**Open and Closed Systems**

**Objective:** To define a system and apply the energy principle in a manner that is consistent with the choice of system; to define an open and closed system and be able to identify a particular system as an open or closed system.

**Review**

- List the equations for spring potential energy, electrical potential energy between two charged particles, and the gravitational potential energy between two massive particles, and their associated force laws.
- Write the equation for the energy of a single particle.
- Identify processes where the system’s rest energy changes.
- List the two types of energy transfer and how you can identify when each type of transfer of energy is zero or nonzero.

**Open and Closed Systems**

It is essential to define your system when applying the energy principle. If the system is an open system, then there is a net increase or decrease in the energy of the system. If the system is a closed system, then the energy of the system remains constant; in this case, the inflow of energy is equal to the outflow of energy and any loss of one type of energy internal to the system is offset by a gain in another type of energy internal to the system. A perfect analogy is your checking and savings accounts.

**Application**

1. A spring hangs from a ringstand. On the end of the spring you attach a 0.100-kg mass using a 0.050-kg mass hanger and hold it at rest so that the spring is unstretched (and uncompressed). Using your hand, you lower the hanger until it is at rest and in equilibrium.

   (a) How much will the spring stretch from its unstretched position?
   (b) Apply the energy principle, defining the spring and mass (with hanger) as your system.
   (c) Apply the energy principle, defining the spring, mass, and Earth as your system.
   (d) Apply the energy principle, defining the spring, mass, Earth, and yourself as your system.

2. RQ 5.6 from the textbook.
3. P 5.6 from the textbook.
4. P 5.8 from the textbook.
5. P 5.9 from the textbook.
6. P 5.11 from the textbook.