STP (Standard Temperature and Pressure)

Scientists established a set of conditions when referring to gases to allow for the comparison of the properties of different gases.

Standard Pressure – 1atm (101.3 kPa)

Standard Temperature - 0°C (273 K)

e.g. a sample of gas occupies 500ml at STP. What volume will it occupy at 124 kPa and 10°C?

Temperature, pressure and volume are varying in this example which makes it well suited to using the combined gas law to answer the question…

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$V_1 = 0.500L$ $V_2 = ?$

$P_1 = 101.3\ kPa$ $P_2 = 124\ kPa$

$T_1 = 273\ K$ $T_2 = 283\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad \frac{(101.3kPa)(0.5L)}{273K} = \frac{(124kPa)(V_2)}{283K}$$

$$V_2 = 0.423L$$

We can also answer this question by employing Boyle's Law to calculate how the change in pressure impacts the volume and then use that resultant volume with Charles' Law to calculate the change in temperature's impact upon the volume…

$V_1 = 0.500L$ $V_2 = ?$

$P_1 = 101.3\ kPa$ $P_2 = 124\ kPa$

Boyle's Law

$$P_1 V_1 = P_2 V_2 \qquad V_2 = \frac{(101.3kPa)(0.5L)}{(124kPa)} \qquad V_2 = 0.409\ L$$

now we take the resultant volume (0.0409 L) and estimate any further impact the change in temperature will have on the resultant volume…

$V_1 = 0.409L$ $V_2 = ?$

$T_1 = 273\ K$ $T_2 = 283\ K$

Charles' Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{0.409L}{273K} = \frac{V_2}{283K} \qquad V_2 = 0.423\ L$$