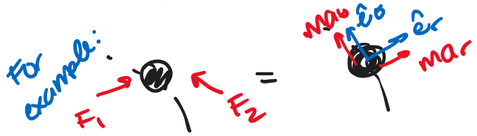
Chapter 4. Kinetics of Particles

4.A Newton's Laws

- FBD → individual particles → system
- $\Sigma \vec{F} = m\vec{a}$
- → • Relating forces & accelerations
- • Vector equation
- * FBD = KD

For example:



$\Sigma \vec{F} = m\vec{a}$

$\Sigma F_r = ma_r$

$\Sigma F_\theta = ma_\theta$

4.B Work-Energy

individual

- FBD → system → particles
  - ↳ conservation of energy?
- $T_1 + U_{1-2} = T_2$

$U_{1-2} = U^{NC}_{1-2} + V_1 - V_2$

$$T_1 + V_1 + U^{NC}_{1-2} = T_2 + V_2$$

- → • Forces, speeds, displacements
- • scalar equation

$T = \frac{1}{2}mv^2$

$V_g = mgh$ → needs a datum

$V_k = \frac{1}{2}k(L - L_0)^2$, L_0 - unstretched length

$U^{NC}_{1-2} = \int_{s_1}^{s_2} \vec{F}_t \cdot \hat{e}_t \, ds = F\Delta s$

* If no non-conservative forces, $U^{NC}_{1-2} = 0$

4.C Impulse-Momentum

FBD → systems → particles

↳ $\Sigma F = 0$ or $\Sigma M_O = 0$

conservation of linear or angular momentum

LIM: $m\vec{v}_1 + \int_{t_1}^{t_2} \vec{F}_R \, dt = m\vec{v}_2$

AIM: $\vec{H}_{O_1} + \int_{t_1}^{t_2} \vec{M}_{R,O} \, dt = \vec{H}_{O_2}$

$\vec{H}_O = \vec{r}_{e/O} \times m\vec{v}$

↳ about point "O"

- vector equations
- → • Forces, times, velocities

Central Impact

$$e = \frac{v_{B_2,N} - v_{A_2,N}}{v_{A_1,N} - v_{B_1,N}}$$

along line of impact $\hat{e}_N$