PRACTICE for Exam 2

No calculators allowed. You must show work at all times in order to receive full credit.

1. Use logarithmic differentiation to find the derivative:
$$f(x) = \frac{e^{3x}(x+1)^6(x^3-2)^4}{\sqrt{2x-7}}$$

2. (a) Find *all* values for x which make the equation true: $x\ln(x+1) = 2x$
   (b) Write the following expression in the form 2^{ax+b} for some a and b: $\dfrac{16^x}{2 \cdot 4^{2x}}$

3. Find $g'(1)$, where $g(x) = e^{3x^2-2x+1}$

4. For the following function, determine the x- and y-value of each critical point, and then use the first or second derivative test to determine whether each point is a maximum, minimum, or neither:
$$f(x) = \frac{x}{\ln(x)}$$

5. To make killer robots, one uses the radioactive isotope `Halloweenium-X`, which has a decay constant of $\lambda = .002$.
   (a) What is the half-life of `Halloweenium-X`?
   (b) What differential equation is satisfied by the decay of `Halloweenium-X`?
   (c) Use the differential equation to answer the question: how much `Halloweenium-X` is in a sample which is decaying at the rate of 4 grams per year?

6. A colony of flesh-eating zombies feeds on the living population of Earth and grows at a rate proportional to its size. (As with all zombie colonies) it starts with just one person, and after one year there are 2,500 zombies.
   (a) Find the growth constant k of the zombie colony.
   (b) Find an equation $P(t)$ which describes the number of zombies in the colony at time t.
   (c) Using this equation, how many years until the colony reaches 10,000 zombies?

7. An evil collector sells his collection of cursed talismans for $\$4,000$, deposits the earnings into his bank account, then abruptly disappears and is never heard from again. The account accrues interest compounded continuously for 100 years before someone discovers it, with a balance of $\$120,000$. What was the annual interest rate for this bank account?

8. The concentration of a drug in the bloodstream of a patient, t hours after injection, is given by:
$$f(t) = 5(e^{-.2t} - e^{-2t}) \text{ units}$$
At what rate is the drug concentration changing after 4 hours?