Practice Problem #1:

Copper reacts with sulfur to form copper(I) sulfide according to the following balanced equation:

80g 25g

$2\ Cu(s) + S(s) \rightarrow Cu_2S(s)$ BALANCED!

a. What is the limiting reagent when 80.0 g Cu reacts with 25.0 g S?

L.R. STEP: $80\text{g Cu} \left| \frac{1\text{ mol Cu}}{63.55\text{g}} \right| \frac{1\text{ mol S}}{2\text{ mol Cu}} \left| \frac{32.06\text{g}}{1\text{ mol S}} \right. =$

$= 20.2\text{g S}$

If you react all 80 grams of copper, you would need (use) 20.2 grams of sulfur. Copper is the limiting reactant. You will use all the copper and have extra (excess) sulfur.

b. What is the maximum number of grams of Cu_2S that can be formed when 80.0 g Cu reacts with 25.0 g S?

$80\text{g Cu} \left| \frac{1\text{ mol Cu}}{63.55\text{g}} \right| \frac{1\text{ mol } Cu_2S}{2\text{ mol Cu}} \left| \frac{159.16\text{g}}{1\text{ mol } Cu_2S} \right. = 100.\text{g } Cu_2S$

Practice Problem #2:

Rust forms when iron, oxygen, water, and carbon dioxide react. One chemical equation for the formation of rust is:

7.00g EXCESS 9.00g EXCESS

$$\underline{4}\ Fe + \underline{3}\ O_2 + \underline{2}\ H_2O + \underline{2}\ CO_2 \rightarrow \underline{2}\ Fe_2O_3 + \underline{2}\ H_2CO_3$$

If 7.00 g of iron and 9.00 g of water are available to react, which is the limiting reagent? Also, oxygen gas and carbon dioxide gas are NOT the limiting reactant. Hint, if a question does not mention an amount for one (or more) of the reactants, assume that the reactant(s) is in EXCESS!

L.R. STEP:

$$7.00\,g\ Fe \left/ \frac{1\ mol\ Fe}{55.85\,g} \right/ \frac{2\ mol\ H_2O}{4\ mol\ Fe} \left/ \frac{18.016\,g}{1\ mol\ H_2O} \right. = 1.13\,g\ H_2O$$

If you used all 7.00 grams of iron, you would only need (use) 1.13 grams of water. The limiting reactant is the iron. You will use all the iron and have "left over" (excess) water.

Practice Problem #3:

In a single replacement reaction, calcium metal replaces gold in a gold(III) nitrate solution. Calculate the mass (in mg) of gold metal produced in this reaction when 410. mL of a 0.650 *M* solution of gold(III) nitrate is reacted with 22.7 grams of calcium metal.

22.7 g 410 mL, 0.650 M ? mg

$$3\,Ca + 2\,Au(NO_3)_3 \rightarrow 3\,Ca(NO_3)_2 + 2\,Au$$

$$410\,mL \left| \frac{1\,L}{10^3\,mL} \right| \frac{0.650\,mol\ Au(NO_3)_3}{L} \left| \frac{3\,mol\ Ca}{2\,mol\ Au(NO_3)_3} \right| \frac{40.08\,g}{1\,mol\ Ca}$$

$$= 16.022\,g\ Ca$$

If you reacted all 410 mL of the 0.650 M solution of $Au(NO_3)_3$ you would only use 16.022 grams of the calcium metal. You will have excess (extra) calcium metal. The limiting reactant is $Au(NO_3)_3$.

$$410\,mL \left| \frac{1\,L}{1000\,mL} \right| \frac{0.650\,mol\ Au(NO_3)_3}{L} \left| \frac{2\,mol\ Au}{2\,mol\ Au(NO_3)_3} \right| \frac{196.97\,g}{1\,mol\ Au} \left| \frac{10^3\,g}{1\,g} \right|$$

$$= 52492.5\,mg = 5.25 \times 10^4\,mg$$