# MATH FORMULAE

1. **Euler's Formula (for Geometry):**

   <u>Formula:</u>  $e^{(i\pi)} + 1 = 0$

   <u>Description:</u> Euler's Formula connects five of the most important numbers in mathematics: e (the base of the natural logarithm), π (pi), i (the imaginary unit), 1 (the multiplicative identity), and 0 (the additive identity). It relates exponential functions, trigonometric functions, and complex numbers.

2. **Pythagorean Theorem (for Geometry):**

   <u>Formula:</u>  $a^2 + b^2 = c^2$

   <u>Description:</u> In a right triangle, $a^2 + b^2 = c^2$ The Pythagorean Theorem states that in a right triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the lengths of the other two sides.

3. **Quadratic Formula (for Algebra):**

   <u>Formula:</u>

   <u>Description:</u> For a quadratic equation $ax^2 + bx + c = 0$, the solutions for x are given by: $x = (-b \pm \sqrt{(b^2 - 4ac)}) / (2a)$ The quadratic formula provides the solutions (roots) for a quadratic equation in the form of $ax^2 + bx + c = 0$. It is derived using the method of completing the square.

4. **Fundamental Theorem of Calculus (for Calculus):**

   <u>Formula:</u>

   <u>Description:</u> If f(x) is continuous on the interval [a, b], and F(x) is an antiderivative of f(x) on that interval, then: $\int$(a to b) f(x) dx = F(b) - F(a) The Fundamental Theorem of Calculus establishes a fundamental relationship between differentiation and integration. It allows us to evaluate definite integrals by finding the antiderivative of the integrand.

5. **Bayes' Theorem (for Probability and Statistics):**

Formula: P(A | B) = (P(B | A) * P(A)) / P(B)

Description:Bayes' Theorem relates conditional probabilities. It allows us to update the probability of an event A given new evidence B by incorporating the prior probability of A and the conditional probability of B given A.

6. **Euler's Identity (for Complex Analysis):**

Formula: $e^{(i\pi)} + 1 = 0$

Description:Euler's Identity is an elegant equation that connects five essential mathematical constants: e (the base of the natural logarithm), π (pi), i (the imaginary unit), 1 (the multiplicative identity), and 0 (the additive identity). It is widely regarded as one of the most beautiful and profound equations in mathematics.

7. **Binomial Theorem (Algebra):**

Formula: $(a + b)^n = C(n, 0)a^n + C(n, 1)a^{n-1}b + C(n, 2)a^{n-2}b^2 + ... + C(n, n-1)ab^{n-1} + C(n, n)b^n$

Description:The Binomial Theorem provides a way to expand the powers of a binomial expression (a + b) raised to a positive integer exponent n.

8. **Law of Cosines (Geometry):**

Formula: $c^2 = a^2 + b^2 - 2ab\cos(C)$

Description:The Law of Cosines relates the lengths of the sides of a general triangle to the cosine of one of its angles. It is useful for solving triangles when the lengths of the sides and/or measures of angles are known.

9. **Law of Sines (Geometry):**

Formula: sin(A)/a = sin(B)/b = sin(C)/c

Description:The Law of Sines relates the ratios of the lengths of the sides of a triangle to the sines of the opposite angles. It is useful for solving triangles when the measures of angles and lengths of certain sides are known.

10. **Fundamental Counting Principle (Combinatorics):**

Formula: If there are $n_1$ ways to perform the first task and $n_2$ ways to perform the second task, then there are $n_1 * n_2$ ways to perform both tasks. The Fundamental Counting Principle states that if two tasks are performed sequentially and independently, the total number of outcomes is the product of the number of outcomes for each task.

## 11. Mean Value Theorem (Calculus):

Formula: If $f(x)$ is continuous on the interval $[a, b]$ and differentiable on the interval $(a, b)$, then there exists at least one value $c$ in $(a, b)$ such that $f'(c) = (f(b) - f(a))/(b - a)$. The Mean Value Theorem states that for a function that is continuous and differentiable on an interval, there exists a point where the instantaneous rate of change (derivative) is equal to the average rate of change.

## 12. Law of Exponents (Algebra):

Formula: $a^n * a^m = a^{\wedge}(n + m)$

Description: The Law of Exponents states that when multiplying two powers with the same base, you can add their exponents.

## 13. Fundamental Theorem of Algebra (Algebra):

Formula: Every polynomial equation of degree $n$ (with complex coefficients) has exactly $n$ complex roots, counting multiplicities. The Fundamental Theorem of Algebra asserts that every polynomial equation has at least one complex root. This theorem has applications in algebra, analysis, and other fields.

## 14. Distance Formula (Geometry):

Formula: The distance between two points $(x_1, y_1)$ and $(x_2, y_2)$ in a coordinate plane is given by $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. The Distance Formula provides a way to find the distance between two points in a two-dimensional Cartesian coordinate system.

## 15. Law of Large Numbers (Probability and Statistics):

Formula: As the number of trials increases, the experimental probability of an event approaches its theoretical probability. The Law of Large Numbers states that the more times an experiment is conducted, the closer the observed results will converge to the expected probabilities.

## 16. Power Rule (Calculus):

Formula: $d/dx(x^n) = nx^{n-1}$

Description: The Power Rule is a differentiation rule that states the derivative of x raised to a constant exponent n is equal to n times x raised to the (n-1) power.

## 17. Perimeter of a Rectangle (Geometry):

Formula: The perimeter of a rectangle is given by P = 2(length + width). The perimeter of a rectangle is the sum of the lengths of all its sides.

## 18. Law of Reflection (Physics):

Formula: The angle of incidence is equal to the angle of reflection, measured with respect to the normal line at the point of incidence. The Law of Reflection describes how light or other waves reflect off a surface, stating that the angle at which the incident ray strikes a surface is equal to the angle at which the reflected ray bounces off the surface.

## 19. Fundamental Theorem of Similarity (Geometry):

Formula: If two polygons are similar, their corresponding sides are proportional, and their corresponding angles are congruent. The Fundamental Theorem of Similarity provides a foundational concept in geometry, stating that two similar polygons have corresponding sides that are proportional and corresponding angles that are congruent.

## 20. Sum of an Arithmetic Series (Algebra):

Formula: The sum of an arithmetic series with n terms is given by $S = (n/2)(a_1 + a_n)$, where $a_1$ is the first term and $a_n$ is the nth term. The formula allows you to find the sum of a finite arithmetic series by multiplying the average of the first and last terms by the number of terms.

## 21. Volume of a Sphere (Geometry):

Formula: The volume of a sphere is given by $V = (4/3)\pi r^3$, where r is the radius. The formula provides the volume of a three-dimensional sphere, a perfectly symmetrical geometric shape.

## 22. Taylor Series Expansion (Calculus):

Formula: A function f(x) can be approximated by its Taylor series expansion centered at a point a: $f(x) = f(a) + f'(a)(x - a)/1! + f''(a)(x - a)^2/2! + f'''(a)(x - a)^3/3! + ...$ The Taylor series expansion represents a function as an infinite sum of terms involving its derivatives evaluated at a particular point. It allows for approximating functions with polynomials.

## 23. Law of Total Probability (Probability):

Formula: $P(A) = \sum[P(A | B) * P(B)]$,

Description: where the summation is over all possible events B. The Law of Total Probability provides a way to find the probability of an event A by considering the conditional probabilities of A given different mutually exclusive events B and their corresponding probabilities.

## 24. Law of Cosine Rule (Geometry):

Formula: $a^2 = b^2 + c^2 - 2bc * \cos(A)$,

Description: where a, b, and c are the sides of a triangle, and A is the angle opposite side a. The Law of Cosine Rule provides a way to calculate the length of one side of a triangle when the lengths of the other two sides and the included angle are known.