An Example of Calorimetry

Problem 7-34

The heat of solution of potassium acetate in water is -15.3 kJ/mol $KC_2H_3O_2$. If 0.136 mol $KC_2H_3O_2$ is dissolved in 525 mL water that is initially at 25.1°C, what will be the final temperature?

Solution:

Write the first law for the problem:

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

The necessary assumption is:

1) $c_{soln} = 4.18 \frac{J}{g \cdot °C}$

$$m_{soln} = m_{H_2O} + m_{KC_2H_3O_2}$$
$$m_{KC_2H_3O_2} = 0.136 \text{ mol} \times 98.142 \frac{g}{mol} = 13.35 \text{ g } KC_2H_3O_2$$
$$m_{soln} = 525 \text{ g} + 13.35 \text{ g} = 538 \text{ g soln}$$

$$(0.136 \text{ mol})\left(-15.3 \times 10^3 \frac{J}{mol}\right) + (538 \text{ g})\left(4.18 \frac{J}{g \cdot °C}\right)(T_f - 25.1°C) = 0$$
$$2250.3 \frac{J}{°C}(T_f - 25.1°C) = 2080.8 \text{ J}$$

$$T_f - 25.1°C = 0.925°C$$

$$T_f = 26.0°C$$