

$$\begin{aligned}
\mu_0 &= 4\pi \times 10^{-7} T \cdot m/A \\
\mu_0 &= 1.26 \times 10^{-6} T \cdot m/A \\
k &= \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 N \cdot m^2/C^2 \\
\epsilon_0 &= 8.85 \times 10^{-12} C^2/(N \cdot m^2) \\
e &= 1.60 \times 10^{-19} C \\
G &= 6.67 \times 10^{-11} N \cdot m^2/kg^2 \\
h &= 6.626 \times 10^{-34} J \cdot s \\
g &= 9.8 m/s^2 \\
c &= 3.00 \times 10^8 m/s \\
N_A &= 6.02 \times 10^{23} \text{ mol}^{-1} \\
m_e &= 9.11 \times 10^{-31} kg \\
m_p &= 1.67 \times 10^{-27} kg \\
1 \text{ m} &= 3.28 \text{ ft} \\
1 \text{ lb} &= 4.45 N \\
1 \text{ eV} &= 1.6 \times 10^{-19} J \\
\rho_{\text{aluminum}} &= 2.75 \times 10^{-8} \Omega \cdot m \\
\rho_{\text{silver}} &= 1.47 \times 10^{-8} \Omega \cdot m \\
\rho_{\text{copper}} &= 1.72 \times 10^{-8} \Omega \cdot m \\
\rho_{\text{gold}} &= 2.44 \times 10^{-8} \Omega \cdot m \\
\rho_{\text{steel}} &= 20 \times 10^{-8} \Omega \cdot m \\
F &= k \frac{|q_1||q_2|}{r^2} \\
dq &= i dt \\
q &= ne \\
\vec{E} &= \frac{\vec{F}}{q_0} \\
E &= \frac{1}{4\pi\epsilon_0} \frac{|q|}{r^2} \\
E &= \frac{qz}{4\pi\epsilon_0 (z^2 + R^2)^{3/2}} \quad (\text{ring}) \\
E &= \frac{\sigma}{2\epsilon_0} \left(1 - \frac{z}{\sqrt{z^2 + R^2}} \right) \quad (\text{disk}) \\
\Phi &= \oint \vec{E} \cdot d\vec{A} \\
\epsilon_0 \Phi &= q_{\text{enc}} \\
\epsilon_0 \oint \vec{E} \cdot d\vec{A} &= q_{\text{enc}} \\
E &= \frac{\sigma}{\epsilon_0} \quad (\text{surface}) \\
E &= \frac{\sigma}{2\epsilon_0} \quad (\text{sheet}) \\
E &= \frac{\lambda}{2\pi\epsilon_0 r} \quad (\text{line}) \\
V &\equiv \frac{U}{q} = \frac{-W}{q}
\end{aligned}$$

$$\begin{aligned}
\Delta V &\equiv \frac{K_2 - K_1}{q} \\
V &= V_f - V_i = - \int_i^f \vec{E} \cdot d\vec{s} \\
V &= \frac{1}{4\pi\epsilon_0} \frac{q}{r} \\
V &= \sum_i \frac{1}{4\pi\epsilon_0} \frac{q_i}{r_i} \\
V &= \int dv = k \int \frac{dq}{r} \\
qV &= \frac{1}{2} mv^2 \\
E_s &= -\frac{\partial V}{\partial s} \\
E_x &= -\frac{\partial V}{\partial x} \\
E_y &= -\frac{\partial V}{\partial y} \\
U &= \frac{kq_1q_2}{r} \\
q &= CV \\
C &= \frac{\epsilon_0 A}{d} \quad \text{parallel} \\
C &= 2\pi\epsilon_0 \frac{L}{\ln(b/a)} \quad \text{cylindrical} \\
C &= 4\pi\epsilon_0 \frac{ab}{b-a} \quad \text{spherical} \\
C &= 4\pi\epsilon_0 R \quad \text{sphere} \\
C_{\text{eq}} &= \sum_{j=1}^n C_j \\
C_{\text{eq}} &= \frac{1}{\sum_{j=1}^n \frac{1}{C_j}} \\
U &= \frac{q^2}{2C} \\
U &= \frac{1}{2} CV^2 \\
i &\equiv \frac{dq}{dt} \\
i &= \int \mathbf{J} \cdot d\mathbf{A} \\
J &= \frac{I}{A} \\
V &= \frac{IR}{E} \\
\rho &\equiv \frac{J}{E} \\
\mathbf{E} &= \rho \mathbf{J} \\
\sigma &\equiv \frac{1}{\rho} \\
R &= \rho \frac{L}{A}
\end{aligned}$$

$$\begin{aligned}
P &= i^2 R \\
P &= \frac{R}{V^2} \\
P &= \frac{R}{E} \\
P &= \frac{t}{iV} \\
P &= \frac{dW}{dq} \\
\mathcal{E} &= \frac{\mathcal{E}}{R} \\
i &= \frac{R}{\sum_{j=1}^n R_j} \\
R_{\text{eq}} &= \frac{1}{\sum_{j=1}^n \frac{1}{R_j}} \\
\frac{1}{R_{\text{eq}}} &= \sum_{j=1}^n \frac{1}{R_j} \\
P_{\text{emf}} &= i\mathcal{E} \\
q &= q_0 e^{-t/RC} \\
T_{1/2} &= RC \ln 2 \\
\vec{F}_B &= q\vec{v} \times \vec{B} \\
F_B &= |q|vB \sin \phi \\
|q|vB &= \frac{mv^2}{r} \\
r &= \frac{mv}{|q|B} \\
T &= \frac{2\pi m}{qB} \\
f &= \frac{qB}{2\pi m} \\
\omega &= \frac{qB}{m} \\
\vec{F}_B &= i\vec{L} \times \vec{B} \\
d\vec{F}_B &= i d\vec{L} \times \vec{B} \\
d\vec{B} &= \frac{\mu_0 i d\vec{s} \times \vec{r}}{4\pi r^3} \\
B &= \frac{\mu_0 i}{2\pi r} \quad (\text{long straight wire}) \\
B &= \frac{\mu_0 i \phi}{4\pi R} \quad (\text{arc}) \\
F_{ba} &= \frac{\mu_0 L i_a i_b}{2\pi d} \quad (\text{two straight wires}) \\
\oint \vec{B} \cdot d\vec{s} &= \mu_0 i_{\text{enc}} \\
B &= \mu_0 i n \quad (\text{solenoid}) \\
B &= \frac{\mu_0 i N}{2\pi r} \quad (\text{toroid}) \\
\Phi_B &= \int \vec{B} \cdot d\vec{A} \quad (\text{magnetic flux}) \\
\Phi_B &= BA \\
\mathcal{E} &= -\frac{d\Phi_B}{dt} \quad (\text{Faraday's Law}) \\
\mathcal{E} &= BLv
\end{aligned}$$

$$\begin{aligned}
\oint \vec{E} \cdot d\vec{s} &= -\frac{d\Phi_B}{dt} \\
L &= \frac{N\Phi}{i} \quad (\text{inductance}) \\
\frac{L}{l} &= \mu_0 n^2 A \quad (\text{solenoid}) \\
\mathcal{E}_L &= -L \frac{di}{dt} \\
L \frac{di}{dt} + Ri &= \mathcal{E} \\
\tau_L &= \frac{L}{R} \\
i &= i_0 e^{-t/\tau_L} \\
U_B &= \frac{1}{2} Li^2 \\
i_{\text{rms}} &= \frac{i}{\sqrt{2}} \\
V_2 &= \frac{N_2}{N_1} V_1 \\
E &= cB \\
c &= \frac{\lambda f}{c} \\
n &= \frac{v}{c} \\
I &= \frac{1}{2} I_0 \quad (\text{unpolarized}) \\
I &= I_0 \cos^2 \theta \quad (\text{polarized}) \\
\theta'_1 &= \theta_1 \quad (\text{reflection}) \\
n_2 \sin \theta_2 &= n_1 \sin \theta_1 \quad (\text{refraction}) \\
\theta_c &= \sin^{-1} \frac{n_2}{n_1} \\
s' &= -\frac{s}{r} \\
f &= \pm \frac{1}{2} \quad (\text{spherical}) \\
\frac{1}{s} + \frac{1}{s'} &= \frac{1}{f} \\
m &= \frac{-s'}{s} \quad (\text{magnification}) \\
\gamma &= \frac{1}{\sqrt{1 - (v/c)^2}} \\
\Delta t &= \gamma \Delta t_0 = \frac{\Delta t_0}{\sqrt{1 - (v/c)^2}} \\
L &= \frac{L_0}{\gamma} = L_0 \sqrt{1 - (v/c)^2} \\
K &= (\gamma - 1) mc^2 \\
E &= \gamma mc^2 \\
E &= hf \\
\lambda &= \frac{h}{p}
\end{aligned}$$