Determine the Specific Heat of a Solid in a Calorimeter

AREN 2110
ITL Lab Assignment
Calorimeter is a multicomponent, adiabatic process

- 1\textsuperscript{st} Law Statement: $\Sigma \Delta U_i = 0$
- Where components are the calorimeter mass and the sample mass.
- Assumptions: rapid heat transfer between sample and calorimeter mass, no heat transfer to surroundings.
- You will be using an aneroid calorimeter, one that uses a metal mass with high thermal conductivity (e.g., aluminum) for the calorimeter mass.
- Characteristics of calorimeter, relatively rapid heat transfer by conduction so equilibrium is reached quickly; relatively low specific heat so measurable temperature change occurs; relatively high mass (compared with sample mass) so temperature change is not so large that it is hard to maintain adiabatic conditions.
Aneroid Calorimeter

- Cap
- Sample Chamber
- Sample
- Calorimeter mass
- Insulation
- Thermometer
- Q
Tips for Procedure

Key Points

• **Submerge** sample in boiling water bath long enough so $T_{\text{sample}}$ reaches $T_{\text{sat}}$
• Record calorimeter and water bath temperature **before** moving sample from bath to calorimeter
• Move sample to calorimeter as quickly as possible using tongs
• Watch calorimeter thermometer reading carefully to make sure you record the equilibrium temperature of the calorimeter (and sample)
Tips for Data Display

<table>
<thead>
<tr>
<th>Sample</th>
<th>C_p Lab</th>
<th>C_p Table</th>
<th>% diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Avg ± std. dev.</td>
<td>0.88 ± 0.11</td>
<td>0.929</td>
<td>5</td>
</tr>
<tr>
<td>Copper Avg ± std. dev.</td>
<td>0.43 ± 0.13</td>
<td>0.39</td>
<td>10</td>
</tr>
</tbody>
</table>
Tips for Discussion of Results

- General comments on accuracy of results, performance of calorimeter, suggestions for improved measurement

**ERRORS**
- Do not just cite “measurement error”
- Use the 1st law calorimeter formula to show how a temperature measurement would result in over- or under-estimate
- If the variability between runs is large, discuss why
- If you think the adiabatic assumption (or any other assumption) is not correct, give specific reason(s)