

Lab 1

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1 Pre-Lab

1.1 Purpose

1. Understand the process of heat transfer, with respect to enthalpy.
2. Utilize and understand the process of calorimetry to determine heat transfer.
3. Apply Hess's law to calculate enthalpy through direct and indirect processes.
4. Determine the enthalpy of formation and enthalpy of reaction.

1.2 Definitions

Calorimetry - A procedure that allows us to measure the amount of energy (as heat given off or absorbed) under carefully controlled conditions.

Calorimeter - An object used for calorimetry. A simple calorimeter just consists of a thermometer attached to a metal container full of water suspended above a combustion chamber.

Enthalpy - The sum of the internal energy and the product of the pressure and volume of a thermodynamic system. Represented with the letter H. $H = E + PV$

Endothermic - Absorbs heat.

Exothermic - Releases heat.

Enthalpy change - The heat change is denoted by ΔH .

1.2.1 Equations

To measure the amount of energy (in the form of heat) absorbed or given off, we can use this equation:

$$q_{\text{solution}} = m_{\text{solution}} * c_{\text{solution}} * \Delta T_{\text{solution}} \quad (1)$$

q = heat, m = mass, c = specific heat capacity of water and ΔT = change in temperature in ($^{\circ}\text{C}$ or K).

We will assume that no heat is lost to the universe (surrounding area) by the calorimeter. With this assumption, the energy as heat lost by the reaction will equal the energy gained by the solution. We can represent this in the following equation:

$$q_{\text{reaction}} = -q_{\text{solution}} \quad (2)$$

If you combine the two above equations you get:

$$q_{\text{reaction}} = -m_{\text{solution}} * c_{\text{solution}} * \Delta T_{\text{solution}} \quad (3)$$

We determine the heat change for the reaction (unknown) by determining the heat change for the solution (known). The heat change is called *enthalpy change*. This is represented as follows:

$$\Delta H = \text{EnthalpyChange} \quad (4)$$

To find the change in Temperature:

$$\Delta T = T_{\text{initial}} - T_{\text{final}} \quad (5)$$

If answer (ΔT) is positive, this means that heat was released to the solution and the reaction is *exothermic*. When q is calculated, then the value will be negative. The negative sign simply indicates the direction of heat flow, not the quantity.

If the answer (ΔT) is negative, heat was absorbed from the solution, the reaction is *endothermic* and q will be positive.

Once the heat quantity (q_{reaction}) is calculated, **at constant pressure:**

$$q_{reaction} = \Delta_{reaction}H \quad (6)$$

Calculate $\Delta_{reaction}H$ per mole of substance:

$$\Delta_{reaction}H = \frac{q_{reaction}}{mol_{substance}} \quad (7)$$

Hess's Law Formula:

$$\Delta H_{net} = \sum \Delta H_r \quad (8)$$

$$\Delta H_{net} = \text{net change in enthalpy} \quad (9)$$

$$\sum \Delta H_r = \text{sum change in enthalpy reactions} \quad (10)$$