# Factoring Polynomials

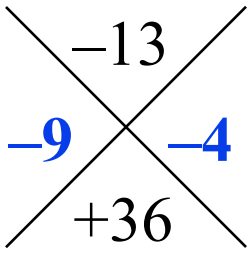
# Factoring Polynomials and Solving

***How do you factor a trinomial with a leading coefficient of 1?***

***Example:*** Factor $x^2 - 13x + 36$

***You can use a diamond...***

Write the middle coefficient here

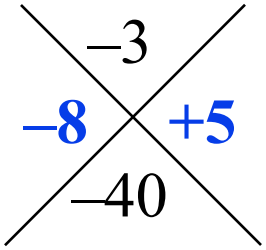



Now, find factors that will multiply to the bottom number, and add to the top number.

Write the last term here.

***The factors are*** **$(x - 9)(x - 4)$**

***Example:*** Factor $x^2 - 3x - 40$




***The factors are*** **$(x - 8)(x + 5)$**

***How do you factor a trinomial whose leading coefficient is not 1?***

***Example:*** Factor $3x^2 + 13x + 4$

***We will make a T to determine the coefficients of the factors...***

Write factors of the first term in this column.

Write factors of the last term in this column.

| 3 | 2 |
|---|---|
| 1 | 2 |

$2 + 6 \neq 13$

Multiple diagonally and add. See if the sum matches the middle term...

| ( 3 | 1 ) |
|---|---|
| ( 1 | 4 ) |

These are the coefficients of the factors...

$1 + 12 = 13$

…if not, try another combination of factors...

**$(3x + 1)(x + 4)$**

***Example:*** Factor $6d^2 + 33d - 63$

***Remember, look for the GCF first...***

GCF: 3

$3(2d^2 + 11d - 21)$

***Now, factor the trinomial (using a T)***

| 2 | –3 |
|---|---|
| 1 | 7 |

$-3 + 14 = 11$

**$3(2d - 3)(d + 7)$**

***How do you factor the sum or difference of cubes?***

***You'll need to memorize the factorization of the sum or difference of two cubes:***

**Sum of Two Cubes:**

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

**Difference of Two Cubes:**

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

***Example:*** *Factor* $x^3 + 27$

*The cube roots of the terms are* $x$ *and* $3$

$$= (x + 3)(x^2 - 3x + 9)$$

***Example:*** *Factor* $128x^3 - 250$

*Factor out the GCF first…*

$$= 2(64x^3 - 125)$$

*The cube roots are* $4x$ *and* $-5$

$$= 2(4x - 5)(16x^2 + 20x + 25)$$

***How do you factor a polynomial that has 4 terms?***

***Example:*** Factor $x^2 - 2xy + x - 2y$

***Group terms together to find a GCF.***

$$(x^2 - 2xy) + (x - 2y)$$

***The GCF of this binomial is x***

**$x(x - 2y) + (x - 2y)$**

***The GCF is the binomial:*** **$(x - 2y)$**

**$(x - 2y)(x + 1)$**

***Example: Factor*** $a^2 + 4ab - 9x^2 + 4b^2$

***This has a perfect square trinomial hidden in it.***

$$\mathbf{a^2 + 4ab + 4b^2} - 9x^2$$

$$\mathbf{(a + 2b)^2} - 9x^2$$

***Now, this is the difference of 2 squares***

$$\mathbf{(a + 2b + 3x)(a - 2b - 3x)}$$

# Factoring Strategy

- Look for the **GCF**.
- If there are 2 terms, look for
  - Difference of 2 squares
  - Difference or Sum of 2 cubes
- If there are 3 terms, look for
  - Perfect Square trinomial
  - Diamond or T
- If there are 4 terms, look for
  - grouping