UG SEM II (MJC-2T), Physical chemistry
1. Gaseous state

Avogadro's Law: In 1811, Amedo Avogadro fixed Gay-Lussac's issue in finding the correlation between the amount of gas (n) and Volume (V) (assuming Temperature, T and Pressure, P remain Constant):

$$V \propto n \rightarrow V = Zn$$

- Volume (V) is directly proportional to the amount of gas (n).

Another form of the equation (assuming there are 2 sets of Conditions, and setting both Constants to each other) that might help solve problems is:

$$\frac{P_1}{n_1} = Z = \frac{P_2}{n_2}$$

Example: A 3.80 g of oxygen gas in a pump has Volume of 150 mL, at Constant temperature and pressure. If 1.20 g of oxygen gas is added into the pump, what will be the new Volume of oxygen gas in the pump if temperature and pressure held Constant?

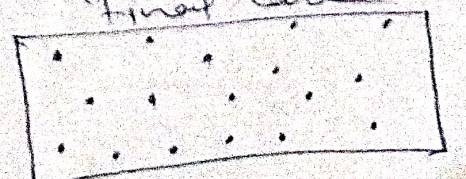
Solution:

Initial Case

3.80 g of oxygen gas
150 mL

At the same temperature

Final Case



5.00 g of oxygen gas
$V_{new} = ?$

$V_1 = 150\ mL$

$n_1 = \dfrac{m_1}{M_{oxygen\ gas}}$

$n_2 = \dfrac{m_2}{M_{oxygen\ gas}}$

$$V_2 = \frac{V_1 \cdot n_2}{n_1} = 150\ mL \times \frac{5.00\ g}{32.0\ g \cdot mol^{-1}} \Big/ \frac{3.80\ g}{32.0\ g \cdot mol^{-1}}$$

$= 197\ mL$

Ideal gas law: The ideal gas law is the combination of the three simple gas laws. By setting all three laws directly or inversely proportional to volume, you get;

$$V \propto \frac{nT}{P}$$

Next, replacing the directly proportional to sign with a constant (R) you get.

$$V = \frac{RnT}{P}$$

And finally get the equation:

$$PV = nRT$$

where, P is the absolute pressure of ideal gas
V = volume of ideal gas, n = amount of gas,
T = absolute temperature, R = gas constant.