Exercise 11.3b
The Ideal Gas Law

Name: _____

Date: _____ Per: _____

The Basic Gas Laws	The Combined Gas Law	Ideal Gas Law
B: $P_1V_1 = P_2V_2$	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	PV = nRT
C: $T_1V_2 = T_2V_1$		
G-L: $P_1T_2 = P_2T_1$	*or* $P_1V_1T_2 = P_2V_2T_1$	

DIRECTIONS: Answer the following in the space provided.

Basic Gas Laws

1. A balloon is moved from inside a warm building to outside where it is cold. It shrinks. Which of the basic gas laws does this represent? Why does this occur?

2. If a volume of gas in a container has its pressure doubled, what will happen to the volume of the gas?

3. At what temperature (in Celsius and Kelvin) do the particles of a sample of gas stop moving? What is this temperature called?

4. An aerosol can is thrown into a fire and it explodes. Which of the basic gas laws does this represent? What is happening in the container?

5. When a person goes up in an airplane and their ears pop, which of the gas laws does this represent? Explain how?

6. Two containers of gas are opened in a room. One contains hydrogen gas (H_2), the other ammonia (NH_3). Which diffuses through the room the fastest? Why? Which law is this?

Dalton's Law of Partial Pressures

7. Container A (with volume 1.20 L) contains a gas under 3.24 atm of pressure. Container B (with volume 0.900 L) contains a gas under 2.84 atm of pressure. Container C (with volume 1.80 L) contains a gas under 1.20 atm of pressure. If all of these gases are put into Container D (with volume 3.60 L), what is the pressure in Container D?

Combined Gas Law

8. A quantity of gas has a volume of 400. L at 23.0 ºC and 700. mmHg of pressure. What will the new pressure be if the temperature is raised to 33.0 ºC and the volume is reduced to 150. L?

Answers: 7) 2.39 atm 8) 1930 mm Hg 10) 1550 L 11) 7.99 mol 12) 3.98 L 13) 381 K or 108 ºC

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The ideal gas law relates the pressure (P), volume (V), temperature (T), and amount of gas in moles (n) by way of the universal gas constant (*R)*. The law describes the relationship of these variables for an ideal gas by combining four basic gas laws – Boyle's, Charles', Gay-Lussac's, and Avogadro's. The law is used to describe a gas under constant conditions rather than predicting the effect of change on the gas as with individual gas laws (i.e., there are no subscripts as in 'T_1', 'V_1', 'T_2', etc. because the conditions are not changing). Because it relates the conditions of the gas to the amount in moles, it is useful in completing gas stoichiometry calculations. The ideal gas law equation is:

$$PV = nRT$$

The value of the universal gas constant, *R*, is calculated by using the statement of standard molar volume (1 mole of gas at STP = 22.4 L) and knowledge of the values of standard atmospheric pressure (1 atm, 760 mmHg, 101.325 kPa, etc.). The value of *R* used must match the unit being used for measuring pressure in the calculation.

9. Derive the value of ***R*** for <u>both mmHg and atm</u> using Avogadro's Principle and the Ideal Gas Law.

10. What is the volume of a 30.5 mol gas sample that exerts a pressure of 0.500 atm at a temperature of 310.K?

11. How many moles of hydrogen gas (H_2) are present in a 20.0 L sample of gas at a pressure of 10.0 atm and a temperature of 305 K?

12. What is the volume in liters of a 50.0 g sample of oxygen gas (O_2) at 310. K and a pressure of 10.0 atm?

13. At what temperature will a 2.30 mol sample of gas at 1.20 atm pressure have a volume of 60.0 L?

Answers: 7) 2.39 atm 8) 1930 mm Hg 10) 1550 L 11) 7.99 mol 12) 3.98 L 13) 381 K or 108 °C