2.0 Power:

Like many other physics terms, *power* has a meaning in English that is not the same as its physics definition. We define Power as the rate of change of energy, or the rate of work:

$P = dE/dt = W/dt$

For instance, with the proper pulleys or gearing, a 1W motor (as in a small toy car) could pull a truck up a hill, raising its elevation 100 m, but it would take many days. However, a massive engine changes the truck's potential energy very quickly.

<u>Exercise 1</u>: The units of power is the *Watt (W),* after James Watt. Please show from the definition of power that $W =$ $kg*m^2/s^3$. The English unit of power is the *horsepower:*
1 hp ~ 746 W

<u>Exercise 2</u>: In the last chapter, you carried a *20 kg* mass *100 m* for an elevation gain of *30 m*. If it took you *30 s* to do that, what was your average power output?

A human being can put out about *1000 W (~ 1.3 hp)*, but only for a few seconds; and can maintain a mechanical power output of *100 W* for a long period of time. Additionally, a person's body produces thermal energy at a rate of about *100 W*, just to maintain our daily life processes. That's why a room full of people heats up *even if no one's dancing*. Energy is conserved, so all the power you put out, you have taken in as *chemical potential energy*, food.

<u>Exercise 3</u>: The dietary energy unit is the Calorie (~*4200 J*), not to be confused with the thermal calorie (with a small "c" of ~*4.2 J*). Estimate how many calories you consume daily, and see if this corresponds to an average power intake of ~ *100 W*.

<u>Exercise 4</u>: Show that if you are pushing a car up a hill at a constant force and a constant speed, the power you are putting out is:

$P = F*v.$

You will want to use the definitions of Power (above) and $W = dE = F*dx$