The Unique Prime Factorization Theorem

Theorem 4.3.5, The Unique Prime Factorization Theorem (UFT) (Also called The Fundamental Theorem of Arithmetic)

Given any integer \( n > 1 \), there exist:

1) a positive integer \( k \) (= the \# of prime factors \( n \) has.) and \( k \) distinct prime numbers, \( p_1, p_2, p_3, \ldots, p_k \) and

2) positive integers \( e_1, e_2, \ldots, e_k \) (exponents), that is \( e_i \geq 1, \forall i \),

such that \( n = p_1^{e_1} p_2^{e_2} p_3^{e_3} \ldots p_k^{e_k} \)

and any other factorization of \( n \) into a product of prime factors is the same as this one except that the prime factors may be rearranged in a different order.