Name: Key Period: ____________ Date: ______________

Video Notes: Ideal Gas Law

BIG IDEAS | ***DETAILS***

Combined Gas Law

Currently we have four laws which each compare 2 properties of gases. These four laws can be combined to make one mega equation.

If you combine Gay-Lussac's, Charles' Law, and Boyle's Law, you find the combined gas law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

This law is used if more than one variable is changing at the same time. To use this law, moles must stay constant.

PRACTICE QUESTION: 322 L of hydrogen is cooled to STP (0°C and 1 atm). After cooling, the gas occupies a volume of 197 L. If the initial temperature of the hydrogen was 37° C, what was its initial pressure?

$V_1 = 322L$ $V_2 = 197L$

$T_1 = 273K$ $T_2 = 310K$

$P_1 = 1atm$ $P_2 = ?$

$$P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{(1atm)(322L)(310K)}{(273K)(197L)}$$

$$P_2 = 1.86 \text{ atm}$$

Ideal Gas Law

Remember that each side of the two variable gas laws equals a constant. If you combine them all and add moles to the combined gas law, pressure times volume divided by moles times temperature equals (you guessed it) a constant.

Those are the only four things we can measure about a gas - so that constant is true for all gases, under all conditions. This is the Universal gas constant, abbreviated R.

$$R = \frac{0.08206 \text{ atm}\cdot L}{mol\cdot K} = \frac{PV}{nT}$$

We can clean this up and rearrange to get the Ideal Gas Law:

$$PV = nRT$$

This gives us information about a given sample of gas under constant conditions.

QUESTION: How is the ideal gas law different from all the other gas laws?

no change in conditions is necessary to use it

Problems	***EXAMPLE PROBLEM:*** A sample of gas is placed in a container with a volume of 2.7 L. The pressure is measured as 1.25 atm at a temperature of 295 K. How many moles of gas are in the container? $P = 1.25$ atm $V = 2.7$ L $T = 295$ K $n = \frac{PV}{RT} = \frac{(1.25 \text{ atm})(2.7 \text{ L})}{259 \text{ K}} \cdot \frac{\text{mol}\cdot\text{K}}{0.08206 \text{ L}\cdot\text{atm}}$ $n = 0.14$ moles
	EXAMPLE PROBLEM: A sample of gas is placed in a container with a volume of 2.7 L, a pressure of 1.5 atm and a temperature of 295K. If the temperature is raised to 325K and the volume is reduced to 1.0L, what will happen to the pressure inside the container? ***QUESTION:*** Which law should you use? combined - conditions are changing! $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ P_1 1.5 atm V_1 2.7 L T_1 295 K P_2 ? V_2 1.0L T_2 325K $P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{(1.5\text{atm})(2.7\text{ L})(325\text{ K})}{(295\text{ K})(1.0\text{ L})}$ $P_2 = 4.5$ atm
SUMMARY	