if μ mole of gas is present in the vessel

$$N = \mu N_A$$

by Eq (9) $\frac{PV}{T} = k_B(\mu N_A)$

μ = No. of moles
N_A = Avogadro number
k_B = Boltzmann const.

$$\frac{PV}{T} = \mu(k_B N_A)$$

$$\frac{PV}{T} = \mu R \quad \text{—(10)}$$

$\boxed{R = k_B N_A}$ → Universal Gas Constant

$$\boxed{PV = \mu RT} \quad \text{—(11)}$$

Determination of value of R:

For $\mu = 1$ mole, $T = 273k$, $P = 1 atm = 1.013 \times 10^5 N/m^2$

$V = 22.4 Lt = 22.4 \times 10^{-3} m^3$

$\because PV = \mu RT \Rightarrow R = \frac{PV}{\mu T}$

$$R = \frac{1.013 \times 10^5 \times 22.4 \times 10^{-3}}{1 \times 273} = 8.31$$

$= 8.31 \ J \ mol^{-1} K^{-1}$

Unit of R:

$R = \frac{PV}{\mu T}$

Unit of $R = \frac{(N/m^2) m^3}{mol \cdot K}$

$= \frac{Nm}{mol \ K} = J \ mol^{-1} k^{-1}$