

Solution Stoichiometry Worksheet #2

1. Consider the reaction: $\text{Pb}(\text{NO}_3)_2(aq) + 2\text{KI}(aq) \rightarrow \text{PbI}_2(s) + 2\text{KNO}_3(aq)$. Suppose you mix 10.0 mL of 0.20 M $\text{Pb}(\text{NO}_3)_2$ and 20.0 mL of 0.20 M KI together. What is the concentration of KNO_3 produced? What are the concentrations of the reactants that remain after the reaction goes to completion?

30.0 mL = total volume

$$0.0100\text{L} \cdot \frac{0.20\text{ mol Pb}(\text{NO}_3)_2}{1\text{L Pb}(\text{NO}_3)_2} = \frac{2\text{ mol KNO}_3}{1\text{ mol Pb}(\text{NO}_3)_2} \cdot \frac{1}{0.0300\text{L}} = 0.27\text{M KNO}_3$$

$$0.0200\text{L} \cdot \frac{0.20\text{ mol KI}}{1\text{L KI}} = \frac{1\text{ mol PbI}_2}{2\text{ mol KI}} \cdot \frac{1}{0.0300\text{L}} = 0.20\text{M PbI}_2$$

Therefore, KI is limiting reactant while $\text{Pb}(\text{NO}_3)_2$ is excess reactant (LR)

Since KI is LR, 0.20 M KI remains

To calculate the concentration of excess reactant remaining, we need to calculate first how many moles of $\text{Pb}(\text{NO}_3)_2$ remain after rxn is complete. LR determines how many moles of $\text{Pb}(\text{NO}_3)_2$ are consumed.

$$0.0200\text{L} \cdot \frac{0.20\text{ mol KI}}{1\text{L KI}} = \frac{1\text{ mol Pb}(\text{NO}_3)_2}{2\text{ mol KI}} = 0.0020\text{ mol Pb}(\text{NO}_3)_2$$

How many moles of $\text{Pb}(\text{NO}_3)_2$ did we start with? $\frac{0.0100\text{L} \cdot 0.20\text{M Pb}(\text{NO}_3)_2}{1\text{L Pb}(\text{NO}_3)_2} = 0.0020\text{ mol Pb}(\text{NO}_3)_2$ consumed

$$0.0100\text{L} \cdot \text{Pb}(\text{NO}_3)_2 = \frac{0.20\text{ mol Pb}(\text{NO}_3)_2}{1\text{L Pb}(\text{NO}_3)_2} = 0.0020\text{ mol Pb}(\text{NO}_3)_2$$

Therefore,

$$[\text{Pb}(\text{NO}_3)_2] = \frac{(0.0050\text{ mol} - 0.0020\text{ mol consumed})}{0.0300\text{L (total volume)}} = 0.10\text{M Pb}(\text{NO}_3)_2 \text{ remains}$$