## Balancing Chemical Equations

## Balance the chemical reaction:

$ـ_{ـ}\left(\mathrm{NH}_{4}\right)_{3} \mathrm{PO}_{4}+\ldots \mathrm{Pb}\left(\mathrm{NO}_{3}\right)_{4} \rightarrow$ _ $\mathrm{Pb}_{3}\left(\mathrm{PO}_{4}\right)_{4}+\ldots \mathrm{NH}_{4} \mathrm{NO}_{3}$

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Step 1. Write out coefficients

$$
\mathrm{a}\left(\mathrm{NH}_{4}\right)_{3} \mathrm{PO}_{4}+\mathrm{b} \mathrm{~Pb}\left(\mathrm{NO}_{3}\right)_{4} \rightarrow x \mathrm{~Pb}_{3}\left(\mathrm{PO}_{4}\right)_{4}+y \mathrm{NH}_{4} \mathrm{NO}_{3}
$$

Step 2. Construct the atom equations:
$\mathrm{N}: 3 \mathrm{a}+4 \mathrm{~b}=2 \mathrm{y}$
$H: 12 a=4 y$
P: $a=4 x$
$\mathrm{Pb}: \mathrm{b}=3 \mathrm{x}$
$0: 4 a+12 b=16 x+3 y$

## Balancing Chemical Equations

Step 3. Set an initial condition and calculate coefficients:
$\mathrm{N}: 3 \mathrm{a}+4 \mathrm{~b}=2 \mathrm{y}$
H: $12 \mathrm{a}=4 \mathrm{y}$
P: $\mathrm{a}=4 \mathrm{x} \quad$ First set $\mathrm{a}=4$ then $\mathrm{x}=1$
$\mathrm{Pb}: \mathrm{b}=3 \mathrm{x}$
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Check $4(4)+12(3)=16(1)+3(12)$ ? Yes!

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Write the balanced equation:
$4\left(\mathrm{NH}_{4}\right)_{3} \mathrm{PO}_{4}+3 \mathrm{~Pb}\left(\mathrm{NO}_{3}\right)_{4} \rightarrow \mathrm{~Pb}_{3}\left(\mathrm{PO}_{4}\right)_{4}+12 \mathrm{NH}_{4} \mathrm{NO}_{3}$

