PHYS 350 Lab #4
7 February 2013

This is another 3-part lab. Your grade will be based on the notes/presentation materials you turn in, on your presentation, and on a short write-up for part 3 (which is totally unrelated to parts 1 and 2, but which is a lot of fun).

Part I. Individual Research

During the 1st hour of lab you will become an expert on a specific kind of heat engine. Using whatever resources you can scrounge together on short notice, prepare a presentation for the class. Turn in some form of this presentation and/or your notes. I would recommend typing up notes as you go along and maybe putting together a couple of web sites or power-point slides.

Part II. Class Presentation

During the 2nd hour of lab you will make 5-10 minute presentation/mini-lecture to the class describing the operation of your heat engine. Pay special attention to unique aspects, but also describe how it converts heat into work and what factors limit its efficiency.

Part III. Fun Mechanical Energy Lab

During the 3rd hour, complete the mini-lab described on the next page. Prepare a short write-up (this doesn't have to be typed; it can be; whatever works best for you) describing your method, showing your calculations, and discussing your final result.

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Mechanical Energy: Climbing Stairs

Goals: To develop an intuitive concept of mechanical energy (kinetic and potential). To practice working with the common units for work, power, and energy.

Procedure: *Climb stairs at a constant speed. To get reliable measurements, you will need to take an average of several trials, maximize the height that you gain, and climb with a constant velocity.* First, climb at a rate you can keep up for 10 flights of stairs. Then climb at your maximum rate for 1 flight of stairs. Determine the amount of Work involved in each case. Calculate the amount of Power involved in each case.

Data: Record any measurements required to determine the height of the stairs and the time it takes to climb them. How do you determine the force?

Questions:

1. Calculate your steady power output that you can keep up for ten flights of stairs. Express your answer in Watts and Horsepower.

2. Calculate your peak power output that you can keep up for one flight of stairs. Express your answer in Watts and Horsepower.

Energy Conversion Thought Experiment:

You could construct an apparatus to generate electricity by climbing stairs. You could, for example, put a drum on a shaft at the base of the stairs, wrap a long rope around the drum and tie the other end to your waste. You can directly transfer your vertical motion (and power) to rotation of the drum. The rotating drum shaft would then serve as a generator (mechanical to electrical energy; an electric motor in reverse). Assume that this generator is 100% efficient.

3. If you wish to be paid minimum wage for your labor (is it still $7.25/hour?) and you climb 100 flights of stairs at a steady speed, how much would you have to charge per kilowatt-hour?