Answer on Question #75492, Chemistry / General Chemistry

The volume of a quantity of SO2 at 18.0 Celsius and 1500 mm Hg is 5.00 ft^3. Calculate its volume at STP.

Solution:

According to the Boyle-Mariotte law, at a constant temperature, the pressure produced by a given gas mass is inversely proportional to the volume of the gas:

$$\frac{P_0}{P_1} = \frac{V_1}{V_0} \ \ or \ \ PV = const.$$

According to the Gay-Lussac's law under constant pressure, the volume of gas varies directly in proportion to the absolute temperature (T):

$$\frac{V_1}{T_1} = \frac{V_0}{T_0} \ \ or \ \frac{V}{T} = const.$$

The relationship between gas volume, pressure and temperature can be expressed by a general equation combining of Boyle-Mariotte and Gay-Lussac's laws:

$$\frac{PV}{T} = \frac{P_0V_0}{T_0}$$

where P and V are the pressure and volume of the gas at a given temperature T; P_0 and V_0 - pressure and volume of gas under normal conditions (STP).

The above equation allows us to find any of the indicated quantities, if the others are known.

STP or normal conditions - the values of standard temperatures and pressures.

These values are: Pressure: 760 mm Hg; Temperature: 273.15 ° K

Substituting the data given in the assignment into the equation, we get:

$$V_0 = \frac{PVT_0}{TP_0} = \frac{1500 \times 5 \times 273}{760 \times 291} \approx 9{,}26\ ft^3$$

Answer: Volume of SO_2 at STP will be 9,26 ft^3