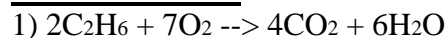


Stoichiometry - Practice Problems

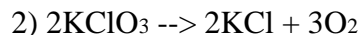
PSI Chemistry

Name _____

Classwork Set 1:

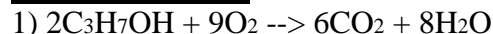


- How many moles of O_2 are required to react with 24 moles of C_2H_6 ?
- How many grams of C_2H_6 are required to react with 12 moles of O_2 ?
- How many grams of O_2 are required to react with 200g of C_2H_6 ?

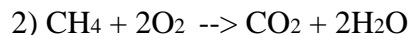


- How many moles of O_2 are required to react with 19 moles of KClO_3 ?
- How many grams of KClO_3 are required to react with 62 moles of KCl ?
- How many grams of O_2 are required to react with 39 grams of KCl ?

Homework Set 1:



- How many moles of O_2 are required to react with 58 moles of $\text{C}_3\text{H}_7\text{OH}$?
- How many moles of CO_2 are required to react with 17 moles of O_2 ?
- How many grams of CO_2 would be required to react with 7.8 moles of H_2O ?
- How many grams of $\text{C}_3\text{H}_7\text{OH}$ are needed to produce 0.45 moles of water?
- How many grams of $\text{C}_3\text{H}_7\text{OH}$ are required to react with 29 grams CO_2 ?
- How many grams $\text{C}_3\text{H}_7\text{OH}$ can be made by reacting with 7.3L of CO_2 at STP?

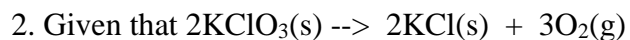


- How many moles of O_2 are required to produce 44 moles of H_2O ?
- How many grams of CH_4 are required to produce 97 moles of CO_2 ?
- How many grams of H_2O is produced when 84 grams of CO_2 is also produced?

Classwork Set 2:



- How many moles of O_2 are required to react with 54 moles of $\text{C}_{25}\text{H}_{52}$?
- How much $\text{C}_{25}\text{H}_{52}$ in grams is needed to react with 43 moles O_2 ?
- How much O_2 in grams is needed to react with 500g $\text{C}_{25}\text{H}_{52}$?
- How many L of water would be produced @STP if 3.90 grams of $\text{C}_{25}\text{H}_{52}$ react with excess oxygen gas?
- How many molecules of CO_2 would be produced if 3 moles of water were made?



- How many grams of potassium chlorate would be needed to produce 63 L of oxygen gas @STP?
- How many moles of potassium chloride would be produced if when potassium chlorate decomposes 4.5 moles of oxygen gas are produced?

- C. How many formula units of potassium chloride would be formed when 120 grams of potassium chlorate decompose?

Homework Set 2:

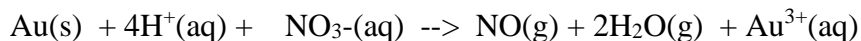
1. When one mole of propane burns in oxygen to produce carbon dioxide and water, a ratio of 3 moles of carbon dioxide is produced for every 4 moles of water.
- Determine the formula for propane and write the balanced equation.
 - How many L of carbon dioxide gas would be produced @STP if 3.4 moles of propane are burned?
 - How many grams of water would be produced for every 10 L of carbon dioxide gas produced @STP?
2. Lead ions react with chloride ions to create a precipitate as represented by the reaction below:
- $$\text{Pb}^{2+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) \rightarrow \text{PbCl}_2(\text{s})$$
- How many grams of lead(II) chloride would be made if 16 grams of Cl^{-} ions react with excess lead ion?
 - How many moles of chloride ion would be needed to react with 0.068 moles of lead ion?
 - How many grams of lead ion would be needed to produce 340 grams of lead(II) chloride precipitate?

Classwork Set 3

1. The space shuttle used two solid rocket boosters to launch it into space. The reaction that occurred is written below:
- $$\text{NH}_4\text{ClO}_4(\text{s}) + \text{Al}(\text{s}) \rightarrow \text{NO}(\text{g}) + \text{Al}_2\text{O}_3(\text{s}) + \text{H}_2\text{O}(\text{g}) + \text{AlCl}_3(\text{g})$$
- Balance the reaction and rewrite.
 - How many grams of aluminum would be needed to react with 56 kg of ammonium perchlorate?
 - If 67 grams of ammonium perchlorate were to react with 10 grams of aluminum:
 - Which material would be the limiting reactant?
 - What would be the theoretical yield of nitrogen monoxide?
 - Was the aluminum oxidized or reduced in the reaction?
2. Acetylene (C_2H_2) is used in welding in areas hard to reach with electricity. It burns with oxygen to produce carbon dioxide and water.
- Write the balanced reaction.
 - Before starting the weld, the acetylene canister had a mass of 34.8 grams. After the weld, the mass of the canister was 30.6 grams. How many L of oxygen gas would have been consumed @STP?
 - If 4.5 grams of acetylene reacts with 0.4 moles of oxygen gas to produce 0.028 grams of water.
 - What would be the theoretical yield of water?
 - What would be the % Yield of water?
 - What would be the proper lewis structure for acetylene?

Homework Set 3:

1. Gold is very valuable because it does not oxidize easily. It can be oxidized by reacting it with nitric acid as shown below:



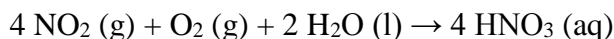
- A. How many moles of nitrate ion would be needed to react with 200 grams of gold metal?
 - B. If 30 grams of gold react with 3.4 grams of nitrate ion:
 - a. Which reactant limits?
 - b. What would be the theoretical yield of water?
 - C. If 3.4 L of NO gas is produced @STP, how many moles of water vapor would be produced?
2. Balance: $\text{___CH}_3\text{OH} + \text{___O}_2 \rightarrow \text{___CO}_2 + \text{___H}_2\text{O}$
- A. How many grams of CO₂ would be produced if the reaction yielded 8 moles of H₂O?
 - B. How many grams of CH₃OH are needed to react with 28 g of O₂?
 - C. If you combine 4.2 L of O₂ @STP with 3.8 moles of methanol, what is the limiting reagent?
 - D. What is the theoretical yield of carbon dioxide using the results from "C"?
 - E. Is this an oxidation reduction reaction? Explain.

Classwork Set 4:

1. Nitrogen monoxide will react with oxygen gas to produce nitrogen dioxide. This reaction occurs in the atmosphere during lightning storms which is why rain produced in thunderstorms is good for crops as some of the nitrogen dioxide will fall to the surface and act as a fertilizer.

- A. Write the balanced reaction.
- B. If 0.0065 grams of NO₂ were produced at a 100% yield, how many moles of oxygen and nitrogen monoxide would have been needed?
- C. If nitrogen dioxide is produced at a 86% yield, how many L of oxygen gas would be needed to react at 1 atmosphere of pressure and a temperature of 273 K?
- D. If 30 grams of nitrogen monoxide react with 22 grams of oxygen gas:
 - a. Which reactant would limit?
 - b. How many grams of the excess reactant remain?
- E. What would be the geometry of a NO₂ molecule?

2. Nitric acid (HNO₃) can be used to make wood look artificially old. Furniture makers apply a low concentration of nitric acid during the finishing process to create the "antique" look. Nitric acid can be synthesized by the reaction below:



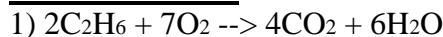
- A. In excess oxygen, 45 grams of nitrogen dioxide reacted with water and 5.97 grams of nitrogen dioxide was left over.
 - a. How many grams of water was required to react?
 - b. What would be the theoretical yield?
 - c. If 0.8 grams of nitric acid, what was the % yield for the reaction?
- B. How many total liters of gas (NO₂ and O₂) @STP would be needed to produce 150 grams of nitric acid?
- C. If 2.8 moles of oxygen gas reacts with excess nitrogen dioxide and water, how many grams of nitric acid could be produced if the reaction is run at a 56% yield?
- D. What is the oxidation state of N in nitric acid (HNO₃)?

Homework Set 4:

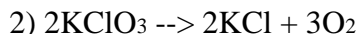
1. No one likes cockroaches. Since the 1970's exterminators have used a chemical called diazinon, among others, to kill the insects. It is toxic to humans also and has been banned in the US since 2004 unless it is being used in agriculture. It is made from PCl_3 which is in turn synthesized from phosphorous (P_4) and chlorine gas.
- A. Write the balanced reaction for the synthesis of phosphorus trichloride from phosphorus and chlorine gas.
 - B. If 4.5 grams of PCl_3 were produced from a stash of 100 grams of P_4 and 100 L of chlorine gas:
 - a. Which reactant limited the reaction?
 - b. How many grams of the excess reactant remain?
 - c. What was the % yield of the reaction?
 - C. Diazinon is roughly 10% phosphorus by mass.
 - a. If 64 grams of chlorine gas reacts with excess P_4 :
 - 1) What would be the theoretical yield of PCl_3 in grams?
 - 2) How many grams of diazinon could be made from the PCl_3 ?

ANSWER KEY!!!

Classwork Set 1:

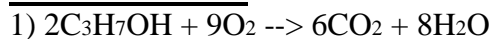


- How many moles of O_2 are required to react with 24 moles of C_2H_6 ? **84 moles**
- How many grams of C_2H_6 are required to react with 12 moles of O_2 ? **102.9 grams**
- How many grams of O_2 are required to react with 200g of C_2H_6 ? **747 grams**

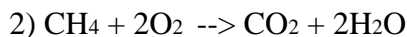


- How many moles of O_2 are produced from 19 moles of KClO_3 ? **28.5 mol**
- How many kilograms of KClO_3 would decompose to form 62 moles of KCl ? **7.60 kg**
- How many grams of O_2 are required to react with 39 grams of KCl ? **25.1 g**

Homework Set 1:



- How many moles of O_2 are required to react with 58 moles of $\text{C}_3\text{H}_7\text{OH}$? **261 moles**
- How many moles of CO_2 would be produced if 17 moles of O_2 were reacted? **11.3 moles**
- How many grams of CO_2 would be produced along with 7.8 moles of H_2O ? **257.4 grams**
- How many grams of $\text{C}_3\text{H}_7\text{OH}$ are needed to produce 0.45 moles of water? **6.75 grams**
- How many grams of $\text{C}_3\text{H}_7\text{OH}$ are needed to produce 29 grams CO_2 ? **13.2 grams**

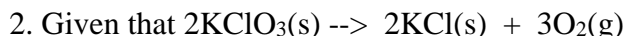


- How many moles of O_2 are required to produce 44 moles of H_2O ? **44 moles**
- How many grams of CH_4 are required to produce 97 moles of CO_2 ? **1552 grams**
- How many grams of H_2O is produced when 84 grams of CO_2 is also produced? **69 grams**

Classwork Set 2:



- How many moles of O_2 are required to react with 54 moles of $\text{C}_{25}\text{H}_{52}$? **2052 moles**
- How much $\text{C}_{25}\text{H}_{52}$ in grams is needed to react with 43 moles O_2 ? **398 grams**
- How much O_2 in grams is needed to react with 500g $\text{C}_{25}\text{H}_{52}$? **1727 grams**
- How many L of water would be produced @STP if 3.90 grams of $\text{C}_{25}\text{H}_{52}$ react with excess oxygen gas? **6.45 L**
- How many molecules of CO_2 would be produced if 3 moles of water were made? **1.7E24 molecules**

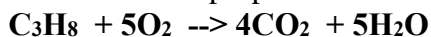


- How many grams of potassium chlorate would be needed to produce 63 L of oxygen gas @STP? **229 grams**
- How many moles of potassium chloride would be produced if when potassium chlorate decomposes 4.5 moles of oxygen gas are produced? **3 moles**
- How many formula units of potassium chloride would be formed when 120 grams of potassium chlorate decompose? **5.9 E23 formula units**

Homework Set 2:

1. When one mole of propane burns in oxygen to produce carbon dioxide and water, a ratio of 3 moles of carbon dioxide is produced for every 4 moles of water.

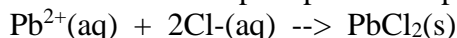
A. Determine the formula for propane and write the balanced equation.



B. How many L of carbon dioxide gas would be produced @STP if 3.4 moles of propane are burned? **305 L**

C. How many grams of water would be produced for every 10 L of carbon dioxide gas produced @STP? **10.0 moles**

2. Lead ions react with chloride ions to create a precipitate as represented by the reaction below:



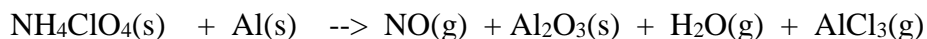
A. How many grams of lead(II) chloride would be made if 16 grams of Cl⁻ ions react with excess lead ion? **63.77 grams**

B. How many moles of chloride ion would be needed to react with 0.068 moles of lead ion? **0.136 moles Cl⁻**

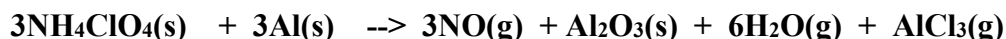
C. How many grams of lead ion would be needed to produce 340 grams of lead(II) chloride precipitate? **253 grams Pb²⁺**

Classwork Set 3

1. The space shuttle used two solid rocket boosters to launch it into space. The reaction that occurred is written below:



A. Balance the reaction and rewrite.



B. How many grams of aluminum would be needed to react with 56 kg of ammonium perchlorate? **12,923 grams**

C. If 67 grams of ammonium perchlorate were to react with 10 grams of aluminum:

a. Which material would be the limiting reactant? **Al**

b. What would be the theoretical yield of nitrogen monoxide in grams? **11.1 grams**

D. Was the aluminum oxidized or reduced in the reaction? **oxidized (0-->3+)**

2. Acetylene (C₂H₂) is used in welding in areas hard to reach with electricity. It burns with oxygen to produce carbon dioxide and water.

A. Write the balanced reaction. **2C₂H₂ + 5O₂ --> 4CO₂ + 2H₂O**

B. Before starting the weld, the acetylene canister had a mass of 34.8 grams. After the weld, the mass of the canister was 30.6 grams. How many L of oxygen gas would have been consumed @STP? **9.05 L**

C. If 4.5 grams of acetylene reacts with 0.4 moles of oxygen gas to produce 0.28 grams of water.

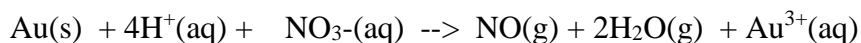
a. What would be the theoretical yield of water in grams? **2.88 grams**

b. What would be the % Yield of water? **9.7%**

D. What would be the proper lewis structure for acetylene? **H - C≡C - H**

Homework Set 3:

1. Gold is very valuable because it does not oxidize easily. It can be oxidized by reacting it with nitric acid as shown below:



- A. How many moles of nitrate ion would be needed to react with 200 grams of gold metal?
1.01 moles
- B. If 30 grams of gold react with 3.4 grams of nitrate ion:
a. Which reactant limits? **nitrate**
b. What would be the theoretical yield of water in grams? **1.97 grams**
- C. If 3.4 L of NO gas is produced @STP, how many moles of water vapor would be produced?
0.30 moles

2. Balance: **2 CH₃OH + 3 O₂ → 2 CO₂ + 4 H₂O**

- A. How many grams of CO₂ would be produced if the reaction yielded 8 moles of H₂O? **176 g**
- B. How many grams of CH₃OH are needed to react with 28 g of O₂? **18.7 g**
- C. If you combine 4.2 L of O₂ @STP with 3.8 moles of methanol, what is the limiting reagent? **O₂**
- D. What is the theoretical yield of carbon dioxide using the results from "C"? **5.5 grams**
- E. Is this an oxidation reduction reaction? Explain. **Yes, carbon gets oxidized (-2 → +4) and oxygen is reduced (0 → -2)**

Classwork Set 4:

1. Nitrogen monoxide will react with oxygen gas to produce nitrogen dioxide. This reaction occurs in the atmosphere during lightning storms which is why rain produced in thunderstorms is good for crops as some of the nitrogen dioxide will fall to the surface and act as a fertilizer.

- A. Write the balanced reaction. **2NO + O₂ → 2NO₂**
- B. If 0.0065 grams of NO₂ were produced at a 100% yield, how many moles of oxygen and nitrogen monoxide would have been needed? **0.00028 moles NO, 0.00014 moles O₂**
- C. If 3 moles of nitrogen dioxide is to be produced at an 86% yield, how many L of oxygen gas would be needed to react at STP? **39.07 L**
- D. If 30 grams of nitrogen monoxide react with 22 grams of oxygen gas:
a. Which reactant would limit? **NO**
b. How many grams of the excess reactant remain? **6 grams**
- E. What would be the geometry of a NO₂ molecule? **bent**

2. Nitric acid (HNO₃) can be used to make wood look artificially old. Furniture makers apply a low concentration of nitric acid during the finishing process to create the "antique" look. Nitric acid can be synthesized by the reaction below:



- A. In excess oxygen, 45 grams of nitrogen dioxide reacted with water and 5.97 grams of nitrogen dioxide was left over.
a. How many grams of water was required to react? **7.63 grams**
b. What would be the theoretical yield? **107 grams**
c. If 80 grams of nitric acid is produced, what was the % yield for the reaction? **74.7%**
- B. How many total liters of gas (NO₂ and O₂) @STP would be needed to produce 150 grams of nitric acid? **9.52 mole NO₂ and 2.38 mol O₂ = 11.9 mol x 22.4 L = 266 L**
- C. If 2.8 moles of oxygen gas reacts with excess nitrogen dioxide and water, how many grams of nitric acid could be produced if the reaction is run at a 56% yield? **395 grams**
- D. What is the oxidation state of N in nitric acid (HNO₃)? **+5**

Homework Set 4:

1. No one likes cockroaches. Since the 1970's exterminators have used a chemical called diazinon, among others, to kill the insects. It is toxic to humans also and has been banned in the US since 2004 unless it is being used in agriculture. It is made from PCl_3 which is in turn synthesized from phosphorous (P_4) and chlorine gas.
 - A. Write the balanced reaction for the synthesis of phosphorus trichloride from phosphorus and chlorine gas. **$\text{P}_4 + 6\text{Cl}_2 \rightarrow 4\text{PCl}_3$**
 - B. If 405 grams of PCl_3 were produced from a stash of 100 grams of P_4 and 100 L of chlorine gas:
 - a. Which reactant limited the reaction? **Chlorine**
 - b. How many grams of the excess reactant remain? **8.68 grams**
 - c. What was the % yield of the reaction? **99.5%**
 - C. Diazinon is roughly 10% phosphorus by mass.
 - a. If 64 grams of chlorine gas reacts with excess P_4 :
 - 1) What would be the theoretical yield of PCl_3 in grams? **82.3 grams**
 - 2) How many grams of diazinon could be made from the PCl_3 ? **186.3 grams**