Chapter C6: Introduction to Energy

Physics I

College of the Atlantic

C6.1: Interactions and Energy

- There is some scalar quantity (energy) that remains constant no matter what. Energy is not "seeable" like momentum is; energy is some number that has to be calculated, and there is more than one formula for energy.
- There are, for now, two sorts of energy, *kinetic and potential*.
  1. *Kinetic:* This is a property of a single moving object.
  2. *Potential:* This arises from an interaction between two objects. It is not the property of a single object.
- The total energy of a system is the sum of all the potential and kinetic energies. This is what Eq. (C6.2) says.

C6.2: Kinetic Energy

- The kinetic energy K of an object of mass m moving with speed v has a kinetic energy given by
$$K \equiv \frac{1}{2}mv^2 \, . \tag{1}$$
  For now, we should view this as a definition.
- The units for energy are *Joules*:
$$1\text{J} \equiv \frac{\text{kg m}^2}{\text{s}^2} \, . \tag{2}$$
- The last several paragraphs of this section argue that because the earth is so massive, interactions change its velocity by a minuscule amount, and hence we can ignore the earth's kinetic energy.

C6.3: Measuring Potential Energy

- Potential energy is measure of the extent to which an interaction can give an object kinetic energy. By measuring the kinetic energy an object gets, we can measure the potential energy associated with the interaction.

- Carrying out this procedure, we are led to:

$$V(r_i) - V(r_f) = mg(z_i - z_f)\ . \tag{3}$$

  This equation is a bit of a mess notationally.

- A simpler way to write this is Eq. (C6.12): Gravitational Potential energy of an object of mass m a height z above a reference position ($z = 0$) is given by

$$V(z) \equiv mgz\ . \tag{4}$$

C6.4: Negative Energy?

- Potential energy can be negative. All that matters physically are potential energy *differences.*

- When doing problems with gravitational potential energy, always state your reference level ($z = 0$).

- If you use a positive value for g, then up must be positive for z.

C6.5: A Look Ahead

- Since all that matters is energy difference, Moore always writes conservation of energy in difference form:

$$0 = \Delta E\ , \tag{5}$$
$$0 = \Delta K_1 + \Delta K_2 + \Delta V\ . \tag{6}$$

- Sometimes there is hidden energy that cannot be accounted for with V or K. The change in this hidden energy is, for now, denoted ΔU:

$$0 = \Delta K_1 + \Delta K_2 + \Delta V + \Delta U\ . \tag{7}$$

- I usually write Eq. (5) as:

$$E_i = E_f\ . \tag{8}$$