Determining a Calorimeter's Heat Capacity

According to the law of conservation of energy, the total energy at the end of the experiment is equal to the energy at the beginning of the experiment. This can be expressed by the following equation:

$q_{metal} = q_{water} + q_{calorimeter}$

Heat change = mass x specific heat capacity x temperature change. Heat change (q) represents the amount of energy expressed by $q = M \times C \times \Delta T$, where M = mass (g), C = specific heat (J/g-ºC), and ΔT = change in temperature (ºC).

This can be solved for $C_{calorimeter}$ or C_{cal}, for short, as follows:

$M_{metal} \times C_{metal} \times \Delta T_{metal} = (M_{water} \times C_{water} \times \Delta T_{water}) + (M_{cal} \times C_{cal} \times \Delta T_{cal})$

Rearranging the formula:

$M_{metal} \times C_{metal} \times \Delta T_{metal} = (M_{water} \times C_{water} \times \Delta T_{water})) + (q_{cal} \times \Delta T_{cal})$

$(q_{cal} \times \Delta T_{cal}) = (M_{metal} \times C_{metal} \times \Delta T_{metal}) - (M_{water} \times C_{water} \times \Delta T_{water})$

The value of C = 1 J/g-ºC for water, by definition. Since the water and the calorimeter both start and end at the same temperature, $\Delta T_{cal} = \Delta T_{water}$. Substituting:

$$q_{cal} = \frac{(M_{metal} \times C_{metal} \times \Delta T_{metal}) - (M_{water} \times \Delta T_{water})}{\Delta T_{water}}$$

This is the equation needed to determine the heat capacity of the calorimeter. Input your measurements from the Calibrating the Calorimeter table to determine their actual values. For easy reference, C_{metal} for aluminum (from tables) = 0.9 J/g-ºC.