

Solution Stoichiometry Worksheet #2

1. Consider the reaction: $\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2 \text{KI} (\text{aq}) \rightarrow \text{PbI}_2 (\text{s}) + 2 \text{KNO}_3 (\text{aq})$. 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

$$0.0100 \text{ L} \times \frac{0.20 \text{ mol Pb}(\text{NO}_3)_2}{1 \text{ L Pb}(\text{NO}_3)_2} = \frac{2.0 \text{ mol KI}}{2 \text{ mol Pb}(\text{NO}_3)_2} \times \frac{1 \text{ mol}}{0.0300 \text{ L}} = 0.33 \text{ M KI}$$

$$0.0200 \text{ L} \times \frac{0.20 \text{ mol KI}}{1 \text{ L KI}} = \frac{2.0 \text{ mol KI}}{2 \text{ mol KI}} \times \frac{1 \text{ mol}}{0.0300 \text{ L}} = 0.33 \text{ M KI}$$

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

Since KI is LR, 0.33 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.

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

How many moles of $\text{Pb}(\text{NO}_3)_2$ did we start with?

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

Therefore,

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