1. Consider the sequence where the $n^{th}$ term is given by $a_n = ne^{-n/2}$.

[5] a). Determine whether the sequence is monotonic. If the sequence is monotonic, is it increasing or decreasing?

[5] b). Does the sequence converge or diverge? If it converges, what is its limit?

2. Consider the infinite series $\sum_{n=2}^{\infty} \frac{(-2)^{n+1}}{2^{2n}}$.

[2] a). Find the sixth term of the series?

[4] b). Find the fourth partial sum of the series. $S_4 =$

[6] c). Does the infinite series converge or diverge? If it converges what is its sum?
3. A ball is dropped from a height of 6 feet and begins bouncing. The height of each bounce is three-fourths \( \left( \frac{3}{4} \right) \), the height of the previous bounce. Find the total vertical distance travelled by the ball.

4. Determine the convergence or divergence of \( \sum_{n=3}^{\infty} \frac{5}{n(\ln n)^3} \). (Use the Integral Test.)

5. Find the sum of the series \( \sum_{n=1}^{\infty} \frac{2}{4n^2 - 1} \).
6. Determine whether the following series converge or diverge. State clearly which test you are using and implement the test as clearly as you can. The answer for each problem is worth 2 points and the work you show 6 points.

[8] a). \( \sum_{n=1}^{\infty} \sin \left( \frac{(2n - 1)\pi}{2} \right) \).

[8] b). \( \sum_{n=0}^{\infty} \frac{(-4)^{n+1}n}{1 \cdot 3 \cdot 5 \cdots (2n + 1)} \).

[8] c). \( \sum_{n=2}^{\infty} \frac{2n^2 - 1}{3n^5 + 2n + 1} \).
7. Determine whether the following series converge or diverge. For those that converge state whether the convergence is conditional or absolute. State clearly which test you are using and implement the test as clearly as you can. The answer for each problem is worth 2 points and the work you show 6 points.

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

[8] b). \[ \sum_{n=1}^{\infty} \frac{(-1)^{n+1}4^n}{n!3^n}. \]

[8] c). \[ \sum_{n=1}^{\infty} \frac{3n}{\sqrt[n]{n!}}. \]