Newton's Laws

- **Newton's 1st Law (Same as Galileo's law of inertia): No force => no acceleration.**

"An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by a force."

$$\vec{F} = 0 \quad \Rightarrow \quad \vec{v} = const$$

Modern interpretation: definition of Inertial Reference Frame.

- **Newton's 2nd Law:**

$$\vec{F} = m\vec{a}$$

"Force equals mass times acceleration"

- **Newton's 3rd Law:**

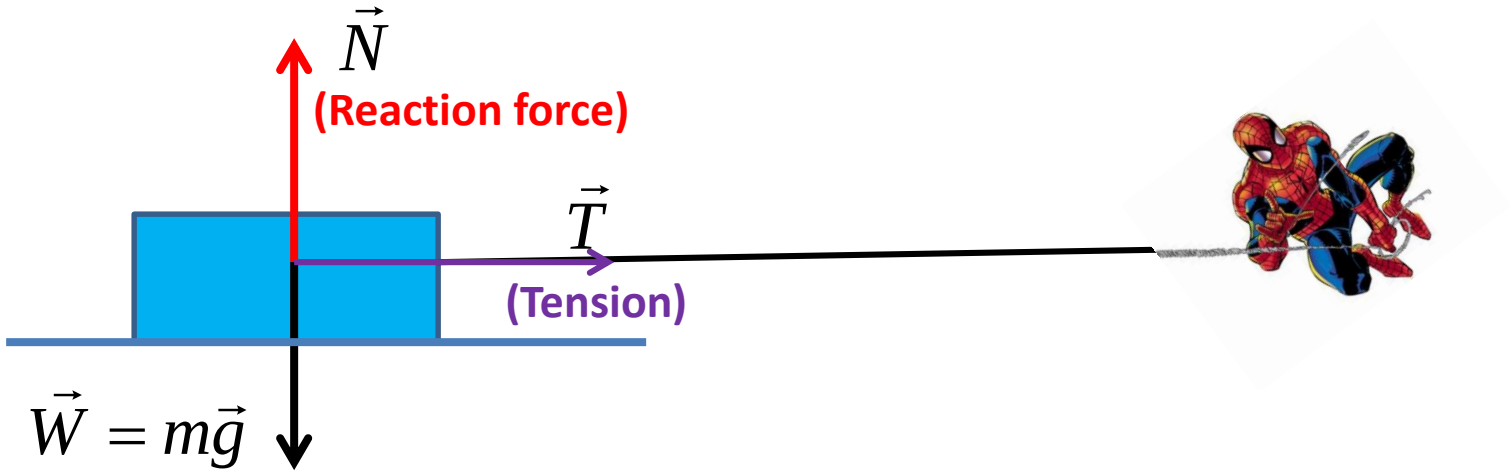
$$\vec{F}_{B\to A} = -\vec{F}_{A\to B}$$

"Force of action has an equal and opposite to Force of reaction"

Unit of force is called Newton (N)

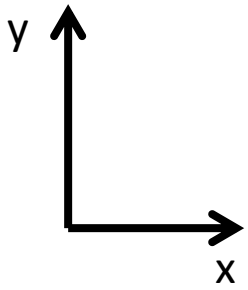
$$1N = 1\frac{kg \cdot m}{s^2}$$

Examples of Forces



(Gravitational force , or Weight)

Forces a vectors! The total force is the *vector sum* of all applied forces:



$$\vec{F}_{total} = \vec{N} + \vec{T} + \vec{W}$$

$$\vec{F}_{total} = (F_x, F_y) = (T, N - mg)$$

Homework

Problem 1.

Starting with Newton's laws, show that the mass of an object is a sum of masses of its parts.

Problem 2.

An elevator moves up with acceleration $\boldsymbol{a}$. A person of mass $\boldsymbol{M}$ is standing on the scales inside the elevator.

a) Sketch the picture, and show all the forces applied to the person.
b) Using Newton's Laws, find the force N with which the person acts on the scales. Note that the person's acceleration is the same as that of the elevator.
c) Based on the result of part (b), what mass will the scales show?