Gas Law: (Different kinds of units for pressure and volume can be used provided the value of the gas constant is adjusted to those units)

PV = nRT P = Pressure in atm
V = Volume in L
n = Number of Moles
T = Temperature in °K; K and °C are the same size, but 0 K = - 273 °C
R = Gas Constant

$$R \text{ is } \frac{0.082 \text{ L} \cdot \text{atm.}}{\text{mol} \cdot \text{K}}$$

Standard conditions for temperature and pressure (STP)
Old definition of STP used in this course
Standard pressure is 1 atmosphere, or 760 mmHg; standard temperature is 273 K
1 mol of gas occupies 22.4 L at STP. –

Sample Question: A certain amount of N_2 gas occupies a volume of 3 mL at 750 mmHg and room temperature (298 K). What volume it will occupy at standard pressure and temperature (STP)?

$\frac{P_1V_1}{P_2V_2} = \frac{nRT_1}{nRT_2}$ divide equations to give $\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$

$P_1 = 760$ mmHg $T_1 = 273$ °K $V_1 = ?$
$P_2 = 750$ mmHg $T_2 = 298$ °K $V_2 = 3$ mL

Solve for V_1

$$V_1 = \frac{T_1P_2V_2}{T_2P_1} = \frac{(273 \text{ °K})(750 \text{ mmHg})(3 \text{ mL})}{(298 \text{ °K})(760 \text{ mmHg})} = 2.71 \text{ mL}$$

Question: How many moles of N_2 is 2.71 mL at STP and what is its mass?

Note: 1 mole of an ideal gas occupies 22.4 L at STP.

$$2.71 \times 10^{-3} \text{ L} \times \frac{1 \text{ mole}}{22.4 \text{ L}} = 1.21 \times 10^{-4} \text{ moles of } N_2$$

$$1.21 \times 10^{-4} \text{ mol} \times 28 \text{ g/mol} = 3.4 \text{ mg of } N_2$$