Mathematica Homework #1

Email notebook to corbin@physics.ucla.edu
with a subject line: [Physics 105A]
by on or about Friday, 18 January

This set is mostly about getting comfortable in the Mathematica environment. It looks long, but don't let that fool you - you should be able to finish all but maybe a problem or two within an hour. If you need to ask me why your code isn't working, please attach a copy of the .nb file to your email so I can see what you did (some bugs are insanely subtle and have to be caught in their native environment).

For each of the following problems, the code for the problem should be contained within a single cell (a single cell for problem 3, a different single cell for problem 4, and so on). Running that single cell should provide the solution for that particular problem. **Speak["Thanks!"]**

- 1) Open a notebook. In your first cell, enter your **name**, **student ID**, **email address** and the **assignment identifier** (eg. "HW 1") as text. This information should be in the first cell on all your future assignments as well.
- 2) In the second cell, tell me a bit about your computer experience. Have you used Mathematica, Matlab or anything similar before? Done any programming? What language (C. C++, Fortran, Python, Perl ...?)
- 3) Set $a = 7$, $b = 3$ and $ab = 52$. Execute the following commands and explain the results: $a\ b$, ab, $ab/(a\ b)$.
- 4) Use Mathematica to factor:

$$ax^2 + ay + bx^2 + by$$

- 5) Factor:

$$-\sin(\alpha - \beta - \gamma) + \sin(\alpha + \beta - \gamma) + \sin(\alpha - \beta + \gamma) - \sin(\alpha + \beta + \gamma)$$

- 6) Evaluate

$$\frac{2.54^{3/5}\sqrt{1.15 \times 10^{-2}} + 5.11^{2/5}}{\sqrt{2.32 \times 10^{-5}}}$$

in scientific notation to 4 significant figures.

- 7) $f[x] = \cos(x) - e^{-2.7x}$

  Use Mathematica to evaluate $f(x)$ at $x = 1.7 \times 10^{-15}$ and at $x = 1.7 \times 10^{-25}$. Note that the answer isn't *(or shouldn't be)* zero for either input value.

  What happened? Find a better way to evaluate the expression, use it to evaluate both input values and comment on what you find.

- 8) Show that the following relationships hold for any pair of 3×3 matrices. (Hint: //Simplify)
  - i) $(AB)^t = B^t A^t$
  - ii) $(AB)^{-1} = B^{-1} A^{-1}$

- 9) The position of a moving particle, as a function of time t, is given by:

$$\vec{r}(t) \;=\; \hat{x}\, V_{x,y}\, t\, \cos(\omega t) \;+\; \hat{y}\, V_{x,y}\, t\, \sin(\omega t) \;+\; \hat{z}\, V_z\, t$$

  i) Use Mathematica to find the velocity, acceleration and speed of the particle at any time t.

  ii) Take $V_{x,y} = 0.5 m/s$, $V_z = 4 m/s$, $R = 2m$ and $\omega = 2\pi s^{-1}$. Use Mathematica to find the angle between the acceleration and the velocity at $t = \pi/3\omega$.

  iii) Use the values given above and **ParametricPlot3D**[] to plot the trajectory of the particle from $t = 0s$ to $t = 10s$.