1. 5 pts. each Consider the sequence \((1, -4, 9, -16, 25, \ldots)\).

(a) Find a recurrence relation that generates the sequence.

(b) Find an explicit formula for the \(n\)th term of the sequence.

2. 10 pts. Find the limit of the sequence

\[ a_n = \frac{3^{n+1} + 3}{3^n}, \]

or determine that it does not exist.

3. 10 pts. Find the limit of the sequence \(a_n = (1/n)^{1/n}\), or determine that it does not exist.

4. 15 pts. Write the repeating decimal \(1.\overline{25} = 1.2525252525\ldots\) first as a geometric series, and then evaluate the series as a fraction (i.e. a ratio of integers).

5. 15 pts. Let \(p\) be a positive integer. For the telescoping series

\[ \sum_{k=1}^{\infty} \frac{1}{(k+p)(k+p+1)}, \]

find a formula for the \(n\)th term of the sequence of partial sums \((s_n)\), and then evaluate \(\lim_{n \to \infty} s_n\) to obtain the value of the series.

6. 5 pts. Determine whether the series

\[ \sum_{n=1}^{\infty} \frac{n^e}{n^\pi} \]

converges or diverges, stating the reason.

7. 10 pts. Determine whether the series

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

converges or diverges using either the Divergence Test or Integral Test.

8. 10 pts. Use either the Direct Comparison Test or Limit Comparison Test to determine whether

\[ \sum_{n=1}^{\infty} \frac{1}{2n - \sqrt{n}} \]

converges or diverges.
9. **10 pts.** Use the Ratio Test to determine whether

\[ \sum_{n=1}^{\infty} \frac{n^{100}}{(n+1)!} \]

converges or diverges.

10. **10 pts.** Use the Root Test to determine whether

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

converges or diverges.

11. **10 pts.** Use the Alternating Series Test to show the series

\[ \sum_{n=0}^{\infty} (-1)^n \frac{n^2 - 1}{4n^2 + 9} \]

converges, or use another test to show it diverges.