1. [5 pts. each] Consider the sequence $(1, -2, 3, -4, 5, \ldots)$.

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

    (b) Find an explicit formula for the nth term of the sequence.

2. [10 pts. each] Find the limit of the sequence, or determine that it does not exist.

    (a) $a_n = \dfrac{\tan^{-1} n}{n}$

    (b) $a_n = \ln\left(\dfrac{3n+1}{3n-1}\right)^n$

3. [10 pts.] Write the repeating decimal $0.0\overline{213}$ as a geometric series.

4. [10 pts.] For the telescoping series

$$\sum_{k=1}^{\infty}\left(\frac{1}{\sqrt{k+1}} - \frac{1}{\sqrt{k+3}}\right),$$

    find a formula for the nth term of the sequence of partial sums (s_n), and then evaluate the series.

5. [10 pts.] Determine whether the series
$$\sum_{n=0}^{\infty} \frac{10}{n^2 + 9}$$

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

6. [10 pts.] Use either the Direct Comparison Test or Limit Comparison Test to determine whether

$$\sum_{n=1}^{\infty} \frac{1}{2n - \sqrt[3]{n^2}}$$

    converges or diverges.

7. [10 pts.] Use the Ratio Test to determine whether

$$\sum_{n=0}^{\infty} \frac{(n!)^3}{(3n)!}$$

    converges or diverges.

8. 10 pts. Choose an appropriate test to determine whether

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

converges or diverges.

9. 10 pts. Choose an appropriate test to determine whether the series

$$\frac{1}{1\cdot 3} + \frac{1}{3\cdot 5} + \frac{1}{5\cdot 7} + \frac{1}{7\cdot 9} + \cdots$$

converges or diverges.

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

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

converges, or use another test to show it diverges.