Dr. Pete's useful stuff
College Physics I*

Momentum $\vec{\mathbf{p}} = m\vec{\mathbf{v}} \quad \vec{\mathbf{P}} = \sum \vec{\mathbf{p}}_i$

Center of mass $X_{\mathrm{cm}} = \dfrac{\sum m_i x_i}{\sum m_i} = \dfrac{\sum m_i x_i}{M}$ similarly for $Y_{\mathrm{cm}} \quad Z_{\mathrm{cm}} \quad \vec{\mathbf{V}}_{\mathrm{cm}} \quad \vec{\mathbf{A}}_{\mathrm{cm}}$

Newton II $\sum \vec{\mathbf{F}}_i = \vec{\mathbf{F}}_{\mathbf{net}} = m\vec{\mathbf{a}} = \dfrac{\Delta\vec{\mathbf{p}}}{\Delta t}$ also $\vec{\mathbf{F}}_{\mathbf{net}} = M\vec{\mathbf{A}}_{\mathrm{cm}}$ **III** $\vec{\mathbf{F}}_{12} = -\vec{\mathbf{F}}_{21}$

Conservation laws for an isolated system $E_i = E_f \quad P_i = P_f$

Gravitation near earth $F = mg \quad U = mgh$ otherwise $F = \dfrac{GmM}{r^2} \quad U = \dfrac{-GmM}{r} \quad \vec{\mathbf{g}} = \dfrac{\vec{\mathbf{W}}}{m}$

Hooke's Law & SHM $F = -kx \quad U = \frac{1}{2}kx^2 \quad w = \sqrt{\dfrac{k}{m}}$ simple pendulum $w = \sqrt{\dfrac{g}{L}}$

$x = A\cos wt \quad (x = A \text{ @ } t = 0) \quad v = -v_m \sin wt \quad a = -a_m \cos wt \quad v_m = wA \quad a_m = w^2 A$

$x = A\sin wt \quad (x = 0 \text{ @ } t = 0) \quad v = v_m \cos wt \quad a = -a_m \sin wt$

Friction static $f_s \le m_s N$ kinetic $f_k = m_k N$

Kinematics $\Delta\vec{\mathbf{r}} = \vec{\mathbf{r}}_f - \vec{\mathbf{r}}_o \quad \vec{\mathbf{v}}_{av} = \dfrac{\Delta\vec{\mathbf{r}}}{\Delta t} \quad \vec{\mathbf{a}}_{av} = \dfrac{\Delta\vec{\mathbf{v}}}{\Delta t}$

Kinematic equations (const. a)

$v = v_o + at \quad x = x_o + v_o t + ½at^2 \quad v^2 = v_o^2 + 2a(x - x_o)$;

where $x = x_o$ and $v = v_o$, when $t = 0$

Quadratic functions

$ax^2 + bx + c = 0 \quad \Rightarrow \quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ sum of roots $= -\dfrac{b}{a}$ product of roots $= \dfrac{c}{a}$

Circular motion and torque

$s = rq \quad w = 2pf = \dfrac{2p}{T} \quad a_c = \dfrac{v^2}{r} = rw^2 \quad t = r_\perp F = rF_\perp$

$v = rw$

$a_t = ra \quad$ (rolling without slipping $v_{\mathrm{axle}} = rw$) $\quad \sum t_i = t_{\mathrm{net}}$

Work energy power $W = F_{\|}d \quad E = K + U \quad K = \frac{1}{2}mv^2 \quad P = \dfrac{W}{t}$

Fluids $P = \dfrac{F}{A} \quad r = \dfrac{m}{V} \quad P_2 = P_1 + rgh \quad A_1 v_1 = A_2 v_2 \quad F_B = m_f g = r_f Vg \quad P_{\mathrm{gauge}} = P_{\mathrm{abs}} - P_{\mathrm{atm}}$

Incompressible fluids

$$P_1 + \tfrac{1}{2}rv_1^2 + rgy_1 = P_2 + \tfrac{1}{2}rv_2^2 + rgy_2 \qquad \frac{\Delta V}{\Delta t} = A_1 v_1 = A_2 v_2 \qquad \frac{\Delta V}{\Delta t} = \frac{p\Delta P r^4}{8hL}$$

Moduli Young's $Y = \dfrac{\text{stress}}{\text{strain}} = \dfrac{F/A}{\Delta L/L}$ Shear $S = \dfrac{F/A}{\Delta x/L}$ Bulk $B = \dfrac{F/A}{-\Delta V/V} = \dfrac{-\Delta P}{\Delta V/V}$

Waves $I = \dfrac{\text{power}}{\text{area}} = \dfrac{P}{4pr^2} \quad v = \sqrt{\dfrac{F}{m}} \quad m = \dfrac{m}{L} \quad k = \dfrac{2p}{l} \quad \dfrac{\sin q_1}{\sin q_2} = \dfrac{v_1}{v_2}$

$v = fl = \dfrac{w}{k} \quad y(x,t) = A\cos(wt - kx) \quad$ standing waves $l_n = \dfrac{2L}{n}$, $n = 1, 2, 3...$