$\vec{v} = \frac{\Delta \vec{r}}{\Delta t}$ $\quad \vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

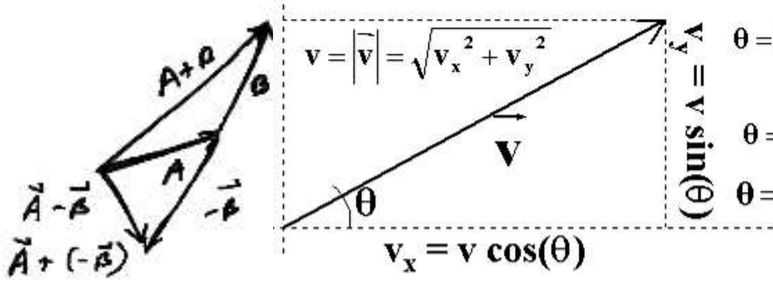
1D

$\Delta x = x_f - x_i$

$\Delta v = v_f - v_i$

$a = \Delta v / \Delta t$

$\Delta x = \bar{v} \, \Delta t$



$v = |\vec{v}| = \sqrt{v_x^2 + v_y^2}$

$v_x = v\cos(\theta)$ $\quad v_y = v\sin(\theta)$

$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$

$\theta = \cos^{-1}\left(\frac{v_x}{v}\right)$

$\theta = \sin^{-1}\left(\frac{v_y}{v}\right)$

$ax^2 + bx + c = 0$ $\quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

a = constant

$\bar{v} = (v_f + v_i)/2$

$v = v_o + at$

$x = x_o + v_o t + \frac{1}{2} a t^2$

$v^2 - v_o^2 = 2a(x - x_o)$

2D

$x \rightarrow x, y \qquad x_o \rightarrow x_o, y_o$

$v \rightarrow v_x, v_y \qquad v_o \rightarrow v_{ox}, v_{oy}$

$a \rightarrow a_x, a_y$

$\omega = \frac{\Delta \theta}{\Delta t}$ $\quad \alpha = \frac{\Delta \omega}{\Delta t}$

$\omega = 2\pi f$ $\quad f = \frac{1}{T}$

Rotation

$\bar{\omega} = \frac{\omega_f + \omega_i}{2}$

$\omega = \omega_o + \alpha t$

$\theta = \theta_o + \omega_o t + \frac{1}{2} \alpha t^2$

$\omega^2 - \omega_o^2 = 2\alpha(\theta - \theta_o)$

$\tau = r_\perp F = r F_\perp$

$I = \sum_i^{all} m_i r_i^2$

$\tau = I\alpha$

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

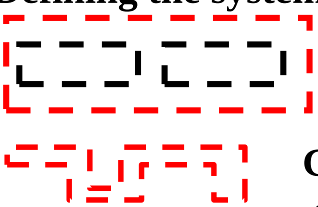
$x = r\,\theta$

$v = \omega\, r$

$a = \alpha\, r$

NL $\quad \vec{F}_{tot} = m\vec{a}$

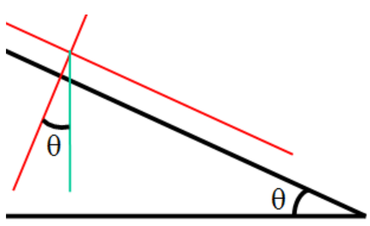
Defining the system



Grouping masses

Identify F – reaction F

Go around corners consistently



μN $\quad a = \frac{v^2}{R}$

$F = -kx$

$L = r_\perp p = m v r_\perp$ $\quad L = I\omega$

$\tau = \frac{\Delta L}{\Delta t}$ $\quad \tau = 0 \Rightarrow \Delta L = 0$

Statics

$\sum_i^{all} \vec{F}_i = 0$ $\quad \sum_i^{all} \vec{\tau}_i = 0$

Energy

$KE = \frac{1}{2} m v^2$ $\quad W = F\, d_{\parallel} = F_{\parallel}\, d$

$W_{tot} = \Delta(KE)$ $\quad \Delta U = -W_{if}$

$E = KE + U$ $\quad U = mg(y - y_0)$

$W_{nc} = \Delta E$ $\quad U = \frac{1}{2} k x^2$ $\quad F = -kx$

$\vec{P}_{init} = \vec{P}_{final}$

$\left(\sum_j^{all} m_j \vec{v}_j\right)_{init} = \left(\sum_j^{all} m_j \vec{v}_j\right)_{final}$

$\vec{p} = m\vec{v}$ $\quad \vec{F} = \frac{\Delta \vec{P}}{\Delta t}$

Momentum