**Mathematica  Lab II**

*Lab report due: October 19th*



*First, read* the following sections (pp 20 – 24) of Thomas’ [An Introduction to Mathematica](http://media.pearsoncmg.com/cmg/pmmg_mml_shared/calculus/mathematica/manual/MM01.pdf).

* 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 = x2 sin(1/x2)*. What happens near x = 0? What happens as

x → ∞? Justify your answers by referring to four or five versions of your graphs over different domains.

1. Let *f(x) = x4 –  x3  – 19 x3 + 156.1 x2 – 391 x + 303*
2. Plot y = f(x) and, using the graph, determine the *number of roots* of this polynomial. Explain how you reached this conclusion.

*You will need to examine the plot with several different domains!*

1. Using the NSolve command, find *all the real roots* of this polynomial.
2. Graph the curve *y = |x| cos(1/x).*
3. Graph the two curves y = |x| cos(1/x) and y = x/2 for *several different domains*. (Use the built-in function Abs[ ] )
4. Viewing this graph, how many solutions do you think the equation

|x| cos(1/x) = x/2 has?

1. Using NSolve, can you find a solution? What happens?
2. Using FindRoot, find 5 positive solutions.
3. 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 → ∞)? *(ln x)7* or *x*? One way of achieving this is by exploring the quotients of these functions for large values of *x*. *Explain why your answer is correct by viewing the plot.*

*(Careful, this problem is quite tricky if you are not careful.)*

1. Let *g(x) = 2 x + 7 sin x*.
2. Find equations of the *tangent and normal lines* to *y = g(x)* at x = 4 (either by hand or using Mathematica).
3. 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.)
4. (a) Plot the implicitly defined curve 2y3 + y2 – y5 = x4 – 2x3 + x2 for each of *x* and *y* in the interval [-2, 3].

(b) Compute dy/dx for this curve.

1. Consider the *Folium of Descartes*: x3 + y3 – 6xy = 0.

Find the equations of the tangent and normal lines to this implicitly defined curve at the point *P* = (4/3, 8/3). Plot the curve and the two lines on the same pair of axes.

*I'm very well acquainted, too, with matters mathematical*

*I understand equations, both the simple and quadratical*

*About binomial theorem, I'm teeming with a lot o' news*

*With many cheerful facts about the square of the hypotenuse*

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*With many cheerful facts about the square of the hypotenuse*

*I'm very good at integral and differential calculus*

*I know the scientific names of beings animalculous*

*In short, in matters vegetable, animal, and mineral*

*I am the very model of a modern Major-General*

- Gilbert and Sullivan*:* ***Pirates of Penzance***

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