

**Exam 3    Calc 1    11/9/2012**

Each problem is worth 10 points. For full credit provide complete justification for your answers.

1. Evaluate  $\int \left( \sqrt[3]{x} - \frac{1}{x} + \cos x \right) dx$ .

2. Find all intervals on which  $y = x^3 - x + 2$  is increasing.

3. Find the linear approximation  $L(x)$  for  $f(x) = \sqrt[3]{x}$  at 8.

4. Evaluate  $\lim_{x \rightarrow \infty} \frac{e^x - x - 1}{x^2}$  .

5. For which values of  $x$  is  $f(x) = x e^{-x}$  concave up?

6. Jon plans to sell jet-propelled golf balls. In his trial program he sold 200 golf balls each week at a price of \$100 apiece. His market research firm tells him that for each \$1 he drops his price, he can sell 5 additional golf balls. What price should he charge to bring in the largest possible revenue?

7. Bunny is a calculus student at Enormous State University, and she's having some trouble. Bunny says "I think calculus is going to kill me! Everything is so totally confusing! I mean, I can do some of the problems, but I have no clue why anything is how it is. It seems like this whole chapter every time we take the derivative and set it equal to zero, but I have no idea why. What does it mean when you do that?"

Explain clearly to Bunny exactly what we accomplish when we take the derivative of a function and set it equal to zero.

8. Let  $f(x) = 12x^5 - 20x^3$  on  $[-1, 2]$ . Find the absolute maximum and absolute minimum values of  $f(x)$  on the interval.

9. Show that a function of the form  $f(x) = a x^2 + b x + c$ , with  $a \neq 0$ , has an extreme value where  $x = -b/2a$ .

10. Jon is finishing his attic, and wants to fit in the largest rectangular storage space he can under the sloping roof around the perimeter of the room. This amounts to finding the largest (in terms of area) rectangle that fits in the first quadrant with two sides along the  $x$ - and  $y$ -axes and the upper right corner on the line  $y = -\frac{2}{3}x + 6$ . What are the dimensions of such a rectangle?

Extra Credit (5 points possible): What's unreasonable about the golf ball problem?