1. Consider the sequence \( \{a_n\}_{n \geq 1} \), where \( a_n = n \sin \left( \frac{3}{n} \right) \). Does this sequence converge to a real number \( L \)? If so, find \( L \).

2. Consider the sequence \( \{b_n\}_{n \geq 1} \), where \( b_n = \left( \frac{n^2 + 3}{n^2} \right)^{-2n^2+7} \). Does this sequence converge to a real number \( L \)? If so, find \( L \).

3. Compute the value of the series \( \sum_{n=1}^{\infty} \frac{2^{3n}}{(-3)^{2n+1}} \).

4. With proof, determine whether or not the following series is convergent or divergent.

\[
1 + \frac{1}{2} \left( \frac{19}{7} \right) + \frac{2!}{3^2} \left( \frac{19}{7} \right)^2 + \frac{3!}{4^3} \left( \frac{19}{7} \right)^3 + \frac{4!}{5^4} \left( \frac{19}{7} \right)^4 + \cdots
\]

5. Determine whether each of the following series is absolutely convergent, conditionally convergent, or divergent. Make sure to clearly state which test you use.

(a) \( \sum_{n=1}^{\infty} \frac{(n^2 + n + 6)^{7/3}}{(n^3 + 3n^2 + 3n + 1)^{7/4}} \)

(b) \( \sum_{n=3}^{\infty} \frac{(-1)^n(n - 2) \ln(n)}{n^{3/2}} \)

(c) \( \sum_{n=1}^{\infty} (n - 1)^2 e^{-n} \)

(d) \( \sum_{n=1}^{\infty} \frac{(-2)^{3n}}{n^n} \)

(e) \( \sum_{n=1}^{\infty} (-1)^{n+3}2^{1/n^2} \)

(f) \( \sum_{n=1}^{\infty} \frac{(-1)^{2n+1}n!}{(1)(5)(9)(13) \cdots (4n - 3)} \)
6. Find the domain of \( g(x) = \sum_{n=10}^{\infty} \frac{(-1)^n(2x-1)^{3n+1}}{n \ln(n)} \).

7. Let \( f(x) = x^{50} - 3x^{30} + x^{10} - 2x^3 + 17 \).
   (a) Find the 3\(^{th}\)-degree Taylor polynomial, \( T_3(x) \), for \( f(x) \) at \( a = 1 \).
   (b) Find the Maclaurin series of \( f(x) \).
   (Hint: Think about this before you do it, although I guess you should do that on every problem.)

8. Consider the matrices \( C = \begin{pmatrix} 3 & 1 & 2 \\ 1 & 0 & 1 \end{pmatrix} \), \( D = \begin{pmatrix} 2 & 1 \\ 3 & 5 \\ 2 & 1 \end{pmatrix} \), and \( E = \begin{pmatrix} 1 & 0 \\ 1 & 2 \end{pmatrix} \).
   (a) Find \( 4C \).
   (b) Find \( D + E \).
   (c) Compute the following, or explicitly state that they do not exist:
   
   \( CD, DC, DE, ED \).