GENERAL

list of all formulas in mathematics

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Welcome to the Ultimate Guide: A Comprehensive List of All Formulas in Mathematics

Mathematics is often described as the language of the universe. Every scientific discovery, engineering breakthrough, and technological innovation relies on a set of equations that describe patterns, relationships, and structures. Whether you're a student preparing for exams, a teacher looking for teaching aids, or a curious mind eager to explore the world of numbers, you'll find this article to be a valuable resource.

In this guide, we'll walk through a **list of all formulas in mathematics**—organized by discipline, level of difficulty, and practical application. Instead of simply dumping a wall of equations, we'll explain the context behind each formula, illustrate how it's used, and provide real-world examples that bring the mathematics to life. By the end, you'll have a clear roadmap of the most essential formulas and the confidence to use them in your studies or projects.

Why a Comprehensive Formula List Matters

Mathematics is cumulative. Mastery of foundational formulas is the key to unlocking more advanced topics. Having a single, organized reference eliminates the need to search multiple textbooks or online resources. It also helps students:

- Build a strong mental framework for problem solving.
- Identify gaps in their knowledge quickly.
- Prepare for standardized tests such as the SAT, ACT, GRE, or GMAT.
- Apply mathematical reasoning in physics, engineering, economics, and data science.

For educators, this list serves as a checklist for curriculum coverage and a source of sample problems. For professionals, it's a quick refresher for formulas they rarely use but might need in a critical situation.

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1. Arithmetic and Number Theory

Arithmetic is the foundation of all mathematics. It deals with basic operations, number properties, and simple formulas that help in everyday calculations.

1.1 Basic Arithmetic Operations

- Addition: a + b = c
- Subtraction: a - b = c
- Multiplication: a × b = c
- Division: a ÷ b = c (where b "` 0)

1.2 Properties of Numbers

- Commutative Property:

  Addition: a + b = b + a
- Multiplication: a × b = b × a
- Addition: (a + b) + c = a + (b + c)
- Multiplication: (a × b) × c = a × (b × c)

1.3 Exponentiation and Logarithms

- Power Rule: a^b × a^c = a^(b+c)
- Logarithm Rule:

  log_b(a × c) = log_b(a) + log_b(c)
- log_b(a^c) = c × log_b(a)

2. Algebraic Formulas

Algebra introduces variables and equations, allowing us to solve for unknowns. Below are the most frequently used algebraic formulas.

2.1 Quadratic Formula

For a quadratic equation in standard form **$ax^2 + bx + c = 0$**, the solutions are:

$x = [–b ± " (b^2 – 4ac)] / (2a)$

2.2 Sum and Product of Roots

- Sum of roots: –b/a
- Product of roots: c/a

2.3 Linear Equation Solving

For a system of two equations:

Ax + By = C

Dx + Ey = F

The solution is obtained via Cramer's Rule:

x = (CF – BE) / (AE – BD)

y = (AF – CD) / (AE – BD)

2.4 Factoring Formulas

- Difference of Squares: $a^2 – b^2 = (a + b)(a – b)$
- Perfect Square Trinomial:

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

3. Geometric and Spatial Formulas

Geometry deals with shapes, sizes, and spatial relationships. Below are the core formulas that define areas, volumes, and other geometric properties.

3.1 Plane Geometry

- Area of a Triangle: A = ½ × base × height
- Area of a Rectangle: A = length × width
- Area of a Circle: A = < +
- Perimeter of a Square: P = 4 × side
- Perimeter of a Triangle: P = a + b + c
- Area of a Parallelogram: A = base × height
- Area of a Trapezoid: A = ½ × (base • + base ,) × height

3.2 Solid Geometry

- Volume of a Cube: V = side³
- Surface Area of a Cube: SA = 6 × side²
- Volume of a Cylinder: V = < +&€
- Surface Area of a Cylinder: SA = 2< "†, ² "•
- Volume of a Sphere: V = (4/3)< +0
- Surface Area of a Sphere: SA = 4< +
- Volume of a Cone: V = (1/3)< +&€
- Surface Area of a Cone: SA = < "‡" ² Â’ ‡v†W&R Â —2 F†R 6Æ çB †V–v‡B•
- Volume of a Pyramid: V = (1/3) × base area × height

3.3 Trigonometric Identities in Geometry

These identities are essential when dealing with right triangles and circles.

- Pythagorean Theorem: $a^2 + b^2 = c^2$
- Law of Sines: sin A / a = sin B / b = sin C / c
- Law of Cosines: $c^2 = a^2 + b^2 – 2ab \cos C$

4. Trigonometric Relationships

Trigonometry extends geometry to the study of angles and their relationships. The following formulas are the building blocks of trigonometric calculations.

4.1 Fundamental Ratios

- sin ;, Ò ÷ ÷6—FR ò ‡— ÷FVàuse
- cos ;, Ò F¦ 6VçB ò ‡— ÷FVàuse
- tan ;, Ò ÷ ÷6—FR ò F¦ 6Vç@

4.2 Reciprocal Functions

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

4.3 Sum and Difference Formulas

- sin(A ± B) = sin A cos B ± cos A sin B
- cos(A ± B) = cos A cos B " sin A sin B
- tan(A ± B) = (tan A ± tan B) / (1 " tan A tan B)

4.4 Double Angle and Half Angle

- sin 2;, Ò " 6–â ¸ cos ;€
- cos 2;, Ò 6÷;" ¸ – sin² ;, Ò " 6÷;" ¸ – 1 = 1 – 2 sin² ;€
- tan 2;, Ò " F â ¸ / (1 – tan² ;,•
- sin² ;, Ò ƒ b 6÷2 #¸) / 2
- cos² ;, Ò ƒ ² 6÷2 #¸) / 2

4.5 Inverse Trigonometric Functions

- arcsin x = sin {¹ x
- arccos x = cos {¹ x

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