

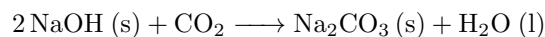
# Problem Set 4: Stoichiometric Calculations and Limiting Reactants

HCHE 111L: Introduction to Elementary Inorganic Chemistry

Due Date: Friday September 22<sup>nd</sup>, 2017

## Problem 1

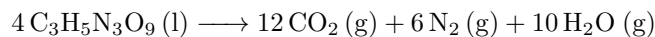
Sodium Hydroxide reacts with carbon dioxide as follows:



Which reactant is the limiting reactant when 1.70 mol NaOH and 1.00 mol CO<sub>2</sub> are allowed to react? How many moles of Na<sub>2</sub>CO<sub>3</sub> can be produced? How many moles of the excess reactant remain after the completion of the reaction?

## Problem 2

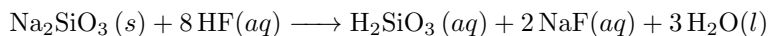
Detonation of nitroglycerin (C<sub>3</sub>H<sub>5</sub>N<sub>3</sub>O<sub>9</sub>) proceeds as follows:



- If a sample containing 3.00 mL of nitroglycerin (density = 1.592 g/mL) is detonated how many total moles of gas are produced?
- How many grams of N<sub>2</sub> are produced in the detonation?

## Problem 3

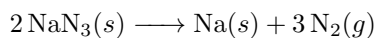
Hydrofluoric acid, HF(*aq*), cannot be stored in glass bottles because compounds called silicates in the glass are attacked by the HF(*aq*). Sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>), for example, reacts as follows:



- How many moles of HF are needed to react with 0.300 mol of Na<sub>2</sub>SiO<sub>3</sub>?
- How many grams of NaF form when 0.500 mol of HF reacts with excess Na<sub>2</sub>SiO<sub>3</sub>?
- How many grams of Na<sub>2</sub>SiO<sub>3</sub> can react with 0.800 g of HF?

## Problem 4

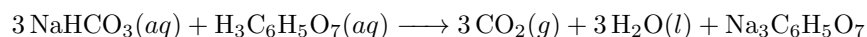
Automotive air bags inflate when sodium azide ( $\text{NaN}_3$ ) rapidly decomposes to its component elements:



- a) How many moles of  $\text{N}_2$  are produced by the decomposition of 2.50 mol of  $\text{NaN}_3$ ?
- b) How many grams of  $\text{NaN}_3$  are required to form 6.00 g of nitrogen gas?
- c) How many grams of  $\text{NaN}_3$  are required to produce 10.0 ft<sup>3</sup> of nitrogen gas if the gas has a density of 1.25 g/L?

## Problem 5

The fizz produced when an Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate ( $\text{NaHCO}_3$ ) and citric acid ( $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ ):

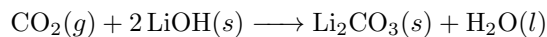


consider an experiment where 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react.

- a) Which is the limiting reactant?
- b) How many grams of carbon dioxide form?
- c) How many grams of the excess reactant remain after the limiting reactant is consumed?

## Problem 6

The  $\text{CO}_2$  exhaled by astronauts must be “scrubbed” (removed) from the spacecraft atmosphere. One way to do this is with solid  $\text{LiOH}$ :



the  $\text{CO}_2$  output of an astronaut is about 1.0 kg/day. What is the minimum mass of  $\text{LiOH}$  required for a six-day space shuttle flight?