1. **[10 pts. each]** Evaluate each integral
   
   (a) \[ \int \frac{1}{x^2 - 2x - 24} \, dx \]
   
   (b) \[ \int \frac{x}{(x + 3)^2} \, dx \]

2. **[10 pts. each]** Evaluate each improper integral or state that it diverges.
   
   (a) \[ \int_2^\infty \frac{\sin(\pi/x)}{x^2} \, dx \]
   
   (b) \[ \int_0^1 \frac{1}{\sqrt{x}} \, dx \]

3. **[5 pts. each]** For the sequence \( \{1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \ldots\} \) do the following.
   
   (a) Find the next two terms of the sequence.
   
   (b) Find a recurrence relation that generates the sequence.
   
   (c) Find an explicit formula for the general \( n \)th term of the sequence.

4. **[10 pts. each]** Find the limit of each sequence, or state that the limit does not exist.
   
   (a) \( \left\{ \frac{2n^{12}}{7n^{12} + 4n^5} \right\} \)
   
   (b) \( a_n = (-1)^n \sqrt{n} \)
   
   (c) \( \left\{ \frac{\cos n}{2^n} \right\} \) (Use Squeeze Theorem)

5. **[10 pts]** Evaluate the geometric series \( \sum_{k=2}^{\infty} \frac{5}{2^k} \)

6. **[10 pts]** For the telescoping series \( \sum_{k=1}^{\infty} \left( \frac{1}{k + 2} - \frac{1}{k + 3} \right) \), find a formula for the \( n \)th term of the sequence of partial sums \( \{s_n\} \), then evaluate \( \lim_{n \to \infty} s_n \) to obtain the value of the series.

7. **[10 pts. each]** Determine whether the series converges or diverges. The test(s) you are allowed to use are indicated in parentheses.
   
   (a) \( \sum_{k=0}^{\infty} \frac{k}{99k + 50} \), (Divergence Test or either Comparison Test)
   
   (b) \( \sum_{k=1}^{\infty} \frac{k}{\sqrt{k^2 + 4}} \), (any test that works)
   
   (c) \( \sum_{k=1}^{\infty} \frac{(k!)^2}{(2k)!} \), (Ratio Test)
   
   (d) \( \sum_{k=1}^{\infty} \frac{k^2}{2k} \), (Root Test)
   
   (e) \( \sum_{k=1}^{\infty} \frac{k^2 - 1}{k^3 + 9} \), (either Comparison Test)
   
   (f) \( \sum_{k=1}^{\infty} \frac{k^8}{k^{11} + 3} \), (any test that works)