1. (8 points) Find the derivative of the function $f : [1, \infty) \to \mathbb{R}$ defined by the formula
   
   \[ f(x) = \int_0^x e^{t^2} \, dt. \]

2. (8 points) Calculate the Taylor series for the function
   \[ f(x) = e^{x^3} + e^{2x^3} \]
   around the point $a = 0$. Where does the series converge to the function $f(x)$?

3. (8 points) Prove that the series
   \[ \sum_{n=1}^{\infty} \frac{n^2 + \cos n}{e^{n^3}} \]
   converges absolutely. (Hint: note that $|\cos n| \leq n^2$ for all $n \in \mathbb{N}$ and use the integral test.)

4. (8 points) Using Taylor series, calculate sinh $1$ correct to 6 decimal places. You must show your work. Simply finding sinh $1$ on a calculator will not earn you any credit.

5. Do the following series converge?
   
   (a) (5 points)
   \[ \sum_{n=3}^{\infty} \frac{1}{n(\log n)(\log(\log n))} \]
   (Hint: use the integral test and perform change of variable twice.)
(b) (5 points)

\[ \sum_{n=3}^{\infty} \frac{1}{n + \log n} \]

(Hint: remember the inequality \( \log n \leq n \).)

6. (8 points) Prove that the limit

\[ \lim_{(x,y,z) \to (0,0,0)} \frac{x^2yz}{x^8 + y^4 + z^2} \]

does not exist. (Hint: what if you approach the origin along the curve \( z = x^4, \ y = x^2 \)?)