Name________________________________ Date__________

Human Power and the Watt! **NAME______________________________**

Introduction:

Power is the rate of energy use or the rate of doing work:

$$\text{Power} = \frac{\text{Energy}}{\text{Time}}$$

The unit of power in the metric system is the watt. Energy is used at a rate of one watt if one joule is used per second. Some useful conversion factors for other units of power are:

1 watt = 1 joule/sec
1 kilowatt (kW) = 1000W = 10^3W
1 megawatt (MW) = 10^6W
1 ft-lb/sec = 1.36W
1 horsepower (hp) = 550 ft-lb/sec = 746W

A. How many horsepower can you generate? Walk up a flight of stairs and record the time it takes. Then run up a flight of stairs and record the time. In going up the stairs, you have gained gravitational potential energy equal to your weight in pounds times the height of the stairs in feet. In the metric system use your mass in kg multiplied by $10 m/s^2$ and divide by the time. This makes the answer in the units of watts. Note:1kg weighs 2.2 lbs on Earth.

Thus your rate of gain of energy or power is

$$\text{Power} = \frac{\text{Energy}}{\text{Time}} = \_\_\_\_\_\_\_\_\_\_\_\_ \text{ ft-lbs/sec}$$

$$\text{or in metric } \frac{Mass(kg) * 10 * height}{Time} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \text{watts}$$

What is your power output in horsepower?

_____________ hp

Calculate the power for walking up the stairs and running up the stairs and compare the results. What can you say about the energy and power differences in running and walking?

Name:	Mass (kg)	Time (sec)	Power (watts)	Power (hp)
Walking Up Stairs				
Running Up Stairs				
Name:	Mass (kg)	Time (sec)	Power (watts)	Power (hp)
Walking Up Stairs				
Running Up Stairs				

Name________________________________ Date___________

B. (HOMEWORK) How do you compare to a 100 watt light bulb? A human being must take in about 2500 Calories (kilocalories) of energy in his or her food each day in order to continue to function properly. This means that he or she uses up energy at a rate of (power) of 2500 kilocalories/day. Using the fact that 1 calorie = 4.2 joules, and the appropriate time conversions show that this rate of energy usage is about the same as a 100 watt light bulb.

Compare this result to Part I. Why are they different?

C. (Homework) The table below lists the rate of energy use by a human being during various activities. Calculate the power rating of your body pursuing one of these activities in watts and horsepower. (Remember that 1Cal = 1kcal = 1000cal)

Table 1. Energy expenditure rate in various activities in $\frac{\textbf{Cal}}{\textbf{hr-lb}}$ of body weight.

Sleeping	0.45	Walking (2.8 mi/h)	1.5
Sitting still	0.6	Carpentry, plumbing	1.75
Standing relaxed	0.7	Active exercise	1.9
Sewing by hand	0.75	Walking fast (4 mi/h)	2.0
Dressing, undressing	0.8	Going down steps	2.25
Singing	0.85	Loading heavy objects	2.5
Typewriting	0.9	Heavy exercise	2.75
Washing dishes, ironing	0.95	Tennis, swimming	3.25
Sweeping	1.0	Running (5.5 mi/h)	3.75
Light exercise	1.25	Very heavy exercise	4.0
Going up stairs	7.0		

How does this compare to the power rating you measured in Part A?