Thermal energy $E_{th} = K_{micro} + U_{micro}$

→ ideal gas : no molecular bonds

↳ $U_{micro} = 0$

Monoatomic (entirely translational kinetic energy)

⇒ $E_{th} = K_{micro} = N \varepsilon_{avg.}$

$= \frac{3}{2} nRT = \frac{3}{2} N k_B T$

**

$W = \int_{V_0}^{V} p\,dV$ gas contracts : neg. work

expands : pos. work

$W = \Delta KE$

$pV = \Delta \left(\frac{2}{3} N \varepsilon_{avg} \right)$

$\Delta E_{sys.} = \Delta E_{mech.} + \Delta E_{th}$

$= W + Q$

---

1. Law : $Q - W = \Delta U_{internal}$

- isochoric (V const.) → no work $W = 0$
- isothermal (T const) → ΔU const. $W = -nRT \ln\left(\frac{V_f}{V_i}\right)$
- adiabatic (no heat transfer)
- isobaric (p const.) $W = -p \Delta V$

* ideal gas law ⇒ $pV = nRT = N k_B T$

R universal gas constant : $R = 8.31$ J/mol K

n number of moles