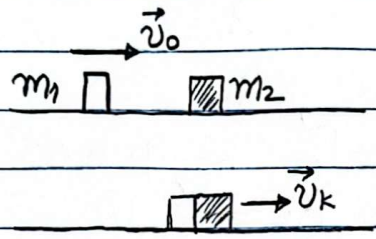
ΘΕΜΑ Α

Α1 → α , Α2 → β , Α3 → δ , Α4 → α

Α5: Λ , Σ , Σ , Λ , Λ

ΘΕΜΑ Β

Β1



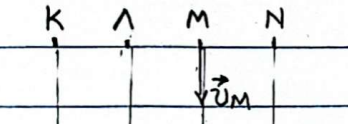
$m_1 = m$, $m_2 = 3m$

Α.Δ.Ο. : $m \cdot v_0 = 4m \cdot v_K \Rightarrow v_K = \frac{v_0}{4}$

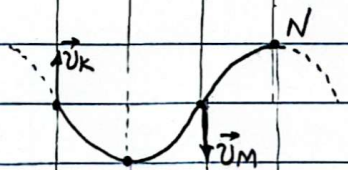
$K_{συσ} = \frac{1}{2} 4m \cdot v_K^2 = \frac{1}{2} \cdot 4m \cdot \frac{v_0^2}{16} \Rightarrow K_{συσ} = \frac{1}{4} \cdot \frac{1}{2} m \cdot v_0^2 \Rightarrow$

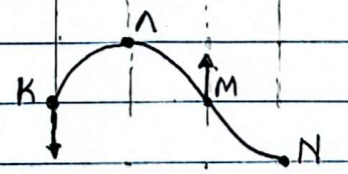
$K_{συσ} = \frac{K_0}{4} \Rightarrow \frac{K_{συσ}}{K_1} = \frac{1}{4}$ → **iii**

Β2

t_1: 

με $\phi_M < \phi_\Lambda \Rightarrow \vec{v}_\sigma \rightarrow$

άρα t_1: 

$t_1 + \frac{3T}{2}$ 

→ **iii**

B3.

Γενικά $E_\phi = p \cdot c = h \cdot f = \frac{h \cdot c}{\lambda}$

$E_{\phi ΑΡΧ} = E_0 \rightarrow E_{\phi ΤΕΛ} = E'$ κ' $\phi = 60°$

δίνεται $K_e = E'$ ①

$\lambda' - \lambda_0 = \lambda_c \cdot (1 - \sigma υν 60°) \Rightarrow \lambda' - \lambda_0 = \frac{\lambda_c}{2}$ ②

ΑΔΕ: $E_0 = E' + K_e \xrightarrow{①} E_0 = 2 \cdot E' \Rightarrow$

$\Rightarrow E' = \frac{E_0}{2}$ άρα $\lambda' = 2 \cdot \lambda_0$ ΤΟΤΕ ② $\Rightarrow \lambda_0 = \frac{\lambda_c}{2}$

Άρα $E_0 = \frac{h \cdot c}{\lambda_0} = \frac{2 h \cdot c}{\lambda_c} \Rightarrow E_0 = 2h \cdot c \cdot \frac{m_e \cdot c}{h} \Rightarrow$

$E_0 = 2 \cdot m_e \cdot c^2 \rightarrow$ ii

ΘΕΜΑ Γ

Τετράγωνο πλαίσιο $A = 2 \cdot 10^{-2} m^2$, $N = 100$ σπ.; $R_{πλ} = 0$

Αγωγός ΚΛ: $l = 1m$, $R = 10\Omega$

Μ, Θ $\rightsquigarrow$ $E = 20V$, $r = 0$

Αρχικά: δ_1, δ_2 ανοικτοί. Κ' πλαίσιο ακίνητο.

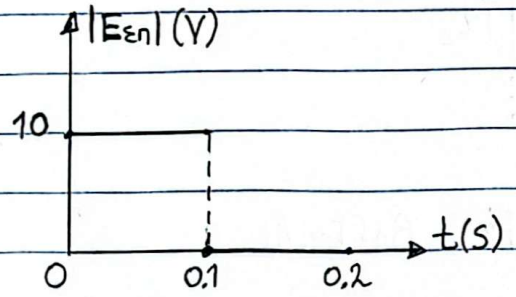
Γ1. $|E_{επ}| = ?$

$$\Phi_{σπ} = B \cdot A \rightsquigarrow \frac{d\Phi_{σπ}}{dt} = \frac{dB}{dt} \cdot A \quad , \quad |E_{επ}| = N \cdot A \left|\frac{dB}{dt}\right| \ (1)$$

$0 \rightarrow 0.1s$: $\frac{dB}{dt} = σταθ. \rightsquigarrow \frac{\Delta B}{\Delta t} = +5 T/s.$

$(1) \rightsquigarrow |E_{επ}| = 10V = σταθ.$

$0.1s \rightarrow 0.2s$: $\frac{dB}{dt} = 0$ άρα $(1) \rightsquigarrow |E_{επ}| = 0.$



Γ2. $B = 0.5T$, $\omega = 50\pi$ rad/s δ_1 κλειστός.

$Q_R = ?$ για $\Delta t = 1 \cdot T = \frac{2\pi}{\omega} = \frac{1}{25} s$

$$V_{max} = N \cdot \omega \cdot B \cdot A = 50\pi \ V$$

$$Q_R = \frac{V_{εν}^2}{R} \cdot \Delta t = \frac{V_{max}^2}{2 \cdot R} \cdot \Delta t \Rightarrow Q_R = 50 j$$

Γ3. $\omega' = 2\omega$ ΤΟΤΕ $V'_{max} = N \cdot 2\omega \cdot B \cdot A \Rightarrow$

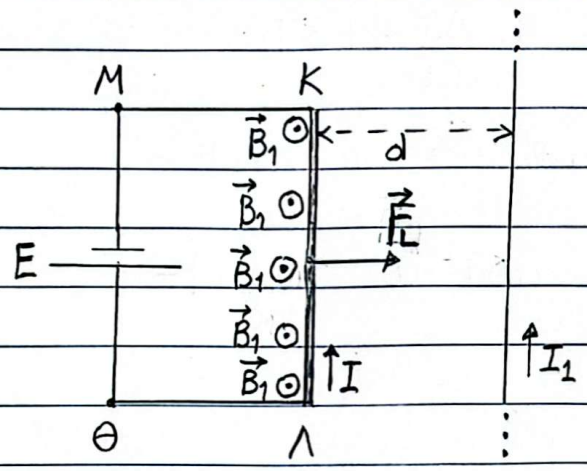
$V'_{max} = 2V_{max}$ Κ' $\Delta t' = 1 \cdot T' = \frac{2\pi}{\omega'} = \frac{2\pi}{2\omega} = \frac{T}{2}$.

$\rightsquigarrow Q'_R = \frac{V'^2_{max}}{2R} \cdot \Delta t' \Rightarrow Q'_R = 4 \cdot \frac{V^2_{max}}{2R} \cdot \frac{T}{2} \Rightarrow$

$\Rightarrow Q'_R = 2 \cdot Q_R$

Άρα: $\Pi\% = \frac{Q'_R - Q_R}{Q_R} \cdot 100\%$ $\Rightarrow \Pi\% = 100\%$

Γ4. Αγωγός ΧΥ σε $d = 2 \cdot 10^{-2}$ m από τον ΚΛ.
$I_{XY} = I_1 = 5A$ δ1 ανοικτός κ' δ2 κλειστός.



$I = \frac{E}{R} = 2A$ ΤΟΤΕ $F_L = B_1 \cdot I \cdot l$

$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2I_1}{d} \Rightarrow B_1 = 10^{-7} \cdot \frac{2 \cdot 5}{2 \cdot 10^{-2}}\ T \Rightarrow B_1 = 5 \cdot 10^{-5}\ T$ $\Rightarrow$

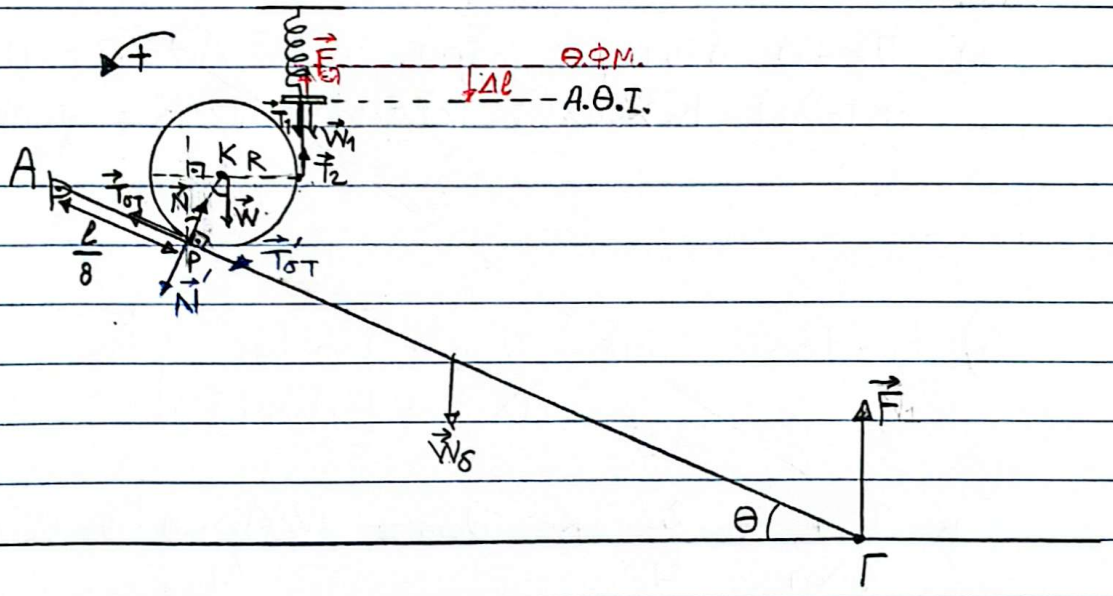
$\Rightarrow F_L = 10^{-4}\ N$

ΘΕΜΑ Δ

Κυκλική στεφάνη: $M = 4kg$, $R = \frac{9}{8\pi} m$

Ομογενής δοκός: $m_\delta = 1kg$, $\ell = 4m$ ακουμπά σε λείο δάπεδο, $\eta\mu\theta = 0.6$

Σώμα Σ_1: $m_1 = 1.5kg \rightsquigarrow k = 60N/m$.



Δ1. $\Delta\ell \overset{?}{=} 0.5m$

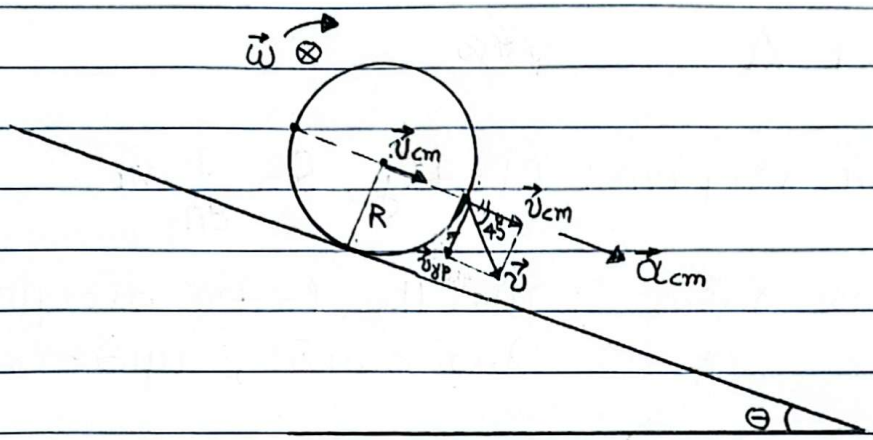
Νήμα αβαρές $\Rightarrow T_2 = T_1$ (μέτρα) $\Rightarrow F_{ελ} = T_2 + m_1 \cdot g$ ①

$\Sigma F_{\Sigma_1} = 0 \Rightarrow F_{ελ} = T_1 + m_1 \cdot g$

$\Sigma \vec{\tau}_P = \vec{0} \Rightarrow \vec{\tau}_W + \vec{\tau}_{T_2} = \vec{0} \Rightarrow |\tau_W| = |\tau_{T_2}| \Rightarrow$

$\Rightarrow Mg \cdot R \cdot \eta\mu\theta = T_2 \cdot (R + R \cdot \eta\mu\theta) \Rightarrow T_2 = \frac{\eta\mu\theta}{1+\eta\mu\theta} \cdot M \cdot g \Rightarrow$

$\Rightarrow T_2 = 15N \overset{①}{\rightsquigarrow} F_{ελ} = 30N \rightsquigarrow \Delta\ell = \frac{F_{ελ}}{k} \Rightarrow \Delta\ell = 0.5m$



Δ2.

α) $v_z = 0$ δεύτερη φορά ΤΟΤΕ $\Delta\theta = \pi + 2\pi = 3\pi$ rad.

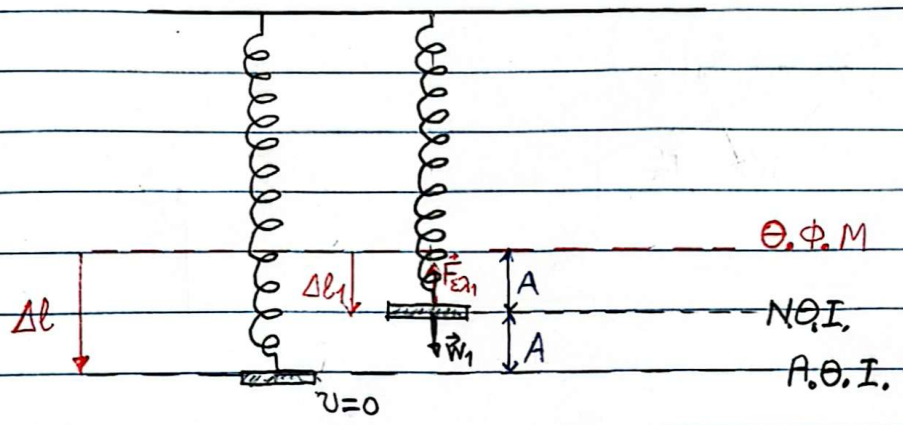
ΕΚΤΕΛΕΙ Κ.Χ.Ο. : $\Delta x_{cm} = \Delta\theta \cdot R = \frac{2f}{8}$ m. $\rightarrow t_1$

β) $t_1 = 1.5$s ΤΟΤΕ $\left.\begin{array}{l} v_{cm} = a_{cm} \cdot t_1 \\ \Delta x_{cm} = \frac{1}{2} a_{cm} \cdot t_1^2 \end{array}\right\} \div \Rightarrow$

$\Rightarrow \frac{v_{cm}}{\Delta x_{cm}} = \frac{2}{t_1} \Rightarrow v_{cm} = \frac{2 \cdot \Delta x_{cm}}{t_1} \Rightarrow v_{cm} = 4.5$ m/s.

$\left.\begin{array}{l} \vec{v} = \vec{v}_{cm} + \vec{v}_{\gamma\rho} \\ \vec{v}_{cm} \perp \vec{v}_{\gamma\rho} \text{ κ' } v_{\gamma\rho} = v_{cm} \text{ Κ.Χ.Ο.} \end{array}\right\} \Rightarrow v = 4.5 \cdot \sqrt{2}$ m/s.

Δ3.



$N.\Theta.I.: k\cdot\Delta l_1 = m_1\cdot g \Rightarrow \Delta l_1 = 0.25m = \frac{\Delta l}{2}$

$t=0 \rightsquigarrow \upsilon=0$ άρα $A = \Delta l - \Delta l_1 \Rightarrow A = 0.25m$

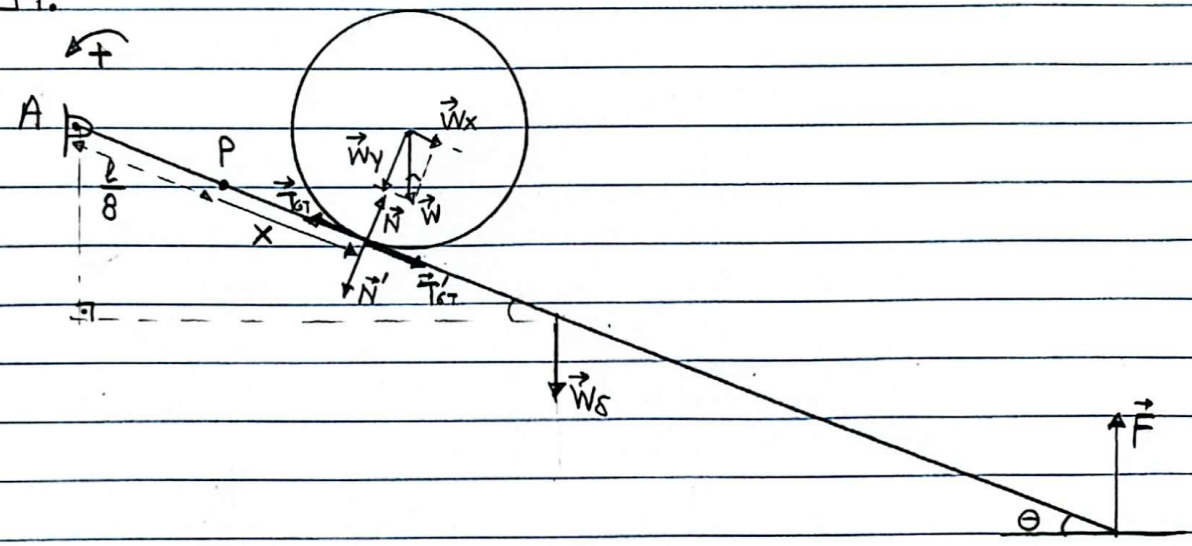
$\omega = \sqrt{\frac{k}{m_1}} = \sqrt{40}\ r/s = 2\pi\ r/s \rightsquigarrow T = \frac{2\pi}{\omega} = 1\,s.$

$t_1 = 1.5s = T + \frac{T}{2}$ επομένως το Σ_1 θα βρίσκεται τότε στην πάνω ακραία θέση της Α.Α.Τ. η οποία ταυτίζεται με τη Θ.Φ.Μ.

Άρα $W_{F_{ελ}} = U_{ελ\,αρχ} - U_{ελ\,τελ} = \frac{1}{2}k\cdot\Delta l^2 - 0 \Rightarrow$

$W_{F_{ελ}} = \frac{1}{2}k\cdot\Delta l^2 \Rightarrow W_{F_{ελ}} = +7.5\,j$

Δ4.



3ο ΝΝ : $N' = N$ κ' $T'_{GT} = T_{GT}$

$\Sigma F_{GT\varepsilon\varphi(y)} = 0 \Rightarrow N = W_y = Mg \cdot \sigma\upsilon\nu\varphi = 32N \rightsquigarrow N' = 32N.$

$\Sigma \tau A = 0 \Rightarrow \tau_{N'} + \tau_{W_\delta} + \tau_F = 0 \Rightarrow$

$\Rightarrow -N' \cdot (x + \ell/8) - m_\delta \cdot g \cdot \frac{\ell}{2} \cdot \sigma\upsilon\nu\theta + F \cdot \ell \cdot \sigma\upsilon\nu\theta = 0 \Rightarrow$

$\Rightarrow -32 \cdot x - 16 - 16 + 3.2 \cdot F = 0 \Rightarrow F = 10 + 10 \cdot x$, SI

$0 \le x \le 3m$