Lab 7: Force and Motion II

Goals: Improve communication and teamwork capacities**;** Improve ability to make, describe, and record observations; Gain more familiarity with circular motion; Use Newton's 2nd Law to relate net force, mass, and acceleration, including situations involving circular motion and static and kinetic friction.

Groups & Lab Notebook: Work in groups of 2 to have a discussion partner. Update Table of Contents. General Lab Notes guidelines apply.

Part 1: Turntable and Circular Motion

a) Note: you are just using LoggerPro for its movie player capacity; you are not actually performing video analysis on the movie. In other words, don't make a motion diagram, position vs. time graphs, etc. Recall that you can slow down the movie playback speed using Movie Options (right click on the movie).
b) Launch LoggerPro. Using Insert: Movie, insert the movie turntable (in the program file share under Handouts/Lab07). Watch the movie and verify that it takes 5.205 seconds for the yellow block to make 3 full revolutions (recall that the time stamp is in the upper right hand corner of the movie window).
c) Calculate the angular speed of the yellow block in revolutions per second (assume constant angular speed).
d) What is the angular speed of the blue block? The green (light blue?) box?
e) Assuming the angular speed is constant, calculate how long it will take to complete 2 full revolutions. Verify your answer using the movie.
f) There are other units for angular speed. Convert your answer from part b) from rev/sec to RPM (revolutions per minute), degrees/sec, and rad/sec. Recall that one full cycle is 360 degrees, which is 2π radians. Clearly show your calculations, and organize your answers into a tidy final form (such as a table).
g) The yellow box is 12 cm from the center of the turntable. Determine the speed of the yellow box in two ways: by determining the total distance the yellow box traveled in some known time and using $v = d/t$ (you will need to recall/look up/use the formula for the circumference of a circle) and by using the relation $v = r\omega$ (be careful with your choice of units for angular speed – ask if you're unsure).

Part 2: Conical Pendulum

a) View the video "Airplane on a string" available at **http://serc.carleton.edu/dmvideos/players/airplane_string.html?hide_banner=true** (you can find a direct link at a post on the program web-site sites.evergreen.edu/summerphysics). You can play the video frame-by-frame (not recommended for general viewing), using the scroll bar, or just by clicking in the video screen. Watch the video several times.
b) In the video, a toy airplane of mass M moving with constant speed v attached to a fixed point on the ceiling by a string of length L makes a circle of radius R with an angle θ (with respect to vertical) in time period T (note here T stands for period, not tension). The string has tension F_T and at the fixed point is connected to a spring scale. Consider the quantities M, v, L, R, θ, T, and F_T. Which of these can you directly determine from the video? (Hint: you can determine 3 of these quantities directly from the video).
c) Using Newton's second law, uniform circular motion, and trigonometry, you can find all the other quantities. Find as many as you can. Note: this is a challenging problem, and similar to (but harder than) the last problem on HW4.

Part 3: Block sliding down ramp.

a) View the video "Block slides down ramp" available at **http://serc.carleton.edu/dmvideos/players/block_slides_ra.html?hide_banner=true**.
b) Determine the coefficients of static friction and kinetic friction. Note: this is a challenging problem, but similar to material from HW4.