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

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

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

$$E_s = -dV/ds$$

$$V = W/q$$

$$V_{ptchg} = \frac{kq}{R}$$

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

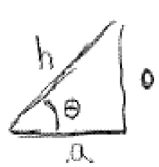
$$V = \int_{vol} \frac{k\,dQ}{r}$$

Sphere: $A = 4\pi r^2$

$V = 4/3\,\pi r^3$

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

$V = \pi r^2 L$



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

$\cos\theta = a/h$

$\tan\theta = o/a$

Lorentz TRANS

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

$y' = y$

$z' = z$

$t' = \gamma(t - \frac{v}{c^2}x)$

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

Const. Accel.

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

$v^2 = v_0^2 + 2a(x - x_0)$

$x^2 = x_0 + \frac{1}{2}(v_0 + v)t$

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

$$S = R\theta$$

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

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

$$V_{ptchg} = \frac{kq}{R}$$

$$U_{capacitor} = \frac{1}{2}CV^2$$

$$E_{//plate} = \sigma/\epsilon_0$$

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

$C_{TOT} = \Sigma C_i$ (Parallel)

$1/C_{TOT} = \Sigma\, 1/C_i$ (Series)

$R_{TOT} = \Sigma R_i$ (Series

$1/R_{TOT} = \Sigma\, 1/R_i$ (Parallel)

$$Q = CV$$

$$P = \frac{dU}{dt} = iV = i^2R = V^2/R$$

$$V = iR$$

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

$$|\vec{\mu}| = N i \vec{A}$$

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

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

$$B_{solenoid} = \mu_0 N i$$

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

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

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

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

$$\Phi = Li$$

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

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

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

$$E = E_0/K$$

$$X_C = 1/\omega C$$

$$X_L = \omega L$$

$$\omega_0 = 1/\sqrt{LC}$$

$$\phi_{LRC} = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

Integrals

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

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

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

$$\int \frac{x\,dx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2}$$

geometric optics

$$v = \lambda \nu$$

$$n = c/v$$

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

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

$i \equiv$ image dist.
$o \equiv$ object dist

$$m = -i/o$$

$$f\# \text{ camera} = \frac{\text{focal length}}{\text{diameter}}$$

Taylor's Series expansions

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} + \cdots \quad -1<x<1$$

$$\ln x = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \cdots \quad x \geq \frac{1}{2}$$

$$(1+x)^{-1} = 1 - x + x^2 - x^3 + \cdots \quad -1<x<1$$

$$(1+x)^{-2} = 1 - 2x + 3x^2 - \cdots \quad -1<x<1$$

$$(1+x)^{1/2} = 1 + \frac{1}{2}x - \frac{x^2}{8} + \cdots \quad -1<x<1$$