Early Booklet E.C.: + 2
Unit 11 Hwk. Pts.: / 19
Unit 11 Lab Pts.: / 20
Late, Incomplete, No Work, No Units **Fees**? Y / N

Unit 11 – Gas Laws

Chapters 13 of your textbook

Learning Targets for Unit 11

1.1 I can state the relationships among pressure, temperature, and volume of a constant amount of gas.
1.2 I can apply gas laws to problems involving the pressure, temperature and volume of a constant amount of gas.
1.3 I can relate number of particles and volume using Avogadro's principle.
1.4 I can relate the amount of gas present to its pressure, temperature and volume using the ideal gas law.
1.5 I can compare the properties of real and idea gases.
1.6 I can determine volume ratios for gaseous reactants and products using coefficients from chemical equations.
1.7 I can apply gas laws to calculate amounts of gaseous reactants and products in a chemical reaction.

Unit Vocabulary for Unit 11

Boyle's law	Absolute zero	Charles's law	Gay-Lussac's law
Combined gas law	Avogadro's principle	Molar volume	Ideal gas constant
Ideal gas law			

Personal Notes for Unit 11.

Possible 11.1 Pts.: 7
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 7

11.1 Problems – Gas Laws
Section 13.1 of your textbook.

1. Give an example of how pressure and volume could change with the temperature remaining constant.

2. How could temperature and volume change in a system while maintaining a constant pressure?

3. How could you alter the pressure and temperature of a system, while maintain a constant volume?

4. If a gas is under a pressure of 1.6 atm in a 19.6 L container, what is the final pressure if its volume is decreased to 5.4 L?

5. A sample of air occupies 2.50 L at a temperature of 22.0 °C. What volume will this sample occupy inside a hot-air balloon at a temperature of 43.0 °C? Assume that the pressure inside the balloon remains constant.

6. A steel-belted automobile tire has a fixed volume as it heats up from 25.0 °C to 37.0 °C. If the pressure in the tire starts out at 1.88 atm, what will it be at 37.0 °C?

7. A sample of air in a syringe exerts a pressure of 1.02 atm at 22.0 °C. The syringe is placed in a boiling water bath at 100.0 °C. The pressure is increased to 1.23 atm by pushing the plunger in, which reduces the volume to 0.224 mL. What was the initial volume?

Possible 11.2 Pts.: 6
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 6

11.2 Problems – The Ideal Gas Law
Section 13.2 of your textbook.

1. Define 'ideal gas', and explain why there are no true ideal gases in nature.

2. What size container do you need to hold 0.0459 moles of N_2 gas at STP?

3. Calculate the volume that 450 g of krypton gas will occupy at STP.

4. What is the density of carbon dioxide gas at STP? Assume it's an ideal gas.

5. What is the pressure in atmospheres of a 0.108 mole sample of helium gas at a temperature of 20.0 °C if its volume is 0.505 L?

6. An ideal gas has a volume of 3.0 L. If the number of moles of gas and the temperature are doubled, while the pressure remains constant, what is the new volume?

Possible 11.3 Pts.: 6
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 6

11.3 Problems – Gas Stoichiometry
Section 14.3 of your textbook.

1. Why must an equation be balanced before using it to determine the volumes of gases involved in a reaction?

2. Explain why the coefficients in a balanced reaction represent not only molar amounts but also relative volumes for gases.

3. How many liters of propane (C_3H_8) gas will undergo complete combustion with 34.0 L of oxygen gas?

4. Determine the volume of hydrogen gas needed to react completely with 5.00 L of oxygen gas to form water.

5. Nitrogen and oxygen gases combine to form dinitrogen monoxide (N_2O). What mass of O_2 is needed to produce 34 L of N_2O?

6. When solid calcium carbonate is heated, it decomposes to form solid calcium oxide and carbon dioxide gas. How many liters of CO_2 will be produced at STP if 2,380 g of $CaCO_3$ react completely?

Chemistry		Lab 11.1: Popcorn Pressure Lab			
Name:					Correction Credit: Half
Lab Points:	Missed:	Late, No Units, No Work Fee:	First Score:	Corrections:	Final Score:
20		- 1 - 2 - 3 - 4			

Overview:

You can use the Ideal Gas Law to approximate how much pressure is required to rupture the husk of a popcorn kernel during the popping of popcorn.

Ideal Gas Law Equation:

$$pV = nRT$$

Materials:

20 popcorn kernels
Deionized water
10-mL graduated cylinder
Vegetable oil
Disposable plastic dropper
Steel can
Balance
Aluminum Foil
Bunsen burner
Ring stand
Tongs

Procedure:

1. Pour 5 mL of distilled water into the graduated cylinder and record the volume in the data table.
2. Put 20 robust popcorn kernels in the cylinder, and record the new volume. Then, subtract the initial volume from the final and record this in the table – it is the volume of the popcorn kernels.
3. Remove the kernels from the cylinder and dry them thoroughly.
4. Place the dry kernels into the steel can.
5. Using the disposable plastic dropper, add 4.0 ml of vegetable oil and record the mass of the can/oil/popcorn system.
6. Put an aluminum foil cover over the can to prevent popcorn from flying out, and put it on the ring stand.
7. Moving the can back and forth over the flame, heat the can evenly using a low flame until the popcorn stops popping.
8. Remove the can promptly after the popping stops, so that your sample does not burn. Let it cool down for five minutes.
9. When the can is cool, measure the mass of the can, popcorn, and remaining oil and record it.
10. Determine the mass of water lost during popping and record it in your table. This is equal to the difference between initial can/popcorn/oil mass and final mass.
11. In your data table, record the temperature of the oil at 225 °C during popping.

Cleanup:

Empty the popcorn sample into the trash, then thoroughly clean the can with soap and water.

Data Table: 10 Points. Include Units for full credit.

Initial Water Volume (mL)	
Final Water Volume (mL)	
Kernel Volume (mL)	
Kernel Volume (L)	
Initial Can/Oil/Popcorn Mass	
Final Can/Oil/Popcorn Mass	
Water Mass	
Oil Temperature (°C)	
Oil Temperature (K)	

Calculations and Questions: Show all work for your calculations.

1. (2 Points) Calculate the number of moles of water released, using data from your table.

2. (2 Points) Convert the mL volume into lliters, and the Celsius temperature into Kelvins.

3. (2 Points) Using the Ideal Gas Law, calculate the pressure inside the kernels when they pop.

4. (2 Points) Sometimes not all popcorn kernels pop. Why do you think this is?

5. (2 Points) We made an assumption in this lab: that the total volume of the kernels is available for the water molecules to move around in until the kernels pop. We know however that there's a lot of other stuff inside the kernels. With this in mind, how would the pressure inside the kernels at the instant of popping be affected? Would the pressure be higher, or lower? Explain your answer.

Points Possible:	10
Late/Inc. Fee: -1 -2	- 3
Final Score:	/ 10

Unit 11 Review – Gas Laws

This serves as test preparation for the Unit 8 Test. Points earned are based on completion, and we will go over any questions you have during the review.

1. Pure methane (CH_4) undergoes complete combustion by reacting with oxygen gas to form carbon dioxide and water vapor.
    a. Write a balanced equation for this reaction

    b. What is the volume ratio of methane to water in this reaction?

    c. If you started with 12.4 moles of methane, how many liters of oxygen would be needed to completely react with methane at STP?

2. A 7.0 L container filled with water vapor has a temperature of 125 °C at 1.0 atm of pressure. How many moles, and grams of water are in the container?

3. Determine the pressure inside an old-school television picture tube with a volume of 3.5 L that contains 2.00 E -5 g of nitrogen gas at 22.0 °C.

4. Write the Charles's Law formula.

5. Write the Boyle's Law formula.

6. Write the Gay-Lussac's Law formula.

7. Write the Ideal Gas Law formula.

8. Why don't real gases behave ideally?

9. How much carbon dioxide gas (in moles, and grams) do you have in a 1.0 L balloon at STP?

10. If the pressure exerted by a gas at 25 °C in a volume of 0.044 L is 3.81 atm, how many moles of gas are present?