Duration: 3 hours
Instructions: Answer all questions, without the use of notes, books or calculators. Partial credit will be awarded for correct work, unless otherwise specified. The total number of points is 100.

1. (points: each) Find the following limits.

    (a) $\lim\limits_{x \to 5} 7x^2 + 6x + 8$

    (b) $\lim\limits_{x \to 0^+} \dfrac{1}{1 + e^{1/x}}$

    (c) $\lim\limits_{x \to \infty} [\ln(5 + x) - \ln(2 + x)]$

2. (points) Derivatives

    (a) Differentiate $\displaystyle\int_3^{\sqrt{x}} \dfrac{5 \sinh t}{t}\, dt$

    (b) Calculate y' if $e^{xy} = x^2 - y$.

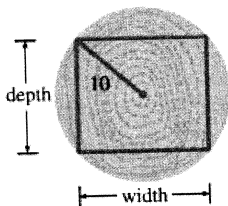   (c) Find the equation of the tangent line to the curve $y = \sqrt{1 + 4 \sin x}$ at $(0, 1)$.

    (d) Differentiate $f(x) = (2x^3 + 1)(x^4 - 2x)$.

3. (points) Integrals

    (a) $\displaystyle\int \dfrac{2 \cos x}{1 + \sin^2 x}\, dx$

    (b) $\displaystyle\int_1^9 \dfrac{x^2 + 2}{\sqrt{x}}\, dx$

4. (points) A hot, wet summer is causing a mosquito population explosion in a lake resort area. The number of mosquitos is increasing at an estimated rate of $2500 + 8e^t$ per week (where t is measured in weeks). By how much does the mosquito population increase between the 4th and 8th weeks of summer?

5. (points) A rectangular beam will be cut from a cylindrical log of radius 10 inches. Suppose that the strength of a rectangular beam is proportional to the product of its width and the square of its depth. Find the dimensions of the strongest beam that can be cut from the cylindrical log.

6. (points total) Two cars start moving from the same point. One travels south at 30 miles/hour and the other travels west at 40 miles/hour. At what rate is the distance between the cars increasing 2 hours later?