Math 111 **Exam 1** September 22, 2004

Read each problem carefully. Please show all your work for each problem! Use only those methods discussed thus far in class. No calculators!

1. Differentiate:

$$(a)\ \ f(x) = -3 + 2x - 2x^2, \qquad (b)\ \ g(t) = 3t^2(5+t)^3,$$
$$(c)\ \ h(z) = \frac{5z-1}{4-z}, \qquad (d)\ \ u(x) = (\sqrt{x} + x^2)^{1/3}.$$

2. Calculate the following limits:

$$(a)\ \lim_{x\to 1} \frac{x^2-3}{x^3+4x-2}, \quad (b)\ \lim_{t\to 9} \frac{6-2\sqrt{t}}{t(t-3)}, \quad (c)\ \lim_{\theta\to 0} \frac{\theta + 2\tan 3\theta}{\sin\theta}, \quad (d)\ \lim_{x\to -1^-} \frac{x}{x+1}.$$

3. For each function below, determine for which values of x these functions are continuous, and if not, whether the discontinuity is removable or not, and explain why:

$$(a)\ \ f(x) = \frac{x^2+1}{x^2-1}, \quad (b)\ \ g(x) = (x+1)\sqrt{x}, \quad (c)\ \ h(x) = \frac{x^2+x-6}{x+3}.$$

4. Find the equation of the line normal to the curve $y = x^2 - 3x + 1$ at the point where $x = -1$.

5. The height, in meters, of a ball thrown vertically upward is $y(t) = -5t^2 + 30t + 5$.

   (a) What is the initial height and velocity of the ball?

   (b) What is the ball's acceleration?

   (c) What is the maximum height the ball attains?

6. Use the definition of the derivative to find $f'(x)$, if

$$f(x) = \sqrt{2x+1}.$$

7. The length of the side of an equilateral triangle increases at a rate of 2 m/s. What is the rate of change of the area of this triangle, when the area is equal to $\sqrt{3}$ m^2?