Math		
$(1\pm x)^n = 1\pm \frac{nx}{1!} + \frac{n(n-1)x^2}{2!} \pm \ldots$ where $x^2 < 1$ $(1\pm x)^{-n} = 1\mp \frac{nx}{1!} + \frac{n(n+1)x^2}{2!} \mp \ldots$ where $x^2 < 1$		

Mechanics			
$G = 6.67\times 10^{-11}\, N\cdot m^2/kg^2$ $g = 9.81 m/\sec^2$	$x = x_0 + v_0 t + \frac{at^2}{2}$ $v = v_0 + at$ $x - x_0 = \frac{v^2 - v_0^2}{2a}$	$M\frac{d\vec{v}}{dt} = \vec{F}_{ext} + \vec{v}_{rel}\frac{dM}{dt}$	$\int Fdt = F_{av}\Delta t = M(v_f - v_i)$ $\int \tau dt = F_{av} r \Delta t = I(\omega_f - \omega_i)$
$v_T = \omega r$ $a_r = \frac{v_T^2}{r} = \omega^2 r$ $a_T = \alpha r$	$\vec{v} = \vec{\omega}\times\vec{R}$ $\vec{a} = \frac{d\vec{\omega}}{dt}\times\vec{R} + \vec{\omega}\times\frac{d\vec{R}}{dt} = \vec{\alpha}\times\vec{R} + \vec{\omega}\times\vec{v}$	$I = \int r^2 dm = I_{CM} + Mh^2$ $\tau = I\alpha$	Hoop about cylinder axis: $I = MR^2$
Annular cylinder or ring about cylinder axis: $I = \frac{1}{2}M(R_1^2 + R_2^2)$	Annular cylinder or ring about diameter: $I = \frac{M}{4}\left(R_1^2 + R_2^2\right)$	Solid cylinder or disk about cylinder axis: $I = \frac{1}{2}MR^2$	Solid cylinder or disk about central diameter: $I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$
Thin rod about axis through center $\perp$ to length: $I = \frac{1}{12}ML^2$	Thin rod about axis through one end $\perp$ to length: $I = \frac{1}{3}ML^2$	Solid sphere about any diameter: $I = \frac{2}{5}MR^2$	Thin spherical shell about any diameter: $I = \frac{2}{3}MR^2$
Hoop about any diameter: $I = \frac{1}{2}MR^2$	Rectangular plate about $\perp$ axis through center: $I = \frac{1}{12}M(a^2 + b^2)$	$L = I\omega$, $K = \frac{1}{2}I\omega^2$ $W = \int_{\theta_1}^{\theta_2}\tau_z d\theta$	$\vec{L} = \vec{r}\times\vec{p}$ $\frac{d\vec{L}}{dt} = \vec{r}\times\vec{F} = \vec{\tau}$
$\vec{\tau} = \vec{r}\times\vec{F}$ $\tau = rF\sin\theta = rF_\perp = r_\perp F$	$W = \int_i^f \vec{F}\cdot d\vec{s}$, $W_{net} = \Delta K = -\Delta U$ $P = \vec{F}\cdot\vec{v}$ COE: $\Delta K + \Delta U + \Delta E_{\text{int}} = W_{ext}$ COM: $F_{ext} s_{CM} = \Delta K_{CM}$	$\vec{F}_{12} = -\frac{Gm_1 m_2}{r_{12}^2}\hat{r}_{12}$ $\vec{F}_{21} = -\vec{F}_{12}$ $U(r) = -\frac{GMm}{r}$	$T^2 = \left(\frac{4\pi^2}{GM}\right)r^3$ $\frac{dA}{dt} = \frac{r^2\omega}{2} = \frac{L_z}{2m}$

Relativity				
$\Delta t = \gamma\Delta t_0$, $L = \frac{L_0}{\gamma}$ $\gamma = \frac{1}{\sqrt{1 - u^2/c^2}}$ $v = \frac{v_0 + u}{1 + v_0 u/c^2}$	$x' = \gamma(x - ut)$ $y' = y$ $z' = z$ $t' = \gamma\left(t - \frac{ux}{c^2}\right)$	$x = \gamma(x' + ut')$ $y = y'$ $z = z'$ $t = \gamma\left(t' + \frac{ux'}{c^2}\right)$	$v'_x = \frac{\Delta x'}{\Delta t'} = \frac{v_x - u}{1 - uv_x/c^2}$ $v'_y = \frac{v_y}{\gamma(1 - uv_x/c^2)}$ $v'_z = \frac{v_z}{\gamma(1 - uv_x/c^2)}$	$v_x = \frac{\Delta x}{\Delta t} = \frac{v'_x + u}{1 + uv'_x/c^2}$ $v_y = \frac{v'_y}{\gamma(1 + uv'_x/c^2)}$ $v_z = \frac{v'_z}{\gamma(1 + uv'_x/c^2)}$
$K = mc^2(\gamma - 1) = E - E_0$ $E = \gamma mc^2$ $E_0 = mc^2$	$E = K + E_0 = \sqrt{(pc)^2 + (mc^2)^2}$ $\vec{p} = \frac{m\vec{v}}{\sqrt{1 - \frac{v^2}{c^2}}}$		$m_p = 1.67\times 10^{-27}\,kg$ $m_e = 9.11\times 10^{-31}\,kg$	$c = 3.00\times 10^8\, m/\sec$ $m_e c^2 = 0.511 MeV$ $m_p c^2 = 938.3 MeV$
$(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 - c^2(\Delta t)^2 = (\Delta x')^2 + (\Delta y')^2 + (\Delta z')^2 - c^2(\Delta t')^2$				

Hamonic Oscillator, Wave Motion, Sound				
	$f=\frac{1}{T}$, $\omega=\frac{2\pi}{T}$, $v=\lambda f=\frac{\omega}{k}=\frac{2\pi f}{k}$		$\omega^2=\frac{k}{m}=\frac{g}{l}=\frac{Mgd}{I}=\frac{\kappa}{I}$	
$m\ddot{x}+b\dot{x}+kx=0$	$x=x_m\exp(-bt/2m)\cos(\omega' t+\phi)$		$\omega'=\sqrt{\frac{k}{m}-\left(\frac{b}{2m}\right)^2}$	
$m\ddot{x}+b\dot{x}+kx=F_m\cos(\omega'' t)$	$x=\frac{F_m}{G}\cos(\omega'' t-\beta)$	$G=\sqrt{m^2(\omega''^2-\omega^2)+b^2\omega''^2}$		$\beta=\cos^{-1}\frac{b\omega''}{G}$
$y(x,t)=y_m\sin(kx-\omega t-\phi)$	$v=\sqrt{F/\mu}$	$v=\sqrt{\frac{B}{\rho_0}}$	$\lambda_n=\frac{2L}{n}$ (open pipe)	$\lambda_n=\frac{4L}{n}$ *(closed pipe)*
$\Delta\rho(x,t)=\Delta\rho_m\sin(kx-\omega t)$ $\Delta p(x,t)=\Delta p_m\sin(kx-\omega t)$ $s(x,t)=\frac{\Delta\rho_m}{k\rho_0}\cos(kx-\omega t)$	$\Delta\rho_m=\Delta p_m\frac{\rho_0}{B}$	$P_{av}=\frac{A(\Delta p_m)^2}{2\rho v}$ $I=\frac{P_{av}}{A}$	$SL=10\log\frac{I}{I_0}$ *where* $I_0=10^{-12}W/m^2$	$f'=\frac{v\pm v_0}{v\mp v_s}f$, $\sin\theta=\frac{v}{v_s}$

Fluids, Thermodynamics				
$B=-\frac{\Delta P}{\Delta V/V}$	$P+\frac{1}{2}\rho v^2+\rho gh=const$ $\frac{dP}{dy}=-\rho g$	$Av=\frac{\Delta V}{\Delta t}=const$, $F_b=\rho Vg$	$\gamma=\frac{F}{L}=\frac{\Delta u}{\Delta A}$	$F=\eta A\frac{dv}{dy}$, $R=\frac{\rho Dv}{\eta}$
$\alpha=\frac{\Delta L/L}{\Delta T}$ $\beta=\frac{\Delta V}{V\Delta T}$	$PV=Nk_BT=nRT$ $(P+a\frac{n^2}{V^2})(V-nb)=nRT$	$N(v)=4\pi N\left(\frac{m}{2\pi kT}\right)^{3/2}v^2\exp(-mv^2/2kT)$ $N(E)=\frac{2N}{\sqrt{\pi}}\frac{1}{(kT)^{3/2}}E^{1/2}\exp(-E/kT)$		$R=8.31J/mol\cdot K$ $k=1.38\times10^{-23}J/K$ $N_A=6.02\times10^{23}mol^{-1}$
$v_p=\sqrt{\frac{2kT}{m}}$, $v_{av}=\sqrt{\frac{8kT}{\pi m}}$, $v_{rms}=\sqrt{\frac{3kT}{m}}$		$\frac{kT}{m}=\frac{RT}{M}=\frac{P}{\rho}$, $\lambda=\frac{kT}{\sqrt{2}\pi d^2p}$, $rate=\frac{v_{rms}}{\lambda}$		$H=-kA\frac{dT}{dx}$, $R=\frac{L}{k}$

Process and Key Equation	Work: $\Delta W=-\int_{V_i}^{V_f}PdV$	Heat: $\Delta Q=nC_{V,P}\Delta T$	$\Delta E_{int}=\frac{3}{2}nR\Delta T$ (monatomic)
Constant Volume	0	$C_V=\frac{3}{2}R,\frac{5}{2}R,3R$	ΔQ
Constant Pressure: $P=P_0$	$-P(V_f-V_i)$	$C_p=C_V+R$	$\Delta W+\Delta Q$
Constant Temperature: $P=\frac{nRT}{V}$	$-nRT\ln\frac{V_f}{V_i}$	$\Delta Q=-\Delta W$	0
Adiabatic: $PV^\gamma=const$, $\gamma=\frac{C_p}{C_V}$	$\frac{1}{\gamma-1}(P_fV_f-P_iV_i)$	0	ΔW
$C=\frac{Q}{\Delta T}$, $c=\frac{C}{m}$, $Q=Lm$	$dS=\frac{dQ}{T}$	$\frac{1}{2}k$ per degree of freedom	$B=\gamma P$
$\varepsilon=\frac{\lvert W\rvert}{\lvert Q_H\rvert}$, $e_C=1-\frac{T_L}{T_H}$, $K_C=\frac{\lvert Q_L\rvert}{W}=\frac{T_L}{T_H-T_L}$	$\Delta S=nR\ln\frac{V_f}{V_i}+nC_V\ln\frac{T_f}{T_i}$		$\ln N!=N\ln N-N$ $S=k\ln w$, $w=\frac{N!}{N_1!N_2!}$