Solution Stoichiometry Worksheet #2

1. Consider the reaction: $Pb(NO_3)_2$ (aq) + 2 KI (aq) → PbI_2 (s) + 2 KNO_3 (aq). Suppose you mix 10.0 mL of 0.50 M $Pb(NO_3)_2$ and 25.0 mL of 0.35 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?

35.0 mL = total volume

$$\frac{0.0100\,L}{Pb(NO_3)_2} \times \frac{0.50\,mol\,Pb(NO_3)_2}{1\,L\,Pb(NO_3)_2} \times \frac{2\,mol\,KNO_3}{1\,mol\,Pb(NO_3)_2} \times \frac{1}{0.0350\,L} = 0.29\,M\,KNO_3$$

$$\frac{0.02500\,L}{KI} \times \frac{0.35\,mol\,KI}{1\,L\,KI} \times \frac{2\,mol\,KNO_3}{2\,mol\,KI} \times \frac{1}{0.03500\,L} = \boxed{0.25\,M\,KNO_3}$$

Therefore, KI is limiting reactant (LR) while $Pb(NO_3)_2$ is excess reactant

Since KI is LR, no KI remains

To calculate the concentration of excess reactant remaining, we need to calculate first how many moles of $Pb(NO_3)_2$ remain after rxn is complete.

LR determines how many moles of $Pb(NO_3)_2$ are consumed.

$$\frac{0.02500\,L}{KI} \times \frac{0.35\,mol\,KI}{1\,L\,KI} \times \frac{1\,mol\,Pb(NO_3)_2}{2\,mol\,KI} = 4.4 \times 10^{-3}\,moles\ Pb(NO_3)_2\ consumed$$

How many moles of $Pb(NO_3)_2$ did we start with?

$$0.0100\,L\,Pb(NO_3)_2 \times \frac{0.50\,mol\,Pb(NO_3)_2}{1\,L\,Pb(NO_3)_2} = 0.0050\,moles\ Pb(NO_3)_2\ initially$$

Therefore,

$$[Pb(NO_3)_2] = \frac{(0.0050\,moles\,initial - 0.0044\,moles\,consumed)}{0.03500\,L\ (total\ volume)}$$

= 0.17M $Pb(NO_3)_2$ remains