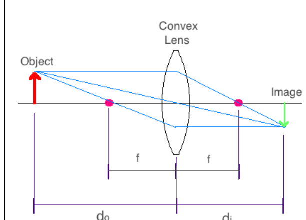
Harold's Physics Formulas
Cheat Sheet
7 April 2026

	Mechanics: Linear Translation	Mechanics: Angular / Rotational Motion	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Kinematics	**Bold** = Vector Red = Calculus Purple = Memorize	See Harold's Physics Units of Measure Cheat Sheet See Harold's Physics of Projectiles Cheat Sheet		See Harold's Physics Optics Cheat Sheet See Math and Greek Symbols	
Position (m) (rad)	*Horizontal:* $\boldsymbol{x} = \boldsymbol{x}_0 + \boldsymbol{v}_{0x}t + \frac{1}{2}\boldsymbol{a}t^2$ *Vertical:* $\boldsymbol{y} = \boldsymbol{y}_0 + \boldsymbol{v}_{0y}t + \frac{1}{2}\boldsymbol{g}t^2$ $\Delta\boldsymbol{x} = \boldsymbol{x}_f - \boldsymbol{x}_0$ $\boldsymbol{x} = \boldsymbol{x_0} + \boldsymbol{v}t$ $\boldsymbol{x} = \int \boldsymbol{v}\,dt$ $\boldsymbol{s} = r\boldsymbol{\theta}$ $\boldsymbol{x}(t) = A\cos(\boldsymbol{\omega}t + \phi)$ $\boldsymbol{x}(t) = A\cos(2\pi ft + \phi)$ *Waves:* $f(x,t) = A\sin\left(2\pi\left(ft - \frac{x}{\lambda}\right) + \phi\right) + k$	*Circular:* $\boldsymbol{\theta} = \boldsymbol{\theta}_0 + \boldsymbol{\omega}_0 t + \frac{1}{2}\boldsymbol{\alpha}t^2$ $\Delta\boldsymbol{\theta} = \boldsymbol{\theta}_f - \boldsymbol{\theta}_0$ $\boldsymbol{\theta} = \boldsymbol{\theta}_0 + \boldsymbol{\omega}t$ $\boldsymbol{\theta} = \int \boldsymbol{\omega}\,dt$	$10^{-100} = googolth$ $10^{-24} = yocto\text{-}$ $10^{-21} = zepto\text{-}$ $10^{-18} = atto\text{-}$ $10^{-15} = femto\text{-}$ $10^{-12} = pico\text{-}$ $10^{-9} = nano\text{-}$ $10^{-6} = micro\text{-}$ $10^{-3} = milli\text{-}$ $10^{-2} = centi\text{-}$ $10^{-1} = deci\text{-}$ $10^{0} = 1$ $10^{1} = deca\text{-}$ $10^{2} = hecto\text{-}$ $10^{3} = kilo\text{-}$ $10^{6} = mega\text{-}$ $10^{9} = giga\text{-}$ $10^{12} = tera\text{-}$ $10^{15} = peta\text{-}$ $10^{18} = exa\text{-}$ $10^{21} = zetta\text{-}$ $10^{24} = yotta\text{-}$ $10^{100} = googol$ $10^{1000} = googolplex$	*Fluid Mechanics:* $\rho = \frac{m}{V}$ $\Delta\ell = \alpha\ell_0\Delta T$ *Optics:*  	*Optics:* $f = \frac{v}{\lambda}$ $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ ***Refraction:*** *(bend)* $n = \frac{c}{v}$ *Snell's Law:* $n_1\sin\theta_1 = n_2\sin\theta_2$ $\frac{n_1}{n_2} = \frac{v_2}{v_1}$ ***Diffraction:*** *(spread out)* $\Delta L = d\sin\theta$ $m\lambda = d\sin\theta$

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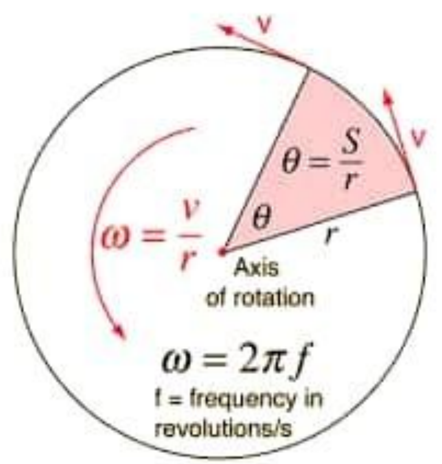
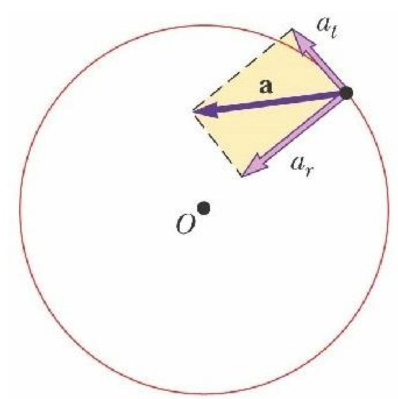
	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Velocity (m/s) Angular Velocity / Angular Frequency (rad/s)	$\boldsymbol{v} = \frac{d}{t} = \frac{\Delta \boldsymbol{x}}{\Delta t} \rightarrow \frac{d\boldsymbol{x}}{dt}$ $\Delta \boldsymbol{v} = \boldsymbol{v}_f - \boldsymbol{v}_0$ $\boldsymbol{v} = \boldsymbol{v}_0 + \boldsymbol{a}t$ $\boldsymbol{v}^2 = \boldsymbol{v}_0^2 + 2\boldsymbol{a}\Delta \boldsymbol{x}$ $\overline{\boldsymbol{v}} = \frac{\boldsymbol{v}_0 + \boldsymbol{v}}{2}$ $\boldsymbol{v} = \int \boldsymbol{a}\, dt$	$\boldsymbol{\omega} = \frac{\theta}{t} = \frac{\Delta \theta}{\Delta t} \rightarrow \frac{d\boldsymbol{\theta}}{dt}$ $\Delta \boldsymbol{\omega} = \boldsymbol{\omega}_f - \boldsymbol{\omega}_0$ $\boldsymbol{\omega} = \boldsymbol{\omega}_0 + \boldsymbol{\alpha}t$ $\boldsymbol{\omega}^2 = \boldsymbol{\omega}_0^2 + 2\boldsymbol{\alpha}\Delta \boldsymbol{\theta}$ $\overline{\boldsymbol{\omega}} = \frac{\boldsymbol{\omega}_0 + \boldsymbol{\omega}}{2}$ $\boldsymbol{\omega} = \int \boldsymbol{\alpha}\, dt$ $\boldsymbol{\omega} = \frac{2\pi}{T} = 2\pi f$ *Spring:* $\boldsymbol{\omega} = \sqrt{\frac{k}{m}}$ *Pendulum:* $\boldsymbol{\omega} = \sqrt{\frac{g}{\ell}}$	*Speed of Light:* $c \approx 3.00 \times 10^8\ \frac{m}{s}$	*Fluid Mechanics:* *Continuity:* $A_1 v_1 = A_2 v_2$ $v_{rms} = \sqrt{\frac{3RT}{M}}$ $v_{rms} = \sqrt{\frac{3k_B T}{\mu}}$ *Torricelli's Law:* $v = \sqrt{2gh}$ *Speed of fluid exiting a hole in a tank.*	*Waves and Optics:* $v = f\lambda$ ***Reflection**:* *(throwback)* *Critical angle:* $\sin \theta_c = \frac{n_1}{n_2}$ ***Maxima for a thin film:*** *Constructive* $2d = \frac{\lambda}{2n}, 3\frac{\lambda}{2n}, 5\frac{\lambda}{2n} \ldots = \left(m + \frac{1}{2}\right)\frac{\lambda}{n}$ *Destructive* $2d = \frac{m}{n}\lambda$
	$\boldsymbol{v} = \boldsymbol{\omega r}$ $\boldsymbol{v} = \boldsymbol{\omega} \times \boldsymbol{r}$ $\boldsymbol{v}(t) = -A\boldsymbol{\omega} \sin(\boldsymbol{\omega}t + \phi)$ $\boldsymbol{v}(t) = -A(2\pi f) \sin(2\pi f t + \phi)$				

	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Acceleration **($\mathbf{m/s^2}$)** (rad/s^2)	*Linear*: $\boldsymbol{a} = \frac{\boldsymbol{v}}{t} = \frac{\Delta \boldsymbol{v}}{\Delta t} \rightarrow \frac{d\boldsymbol{v}}{dt}$ $\boldsymbol{a} = \frac{\sum \boldsymbol{F}}{m} = \frac{\boldsymbol{F}_{net}}{m}$ *Tangential (linear)*: $\boldsymbol{a} = \boldsymbol{a}_t$ $gravity\ (\boldsymbol{g})$	*Angular*: $\boldsymbol{\alpha} = \frac{\boldsymbol{\omega}}{t} = \frac{\Delta \boldsymbol{\omega}}{\Delta t} \rightarrow \frac{d\boldsymbol{\omega}}{dt}$ $\boldsymbol{\alpha} = \frac{\sum \boldsymbol{\tau}}{I} = \frac{\boldsymbol{\tau}_{net}}{I}$ *Centripetal (center)*: $\boldsymbol{a}_c = \frac{\boldsymbol{v}^2}{r} = \boldsymbol{\omega}^2 r$	***Constants:*** *Gravitational Constant* $G \approx 6.674\,30(15) \times 10^{-11}\ \frac{m^3}{kg\ s}$ *Gravity Acceleration (Earth)* $\boldsymbol{g} \approx -9.806\,65\ \frac{m}{s^2} \approx -32.174\,0\ \frac{ft}{s^2}$ *Speed of Light in Vacuum* $c = 2.997\,924\,58 \times 10^8\ \frac{m}{s}$ *Electron-Volt* $1eV = 1.602\,176\,634 \times 10^{-19}\ J$ *Charge of an Electron* $e = -1.602\,176\,634 \times 10^{-19}\ C$ *Mass of an Electron* $m_e \approx 9.109\,383\,701\,5(28) \times 10^{-31}\ kg$ *Mass of a Proton* $m_p \approx 1.672\,621\,923\,69(51) \times 10^{-27}\ kg$ *Mass of a Neutron* $m_n \approx 1.674\,927\,498\,04(95) \times 10^{-27}\ kg$ *Electric Permittivity* $\varepsilon_0 \approx \frac{1}{\mu_0 c^2} \approx 8.854\,187\,812\,8 \times 10^{-12}\ \frac{C^2}{Nm^2}$ *Magnetic Permeability* $\mu_0 \approx 1.256\,637\,062\,12(19) \times 10^{-6}\ \frac{N}{A^2}$ *Boltzmann Constant* $k_B = 1.380\,649 \times 10^{-23}\ \frac{J}{K}$ *Coulomb Constant* $k_e = \frac{1}{4\pi\varepsilon_0} \approx 8.987\,551\,792\,3 \times 10^9\ \frac{Nm^2}{C^2}$ *Faraday Constant* $F = eN_A = 9.648\,533\,212 \times 10^4\ \frac{C}{mol}$ *Planck Constant* $h = 6.626\,070\,15 \times 10^{-34}\ Js$ *Avogadro Constant* $N_A = 6.022\,140\,76 \times 10^{23}\ /\ mole$ *Ideal Gas Constant* $R = 0.082\,057\,366\,080\ \frac{L\ atm}{mole\ K}$ *"* $R = 8.314\,462\,618\ \frac{J}{mole\ K}$ *pi* $\pi \approx 3.141\,592\,653\,589\,793\,238\,462\ldots$		
	 *Net*: $\boldsymbol{a}_{net}^2 = \boldsymbol{a}_t^2 + \boldsymbol{a}_c^2$				
	$\boldsymbol{a} = \boldsymbol{\alpha} \boldsymbol{r}$ $\boldsymbol{a}(t) = -A\boldsymbol{\omega}^2 \cos(\boldsymbol{\omega} t + \phi)$				
Jerk (Jolt) **($\mathbf{m/s^3}$)** (rad/s^3)	$\vec{\boldsymbol{j}} = \frac{\boldsymbol{a}}{t} = \frac{\Delta \boldsymbol{a}}{\Delta t} \rightarrow \frac{d\boldsymbol{a}}{dt}$	$\boldsymbol{\zeta} = \frac{\boldsymbol{\alpha}}{t} = \frac{\Delta \boldsymbol{\alpha}}{\Delta t} \rightarrow \frac{d\boldsymbol{\alpha}}{dt}$			

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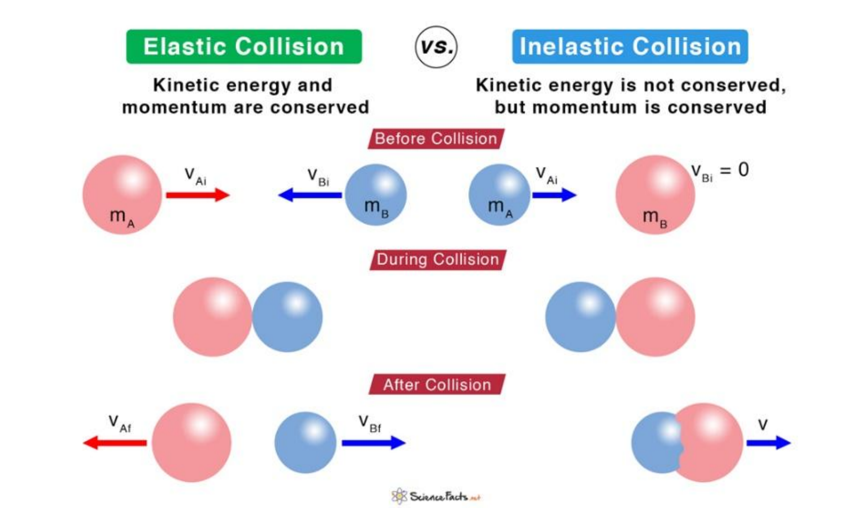
	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Dynamics		See Harold's Physics Forces on an Incline Cheat Sheet See Harold's Physics Forces on an Incline with Pully Cheat Sheet See Harold's Physics Attwood Machine Cheat Sheet			
Mass (kg) / Moment of Inertia $(kg \bullet m^2)$	m = actual mass I = effective mass (Inertia is an object's resistance to changes in its state of motion.)	$I = \sum mr^2$ $I = \int r^2\, dm$ $I = \int \boldsymbol{r} \bullet \boldsymbol{r}\, dm$	$m_p \approx m_n$ $m_p \approx 1{,}836\ m_e$	*Density:* $\rho = \frac{m}{V}$ $\rho_{H_2O} = 1000\ kg/m^3$	*Magnification:* $\lvert M \rvert = \left\lvert \frac{d_i}{d_o} \right\rvert = \left\lvert \frac{h_i}{h_o} \right\rvert$ $M_{Telescope} = -\frac{f_{objective\ lens}}{f_{eyepiece}}$
Momentum (kg•m/s) $(kg \bullet m^2/s)$	$\boldsymbol{p} = m\boldsymbol{v}$ $\Delta\boldsymbol{p} = m\Delta\boldsymbol{v}$ *Conservation of Linear Momentum:* $\boldsymbol{p}_i = \boldsymbol{p}_f$ $\sum m\boldsymbol{v}_i = \sum m\boldsymbol{v}_f$ $\boldsymbol{p} = \boldsymbol{\omega} \times \boldsymbol{m}$ $\Delta\boldsymbol{p} = \boldsymbol{J} = \int_{t_1}^{t_2} \boldsymbol{F}\, dt$	$\boldsymbol{L} = I\boldsymbol{\omega}$ $\boldsymbol{L} = \boldsymbol{r}m\boldsymbol{v}$ *Conservation of Angular Momentum:* $\boldsymbol{L}_i = \boldsymbol{L}_f$ $\sum I\boldsymbol{\omega}_i = \sum I\boldsymbol{\omega}_f$ $\boldsymbol{L} = \boldsymbol{r} \times \boldsymbol{p}$ $\boldsymbol{L} = m\boldsymbol{r} \times \boldsymbol{v}$ $L = \int \boldsymbol{r} \times \boldsymbol{v}\ dm$ $\Delta\boldsymbol{L} = \int \boldsymbol{\tau}\ dt$		*Fluid Mechanics:* $\nabla\boldsymbol{p} = \rho\boldsymbol{g}$	*Atomic and Nuclear:* $\lambda = \frac{h}{p}$

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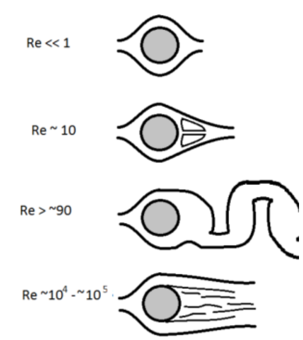
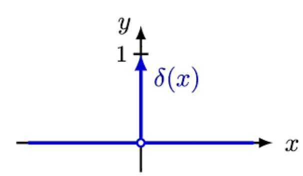
<table>
<tr><th></th><th>Mechanics: Linear</th><th>Mechanics: Angular</th><th>Electricity / Magnetism</th><th>Fluid Mechanics / Thermodynamics</th><th>Atomic and Nuclear / Waves and Optics</th></tr>
<tr><td rowspan="2">Force (N = kg•m/s^2) / Torque (J = N•m)</td>
<td rowspan="2">$\boldsymbol{F} = m\boldsymbol{a}$
$\boldsymbol{F}_g = m\boldsymbol{g}$
$\sum \boldsymbol{F} = \boldsymbol{F}_{net} = m\boldsymbol{a}$
$F = \frac{p}{t} = \frac{\Delta p}{\Delta t}$
$\boldsymbol{F} = \frac{d\boldsymbol{p}}{dt} = \frac{d}{dt}(m\boldsymbol{v})$
Friction:
$\boldsymbol{F}_f \leq \mu \boldsymbol{N}$
$0 \leq \mu_k \leq \mu_s \leq 1$
Gravitational Force:
$F_G = -G\frac{m_1 m_2}{r^2}$
$\boldsymbol{F}_G = -G\frac{m_1 m_2}{r^2}\hat{\boldsymbol{r}}$</td>
<td rowspan="2">$\boldsymbol{\tau} = I\boldsymbol{\alpha}$
$\tau = r\boldsymbol{F} = rF\sin\theta$
$\boldsymbol{\tau} = \boldsymbol{r} \times \boldsymbol{F}$
$\sum \boldsymbol{\tau} = \boldsymbol{\tau}_{net} = I\boldsymbol{\alpha}$
$\tau = \frac{L}{t} = \frac{\Delta L}{\Delta t}$
$\boldsymbol{\tau} = \frac{d\boldsymbol{L}}{dt} = I\frac{d\boldsymbol{\omega}}{dt}$
$\boldsymbol{F} = m\boldsymbol{a_c}$
$\boldsymbol{F} = \frac{m\boldsymbol{v}^2}{r}$
$\boldsymbol{F} = mr\boldsymbol{\omega}^2$
Hooke's Law:
$\boldsymbol{F}_s = -k\Delta\boldsymbol{x}$</td>
<td rowspan="2"><u>Electricity</u>:
Coulomb's Law:
$\boldsymbol{F} = k\frac{q_1 q_2}{\boldsymbol{r}^2}$
$\boldsymbol{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{\boldsymbol{r}^2}$
$\boldsymbol{F} = \boldsymbol{E}q$
<u>Magnetism</u>:
$F_B = qvB\sin\theta$
$F_B = \boldsymbol{B}I\ell\sin\theta$
$\boldsymbol{F}_B = q\boldsymbol{v} \times \boldsymbol{B}$
$\boldsymbol{F}_B = I\boldsymbol{\ell} \times \boldsymbol{B}$
$\boldsymbol{F} = \int I\, d\boldsymbol{\ell} \times \boldsymbol{B}$</td>
<td><u>Fluid Mechanics</u>:
$F = PA$
$P = \frac{F}{A} = \rho h g$
$F_{buoy} = \rho V g$
Universal Gas Law:
$PV = nRT = Nk_B T$</td>
<td>Strong Nuclear Force:
$F = -\frac{g^2}{4\pi c^2}\frac{e^{-mr}}{r}$
Weak Nuclear Force:
$n \to p^+ + e^- + \overline{ve}$
(Beta Decay)
where $\overline{ve}$ is an antineutrino</td></tr>
<tr><td>Reynolds Number:
$Re = \frac{uL}{v} = \frac{\rho uL}{\mu}$
• Low Re → laminar (sheet-like) flow
• High Re → turbulent flow (cavitation)</td>
<td>
</td></tr>
<tr><td>Impulse (N•s)
(N•m•s)</td>
<td>$\boldsymbol{J} = \boldsymbol{F}\,\Delta t = \Delta\boldsymbol{p} = m\,\Delta\boldsymbol{v}$
$\boldsymbol{J} = \Delta\boldsymbol{p} = \int \boldsymbol{F}\,dt$</td>
<td>$\boldsymbol{H} = \boldsymbol{\tau}\,\Delta t = \Delta\boldsymbol{L} = I\,\Delta\boldsymbol{\omega}$
$\boldsymbol{H} = \Delta\boldsymbol{L} = \int \boldsymbol{\tau}\,dt$</td>
<td colspan="3" rowspan="2"><u>Electricity</u>:
Unit Impulse:
(Dirac Delta Function)
$\delta(x) = \begin{cases} 0, & x \neq 0 \\ \infty, & x = 0 \end{cases}$
such that
$\int_{-\infty}^{\infty} \delta(x)\,dx = 1$

</td></tr>
<tr><td>Yank (N/s^2) /
Rotatum (J/s)</td>
<td>$\boldsymbol{Y} = m\boldsymbol{J}$
$\boldsymbol{Y} = \frac{\boldsymbol{F}}{t} = \frac{\Delta F}{\Delta t} \to \frac{d\boldsymbol{F}}{dt}$</td>
<td>$\boldsymbol{P} = I\,\boldsymbol{\zeta}$
$\boldsymbol{P} = \boldsymbol{r} \times \boldsymbol{Y}$
$\boldsymbol{P} = \frac{\boldsymbol{\tau}}{t} = \frac{\Delta\tau}{\Delta t} \to \frac{d\boldsymbol{\tau}}{dt} = I\boldsymbol{\zeta}$</td></tr>
</table>

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	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Energy					
Work (J = N•m)	$W = Fd$ $W = \boldsymbol{F}\Delta x \cos\theta$ $W = \int \boldsymbol{F} \bullet d\boldsymbol{r}$	$W = \boldsymbol{\tau}\,\Delta\theta$ $W = \int \boldsymbol{\tau} \bullet d\boldsymbol{\theta}$	$W = QV$	*Thermodynamics*: $W = -P\,\Delta V$ $e = \left\lvert\frac{W}{Q_H}\right\rvert$ $e_c = \frac{T_H - T_C}{T_H}$	
Kinetic Energy (J)	*Translational:* $K = KE = \frac{1}{2}mv^2$	*Rotational:* $K = KE = \frac{1}{2}I\omega^2$	$1\ eV \approx 1.60 \times 10^{-19}\ J$	*Fluid Mechanics*: *Bernoulli's Equation:* $P_1 + \rho g y_1 + \frac{1}{2}\rho {v_1}^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho {v_2}^2$ *Thermodynamics*: $K_{avg} = \frac{3}{2}k_B T$	*Atomic and Nuclear*: $K_{max} = hf - \phi$ *Electron Energy Levels:* $E_n = \frac{-13.6\ eV}{n^2}$ *n = principal quantum number (1, 2, 3, etc.)*
Potential Energy (J)	$\Delta U_g = PE = mgh$ $U_G = -G\frac{m_1 m_2}{r}$ $G \approx 6.67 \times 10^{-11}\ \frac{Nm^2}{kg^2}$	*Coiled Spring:* $U_S = \frac{1}{2}k\Delta x^2$ *Mechanical Energy:* $ME = KE + PE$	$U_E = qV$ $U_E = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r}$ $U_C = \frac{1}{2}QV$ $U_C = \frac{1}{2}CV^2$ $U_L = \frac{1}{2}LI^2$	*Fluid Mechanics*: $P = P_0 + \rho g h$ *Continuity of Mass:* $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$ *Continuity of Volume:* $A_1 v_1 = A_2 v_2$ *Thermodynamics*: $\Delta U = Q - W$	*Atomic and Nuclear*: $E = hf$ $E = mc^2$ $\Delta E = (\Delta m)c^2$ *Relativity:* $E = mc^2\left(\frac{1}{\sqrt{1 - \frac{\boldsymbol{v}^2}{c^2}}}\right)$

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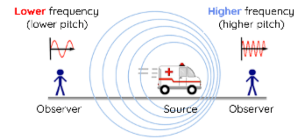
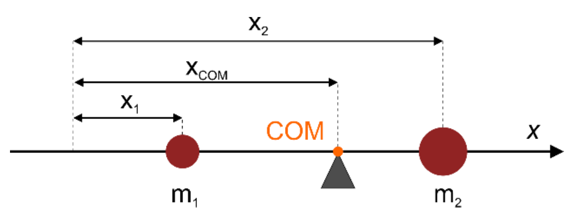
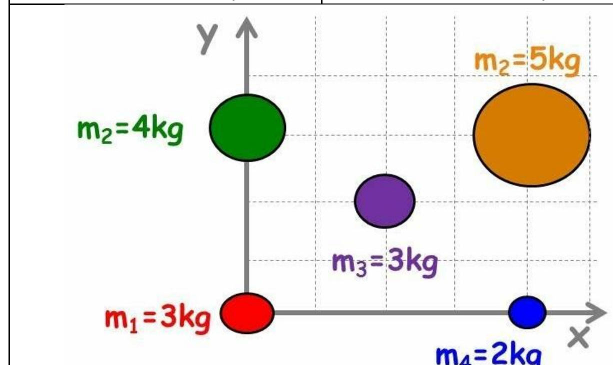
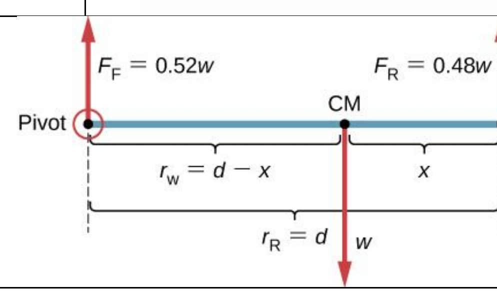
	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Heat Energy (J)	*Conservation of Energy:* $E_i = E_f$ $\sum E_i = \sum E_f$ $E = W + Q + K + \Delta U_g + U_G + U_S + U_E + U_C + U_L + \cdots = constant$			<u>*Thermodynamics*</u>*:* $H = \frac{kA\Delta T}{L}$ $Q = mH_f$ $Q = mH_v$ $\Delta E = Q = mC\Delta T$ $mC\Delta T = mC(T_f - T_i)$ $C_{H_2O} = 4{,}184\ \frac{J}{kg\ °K}$ $T_f = \frac{m_1 C_1 \Delta T_{1i} + m_2 C_2 \Delta T_{2i}}{m_1 C_1 + m_2 C_2}$	
Power (W)	$P = \frac{W}{t} = Fv$ $P = \frac{\Delta E}{\Delta t} \rightarrow \frac{dE}{dt}$ $P = \mathbf{F}\mathbf{v} \cos\theta$ $P = \mathbf{F} \bullet \mathbf{v}$	$P = \frac{W}{t} = \tau\omega$ $P = \frac{\Delta W}{\Delta t} \rightarrow \frac{dW}{dt}$ $P = \boldsymbol{\tau}\boldsymbol{\omega} \cos\theta$ $P = \boldsymbol{\tau} \bullet \boldsymbol{\omega}$	$P = IV$ $P = I^2 R$ $P = \frac{V^2}{R}$	$P = pQ$ *Where:* $p = pressure \left(\frac{N}{m^2}\right)$ $Q = volumetric\ flow\ rate \left(\frac{m^3}{s}\right)$	

	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Engineering Application		See Harold's Center of Mass / Moment of Inertia Cheat Sheet See Harold's Physics Doppler Effect Cheat Sheet			
Period / Frequency (Hz)	$T = \frac{1}{f}$ $f = \frac{1}{T}$ *Kepler's Third Law:* $T^2 = \left(\frac{4\pi^2}{GM}\right) r^3$	$T = \frac{1}{f} = \frac{2\pi}{\omega} = \frac{2\pi r}{v}$ $T_s = 2\pi\sqrt{\frac{m}{k}}$ $T_p = 2\pi\sqrt{\frac{\ell}{g}}$	$T = \frac{2\pi}{b}$ *For:* $y = sin(b\theta)$ $y = cos(b\theta)$		*Waves and Optics:* $f = \frac{v}{\lambda}$ *Doppler Effect:* $f_r = f_s\left(\frac{v \pm v_r}{v \mp v_s}\right)$
Center of Mass (m)	$x_{CM} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$ $\boldsymbol{r}_{CM} = \frac{\sum m\boldsymbol{r}}{\sum m}$ $\bar{x} = \frac{1}{M}\int_0^M x\,dm$ *where* $M = \int_0^M dm$ *and* $dm = \rho\,dz\,dy\,dx$			$x_{CM} = \frac{\sum m_i x_i}{\sum m_i}$ 	$y_{CM} = \frac{\sum m_i y_i}{\sum m_i}$
Rigid Bodies (Statics)	$\sum F_y = \sum mg = 0$ *(Down = '–')*	$\sum \tau = \sum F_y\,x_{CM} = 0$ *(CW = '–')*			

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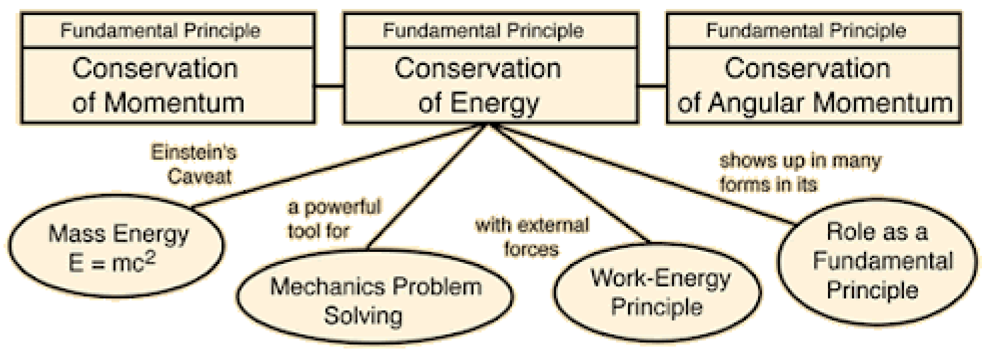
	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Conservation Laws					
Fundamental Principle	*Conservation of Linear Momentum*	*Conservation of Angular Momentum*	*Conservation of Electric Charge*	*Conservation of Mass (or Matter)*	*Conservation of Energy*
Discipline	*Physics*	*Physics*	*Chemistry & Circuits*	*Chemistry & Fluid Mechanics*	*Physics*
Formula	$\sum \boldsymbol{p}_i = \sum \boldsymbol{p}_f$ $\sum m\boldsymbol{v}_i = \sum m\boldsymbol{v}_f$	$\sum \boldsymbol{L}_i = \sum \boldsymbol{L}_f$ $\sum I\boldsymbol{\omega}_i = \sum I\boldsymbol{\omega}_f$	$\sum Q_i = \sum Q_f$	$\sum m_i = \sum m_f$	$\sum E_i = \sum E_f$
Example			*Kirchhoff's Current Law (KCL):* $\sum_{i=1}^{n} I_i = 0$	*Bernoulli's Equation:* $P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$	$E = W + Q + K + \Delta U_g + U_G + U_s + U_E + U_c + U_L + \cdots = constant$
					

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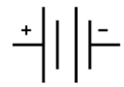
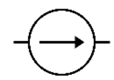
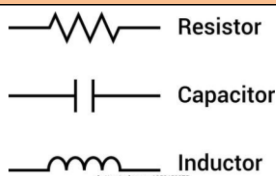
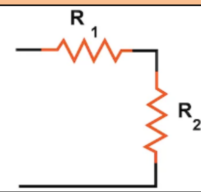
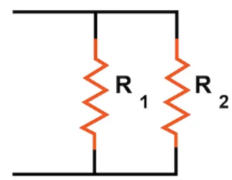
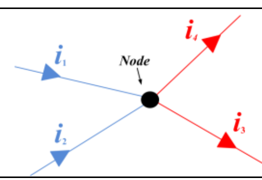
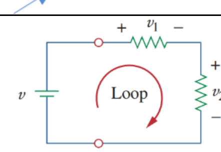
Electricity

Terms	Formulas	See Harold's Electromatic Spectrum Cheat Sheet See Harold's DC Circuits Cheat Sheet	
Electric Field (V/m or N/C)	$\boldsymbol{E} = \frac{\boldsymbol{F}}{q}$ $E_{avg} = -\frac{V}{d}$ $E = -\frac{\Delta V}{\Delta r}$	$\boldsymbol{E} = \rho \boldsymbol{J}$ $E = -\frac{dV}{dr}$	Gauss's Law: $\phi = \oint \boldsymbol{E} \bullet d\boldsymbol{A} = \frac{Q_{enc}}{\epsilon_0}$
Potential / Voltage (V)	$V = IR$ $V = \frac{Q}{C}$	$V = k \sum_i \frac{q_i}{r_i}$ $= \frac{1}{4\pi\epsilon_0} \sum_i \frac{q_i}{r_i}$	
Current (A)	$I = \frac{\Delta Q}{\Delta t}$ $I = \frac{V}{R}$	$I = \frac{dQ}{dt}$ $I = Nev_d A$	
Circuits		**Series**	**Parallel**
Circuit Terms			
Resistance (Ω)	$R = \frac{V}{I}$ $R = \frac{\rho \ell}{A}$	$R_s = \sum_i R_i$	$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$ $R_p = \frac{R_1 R_2}{R_1 + R_2}$
Inductance (H)	$L = N\frac{\Phi}{I}$ $L = \frac{V_L}{dI/dt}$ $L = \mu_0 \frac{N^2 A}{\ell}$	$L_s = \sum_i L_i$	$\frac{1}{L_p} = \sum_i \frac{1}{L_i}$
Capacitance (F)	$C = \frac{Q}{V}$ $C = \frac{\epsilon_0 A}{d} = \frac{\kappa \epsilon_0 A}{d}$	$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$	$C_p = \sum_i C_i$
Kirchhoff's Current Law (KCL)	$\sum_{i=1}^{n} I_i = 0$ The algebraic sum of currents in a network of conductors meeting at a **point** (node) is zero.		
Kirchhoff's Voltage Law (KVL)	$\sum_{i=1}^{n} V_i = 0$ The directed sum of the potential differences (voltages) around any closed **loop** is zero.		 $KVL: -v + v_1 + v_2 = 0$

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Magnetism		
	See Harold's Physics Maxwell's Equations Cheat Sheet	
Term	**Formulas**	**Laws**
Magnetic Field (T)	$B = \frac{\mu_0}{2\pi}\frac{I}{r}$ $Solenoid:$ $B_s = \mu_0 nI$ $where\ n = \frac{N}{\boldsymbol{\ell}}\ turns\ per\ meter$ $\boldsymbol{B} = \frac{\mu_0}{4\pi}\frac{q\vec{\boldsymbol{v}} \times \vec{\boldsymbol{r}}}{r^3}$ $\boldsymbol{B} = \frac{\mu_0}{4\pi}\frac{q\vec{\boldsymbol{v}} \times \hat{\boldsymbol{r}}}{r^2}$	*Ampere's Circuit Law:* $\oint \boldsymbol{B} \bullet d\boldsymbol{\ell} = \mu_o I + \mu_0 \varepsilon_0 \frac{d\phi_E}{dt}$ *Gauss's Law for Magnetism:* $\oint \boldsymbol{B} \bullet d\boldsymbol{A} = 0$ $d\boldsymbol{B} = \frac{\mu_0}{4\pi}\frac{I\, d\boldsymbol{\ell} \times \vec{\boldsymbol{r}}}{r^3}$
Magnetic Flux (Wb)	$\phi_{\boldsymbol{B}} = BA\cos\theta$ $\phi_B = \boldsymbol{B} \bullet \boldsymbol{A}$	*Gauss's Law for Magnetism:* $\phi_B = \int \boldsymbol{B} \bullet d\boldsymbol{A}$
EMF (V)	$\varepsilon_{avg} = -\frac{\Delta\phi_B}{\Delta t}$ $\boldsymbol{\varepsilon} = \oint \boldsymbol{E} \bullet d\boldsymbol{s} = -\frac{d\phi_B}{dt}$ $\boldsymbol{\varepsilon} = \boldsymbol{B}lv$	*Faraday's Law of Induction:* $\oint \boldsymbol{E} \bullet d\boldsymbol{\ell} = -\frac{\Delta\phi_B}{\Delta t}$ $\varepsilon = -L\frac{dI}{dt}$

Sources

- NIST SP 961 (May 2019). CODATA Recommended Values of the Fundamental Physical Constants: 2018. https://physics.nist.gov/cuu/pdf/wall_2018.pdf
- Wikipedia (2025).
  - Metric prefix. https://en.wikipedia.org/wiki/Metric_prefix
  - Reynolds number. https://en.wikipedia.org/wiki/Reynolds_number
  - SI derived unit. https://en.wikipedia.org/wiki/SI_derived_unit

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