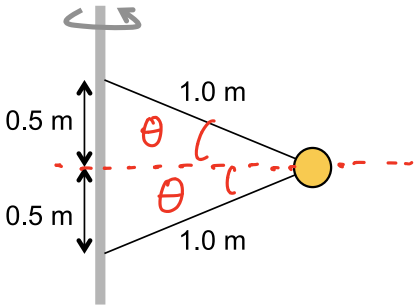
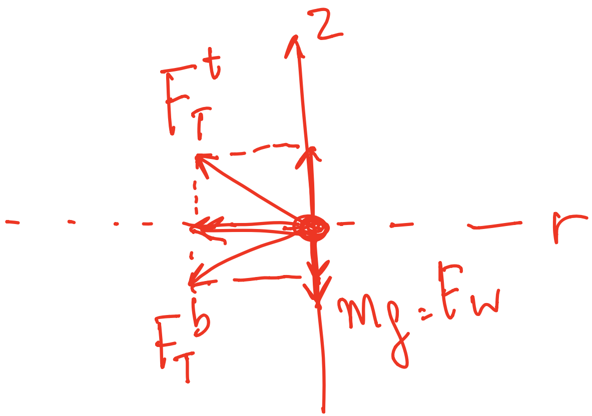
ÉQUILIBRE

PGC-08

EXEMPLE
SE BALANCER SUR DEUX CORDES





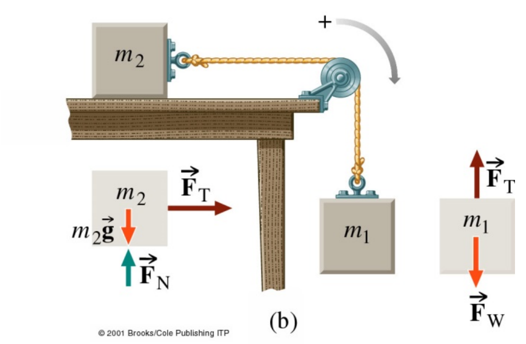
$$\Sigma F_r = F_T^t \cos\theta + F_T^b \cos\theta = m\omega^2 r$$
$$\Sigma F_z = F_T^t \sin\theta - F_T^b \sin\theta - mg = 0$$
$$\Rightarrow$$

$$F_T^t + F_T^b = \frac{m\omega^2 r}{\cos\theta}$$
$$F_T^t - F_T^b = \frac{mg}{\sin\theta}$$
$$(-)$$

$$F_T^b = \frac{m}{2}\left(\frac{\omega^2 r}{\cos\theta} - \frac{g}{\sin\theta}\right)$$

$$F_T^b = 0 \Rightarrow \omega_c = \sqrt{\frac{g}{r\tan\theta}}$$

RAPPEL – MOUVEMENT COUPLÉ

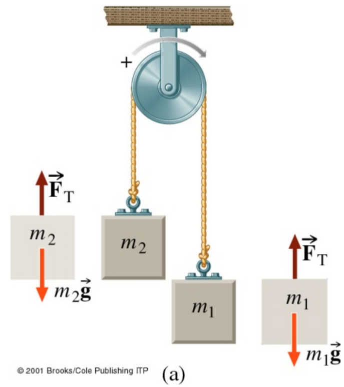


au repos

a) $F_T = F_W$

b) $F_T > F_W$

c) $F_T < F_W$



$m_1 > m_2$

a) $a_1 = a_2$

b) $a_1 > a_2$

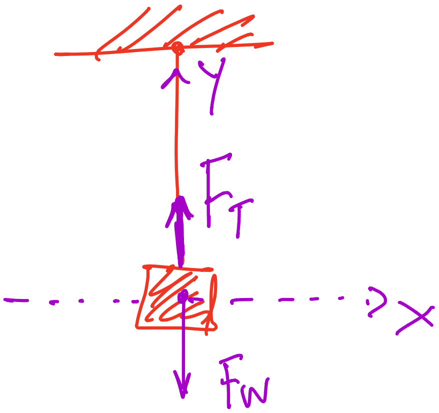
c) $a_1 < a_2$

ÉQUILIBRE STATIQUE

$\sum \vec{F} = 0 \iff \vec{v} = \text{constante}$

$\sum F_x = 0 \qquad \sum F_y = 0$

$0 = \sum F_y \Rightarrow F_w = F_T$



Sans Rotation.

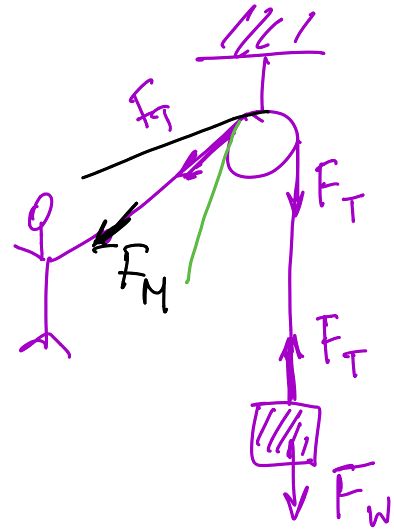
SYSTÈMES DE FORCES PARALLELES

Poulies

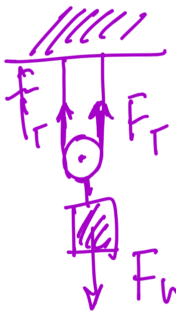
- Reorienter les forces

$$F_T = F_W$$

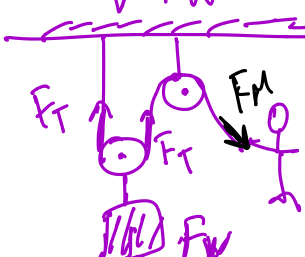
$$F_M = F_T$$



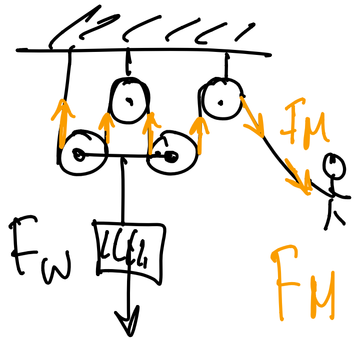
- Démultiplication des forces



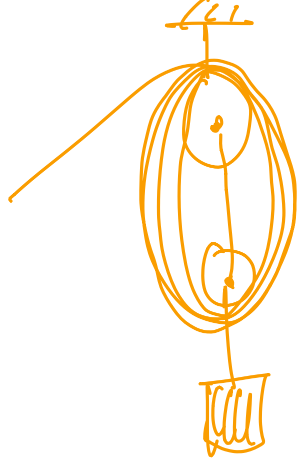
$$2F_T = F_W$$

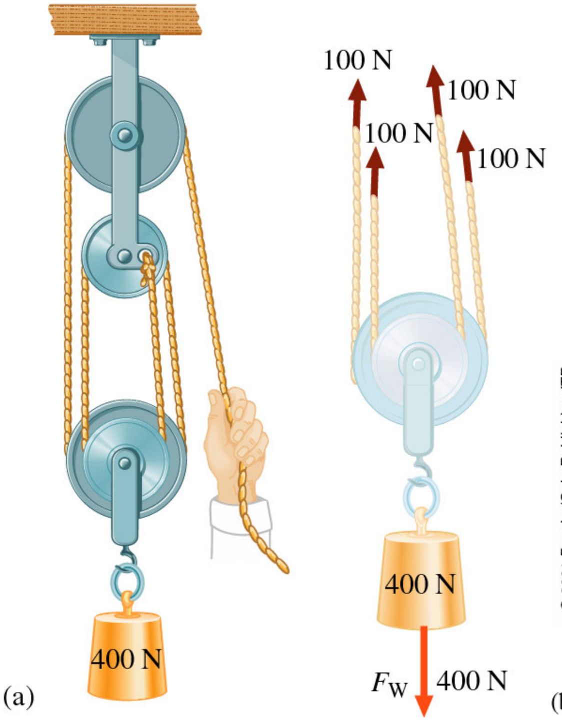


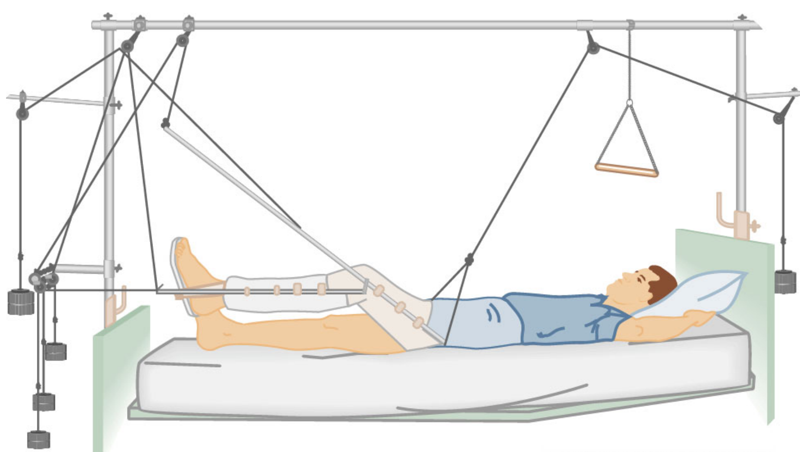
$$F_M = \frac{1}{2} F_W$$



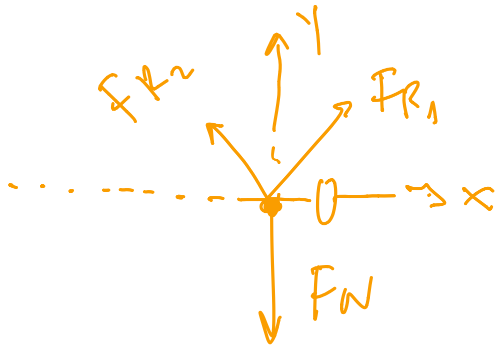
$$F_M = \frac{1}{4} F_W$$



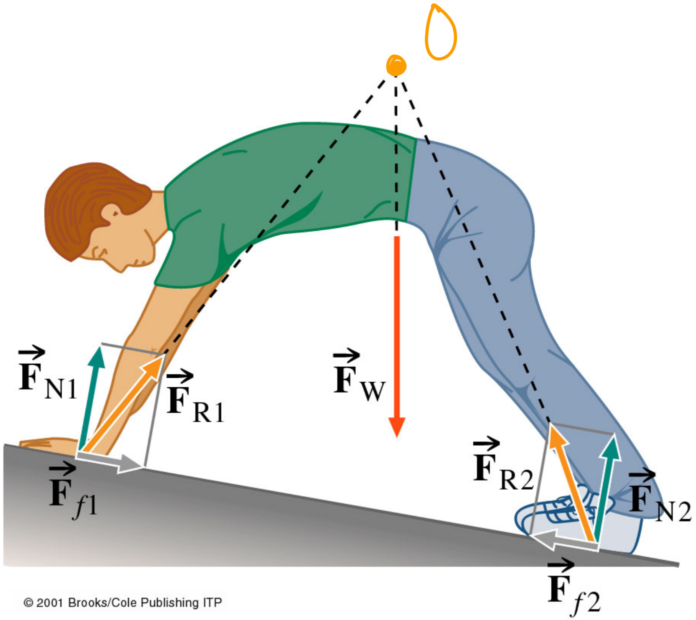

100 N
100 N
100 N
100 N
400 N
400 N
F_W
400 N
(a)
(b)



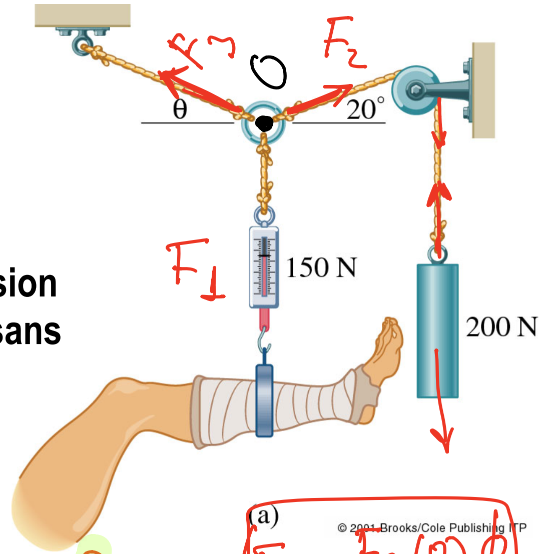
FORCES CONCOURANTES



ajouter vectoriellement

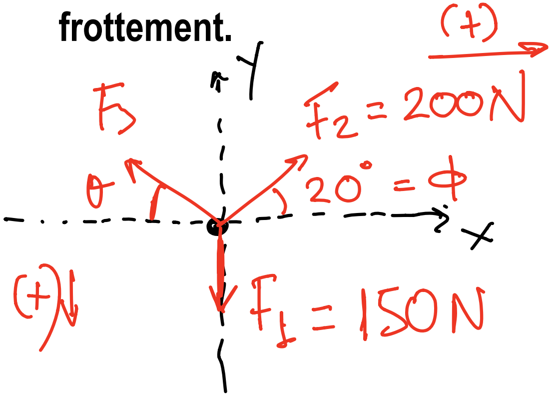


$$\text{Éq}: \sum \vec{F} = 0$$



EXEMPLE

QUESTION: Déterminez l'angle *θ* dans le dispositif de suspension de la jambe ci-contre. On suppose que la poulie est légère et sans frottement.



$$\sum F_x = 0$$
$$\sum F_y = 0$$

$$\sum F_x = F_2 \cos\phi - F_3 \cos\theta = 0 \Rightarrow F_3 = \frac{F_2 \cos\phi}{\cos\theta}$$

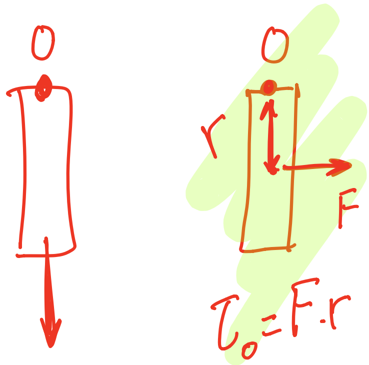
$$\sum F_y = F_1 - F_2 \sin\phi - F_3 \sin\theta = 0$$

$$F_1 - F_2 \sin\phi - \frac{F_2 \cos\phi}{\cos\theta} \cdot \sin\theta = 0 \rightarrow$$

$$\Rightarrow F_1 - F_2 \sin\phi - F_2 \cos\phi \tan\theta = 0$$

$$\tan\theta = \frac{F_1 - F_2 \sin\phi}{F_2 \cos\phi}$$

LE MOMENT DE FORCE



$\tau_O = r_\perp \cdot F$

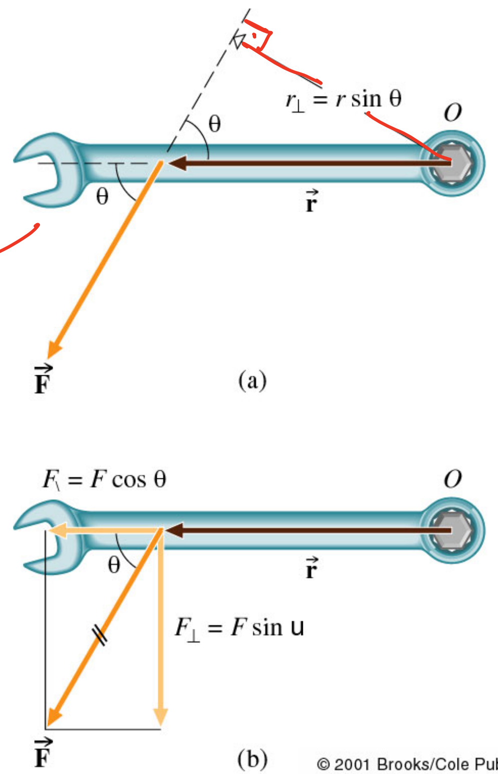
"bras du levier"

$\tau_O = r\sin\theta\, F$

$\tau_O = r\, F\sin\theta$

$\theta = 90°$

$\tau_O = F.r$



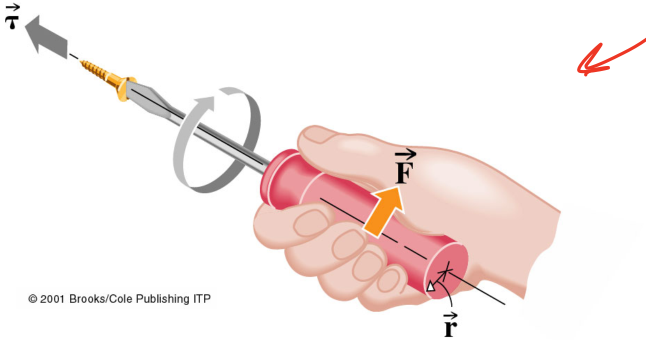
LE MOMENT DE FORCE

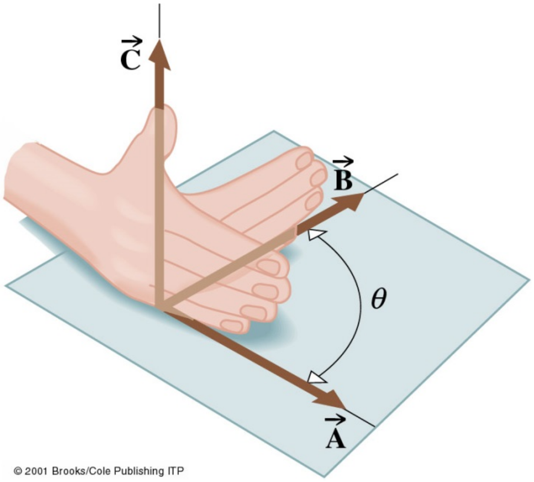
$\vec{\tau}$: vecteur

$\tau_o = r \sin\theta \, F$

$\vec{\tau}_o = \vec{r} \times \vec{F}$

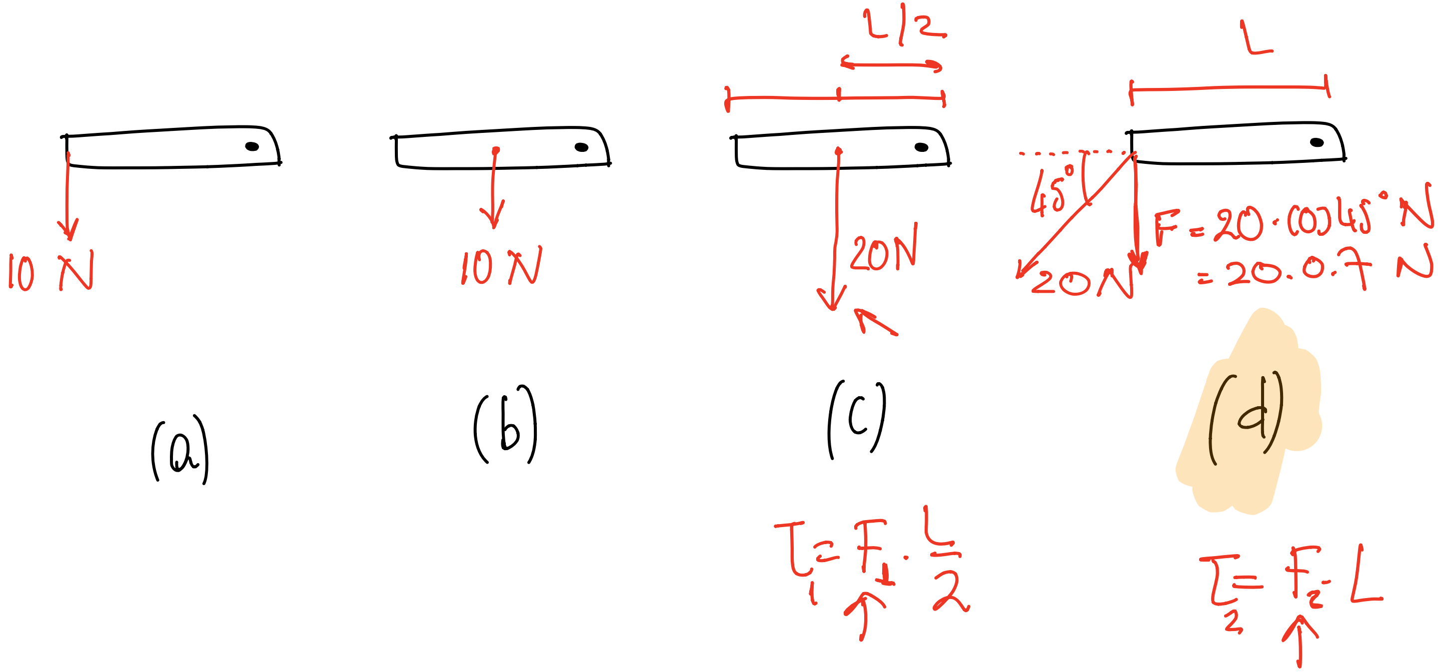
direction :



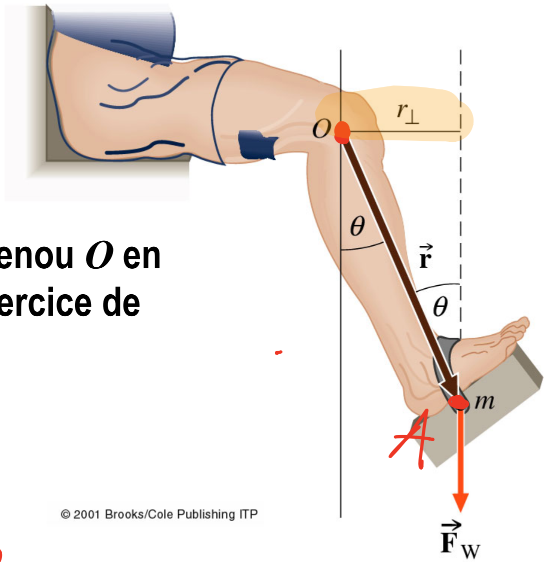


QUESTION

Dans quelle situation le moment de force est-il plus grand?



EXEMPLE



QUESTION: Exprimez le moment des forces par rapport au genou *O* en fonction de *θ*, *m*, et la distance *r* du genou au talon dans l'exercice de musculation ci-contre. Négligez la masse de la jambe.

$$\tau_o = r_\perp \cdot F_W = r_\perp \cdot mg$$

$$= r \cdot \sin\theta \, mg$$

τ_o min pour $\theta = 0 \Rightarrow \vec{F}_W \parallel \vec{r}$

max $\theta = 90° \Rightarrow \vec{F}_W \perp \vec{r}$

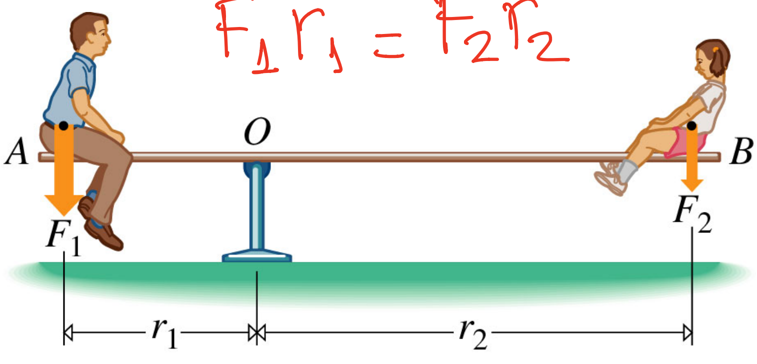
SECONDE CONDITION D'ÉQUILIBRE

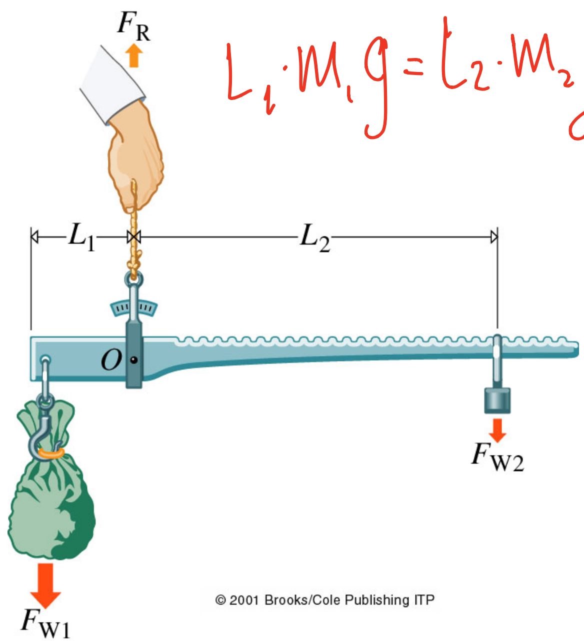
$$\sum \vec{F} = \vec{0} \Rightarrow \vec{v} = const.$$

$$\boxed{\sum \vec{T} = \vec{0}} \Rightarrow \vec{\omega} = const$$

$$L_1 \cdot m_1 g = L_2 \cdot m_2 g$$

$$F_1 r_1 = F_2 r_2$$





QUESTION

Quelle est l'indication de la balance?

$$\sum \vec{\tau} = 0$$

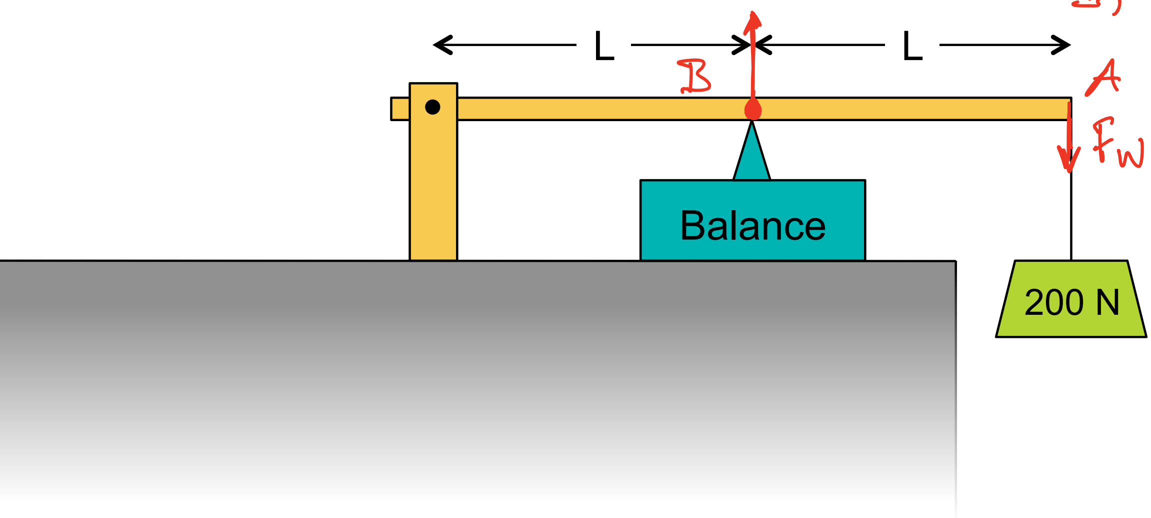
$$\tau_A = 2L\,F_W$$

$$\tau_B = L\,F_B$$

$$\tau_A = \tau_B$$

$$\Rightarrow 2\cancel{L}F_W = \cancel{L}F_B$$

$$\Rightarrow 2F_W = F_B$$



FORCES NON-CONCOURANTES

Un couple des Forces

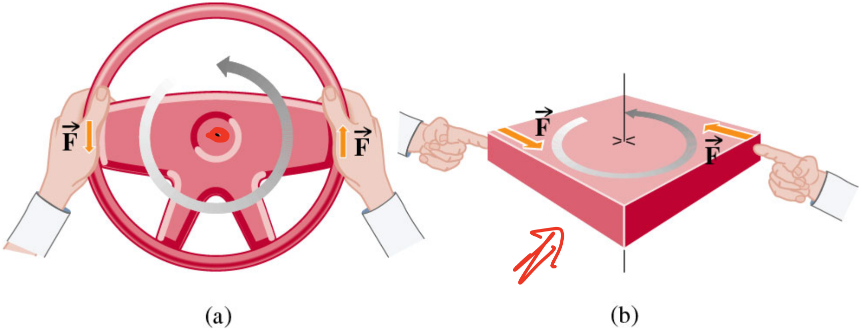
Non-collinéaires

$\sum \vec{F} = 0$

$\sum \vec{T} \neq 0$

$\sum \vec{F} = 0$

$\sum \vec{T} \neq 0$



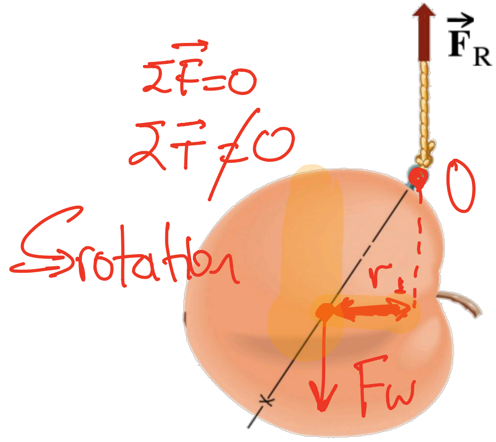
CENTRE DE MASSE

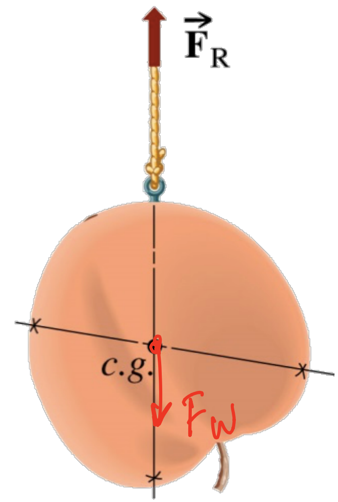
$X_{c.g.}$

$$X_{cg} = \frac{\sum_{j=1}^{N} F_{W_j} \cdot x_j}{\sum_{j=0}^{N} F_{W_j}}$$

y.

$X_{c.g.}$ $Y_{c.g.}$





STABILITÉ ET ÉQUILIBRE