

## 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,  $p_1, p_2, p_3, \dots, p_k$  and**
- 2) positive integers  $e_1, e_2, \dots, e_k$  (exponents), that is  $e_i \geq 1, \forall i$ ,**

**such that  $n = p_1^{e_1} p_2^{e_2} p_3^{e_3} \dots p_k^{e_k}$**

**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.**