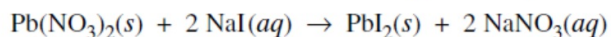


A 0.150 g sample of solid lead(II) nitrate is added to 125 mL of 0.100 M sodium iodide solution. Assume no change in volume of the solution. The chemical reaction that takes place is represented by the following equation.



- (a) List an appropriate observation that provides evidence of a chemical reaction between the two compounds.

A precipitate forms with an appearance that is different from that of the dissolving solid.

One point is earned for stating that a precipitate is formed.

- (b) Calculate the number of moles of each reactant.

$$\text{mol Pb}(\text{NO}_3)_2 = 0.150 \text{ g Pb}(\text{NO}_3)_2 \times \frac{1 \text{ mol Pb}(\text{NO}_3)_2}{331 \text{ g Pb}(\text{NO}_3)_2}$$

$$= 4.53 \times 10^{-4} \text{ mol}$$

$$\text{mol NaI} = 0.100 \text{ M} \times 0.125 \text{ L} = 1.25 \times 10^{-2} \text{ mol}$$

One point is earned for the correct number of moles of $\text{Pb}(\text{NO}_3)_2$.

One point is earned for the correct number of moles of NaI.

$$\text{Molarity} = \frac{\text{mol}}{\text{L}}$$

$$0.100 \text{ M} = \frac{\text{mol NaI}}{0.125 \text{ L}}$$

$$4153 \text{ g} = 4.153 \times 10^3 \text{ g}$$

$$\cancel{4200 \text{ g}}$$

$$4200 \text{ g}$$

$$4.2 \times 10^3 \text{ g}$$

$$\frac{\text{grams}}{\text{mol}}$$

$$\frac{\text{mol}}{\text{grams}}$$

$$\frac{\text{mol}}{\text{L}}$$

0.125 L	0.100 mol
	1 L

0.250 mol NaI	1 L
	0.100 mol

(c) Identify the limiting reactant. Show calculations to support your identification.

$$\begin{aligned}\text{mol NaI reacting} &= 4.53 \times 10^{-4} \text{ mol Pb(NO}_3)_2 \times \frac{2 \text{ mol NaI}}{1 \text{ mol Pb(NO}_3)_2} \\ &= 9.06 \times 10^{-4} \text{ mol required}\end{aligned}$$

There is 1.25×10^{-2} mol of NaI initially, thus $\text{Pb}(\text{NO}_3)_2$ is the limiting reactant.

One point is earned for the identification of $\text{Pb}(\text{NO}_3)_2$.

One point is earned for a justification in terms of the relative numbers of moles.

4.53×10^{-4} mol $\text{Pb}(\text{NO}_3)_2$	=	mol PbI_2
1.25×10^{-2} mol NaI	=	mol PbI_2

molarity

↑
Compare
↓

(d) Calculate the molar concentration of $\text{NO}_3^-(aq)$ in the mixture after the reaction is complete.

$$[\text{NO}_3^-]_f = \frac{2 \times (4.53 \times 10^{-4} \text{ mol})}{0.125 \text{ L}} = 7.25 \times 10^{-3} \text{ M}$$

One point is earned for the correct $\text{NO}_3^-/\text{Pb}^{2+}$ stoichiometry.

One point is earned for the correct molarity.

$$\frac{4.53 \times 10^{-4} \text{ mol Pb(NO}_3)_2}{1 \text{ mol Pb(NO}_3)_2} \times \frac{2 \text{ mol NO}_3^-}{1 \text{ mol Pb(NO}_3)_2} = 9.06 \times 10^{-4} \text{ mol NO}_3^-$$
$$[\text{NO}_3^-] = \frac{\text{mol NO}_3^-}{\text{L soln.}} = \frac{9.06 \times 10^{-4} \text{ mol NO}_3^-}{0.125 \text{ L}}$$
$$= 7.25 \times 10^{-3} \text{ M NO}_3^-$$

- (e) Circle the diagram below that best represents the results after the mixture reacts as completely as possible. Explain the reasoning used in making your choice.

