NAME: HONORS CHEMISTRY

SECTION: Real-life Stoichiometry: Limiting Reagent Problems

When the quantities of two (or more) reactants are given in a problem, you must first determine which reactant is the "limiting reagent," or the one which will run out first, causing the reaction to stop. You can then calculate subsequent quantities using the limiting reagent to do the calculation.

There are a number of strategies you can use to solve limiting reagent problems. Here's one way:

1. Calculate the amount of product that would be formed if the first reactant were completely consumed.
2. Repeat this calculation for the second reaction; i.e., calculate how much product would be formed if all that reactant were consumed.
3. Choose the smaller of the two amounts calculated in 1 and 2. This is the theoretical yield of product; the reactant that produces the smaller amount is the limiting reagent. The other reactant is in excess.
    - Any subsequent calculations must be based on the LR

Example:
How many grams of ammonia can be formed when 20.0 g of nitrogen gas react with 10.0 g of hydrogen gas according to the equation:

$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

1. When copper metal comes in contact with silver nitrate solution, silver metal comes out of solution and copper (II) nitrate is formed. If 100.0 grams of copper metal are reacted with 100.0 g of silver nitrate, how many grams of silver metal will be produced? Be sure to start with a balanced equation.

2. Nitrogen gas can be prepared by passing gaseous ammonia over solid copper (II) oxide at high temperatures. The other products of the reaction are solid copper and water vapor. How many grams of N_2 are formed when 18.1 g of NH_3 are reacted with 90.4 g of CuO?

3. An experiment that led to the formation of the field of organic chemistry involved the synthesis of urea, CN_2H_4O, by the controlled reaction of ammonia and carbon dioxide:

   $2\ NH_3\ (g) + CO_2(g) \rightarrow CN_2H_4O(s) + H_2O(l)$

   What is the theoretical yield of urea when 100. g of ammonia is reacted with 100. g of carbon dioxide?

4. Elemental bromine, $Br_2(\ell)$, can be produced by treating a concentrated aqueous sodium bromide solution with gaseous elemental chlorine. If 10.0 g of chlorine gas is reacted with a solution containing 25.00 g of sodium bromide, calculate the mass of bromine produced. (Be sure to start with a balanced equation!)

Answers

1. *63.50 g Ag*
2. *10.6 g N_2*
3. *136 g urea*
4. *19.4 g Br_2*