Harold's Physics Formulas
Cheat Sheet
29 September 2025

<table>
<tr><th></th><th>Mechanics: Linear Translation</th><th>Mechanics: Angular / Rotational Motion</th><th>Electricity / Magnetism</th><th>Fluid Mechanics / Thermodynamics</th><th>Atomic and Nuclear / Waves and Optics</th></tr>
<tr><td>Kinematics</td><td></td><td></td><td>Harold's Physics Units of Measure</td><td></td><td></td></tr>
<tr>
<td rowspan="3">Position (m)
(rad)</td>
<td>Horizontal:
$\boldsymbol{x} = \boldsymbol{x}_0 + \boldsymbol{v}_{x0}t + \frac{1}{2}\boldsymbol{a}t^2$

Vertical:
$\boldsymbol{y} = \boldsymbol{y}_0 + \boldsymbol{v}_{y0}t + \frac{1}{2}\boldsymbol{g}t^2$

$\Delta\boldsymbol{x} = \boldsymbol{x}_f - \boldsymbol{x}_0$

$\boldsymbol{x} = \boldsymbol{x}_0 + \boldsymbol{v}t$

$\boldsymbol{x} = \int \boldsymbol{v}\,dt$</td>
<td>Circular:
$\boldsymbol{\theta} = \boldsymbol{\theta}_0 + \boldsymbol{\omega}_0 t + \frac{1}{2}\boldsymbol{\alpha}t^2$

$\Delta\boldsymbol{\theta} = \boldsymbol{\theta}_f - \boldsymbol{\theta}_0$

$\boldsymbol{\theta} = \boldsymbol{\theta}_0 + \boldsymbol{\omega}t$

$\boldsymbol{\theta} = \int \boldsymbol{\omega}\,dt$</td>
<td rowspan="3">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}
$= googolplex$</td>
<td rowspan="2"><u>Fluid Mechanics</u>:
$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2$
$= P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$
(Conservation of Mass)

$\rho = \frac{m}{V}$

$\Delta\ell = \alpha\ell_0\Delta T$</td>
<td rowspan="3"><u>Optics</u>:
$f = \frac{v}{\lambda}$

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

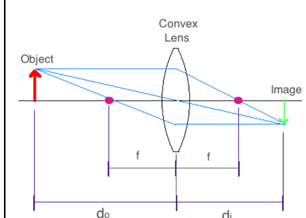
Refraction:
(bend)
$n = \frac{c}{v}$

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)
$\Delta L = d\sin\theta$
$m\lambda = d\sin\theta$</td>
</tr>
<tr><td colspan="2">$s = r\theta$</td></tr>
<tr>
<td colspan="2">$\boldsymbol{x}(t) = A\cos(\boldsymbol{\omega}t + \phi)$

$\boldsymbol{x}(t) = A\cos(2\pi f t + \phi)$

<u>Waves</u>:
$f(x,t) = A\sin\left(2\pi\left(ft - \frac{x}{\lambda}\right) + \phi\right) + k$</td>
<td><u>Optics</u>:
</td>
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<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">Velocity (m/s)

Angular Velocity / Angular Frequency (rad/s)</td>
<td>$\boldsymbol{v} = \frac{d}{t} = \frac{\Delta \boldsymbol{x}}{\Delta t} \to \frac{d\boldsymbol{x}}{dt}$

$\Delta \boldsymbol{v} = \boldsymbol{v}_f - \boldsymbol{v}_0$

$\boldsymbol{v} = \boldsymbol{v}_0 + \boldsymbol{a}t$

$\boldsymbol{v}^2 = \boldsymbol{v}_0^2 + 2\boldsymbol{a}(x - x_0)$

$\bar{\boldsymbol{v}} = \frac{\boldsymbol{v}_0 + \boldsymbol{v}}{2}$

$\boldsymbol{v} = \int \boldsymbol{a}\, dt$

$f = \frac{1}{T}$</td>
<td>$\boldsymbol{\omega} = \frac{\theta}{t} = \frac{\Delta \theta}{\Delta t} \to \frac{d\boldsymbol{\theta}}{dt}$

$\Delta \boldsymbol{\omega} = \boldsymbol{\omega}_f - \boldsymbol{\omega}_0$

$\boldsymbol{\omega} = \boldsymbol{\omega}_0 + \boldsymbol{\alpha}t$

$\boldsymbol{\omega}^2 = \boldsymbol{\omega}_0^2 + 2\boldsymbol{\alpha}(\theta - \theta_0)$

$\bar{\boldsymbol{\omega}} = \frac{\boldsymbol{\omega}_0 + \boldsymbol{\omega}}{2}$

$\boldsymbol{\omega} = \int \boldsymbol{\alpha}\, dt$

$\boldsymbol{\omega} = \frac{2\pi}{T} = 2\pi f$

Spring:
$\boldsymbol{\omega} = \sqrt{\frac{k}{m}}$

Pendulum:
$\boldsymbol{\omega} = \sqrt{\frac{\boldsymbol{g}}{\ell}}$</td>
<td rowspan="2">Speed of Light:
$c \approx 3.00 \times 10^8 \ \frac{m}{s}$</td>
<td rowspan="2"><u>Fluid Mechanics</u>:
$A_1 v_1 = A_2 v_2$

$v_{rms} = \sqrt{\frac{3RT}{M}}$

$v_{rms} = \sqrt{\frac{3k_B T}{\mu}}$</td>
<td rowspan="2"><u>Waves and Optics</u>:
$v = f\lambda$

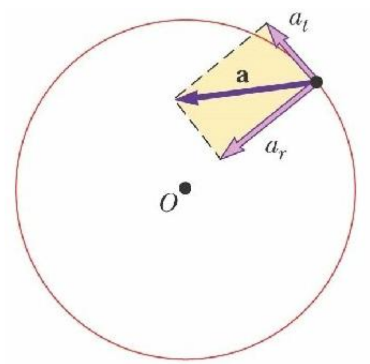
Reflection:
(throwback)

Critical angle:
$\sin \theta_c = \frac{n_1}{n_2}$

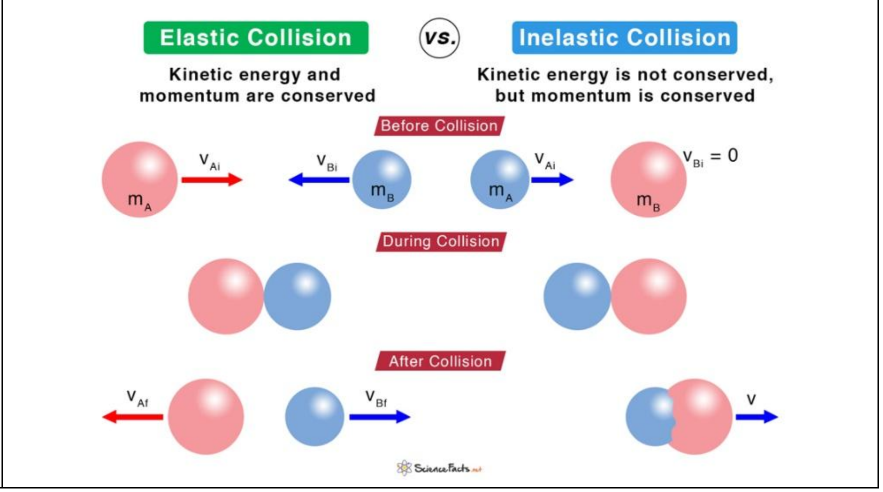
Maxima for a thin film:
$2d = \frac{\lambda}{2n}, 3\frac{\lambda}{2n}, 5\frac{\lambda}{2n} \ldots$</td>
</tr>
<tr>
<td colspan="2">$\boldsymbol{v} = \boldsymbol{\omega} r$
$\boldsymbol{v} = \boldsymbol{\omega} \times \boldsymbol{r}$

$\boldsymbol{v}(t) = -A\boldsymbol{\omega} \sin(\omega t + \phi)$

$\boldsymbol{v}(t) = -A(2\pi f) \sin(2\pi f t + \phi)$</td>
</tr>
</table>

	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Acceleration **(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):* $\boldsymbol{a} = \boldsymbol{a}_t = \boldsymbol{\alpha} r$ $gravity\ (\boldsymbol{g})$	*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* $G \approx 6.67430 \times 10^{-11}\ \frac{Nm^2}{kg}$ *Gravity Acceleration (Earth)* $\boldsymbol{g} \approx -9.80665\ \frac{m}{s^2} \approx -32.1740\ \frac{ft}{s^2}$ *Speed of Light in Vacuum* $c \approx 2.99792458 \times 10^8\ \frac{m}{s}$ *Electron-Volt* $1eV \approx 1.602176634 \times 10^{-19}\ J$ *Charge of an Electron* $e \approx -1.602176634 \times 10^{-19}\ C$ *Mass of an Electron* $m_e \approx 9.1093837015(28) \times 10^{-31}\ kg$ *Mass of a Proton* $m_p \approx 1.67262192369(51) \times 10^{-27}\ kg$ *Mass of a Neutron* $m_n \approx 1.67492749804(95) \times 10^{-27}\ kg$ *Electric Permittivity* $\varepsilon_0 = \frac{1}{\mu_0 c^2} \approx 8.8541878128 \times 10^{-12}\ \frac{C^2}{Nm^2}$ *Magnetic Permeability* $\mu_0 = 4\pi \times 10^{-7}\ \frac{Tm}{A}$ *Avogadro's Number* $N_A \approx 6.02214076 \times 10^{23}\ \frac{1}{mol}$ *Boltzmann Constant* $k_B \approx 1.380649 \times 10^{-23}\ \frac{J}{K}$ *Coulomb Constant* $k_e = \frac{1}{4\pi\varepsilon_0} \approx 8.9875517923 \times 10^9\ \frac{Nm^2}{C^2}$ *Faraday Constant* $F \approx 9.64853321233100184 \times 10^4\ \frac{C}{mol}$ *Planck's Constant* $h \approx 6.6267015 \times 10^{-34}\ Js$ *Avogadro's Number* $N_A \approx 6.02214076 \times 10^{23}\ /\ mole$ *Ideal Gas Constant* $R \approx 0.082057366080960\ \frac{L\ atm}{mole\ K}$ *pi* $\pi \approx 3.14159265358979323846\ldots$		
	 *Net:* $\boldsymbol{a}_{net}^2 = \boldsymbol{a}_t^2 + \boldsymbol{a}_c^2$				
	$\boldsymbol{a}(t) = -A\boldsymbol{\omega}^2 \cos(\omega t + \phi)$ $\boldsymbol{a}(t) = -A(2\pi f)^2 \cos(2\pi f t + \phi)$				
Jerk (Jolt) **(m/s^3)** (rad/s^3)	$\vec{\boldsymbol{j}} = \frac{\boldsymbol{a}}{t} = \frac{\Delta \boldsymbol{a}}{\Delta t} \rightarrow \frac{d\boldsymbol{a}}{dt}$	$\boldsymbol{\zeta} = \frac{\boldsymbol{\alpha}}{t} = \frac{\Delta \boldsymbol{\alpha}}{\Delta t} \rightarrow \frac{d\boldsymbol{\alpha}}{dt}$			

	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Dynamics					
Mass (kg) / Moment of Inertia $(kg \bullet m^2)$	m = actual mass I = effective mass	$I = \sum mr^2$ $I = \int r^2\, dm$ $I = \int \boldsymbol{r} \bullet \boldsymbol{r}\, dm$	$m_p \approx m_n$ $m_p \approx 1{,}836\, m_e$	*Density:* $\rho = \frac{m}{V}$ $\rho_{H_2O} = 997\, kg/m^3$	*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:* $\boldsymbol{p}_i = \boldsymbol{p}_f$ $\sum m\boldsymbol{v}_i = \sum m\boldsymbol{v}_f$ $\boldsymbol{p} = \boldsymbol{\omega} \times \boldsymbol{m}$ *Elastic = bounce off* *Inelastic = stick together* $\Delta\boldsymbol{p} = \boldsymbol{J} = \int_{t_1}^{t_2} \boldsymbol{F}\, dt$	$\boldsymbol{L} = I\boldsymbol{\omega}$ $\boldsymbol{L} = \boldsymbol{r}m\boldsymbol{v}$ *Conservation of Angular Momentum:* $\boldsymbol{L}_i = \boldsymbol{L}_f$ $\sum I\boldsymbol{\omega}_i = \sum I\boldsymbol{\omega}_f$ $\boldsymbol{L} = \boldsymbol{r} \times \boldsymbol{p}$ $\boldsymbol{L} = m\boldsymbol{r} \times \boldsymbol{v}$ $L = \int \boldsymbol{r} \times \boldsymbol{v}\, dm$ $\Delta\boldsymbol{L} = \int \boldsymbol{\tau}\, dt$		<u>*Fluid Mechanics*</u>*:* $\nabla\boldsymbol{p} = \rho\boldsymbol{g}$	<u>*Atomic and Nuclear*</u>*:* $\lambda = \frac{h}{p}$



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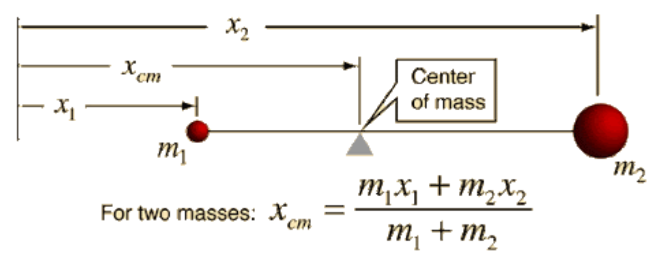
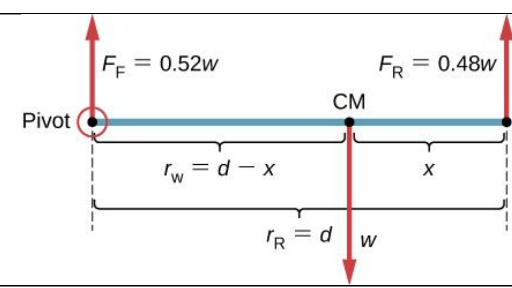
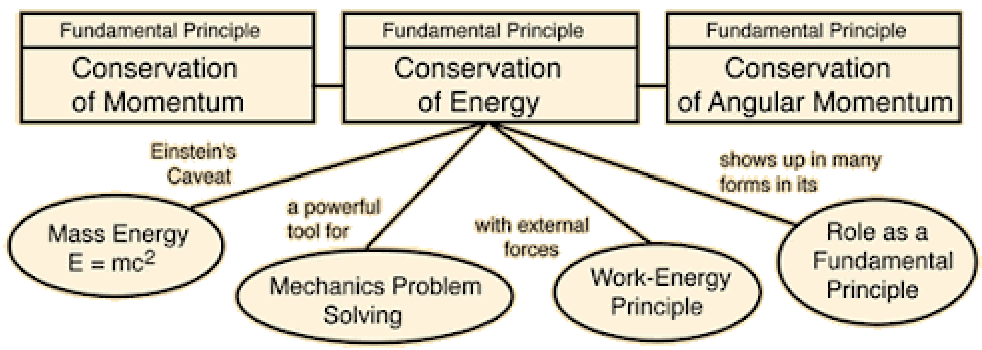
<tr>
<td>Force
(N = kg•m/s^2)
/
Torque
(J = N•m)</td>
<td>$\boldsymbol{F} = m\boldsymbol{a}$
$\boldsymbol{F}_g = m\boldsymbol{g}$
$\sum \boldsymbol{F} = \boldsymbol{F}_{net} = m\boldsymbol{a}$
$\boldsymbol{F} = \frac{\boldsymbol{p}}{t} = \frac{\Delta p}{\Delta t}$
$\boldsymbol{F} = \frac{d\boldsymbol{p}}{dt} = \frac{d}{dt}(m\boldsymbol{v})$
$\boldsymbol{F}_f \le \mu \boldsymbol{N}$
Hooke's Law:
$\boldsymbol{F}_s = -k\boldsymbol{\Delta x}$
Gravitational Force:
$F_G = -\frac{Gm_1m_2}{r^2}$
$\boldsymbol{F}_G = -\frac{Gm_1m_2}{r^2}\hat{\boldsymbol{r}}$</td>
<td>$\tau = rF\sin\theta$
$\sum \boldsymbol{\tau} = \boldsymbol{\tau}_{net} = I\boldsymbol{\alpha}$
$\tau = r\boldsymbol{F} = I\boldsymbol{\alpha}$
$\boldsymbol{\tau} = \boldsymbol{r} \times \boldsymbol{F}$
$\boldsymbol{\tau} = \frac{d\boldsymbol{L}}{dt} = I\frac{d\boldsymbol{\omega}}{dt}$
$\boldsymbol{F} = m\boldsymbol{a}_c$
$\boldsymbol{F} = \frac{m\boldsymbol{v}^2}{r}$
$\boldsymbol{F} = mr\boldsymbol{\omega}^2$</td>
<td><u>Electricity</u>:
Coulomb's Law:
$\boldsymbol{F} = k\frac{q_1q_2}{\boldsymbol{r}^2}$
$\boldsymbol{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{\boldsymbol{r}^2}$
$\boldsymbol{F} = \boldsymbol{E}q$
<u>Magnetism</u>:
$F_B = qvB\sin\theta$
$F_B = BI\ell\sin\theta$
$\boldsymbol{F}_B = q\boldsymbol{v} \times \boldsymbol{B}$
$\boldsymbol{F}_B = I\boldsymbol{\ell} \times \boldsymbol{B}$
$\boldsymbol{F} = \int I\, d\boldsymbol{\ell} \times \boldsymbol{B}$</td>
<td><u>Fluid Mechanics</u>:
$F = PA$
$P = \frac{F}{A} = \rho hg$
$F_{buoy} = \rho V g$
Universal Gas Law:
$PV = nRT = Nk_BT$
$R \approx 8.31446 \frac{J}{(mol \bullet K)}$
$k_B = 1.38 \times 10^{-23} \frac{J}{K}$</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>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="2" 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>
<td></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>
<td></td>
</tr>
</table>

	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Energy					
Work (J = N•m)	$W = Fd$ $W = F\,\Delta x \cos\theta$ $W = \int \boldsymbol{F} \bullet d\boldsymbol{r}$	$W = \boldsymbol{\tau}\,\Delta\theta(\theta - \theta_0)$ $W = \tau\,\Delta\theta \cos\theta$ $W = \int \boldsymbol{\tau} \bullet d\boldsymbol{\theta}$	$\boldsymbol{W} = \boldsymbol{Q}V$	<u>*Thermodynamics*</u>*:* $W = -P\,\Delta V$ $e = \left\lvert \frac{W}{Q_H} \right\rvert$ $e_c = \frac{T_H - T_C}{T_H}$	
Kinetic Energy (J)	*Translational:* $K = KE = \frac{1}{2}m\boldsymbol{v}^2$	*Rotational:* $K = KE = \frac{1}{2}I\boldsymbol{\omega}^2$	$1\ eV \approx 1.60 \times 10^{-19}\ J$	<u>*Fluid Mechanics*</u>*:* *Bernoulli's Equation:* $P_1 + \rho g y_1 + \frac{1}{2}\rho {v_1}^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho {v_2}^2$ <u>*Thermodynamics*</u>*:* $K_{avg} = \frac{3}{2}k_B T$	<u>*Atomic and Nuclear*</u>*:* $K_{max} = hf - \phi$ *Electron Energy Levels:* $E_n = \frac{-13.6\ eV}{n^2}$ *n = principal quantum number (1, 2, 3, etc.)*
Potential Energy (J)	$\Delta U_g = mgh$ $U_G = -\frac{Gm_1m_2}{r}$ $G \approx 6.67 \times 10^{-11}\ \frac{Nm^2}{kg^2}$	*Coiled Spring:* $U_s = -\frac{1}{2}k\Delta x^2$	$U_E = qV$ $U_E = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r}$ $U_c = \frac{1}{2}QV$ $U_c = \frac{1}{2}CV^2$ $U_L = \frac{1}{2}LI^2$	<u>*Fluid Mechanics*</u>*:* $P = P_0 + \rho g h$ *Continuity of Mass:* $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$ *Continuity of Volume:* $A_1 v_1 = A_2 v_2$ <u>Thermodynamics</u>*:* $\Delta U = Q - W$	<u>*Atomic and Nuclear*</u>*:* $E = hf$ $E = mc^2$ $\Delta E = (\Delta m)c^2$ *Relativity:* $E = mc^2\left(\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\right)$

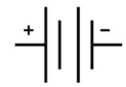
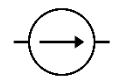
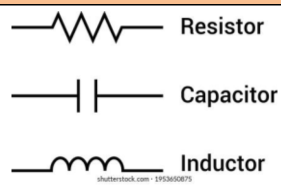
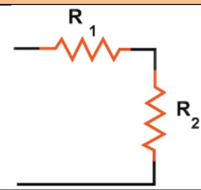
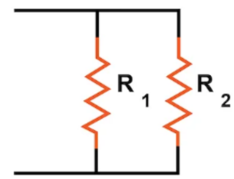
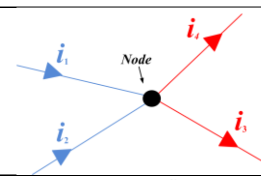
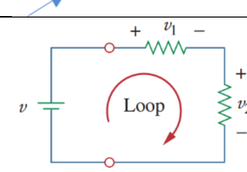
	Mechanics: Linear	Mechanics: Angular	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Heat Energy (J)	*Conservation of Energy:* $E_i = E_f$ $\sum E_i = \sum E_f$ $E = W + Q + K + \Delta U_g + U_G + U_s + U_E + U_c + U_L + \cdots = constant$			*Thermodynamics:* $H = \frac{kA\Delta T}{L}$ $Q = mH_f$ $Q = mH_v$ $\Delta E = Q = mC\Delta T$ $mC\Delta T = mC(T_f - T_i)$ $C_{H_2O} = 4{,}184\ \frac{J}{kg\ °K}$ $T_f = \frac{m_1C_1\Delta T_{1i} + m_2C_2\Delta T_2}{m_1C_1 + m_2C_2}$	
Power (W)	$P = \frac{W}{t} = Fv$ $P = \frac{\Delta E}{\Delta t} \rightarrow \frac{dE}{dt}$ $P = Fv\cos\theta$ $P = \mathbf{F} \bullet \boldsymbol{v}$	$P = \frac{W}{t} = \tau\omega$ $P = \frac{\Delta W}{\Delta t} \rightarrow \frac{dW}{dt}$ $P = \tau\omega\cos\theta$ $P = \boldsymbol{\tau} \bullet \boldsymbol{\omega}$	$P = IV$ $P = I^2R$ $P = \frac{V^2}{R}$	$P = pQ$ $P = pressure\ \left(\frac{N}{m^2}\right)$ $Q = volumetric$ $flow\ rate\ \left(\frac{m^3}{s}\right)$	

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

	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	$\sum p_i = \sum p_f$ $\sum m\boldsymbol{v}_i = \sum m\boldsymbol{v}_f$	$\sum L_i = \sum L_f$ $\sum I\boldsymbol{\omega}_i = \sum I\boldsymbol{\omega}_f$	$\sum Q_i = \sum Q_f$	$\sum m_i = \sum m_f$ *Bernoulli's Equation:* $P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$	$\sum E_i = \sum E_f$ $E = W + Q + K + \Delta U_g + U_G + U_s + U_E + U_c + U_L + \cdots = constant$



Electricity

Terms	Formulas		
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:* $\oint \boldsymbol{E} \bullet d\boldsymbol{A} = \frac{Q}{\epsilon_0}$
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)	$C = \frac{Q}{V}$ $C = \frac{\epsilon_0 A}{d}$ $C = \frac{\kappa \epsilon_0 A}{d}$	$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$	$C_p = \sum_i C_i$
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.		 $KVL: -v + v_1 + v_2 = 0$

Magnetism		
Term	**Formulas**	**Laws**
Magnetic Field (T)	$B = \frac{\mu_0}{2\pi}\frac{I}{r}$ $Solenoid:$ $B_s = \mu_0 nI$ $where\ n = \frac{N}{\boldsymbol{\ell}}\ turns\ per\ meter$ $\boldsymbol{B} = \frac{\mu_0}{4\pi}\frac{q\vec{\boldsymbol{v}} \times \vec{\boldsymbol{r}}}{r^3}$ $\boldsymbol{B} = \frac{\mu_0}{4\pi}\frac{q\vec{\boldsymbol{v}} \times \hat{\boldsymbol{r}}}{r^2}$ $\mu_0 = 4\pi \times 10^{-7}\frac{(T \bullet m)}{A}$	*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:* $\oint \boldsymbol{B} \bullet d\boldsymbol{A} = 0$ $dB = \frac{\mu_0}{4\pi}\frac{I\,d\boldsymbol{\ell} \times \vec{\boldsymbol{r}}}{r^3}$
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

- Wikipedia (2025).
  - SI derived unit. https://en.wikipedia.org/wiki/SI_derived_unit
  - Metric prefix. https://en.wikipedia.org/wiki/Metric_prefix