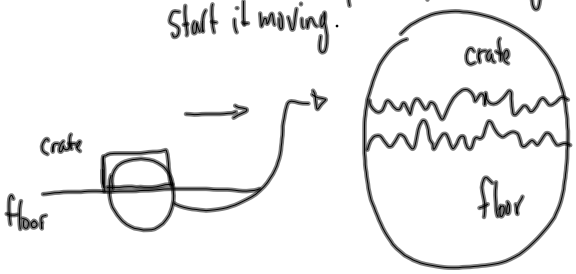
Friction

Frictional forces oppose an object's motion.

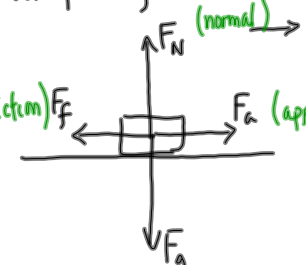
Static friction - the frictional force that must be overcome in order to just start an object moving

Kinetic friction - the frictional force that opposes a moving object. It is easier (i.e. takes less force) to keep an object moving than to start it moving.



- The smoother the surfaces, the less friction
- The heavier the object, the more friction there is.
  (The frictional force depends on the weight)
  ↓
  it really depends on the "normal force" which is related to the object's weight

Consider pushing a crate along the floor at a constant velocity (i.e. $a = 0$)



↑ all the forces must be balanced

Vertically $F_N = F_g$

Horizontally $F_a = F_f$

FREE BODY DIAGRAM (FBD)

If $F_a > F_f$, then there would be + acceleration

$F_a < F_f$, then there would be - acceleration

$F_a = F_f$, then the acceleration is zero (not moving or has constant velocity)
(static friction) (kinetic friction)

So how do you calculate the frictional force?

$$F_f \propto F_N$$

$$F_f = \mu F_N$$

where F_f is the frictional force (N)

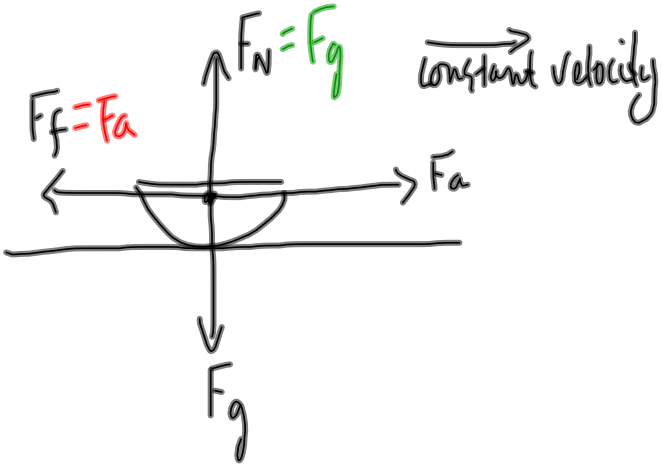
F_N is the normal force (N)

* $F_N = F_g$ IF ① surface is horizontal AND ② F_a is horizontal

μ is the coefficient of friction

* depends on the surfaces

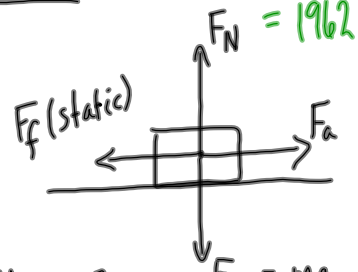
Drag sled....
used in traffic accident investigations to find μ.



$$F_f = \mu F_N$$

$$\mu = \frac{F_f}{F_N}$$

MP|141



$\mu_s = 0.70$ (look up in book)

$m = 200kg$ $(2.00 \times 10^2 kg)$

$F_g = (2.00 \times 10^2 kg)(9.81 m/s^2)$

$F_g = 1962 N$

$F_f(static) = \mu_s F_N$

$F_f(static) = (0.70)(1962N)$

$F_f(static) \doteq 1.4 \times 10^3 N$

↑ the increase in static frictional force

MP|143

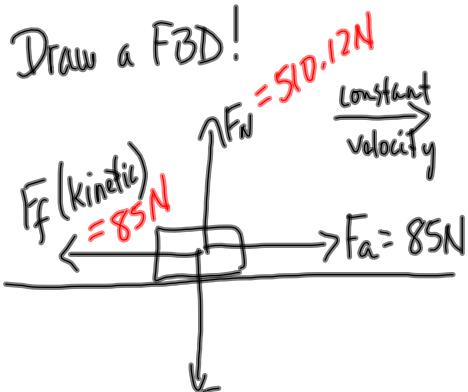
$m = 52kg$

$F_a = 85N$

constant velocity

$\mu_k = ?$

Draw a FBD!



$F_g = (52kg)(9.81 m/s^2)$

$F_g = 510.12 N$

$F_f(kinetic) = \mu_k F_N$

$$\mu_k = \frac{F_f(kinetic)}{F_N}$$

$$\mu_k = \frac{85\cancel{N}}{510.12\cancel{N}}$$

$\mu_k \doteq 0.17$

TO DO:

① PP|137 (Weight)

② PP|144 (Friction)

} to be done for Friday