Final Examination
Thursday, May 11, 2006, 10:15AM–12:45PM

Instructions: This exam should be done on your own paper. The answers should be written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. You may keep this exam sheet. Each entire problem is worth 20 points.

1. Use the fundamental theorem of calculus to compute an exact answer for $\int_0^1 3x^2 dx$. Show all of your work.

2. A bond is guaranteed to pay $50 + 100t$ dollars per year for 10 years, where t is in years from the present. Find the present value of this income stream, given an interest rate of 5% compounded continuously.

3. Find the global maximum and global minimum of $f(x) = xe^{-x^2/2}$, $-10 \leq x \leq 10$. Give both the maximum and minimum values and the points at which these values occur.

4. The world's population is about $P(t) = 6e^{0.013t}$ billion, where t is the time in years since 1999. Find $P(0)$, $P'(0)$, $P(10)$, and $P'(10)$. Using units, interpret your answers in terms of population.

5. The oxygen supply S in the blood depends on the hematocrit H, the percentage of red blood cells in the blood:
$$S = aHe^{-bH} \quad \text{for positive constants } a \text{ and } b.$$

   (a) What value of H maximizes the oxygen supply?

   (b) How does increasing the constant a change the maximum value of S?

   (c) How does increasing the constant b change the maximum value of S?