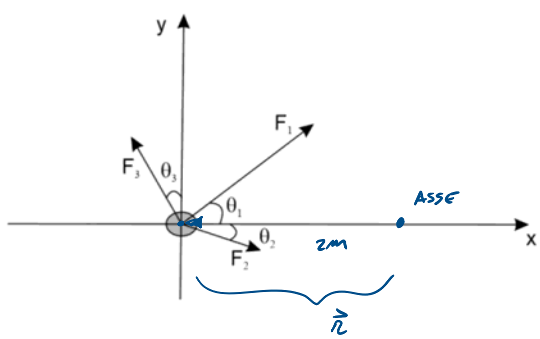
Lezione #7

2/12/2021

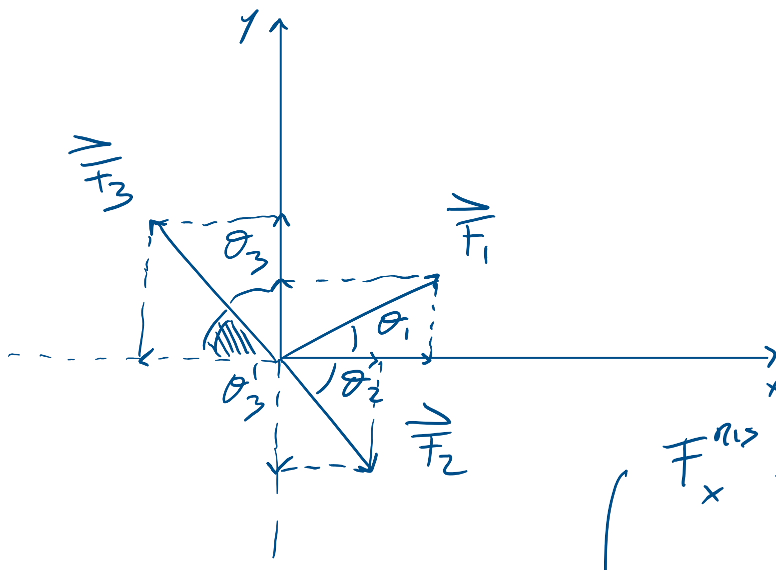
Esercitazione su $\vec{F}$ e $\vec{M}$:

Un disco da hockey di massa m=0.32 kg scorre su una superficie orizzontale (priva di attrito) di una pista di ghiaccio. Esso è colpito simultaneamente da tre diverse mazze da hockey come mostrato in figura. La forza F_1 ha modulo 8.5 N, F_2 ha modulo 3.1 N e F_3 ha modulo 5.3 N. Gli angoli che le forze formano con l'asse x sono rispettivamente θ_1=45°, θ_2= 31° e θ_3=32°. Calcolare:

1. Il modulo della risultante delle forze agenti sul disco nel piano xy;
2. Modulo direzione e verso della sua accelerazione;
3. Il momento risultante di F_1 ed F_2 rispetto a un asse perp. al piano xy e posto a distanza di +2 m sull'asse x;
4. Se ora sul piano fosse presente attrito dinamico con μ_k = 0.04, calcolare di quanto varia l'accelerazione del disco.



1)



$$\theta_3' = 90° - 32° = 58°$$

$$F_x^{ris} = F_1 \cos\theta_1 + F_2 \cos\theta_2 - F_3 \cos\theta_3'$$

$$\vec{F}^{ris} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

$$\begin{cases} F_x^{ris} = F_1 \cos\theta_1 + F_2 \cos\theta_2 - F_3 \cos\theta_3 \\ F_y^{ris} = F_1 \sin\theta_1 - F_2 \sin\theta_2 + F_3 \sin\theta_3' \end{cases}$$

$$\begin{cases} F_x^{ris} = 8,5 \cdot \cos(45°) + 3,1 \cdot \cos(31°) - 5,3 \cos(58°) \\ F_y^{ris} = 8,5 \sin(45°) - 3,1 \sin(31°) + 5,3 \sin(58°) \end{cases}$$

$$\begin{cases} F_x^{ris} = 5,8591 \text{ N} \\ F_y^{ris} = 8,9084 \text{ N} \end{cases}$$

$$|\vec{F}^{ris}| = \sqrt{F_x^{2\,ris} + F_y^{2\,ris}}$$

$$|\vec{F}^{ris}| = 10,66 \text{ N} \simeq 11 \text{ N}$$

$$\boxed{|\vec{F}^{ris}| = 11N}$$

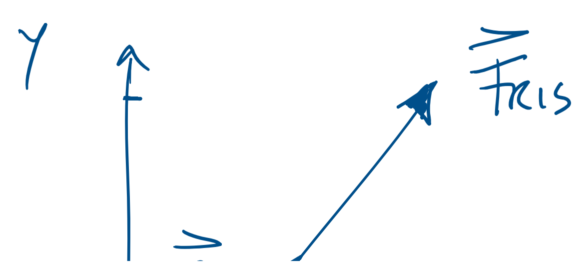
2) $\vec{a}$; (a, ϑ_a)

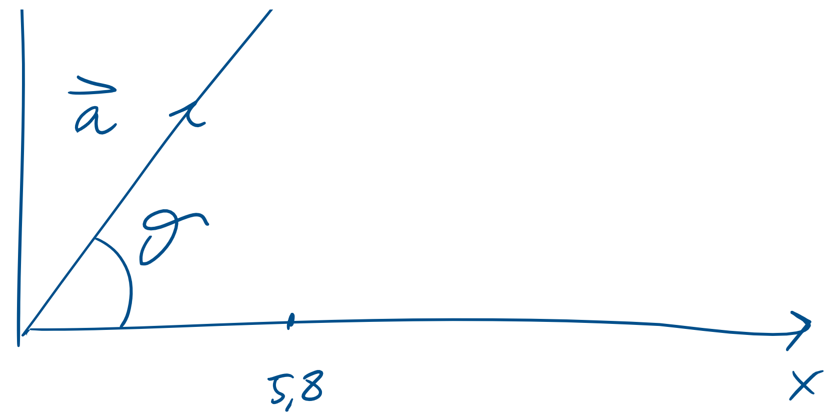
$$\boxed{\vec{F}^{ris} = m\vec{a}}$$

II^a LEGGE DI NEWTON

$$a = \frac{F^{ris}}{m} = \frac{10,66}{0,32} = 33,31\,m/s^2$$

$$\boxed{a \simeq 33\,m/s^2}$$





$$\theta = \operatorname{arctg}\left(\frac{a_y}{a_x}\right)$$

$$\begin{cases} F_x = m a_x \\ F_y = m a_y \end{cases}$$

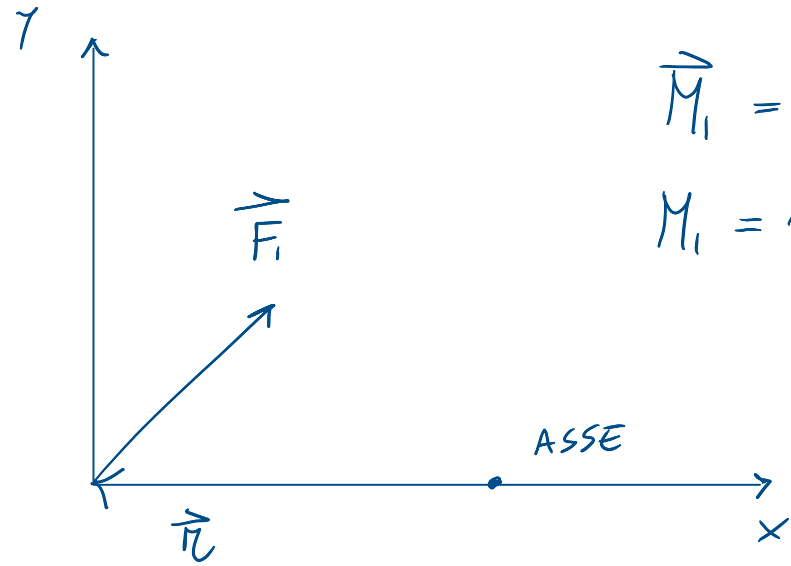
$$\begin{cases} a_x = \dfrac{F_x}{m} = \dfrac{5{,}8}{0{,}32} = 18{,}125 \ m/s^2 \\ a_y = F_y/m = \dfrac{8{,}9}{0{,}32} = 27{,}812 \ m/s^2 \end{cases}$$

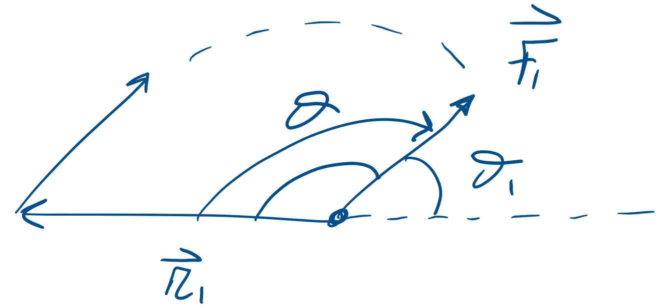
$$\theta = \operatorname{arctg}\left(\frac{27{,}812}{18{,}125}\right) = 56{,}9^\circ \simeq 57^\circ$$

3) $\vec{M}^{RIS} = \vec{M}_1 + \vec{M}_2$

$$\vec{M}_1 = \vec{r}_1 \times \vec{F}_1$$

$$M_1 = r_1 F_1 \sin\theta$$





$\otimes$

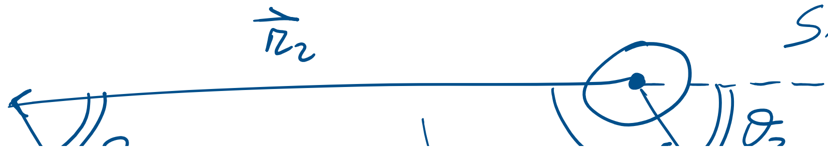
$M_1 < 0$

$$\theta = 180° - \theta_1 = 180° - 45° = 135°$$

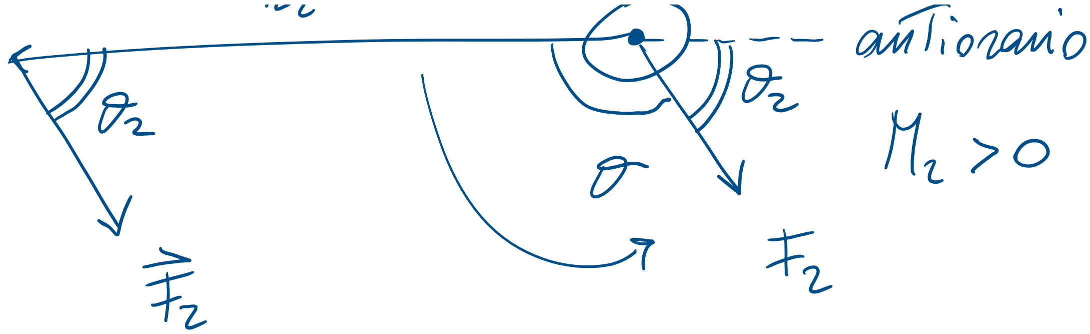
$$M_1 = -r_1 F_1 \sin(135°) = -2 \cdot 8{,}5 \cdot \sin(135°)$$

$$M_1 = -12{,}02 \ \mathrm{Nm}$$

M_2:



senso antiorario



$M_2 > 0$

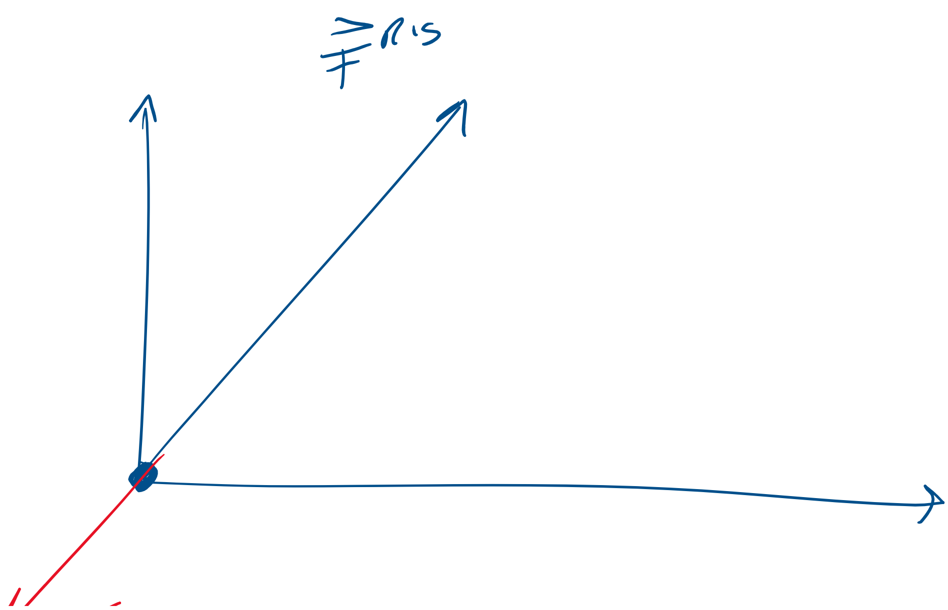
$$M_2 = 2 \cdot 3{,}1 \cdot \sin(149^\circ) \qquad \begin{aligned} \theta &= 180^\circ - 31^\circ \\ \theta &= 149^\circ \end{aligned}$$

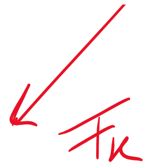
$$M_2 = 3{,}2 \ Nm$$

$$M^{ris} = -12{,}02 + 3{,}2$$

$$\boxed{M^{ris} = -8{,}82 \ Nm \simeq -8{,}8 \ Nm}$$

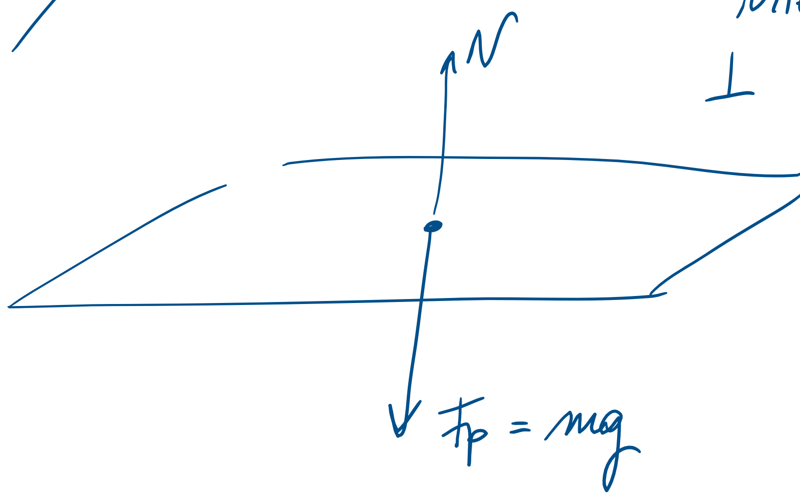
4)





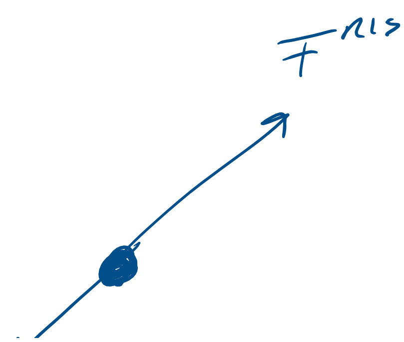
$$F_k = -\mu_k N$$

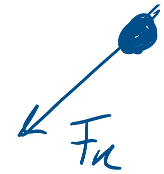
N = RISULTANTE DI TUTTE LE FORZE $\perp$ alla sup.



$$N = mg \Rightarrow F_k = -\mu_k N = -\mu_k mg$$

$$F_k = -0{,}04 \cdot 0{,}32 \cdot 9{,}81 = -0{,}1256 \text{ N}$$





$$F'_{ris} = F^{ris} - F_r = m a'$$

$$a' = \frac{F^{ris} - F_r}{m} = \frac{10{,}66 - 0{,}1256}{0{,}32}$$

$$\boxed{a' = 32{,}9 \ m/s^2}$$

$$\frac{\Delta a}{a} = \frac{(32{,}9 - 33{,}31)}{32{,}9} \simeq -0{,}01 \simeq -1\%$$