Constants:

$e = 1.6 \times 10^{-19} C$; $\epsilon_0 = 8.85 \times 10^{-12}\, C^2/Nm^2$; $k = \frac{1}{4\pi\epsilon_0} = 9.0 \times 10^9\, N \cdot m^2/C^2$;

$\mu_0 = 4\pi \times 10^{-7}\, T \cdot m/A$; $\sigma = 5.670400 \times 10^{-8}\, W/m^2 \cdot K^4$; $R = 8.314\, J/mol \cdot K$

Unit conversion:

$eV = 1.6 \times 10^{-19} J$; Magnetic field is: tesla ($1T = 1\, N/A \cdot m$); Magnetic flux: weber ($1 Wb = 1 T \cdot m^2 = 1\, N \cdot m/A$); $1\, cal = 4.186\, J$; $1\, Btu = 252\, cal = 1055\, J$

Formulas

- $\vec{F}_m = q\vec{v} \times \vec{B}$; $d\vec{F} = I\, d\vec{l} \times \vec{B}$
- $\vec{\tau} = I\vec{A} \times \vec{B}$ (magnetic torque for a current-carrying loop in magnetic field)
- $\vec{\mu} = I\vec{A}$ (magnetic dipole moment); $\vec{\tau} = \vec{\mu} \times \vec{B}$; $U_m = -\vec{\mu} \cdot \vec{B}$
- $d\boldsymbol{\vec{B}} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2}$
- Magnetic field produced by a circular current loop: $\vec{B} = \frac{\mu_0 I a^2}{2(x^2+a^2)^{3/2}} \hat{\imath}$ (on the axis of a circular loop who axis is aligned along $\hat{i}$)
- $\epsilon = \frac{-d\Phi_B}{dt}$
- $\Delta L = \alpha L_0 \Delta T$ (thermal expansion in 1 dimension) $\Delta V = \beta V_0 \Delta T$ (thermal expansion in 3 dimension)
- $Q = mc\Delta T$; $Q = nC\Delta T$ (C is molar heat capacity, could be either C_V or C_p)
- $Q = mL$ (L: latent heat)
- $H = \frac{dQ}{dt} = kA\frac{T_H - T_L}{L}$ (heat conduction); $H = Ae\sigma T^4$ (heat radiation)
- $pV = nRT$ (ideal gas); $(p + \frac{an^2}{V^2})(V - nb) = nRT$ (van der Waals gas (non-ideal gas))
- $K_{tr} = \frac{3}{2} nRT$ (total kinetic energy); $E_k = \frac{1}{2} m(v^2)_{av} = \frac{3}{2} kT$ (single molecule kinetic energy)
- $v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$ (rms speed of gas molecules); $C_V = \frac{dof}{2} R$ (molar heat capacity in constant volume condition)

Maxwell's equations

- $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{encl}}{\epsilon_0}$ (Gauss's Law for $\vec{E}$); $\oint \vec{B} \cdot d\vec{A} = 0$ (Gauss's Law for $\vec{B}$)
- $\oint \vec{B} \cdot d\vec{l} = \mu_0 (I_{encl} + \epsilon_0 \frac{d\Phi_E}{dt})$ (Ampere's Law); $\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$ (Faraday's Law)

- $\vec{B} = \frac{\mu_0 I}{2\pi r}$
- $\varepsilon = N \frac{\mu_0 B}{2\pi} ln\left(1 + \frac{a}{c}\right) \frac{I(t)}{R_0 C}$