1. Consider the sequence $a_n = ne^{-n}$.

(6) a) Determine whether the sequence is increasing, decreasing or not monotonic.

(4) b) Does the sequence converge or diverge, and if it converges what is the limit.
2. Consider the series \( \sum_{n=1}^{\infty} \left( \frac{1}{2^{n-1}} - \frac{1}{3^{n-1}} \right) \).

(2) a) Find the third term of the series.

(4) b) Find the third partial sum \( S_3 \).

(4) c) Does the series converge or diverge, and if it converge what is the sum.
(10) 3. Check if The Integral Test is applicable, and if it is use it to determine if the following series converge or diverge.

$$\sum_{n=2}^{\infty} \frac{1}{n \ln(n)}$$
4. Determine whether the series is convergent or divergent. State which test you use.

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

\[ b) \sum_{n=1}^{\infty} (-1)^n \frac{2n}{4n^2 + 1}. \]
(10) c) \[ \sum_{n=1}^{\infty} \frac{(-3)^{n+1}}{23^n} \].

(10) d) \[ \sum_{n=2}^{\infty} \frac{2 + (-1)^n}{n\sqrt{n}} \].
5. Determine whether the following series **converge conditionally**, **converge absolutely** or **diverge**. State the test you use.

\[(15)\] a) \[\sum_{n=1}^{\infty} \frac{n!}{n^n}\].

\[(15)\] b) \[\sum_{n=2}^{\infty} \frac{(-1)^n}{\ln n}\].