

Unit 4
Homework #2 – Stoichiometry Problems

- 1) Consider the reaction between sodium and chlorine: $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$. 5 moles of sodium will produce how many moles of sodium chloride?
- 2) Water is produced in the following reaction: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 - a) How many moles of hydrogen are needed to react with 10 moles of oxygen?
 - b) If you wanted 15 moles of water, how much oxygen should you start with?
 - c) What is the mass of the 15 moles of water produced in the previous problem?
- 3) Given the chemical equation determine the molar masses of both the products and the reactants. $\text{Na}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{NaOH} + \text{CaCO}_3$
- 4) Hydrogen and oxygen react to produce water according to the reaction: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$.
 - a) how many moles of hydrogen would be required to produce 5.0 mol of water?
 - b) how many moles of oxygen would be required?
- 5) a) If 4.5 mol of ethane (C_2H_6) undergo combustion according to the *unbalanced* reaction $\text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$, how many moles of oxygen are required? b) How many moles of each product are formed?
- 6) Sulfuric acid reacts with sodium hydroxide according to the following $\text{H}_2\text{SO}_4 + \text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$.
 - a) balance the equation for the reaction.
 - b) What mass of sulfuric acid would be required to react with 0.75 mol NaOH?
 - c) What mass of each product is formed in this reaction?
- 7) Sodium chloride is produced from its elements through the a synthesis reaction.
 - a) Write the equation for this process.
 - b) What mass of each reactant would be required to produce 25.0 mol of sodium chloride?
- 8) Copper reacts with silver nitrate through a single replacement reaction. (assume copper (II) will be the form of copper)
 - a) Write the equation for this process.
 - b) If 2.25 g of silver are produced from the reaction, how many moles of copper(II) nitrate are also produced?
 - c) How many moles of each reactant are required for the reaction?
- 9) Iron is generally produced from iron ore through the following reaction in a blast furnace: $\text{Fe}_2\text{O}_3(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{Fe}(\text{s}) + \text{CO}_2(\text{g})$
 - a) If 4.0 kg of iron (III) oxide are available to react, how many moles of CO are needed?
 - b) How many moles of each product are formed?
- 10) Methanol (CH_3OH) is an important industrial compound that is produced from the following reaction: $\text{CO}(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{g})$. What mass of each reactant would be needed to produce 100.0 kg of methanol?
- 11) Nitrogen combines with oxygen in the atmosphere during lightning flashes to form nitrogen monoxide which then reacts further with O_2 to produce nitrogen dioxide.
 - a) Write the equation for this process.
 - b) What mass of NO_2 is formed when NO reacts with 384 g O_2 ?
 - c) How many grams of NO are required to react with this amount of O_2 ?
- 12) As early as 1938, the use of NaOH was suggested as a means of removing CO_2 from the cabin atmosphere of spacecraft according to the following reaction: $\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$.
 - a) If the average human body discharges 925.0 g of CO_2 per day, how many moles of NaOH would be needed each day?
 - b) How many moles of each product would be formed each day?
- 13) The double-displacement reaction between silver nitrate and sodium bromide produces silver bromide, a component of photographic films.
 - a) If 4.5 mol of silver nitrate react, what mass of sodium bromide is required?
 - b) what mass of silver bromide is formed?
- 14) In a soda-acid fire extinguisher, concentrated sulfuric acid reacts with sodium bicarbonate to produce carbon dioxide, sodium sulfate and water.
 - a) How many moles of sodium bicarbonate would be needed to react with 150 g of sulfuric acid?
 - b) How many moles of each product would be formed?
- 15) Aspirin ($\text{C}_9\text{H}_8\text{O}_4$) is produced through the following reaction of salicylic acid ($\text{C}_7\text{H}_6\text{O}_3$) and acetic anhydride ($\text{C}_4\text{H}_6\text{O}_3$): $\text{C}_7\text{H}_6\text{O}_3(\text{s}) + \text{C}_4\text{H}_6\text{O}_3(\text{l}) \rightarrow \text{C}_9\text{H}_8\text{O}_4(\text{s}) + \text{H}_2\text{O}(\text{l})$.
 - a) What mass of aspirin (in kg) could be produced from 75.0 mol of salicylic acid?
 - b) What mass of acetic anhydride (in kg) would be required?
 - c) Given the density of water, how many liters of water would be formed?