

# List Of Algebra 2 Formulas

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## INTRODUCTION: WHY A COMPREHENSIVE LIST OF ALGEBRA 2 FORMULAS MATTERS

Algebra 2 is a pivotal course in high school mathematics, bridging foundational concepts from Algebra 1 and Geometry to the more abstract thinking required for precalculus and calculus. At its core, Algebra 2 introduces students to polynomial functions, exponential and logarithmic relationships, complex numbers, and data analysis. Mastering the material often comes down to memorizing and knowing how to apply key formulas. A well-organized **list of algebra 2 formulas** can serve as a lifeline for homework, test preparation, and real-world problem solving. Whether you are a student reviewing for finals, a teacher creating a reference sheet, or someone returning to math after many years, having all those essential equations in one place saves time and reduces frustration. This article provides a comprehensive, clearly categorized guide to the most important formulas you will encounter in a typical Algebra 2 course. We will explore each formula's purpose, its components, and when to use it, so you can build both fluency and confidence.

## LINEAR FUNCTIONS AND EQUATIONS

Linear relationships are the foundation of algebra. Even as Algebra 2 dives into higher-degree polynomials, working with lines remains essential for modeling and for understanding slopes.

## Slope Formula

Given two points  $(x_1, y_1)$  and  $(x_2, y_2)$ :

- Slope  $(m)$**   $= \frac{y_2 - y_1}{x_2 - x_1}$

This formula expresses the rate of change of a linear function. It is used to determine whether lines are parallel ( $m_1 = m_2$ ) or perpendicular ( $m_1 \cdot m_2 = -1$ ).

## Forms of Linear Equations

- Slope-intercept form:**  $y = mx + b$
- Point-slope form:**  $y - y_1 = m(x - x_1)$
- Standard form:**  $Ax + By = C$

Each form has advantages: slope-intercept is ideal for graphing; point-slope is perfect when you

know a point and the slope; standard form is useful for quickly finding intercepts.

## Distance and Midpoint Formulas

- Distance:**  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
- Midpoint:**  $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

These formulas extend the coordinate geometry skills from Algebra 1 into more complex problem contexts in Algebra 2, such as finding lengths of segments or centers of figures.

## QUADRATIC FUNCTIONS AND EQUATIONS

Quadratic equations are central to Algebra 2. They appear in projectile motion, area optimization, and many science applications.

## Standard Form of a Quadratic

- $f(x) = ax^2 + bx + c$ , where  $a \neq 0$

## Vertex Form

- $f(x) = a(x - h)^2 + k$
- The vertex is at  $(h, k)$ .

## Quadratic Formula (for solving $ax^2 + bx + c = 0$ )

- $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

The discriminant  $(b^2 - 4ac)$  tells us about the nature of roots: positive means two real solutions, zero means one real solution, negative means two complex solutions.

# Factoring Formulas

- **Difference of squares:**  $a^2 - b^2 = (a - b)(a + b)$
- **Perfect square trinomial:**  $a^2 \pm 2ab + b^2 = (a \pm b)^2$

Recognizing these patterns helps solve quadratic equations efficiently without always using the quadratic formula.

## POLYNOMIAL FUNCTIONS

Algebra 2 expands polynomial operations to include higher degrees. The following formulas are essential for factoring and analyzing polynomial behavior.

# Sum and Difference of Cubes

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

# Remainder and Factor Theorems

- **Remainder Theorem:** If polynomial  $P(x)$  is divided by  $(x - c)$ , the remainder is  $P(c)$ .
- **Factor Theorem:**  $(x - c)$  is a factor of  $P(x)$  if and only if  $P(c) = 0$ .

# Rational Root Theorem

For a polynomial  $a_n x^n + a_{n-1} x^{n-1} + \dots + a_0$ , possible rational roots are  $\pm \frac{\text{factors of } a_0}{\text{factors of } a_n}$ .

# Fundamental Theorem of Algebra

Every nonzero polynomial of degree  $n$  has exactly  $n$  complex roots (counting multiplicities).

## EXPONENTIAL AND LOGARITHMIC FUNCTIONS

These functions model growth, decay, and many natural processes. A firm grasp of their formulas is critical for Algebra 2 success.

# Laws of Exponents

- $a^m \cdot a^n = a^{m+n}$
- $\frac{a^m}{a^n} = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $a^{-n} = \frac{1}{a^n}$
- $a^{1/n} = \sqrt[n]{a}$

# Definition of a Logarithm

- $\log_b(x) = y$  if and only if  $b^y = x$

# Logarithm Properties

- $\log_b(MN) = \log_b M + \log_b N$
- $\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$
- $\log_b(M^p) = p \log_b M$
- $\log_b(1) = 0$
- $\log_b(b) = 1$
- **Change-of-base formula:**  $\log_b x = \frac{\log_a x}{\log_a b}$

# Exponential and Logarithmic Equations

When solving equations, these formulas allow you to move between exponential and logarithmic forms. Common applications include compound interest  $A = Pe^{rt}$  (continuous) or  $A = P(1 + r/n)^{nt}$ .

## RADICAL EXPRESSIONS AND COMPLEX NUMBERS

Radicals and imaginary numbers often appear together. The following list of algebra 2 formulas helps simplify radicals and operate with complex numbers.

# Simplifying Radicals

- $\sqrt[n]{a^n} = |a|$  if  $n$  is even, or just  $a$  if  $n$  is odd.
- $\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$
- $\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$

# Imaginary Unit and Complex Numbers

- $i = \sqrt{-1}$
- $i^2 = -1$
- $i^3 = -i$
- $i^4 = 1$  (cyclic pattern)
- **Complex number form:**  $a + bi$  where  $a$  and  $b$  are real numbers.
- **Conjugate:**  $a + bi$  and  $a - bi$
- **Modulus:**  $|a + bi| = \sqrt{a^2 + b^2}$

## RATIONAL FUNCTIONS AND EQUATIONS

Rational functions involve fractions with polynomials in the numerator and denominator. Working with these requires careful algebraic manipulation.

# Simplifying Rational Expressions

Factor numerator and denominator completely, then cancel common factors. Keep track of excluded values where denominator equals zero.

# Solving Rational Equations

Multiply both sides by the least common denominator (LCD) to clear fractions, then solve the resulting polynomial equation. Always check for extraneous solutions.

# Asymptotes

- **Vertical asymptote:** Values that make denominator zero (after canceling common factors).
- **Horizontal asymptote:** Compare degrees: if numerator degree < denominator degree,  $y=0$ ; if equal,  $y =$  ratio of leading coefficients; if greater, no horizontal asymptote (oblique possible).

## SEQUENCES AND SERIES

Algebra 2 introduces arithmetic and geometric sequences, leading to series and summation notation.

# Arithmetic Sequences

- $a_n = a_1 + (n-1)d$
- Sum of first  $n$  terms:  $S_n = \frac{n}{2}(a_1 + a_n)$  or  $S_n = \frac{n}{2}[2a_1 + (n-1)d]$

# Geometric Sequences

- $a_n = a_1 \cdot r^{n-1}$
- Sum of first  $n$  terms:  $S_n = a_1 \frac{1 - r^n}{1 - r}$  for  $r \neq 1$
- Infinite geometric series (if  $|r| < 1$ ):  $S_{\infty} = \frac{a_1}{1 - r}$

# Summation Notation

$\sum_{k=1}^n a_k$  is a compact way to write a series. Knowing the formulas above makes evaluating sums straightforward.

## PROBABILITY AND COMBINATORICS

Counting and probability are integral parts of the Algebra 2 curriculum, especially for data analysis.

# Factorial

- $n! = n \cdot (n-1) \cdot (n-2) \cdot \dots \cdot 1$

# Permutations (order matters)

- $_nP_r = \frac{n!}{(n-r)!}$

# Combinations (order does not matter)

- $_nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$

# Binomial Theorem

$(x + y)^n = \sum_{k=0}^n \binom{n}{k} x^{n-k} y^k$