# Calorimetry and Reaction Enthalpy

**Skills to Develop**

- Perform and describe calorimetry calculations

## How do you measure ΔH?

If you want to measure ΔH, you usually use calorimetry, which just means measuring heat. The usual way this is done is by measuring how much the temperature of a system increases when the process occurs. For instance, perhaps we have 2 solutions (like an acid and a base solution) and we mix them in a thermos. We measure the temperature of the solutions before mixing and also after the reaction. Because we run the reaction in a thermos, we expect that almost all the heat from the reaction will stay in the thermos. Also, we don't close the thermos all the way, so the pressure is always atmospheric pressure. The reaction enthalpy is related to the temperature change, but how, exactly?

## Heat Capacity

**Heat capacity** tells us how much heat is needed to increase the temperature of an object or substance by a certain amount. The unit **calorie** is the energy needed to increase the temperature of 1 g of water by 1 degree (either Celsius or Kelvin). 1 calorie = 4.18 J. Generally, the heat capacity is

$$C = \frac{q}{\Delta T} \tag{1}$$

Depending on what is convenient, heat capacity can be defined in different ways. Sometimes it is defined using heat transferred at constant pressure, and other times heat transferred at constant volume. Specific heat is the heat capacity per unit of mass:

$$C = \frac{q}{\Delta T \ \times m} \tag{2}$$

Molar heat capacity is the heat capacity per mole of substance. If you know the heat capacity of the system, you can calculate ΔH using the temperature change data from a calorimetry experiment. In the example of the acid-base reaction in the thermos, you would want the heat capacity of the thermos and you would add the heat capacity of the solution, which you could calculate using the specific or molar heat of water.

## Doing Calorimetry Calculations

First, you need to be a little careful about whether the experiment was done at constant pressure or constant volume. This will determine whether you calculate enthalpy or internal energy of reaction. Second, make sure you figure out the heat capacity of the system correctly. You might have to add up heat capacities of different parts of the system using (mass x specific heat) or (moles x molar heat capacity) of each part. Once you've figured that out, you can usually think of it as a "unit conversion" and use dimensional analysis to combine all the quantities you know to find the quantity you want.

### Outside Links

- Khan Academy: Specific Heat, Heat of Fusion, and Vaporization Example (15 min)
- CrashCourse Chemistry: Calorimetry (12 min)

## Contributors and Attributions

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