1. Use the ratio test to determine the convergence or divergence of each of the following series.

(a). \[ \sum_{n=1}^{\infty} \frac{(3n)!}{6^n n!(2n)!} \]

(b). \[ \sum_{n=1}^{\infty} a_n, \text{ where } a_1 = 1, \ a_n = 2 \left(1 - \frac{1}{n}\right)^n a_{n-1}, \ n = 2, 3, \ldots. \]

2. Use the (simplified) root test to determine the convergence or divergence of each of the following series.

(a). \[ \sum_{n=1}^{\infty} \frac{5n^2 \cdot 3^n}{4n+4}. \]

(b). \[ \sum_{n=1}^{\infty} \frac{3^{2n}}{5^n} \left(1 - \frac{1}{2n}\right)^n. \]

(c). \[ \frac{1}{4} + \frac{1}{5^2} + \frac{1}{4^3} + \frac{1}{5^4} + \frac{1}{4^5} + \frac{1}{5^6} + \frac{1}{4^7} + \frac{1}{5^8} + \cdots. \]

3. Determine the convergence or divergence of each of the following series. Justify your answers.

(a). \[ \sum_{n=1}^{\infty} \frac{(\sqrt{2n} + 2 - \sqrt{n})}{n}. \]

(b). \[ \sum_{n=1}^{\infty} \frac{1 \cdot 3 \cdot 5 \cdots (2n - 1)}{n!} \cdot \frac{2^n}{5^n}. \]

(c). \[ \sum_{n=1}^{\infty} \frac{\ln n}{n^{1.2}}. \]

(d). \[ \sum_{n=1}^{\infty} \left(\frac{n}{n + 2}\right)^n. \]

(e). \[ \sum_{n=2}^{\infty} \frac{1}{(\ln n)^3}. \]

(f). \[ \sum_{n=1}^{\infty} \left(\frac{4}{9} + \frac{n^3}{3^n}\right)^{\frac{2}{3}}. \]

4. Consider the series \[ \sum_{n=1}^{\infty} (-1)^{n+1} \frac{\ln n}{\sqrt{n}}. \]

i) Use the alternating series test to show that the series is convergent.

ii) Using part i) or otherwise, show that the series is conditionally convergent.