1. By means of partial fractions, find a formula for the partial sums of the series
\[ \sum_{n=1}^{\infty} \frac{1}{n(n + 3)} \]. Does this series converge, and if so, to what?

2. Discuss the convergence of
   
   a. \[ \sum_{n=2}^{\infty} \frac{1}{n \log(n^2)} \]
   b. \[ \sum_{n=2}^{\infty} \frac{1}{n(n \log n)^2} \]
   c. \[ \sum_{n=1}^{\infty} n^2 \cdot 3^{-n} \]
   d. \[ \sum_{n=1}^{\infty} \frac{1}{[n^2(2n + 1)]^2} \]

3. Let \( b_n = 1 + \frac{1}{2} + \cdots + \frac{1}{n-1} - \log(n) \).
   
   a. Show that \( (b_n) \) is a bounded increasing sequence, and hence has a limit \( \gamma \).
   b. Letting \( s_N = \sum_{n=1}^{N} \frac{1}{n} \) denote the partial sum of the harmonic series, calculate
   \[ \lim_{N \to \infty} (s_{2N} - s_N) \].

4. Calculate the radii of convergence of
   
   a. \[ \sum_{n=0}^{\infty} (n+2)3^n x^n \]
   b. \[ \sum_{n=0}^{\infty} (\sqrt{n+1} - \sqrt{n})x^n \]
   c. \[ \sum_{n=0}^{\infty} 2^n x^{(n^2)} \]