Worksheet: Gas Laws, Part I

1. A 10.0 L balloon contains helium gas at a pressure of 655 mm Hg. What is the new pressure, in mm Hg, of the helium gas at each of the following volumes, if there is no change in temperature and amount of gas?

a. 20.0 L

$P_1 = 655$ mm Hg $\quad P_2 = ?$

$V_1 = 10.0$ L $\quad V_2 = 20.0$ L

$P_1V_1 = P_2V_2$

$(655)(10.0) = (P_2)(20.0)$

$P_2 = 328$ mm Hg

b. 2.50 L

$P_1 = 655$ mm Hg $\quad P_2 = ?$

$V_1 = 10.0$ L $\quad V_2 = 2.50$ L

$P_1V_1 = P_2V_2$

$(655)(10.0) = (P_2)(2.50)$

$P_2 = 2620$ mm Hg

c. 1500. mL

$P_1 = 655$ mm Hg $\quad P_2 = ?$

$V_1 = 10.0$ L $\quad V_2 = 1.500$ L

$P_1V_1 = P_2V_2$

$(655)(10.0) = (P_2)(1.500)$

$P_2 = 4370$ mm Hg

2. A sample of neon initially has a volume of 2.50 L at 15°C. What final temperature, in °C, is needed to change the volume of the gas to each of the following, if P and n do not change?

a. 5.00 L

$V_1 = 2.50$ L $\quad V_2 = 5.00$ L

$T_1 = 15°C + 273.15 = 288$ K $\quad T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{2.50}{288} = \frac{5.00}{T_2}$

$T_2 = 576$ K $- 273.15$

$T_2 = 303°C$

b. 1250 mL

$V_1 = 2.50$ L $\quad V_2 = 1.25$ L

$T_1 = 288$ K $\quad T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{2.50}{288} = \frac{1.25}{T_2}$

$T_2 = 144$ K $- 273.15$

$T_2 = -129°C$

c. 7.50 L

$V_1 = 2.50$ L $\quad V_2 = 7.50$ L

$T_1 = 288$ K $\quad T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{2.50}{288} = \frac{7.50}{T_2}$

$T_2 = 864$ K $- 273.15$

$T_2 = 591°C$

3. A sample of xenon at 25°C and 745 mm Hg is cooled to give a pressure of 625 mm Hg. Calculate the final temperature, in °C.

$P_1 = 745$ mm Hg $\quad P_2 = 625$ mm Hg

$T_1 = 25°C + 273.15 = 298$ K $\quad T_2 = ?$

$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \frac{745}{298} = \frac{625}{T_2}$

$T_2 = 250$ K $- 273.15$ $\quad T_2 = -23°C$

4. A sample of helium gas has a volume of 6.50 L at a pressure of 845 mm Hg and a temperature of 25°C. What is the final pressure of the gas, in atmospheres, when the volume and temperature of the gas sample are changed to the following, if the amount of gas does not change?

a. 1850 mL and 325 K

$P_1 = 845\ mm\ Hg$ $\quad P_2 = ?$

$V_1 = 6.50\ L$ $\quad V_2 = 1.85\ L$

$T_1 = 25°C + 273.15 = 298\ K$ $\quad T_2 = 325\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(845)(6.50)}{(298)} = \frac{(P_2)(1.85)}{(325)}$$

$$P_2 = 3240\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = \boxed{4.26\ atm}$$

b. 2.25 L and 12°C

$P_1 = 845\ mm\ Hg$ $\quad P_2 = ?$

$V_1 = 6.50\ L$ $\quad V_2 = 2.25\ L$

$T_1 = 298\ K$ $\quad T_2 = 12°C + 273.15 = 285\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(845)(6.50)}{(298)} = \frac{(P_2)(2.25)}{(285)}$$

$$P_2 = 2330\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = \boxed{3.07\ atm}$$

c. 12.8 L and 47°C

$P_1 = 845\ mm\ Hg$ $\quad P_2 = ?$

$V_1 = 6.50\ L$ $\quad V_2 = 12.8\ L$

$T_1 = 298\ K$ $\quad T_2 = 47°C + 273.15 = 320.\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(845)(6.50)}{(298)} = \frac{(P_2)(12.8)}{(320.)}$$

$$P_2 = 461\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = \boxed{0.606\ atm}$$