Take-Home Assignment 02 Key

A mixture of solid $NaNO_3$ and solid KF, with a combined mass of 10.355 g, is added to water in a perfectly insulated calorimeter and allowed to dissolve. When dissolution is complete, the temperature of the solution has decreased by -0.05°C and the solution is found to weigh 100.902 g. The dissolution reactions and their enthalpy changes are

reaction	ΔH^o
$NaNO_3(s) \rightarrow NaNO_3(aq)$	+20.4 kJ/mol$_{rxn}$
$KF(s) \rightarrow KF(aq)$	–17.6 kJ/mol$_{rxn}$

Assuming that the specific heat of the solution is 4.184 J/g $\bullet$ °C, determine the grams of $NaNO_3$ and the grams of KF in the mixture, and report the %KF in the mixture. Place your work in the space below and turn in this take-home assignment one week from today. Your sample number is 56b.

Solution

First, we calculate $q_{solution}$, which is

$$100.902 \text{ g} \times 4.184 \text{ J/g°C} \times -0.05°C = -21.548 \text{ J}$$

Next, we note that

$$-q_{solution} = q_K + q_{Na}$$

$$-q_{solution} = \frac{\Delta H_K^o \times g_K}{FW_K} + \frac{\Delta H_{Na^o} \times g_{Na}}{FW_{Na}}$$

where K represents KF and where Na represents $NaNO_3$. Substituting in known values, and recognzing that g_N = total mass of mixture – g_K

$$21.548 \text{ J} = \frac{-17600 \text{ J/mol} \times g_K}{58.10 \text{g/mol}} + \frac{20400 \text{ J/mol} \times (10.355 \text{ g} - g_K)}{84.99 \text{g/mol}}$$

and solving gives 4.381 g of KF, 5.974 g of $NaNO_3$. The mass percent of KF in the sample is 42.31 %.