Module #8: Work and Energy

* The Definitions of Work and Energy
  + Energy = the ability to do work
  + Work = the product of the displacement of an object and the component of the applied force that is parallel to the displacement
    - In order for work to occur there must be displacement
    - Therefore, energy can be redefined as the ability to apply a force which results in a displacement that has a component parallel to the force
  + In order for energy to exist in a situation, the application of the force and the displacement do not have to actually occur
* The Mathematical Definition of Work
  + W = F∥ \* ∆x
    - W represents work
    - ∆x stands for the magnitude of the displacement vector
    - F∥ is used toindicate the magnitude of the component of the force vector that is parallel to the displacement vector
    - If the force is not constant, or if motion is not in a straight line, you cannot use this equation to calculate work
    - SI Unit = N\*m = Joule “J”
      * Any force unit multiplied by any distance unit is a valid energy unit
      * Standard English unit = ft\*lbs
  + James Prescott Joule
    - Known for his studies of both electricity and energy
    - Developed a law that describes the heat produced in an electrical circuit
    - Studied the behavior of gases
    - Saw science as a means of understanding God
  + Ex 8.1 p.254
  + OYO #8.1 p.254
* Kinetic and Potential Energy
  + Energy exists in a situation simply if there is an ability to do the work
  + We make the distinction between the ability to do work and actually doing the work
  + If energy exists in a situation but is not used to perform work it is called potential energy: energy that is stored, ready to do work
  + If the work is actually being performed, then motion occurs. We call the energy associated with motion kinetic energy: energy in motion
  + PE= mgh
    - PE: potential energy
    - H: height
    - G: acceleration due to gravity
    - M: mass
  + KE= ½ mv2
    - KE: kinetic energy
    - M: mass
    - V: speed
  + Potential energy is a relative quantity – it must be calculated in relation to something else
  + Ex 8.2 p.256
  + OYO p.257 #8.2
  + Ex 8.3 p.257
  + OYO p.257 #8.3
* The First Law of Thermodynamics
  + The first law of thermodynamics = energy cannot be created or destroyed; it can only change form
  + There is no way to add or subtract the amount of energy, from the time of creation the total amount of energy in the universe was fixed
  + Energy can change form from potential energy into kinetic energy
  + In order to follow the First Law of Thermodynamics, there must be a one-to-one relationship between the potential energy decrease and the kinetic energy increase
  + There is a certain amount of energy in each situation
    - TE= PE + KE
    - Total energy
    - “conservation of energy equation”
  + Ex 8.4 p.259-260
  + Ex 8.5 p.261-263
  + OYO #8.4-8.6 p.264
  + Experiment 8.1: Energy in a Pendulum
* Friction, Work, and Energy
  + Mechanical energy = energy associated with the movement (or potential movement) of objects
  + Chemical energy = energy associated with the chemical bonds of a molecule
  + Electrical energy = energy associated with the motion (or potential movement) of charged particles
  + Heat = energy that is transferred from one object to another as a result of a difference in temperature
    - Must always be kinetic
  + Friction removes mechanical kinetic energy from a moving object and transforms it into heat.
    - Every Joule of work that friction does removes a Joule of kinetic energy
  + Ex 8.6 p.268
  + Experiment 8.2 p.269
    - Read p.270-272 and complete the calculations outline there
  + OYO p.272 #8.6
  + Ex 8.7 p.272
  + OYO p.273 #8.7
  + Ex 8.8 p.273-274
  + OYO p.274 #8.8-8.9
* Energy and Power
  + The concept of power tells us how much energy is used during a certain time interval.
    - Power = the amount of energy expended per second
    - P= ∆W/ ∆t
      * ∆W is the work done within a certain time interval
      * ∆t is the time interval
    - Units of power are J/sec which is named the Watt
  + Ex 8.9 p.276
  + OYO p.276 #8.10