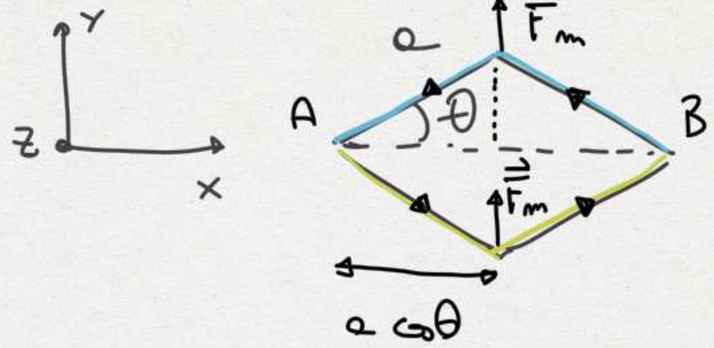
Es. 1



$\vec{B}_1 \parallel \hat{z}$

$\vec{B}_2 \parallel -\hat{z}$

$$\vec{F} = i\vec{\ell} \times \vec{B}$$

① ANTIORARIO

$F_1 + F_2 = F_p$, $i\ell B_1 + i\ell B_2 = mg$

$\ell = 2a\cos\theta \Rightarrow 2a\cos\theta\, i\,(B_1 + B_2) = mg$

$$i = \frac{mg}{2a\cos\theta\,(B_1+B_2)} = 1.25\,A$$

② $F = i\ell B \rightarrow i a B_1 = 0.044\,N$ (lunghezza segmento)

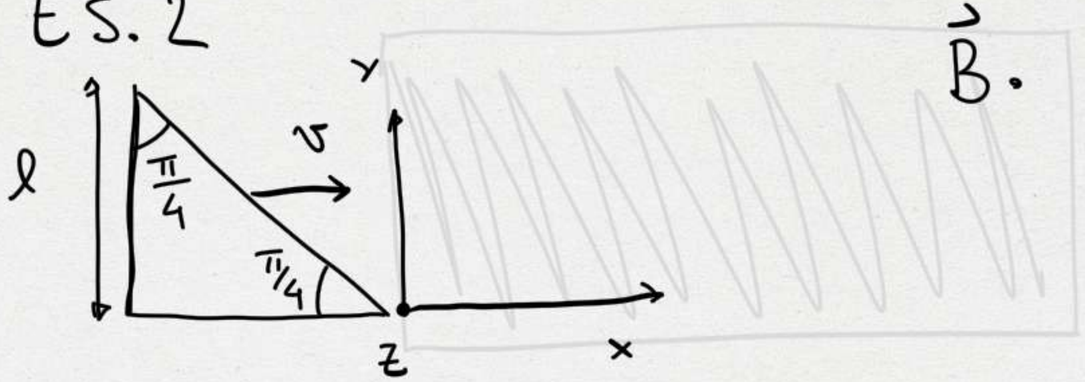
③ $B_2' \longrightarrow B_1 + B_2$

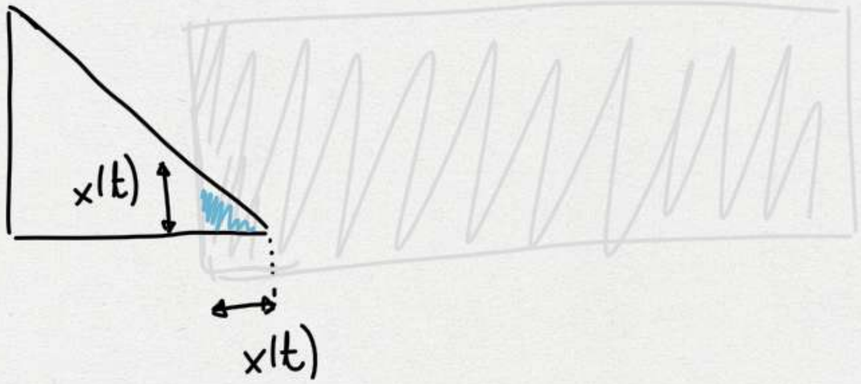
$B_2' = 1\,T$

$F_m = F_1 + F_2 = i\ell(B_1+B_2) = mg$

$F_m' = i\ell B_2' = mg$

ES. 2





① $\Phi = \Sigma(t)\, B = \frac{1}{2} x^2(t)\, B = \underbrace{\frac{1}{2} v^2 t^2 B}_{\text{per } x < \ell}$

② verso orario per Lenz

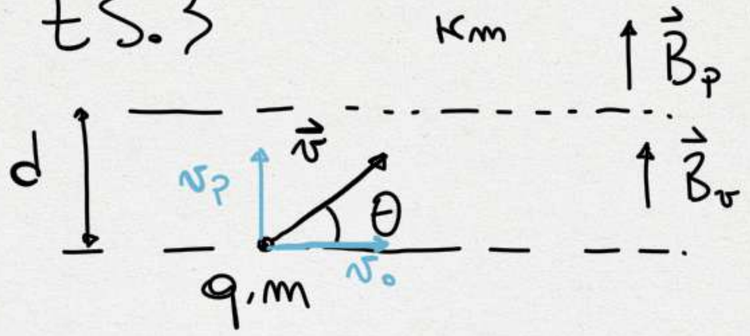
$$\iota(t) = -\frac{1}{R}\frac{d\Phi}{dt} = -\frac{B v^2 t}{R}$$

③ $t_f = \frac{\ell}{v} = 10\ s$

$$Q = \frac{\Phi_f - \Phi_0}{R} = \frac{\frac{1}{2}\ell^2 B - 0}{R} = \frac{1}{2}\frac{\ell^2 B}{R} =$$

$$= 0.5\ C$$

ES.3



$\omega, P, q, m, \theta, k_m$

① r_v, r_p

$$\omega = \frac{q B_v}{m} \Rightarrow B_v = \frac{\omega m}{q} = 1\,T \Rightarrow B_p = k_m B_v = 10\,T$$

$$P = \frac{2\pi}{\omega} v_p = \frac{2\pi}{\omega} v \sin\theta \Rightarrow v = \frac{P\omega}{2\pi \sin\theta} = 10^6\ m/s$$

$$v_0 = v \cos\theta$$

$$r_v = \frac{m v_0}{q B_v} = 9.03 \cdot 10^{-3}\ m \qquad r_p = \frac{m v_0}{q B_p} = 9.03 \cdot 10^{-4}\ m$$

② $T = \frac{2\pi}{\omega}$, $t_f = \frac{d}{v_p} \Rightarrow$

$$N_c = \frac{t_f}{T} = 30.9 \rightarrow 30$$

$$N_c = \frac{d}{P} = 30.9$$

③ $v_0^p = v_0$

$v_p^p = v_p$

perché la forza di Lorentz non fa lavoro