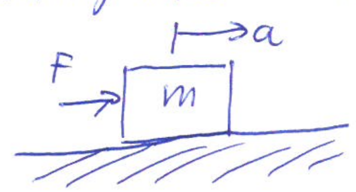
Determination of center of mass

Force:

In physics a force is any interaction which tends to change the motion of an object.
In other words, a force can cause object with mass to change its velocity (which includes to begin moving from a state of rest)

The original form of Newton's second law states that the net force acting upon an object is equal to the rate at which its momentum changes with time.

Sliding mass "translational"



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

force ↗ mass ↑ acceleration ↖

units

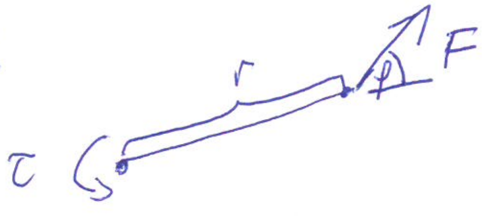
F [N] - Newton

m [kg] - kg

a $\left[\frac{m}{s^2}\right]$

Torque

In other words torque, moment or moment of force is the tendency of a force to rotate an object about an axis (Just as a force is a push or a pull, a torque can thought of as a twist to an object.

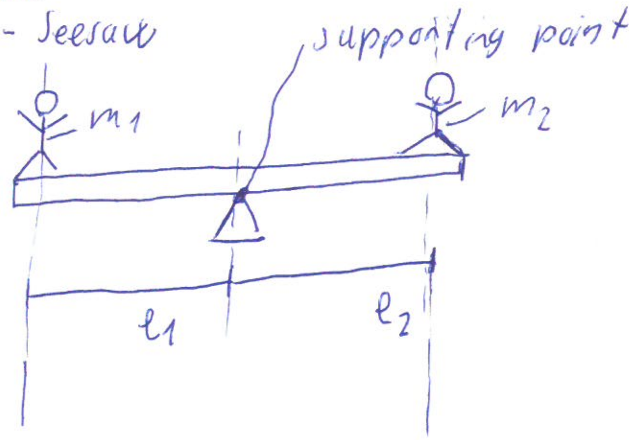


$$\tau = r \cdot \sin(\varphi) \cdot F$$

/ $\sin 90° = 1$ /

Example

- Seesaw



m_1 is the mass of the first child

The children pushes the seesaw with their own mass-force which is equal to $m \cdot g$ where g is the gravitational acceleration /in the space no gravity the reason of free moving/ $g = 9.81 \left[\frac{m}{s^2}\right]$ (On the Earth)

The torque of the mass force respect to the supporting point

$$m_1 g \cdot l_1 \quad \& \quad m_2 g l_2$$

↑ the distance from the supporting point

For the equilibrium

$$m_1 g l_1 = m_2 g l_2$$

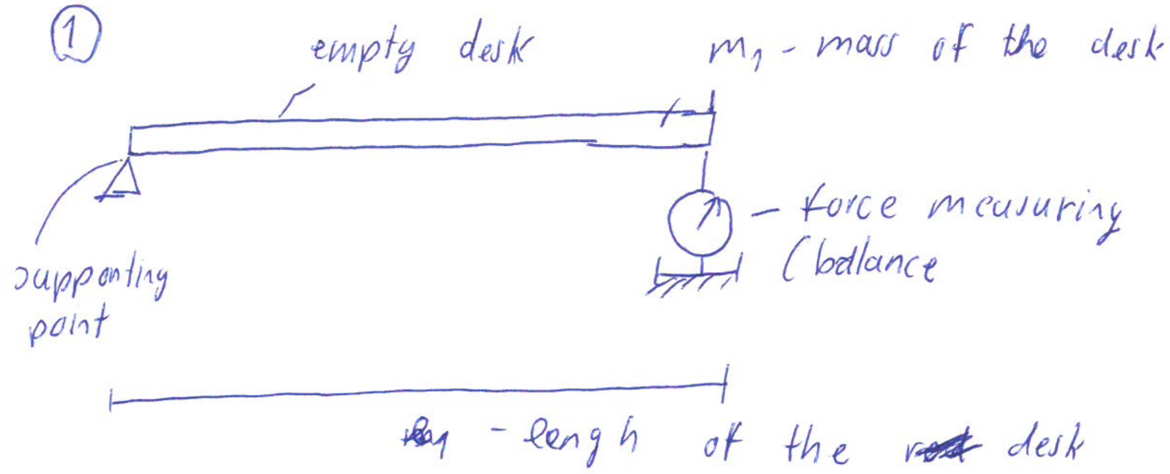
see : simple machines

„Lever"

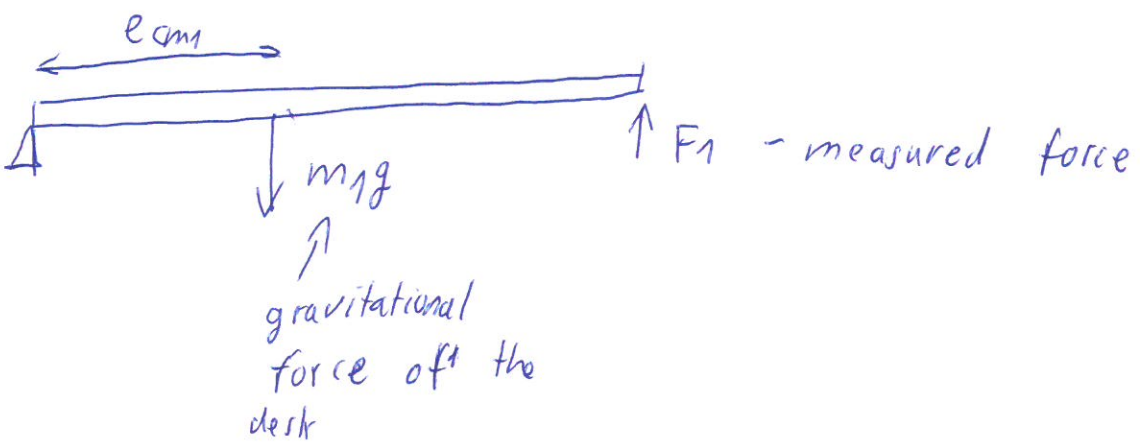
en. wikipedia.org/wiki/Lever

Center of mass of lying body

The measurement setup



The gravitational force acting at the center of gravity l_{cm1}



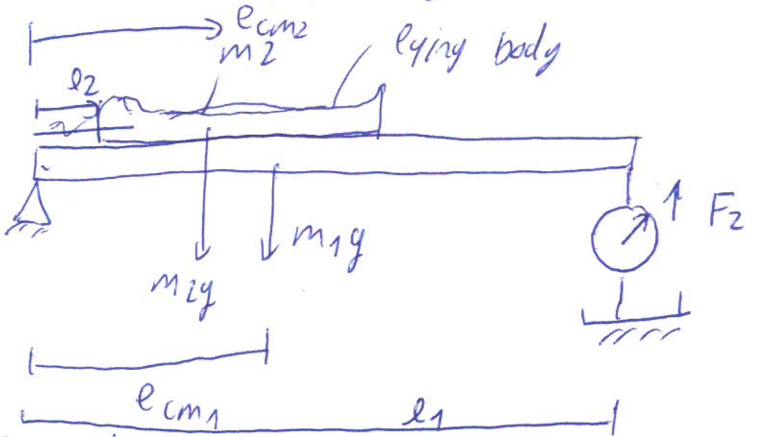
The torques of the forces respect to the supporting point should be equal

$$m_1 g \, l_{cm_1} = F_1 l_1$$

The place of the center of the mass of the desk should be expressed

$$l_{cm1} = \frac{F_1 l_1}{m_1 g}$$

② With the lying body



m_2 - mass of the body

The torques should be equal for the equilibrium (remember the seesaw)

$$m_1 g \cdot l_{cm_1} + m_2 g \, l_{cm_2} = F_2 l_1$$

$$l_{cm_2} = \frac{F_2 l_1 - m_1 g \, l_{cm_1}}{m_2 g}$$

the place of the center of mass in the global coordinate frame

The center of mass from the head

$l_{cm_2} - l_2$