Chapter 5 Part 4

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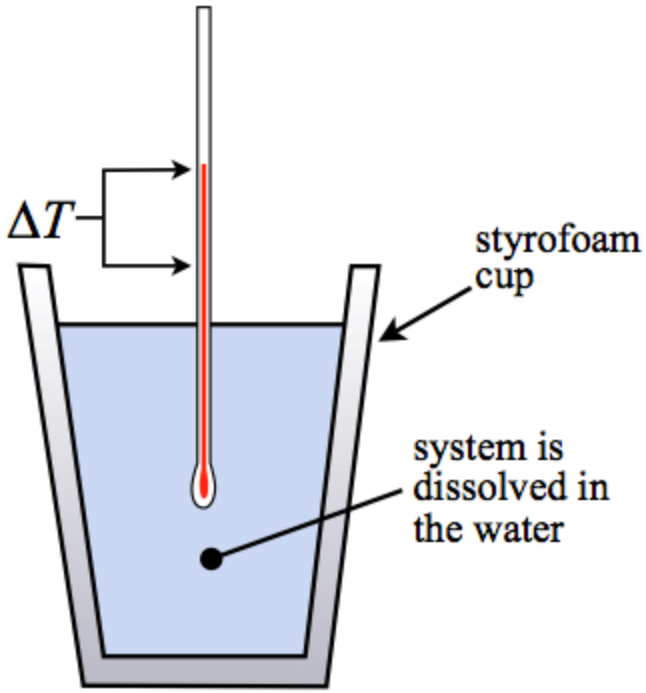
Measuring ΔH_{rxn} in a calorimeter

- If a reaction happens in a calorimeter, the insulation of the calorimeter keeps heat from escaping
- Thus, you can assume that the heat gained by the solution equals the heat lost by the reaction

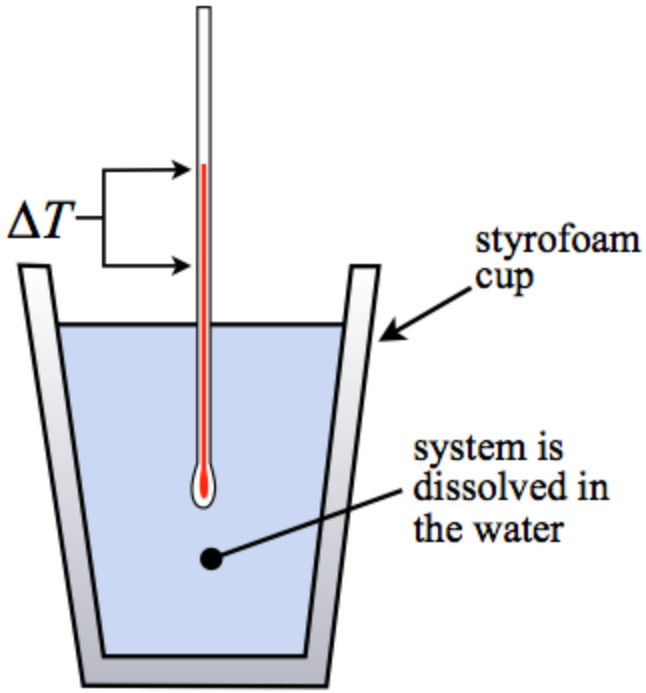
$$q_{rxn} = -q_{soln}$$



Measuring ΔH_{rxn} in a calorimeter

- Since the reaction happens under constant pressure (open to the atmosphere), the heat of the reaction per mole of reaction is the enthalpy of the reaction.
- The amount of reaction that can occur is limited by the limiting reactant. Thus, the moles of the rection are limited by the limiting reactant.

$$\Delta H_{rxn} = \frac{q_{rxn}}{mol_{LR}}$$



Measuring ΔH_{rxn} in a calorimeter

A 0.158 g sample of Mg is added to 100.0 mL of a 2.00 M solution of HCl in a calorimeter. The observed increase in temperature is 7.2 °C. Using these data, calculate the standard enthalpy of reaction. Use $1.00\,\frac{g}{mL}$ as the density of the solution and $c = 4.184\,\frac{J}{g\,°C}$ as the specific heat capacity.

$$Mg(s) + 2\,HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Measuring ΔH_{rxn} in a calorimeter

When 50.0 mL of 0.100 M $AgNO_3$ is combined with 50.0 mL of 0.100 M HCl in a coffee-cup calorimeter, the temperature changes from 23.40 °C to 24.21 °C. Calculate ΔH_{rxn} (in kJ/mol) for the reaction. Use $1.00\,\frac{g}{mL}$ as the density of the solution and $c = 4.184\,\frac{J}{g\,°C}$ as the specific heat capacity.

$$AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$$

Thermostoichiometry

A mixture containing 10.0 g of NH_3 and 20.0 g of O_2 reacts by the following equation. (A) Determine which reactant is limiting. (B) How much heat will be released by the reaction?

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O;\ \Delta H_{rxn} = -906\ kJ$$

Thermostoichiometry

The reaction for the combustion of octane, C_8H_{18}, is shown below.

$$2\ C_8H_{18}(g) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O(g) \quad \Delta H = -10{,}942\ kJ$$

Determine the amount of heat released when 0.2430 mol of C_8H_{18} reacts with excess O_2.

A. −10942 kJ
B. −5471 kJ
C. −1329 kJ
D. −2659 kJ
E. −3371 kJ

Thermostoichiometry

Gaseous hydrogen iodide, HI, is formed from the reaction of hydrogen and iodine gas.

$$H_2(g) + I_2(g) \rightarrow 2\ HI(g) \quad \Delta H = 52.96\ kJ$$

Determine the enthalpy of the reaction per mole of HI produced.

A. 52.96 kJ/mol
B. 26.48 kJ/mol
C. 37.76 J/mol
D. 018.88 J/mol

Thermostoichiometry

Consider the following reaction:

$$CH_3OH(g) \rightarrow CO(g) + 2\ H_2(g) \qquad \Delta H = +90.7\ kJ$$

(A) Is this reaction endothermic or exothermic? (B) Calculate the amount of heat absorbed when 45.0 g of CH_3OH is decomposed at a constant pressure. (C) How many grams of H_2 are produced during an enthalpy change of 25.8 kJ?