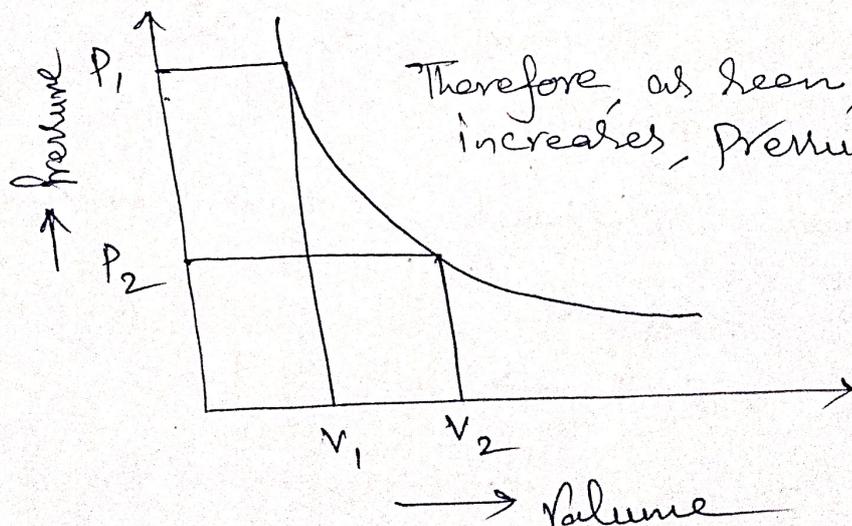# 1. Gaseous State

Boyle's Law : In 1662, Robert Boyle discovered the correlation between pressure (P) and volume (V) (assuming Temperature T and amount of gas (n) remain Constant):

$$P \alpha \frac{1}{V} \rightarrow PV = x$$

where, x is a Constant depending on amount of gas at a given temperature.

- Pressure is inversely proportional to Volume.

Therefore, as seen, as Volume increases, Pressure decreases.

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

$$P_1 V_1 = x = P_2 V_2$$

30.1 A 17.50 mL sample of gas is at 4.500 atm. what will be the Volume if the pressure becomes 1.500 atm, with a fixed amount of gas and temperature?

Solution:

Initial Case

4.500 atm
17.50 mL

← At the same temperature →

Final Case

1.500 atm

$V_{new} = ?$
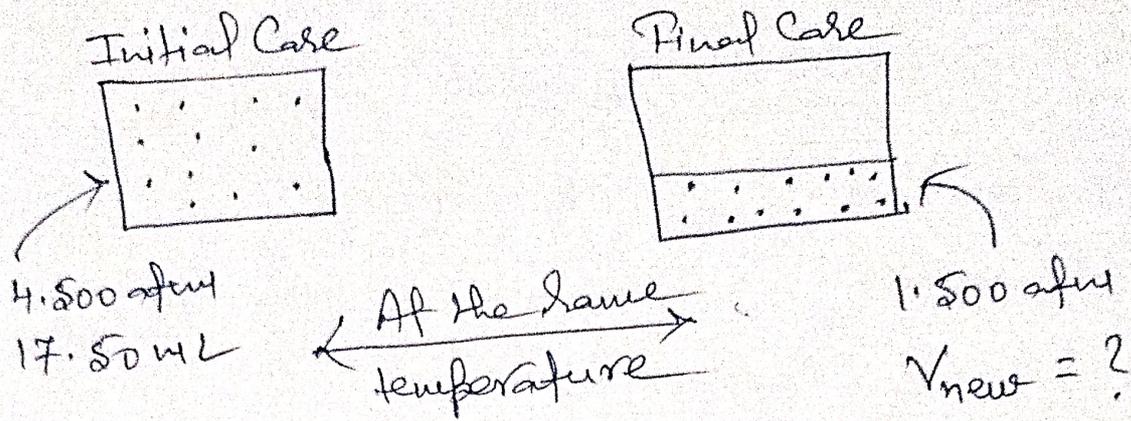
$$V_2 = \frac{P_1 V_1}{P_2} = \frac{4.500 \text{ atm} \times 17.50 \text{ mL}}{1.500 \text{ atm}}$$

$$= 52.50 \text{ mL}.$$

Charles' Law:

In 1787, French physicist Jacques Charles, discovered the correlation between Temperature (T) and Volume (V) (assuming Pressure, P and amount of gas, n remain Constant):

$$V \propto T \rightarrow V = yT$$

where, y is a constant depending on amount of gas and pressure. Volume is directly proportional to Temperature.
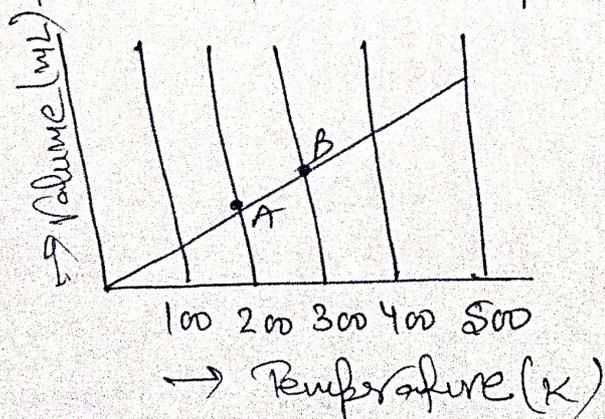
The graph shows as the temperature increases, Volume increases (linear graph).

Another form of equation:

$$\frac{V_1}{T_1} = y = \frac{V_2}{T_2}$$