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

$$0.01000\ L\ Pb(NO_3)_2 \times \frac{0.50\ mol\ Pb(NO_3)_2}{1\ L\ Pb(NO_3)_2} \times \frac{2\ mol\ KNO_3}{1\ mol\ Pb(NO_3)_2} \times \frac{1}{0.0350\ L} = 0.29\ M\ KNO_3$$

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

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.

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

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

$$0.01000\ L\ Pb(NO_3)_2 \times \frac{0.50\ mol\ Pb(NO_3)_2}{1\ L\ Pb(NO_3)_2} = 0.0050\ moles\ Pb(NO_3)_2\ initially$$

Therefore,

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

= 0.017 M $Pb(NO_3)_2$ remaining