# Lesson 19: Factoring Trinomials with a Leading Coefficient of One

**Objective:** Factor a trinomial with a leading coefficient of one.

**Students will be able to:**

- Identify two integer values that add to $b$ and multiply to $a \cdot c = c$ in a trinomial expression with ordered coefficients $a, b$, and $c$.

- Multiply binomials to verify the accuracy of a factorization.

- Recognize the relationship between factoring and expanding an expression.

**Prerequisite Knowledge:**

- Identifying a greatest common factor.

- Factor by grouping.

- Application of the distributive property.

- Multiplication and division of algebraic expressions.

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**Lesson:**
**I - Motivating Example(s):**

**Example:** Write the expanded form for the given expression.

$$(x + 6)(x - 4) \qquad \text{Distribute } (x + 6) \text{ through the second set of parentheses.}$$
$$x(x + 6) - 4(x + 6) \qquad \text{Distribute each monomial through parentheses.}$$
$$x^2 + 6x - 4x - 24 \qquad \text{Combine like terms.}$$
$$x^2 + 2x - 24 \qquad \text{Our solution.}$$

Notice that if we reverse the last three steps of the previous example, the process resembles grouping. This is because it is grouping! In the second-to-last line, the GCF of the first two terms is $x$ and the GCF of the last two terms is $-4$. In this manner, we will factor trinomials by writing them as a polynomial containing four terms, splitting up the middle term, and then factor by grouping. This is demonstrated in the following example, which is the previous one done in reverse.

**Example:** Factor the given expression.

$$x^2 + 2x - 24 \qquad \text{Split middle (linear) term into } + 6x - 4x,$$
$$\text{since } 6 + (-4) = 2 \text{ and } 6 \cdot (-4) = -24.$$
$$x^2 + 6x - 4x - 24 \qquad \text{Grouping: GCF on left is } x, \text{ on right is } -4.$$
$$x(x + 6) - 4(x + 6) \qquad (x + 6) \text{ appears twice, factor out this GCF.}$$
$$(x + 6)(x - 4) \qquad \text{Our solution.}$$

## II - Demo/Discussion Problems:

Factor each of the given trinomial expressions.

1. $x^2 + 9x + 18$
2. $x^2 - 4x + 3$
3. $x^2 - 13x + 30$
4. $x^2 + 13x - 30$
5. $5x^2 - 40x - 100$
6. $x^2 - 9xy + 14y^2$

## III - Practice Problems:

Factor each of the given trinomial expressions.

1. $p^2 + 17p + 72$
2. $x^2 + x - 72$
3. $n^2 - 9n + 8$
4. $x^2 + x - 30$
5. $x^2 - 9x - 10$
6. $x^2 + 13x + 40$
7. $b^2 + 12b + 32$
8. $b^2 - 17b + 70$
9. $x^2 + 3x - 70$
10. $x^2 + 3x - 18$
11. $n^2 - 8n + 15$
12. $a^2 - 6a - 27$
13. $p^2 + 15p + 54$
14. $p^2 + 7p - 30$
15. $n^2 - 15n + 56$
16. $m^2 - 15mn + 50n^2$
17. $u^2 - 8uv + 15v^2$
18. $m^2 - 3mn - 40n^2$
19. $m^2 + 2mn - 8n^2$
20. $x^2 + 10xy + 16y^2$
21. $x^2 - 11xy + 18y^2$
22. $u^2 - 9uv + 14v^2$
23. $x^2 + xy - 12y^2$
24. $x^2 + 14xy + 45y^2$
25. $x^2 + 4xy - 12y^2$
26. $4x^2 + 52x + 168$
27. $5a^2 + 60a + 100$
28. $5n^2 - 45n + 40$
29. $6a^2 + 24a - 192$
30. $5v^2 + 20v - 25$
31. $6x^2 + 18xy + 12y^2$
32. $5m^2 + 35mn - 90n^2$
33. $6x^2 + 96xy + 378y^2$
34. $6m^2 - 36mn - 162n^2$