

Newton's Laws

- **Newton's 1st Law (Same as Galileo's law of inertia):** No force \Rightarrow 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."

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

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

"Force equals mass times acceleration"

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

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

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

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

Unit of force is called Newton (N)

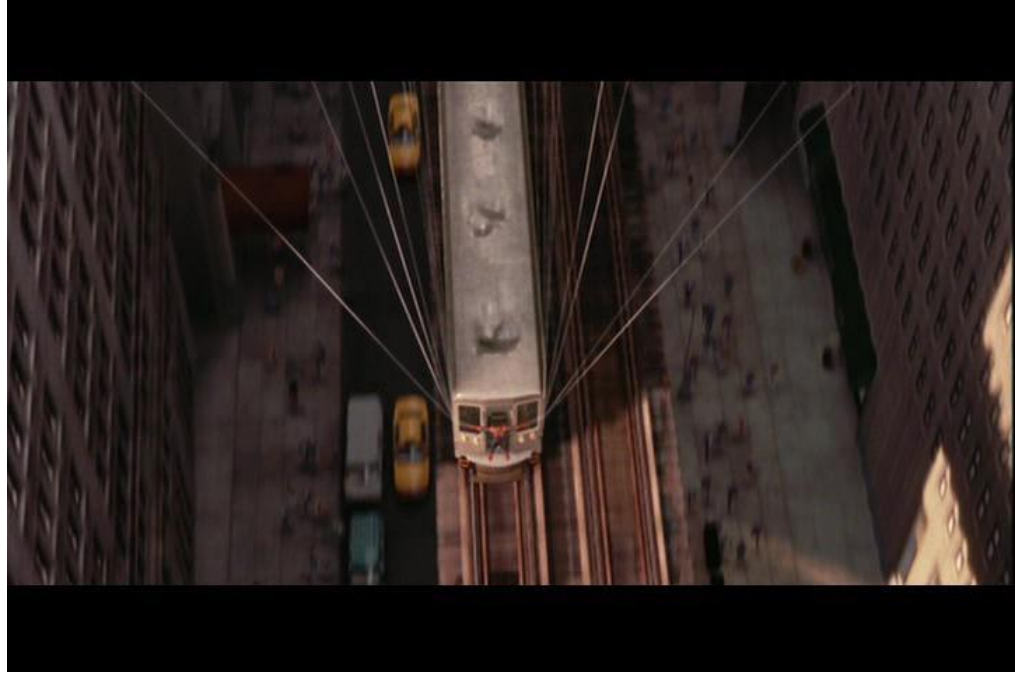
$$1N = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$$

Homework 11

Problem 1.

Two pirates have found a treasure chest. Both want it for themselves, so they start pulling it in the opposite directions with forces 400 N and 250 N (see the figure). In what direction will the chest move? What is the mass of the chest with the treasures if acceleration of the chest is 5 m/s^2 ?





Problem 2

In the movie Spiderman 2, Peter Parker aka Spiderman manages to stop the train by using his web. (search youtube for “**Peter Stops The Train!**” clip). It takes $t=45\text{s}$ of screen time. The initial speed of the train is approximately $v=80\text{ km/hr}$ (you’ll need to convert to m/s !).

Find the average acceleration of the train, and the force that Spiderman can hold. This force is of strategic importance for any villain: you can see from the video that the superhero is close to his limit. Mass of the NYC subway train (full of people) is $300,000\text{kg}$.