MATHEMATICA LAB II

(Lab report due: Wednesday, Oct 30th)

First read the following sections (pp 20 – 24) of Thomas' An Introduction to Mathematica.

- Built-in commands and constants
- Command options and additional plots

Submit a *printed version* of your Mathematica notebook. You may (*and are encouraged to*) work with other students and compare results, but ultimately you must submit *your own* lab results --- *not* a shared copy. On your front page (using *Mathematica*) state your name and "Mathematica Lab II" using an appropriate style, font, size and color. *Number* each problem and *restate the problem* before giving the solution. Use *Mathematica* input, not free-form input!

1. Plot the curve $y = x^2 \sin(1/x^2)$. What happens near x = 0? What happens as $x \to \infty$? Justify your answers by referring to appropriate versions of your graphs. (You may wish to use *at least* two different domains to answer these questions.)

2. Let $f(x) = x^4 - \pi x^3 - 19.93 x^3 + 156.567 x^2 - 391.693 x + 303.242$
   (a) Plot y = f(x) and, using the graph, determine the *number of roots* of this polynomial. Explain how you reached this conclusion.
   (b) Using the NSolve command, find *all the real roots* of this polynomial.

3. Graph the curve y = |x| cos(1/x).
   (a) Graph the two curves y = |x| cos(1/x) and y = x/2 for *several different domains*. (Use the built-in function Abs[ ])
   (b) Viewing this graph, how many solutions do you think the equation |x| cos(1/x) = x/2 has?
   (c) Using NSolve, can you find a solution? What happens?

(d) Using FindRoot, find 5 positive solutions.

4. Compare *logarithmic growth* with *linear growth* by plotting the two curves, $(\ln x)^7$ and x on the same set of axes. Which function tends to infinity faster (as $x \to \infty$)?: $(\ln x)^7$ or x?

Note: Be careful in choosing your domain. *Explain why your answer is correct by viewing the plot.*

5. Let $g(x) = x + 4 \sin x$.

(a) Find equations of the *tangent and normal lines* to $y = g(x)$ at $x = 4$ (either by hand or using Mathematica).

(b) Graph *(on the same pair of axes)* the curve $y = g(x)$ *together with* its *tangent and normal lines* at $x = 4$. (You may wish to use AspectRatio→Automatic to make sure that the tangent and normal lines actually *appear to be* perpendicular.)

If a lion could talk, we could not understand him.

- *Ludwig Wittgenstein*