Equations:

Work-done: $W = PdV = \int PdV$

1st law of Thermodynamics: $q = dE + W$

Entropy: $\Delta S = \frac{q}{T} = k\ln(\text{Multiplicity}) = k\ln[\text{D(E)}\delta\text{E}]$

Density of states in 3D: $D(\varepsilon) = \frac{2\pi(2m)^{3/2}}{h^3} V\varepsilon^{1/2}$

$\frac{1}{T} = \left(\frac{\partial S}{\partial E}\right)_{\text{fixed external parameters}}$

Ideal gas law: $PV = NkT$

For an adiabatic process: $PV^{\gamma} = \text{constant}$ or $TV^{\gamma-1} = \text{constant}$

$q = C_p dT$ at a constant pressure. $q = C_V dT$ at a constant volume.

$\gamma = \frac{C_p}{C_V}$, $\gamma = 1.6$ for monatomic gas and $\gamma = 1.4$ for diatomic gas

Efficiency of an engine (cycle): $\eta = \frac{W}{Q_H} = \frac{Q_H - Q_C}{Q_H}$

For Carnot engine: $\eta_{\text{Carnot}} = 1 - \frac{Q_C}{Q_H} = 1 - \frac{T_C}{T_H}$

Boltzmann constant $k = 1.381\times10^{-23}$ J/K Plank's constant $h = 6.63 \times 10^{-34}$ Js

1.0 eV $= 1.6 \times 10^{-19}$ J