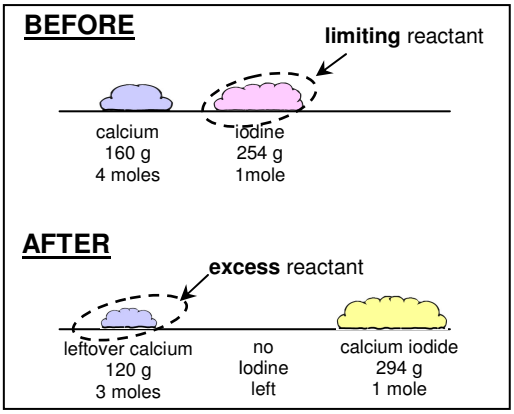
Limiting Reactants
Chem Worksheet 12-3

Name _____

When an automobile production plant runs out of tires no more cars can be produced even if there are still plenty of engines, bodies, seats, and other parts. When one of the reactants in a chemical reaction runs out the reaction stops as well. The substance that limits production in a chemical reaction is known as the **limiting reactant**. The reactant that is left over when the reaction stops is called the **excess reactant**.

$$1\ Ca + 1\ I_2 \rightarrow 1\ CaI_2$$

Consider the chemical reaction between calcium and iodine. When 160 g (4 moles) of calcium reacts with 254 g (1 mole) of iodine the reaction makes 294 g (1 mole) of calcium iodide. Although there is enough calcium to make more calcium iodide, the iodine runs out first. Since all of the iodine gets used up it is called the limiting reactant. According to the balanced equation, if one mole of iodine reacts, one mole of calcium will react. This means that there are still 3 moles of calcium left. Because calcium is left over it is called the excess reactant.



Example

What mass of iron (II) sulfide will be produced if 9.68 g of iron reacts with 6.28 g of sulfur? $\_\_Fe + \_\_S \rightarrow \_\_FeS$

- balance the equation: $1\ Fe + 1\ S \rightarrow 1\ FeS$

- perform a calculation for each reactant:

$$F: \frac{9.68\ g\ Fe}{1} \times \frac{1\ mol\ Fe}{55.85\ g\ Fe} \times \frac{1\ mol\ FeS}{1\ mol\ Fe} \times \frac{87.91\ g\ FeS}{1\ mol\ FeS} = 15.24\ g\ FeS$$

$$S: \frac{6.28\ g\ S}{1} \times \frac{1\ mol\ S}{32.06\ g\ S} \times \frac{1\ mol\ FeS}{1\ mol\ S} \times \frac{87.91\ g\ FeS}{1\ mol\ FeS} = 17.22\ g\ FeS$$

- whichever reactant makes less product is the limiting reactant: Iron is the limiting reactant. There is enough sulfur to make 17.22 g FeS, but only enough iron to make 15.24 g of FeS.

Find the amount of product formed in each of the following reactions.

1. What mass of H_2O will be produced if 9.5 g of H_2 reacts with 1.2 g of O_2?
   $\_\_ H_2 + \_\_ O_2 \rightarrow \_\_ H_2O$

2. If 1.85 g of $Mg(OH)_2$ reacts with 3.71 g of HCl, how much $MgCl_2$ is produced? What is the limiting reactant?
   $\_\_ Mg(OH)_2 + \_\_ HCl \rightarrow \_\_ MgCl_2 + \_\_ H_2O$

3. What mass of AgCl is produced when 53.42 g of $AgNO_3$ reacts with 14.19 g of NaCl?
   $\_\_ AgNO_3 + \_\_ NaCl \rightarrow \_\_ AgCl + \_\_ NaNO_3$

4. If 14.7 g of calcium is placed in 11.5 g of water, what mass of hydrogen gas is produced?
   $\_\_ Ca + \_\_ H_2O \rightarrow \_\_ Ca(OH)_2 + \_\_ H_2$

5. What mass of potassium hydroxide is formed when 8.2 g of potassium oxide is added to 1.3 g of water?
   $\_\_ K_2O + \_\_ H_2O \rightarrow \_\_ KOH$

6. What mass of aluminum chloride could be made from 8.1 g of aluminum and 4.2 L of chlorine at STP?
   $\_\_ Al + \_\_ Cl_2 \rightarrow \_\_ AlCl_3$

7. If 5.26 L of nitrogen monoxide and 7.64 L of oxygen are combined, what mass of nitrogen dioxide is formed? Assume conditions are STP.
   $\_\_ NO + \_\_ O_2 \rightarrow \_\_ NO_2$

8. If 18.1 g of silicon tetrachloride reacts with 8.4 L of hydrogen at STP, what mass of silicon is formed?
   $\_\_ SiCl_4 + \_\_ H_2 \rightarrow \_\_ Si + \_\_ HCl$

9. What mass of $Cu(OH)_2$ is produced in the reaction of 7.6 g $Cu(NO_3)_2$ with 6.2 g of KOH?
   $\_\_ Cu(NO_3)_2 + \_\_ KOH \rightarrow \_\_ Cu(OH)_2 + \_\_ KNO_3$

10. What mass of carbon dioxide is formed when 64 kg of ethylene is burned in 142 kg of oxygen?
    $\_\_ C_2H_4 + \_\_ O_2 \rightarrow \_\_ CO_2 + \_\_ H_2O$