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Section \_\_\_\_\_

Date \_\_\_\_\_

## EXPERIMENT 19

# Lab Report

## Part A – Determination of the Calorimeter Constant

Experimental data and calculations - Trial 1

$$\begin{aligned}
 m_{\text{cool}} &= 47.0 \text{ g} \\
 m_{\text{hot}} &= 50.0 \text{ g} \\
 T_{\text{cool}} &= 19.31^\circ\text{C} \\
 T_{\text{hot}} &= 80^\circ\text{C} \\
 C_{\text{water}} &= 4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} \\
 T_f &= 39.72
 \end{aligned}$$

$$\begin{aligned}
 q_{\text{cal}} &= -q_{\text{hot}} - q_{\text{cool}} \therefore q_{\text{cal}} = [m_{\text{hot}} C_w \Delta T_{\text{hot}}] - [m_{\text{cool}} C_w \Delta T_{\text{cool}}] \\
 \therefore q_{\text{cal}} &= -[50.0 \cdot 4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} \cdot (39.72 - 80)] - [47.0 \cdot 4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} \cdot (39.72 - 19.31)] \\
 \therefore q_{\text{cal}} &= 4408.7 \text{ J} \\
 \therefore C_{\text{cal}} &= \frac{q_{\text{cal}}}{\Delta T_{\text{cool}}} = \frac{4408.7 \text{ J}}{20.41 \text{ K}} = 216 \frac{\text{J}}{\text{K}} \quad \boxed{0.22 \frac{\text{kJ}}{\text{K}}}
 \end{aligned}$$

Experimental data and calculations - Trial 2

$$\begin{aligned}
 m_{\text{cool}} &= 42.0 \text{ g} \\
 m_{\text{hot}} &= 50.0 \text{ g} \\
 T_{\text{cool}} &= 22.13^\circ\text{C} \\
 T_{\text{hot}} &= 71^\circ\text{C} \\
 C_{\text{water}} &= 4.18 \frac{\text{kJ}}{\text{kg}^\circ\text{C}} \\
 T_f &= 45.54^\circ\text{C}
 \end{aligned}$$

$$\begin{aligned}
 q_{\text{cal}} &= -q_{\text{hot}} - q_{\text{cool}} \therefore q_{\text{cal}} = -[m_{\text{hot}} C_w \Delta T_{\text{hot}}] - [m_{\text{cool}} C_w \Delta T_{\text{cool}}] \\
 q_{\text{cal}} &= -[50.0 \cdot 4.18 \frac{\text{kJ}}{\text{kg}^\circ\text{C}} \cdot (45.54 - 71)] - [42.0 \cdot 4.18 \frac{\text{kJ}}{\text{kg}^\circ\text{C}} \cdot (45.54 - 22.13)] \\
 q_{\text{cal}} &= +[5.32 \text{ kJ}] - [4.11 \text{ kJ}] = 1.21 \text{ kJ} = C_{\text{cal}} \Delta T_{\text{cool}} \\
 \therefore C_{\text{cal}} &= \frac{q_{\text{cal}}}{\Delta T_{\text{cool}}} = \frac{1.21 \text{ kJ}}{23.41 \text{ K}} \quad \boxed{0.052 \frac{\text{kJ}}{\text{K}}}
 \end{aligned}$$

What is the average calorimeter constant?

$$C_{cal} = \frac{(0.216 + 0.052) \frac{\text{kJ}}{\text{K}}}{2} = 0.134 \frac{\text{kJ}}{\text{K}}$$

### Part B – Determination of the Heat of Dissolution of a Salt

Experimental data and calculations - Trial 1

$$m_{\text{H}_2\text{O}} = 25.0 \text{ g}$$

$$m_{\text{KNO}_3} = 0.995 \text{ g}$$

$$T_{\text{H}_2\text{O}} = 25.64^\circ\text{C}$$

$$T_{\text{KNO}_3} = 24.0^\circ\text{C}$$

$$C_{\text{H}_2\text{O}} = 4.18 \frac{\text{kJ}}{\text{kg K}}$$

$$T_{\text{sol}} = \frac{25.64 + 24.0}{2} = 24.82^\circ\text{C}$$

$$m_{\text{sol}} = 25.0 + 0.995 = 25.995 \text{ g}$$

$$T_{\text{f}} = 21.599^\circ\text{C}$$

$$-q_{\text{rxn}} = q_{\text{sol}} + q_{\text{cal}}$$

$$q = (25.995 \text{ g} \cdot 4.18 \frac{\text{J}}{\text{g K}} \cdot (21.599 - 24.82)^\circ\text{C}) + \left( 0.134 \frac{\text{kJ}}{\text{K}} \cdot (-0.321 \text{ K}) \right)$$

$$q = -2385 \text{ J}$$

Experimental data and calculations - Trial 2

Did not receive data

What is the average  $\Delta H_{\text{dissolution}}$  for potassium nitrate? Is the dissolution an endothermic or exothermic process?

$$\Delta H = \frac{-2385 \text{ J}}{n}$$

$$\therefore \Delta H = \frac{-2385 \text{ J}}{0.0098 \text{ mol}} = -2.4 \times 10^5 \frac{\text{J}}{\text{mol}}$$

$$n = \frac{0.975 \text{ g}}{101.10 \frac{\text{g}}{\text{mol}}} = 0.0098 \text{ mol}$$

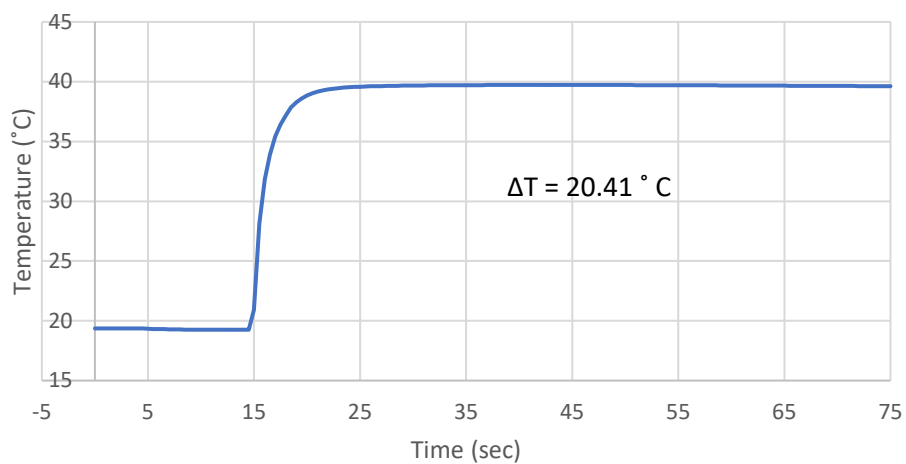
Exothermic

### Part C – Determination of the Molar Heat of Reaction of an Acid-Base Reaction

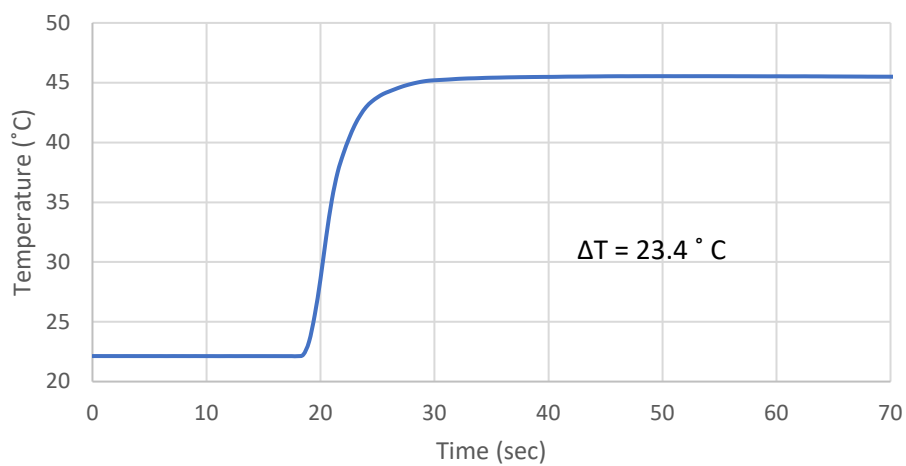
Experimental data and calculations - Trial 1

Experimental data and calculations - Trial 2

Calibration of Styrofoam Cup Calorimeter (Trial 1)



Calibration of Styrofoam Cup Calorimeter (Trial 2)



Enthalpy Change for  $\text{KNO}_3$  in Water

