Course 6

01.11.2021 13:59

I DYNAMICS

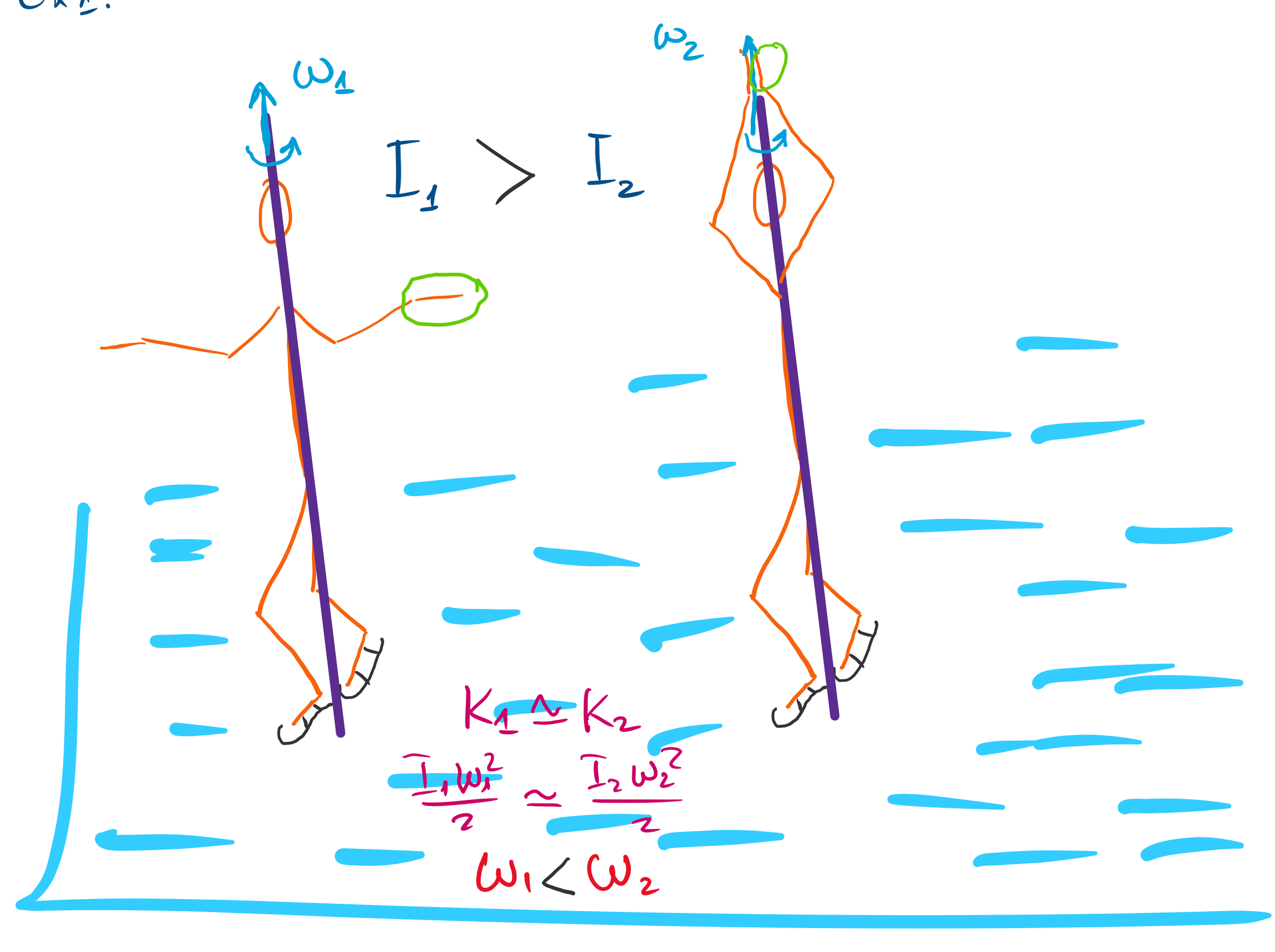
7.7. The momentum of inertia

A)

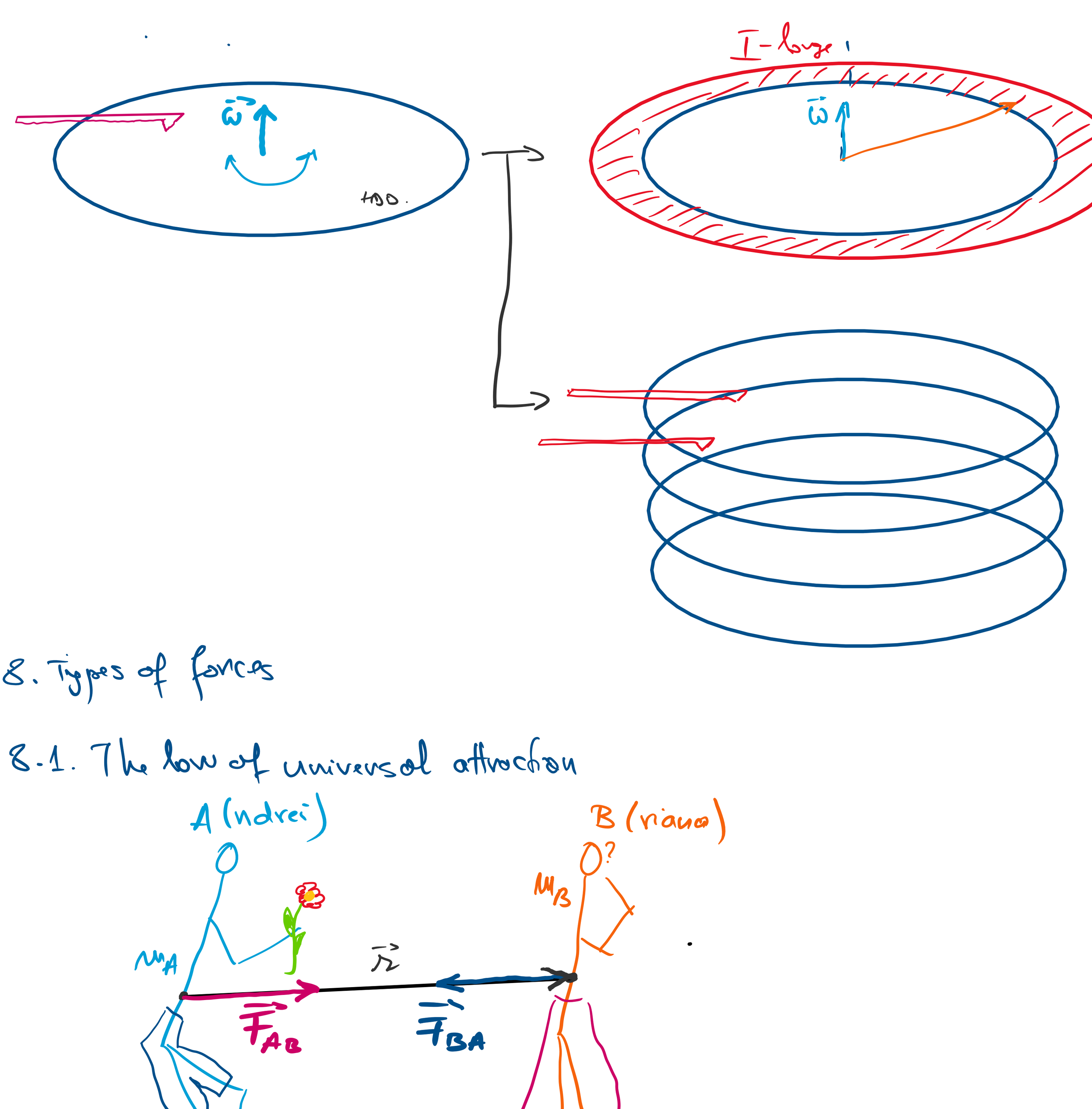
$$I=\int_V \rho(\vec{r})\, r^2\, dV$$

B) Examples

Ex1.

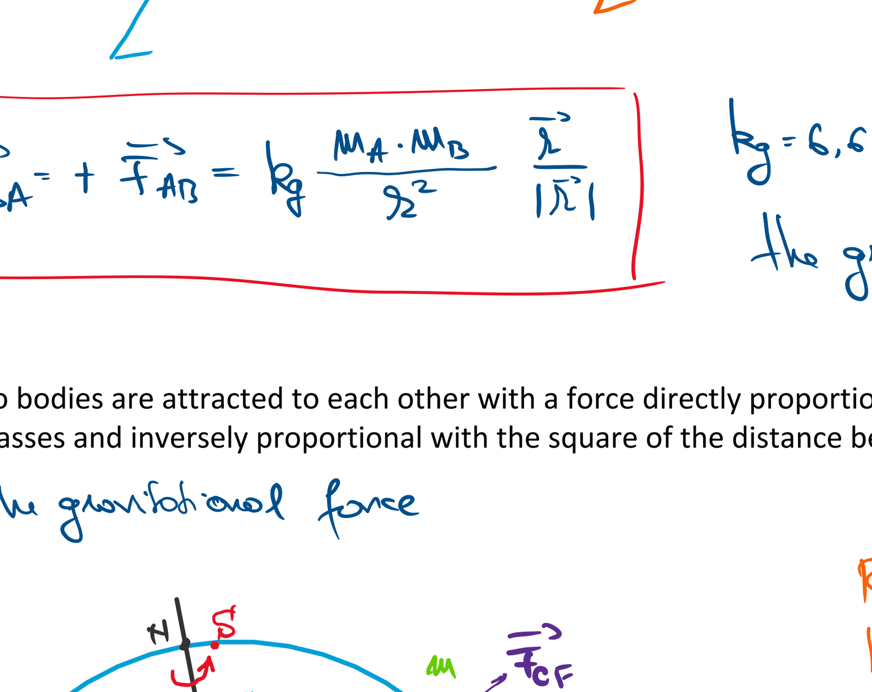


Ex2



8. Types of forces

8.1. The law of universal attraction



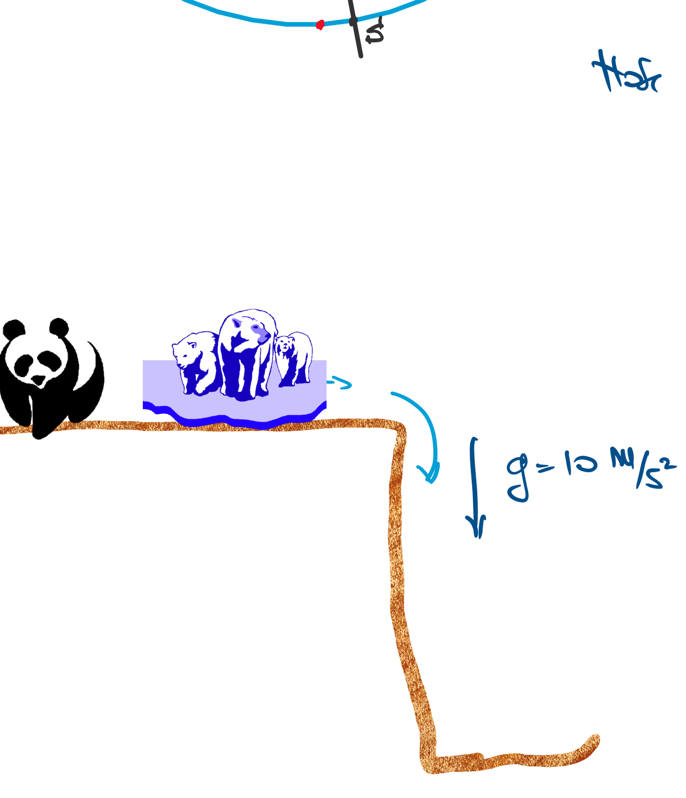
$$\boxed{-\vec{F}_{BA}=+\vec{F}_{AB}=k_g\frac{m_A\cdot m_B}{r^2}\frac{\vec{r}}{|\vec{r}|}}$$

$k_g = 6{,}6732\cdot 10^{-11}\ \frac{N\cdot m^2}{kg^2}$ the gravitational constant

Any two bodies are attracted to each other with a force directly proportional with the product of their masses and inversely proportional with the square of the distance between them.

8.2. The gravitational force

A)



$R \simeq 6400$ km

$h_{Everest} \sim 8{,}848$ km

$G = k_g \frac{Mm}{R^2}$ | $\vec{a}=\frac{\vec{F}}{m} \Rightarrow$ $\vec{F}=m\vec{a}=\vec{a}m$

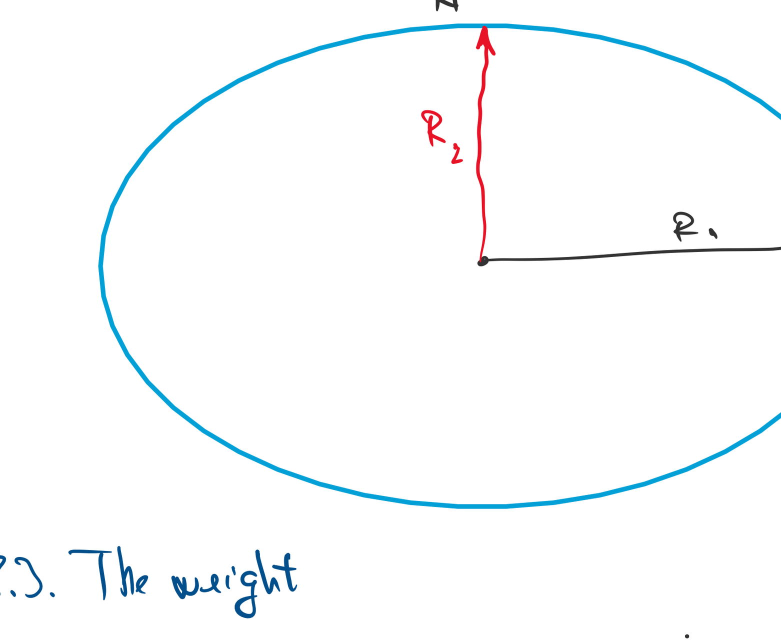
$G = k_g\frac{M}{R^2}\cdot m$

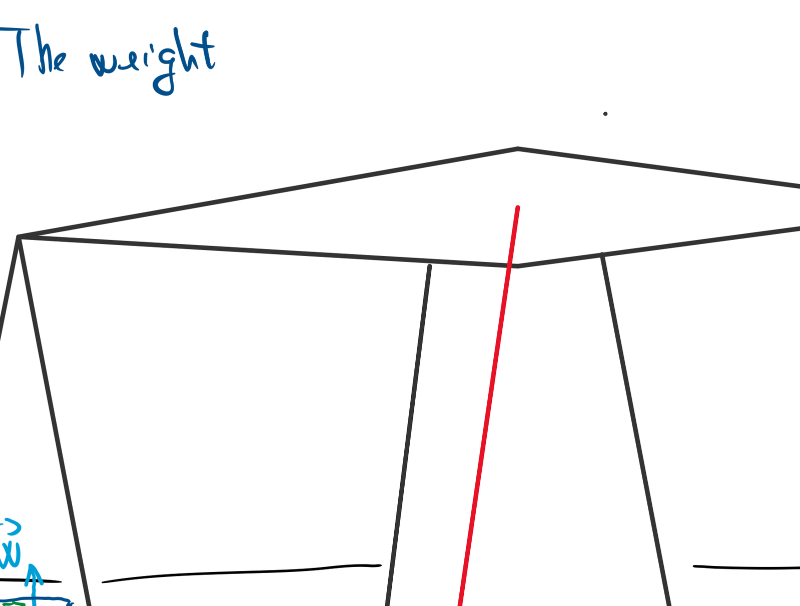
$G = g\ m$ | $\Rightarrow$

Note $g = k_g\frac{M}{R^2}$ - the gravitational acceleration

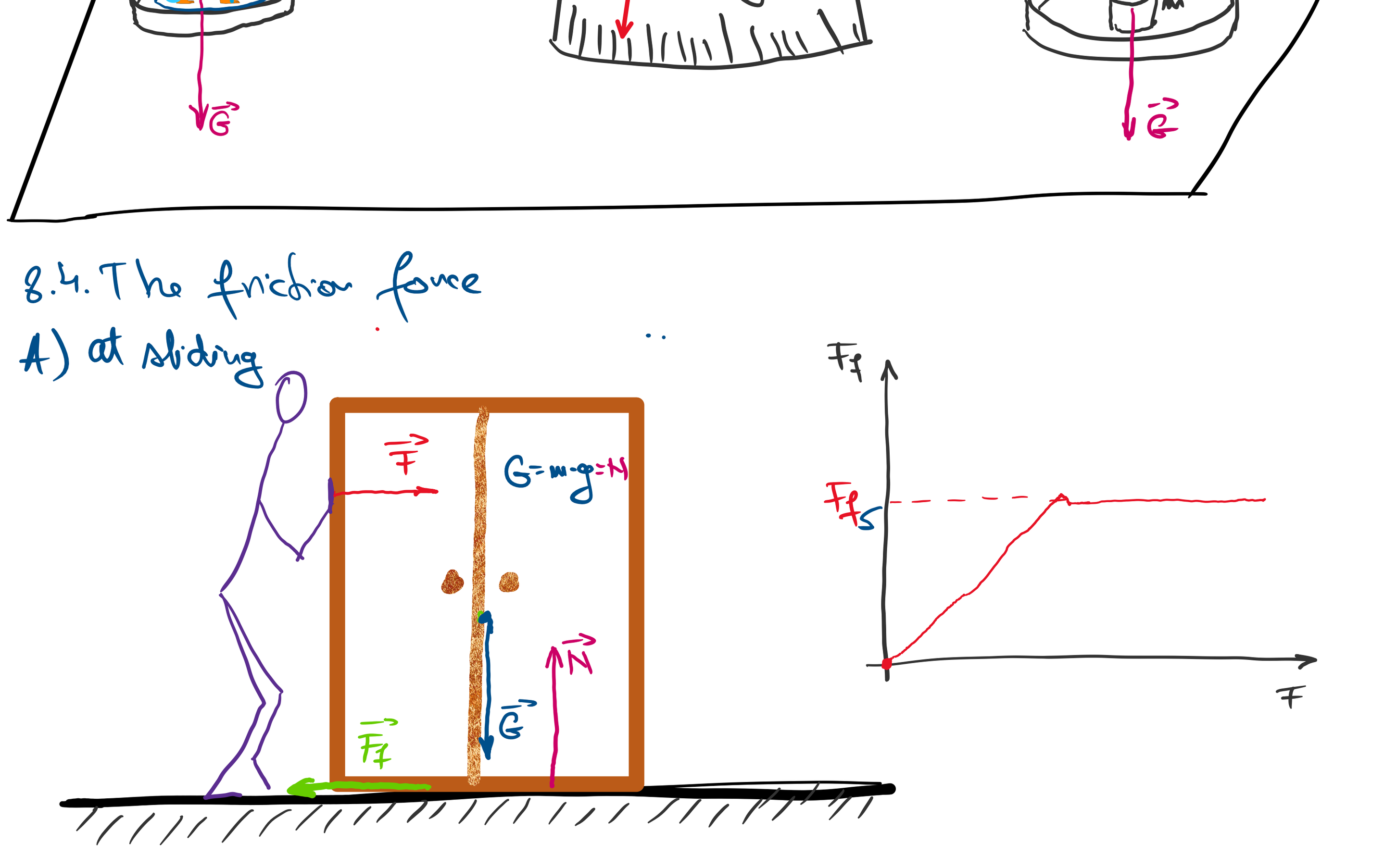
$g = $ 9.81 m/s^2 Cluj-Napoca ✓; 10 m/s^2

B)



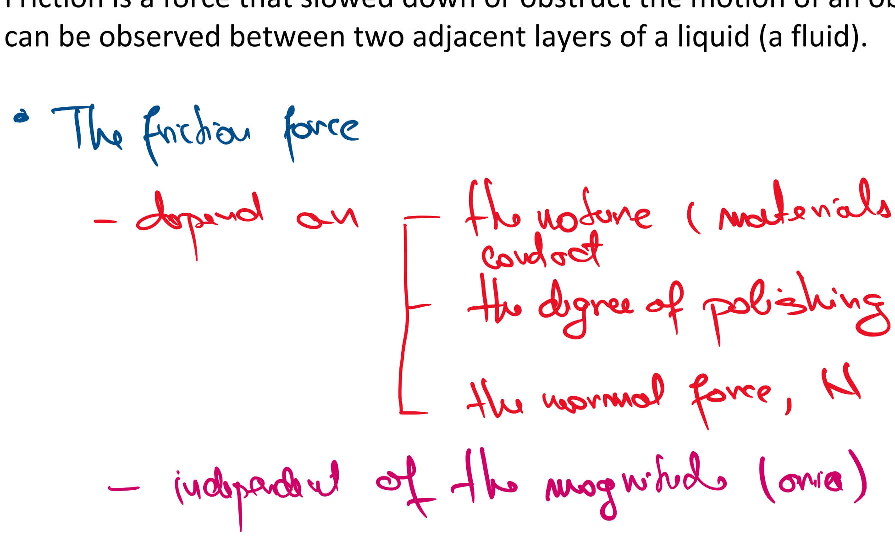


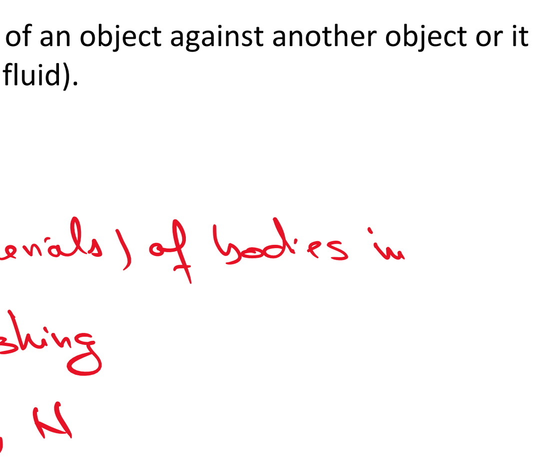
8.3. The weight



8.4. The friction force

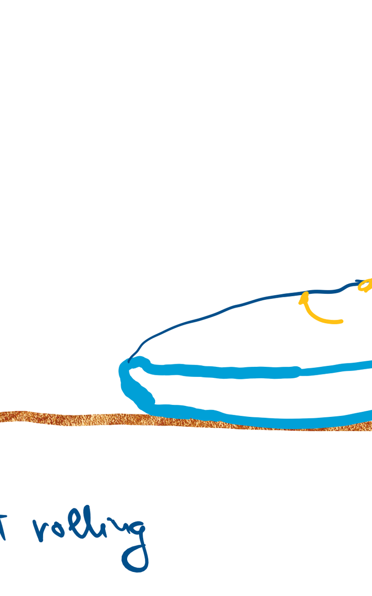
A) at sliding





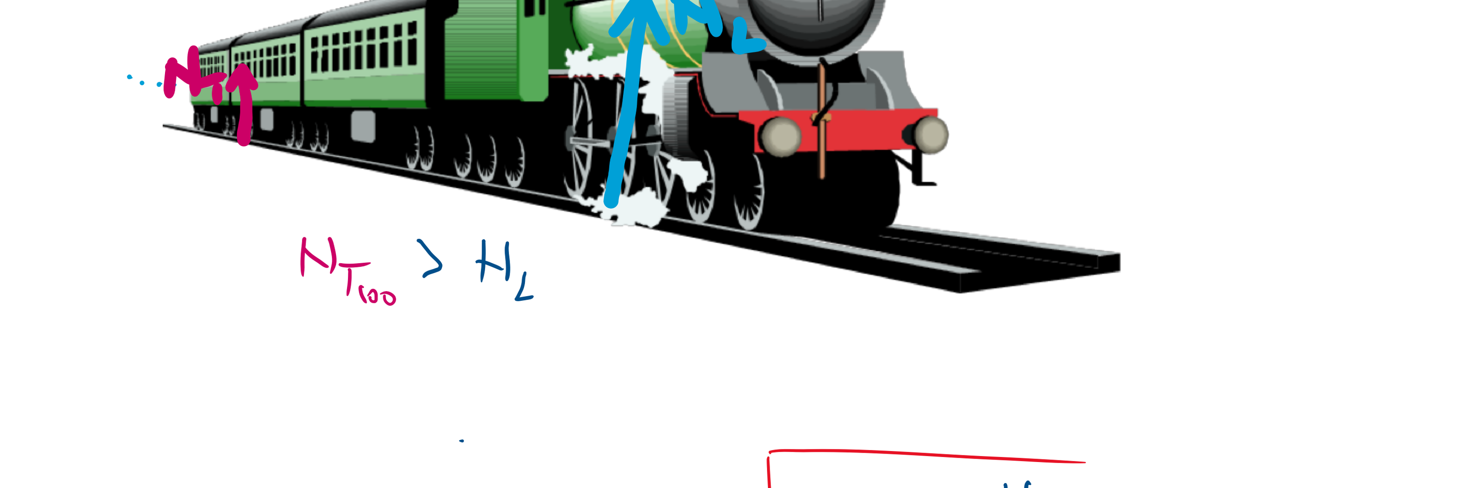
Friction is a force that slowed down or obstruct the motion of an object against another object or it can be observed between two adjacent layers of a liquid (a fluid).

- The friction force
  - depend on
    - the nature (materials) of bodies in contact
    - the degree of polishing
    - the normal force, N
  - independent of the magnitude (area) of surfaces in contact

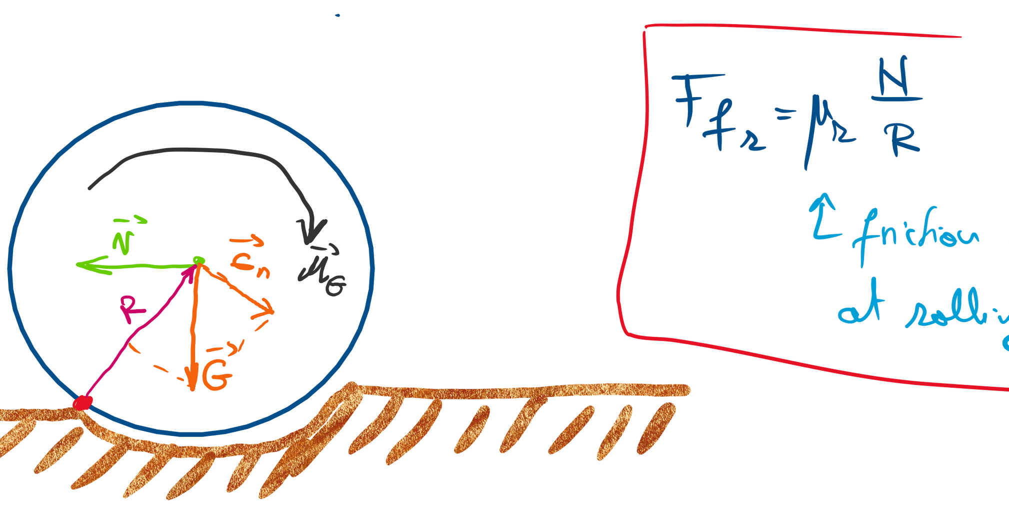


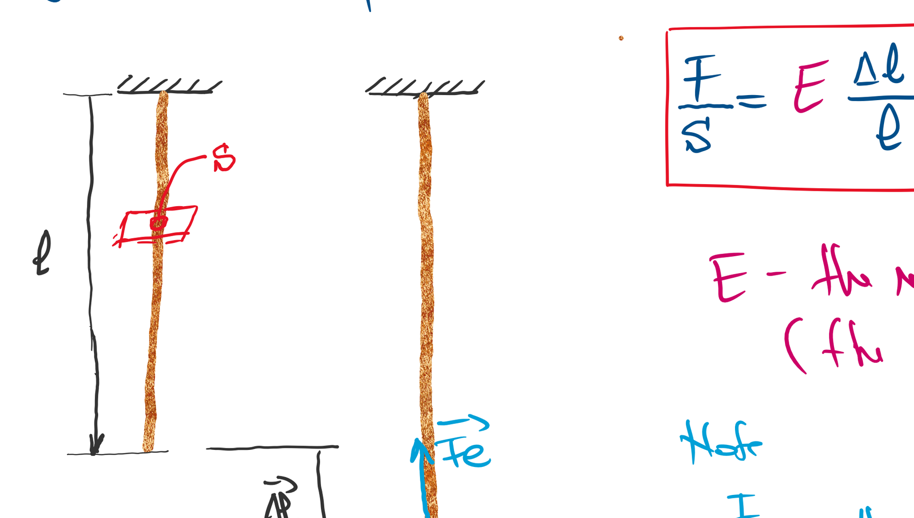
$F_{fs} = \mu_s \cdot N$, μ_s - the friction coefficient at sliding

https://phys.utcluj.ro/resurse/Facultati/Constructii/2020-2021/Aplicatii/CutieInGol/



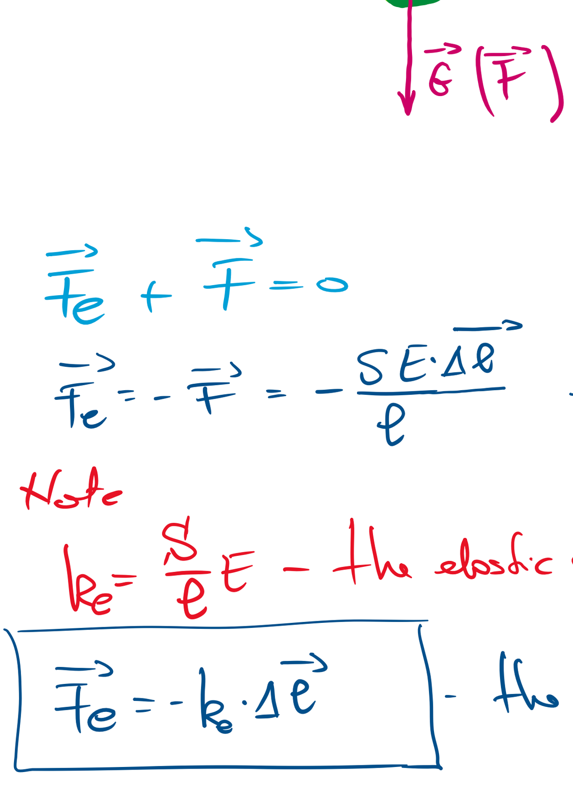
B) at rolling





$F_{fr} = \mu_r \frac{N}{R}$, μ_r - friction coefficient at rolling

8.5 The elastic force



$$\boxed{\frac{F}{S}=E\frac{\Delta\ell}{\ell}}$$ - the Hooke's law

E - the modulus of elasticity $[E]_{IS}=\frac{N}{m^2}$ (the Young's modulus)

Note

1° $\sigma = \frac{F}{S}$ - the stress

2° $\varepsilon = \frac{\Delta\ell}{\ell}$ - the strain

$\boxed{\sigma = E\varepsilon}$ - the Hooke's law

$$\vec{F}_e + \vec{F} = 0$$

$$\vec{F}_e = -\vec{F} = -\frac{S E\cdot\Delta\vec{\ell}}{\ell} \Rightarrow \vec{F}_e = -\frac{S\cdot E}{\ell}\cdot\Delta\vec{\ell}$$

Note

$k_e = \frac{S}{\ell}E$ - the elastic constant

$$\boxed{\vec{F}_e = -k_e\cdot\Delta\vec{\ell}}$$ - the elastic force