

Unit 5: Forces  
**Force of Friction**

Friction is created whenever...two surfaces move past one another.

On the microscopic level...irregularities in the two surfaces catch on each other.

Friction is given by the equation:

$$F_f = \mu F_N$$

Where:

- $F_N$  = Normal force
- = always perpendicular to surface
- $\mu$  = coefficient of friction, no units
- = greek letter "myu"
- = depends on both surfaces

Static Friction: friction on a stationary object

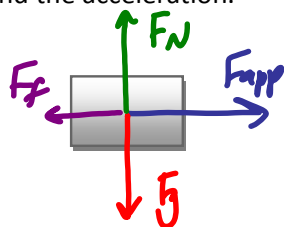
Kinetic Friction: friction on a moving object

$F_{\text{static}} > F_{\text{kinetic}}$

$\mu_{\text{static}} > \mu_{\text{kinetic}}$

Ex 1: A 3.75 kg block is pushed along a tabletop with a force of 45.0N. The coefficient of friction is 0.65.

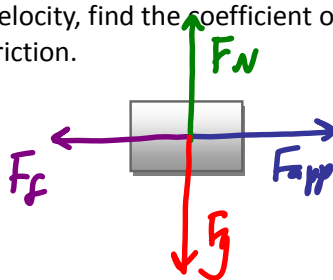
- Find the force of friction.
- Find the acceleration.



$$\begin{aligned} \text{a) } F_f &= \mu F_N & F_N &= F_g \\ &= \mu F_g \\ &= \mu mg = (0.65)(3.75\text{kg})(9.80\text{m/s}^2) \\ &= 23.89\text{N} = \boxed{24\text{N}} \end{aligned}$$

$$\begin{aligned} \text{b) } F_{\text{net}} &= F_{\text{app}} - F_f = ma \\ a &= \frac{F_{\text{app}} - F_f}{m} = \frac{45 - 23.89}{3.75} \\ &= \boxed{5.6\text{m/s}^2} \end{aligned}$$

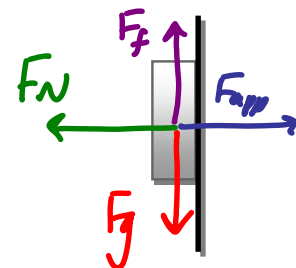
Ex 2: A 0.200 kg puck is pushed along a sheet of ice with a force of 0.240 N. If it moves at a constant velocity, find the coefficient of friction.



$$\begin{aligned} \text{Const. } v &\therefore F_{\text{app}} = F_f = 0.240\text{N} \\ F_N &= F_g = mg = (0.200\text{kg})(9.80\text{m/s}^2) \\ &= 1.96\text{N} \end{aligned}$$

$$\begin{aligned} F_f &= \mu F_N \\ \mu &= \frac{F_f}{F_N} = \frac{0.240\text{N}}{1.96\text{N}} \\ &= \boxed{0.122} \end{aligned}$$

Ex 3: A 1.1 kg textbook is held against a vertical wall with a force of 45 N. What is the coefficient of friction between the book and the wall?



$$\begin{aligned} F_{\text{app}} &= F_N = 45\text{N} \\ F_f &= F_g = mg = (1.1\text{kg})(9.80\text{m/s}^2) \\ &= 10.78\text{N} \end{aligned}$$

$$\begin{aligned} F_f &= \mu F_N \\ \mu &= \frac{F_f}{F_N} = \frac{10.78\text{N}}{45\text{N}} \\ &= \boxed{0.24} \end{aligned}$$