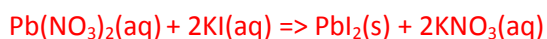


Chemical calorimetry worksheet 4

- 1) An electric current of 1.35A at a potential difference of 6.80V was passed for 4.00 minutes through a calorimeter containing 80.0 mL of water. The temperature rose from 22.00 to 26.53 °C.
- a) Calculate the calibration factor in J/°C, for this calorimeter
- b) 40.0 mL of 1.00 mol L⁻¹ lead(II) nitrate solution, Pb(NO₃)₂, at 20.6°C was added to 40 mL of a solution containing excess potassium iodide, KI also at 20.6°C.
- i. Write a balanced chemical equation for the reaction



- ii. Calculate the ΔH for the reaction above if the temperature of the water in the calorimeter reached a maximum of 27.8 °C.

Step 1 Calculate the mol of Pb(NO₃)₂ that reacted

$$\Rightarrow n = C \times V = 1.00 \times 0.0400 = 4.00 \times 10^{-2}$$

Step 2 Calculate the amount of energy released

$$\Rightarrow 486 \text{ J/}^\circ\text{C} \times (27.8 - 20.6) = 3499 \text{ J}$$

Step 3 Calculate ΔH

$$\Rightarrow 3499 \text{ J} / 0.0400 = -87.5 \text{ kJ/mol}$$

- iii. Using the same calorimeter, as above, 40.0 mL of 1.00 mol L⁻¹ lead(II) nitrate solution, Pb(NO₃)₂, at 20.6°C was added to 40.0 mL of 0.500 mol L⁻¹ potassium iodide solution, KI, also at 20.6°C. What is the highest temperature reached by the water

Step 1 Find the mol of each reactant and determine the limiting reactant.

In this case it is KI.

$$n_{\text{lead nitrate}} = 0.04 \times 1.00 = 0.0400 \text{ mol}$$

$$n_{\text{potassium iodide}} = 0.04 \times 0.500 = 0.0200 \text{ mol}$$

Step 2 Calculate the amount of energy released if the 0.0200 mol of KI reacted.

Since, according the thermochemical equation, for every 2 mol of KI used 87.5 KJ of energy is released we can write the expression below.

$$\Rightarrow 87.5 \text{ kJ mol}^{-1} \times 0.0200/2 = 0.875 \text{ kJ.}$$

Step 3 Calculate the temperature increase using the calibration factor.

$$\Rightarrow 875.0 \text{ J} / 486 \text{ J/}^\circ\text{C} = 1.80^\circ\text{C}$$

Step 4 Calculate the final temperature of the water.

$$\Rightarrow 20.6 + 1.80 = 22.4^\circ\text{C}$$