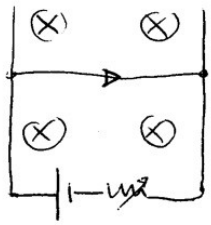
Soluzioni compitino 16/01/10

1. $F_m = i \ell B$

$F_p = mg$

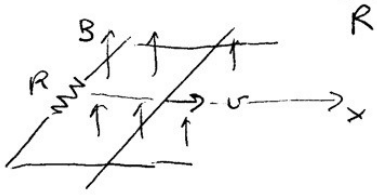
$mg = i \ell B$

$i = \frac{mg}{\ell B} = 1.5\ A$



2. $\mathcal{E}_i = -B\ell v$, $i = -\frac{B\ell v}{R}$

$F = i\ell B = -\frac{B^2\ell^2}{R} v$, $v = \frac{dx}{dt} \Rightarrow$ $m\frac{d^2x}{dt^2} = -\frac{B^2\ell^2}{R}\frac{dx}{dt}$



$m\frac{dv}{dt} = -\frac{B^2\ell^2}{R} v$

$\frac{dv}{v} = -\frac{B^2\ell^2}{Rm} dt$

segue $\ln\frac{v}{v_0} = -\frac{B^2\ell^2}{Rm} t$

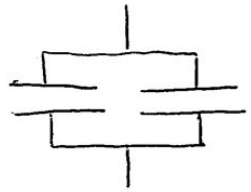
$v = v_0 e^{-\frac{B^2\ell^2}{Rm} t}$

a) $\tau = \frac{Rm}{B^2\ell^2}$ "costante di tempo"

b) $dx = v\,dt$ $\int_{x_0}^{\infty} dx = \int_0^{\infty} v_0 e^{-\frac{B^2\ell^2}{Rm} t} dt$

spazio percorso $x - x_0 = \frac{Rm}{B^2\ell^2} v_0$

c) $\int_0^{\infty} Ri^2\,dt = \frac{B^2\ell^2 v_0^2}{R^2} \int_0^{\infty} e^{-2\frac{B^2\ell^2}{Rm} t} dt = \frac{1}{2} m v_0^2$

3. 

$C' = \frac{C_0}{2}(1+K)$ $\omega_0 = \frac{1}{\sqrt{LC_0}}$

$\omega' = \frac{1}{\sqrt{LC'}}$

$\frac{\omega'}{\omega_0} = \frac{1}{\sqrt{\frac{1+K}{2}}}$

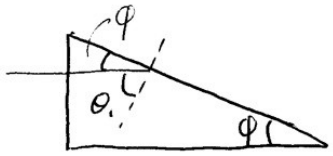
4. $i(t) = \frac{dq(t)}{dt} = \omega q \cos \omega t$, $C = \frac{1}{L\omega^2}$

$$U_m(t) = \frac{1}{2} L i^2(t) = \frac{1}{2} L \omega^2 q^2 \cos^2 \omega t$$

$$U_e(t) = \frac{1}{2} \frac{q^2(t)}{C} = \frac{1}{2} L \omega^2 q^2 \sin^2 \omega t$$

$$U_m(t) + U_e(t) = \frac{1}{2} L \omega^2 q^2 \quad \text{constante}$$

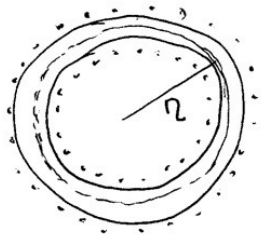
5. $\theta_i = \frac{\pi}{2} - \varphi$



$n \sin \theta_{i,\text{limite}} = 1$

$n \sin\left(\frac{\pi}{2} - \varphi\right) = n \cos \varphi$

$n \cos \varphi_{max} = 1$ $\qquad \varphi_{max} = 49°$

6. 

$\oint \vec{H} \cdot d\vec{\ell} = Ni$ $\qquad 2\pi r H = Ni$

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$M = (K_m - 1) H$ $\qquad H = \frac{M}{K_m - 1}$

$H = 50$ A/m $\qquad i = \frac{2\pi r H}{N} = 0.19$ A

$B = \mu_0 K_m H = 0.315$ T

7. a) $\sin \theta_{max} = \frac{m\lambda}{d} \Rightarrow x_{max} = m \frac{\lambda}{d} L$

$\sin \theta \sim \theta$

$\Delta x = \delta x_1 = \delta \frac{\lambda}{d} L$

$d = \frac{\delta L \lambda}{\Delta x} = 5{,}6 \times 10^{-4}$ m

b) $\frac{2\lambda_R}{d} = \frac{3\lambda_x}{d}$ $\qquad \lambda_x = \frac{2}{3} \lambda_R = 4.7 \times 10^{-7}$ m