

MA131 Calculus for Life and Management Sciences A

Exam 3 Review Questions

October 27, 2009

1. Differentiate.

a. $f(x) = (x^2 + 6x)^5(3x^5 + 9)^4$

b. $f(x) = \ln\left(\frac{x^2-1}{x+1}\right)$

c. $f(x) = \ln\left(\frac{1}{\sqrt{3x+2}}\right)$.

d. $f(x) = \frac{x^2+19x+1}{x+1}$

e. $f(x) = e^{x^2+6x}$

f. $f(x) = (x^2 + 4)^5 + (x^2 + 4)^4$

g. $f(x) = x \ln(x)$

h. $f(x) = \ln\left(\frac{(x^2+4)^2(x+3)}{(x-5)e^x}\right)$. *Hint. Think about the properties of logarithms and use them to write a "nicer" function.*

i. $f(x) = x^2 e^{2x}$

2. Consider the function $f(x) = x^3 + 3x^2 + 3x + 1$. Find the *absolute* max and *absolute* minimum over the domain $[-4, 4]$.

3. I wish to enclose a rectangular lot with fencing. The area of the lot must be 400 square feet. One side of the lot borders a river. Find the dimensions of the lot which minimize the amount of fencing required.

4. A craftsman wants to make a cylindrical jewelry box that has volume, V , equal to 100 cubic inches. He will make the base and side of the box out of a metal that costs 90 cents per square inch. The lid of the box will be made from a metal with a more ornate finish which costs 700 cents per square inch. Find the value of r , the radius of the base, for which we have a potential relative extreme point of C , the total cost of the materials. Is the extreme point a minimum or a maximum? How do you know?

5. A manufacturer wants to design an open-top box having a square base and a surface area of 216 square inches. What dimensions will provide a box with maximum volume?

6. Let $f(5) = 12$, $g(5) = 10$, $f'(5) = -3$, $g'(5) = -8$. Find $h'(5)$ if $h(x) = xe^{f(x)}$.

7. Let $f(5) = 12$, $g(5) = 10$, $f'(5) = -3$, $g'(5) = -8$. Find $h'(5)$ if $h(x) = \sqrt{f(x)g(x)}$.

8. A spherical snowball is melting. The measure of its diameter is decreasing at the rate of 4 inches per hour. At what rate is the volume decreasing when the diameter is 6 inches?

9. In October 2009 Milton's consumption of cat food is 20lb per month, and is increasing at the rate of .5lb per month. The cost per pound is 2 dollars, and is increasing at the rate of .05 dollars per month. What is Milton's total food bill for the month? At what rate is it increasing?
10. Let $f(x) = 4^x$. Let $g(x) = e^{kx}$. Find the value of k so that $f(x) = g(x)$.
11. Solve for x : $\ln(\ln(x)) = 0$.
12. Milton City boasted a total population of 90,000 in 1990. In 2000, the population had increased to 100,000. Assuming exponential growth, predict the population in the year 2050. Find the rate at which the population is increasing at that time.
13. Scientists unearth the legendary tomb of the Cat god Milton, lord of hairballs, and wish to determine its age using Carbon dating. They determine 31% of the tombs' original amount of Carbon-14 remains. Assuming Carbon-14 has a half-life of 5750 years, and the **exponential decay** relation $A(t) = A_0 e^{-kt}$,
- Find the value of the unknown parameter k , where $A(t)$ is the current amount of Carbon-14 present, and t is the number of years that have passed.
 - Determine the age of the tomb.
14. The number of bacteria in a flask grows according to the differential equation $\frac{dy}{dt} = 0.08y$, where time, t is measured in hours. The initial number of bacteria is 500,000. Find a formula for $y(t)$, the number of bacteria at time t . Use your formula to predict the number of hours to pass before the number of bacteria doubles.