Pendulum and Simple Harmonic Motion

In this lab activity, you will utilize the relatively simple system of a pendulum to make measurements of the acceleration due to gravity *g*. You will do this both with a "classic" simple pendulum and with a physical pendulum (*i.e*. a not-so-simple pendulum).

Because these two systems are not very complicated, your focus should be on making as *precise measurements* as you can, and also making *reasonable estimates* of your measurement uncertainties. It will be up to you to compare your extracted values of *g* to the accepted value of *g*, and making a judgment as to whether or not your measurements are in agreement with that value (within errors).

I. Simple pendulum

Set up a simple pendulum using the string and metal ball, along with the clamps and rods. Your procedure is fairly straightforward, but you will have to determine how to make the measurements and how many measurements to make in order to improve your precision.

1. Measure the period for 5 different pendulum lengths. You should perform these measurements carefully, recording all data trials and relevant experimental parameters in a neatly organized data table. Since you are devising the procedure, you must document what you are doing in some detail.
2. Use your data to extract the value of *g* from a *graphical* analysis. You must use all of your data and obtain a nice fit to your data. Note: *linear* relationships are generally much easier to fit and interpret than complicated functional forms.
3. Make an estimate of the uncertainty in your extracted value of *g*. This does *not* mean that you just "think about it" and come up with some guess. What it means is that you make sensible error estimates for your measured parameters or from your graphical analysis, and that you explain how you arrived at these error estimates.
4. Does your extracted value agree with the accepted value of *g* at our location? If not, then what possible additional errors might be contributing to this discrepancy?

II. Simple pendulum, video analysis)

5. Make a video of your pendulum with your cell phone camera. Upload it to the class's facebook page (email to: glop393tramp@m.facebook.com).
6. Now download the video to your computer as an mp4 file. You may have a way to do this already, if not, then try the following:
    1. Open firefox and download the video helper add-on (https://addons.mozilla.org/en-US/firefox/addon/video-downloadhelper/)
    2. Install and restart firefox. On your toolbar, you will see a little icon that looks like a water molecule. Navigate to your video and start it up. The water molecule will light up. Press the water molecule button and download your video as an mp4.
    3. Load the mp4 into loggerpro as a video and follow the analysis that we did in class.

II. Physical pendulum

Set up a physical pendulum using the metersticks provided. You may have to be resourceful in constructing your setup, since you need a good place from which to hang the meterstick! Other than this difference, Part II follows the same basic procedure as Part I.

1. Measure the period for 3 different pendulum lengths (full meterstick, half meterstick and small clear plastic ruler). As before, proceed carefully and record all data.
2. Use your data to extract the effective length of the pendulum (what do we mean by this?) from a *graphical* analysis, similar to Part I.
3. Make a reasonable estimate of the uncertainty in your extracted value of l.

III. Pendulum with damping

Set up a pendulum with damping. For example, use a ball of paper as the bob. Part III follows the same basic procedure as Part I.

1. Video your pendulum in action, and using the digitizing function of loggerpro, plot the bob's position as a function of time.
2. Use your data to extract the value of g from a *graphical* analysis, similar to Part I.
3. Make a reasonable estimate of the uncertainty in your extracted value of g.
4. Use your data to extract the damping constant for your pendulum.