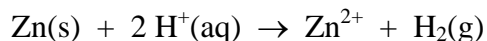


## An Example of Calorimetry

### Problem 7-32

A “coffee-cup” calorimeter contains 100.0 mL of 0.300 M HCl at 20.3°C. When 1.82 g Zn(s) is added, the temperature rises to 30.5°C. What is the heat of reaction per mol Zn? Make the same assumptions as in Example 7-4, and also that there is no heat lost to the H<sub>2</sub>(g) that escapes.



### Solution:

Write the first law for the problem:

$$q_{\text{rxn}} + q_{\text{soln}} = 0$$

$$n\Delta H_{\text{rxn}} + m_{\text{soln}}c_{\text{soln}}\Delta T_{\text{soln}} = 0$$

The necessary assumptions are:

$$1) c_{\text{soln}} = 4.18 \frac{\text{J}}{\text{g}\cdot^{\circ}\text{C}}$$

$$2) d_{\text{soln}} = 1.00 \frac{\text{g}}{\text{mL}}$$

$$n_{\text{Zn}} = \frac{1.82 \text{ g}}{65.39 \frac{\text{g}}{\text{mol}}} = 0.02783 \text{ mol Zn (excess reagent)}$$

$$n_{\text{HCl}} = 0.100 \text{ L} \times 0.300 \text{ M} = 0.0300 \text{ mol H}^{\text{+}} \text{ (limiting reagent)}$$

$$n_{\text{Zn}}^{\text{reacted}} = 0.0300 \text{ mol H}^{\text{+}} \times \frac{1 \text{ mol Zn}}{2 \text{ mol H}^{\text{+}}} = 0.0150 \text{ mol Zn}$$

$$m_{\text{soln}} = 100.0 \text{ g}$$

$$\Delta T = 30.5^{\circ}\text{C} - 20.3^{\circ}\text{C} = 10.2^{\circ}\text{C}$$

$$(0.0150 \text{ mol})\Delta H_{\text{rxn}} + (100.0 \text{ g})\left(4.18 \frac{\text{J}}{\text{g}\cdot^{\circ}\text{C}}\right)(10.2^{\circ}\text{C}) = 0$$

$$(0.0150 \text{ mol})\Delta H_{\text{rxn}} = -4263.6 \text{ J}$$

$$\Delta H_{\text{rxn}} = -284000 \frac{\text{J}}{\text{mol}} = -284 \frac{\text{kJ}}{\text{mol}}$$