2. [6 points] Let \( f(x) = xe^{-x^2} \).
   
   a. [4 points] Find the Taylor series of \( f(x) \) centered at \( x = 0 \). Be sure to include the first 3 nonzero terms and the general term.

   b. [2 points] Find \( f^{(15)}(0) \).

3. [3 points] Determine the exact value of the infinite series

\[
1 - \frac{2}{1!} + \frac{4}{2!} - \frac{8}{3!} + \cdots + \frac{(-1)^n 2^n}{n!} + \cdots
\]