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.

$$Pb(NO_3)_2(s) + 2\,NaI(aq) \rightarrow PbI_2(s) + 2\,NaNO_3(aq)$$

(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.

mol $Pb(NO_3)_2$ = 0.150 g $Pb(NO_3)_2$ × $\frac{1 \text{ mol } Pb(NO_3)_2}{331 \text{ g } Pb(NO_3)_2}$ = 4.53×10^{-4} mol mol NaI = 0.100 *M* × 0.125 L = 1.25×10^{-2} mol	One point is earned for the correct number of moles of $Pb(NO_3)_2$. One point is earned for the correct number of moles of NaI.

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

0.100M = $\frac{mol\ NaI}{.125L}$

4153 g = 4.153×10^3 g

~~42g~~

4.2×10^3 g

4200 g

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

$\frac{mol}{L}$

.125 L | .100 mol / 1 L

.250 mol NaI | 1 L / .100 mol

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

mol NaI reacting $= 4.53 \times 10^{-4}$ mol $Pb(NO_3)_2 \times \frac{2 \text{ mol NaI}}{1 \text{ mol } Pb(NO_3)_2}$ $= 9.06 \times 10^{-4}$ mol required There is 1.25×10^{-2} mol of NaI initially, thus $Pb(NO_3)_2$ is the limiting reactant.	One point is earned for the identification of $Pb(NO_3)_2$. One point is earned for a justification in terms of the relative numbers of moles.

$$\frac{4.53\times10^{-4} \text{ mol } Pb(NO_3)_2}{\quad} = \text{mol } PbI_2$$

↕ compare

$$\frac{1.25\times10^{-2} \text{ mol NaI}}{\quad} = \text{mol } PbI_2$$

molarity

(d) Calculate the molar concentration of $NO_3^-(aq)$ in the mixture after the reaction is complete.

$[NO_3^-]_f = \frac{2 \times (4.53 \times 10^{-4} \text{ mol})}{0.125 \text{ L}} = 7.25 \times 10^{-3}\ M$	One point is earned for the correct NO_3^-/Pb^{2+} stoichiometry. One point is earned for the correct molarity.

$$\frac{4.53\times10^{-4} \text{ mol } Pb(NO_3)_2 \;\big|\; 2 \text{ mol } NO_3^-}{\;\big|\; 1 \text{ mol } Pb(NO_3)_2} = 9.06\times10^{-4} \text{ mol } NO_3^-$$

$$[NO_3^-] = \frac{\text{mol } NO_3^-}{\text{L soln.}} = \frac{9.06\times10^{-4} \text{ mol } NO_3^-}{.125 \text{ L}}$$

$$= 7.25\times10^{-3}\ M\ NO_3^-$$

(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.