Determine the limiting reagent in a reaction where 12 grams of $Ca(OH)_2$is mixed with 28 grams of Na_3PO_4. Please be sure to balance the equation.

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Solution: Step 1. Balance the chemical equation.

$$3\,Ca(OH)_2(aq) + 2\,Na_3PO_4(aq) \rightarrow Ca_3(PO_4)_2 + 6\,NaOH$$

Step 2. calculate the number of moles of each reactant:

$$n_{Ca(OH)_2} = \frac{m\ of Ca(OH)_2}{M_m of Ca(OH)_2} = \frac{12\ gm}{\left(74\ \frac{gm}{mol}\right)} = 0.162\ moles$$

$$n_{Na_3PO_4} = \frac{m\ of Na_3PO_4}{M_m of Na_3PO_4} = \frac{28\ gm}{\left(164\ \frac{gm}{mol}\right)} = 0.164\ moles$$

Determine the limiting reagent.

Step 3. Compare to the stoichiometric value. One way to do this is to ask whether the actual ratio of $Ca(OH)_2$:Na_3PO_4 is greater than the stoichiometric ratio of 3:2. If it is greater than this means that there is excess $Ca(OH)_2$ and Na_3PO_4 is limiting. The ratio is:

$$Actual\ Ratio = \frac{n_{Ca(OH)_2}}{n_{Na_3PO_4}} = \frac{0.162}{0.164} = 0.99$$

Since this actual ratio is less than the stoichiometric ratio we conclude that $Ca(OH)_2$ is limiting.