Pressure Conversion Problems

1 atm = 101.3 kPa = 101,325 Pa = 760 mm Hg = 760 torr

1. The air pressure for a certain tire is 109 kPa. What is this pressure in atmospheres?

2. The air pressure inside a submarine is 0.62 atm. What would be the height of a column of mercury balanced by this pressure?

3. The weather news gives the atmospheric pressure as 1.07 atm. What is this atmospheric pressure in torr?

4. An experiment at Sandia National Labs in New Mexico is performed at an atmospheric pressure of 758.7 mm Hg. What is this pressure in atm?

5. A bag of potato chips is sealed in a factory near sea level. The atmospheric pressure at the factory is 761.3 mm Hg. The pressure inside the bag is the same. What is the pressure inside the bag of potato chips in Pa?

6. The same bag of potato chips from Problem 5 is shipped to a town in Colorado, where the atmospheric pressure is 99.82 kPa. What is the difference (in Pa) between the pressure in the bag and the atmospheric pressure of the town?

7. The pressure gauge on a compressed air tank reads 2235 mm Hg. What is the pressure in atm?

8. The pressure in the tire of an automobile in 2.37 atm. What is the pressure in kPa?

Name:_____Date:_____Period:_____

Gas Laws Worksheet

atm = 760.0 mm Hg = 101.3 kPa= 760 .0 torr

Boyle's Law Problems:

1. If 22.5 L of nitrogen at 748 mm Hg are compressed to 725 mm Hg at constant temperature. What is the new volume?

2. A gas with a volume of 4.0L at a pressure of 205kPa is allowed to expand to a volume of 12.0L. What is the pressure in the container if the temperature remains constant?

3. What pressure is required to compress 196.0 liters of air at 1.00 atmosphere into a cylinder whose volume is 26.0 liters?

4. A 40.0 L tank of ammonia has a pressure of 12.7 kPa. Calculate the volume of the ammonia if its pressure is changed to 8.4 kPa while its temperature remains constant.

Name:_____Date:_____Period:_____

Charles' Law Problems:

1. Calculate the decrease in temperature when 6.00 L at 20.0 °C is compressed to 4.00 L.

2. A container containing 5.00 L of a gas is collected at 100 K and then allowed to expand to 20.0 L. What must the new temperature be in order to maintain the same pressure (as required by Charles' Law)?

3. A gas occupies 900.0 mL at a temperature of 27.0 °C. What is the volume at 132.0 °C?

4. If 15.0 liters of neon at 25.0 °C is allowed to expand to 45.0 liters, what must the new temperature be to maintain constant pressure?

Name:_____Date:_____Period:_____

Guy-Lussac's Law

The gases in a hair spray can are at a temperature of 27°C and a pressure of 30 lbs/in^2. If the gases in the can reach a pressure of 90 lbs/in^2, the can will explode. To what temperature must the gases be raised in order for the can to explode? Assume constant volume. (630 °C)

2. Maybelline Cousteau's backup oxygen tank reads 900 mmHg while on her boat, where the temperature is 27°C. When she dives down to the bottom of an unexplored methane lake on a recently-discovered moon of Neptune, the temperature will drop down to –183°C. What will the pressure in her backup tank be at that temperature? (270 mmHg)

Avogadros Law and Molar Volume at STP

(1 mole of any gas = 22.4 L at STP)

1. 50 g of nitrogen (N_2) has a volume of ___ liters at STP. (40 L)

2. 100 g of oxygen(O_2) is added to the gas in Question 16. What is the volume of the combined gases at STP. (110 L)

3. What is the density of carbon dioxide at STP? (2.0 g/L)

Name:_____Date:_____Period:_____

Combined Gas Law Problems:

1. A gas balloon has a volume of 106.0 liters when the temperature is 45.0 °C and the pressure is 740.0 mm of mercury. What will its volume be at 20.0 °C and 780 .0 mm of mercury pressure?

2. If 10.0 liters of oxygen at STP are heated to 512 °C, what will be the new volume of gas if the pressure is also increased to 1520.0 mm of mercury?

3. A gas is heated from 263.0 K to 298.0 K and the volume is increased from 24.0 liters to 35.0 liters by moving a large piston within a cylinder. If the original pressure was 1.00 atm, what would the final pressure be?

4. The pressure of a gas is reduced from 1200.0 mm Hg to 850.0 mm Hg as the volume of its container is increased by moving a piston from 85.0 mL to 350.0 mL. What would the final temperature be if the original temperature was 90.0 °C?

Mixed Gas Laws Worksheet

1) How many moles of gas occupy 98 L at a pressure of 2.8 atmospheres and a temperature of 292 K?

2) If 5.0 moles of O_2 and 3.0 moles of N_2 are placed in a 30.0 L tank at a temperature of 25^0 C, what will the pressure of the resulting mixture of gases be?

3) A balloon is filled with 35.0 L of helium in the morning when the temperature is 20.0^0 C. By noon the temperature has risen to 45.0^0 C. What is the new volume of the balloon?

4) A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?

5) A balloon that can hold 85 L of air is inflated with 3.5 moles of gas at a pressure of 1.0 atmosphere. What is the temperature in ^{0}C of the balloon?

6) $CaCO_3$ decomposes at 1200^0 C to form CO_2 gas and CaO. If 25 L of CO_2 are collected at 1200^0 C, what will the volume of this gas be after it cools to 25^0 C?

7) A helium balloon with an internal pressure of 1.00 atm and a volume of 4.50 L at 20.0^0 C is released. What volume will the balloon occupy at an altitude where the pressure is 0.600 atm and the temperature is -20.0^0 C?

8) There are 135 L of gas in a container at a temperature of 260^0 C. If the gas was cooled until the volume decreased to 75 L, what would the temperature of the gas be?

9) A 75 L container holds 62 moles of gas at a temperature of 215^0 C. What is the pressure in atmospheres inside the container?

10) 6.0 L of gas in a piston at a pressure of 1.0 atm are compressed until the volume is 3.5 L. What is the new pressure inside the piston?

11) A gas canister can tolerate internal pressures up to 210 atmospheres. If a 2.0 L canister holding 3.5 moles of gas is heated to 1350^0 C, will the canister explode?

12) The initial volume of a gas at a pressure of 3.2 atm is 2.9 L. What will the volume be if the pressure is increased to 4.0 atm?

13) An airtight container with a volume of 4.25×10^4 L, an internal pressure of 1.00 atm, and an internal temperature of 15.0^0 C is washed off the deck of a ship and sinks to a depth where the pressure is 175 atm and the temperature is 3.00^0 C. What will the volume of the gas inside be when the container breaks under the pressure at this depth?

14) Two flasks are connected with a stopcock. Flask #1 has a volume of 2.5 L and contains oxygen gas at a pressure of 0.70 atm. Flask #2 has a volume of 3.8 L and contains hydrogen gas at a pressure of 1.25 atm. When the stopcock between the two flasks is opened and the gases are allowed to mix, what will the resulting pressure of the gas mixture be?

15) A weather balloon has a volume of 35 L at sea level (1.0 atm). After the balloon is released it rises to where the air pressure is 0.75 atm. What will the new volume of the weather balloon be?

CHEM 150: Ch. 10 Ideal Gas Law

1. How many moles of gas (air) are in the lungs of an adult with a lung capacity of 3.9 L? Assume that the lungs are at 1.00 atm pressure and at a body temperature of 40 °C.
   (Hint: V, P, and T are given. Use the equation PV = nRT where R = 0.082058 $\frac{L \cdot atm}{K \cdot mol}$)

2. Calculate the volume occupied by 0.921 moles of nitrogen gas (N_2) at a pressure of 1.38 atm and a temperature of 316 K.

3. A sample of gas has a mass of 0.312 g. Its volume is 0.255 L at a temperature of 55 °C and a pressure of 888 mmHg (1 atm = 760 mmHg). Find its molar mass $\frac{Mass\ (m)}{Moles\ (n)}$

   (Hint: use PV = nRT)

4. A piece of dry ice (solid carbon dioxide) with a mass of 30.0 g sublimes (solid to gas) into a large balloon. Assuming that all of the carbon dioxide ends up in the balloon, what is the volume of the balloon at a temperature of 22 oC and a pressure of 742 mmHg?

   (Hint: 1 atm = 760 mmHg)

5. What is the volume occupied by 0.212 mol of helium gas at a pressure of 0.95 atm and a temperature of 325 K?

6. A cylinder contains 32.4 L of oxygen gas at a pressure of 2.3 atm and a temperature of 298 K. How much gas (in moles) is in the cylinder?

7. A sample of gas has a mass of 0.501 g. Its volume is 0.425 L at a temperature of 110 ^{o}C and a pressure of 1120 mmHg. Find its molar mass.

Name: Period:

Gas Stoichiometry Worksheet

Directions: Use the gas laws we have learned to solve each of the following problems. ***Each of the chemical equations must first be balanced***. Show all your work for credit.

1. When calcium carbonate is heated strongly, carbon dioxide gas is released according to the following equation:

   $$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

   What volume of $CO_2(g)$, measured at STP, is produced if 15.2 grams of $CaCO_3(s)$ is heated?

2. The synthesis of sodium chloride occurs according to the reaction:

   $$Na(s) + Cl_2(g) \rightarrow NaCl(s)$$

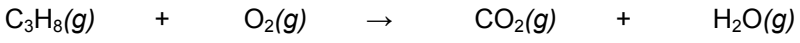
   What volume of chlorine at STP is necessary for the complete reaction of 4.81 grams of sodium metal?

3. Potassium permanganate is produced commercially by the this reaction:

   $$K_2MnO_4(aq) + Cl_2(g) \rightarrow KMnO_4(s) + KCl(aq)$$

   What volume of chlorine gas at STP would be required to produce 10.0 grams of $KMnO_4$?

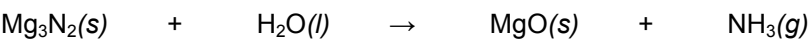
4. Consider the following *unbalanced* chemical equation for the combustion of propane:



$$C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$

What volume of oxygen at 25°C and 1.04 atm is needed for the complete combustion of 5.53 grams of propane?

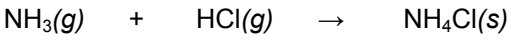
5. If water is added to magnesium nitride, ammonia gas is produced when the mixture is heated.



$$Mg_3N_2(s) + H_2O(l) \rightarrow MgO(s) + NH_3(g)$$

When excess water is added to 10.3 grams of magnesium nitride, what volume of ammonia gas would be collected at 24°C and 752 mmHg?

6. Ammonia and gaseous hydrogen chloride combine to form ammonium chloride according to this equation:



$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

If 4.21 L of $NH_3(g)$ at 27°C and 1.02 atm is combined with 5.35 L of $HCl(g)$at 26°C and 0.998 atm, what mass of $NH_4Cl(s)$ will be produced? Which gas is the limiting reactant? Which gas is the excess reactant?

Name _____ Period _____

GAS STOICHIOMETRY WORKSHEET

Please answer the following on separate paper using proper units and showing all work. Please note that these problems require a **balanced chemical equation**.

1. Carbon monoxide reacts with oxygen to produce carbon dioxide. If 1.0 L of carbon monoxide reacts with oxygen at STP,
    a. how many liters of oxygen are required to react?
    b. How many liters of carbon dioxide are produced?

2. Acetylene gas (C_2H_2) undergoes combustion to produce carbon dioxide and water vapor.
    a. How many liters of C_2H_2 are required to produce 75.0 L of CO_2?
    b. What volume of H_2O is produced?
    c. What volume of O_2 is required?

3. If liquid carbon disulfide (CS_2) reacts with 450 mL of oxygen to produce the gases carbon dioxide and sulfur dioxide, what volume of each product is produced?

4. Assume that 5.60 L of hydrogen gas at STP reacts with copper (II) oxide according to the following balanced equation:

$$CuO\ (s) + H_2\ (g) \rightarrow Cu\ (s) + H_2O\ (g)$$

    a. How many moles of H_2 react?
    b. How many moles of copper are produced?
    c. How many grams of copper are produced?

5. Assume that 8.5 L of iodine gas (I_2) are produced at STP according to the following balanced equation:

$$2\ KI\ (aq) + Cl_2\ (g) \rightarrow 2\ KCl\ (aq) + I_2\ (g)$$

    a. How many moles of I_2 are produced?
    b. How many moles of KI were used?
    c. How many grams of KI were used?

6. Solid iron (III) hydroxide decomposes to produce iron (III) oxide and water vapor. If 0.75 L of water vapor are produced at STP,
    a. How many grams of iron (III) hydroxide were used?
    b. How many grams of iron (III) oxide were produced?

7. Solid iron reacts with sulfuric acid (H_2SO_4) to produce iron (II) sulfate and hydrogen gas. If 650 mL of hydrogen gas are collected at STP, how many grams of iron (II) sulfate are also produced?

8. Assume that 13.5 grams of solid aluminum react with HCl according to the following balanced equation at STP:

$$2\ Al\ (s)\ +\ 6\ HCl\ (aq)\ \rightarrow\ 2\ AlCl_3\ (aq)\ +\ 3\ H_2\ (g)$$

   a. How many moles of Al react?
   b. How many moles of H_2 are produced?
   c. How many liters of H_2 are produced?

9. If air is 20.9% oxygen by volume,
   a. How many liters of **air** are needed to complete the combustion of 25.0 L of octane vapor (C_8H_{18}) at STP?
   b. What volume of each product is produced?

The following problems deal with reactions that <u>do not</u> occur at STP:

10. Ammonium sulfate, an important fertilizer, can be prepared by the reaction of ammonia with sulfuric acid according to the following balanced equation:

$$2\ NH_3\ (g)\ +\ H_2SO_4\ \rightarrow\ (NH_4)_2SO_4\ (aq)$$

    Calculate the volume of NH_3 (in liters) needed at 20ºC and 25.0 atm to react with 150 kg of H_2SO_4.

11. If 45.0 L of natural gas, which is essentially methane (CH_4), undergoes complete combustion at 730 mm Hg and 20ºC, how many grams of each product are formed?

12. Fritz Haber, a German chemist, discovered a way to synthesize ammonia gas (NH_3) by combining hydrogen and nitrogen gases at extremely high temperatures and pressures.
    a. Write the balanced equation for this reaction.
    b. If 10 kg of nitrogen combines with excess hydrogen at 550ºC and 250 atm, what volume of ammonia gas is produced?

13. A 3.25 gram sample of solid calcium carbide (CaC_2) reacts with water to produce acetylene gas (C_2H_2) and aqueous calcium hydroxide. If the acetylene was collected over water at 17ºC and 740.0 mm Hg, how many milliliters of acetylene were produced?

Chemistry 1

Volume 5

Worksheet 19

Dalton's Law of Partial Pressures – Part 2

1. A mixture of 4.5% H_2, 76% O_2, and 19.5% N_2 has a total pressure of 2.3 atm. What is the partial pressure of each of the gases?

2. A 2.5 L sample at 273 K contains 0.006 mol H_2, 0.0024 mol O_2, and 0.0002 mol CH_4. What is the partial pressure of O_2?

3. A 1.5 L sample at 298 K contains 0.030 mol N_2 and 0.0020 mol O_2. If the total pressure of the system is 0.52 atm, what is the partial pressure of the two gases?

4. A 500.0 mL sample of gases is at 307 K and contains N_2 at a pressure of 1.4 atm and O_2 at a pressure of 0.24 atm. What is the mole fraction of each of the two gases?

5. If a mixture of Ne and Ar has a total pressure of 1.5 atm at 296 K in a 0.5 L container, what is the partial pressure of Ne if Ar is present in a mole fraction of 0.34?

6. A mixture of H_2 and NH_3 has a total pressure of 1.02 atm at 273 K in a 0.75 L container. If H_2 is present in a mole fraction of 0.21, how many moles of NH_3 are present?

7. A mixture of unknown gases, A and B have partial pressure of P_A = 0.35 atm and P_B = 0.45 atm. If the gas mixture is at 256 K in a 1.1 L container how many moles of gas are present?

8. At 304 K, a 5.6 L container with H_2 and N_2 has a total pressure of 1.55 atm. If there are 0.034 moles of H_2, what is the partial pressure of N_2?