Chapter C10: Thermal Energy

Physics I

College of the Atlantic

C10.1: Disappearing Energy

We can't concoct a potential energy function for the frictional part of a contact interaction.

C10.2: Caloric is Energy

This section mostly gives some historical background on what scientists thought about heat in the 1700's and early 1800's. I think the main thing to take from this section is that it's not obvious (or at least it wasn't then) that heat and energy are directly related.

C10.3: Thermal Energy

A substance's temperature is related to average kinetic energy of its molecules:

$$K_{\text{ave}} = \frac{3}{2} k_B T \ . \tag{1}$$

We won't use this equation much, if at all. It's important, though, because it sets up the connection between temperature and average energy. One could (more or less) think of this relationship as defining temperature.

One can also think of k_B as forming a bridge between microscopic (molecular) and macroscopic energy.

C10.4: Friction and Thermal Energy

C10.5: Heat and Work

- Heat: Energy transfer from one object to another across a well defined boundary, and which is directly due to a difference in temperature between the two objects.
- Work: Work is any other kind of energy flowing across the boundary between two systems.
- Internal Energy: Energy (kinetic and otherwise) "hidden" inside an object. Unlike heat, internal energy is a property of an object.

C10.6: Specific "Heat"

The specific "heat" c is defined via:

$$dU^{\text{th}} = mcdT \tag{2}$$

This relates internal energy changes to temperature changes.

C10.8: Keeping Track of Internal Energies

Using Eq. (2) we can apply conservation of energy as we did in earlier chapters, but now we can keep track of thermal energy as well. One has to think hard about minus signs, though.

Examples:

1. How much energy is needed to increase the temperature of 500g of water from 25C to 100C?

2. Suppose that energy was instead used to heat up 500g of copper whose initial temperature was 25C. What would the final temperature of the copper be?