Newton's Laws

1^{st} Law (Same as Galileo's Law of Inertia): $\vec{F} = 0 \quad \Rightarrow \quad \vec{v} = const$

An object moves with constant velocity, unless acted by a force.

2^{nd} Law: $\vec{F} = m\vec{a}$

Force is equal to Mass times Acceleration

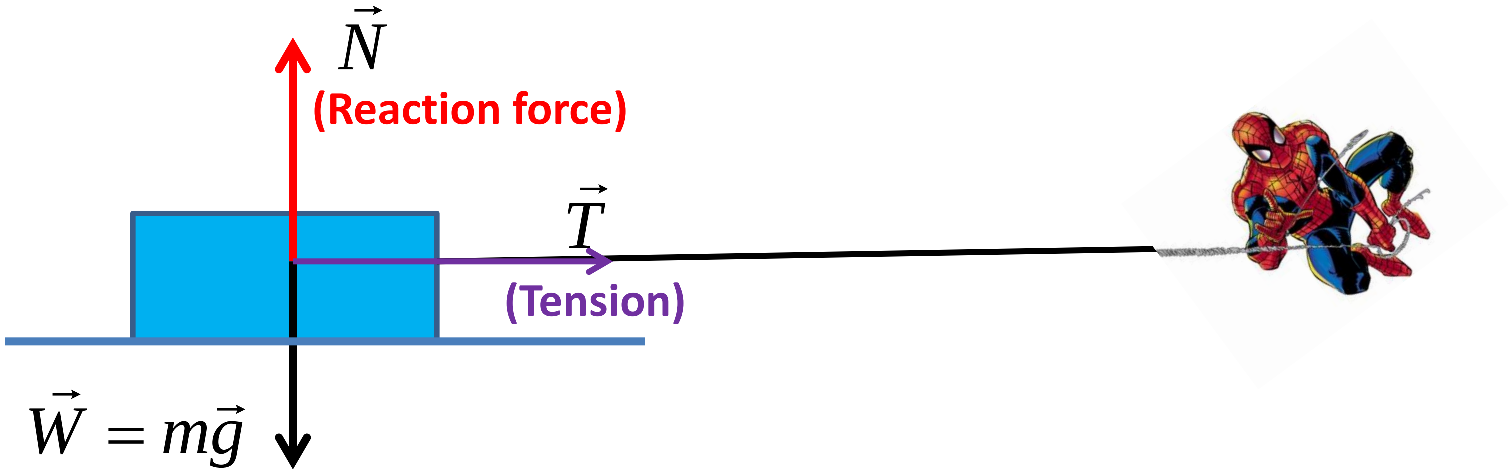
3^{rd} Law: $\vec{F}_{B\to A} = -\vec{F}_{A\to B}$

Force of action is equal and opposite to force of counter-action.

Unit of force is called Newton (N)

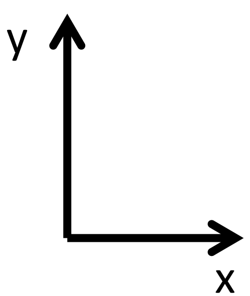
$$1N = 1\frac{kg \cdot m}{s^2}$$

Examples of Forces



(Gravitational force , or Weight)

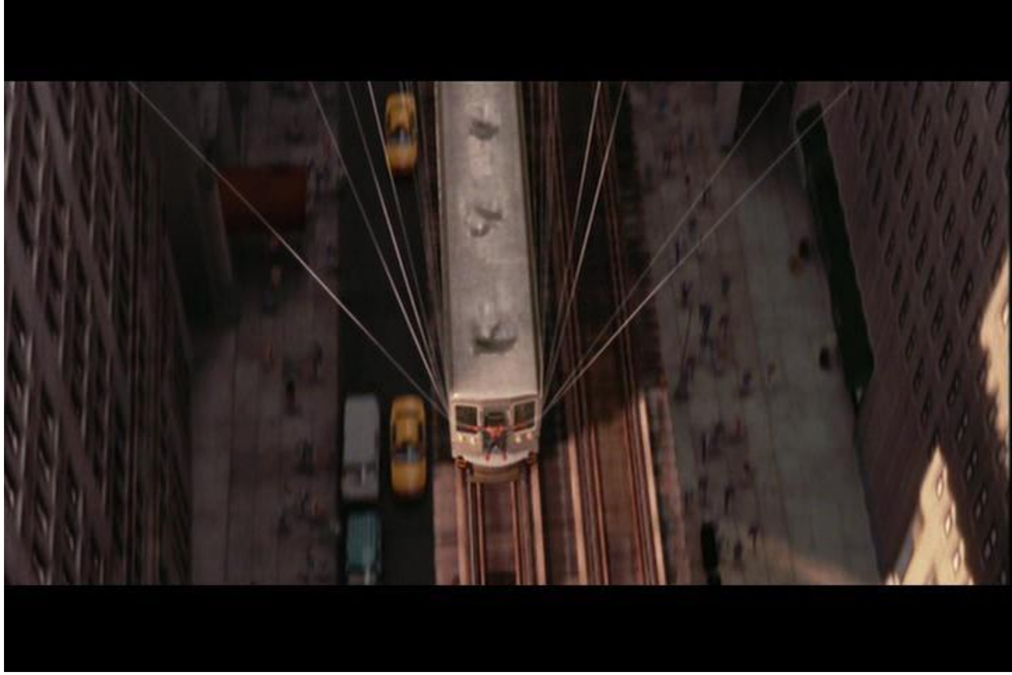
Forces a vectors! The total force is the *vector sum* of all applied forces:



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

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

Homework 9



Problem 1.

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=45s of screen time. The initial speed of the train is approximately v=80 km/hr.

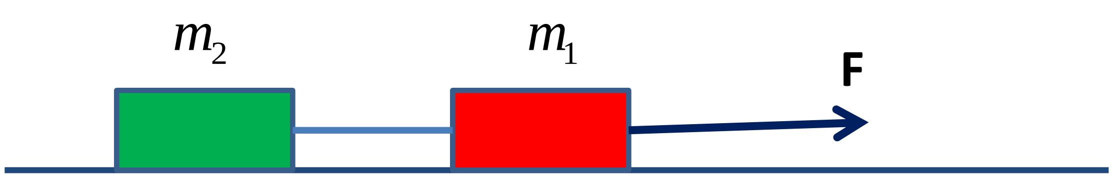
Find the average acceleration of the train, and the force that Spiderman can hold. This force is of strategic importance for any villain: you can see from the video that the superhero is close to his limit. Mass of the NYC subway train (full of people) is 300,000kg. How this force approximately compares to Spiderman's weight?

Problem 2.

Two blocks, connected by a string can move without friction along a horizontal surface. The string is weightless and unstretchable. Blocks have masses m_1 and m_2, respectively. A force F is pulling mass m_1, as shown in figure.

a)Find the accelerations of both blocks (which one is larger?).

b)Determine tension force T in the string.



I encourage you to use the Free Body Diagram method:

1. Choose the coordinate system (for each object).
2. Show all forces applied to each object.
3. Write 2^{nd} Newton's Law for each object, and each axis.
4. Solve equations to find acceleration(s) and tension T.