Study Guide for the General Physics I Lab Final Exam **Dr. Pogo**

Here are the skills you might be asked to demonstrate on the final exam. The exam is open logbook and calculator.

I. Generic Skills that apply to every lab

- Writing numerical results in proper notation, including sig-figs and scientific notation.
- Knowing the proper characteristics of a proper plot, based on the template. This could include axes labels and units, boundaries, tick marks, marker size, font size, aspect ratio, and so on.
- The three main methods for getting numbers for uncertainty, and when to use each. Also, how to estimate uncertainties that are neither too big nor too small, based on the measurement method.
- The difference between random and systematic errors. *All* calculated errors are random. If a result disagrees with the expected value, it's because there is some other unknown systematic error.
- Entering Formulas into Excel, including when to use the "$" character, and finding π in Excel.
- Reading/understanding information from a plot (including from a trendline).
- Creating a Linest, and extracting information from a Linest. Could you draw the plot if given the Linest results? Can you interpret all four (or all six) Linest values properly?
- Connecting a formula to a plot. Although we do this every single week, I feel like you're not always paying enough attention to it because it's usually "given". This was a big part of the Oscillations lab…

  For example, suppose we're testing a generic theoretical formula that looks like: $a = \frac{b+c}{d^2} - g$,

  where g is known to be +10 m/s^2. We measure d (units?) and b (in meters) and we want to know a and c.
  So, we decide to plot b vs. d^2. Trendline tells us that $b = 12\,d^2 + 5$. What are a and c?
  <u>Solution</u>: always solve the theoretical formula so that it looks like the plot… b vs. d^2.
  In this case, that's $b = (a + g)d^2 - c$. Therefore, slope = $(a + g)$ and intercept = $-c$.
  So $(a + 10) = 12$, meaning $a = 2$, and $(5) = -c$, meaning $c = -5$.
  Regarding units, a is added to g, so it must have the same units as g. So, b and c must have the same units as each other for the same reason. Final answers: $a = 2$ m/s^2, and $c = -5$ m.
  Also, we should be able to use the original formula to see that d must be in seconds.

II. Skills based on specific labs

- For each lab, we measured some things and calculated some things. For each lab, I might ask "what were the axes of the plot", or "what was the main thing we computed?", or "what did we keep constant".
- For each lab, you should be able to repeat any quiz question. You should be able to state and use the main formulas for every lab.
- For each lab, you should know how to use the equipment. For example, how to use the photogate timers (including memory mode), or how to have good alignment on the Force Table, or how we calculate a frame rate for a camera.
- Similarly, you should know how to use Tracker: how and why to set a coordinate system, how to set the proper scale, how to click to add points into our spreadsheet, how to correct for parallax, etc.
- For each lab, you should be able to draw any necessary Free Body Diagram, and also use that diagram to solve for things like a or α or μ_k.
- For each lab, I might give you example numbers for any of our measurements, and ask you to calculate the appropriate result. For example, in the rotation lab, I might give you m_{brick}, x_1, x_2, and x_3, and ask you to find the density. Or, I might tell you some photogate times and ask you to compute a velocity.
- For example, in the 1D airtrack lab, I might ask "What measurements were used to compute the angle of the airtrack, and how were they used to compute it?". Or, in the N2L lab, I might ask "I plotted m_2 vs a, but didn't directly measure a. So, how was a calculated from the measurements?", or "How did I use the intercept to find μ_k?"