Kinematics

$\bar{v} = \frac{\Delta x}{\Delta t}$ $\bar{a} = \frac{\Delta v}{\Delta t}$

$v_f^2 = v_0^2 + 2a(\Delta x)$

$\Delta x = \left(\frac{v_0 + v_f}{2}\right)t$

$x = x_0 + vt$

$v_f = v_0 + at$

$x_f = x_0 + v_0 t + \frac{1}{2}at^2$

Projectile Motion

$x = v_0(\cos\theta)t$ $\quad v_x = v_0\cos\theta$

$y = v_0(\sin\theta)t + -\frac{1}{2}gt^2$ $\quad v_y = v_0\sin\theta - gt$

trajectory shape -> $y = (\tan\theta_0)x - \frac{g}{2v_0^2\cos^2\theta_0}x^2$

$R = \frac{v_0^2 \sin 2\theta_0}{g}$

Force

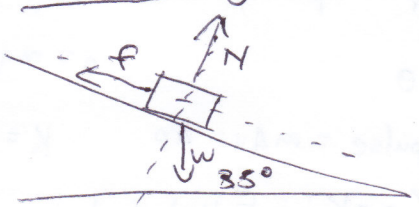
equilibrium -> $\sum \vec{F} = \vec{0}$

3rd law -> $\vec{F}_{A\text{ on }B} = -\vec{F}_{B\text{ on }A}$

$f_k = \mu_k n$

$f_s \le \mu_s n$

Box Sliding on Ramp



$\mu_k = .5$

N? a? v_f?

$\sum F_x = mg\sin\theta - f_k = ma_x$

$\sum F_y = N - mg\cos\theta = ma_y = 0$

1) $mg\cos\theta = N = (50\text{kg})(9.8\text{m/s}^2)\cos 35° = 401\text{ N}$

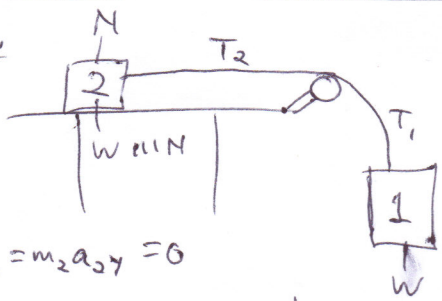
$f_k = 201\text{ N}$

a? 2) $a_x = g\sin\theta - f_k/m = 1.62\text{m/s}^2$

3) if 10m long, start from rest, v_f?

$v_f^2 = v_0^2 + 2a(\Delta x)$

Pulley Sys.



T? a?

Let $T_1 = T_2$

1) $\sum F_{2y} = N - m_2 g = m_2 a_{2y} = 0$

2) $\sum F_{2x} = T_2 = m_2 a_{2x}$

3) $\sum F_{1y} = T - m_1 g = -m_1 a_{1y}$

4) $\sum F_{1x} = 0$

Subtract 3 from 2

-> $a = \frac{m_1}{m_1 + m_2} g$ plug into 2) -> $T = \frac{m_2 m_1}{m_1 + m_2} g$ $T \ne m_1 g$ no equilibrium

$a < g$

Bullet, 350m/s goes in tree .130m

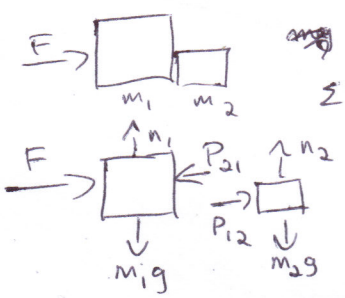
$m = 1.80\text{g}$ const F +? $\vec{F}$?

$F_r = ma_x$

$a_x = \frac{v_f^2 - v_0^2}{2(\Delta x)}$ $\quad -848\text{N}$

Kinematic

find a, then $v_f = v_0 + a_x t = 0$



a? of 2 blocks, contact force?

$\sum F_x = (m_1 + m_2)a_x$ $\quad \sum F_y = n - (m_1 + m_2)g = ma_y = 0$

$\sum F_x' = F_x - P_{21} = m_1 a_x$

$\sum F_x^2 = P_{12} = m_2 a_x$

both have same accel -> $a_x = \frac{F}{m_1 + m_2}$

plug into -> $P_{12} = m_2 a_x = \frac{m_2 F}{m_1 + m_2}$

contact force < free pushing both makes sense

$P_{12} = P_{21}$?

$F - P_{21} = F - P_{12} = m_1 a_x$, $P_{12} = F - m_1 a_x$

$P_{12} = \frac{m_2 F}{m_1 + m_2} = F - \frac{m_1 F}{m_1 + m_2}$

$F\left(\frac{m_1 + m_2}{m_1 + m_2}\right) - \frac{m_1 F}{m_1 + m_2} = \frac{m_2 F}{m_1 + m_2} = P_{12} = P_{21}$