**Phys 135A College Physics I**

**Activity 11: Power**

The average value of Power is defined as the rate at which work is done (or energy transferred):

where is the energy transferred during Then if a force is doing the work on an object we can calculate the average power of that force from

where is the velocity of the object on which the force is acting.

**A few words on units**

**Watt**:

Work has a unit of Joules, so power must have a unit of

Thus watt is the standard unit for power.

**Horsepower (hp)**:

If one is talking about everyday usage of power, a larger unit is sometimes used. It is the horsepower (hp)! This is a historical unit as people used to use horses to carry heavy objects. The unit stuck with us since then. Arguably, it is a convenient unit of expressing power.

For example, your car might have around 200 hp of traction power. Please not that, kW is increasingly used as a practical unit instead of hp.

**Kilowatt-hour (kWh)**:

Another unit we need to be familiar with is the kilowatt-hour (kWh). This is not a unit of power, rather it is a unit of energy. Precisely, it is the amount of energy a 1000-W bulb burns if it stays on for 1 hour. This is very practical especially for power-plant companies to calculate how much energy has been used by a particular costumer.

**Calories (Scientific)**:

1 calorie (cal) is 4.184 J

**Calories (Dietary)**:

1 Calorie (with capital C)

This is used in the dietary energy-content calculations. For example, when we say an average human being burns 2000 (food) Calories daily, what we mean is that it is (scientific) calories per day.

**Example 1**: How many kWh does an average human being consume daily?

**Example 2**: How much energy would a 100-W bulb consume in terms of kWh

(a) in one hour?

(b) in 8 hours?

(c) in 30 days for 8 hours a day?

(d) If 1 kWh costs 10 cents, how much would the above usage in (c) cost per month?

**Example 3**: A car has a retarding (friction) force of 700 N due to its internal structure. Calculate the power required of a 1400-kg car under the following circumstances:

(a) The car accelerates along a level road from 90 km/h to 110 km/h in 6 seconds to pass another car.

(b) The car climbs a hill at a steady 80 km/h speed.

**Example 4**: An elevator has a mass of 1000 kg and carries a maximum load of 800 kg (total 1800 kg). A constant (frictional) force of 4000-N retards its upward motion.

(a) What must be the minimum power delivered by the motor to lift the elevator at a constant speed of 3 m/s?

(b) Assuming that the elevators starts from rest, what power must the motor deliver at any instant if it is designed to provide an upward acceleration of 1m/s2?