Physics — Equation Sheet — Mr. C

$$\vec{d} = \vec{d}_o + \vec{v}_i\Delta t + \tfrac{1}{2}\vec{a}\Delta t^2 \qquad \vec{v}_f = \vec{v}_i + \vec{a}\Delta t \qquad \vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t} \qquad \vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{d}$$

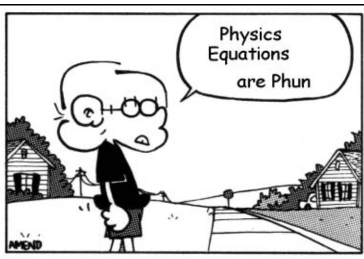
$$\sin(2\theta) = 2\sin\theta\cos\theta$$
$$\cos(2\theta) = \cos^2\theta - \sin^2\theta$$
$$\sin^2\theta + \cos^2\theta = 1$$

SOH-CAH-TOA
CHO-SHA-CAO

$$\frac{\sin\alpha}{A} = \frac{\sin\beta}{B} = \frac{\sin\gamma}{C}$$

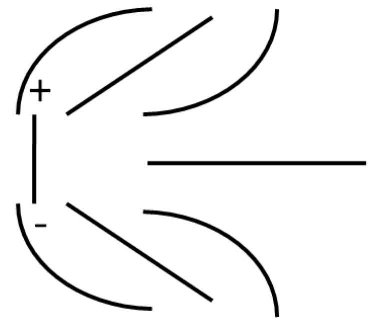
$$A^2 = B^2 + C^2 - 2BC\cos\alpha$$
$$B^2 = A^2 + C^2 - 2AC\cos\beta$$
$$C^2 = A^2 + B^2 - 2AB\cos\gamma$$

$$\Sigma\vec{F} = M\vec{a} \qquad F_f = \mu F_N \qquad \vec{F}_G = m\vec{g} \qquad \vec{F}_{spring} = -k\vec{x}$$



$$W = F_{\parallel}\Delta d_{\parallel} \quad \vec{W} = \vec{F}\cdot\Delta\vec{d}$$

$$P = \frac{\Delta W}{t} = \frac{\Delta E}{t} = FV$$



Jason the Slope Crab

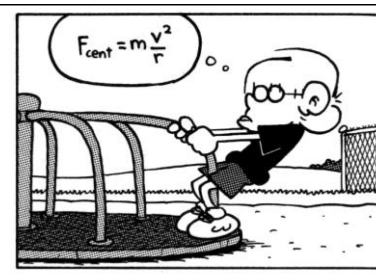
$$W_{net} = W_c + W_{nc} \qquad KE = \tfrac{1}{2}mV^2$$

$$W_{net} = \Delta KE \qquad PE_{spring} = \tfrac{1}{2}kx^2$$

$$\vec{p} = m\vec{V} \qquad PE_{grav} = mgh$$

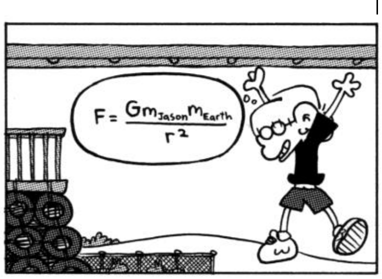
$$\vec{J} = \vec{F}\Delta t \Rightarrow \Delta m\vec{V} = m\Delta\vec{V} = \Delta\vec{p}$$

$$\vec{F}_c = m\vec{a}_c \qquad \vec{a}_c = \frac{v^2}{r} \qquad \vec{a}_c = \frac{4\pi^2 r}{T^2}$$



$$T = \frac{2\pi r}{V} \qquad F_G = G\frac{m_1 m_1}{r^2} \qquad g = \frac{GM}{r^2} \qquad \frac{T_a^2}{r_a^3} = \frac{T_b^2}{r_b^3} = \frac{4\pi^2}{GM}$$

$$V_{orbit} = \sqrt{\frac{GM}{h+R}} \qquad V_{Escape} = \sqrt{\frac{2GM}{r}} \qquad f = \frac{1}{T} \qquad v = \frac{2\pi r}{T} = 2\pi r f$$



$$V_{Sphere} = \frac{4}{3}\pi r^3$$

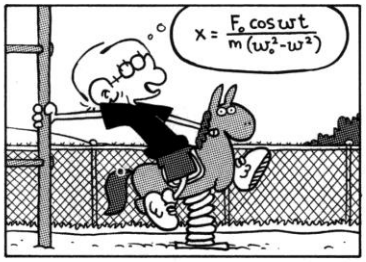
$R_{sun} = 6.96\text{x}10^8$ m
$R_{earth} = 6.38\text{x}10^6$ m
$R_{moon} = 1.74\text{x}10^6$ m

$G = 6.67\text{x}10^{-11}$ N·m^2/kg^2

$r_{earth\ to\ sun} = 149.6\text{x}10^9$ m
$r_{earth\ to\ moon} = 384\text{x}10^6$ m

$g = 9.80$ m/s^2

$M_{sun} = 1.99\text{x}10^{30}$ kg
$M_{earth} = 5.98\text{x}10^{24}$ kg
$M_{moon} = 7.35\text{x}10^{22}$ kg



$$\vec{\omega} = \frac{\Delta\vec{\theta}}{\Delta t} \qquad \vec{\alpha} = \frac{\Delta\vec{\omega}}{\Delta t}$$

$$\vec{\theta} = \vec{\theta}_o + \vec{\omega}_i \Delta t + \frac{1}{2}\vec{\alpha}\Delta t^2$$

$$\vec{\omega}_f = \vec{\omega}_i + \vec{\alpha}\Delta t$$

$$\vec{\omega}_f^2 = \vec{\omega}_i^2 + 2\vec{\alpha}\Delta\vec{\theta}$$

$$T_{pendulum} = \sqrt{2\pi\left({}^1/_g\right)}$$

$$T_{spring} = \sqrt{2\pi\left({}^m/_k\right)}$$

$$\vec{\tau} = \vec{F} \times \vec{r}$$

$$\vec{\tau} = Fr\sin\theta$$

$$\vec{d}_T = r\vec{\theta}$$

$$\vec{v}_T = r\vec{\omega}$$

$$\vec{a}_T = r\vec{\alpha}$$

$$\vec{a}_c = r\vec{\omega}^2$$

$$\vec{L} = I\vec{\omega}$$

$$L_i = L_f$$

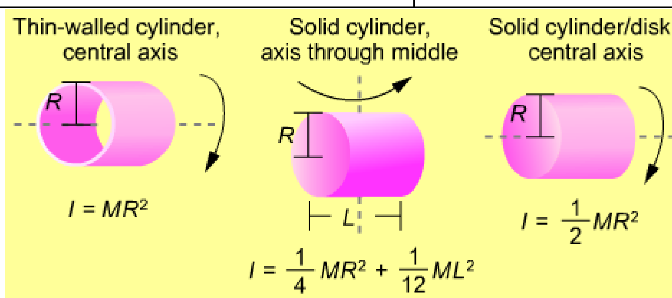
$$\Sigma\vec{\tau} = \frac{\Delta\vec{L}}{\Delta t}$$

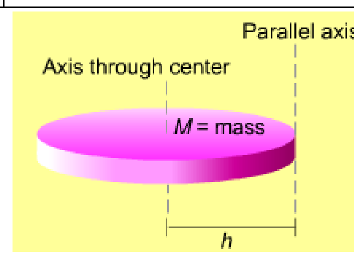
$$I = \Sigma m r^2$$

$$\Sigma\vec{\tau} = I\vec{\alpha}$$

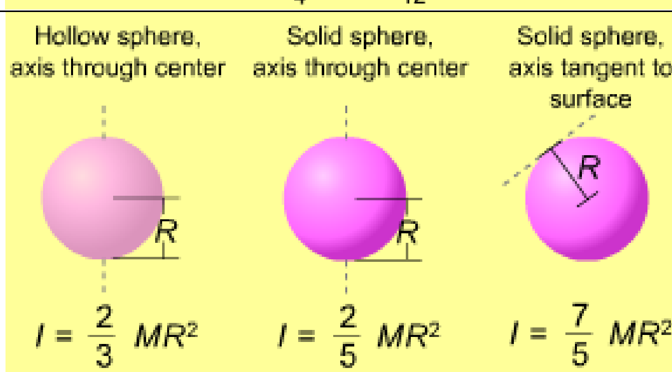
$$\vec{W} = \vec{\tau}\Delta\vec{\theta}$$

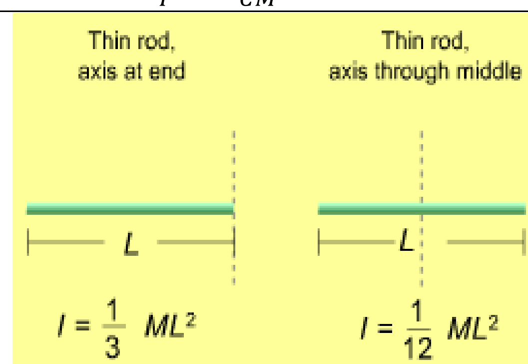
$$KE = \frac{1}{2}I\omega^2$$

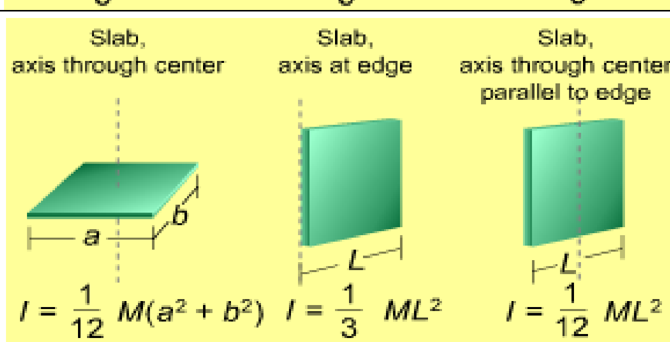


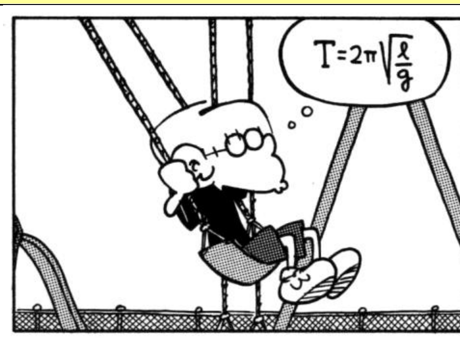


$$I_P = I_{CM} + Mh^2$$









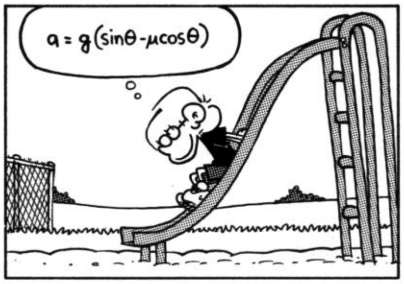
$$M_{Total}X_{CM} = M_1X_1 + M_2X_2 + M_3X_3 + \cdots + M_nX_n$$

$M_e = 9.11 \times 10^{-31}$ Kg	$M_p = 1.672 \times 10^{-27}$ kg	$M_n = 1.674 \times 10^{-27}$ kg

$$F = K\frac{q_1 q_2}{r^2}$$

$$K = \frac{1}{4\pi\varepsilon_o}$$ e = 1.602x10^{-19} C

$$K = 8.988x10^9\ \frac{Nm^2}{C^2} \qquad \varepsilon_o = 8.85x10^{-12}\ \frac{C^2}{Nm^2}$$



$$q = ne$$

$$E = \frac{Kq}{r^2} \qquad E = \frac{F}{q} \qquad E = \frac{V}{\Delta d}$$

$$V = \frac{Kq}{r} \qquad V = \frac{PE_e}{q}$$

$$PE_e = \frac{Kq_1 q_2}{r}$$

$$1eV = 1.602x10^{-19}J$$

$$\Delta V = \frac{\Delta W}{q} \qquad \Delta V = -E\Delta d$$

$$I = \frac{\Delta q}{\Delta t}$$

$$P = I\Delta V = I^2 R = \frac{\Delta V^2}{R} \qquad R = \rho\frac{L}{A} \qquad \rho_2 = \rho_1[1 + \alpha\Delta T] \qquad \Delta V = IR$$

$$\rho_{silver} = 1.59x10^{-8}\Omega m \qquad \rho_{copper} = 1.68x10^{-8}\Omega m \qquad \rho_{alum} = 2.65x10^{-8}\Omega m$$

$$C = \frac{\varepsilon_o A}{d} \qquad C = \frac{q}{\Delta V}$$

$$U = \frac{q\Delta V}{2} = \frac{C(\Delta V)^2}{2} = \frac{q^2}{2C}$$

$$C_\kappa = \kappa C$$

	Dielectric constant	Dielectric strength (in 10^6 V/m)
Vacuum	1	n/a
Air	1.00054	3.0
Paper	1.7 to 2.6	4 to 9
Rubber	2 to 3.5	20 to 27
Glass	5.4 to 9.9	30 to 150
Water (293K)	80.20	65 to 70
Strontium titanate (298K, 78K)	332, 2080	

$$\kappa = \frac{E_{vacuum}}{E_{dielectric}}$$

$$\Sigma\Delta V_{loop} = 0 \qquad \Sigma I_{in} = \Sigma I_{out}$$

$$R_{Series} = R_1 + R_2 + R_3 + \cdots + R_n \qquad \frac{1}{R_{Parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}$$

$$\frac{1}{C_{Series}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_n} \qquad C_{Parallel} = C_1 + C_2 + C_3 + \cdots + C_n$$

$$\varepsilon - \Delta V_r = \Delta V_{bat}$$

$$y = A\sin(2\pi ft) \qquad x = A\cos(\omega t + \varphi) \qquad x = A\cos\theta$$

$$f = \frac{1}{T} \qquad T = 2\pi\sqrt{\frac{L}{g}}$$

$$v = \lambda f \qquad v = \sqrt{\frac{F_t}{m/L}}$$

$$y_s = 2A\sin(kx)\cos(\omega t)$$

$$\Delta p_C = n\lambda \qquad \Delta p_D = \frac{2n+1}{2}\lambda$$

$$f_{beat} = |f_1 - f_2|$$

$$x_n = n\frac{\lambda}{2} \qquad x_{an} = \left[n + \frac{1}{2}\right]\frac{\lambda}{2}$$

$$f_n = \frac{v}{\lambda_n} = n\frac{v}{2L}$$

Open Pipe

$$f_n = \frac{nv}{2L}$$

Closed Pipe

$$f_n = \frac{nv}{4L}$$

$$v_{sound} = (331\,m/s)\sqrt{1 + \frac{T_c}{273^o C}} \qquad v_{fluid} = \sqrt{\frac{B}{\rho}} \qquad v_{solid} = \sqrt{\frac{Y}{\rho}}$$

N/m^2	Tensile	Compress	Shear	E	G	B
Steel	$500x10^6$	$500x10^6$	$250x10^6$	$200x10^9$	$80x10^9$	$140x10^9$
Nylon	$500x10^6$			$5x10^9$		
Brick		$35x10^6$		$14x10^9$		
Air						$1.01x10^5$

ρ of materials (kg/m^3)					
Al	$2.70x10^3$	Ice	$.917x10^3$	Sea Water	$1.025x10^3$
Steel	$7.80x10^3$	Water	$1.00x10^3$	Hg	$13.6x10^3$
Gold	$19.3x10^3$	Air	1.29	CO_2	1.98

$$I = \frac{P}{A} \qquad I = \frac{P}{4\pi r^2}$$

$$\beta = (10dB)\log\frac{I}{I_o} \qquad I_o = 1.0 \times 10^{-12}\ W/m^2$$

$$f' = f\left[\frac{v_{sound} \pm v_{observer}}{v_{sound} \pm v_{source}}\right]$$

$$\sin\theta_{mach} = \frac{v_{sound}}{v_{object}} \qquad Mach\ Number = \frac{v_{object}}{v_{sound}} \qquad I_p = \frac{I_o}{2}$$

$$\theta_i = \theta_r \qquad f = {}^{r}/_{2} \qquad \frac{1}{d_i} + \frac{1}{d_o} = \frac{1}{f} \qquad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o} \qquad I_a = I_p\cos^2\theta$$

$$n = {}^{c}/_{v} \qquad n_i\sin\theta_i = n_r\sin\theta_r \qquad \frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] \qquad P = \frac{1}{f}$$

$$c = 2.99792458 \times 10^8\ {}^{m}/_{s}$$

Medium	n	Medium	n
Vacuum	1.000	Air	1.0003
Crown Glass	1.52	Light Flint Glass	1.58
Water	1.33	Fused Quartz Glass	1.46
Lucite	1.51	Sodium Chloride	1.53
Diamond	2.42	Ethyl Alcohol	1.36

$$\gamma = \frac{1}{\sqrt{1 - {}^{v^2}/_{c^2}}} \qquad t = \gamma t_o \qquad L = \frac{L_o}{\gamma} \qquad p = \gamma m u$$

$$m = \gamma m_o \qquad u = \frac{u' + v}{1 + {}^{u'v}/_{c^2}}$$

$$KE_{rel} = (\gamma - 1)mc^2 \qquad E_o = mc^2 \qquad E = \gamma mc^2$$

$1\ atm = 101.3\ kPa$ $E = 2\pi^2\rho Avtf^2x_o^2$ $\lambda_n = 2L/n$

$MA = F_r/F_e$ $MA = L_{ea} / L_{la}$ $IMA = d_e/d_r$

$eff = (W_o/W_i)x100\% = (MA/IMA)x100\%$

$L = (n\lambda_n)/2$ $d\sin\theta = m\lambda$ $d\sin\theta = (m + 1/2)\lambda$ $2t = m\lambda$

$2t = (m + 1/2)\lambda$

$I = I_o\cos^2\theta$ $\tan\theta_p = n_2/n_1$

$V = V_o\sin 2\pi ft$ $I = I_o\sin 2\pi ft$

$P = \frac{1}{2}V_o^2/R$ $P = \frac{1}{2}I_o^2R$

$I_{rms} = I_o/\sqrt{2}$ $V_{rms} = V_o/\sqrt{2}$

$T = (R-R_o)/\alpha R_o$ $V = \varepsilon(1-e^{-t/RC})$ $V = V_oe^{-t/RC}$

$F = qVB\sin\theta$ $F = IlB\sin\theta$ $B = (\mu_oI)/(2\pi r)$

$\mu_o = 4\pi\ x10^{-7}\ Tm/A$ $F/l = (\mu_o/2\pi)(I_1I_2/L)$ $B = \mu_onI/l$

$\Delta L = (1/E)(F/A)L_o$

$Stress = F/A$ $Strain = \Delta L/L_o$

$\Delta V/V_o = -(1/B)\Delta P$

$F_B = \rho_FgV$ $A_1V_1 = A_2V_2$

$P_1 + \frac{1}{2}\rho v_1^2 + \rho gy_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gy$ $(F_{out}/A_{out})=(F_{in}/A_{in})$

$D = d/(\tan\phi)$

$d = 1/\phi$ $l = L/(4\pi d^2)$ $\lambda pT = 2.90x10^{-3}\ mK$

$1.4959x10^{11}m=1AU$ $6.3240x10^4Au=1ly$ $3.261633ly=1pc$

$M_{sun} = 1.99x10^{30}\ kg$

$$Cosecant = \frac{Hypotenuse}{Opposite} \quad Secant = \frac{Hypotenuse}{Adjecent} \quad Cotangent = \frac{Adjecent}{Opposite}$$