- Use graduated cylinders to get your approximate amounts of water.

Measure the exact amounts of water, ice , or Al by finding the differences in mass.

$$m_w = m_{cup+water} - m_{cup}$$

- The quantities and temperatures used are only suggestions.

Make sure that the aluminum pellets or glass beads are dry before you use them.

- Return the wet aluminum and glass beads to the hot metal beakers for drying. Be careful not to touch the hot metal beakers or hot plates with your bare fingers.
- Use the same thermometer for all your measurements.

A) Mixing hot and cold water.Take around 35 ml of hot water and mix it with about 70 ml of water at room temperature. Measure the final temperature once thermal equilibrium has been established.

$$m_c c_w \left(T_f - T_c\right) = m_{hot} c_w \left(T_h - T_f\right)$$

$$T_f = \frac{m_h T_h + m_c T_c}{m_c + m_h}$$

B) Latent heat of melting for ice: Add two or three dry ice cubes to a measured amount of water at around 60° C. Measure the amount of temperature drop when thermodynamic equilibrium has been established. From these data, determine the latent heat of melting for ice. Perform all experiments in a styrofoam cup.
Prepare a styrofoam cup with about 100g warm water around 60 degrees. Measure the temperature of the water in the cup right before immersing the ice.
Take 1-2 ice cubes, dry them as fast as possible and immerse them into the cup with water. Cover the cup and stir with the thermometer until all the ice has melted. This point will be reached when the temperature of the water will stop falling.
Measure the mass of the cup + water + ice, to determine the mass of the ice used.
Calculate the latent heat of ice.

$$Q = L_{ice} m_{ice} + m_{ice} c_w T_f = m_w c_w \left(T_i - T_f\right)$$

$$T_f = \frac{m_w c_w T_i - m_{ice} L}{c_w (m_{ice} + m_w)}$$

$$L_{ice} = \frac{m_w c_w \left(T_i - T_f\right) - m_{ice} c_w T_f}{m_{ice}}$$

Calculate your expected percent error, using L=79.6cal/g.

C) Determine the specific heat of aluminum by adding aluminum (100 g) pellets at room temperature to 50g (approximately) of water at around 10C. Use icewater to cool down the water. Consider that you need about five grams of aluminum to change the

temperature of 1 gram of water by one degree. You should get a final temperature around17C. $m_{Al}c_{Al}(T_{Al,in}-T_{fin})=m_w c_w(T_{fin}-T_{w,in})$

D) Use hot water (50g) at around 35 C, and add it to 100 g aluminum pellets at room temperature. Measure the final temperature (around 30C) and determine the specific heat of aluminum

$$m_{Al}c_{Al}(T_{Al,in}-T_{fin})=m_w c_w(T_{fin}-T_{w,in})$$

$$T_{fin}=\frac{m_{Al}c_{Al}T_{Al,in}+m_w c_w T_{w,in}}{m_{Al}c_{Al}+m_w c_w}$$

For results with errors less than 1% you get 0.5 credit point.