Factoring Difference of Squares

1. Find the square root of both terms
    a. If there is a coefficient in front of the variable(s), make sure that it is also a perfect square to be able to continue
2. For the parentheses, one will be an addition, and one will be a subtraction
3. Plug in the two answers you found from part 1

Examples:

$x^2 - 9$

The square root of x^2 is x, and the square root of 9 is 3

Therefore, the factored form is $(x + 3)(x - 3)$

$x^2 - a^2$

The square root of x^2 is x, and the square root of a^2 is a

Therefore, the factored form is $(x + a)(x - a)$

$25x^2 - 64y^2$

25 is a perfect square, as is 64, so we are able to continue to factor as a difference of squares

The square root of $25x^2$ is 5x, and the square root of $64y^2$ is 8y

Therefore, the factored form is $(5x + 8y)(5x - 8y)$

***Note, the sum of squares is not factorable with real numbers. For example, $x^2 + 25$ cannot be factored with real numbers.**

Factoring a Sum or Difference of Cubes

1. Take the cube root of both terms
    a. If there is a coefficient in front of the variable(s), make sure that it is also a perfect cube to be able to continue
2. For the first parentheses, the two terms will be the cube roots found in part 1. The sign inside that parentheses will be the same as the original sign in the problem

3. For the second parentheses, the first term will be first cube root found, and then squared. The second term will be both cube roots multiplied together. The third term will be the second cube root found, and then squared.
4. The first sign in the second parentheses will be the opposite of the sign in the first parentheses. The second sign will ALWAYS be an addition sign.

Examples: $x^3 - 27$

The cube root of x^3 is x, and the cube root of 27 is 3.

Therefore, the first parentheses is $(x - 3)$

The second parentheses has three terms: $(x)^2, 3 \cdot x, (3)^2 \; or \; x^2, 3x, 9$

Therefore, the second parentheses is $(x^2 + 3x + 9)$

And thusly our factored form is $(x - 3)(x^2 + 3x + 9)$

$8x^3 + 125$

The cube root of $8x^3$ is 2x, and the cube root of 125 is 5

Therefore, the first parentheses is $(2x + 5)$

The second parentheses has three terms: $(2x)^2, 2x \cdot 5, (5)^2 \; or \; 4x^2, 10x, 25$

Therefore, the second parentheses is $(4x^2 - 10x + 25)$

And thusly our factored form is $(2x + 5)(4x^2 - 10x + 25)$

$343x^3 - 216y^3$

The cube root of $343x^3$ is 7x, and the cube root of $216y^3$ is 6y

Therefore, the first parentheses is $(7x - 6y)$

The second parentheses contains: $(7x)^2, 7x \cdot 6y, (6y)^2 \; or \; 49x^2, 42xy, 36y^2$

Therefore the second parentheses is $(49x^2 + 42xy + 36y^2)$

And thusly our factored form is $(7x - 6y)(49x^2 + 42xy + 36y^2)$