**APPM 1350** **EXAM 1** **SUMMER 2006**

On the front of your bluebook write: (1) your name, (2) your student ID number, (3) your instructor's name, and (4) a grading table. You must work all of the problems on the exam. Show ALL of your work in your bluebook and BOX in your final answers. A correct answer with no relevant work may receive no credit, while an incorrect answer accompanied by some correct work may receive partial credit. Text books, class notes, calculators and crib sheets are NOT permitted. Please start each new problem on a new page of the bluebook.

1. (15 points) For each of the following unrelated questions, answer either ALWAYS TRUE, ALWAYS FALSE, or NEITHER. No justification is necessary.
   (a) If $f$ and $g$ are continuous at the point $x = c$, then $\frac{f}{g^2+1}$ is continuous at $x = c$.
   (b) If $f$ is differentiable at $x = c$, then $\frac{1}{f}$ is differentiable at $x = c$.
   (c) $f(x) = \dfrac{\cos^3 x - \sin(x + \frac{\pi}{4})}{\tan^2 x + 1}$ crosses the $x$-axis between $x = \pi$ and $x = 2\pi$.
   (d) If $f$ is odd and $g$ is even, then $f \circ g$ is even.
   (e) If $|3x - 2| > 4$ then $|x| > 1$.

2. (30 points) Evaluate each of the following limits, if it exists. If the limit does not exist, state this and state your justification. Show all your work.
   (a) $\lim\limits_{t\to 1^-} \dfrac{1}{1-t}$
   (b) $\lim\limits_{r\to -2} \dfrac{r^2 - r - 6}{r + 2}$
   (c) $\lim\limits_{x\to -3} (x+2)^3 \dfrac{|x+3|}{(x+3)}$
   (d) $\lim\limits_{y\to 0^-} \dfrac{\sqrt{x+y} - \sqrt{x}}{y}$
   (e) $\lim\limits_{t\to 3} \dfrac{t}{(t-2)^2}$

3. (15 points)
   (a) State the definition of $\frac{d}{dx} f(x)$.
   (b) Use the *definition* to find $\dfrac{d}{dx}\dfrac{x}{x^2+1}$.
   (c) Find the equation for the tangent line to the curve $y = \dfrac{x}{x^2+1}$ at $x = 1$.

4. (24 points) Using the appropriate rules of differentiation, evaluate the derivatives with respect to $x$ for the following functions:
   (a) $f(x) = \sqrt{x} - \dfrac{3}{\sqrt{x}}$
   (b) $g(x) = \dfrac{1}{x^4 + x^2 + 1}$
   (c) $y(x) = (x^2 + 3x + 2)(x^3 - 2x - 1)$
   (d) $z(x) = \dfrac{x^2 + x}{(\sqrt{x} - 2)(x + 1)}$

5. (16 points)
   (a) Find the average rate of change of the volume of a cube with respect to its edge length $x$ as $x$ changes from 1 to 2.
   (b) Find the instantaneous rate of change of the volume when $x = 2$.
   (c) Show that the rate of change of the volume of a cube with respect to its edge length is equal to exactly half the surface area of the cube. (Hint: Write down the equation for the surface area of a cube.)