

# Newton's Laws

- **Newton's 1<sup>st</sup> 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."*

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

Modern interpretation: definition of Inertial Reference Frame.

- **Newton's 2<sup>nd</sup> Law:**

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

*"Force equals mass times acceleration"*

- **Newton's 3<sup>rd</sup> Law:**

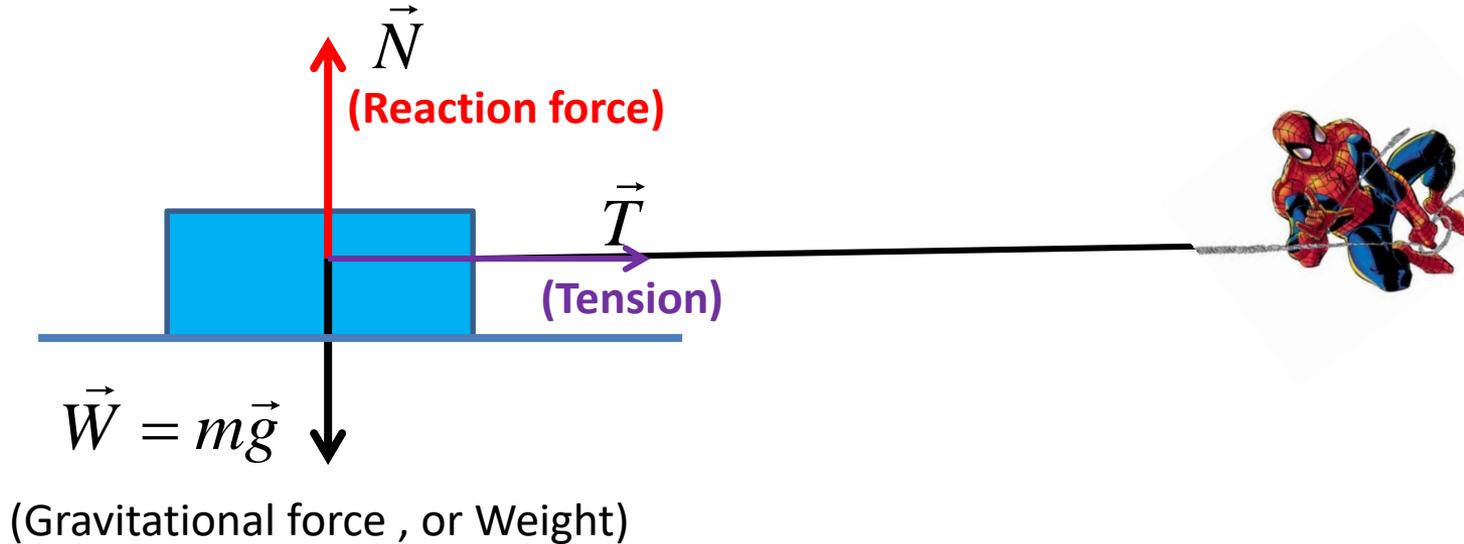
$$\vec{F}_{B \rightarrow A} = -\vec{F}_{A \rightarrow B}$$

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

Unit of force is called Newton (N)

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

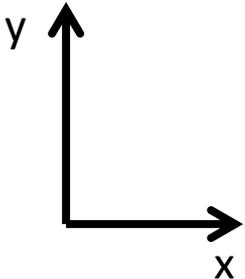
# Examples of Forces



Forces are 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  $a$ . A person of mass  $M$  is standing on the scales inside the elevator.

- Sketch the picture, and show all the forces applied to the person.
- 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.
- Based on the result of part (b), what mass will the scales show?