GENERAL

important formulas for algebra 2

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Important Formulas for Algebra /2

Algebra 2 is the bridge between the algebra you learned in middle school and the advanced mathematics that follows in calculus, statistics, and beyond. While the concepts may seem intimidating at first, a solid grasp of the key formulas can make the subject feel much more approachable. This article compiles the most essential algebra 2 formulas—organized by topic—so you can study efficiently, ace your exams, and build a strong foundation for future math courses.

Why Mastering Formulas Matters

Formulas are the language of mathematics. They let you express complex relationships in a concise, universal way. In Algebra /2 you'll encounter:

- Quadratic equations and their solutions
- Polynomials and their properties
- Rational expressions and equations
- Exponential and logarithmic relationships
- Trigonometric identities and equations
- Conic sections and their standard equations
- Systems of equations and matrices

Memorizing the core formulas gives you a toolkit that you can apply to a wide range of problems—whether you're simplifying an expression, solving an equation, or analyzing a graph.

Quadratic Equations

Quadratics are the backbone of Algebra 2. They appear in real world contexts such as projectile motion, economics, and population models. Below are the formulas you'll use most often.

Standard, Vertex, and Factored Forms

A quadratic function can be written in three equivalent ways:

- Standard form: $f(x) = ax^2 + bx + c$
- Vertex form: $f(x) = a(x – h)^2 + k$ where (h, /k) is the vertex
- Factored form: f(x) = a(x – r •)(x – r ,) where r • and r , are the roots

The Quadratic Formula

When factoring is difficult or impossible, the quadratic formula gives the solutions for x:

x = [–b ± " (b² – 4ac)] / (2a)

The term under the square root, 9B Ò +" b F 0, is called the **discriminant**. It tells you the nature of the roots:

- 9B â " Gpo distinct real roots
- 9B Ò " öæR &V Â ‡&W V FVB' &ö÷@
- 9B " Gpo complex conjugate roots

Vertex Coordinates

For a quadratic in standard form, the vertex (h, /k) can be found directly:

h = –b / (2a)

k = f(h) = c – b² / (4a)

Axis of Symmetry

The line that divides the parabola into two mirror image halves is given by:

x = –b / (2a)

Factoring by Grouping and the Rational Root Theorem

When a "` 1, factor out the leading coefficient first. The Rational Root Theorem says any rational root p/q of $ax^3 + bx^2 + cx + d$ satisfies:

- p divides the constant term d
- q divides the leading coefficient a

Test each candidate by substitution.

Polynomial Functions and Properties

Polynomials are algebraic expressions with non negative integer exponents. Understanding their behavior is crucial for graphing and solving equations.

Degree and Leading Term

The **degree** of a polynomial is the highest exponent. The coefficient of that term is the **leading coefficient**.

End Behavior

For a polynomial of degree n with leading coefficient a:

- If n is even and a > 0, both ends rise.
- If n is even and a , both ends fall.
- If n is odd and a > 0, left end falls, right end rises.
- If n is odd and a , left end rises, right end falls.

Rational Root Theorem (Revisited)

For a polynomial p(x) = a ™x • + … + a €, any rational root p/q satisfies:

- p divides a €
- q divides a ™

Polynomial Division

Use long division or synthetic division to divide a polynomial by a linear factor (x – r). The remainder is zero if r is a root.

Rational Expressions

Rational expressions are fractions whose numerators and denominators are polynomials. Mastering them involves simplifying, adding, and solving equations.

Factoring Polynomials for Simplification

Always factor both numerator and denominator completely. Cancel common factors, but remember to note any values that make the denominator zero—they're excluded from the domain.

Adding and Subtracting

Find a common denominator LCD, then combine numerators:

(A/B) ± (C/D) = (A·(LCD/B) ± C·(LCD/D)) / LCD

Multiplying and Dividing

Multiply numerators and denominators separately. For division, multiply by the reciprocal:

(A/B) ÷ (C/D) = (A·D) / (B·C)

Solving Rational Equations

Multiply both sides by the LCD to eliminate denominators. After simplifying, solve the resulting polynomial equation. Finally, check each solution against the original denominators to exclude extraneous roots.

Exponential and Logarithmic Relationships

Exponential growth/decay and logarithms appear in finance, biology, physics, and more.

Exponential Function

f(x) = a·b.0 where a is the initial value and b is the base.

Natural Exponential and Logarithm

Base e "H 2.71828 is used in continuous growth/decay models.

Logarithm Laws

- Product Rule: log_b(M·N) = log_b M + log_b N
- Quotient Rule: log_b(M/N) = log_b M – log_b N
- Power Rule: log_b(M •) = n·log_b M
- Change of Base: log_b a = ln a / ln b = log • € a / log • € b

Solving Exponential Equations

Rewrite the equation so the bases match, then use logarithms:

Example: 3^{2x} = 27 !' 3^{2x} = 3³ !' 2x = 3 !' x = 3/2

Solving Logarithmic Equations

Rewrite the equation in exponential form:

Example: log ,(x – 1) = 3 !' 2³ = x – 1 !' x = 9

Trigonometric Identities and Equations

Trigonometry is essential for modeling periodic phenomena and solving right triangle problems.

Primary Trigonometric Functions

For an angle ;, –â ight triangle:

- sin ;, Ò ÷ ÷6—FR ò €ypotenuse
- cos ;, Ò F¦ 6VçB ò €ypotenuse

- tan ;, Ò ÷ ÷6—FR ò F¦ 6Vç@

Pythagorean Identity

sin²;, ² 6÷;#¸ = 1

Reciprocal Identities

- csc ;, Ò ò 6–â ¸
- sec ;, Ò ò 6÷2 ¸
- cot ;, Ò ò F â ¸

Double Angle Formulas

- sin 2;, Ò " 6–â ¸ cos ;€
- cos 2;, Ò 6÷;#¸ – sin²;, Ò " 6÷;#¸ – 1 = 1 – 2 sin²;€
- tan 2;, Ò " F â ¸ / (1 – tan²;,•

Sum and Difference Formulas

- sin(; ²) = sin ; 6÷2 ² ± cos ; 6–â ²
- cos(; ²) = cos ; 6÷2 ² " sin ; 6–â ²
- tan(; ²) = (tan ; F â ²) / (1 " tan ; F â ²)

Solving Trigonometric Equations

Use identities to simplify, then isolate the trig function. Convert to algebraic form, solve, and apply the unit circle to find all solutions in the desired interval.

Conic Sections

Conic sections—circles, ellipses, parabolas, and hyperbolas—are described by quadratic equations in two variables.

Circle

Standard form: **(x – h)² + (y – k)² = r²**

- Center: (h, /k)
- Radius: r

Ellipse

Standard form: **((x – h)² / a²) + ((y – k)² / b²) = 1**

- Major axis length: 2a if a > b; otherwise 2b
- Focal distance: c = " (a² – b²)

Parabola

Vertical orientation: (x – h)² = 4p(y – k)

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