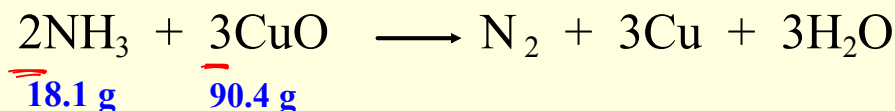


## Limiting Reagent

In a chemical reaction, the reactant that will "run out" first is called the **limiting reagent**.

The other reactant is called the **excess reagent**.



IF NH<sub>3</sub> is L.R.:

$$18.1 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \times \frac{1 \text{ mol N}_2}{2 \text{ mol NH}_3} \times \frac{28.02 \text{ g N}_2}{1 \text{ mol N}_2} = 14.88 \text{ g N}_2$$

IF CuO is L.R.:

$$90.4 \text{ g CuO} \times \frac{1 \text{ mol CuO}}{79.54 \text{ g CuO}} \times \frac{1 \text{ mol N}_2}{3 \text{ mol CuO}} \times \frac{28.02 \text{ g N}_2}{1 \text{ mol N}_2} = 10.62 \text{ g N}_2$$

CuO is L.R.

How much NH<sub>3</sub> remains? XS

$$18.1 \text{ g start} - \boxed{12.91 \text{ g used}} = \boxed{5.19 \text{ g remaining}}$$

$$90.4 \text{ g CuO} \times \frac{1 \text{ mol CuO}}{79.54 \text{ g CuO}} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol CuO}} \times \frac{17.04 \text{ g NH}_3}{1 \text{ mol NH}_3} =$$

12.91 g NH<sub>3</sub>  
used

Step 1: Moles Known

$$90.4 \text{ g CuO} \times \frac{1 \text{ mol CuO}}{79.54 \text{ g CuO}} = \underline{\hspace{2cm}}$$

Step 2: Moles Unknown

$$\underline{\hspace{2cm}} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol CuO}} = \underline{\hspace{2cm}}$$

Step 3: Mass Unknown

$$\underline{\hspace{2cm}} \times \frac{17.04 \text{ g NH}_3}{1 \text{ mol NH}_3} = \underline{\hspace{2cm}}$$

# Percent Reaction

Percent Reaction (percent yield) - is the amount of product measured at equilibrium compared with the maximum possible amount of product.

Equilibrium position

relative concentration of reactants and products at equilibrium

⇒ 0 % indicates no product formed

⇒ 100 % indicates the maximum possible product formed

- maximum amount of possible product is found using stoichiometry, assuming a forward reaction with no reverse reaction.

$$\% \text{ reaction} = \frac{\text{Experimental yield}}{\text{Theoretical yield (maximum)}} \times 100 \%$$

*eqm.*

*not @ eqm.*

## Classifying Chemical Equilibria

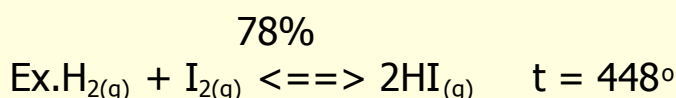
< 50 % - reactants favored

> 50 % - products favored

> 99 % - quantitative



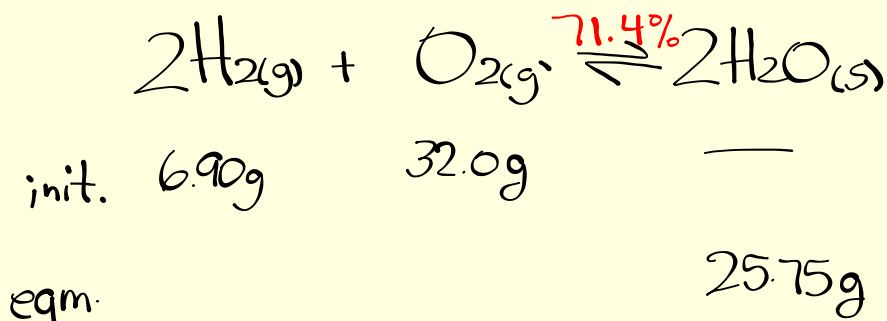
The equilibrium position of the reaction is indicated in the following manner :



Indicates that 78 % of the total amount of HI possible is produced at 448°C. Therefore this is a **product** favored reaction.

**SAMPLE PROBLEM : % REACTION**

Find the % reaction and write the expression if 6.90 g of  $\text{H}_{2(g)}$  and 32.0 g of  $\text{O}_{2(g)}$  react to form 25.75 g of ice at  $-70\text{ }^{\circ}\text{C}$ .



$$\% \text{rxn} = \frac{\text{exp.}}{\text{theor.}} \times 100\%$$

$$\% \text{rxn} = \frac{25.75\text{g}}{36.04\text{g}} \times 100\%$$

$$\% \text{rxn} = 71.4\%$$

Find max. product

IF  $\text{H}_2$  is L.R.:

$$6.90\text{g H}_2 \times \frac{1\text{mol H}_2}{2.02\text{g H}_2} \times \frac{2\text{mol H}_2\text{O}}{2\text{mol H}_2} \times \frac{18.02\text{g H}_2\text{O}}{1\text{mol H}_2\text{O}} = 61.55\text{g H}_2\text{O}$$

IF  $\text{O}_2$  is L.R.:

$$32.0\text{g O}_2 \times \frac{1\text{mol O}_2}{32.00\text{g O}_2} \times \frac{2\text{mol H}_2\text{O}}{1\text{mol O}_2} \times \frac{18.02\text{g H}_2\text{O}}{1\text{mol H}_2\text{O}} = 36.04\text{g H}_2\text{O}$$

$\text{O}_2$  is L.R.

Find the % reaction and write the expression if 10.0 g of  $\text{H}_{2(g)}$  and 94.0 g of  $\text{Cl}_{2(g)}$  react to form 15.4 g of hydrochloric acid.