INSTRUCTIONS: Books, notes, and electronic devices are not permitted. Write (1) your name, (2) 1350/Final, (3) lecture number/instructor name and (4) FALL 2014 on the front of your bluebook. Also make a grading table with room for 6 problems and a total score. Start each problem on a new page. Box your answers. A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. SHOW ALL WORK! SIMPLIFY YOUR ANSWERS AS MUCH AS POSSIBLE!

1. The following parts are not related:
   (a)(5 pts) Evaluate the limit \( \lim_{x \to \infty} \cosh(x)^{1/x} \)
   (b)(5 pts) Evaluate the limit \( \lim_{x \to 0^+} [\ln(\sin(x)) - \ln(x)] \)
   (c)(7 pts) Prove that \( \lim_{x \to 0} x^4 \cos \left( \frac{2}{x} \right) = 0 \). Justify your answer.
   (d)(8 pts) Suppose \( f(x) = \begin{cases} x^2, & x \leq 2 \\ 4, & x > 2 \end{cases} \). Use the limit definition of the derivative to determine whether or not \( f(x) \) is differentiable at the point \( x = 2 \). You may not use L’Hospital’s Rule for this problem. Justify your answer.

2. The following problems are not related:
   (a)(5 pts) Find the derivative of \( y = \ln(\arctan(x)) \).
   (b)(5 pts) Find \( f'(x) \) if \( f(x) = \int_{2x}^{10} \sin^{-1}(\theta) d\theta \).
   (c)(7 pts) Use the Intermediate Value Theorem to show that there is a root to the equation \( 2^x + x = 0 \). Justify your answer.
   (d)(8 pts) A kite 100 ft above the ground moves horizontally at a speed of 8 ft/s. At what rate is the angle between the string and the horizon changing when 200 ft of string has been let out?

3. The following problems are not related:
   (a)(5 pts) Find the instantaneous rate of change of \( f(x) = \frac{\tanh(x)}{x} \) with respect to \( x \).
   (b)(5 pts) Find \( \frac{dy}{dx} \) given \( y = x^{\cos(x)} \).
   (c)(7 pts) Use logarithmic differentiation to find \( y' \) if \( y = \frac{e^x(x + 1)^3}{\sqrt{\sec(x)}} \).
   (d)(8 pts) Classify all discontinuities of \( f(x) = \frac{2x^2 + 12x}{x|x+6|} \) as either jump, removable or infinite. Justify your answers.
4. The following problems are not related:
   (a)(5 pts) Find the following antiderivative \( \int (x^5 + 5^x) \, dx \)
   (b)(5 pts) Evaluate the definite integral \( \int_0^8 \frac{x}{\sqrt{1+x}} \, dx \)
   (c)(7 pts) A curve passes through the point \((\ln(2), 8)\) and has the property that the slope of the curve at every point \(P\) is 2 times the \(y\)-coordinate of \(P\). What is the equation of the curve?
   (d)(8 pts) Find the linear approximation of \(f(x) = \sqrt[3]{1+x}\) at \(a = 0\) and use it to approximate \(\sqrt[3]{1.1}\)

5. The following problems are not related.
   (a)(5 pts) Evaluate the integral \( \int e^x \frac{1}{1+e^x} \, dx \).
   (b)(5 pts) Evaluate the definite integral \( \int_0^{\pi/2} \frac{\cos(x)}{1 + \sin^2(x)} \, dx \).
   (c)(7 pts) If \(f(x) = 3 + x + e^x\) find \((f^{-1})'(4)\).
   (d)(8 pts) Use the Mean Value Theorem to show that there exists a number \(c\) in \((-1, 1)\) such that \(e^c = \sinh(1)\).

6. For this problem we have \(f(x) = \frac{x^2 - 4}{x^2 + 4}\), \(f'(x) = \frac{16x}{(x^2 + 4)^2}\), and \(f''(x) = \frac{16(4 - 3x^2)}{(x^2 + 4)^3}\)
   (a)(8 pts) Find the intervals of concavity and the inflection points of \(f(x)\).
   (b)(8 pts) On what intervals is \(f(x)\) increasing? decreasing? Find and classify all local extrema of \(f(x)\).
   (c)(4 pts) Find all Vertical and Horizontal Asymptotes of \(f(x)\).
   (d)(3 pts) Is \(f(x)\) an even function an odd function or neither? Why or why not? Justify your answer.
   (e)(2 pts) Sketch the graph of \(f(x)\) (Clearly label all the axes, intercepts, asymptote and local extrema).

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