m_p=1.67 x 10^{-27} kg ; m_e=9.11 x 10^{-31} kg $q_{e,p}$ = 1.602 x 10^{-19} C ; 1 eV = 1.602 x 10^{-19} J

ε_o=8.85x10^{-12} F/m μ_o=4πx10^{-7} Tm/A c=3.00x10^8 m/s

$$\vec{A}\cdot\vec{B}=|A||B|\cos\theta$$

$$\vec{A}\cdot\vec{B}=a_xb_x+a_yb_y+a_zb_z$$

$$\vec{A}\times\vec{B}=|A||B|\sin\theta$$

$$\Phi_E=\oint\vec{E}\cdot d\vec{A}=\frac{Q_{in}}{\varepsilon_0}$$

$J = I/A;\ U = qV$

$E = \Delta V_c/d;\ C = Q/\Delta V_c$

$I = \Delta V/R;\ R = \rho L/A$

$P = I^2R$

$$\vec{F}_c=\frac{mv^2}{r}$$

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

$$\vec{F}=IL\times\vec{B}$$

$$d\vec{F}=Id\vec{l}\times\vec{B}$$

$$\vec{\mu}=NI\vec{A}$$

$$\vec{\tau}=\vec{\mu}\times\vec{B}$$

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

$$B=\frac{\mu_o}{4\pi}\frac{Id\vec{l}\times\hat{r}}{r^2}$$

$$B=\frac{\mu_o}{4\pi}\frac{qv\sin\theta}{r^2}=\frac{\mu_o}{4\pi}\frac{q\vec{v}\,x\,\hat{r}}{r^2}$$

$$B_{wire}=\frac{\mu_oI}{2\pi r}$$

$$B_{loop}=\frac{\mu_0NIa^2}{2(x^2+a^2)^{3/2}}$$

$$B_{solenoid}=\mu_o\frac{N}{l}I$$

$$\oint\vec{B}\cdot d\vec{l}=\mu_oI_{encl}$$

$$\varepsilon=-N\frac{d\Phi_B}{dt}=\oint\vec{E}\cdot d\vec{l}$$

$$\Phi_B=\int\vec{B}\cdot d\vec{A}$$

$$\varepsilon=vBL$$

$$L=\frac{N\Phi_B}{i}$$

$$L_{solenoid}=\frac{\mu_oN^2A}{l}$$

$$\varepsilon=-L\frac{di}{dt}$$

$$U=\frac{1}{2}LI^2$$

$$c=\frac{E}{B}=\frac{1}{\sqrt{\mu_o\varepsilon_o}}$$

$$\vec{S}=\frac{1}{\mu_o}\vec{E}\times\vec{B}$$

$$I=S_{av}=\frac{E_{\max}^2}{2c\mu_o}=\frac{1}{2}\varepsilon_0cE_{\max}^2$$

$$I=\frac{P}{A}$$

$$p_{rad}=\frac{(2)I}{c}=\frac{F}{A}$$

$$I=I_{\max}/2$$

$$I=I_{\max}\cos^2\phi$$

$$\theta_r=\theta_a$$

$$n_a\sin\theta_a=n_b\sin\theta_b$$

$$\theta_{crit}=\sin^{-1}\frac{n_b}{n_a}$$

$$\frac{n_a}{s}+\frac{n_b}{s'}=\frac{n_b-n_a}{R}$$

$$\tan\theta_P=\frac{n_b}{n_a}$$

$$n=\frac{c}{v}$$

$$\frac{1}{s}+\frac{1}{s'}=\frac{1}{f}$$

$$M=-\frac{n_a}{n_b}\frac{s'}{s}=\frac{y'}{y}$$

$$\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\lambda_n=\frac{\lambda}{n}$$

$$r_2-r_1=m\lambda$$

$$r_2-r_1=(m+1/2)\lambda$$

$$d\sin\theta=m\lambda$$

$$d\sin\theta=(m+\frac{1}{2})\lambda$$

$$\sin\theta\approx\tan\theta\approx\theta=y/R$$

$$\phi=\frac{2\pi}{\lambda}(r_2-r_1)+\phi_0$$

$$I=I_0\cos^2\frac{\phi}{2}$$

$$\phi=\frac{2\pi d}{\lambda R}y$$

$$I=I_0\left[\frac{Sin(\beta/2)}{\beta/2}\right]^2$$

$$\beta=(2\pi/\lambda)a\sin\theta$$

$$\Delta t=\frac{\Delta\tau_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$l=\sqrt{1-\frac{v^2}{c^2}}\,\ell_0$$