

Keep in mind that polynomial multiplication (which was covered in Lesson 5) and factoring polynomials (which we cover in Lesson 6) are inverses of one another. That means that one undoes the other. If you take two binomial factors, such as $2x - 3$ and $5x - 4$, and multiply them together, you get the following:

$$(2x - 3)(5x - 4)$$

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$$2x \cdot 5x + 2x \cdot (-4) + (-3) \cdot 5x + (-3) \cdot (-4)$$

$$10x^2 - 8x - 15x + 12$$

$$**10x^2 - 23x + 12**$$

So multiplying the factors $2x - 3$ and $5x - 4$ results in the product $10x^2 - 23x + 12$. To undo that polynomial, we can factor. Obviously in this case we already know that $2x - 3$ and $5x - 4$ are the factors that produce the polynomial $10x^2 - 23x + 12$. However if we didn't already know that, we could find those two factors by factoring the polynomial. Since $10x^2 - 23x + 12$ is a trinomial, I will factor it using the *ac*-method. To do so, I'll need to find two numbers whose product is *a* times ($10 \cdot 12$), and whose sum is *b* (-23):

$ac = 120$	$b = -23$
<u>Factors</u>	<u>Sum</u>
$(-1)(-120)$	-121
$(-2)(-60)$	-62
$(-3)(-40)$	-43
$(-4)(-30)$	-34
$(-5)(-24)$	-29
$(-6)(-20)$	-26
$(-8)(-15)$	-23

Since the product of *a* times *c* is positive (120), and the sum is negative (-23), the factors we're looking for must both be negative. Be sure to consider the signs of the product and sum when identifying factors.

$$10x^2 - 23x + 12$$

$$10x^2 - 8x - 15x + 12$$

$$2x(5x - 4) - 3(5x - 4)$$

$$(5x - 4)(2x - 3)$$

So multiplying two polynomial factors results in a single polynomial, and factoring that one polynomial leads us back to the two original factors that we started with. So factoring undoes the multiplication that we did first, and vice versa multiplying those two factors together again will undo the factoring.

Polynomial Multiplication	Factoring
$(2x - 3)(5x - 4)$	$10x^2 - 23x + 12$
$10x^2 - 8x - 15x + 12$	$10x^2 - 8x - 15x + 12$
$10x^2 - 23x + 12$	$(5x - 4)(2x - 3)$

This process works the same using other trinomials as well:

Polynomial Multiplication	Factoring
$(7x - 1)(x + 3)$	$7x^2 + 20x - 3$
$7x^2 + 21x - x - 3$	$7x^2 + 21x - x - 3$
$7x^2 + 20x - 3$	$(7x - 1)(x + 3)$

Keep in mind that using the *ac*-method is my preferred way of factoring trinomials, but it is not the only way to factor trinomials or other types of polynomials. In Lesson 7 we'll cover steps for factoring (listed on the next page), which can be used as a guide to decide which factoring method to use based on the type of polynomial you are given.

Steps for Factoring:**1. ALWAYS check for a GCF first**

- a. this should be done regardless of how you are factoring or what type of polynomial you have (binomial, trinomial ...)
2. if the polynomial has two terms (binomial), check to see if both terms are perfect squares or perfect cubes
 - a. If the two terms are perfect squares, and they are being subtracted, use the difference of squares formula
 - i. $x^2 - y^2 = (x + y)(x - y)$
 - b. If the two terms are perfect cubes, and they are being added or subtracted, use the sum or difference of cubes formulas
 - i. $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$
 - ii. $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$
 - c. If none of the above apply to a binomial, it is not factorable
3. if the polynomial has three terms (trinomial), use the *ac*-method
4. if the polynomial has four terms, factor by grouping