

## 11.3 Notes - Limiting Reagents

- One substance in a chemical reaction is called a limiting reagent - which is a reactant that the reaction depends upon to occur.

- when the limiting reagent is used up - the reaction stops and no more of the other reactant(s) will be used - and no more product made.

- reaction depends on the reactant that is limited in amount.

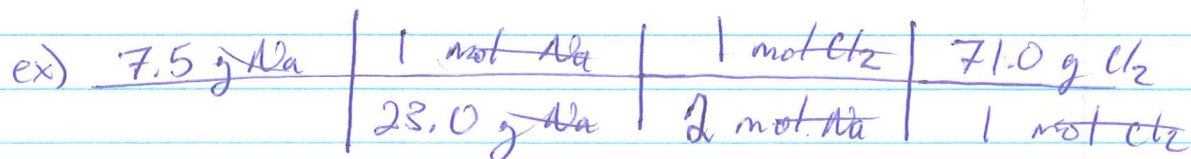
\* Left-over reactant(s) are called excess reactant(s)

The easiest way to determine which reactant is the limiting reagent is to use mass.



If we start w/ 7.5g Na & 3.2g Cl<sub>2</sub>, then we can use stoich to compare what we need vs what we have.

\* Choose 1 mass & then do a mass-to-mass stoich.



$$= \boxed{11.6 \text{ g Cl}_2 \text{ needed}}$$

We started w/ 3.2 g Cl<sub>2</sub>, but need 11.6 g Cl<sub>2</sub> to react fully w/ 7.5 g Na

$$\text{so } 3.2 < 11.6$$

have < need, so  $\boxed{\text{Cl}_2 = \text{Limiting Reagent}}$

\* Another example of determining Limiting Reagent



Given: 12.3 g H<sub>2</sub> & 440.0 g Cl<sub>2</sub>    L.R. = ?    E.R. = ?

\* Choose one & do mass to mass stoich.

	molar mass	mole ratio	molar mass	
<u>12.3 g H<sub>2</sub></u>	$1 \text{ mol H}_2$	$1 \text{ mol Cl}_2$	<u>71.0 g Cl<sub>2</sub></u>	= <u>436.7 g Cl<sub>2</sub></u>
	$2.02 \text{ g H}_2$	$1 \text{ mol H}_2$	$1 \text{ mol Cl}_2$	

$$\begin{array}{l} \text{have} \\ 440.0 \text{ g Cl}_2 \end{array} > \begin{array}{l} \text{need} \\ 436.7 \text{ g Cl}_2 \end{array}$$

\* So, since we have more than we need, we have extra Cl<sub>2</sub> (Excess Reactant - E.R.) & H<sub>2</sub> must be the Limiting Reagent

Try this one:  $\text{Zn} + \text{MnO}_2 + \text{H}_2\text{O} \rightarrow \text{Zn(OH)}_2 + \text{Mn}_2\text{O}_3$

Given: 25.0 g Zn & 30.0 g MnO<sub>2</sub>, who's the L.R.? E.R.?

	molar mass	mole ratio	molar mass	
<u>g</u>	$\frac{\text{mol}}{\text{g}}$	$\frac{\text{mol}}{\text{mol}}$	$\frac{\text{g}}{\text{mol}}$	=
				<u>g</u>

Have:

g

Need:

g

L.R. =           

E.R. =



③

\*To determine how much extra excess reactant you have, just subtract what you need from what you are given.

$$\boxed{\text{Excess} = \text{Mass Given} - \text{Mass Needed}}$$

ex) we calculated for  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$  that we needed 436.7 g  $\text{Cl}_2$ , but were given 440.0 g  $\text{Cl}_2$

$$\text{so, excess } \text{Cl}_2 = 440.0 \text{ g} - 436.7 \text{ g} = \text{3.3 g } \text{Cl}_2$$

Another example;  $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$

we know Na = E.R., & we were given 7.5 g Na & 3.2 g  $\text{Cl}_2$

So to find how much Na needed, start w/ given  $\text{Cl}_2$

3.2 g $\text{Cl}_2$	molar mass	mole ratio	
	1 mol $\text{Cl}_2$	2 mol Na	23.0 g Na
	<del>71.0 g</del>	1 mol $\text{Cl}_2$	<del>1 mol Na</del>

$$= \text{2.1 g Na needed}$$

so, excess Na = given - needed

$$7.5 \text{ g Na} - 2.1 \text{ g Na} = \text{5.4 g Na excess}$$