Name_____

Gases – Study Guide

Part 1. Fill in the Blank

Boyle's Law relates the pressure and volume of a gas with the relationship **$P_1V_1=P_2V_2$** . This law explains that at a constant temperature, as the volume of a gas increases, the pressure **decreases**. **Charles' Law** relates the temperature and volume of a gas with the relationship **$V_1T_2 = V_2T_1$** . This law explains that as the temperature of a gas increases, the volume **increases** (at a constant pressure). The **Ideal Gas Law** relates all 4 properties of a gas **Pressure,Volume,Temperature,# of moles** with the relationship **PV=nRT**. R has two values depending on the units of the problem you are trying to solve. R =**8.314**(L*kPa)/(mol*˚K) or R = **0.0821**(L*atm)/(mol*˚K). Temperature must be measured in Degrees Kelvin. To convert Celsius to Kelvin, use the relationship: K= ˚C + **273.15**. Standard temperature and pressure (STP) refers to **0** ˚C (**273.15** K) and **1** atm. A gas at STP has a volume of **22.4 L (per mole!)**.

Word Bank: decreases, pressure, Charles's Law, moles, Boyle's Law, Ideal gas Law, $P_1V_1=P_2V_2$, temperature, $V_1T_2=V_2T_1$, volume, PV=nRT, 0.0821, 8.314, 22.4, 273.15, 273.15, 0, 1

Part 2. Circle the correct response.

In the Cartesian Diver lab, the soda bottle was sealed. When you squeezed it, the pressure inside the bottle (**increases**/decreases) and the diver sank. Which gas law explains this? (**Boyle's**/Charles's).

In the Classic Can Crush lab, the water in the can is heated up. This causes the steam and hot air to (**expand**/contract). When it is suddenly cooled in the tub of water the hot air/steam is forced to (expand/**contract**) creating a vacuum in the can and causing the can to implode. Which gas law explains this? (Boyle's/**Charles's**)

Part 3. Calculation

1. A gas has a pressure measured at 79,000 pascals. What is this pressure in atmospheres?

(make a note on back if you have to:
1 atm = 101,325 Pa = 101.325 kPa = 14.7 psi = 760 mmHg = 760 torr)

$$\frac{79{,}000\ \text{Pa}}{} \times \frac{1\ \text{atm}}{101{,}325\ \text{Pa}} = 0.779\ \text{atm}$$

2. A sample of a gas has a volume of 200 mL when its pressure is 0.750 atm. What will the volume of the gas be at a pressure of 0.250 atm, if the temperature remains constant?

Boyle's Law: $P_1V_1 = P_2V_2$

$V_2 = P_1V_1/P_2$ = 0.750 ~~atm~~ * 200 mL / 0.250 ~~atm~~ = 600 mL

3. A sample of a gas occupies a volume of 245 mL at 25°C. What volume will the gas occupy if the temperature increases to 100°C, while the pressure remains constant? **Charles' Law: $V_1T_2 = V_2T_1$**

$V_2 = V_1T_2/T_1$

V1 = 245 mL T1 = 25 C + 273 = 298 K T2 = 100 C + 273 = 373 K

V2 = 245 mL * 373 / 298 = 307 mL

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4. Calculate the approximate volume of a 0.800 mol sample of gas at 35.0°C and a pressure of 1.25 atm.
Ideal gas law: PV = nRT n = 0.800 mol P = 1.25 atm T = 35 C + 273 = 308 K
V = nRT/P = 0.800 * 0.0821 * 308 / 1.25 = 16.2 L

Part 4. Honors Only

10. An unknown gas occupies 11.2 L of volume at 298 K under 1 atm of pressure.
This gas sample has a mass of 19.97 grams. Please give the molar mass, in grams per mole, of this gas.
How do you find the molar mass here? Molar mass = mass in grams/ # of moles
Mass in grams = 19.97 g
#moles is 'n': n = PV/RT = 1 atm*11.2 L / (0.0821 * 298 K) = 0.458 mol
Molar mass = 19.97 g / 0.458 mol = 43.6 g/mol