Chapter 7

Terms

Be able to define or discuss the following terms and ideas, with their SI units if appropriate.

1. spring potential energy (for an ideal spring)
2. Morse potential
3. conservative force
4. path independence of potential energy
5. internal energy
6. thermal energy
7. temperature
8. kelvin and celsius temperature scales
9. specific heat capacity
10. phase change
11. heat transfer (energy transfer due to a temperature difference between the system and surroundings)
12. power
13. energy dissipation

Equations

Understand the meaning and know the SI units of all symbols in these equations; know how to perform each mathematical operation, such as trig functions; know how to solve for any unknown quantity; understand how changing one quantity affects another quantity (if all other quantities remain constant); be able to apply one or more equations to solve a problem.

- Spring potential energy (for an ideal spring).

$$U_s = \frac{1}{2}ks^2$$

- Change in thermal energy for a system.

$$\Delta E_{therm} = mc\Delta T$$

- Energy principle for an open system.

$$\Delta E_{sys} = W + Q$$

- Power

$$P = \frac{dE}{dt}$$

- Quadratic drag

$$\vec{F}_{drag} = -cv^2\hat{v}$$

- Latent Heat of Vaporization:

$$\Delta\vec{E}_v = \pm mL_v$$

- Latent Heat of Fusion:

$$\Delta\vec{E}_f = \pm mL_f$$

Skills

1. Apply conservation of energy to a system that includes a spring.
2. Apply conservation of energy to a system that includes a change in thermal energy.
3. Apply conservation of energy to a system that includes heat transfer (i.e. a system which is at a different temperature than the surroundings and is not insulated from the surroundings).
4. Apply conservation of energy to a system that includes dissipation of potential energy and kinetic energy, such as a system that includes friction or air resistance.
5. Apply conservation of energy to a mixture of substances of different initial temperatures and calculate the equilibrium temperature of a system. This is called *calorimetry*.
6. Know that when a system undergoes a phase change, there is a change in thermal energy of the system.
7. Know that a solid has less thermal energy than a liquid of the same mass, temperature, and material as the solid.
8. Know that a liquid has less thermal energy than a gas of the same mass, temperature, and material as the liquid.
9. Know that potential energy is path independent.
10. Know that the total energy of a harmonic oscillator depends on the amplitude of oscillation. The total energy does NOT depend on the angular frequency of the oscillator.

Lab Skills

1. Apply conservation of energy to a harmonic oscillator; graph the total energy, potential energy, and kinetic energy of a harmonic oscillator.
2. Graph total energy as a function of amplitude for a harmonic oscillator.