AP exam question - Metathesis NAME_____

This question was taken from the free response section of a previous AP exam. If the question requires problem solving, please show your work and express your answer with the correct number of significant figures. If the question requires you to explain something, please do so in clear concise sentences using appropriate chemical principles.

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.

A) Write the balanced molecular equation of the chemical reaction that takes place

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

B) Write the net ionic equation of the reaction.

$Pb(NO_3)_2(s) + 2I^-(aq) \rightarrow PbI_2(s) + 2NO_3^-(aq)$

C) List an appropriate observation that provides evidence of a chemical reaction between the 2 compounds. Precipitate forms (PbI_2)

D) Calculate the number of moles of each reactant.

$$0.150\ g\ Pb(NO_3)_2 \left| \frac{1\ mol\ Pb(NO_3)_2}{331.22\ g\ Pb(NO_3)_2} \right| = 4.53 \times 10^{-4}\ mol\ Pb(NO_3)_2$$

$$0.125\ L\ NaI \left| \frac{0.100\ mol\ NaI}{1\ L\ NaI} \right| = 0.0125\ mol\ NaI$$

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

$$4.53 \times 10^{-4}\ mol\ Pb(NO_3)_2 \left| \frac{1\ mol\ PbI_2}{1\ mol\ Pb(NO_3)_2} \right| = 4.53 \times 10^{-4}\ mol\ PbI_2$$

$$0.0125\ mol\ NaI \left| \frac{1\ mol\ PbI_2}{2\ mol\ NaI} \right| = 0.00625\ mol\ PbI_2$$

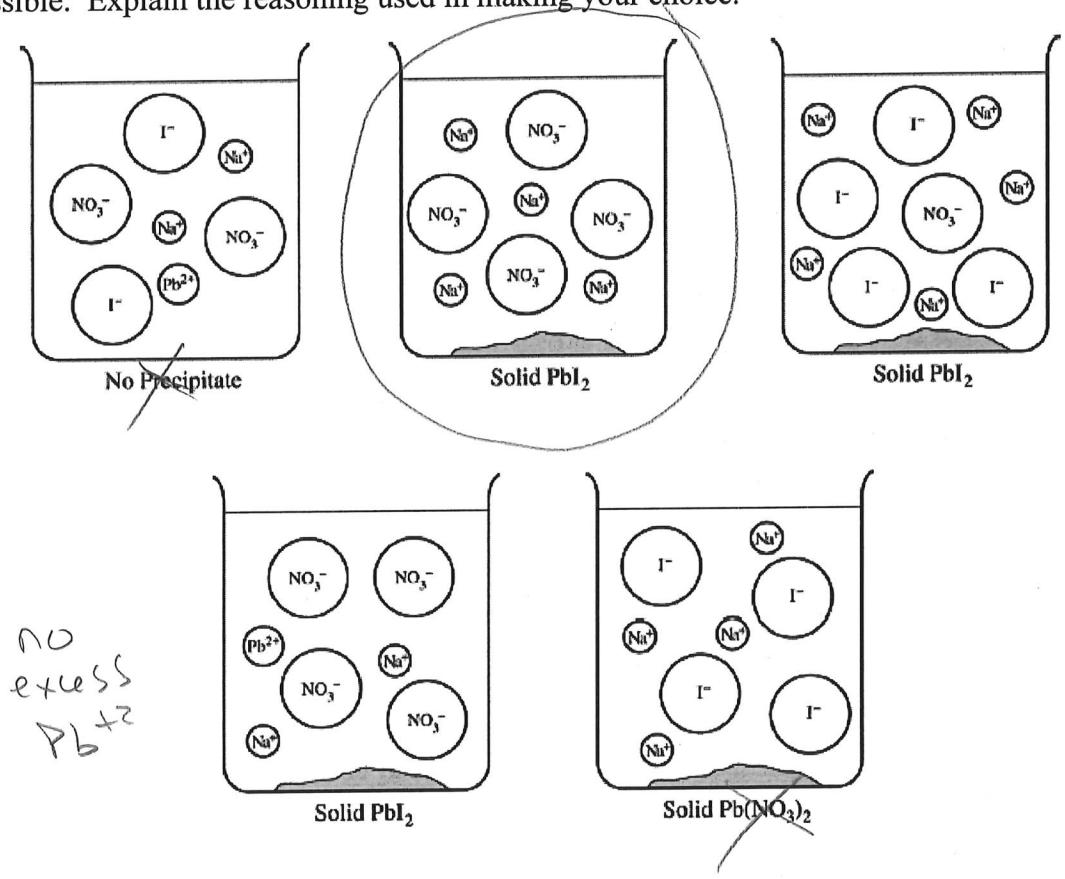
$Pb(NO_3)_2$ = Limiting Reactant

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

$$4.53 \times 10^{-4}\ mol\ Pb(NO_3)_2 \left| \frac{2\ mol\ NO_3^-}{1\ mol\ Pb(NO_3)_2} \right| = 9.06 \times 10^{-4}\ mol\ NO_3^-$$

$$\frac{9.06 \times 10^{-4}\ mol\ NO_3^-}{0.125\ L\ solution} = 0.00725\ M\ NO_3^-$$

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



no excess I^-

no excess Pb^{+2}

1:1 ratio of Na^+ and NO_3^- w/ solid PbI_2 precipitate