

EVSS 650 Laboratory Exercises
(make measurements today; writeup due 11 February)

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 (Work = Force * Distance). Calculate the amount of power involved in each case (Power = Work / time).

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?