Calorimetry Exercises

1. When 12.29 g of finely divided brass (60% Cu, 40% Zn) at 95.0°C is quickly stirred into 40.00 g of water at 22.0°C in a calorimeter, the water temperature rises to 24.0°C. Find the specific heat of brass.

Hints:

- The heat lost by the brass is gained by the surroundings (the water plus the calorimeter). What relation can you therefore write between q_{brass} and q_{surr}?
- Since no information is given about the heat capacity of the calorimeter, you should assume it is negligible.
- The final temperature of the brass is the same as the final temperature of the water. The specific heat of water, $s(H_2O)$, is 4.184 J g^{-1} $°C^{-1}$.

Answers: $q_{surr} = q(H_2O) = 334.7$ J; $q_{brass} = -334.7$ J; $s_{brass} = 0.38$ J g^{-1} $°C^{-1}$.

2. In an experiment, 400. mL of 0.600 M $HNO_3(aq)$ is mixed with 400. mL of 0.300 M $Ba(OH)_2(aq)$ in a constant-pressure calorimeter having a heat capacity of 387 J/°C. The initial temperature of both solutions is the same at 18.88°C, and the final temperature of the mixed solution is 22.49°C. Calculate the heat of neutralization in kJ per mole of HNO_3.

Hints:

- The heat evolved in the neutralization reaction is gained by the surroundings (the mixed solution plus the calorimeter). What relation can you therefore write between q_{rxn} and q_{surr}?
- There are two contributions to q_{surr}. What are they? What assumptions (if any) need to be made in calculating these contributions?
- Is this a limiting reagent problem, or are reactants supplied in the stoichiometric ratio given by the equation? (Why do we care about this?)
- We want our answer in kJ per mole of HNO_3. How do we calculate that?