I, ______________________________, have neither given nor received unauthorized aid on this test.

- Show all work! Work may include explanations in phrases/sentences. Use proper mathematical notation and make complete mathematical statements.

- If you need more room to write, get blank paper from me. Do not use your own paper.

- Only Scientific Calculators are allowed. NO Graphing Calculators. Test is designed to be completed without a calculator.

- Exact solutions only.

- Multiple choice and True/False will be graded correct or incorrect, free response will be graded based on partial credit (NO WORK NO CREDIT)
#1-6 Multiple Choice (9 points each)

1. Determine the convergence or divergence of the series \( \sum_{n=2}^{\infty} \frac{1}{n(\ln n)^2} \) using the Integral Test.

   a) Converges since \( \int_{2}^{\infty} \frac{1}{x^3} \, dx \) converges
   
   b) Diverges since \( \int_{2}^{\infty} \frac{1}{x} \, dx \) diverges
   
   c) Converges since \( \int_{2}^{\infty} \frac{1}{x(\ln x)^2} \, dx \) converges
   
   d) Diverges since \( \int_{2}^{\infty} \frac{1}{x(\ln x)^2} \, dx \) diverges
   
   e) Converges since \( \int_{2}^{\infty} \frac{1}{x(\ln x)^2} \, dx \) converges

2. Determine the convergence or divergence of the series \( \sum_{n=1}^{\infty} \frac{n}{n^2 - 2n + 5} \) using the Limit Comparison Test.

   a) Converges since \( \lim_{n \to \infty} \frac{n^{1/2}}{n/(n^2 - 2n + 5)} = 1 \)
   
   b) Converges since \( \lim_{n \to \infty} \frac{1/n}{n/(n^2 - 2n + 5)} = 1 \)
   
   c) Converges since \( \lim_{n \to \infty} \frac{1/n}{n/(n^2 - 2n + 5)} = 0 \)
   
   d) Diverges since \( \lim_{n \to \infty} \frac{1/n}{n/(n^2 - 2n + 5)} = 1 \)
   
   e) Diverges since \( \lim_{n \to \infty} \frac{n^{1/2}}{n/(n^2 - 2n + 5)} = 1 \)
3. Using the Remainder Estimate for the Integral Test, find an upper bound for the error using $S_3$ as an approximation to $S$. \( \sum_{n=1}^{\infty} \frac{1}{n^4} \)

a) $-\frac{1}{81}$

b) $-\frac{1}{192}$

c) $\frac{1}{9}$

d) $\frac{1}{81}$

e) $\frac{1}{192}$

4. Determine if the infinite series is convergent or divergent. If convergent, find the sum. \( \sum_{n=1}^{\infty} \frac{3}{\sqrt{n}} \)

a) Converges to 0

b) Converges to 1

c) Converges to 3

d) Converges to $\frac{1}{\sqrt{3}}$

e) Diverges
5. Determine if the series is convergent or divergent. If convergent, find the sum. \( \sum_{n=0}^{\infty} \left( \frac{2}{e+1} \right)^n \)

a) Converges to 0

b) Converges to 1

c) Converges to \( \frac{e+1}{e-1} \)

d) Converges to \( \frac{2}{e-1} \)

e) Diverges

6. Determine if the infinite sequence is convergent or divergent. \( \left\{ \frac{1}{18}, \frac{2}{27}, \frac{3}{64}, \frac{4}{125}, \ldots \right\} \)

a) Converges to 0

b) Converges to 1

c) Converges to \( \frac{1}{3} \)

d) Converges to \( \frac{1}{6} \)

e) Diverges
#7-9 True/False (3 points each)

7. If an infinite series \( \sum_{n=1}^{\infty} a_n \) is convergent, then the \( \lim_{n \to \infty} a_n = 0 \). **TRUE**  **FALSE**

8. An infinite sequence \( \{a_n\} \) is convergent *only if* \( \lim_{n \to \infty} a_n = 0 \). **TRUE**  **FALSE**

9. The integral \( \int_{-2}^{2} \frac{1}{(x-1)^2} \, dx = \left. \frac{-1}{x-1} \right|_{-2}^{2} = -\frac{4}{3} \). **TRUE**  **FALSE**

#10-12 Free Response/Partial Credit (#10 worth 13 points, #11-12 worth 12 points each)

10. Determine the convergence or divergence of the series \( \sum_{n=1}^{\infty} \frac{\cos^2 3n}{1 + (1.5)^n} \).
11. Determine the convergence or divergence of the series using a telescoping series for
\[ \sum_{n=2}^{\infty} \frac{1}{(n-1)(n+2)} \]. If convergent, find the sum.

12. Determine the convergence or divergence of \( \int_{1}^{\infty} \frac{2+e^{-x}}{x} \, dx \) using the Comparison Theorem.