NUMBER THEORY FORMULAS:

GCD(a,b) \* LCM(a,b) = a \* b

**Useful Math Formulas and Tricks**

**Division and Multiplication**

1. (a + b) % m = ((a % m) + (b % m)) % m
2. (a \* b) % m = ((a % m) \* (b % m)) % m
3. a^n % m = ((a % m)^n) % m (useful for large exponents)

**GCD and LCM**

1. GCD(a,b) \* LCM(a,b) = a \* b
2. GCD(a,b) = GCD(b, a % b) (Euclidean algorithm)
3. LCM(a,b) = (a \* b) / GCD(a,b)

**Permutations and Combinations**

1. nPr = n! / (n-r)!
2. nCr = n! / (r! \* (n-r)!)
3. (n+1)Cr = nCr + nC(r-1) (Pascal's identity)

**Number Theory**

1. Sum of first n natural numbers: n \* (n + 1) / 2
2. Sum of squares of first n natural numbers: n \* (n + 1) \* (2n + 1) / 6
3. Number of divisors of n = product of (ai + 1), where ai are the exponents in prime factorization of n
4. Sum of divisors of n = product of (pi^(ai+1) - 1) / (pi - 1), where pi are prime factors and ai their exponents

**Modular Arithmetic**

1. (a / b) % m = (a \* modInverse(b, m)) % m, where modInverse(b, m) is the modular multiplicative inverse of b modulo m
2. a^φ(m) ≡ 1 (mod m), where φ(m) is Euler's totient function (if a and m are coprime)

**Geometry**

1. Area of triangle = (1/2) \* base \* height
2. Heron's formula for triangle area: sqrt(s(s-a)(s-b)(s-c)), where s = (a+b+c)/2 is the semi-perimeter

**Miscellaneous**

1. Fibonacci numbers: F(n) = F(n-1) + F(n-2), with F(0) = 0 and F(1) = 1
2. Catalan numbers: C(n) = (1 / (n+1)) \* (2n choose n)
3. Probability of union of events: P(A ∪ B) = P(A) + P(B) - P(A ∩ B)

LINKS:

<https://www.geeksforgeeks.org/math-in-competitive-programming/>

[https://blog.shahjalalshohag.comc/equation-list/](https://blog.shahjalalshohag.com/equation-list/)

<https://www.omegalearn.org/thebookofformulas?gad_source=1&gclid=CjwKCAjwooq3BhB3EiwAYqYoElNsoarWGI6DuuPLe-3KR9HXH3PXZM1MkbR8g1nDrOqnB-5S5PrMihoCIYQQAvD_BwE>

<https://www.geeksforgeeks.org/competitive-programming-cp-handbook-with-complete-roadmap/?ref=previous_article>

