

Lab M17

PH305 11/22/02

Human Power Production

Goal

To investigate the nature of power and determine the maximum power that the human body (in this case, yours) can produce over a short period of time.

Prelab

Look around the class and see if you can predict who will run the stairs with the greatest power output, and also with the greatest power/mass ratio. In past experiments, power outputs as high as 1 hp (750 W) have been recorded, but a typical power output is about 0.5 hp. On the back of the lab report, write down the names of those you predict will win each title. In a word or two, state why you picked each person.

Introduction

Power is the rate at which energy is produced (or used) and in the SI system of units is measured in watts, or joules per second. The original power unit, devised by James Watt, the inventor of the practical steam engine, was the horsepower, corresponding to the amount of work a horse could reasonably be expected to do, and is equivalent to 550 foot-pounds per second, or approximately 750 watts. You will measure your power expended in running up the stairs at the back of Bryan.

Anyone with a physical or health problem that will make it impossible to run up five flights of stairs should let the instructor know and plan on contributing to this experiment in other ways. If you would be able to walk rather than run, it is of interest to compare the power required to walk with that required to run.

Method

Equipment

The three measurements you need for this experiment are the height from the basement landing to the top landing in the stair well, your mass and the time it took you to run up all the flights of stairs. Thus there will be a supply of stopwatches, string, a meter stick, and a bathroom scale available.

Procedure

Since the stair well in which we will conduct this experiment is a primary passageway in and out of the building, it is important to make sure that the doors to each floor are open and guarded to minimize the possibility of collisions with innocent passersby.

In order for everyone to have a chance to run up the stairs, a person who finishes the run will relieve one of the door guards.

You should complete your calculations in the classroom to avoid being in the way of people still climbing the stairs.

M17 Lab Report

Name _____

Human Power Production

Block _____

Theory.....

Write the expression (symbols only) for the power required to raise a mass M by a height h in a gravitational field g in a time t [Remember power is energy converted from one type to another per unit time].

Note that this expression makes no mention of the means by which the raising is carried out. The power required is the same (provided the time is the same), whether the mass (in this case, your body) gets up by running up a shallow ramp, by running up stairs, or by climbing a rope or a vertical ladder.

Data/Analysis.....

Record your mass = _____ Kg, (hint: 2.2 pounds is equivalent to one kilogram)

Record the height of the stairs, from the bottom to the top landing = _____ m,

and record the time(s) you took to climb the stairs = _____ sec. (trial 1)

Calculate the power you expended, first in watts, then show the conversion calculation to horsepower (1 hp = 750 watts).

Secondly, calculate the power/mass ratio (in w/Kg) for your run (this is important because in the real world we want to deliver the maximum power from as small a source as possible).

Discussion question:

Why, if you jog up a ramp, walk up stairs, climb a ladder, or climb a rope to the same height in the same time, would you feel a great difference in your fatigue level after each? Discuss the difference between mechanical power and biological power. What do you do differently in each of these three types of locomotion?