Boyz on the Hood

Fall 2004

Introduction

This experiment is based on Example N12.4 in Moore.

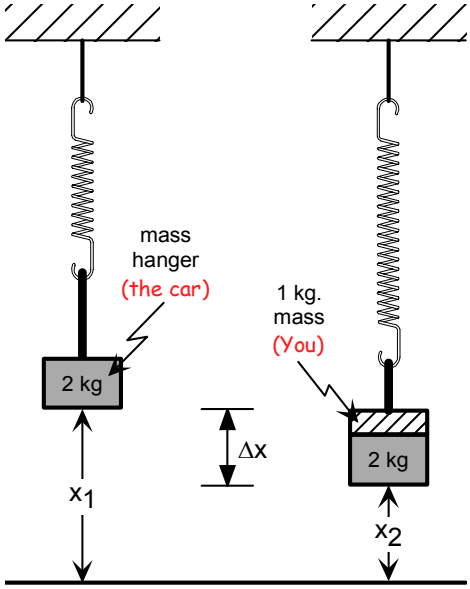
The Problem:

You see a couple of neighborhood boys bouncing on the hood of your car. When one jumps on the hood, you see the car's front end oscillate with a period of about 0.5 *s*. After you yell at the boys, you start to wonder about the spring constant *k* of the car's suspension. You will estimate *k* from what you observed, and use this information to determine the mass of the car.

Procedure

I. *Inside Experiment*

1. In the lab, you have a spring with a 2 *kg* mass hanger attached. Measure x_1, the height of the *bottom* of the mass hanger above the floor.



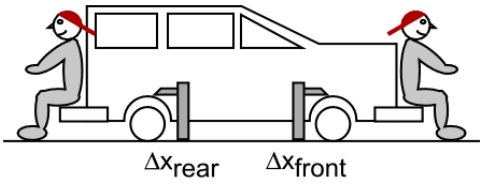
2. Add a 1 *kg* mass, and measure the new height, x_2. Calculate the change in spring length, Δx.
3. *Remove the mass added in step 2*, and start the spring oscillating. Measure the period of oscillation with the stopwatch (your instructor will show you the correct counting procedure). Time the period of 10 oscillations, and then calculate the period of a single oscillation.
4. Use Hooke's law ($F_x = -k_s \Delta x$) to determine the spring constant, *k*, from your measurement of Δx.
5. Applying Newton's laws to a spring undergoing simple harmonic motion gives the following:

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

Use your values of *k* and *T* to calculate *m*. What *should* you get?

II. *Outside Experiment*

1. Before going outside, weigh yourself on a bathroom scale and convert your weight to Newtons (recall that 1 *lb* = 4.45 *N*). Then calculate your mass.
2. Take a stopwatch and a meter stick with a caliper jaw out to the parking lot. Your instructor will tell you which suckers, err, *colleague's* car you will be using.
3. Two or three people will sit on the front bumper of the car to compress both springs evenly. Calculate Δx_{front}, the distance the car sinks compared to its "rest" value (measured at the left and right wheel wells). Calculate an average Δx for the front from the left and right side measurements. Repeat your measurements at the rear wheels, and again calculate an average Δx for the rear (keep the front and rear averages separate).



4. Next, bounce on the *front* of the car, and measure the period, T (use 10 oscillations per trial). Repeat your measurements for the *rear* of the car. **Note:** Don't sit on the hood/trunk/bumper when bouncing the car!
5. Back in the lab, use Hooke's law to determine the spring constant, k, from your measurement of Δx.
6. Use your values of k and T and Newton's laws to calculate m_{front} and m_{rear}. Then calculate the value of m_{car}.
7. Convert your value of m_{car} into units of pounds, and compare your value to the "published" value (available on the owner's registration card). Calculate the percent difference between the two.

Report

- Write up your results like a regular lab report. In your discussion, include the assumptions that were made for this experiment.