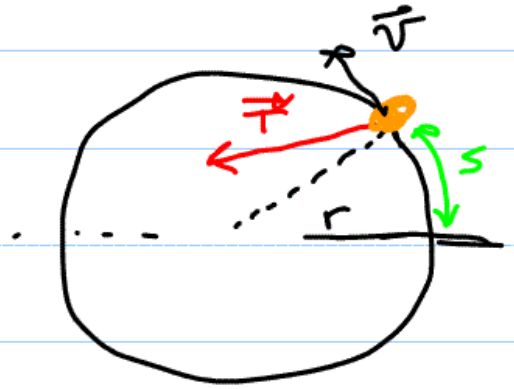
Class 8 - Oct 5/05

§ 7.6 - Nonuniform ⊙ Motion



$$\vec{T} = T_r \hat{r} + T_t \hat{t}$$

$$\vec{a} = \underbrace{a_r}_{\frac{v^2}{r}} \hat{r} + \underbrace{a_t}_{\neq 0} \hat{t}$$

Eqns 2.18 ; 2.22 $\quad a_t = \text{const}$

Divide by r

$$\begin{cases} s_f = s_i + v_i \Delta t + \frac{1}{2} a_t (\Delta t)^2 \\ v_{ft} = v_{it} + a_t \Delta t \end{cases}$$

$$\begin{cases} \theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2} \frac{a_t}{r} (\Delta t)^2 \\ \omega_f = \omega_i + \frac{a_t}{r} \Delta t \end{cases}$$

§17.1 angular accel. $\alpha = \frac{a_t}{r}$ α = const

$$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$$

$$\omega_f = \omega_i + \alpha t$$

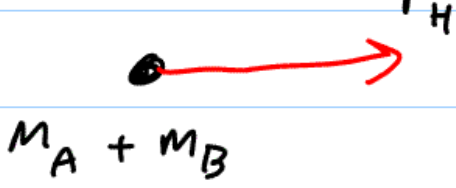
CHAPT 8 - Newton's 3rd Law

Series of examples

all { model' particle; ignore vertical forces }

System: all

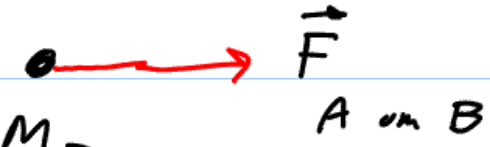
FBD:



$$a = \frac{F_H}{m_A + m_B}$$

System: B

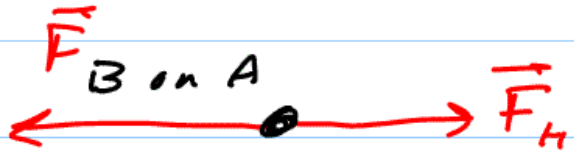
FBD



$$F_{A \text{ on } B} = m_B \frac{F_H}{m_A + m_B} \quad \text{right}$$

System A

FBD:



$$F_H - F_{B \text{ on } A} = m_A a$$

$$F_H - F_{B \text{ on } A} = m_A \frac{F_H}{m_A + m_B}$$

algebra

$$F_{B \text{ on } A} = \frac{m_B F_H}{m_A + m_B} \quad \text{left}$$

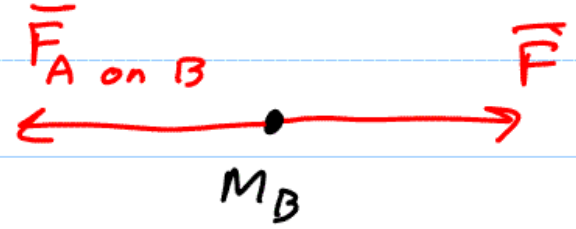
Example:

$$F = (m_A + m_B)\, a$$

$$\underset{\sim}{a} = \frac{F}{m_A + m_B}$$

System B

FBD



$$F - F_{A \text{ on } B} = m_B a$$

$$F - F_{A \text{ on } B} = m_B \frac{F}{m_A + m_B}$$

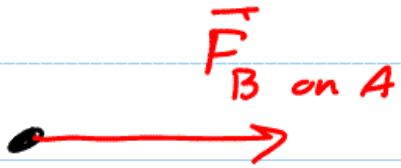
algebra $\Rightarrow$

$$F_{A \text{ on } B} = \frac{m_A F}{m_A + m_B}$$

left

System: A

FBD



$$F_{B \text{ on } A} = m_a a$$

$$F_{B \text{ on } A} = \frac{m_A F}{M_A + M_B}, \text{ right}$$

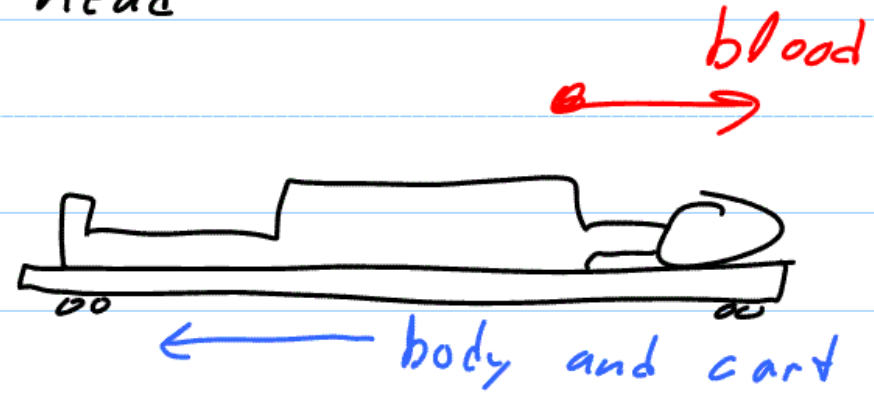
Newton's 3rd Law

$$\vec{F}_{A \text{ on } B} = -\vec{F}_{B \text{ on } A}$$

for any A & B

Ballistocardiogram

heart pumps blood largely up towards head

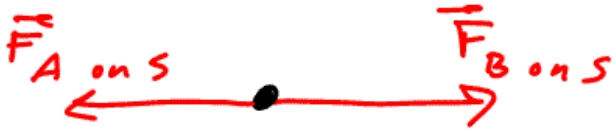


Example

$$F = (m_A + m_B)\, a$$

System: string

FBD:



$$F_{B \text{ on } S} - F_{A \text{ on } S} = m_S \; a$$

$$\vec{F}_{B \text{ on } S} = -\vec{F}_{A \text{ on } S}$$

Not 3rd Law

$$m_S \neq 0$$

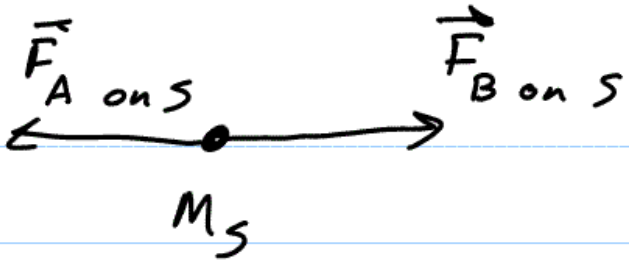
$$m_{tot} = m_A + m_S + m_B$$

$$F = m_{tot} \; a$$

$$a = \frac{F}{m_{tot}}$$

System' string

FBD

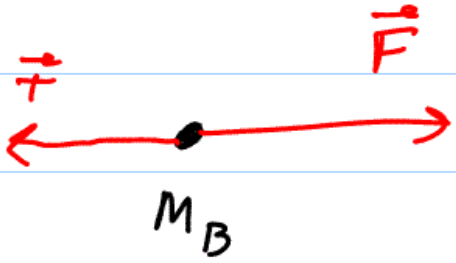


$$F_{B \text{ on } S} - F_{A \text{ on } S} = m_S a$$

$$\neq 0$$

System: B

FBD:



$$F - T = m_B a$$

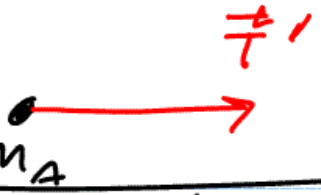
CORRECTION

$$\Rightarrow \quad T = \frac{(m_A + m_S) F}{m_{tot}}, \text{ left}$$

algebra

System A

FBD:



$$T' = m_A a = \frac{m_A}{m_{tot}} F \text{ right}$$