

Section 5.3: Friction

Friction is created whenever two surfaces

slide against each other (Kinetic friction)

or

try to slide against each other (static friction)

It's caused by microscopic irregularities catching on each other.



The magnitude of the friction force can be calculated using

$$F_f \leq \mu_{\text{static}} (F_N)$$

parallel to the interface

coefficient of friction

perpendicular to the interface

$$F_f = (\mu_{\text{kinetic}})(F_N)$$

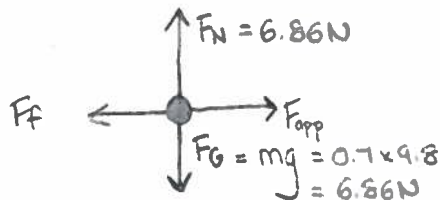
"How grippy something is"

Note #1: friction doesn't depend on speed and on contact area

Note #2: $\mu_s > \mu_k$

Note #3: μ has no units! $0 < \mu < 1$

Example: The interface between Mr. Q's 0.7 kg hole-punch and the table has $\mu_{\text{static}}=0.2$ and $\mu_{\text{kinetic}}=0.15$. What is the force of friction on the hole punch if Mr. Q pushes on it with 0.5 N, 1 N, 1.372 N, and 10 N?



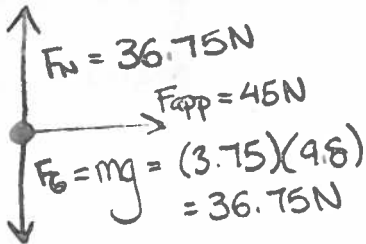
F_{app}	F_f
0.5 N	0.5 N
1 N	1 N
1.372 N	1.372 N
10 N	$F_f = \mu_k F_N = 0.15 \times 6.86 = 1.029 \text{ N}$

$$F_f \leq \mu_s F_N$$

$$F_f \leq 0.2 \times 6.86 = 1.372 \text{ N}$$

Example: A 3.75 kg block is pushed along a tabletop with a force of 45 N. The coefficient of friction is 0.65.

- Find the magnitude of the friction force.
- Find the acceleration.



$$\begin{aligned} \text{a) } F_f &= \mu_k F_N \\ &= (0.65)(36.75) \\ &= \boxed{23.9 \text{ N}} \end{aligned}$$

$$\begin{aligned} \text{b) } \sum \vec{F} &= m\vec{a} \\ 45 - 23.9 &= (3.75)\vec{a} \\ 5.63 &= \vec{a} \end{aligned}$$

$$\vec{a} = 5.63 \text{ m/s}^2 \text{ Forward}$$