1. Find \( x - y \), given that \( x^4 = y^4 + 24 \), \( x^2 + y^2 = 6 \), and \( x + y = 3 \).

2. Find \((x + 1)(x^2 + 1)(x^4 + 1)(x^8 + 1) \cdots\), where \(|x| < 1\).

3. How many times does 24 divide into 100! (factorial)?

4. Given that 7,999,999,999 has at most two prime factors, find its largest prime factor.

5. Find the 6-digit number beginning and ending in the digit 2 that is the product of three consecutive even integers.

6. What is the last digit of \(1^1 + 2^2 + 3^3 + \cdots + 100^{100}\)?

7. A polynomial \( P \) has four roots, \( \frac{1}{4}, \frac{1}{2}, 2, 4 \). The product of the roots is 1, and \( P(1) = 1 \). Find \( P(0) \).

8. How many integers between 1 and 2000 inclusive share no common factors with 2001?

9. Find the number of positive integer solutions to \( n^x + n^y = n^z \) with \( n^z < 2001 \).

10. Find the real solutions of \((2x + 1)(3x + 1)(5x + 1)(30x + 1) = 10\).