Gas Laws: Part 1

1. A cylinder is filled with a gas. The cylinder has a moveable piston. Indicate how the following would affect the pressure of the gas.

a) double the temperature while keeping the volume constant.

Let P_1 = 1 atm, T_1 = 100 K, T_2 = 200 K

$P_2 = \frac{1\ atm \times 200\ K}{100\ K} = 2\ atm$ Pressure doubles

b) Increase the volume by three times while keeping the temperature constant.

Let P_1 = 1 atm, V_1 = 1 L, V_2 = 3 L

$P_2 = \frac{1\ atm \times 1\ L}{3\ L} = 0.3\ atm$ Pressure decreases by one third.

c) double the volume while decreasing the temperature by one half.

Let P_1 = 1 atm, T_1 = 100 K, T_2 = 50 K, V_1 = 1 L, V_2 = 2L

$P_2 = \frac{1\ atm \times 1\ L \times 50\ K}{2\ L \times 100\ K} = 0.25\ atm$ The pressure would decrease

d) increase the amount of gas by three while keeping the volume and temperature constant.

Let P_1 = 1 atm, n_1 = 1 mol, n_2 = 3 mol

$P_2 = \frac{1\ atm \times 3\ mol}{1\ mol} = 3\ atm$ The pressure would increase

2. A cylinder with a moveable piston is filled with gas. Indicate how the following would affect the volume of the gas.

a) decrease the temperature by one-third while keeping the pressure constant

Let V_1 = 1 L, T_1 = 100 k, T_2 = 33.3 K

$V_2 = \frac{1\ L \times 33.3 K}{100\ K} = 0.33\ L$ Volume has decreased

b) Increase the pressure by 75% while keeping the temperature constant.

Let P_1 = 1 atm, V_1 = 1 L, P_2 = 1.75 atm

$V_2 = \frac{1\ atm \times 1\ L}{1.75\ atm} = 0.6\ L$ Volume has decreased

c) Halve the temperature and triple the pressure

Let P_1 = 1.00 atm, T_1 = 100 K, V_1 = 1 L, T_2 = 50 K, P_2 = 3.00 atm

$V_2 = \frac{1.00\ atm \times 50\ K \times 1\ L}{100\ K \times 3.00\ atm} = 0.17\ L$ The volume decreases.

d) Increase the amount of gas by one-half while keeping the temperature and pressure constant.

Let n_1 = 1 mol, n_2 = 0.5 mol, V_1 = 1 L

$V_2 = \frac{1\ L \times 0.5\ mol}{1\ mol} = 2\ L$ The volume increases by 2 L

3. Which of the following has more molecules?

1.00 L of CO_2 at STP, 1.00 L of O_2 at STP, or 1.00 L N_2 at STP?

They all contain the same number of gas molecules.