PHYS 2211, Summer 2021

Week 4

In this video:

- ✓ static & dynamic equilibrium
- ✓ tension
- ✓ normal & friction
- ✓ free body diagrams

EQUILIBRIUM

$$\vec{F}_{net} = 0$$

Static

$\vec{F}_{net} = 0$

$\vec{v} = 0$

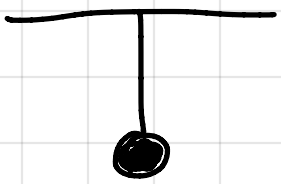
motionless

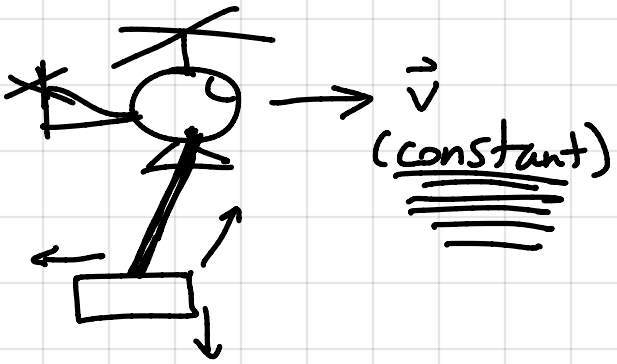
Dynamic

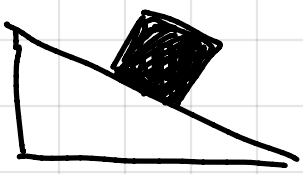
$\vec{F}_{net} = 0$

$\vec{v}$ = constant

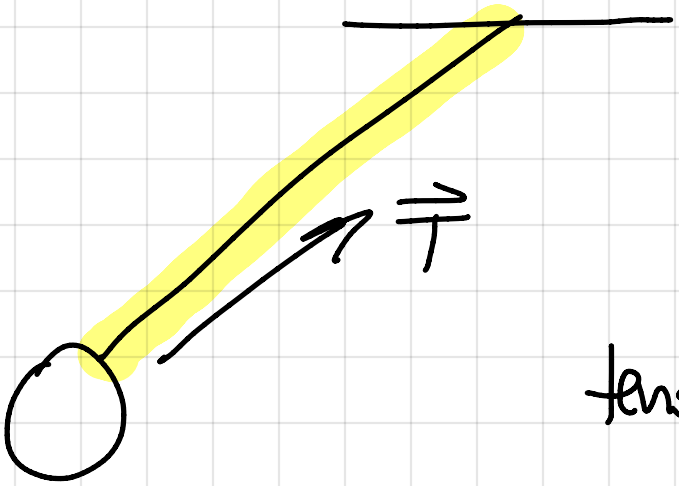
not motionless



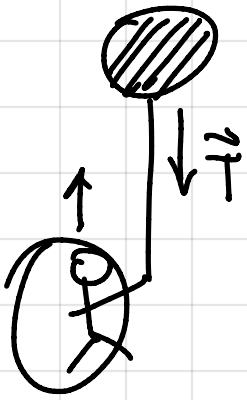


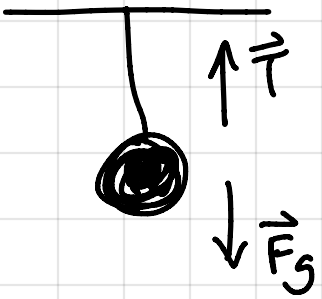


Tension



tension always pulls away from the system





$$\vec{F}_{net} = 0$$

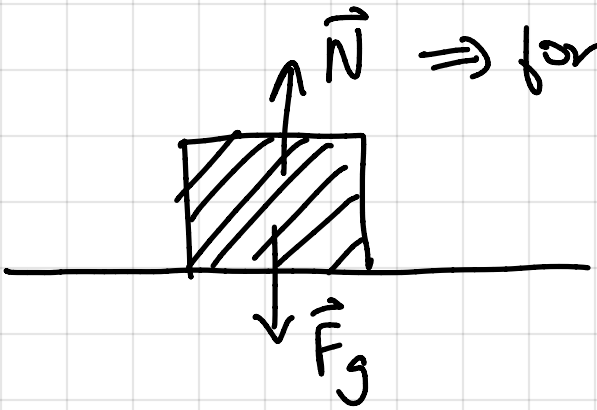
$$\vec{F}_g + \vec{T} = 0$$

$$T(\hat{y}) + mg(-\hat{y}) = 0$$

$$T - mg = 0$$

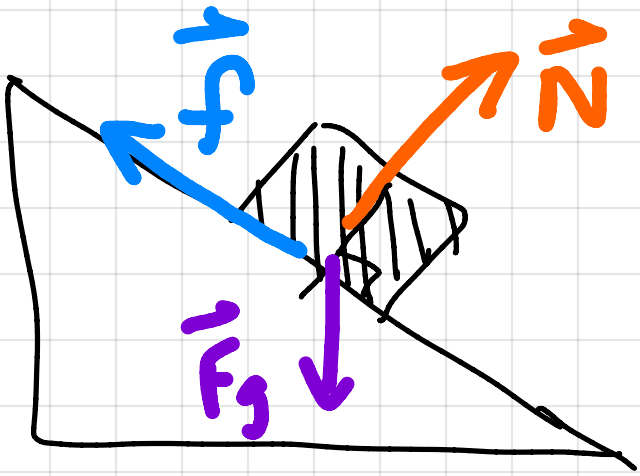
$$\boxed{T = mg}$$

Normal & friction



$\vec{N}$ ⇒ force on box by table

Normal force ALWAYS ⊥ to surface



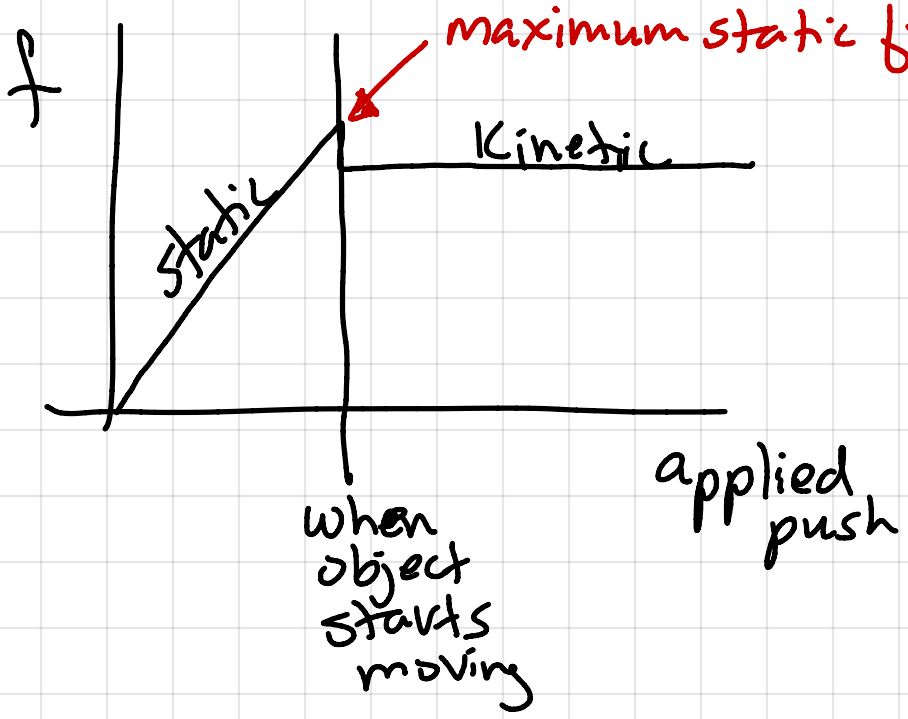
friction ⇒ parallel to surface

↳ opposes sliding

Static → f_s ⇒ increases magnitude with external force applied

Sliding → f_k ⇒ constant

↑ kinetic

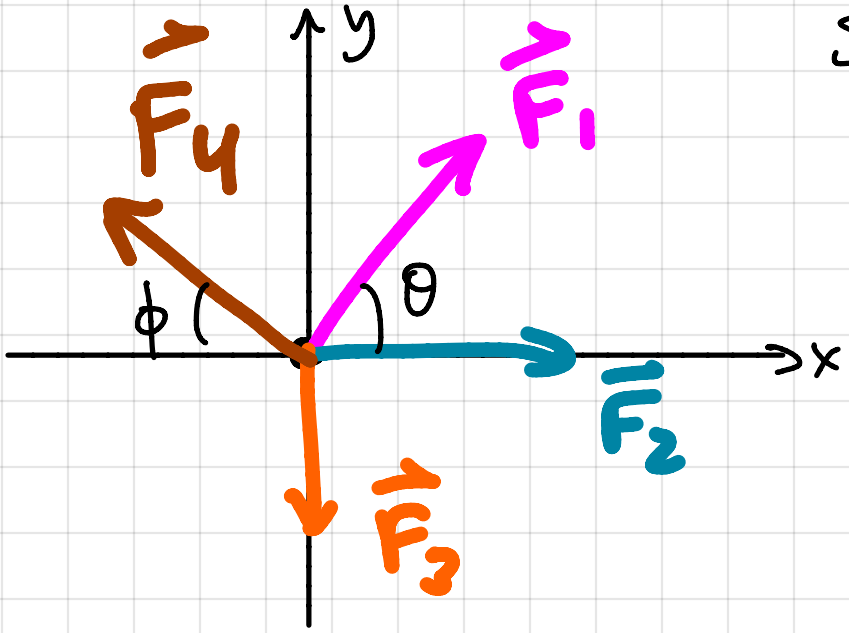


$$|\vec{f}| = \mu |\vec{N}|$$

↑ coefficient of friction

μ_s, μ_k

Free Body Diagram (FBD, force diagrams)



SOHCAHTOA

$F_{1x} = F_1 \cos\theta$

$F_{1y} = F_1 \sin\theta$

$F_{4x} = -F_4 \cos\phi$

$F_{4y} = F_4 \sin\phi$

Equilibrium means $\vec{F}_{net} = 0$

sum of all forces $= 0$

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 = 0$$

$\vec{F}_{net_x} = 0$

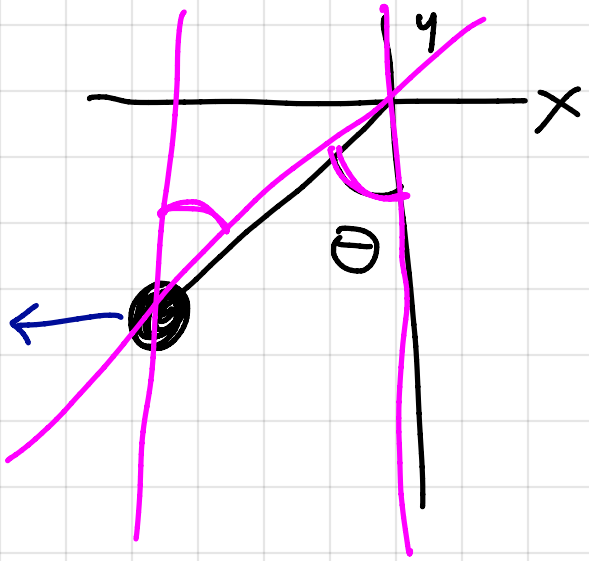
$\vec{F}_{1x} + \vec{F}_{2x} + \vec{F}_{3x} + \vec{F}_{4x} = 0$

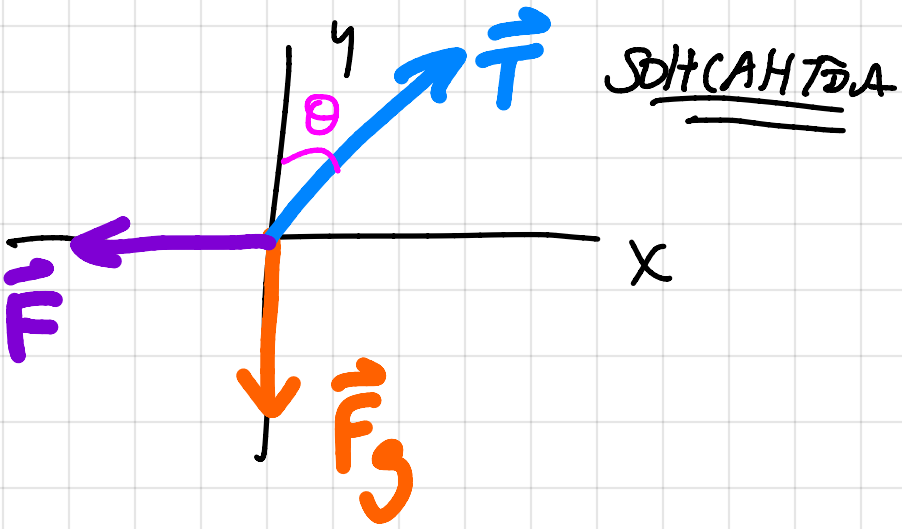
$F_1 \cos\theta + F_2 - F_4 \cos\phi = 0$

$\vec{F}_{net_y} = 0$

$\vec{F}_{1y} + \vec{F}_{2y} + \vec{F}_{3y} + \vec{F}_{4y} = 0$

$F_1 \sin\theta + F_3 + F_4 \sin\phi = 0$





$F_{net_x} = 0$

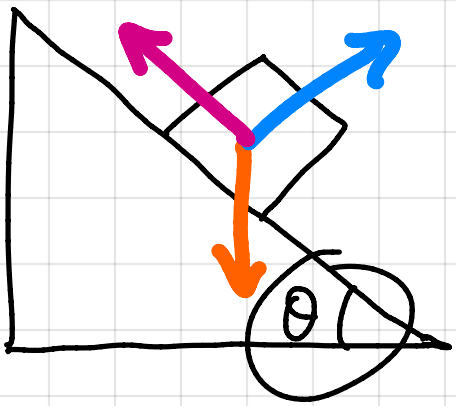
$T\sin\theta - F = 0$

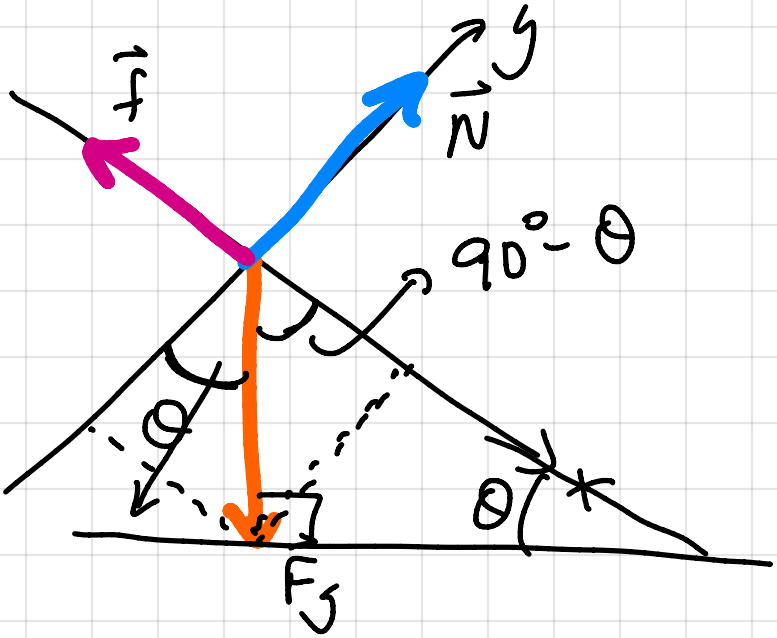
$T\sin\theta = F$

$F_{net_y} = 0$

$T\cos\theta - mg = 0$

$T\cos\theta = mg$





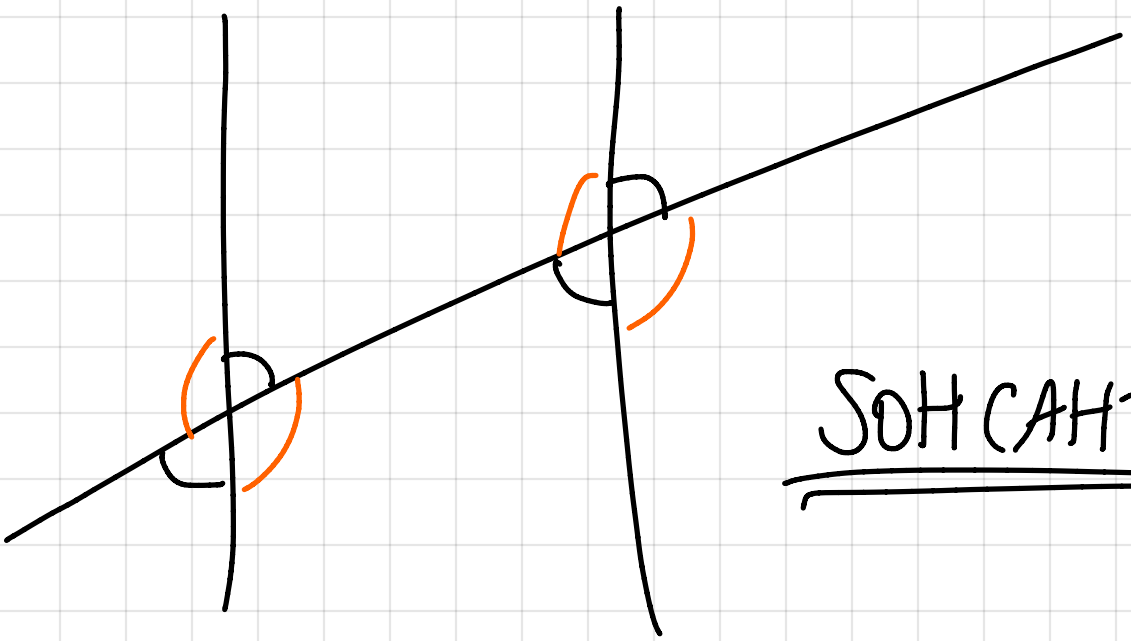
$F_{net_x} = 0$

$-f + mg\sin\theta = 0$

$F_{net_y} = 0$

$N - mg\cos\theta = 0$

$f = \mu N$



SOH CAH TOA

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$