# Factoring Trinomials Using the Key Number Method

(http://www.sheboygan.uwc.edu/developmental-math/BAW/thirteen/lesson13.htm)

A trinomial is a polynomial with exactly three terms. These polynomials have a very special form since they are the typical polynomials that come out of the FOIL method for multiplying two binomials. The *Key Number Method* of factoring applies to any trinomials $ax^2 + bx + c$, where $a$, $b$, and $c$ are integers and $x$ represents any letter variable or string of variables.

| | ***Key Number Method*** | **Example 1:** Factor $6x^2 + x - 15$. |
|---|---|---|
| | ***To Factor*** $ax^2 + bx + c$ | |
| Step 1: | Calculate the product of the first and last coefficients: $a\ c$.<br>This is called the key number. | Find the key number: $(6)(-15) = -90$. |
| Step 2: | Find two factors of the key number $ac$ whose sum is $b$ (the middle coefficient). | Find factors of -90 that add up to 1 (the middle term is $1x$). Since $90 = 1 \cdot 90$ or $2 \cdot 45$ or $3 \cdot 30$ or $5 \cdot 18$ or $6 \cdot 15$ or $9 \cdot 10$, it looks like +10 and -9 will work since they multiply to -90 and add to +1. |
| Step 3: | Rewrite the original trinomial as a four term polynomial: replace the middle term by two terms that have coefficients equal to the factors found in step 2. | Substitute two terms for the middle term whose coefficients equal the factors from step 2.<br>$6x^2 + x - 15 = 6x^2 + 10x - 9x - 15$ |
| Step 4: | Factor the four term polynomial by grouping. | Factor by grouping.<br>$6x^2 + 10x - 9x - 15$<br>$= (6x^2 + 10x) + (-9x - 15)$<br>$= 2x(3x + 5) - 3(3x + 5)$<br>$= (3x + 5)(2x - 3)$ |
| Step 5: | Check by multiplying (use FOIL). | $(3x + 5)(2x - 3)$<br>$= 6x^2 - 9x + 10x - 15$<br>$= 6x^2 + x - 15$ |