

M408N Second Midterm Exam, October 27, 2011

1) (48 points, 2 pages) Compute the derivatives of the following functions with respect to x . Except in part (e), you do not need to simplify.

a) $x^2 \ln(x)$

b) $\frac{\tan^{-1}(x)}{x^2 + 1}$

c) $\sin^5(\ln(e^x + 7))$.

d) $\frac{e^{3x}}{x^2 + \cos(5x)}$

e) $\sin^{-1}(\cos(x))$, with $0 < x < \pi/2$. Simplify your answer as much as possible!

f) $x^{(x^2)}$

2) The curve $x^2 \ln(y) + ye^{x-3} = 1$ goes through the point $P = (3, 1)$. Find the equation of the line that is tangent to the curve at P .

3) Estimate $\sqrt{628}$ and $\sqrt{623}$, each to within .01. (Hint: Use the fact that $\sqrt{625} = 25$.)

4) A F-15 fighter jet is flying 1 km above the ground, and will soon pass directly overhead. It is flying due east at 0.6 km/sec. Where will it be when the distance between you and the plane is decreasing at 0.3 km/sec? That is, how far west of you will the plane be? (Obviously it will still be a kilometer above the ground.) [In case you're interested, here's the physics behind the problem. A jet flying faster than sound generates a sonic boom in your direction when it is approaching you at *exactly* the speed of sound, which is a little over 0.3 km/s. If a jet flies by at Mach 2, it will take a few seconds for the boom to reach you, but the boom will come from exactly the spot that you calculate in this problem.]

5) Find all the critical points of the function $f(x) = x^2/(1 + x^4)$. Then use these critical points to find the (global) maximum and minimum values of $f(x)$ on the interval $[-10, 10]$.

6) (12 points) The position of a particle at time t is given by the function $f(t) = t^3 - 3t$. (a) What are the position, velocity and acceleration of the particle at time $t = -2$?

b) Indicate all times when the particle is moving forwards (e.g., your answer might be something like "when $t > -7$ ").

c) Indicate all times when the particle is accelerating forwards.