Friction

Friction

- Friction is the force that opposes applied forces.
- Caused by the interaction between the two surfaces in contact
- Two types
  - > Static friction
  - > Kinetic friction

Static Friction

- Frictional force that keeps the object from beginning to move.
- Always matches the applied force until the applied force is large enough to move the object. ($F_{applied} = F_{f,static}$)
- When the applied force is as great as it can be without moving the object, the force of static friction is at a maximum, $F_{f,max\ static}$. ($F_{applied} = F_{f,max\ static}$)

Kinetic Friction

- The frictional force that opposes the motion of a moving object.
- The force of kinetic friction, $F_{f,kinetic}$, is less than the $F_{f,max\ static}$
- $F_{net} = F_{applied} - F_{f,kinetic}$
- When an object is moving at a constant velocity, the net force is zero, then $F_{applied} = F_{f,kinetic}$

What Affects Friction?

- The surfaces themselves (Rubber on Ice vs Rubber on concrete)
- The normal force
- The relationship between surfaces and the normal force is expressed by the coefficient of friction, μ
- Table 4.1 on p.124 has several values

Coefficients of Friction

- The coefficient of static friction, μs, is the ratio of the maximum static friction force to the normal force.

$$\mu_s = \frac{F_{f,\max,\text{static}}}{F_N}$$

- The coefficient of kinetic friction, μ_k, is the ratio of the kinetic friction force to the normal force.

$$\mu_k = \frac{F_{f,\text{kinetic}}}{F_N}$$

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.

$m = 29\,kg$

$F_{f_K} = 65\,N$

$F_{f_s} = 75\,N$

$F_N = W = mg = (29\,kg)(9.8\,m/s^2) = 284\,N$

$\mu_s = \frac{F_{f_s}}{F_N} = \frac{75\,N}{284\,N} = .264$

$\mu_K = \frac{F_{f_K}}{F_N} = \frac{65}{284} = .229$

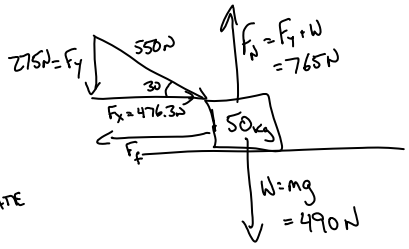
Sample Problem 2

- A 50 kg wood crate is pushed across a wooden plank. A 550 N force is applied at an angle of 30^0 to the horizontal.
  - > Will the crate move?
  - > If it does, what is the acceleration of the crate?

$F_{f_s} = (.58)(765\,N) = 443.7\,N$

↓

SMALLER THAN F_x SO IT WILL ACCELERATE



Sample Problem 2

$F_{f_K} = (.40)(765N)$

$= 306N$

$F_{NET} = F_x - F_{f_K}$

$= 476.3 - 306$

$= 170.3N$

$A = \frac{F_{NET}}{m} = \frac{170.3N}{50kg} = 3.4 m/s^2$

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