92.128 Calculus 1A Fall 2010 Exam II Name _____ Section # _____

Instructions: Calculators and note sheets are **not allowed**. All answers must be supported by work on your exam sheets. Answers with little or no supporting work will receive little or no credit. Work must be **neat**, **organized** and **easily interpreted**. Graders will deduct points if your work is not expressed in complete mathematical sentences (e.g., $f'(x) = something$). Please box in your final answers. Your name and section number must be printed on **ALL** sheets.

MEMORY QUESTIONS (4 points each):

M.1. Expand and simplify (replace all trigonometric functions of standard angles with their values):

$\sin(\theta + \pi/3) =$

M.2. A triangle has sides A, B, and C with opposite angles a, b, and c. Express the ratio $\frac{\sin(a)}{A}$ in terms of the remaining variables.

$\frac{\sin(a)}{A} =$

M.3. A cylinder of radius r and height h is topped with a hemi-sphere having the same radius. Its volume is given by:

$V(r,h) =$

ANALYTIC QUESTIONS:

1. (15 points) Determine the derivative of $f(x) = \frac{1}{2x-1}$ using the limit of the difference quotient.

(Optional but advised: You should check your final answer using the rules of differentiation.)

2. Find the derivative of the following functions using the rules of differentiation. **NOTE:** YOU DO NOT NEED TO SIMPLIFY. (Each problem is worth 6 points)

a. $h(x) = 2x^{2/5} - 3x^{-3} + 5\sqrt[3]{x} + 3$

$h'(x) =$

b. $s(x) = \dfrac{4x^2 + 3x - 1}{\sqrt{x}}$

$s'(x) =$

c. $f(t) = 3e^{-t}\sec(t)$

$f'(t) =$

3. Find the derivative of the following functions using the rules of differentiation. **NOTE:** YOU DO NOT NEED TO SIMPLIFY. (Each problem is worth 7 points)

a. $g(x) = \dfrac{2\tan(x)}{x^3 - \cos(x)}$

$g'(x) =$

b. $r(\theta) = 2\cos(\sin(\sqrt{\theta - 3}))$

$r'(\theta) =$

4. (15 Points) A particle's position as a function of time for $t \geq 0$ is given by $g(t) = t + \sin(2t)$. Find an equation for the particle's velocity, $v(t)$, and its acceleration, $a(t)$. What is the first value of t for which $v(t) = 0$?

5. (7 points) Find the equation of the line (in slope-intercept form) that is tangent to $y = 3\sqrt{x} + \frac{1}{x}$ at $x = 1$.

6. (7 points) Find the values of t where $f(t) = 3t^4 + 8t^3 - 18t^2 + 11$ has a horizontal tangent.

7. (12 points) The trajectory of a particle in the x-y plane is described by the parametric equations $x(t) = \sin(\pi t)$ and $y(t) = e^{2t} + e^{t}$. Determine $\frac{dy}{dx}$ as a function of t. What is the slope of the line tangent to the particle's trajectory at $t = 0$? (Note: You do NOT need to find the equation of the tangent line.)

BONUS: (10 Points) Determine the exact value of the second derivative of $f(x) = e^{x}\sin(x)$ at $x = \pi$ **.**