Problem of the Week
Problem D
How Many Fives?

The product of the first seven positive integers is equal to

\[ 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040 \]

Mathematicians will write this product as 7!. This is read as “7 factorial”. So, \( 7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040 \).

This factorial notation can be used with any positive integer. For example, \( 11! = 11 \times 10 \times 9 \times \cdots \times 3 \times 2 \times 1 = 39,916,800 \). The three dots “\( \cdots \) ” represent the product of the integers between 9 and 3.

Suppose \( N = 1000! \). That is,

\[ N = 1000! = 1000 \times 999 \times 998 \times 997 \times \cdots \times 3 \times 2 \times 1 \]

Note that \( N \) is divisible by 5, 25, 125, and 625. Each of these factors is a power of 5. That is, 5 = 5\(^1\), 25 = 5\(^2\), 125 = 5\(^3\), and 625 = 5\(^4\).

Determine the largest power of 5 that divides \( N \).