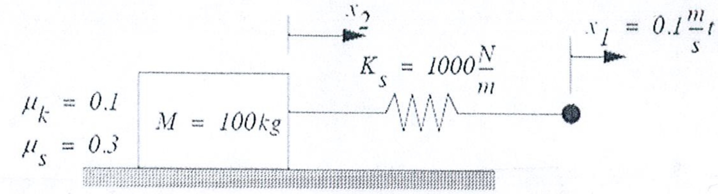
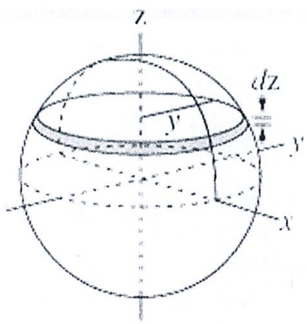
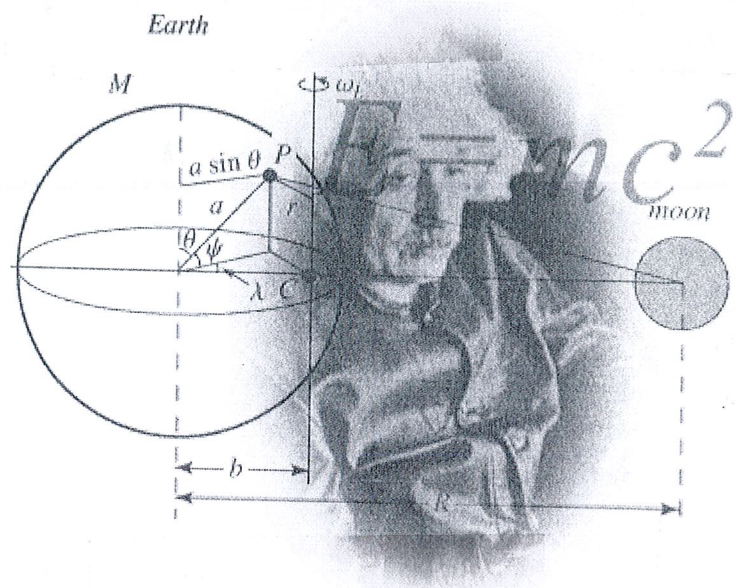
University Physics
Formula Sheets







Radius $= R$

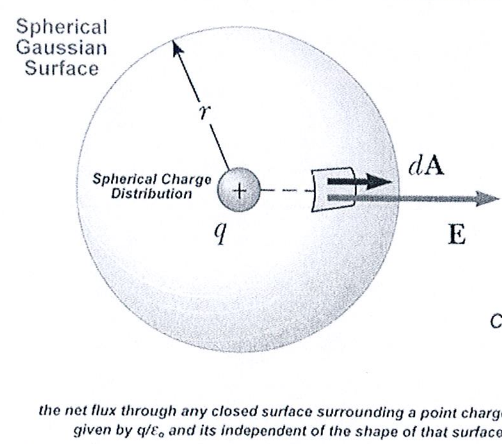
Mass $= M$

Density $= \rho = \dfrac{M}{V} = \dfrac{M}{\frac{4}{3}\pi R^3}$

$$I = \frac{8}{15}\left[\frac{M}{\frac{4}{3}\pi R^3}\right]\pi R^5 = \frac{2}{5}MR^2$$

Electric Flux $\Phi_E = \oint E \cdot dA = \oint E\, dA = E\oint dA = \dfrac{q_{in}}{\varepsilon_o}$

E and dA are parallel everywhere on the surface



$$E(4\pi r^2) = \frac{q_{in}}{\varepsilon_o}$$

surface area of a sphere

$$E = \frac{q_{in}}{4\pi\varepsilon_o r^2}$$

$$k = \frac{1}{4\pi\varepsilon_o}$$

Coulomb's Law

$$E = \frac{kq_{in}}{r^2}$$

the net flux through any closed surface surrounding a point charge q is given by q/ε_o and its independent of the shape of that surface

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University Physics II - 1

$\vec{v} = \frac{d\vec{r}}{dt}$ $\omega_z = \frac{d\theta}{dt}$ $\omega_{av} = \frac{\Delta\theta}{\Delta t}$ $s = r\theta$ $v = v_o + at$ $\omega = \omega_o + \alpha t$

$v = r\omega$ $x = x_o + v_o t + \frac{1}{2}at^2$ $\theta = \theta_o + \omega_o t + \frac{1}{2}\alpha t^2$

$\vec{a} = \frac{d\vec{v}}{dt}$ $\alpha_z = \frac{d\omega_z}{dt} = \frac{d^2\theta}{dt^2}$ $\alpha_{av} = \frac{\Delta\omega}{\Delta t}$ $a_{\tan} = r\alpha$ $x = x_o + \frac{1}{2}(v_o + v)t$ $\theta = \theta_o + \frac{1}{2}(\omega_o + \omega)t$

$\Delta\theta = \theta - \theta_o$ $\Delta\omega = \omega - \omega_o$ $a_{rad} = \frac{v^2}{r} = \omega^2 r$ $v^2 = v_o^2 + 2a(x - x_o)$ $\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$

$\vec{F}_{net} = m\vec{a}$ $\vec{\tau}_{net} = I\vec{\alpha}$ $I = \sum_i m_i r_i^2$ $I = \int r^2 dm$ $I_P = I_{cm} + Md^2$

$\vec{\tau} = \vec{r} \times \vec{F}$ $\tau = rF\sin\phi = rF_\perp = r_\perp F$ $P = \tau\,\omega$ $a_{cm} = r\alpha$ $v_{cm} = r\omega$

$K = \frac{1}{2}I\omega^2$ $W_{total} = K_{final} - K_{initial}$ $K_{final} + U_{final} = K_{initial} + U_{initial} + W_{nonconserative}$ $W = \int_{\theta_i}^{\theta_f} \tau\, d\theta$

$\vec{\tau}_{net} = \frac{d\vec{L}}{dt}$ $\vec{L} = \Sigma\vec{\ell}$ $\vec{\ell} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}$ $\ell = rp\sin\phi = rp_\perp = r_\perp p$ $\vec{L} = I\vec{\omega}$

$F = -kx$ $x(t) = A\cos(\omega t + \phi)$ $\omega = \frac{2\pi}{T} = 2\pi f$ $T = 2\pi\sqrt{\frac{m}{k}}$ $T = 2\pi\sqrt{\frac{I}{mgd}}$

$U = \frac{1}{2}kx^2$ $a(t) = -\omega^2 x(t)$

$\frac{F_\perp}{A} = Y\left(\frac{\Delta\ell}{\ell_o}\right)$ $\frac{F_\parallel}{A} = S\left(\frac{x}{h}\right)$ $B = \frac{-\Delta p}{\Delta V / V_o}$ $v = \sqrt{\frac{B}{\rho}}$ $v = \sqrt{\frac{Y}{\rho}}$ $v = \sqrt{\frac{F}{\mu}}$

$y(x,t) = funct(x \pm vt)$ $y(x,t) = A\cos(kx \pm \omega t + \phi)$ $k = \frac{2\pi}{\lambda}$ $v = \lambda f = \frac{\omega}{k}$ $f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right) f_S$

$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin\left(kx - \omega t - \frac{\phi}{2}\right)$ $y(x,t) = [2A\sin(kx)]\sin(\omega t)$ $P_{av} = \frac{1}{2}\sqrt{\mu F}\,\omega^2 A^2$

$f_n = nf_1$ $\lambda_n = \frac{2L}{n};\ n = 1,2,3,\ldots$ $p(x,t) = BkA\cos(kx - \omega t)$ $f_{beat} = |f_a - f_b|$

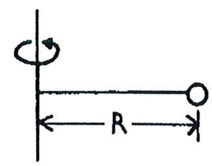
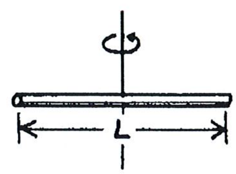
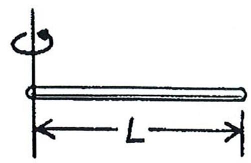
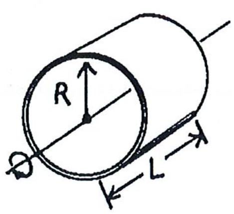
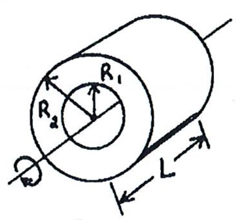
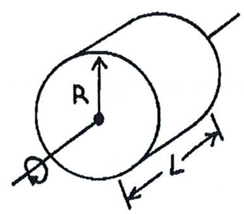
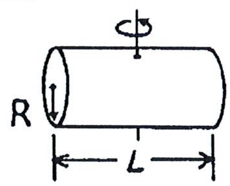
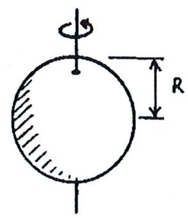
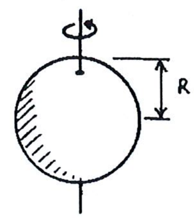
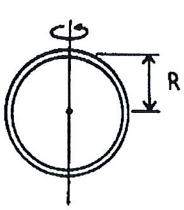
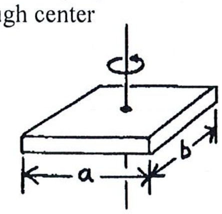
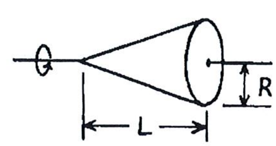
$I = \frac{P}{A} = \frac{P}{4\pi r^2}$ $I = \frac{1}{2}\sqrt{\rho B}\,\omega^2 A^2$ $\beta = (10\,\text{dB})\log\left(\frac{I}{I_o}\right)$ $I_o = 10^{-12}\,\frac{\text{W}}{\text{m}^2}$

$n = \frac{c}{v}$ $n_a \sin\theta_a = n_b \sin\theta_b$ $\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$ $m = \frac{y'}{y} = -\frac{s'}{s}$ $I = I_{\max}\cos^2\phi$ $\tan\theta_B = \frac{n_b}{n_a}$

$d\sin\theta = m\lambda$ $m = 0, \pm1, \pm2, \ldots$ (constructive) $I = I_0\left(\cos\frac{\phi}{2}\right)^2\left(\frac{\sin(\beta/2)}{(\beta/2)}\right)^2$ $\phi = \frac{2\pi d}{\lambda}\sin\theta$

$a\sin\theta = m\lambda$ $m = \pm1, \pm2, \pm3, \ldots$ (destructive) $I = I_o\left(\frac{\sin(\beta/2)}{(\beta/2)}\right)^2$ $\beta = \frac{2\pi}{\lambda}a\sin\theta$

Table of Selected Moments of Inertia

Point mass at a radius R  $I = MR^2$	Thin rod about axis through center perpendicular to length  $I = \frac{1}{12}ML^2$	Thin rod about axis through end perpendicular to length  $I = \frac{1}{3}ML^2$
Thin-walled cylinder about central axis  $I = MR^2$	Thick-walled cylinder about central axis  $I = \frac{1}{2}M(R_1^2 + R_2^2)$	Solid cylinder about central axis  $I = \frac{1}{2}MR^2$
Solid cylinder about central diameter  $I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$	Solid sphere about center  $I = \frac{2}{5}MR^2$	Thin hollow sphere about center  $I = \frac{2}{3}MR^2$
Thin ring about diameter  $I = \frac{1}{2}MR^2$	Slab about perpendicular axis through center  $I = \frac{1}{12}M(a^2 + b^2)$	Cone about central axis  $I = \frac{3}{10}MR^2$

Note: All formulas shown assume objects of uniform mass density.

University Physics III

$e \approx 1.602 \text{ x } 10^{-19}$ C	$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$		
$m_e \approx 9.11 \text{ x } 10^{-31}$ kg	$\vec{F} = i\vec{L} \times \vec{B}$	$i = \frac{dq}{dt} = \int \vec{J} \cdot d\vec{A}$	
$m_p \approx 1.67 \text{ x } 10^{-27}$ kg	$V = i\,R$	$P = i\,V$	
$k \approx 8.99 \text{ x } 10^{9}$ N m^2/C^2	$R_{eq} = \sum R_n$	$\frac{1}{R_{eq}} = \sum \frac{1}{R_n}$	
$\varepsilon_o \approx 8.85 \text{ x } 10^{-12}$ C^2/N m^2	$C_{eq} = \sum C_n$	$\frac{1}{C_{eq}} = \sum \frac{1}{C_n}$	
$\mu_o = 4\pi \text{ x } 10^{-7}$ Tm/A	$Q = C\,V$	$V = -L\frac{dI}{dt}$	$u_e = \frac{1}{2}\varepsilon_0 E^2$
$\vec{F} = \frac{kq_1q_2}{r^2}\hat{r}$	$U = \frac{1}{2}CV^2$	$C = \frac{\kappa A \varepsilon_o}{d}$	$u_B = \frac{1}{2\mu_0}B^2$
$\vec{E}_{ptch} = \frac{kq}{r^2}\hat{r}$	$\vec{p} = q\vec{d}$	$\vec{\tau} = \vec{p} \times \vec{E}$	$\vec{\tau} = \vec{\mu} \times \vec{B}$
$V_{ptch} = \frac{kq}{r}$	$R = \rho\frac{L}{A}$	$\rho = \rho_o(1 + \alpha(\mathbf{T} - \mathbf{T}_o))$	
$V_f - V_i = -\int_i^f \vec{E} \cdot d\vec{s}$	$\vec{\mu} = Ni\vec{A}$	$V = V_o e^{-t/\tau}$	$V = V_o\left(1 - e^{-t/\tau}\right)$
$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_o}$	$\oint \vec{B} \cdot d\vec{s} = \mu_o i_{enc}$	$\tau = RC$	$\tau = L/R$
$\Delta U = q\,\Delta V$	$B_{long} = \frac{\mu_o i}{2\pi r}$	$B_{arc} = \frac{\mu_o i}{4\pi r}\varphi$	$B_{solenoid} = \mu_o ni$
$E_x = -\frac{\Delta V}{\Delta x}$	$d\vec{B} = \frac{\mu_o i d\vec{s} \times \hat{r}}{4\pi r^2}$	$\varepsilon = -N\frac{d\Phi}{dt}$	$\Phi = \int \vec{B} \cdot d\vec{A}$
$x = x_0 + v_o t + \frac{1}{2}at^2$	$v = v_0 + at$	$v^2 = v_0^2 + 2a(x - x_0)$	$F_c = mv^2/r$