1. (18 points) Consider the power series $\sum_{n=1}^{\infty} \frac{(3x-1)^n}{4^n n}$.

   (a) Determine the radius of convergence of this series.

   (b) Determine the interval of convergence of this series.

2. (24 points) Determine if each of the following absolutely converges, conditionally converges, or diverges. Be sure to fully justify your answers using the techniques learned in this course. If you use a Test or Theorem, be sure to state its name and show its hypotheses are satisfied.

   (a) $\sum_{n=1}^{\infty} \frac{(-5)^{n+1}(n!)^2}{(2n)!}$

   (b) $\sum_{n=4}^{\infty} (-1)^n \frac{\sqrt{2n+1}}{n-3}$

3. (16 points) Suppose $g(x) = \frac{1}{1+5x^2}$.

   (a) Determine a power series representation for $h(x) = xg'(x)$. (Write your final answer using sigma notation.)

   (b) Find the sum of
   $$-\frac{10}{3^2} + \frac{100}{3^4} - \frac{750}{3^6} + \frac{5000}{3^8} - \cdots .$$

4. (20 points) Consider $f(x) = \ln x$.

   (a) Determine the 2nd Taylor polynomial of $f(x) = \ln x$ centered at $x = 1$.

   (b) Use the 2nd Taylor polynomial of $f(x) = \ln x$ centered at $x = 1$ to approximate $\ln\left(\frac{11}{10}\right)$.

   (c) Use Taylor's Formula to find an upper bound on the error of your approximation from (b).

5. (12 points) Consider the parametric curve defined by $x(t) = \ln t$ and $y(t) = \frac{\ln t}{t}$ for $1 \le t \le e^3$.

   (a) Find the x and y coordinates of the initial and terminal points of the parametric curve.

   (b) Eliminate the parameter to find y as a function of x.

6. (10 points) Indicate whether the following are **Always True** or **Sometimes False** by circling your answer below the statement. If the answer is Sometimes False, provide an example below to show why it's Sometimes False. No further justification is necessary.

   (i) If $\sum_{n=1}^{\infty} |c_n|$ diverges then $\sum_{n=1}^{\infty} c_n$ diverges.

   (ii) If $\sum_{n=1}^{\infty} |c_n|$ converges then $\sum_{n=1}^{\infty} (-1)^n c_n$ converges.

(iii) Suppose $\sum_{n=0}^{\infty} a_n(x-2)^n$ has an interval of convergence of $(-1, 5)$ and $\sum_{n=0}^{\infty} b_n(x+5)^n$ has an interval of convergence of $(-\infty, \infty)$, then the interval of convergence of $\sum_{n=0}^{\infty}(a_n + b_n)x^n$ is $(-3, 3)$.

(iv) $\sum_{n=2}^{\infty} c_n x^{n+5}$ has the same radius of convergence as $\sum_{n=0}^{\infty} c_n x^n$.