Calibration of the Calorimeter

The calorimeter must first be calibrated. This will be accomplished by burning ethanol, an oxygenated fuel with a known $\Delta H_{\text{combustion}}$. The amount of energy released in the form of heat is related to $\Delta H_{\text{combustion}}$, where $n$ is the number of moles of ethanol consumed.

$$q_{\text{combustion}} = n \cdot \Delta H_{\text{combustion}}$$

The energy transferred to the water in the calorimeter can be determined using the following relationship:

$$q_{\text{water}} = m \cdot s \cdot \Delta T$$

where $m$ is the mass of the water in the calorimeter, $s$ is the specific heat of water (4.184 J/$^\circ$C·g), and $\Delta T$ is the change in temperature of the water. The heat capacity of the can is assumed to be negligible.

In this experiment, not all of the energy is transferred to the water, so the efficiency of the energy transfer must be determined. The efficiency factor can be calculated using the following definition.

$$\text{Efficiency} = \frac{-q_{\text{water}}}{q_{\text{combustion}}}$$

Energy Content of Fuels

Once the efficiency of energy transfer is known for a particular calorimeter, the calorimeter can be used to determine the energy content of other fuels, such as n-octane and 2-pentanol in this experiment. Burners containing these fuels will be used to heat the water in the calorimeter using the same procedure followed with the ethanol.

The energy content of the fuel is calculated in two steps. The first step is determining the $q_{\text{combustion}}$.

$$q_{\text{combustion}} = -\frac{q_{\text{water}}}{\text{Efficiency}}$$

The energy content is then calculated by dividing $q_{\text{combustion}}$ by the mass of the fuel consumed. Note that we will be defining energy contents as positive values.

$$\text{Energy content} = \left| \frac{q_{\text{combustion}}}{|\text{mass of fuel}|} \right|$$