Honors Unit 8 – Gas Laws

Homework & Handouts

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Name: _____
Period: _____

Homework #1: Pressure Calculations and Manometer Problems

I. Complete the following table using pressure conversions:

Mm Hg	Atm	kPa
396		
	1.15	
		97.1

II. Manometer Problems

1. An open manometer is filled with mercury and connected to a container of hydrogen. The mercury level is 30.0 mm higher in the arm of the tube connected to the air. Air pressure is 1.00 atm. What is the pressure of the hydrogen gas in mm of Hg?

2. An open manometer is filled with mercury and connected to a container of oxygen. The mercury level is 75.0 mm higher in the arm of the tube connected to the container of oxygen. Air pressure is 1.00 atm. What is the pressure of the oxygen gas in atm?

Homework #2: Boyle's and Charles' Laws Worksheet

Boyle's Law

Use Boyle's Law to answer the following questions:

1) 1.00 L of a gas at standard temperature (0 deg. C) and pressure (1.00 atm) is compressed to 473 mL. What is the new pressure of the gas in atm? in mm Hg?

2) Synthetic diamonds can be manufactured at pressures of 6.00×10^4 atm. If we took 2.00 liters of gas at 760 torr and compressed it to a pressure of 6.00×10^4 atm, what would the volume of that gas be in mL?

3) Submarines need to be extremely strong to withstand the extremely high pressure of water pushing down on them. An experimental research submarine with a volume of 15,000 liters has an internal pressure of 1.2 atm. If the pressure of the ocean breaks the submarine forming a bubble with a pressure of 250 atm pushing on it, how big will that bubble be in L?

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Charles' Law

Use Charles' Law to answer the following questions:

4) A man heats a balloon in the oven. If the balloon initially has a volume of 400.0 mL and a temperature of 20 ^{0}C, what will the volume of the balloon be in L after he heats it to a temperature of 250 ^{0}C?

5) On hot days, you may have noticed that potato chip bags seem to "inflate", even though they have not been opened. If I have a 250 mL bag at a temperature of 19 ^{0}C, and I leave it in my car which has a temperature of 60^0 C, what will the new volume of the bag be?

6) A soda bottle is flexible enough that the volume of the bottle can change even without opening it. If you have an empty soda bottle (volume of 2.0 L) at room temperature (25 ^{0}C), what will the new volume be in mL if you put it in your freezer (-4 ^{0}C)?

7) I place a balloon in my fridge that initially has a temperature of 22^0 C and an initial volume of 0.5 liters. Once the balloon reaches the temperature of the refrigerator, I measure the final volume as 0.47 L. What is the final temperature of my refrigerator in Kelvin? In degrees Celsius?

HW #3: Gas Laws

1. What is a pressure of 3.00 atm equal to in mm Hg?

2. What is a pressure of 253 torr equal to in atm?

3. A balloon inflated in an air- conditioned room at 27^{o}C, has a volume of 4 L. It is heated to a temperature of 57^{o}C. What is the new volume of the balloon if the pressure remains constant?

4. The gas left in a used aerosol can is at a pressure of 1 atm at 27^{o}C. If this can is thrown unto a fire, what is the internal pressure of the gas when its temperature reaches 927^{o}C?

5. A container with an initial volume of 1.00 L is occupied by a gas at a pressure of 1.5 atm at 25^{o}C. By changing the volume, the pressure of the gas increases to 6.00 atm as the temperature is raised to 100^{o}C. What is the new volume?

6. What is the volume of 0.05 mol of nitrogen monoxide gas at STP?

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7. How many moles of molecules are present in 11.2 L of diphosphorus pentoxide gas at STP? What is the mass of this gas?

8. A gas occupies a volume of 180 mL at 35.0^{o}C and 740 mm Hg. What is the volume of the gas at conditions of STP?

9. Determine the volume in liters occupied by 22.6 g of chlorine gas at STP.

10. A gas storage tank has a volume of 3.5 x 10^{5} m^{3} when the temperature is 27^{o}C and the pressure is 1.0 atm. What is the new volume of the tank if the temperature drops to -10^{o}C and the pressure drops to 0.95 atm?

Homework #4: Ideal Gas Law Worksheet

I. Complete the following table for dinitrogen tetroxide (N_2O_4) gas.

Pressure	Volume	Temperature	Moles	Grams
	1.75 L	19 deg. C	1.66	
0.895 atm		6 deg. C		14.0
433 mm Hg	92.4 mL		0.395	

WORK:

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II. Problems

1. If the pressure exerted by a gas at 25 deg. C in a volume of 44 mL is 3.81 atm, how many moles of gas are present?

2. What is the pressure in mm Hg of a 0.108 mol sample of helium gas at a temperature of 20.0 deg. C, if its volume is 505 mL?

3. Determine the temperature in K and in deg. C required for a 0.09494 g sample of hydrogen gas (H_2) to fill a balloon to 1.20 L under 0.988 atm pressure.

Homework #5: Using the Ideal Gas Law to solve for Density or Molar Mass

A. Helium-filled balloons rise in the air because the density of helium is less than the density of air.

1. If air has an average molar mass of 29.0 g/mol, what is the density of air at 25 deg. C and 770 mm Hg?

2. What is the density of helium at the same temperature and pressure?

3. Would a balloon filled with carbon dioxide at the same temperature and pressure rise? Justify your answer by calculating the density of carbon dioxide.

B. Phosgene has a density of 4.24 g/L at 1.05 atm and 25 deg.C. What is the molar mass of phosgene?

C. Cyclopropane has a density of 1.71 g/L at 755 mm Hg and 25 degrees C.

1. What is the molar mass of cyclopropane?

2. If cyclopropane is made of 85.7% C and 14.3 % H, what is the molecular formula of cyclopropane? Hint: Review how to calculate an empirical and molecular formula from Semester 1!!

HW #6: Gases & Stoichiometry

1. Consider the following UNBALANCED equation:

$$C_8H_{18}\ (l) \quad + \quad O_2\ (g) \rightarrow CO_2\ (g) \quad + \quad H_2O\ (l)$$

A. If 7.25 L of oxygen at STP are reacted with an excess of C_8H_{18}, what volume of carbon dioxide also at STP can be produced?

B. What mass of water will be produced if 7.25 L of oxygen at STP are reacted with an excess of C_8H_{18}?

C. What volume of CO_2, measured at 44°C and 600 Torr, can be produced from a reaction of 2.90 g of C_8H_{18} with an excess of oxygen?

2. Given the following word equation:

Solid calcium carbonate + aqueous hydrochloric acid ➔
carbon dioxide gas + aqueous calcium chloride + liquid water

A. Write a balanced chemical equation, using symbols and states of matter.

B. What mass of calcium carbonate is needed to produce 125 L of carbon dioxide, measured at 1.50 atm and 127°C?

HW #7: Effusion & Diffusion

1. Put the following gases in order of their rates of effusion/diffusion, from the slowest to the most rapid, and then explain your reasoning in a complete sentence.

He SO_2 O_2 Cl_2

2. A gas diffuses three times as fast as sulfur trioxide. What is the molar mass of this gas?

3. An equal number of oxygen and hydrogen molecules are in a container covered with a piece of aluminum foil. A small foil is punched in the foil and some of the gas escapes from the container.

A. After a period of time, will there still be an equal mixture of oxygen and hydrogen in the container, or will there be more of one gas than the other?

B. If there will be more of one gas than the other, which one will you find more of inside the container?