \end{array}$$

Notice that the GCFs you factored out become their own parentheses in the factored expression. This only works since the other set of parentheses are the same. If that set of parentheses was not the same, we would not be able to factor.

$$\begin{array}{l} \text{c) } 3x^3 - 6x^2 + 15x - 30 \\ 3x^2(x-2) + 15(x-2) \\ \rightarrow (3x^2+15)(x-2) \\ \text{GCF } \boxed{3(x^2+5)(x-2)} \end{array}$$

$$\begin{array}{l} \text{vs. } 3x^3 - 6x^2 + 15x - 30 \leftarrow \text{GCF} \\ 3(x^3 - 2x^2 + 5x - 10) \\ 3(x^2(x-2) + 5(x-2)) \\ \boxed{3(x^2+5)(x-2)} \end{array}$$

If there is a GCF for the entire expression, you can either factor it out in the beginning or at the end. You will end up with the same answer.

- factoring trinomials (3 terms)
- the goal is to create a factoring by grouping situation

Standard Form
 $ax^2 + bx + c$

a, b, c represent coefficients

3) a) $x^2 - 7x + 6$

$x^2 - 1x - 6x + 6$ $2x \quad 3x = 5x$

$x(x-1) - 6(x-1)$ $1x \quad 6x = 7x$

$(x-6)(x-1)$ $-1x \quad -6x = -7x$

Start by multiplying first & last term (acx^2)
 Find two numbers that multiply to ac but add to b , then substitute that in.
 Then factor by grouping.

b) $x^2 + 9x + 18$

$x^2 + 6x + 3x + 18$ $18x^2$

$x(x+6) + 3(x+6)$ $2x \quad 9x = 11x$

$(x+3)(x+6)$ $6x \quad 3x = 9x$

c) $x^2 + 10x - 24$

$x^2 + 12x - 2x - 24$ $-24x^2$

$x(x+12) - 2(x+12)$ $6x \quad -4x = 2x$

$(x-2)(x+12)$ $12x \quad -2x = 10x$

Now that we know how to factor, we are going to use it to help us solve equations. We need to find solutions any time there is an equal sign.

Zero Product Property - If two things multiply to equal 0, then one of those things must be 0

4) a) $x^2 - x - 20 = 0$ $-20x^2$

$x^2 - 5x + 4x - 20 = 0$ $-5x \quad 4x$

$x(x-5) + 4(x-5) = 0$

$(x+4)(x-5) = 0$

$x = -4 \quad x = 5$

Once we factor, using the zero product property we will determine what value of x will make each factor equal 0.

Fun fact: It is always the opposite of what is in the factor

b) $2x^2 + 20x + 18 = 0$

$2(x^2 + 10x + 9) = 0$ $9x^2$

$2(x^2 + 1x + 9x + 9) = 0$ $1x \quad 9x$

$2(x(x+1) + 9(x+1)) = 0$

$2(x+9)(x+1) = 0$

$x = -9 \quad x = -1$

c) $x^3 + 12x^2 - 28x = 0$

$x(x^2 + 12x - 28) = 0$ $-28x^2$

$x(x^2 + 14x - 2x - 28) = 0$ $28x \quad 1x$

$x(x(x+14) - 2(x+14)) = 0$ $14x \quad -2x$

$x(x-2)(x+14) = 0$

$x = 0 \quad x = 2 \quad x = -14$

If the GCF is not a variable, it will not affect your solutions.

If the GCF is a variable, then one of the solutions will be $x=0$.