Kinematics:

$\Delta\vec{d} = \vec{d}_2 - \vec{d}_1$

$\Delta\vec{d} = \vec{v}\Delta t$

$\Delta t = t_2 - t_1$

$\vec{v}_{av} = \dfrac{\Delta\vec{d}}{\Delta t} = \dfrac{\vec{d}_2 - \vec{d}_1}{t_2 - t_1}$

$\vec{v}_{av} = \dfrac{\vec{v}_1 + \vec{v}_2}{2}$

$\vec{a}_{av} = \dfrac{\Delta\vec{v}}{\Delta t} = \dfrac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$

$\vec{a}_g = 9.8\, m/s^2\,[down]$

$\Delta\vec{v} = \vec{a}_{av}\Delta t$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$\Delta\vec{d} = \dfrac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$

$\Delta\vec{d} = \vec{v}_{av}\Delta t$

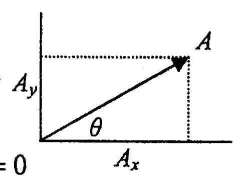
$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$

$\Delta\vec{d} = \vec{v}_2\Delta t - \frac{1}{2}\vec{a}(\Delta t)^2$

$(\vec{v}_2)^2 = (\vec{v}_1)^2 + 2\vec{a}\Delta\vec{d}$

$A_y = A\sin\theta$

$A_x = A\cos\theta$



$ax^2 + bx + c = 0$

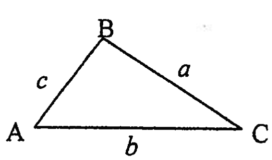
$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a^2 = b^2 + c^2 - 2bc\cos A$

$b^2 = a^2 + c^2 - 2ac\cos B$

$c^2 = a^2 + b^2 - 2ab\cos C$

$\dfrac{\sin A}{a} = \dfrac{\sin B}{b} = \dfrac{\sin C}{c}$



Centripetal Acceleration

$\vec{a}_c = \dfrac{\vec{v}^2}{r}$

$\vec{a}_c = \dfrac{4\pi^2 r}{T^2}$

$\vec{a}_c = 4\pi^2 r f^2$

Centripetal Force

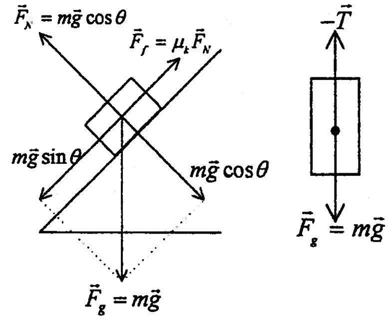
$\vec{F}_c = m\vec{a}_c$

$\vec{F}_c = \dfrac{m\vec{v}^2}{r}$

$\vec{F}_c = \dfrac{4\pi^2 mr}{T^2}$

$\vec{F}_c = 4\pi^2 mrf^2$

Dynamics:



$\vec{F}_{net} = m\vec{a}$

$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \ldots$

$\vec{F}_{net} = \vec{F}_g - \vec{T}$

$\vec{F}_{net} = \vec{F}_e - \vec{F}_g = m\vec{a}$ (Elevator)

$\vec{F}_g = m\vec{g}$ $\quad \vec{g} = 9.8\,N/kg\,[down]$

$\vec{F}_f = \mu_k\vec{F}_n \qquad \vec{F}_f \le \mu_s\vec{F}_n$

Horizontal Projection
Vertical Acceleration (-g)

$\Delta\vec{d}_h = \Delta\vec{v}_h\Delta t$

$\Delta\vec{d}_v = \frac{1}{2}\vec{a}_g(\Delta t)^2$

$\Delta\vec{d}_v = \frac{1}{2}\vec{a}_g\left(\dfrac{\Delta\vec{d}_h}{\vec{v}_h}\right)^2$

$\Delta\vec{d}_h = \vec{v}_1\Delta t\cos\theta$

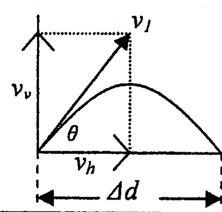
$\Delta\vec{d}_v = \vec{v}_1\Delta t\sin\theta - \frac{1}{2}\vec{g}(\Delta t)^2$

$\Delta t = \dfrac{2\vec{v}_1\sin\theta}{\vec{g}}$

$\Delta\vec{d}_h = \dfrac{(\vec{v}_1)^2\sin 2\theta}{\vec{g}}$

$\vec{v}_h = \vec{v}_1\cos\theta$

$\vec{v}_v = \vec{v}_1\sin\theta$



Dynamics (continued):

Skier Down a Hill (Down = +)

$\vec{a} = \vec{g}\sin\theta - \mu_k\vec{g}\cos\theta$

Skier Up a Hill (Up = +)

$\vec{a} = -\vec{g}\sin\theta - \mu_k\vec{g}\cos\theta$

Ball on String (Horizontal Motion, constant speed)

$\vec{T} = \vec{F}_c - \vec{F}_f$ along the radius

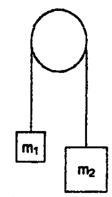
Ball on String (Vertical Motion, constant speed) (enter mg as a + value)

$\vec{T} = \vec{F}_c - m\vec{g} \quad \vec{F}_c = \vec{T} + m\vec{g}$ Top

$\vec{T} = \vec{F}_c + m\vec{g} \quad \vec{F}_c = \vec{T} - m\vec{g}$ Bottom

Atwood's Machine

$\vec{a} = \dfrac{2\Delta h}{\Delta t^2}$



$\vec{g} = \dfrac{\vec{a}(m_1 + m_2)}{m_2 - m_1} \qquad m_1 < m_2$

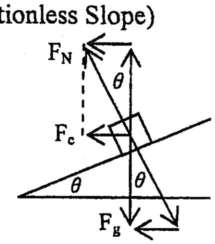
$\vec{v}_{impact} = \sqrt{\dfrac{2\vec{g}\Delta h(m_2 - m_1)}{(m_1 + m_2)}}$

Δh = meters Δt = s m = kg a & g = m/s² v = m/s

Car (Banked Frictionless Slope)

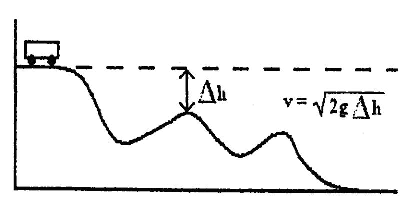
$\tan\theta = \dfrac{\vec{v}^2}{R\vec{g}}$

$\vec{F}_N = \dfrac{mg}{\cos\theta}$

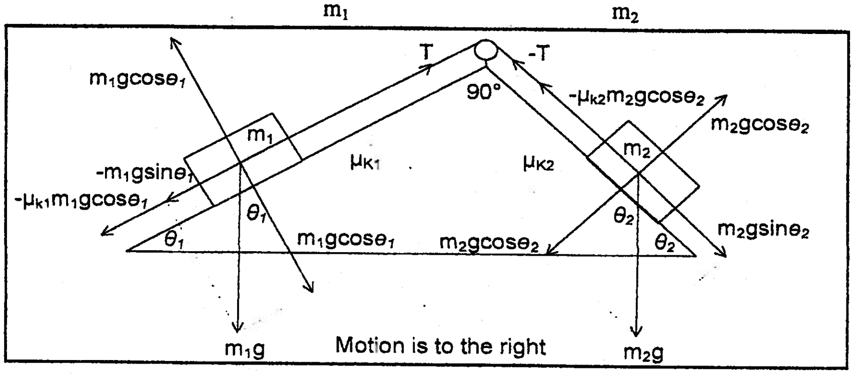


$\vec{F}_c = \vec{F}_N\sin\theta \qquad \vec{F}_c = mg\tan\theta$

Roller Coaster



$\dfrac{T - m_1 g\sin\theta_1 - \mu_{k1} m_1 g\cos\theta_1}{m_1} = \dfrac{m_2 g\sin\theta_2 - \mu_{k2} m_2 g\cos\theta_2 - T}{m_2}$



Mr. Larry Schincariol Dec. 17th, 2012