Math 273 - Fall 2015
Practice Midterm

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(1) Find the derivative of the following functions.
   (a) $f(\theta) = \frac{\sec\theta}{1+\tan\theta}$.
   (b) $y(x) = \sqrt{e^x + 1}$.
   (c) $h(t) = \ln t + \frac{1}{sin^{-1}t}$.
   (d) $g(x) = \frac{x(x+2)^2(x-1)^8}{\sqrt{x^3(x+3)e^x}}$.
   (e) $r(x) = x^{1/x}$.
   (f) $h(x) = \sinh(\sqrt{x}) + \cosh(1/x)$.

(2) Let $f(x) = sin(2x)$. What is $f'(x)$? What is $f''(x)$? What is $f'''(x)$? What is $f^{(4)}(x)$? What is $f^{(42)}(x)$? Give a formula for $f^{(n)}(x)$ valid for all positive integers n. (Here $f^{(n)}(x)$ means the n-th derivative of $f(x)$.)

(3) What is the derivative of $\ln(x)$? Prove your answer using implicit differentiation.

(4) At what point on the curve $y = [\ln(x+4)]^2$ is the tangent line horizontal?

(5) Strontium-90 has a half likfe of 28 days.
   (a) A sample has a mass of 50 mg initially. Find a formula for the mass remaining after t days.
   (b) Find the mass remaining after 40 days.
   (c) sketch a graph of the mass function.

(6) Find the equation to the tangent line to $y^2 + \ln(y-1) = x^2(3-x)$ at the point (2,2).

(7) A man walks along a straight path at a speed of 3 ft/s. A searchlight is located on the ground 15 feet from the path and is kept focused on the man. At what rate (in radians/sec) is the searchlight rotating when the man is 30 feet from the searchlight?

(8) Below are the graphs of a function $f(x)$, together with $f'(x)$, $f''(x)$ and an unrelated function $g(x)$. Identify each.