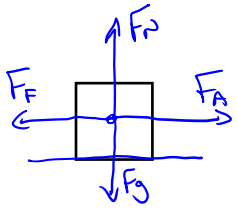
Friction Notes

- Friction
  - What is it? FORCE THAT OPPOSES MOTION
  - How does is affect the net force? DECREASES THE NET FORCE ON AN OBJECT ==
    ======
  - What affects the amount of friction?
    - SMOOTHNESS / ROUGHNESS OF THE SURFACE => μ (COEFFICIENT OF FRICTION)
    - WEIGHT / NORMAL FORCE
      F_g F_N
  - Equation:

$$F_F = \mu(F_N)$$

- Types of Friction
  - Static Friction



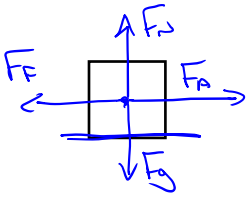
$F_{NET} = 0$

$F_{NET} = F_A - F_F$

$0 = F_A - F_F$ → $F_F = F_A$

    - What does it do? KEEPS AN OBJECT FROM STARTING TO MOVE
    - How does it compare to the applied force? ALWAYS EQUAL TO F_A
    - Maximum Static Friction Force IS EQUAL TO THE MAXIMUM APPLIED FORCE BEFORE THE OBJECT MOVES
  - Kinetic Friction

$F_{NET} = F_A - F_F$



    - What does it do? OPPOSES THE MOTION OF A MOVING OBJECT
    - How does the force of kinetic friction compare the to the force of static friction?
      KINETIC FRICTION IS ALWAYS LESS THAN STATIC FRICTION
    - How does it compare to the applied force? KINETIC FRICTION IS LESS THAN OR EQUAL TO APPLIED FORCE
    - What happens when the applied force is equal to the kinetic friction force?
      $F_{NET} = 0$ => NO ACCELERATION => CONSTANT VELOCITY

- Sample Problem 1
  - A 29 kg crate is initially at rest on a horizontal surface requires 75 N to set it in motion and 65 N to keep it in motion at a constant velocity. Find the coefficients of static and kinetic friction.

Static

$F_{NET} = F_A - F_F$

$0 = F_A - F_F$

$F_F = F_A$

$F_F = 75\,N$

$F_F = \mu F_N$

$75 = \mu(284.2)$

$\mu = \frac{75\,N}{284.2\,N}$

$= .26$

Kinetic

$F_{NET} = F_A - F_F$

$0 = F_A - F_F$

$F_F = F_A$

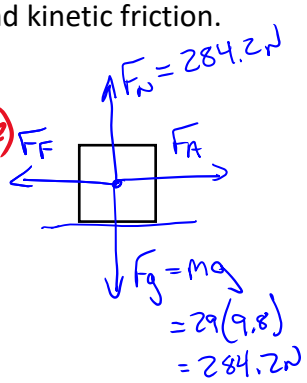
$F_F = 65\,N$

$F_F = \mu F_N$

$65 = \mu(284.2)$

$\mu = \frac{65}{284.2}$

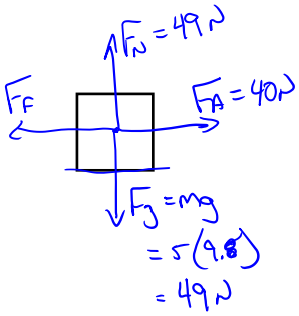
$\mu = .23$



- Sample Problem 2
  - A 5.0 kg mass is pulled across the table, to the right, with a force of 40 N. This causes the mass to accelerate at a rate of 6.0 m/s^2.
    - What is the net force on the mass?

$F_{NET} = MA$

$= 5(6) = 30N$



    - What is the force of friction between the mass and the table?

$F_{NET} = F_A - F_F$

$30 = 40 - F_F$

$F_F = 10N$

    - What is the coefficient of friction between the table and the mass?

$F_F = \mu F_N$

$10 = \mu(49)$

$\mu = \frac{10}{49} = .20$

- Sample Problem 3
  - An applied force of 21 N accelerates a 9.0 kg wagon at 2.0 m/s^2 along the sidewalk.
    - How large is the friction force?

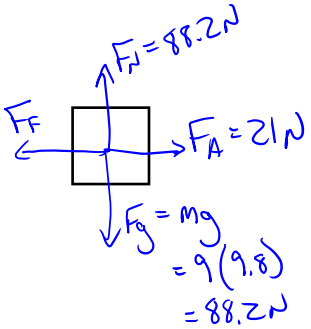
$F_{NET} = MA$

$= 9(2) = 18N$

$F_{NET} = F_A - F_F$

$18N = 21 - F_F$

$F_F = 3N$



    - What is the coefficient of friction?

$F_F = \mu F_N$

$3 = \mu(88.2)$

$\mu = \frac{3}{88.2} = .034$

- Sample Problem 4
  - A 2.0 kg brick has a sliding coefficient of friction of 0.38. What force must be applied to the brick for it to move at a constant velocity? $\Rightarrow F_{NET} = 0$

$F_F = \mu F_N$

$= (.38)(19.6)$

$= 7.45$

$F_{NET} = F_A - F_F$

$0 = F_A - 7.45$

$F_A = 7.45\,N$