Standard force and motion

$v^2 - u^2 = 2as$	$v = u + at$
$s = \frac{1}{2}at^2 + ut$	$s = \frac{(u+v)t}{2}$
$F = \frac{dp}{dt} = m\frac{dv}{dt} = ma$	$f_{max} = \mu F_N$
$F_{drag} = \frac{1}{2}C\rho A v^2$	$\vec{J} = \Delta\vec{p} = m \cdot \Delta\vec{v} = \int \vec{F}\, dt$
$W = \vec{F}\cdot\vec{s} = \lvert\vec{F}\rvert\lvert\vec{s}\rvert\cos\theta = \int F\, ds$	
$\vec{r}_{CoM} = \frac{1}{M}\sum \vec{r}m = \frac{1}{M}\int \vec{r}\, dm$	

Rotation stuff

$\omega^2 - {\omega_0}^2 = 2\alpha\theta$	$\omega = \omega_0 + \alpha t$
$\theta = \frac{1}{2}\alpha t^2 + \omega_0 t$	$\theta = \frac{(\omega_0 + \omega)t}{2}$
Linear quantity = Angular quantity × Radius	
$\vec{v} = \vec{\omega}\times\vec{r}$	
$a_{radial} = \vec{\alpha}\times\vec{r}$	$a_{centripetal} = \vec{\omega}\times\vec{v}$
$\vec{a} = \vec{\alpha}\times\vec{r} + \vec{\omega}\times\vec{v} = a_{radial} + a_{centripetal}$	
$F_{centripetal} = m\frac{v^2}{r} = mr\omega^2$	
$I = \sum mr^2 = \int r^2\, dm$	
$KE = \frac{1}{2}I\omega^2 = \frac{1}{2}\omega^2\int r^2\, dm$	
Shifting centre of rotation: $I = I_0 + Mh^2$	
Angular momentum: $\vec{L} = I\omega = \vec{r}\times\vec{p} = \vec{r}\times m\vec{v}$	
$\vec{\tau} = \vec{r}\times\vec{F} = rF\sin\theta = I\alpha = \frac{dL}{dt}$	
$P = \tau\omega$	$W = \frac{1}{2}I(\omega^2 - {\omega_0}^2)$

Pure rolling:

$v = R\omega$	$KE = \frac{1}{2}I\omega^2$

Rolling + Sliding:

$$KE = \frac{1}{2}I\omega^2 + \frac{1}{2}Mv^2 = \frac{1}{2}(I + MR^2)\omega^2$$

Spring stuff

$F = kx$
$W = \int F\, dx = \int kx\, dx = \frac{1}{2}k(x_f^2 - x_i^2)$

Power and energy

$W = \Delta KE = -\Delta U$	$F = -\frac{d}{dx}U$
$P = \frac{d}{dt}W = \frac{d}{dt}(Fx\cos\theta) = Fv\cos\theta = \vec{F}\cdot\vec{v}$	

Fluidics Density - ρ

$\rho = \frac{m}{V}$	$p = \frac{F}{A}$
$p = p_{atmosphere/external} + \rho gh$	
$F_{buoyant} = Weight_{displaced} = \rho V g$	
Bernoulli's: $p + \frac{1}{2}\rho v^2 + \rho gh = \text{const.}$	
Pipe continuity: $Av = \text{const.}$	

Harmonic motion Torsion - κ

$x(t) = A\cos(\omega t + \phi)$	$a(t) = -\omega^2 x(t)$
$\omega = 2\pi f$	$T = 2\pi\sqrt{\frac{m}{k}}$
$U(t) = \frac{1}{2}kA^2\cos^2(\omega t + \phi)$	
$KE(t) = \frac{1}{2}kA^2\sin^2(\omega t + \phi)$	
$E_{total} = U(t) + KE(t) = \frac{1}{2}kA^2$	

Angular oscillator (Rotating stuff):

$\tau = I\alpha = -\kappa\theta$	$T = 2\pi\sqrt{I/\kappa}$

Simple pendulum: Linear density - μ

$\tau = Lmg\sin\theta$	$\alpha = -\frac{mgL}{I}\theta$
$\omega = \sqrt{\frac{mgL}{I}}$	$T = 2\pi\sqrt{\frac{I}{mgL}}$
$v_{wave} = f\lambda = \frac{\omega}{k} = \sqrt{\frac{T}{\mu}}$	**Small A:** $T = 2\pi\sqrt{\frac{L}{g}}$

Mathematics fundamentals

Dot product	$\vec{a} \cdot \vec{b} = \lvert\vec{a}\rvert\lvert\vec{b}\rvert \cos\theta = i_a i_b + j_a j_b + k_a k_b$
Cross product	$\vec{a} \times \vec{b} = \hat{n}\,\lvert\vec{a}\rvert\lvert\vec{b}\rvert \sin\theta = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ i_a & j_a & k_a \\ i_b & j_b & k_b \end{vmatrix}$
Vector projection	$\vec{a} \xrightarrow[proj.]{} \vec{b} = (\vec{a} \cdot \hat{b})\,\hat{b}$