Final Exam Formulas

$\vec{F} = q\vec{E}$

$\vec{F} = \frac{k q_1 q_2}{r_{12}^2}\hat{r}_{12} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$

$\phi_E = \oint \vec{E}\cdot d\vec{A}$

$\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enclosed}}{\epsilon_0}$

$\vec{E} = \int_{vol} \frac{k\,dQ}{r^2}\hat{r}$

V = work/charge

$V_{\text{point charge}} = \frac{kQ}{r}$

$V = \int_{vol} \frac{k\,dQ}{r}$

$E_s = -dV/ds$

$V = IR$

$Q = CV$

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

$P = IV = I^2R = \frac{V^2}{R}$

$|e| = 1.6\times10^{-19}$ coulombs

$k = 8.99\times10^{9}\ \frac{Nm^2}{C^2}$

$\epsilon_0 = 8.85\times10^{-12}\ C^2/Nm^2$

$\mu_0 = 4\pi\times10^{-7}\ \frac{Tm}{A}$

$E = E_0/K$

$U_E = \frac{\epsilon_0 E^2}{2}$

$C = KC_0$

$Q(t) = C\mathcal{E}(1-e^{-t/RC})$

$Q(t) = Q_0 e^{-t/RC}$

$R_{eq} = \Sigma r_i$
$1/C_{eq} = \Sigma \frac{1}{C_i}$
] For series geometry

$\vec{F} = q\vec{v}\times\vec{B} = l\,\vec{i}\times\vec{B}$

$\vec{\mu} = nIA$

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

$B_{solenoid} = \mu_0 n I$

$\vec{B} = \frac{\mu_0}{4\pi}\int \frac{i\,d\vec{l}\times\hat{r}}{r^2}$

$\int_{curve} \vec{B}\cdot d\vec{l} = \mu_0 I_{encl}$

$\mathcal{E} = -d\Phi_B/dt$

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

$\Phi_B = Li$

$\mathcal{E} = -L\,di/dt$

$U_B = B^2/2\mu_0$

$B = E/c$ For plane wave

$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$

$\langle S\rangle = \frac{EB}{2\mu_0}$

$P_{radiation} = S/c$ (Absorbed)

$c = \frac{1}{\sqrt{\epsilon_0\mu_0}}$

$v = \lambda\nu$

$\vec{B} = \mu_0(1+\chi_M)\vec{B}_{ext}$

$\mu_0\chi_M = \mu$

$v = \lambda \nu$

$E = h\nu$

$\lambda = h/p$

$E_n = -\frac{Z^2 \, 13.6\,\text{eV}}{n^2}$

$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + U\psi = E\psi$

$(A-Z)m_n c^2 + Z m_p c^2 - M_x c^2 = \text{TOT BE}$

$\frac{dN}{dt} = -\lambda N$

$N = N_0 e^{-\lambda t}$

$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$

$\int u^n du = \frac{u^{n+1}}{n+1}$

$\int \frac{du}{u} = \ln|u|$

$\int e^u du = e^u$

$\int \frac{x\,dx}{(x^2+a^2)^{1/2}} = \sqrt{x^2+a^2}$

$\gamma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$

$\Delta t' = \gamma \Delta t$

$\Delta x' = \gamma \Delta x$

$n = c/v$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\frac{1}{i} + \frac{1}{o} = \frac{1}{F}$

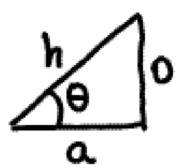
$m = -i/o$

$P = \frac{1}{F}$

$\theta \sim 1.22\, \lambda/D$

$\lambda/a = \sin\theta$

$d\sin\theta = m\lambda$



$\sin\theta = \frac{o}{h}$ $\cos\theta = \frac{a}{h}$

$\tan\theta = o/a$

Sphere: $A = 4\pi r^2$ $V = \frac{4}{3}\pi r^3$

cylinder: $A = 2\pi r L + 2\pi r^2$

$V = \pi r^2 L$

$V = V_0 + at$

$x = x_0 + V_0 t + \frac{1}{2}at^2$

$V^2 = V_0^2 + 2a(x - x_0)$

$x = x_0 + \frac{1}{2}(V + V_0)t$

$S = r\theta$

$KE = \frac{1}{2}mv^2$

$PE_{spring} = \frac{1}{2}kx^2$

$a_c = \frac{mv^2}{r}$