MAT 331 Homework Exercises. Set #1 (Sep 05, 00).

NOTE: *Each exercise is worth 10 points and can be turned in at any time before its "expiration date". You can work on any number of problems per homework sheet (none to all, usually 5). However, at the end of the semester, we will expect you to have turned in at least 3/5 of the exercises assigned (approximately 20–25). If you do more, we will pick your best grades. If you do less, the missing grades will be counted as zeros. This will determine 20% of your final grade for the class.*

#01 (exp. 9/20) Factor the polynomial $3x^4 - 4x^3 - 17x^2 - 20x - 13$, then find all its complex roots. [*Hint: See* `factor` *and/or* `solve`.]

#02 (exp. 9/20) Plot the function $f(x) = 2\sin x - x^3 - 1/5$, for $x \in [-4, 4]$. Find all the zeros of the function with an accuracy of 20 decimal digits. [*Hint: See* `Digits`, `fsolve`.]

#03 (exp. 9/20) Consider the planar curve γ defined by $x^2y^3 + y^2 + y - 2e^x = 0$. Using **only** Maple, find the slope of the tangent line to the curve at $(0, 1)$. Then plot the curve and the tangent line on the same graph. [*Hint:* `implicitplot` *belongs to the library* `plots`.]

#04 (exp. 9/20) Define a Maple function g that, given $k \in \mathbb{N}$, yields the sum of the first k primes. What is k such that $g(k) \leq 90,000$ but $g(k+1) > 90,000$? Write the solution as text in the Maple worksheet. [`sum`, `ithprime`]

#05 (exp. 9/20) [*This problem is designed partly to frustrate you and partly to show that Maple can give you trouble, even when you do everything correctly. Hints are scattered throughout the text.*] Define $h(x) = (1 + x)e^x$. Use Maple to evalute the following quantities: $h(0)$, $h'(0)$ and $h''(x) - h(x)$. Then solve the differential equation

$$y''(x) - y(x) = 2e^x; \qquad y(0) = 1,\ y'(0) = 2.$$

[*It might take some time to find out how to use* `dsolve` *to solve a differential equation with* ***initial conditions***.] If there are no mistakes, the solution should coincide with $h(x)$, but it doesn't look that way, even if you `simplify` it! At any rate, tell Maple to call $f(x)$ this solution. [*Cool Maple users try to never re-type what the computer just churned out; in this case* `rhs` *and* `unapply` *can help.*] Plot $f(x) - h(x)$, between—say—0 and 20. What happens? Can you explain why?