Physics 350 Lab 1: Basics of Maple

Objective: Throughout this semester we will be using *Maple*, a very powerful symbolic mathematics package available for MacOS X, Windows, and Linux, to perform investigations of various physical systems. *Maple* is capable of numerically or symbolically solving math problems. Such programs (*Mathematica* is a competing program by Wolfram Research) are becoming more common as scientists try to speed up their work by speeding up their mathematics.

We hope that the experience you gain in doing labs with *Maple* this semester will at least give you a sense of how computers can aid your mathematical endeavors beyond simply acting as computers.

Lab Requirements:
The supplemental *Maple* worksheet for this lab (`lab01supplement.mw`) can be found online on the class website in the Electronic Handouts area. You should download this worksheet first thing upon arriving in lab.

Procedure: After you study the *Maple* worksheet (`lab01supplement.mw`) and work through all the listed examples of things you can do with *Maple*, use *Maple* to answer the following questions.

A warning about the GUI

Recent versions of *Maple* have introduced a feature where you can type in integrals and other functions by literally selecting the functions from a sidebar of "2-D" symbols. While good for simple functions, this "2-D Math Notation" mode really gets in the way for some of the later work in the course. We suggest you switch to using traditional "Maple Notation" (and all the worksheets I hand out are in this mode). To switch to "Maple Notation" for input:

On Windows/Linux: Select "Options…" from the "Tools" menu.
On Mac OS X: Select "Preferences…" under the "Maple" menu.

On the Options/Preferences panel, select the "Display" tab, then select "Maple Notation" from the Input Display option at the top of the page. Select "Apply Globally" to have this choice apply into the future.

Once you have made sure *Maple* is in the proper mode for accepting input (see warning above), create a new worksheet and include everything you need to answer these questions in that worksheet. **Save often, as *Maple will occasionally lock up in an infinite loop if you are not careful.***

Today's Exercises:

1. Evaluate the indefinite integral
   $\int x^5 e^{-7x} dx$
   (Note that the exponential function e^x is written `exp(x)` in Maple.)

2. Evaluate the definite integral
   $\int_0^\infty e^{-qx} dx$

   You'll have to look up how to do definite integrals by getting help on the `int` command. Even when you do, you will probably find that Maple gives you an error message. Convergence properties depend on whether q is positive or not. Look up the `assume` command, and use it to tell Maple that q is positive before it tries to evaluate the integral.

3. Evaluate the definite integral
   $\int_{-\infty}^{\infty} \frac{\sin^2 x}{x^2 + a^2} dx$
   assuming that a is positive. (Actually, you only need to assume that a is real, but it's simpler just to assume it's positive.) Also…
   a. Plot a graph of the answer as a function of a for a range of a from 0 to 10.
   b. Establish the limit as $a \rightarrow 0$?

4. The distribution of speeds of molecules in a gas (that is, the number of molecules with a given speed v) is
   $f(v) = Nv^2 e^{-mv^2/2kT}$
   where m is the molecular mass, T is the absolute temperature, and k is Boltzmann's constant (N is a constant irrelevant for this discussion). Use Maple to find the value of v which maximizes this function. This is the most probable speed for a molecule.

   (To do this, take the first derivative and solve the equation that says that the derivative is equal to zero.)

When you are finished, either
• turn in a printout of the worksheet **with your name and lab number up top**
or
• email that worksheet to your instructor **using your mnstate.edu account.**