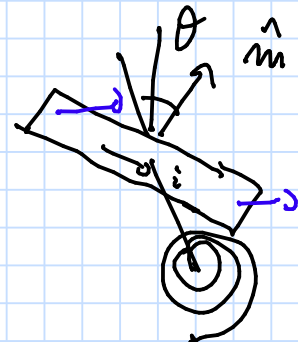
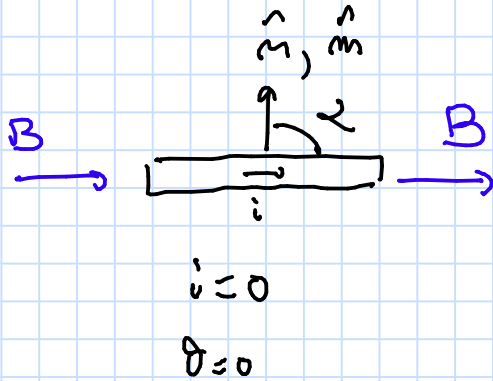


Galvanometro a bobina mobile

bobina = { spire }



molla
elicaoidale

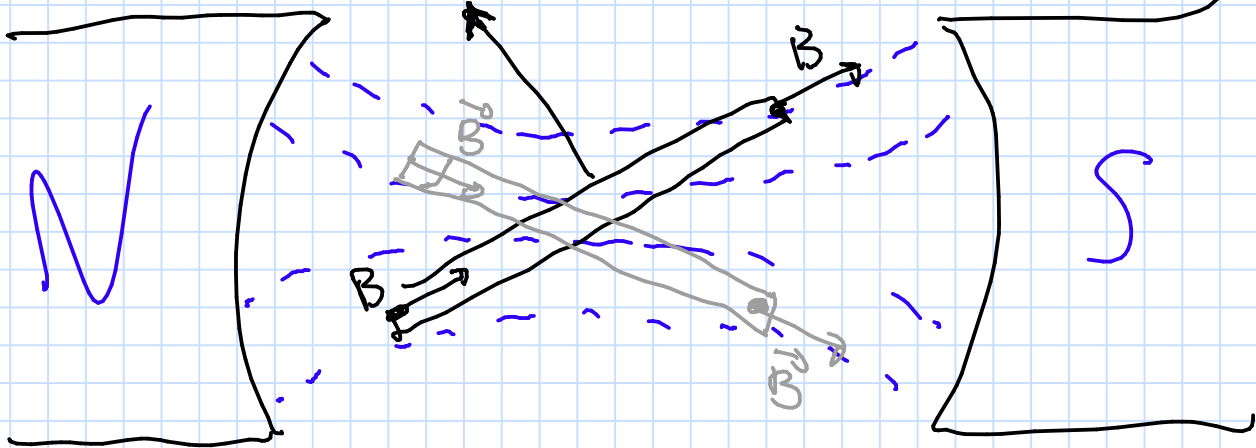
$$M_{molla} = -k \theta$$

$$|\vec{M}| = |\vec{m} \times \vec{B}|$$

$$= N m_{spira} \sin \alpha$$

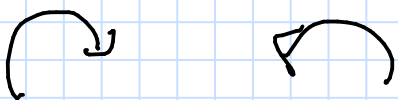
$$= N i \Sigma B \sin \alpha$$

per angoli $\alpha \approx 90$



$\sin \alpha \approx 1$ sempre

$$|M_{bobina}| \leq |M_{molla}|$$

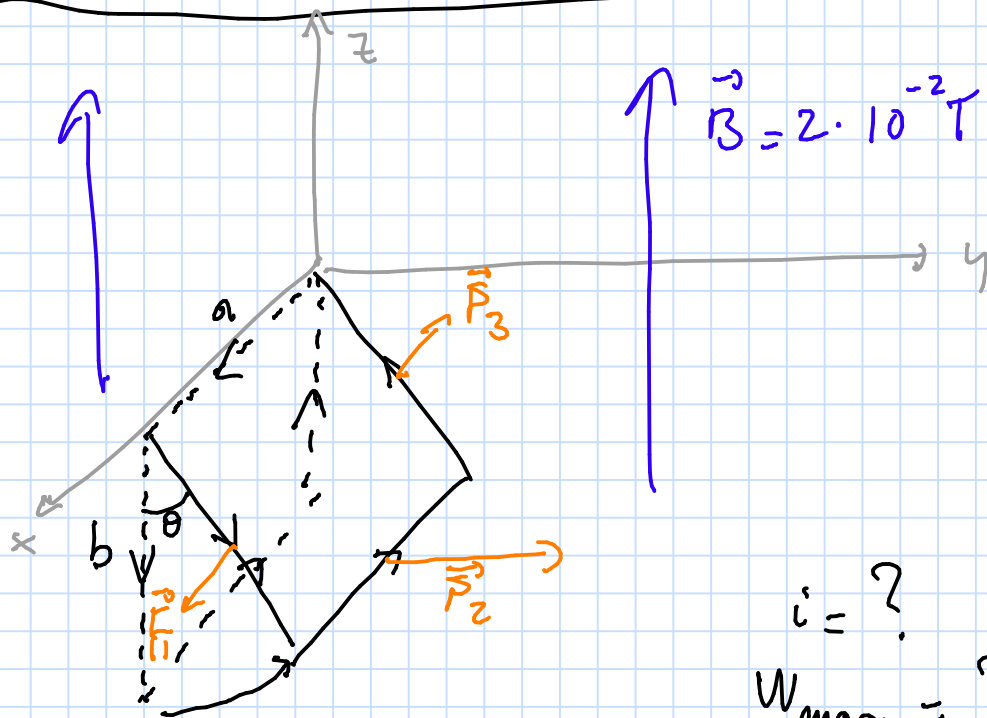


$$N i \Sigma B = k \theta$$

$$\theta = \left(\frac{N \Sigma B}{k} \right) i$$

$$\theta \sim i$$

7.13 MNV p 410



$$a = 20 \text{ cm}$$

$$b = 10 \text{ cm}$$

massa / m

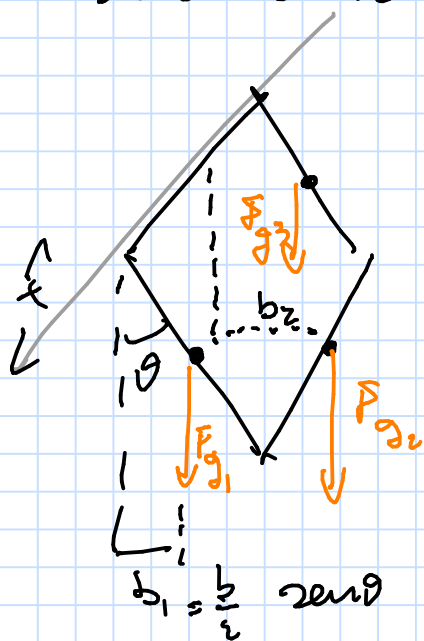
$$\delta = 5 \cdot 10^{-2} \text{ g/cm}$$

$$\theta = 30$$

$$i = ?$$

$$W_{\text{magn}} = ? \quad (\text{durante rotazione})$$

bilanciamento dei mom. delle forze



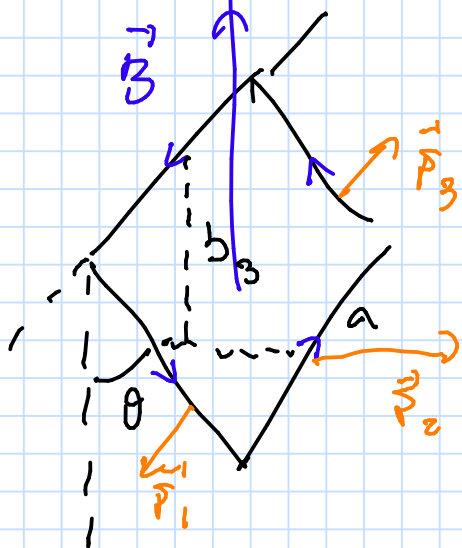
$$\vec{M}_g = M_g (\hat{x})$$

$$M_g = (F_{g1} \cdot b_1) * 2 + F_{g2} \cdot b_2$$

$$= \left(\underbrace{(\delta \cdot b \cdot g)}_m \cdot \underbrace{\frac{b}{2} \sin \theta}_{b_1} \right) 2 + (\delta a \cdot g) \underbrace{b \sin \theta}_{b_2}$$

$$= \delta (a+b) g b \sin \theta$$

$$\delta = 5 \cdot 10^{-2} \frac{\text{g}}{\text{cm}} = 5 \cdot 10^{-2} \frac{10^{-3} \text{ kg}}{10^{-2} \text{ m}}$$



$$\vec{M}_{\text{magn}} = M_{\text{magn}} \cdot \hat{x}$$

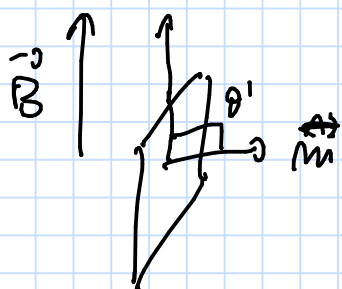
$$M_{\text{magn}} = b_3 \cdot F_2 \\ = (b \sin \theta) (i a B)$$

in equil

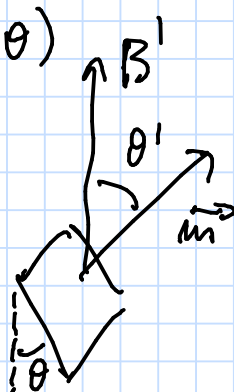
$$|\vec{M}_g| = |\vec{M}_{\text{magn}}|$$

$$i = \frac{g}{B} \frac{a+b}{a} \tan \theta = 2.12 \text{ A}$$

$$W_{\text{magn}} = U_m(\theta=0) - U_m(\theta)$$



$$U_m(\theta=0) = -\vec{m} \cdot \vec{B} = 0$$



$$U_m(\theta) = -m B \cos(90^\circ - \theta) \\ = -m B \sin 30^\circ \\ = -i a b B \sin 30^\circ \\ = -4.24 \cdot 10^{-4} \text{ J}$$

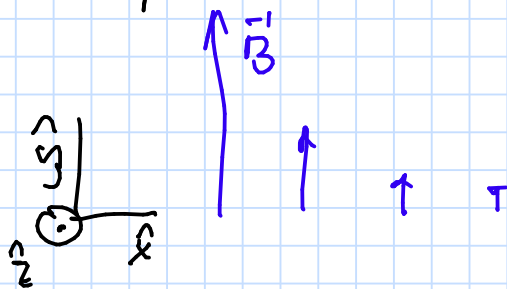
$$W_{\text{magn}} = U_m(\theta=0) - U_m(\theta) = +4.24 \cdot 10^{-4} \text{ J}$$

↑
lavoro fatto dalle forze magnetiche

esercizio

spira circolare $R = 1 \text{ mm}$

$$i = 3 \text{ A}$$



$$P = (3 \text{ m}, 0 \text{ m})$$

$$\vec{B} = \left(\frac{12}{x} \text{ Gm}\right) \hat{y}$$

x in meters

1) modulo di $\vec{M}$ sulla spira

$$m = i \pi R^2 = 9.4 \cdot 10^{-6} \text{ A m}^2$$

$$\theta = 90^\circ \text{ tra } \vec{m} \text{ e } \vec{B}$$

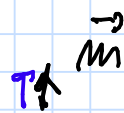
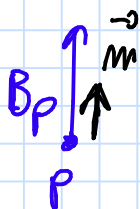
$$M = m B \sin \theta = 3.77 \cdot 10^{-9} \text{ Nm}$$

2) energia dissipata per equilibrarsi automaticamente

$$U(\theta = 90^\circ) = -m B_P \cos 90^\circ = 0$$

$$\text{equilib. } \vec{m} // \vec{B}_P$$

$$U(\theta = 0) = -m B_P \cdot 1 = 3.77 \text{ mJ}$$



$$P' = (5 \text{ mm}, 0 \text{ mm})$$

fissando orientazione, W per portare spira da P a P'

$$W = U_{P'} - U_P \quad \text{con } \theta = 0$$

$$U_{P'} = -m B_{P'} = -2.26 \text{ mJ}$$

$$W_{P \rightarrow P'} = U_{P'} - U_P = 1.51 \text{ mJ}$$