Equations

$\vec{B} = \frac{\mu_o}{4\pi}\frac{q\vec{v}\times\hat{r}}{|\vec{r}|^2}$ $\qquad$ $\vec{E} = \frac{1}{4\pi\epsilon_o}\frac{q}{|\vec{r}|^2}\hat{r}$

$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B}$

$\Delta V = \dfrac{\Delta U_{el}}{q}$ $\qquad$ $q\Delta V = \Delta U_{el}$

$\Delta V = -\int_i^f \vec{E}\bullet d\vec{l}$ $\qquad$ $\Delta V \approx -\sum\left(E_x\Delta x + E_y\Delta y + E_z\Delta z\right)$

$\oint \vec{E}\bullet\hat{n}dA = \dfrac{\sum q_{inside}}{\epsilon_0}$ $\qquad$ $\oint \vec{B}\bullet\hat{n}dA = 0$

$\oint \vec{B}\bullet d\vec{l} = \mu_0\left[\sum I_{insidepath} + \epsilon_0\dfrac{d}{dt}\int\vec{E}\bullet\hat{n}dA\right]$ $\qquad$ $|\text{emf}| = \left|\dfrac{d\Phi_{mag}}{dt}\right|$, $\Phi_{mag} = \int\vec{B}\bullet\hat{n}dA$

Specific Results

Electric field due to uniformly charged spherical shell: outside like point charge; inside zero.

$\left|\vec{E}_{rod}\right| = \dfrac{1}{4\pi\epsilon_0}\dfrac{Q}{r\sqrt{r^2+(L/2)^2}}$ (r perpendicular from center)

$\left|\vec{E}_{rod}\right| \approx \dfrac{1}{4\pi\epsilon_0}\dfrac{2Q/L}{r}$ (if $r \ll L$) $\qquad$ $\left|\vec{E}_{ring}\right| = \dfrac{1}{4\pi\epsilon_0}\dfrac{qz}{(z^2+R^2)^{3/2}}$ (z along axis)

$\left|\vec{E}_{disk}\right| = \dfrac{Q/A}{2\epsilon_0}\left[1 - \dfrac{z}{(z^2+R^2)^{1/2}}\right]$ (z along axis); $\left|\vec{E}_{disk}\right| \approx \dfrac{Q/A}{2\epsilon_0}\left[1-\dfrac{z}{R}\right] \approx \dfrac{Q/A}{2\epsilon_0}$ (if $z \ll R$)

$\left|\vec{E}_{capacitor}\right| \approx \dfrac{Q/A}{\epsilon_0}$ ($+Q$ or $-Q$ disks) $\qquad$ $\left|\vec{E}_{fringe}\right| \approx \dfrac{Q/A}{\epsilon_0}\left(\dfrac{s}{2R}\right)$ just outside capacitor

$\left|\vec{E}_{dipole,axis}\right| \approx \dfrac{1}{4\pi\epsilon_0}\dfrac{2qs}{r^3}$ (along dipole axis, where $r \gg s$)

$\left|\vec{E}_{dipole,perp}\right| \approx \dfrac{1}{4\pi\epsilon_0}\dfrac{qs}{r^3}$ (along axis perpendicular to dipole axis, where $r \gg s$)

$i = nA\bar{v}$; $\quad I = |q|\,nA\bar{v}$; $\quad \bar{v} = uE$ $\qquad$ $\Delta V = \dfrac{q}{4\pi\epsilon_0}\left[\dfrac{1}{r_f} - \dfrac{1}{r_i}\right]$

$E_{dielectric} = \dfrac{E_{applied}}{K}$ $\qquad$ kinetic energy $\approx \frac{1}{2}mv^2$ if $v \ll c$

$\Delta\vec{B} = \dfrac{\mu_0}{4\pi}\dfrac{I\Delta\vec{l}\times\vec{r}}{r^2}$ (short wire) $\qquad$ $\Delta\vec{F} = I\Delta\vec{l}\times\vec{B}$

$\left|\vec{B}_{wire}\right| = \dfrac{\mu_0}{4\pi}\dfrac{LI}{r\sqrt{r^2+(L/2)^2}} \approx \dfrac{\mu_0}{4\pi}\dfrac{2I}{r}$ ($r \ll L$)

$\left|\vec{B}_{loop}\right| = \dfrac{\mu_0}{4\pi}\dfrac{2I\pi R^2}{(z^2+R^2)^{3/2}} \approx \dfrac{\mu_0}{4\pi}\dfrac{2I\pi R^2}{z^3}$ (on axis, $z \gg R$); $\quad \mu = IA = I\pi R^2$

$\left|\vec{B}_{dipole,axis}\right| \approx \dfrac{\mu_0}{4\pi}\dfrac{2\mu}{r^3}$ (along dipole axis, where $r \gg s$)

$\left|\vec{B}_{dipole,perp}\right| \approx \dfrac{\mu_0}{4\pi}\dfrac{\mu}{r^3}$ (along axis perpendicular to dipole axis, where $r \gg s$)

$\vec{E}_{rad} = \dfrac{1}{4\pi\epsilon_0}\dfrac{-q\vec{a}_\perp}{c^2 r}$; $\quad \hat{v} = \hat{E}_{rad}\times\hat{B}_{rad}$; $\quad \left|\vec{B}_{rad}\right| = \dfrac{\left|\vec{E}_{rad}\right|}{c}$

$\sigma = |q|\,nu$; $J = \dfrac{I}{A} = \sigma E$; $R = \dfrac{L}{\sigma A}$

$I = \dfrac{|\Delta V|}{R}$ for an ohmic resistor (R independent of ΔV);   power $= I\Delta V$

$Q = C\,|\Delta V|$

circular motion: $\left|\dfrac{d\vec{p}}{dt}_\perp\right| = \dfrac{|\vec{v}|}{R}\,|\vec{p}| \approx \dfrac{mv^2}{R}$

$f = \frac{1}{T}$

$\omega = \frac{2\pi}{T}$

$v = f\lambda$

Constant	Symbol	Approximate Value
Speed of light	c	3×10^8 m/s
Gravitational constant	G	6.7×10^{-11} N $\cdot$ m^2/kg^2
Approx. grav field near Earth's surface	g	9.8 N/kg
Electron mass	m_e	9×10^{-31} kg
Proton mass	m_p	1.7×10^{-27} kg
Neutron mass	m_n	1.7×10^{-27} kg
Electric constant	$\dfrac{1}{4\pi\epsilon_0}$	9×10^9 N $\cdot$ m^2/C^2
Electric constant	ϵ_0	8.85×10^{-12} N $\cdot$ m^2/C^2
Magnetic constant	$\dfrac{\mu_0}{4\pi}$	1×10^{-7} T $\cdot$ m/A
Magnetic constant	μ_0	$4\pi \times 10^{-7}$ T $\cdot$ m/A
Proton charge	e	1.6×10^{-19} C
Electron volt	1 eV	1.6×10^{-19} J
Avogadro's number	N_A	6.02×10^{23} molecules/mole
Atomic radius	R_a	1×10^{-10} m
Proton radius	R_p	$\approx 1 \times 10^{-15}$ m
E to ionize air	E_{ionize}	$\approx 3 \times 10^6$ V/m
B_{Earth}	B_{Earth}	$\approx 2 \times 10^{-5}$ T

Maxwell Equations - Integral Form

$\oint \vec{B} \cdot \hat{n} dA = 0$

$\oint \vec{B} \cdot d\vec{l} = \mu_o \left[\sum I_{\text{enclosed}} + \epsilon_o \frac{d}{dt} \int \vec{E} \cdot \hat{n} dA \right]$

$\oint \vec{E} \cdot \hat{n} dA = \frac{1}{\epsilon_o} \sum Q_{\text{enclosed}}$

$\oint \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \int \vec{B} \cdot \hat{n} dA$

Maxwell Equations - Differential Form

$\vec{\nabla} \times \vec{B} = \mu_o \left(\vec{J} + \epsilon_o \frac{\partial \vec{E}}{\partial t} \right)$

$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

$\vec{\nabla} \cdot \vec{B} = 0$

$\vec{\nabla} \cdot \vec{E} = \frac{1}{\epsilon_o} \rho$