Name_____ Date_____ Hour_____

Boyle's and Charles' Law Worksheet

Boyle's Law: $P_1V_1 = P_2V_2$ **Charles' Law:** $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

1) 1.00 L of a gas at standard temperature and pressure is compressed to 473 mL. What is the new pressure of the gas?

P_1 = pressure at 1 atm; V_1; P_2

$473\text{ mL} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.473\text{ L}$

$P_1V_1 = P_2V_2$

$\frac{(1\text{ atm})(1.00\text{ L})}{0.473\text{ L}} = \frac{(P_2)(0.473\text{ L})}{0.473\text{ L}}$

$P_2 = 2.11\text{ atm}$

2) In a thermonuclear device, the pressure of 0.050 L of gas within the bomb casing reaches 4.0×10^6 atm. When the explosion destroys the bomb casing, the gas is released into the atmosphere where it reaches a pressure of 1.00 atm. What is the volume of the gas after the explosion?

V_1; P_1; P_2; V_2

$P_1V_1 = P_2V_2$

$\frac{(4.0\times10^6\text{ atm})(0.050\text{ L})}{1.00\text{ atm}} = \frac{(1.00\text{ atm})(V_2)}{1.00\text{ atm}}$

$V_2 = 200{,}000\text{ L}$

3) The temperature inside my refrigerator is about 4°C. If I place a balloon in my fridge that initially has a temperature of 22°C and a volume of 0.5 L, what will be the volume of the balloon when it is fully cooled by my refrigerator?

T_2; T_1; V_1; V_2

$T_1 = 22^\circ\text{C} + 273.15 = 295.15\text{ K}$

$T_2 = 4^\circ\text{C} + 273.15 = 277.15\text{ K}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{0.5\text{ L}}{295.15\text{ K}} = \frac{V_2}{277.15\text{ K}}$

$V_2 = 0.47\text{ L}$

4) The highest pressure ever produced in a laboratory setting was about 2.0×10^6 atm. If we have a 1.0×10^{-5} L sample of a gas at that pressure, then release the pressure until it is equal to 0.275 atm, what would the new volume of that gas be?

P_1; V_1; P_2; V_2

$P_1V_1 = P_2V_2$

$\frac{(2.0\times10^6\text{ atm})(1.0\times10^{-5}\text{ L})}{0.275\text{ atm}} = \frac{(0.275\text{ atm})(V_2)}{0.275\text{ atm}}$

$V_2 = 73\text{ L}$

5) A man heats a balloon in the oven. If the balloon initially has a volume of 0.40 L and a temperature of 20°C, what will be the volume of the balloon after he heats it to a temperature of 250°C?

V_1; T_1; V_2; T_2

$T_1 = 20^\circ\text{C} + 273.15 = 293.15\text{ K}$

$T_2 = 250^\circ\text{C} + 273.15 = 523.15\text{ K}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{0.40\text{ L}}{293.15\text{ K}} = \frac{V_2}{523.15\text{ K}}$

$V_2 = 0.71\text{ L}$

6) On hot days, you may have noticed that potato chip bags seem to "inflate", even though they have not been opened. If I have a 250 mL (V_1) bag at a temperature of 19.0°C (T_1), and I leave it in my car, which has a temperature of 60.0°C (T_2), what will the new volume (V_2) of the bag be?

$T_1 = 19°C + 273.15 = 292.15K$

$T_2 = 60°C + 273.15 = 333.15K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{250mL}{292.15K} = \frac{V_2}{333.15K}$$

$$\boxed{V_2 = 290mL}$$

7) Some students believe that teachers are full of hot air. If I inhale 2.2 L (V_1) of gas at a temperature of 18°C (T_1) and it heats to a temperature of 38°C (T_2) in my lungs, what is the new volume (V_2) of the gas?

$T_1 = 18°C + 273.15 = 291.15K$

$T_2 = 38°C + 273.15 = 311.15K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{2.2L}{291.15K} = \frac{V_2}{311.15K}$$

$$\boxed{V_2 = 2.4\ L}$$

8) To compress nitrogen at 1.0 atm (P_1) from 750.0 mL (V_1) to 500.0 mL (V_2), what must the new pressure (P_2) be if the temperature is kept constant?

$$P_1V_1 = P_2V_2$$

$$\frac{(1.0\ atm)(750.0mL)}{500.0mL} = \frac{P_2(500.0mL)}{500.0mL}$$

$$\boxed{P_2 = 1.5\ atm}$$

9) How hot will a 2.3 L (V_1) balloon have to get to in order to expand to a volume of 400.0 L (V_2)? Assume that the initial temperature of the balloon is 25°C (T_1).

$T_1 = 25°C + 273.15 = 298.15K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{2.3L}{298.15K} = \frac{400.0L}{T_2}$$

$$\boxed{T_2 = 52{,}000\ K}$$

10) A sample of nitrogen at 20°C was compressed from 300.0 mL (V_1) to 0.360 mL (V_2), and its new pressure was found to be 400.0 Pa (P_2). What was the original pressure (P_1)?

$$P_1V_1 = P_2V_2$$

$$\frac{P_1(300.0mL)}{300.0mL} = \frac{(400.0Pa)(0.360mL)}{300.0mL}$$

$$\boxed{P_1 = 0.48\ Pa}$$