# Online Lab: Specific Heat

Name: Date:

Instructor: Section:

## Online Experiment Setup Instructions:

1. Go to the following website:
   **https://www.youtube.com/watch?v=8_Ef04n-F2A&t=1s**
2. Watch the Specific Heat video that Brian Espino created, and follow along. Enter the values for the masses and the temperatures. Then use these values to complete the table.
3. Take a photo and upload your calculations of $c_M$ and $\%_{error}$ with this Lab Report in D2L.

## Specific Heat Theory:

The specific heat $c$ of a substance is the amount of thermal energy (heat) that a single gram of the substance must absorb in order to change its temperature by one degree Celsius (or Kelvin). The specific heat of water, for example, is $c_W = 1$ cal/g°C. That is: 1 calorie of heat is needed to raise the temperature of 1g of water by 1°C. In general, we have:

$$Q = c\, m\, \Delta T \tag{1}$$

where $Q$ is the thermal energy (heat) required to produce a temperature change $\Delta T$ in a material with a specific heat $c$ and a mass $m$. If there is no loss into the environment, when we add a warm metal to cold water, the heat gained by the water, $Q_W$, must equal the heat lost by the metal, $-Q_M$, and we have:

$$Q_W = -Q_M = c_W\, m_W\, \Delta T_W = -\, c_M\, m_M\, \Delta T_M \tag{2}$$

Solving for the specific heat of the metal gives:

$$c_M = c_W\, (m_W/m_M)\, (-\Delta T_W/\Delta T_M) \tag{3}$$

Since the specific heat of water is much higher than that of the metals we use, the water temperature change will be small and limits the precision of the experiment. To maximize $\Delta T_W$ , we need to keep the water mass as small as possible and the initial temperature difference between the warm metal and cold water as high as possible. However, for safety reasons we will limit the hot water temperature in the steam generator. We also note there are complications in energy loss as described in the example below for a similar experiment mixing warm water with a cold metal mass.

# Experimental Results

Table 1: Specific Heat Data

| **Metal** | $m_M$ **(g)** | $m_W$ **(g)** | $T_{iM}$ $^\circ C$ | $T_{iW}$ $^\circ C$ | $T_f$ $^\circ C$ | $c_M$ **cal/g**$^\circ C$ | $\%_{error}$ |
|---|---|---|---|---|---|---|---|
| **Aluminum** | | | | | | | |
| **Copper** | | | | | | | |
| **Steel** | | | | | | | |

# Conclusions

1. What physics was observed and verified?

2. What did you notice about $T_f$ for the different metals? Describe the pattern for $T_f$ relative to the 3 specific heats.

3. Why do the metals drop in temperature a lot more than the water is heated?