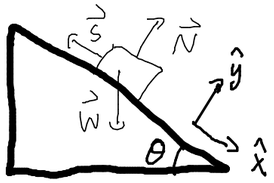
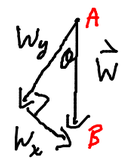


$\vec{N} + \vec{S} + \vec{W} = 0$

static equilibrium (not moving)

$\vec{N} = N\hat{y}$ $\quad \vec{S} = -S\hat{x}$



$\vec{W} = mg(+\sin\theta\,\hat{x} - \cos\theta\,\hat{y})$

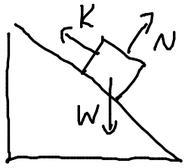
Which is θ?

$N\hat{y} - S\hat{x} + mg\sin\theta\,\hat{x} - mg\cos\theta\,\hat{y} = 0$

$(-S + mg\sin\theta)\,\hat{x} + (N - mg\cos\theta)\,\hat{y} = 0$

$-S + mg\sin\theta = 0$ $\quad N - mg\cos\theta = 0$

$S = mg\sin\theta$ $\quad N = mg\cos\theta$



$K = mg\sin\theta$ $\quad N = mg\cos\theta$

but only if velocity is constant

because $\vec{K} + \vec{N} + \vec{W} = m\vec{a}$

Kinetic friction does not adjust to balance other forces.

Therefore $K = mg\sin\theta$ is only true for one value of θ.

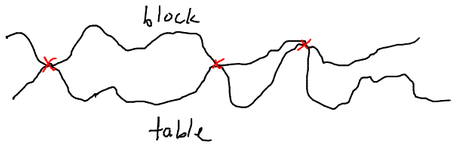
If θ is bigger, $mg\sin\theta$ "wins" and block ~~accelerates~~ speeds up.

If θ is smaller, K "wins" and block slows down.

How

How does friction work?

Microscopic scale



at these contact points, atoms of block & table will stick together

(if two completely flat surfaces they would cold-weld together)

As you slide block against table, these bonds form & break repeatedly
→ kinetic friction

If block sits on table, bonds have time to get stronger
→ static friction

Our model of friction gives us an average picture

$$|\vec{K}| = \mu_K |\vec{N}|$$ ← normal force between surfaces

μ_K : coefficient of kinetic friction
unit less

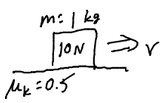
$$\mu_K = \frac{|\vec{k}|}{|\vec{N}|}$$

μ_K depends on type of surfaces

e.g. $\mu_K = 0.2$ wood against wood

$\mu_K = 0.8$ rubber against concrete

e.g.

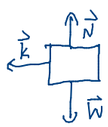


What is block's acceleration?

$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

This points

A) ← B) ↑ C) → D) ↓ E) other



$\vec{N} + \vec{w} = 0 \rightarrow N = W = 10\,N$

$\vec{F}_{net} = \vec{k} = \leftarrow$

$K = \mu_K N$

$K = (0.5)(10N) = 5N$

$a = \frac{F_{net}}{m} = \frac{5N}{1kg} = 5\,m/s^2$

Static Friction

is adjustable unlike $\vec{K}$

but it's breakable

$$|\vec{S}| \leq \mu_S |\vec{N}|$$

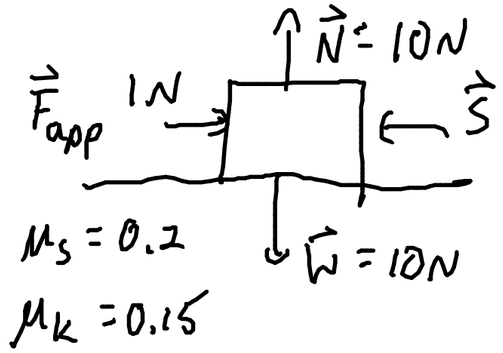
μ_S : coefficient of static friction

usually $\mu_S \geq \mu_K$

e.g. egg on Teflon $\mu_S = 0.04$

boots on rock $\mu_S = 1.2$

wood on wood
$\mu_S = 0.25$–0.3
$\mu_K = 0.2$



What is $|\vec{S}|$?

A) 0.2N

B) 1N

C) 1.5N

D) 2N

E) 10N

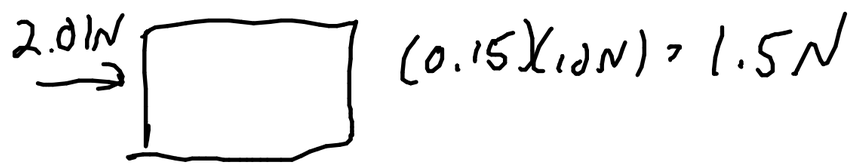
S will balance out other forces

so long as $S \leq \mu_s N$

$\mu_s N = (0.2)(10N) = 2N$

$1N \leq 2N$ so Ok!

if $F_{app} = 2.01N$ then static friction breaks & kinetic friction takes over



$F_{net} = 0.51N$

sudden increase in F_{net} and acceleration