$1 cal = 4.18 J \Rightarrow 1 J = \frac{1}{4.18} cal$

$R = \frac{8.31}{4.18} cal\ mol^{-1} K^{-1} \approx 2 cal\ mol^{-1} K^{-1}$

**Determination of value of $k_B$:** $\because R = k_B \cdot N_A$

$$k_B = \frac{R}{N_A} \Rightarrow k_B = \frac{8.31}{6.023 \times 10^{23}} = 1.38 \times 10^{-23} J K^{-1}$$

**Note:**

gas → mass of gas = m

→ No. of moles of gas = $\mu$ mole

$$m = \mu M \quad (12)$$

$$\mu = \frac{m}{M} \quad (13)$$

$$PV = \left(\frac{m}{M}\right) \cdot RT \quad (14)$$

$\frac{m}{V}$ = density of gas ($\rho$)