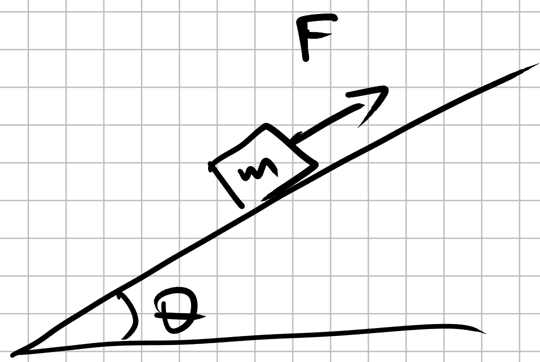


F needed to keep steady $\vec{a} = \vec{0}$

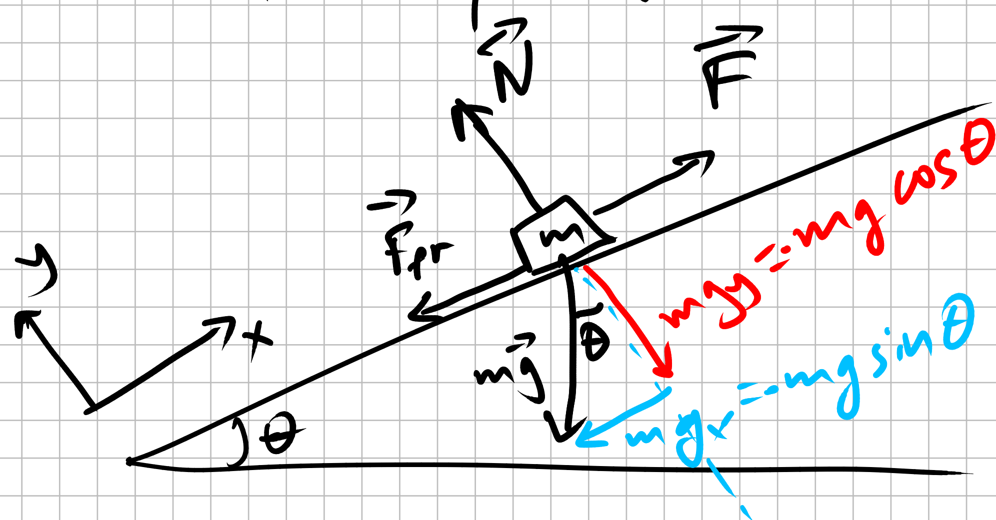
$|\vec{a}| = 0$

no friction!

$$F = mg \cdot \sin\theta$$

---

with friction



$$m\vec{a} = m\vec{g} + \vec{F} + \vec{N} + \vec{F}_{fr}$$

$|\vec{a}| = 0$ stationary

x: $ma_x = mg_x + F_x + N_x + F_{fr\,x}$

y: $ma_y = mg_y + F_y + N_y + F_{fr\,y}$

$$x: \quad m \cdot \overset{a_x = 0}{0} = -mg\sin\theta + F + 0 - \mu \overset{\swarrow f_{frx}}{N}$$

$$y: \quad m \cdot \overset{a_y = 0}{0} = -mg\cos\theta + 0 + N + 0$$

$$\hookrightarrow N = mg\cos\theta$$

$$0 = -mg\sin\theta + F + 0 - \mu mg\cos\theta$$

$$\boxed{F = mg(\sin\theta + \mu\cos\theta)}$$

$$\boxed{F_{fr} \leq \mu N}$$

!

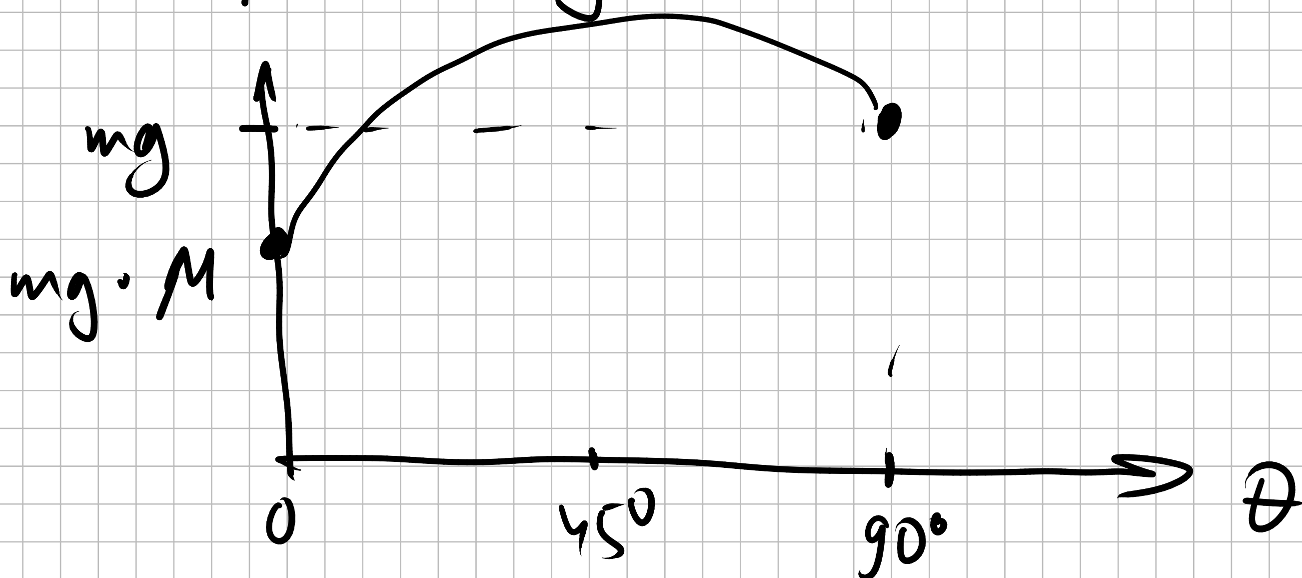
Sub problem

$$ma_x = -mg\sin\theta + F - \mu mg\cos\theta$$

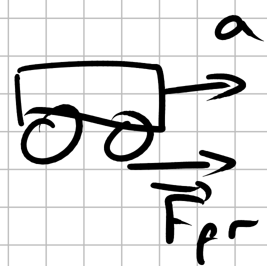
$$a_x = \frac{F}{m} - g(\sin\theta \overset{-}{\cancel{+}} \mu\cos\theta)$$

for this case $F = 0$

$$F = mg(\sin\theta + \mu\cos\theta)$$



Car and tires



$$F_{fr} = \mu m g$$

$$a_x = \frac{F_{fr}}{m} = \mu g$$

60 mi/h stop distance

$v_0 = 60$ mi/h

$$d = \frac{v_{f_x}^2 - v_{0_x}^2}{2a_x} \qquad a_x < 0$$

dry conditions

$\mu \approx 0.8$

$$d = +\frac{v_0^2}{2|a_x|} = \frac{v_0^2}{2\mu g}$$

$$60\ mi = \frac{60\frac{mi}{h}\ 1.6\ \frac{km}{mi}}{3600\ h/s} = \frac{\overset{100}{96}\cdot 10^3}{\underset{40}{3600}} = 2.5\cdot 10 = 25\ m/s$$

$$d = \frac{v_0^2}{2\mu g} = \frac{25^2}{2\cdot 0.8\cdot 10} = \frac{625}{2\cdot \underbrace{0.8}_{\approx 1}\cdot 10} = 31\ m$$

icy case $\mu = 0.4 \Rightarrow d = 60\ m$