FOUR STEPS TO SOLVE STOICHIOMETRIC PROBLEMS

1. Balance the equation
2. Convert units of given substance to moles
3. Find moles of wanted substance using mole ratio
4. Convert moles of wanted substance to desired units

EXAMPLE: Hydrogen gas combines with oxygen gas to form water. \( \text{H}_2 (g) + \text{O}_2 (g) \rightarrow \text{H}_2\text{O} \). How many grams of water can be prepared from 10.1 grams of hydrogen gas?

STEP 1: Balance the Equation

\[ 2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O} \]

In English, this means: Two moles of hydrogen gas combine with one mole of oxygen gas to yield two moles of water.

STEP 2: Convert units of given substance to moles.

What is given: grams of \( \text{H}_2 \). You need to multiply this by the molar mass of \( \text{H}_2 \) to convert it to moles. It is very important that you include your units \{ex) grams \( \text{H}_2 \) or moles \( \text{H}_2 \} \)

\[
10.1 \text{ grams } \text{H}_2 \times \frac{1 \text{ mol } \text{H}_2}{2.02 \text{ grams } \text{H}_2} = 5 \text{ mol } \text{H}_2
\]

The grams \( \text{H}_2 \) cancel out.

STEP 3: Find moles of wanted substance using mole ratio

The mole ratio is the ratio of moles of the wanted substance to moles of the given substance. In this case, according to the balanced equation, there are 2 moles of \( \text{H}_2\text{O} \) produced for 2 moles of \( \text{H}_2 \) gas.

\[
5 \text{ mol } \text{H}_2 \times \frac{2 \text{ mol } \text{H}_2\text{O}}{2 \text{ mol } \text{H}_2} = 5 \text{ mol } \text{H}_2\text{O}
\]

The moles of \( \text{H}_2 \) cancel out.

STEP 4: Convert moles of wanted substance to desired units.

The desired units are grams of \( \text{H}_2\text{O} \). We have moles of \( \text{H}_2\text{O} \), so we need to multiply by the molar mass of water.

\[
5 \text{ mol } \text{H}_2\text{O} \times \frac{18.02 \text{ grams } \text{H}_2\text{O}}{1 \text{ mol } \text{H}_2\text{O}} = 90.1 \text{ grams of } \text{H}_2\text{O}
\]

The moles of \( \text{H}_2\text{O} \) cancel out.