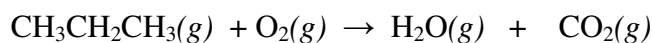


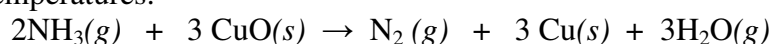
## Calculations involving concentrations, stoichiometry

1) Propane gas burns on air producing water and carbon dioxide:



Balance the equation and then calculate how many grams of water and carbon dioxide will result from complete burning of 10 liters of propane gas (consider molar volume at 25 °C and atmospheric pressure).

2) Nitrogen gas can be prepared by passing a gaseous ammonia over solid copper(II) oxide at high temperatures:

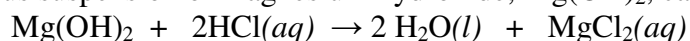


Suppose you have 20 g of copper oxide and 15 g of gaseous ammonia. How many liters of nitrogen gas can you produce from these reagents? Consider that about 10 % of nitrogen gas will be lost in your apparatus. (AW of copper 63.55, consider molar volume at 25 °C and atmospheric pressure).

3) Baking soda,  $\text{NaHCO}_3$ , is often used as an antacid. It neutralizes hydrochloric acid in the stomach:



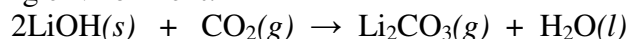
Aqueous suspension of magnesium hydroxide,  $\text{Mg}(\text{OH})_2$ , can also be used as an antacid:



Which is more potent antacid per gram,  $\text{NaHCO}_3$  or  $\text{Mg}(\text{OH})_2$  ?

4) The neutralization reaction between baking soda  $\text{NaHCO}_3$  and  $\text{HCl}$  in the stomach produces  $\text{CO}_2$  gas. In order to assess whether the gas production can cause a significant gastric discomfort to the patient, calculate the volume of carbon dioxide gas that can originate in the stomach following ingestion of 2 teaspoons (cca 10 grams) of sodium hydrogen carbonate. (Consider molar volume at the body temperature 37 °C).

5) Solid lithium hydroxide is used in space shuttles to remove exhaled carbon dioxide from the living environment:



Imagine that you are planning a space mission of two astronauts for 72 hours. One astronaut will produce 250 ml of  $\text{CO}_2$  per minute at rest. How many kg of solid lithium hydroxide are needed for the mission?

(1.-3., 5. according to Steven S. Zumdahl: Chemistry, 4<sup>th</sup> edition, Houghton Mifflin Co., Boston, 1997)

[Correct answers: 1) 29.4 g  $\text{H}_2\text{O}$  and 53.9 g  $\text{CO}_2$ ; 2) 1.845 liters  $\text{N}_2$ ; 3)  $\text{Mg}(\text{OH})_2$  more potent, 1 g neutralizes 0.034 HCl while 1 g  $\text{NaHCO}_3$  only 0.012 mol; 4) 3.03 liters  $\text{CO}_2$ , likely significant discomfort; 5) 4.23 kg LiOH needed for the mission]