

Stoichiometry quiz essay sample



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Stoichiometry II - Mole Calculations/ Limiting and Excess Reagent - Lecture

Notes 1. Given the balanced equation $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ How many

moles of ammonia are produced when 0.60 mol of nitrogen reacts with

hydrogen? 2. Given the equation: $\text{SiO}_2 + \text{HF} \rightarrow \text{SiF}_4 + \text{H}_2\text{O}$ a. Calculate the number of moles HF that would completely react with 2.5 moles of SiO_2 . b.

Calculate the number of moles SiF_4 formed by completely reacting 2.5

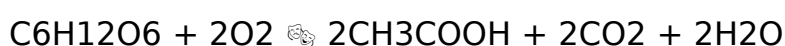
moles SiO_2 with HF. c. Calculate the mass of water formed by reacting 2.5 moles SiO_2 with HF.

d. Calculate the number of water molecules formed by reacting 2.5 moles SiO_2 with HF.

e. Calculate the mass of oxygen formed by reacting 2.5 moles SiO_2 with HF.

3. Calculate the number of grams NH_3 produced by the reaction of 5.40 grams of hydrogen with an excess nitrogen.

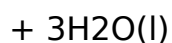
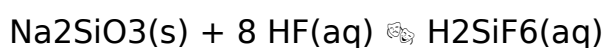
1. The overall reaction for the conversion of sugar(glucose) to acetic acid is:



A given volume of nipa sap contains 69.0 g of glucose. If all of this sugar is fermented, how many grams of acetic acid would be produced?

2. How many molecules of oxygen are produced when 29.2 g of water is decomposed forming hydrogen gas and oxygen gas?

3. Hydrofluoric acid, $\text{HF}(\text{aq})$, cannot be stored in glass bottles because compounds called silicates in the glass are attacked by the $\text{HF}(\text{aq})$. Sodium silicate(Na_2SiO_3), for example reacts as follows:



a. How many moles of HF are needed to react with 0.300 mol Na_2SiO_3 ?

b. How many grams of NaF form when 0.500 mol of HF reacts with excess sodium silicate?

How many grams sodium silicate can react with 0.800 g of HF?

4. Automotive air bags inflate when sodium azide, NaN_3 , rapidly decomposes to its component elements: $2 \text{NaN}_3(\text{s}) \rightarrow 2\text{Na}(\text{s}) + 3\text{N}_2(\text{g})$ a. How many moles of N_2 are produced by the decomposition of 2.50 mol NaN_3 ? b. How many grams of NaN_3 are required to form 6.00 g of nitrogen gas?

5. The complete combustion of octane, C_8H_{18} , a component of gasoline, proceeds as follows: $2\text{C}_8\text{H}_{18}(\text{l}) + 25 \text{O}_2(\text{g}) \rightarrow 16 \text{CO}_2(\text{g}) + 18 \text{H}_2\text{O}(\text{g})$ a. How many moles of O_2 are needed to burn 0.750 mol of C_8H_{18} ? b. How many grams of O_2 are needed to burn 5.00 g of C_8H_{18} ?

6. Detonation of nitroglycerin proceeds as follows: $4\text{C}_3\text{H}_5\text{N}_3\text{O}_9(\text{l}) \rightarrow 12 \text{CO}_2(\text{g}) + 6\text{N}_2(\text{g}) + \text{O}_2(\text{g}) + 10\text{H}_2\text{O}(\text{g})$

a) If a sample containing 3.00 mL of nitroglycerin ($d = 1.592 \text{ g/ml}$) is detonated, how many total moles of gas are produced?

b) How many grams of N₂ are produced in the detonation? Limiting Reagents and Excess Reagents

1. Sodium chloride can be prepared by the reaction of sodium metal with chlorine gas. $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$

a. If 6.70 mol Na reacts with 3.20 mol Cl₂ what is the limiting reagent? b.

How many moles of NaCl are produced?

How much of the excess reagent remains unreacted?

2. Phosphorus trichloride, PCl₃ is commercially important compound used in the manufacture of pesticides, gasolines, additives, and number of other products. It is made by the direct combination of phosphorus and chlorine.

$\text{P}_4 + 6\text{Cl}_2 \rightarrow 4\text{PCl}_3$ What mass of PCl₃ forms in the reaction of 125 g P₄ with 323 g Cl₂?

3. Sodium hydroxide reacts with carbon dioxide as follows; $2\text{NaOH(s)} + \text{CO}_2\text{(g)} \rightarrow \text{Na}_2\text{CO}_3\text{(s)} + \text{H}_2\text{O(l)}$

a. Which reagent is a limiting reactant when 1.70 mol NaOH and 1.00 mol CO₂ are allowed to react?

b. How many moles of Na₂CO₃ can be produced?

How many moles of the excess reactant remain after the completion of the reaction?

1. The fizz produced when Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate (NaHCO₃) and citric acid

(H₃C₆H₅O₇): $3\text{NaHCO}_3\text{(aq)} + \text{H}_3\text{C}_6\text{H}_5\text{O}_7\text{(aq)} \rightarrow 3\text{CO}_2\text{(g)} + 3\text{H}_2\text{O(l)} +$

$\text{Na}_2\text{CO}_3(\text{aq})$ In a certain experiment 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?

How many grams of excess reactant remained after the limiting reactant is completely consumed?

2. One of the steps in the commercial process for converting ammonia to nitric acid is conversion of NH_3 to NO : $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$ In a certain experiment, 2.25 g of NH_3 reacts with 3.75 g of O_2 . a.

Which is the limiting reactant

b. How many grams of NO forms?

How many grams of excess reactant remain after the limiting reactant is completely consumed?

3. Solutions of sodium carbonate and silver nitrate react to form solid silver carbonate and a solution of silver nitrate. A solution containing 6.50 g sodium carbonate is mixed with one containing 7.00 g silver nitrate. How many grams of sodium carbonate, silver nitrate, silver carbonate, and sodium nitrate are present after the reaction is complete

4. Solutions of sulfuric acid and lead(II) acetate react to form solid lead(II) sulfate and a solution of acetic acid. If 7.50 g of sulfuric acid and 7.50 g of lead(II) acetate are mixed, calculate the number of grams of sulfuric acid, lead(II) acetate, lead(II) sulfate, and acetic acid present in the mixture after the reaction is complete.

5. Turpentine, a hydrocarbon commonly used as paint thinner, burst into flame when warmed and placed in contact with chlorine. $C_{10}H_{16} + Cl_2 \rightarrow HCl + 10C$ a) How many moles of HCl are formed from 0.025 mole $C_{10}H_{16}$?

b) How many moles of Cl_2 are required to react with 3.6 g $C_{10}H_{16}$?

c) Calculate the mass of C produced when the amount of $C_{10}H_{16}$ given above in (b) reacts with Cl_2 ? d) Calculate the number of C atoms produced in (b).

6. Copper is obtained from copper ores by roasting and smelting. The process may be represented by the overall equation: $2CuFeS_2 + 5O_2 \rightarrow 2Cu + 2FeO + 4SO_2$

a) What mass of copper may be obtained from 100 kg of $CuFeS_2$?

b) How many moles of O_2 would be required for the reaction?

c) Calculate the number of molecules of SO_2 that would be produced?

7. The ozone hole in the Antarctic is growing. Chlorofluorocarbons (CFC) produced by humans and used as coolants in air conditioners and refrigerators have been pointed at as the culprits. One such CFC compound is dichlorodifluoromethane or Freon-12. A reaction involved in the production of Freon-12 is as follows: $CCl_4 + SbF_3 \rightarrow CCl_2F_2 + SbCl_3$ a) Determine the mass in grams of CCl_4 required to completely react with 25.75 g of SbF_3 . b) Calculate the mass in grams and the number of molecules of Freon-12 (CCl_2F_2) that would be produced from the reaction.

8. Aspirin, $C_9H_8O_4$ is prepared from the reaction of salicylic acid ($C_7H_6O_3$) and acetic anhydride ($C_4H_6O_3$). The reaction is $C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$ If 40 grams of salicylic acid and 150 grams of acetic anhydride were allowed to react, a) What mass of aspirin would be produced?
- b) Which is the limiting reactant?
- c) Which is the reactant present in excess?
- d) What mass of the reactant in excess remains unreacted?

Theoretical Yield, Actual Yield, and Percentage Yield 1. Wine is produced by the fermentation of fruit sugars to alcohol. The chemical reaction is $C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2$ Five kilograms of banana pulp containing 625 grams of fructose was used in preparation of banana wine. What is the percentage yield if, at the end of fermentation 218 g of ethanol was produced?

2. Tuba is an alcoholic drink produced by the spontaneous fermentation of sap collected from coconut inflorescence. Yeasts convert sucrose and other sugars to alcohol. The conversion of sucrose to ethanol may be represented by the chemical equation: $C_{12}H_{22}O_{11} + H_2O \rightarrow 4 CH_3CH_2OH + 4 CO_2$ Coconut sap contains 16.5 grams/100 mL $C_{12}H_{22}O_{11}$. What volume of sap must a tuba gatherer collect to produce tuba containing 598 g of alcohol, CH_3CH_2OH , if the efficiency of the fermentation process is 66.7 percent?

3. A 15.6 gram sample of C_6H_6 is mixed with excess HNO_3 . We isolate 18.0 grams of $C_6H_5NO_2$. What is the percent yield of $C_6H_5NO_2$? $C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$

Determination of Molecular Formula Using Combustion Analysis 1. A 0.1014 gram sample of purified glucose was burned in a C-H combustion train to produce 0.1468 gram of CO₂ and 0.0609 gram of H₂O. An elemental analysis showed that glucose contains only carbon, hydrogen and oxygen. Determine the masses of C, H and O in the sample. Determine the EF and MF.

2. Complicated chemical reactions occur at hot springs on the ocean floor. One compound obtained from such hot spring consists of Mg, Si, H, and O. From a 0.334 gram sample, the Mg is recovered as 0.115 g of MgO; H is recovered as 25.7 mg of H₂O; and Si is recovered as 0.172 g of SiO₂. What is the simplest formula of this compound?

Sequential Reactions 1. Consider the two step process for the formation of tellurous acid described by the following equations: $3\text{TeO}_2 + 2\text{OH}^- \rightarrow \text{TeO}_3 + \text{H}_2\text{O}$ $2\text{TeO}_3 + 2\text{H}^+ \rightarrow \text{H}_2\text{TeO}_3$ What mass of H₂TeO₃ would be formed from 62.1 g of TeO₂, assuming 100% yield?

2. Consider the formation of cyanogens, C₂N₂, and its subsequent decomposition in water given by the equations $2\text{Cu} + 6\text{CN}^- \rightarrow 2[\text{Cu}(\text{CN})_2] + \text{C}_2\text{N}_2$ $\text{C}_2\text{N}_2 + \text{H}_2\text{O} \rightarrow \text{HCN} + \text{HOCN}$ How much cyanic acid, HCN, can be produced from 10.00 g of KCN, assuming 100% yield?

3. What mass of potassium chlorate would be required to supply the proper amount of oxygen needed to burn 35.0 g of methane, CH₄? $2\text{KClO}_4 \rightarrow 2\text{KCl} + 3\text{O}_2$ $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$