Phys 1050 - Review by Dawity (plankton@yahoo.com)

↣ friction: $f_{smax} = \mu_s F_N$

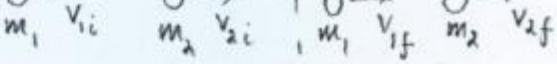
- $F_{ap} > f_{smax}$ → motion occurs ($f = f_k = \mu_k F_N$)
- $F_{ap} < f_{smax}$ → No Motion ($f = F_{ap}$)

↣ Given position $\vec{r}(t)$: $\vec{v} = \frac{d\vec{r}}{dt}$, $\vec{a} = \frac{d^2\vec{r}}{dt^2}$

$\vec{F} = m\vec{a} = m\frac{d^2\vec{r}}{dt^2}$, $\vec{p} = m\vec{v} = m\frac{d\vec{r}}{dt}$, $\vec{\tau} = \vec{r}\times\vec{F} = m\vec{r}\times\frac{d^2\vec{r}}{dt^2}$ (+)

$P = \vec{F}\cdot\vec{v} = m\frac{d^2\vec{r}}{dt^2}\cdot\frac{d\vec{r}}{dt}$, $\vec{\ell} = \vec{r}\times\vec{p} = m\vec{r}\times\vec{v} = m\vec{r}\times\frac{d\vec{r}}{dt}$ (+)

↣ Momentum and Collisions:

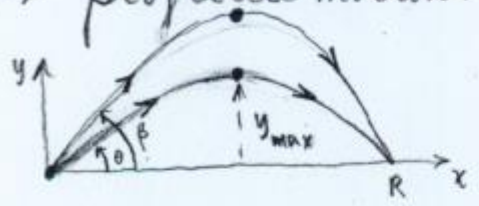


$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

elastic → rel-vel of approach = rel-vel of Separation

★ $v_{1i} - v_{2i} = v_{2f} - v_{1f}$

↣ projectile motion: $t = \frac{2v_0 \sin\theta}{g}$, $y_{max} = \frac{v_0^2 \sin^2\theta}{2g}$, $R = \frac{2v_0^2 \sin\theta\cos\theta}{g}$ (R: Range)



$\theta + \beta = 90°$

v_x = Constant ($a_x = 0$)

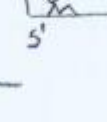
$R = \frac{v_0^2 \sin 2\theta}{g}$

$R_{max} = \frac{v_0^2}{g}$

↣ Mass-Spring System: $\frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kx_{max}^2 = \frac{1}{2}mv_{max}^2$

$v_{max} = \sqrt{\frac{k}{m}}\, x_{max}$, $a_{max} = \frac{k}{m} x_{max}$

↣ Relativity:



relative velocity $v = \beta c$; Lorentz factor $\gamma = \frac{1}{\sqrt{1-\beta^2}} \geq 1$; Speed factor $\beta < 1$

$x = \gamma(x' + vt')$

$t = \gamma(t' + \frac{vx'}{c^2})$

facts:
observers at rest with respect to an event measure
- the shortest time and the biggest length
Compared to all moving observers (relative to the event)

$E = K + E_r$ (E_r - rest energy)

$E = \gamma E_r$

→ Mass-pulley System (frictionless)

(I, R)

* $a = \frac{F_{net}}{\sum_i m_i + I/R^2}$

$\left\{ \begin{array}{l} M = I/R^2 \\ v = \omega R \\ a = \alpha R \end{array} \right.$ *

$\sum_i m_i$ = Sum of all moving masses.

* (for a massless pulley): $I/R^2 = 0 \Rightarrow a = \frac{F_{net}}{\sum m_i}$

→ Center of mass: $x_{cm} = \frac{\sum_i m_i x_i}{\sum_i m_i}$, $V_{cm} = \frac{\sum_i m_i v_i}{\sum_i m_i}$

* (in the absence of external forces), $V_{cm} = 0$, x_{cm} = fixed (never changes)

→ Impulse-Momentum

* on F-t graph, the area under the graph is the impulse { above t-axis (+) / below t-axis (-