WKS 3-5 – Limiting & Excess Reagents; Reaction Yields **Name:**______________________

3.79 Define limiting reagent and excess reagent.
Limiting reagent is the reactant that is depleted; excess reagent is a reagent that is not depleted.

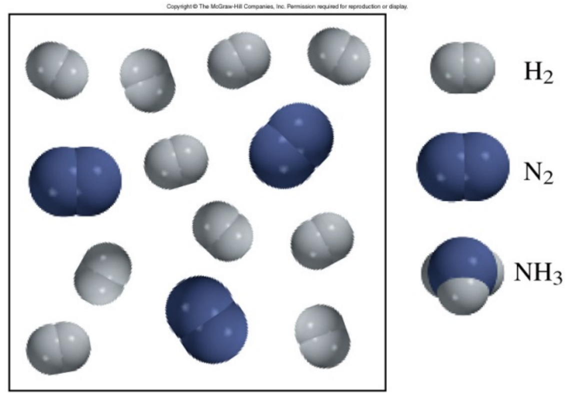
What is the significance of the limiting reagent in predicting the amount of the product obtained in a reaction? In a reaction, since the reaction stops when one reactant is depleted, the amount of limiting reagent determines the amount of each product possible.

Can there be a limiting reagent if only one reactant is present? If there is only one reactant, then technically it must be the limiting reagent since it will be depleted.

3.82 $N_2 + 3H_2 \rightarrow 2NH_3$ From diagram, one sees that there are 3 moles of N_2 and 10 moles of H_2

Fill in the "ICF" table to help answer all questions:

	N_2	+	$3\ H_2$	→	$2\ NH_3$
Initial	**3 mc**		**10 mc**		**0 mc**
Change	−3 mc		−9 mc		+6 mc
Final	0 mc		1 mc		6 mc



What is the limiting reagent? Explain. There are 3 molecules of N_2 in the diagram. We need 9 molecules of H_2 to react completely with 3 molecules of N_2. Since there are 10 molecules of H_2, H_2 is in excess.

Number of moles of product produced: When 3 molecules of N_2 react, 6 molecules of NH_3 will be produced.

Number of moles of excess reagent left: 9 molecules of H_2 will react with 3 molecules of N_2, leaving 1 molecule of H_2 in excess.

3.83 Nitric oxide reacts with oxygen gas to form nitrogen dioxide, a dark-brown gas:

$$2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$$

In one experiment 0.886 mole of NO is mixed with 0.503 mole of O_2. Calculate which of the two reactants is the limiting reagent. Calculate also the number of moles of NO_2 produced.

$$\frac{0.886 \text{ mol NO}}{2} = 0.443 \text{ mol Rxn}; \quad \frac{0.503 \text{ mol } O_2}{1} = 0.503 \text{ mol Rxn};$$ **NO** is the **limiting reagent**

$$\text{mol } NO_2 = 0.443 \text{ mol Rxn} \times \frac{2 \text{ mol } NO_2}{1 \text{ mol Rxn}} = \boxed{\mathbf{0.886\ mol\ NO_2}}$$

Here is an ICF table, to see the information in an organized fashion:

	2 NO	+	**O_2**	→	**2 NO_2**
Initial	**0.886 mol**		**0.503 mol**		**0 mol**
Change	−0.886 mol		−0.443 mol		+0.886 mol
Final	0 mol		0.060 mol		0.886 mol

3.88 Why is the actual yield of a reaction almost always smaller than the theoretical yield?
The actual yield of a reaction is usually less than the theoretical yield because not all reactants form products (reversible reactions or side products), and not all product may be recovered.