1. (15%) Evaluate the limit (if it exists) of the following questions.
   (a) \( \lim_{x \to a} (\sqrt{x^2 + a^2} - x) \)
   (b) \( \lim_{x \to a} \frac{x^2 - a^2}{x + a} \), \(a > 0\)
   (c) \( \lim_{x \to 0} (1 + x)^{1/x} \)

2. (15%) Evaluate the following integrals:
   (a) \( \int \frac{e^x - e^{-x}}{e^x + e^{-x}} \, dx \)
   (b) \( \int x^3 (\ln x)^2 \, dx \)
   (c) \( \int_0^1 \int_0^1 \sqrt{1 + x^2} \, dx \)

3. (5%) Given \( F(x) = \int_0^x f(t) \, dt \), show \( \int_0^x (1 - F(x)) \, dx = \int_0^x x f(x) \, dx \).

4. (5%) Present the result of \( \frac{d}{dx} \int_0^x (a - x) f(x) \, dx \) in terms of \( F(x) \) where \( F(x) = \int_0^x f(x) \, dx \).

5. (10%) Show directly from the definition that \( \lim_{x \to 1} \frac{x - 1}{x + 1} = \frac{1}{2} \). (Hint: Definition of Limit)
   - Given a function \( f \) and numbers \( a \) and \( L \), we say that \( f(x) \) tends to \( L \) as \( x \) tends to \( a \) if for each positive number \( \varepsilon \) there is positive number \( \delta \) such that \( f(x) \) is defined and \( |f(x) - L| < \varepsilon \) whenever \( 0 < |x - a| < \delta \).

6. (10%) The region bounded by \( f(x) = 1/x \), the \( x \) axis, and the line \( x = 1 \), and situated to the right of \( x = 1 \), is revolved about the \( x \) axis. Evaluate the improper integral and assign a value to the volume of the solid generated.

7. (10%) Use Simpson's Rule with \( 2n = 4 \) to compute the approximate value for \( \int_1^3 \frac{dx}{x} \).
   Keep two decimal places and round off to one less.

8. (10%) For what values of \( p \) and \( q \) does the series \( \sum_{n=1}^{\infty} \frac{(\ln n)^p}{n^q} \) converge?

9. (10%) Use Taylor's Theorem to compute \((1.1)^{1/5}\) to an accuracy of four decimal places.
   (Hint: Taylor's Theorem with Derivative Form of Remainder -- Suppose that \( f \), \( f', f'' \), \ldots, \( f^{(n)} \) are all continuous on some interval containing \( a \) and \( b \). Then there is a number \( c \) between \( a \) and \( b \) such that \( f(b) = f(a) + f'(c)(b-a) + \cdots + f^{(n)}(c)(b-a)^n/n! + f^{(n+1)}(d)(b-a)^{n+1}/(n+1)! \). That is, the remainder \( R_n \) is given by the formula \( R_n = f^{(n+1)}(c)(b-a)^{n+1}/(n+1)! \).)

10. (10%) Find the critical values of \( f(x,y) = x^2 + y^2 \), subject to the condition that \( x^2 + y^2 + 6xy = 0 \).