One Learning a Day, One Subject at a Time

Github Repository

01-01-2021, A Simple Proof

Are there infinitely many prime numbers? If yes, how do we prove they exist? Here's a simple proof.
Assume we have only n prime numbers; $P_1, P_2, P_3, \ldots P_n$.

$$\text{Let } N = P_1 \cdot P_2 \cdot P_3 \ldots P_n + 1$$

N isn't divisible by any of the primes $P_1, P_2, P_3, \ldots P_n$[a] which implies N's prime factorisation is $N \times 1$. N being prime contradicts our initial assumption. Thus, there exist infinite primes. QED

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[a]Prime numbers start from 2 and N is the LCM of all the prime numbers added to 1.

02-01-2021, Neutrons and Protons have Components too!

Have you ever wondered whether protons, neutrons and electrons; the constituents of an atom, can be divided further into constituting components? The answer is "Yes". A quark is an elementary particle and a fundamental constituent of matter. Quarks combine to form particles called hadrons. All commonly observable matter is composed of up quarks, down quarks and electrons. Quarks are never found existing individually, they can be found only composing hadrons, which include baryons (protons and neutrons) and mesons, or in quark–gluon plasma.

03-01-2021, A Salty Bond

The Ionic bond is a type of a chemical bond that is a result of the attraction between oppositely charged particles in ionic compounds like $NaCl$[a]. Ions are atoms (or a group of atoms) having a net charge. Atoms that gain electrons to become stable are called anions while those that lose electrons for the same are called cations. This transfer of electrons is known as electrovalence. Ionic bonds are mostly formed between metals and non-metals. In simpler words, an ionic bond is a result of the transfer of electrons from a metal (cation) to a non-metal (anion) in order for both atoms to attain stability.

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[a]More examples; KCl, $CaCl_2$

04-01-2021, It's Hot. But it Helps

There are more than 10 million cases of Vitamin D deficiency per year in India. Is Vitamin D really inaccessible? It is not! We can get Vitamin D from something as simple as sunlight. When our skin is exposed to sunlight, it makes Vitamin D (which, in reality, is a hormone) from cholesterol, a fat-rich and structural component of the animal cell membrane through the energy obtained from the sun's Ultraviolet-B (UVB) rays and by the process of Vitamin D synthesis.
Work Hard, Play Harder!

05-01-2021, Exponentiation^{-1}

The logarithm function (denoted by $\log$) is the inverse function of exponentiation. It denotes the exponent/power to which the 'base' has been raised to in a number. Here's an example;

$$\text{Let } x = a^b. \text{ This implies } \log_a(x) = b$$

The logarithm of x to the base a can be a whole number, decimal number, irrational number or even a complex number depending on its value. Often, log graph are used to make growth, forecast and even the number of cases during a pandemic. Logarithms involving complex numbers[a] (i) can be plotted on the real-complex plane.

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[a] $\sqrt{-x}, \sqrt[3]{-x}, \dots$

09-01-2021, Prime Number Theorem

The prime number theorem describes the asymptotic[a] distribution of prime numbers among positive integers. It formalizes the intuitive idea that primes become less common as they become larger. The prime number theorem addresses this by precisely quantifying the rate at their frequency decreases. The first breakthrough was the $\pi(n)$ function, which calculates the probability that a random integer less than or equal to n is prime. It's defined as;

$$\pi(n) \sim \frac{1}{\ln(n)}$$

where $\ln(n)$ is the natural logarithm[a] of n.

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[a] Asymptotic here means approximate in mathematical terms.
[a] $\log_e(n)$

Some Day, Catalan's Conjecture

There exists only one solution where $x = 3, a = 2, y = 2, b = 3$ to the equation

$$x^a - y^b = 1$$

for $a, b > 1$ and $x, y > 0$.

Another Day, Angular Momentum of an Electron

The angular momentum (L) of an electron in the nth orbit is given by

$$L = \frac{nh}{2\pi}$$

where h is the Planck's constant.

Some Other Day, Gibbs Free Energy

In thermodynamics, the Gibbs Free Energy (G) (named after Josiah Willard Gibbs) is a thermodynamic potential that calculates the maximum reversible work performed by a thermodynamic system at a constant temperature (T) and pressure (P). It is given by

$$\Delta G = \Delta H - T\Delta S$$

where S represents its Entropy, i.e. the measure of randomness. S.I unit - Joules.