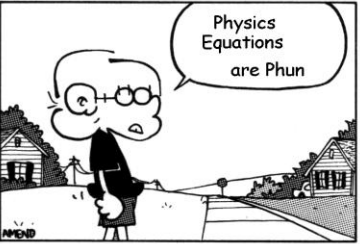
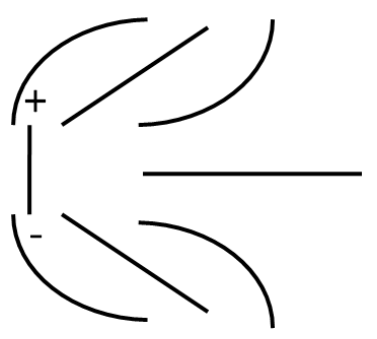
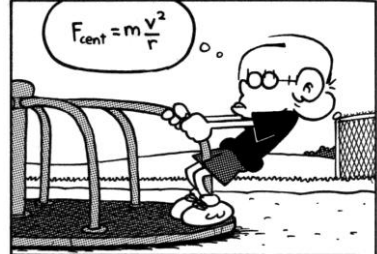
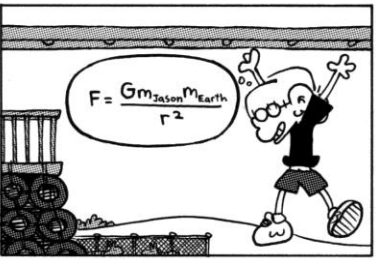
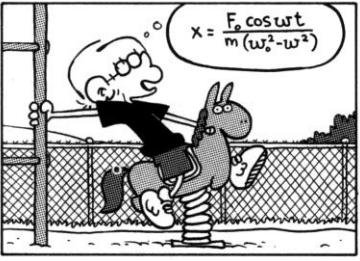
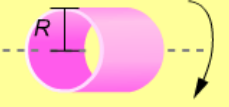
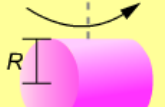

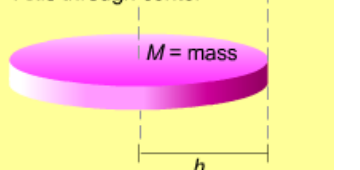



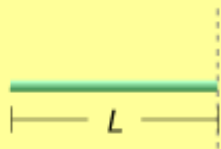
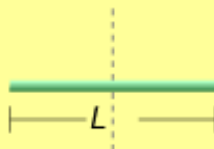
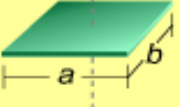
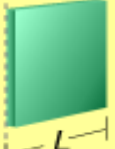
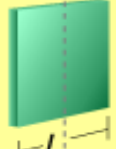
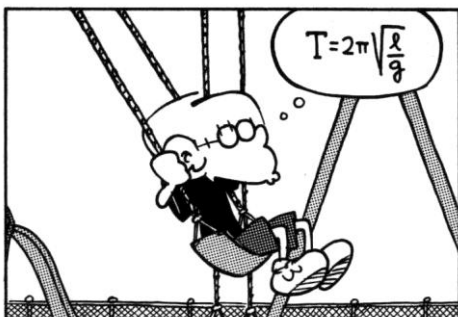
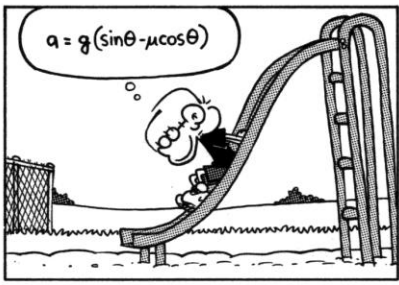



$\vec{d} = \vec{d}_o + \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2$			$\vec{v}_f = \vec{v}_i + \vec{a} \Delta t$			$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$			$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a} \Delta \vec{d}$		
$\sin(2\theta) = 2 \sin \theta \cos \theta$ $\cos(2\theta) = \cos^2 \theta - \sin^2 \theta$ $\sin^2 \theta + \cos^2 \theta = 1$			SOH-CAH-TOA CHO-SHA-CAO $\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$			$A^2 = B^2 + C^2 - 2BC \cos \alpha$ $B^2 = A^2 + C^2 - 2AC \cos \beta$ $C^2 = A^2 + B^2 - 2AB \cos \gamma$					
$\Sigma \vec{F} = M\vec{a}$			$F_f = \mu F_N$			$\vec{F}_G = m\vec{g}$			$\vec{F}_{\text{spring}} = -k\vec{x}$		
			$W = F_{\parallel} \Delta d_{\parallel}$			$W = \vec{F} \cdot \Delta \vec{d}$			 <p>Jason the Slope Crab</p>		
			$P = \frac{\Delta W}{t} = \frac{\Delta E}{t} = FV$								
$W_{\text{net}} = W_c + W_{nc}$ $W_{\text{net}} = \Delta KE$			$KE = \frac{1}{2} mV^2$ $PE_{\text{spring}} = \frac{1}{2} kx^2$								
$\vec{p} = m\vec{V}$ $\vec{J} = \vec{F} \Delta t \Rightarrow \Delta m\vec{V} = m\Delta \vec{V} = \Delta \vec{p}$			$PE_{\text{grav}} = mgh$								
$\vec{F}_c = m\vec{a}_c$			$\vec{a}_c = \frac{v^2}{r}$			$\vec{a}_c = \frac{4\pi^2 r}{T^2}$					
$T = \frac{2\pi r}{V}$			$F_G = G \frac{m_1 m_2}{r^2}$			$g = \frac{GM}{r^2}$			$\frac{T_a^2}{r_a^3} = \frac{T_b^2}{r_b^3} = \frac{4\pi^2}{GM}$		
$V_{\text{orbit}} = \sqrt{\frac{GM}{h+R}}$			$V_{\text{Escape}} = \sqrt{\frac{2GM}{r}}$			$f = \frac{1}{T}$			$v = \frac{2\pi r}{T} = 2\pi r f$		
			$V_{\text{Sphere}} = \frac{4}{3} \pi r^3$			$R_{\text{sun}} = 6.96 \times 10^8 \text{ m}$ $R_{\text{earth}} = 6.38 \times 10^6 \text{ m}$ $R_{\text{moon}} = 1.74 \times 10^6 \text{ m}$					
			$G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2$			$r_{\text{earth to sun}} = 149.6 \times 10^9 \text{ m}$ $r_{\text{earth to moon}} = 384 \times 10^6 \text{ m}$					
			$g = 9.80 \text{ m/s}^2$			$M_{\text{sun}} = 1.99 \times 10^{30} \text{ kg}$ $M_{\text{earth}} = 5.98 \times 10^{24} \text{ kg}$ $M_{\text{moon}} = 7.35 \times 10^{22} \text{ kg}$					

	$\vec{\omega} = \frac{\Delta\vec{\theta}}{\Delta t} \quad \vec{\alpha} = \frac{\Delta\vec{\omega}}{\Delta t}$ $\vec{\theta} = \vec{\theta}_o + \vec{\omega}_i\Delta t + \frac{1}{2}\vec{\alpha}\Delta t^2$ $\vec{\omega}_f = \vec{\omega}_i + \vec{\alpha}\Delta t$ $\vec{\omega}_f^2 = \vec{\omega}_i^2 + 2\vec{\alpha}\Delta\vec{\theta}$	$T_{pendulum} = \sqrt{2\pi\left(\frac{1}{g}\right)}$	
$\vec{\tau} = \vec{F} \times \vec{r}$ $\vec{\tau} = Fr \sin \theta$	$\vec{d}_T = r\vec{\theta}$ $\vec{v}_T = r\vec{\omega}$ $\vec{a}_T = r\vec{\alpha}$	$\vec{L} = I\vec{\omega}$ $L_i = L_f$ $\Sigma\vec{\tau} = \frac{\Delta\vec{L}}{\Delta t}$	
$I = \Sigma mr^2$ $\Sigma\vec{\tau} = I\vec{\alpha}$	$\vec{a}_c = r\vec{\omega}^2$	$\vec{W} = \vec{\tau}\Delta\vec{\theta}$ $KE = \frac{1}{2}I\omega^2$	
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Thin-walled cylinder, central axis</p>  <p>$I = MR^2$</p> </div> <div style="text-align: center;"> <p>Solid cylinder, axis through middle</p>  <p>$I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$</p> </div> <div style="text-align: center;"> <p>Solid cylinder/disk, central axis</p>  <p>$I = \frac{1}{2}MR^2$</p> </div> </div>			<div style="text-align: center;">  <p>Parallel axis</p> <p>Axis through center</p> <p>$M = \text{mass}$</p> <p>$I_P = I_{CM} + Mh^2$</p> </div>
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Hollow sphere, axis through center</p>  <p>$I = \frac{2}{3}MR^2$</p> </div> <div style="text-align: center;"> <p>Solid sphere, axis through center</p>  <p>$I = \frac{2}{5}MR^2$</p> </div> <div style="text-align: center;"> <p>Solid sphere, axis tangent to surface</p>  <p>$I = \frac{7}{5}MR^2$</p> </div> </div>			<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Thin rod, axis at end</p>  <p>$I = \frac{1}{3}ML^2$</p> </div> <div style="text-align: center;"> <p>Thin rod, axis through middle</p>  <p>$I = \frac{1}{12}ML^2$</p> </div> </div>
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Slab, axis through center</p>  <p>$I = \frac{1}{12}M(a^2 + b^2)$</p> </div> <div style="text-align: center;"> <p>Slab, axis at edge</p>  <p>$I = \frac{1}{3}ML^2$</p> </div> <div style="text-align: center;"> <p>Slab, axis through center parallel to edge</p>  <p>$I = \frac{1}{12}ML^2$</p> </div> </div>			
$M_{Total} X_{CM} = M_1X_1 + M_2X_2 + M_3X_3 + \dots + M_nX_n$			
$M_e = 9.11 \times 10^{-31} \text{ Kg}$	$M_p = 1.672 \times 10^{-27} \text{ kg}$	$M_n = 1.674 \times 10^{-27} \text{ kg}$	

$F = K \frac{q_1 q_2}{r^2}$	$K = \frac{1}{4\pi\epsilon_0}$		$e = 1.602 \times 10^{-19} \text{ C}$																
	$K = 8.988 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$		$\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}$																
	$q = ne$	$E = \frac{Kq}{r^2}$	$E = \frac{F}{q}$ $E = \frac{V}{\Delta d}$																
	$V = \frac{Kq}{r}$	$V = \frac{PE_e}{q}$	$PE_e = \frac{Kq_1 q_2}{r}$																
$1eV = 1.602 \times 10^{-19} \text{ J}$	$\Delta V = \frac{\Delta W}{q}$	$\Delta V = -E\Delta d$	$I = \frac{\Delta q}{\Delta t}$																
$P = I\Delta V = I^2 R = \frac{\Delta V^2}{R}$	$R = \rho \frac{L}{A}$	$\rho_2 = \rho_1 [1 + \alpha \Delta T]$	$\Delta V = IR$																
$\rho_{\text{silver}} = 1.59 \times 10^{-8} \Omega \text{ m}$ $\rho_{\text{copper}} = 1.68 \times 10^{-8} \Omega \text{ m}$ $\rho_{\text{alum}} = 2.65 \times 10^{-8} \Omega \text{ m}$																			
$C = \frac{\epsilon_0 A}{d}$	$C = \frac{q}{\Delta V}$	$U = \frac{q\Delta V}{2} = \frac{C(\Delta V)^2}{2} = \frac{q^2}{2C}$	$C_\kappa = \kappa C$																
<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Dielectric constant</th> <th style="text-align: left; border-bottom: 1px solid black;">Dielectric strength (in 10^6 V/m)</th> </tr> </thead> <tbody> <tr><td>Vacuum</td><td>1</td></tr> <tr><td>Air</td><td>1.00054</td></tr> <tr><td>Paper</td><td>1.7 to 2.6</td></tr> <tr><td>Rubber</td><td>2 to 3.5</td></tr> <tr><td>Glass</td><td>5.4 to 9.9</td></tr> <tr><td>Water (293K)</td><td>80.20</td></tr> <tr><td>Strontium titanate (298K, 78K)</td><td>332, 2080</td></tr> </tbody> </table>		Dielectric constant	Dielectric strength (in 10^6 V/m)	Vacuum	1	Air	1.00054	Paper	1.7 to 2.6	Rubber	2 to 3.5	Glass	5.4 to 9.9	Water (293K)	80.20	Strontium titanate (298K, 78K)	332, 2080	$\kappa = \frac{E_{\text{vacuum}}}{E_{\text{dielectric}}}$	
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$\Sigma \Delta V_{\text{loop}} = 0$		$\Sigma I_{\text{in}} = \Sigma I_{\text{out}}$																	
$R_{\text{Series}} = R_1 + R_2 + R_3 + \dots + R_n$		$\frac{1}{R_{\text{Parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_n}$																	
$\frac{1}{C_{\text{Series}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots + \frac{1}{C_n}$		$C_{\text{Parallel}} = C_1 + C_2 + C_3 + \dots + C_n$																	
$\epsilon - \Delta V_r = \Delta V_{\text{bat}}$	$y = A \sin(2\pi ft)$	$x = A \cos(\omega t + \varphi)$	$x = A \cos \theta$																
$f = \frac{1}{T}$	$T = 2\pi \sqrt{\frac{L}{g}}$	$v = \lambda f$	$v = \sqrt{\frac{F_t}{m/L}}$																
$y_s = 2A \sin(kx) \cos(\omega t)$																			
$\Delta p_C = n\lambda$	$\Delta p_D = \frac{2n+1}{2} \lambda$	$f_{\text{beat}} = f_1 - f_2 $	$x_n = n \frac{\lambda}{2}$ $x_{\text{an}} = \left[n + \frac{1}{2} \right] \frac{\lambda}{2}$																

$f_n = \frac{v}{\lambda_n} = n \frac{v}{2L}$	Open Pipe $f_n = \frac{nv}{2L}$	Closed Pipe $f_n = \frac{nv}{4L}$																																							
$v_{sound} = (331 \text{ m/s}) \sqrt{1 + \frac{T_c}{273^\circ C}} \quad v_{fluid} = \sqrt{\frac{B}{\rho}} \quad v_{solid} = \sqrt{\frac{Y}{\rho}}$																																									
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$\beta = (10\text{dB}) \log \frac{I}{I_o} \quad I_o = 1.0 \times 10^{-12} \text{ W/m}^2$			$f' = f \left[\frac{v_{sound} \pm v_{observer}}{v_{sound} \pm v_{source}} \right]$																																						
$\sin \theta_{mac h} = \frac{v_{sound}}{v_{object}}$		$\text{Mach Number} = \frac{v_{object}}{v_{sound}}$			$I_p = \frac{I_o}{2}$																																				
$\theta_i = \theta_r$	$f = r/2$	$\frac{1}{d_i} + \frac{1}{d_o} = \frac{1}{f}$	$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$	$I_a = I_p \cos^2 \theta$																																					
$n = c/v$	$n_i \sin \theta_i = n_r \sin \theta_r$		$\frac{1}{f} = (n - 1) \left[\frac{1}{R_1} - \frac{1}{R_2} \right]$		$P = \frac{1}{f}$																																				
$c = 2.99792458 \times 10^8 \text{ m/s}$				<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 25%;">Medium</th> <th style="width: 25%;">n</th> <th style="width: 25%;">Medium</th> <th style="width: 25%;">n</th> </tr> </thead> <tbody> <tr> <td>Vacuum</td> <td>1.000</td> <td>Air</td> <td>1.0003</td> </tr> <tr> <td>Crown Glass</td> <td>1.52</td> <td>Light Flint Glass</td> <td>1.58</td> </tr> <tr> <td>Water</td> <td>1.33</td> <td>Fused Quartz Glass</td> <td>1.46</td> </tr> <tr> <td>Lucite</td> <td>1.51</td> <td>Sodium Chloride</td> <td>1.53</td> </tr> <tr> <td>Diamond</td> <td>2.42</td> <td>Ethyl Alcohol</td> <td>1.36</td> </tr> </tbody> </table>			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											
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$KE_{rel} = (\gamma - 1)mc^2$		$m = \gamma m_o$		$u = \frac{u' + v}{1 + u'v/c^2}$																																					
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$$1 \text{ atm} = 101.3 \text{ kPa}$$

$$MA = F_r/F_e$$

$$\text{eff} = (W_o/W_i) \times 100\% = (MA/IMA) \times 100\%$$

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

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

$$I = I_o \cos^2 \theta$$

$$\tan \theta_p = n_2/n_1$$

$$E = 2\pi^2 \rho A v t f^2 x_o^2$$

$$MA = L_{ea} / L_{la}$$

$$\lambda_n = 2L/n$$

$$IMA = d_e/d_r$$

$$2t = m\lambda$$

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

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

$$I_{\text{rms}} = I_o / 2$$

$$T = (R - R_o) / \alpha R_o$$

$$F = qVB \sin \theta$$

$$\mu_o = 4\pi \times 10^{-7} \text{ Tm/A}$$

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

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

$$V_{\text{rms}} = V_o / 2 \sqrt{\quad}$$

$$V = \epsilon(1 - e^{-t/RC})$$

$$F = IlB \sin \theta$$

$$F/l = (\mu_o/2\pi)(I_1 I_2/L)$$

$$V = V_o e^{-t/RC}$$

$$B = (\mu_o I) / (2\pi r)$$

$$B = \mu_o n I / l$$

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

$$\text{Stress} = F/A$$

$$\text{Strain} = \Delta L/L_o$$

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

$$F_B = \rho_F g V$$

$$A_1 V_1 = A_2 V_2$$

$$P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$$

$$(F_{\text{out}}/A_{\text{out}}) = (F_{\text{in}}/A_{\text{in}})$$

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

$$d = 1/\phi$$

$$l = L/(4\pi d^2)$$

$$\lambda_p T = 2.90 \times 10^{-3} \text{ mK}$$

$$1.4959 \times 10^{11} \text{ m} = 1 \text{ AU}$$

$$6.3240 \times 10^4 \text{ Au} = 1 \text{ ly}$$

$$3.2616331 \text{ ly} = 1 \text{ pc}$$

$$M_{\text{sun}} = 1.99 \times 10^{30} \text{ kg}$$

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