Distributive Property/Law/Rule/whatever you want to call it

This is probably the most important thing you will need to know for this class. If you understand this one thing, you can apply it to a seriously broad range of problems. First, a definition.

Definition 1. If a, b, c are numbers, then these equalities are true:

$$a(b + c) = ab + ac$$

$$(b + c)a = ba + ca$$

The process of changing the right hand side expressions into the left hand side expressions is called "distribution." This is because you are distributing the a to the b *and* c. Notice that the a goes to *both* the b *and* c in both situations. Also notice that the distribution works in both directions: from the left and from the right.

Now lots of examples.

Examples.

1. $3(x + y) = 3x + 3y$
2. $4(x + y + z) = 4x + 4y + 4z$
3. $(x + y)\pi = \pi x + \pi y$
4. $(x + y + z)2 = 2x + 2y + 2z$
5. $-(x + y) = -x - y$
6. $-16(x + y + z) = -16x - 16y - 16z$
7. $(x + y)(-2) = -2x - 2y$
8. $a(x + y) = ax + ay$

More complicated examples with work shown

1. $$\overbrace{(x + 1)}(x + 3) = (x + 1)x + (x + 1)3 = x^2 + \underbrace{x + 3x}_{\text{combine like terms}} + 3 = x^2 + 4x + 3$$

   Step 1. Distribute the $(x + 1)$ to the x *and* the 3, as illustrated.
   Step 2. Distribute (from the left) the x outside the first set of the parentheses to the x inside the parentheses *and* to the 1 inside the parentheses. The process is similar for the second set of parentheses with the 3 next to it.
   Step 3. Finally, combine like terms (terms which have the same power of x), and you are finished.

2. $$\begin{aligned}(x - 5)(x + 4) &= (x - 5)x + (x - 5)4 \\ &= x^2 - 5x + 4x - 20 = x^2 - x - 20\end{aligned}$$

3. Be careful with negatives.

   $$\begin{aligned}(x - 3)(x - 8) &= (x - 3)x + (x - 3)(-8) \\ &= x^2 - 3x + (-8)x + (-3)(-8) \\ &= x^2 - 3x - 8x + 24 = x^2 - 11x + 24\end{aligned}$$