Applications of Newton’s Law

Frictional Forces

Static Friction	$0 \le f_s \le \mu_s N$	$f_s = \mu_s N$
Kinetic Friction	$f_k < f_s$ always	$f_k = \mu_k N$

Equilibrium

net force = zero

$$\Sigma\overrightarrow{F} = 0,\ \ \Sigma\overrightarrow{F}_x = 0\ \ and\ \ \Sigma\overrightarrow{F}_y = 0$$

Non-Equilibrium

net force ≠ 0

$$\Sigma\overrightarrow{F} = m\overrightarrow{a},\ \ \Sigma\overrightarrow{F}_x = m\overrightarrow{a}\ \ and\ \ \Sigma\overrightarrow{F}_y = m\overrightarrow{a}$$

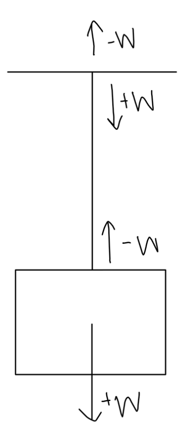
Springs: Hooke’s Law

$F = -kx$

$|k| = \frac{F}{x}$, F is N, x is m

Tension

Forces acting on a box:



The whole system

$$\Sigma\overrightarrow{F} = W - W + W - W$$
$$\Sigma\overrightarrow{F} = 0$$

Just the rope

$$\Sigma\overrightarrow{F} = W - W = 0$$

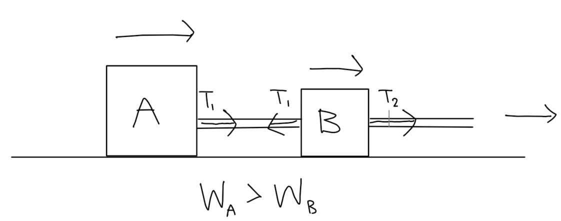
- on its own there is a counteracting force applied to it
- similar to a normal force

No acceleration (object at constant speed)

$$\overrightarrow{T} - ma = 0, \;\; \overrightarrow{T} = ma$$

Connected Objects

Forces acting on two boxes, no friction



$T_2 = (ma_A + ma_B)a$

$\therefore T_1 = ma_A = \frac{m_A T_2}{m_A + m_B}$

Comparing the tension,

$T_1 < T_2$

Sum of forces never changes as long as total mass stays the same

Circular motion

Centripetal acceleration

$a_C = \frac{v_1^2}{R}$

$\therefore T = ma = m\frac{v^2}{R}$