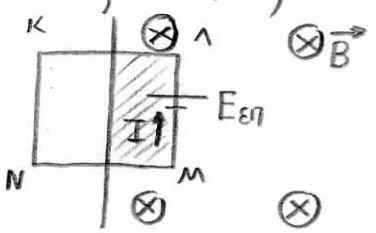
Απαντήσεις

⑤ $\ell = 1m$, $R = 0{,}2\Omega$, $B = 0{,}8T$, $v = 0{,}5 m/s$

A)



i) $I = \frac{B v \ell}{R} = \frac{0{,}8 \cdot 0{,}5 \cdot 1}{0{,}2} = 2A$

ii) $F_{L,KΛ} = BI\frac{\ell}{2} = 0{,}8 \cdot 2 \cdot 0{,}5 = 0{,}8N$

iii) $F_{L,ση} = F_{ΛM} = BI\ell = 0{,}8 \cdot 2 \cdot 1 = 1{,}6N$

iv) $F_{εξ} = F_{L,ση} = 1{,}6N$, $P_{Fεξ} = F_{εξ} \cdot v = 1{,}6 \cdot 0{,}5 = 0{,}8\,W$

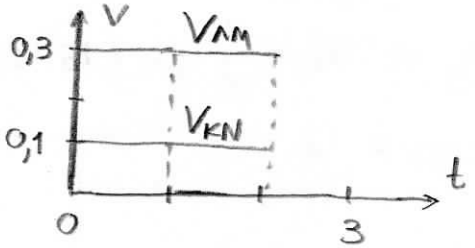
B) • $0 \le t < \frac{\ell}{v} \Rightarrow 0 \le t < 2s$

$V_{KN} = I \cdot \frac{R}{4} = 2 \cdot \frac{0{,}2}{4} = 0{,}1\,V$

$V_Λ - E_{επ} + I \cdot R_{ΛM} = V_M \Rightarrow V_{ΛM} = E_{επ} - I \cdot R_{KΛ} = 0{,}4 - 2 \cdot \frac{0{,}2}{4} =$

$= 0{,}4 - 0{,}1 = 0{,}3\,V$

• $2 \le t \le 3$ $V_{KN} = V_{ΛM} = 0$



Γ) $W_{Fεξ(0\to 2)} = 1{,}6N \cdot 1m = 1{,}6J$

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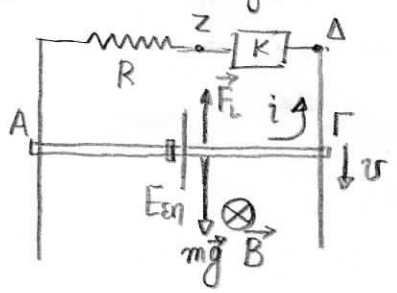
⑥ $m = 0{,}1kg$, $\ell = 1m$, $B = 0{,}5T$, $R = 1\Omega$, $t_1 \to v = 4 m/s$, $i = 0{,}8A$



i) $E_{επ} = Bv\ell = 0{,}5 \cdot 4 \cdot 1 = 2V$

ii) $V_Δ - E_{επ} + iR = V_Z \Rightarrow V_{ΔZ} = E_{επ} - iR \Rightarrow$

$\Rightarrow V_{ΔZ} = 2 - 0{,}8 \cdot 1 = 1{,}2\,V$

iii) $mg - F_L = m \cdot a \Rightarrow mg - BI\ell = ma \Rightarrow$

$\Rightarrow 1 - 0{,}5 \cdot 0{,}8 \cdot 1 = 0{,}1 \cdot a \Rightarrow 0{,}6 = 0{,}1 \cdot a \Rightarrow a = 6\,m/s^2$

$P_B = -\frac{\Delta U_B}{\Delta t} = mgv = 4W$, $P_{F_L} = -F_L \cdot v = -0{,}4 \cdot 4 = -1{,}6\,W$

$P_B \longrightarrow |P_{F_L}| = P_{ση} = \Delta Q/\Delta t = P_θ$

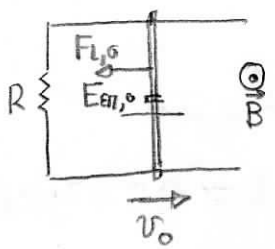
$\longrightarrow \frac{\Delta K}{\Delta t}$

iv) $P_{ση} = E_{επ} \cdot i = 2 \cdot 0{,}8 = 1{,}6\,W$

$P_K = V_{ΔZ} \cdot i = 1{,}2 \cdot 0{,}8 = 0{,}96W$ · $\Pi\% = \frac{0{,}96}{1{,}6} = 0{,}6 \to 60\%$

⑦ $m=0,2kg$, $\ell=1m$, $v_0=10\,m/s$, $B=0,4T$, $R=2\Omega$,

i)



i) α) $E_{επ,0}=Bv_0\ell=0,4\cdot10\cdot1=4V$, $I_{επ,0}=\frac{E_{επ,0}}{R}=2A$, $F_{L,0}=BI_{επ,0}\cdot\ell=$

$=0,4\cdot2\cdot1=0,8N$

$a_0=\frac{-F_{L,0}}{m}=-\frac{0,8}{0,2}=-4\,m/s^2$

β) $\frac{dK}{dt}=P_{ΣF}=-F_{L,0}\cdot v_0=-0,8\cdot10=-8W$

ii) α) t_1: $v_1=4\,m/s$: $E_{επ}=Bv\ell=0,4\cdot4\cdot1=1,6V$

$I_{επ}=\frac{E_{επ}}{R}=\frac{1,6}{2}=0,8A$, $F_L=BI_{επ}\ell=0,4\cdot0,8\cdot1=0,32N$

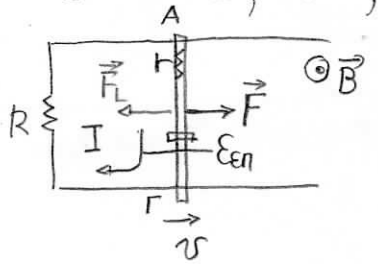
$P_{F_L}=-F_L\cdot v=-0,32\cdot4=-1,28\,W$

β) $P_{πλ}=E_{επ}\cdot I=1,6\cdot0,8=1,28W=|P_{F_L}|$

γ) ΘΜΚΕ $\frac{1}{2}mv_1^2-\frac{1}{2}mv_0^2=W_{F_L}\Rightarrow W_{F_L}=\frac{1}{2}0,2\,(16-100)$

$=-8,4J=W_{πλ}$ (ηλεκτρ. ενέργεια) $=Q$

⑧ $R=3\Omega$, $m=0,5\,kg$, $\ell=1m$, $r=1\Omega$, $F=6N$, $v=6\tau\alpha\theta$, $B=2T$



i) $ΣF=0\Rightarrow F_L=F\Rightarrow BI\ell=F\Rightarrow I=\frac{F}{B\ell}$

$\Rightarrow I=\frac{6}{2}=3A$

ii) $\mathcal{E}_{επ}=I(R+r)=3\cdot(3+1)=12V$

$\mathcal{E}_{εθ}=Bv\ell\Rightarrow v=\frac{\mathcal{E}_{επ}}{B\ell}=\frac{12}{2}=6\,m/s$

$V_{AΓ}=I\cdot R=3\cdot3=9V$

iii) $P_F=F\cdot v=6\cdot6=36W$

$P_{πλ}=\mathcal{E}_{επ}\cdot I=12\cdot3=36W=|P_{F_L}|=P_θ$

iv) α) $I_1=2A$, $F_L=BI_1\ell=4N$, $ΣF=m\cdot a\Rightarrow -F_L=m\cdot a$

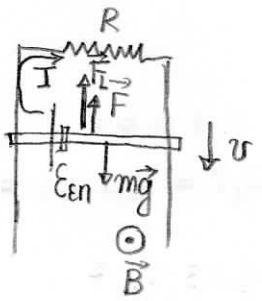
$-4=0,5\cdot a\Rightarrow a=-8\,m/s^2$

β) $\mathcal{E}_{επ}=I_1\cdot(R+r)=2\cdot4=8V$ $\mathcal{E}_{επ}=Bv_1\ell\Rightarrow v_1=4\,m/s$

$\frac{dK}{dt}=P_{F_L}=-F_L\cdot v_1=-4\cdot4=-16W$

<u>β' τρόπος</u> $P_{F_L}=-P_{πλ}=-I_1^2(R+r)=-4\cdot4=-16W$

(9) $l=1m$, $m=0,4kg$, $F=1N$, $R=2\Omega$, $B=2T$, $g=10m/s^2$, $v=$σταθ



α) $\Sigma F=0 \Rightarrow F_L+F-mg=0 \Rightarrow$

$BIl+F-mg=0 \Rightarrow$

$2I=4-1 \Rightarrow 2I=3 \Rightarrow I=1,5A$

$\mathcal{E}_{επ}=I\cdot R=1,5\cdot 2=3V$

$\mathcal{E}_{επ}=Bvl \Rightarrow v=\frac{\mathcal{E}_{επ}}{Bl}=1,5m/s$

β) Αν $F=0$, αμέσως μετά αυτό $v=1,5m/s \Rightarrow I=1,5A$

$F_L=BIl=3N$.

$\frac{dK}{dt}=P_{\Sigma F}=(mg-F_L)\cdot v=(4-3)\cdot 1,5=1,5W$

γ) $\Sigma F=mg-F_L \Rightarrow \Sigma F=mg-BIl \Rightarrow \Sigma F=mg-Bl\cdot\frac{Bvl}{R}$

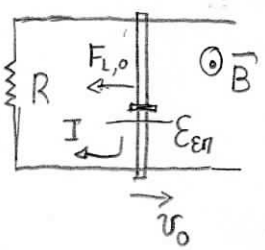
$\Rightarrow \Sigma F=mg-\frac{B^2l^2}{R}v$. Όσο $v\uparrow$ τόσο $\Sigma F\downarrow$

και όταν $\Sigma F=0 \Rightarrow v_{op}$ και I σταθεροποιείται.

$\Sigma F=0 \Rightarrow v_{op}=\frac{mgR}{B^2l^2}=\frac{0,4\cdot 10\cdot 2}{4}=2m/s$

$\Sigma F=0 \Rightarrow BI_{op}l=mg \Rightarrow I_{op}=\frac{mg}{Bl}=\frac{4}{2}=2A$

(10) $m=0,2kg$, $l=1m$, $v_0=10m/s$, $B=0,4T$, $R=2\Omega$,



i) α) $\mathcal{E}_{επ,0}=Bv_0l=0,4\cdot 10\cdot 1=4V$

$I_0=\frac{\mathcal{E}_{επ,0}}{R}=2A$

$F_{L,0}=BI_0l=0,4\cdot 2\cdot 1=0,8N$

$-F_{L,0}=m\cdot a_0 \Rightarrow a_0=-4m/s^2$

β) $\frac{dK}{dt}=P_{\Sigma F}=-F_{L,0}\cdot v_0=-0,8\cdot 10=-8W$

$\frac{dQ}{dt}=|P_{F_L}|=\mathcal{E}_{επ,0}\cdot I_0=4\cdot 2=8W$

ii) α) $v_1=4m/s$ $\mathcal{E}_{επ}=Bvl=0,4\cdot 4\cdot 1=1,6V$, $I=\frac{\mathcal{E}_{επ}}{R}=\frac{1,6}{2}=0,8A$

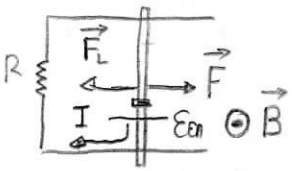
$F_L=BIl=0,4\cdot 0,8\cdot 1=0,32N$, $P_{F_L}=-F_L\cdot v=-0,32\cdot 4=-1,28W$

$P_{πγ}=\mathcal{E}_{επ}\cdot I=1,6\cdot 0,8=1,28W$

iii) ΘΜΚΕ: $W_{F_L}=\frac{1}{2}mv_1^2-\frac{1}{2}mv_0^2=\frac{1}{2}\cdot 0,2\cdot(16-100)=0,1\cdot(-84)=-8,4J$

$W_{F_L}=W_{πλ}=Q_R$

(11) $m=0,2\,kg$, $\ell=1\,m$, $F=1\,N$, $B=0,5\,T$, $R=2\,\Omega$,



i) $F=m\cdot a_0 \Rightarrow a_0=5\,m/s^2$

ii) $v_1=6\,m/s$. $\mathcal{E}_{επ}=Bv_1\ell=0,5\cdot6\cdot1=3\,V$

$I_1=\frac{\mathcal{E}_{επ}}{R}=\frac{3}{2}=1,5\,A$, $F_L=BI_1\ell=0,5\cdot1,5=0,75\,N$

$\Sigma F=m\cdot a_1 \Rightarrow 1-0,75=0,2\cdot a_1 \Rightarrow a_1=\frac{0,25}{0,2}=1,25\,m/s^2$

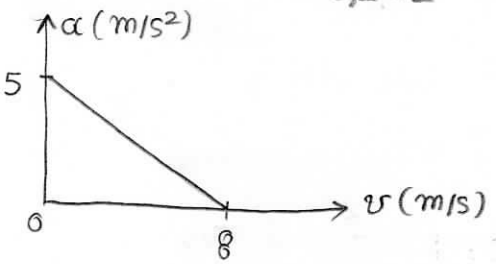
iii) Τυχαία t: $\Sigma F=m\cdot a \Rightarrow F-F_L=m\cdot a \Rightarrow F-BI\ell=ma \Rightarrow$

$\Rightarrow F-B\ell\cdot\frac{Bv\ell}{R}=m\cdot a \Rightarrow F-\frac{B^2\ell^2}{R}\cdot v=m\cdot a \Rightarrow a=\frac{FR-B^2\ell^2 v}{mR}$

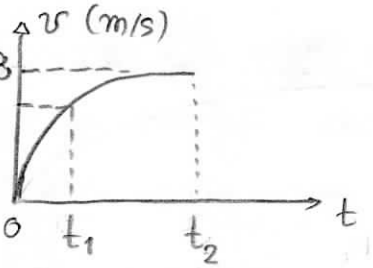
Όσο $v\nearrow \Rightarrow a\searrow$ και όταν $a=0 \rightarrow v_{op}$

$FR-B^2\ell^2 v_{op}=0 \Rightarrow v_{op}=\frac{FR}{B^2\ell^2}=\frac{1\cdot2}{0,25}=8\,m/s$

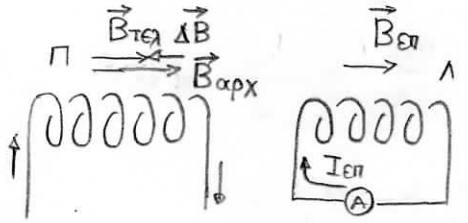
iv) $a=\frac{1\cdot2-0,25\cdot1\cdot v}{0,2\cdot2} \Rightarrow a=\frac{2-0,25v}{0,4} \Rightarrow a=5-0,625\cdot v$



v)



(12)

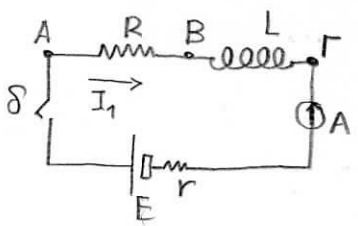


$\vec{B}_{επ}$ έχει κατεύθυνση αντίθετη του $\Delta\vec{B}$

$\alpha\rightarrow\Lambda$ $\beta\rightarrow\Sigma$ $\gamma\rightarrow\Sigma$

$E_2=-M\cdot\frac{dI_1}{dt} \Rightarrow 0,3=-M\cdot(-2) \Rightarrow M=0,15\,H$

(13) $E=40V$, $R=3\,\Omega$, $r=1\,\Omega$, $L=0,8\,H$, $I_1=6\,A$



i) $V_{AΓ}=V_η=E-I_1\cdot r=40-6\cdot1=34V$

$V_{AB}=V_R=I_1\cdot R=6\cdot3=18V$

$V_{AΓ}=V_{AB}+V_{BΓ} \Rightarrow V_{BΓ}=16V$ με την πολικότητα B(+) Γ(−)

Το ηηνίο λειτουργεί ως αποδέκτης: $E_{αυτ}=-V_{BΓ}=-16V$

Το (−) το περιμέναμε αφού $di/dt>0 \Rightarrow E_{αυτ}=-L\cdot di/dt<0$

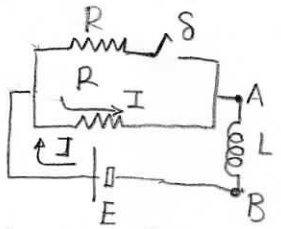
ii) $P_E=E\cdot I_1=40\cdot6=240W$, $P_{Eεπ}=E_{επ}\cdot I_1=-16\cdot6=-96W$

$P_θ=I_1^2(r+R)=36\cdot4=144\,W$

iii) $U_B=\frac{1}{2}LI_1^2=\frac{1}{2}\cdot0,8\cdot6^2=0,4\cdot36=14,4\,J$

$\frac{dU_B}{dt}=P_B=V_{BΓ}\cdot I_1=16\cdot6=96\,J/s$

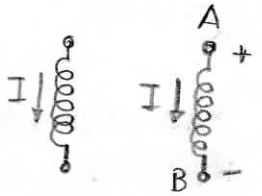
(14) $R=10\Omega$, $L=2H$, $E=40V$,

i) 

$I:$ σταθ $\Rightarrow \frac{di}{dt}=0 \Rightarrow E_{αυτ}=0 \Rightarrow V_{AB}=0$

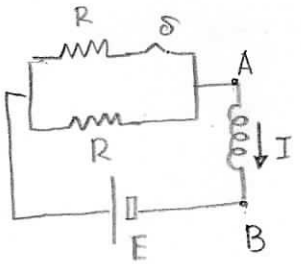
Αν συνδεθεί και η R

$R_{ολ}=\frac{R}{2}=5\Omega \Rightarrow R_{ολ}\downarrow \Rightarrow I$ τείνει να <u>αυξηθεί</u>

ii) α) 

Εμφανίζεται $E_{αυτ}$ ώστε να "εμποδίσει" το I που αυξάνεται

$V_{AB}>0 \rightarrow$ (γ)

β) 

Την $t=0^+$ που κλείνει ο δ

$I=\frac{E}{R}=\frac{40}{10}=4A$

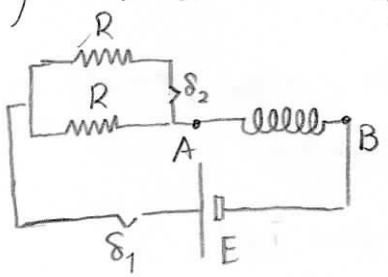
$E+E_{αυτ}=I\cdot R_{ολ} \Rightarrow 40+E_{αυτ}=1\cdot 5 \Rightarrow E_{αυτ}=-20V$

Το (−) το περιμέναμε διότι $\frac{di}{dt}>0$ και $E_{αυτ}=-L\frac{di}{dt}<0$

και το πηνίο λειτουργεί ως αποδέκτης $\rightarrow$ (β)

γ) $E_{αυτ}=-L\frac{di}{dt} \Rightarrow \frac{di}{dt}=-\frac{E_{αυτ}}{L}=-\frac{-20}{2}=+10\frac{A}{S} \rightarrow$ (γ)

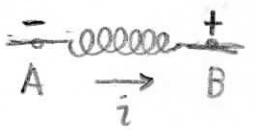
(15) i) δ_1: μένει : α) $I=0$ και αρχίζει να αυξάνει $\rightarrow$ Λ



β) Σ γ) Σ

δ) Λ $\frac{dU_B}{dt}=V_{AB}\cdot I$ μεταβάλλεται

ii) δ_2: ανοίγει : $R_{ολ}=R$ δηλ. αυξάνει $\Rightarrow I$ τείνει να μειωθεί



α) $E_{αυτ}$ ώστε να "ενισχύσει" το I

A (−), B (+)

β) δ_2 μένει σταθ.: $I=\frac{E}{\frac{R}{2}}=\frac{2E}{R}$, $U_1=\frac{1}{2}L\frac{4E^2}{R^2}$

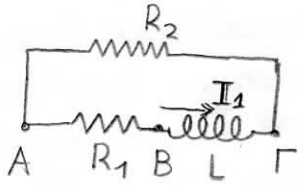
δ_2 ανοιχτό: $I'=\frac{E}{R}$, $U_2=\frac{1}{2}L\frac{E^2}{R^2}$

$\Rightarrow \frac{U_1}{U_2}=4 \rightarrow$ (δ)

(16) $R_1=4\Omega$, $R_2=10\Omega$, $L=0{,}2H$, $E=20V$, $t_1=5s$

α) $I_1=\frac{E}{R_1}=5A$, $I_2=\frac{E}{R_2}=2A$

β)



$V_{AB}+V_{B\Gamma}+V_{\Gamma A}=0 \Rightarrow$

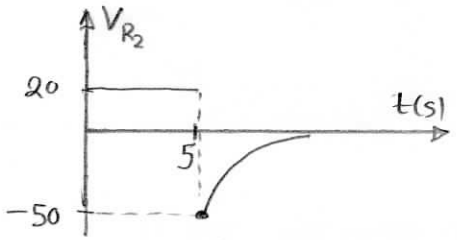
$I_1R_1+V_{B\Gamma}+I_1\cdot R_2=0$

$V_{B\Gamma}=-I_1(R_1+R_2)=-5\cdot 14=-70V$

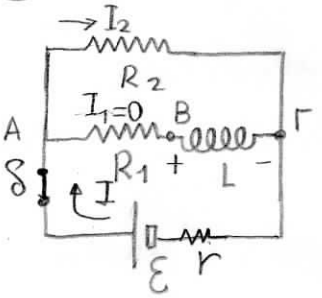
$E_{\alpha\upsilon\tau}=+70V$

γ) $\frac{dU_B}{dt}=P_B=V_{B\Gamma}\cdot I_1=-70\cdot 5=-350\,J/s$

δ) ΠΡΙΝ : $V_{R_2}=I_2R_2=20V$, ΜΕΤΑ: $V_{R_2}=-I_1\cdot R_2=-50V$



(17) $R_1=10\Omega$, $R_2=10\Omega$, $L=0{,}2H$, $E=84V$, δ: ιδεινή, $r=2\Omega$



i) $I_1=0$, $I_2=\frac{E}{r+R_2}=\frac{84}{12}=7A=I$

ii) $V_\Pi=\mathcal{E}-I\cdot r=84-7\cdot 2=70V$

$V_{A\Gamma}=V_{AB}+V_{B\Gamma} \Rightarrow 70=V_{B\Gamma}$

iii) $E_{\alpha\upsilon\tau}=-70V \Rightarrow -0{,}2\cdot\frac{di}{dt}=-70 \Rightarrow \frac{di}{dt}=350\,A/s$

iv) Τζιμα: $R_{1,2}=\frac{R_1\cdot R_2}{R_1+R_2}=5\Omega$, $I=\frac{E}{r+R_{1,2}}=\frac{84}{7}=12A$

$V_\Pi=\mathcal{E}-I\cdot r=84-12\cdot 2=60V$

$I_1=\frac{V_\Pi}{R_1}=\frac{60}{10}=6A$

$U_B=\frac{1}{2}LI_1^2=\frac{1}{2}\cdot 0{,}2\cdot 36=3{,}6\,J$