PRACTICE: CALORIMETRY

Complete the analysis and conclusion for each calorimetry problem. Each analysis must be presented step-by-step and include all formulas, calculations, and unit analyses. State any assumptions and clearly show where in the calculations each assumption is made. The conclusion must give the answer rounded to the proper number of digits and include correct units.

Problem 1

Question

What is the molar enthalpy of dissolution of sodium hydroxide?

Chemical System

$NaOH(s) \rightarrow Na^+(aq) + OH^-(aq)$ $\quad \Delta H_{sol} = ?$ kJ/mol NaOH

Data

volume of water put in the calorimeter, $V_{H2O} = 100.0$ mL
initial temperature of the water, $T_1 = 19.2\,°C$
mass of sodium hydroxide added to the water, $m_{NaOH} = 4.00$ g
final temperature of the solution when dissolving is complete, $T_2 = 29.8\,°C$

Notes

1. Dissolution refers to the dissolving of the substance in water.

2. The word *change* is commonly omitted when referring to molar enthalpy changes. The phrase "molar enthalpy of..." should be taken to mean "molar enthalpy change..."
   For example:
   molar enthalpy of dissolution
   molar enthalpy of combustion
   molar enthalpy of vaporization
   molar enthalpy of neutralization

Problem 2

Question

What is the molar enthalpy change with respect to barium hydroxide for the reaction between aqueous barium hydroxide and aqueous ammonium chloride?

Chemical System

$Ba(OH)_2(aq) + 2\,NH_4Cl(aq) \rightarrow BaCl_2(aq) + 2\,H_2O(l) + NH_3(g)$ $\quad \Delta H_{rxn} = ?$ kJ/mol $Ba(OH)_2$

Data

concentration of the barium hydroxide solution, $c_{Ba(OH)2} = 0.50$ mol/L
volume of barium hydroxide used, $V_{Ba(OH)2} = 75$ mL
volume of ammonium chloride solution use, $V_{Ba(OH)2} = 75$ mL (contains excess NH_4Cl)
initial temperature of the solutions, $T_1 = 22.3\,°C$
final temperature of the combined solutions after mixing in a calorimeter, $T_2 = 18.5\,°C$

Notes

1. Because barium hydroxide is in solution, you must use the concentration formula to find the amount of barium hydroxide.

2. When calculating the heat transfer for the calorimeter, q_{cal}, use the combined volume of solution and assume that the solution has the same density and specific heat capacity as water.