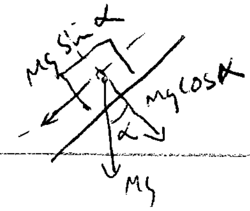
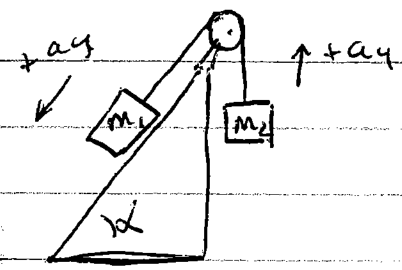




$$\text{I} \quad N - m_1 g\cos\alpha = 0$$

$$\text{II} \quad T - m_2 g = m_2 a_y$$

$$\text{III} \quad m_1 g\sin\alpha - T = m_1 a_y$$

$$\text{I} \rightarrow \quad N = m_1 g\cos\alpha = (5\ \text{kg})(9.8\ \text{m/s}^2)\cos 30 = 42.4\ \text{N}$$

$$\text{II} \rightarrow \quad T = m_2 a_y + m_2 g$$

sub in III

$$m_1 g\sin\alpha - m_2 a_y - m_2 g = m_1 a_y$$

$$m_1 g\sin\alpha - m_2 g = a_y(m_1 + m_2)$$

$$\boxed{\frac{m_1 g\sin\alpha - m_2 g}{m_1 + m_2} = a_y}$$

units ok

Big $M_2 \rightarrow a_y$ is neg

Big $M_1 \rightarrow a_y$ is +

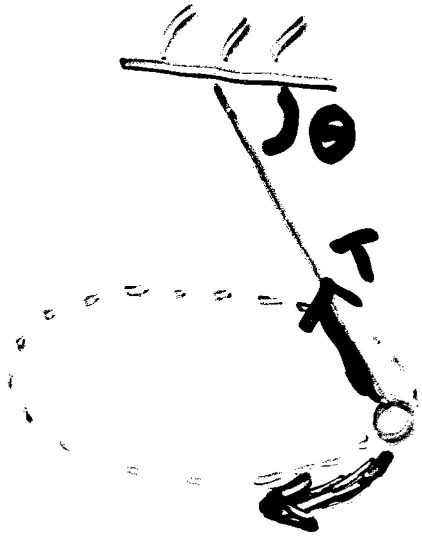
$\alpha = 90 \rightarrow a_y = \left(\frac{M_1 - M_2}{M_1 + M_2}\right) g$

solve for T

$$T = m_2 g + \frac{m_2 m_1 g\sin\alpha - m_2^2 g}{m_1 + m_2}$$

$$T = \frac{m_1 m_2 g + \cancel{m_2^2 g} + m_1 m_2 g\sin\alpha - \cancel{m_2^2 g}}{m_1 + m_2}$$

$$\boxed{T = \frac{m_1 m_2 g\,(1 + \sin\alpha)}{m_1 + m_2}}$$



Ball moves in horizontal circle

Force that keep ball moving on the circle (supplies centripetal a) is

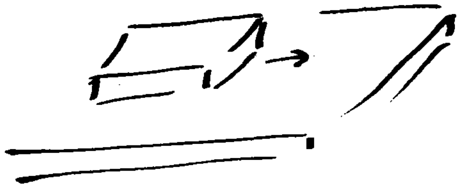
① T

② $T\sin\theta$

③ $T\cos\theta$

The Force of Friction

Observations:



Push book on surface of Table ... remove hand

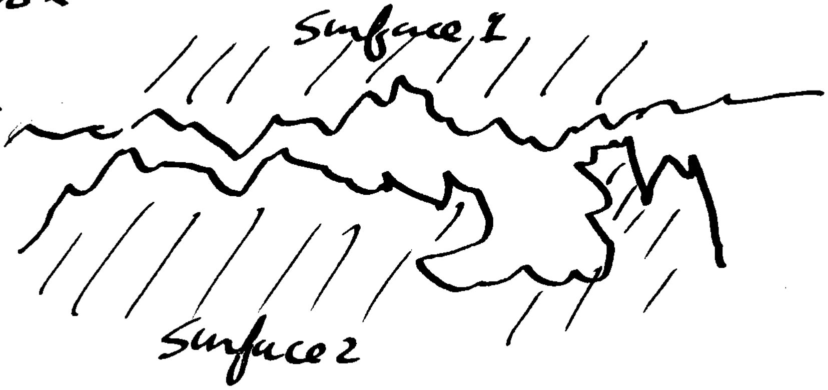
It stops

Same in a different direction

Acceleration

Newton's 2ND law says a force is acting on the book

→ force of Friction



Microscopically surfaces are rough

Gives a force in the direction opposite the motion relative to the other object.

Can feel it when you try to slide book. Also Note that it is easier to slide small book than big book.

So frictional force $\propto$ weight ?

...

but what about bicycle brakes

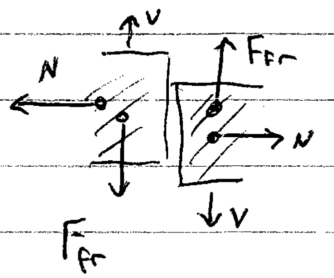
instead of weight ... let's use Normal force → this can cover cases at an angle too!

$M_1 = 5$ kg
$M_2 = 5$ kg
$\alpha = 30^{\circ}$

$a_y = -2.45 \ m/s^2$
$T = 36.7$ N

<u>Quantifying</u> <u>Friction</u>

between surfaces moving w/ resp. to ~~you~~ each other



$F_{fr} = \mu_k N$

between "STATIC" surfaces

velocity
F_{fr} opposes net force

$|\vec{F}_{fr}| \leq \mu_s N$

$F_{fr} = \mu_s N$ right at <u>threshold</u> of surfaces moving

$$|\vec{F}_{FRICT}| \propto |\vec{N}|$$

$$|\vec{F}_{FRICT}| = \mu_k |\vec{N}|$$ direction → opposes motion

unitless

coefficient of kinetic friction

Depends on Materials

Might depend on velocity, Temperature

kinetic vs. STATIC Friction

harder to get things moving than to keep them moving

Know this if you've ever pushed a car

Friction force between two objects where surfaces are NOT sliding past one another (STATIC)

$$|\vec{F}_{FRICT}| = \mu_s |\vec{N}|$$

coefficient of Static Friction

usually ... always $\mu_s > \mu_k$