Name: ____ Date: ________

CHEMISTRY: Gases and Gas Laws
Boyle's Law & Charles's Law

Part 1: Temperature conversions. Celsius is used for some chemistry applications, however, Kelvin is used for gas applications. Convert from Celsius to Kelvin, and from Kelvin to Celsius.

Convert from Celsius to Kelvin:
K = ºC + 273

K = temp Kelvin
ºC = temp Celsius

Convert from Kelvin to Celsius:
ºC = K – 273

Convert 37 ºC to K		Convert 37 K to ºC	
Convert 8 ºC to K		Convert 190 K to ºC	
Convert -210 ºC to K		Convert 365 K to ºC	
Convert 350 ºC to K		Convert 600 K to ºC	

Part 2: Pressure conversions. Pressure is the amount of force applied per unit area on a surface. Pressure units may be reported in Pascals (the SI units) or in Atmospheres. You will encounter both units for pressure when using gas applications.

Convert from Pascals to Atmospheres:

$$\text{Atm} = \text{Pa} \cdot \frac{1\ \text{Atm}}{101325\ \text{Pa}}$$

Pa = pressure Pascals
Atm = pressure atmospheres

Convert from Atmospheres to Pascals:

$$\text{Pa} = \text{Atm} \cdot \frac{101325\ \text{Pa}}{1\ \text{Atm}}$$

Convert 2.0 Atm to Pa		Convert 85,000 Pa to Atm	
Convert 0.033 Atm to Pa		Convert 450,100 Pa to Atm	
Convert 3.75 Atm to Pa		Convert 7,200 Pa to Atm	

Part 3: Boyle's Law. Boyle's Law relates the amount of pressure of a gas acting on its surroundings as a function of changing volume of the gas. A compressed gas (reduced volume) will apply a greater force on the surroundings, like the walls of the container.

Boyle's law

$$P_1 \cdot V_1 = P_2 \cdot V_2$$

P_1 = initial pressure (Pa or atm
V_1 = initial volume (liters or m^3)
P_2 = final pressure (Pa or atm)
V_2 = final volume (liters or m^3)

Solving for final pressure or final volume.

$$P_2 = \frac{P_1 \cdot V_1}{V_2} \quad \text{or} \quad V_2 = \frac{P_1 \cdot V_1}{P_2}$$

Show your work in the large rectangles to the right of the questions.

2.40 moles of Kr gas has a volume of 4.75 L with a pressure of 14.6 atmospheres. Calculate the pressure of the Kr gas when the volume expands to 22.4 L.	
1.25 moles of CO_2 gas has a volume of 68 L with a pressure of 0.44 atmospheres. The volume is compressed such that the final pressure of the gas is 7.20 atmospheres. Calculate the final volume.	

Part 4: Charles's Law. Charles's Law relates the volume of a gas in a free space as a function of changing temperature (in Kelvin). Hotter gases will occupy larger volumes. Cooler gases will occupy smaller volumes.

Charles's law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

V_1 = initial volume (L or m^3)
T_1 = initial temperature (K)
V_2 = final volume (L or m^3)
T_2 = final temperature (K)

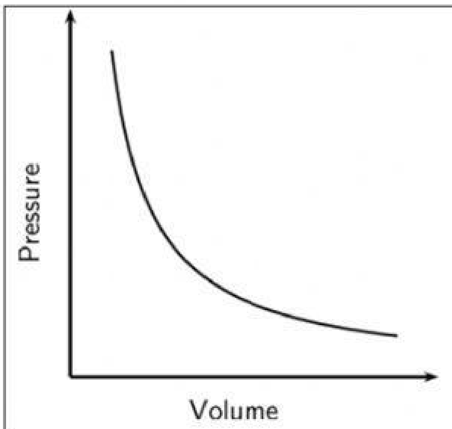
Solving for final pressure or final temperature.

$$V_2 = \frac{V_1 \cdot T_2}{T_1} \quad \text{or} \quad T_2 = \frac{V_2 \cdot T_1}{V_1}$$

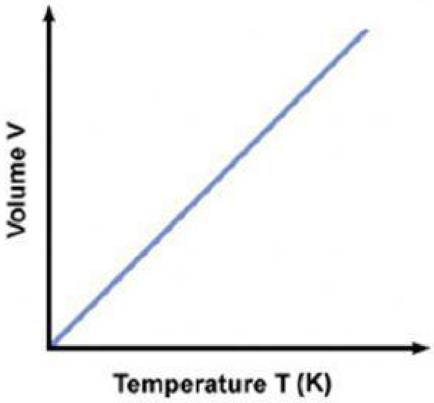
Show your work in the large rectangles to the right of the questions. Temperatures must be in Kelvin.

2.40 moles of Kr gas has a volume of 4.75 L with a pressure of 14.6 atmospheres at 80ºC. Pressure does not change. Calculate the volume of the Kr gas at 300ºC.	
1.25 moles of CO_2 gas has a volume of 68 L with a pressure of 0.44 atmospheres at 20ºC. The gas is cooled to a temperature of -180ºC. Calculate the volume of the gas at -180ºC.	

Part 5. Follow-up questions.

	Study the graph to the left. The independent variable (x) is the volume of the gas. The dependent variable (y) is the pressure of the gas. In your own words, describe the shape of the black line on the graph.
If the volume of the gas is decreased to **½ of the original volume**, what should happen to the pressure of the gas? Use the example to help you.	The pressure inside a sealed vessel is 8 atmospheres when the volume is 20 liters. The gas is compressed into a volume of 10 liters. $P_1 \cdot V_1 = P_2 \cdot V_2$ $8.0\ \text{atm} \cdot 20\ \text{l} = \mathbf{P_2} \cdot 10\ \text{l}$

If the volume of the gas is expanded to **4-times the original volume**, what should happen to the pressure of the gas? Use the example to help you.	The pressure inside a sealed vessel is 8 atmospheres when the volume is 20 liters. The gas is allowed to expand in volume to 80 liters. $P_1 \cdot V_1 = P_2 \cdot V_2$ $8.0\text{ atm} \cdot 20\text{ l} = \mathbf{P_2} \cdot 80\text{ l}$

	Study the graph to the left. The independent variable (x) is the temperature of the gas. The dependent variable (y) is the volume of the gas. In your own words, describe the shape of the blue line on the graph.
If the temperature of the gas is heated to 2-times the original temperature, what will happen to the volume of the gas?	The temperature of 10 liters of gas is 100 K. The temperature is raised to 200 K. $\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{10\ l}{100\ K} = \frac{\mathbf{V_2}}{200\ K}$
If the temperature of the gas is cooled to 1/5 of the original temperature, what will happen to the volume of the gas?	The temperature of 10 liters of gas is 250 K. The temperature is cooled to 50 K. $\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{10\ l}{250\ K} = \frac{\mathbf{V_2}}{50\ K}$