

STOICHIOMETRY PRACTICE PROBLEMS**Basic Stoichiometry**

- Several brands of antacid tablets use aluminum hydroxide to neutralize excess acid.

$$\text{Al(OH)}_3(\text{s}) + 3 \text{HCl}(\text{aq}) \rightarrow \text{AlCl}_3(\text{aq}) + 3 \text{H}_2\text{O}(\text{l})$$
 - What quantity of HCl, in grams, can a tablet with 0.750 g of Al(OH)_3 consume?
 - What quantity of water is produced?
- If 10.0 g of carbon is combined with an exact, stoichiometric amount of oxygen (26.6 g) to produce carbon dioxide, what mass, in grams, of CO_2 can be obtained? That is, what is the theoretical yield of CO_2 ?
- The equation for one of the reactions in the process of reducing iron ore to the metal is

$$\text{Fe}_2\text{O}_3(\text{s}) + 3 \text{CO}(\text{g}) \rightarrow 2 \text{Fe}(\text{s}) + 3 \text{CO}_2(\text{g})$$
 - What is the maximum mass of iron, in grams, that can be obtained from 454 g of iron(III) oxide?
 - What mass of CO is required to reduce the iron(III) oxide to iron metal?
- Burning coal and oil in a power plant produces pollutants such as sulfur dioxide, SO_2 . The sulfur-containing compound can be removed from other waste gases, however, by the following reaction:

$$2 \text{SO}_2(\text{g}) + 2 \text{CaCO}_3(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{CaSO}_4(\text{s}) + 2 \text{CO}_2(\text{g})$$
 - Name the compounds involved in the reaction.
 - What mass of CaCO_3 is required to remove 155 g of SO_2 ?
 - What mass of CaSO_4 is formed when 155 g SO_2 is consumed completely?
- Your body deals with excess nitrogen by excreting it in the form of urea, NH_2CONH_2 . The reaction producing it is the combination of argentine ($\text{C}_6\text{H}_{14}\text{N}_4\text{O}_2$) with water to give urea and ornithine ($\text{C}_3\text{H}_7\text{N}_2\text{O}_2$).

$$\text{C}_6\text{H}_{14}\text{N}_4\text{O}_2 + \text{H}_2\text{O} \rightarrow \text{NH}_2\text{CONH}_2 + \text{C}_3\text{H}_7\text{N}_2\text{O}_2$$
 - If you excrete 95 mg of urea, what quantity of arginine must have been used?
 - What quantity of ornithine must have been produced?

Limiting Reactants

- The reaction of methane and water is one way to prepare hydrogen:

$$\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}(\text{g}) + 3 \text{H}_2(\text{g})$$
 If you begin with 995 g of CH_4 and 2510 g of water, what is the maximum possible yield of H_2 ?
 - Disulfur dichloride, S_2Cl_2 , is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine:

$$\text{S}_8(\text{l}) + 4 \text{Cl}_2(\text{g}) \rightarrow 4 \text{S}_2\text{Cl}_2(\text{l})$$
 - Starting with a mixture of 32.0 g of sulfur and 71.0 g of Cl_2 , which is the limiting reactant?
 - What mass of S_2Cl_2 (in grams) can be produced?
 - What mass of the excess reactant remains when the limiting reactant is consumed?
 - Aspirin ($\text{C}_9\text{H}_8\text{O}_4$) is produced by the reaction of salicylic acid ($\text{C}_7\text{H}_6\text{O}_3$) and acetic anhydride ($\text{C}_4\text{H}_6\text{O}_3$).

$$\text{C}_7\text{H}_6\text{O}_3(\text{s}) + \text{C}_4\text{H}_6\text{O}_3(\text{l}) \rightarrow \text{C}_9\text{H}_8\text{O}_4(\text{s}) + \text{CH}_3\text{CO}_2\text{H}(\text{aq})$$
 If you mix 100. g of each of the reactants, what is the maximum mass of aspirin that can be obtained?
- Percent Yield**
- Diborane, B_2H_6 , is a valuable compound in the synthesis of new organic compounds. One of several ways this born compound can be made is by the reaction

$$2 \text{NaBH}_4(\text{s}) + \text{I}_2(\text{s}) \rightarrow \text{B}_2\text{H}_6(\text{g}) + 2 \text{NaI}(\text{s}) + \text{H}_2(\text{g})$$
 Suppose you use 1.203 g of NaBH_4 with an excess of iodine and obtain 0.295 g of B_2H_6 . What is the percent yield of B_2H_6 ?
 - Disulfur dichloride, which has a revolting smell, can be prepared by directly combining S_8 and Cl_2 , but it can also be made by the following reaction:

$$3 \text{SCl}_2(\text{l}) + 4 \text{NaF}(\text{s}) \rightarrow \text{SF}_4(\text{g}) + \text{S}_2\text{Cl}_2(\text{l}) + 4 \text{NaCl}(\text{s})$$
 - Assume you begin with 5.23 g of SCl_2 and excess NaF. What is the theoretical yield of S_2Cl_2 ?
 - If only 1.19 g of S_2Cl_2 is obtained, what is the percent yield of the compound?