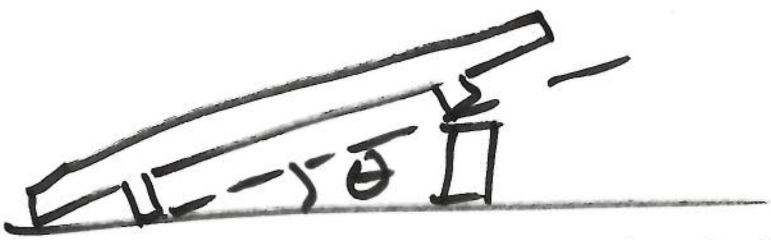
Physics 200 — Day #7

Quiz 1.0 Next Monday on: 2-d projectile motion) some examples are on Canvas.

Review: In Lab Fri + next Tues p.m.

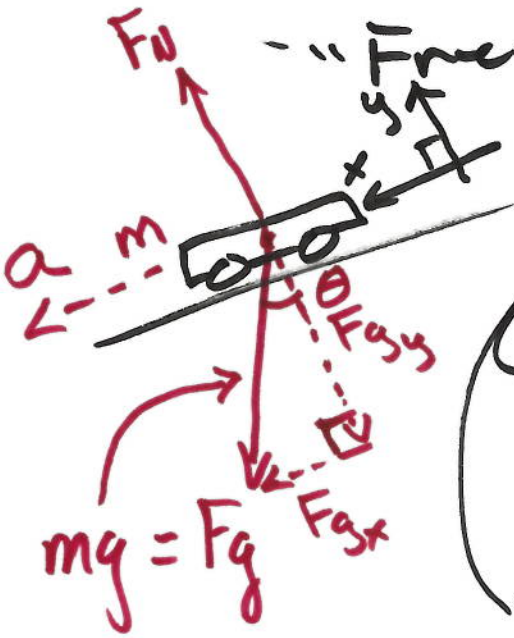
Forces:

lab 2: Inclined plane: at θ above horizontal.



$\vec{a}$ points down plane

$a = g\sin\theta$. Why?



"Free Body" Diagram

all $\vec{F}$ acting on cart.

Given: m, θ, g

Want: $\vec{a}$.

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

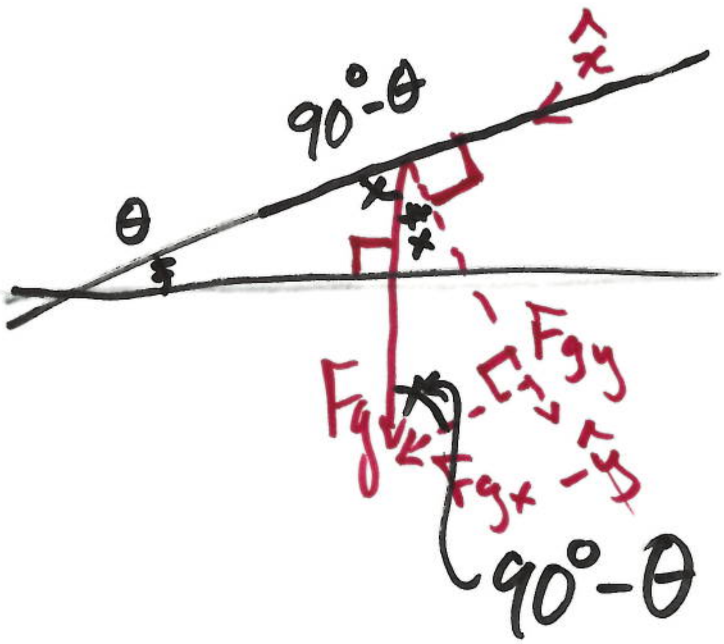
$$\sum F_x = ma_x$$

$$F_{gx} = ma$$

$$\sum F_y = ma_y$$

$$F_N - F_{gy} = 0 = m\cancel{a_y}^{\,0}$$

$$\sin\theta = \frac{opp}{hyp} = \frac{F_{gx}}{mg} \rightarrow F_{gx} = mg\sin\theta$$



$$90^\circ - \theta + x = 90^\circ$$

perpendicular

$$\Rightarrow \boxed{x = \theta}$$

$$-\theta + x = 0$$

$$x = \theta$$

$$\underbrace{\cancel{m}g\sin\theta}_{F_{g_x}} = \cancel{m}a \rightarrow \boxed{a = g\sin\theta}$$

independent of mass

yes, lab 2 worked ☺

$$\Sigma F_y = m\cancel{a_y}^{\,0}$$

$$F_N - F_{g_y} = 0$$

$$F_N - mg\underline{\cos}\,\theta = 0$$

$\boxed{F_N = mg\cos\theta}$ used later to find F_f.

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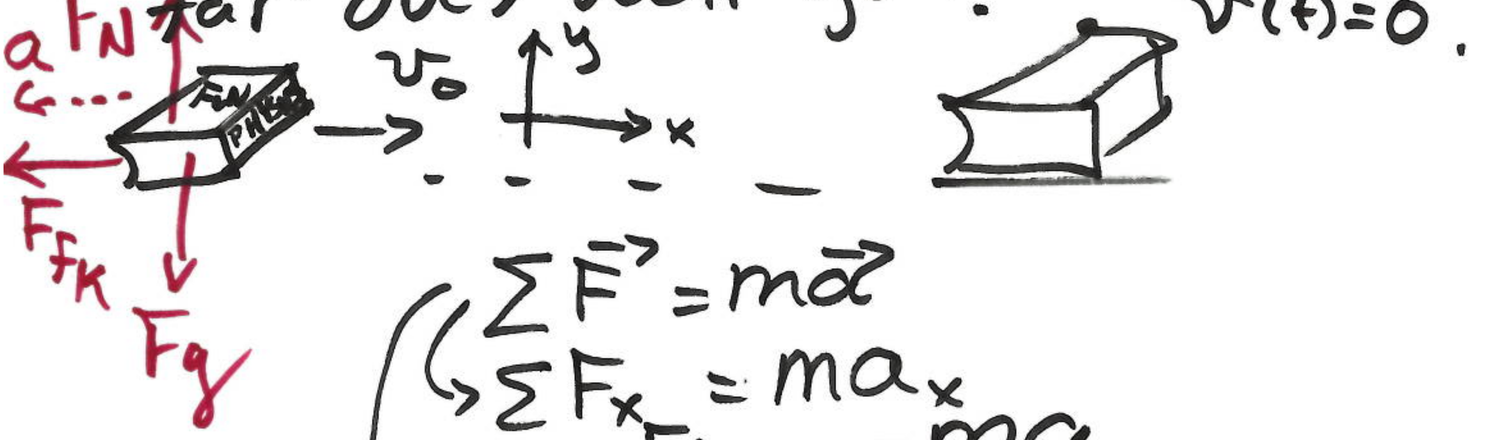
slide our textbook $m = 1.1\text{ kg}$ at $v_0 = 5.5\text{ m/s}$ along rough, flat ground $\mu_K = 0.39$. How far does book go?



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

$$\Sigma F_x = ma_x$$

$$-F_{fK} = -ma$$

$$\Sigma F_y = ma_y$$

$$F_N - F_g = m\cancel{a_y}0 \quad F_N = F_g = mg$$

$$x: \quad -F_{f_K} = -ma$$

$$-\mu_K F_N = -ma$$

$$+\mu_K \cancel{m}g = +\cancel{m}a$$

$$\boxed{\mu_K g = a} = 0.39 \times 9.8\,m/s^2$$

$$= 3.8\,m/s^2$$

Know: $v_0 = 5.5\,m/s \quad v(t) = 0$ (rest)

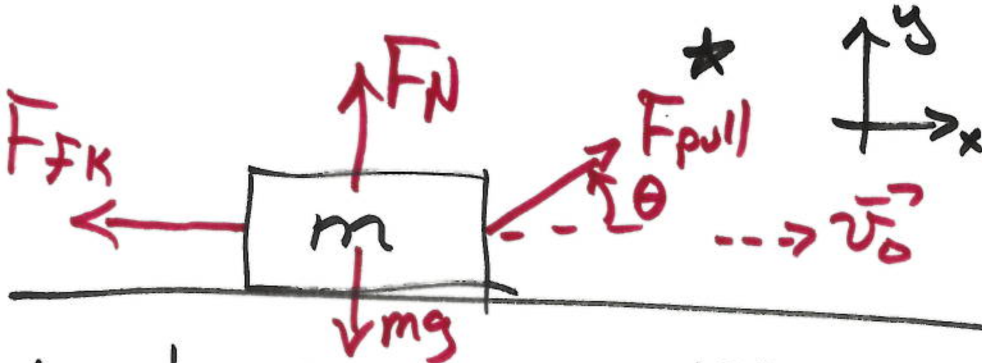
$a = -3.8\,m/s^2 \quad$ find: d

$$\text{(III)} \quad v^2(t) = v_0^2 + 2a\,(\underbrace{x(t) - x_0}_{d})$$

$$0 = (5.5\,m/s)^2 + 2(-3.8\,m/s^2)\,d$$

$$\frac{-(5.5\,m/s)^2}{2(-3.8\,m/s^2)} = d = 3.98\,m$$

$$\boxed{d \approx 4.0\,m}$$



$a=0$ since $\vec{v}$ = const.

big, heavy mass m on level floor, which has μ_K. Want to pull straight forward at const. $\vec{v}$. Find F_{pull} if it acts at θ above horizontal.

$m = 81\,\text{kg}$ $\quad \mu_K = 0.80$ $\quad \theta = 60^\circ$ $\quad g = 9.8\,\frac{m}{s^2}$

$$\sum F_x = m\cancel{a_x}^{\,0}$$

$$F_{pull_x} - F_{fK} = 0 \longrightarrow F_{pull}\cos 60^\circ = F_{fK} = \mu_K F_N$$

$$\sum F_y = m\cancel{a_y}^{\,0}$$

$$F_N + F_{pull_y} - mg = 0$$

$$F_N + F_{pull}\sin 60^\circ - mg = 0$$

$$F_N = \left(mg - F_{pull}\sin 60^\circ\right)$$

$$F_{pull}\cos 60^\circ = \mu_K \underbrace{\left(mg - F_{pull}\sin 60^\circ\right)}_{F_N}$$

$$F_{pull}\cos 60^\circ + F_{pull}\,\mu_K \sin 60^\circ = \mu_K m g$$

$$\boxed{F_{pull} = \frac{\mu_K m g}{\cos 60^\circ + \mu_K \sin 60^\circ}}$$