Harold's Physics Formulas – Algebra
Cheat Sheet
30 October 2026

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Linear Translation</th><th>Mechanics:
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<tr><td>Kinematics</td><td>Bold = Vector
Red = Memorize</td><td colspan="2">See Harold's Physics Units of Measure Cheat Sheet
See Harold's Physics of Projectiles Cheat Sheet</td><td colspan="2">See Harold's Physics Optics Cheat Sheet
See Math and Greek Symbols</td></tr>
<tr><td rowspan="3">Position
(m)
(rad)</td><td>Horizontal:
$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$
(constant a_x)

Vertical:
$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$
(up is +, constant g,
neglect air resistance)

$\Delta x = x_f - x_0$

$x = x_0 + vt$
(constant v)</td><td>Circular:
$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
(constant α)

$\Delta\theta = \theta_f - \theta_0$

$\theta = \theta_0 + \omega t$
(constant ω)</td><td rowspan="3">$10^{-30} = quecto-$
$10^{-27} = ronto-$
$10^{-24} = yocto-$
$10^{-21} = zepto-$
$10^{-18} = atto-$
$10^{-15} = femto-$
$10^{-12} = pico-$
$10^{-9} = nano-$
$10^{-6} = micro-$
$10^{-3} = milli-$
$10^{-2} = centi-$
$10^{-1} = deci-$
$10^{0} = 1$
$10^{1} = deca-$
$10^{2} = hecto-$
$10^{3} = kilo-$
$10^{6} = mega-$
$10^{9} = giga-$
$10^{12} = tera-$
$10^{15} = peta-$
$10^{18} = exa-$
$10^{21} = zetta-$
$10^{24} = yotta-$
$10^{27} = ronna-$
$10^{30} = quetta-$</td><td rowspan="2"><u>Fluid Mechanics</u>:

Mass Density:
$\rho = \frac{m}{V}$

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

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

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

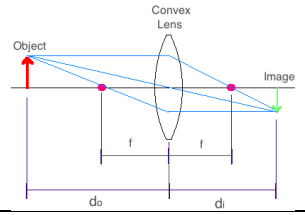
Snell's Law:
$n_1 \sin\theta_1 = n_2 \sin\theta_2$
(angles measured from
the normal)

$\frac{n_1}{n_2} = \frac{v_2}{v_1}$

Diffraction (spread):
$\Delta L = d \sin\theta$

Double-slit Maxima:
$d \sin\theta = m\lambda$
$m = 0, \pm1, \pm2, \ldots$</td></tr>
<tr><td colspan="2">$s = r\theta$</td></tr>
<tr><td colspan="2">$x(t) = A\cos(\omega t + \phi)$

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

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

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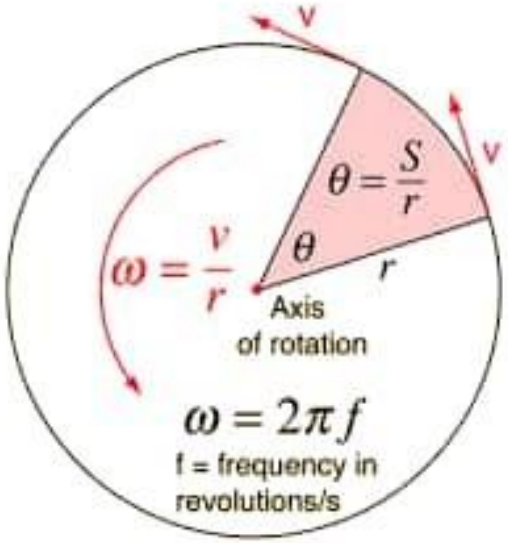
	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Velocity (m/s) **Angular Velocity /** Angular Frequency (rad/s)	$v_{ave} = \frac{\Delta x}{\Delta t}$ $\Delta v = v_f - v_0$ *Constant linear acceleration:* $v = v_0 + at$ $v^2 = v_0^2 + 2a\Delta x$ $\bar{v} = \frac{v_0 + v}{2}$	$\omega_{ave} = \frac{\Delta \theta}{\Delta t}$ $\Delta \omega = \omega_f - \omega_0$ *Constant angular acceleration:* $\omega = \omega_0 + \alpha t$ $\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$ $\bar{\omega} = \frac{\omega_0 + \omega}{2}$ $\omega = \frac{2\pi}{T} = 2\pi f$ $\omega_{spring} = \sqrt{\frac{k}{m}}$ $\omega_{pendulum} = \sqrt{\frac{g}{\ell}}$ *(for small $\Delta\theta$)*	*Speed of Light:* $c \approx 3.00 \times 10^8 \frac{m}{s}$	*<u>Fluid Mechanics</u>:* *Continuity:* $A_1 v_1 = A_2 v_2$ *(Steady incompressible flow)* *Torricelli's Law:* $v = \sqrt{2gh}$ *(Speed of fluid exiting a small outlet in a large tank, equal pressure at the surface and outlet, negligible losses.)*	*<u>Waves and Optics</u>:* $v = f\lambda$ ***Reflection**:* *(return into the original medium)* *Critical angle:* $\sin\theta_c = \frac{n_2}{n_1}$ *For light traveling from medium 1 to medium 2, with $n_1 > n_2$.* ***Maxima for a thin film:*** *Constructive* $2d = \frac{\lambda}{2n}, 3\frac{\lambda}{2n}, 5\frac{\lambda}{2n} \ldots$ $= \left(m + \frac{1}{2}\right)\frac{\lambda}{n}$ *(λ = vacuum wavelen.)* *Destructive* $2d = \frac{m}{n}\lambda$ *(Assumes normal incidence and one reflection phase reversal)*
	$v = \omega r$ $v(t) = -A\omega \sin(\omega t + \phi)$ $v(t) = -A(2\pi f) \sin(2\pi f t + \phi)$				

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	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics

Acceleration
(m/s^2)
(rad/s^2)

Linear:

$$a_{ave} = \frac{\Delta v}{\Delta t}$$

$$a = \frac{\sum F}{m} = \frac{F_{net}}{m}$$

Straight-line motion:

$\boldsymbol{a} = \boldsymbol{a}_t$

(***a*** *has no normal acceleration component)*

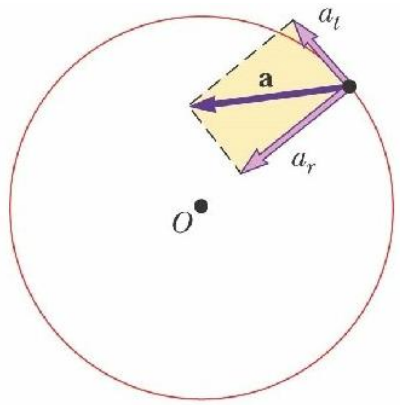
Angular:

$$\alpha_{ave} = \frac{\Delta \omega}{\Delta t}$$

$$\alpha = \frac{\sum \tau}{I} = \frac{\tau_{net}}{I}$$

Centripetal (center):

$$a_c = \frac{v^2}{r} = \omega^2 r$$



$$a^2 = a_t^2 + a_r^2$$

$a_r = -a_c$ radial/centripetal (outward radial is +)
$a_t = a_\theta$ tangential/transverse

$$a_t = \alpha r$$

(fixed-radius circular motion)

$$a(t) = -A\omega^2 \cos(\omega t + \phi)$$

Physical Constants (2022 CODATA):

Gravitational Constant	$G \approx 6.6743 \times 10^{-11} \frac{m^3}{kg\, s^2}$
Std. Acceleration Gravity	$g_n \approx 9.81 \frac{m}{s^2} \approx 32.1740 \frac{ft}{s^2}$, $(g \approx g_n)$
Speed of Light in Vacuum	$c \approx 3.00 \times 10^8 \frac{m}{s}$
Electron-Volt	$1eV \approx 1.6022 \times 10^{-19}\, J$
Elementary Charge	$e \approx 1.6022 \times 10^{-19}\, C,\ (q_e = -e)$
Mass of an Electron	$m_e \approx 9.1094 \times 10^{-31}\, kg$
Mass of a Proton	$m_p \approx 1.6726 \times 10^{-27}\, kg$
Mass of a Neutron	$m_n \approx 1.6749 \times 10^{-27}\, kg$
Electric Permittivity	$\varepsilon_0 = \frac{1}{\mu_0 c^2} \approx 8.8542 \times 10^{-12} \frac{C^2}{Nm^2}$
Magnetic Permeability	$\mu_0 \approx 1.2566 \times 10^{-6} \frac{N}{A^2}$
Boltzmann Constant	$k_B \approx 1.3806 \times 10^{-23} \frac{J}{K}$
Coulomb Constant	$k_e = \frac{1}{4\pi\varepsilon_0} \approx 8.9876 \times 10^9 \frac{Nm^2}{C^2}$
Faraday Constant	$F \approx eN_A \approx 9.6485 \times 10^4 \frac{C}{mol}$
Planck Constant	$h \approx 6.6261 \times 10^{-34}\, Js$
Avogadro Constant	$N_A \approx 6.0221 \times 10^{23}\, / mole$
Ideal Gas Constant	$R \approx 0.08206 \frac{L\, atm}{mole\, K}$
"	$R \approx 8.3145 \frac{J}{mole\, K}$
pi	$\pi \approx 3.1416$

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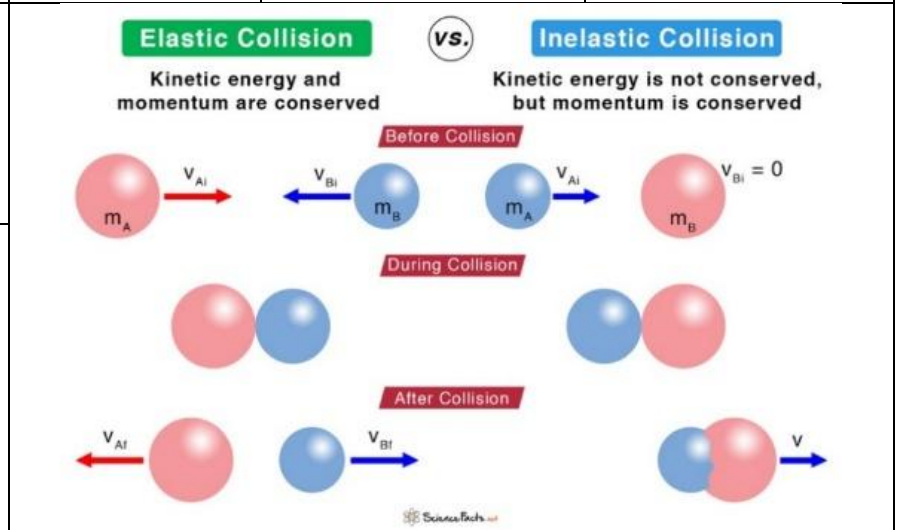
	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Dynamics	See Harold's Physics Forces with FBD Cheat Sheet See Harold's Physics Atwood Machine Cheat Sheet		See Harold's Physics Forces on an Incline Cheat Sheet See Harold's Physics Forces on an Incline with Pulley Cheat Sheet		
Mass (kg) / Moment of Inertia ($\text{kg} \bullet \text{m}^2$)	m = actual mass I = rotational analog of mass Inertia is an object's resistance to changes in its state of motion.	$I = \sum mr^2$ *(r = perp. distance from the rotation axis.)*	$m_p \approx m_n$ $m_p \approx 1{,}836\, m_e$	*Density:* $\rho = \frac{m}{V}$ $\rho_{H_2O} = 1000\ \frac{kg}{m^3}$	*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) ($\text{kg} \bullet \text{m}^2/\text{s}$)	*Constant Mass:* $\boldsymbol{p = mv}$ $p = m\omega r$ *Constant m:* $\Delta \boldsymbol{p} = m\Delta \boldsymbol{v}$ $\Delta \boldsymbol{p} = m\boldsymbol{v_2} - m\boldsymbol{v_1}$	*Constant Mass:* $L = pr \sin\theta$ $L = mvr \sin\theta$ *Fixed-axis constant I:* $\Delta \boldsymbol{L} = I\Delta \boldsymbol{\omega}$ $\Delta \boldsymbol{L} = I\boldsymbol{\omega_2} - I\boldsymbol{\omega_1}$		*Fluid Mechanics:* $\Delta P = \rho g \Delta h$ *(Δh is the increase in depth)* $F = \rho V g$	*Atomic and Nuclear:* $\lambda = \frac{h}{p}$
	Conservation of Linear Momentum: $\boldsymbol{p}_i = \boldsymbol{p}_f$ $\sum m\boldsymbol{v}_i = \sum m\boldsymbol{v}_f$	*Conservation of Angular Momentum:* $\boldsymbol{L}_i = \boldsymbol{L}_f$ $\sum I\boldsymbol{\omega}_i = \sum I\boldsymbol{\omega}_f$			
	Elastic Collision: $m_A(v_A)_1 + m_B(v_B)_1 = m_A(v_A)_2 + m_B(v_B)_2$ *(conservation of momentum)* $K_{A1} + K_{B1} = K_{A2} + K_{B2}$ *(conservation of kinetic energy)*	***Perfectly Inelastic Collision:*** $m_A(v_A)_1 + m_B(v_B)_1 = (m_A + m_B)v_2$ *(conservation of momentum)*			

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Force (N = kg•m/s^2) / **Torque** (N•m)	$F = ma$ $F_g = mg$ *(constant mass)* $\sum \boldsymbol{F} = \boldsymbol{F}_{net} = m\boldsymbol{a}$ $F_{net,ave} = \frac{\Delta p}{\Delta t}$ Friction: $F_{\mu_s} \leq \mu_s N$ $F_{\mu_k} = \mu_k N$ $Typically\ 0 \leq \mu_k \leq \mu_s$ *Gravitational Force:* $F_G = G\frac{m_1\, m_2}{r^2}$ *Hooke's Law:* $\boldsymbol{F}_s = -k\Delta\boldsymbol{x}$	$\tau = I\alpha$ (fixed-axis rotation with constant I) $\tau = rF\sin\theta = rF_\perp$ $\sum \boldsymbol{\tau} = \boldsymbol{\tau}_{net} = I\boldsymbol{\alpha}$ $\tau_{net,ave} = \frac{\Delta L}{\Delta t}$ $F = ma_c$ $F = \frac{mv^2}{r} = mr\omega^2$ *(net inward force)*	<u>*Electricity*</u>*:* *Coulomb's Law:* $F = k\frac{\lvert q_1\, q_2\rvert}{r^2}$ $F = \frac{1}{4\pi\epsilon_0}\frac{\lvert q_1\, q_2\rvert}{r^2}$ $\boldsymbol{F} = \boldsymbol{E}q$ <u>*Magnetism*</u>*:* $F_B = \lvert qvB\sin\theta\rvert$ $F_B = BI\ell\sin\theta$	<u>*Fluid Mechanics*</u>*:* $P = \frac{F}{A}$ $\Delta P = \rho hg$ $F_{buoy} = \rho Vg$ *Universal Gas Law:* $PV = nRT = Nk_BT$ *(absolute pressure; T is in kelvins)*	
Impulse (N•s) (N•m•s)	*Constant net force:* $J = F\Delta t$ $J = \Delta p = m\Delta v$	*Constant net torque:* $H = \Delta L = \tau\Delta t$ $H = I\Delta\omega$			

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	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Energy					
Work (J = N•m)	*Constant force:* $W = F_{\parallel} s = Fs\cos\theta$ *(s is displacement)*	*Constant torque:* $W = \tau\,\Delta\theta$ *(fixed axis, θ in rad)*	$W = QV_{drop}$ $W_{\text{electric}} = -q\Delta V$	*Thermodynamics:* $W = P\Delta V$ *(constant pressure)* $e = \left\lvert\frac{W}{Q_H}\right\rvert = \left\lvert\frac{output/cycle}{heat\ absorbed}\right\rvert$ *Max. Carnot efficiency[2]:* $e_c = \frac{T_H - T_C}{T_H}$	[1] *Needs steady, incompressible, inviscid flow along a streamline, with no pump/turbine work.* [2] T_H, T_C *in kelvins*
Kinetic Energy (J)	*Translational:* $K_{trans} = \frac{1}{2}mv^2$	*Rotational:* $K_{rotat} = \frac{1}{2}I\omega^2$	$1\ eV \approx 1.60\times10^{-19}\ J$	*Fluid Mechanics:* *Bernoulli's Equation[1]:* $P_1 + \rho g y_1 + \frac{1}{2}\rho {v_1}^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho {v_2}^2$	
	Work-Energy Theorem: $W_{net} = \Delta K$ $W_{\text{net}} = W_{\text{other}} - \Delta U = W_{\text{other}} - \Delta U_g - \Delta U_s$ $\Delta K = K_2 - K_1 = \frac{1}{2}m(v_2^2 - v_1^2) + \frac{1}{2}I(\omega_2^2 - \omega_1^2)$		***Mechanical Energy:*** $E_{mech} = K + U$ $K = K_{trans} + K_{rotat}$ $U = U_g + U_s$	*Thermodynamics:* $K_{avg} = \frac{3}{2}k_B T$ *(T is in kelvins)*	*Atomic and Nuclear:* $K_{max} = hf - \phi$ *(emission requires $hf \geq \phi$)*
Potential Energy (J)	*Surface of Earth Gravity:* $\Delta U_g = mg\Delta h$ $U_g = mgh$ *Planetary Gravity:* $U_G = -G\frac{m_1 m_2}{r}$ ***Conservation of Mechanical Energy:*** $\Delta E_{mech} = \Delta(K + U_g + U_s) = 0$ *(if only conservative forces do work)*	*Coiled Spring:* $U_s = \frac{1}{2}k\Delta x^2$ ***Nonconservative Work:*** $W_{noncons.} = \Delta(K + U_g + U_s)$	*Point charges:* $U_E = qV$ $U_E = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r}$ *Capacitor/inductor:* $U_C = \frac{1}{2}QV = \frac{1}{2}CV^2$ $U_L = \frac{1}{2}LI^2$	*Fluid Mechanics:* $P = P_0 + \rho gh$ *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 1st Law[3]:* $\Delta U_{internal} = Q - W_{by}$	*Atomic and Nuclear:* $E = hf$ $E_0 = mc^2$ $\Delta E = (\Delta m)c^2$ [3] *Closed system; negligible changes in macroscopic kinetic and potential energy.*

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<tr><td>Heat Energy (J)</td><td colspan="3">Energy transferred by heating is Q.

Closed-system energy balance:
$Q > 0$ into the system
$W_{by} > 0$ for work done by it</td><td><u>Thermodynamics</u>:
$H = \frac{Q}{\Delta t} = \frac{kA\Delta T}{L}$
(steady heat conduction)

$Q = mL_f$
$Q = mL_v$</td><td>Hydrogen Electron Energy Levels:
$E_n = \frac{-13.6\ eV}{n^2}$
n = principal quantum number (1, 2, 3, etc.)</td></tr>
<tr><td>Energy (J)</td><td colspan="3">Conservation of Energy for an isolated system:
$E_{total} = E_i = E_f$

$E_{total} = \sum E_i = \sum E_f$

$E_{total} = K + U_{potential} + U_{internal}$

Closed-system energy balance:
$\Delta E_{\text{total}} = \Delta K + \Delta U_{potential} + \Delta U_{internal} = Q - W_{by}$</td><td colspan="2">$\Delta E = Q = mc\Delta T = mc(T_f - T_i)$
(Heat is the only energy transfer, no phase change, and approximately constant specific heat)

$T_f = \frac{m_1c_1T_{1i} + m_2c_2T_{2i}}{m_1c_1 + m_2c_2}$
(No heat exchange with surroundings, no phase change, negligible calorimeter heat capacity, constant specific heats)

$c_{H_2O} = 4{,}184\ \frac{J}{kg \cdot K}$</td></tr>
<tr><td rowspan="2">Power (W)</td><td colspan="2">Energy transferred by the process:

$P_{ave} = \frac{W}{\Delta t} = \frac{\Delta E_{transferred}}{\Delta t}$</td><td rowspan="2">$P = IV$

$P = I^2R$

$P = \frac{V^2}{R}$</td><td rowspan="2">$P = \Delta p\ Q$

where:
$p = pressure\ \left(\frac{N}{m^2}\right)$

$Q = volumetric\ flow\ rate\ \left(\frac{m^3}{s}\right)$</td><td rowspan="2"></td></tr>
<tr><td>$P = F_{\parallel}v$

$P = Fv\cos\theta$</td><td>$P = \tau_{\parallel}\omega$

$P = \tau\omega\cos\phi$</td></tr>
</table>

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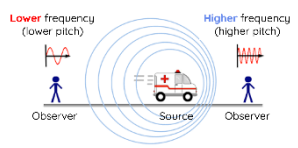
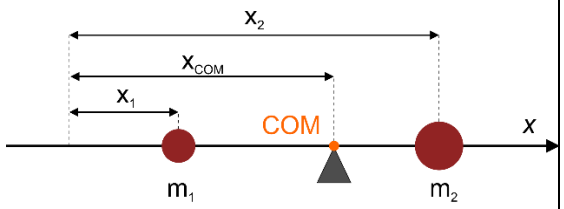
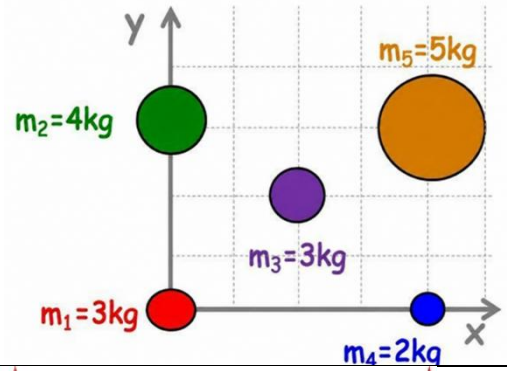
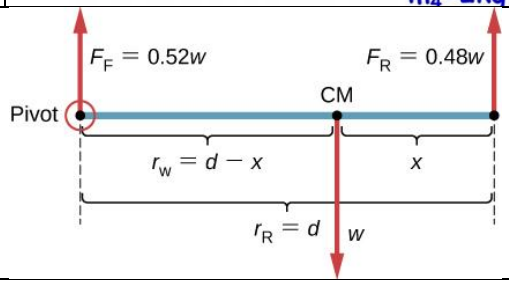
	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Engineering Application		See Harold's Center of Mass / Moment of Inertia Cheat Sheet See Harold's Physics Doppler Effect Cheat Sheet			
Period (s) / Frequency (Hz)	$T = \frac{1}{f}$ $f = \frac{1}{T}$ *Kepler's Third Law:* $T^2 = \left(\frac{4\pi^2}{GM}\right) r^3$ *(M dominant; r is circular-orbit radius)*	$T = \frac{1}{f} = \frac{2\pi}{\omega} = \frac{2\pi r}{v}$ $T_{spring} = 2\pi\sqrt{\frac{m}{k}}$ $T_{pendulum} = 2\pi\sqrt{\frac{\ell}{g}}$ *(small oscillations)*	$T_{angular} = \frac{2\pi}{\lvert b \rvert}$ *For:* $y = sin(b\theta)$ $y = cos(b\theta)$	 ** = Receiver toward source: numerator +; source toward receiver: denominator –, with speeds measured relative to the medium.*	*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)	$x_{CM} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$ $r_{CM} = \frac{\sum mr}{\sum m}$			$x_{CM} = \frac{\sum m_i x_i}{\sum m_i}$ 	$y_{CM} = \frac{\sum m_i y_i}{\sum m_i}$
Rigid Bodies (Statics)	$\sum F_x = 0$ *(Right = '+')* $\sum F_y = 0$ *(Down = '–')*	$\sum \tau = 0$ *(CW = '–')*			

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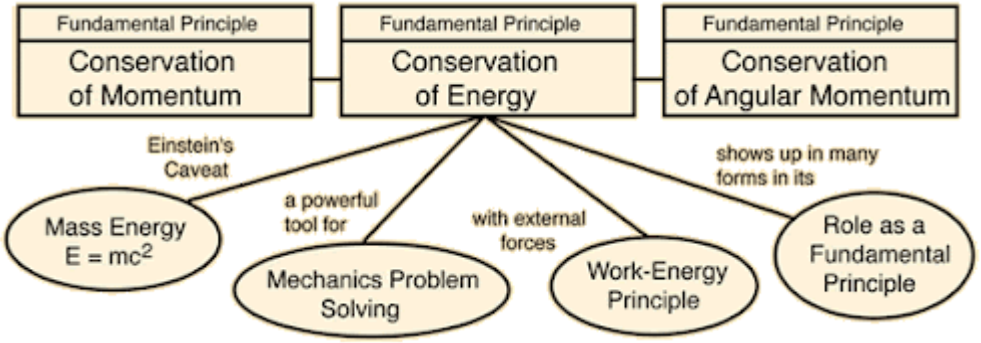
	Mechanics: Linear Translation	Mechanics: Angular / Rotational	Electricity / Magnetism	Fluid Mechanics / Thermodynamics	Atomic and Nuclear / Waves and Optics
Conservation Laws					
Fundamental Principle	*Conservation of Linear Momentum*	*Conservation of Angular Momentum*	*Conservation of Electric Charge*	*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	*Zero net external impulse for linear momentum. Zero net external angular impulse about the chosen origin for angular momentum.*		*Kirchhoff's Current Law (KCL):* $\sum_{i=1}^{n} I_i = 0$	*Continuity of Mass:* $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$ *(Classical mass conservation, since mass alone is not conserved in nuclear reactions.)*	$\sum E_i = constant$ $\Delta E_{\text{total}} = \Delta K + \Delta U_{potential} + \Delta U_{internal} = Q - W_{by}$ *For an isolated system:* $E_{total} = K + U_{potential} + U_{internal} = constant$
					

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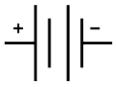
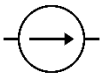
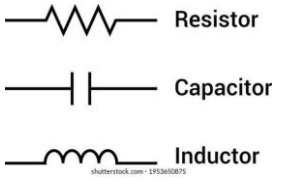
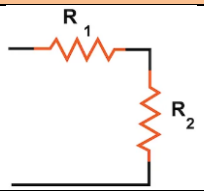
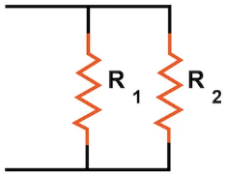
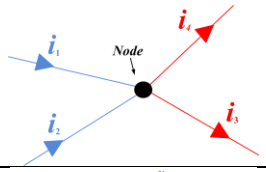
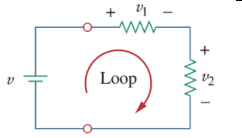
Electricity

Terms	Formulas	See Harold's Electromagnetic Spectrum Cheat Sheet See Harold's DC Circuits Cheat Sheet	
Electric Field (V/m or N/C)	$\boldsymbol{E} = \frac{\boldsymbol{F}}{q}$ $E_{x,avg} = -\frac{\Delta V}{\Delta x}$ $E = \rho J$ *(ρ = electrical resistivity)*	$E_{r,avg} = -\frac{\Delta V}{\Delta r}$	*Gauss's Law:* $\phi = \frac{Q_{enc}}{\epsilon_0}$
Potential / Voltage (V)	$V = IR$ $V = \frac{Q}{C}$	$V = k\sum_i \frac{q_i}{r_i}$ $V = \frac{1}{4\pi\epsilon_0}\sum_i \frac{q_i}{r_i}$	
Current (A)	$I_{ave} = \frac{\Delta Q}{\Delta t}$ $I = \frac{V}{R}$	$I = n\lvert e\rvert v_d A$	
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)	$L = N\frac{\Phi}{I}$ $L = \mu_0 \frac{N^2 A}{\ell}$ [1]	$L_s = \sum_i L_i$	$\frac{1}{L_p} = \sum_i \frac{1}{L_i}$
		L_s and L_p assume negligible mutual inductance. *[1] For a long air-core solenoid; negligible end effects.*	
Capacitance (F)	$C = \frac{Q}{V}$ $C = \frac{\kappa\epsilon_0 A}{d}$	$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$	$C_p = \sum_i C_i$
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:* $-v + v_1 + v_2 = 0$

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Magnetism	
Term	**Formulas**
Magnetic Field (T)	$B = \frac{\mu_0}{2\pi}\frac{I}{r}$ *(Long straight wire)* $Solenoid$: $B_s = \mu_0 nI$ *(Long air-core solenoid, away from the ends)* $where\ n = \frac{N}{\ell}\ turns\ per\ meter$ *Moving-charge magnetic field:* $\mathrm{B} = \frac{\mu_0 \lvert q \rvert \mathrm{vr}}{4\pi \mathrm{r}^3}\sin\theta$ *(Nonrelativistic approximation, $v \ll c$)*
Magnetic Flux (Wb)	$\phi_B = BA\cos\theta$ *(Uniform field through a flat surface;* *θ is measured from the surface normal)*
EMF (V)	$\varepsilon = Blv$ *(magnitude; perpendicular rod, velocity, and uniform magnetic field)* $\varepsilon_{avg} = -\frac{N\Delta\phi_B}{\Delta t}$ *(N turns, stationary loop)*

Sources

- NIST SP 961 (2022). CODATA Recommended Values of the Fundamental Physical Constants: 2022. https://physics.nist.gov/cuu/pdf/wall_2022.pdf
- Wikipedia (2025).
  - Metric prefix. https://en.wikipedia.org/wiki/Metric_prefix
  - SI derived unit. https://en.wikipedia.org/wiki/SI_derived_unit

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