GAS LAW NOTES Name: ______________________________

gas laws – simple mathematical relationships between volume (V), temperature (T), pressure (P) and amount (moles) of a gas (n)

Boyle's Law – the **volume** of a fixed mass of a gas varies inversely with the **pressure.**

Formula:

$P \cdot V = k$ ↑ ↓ | $P_1 \cdot V_1 = P_2 \cdot V_2$ (initial, final)

Sample Problem:

$(0.947 \text{ atm})(150. \text{ mL}) = (0.987 \text{ atm})(V_2)$

144 mL

k= constant dependent on moles and temp

Kelvin Temperature Scale: Celsius + 273.15 degrees

Ex) 25 deg Celsius = 298.15 K

0 in Kelvin = absolute zero = *volume of a gas equals zero!*

How: Kelvin found that decreasing the temp of a gas and holding pressure constant decreased vol of gas by 1/273 of original volume starting at 0 Celsius. Therefore, at –273 Celsius, the volume should be zero!

BUT, in real gases, IMFs exceed kinetic energy at low temps and the gases condense to liquids (like liquid nitrogen or liquid oxygen).

Charles's Law – **volume** (V) of a fixed mass of a gas at constant pressure varies directly with the **Kelvin temperature** (T)

Formula:

$\frac{V}{T} = k$ | $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Sample Prob:

$\frac{752 \text{ mL}}{298 \text{ K}} = \frac{V_2}{323 \text{ K}}$

$V_2 = 815 \text{ mL}$

k= constant dependent on moles of gas and pressure

Gay-Lussac Law – the **pressure** of a fixed mass of gas at a constant volume varies directly with the Kelvin **temperature**

Formula:

↑ ↑ $\frac{P}{T} = k$ | $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Sample Prob:

$\frac{3.00 \text{ atm}}{298 \text{ K}} = \frac{P_2}{325 \text{ K}}$ = 3.27 atm

k= constant dependent on moles of gas and volume

The Combined Gas Law: puts together the previous three laws

Formula:

$\frac{P \cdot V}{T} = k$ | $\frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2}$

Sample Problem:

k= constant dependent only on mass of gas

STP

Boyles, Charles, Gay-Lussac and Combined EXAMPLE PROBLEMS!!

P_1 1) A sample of oxygen gas has a volume of 150. mL (V_1) when its pressure is 0.947 atm. What will the volume of the gas be at a pressure of 0.987 atm (P_2) if the temperature is held constant?

solved on first sheet

2) A sample of neon gas occupies a volume of 752 mL at 25 °C (298K). What volume will the gas occupy at 50.°C (323 K) if the pressure remains constant?

solved on first sheet

3) A gas in an aerosol can is at a pressure of 3.00 atm at 25 °C. Directions warn not to heat the can past 52 °C. What would the pressure of the can be at 52 °C?

solved on first sheet

4) A helium balloon has a volume of 50.0 L at 25 °C and 1.08 atm. What volume will it have at 0.855 atm and 10. °C?

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(1.08\,atm)(50.0\,L)}{298\,K} = \frac{(0.855\,atm)V_2}{283\,K}$$

$59.97 \approx 60.0\ L$