Official Starting Equations
PHYS 2135, Engineering Physics II

From PHYS 1135:

$x = x_0 + v_{0x}\Delta t + \frac{1}{2}a_x(\Delta t)^2$ $v_x = v_{0x} + a_x\Delta t$ $v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$ $\sum \vec{F} = m\vec{a}$

$F_r = -\frac{mv_t^2}{r}$ $P = \frac{F}{A}$ $\vec{p} = m\vec{v}$ $P = \frac{dW}{dt}$ $W = \int \vec{F} \cdot d\vec{s}$

$K = \frac{1}{2}mv^2$ $U_f - U_i = -W_{\text{conservative}}$ $E = K + U$ $E_f - E_i = (W_{\text{other}})_{i \to f}$ $E = P_{\text{ave}}t$

Constants:

$g = 9.8\,\frac{\text{m}}{\text{s}^2}$ $m_{\text{electron}} = 9.11 \times 10^{-31}\text{kg}$ $m_{\text{proton}} = 1.67 \times 10^{-27}\text{kg}$ $e = 1.6 \times 10^{-19}\text{C}$

$c = 3.0 \times 10^8\,\frac{\text{m}}{\text{s}}$ $k = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9\,\frac{\text{Nm}^2}{\text{C}^2}$ $\epsilon_0 = 8.85 \times 10^{-12}\,\frac{\text{C}^2}{\text{Nm}^2}$ $\mu_0 = 4\pi \times 10^{-7}\,\frac{\text{Tm}}{\text{A}}$

Electric Force, Field, Potential and Potential Energy:

$\vec{F} = k\frac{q_1q_2}{r_{12}^2}\hat{r}_{12}$ $\vec{E} = k\frac{q}{r^2}\hat{r}$ $\vec{F} = q\vec{E}$ $\Delta V = -\int_i^f \vec{E} \cdot d\vec{s}$

$U = k\frac{q_1q_2}{r_{12}}$ $V = k\frac{q}{r}$ $\Delta U = q\Delta V$ $E_x = -\frac{\partial V}{\partial x}$

$\vec{p} = q\vec{d}$ (from – to +) $\vec{\tau} = \vec{p} \times \vec{E}$ $U_{\text{dipole}} = -\vec{p} \cdot \vec{E}$

$\Phi_E = \int_S \vec{E} \cdot d\vec{A}$ $\oint_S \vec{E} \cdot d\vec{A} = \frac{q_{\text{enclosed}}}{\epsilon_0}$ $\lambda \equiv \frac{\text{charge}}{\text{length}}$ $\sigma \equiv \frac{\text{charge}}{\text{area}}$ $\rho \equiv \frac{\text{charge}}{\text{volume}}$

Circuits:

$C = \frac{Q}{V}$ $\frac{1}{C_T} = \sum \frac{1}{C_i}$ $C_T = \sum C_i$ $C_0 = \frac{\epsilon_0 A}{d}$ $C = \kappa C_0$

$U = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}QV$ $I = \frac{dq}{dt}$ $J = \frac{I}{A}$ $\vec{J} = nq\vec{v}_d$

$\vec{J} = \sigma\vec{E}$ $V = IR$ $R = \rho\frac{L}{A}$ $\sigma = \frac{1}{\rho}$ $\rho = \rho_0[1 + \alpha(T - T_0)]$

$\sum I = 0$ $\sum \Delta V = 0$ $\frac{1}{R_T} = \sum \frac{1}{R_i}$ $R_T = \sum R_i$ $P = IV = \frac{V^2}{R} = I^2R$

$Q(t) = Q_{\text{final}}\left[1 - e^{-t/\tau}\right]$ $Q(t) = Q_0 e^{-t/\tau}$ $\tau = RC$

Magnetic Force, Field and Inductance:

$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$ $\quad$ $\vec{F} = I\vec{L} \times \vec{B}$ $\quad$ $\Phi_B = \int \vec{B} \cdot d\vec{A}$ $\quad$ $\oint \vec{B} \cdot d\vec{A} = 0$

$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{enclosed}}$ $\quad$ $\vec{\mu} = NI\vec{A}$ $\quad$ $\vec{\tau} = \vec{\mu} \times \vec{B}$ $\quad$ $U_{\text{dipole}} = -\vec{\mu} \cdot \vec{B}$

$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \hat{r}}{r^2}$ $\quad$ $d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{d\vec{s} \times \hat{r}}{r^2}$ $\quad$ $\mathcal{E} = -N \frac{d\Phi_B}{dt}$ $\quad$ $\oint \vec{E} \cdot d\vec{s} = -\frac{d\phi_B}{dt}$

$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{enclosed}} + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$ $\quad$ $B = \frac{\mu_0 I}{2\pi r}$ $\quad$ $B = \mu_0 n I$

Electromagnetic Waves:

$I = \frac{P}{A}$ $\quad$ $u = \frac{1}{2}\left(\epsilon_0 E^2 + \frac{B^2}{\mu_0}\right) = \epsilon_0 E^2 = \frac{B^2}{\mu_0}$ $\quad$ $\langle u \rangle = \frac{1}{4}\left(\epsilon_0 E_{\text{max}}^2 + \frac{B_{\text{max}}^2}{\mu_0}\right) = \frac{1}{2}\epsilon_0 E_{\text{max}}^2 = \frac{B_{\text{max}}^2}{2\mu_0}$

$\frac{E}{B} = c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$ $\quad$ $\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$ $\quad$ $I = \langle S \rangle = c\langle u \rangle$ $\quad$ $\langle P_{\text{rad}} \rangle = \frac{I}{c}$ or $\frac{2I}{c}$

$k = \frac{2\pi}{\lambda}$ $\quad$ $\omega = 2\pi f$ $\quad$ $T = \frac{1}{f}$ $\quad$ $v = f\lambda = \frac{\omega}{k} = \frac{c}{n}$

Optics:

$I = I_{\text{max}} \cos^2 \phi$ $\quad$ $\theta_r = \theta_i$ $\quad$ $n = \frac{c}{v} = \frac{\lambda_0}{\lambda_n}$ $\quad$ $n_r \sin\theta_r = n_i \sin\theta_i$

$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$ $\quad$ $m = \frac{y'}{y} = -\frac{s'}{s}$ $\quad$ $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\quad$ $f = \frac{R}{2}$

$\frac{n_a}{s} + \frac{n_b}{s'} = \frac{n_b - n_a}{R}$ $\quad$ $m = \frac{y'}{y} = -\frac{n_a s'}{n_b s}$ $\quad$ $\Delta L = m\lambda$ $\quad$ $\Delta L = \left(m + \frac{1}{2}\right)\lambda$

$\Delta L = d\sin\theta$ $\quad$ $\phi = 2\pi\left(\frac{\Delta L}{\lambda}\right)$ $\quad$ $I = I_0 \cos^2 \frac{\phi}{2}$ $\quad$ $R = \frac{\lambda}{\Delta\lambda} = Nm$

$m\lambda = a\sin\theta$ $\quad$ $\beta = \frac{2\pi}{\lambda} a\sin\theta$ $\quad$ $I = I_0 \left[\frac{\sin(\beta/2)}{\beta/2}\right]^2$

Integral:

$$\int \frac{du}{(u^2+a^2)^{3/2}} = \frac{u}{a^2\sqrt{u^2+a^2}} + c$$

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