STOICHIOMETRY - the study of the quantitative aspects of chemical reactions.

STOICHIOMETRY

It rests on the principle of the conservation of matter.

2 Al(s) + 3 Br₂(liq) ----> Al₂Br₆(s)

PROBLEM: If 454 g of NH₄NO₃ decomposes, how much N₂O and H₂O are formed? What is the theoretical yield of products?

STEP 1 Write the balanced chemical equation
NH₄NO₃ ----> N₂O + 2 H₂O

STEP 2 Convert mass reactant (454 g) --> moles
454 g • 1 mol
80.04 g = 5.68 mol NH₄NO₃

STEP 3 Convert moles reactant (5.68 mol) --> moles product
Relate moles NH₄NO₃ to moles product expected.
1 mol NH₄NO₃ --> 2 mol H₂O
Express this relation as the STOICHIOMETRIC FACTOR.
2 mol H₂O produced
1 mol NH₄NO₃ used

STEP 3 Convert moles reactant (5.68 mol) --> moles product
5.68 mol NH₄NO₃ • 2 mol H₂O produced
1 mol NH₄NO₃ used
= 11.4 mol H₂O produced
454 g of NH₄NO₃ → N₂O + 2 H₂O

**STEP 4** Convert moles product (11.4 mol) → mass product
--- called the **THEORETICAL YIELD**

\[
11.4 \text{ mol H}_2\text{O} \times \frac{18.02 \text{ g}}{1 \text{ mol}} = 204 \text{ g H}_2\text{O}
\]

**ALWAYS FOLLOW THESE STEPS IN SOLVING STOICHIOMETRY PROBLEMS!**

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**GENERAL PLAN FOR STOICHIOMETRY CALCULATIONS**

![Diagram showing the general plan for stoichiometry calculations](image1)

**454 g of NH₄NO₃ → N₂O + 2 H₂O**

**STEP 5** How much N₂O is formed?
Total mass of reactants = total mass of products
454 g NH₄NO₃ = ___ g N₂O + 204 g H₂O
mass of N₂O = 250. g

**STEP 6** Calculate the percent yield
If you isolated only 131 g of N₂O, what is the percent yield?
This compares the theoretical (250. g) and actual (131 g) yields.

% yield = \( \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\% \)

% yield = \( \frac{131 \text{ g}}{250. \text{ g}} \times 100\% = 52.4\% \)

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**PROBLEM:** Using 5.00 g of H₂O₂, what mass of O₂ and of H₂O can be obtained?

2 H₂O₂(liq) → 2 H₂O(g) + O₂(g)
Reaction is catalyzed by MnO₂

Step 1: moles of H₂O₂
Step 2: use STOICHIOMETRIC FACTOR to calculate moles of O₂
Step 3: mass of O₂