CHARLES' LAW

Name _____ EN 8

Charles' Law states that the volume of a gas varies directly with the Kelvin temperature, assuming that pressure is constant. We use the following formulas:

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

$$K = °C + 273$$

Solve the following problems assuming a constant pressure.

1. A sample of nitrogen occupies a volume of 250 mL at 25° C. What volume will it occupy at 95° C?

$\frac{250\ K}{298\ K} = \frac{V_2}{368\ K}$ → 368 K T_1

309 mL

2. Oxygen gas is at a temperature of 40° C when it occupies a volume of 2.3 liters. V_1 To what temperature should it be raised to occupy a volume of 6.5 liters? V_2

$T_2\ \frac{2.3\ L}{313\ K} = \frac{6.5\ L}{T_2} \cdot T_2$ $\quad \frac{T_2(0.0073\ L/K)}{.0073} = \frac{6.5\ L}{.0073}$

890 K

3. Hydrogen gas was cooled from 150° C to 50° C. Its new volume is 75 mL. What was its original volume?

$\frac{V_1}{423\ K} = \frac{75\ mL}{323\ K}$ V_1 T_1

98 mL

4. Chlorine gas occupies a volume of 25 mL at 300 K. What volume will it occupy at 600 K? V_2 T_2

$\frac{(25\ mL)(600\ K)}{300\ K} = \frac{(V_2)(300\ K)}{300\ K}$

50 mL

5. A sample of neon gas at 50° C and a volume of 2.5 liters is cooled to 25° C. What is the new volume?

$\frac{2.5\ L}{323\ K} = \frac{V_2}{298\ K}$

2.3 L

6. Fluorine gas at 300 K occupies a volume of 500 mL. To what temperature should it be lowered to bring the volume to 300 mL? T_1 V_1 T_2 V_2

$\frac{(500\ mL)(T_2)}{500\ mL} = \frac{(300\ mL)(300\ K)}{500\ mL}$

180 K

7. Helium occupies a volume of 3.8 liters at -45° C. What volume will it occupy at 45° C?

$\frac{3.8\ L}{228\ K} = \frac{V_2}{318\ K}$

5.3 L

8. A sample of argon gas is cooled and its volume went from 380 mL to 250 mL. If its final temperature was -55° C, what was its original temperature?

$\frac{380\ mL}{T_1} = \frac{250\ mL}{218\ K}$

331 K

BOYLE'S LAW

Name _____

Boyle's Law states that the volume of a gas varies inversely with its pressure if temperature is held constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

Solve the following problems (assuming constant temperature).

1. A sample of oxygen gas occupies a volume of 250. mL at 740. torr pressure. What volume will it occupy at 800. torr pressure?

$(740\ \text{torr})(250\text{mL}) = (800\ \text{torr})(V_2)$ 231 mL

2. A sample of carbon dioxide occupies a volume of 3.50 liters at 125 kPa pressure. What pressure would the gas exert if the volume was decreased to 2.00 liters?

initial condition $V_1 = 3.5\text{L}$ $P_1 = 125\ \text{kPa}$ $V_2 = 2\text{L}$ $\frac{(125\ \text{kPa})(3.5\text{L})}{2\text{L}} = \frac{P_2(2\text{L})}{2\text{L}}$ 219 kPa

3. A 2.0 liter container of nitrogen had a pressure of 3.2 atm. What volume would be necessary to decrease the pressure to 1.0 atm?

$(3.2\ \text{atm})(2\text{L}) = (1\ \text{atm})V_2$ 6.4L

4. Ammonia gas occupies a volume of 450. mL at a pressure of 720. mm Hg. What volume will it occupy at standard pressure?

$V_1 = 450\text{mL}$ $V_2 = ?$ $P_1 = 720\ \text{mm Hg}$ $P_2 = 760\ \text{mm Hg}$

$\frac{(450\text{mL})(720\ \text{mm Hg})}{760\ \text{mm Hg}} = \frac{V_2(760\ \text{mm Hg})}{760}$ 426mL

5. A 175 mL sample of neon had its pressure changed from 75 kPa to 150 kPa. What is its new volume?

$(75\ \text{kPa})(175\text{mL}) = (150\ \text{kPa})(V_2)$ 87.5 mL

6. A sample of hydrogen at 1.5 atm had its pressure decreased to 0.50 atm producing a new volume of 750 mL. What was its original volume?

$P_1 = 1.5\text{atm}$ $P_2 = 0.5\text{atm}$ $V_1 = ?$ $V_2 = 750\text{mL}$

$\frac{(1.5\text{atm})(V_1)}{1.5\text{atm}} = \frac{(0.5\text{atm})(750\text{mL})}{1.5\text{atm}}$ 250 mL

7. Chlorine gas occupies a volume of 1.2 liters at 720 torr pressure. What volume will it occupy at 1 atm pressure?

760 torr = 1atm

$(720\ \text{torr})(1.2\text{L}) = (760\ \text{torr})V$ 1.1L

8. Fluorine gas exerts a pressure of 900. torr. When the pressure is changed to 1.50 atm, its volume is 250. mL. What was the original volume?

1140 torr

317 mL