PHYSICS 191 **CLASS 28** **Fall 2009**

13 November 09

ASSIGNMENT: Text, Chapter 10; Chapter 11, Sections 1–3

CONCEPTS:

1. Sections 1–3 of Chapter 11 consider systems of masses in equilibrium. For such systems both net external force and net external torque must be zero.

2. Note the following Theorem: If $\vec{F}^{\text{ext}} = 0$ and $\vec{\tau}^{\text{ext}} = 0$, then the torque is zero about *any* axis of rotation. We can therefore calculate the torque about any convenient axis. YF allude to this important result on 355.

   In general, of course, this theorem will not be true. It holds only if $\vec{F}^{\text{ext}} = 0$ and $\vec{\tau}^{\text{ext}} = 0$.

DO BUT DO NOT TURN IN: Chapter 10, Problem 10.96; Chapter 11, Exercises 11.8, 11.13, 11.14; Problems 11.41, 11.52; Extra Credit Question Q11.7, Problem 11.72

Hint on Problem 11.72: Calculate the torque about the point at which the wheel touches the step, and assume the wheel has barely lifted off the ground, so you don't have to worry about the normal force. Suppose the force exerted by the step has vertical and horizontal components.

NOTES AND ANNOUNCEMENTS

1. The laboratory will meet Wednesday, Thursday, and Friday of next week, 18–20 November, Days 4, 5, and 6. We will do Experiment 11, Simple Harmonic Motion. This experiment will conclude the laboratory for this semester.

2. Our next exam will be on Thursday, 19 November. The exam will cover Chapters 9, 10, and possibly the first three sections of Chapter 11. We will decide today on whether to include the Chapter 11 material. This schedule will allow us to set aside Tuesday 17 November for review.

   You may bring to the exam one sheet of paper with anything you like written on it *except* worked-out problem or sample problem solutions. I will ask you to turn in this sheet of paper with the exam.

OVER

3. For the laboratory:.

   (a) **Be sure** that you have included the mass of the weight holder in all of your calculations.

   (b) In the second part, we will investigate the dependence of the period of a harmonic oscillator (spring-mass system) on its mass. We will study this material in class after the Thanksgiving break. For now, take it as an empirical exercise in curve fitting.

   Note that a theoretical expression for the period T is given by Equation 13.12 in Chapter 13:

$$T = 2\pi\sqrt{\frac{m}{k}} = \frac{2\pi}{\sqrt{k}}\sqrt{m}$$

   But do NOT simply assume that this equation is correct. First, do a graph of your data, either on paper or in Linfit. Then, review the logarithmic data plotting techniques that you have learned in Appendix C of the laboratory manual, and do semi-log and log-log plots. One of these graphs should be a straight line, and should allow you to determine whether your data are consistent with an exponential function or a power law.

   Discuss your conclusions in your lab book, BEFORE you do a least-squares fit.

   At this point, you should be able to decide what fitting function you should use to do a least-squares fit to your data. Describe the reasons for your choice in your lab book, and ONLY THEN do the least-squares fit.

   (c) One can use the fit result to find a value for the spring constant k.

   If you found that your data fit a power law of the form

$$T = Am^B$$

   and that B was about equal to 0.5, you should see a way to calculate the spring constant k from your least-squares fit. Note that you will have to use the equations in the back of the lab manual to transform the uncertainty in the parameter A into an uncertainty for k. The goal is; to see whether the values of k from the two parts of the experiment agree, within experimental uncertainty.

   If you are not getting reasonable agreement, check your units carefully. There may be other problems as well—we sometimes see inconsistent results for this part.