You may keep this list of questions. Turn in your answers with all of your work on the green paper and pink paper. You are NOT allowed to use calculators on questions #1 – 14. Work these questions on the green paper. After you have finished these first fourteen questions, turn in the first part of the exam and receive pink paper to use for the last two questions.

(1) 10 Points. State the \( \epsilon - \delta \) definition for \( L = \lim_{x \to a} g(x) \). Illustrate with a sketch.

(2) 10 Points. State the Mean Value Theorem.

(3) 16 Points. Find exact values for the following limits.

(a) \( \lim_{x \to 3} \frac{\cos(\pi x)}{(x + 4)^2} \)  
(b) \( \lim_{x \to \infty} \left( 1 + \frac{3}{x} \right)^{2x} \)

(4) 8 Points. Find \( \frac{dw}{dz} \) if \( w = \cosh(4z) \).

(5) 8 Points. Find \( f'(x) \) if \( f(x) = \tan^{-1}(x^3) \).

(6) 8 Points. Find \( \frac{dr}{dt} \) if \( r = t \ln(t^2 + 4) \).

(7) 8 Points. Find \( \frac{dy}{dx} \) implicitly if \( x^3y + e^{y^2} = x + \ln 3 \).

(8) 8 Points. Find \( G'(x) \) if \( G(x) = \int_{2}^{x} \sqrt{5 + e^{-3t}} \, dt \).

(9) 24 Points. Evaluate the following definite integrals and antiderivatives.

(a) \( \int_{1}^{4} \sqrt{x} (x + 3) \, dx \)  
(b) \( \int_{0}^{2} e^{-3t} \, dt \)  
(c) \( \int \cos(5\theta) \, d\theta \)  
(d) \( \int \frac{w \, dw}{w^2 + 1} \)
(10) 20 Points. In the following table, values are given for \( f(x), g(x), f'(x) \) and \( g'(x) \). Let \( p(x) = f(x)g(x) \) be the product, \( q(x) = f(x)/g(x) \) be the quotient, \( N(x) = f^{-1}(x) \) be the inverse of \( f(x) \) with respect to composition and \( \text{cmp}(x) = f(g(x)) \) be the composition of \( f \) and \( g \).

<table>
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<th>( g(x) )</th>
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</table>

(a) Find \( p'(0.0) \).  
(b) Find \( q'(0.6) \).  
(c) Find \( N'(1.0) \).  
(d) Find \( \text{cmp}'(0.8) \).

(11) 10 Points. Let \( f(x) = \ln(5x + 3) \).
(a) Find the domain for \( f \).
(b) Find \( f^{-1}(x) \).

(12) 12 Points. Solve the initial value problem
\[
\frac{dy}{dx} = \frac{2y}{3x}, \quad y(1) = -3
\]

(13) 16 Points. A rectangle has one side on the \( x \)-axis and two vertices on the curve \( y = \frac{x^2}{(1 + x^2)^2} \). Find the four vertices for the rectangle with maximum area.
Turn in your work and answers for the first fourteen questions and any remaining green paper before continuing.

(15) 12 Points. Suppose that \( g(t) = t^a e^{-bt} \) where \( a \) and \( b \) are positive constants. Approximate \( a \) and \( b \) to the nearest thousandth if \( g \) has a local maximum at the point \((4.250, 9.700)\).

(16) 12 Points. Use your calculator and the Riemann sum for the partition \( \{3.0, 3.5, 3.8, 4.6, 5.0\} \) augmented by the values \( \{3.1, 3.6, 4.3, 4.9\} \) to approximate the integral

\[
\int_{3}^{5} x^2 \sin\left(\frac{\pi}{x}\right) \, dx
\]

If you round values from your calculator, retain at least 6 significant digits.