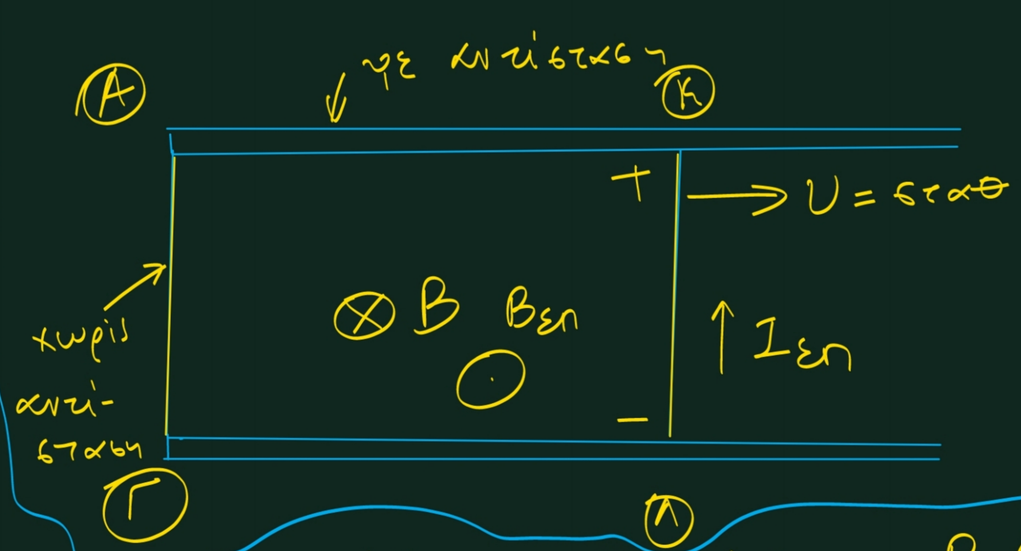
Ασκ. 5.59.

$l = 10\,cm = 0,1\,m$

$R^* = 0,01\,\Omega/cm =$

$= \frac{0,01\,\Omega}{0,01\,m} = 1\,\Omega/m$

$B = 5 \cdot 10^{-2}\,T$



Ο αγωγός ΚΛ τη στιγμή $t=0$ βρίσκεται στη θέση ΑΓ.

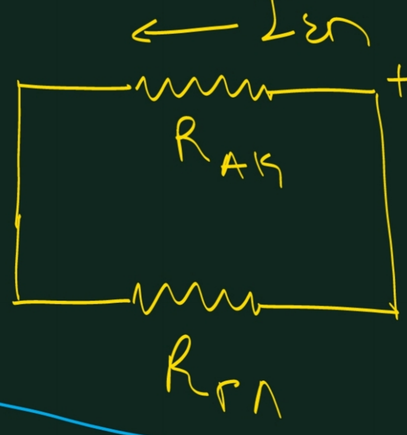
$$E_{επ} = \frac{\Delta\Phi}{\Delta t} = \frac{B \cdot \Delta A}{\Delta t} = \frac{B l \cdot v \cdot \Delta t}{\Delta t} = B l v$$

$$R_{ΑΚ} = R^* \cdot ΑΚ = R^* \cdot v \cdot t = R_{ΓΛ}$$

$$\text{Άρα: } I_{επ} = \frac{E_{επ}}{R_{ολ}} = \frac{B l \cdot v}{R_{ΑΚ} + R_{ΓΛ}} = \frac{B l v}{2 R^* v t} \Rightarrow$$

$$I_{επ} = \frac{Bl}{2R^* t} \Rightarrow I_{επ}(t) = \frac{5 \cdot 10^{-3}}{2 \cdot 1 \cdot t} \Rightarrow \boxed{I_{επ}(t) = \frac{2,5 \cdot 10^{-3}}{t}\,(SI)}$$

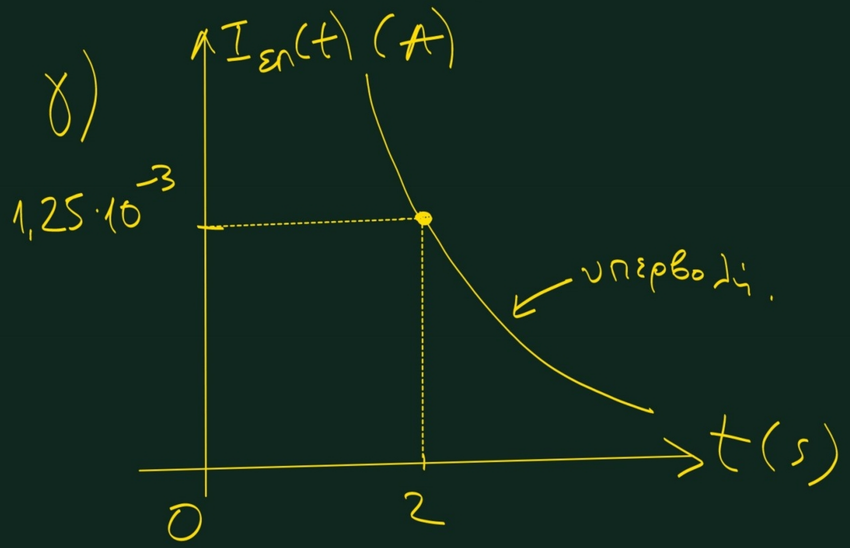
$I_{επ}$ ισοδύναμο κύκλωμα.



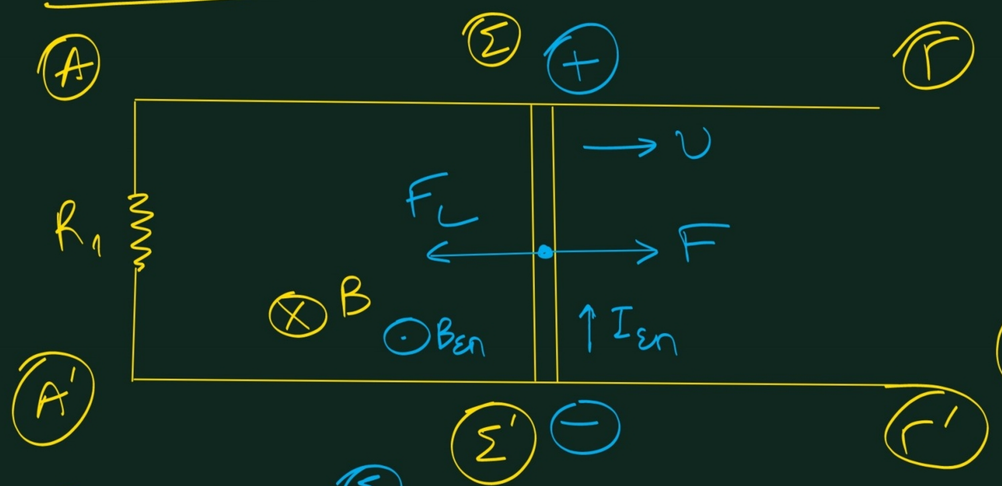
β) Τη στιγμή $t_1 = 2\,sec$ έχουμε:

$$I_{επ}(2) = \frac{2,5 \cdot 10^{-3}}{2} = 1,25 \cdot 10^{-3}\,A$$

γ)

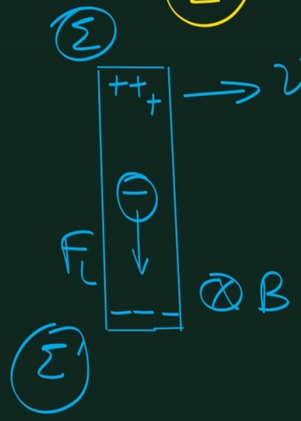


Ασκ. 5.60.)

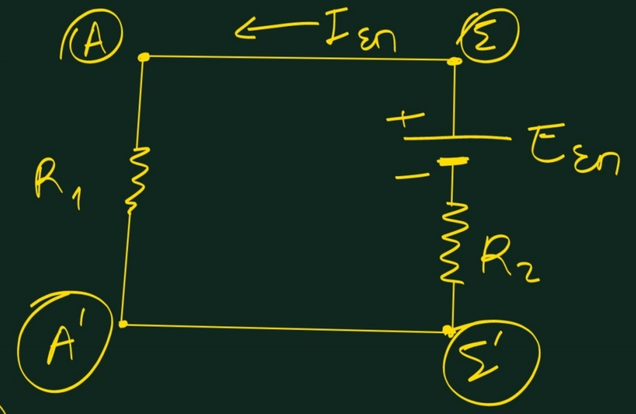


$R_1 = 0,1\,\Omega$

$R_2 = 0,5\,\Omega$



Ισοδύναμο κύκλωμα.



α) Όταν σταθεροποιείται η ταχύτητα γίνεται: $F = F_L \Rightarrow F = BI_{επ}\ell \Rightarrow$

$$F = B\cdot\frac{BV_{σρ}\ell}{R_1+R_2}\ell \Rightarrow V_{σρ} = \frac{F(R_1+R_2)}{B^2\ell^2} \Rightarrow$$

$$V_{σρ} = \frac{1\cdot 0,6}{0,04\cdot 1} = \frac{60}{4} = 15\ m/s.$$

$$V_{\Sigma\Sigma'} = E_{\epsilon\pi} - I_{\epsilon\pi} \cdot R_2 =$$

$$= 0,2 \cdot 15 \cdot 1 - 15 \cdot 0,5$$

$$= 7,5 - 9 \ ;$$

$$I_{\epsilon\pi} = \frac{E_{\epsilon\pi}}{R_1 + R_2} = \frac{B v_{o\rho} \ell}{R_1 + R_2} = \frac{0,2 \cdot 15 \cdot 1}{0,6} \Rightarrow$$

$$I_{\epsilon\pi} = 5 \, A$$

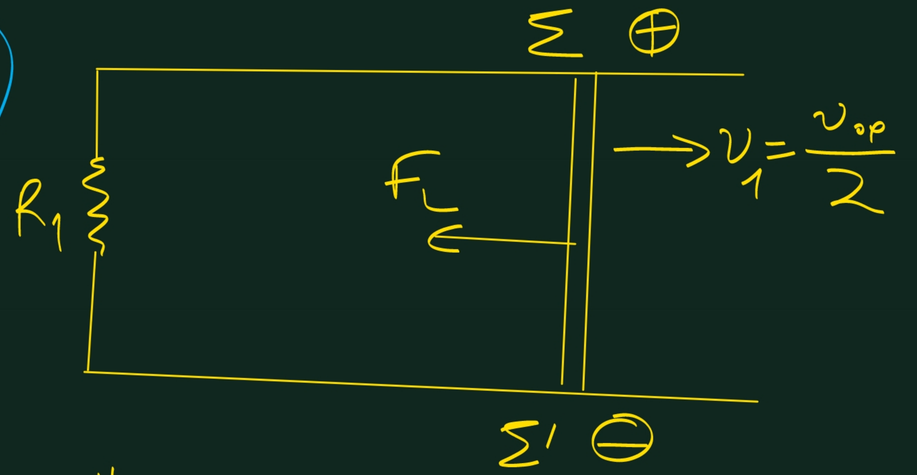
$$V_{\Sigma\Sigma'} = E_{\epsilon\pi} - I_{\epsilon\pi} \cdot R_2 \Rightarrow$$

$$V_{\Sigma\Sigma'} = B v_{o\rho} \cdot \ell - I_{\epsilon\pi} \cdot R_2 \Rightarrow$$

$$V_{\Sigma\Sigma'} = 0,2 \cdot 15 \cdot 1 - 5 \cdot 0,5 \Rightarrow$$

$$V_{\Sigma\Sigma'} = 3 - 2,5 \Rightarrow \boxed{V_{\Sigma\Sigma'} = 0,5 \, Volt}$$

β)



Η τάση είναι μη σταθερά επιβραδυνόμενη

$$E'_{\epsilon\pi} = B v_1 \ell = B \cdot \frac{v_{o\rho}}{2} \cdot \ell = 0,2 \cdot \frac{15}{2} \cdot 1 \Rightarrow$$

$$E'_{\epsilon\pi} = 1,5 \, Volt$$

$$I'_{\text{επ}} = \frac{E'_{\text{επ}}}{R_1+R_2} = \frac{1,5}{0,1+0,5} = \frac{1,5}{0,6} = \frac{15}{6} = 2,5\ \text{Volt}.$$

Η ταχύτητα μειώνεται άρα:

$$m\cdot\frac{\Delta v}{\Delta t} = -F'_L \Rightarrow 0,1\cdot\frac{\Delta v}{\Delta t} = -B I'_{\text{επ}}\cdot\ell \Rightarrow$$

$$0,1\cdot\frac{\Delta v}{\Delta t} = -0,2\cdot 2,5\cdot 1 \Rightarrow$$

$$\boxed{\frac{\Delta v}{\Delta t} = -5\ \text{m/sec}^2}$$

Η κινητική ενέργεια μειώνεται άρα:

$$\frac{\Delta K}{\Delta t} = -\Sigma F\cdot v_1 \Rightarrow$$

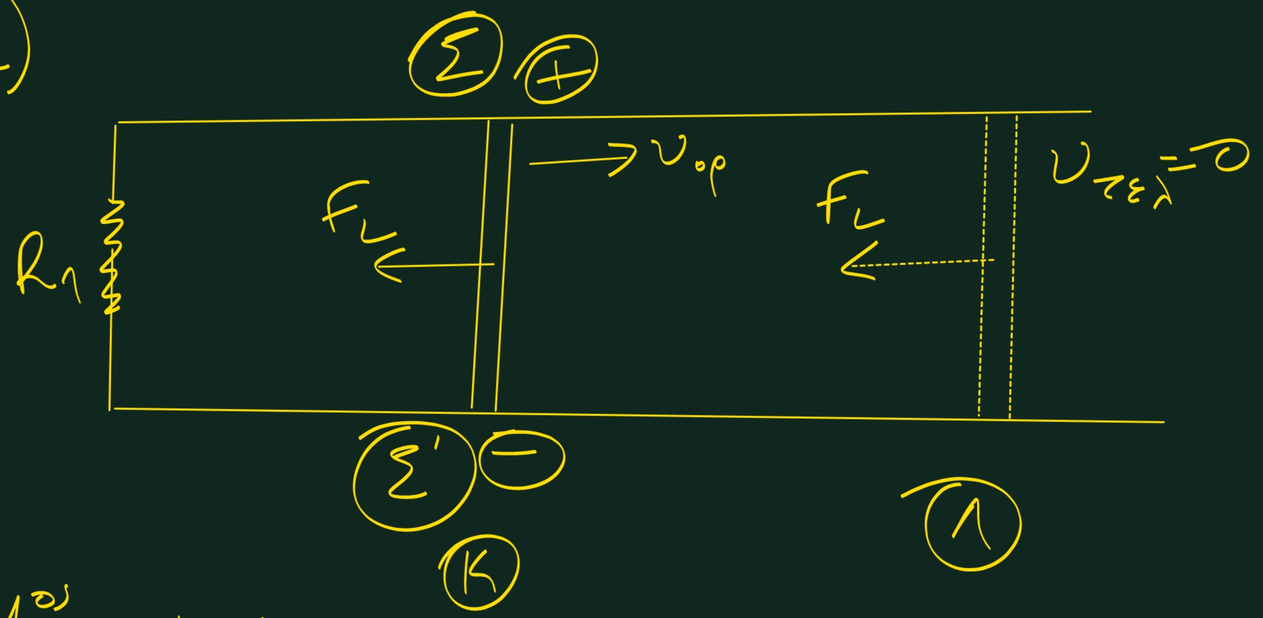
$$\frac{\Delta K}{\Delta t} = -F_L\cdot v_1 = -B I'_{\text{επ}}\cdot\ell\cdot\frac{v_{\text{αφ}}}{2} =$$

$$= -0,2\cdot 2,5\cdot 1\cdot\frac{15}{2} \Rightarrow$$

$$\frac{\Delta K}{\Delta t} = -0,25\cdot 15 = -\frac{15}{4} =$$

$$\boxed{\frac{\Delta K}{\Delta t} = -3,75\ \text{J/sec}}$$

B2)



2ος τρόπος (Θεώρημα Κινητικής Ενέργειας)

$\Delta K = \Sigma W \Rightarrow 0 - \frac{1}{2} m \upsilon_{ορ}^2 = W_{F_L} \Rightarrow$

$W_{F_L} = -\frac{1}{2} m \upsilon_{ορ}^2 = -11,25 \text{ Joule}.$

Αλλά: $Q = |W_{F_L}| \Rightarrow$

$Q = 11,25 \text{ Joule}.$

1ος τρόπος

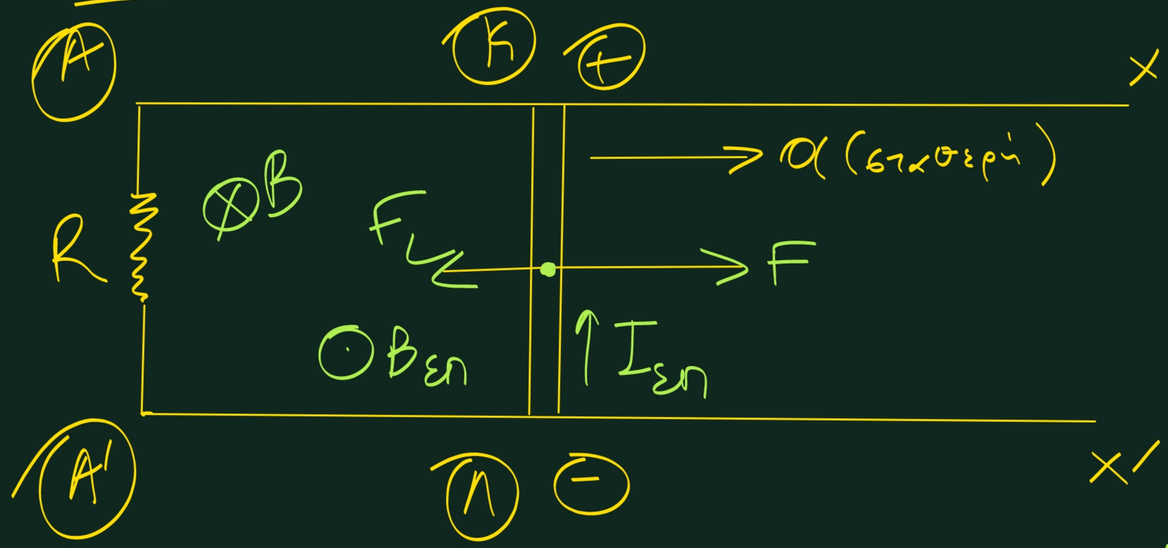
ΑΔΕ: Κ → Λ : $E_{μηχ(Κ)} + W_{F_{εξ}} = E_{μηχ(Λ)} + Q \Rightarrow$

$\frac{1}{2} m \upsilon_{ορ}^2 + \overbrace{W_{F_{εξ}}}^{0} = 0 + Q \Rightarrow Q = \frac{1}{2} m \upsilon_{ορ}^2 = \frac{1}{2} \cdot 0,1 \cdot 15^2 = \frac{0,1 \cdot 225}{2} \Rightarrow$

$Q = \frac{22,5}{2} \Rightarrow \boxed{Q = 11,25 \text{ Joule}}$

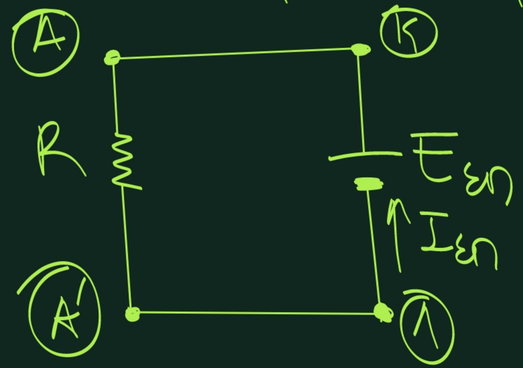
αφού καταφθάνει η F_L.

Ασκ. 5.62



$U_0 = 0$.

Ισοδύναμο κύκλωμα:



α) $\Sigma F = ma \Rightarrow F - F_L = ma \Rightarrow$

$F - BI_{επ} \cdot l = ma$.

$I_{επ} = \frac{E_{επ}}{R} = \frac{Bul}{R} = \frac{Blat}{R} \Rightarrow$

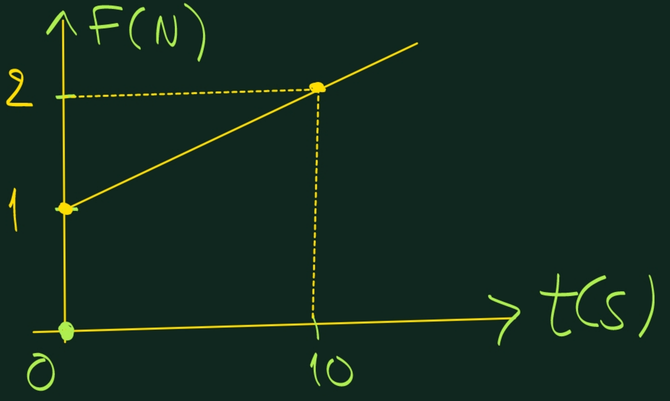
$I_{επ} = \frac{0,5 \cdot 1 \cdot 2 \cdot t}{5} \Rightarrow I_{επ} = 0,2t\,(SI)$

Άρα: $F - 0,5 \cdot 0,2t \cdot 1 = 0,5 \cdot 2 \Rightarrow$

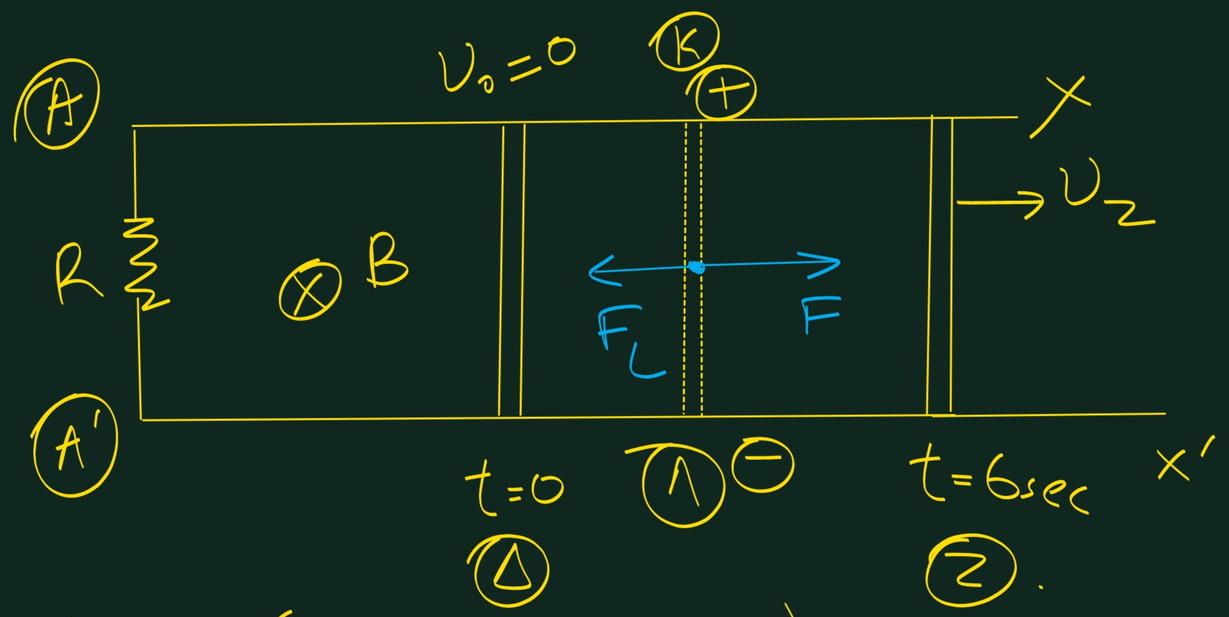
$F - 0,1t = 1 \Rightarrow F = 1 + 0,1t\,(SI)$

$F(0) = 1\,N$

$F(10) = 1 + 1 = 2\,N$



Β) Γνωρίζουμε ότι από $t=0$ sec μέχρι $t=6$ sec είναι: $W_F = 50,4$ Joule



1ος τρόπος (Διατήρηση ενέργειας)

$E_{μηχ(Δ)} + W_{Fεξ} = E_{μηχ(Ζ)} + Q \Rightarrow$

$K_Δ + W_{Fεξ} = K_Ζ + Q \Rightarrow 0 + W_F = \frac{1}{2}mU_2^2 + Q \Rightarrow$

$W_F = \frac{1}{2}m(at)^2 + Q \Rightarrow$

$50,4 = \frac{1}{2}\cdot 0,5\cdot(2\cdot 6)^2 + Q \Rightarrow$

$50,4 = 0,25\cdot 4\cdot 36 + Q \Rightarrow$

$50,4 = 36 + Q \Rightarrow Q = 14,4$ Joule

2ος τρόπος (ΘΜΚΕ)

$ΔK = ΣW \Rightarrow K_Ζ - K_Δ = W_{Fεξ} + W_{F_L} \Rightarrow$

$\frac{1}{2}mU_2^2 - 0 = W_F - |W_{F_L}| \Rightarrow$

$\frac{1}{2}mU_2^2 = W_F - Q \Rightarrow$

$Q = W_F - \frac{1}{2}mU_2^2$

$F = 1 + 0{,}1t \ (SI)$

$x = \frac{1}{2} a t^2 \Rightarrow x = \frac{1}{2} \cdot 2 \cdot t^2 \Rightarrow$

$t^2 = x \Rightarrow t = \sqrt{x}$

$t = 0 \Rightarrow x = 0$

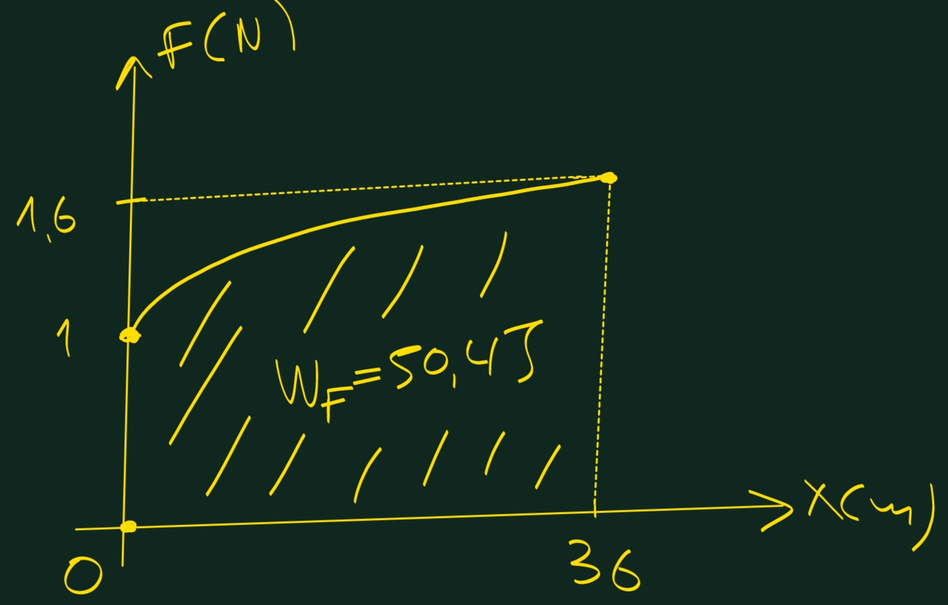
$t = 6s \Rightarrow x = 36\,m.$

Άρα: $F(x) = 1 + 0{,}1\sqrt{x} \ (SI)$

$F(0) = 1N$

$F(36) = 1{,}6N$

Έχουμε έργο μεταβλητής δύναμης που βρίσκεται από το εμβαδό στο διάγραμμα $F - x$.



γ) $\frac{\Delta K}{\Delta t} = \Sigma F \cdot v = ma \cdot at = ma^2 t \Rightarrow$

$\frac{\Delta K}{\Delta t} = 0,5 \cdot 4 \cdot 6 = 12\ J/sec$

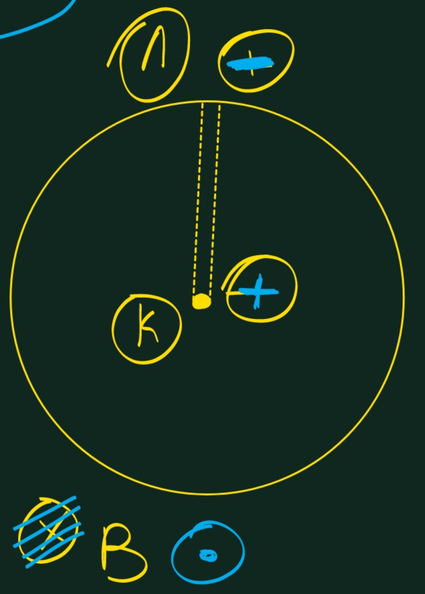
$\left(\frac{\Delta K}{\Delta t} > 0$ επειδή κινείται επιταχυνόμενη$\right)$

Η τάση μεταξύ περιφέρειας και κέντρου είναι $V_{ΛK} = V_Λ - V_K = -0,628\ Volt$

Άρα: $V_Λ < V_K$ οπότε στο (Λ) έχουμε (−) και στο (Κ) έχουμε (+)

Άσκ. 5.45.)

$R = 10\ cm$



Τον δίσκο τον βλέπουμε σαν ένα σύνολο ευθυγράμμων ρευματοφόρων αγωγών μήκους $l = R$.

Άρα: $E_{επ} = V_{ΚΛ} = \frac{1}{2} B\omega l^2 \Rightarrow$

$E_{επ} = \frac{1}{2} B\omega R^2$

$f = 1500\ στρ/min = 1500\ στρ/60\ sec \Rightarrow$

$f = \frac{1500}{60} Hz \Rightarrow f = 25\ Hz$

$\omega = 2\pi f = 2\pi \cdot 25 = 50\pi\ rad/sec$

$E_{\varepsilon\pi} = 0,628 = 0,1 \cdot 2\pi = 0,2\pi \ (V.\sigma\tau)$

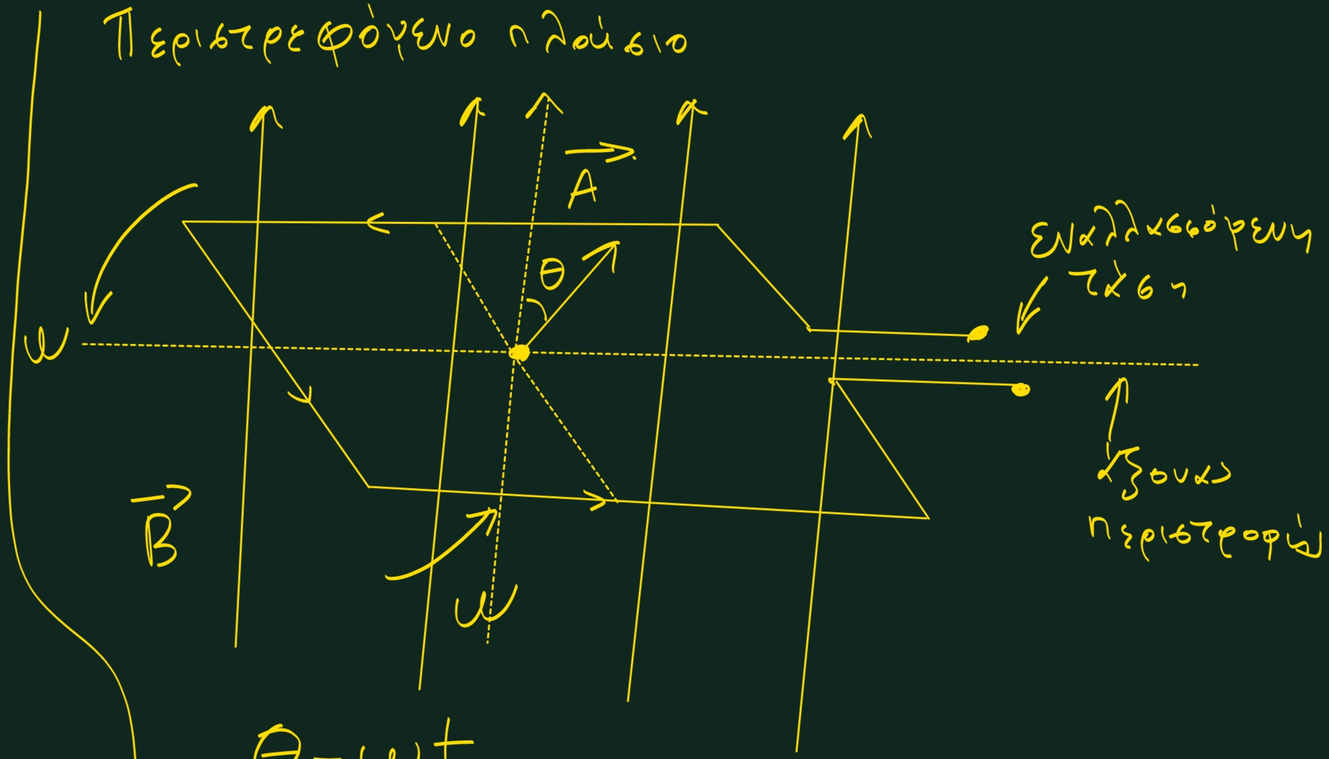
$6,28 \cong 2\pi$

$E_{\varepsilon\pi} = \frac{1}{2} B \omega R^2 \Rightarrow$

$0,2\pi = \frac{1}{2} \cdot B \cdot 50\pi \cdot (0,1)^2 \Rightarrow$

$0,4\pi = 50\pi \cdot B \cdot 0,01 \Rightarrow$

$0,4\pi = 0,5\pi B \Rightarrow B = \frac{0,4\pi}{0,5\pi} = 0,8 \ Tesla.$



$\theta = \omega t$

$\Phi = \vec{B} \cdot \vec{A} = BA \cdot \sigma\upsilon\nu\omega t$ (για μία σπείρα)

Γενικά: $\Phi = NBA\sigma\upsilon\nu\omega t$