WORK & POWER

Partners, (first & last name) ______________________________, ______________________________,

______________________________, ______________________________

Section ____________ Day ____________ Time ____________

Reference: Ch2 and Ch3, Phys 250 text

Theory: Work as defined by Merriam-Webster can be a noun, a verb, or an adjective. As a noun, the definitions are varied: *a)* an activity in which one exerts strength or faculties to do or perform something, *b)* sustained physical or mental effort to overcome obstacles and achieve an objective or result, *c)* the labor, task, or duty that is one's accustomed means of livelihood, and *d)* a specific task, duty, function, or assignment often being a part or phase of some larger activity. You will work hard to graduate (*b*), maybe even have to work (*c*) several jobs to pay for that eduation, and if you have classes in several locations, may be tired from the work (*a*) to get to all of those classes.

In physics, **work** (*a*) is the amount of energy transferred by a force acting through a distance in the direction of the force. Like energy, it is a scalar quantity (physical quantity that is not changed by coordinate system rotations or translations), with SI units of joules.

If a **force F** that is constant with respect to time (ex. mass) acts on an object while the object is displaced in a straight line along the length and direction of a vector **d**, the mechanical work done by the force on the object is the product of the vectors **F** and **d.**

Here we will look at WORK as defined below. We will assume that work only occurs when the force is sufficient to move the object. Work is a measure of what is done, not the effort applied in attempting to move the object. Work can be said to be energy in transit. Work has the same unit as energy.

Weight = mass x acceleration **Work = Force x Distance**

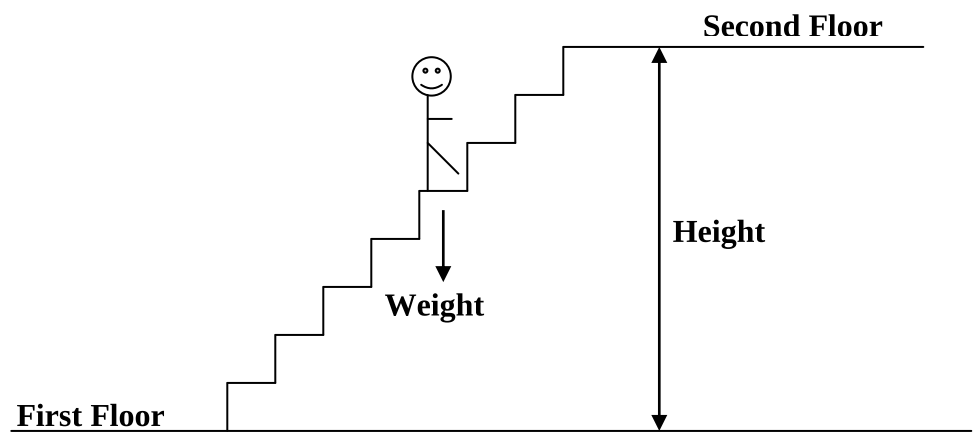
Power = Work/Time **1 horse power (hp) = 550 (ft·lb)/s**

UNITS

	Time	Distance	Mass	Weight	Velocity	Acceleration	Work	Power
Metric cgs	s	cm	g	dyne	cm/s	cm/s^2	erg	erg/s
System International SI	s	m	kg	newton, N	m/s	m/s^2	joule, J	J/s = W
British United States BE/US	s	ft	slug	pound, lb	ft/s	ft/s^2	ft. lb	ft. lb/s

Purpose: To determine the work done and power developed by a person during walking & running up the steps.

Apparatus: ruler, stop-watch, scale, and person.



PROCEDURE:

1. Two people need to do all the walking and running. Choose two with different weights.
2. Walk out to the steps and measure the height of each step, number of steps, and determine the height for one level. Make sure you express this in feet.
3. Time the walking and running.
4. Repeat 1-3 for two levels.
5. Complete the data table.
6. Answer the questions at the end.

DATA TABLE: (Use BE/USC units)

		One Level From 1st Floor to 2nd Floor				**Two Levels From 1st Floor to 3rd Floor**			
		Walking		**Running**		**Walking**		**Running**	
		P1	**P2**	**P1**	**P2**	**P1**	**P2**	**P1**	**P2**
A	Weight (lbs) *of Person*	1	2	1	2	1	2	1	2
B	Height of 1 stair rise (ft)	3	3	3	3	3	3	3	3
C	# of stairs	4	4	4	4	5	5	5	5
D	Total height increase (**B•C**)	6	6	6	6	7	7	7	7
E	Time (s)	8	9	10	11	12	13	14	15
F	Work (ft*lb) (**D•A**)	16	17	18	19	20	21	22	23
G	Power (ft*lb/s) (**F/E**)	24	25	26	27	28	29	30	31
H	Horse Power (hp) 1 Hp = 550 (ft·lb)/s **G**/550								

Answer the following questions:

1. Explain why there is a difference in the power output for walking, versus running, by the same individual?

2. What will happen to the power output as the person goes up many flights of stairs, say 15, as opposed to just two?

3. Explain why mountain roads are designed round & round, not just straight up. (Hint: think of the requirement of the vehicle engine).

4. Select two boxes which report **WORK** values. A) _____ B) _____
   What factor made the difference between the two you selected?

5. Select two boxes which report **POWER** values. A) _____ B) _____
   What factor made the difference between the two you selected?

6. Were the results consistent? (Using numbered cells on the data table, compare two of the following pairs: 16/17, 18/19, 20/21, 22/23, 16/20, 17/21, 18/22, 19/22, 24/26, 25/27, 28/30, 29/31.
   Pairs being compared: A) _____ B) _____ Explanation.