THERMODYNAMIC PROCESSES

In this section, three distinct quantities have been related to each other: internal energy (U), heat (Q), and work (W). Processes that involve only work or only heat are rare. In most cases, energy is transferred as both heat and work. However, in many processes, one type of energy transfer is dominant, and the other type is negligible. In these cases, the real process can be approximated with an ideal process. For example, if the dominant form of energy transfer is work and the energy transferred as heat is extremely small, we can neglect the heat transfer and still obtain an accurate model. In this way, many real processes can be approximated by one of three ideal processes.

The rest of this chapter deals with ideal processes in gases. All objects have internal energy, which is the sum of the kinetic and potential energies of their molecules. However, monatomic gases present a simpler situation to study because all of their internal energy is kinetic. (The reason is that the molecules of a gas are too far apart to interact with each other significantly.)

No work is done in a constant-volume process

In general, when a gas undergoes a change in temperature but no change in volume, no work is done on or by the system. Such a process is called a constant-volume process, or **isovolumetric process.**

isovolumetric process

a thermodynamic process that takes place at constant volume so that no work is done on or by the system

One example of an isovolumetric process takes place inside a *bomb calorimeter,* shown in **Figure 3.** This device is a thick container in which a small quantity of a substance undergoes a combustion reaction. The energy released by the reaction increases the pressure and temperature of the gaseous reaction products. Because the container's walls are thick, there is no change in the volume of the gas. Energy can be transferred to or from the container only as heat. As in the case of the simple calorimeter discussed in the chapter "Heat," the increase in the temperature of water surrounding the bomb calorimeter provides information for calculating the total amount of energy produced by the reaction.

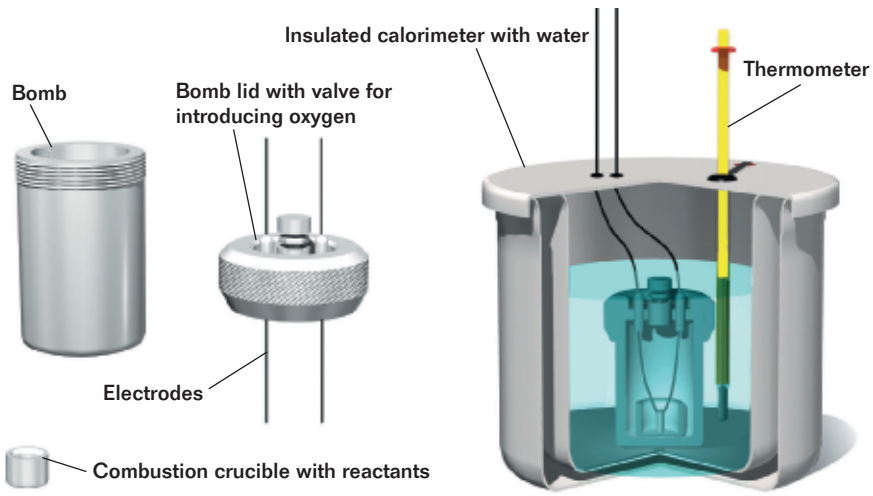

Figure 3
The volume inside the bomb calorimeter is nearly constant, so most of the energy is transferred to or from the calorimeter as heat.