Formulae Exam #1

Magnetostatics

$$\oint \underset{\sim}{B} \cdot d\underset{\sim}{l} = \mu_0 I'$$

$$d\underset{\sim}{B} = \frac{\mu_0 I}{4\pi} \frac{d\underset{\sim}{l} \times \hat{r}}{r^2}$$

$$\frac{\mu_0}{4\pi} = 10^{-7} \frac{Tm}{A}$$

$B = \frac{\mu_0 I}{2\pi r}$ wire

$B = \mu_0 I n$ solenoid

$\underset{\sim}{F} = I \underset{\sim}{l} \times \underset{\sim}{B}$ wire

$\underset{\sim}{F} = q \underset{\sim}{v} \times \underset{\sim}{B}$ charge

$U = -\underset{\sim}{\mu} \cdot \underset{\sim}{B}$ $\mu = IA$

$\underset{\sim}{\tau} = \underset{\sim}{\mu} \times \underset{\sim}{B}$ $\omega_B = \frac{qB}{m}$

$u = \frac{B^2}{2\mu_0}$

Induction

$$\mathcal{E} = \oint \underset{\sim}{E} \cdot d\underset{\sim}{l} = -\frac{d\Phi}{dt}$$

$$\Phi = \int_A \underset{\sim}{B} \cdot d\underset{\sim}{A}$$

$L = N\Phi / I$

Misc

$\underset{\sim}{A} \cdot \underset{\sim}{B} = AB\cos\theta$

$\underset{\sim}{C} = \underset{\sim}{A} \times \underset{\sim}{B}$

$C = AB\sin\theta$

areas πr^2 circle
$4\pi r^2$ sphere

Circuits

$\sum_i I_i = 0$ point rule

$\sum_i V_i = 0$ loop rule

$I = \frac{dQ}{dt}$

$V = \frac{Q}{C}$, $V = -IR$

$V = -L\frac{dI}{dt}$, $\tau = RC$, $\tau = \frac{L}{R}$

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

$P = I^2 R$

$R = R_1 + R_2 + \ldots$ series

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ parallel

Circular Motion

$a = \frac{v^2}{R} = \omega^2 R$

$v = \omega R$

Electrostatics

$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2}$

$U = \frac{q_1 q_2}{4\pi\epsilon_0 r}$

Formulae Exam #2

EM Waves

$c = 3\times10^8 m/s$

$E = cB$

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

$u = \frac{1}{2}\epsilon_0 E^2 + \frac{1}{2\mu_0} B^2$

$u = \frac{S}{c}$, $f\lambda = \frac{c}{n}$

$I = uV$, $P = \frac{U}{c}$

Wave optics

$d\sin\theta = m\lambda$ $m = 0, 1, 2\ldots$ double slit max

$a\sin\theta = m\lambda$ $m = 1, 2, \ldots$ single slit min

$\sin\theta = \frac{\lambda}{Nd}$ grating 1st min

$2t = m\lambda$ dest. int. in films

Geometrical Optics

$\theta_i = \theta_r$

$n_i \sin\theta_i = n_t \sin\theta_t$

$\lambda_0 = \frac{c}{f}$ $\sin\theta_{ic} = \frac{n_t}{n_i}$

$\lambda_n = \frac{\lambda_0}{n}$

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

Special Relativity

length cont. $L = \frac{L_0}{\gamma}$

time dilation $t = \gamma\tau_0$

$\gamma_p = \frac{1}{\left(1 - \frac{u^2}{c^2}\right)^{1/2}}$

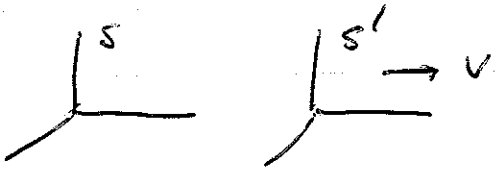
$E = \gamma_p mc^2$

$p = \gamma_p mu$

$E^2 = m^2c^4 + p^2c^2$

$u_x' = \frac{u_x - V}{1 - \frac{u_x V}{c^2}}$

$u_y' = \frac{u_y}{\gamma\left(1 - \frac{u_x V}{c^2}\right)}$



$x' = \gamma(x - vt)$

$t' = \gamma\left(t - \frac{xv}{c^2}\right)$

$y' = y$

$z' = z$

inverse $\Rightarrow$ $V \Rightarrow -V$

$\gamma = \frac{1}{(1 - V^2/c^2)^{1/2}}$

Formula Sheet Exam #3

Hydrogen Atom

$$E_n = -\frac{E_1}{n^2}$$

$$E_1 = \frac{m_e e^4}{2\hbar^2(4\pi\epsilon_0)^2} = 13.6\,eV$$

$$a_B = \frac{4\pi\epsilon_0\hbar^2}{me^2} = .0529\,nm$$

$$r_n = n^2 a_B$$

$$L = n\hbar$$

$$2\pi r_n = n\lambda_D$$

Light

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

$$E = cB$$

$$u = \frac{1}{2}\epsilon_0 E^2 + \frac{1}{2\mu_0}B^2$$

$$u = \frac{S}{c}$$

$$p = \frac{u}{c}$$

$$E = hf$$

$$f\lambda = \frac{c}{n}$$

$$E = pc$$

De Broglie

$$\lambda_D = \frac{h}{p}$$

Circular motion

$$F = -mv^2/r$$

$$v = \omega r, \quad a = -v^2/r$$

Constants

$h = 6.626\times10^{-34}\,Js$
$= 4.14\times10^{-15}\,eVs$

$\hbar = 1.05\times10^{-34}\,Js$
$= 6.58\times10^{-16}\,eVs$

$1eV = 1.6\times10^{-19}\,J$

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

$e = 1.6\times10^{-19}\,C$

$c = 3\times10^8\,m/s$

$m_e = 9.11\times10^{-31}\,kg$

$m_e c^2 = .511\,MeV$

$\mu_0 = 1.26\times10^{-6}\,Tm/A$

1-D Quantum

$$\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} = -(E-u(x))\psi$$

$$\psi_n = \sqrt{\frac{2}{L}}\sin\left(\frac{n\pi x}{L}\right)$$

probability $P dx = \psi^2 dx$

$$\int_a^b dx\,\psi^2 = 1$$

$$\psi \sim e^{-\frac{x}{\eta}}$$

$$\eta = \frac{\hbar}{[2m(u_0-E)]^{1/2}}$$

$$E_n = n^2\frac{h^2}{8mL^2}$$

Photoelectric Effect

$$k = hf - E_0$$