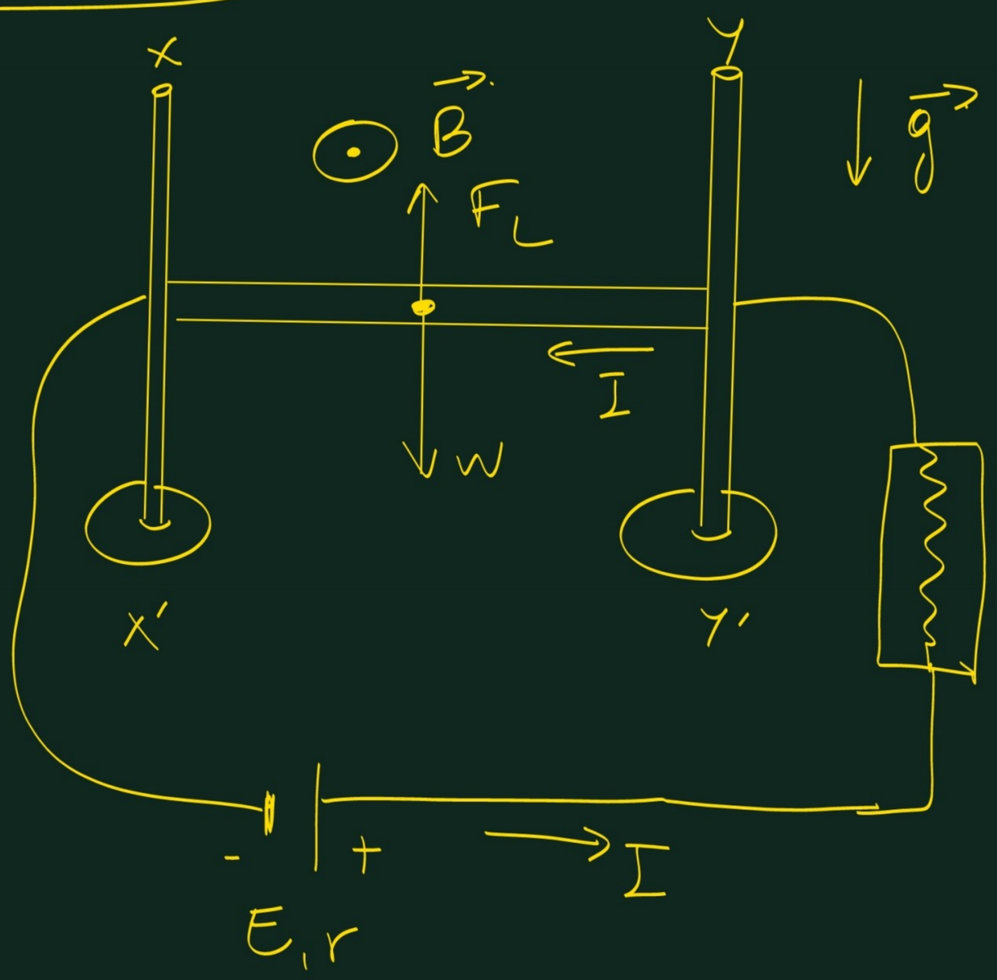
Ασκ. 4.88. $\ell = 1\,m$ $m = 0{,}2\,kg$. $R_1 = 4\,\Omega$ $E = 50\,V$ $r = 1\,\Omega$

$B = 0{,}4\,Tesla$



α) Η φορά των δυναμικών γραμμών του $\vec{B}$ είναι προς τα έξω.

β) $mg = BI\ell \Rightarrow$

$0{,}2 \cdot 10 = 0{,}4 \cdot I \cdot 1 \Rightarrow$

$I = 5\,A$

R_Σ

γ) $R_{o\lambda} = \frac{E}{I} = \frac{50}{5} = 10\,\Omega$

$R_{o\lambda} = R_1 + r + R_\Sigma \Rightarrow 10 = 4 + 1 + R_\Sigma \Rightarrow$

$R_\Sigma = 5\,\Omega$

$V_K = I \cdot R_\Sigma \Rightarrow$

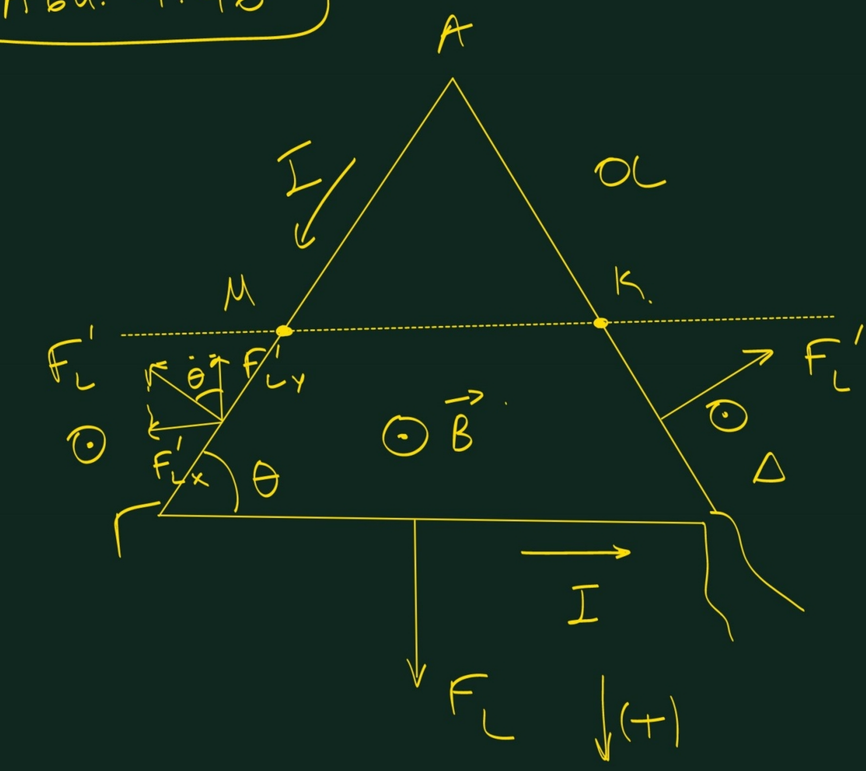
$V_K = 25\,Volt$

$P_K = \frac{V_K^2}{R_\Sigma} \Rightarrow$

$P_K = \frac{625}{5} \Rightarrow$

$P_K = 125\,Watt$

Άσκ. 4.46.



$$F_L = BI(\Gamma\Delta) = BI\alpha$$

$$F_L' = BI(\Gamma M) = BI\cdot\frac{\alpha}{2}$$

$$F_{Ly}' = F_L'\cdot\sigma\upsilon\nu\theta = BI\frac{\alpha}{2}\cdot\sigma\upsilon\nu 60^\circ = \frac{BI\alpha}{4}$$

$$\Sigma F_x = F_{Lx}' - F_{Lx}' = 0$$

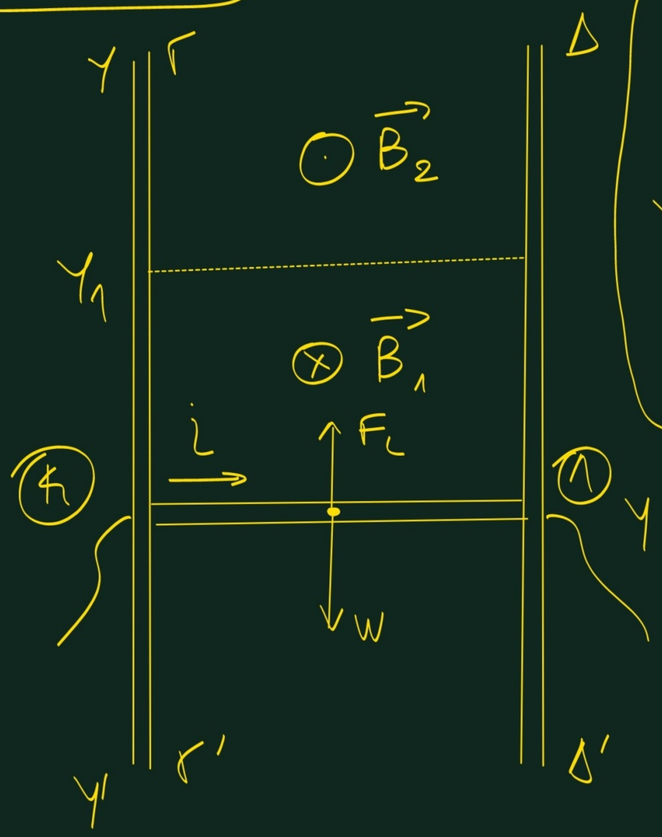
αφού $F_{L(\Gamma M)}' = F_{L(K\Delta)}'$

$$\Sigma F_y = F_L - 2F_{Ly}' = BI\alpha - 2\frac{BI\alpha}{4} \Rightarrow$$

$$\Sigma F_y = \frac{BI\alpha}{2} \Rightarrow \boxed{\Sigma F = \frac{F}{2}}$$

αφού $\Sigma\vec{F} = \Sigma\vec{F}_y + \cancel{\Sigma\vec{F}_x}^{\,0} = \Sigma\vec{F}_y$

Ασκ. 4.91.



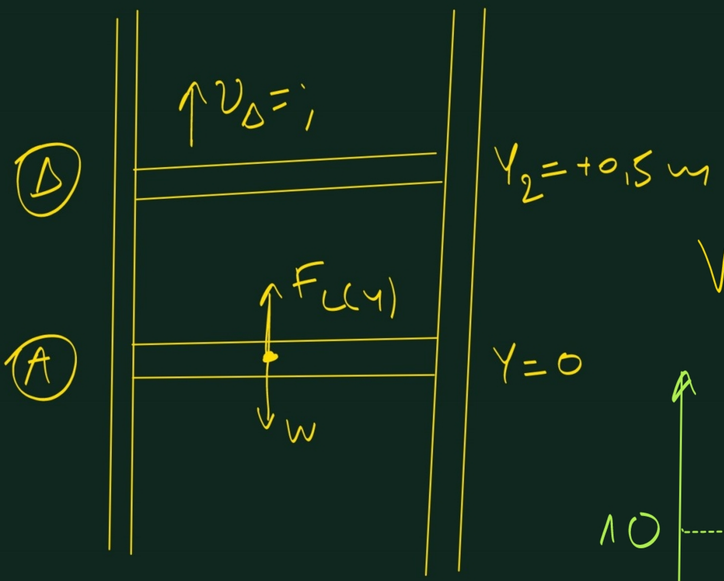
$l = 2,5\,m$
$m = 0,5\,kg$
$i = 4 + 2y\,(SI)$
$y_1 = +1,5\,m$
$B_1 = 0,8\,T$
$B_2 = 0,4\,T$

α) Στη θέση $y=0$ έχουμε:
$i(0) = 4\,A$
$F_L = B_1 \cdot l \cdot i(0) \Rightarrow$
$F_L = 0,8 \cdot 2,5 \cdot 4 \Rightarrow$
$F_L = 8\,N$ (προς τα πάνω)
$W = mg = 5\,N$ (προς τα κάτω)

Άρα ο αγωγός ΚΛ αρχικά θα κινηθεί προς τα πάνω με επιτάχυνση:
$ma = F_L - W \Rightarrow 0,5a = 8 - 5 \Rightarrow a = 6\,m/s^2$

β) $F_{L(y)} = B_1 l i(y) = 0,8 \cdot 2,5 \cdot (4 + 2y) \Rightarrow$
$F_{L(y)} = 8 + 4y\,(SI)$

ב)



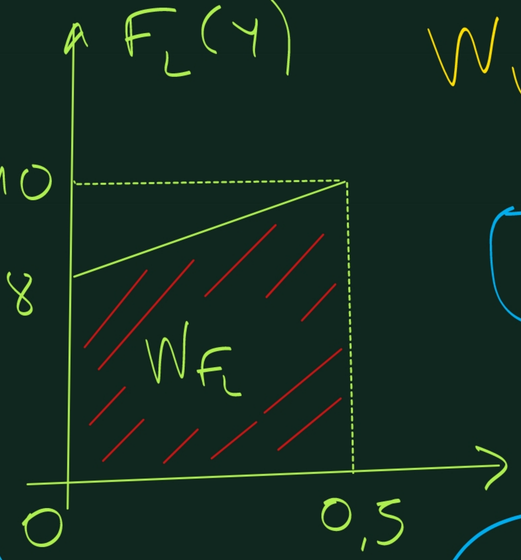
$F_L(0) = 8\ N$

$F_L(0,5) = 10\ N$

$W_{F_L(A\to\Delta)} = \frac{8+10}{2} \cdot 0,5 = 4,5\ Joule.$

$W_{W(A\to\Delta)} = -mgy_2 = -0,5 \cdot 10 \cdot 0,5 =$

$= -2,5\ J$



$F_L(y) = 8 + 4y\ (SI).$

$P_{F_L(y_2)} = F_L(y_2) \cdot v_\Delta \Rightarrow$

$\Rightarrow P_{F_L(y_2)} = 20\sqrt{2}\ Watt$

משפט: $A \to \Delta$:

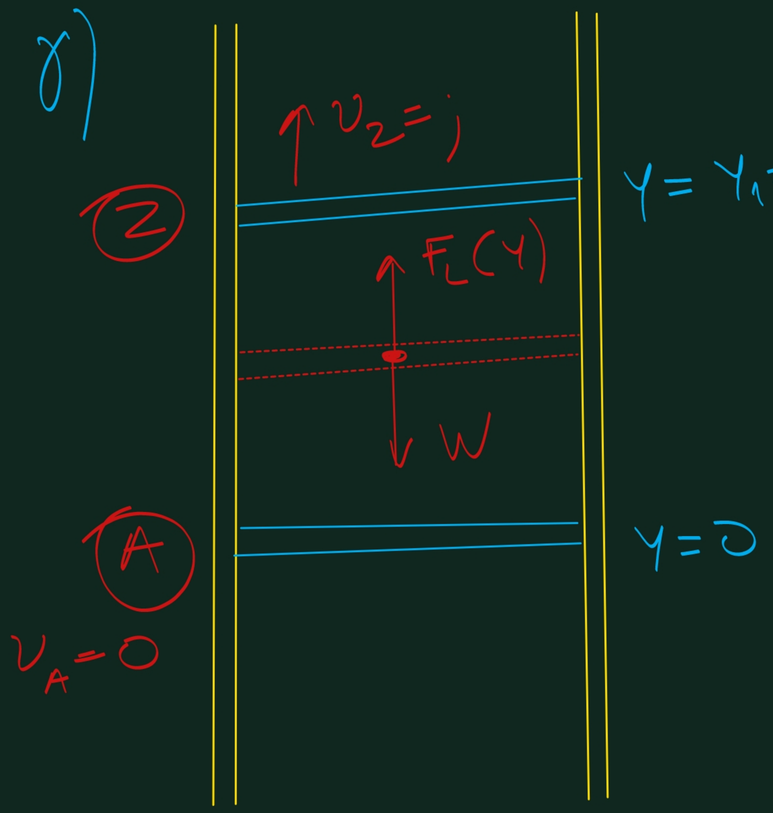
$\Delta K = \Sigma W \Rightarrow$

$\frac{1}{2} m v_\Delta^2 = W_{F_L(A\to\Delta)} + W_{W(A\to\Delta)} \Rightarrow$

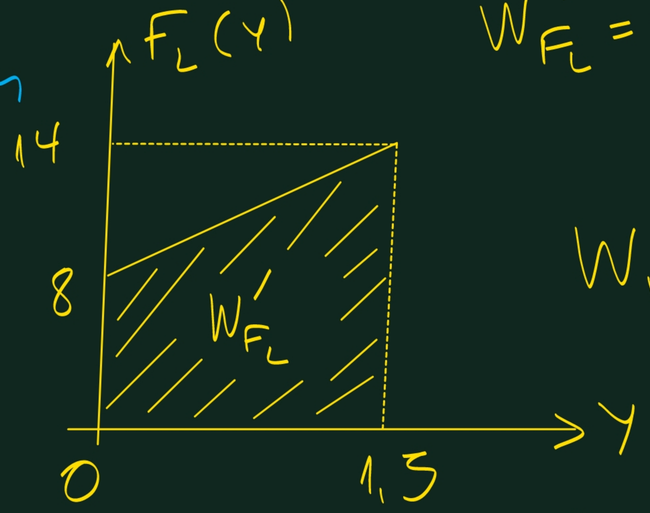
$\frac{1}{2} \cdot 0,5 \cdot v_\Delta^2 = 4,5 - 2,5 \Rightarrow \frac{v_\Delta^2}{4} = 2 \Rightarrow$

$v_\Delta = 2\sqrt{2}\ m/s.$

γ)



$F_L(y_1) = 8 + 4 \cdot 1,5 = 8 + 6 = 14N$



$W'_{F_L} = W_{F_L(A \to Z)} = \frac{8+14}{2} \cdot 1,5 =$

$= 11 \cdot 1,5 = 16,5$ Joule.

$W_{W(A \to Z)} = -0,5 \cdot 10 \cdot 1,5 =$

$= -7,5$ Joule.

ΘΜΚΕ: $A \to Z$: $\frac{1}{2} m \upsilon_2^2 = W_{F_L(A \to Z)} + W_{W(A \to Z)} \Rightarrow$

$\frac{1}{2} \cdot 0,5 \cdot \upsilon_2^2 = 16,5 - 7,5 \Rightarrow \frac{\upsilon_2}{4} = 9 \Rightarrow \upsilon_2 = 6\ m/s.$

Άρα η ζητούμενη ορμή είναι: $p_2 = m\upsilon_2 = 0,5 \cdot 6 = 3\ kg \cdot m/s$

με φορά προς τα πάνω.

δ) Στη θέση y_1 το ρεύμα είναι:

$i(y_1) = 4 + 2 \cdot 1,5 = 7\,A$

Από κει και πάνω γίνει σταθερό.

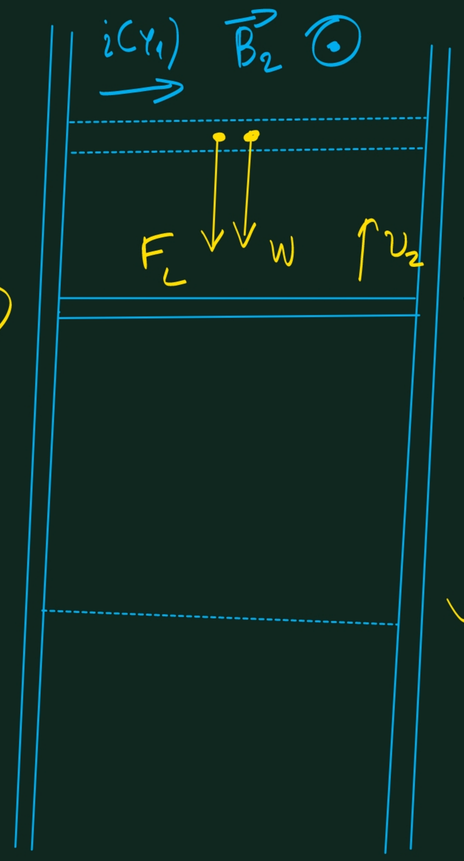
$$F_L = B_2\, i(y_1)\cdot \ell = 0,4 \cdot 7 \cdot 2,5 \Rightarrow$$

$$\left.\begin{array}{l} F_L = 7\,N \\ W = 5N \end{array}\right\} \text{σταθερές.}$$

Έστω ότι στη θέση (Θ) μηδενίζεται η ταχύτητα:

ΘΜΚΕ: $0 - \frac{1}{2}mv_2^2 = -F_L \cdot y_2 - W \cdot y_2 \Rightarrow$

$$-\frac{1}{2}\cdot 0,5 \cdot 6^2 = -12\,y_2 \Rightarrow y_2 = \frac{9}{12} = 0,75\,m$$



Άρα η ταχύτητα μηδενίζεται στη θέση

$y_1 + y_2 = 1,5 + 0,75 =$

$= 2,25\,m.$

ε) Στη θέση $y_3 = 2\,m$ ο κιμπάς έχει ανέβει κατά $y_4 = 2 - 1,5 = 0,5\,m$

Άρα αν η ταχύτητά του είναι στη θέση αυτή (έστω (Η)) v_H θα έχουμε:

ΘΜΚΕ: (Σ) → (Η)

$$\frac{1}{2}mv_H^2 - \frac{1}{2}mv_2^2 = -F_L \cdot y_4 - W \cdot y_4 \Rightarrow$$

$$\frac{1}{4}v_H^2 - \frac{1}{4}\cdot 36 = -12 \cdot 0,5 \Rightarrow \frac{v_H^2}{4} = 3 \Rightarrow$$

$$v_H = 2\sqrt{3}\,m/s.$$

$\left(\frac{\Delta K}{\Delta t} = \pm \Sigma F \cdot U\right)$ Γενικά.

Στην περίπτωσή μας:

$$\frac{\Delta K}{\Delta t} = -\Sigma F \cdot U_H = -12 \cdot 2\sqrt{3} = -24\sqrt{3}\ J/s$$