ΠΑΝΕΛΛΑΔΙΚΕΣ ΕΞΕΤΑΣΕΙΣ
ΓΕΝΙΚΟΥ ΛΥΚΕΙΟΥ
(ΠΑΛΑΙΟ ΣΥΣΤΗΜΑ)
ΦΥΣΙΚΗ ΠΡΟΣΑΝΑΤΟΛΙΣΜΟΥ
22 ΙΟΥΝΙΟΥ 2020

ΑΠΑΝΤΗΣΕΙΣ

ΘΕΜΑ Α

Α1. **β)**

Α2. **γ)**

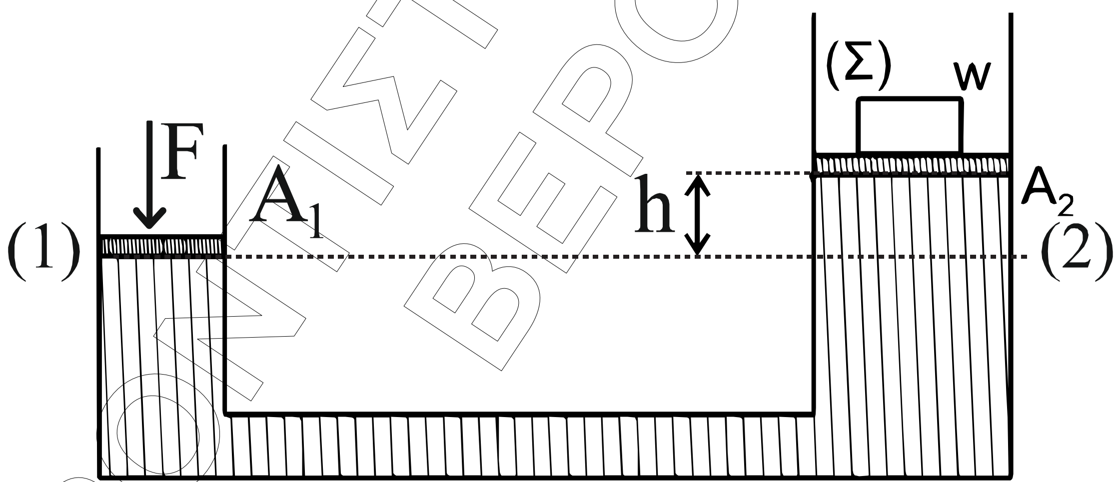
Α3. **α)**

Α4. **α)**

Α5. **α)** Σωστό **β)** Λάθος **γ)** Λάθος **δ)** Λάθος **ε)** Σωστό.

ΘΕΜΑ Β

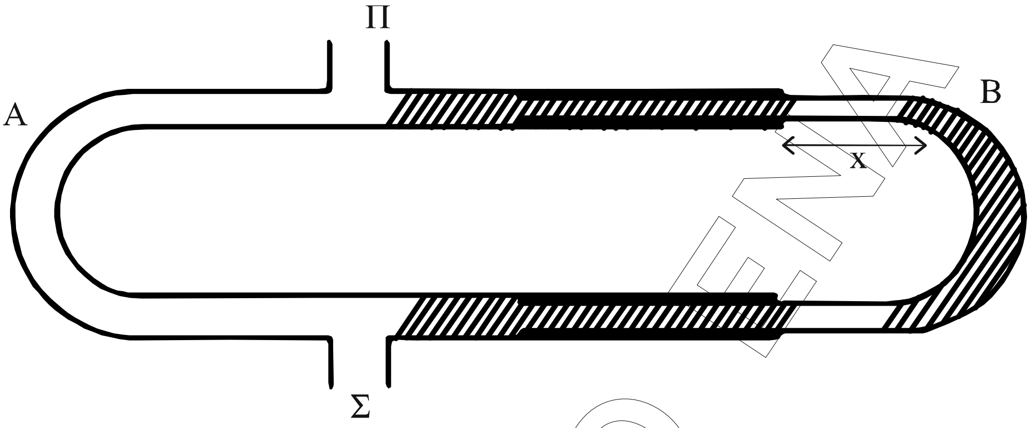
Β1. Σωστή η **(ii)**



Στα σημεία (1) και (2) έχουμε την ίδια πίεση αφού είναι το ίδιο υγρό στο ίδιο ύψος.

Άρα: $P_1 = P_2 \Rightarrow \frac{F}{A_1} + P_{\alpha\tau\mu} = \rho \cdot g \cdot h + \frac{W}{A_2} + P_{\alpha\tau\mu} \Rightarrow \frac{F}{A_1} = \rho \cdot g \cdot h + \frac{W}{A_2} = \frac{W + \rho \cdot g \cdot h \cdot A_2}{A_2}$

B2.



Για $x = x_1 \;\rightarrow\;$ Σ: ενισχυτική

$x = x_2 = x_1 + 4\,\text{cm}$ ακυρωτική (1^{η} φορά)

$$x_1 : \left|(\Pi A \Sigma) - (\Pi B \Sigma) - 2x_1\right| = N\lambda$$

$$x_2 : \left|(\Pi A \Sigma) - (\Pi B \Sigma) - 2x_2\right| = (2N+1)\frac{\lambda}{2}$$

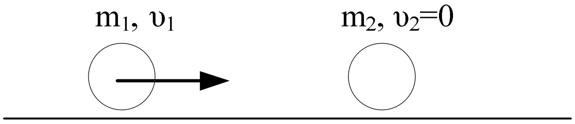
Αφαιρούμε κατά μέρη:

$$\left|(\Pi A \Sigma) - (\Pi B \Sigma) - 2x_2 - (\Pi A \Sigma) + (\Pi B \Sigma) + 2x_1\right| = (2N+1)\frac{\lambda}{2} - N\lambda \Rightarrow$$

$$\Rightarrow 2x_2 - 2x_1 = 2N\frac{\lambda}{2} + \frac{\lambda}{2} - N\lambda \Rightarrow 2(x_1 + 4 - x_1) = \frac{\lambda}{2} \Rightarrow$$

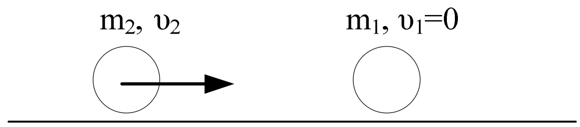
$$\Rightarrow \lambda = 8 \cdot 2 = 16\,\text{cm} \;\; \text{(ii)}$$

B3.



$$\upsilon_2' = \frac{2 \cdot m_1 \cdot \upsilon_1}{(m_1 + m_2)}$$

$$\Pi_1 = \frac{k_2'}{k_1} = \frac{\frac{1}{2} \cdot m_2 \cdot \frac{4 \cdot m_1^2 \cdot \upsilon_1^2}{(m_1 + m_2)^2}}{\frac{1}{2} \cdot m_1 \cdot \upsilon_1^2} \Rightarrow \frac{k_2'}{k_1} = \frac{4 m_1 \cdot m_2}{(m_1 + m_2)^2}$$



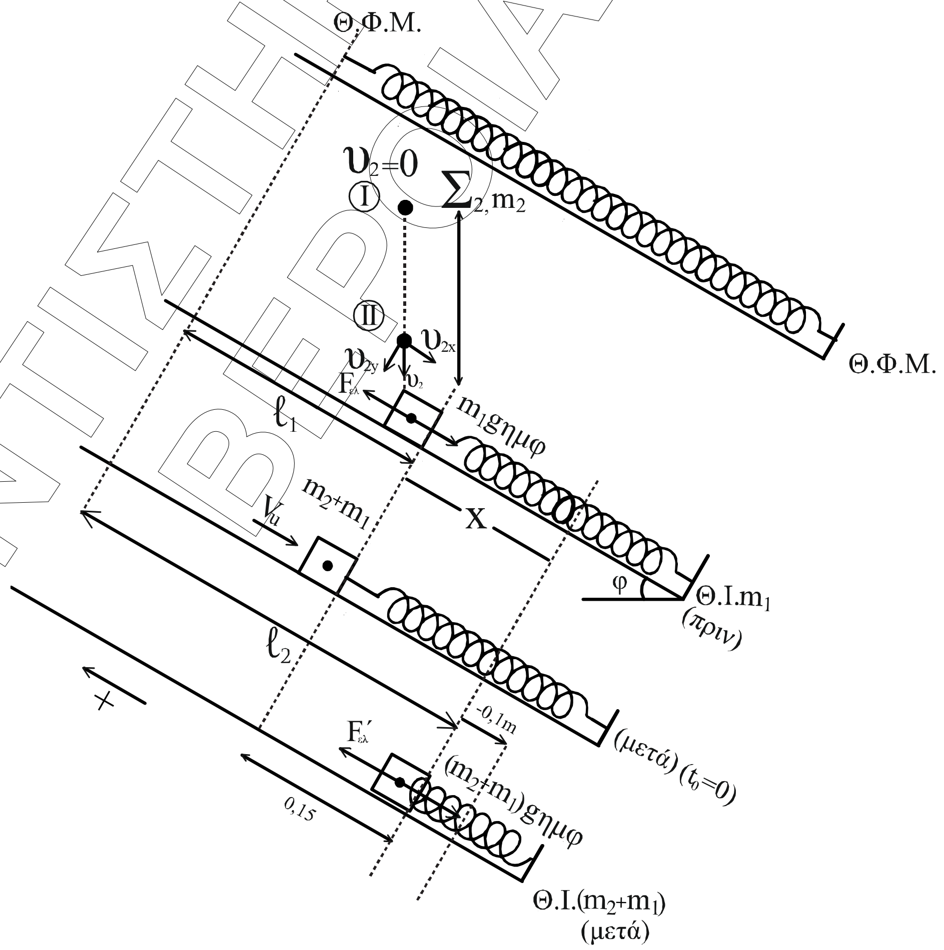
Όπου $\upsilon_1' = \dfrac{2 \cdot m_2 \cdot \upsilon_2}{(m_1 + m_2)}$

$$\Pi_2 = \frac{k_1'}{k_2} = \frac{\frac{1}{2} \cdot m_1 \cdot \upsilon_1'^2}{\frac{1}{2} \cdot m_2 \cdot \upsilon_2^2} = \frac{m_1 \cdot \frac{4 \cdot m_2^2 \cdot \upsilon_2^2}{\left(m_1 + m_2\right)^2}}{m_2 \cdot \upsilon_2^2} = \frac{4 \cdot m_1 \cdot m_2}{\left(m_1 + m_2\right)^2}$$

Άρα $\Pi_1 = \Pi_2$.

ΘΕΜΑ Γ

$m_1 = 1$ kg
$\theta = 30^o$
$k = 100$ N/m
$h = 0,6$ m
$m_2 = 3$ kg
$D = k$
Γ1. Vu = ;
Γ2. Α = ;
Γ3. $x = f(+) \uparrow \oplus$
Γ4. $\frac{F_{\varepsilon\lambda}}{\Sigma F} =;\ k = 8\upsilon$



Γ1. $ΘΜΚΕ_{Ι\to ΙΙ}: \Delta_k = W_w \Rightarrow \frac{1}{2}\cancel{m_2}\upsilon_2^2 - 0 = \cancel{m_2}gh$

$$\upsilon_2 = \sqrt{2gh} \Rightarrow \upsilon_2 = \sqrt{2\cdot 10\cdot 0,6} \Rightarrow$$

$$\upsilon_2 = \sqrt{12} = \sqrt{3\cdot 4} \Rightarrow \upsilon_2 = 2\sqrt{3}\ \text{m/s}$$

$ΑΔΟ_x$: $\vec{p}_{αρχ_x} = \vec{p}_{τελ_x} \Rightarrow m_2\upsilon_{2x} = (m_1+m_2)v_u \Rightarrow$

$$v_u = \frac{m_2\upsilon_{2x}}{m_1+m_2} \Rightarrow v_u = \frac{3\cdot\sqrt{3}}{4} \Rightarrow \boxed{v_u = \frac{3}{4}\sqrt{3}\ \text{m/s}}$$

$$\upsilon_{2x} = \upsilon_2 ημφ = \frac{\upsilon_2}{2} = \sqrt{3}\ \text{m/s.}$$

Γ2. $ΘΙ_{m_1}$: $\Sigma Fx = 0 \Rightarrow F_{εξ} = w_1x \Rightarrow m_1gημφ = k\ell_1 \Rightarrow$

$$\ell_1 = \frac{m_1gημφ}{k} = \frac{1\cdot 10\cdot\frac{1}{2}}{100} \Rightarrow \ell_1 = \frac{5}{100} \Rightarrow \ell_1 = 5\cdot 10^{-2}\ \text{m.}$$

$ΘΙ_{m_1+m_2}$: $\Sigma F'x = 0 \Rightarrow F'_{εξ} = (w_1+w_2)x \Rightarrow (m_1+m_2)gημφ = k\ell_2 \Rightarrow$

$$\ell_2 = \frac{(m_1+m_2)gημφ}{k} \Rightarrow \ell_2 = \frac{4\cdot 10\cdot\frac{1}{2}}{100} \Rightarrow \ell_2 = 20\cdot 10^{-2}\ \text{m.}$$

Η κρούση συμβαίνει τη t = 0 αμέσως μετά την κρούση, όπου $x = \ell_2 - \ell_1 = 15\cdot 10^{-2}\ \text{m}$

$$ΑΔΕ_{1\ (t_0=0)}: E = k_0 + \upsilon_0 \Rightarrow \frac{1}{\cancel{2}}\upsilon A^2 = \frac{1}{\cancel{2}}m_{ΟΛ}v_k^2 + \frac{1}{2}kx^2 \Rightarrow$$

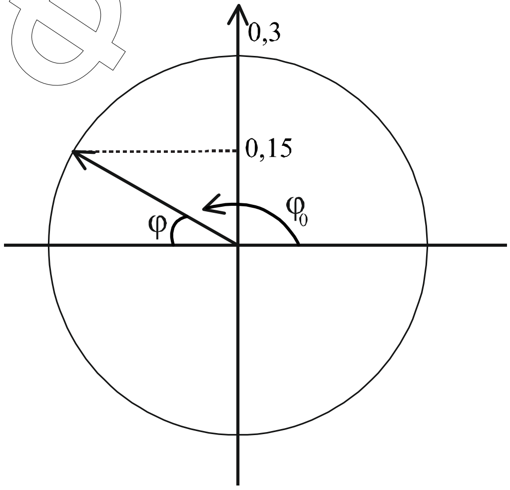
$$A = \sqrt{\frac{m_1+m_2}{k}v_\upsilon^2 + x^2} \Rightarrow A = \sqrt{\frac{\cancel{4}}{100}\cdot\frac{9}{\cancel{16}_4}\cdot 3 + 225\cdot 10^{-4}}$$

$$A = \sqrt{675\cdot 10^{-4} + 225\cdot 10^{-4}} \Rightarrow A = \sqrt{900\cdot 10^{-4}} \Rightarrow$$

$$A = \sqrt{9\cdot 10^{-2}} \Rightarrow A = 3\cdot 10^{-1}\ \text{m} \Rightarrow \boxed{A = 0,3\ \text{m}}$$

Γ3 $x = A\cdot ημ(\omega\cdot t + \varphi_0)$

$$\omega = \sqrt{\frac{k}{m_1+m_2}} \Rightarrow \omega = \sqrt{\frac{100}{4}} = \sqrt{25} \Rightarrow \omega = 5\ \text{r/s}$$



Για $t_0 = 0$ $\quad x = +0,15\,\text{m} \quad v < 0$

$$\varphi_0 = \pi - \varphi$$

$$ημφ = \frac{0,15}{0,3} = \frac{1}{2} \Rightarrow \varphi = \frac{\pi}{6}$$

Οπότε $\varphi_0 = \pi - \frac{\pi}{6} \Rightarrow \varphi_0 = \frac{5\pi}{6}\ \text{rad}$

Άρα $x = 0,3 \cdot ημ(5 \cdot t + \frac{5π}{6}) \cdot (5t)$

Γ4. $K = 8 \cdot U$

$$E = K + U \Rightarrow E = 8U + U \Rightarrow E = 9U \Rightarrow \frac{1}{2} \cdot k \cdot A^2 = 9 \cdot \frac{1}{2} \cdot k \cdot x^2$$

$$x = \pm \frac{A}{3}$$

$2^η$ φορά $x = -\frac{A}{3} \Rightarrow x = -0,1m.$

$$F_{εξ} = k \cdot (\ell_2 + x) \Rightarrow F_{εξ} = 100 \cdot (0,2 + 0,1) = 100 \cdot 0,3 = 30\,N$$

$$ΣF = k \cdot x = 100 \cdot 0,1 = 10N$$

$$\frac{F_{εξ}}{ΣF} = 3.$$

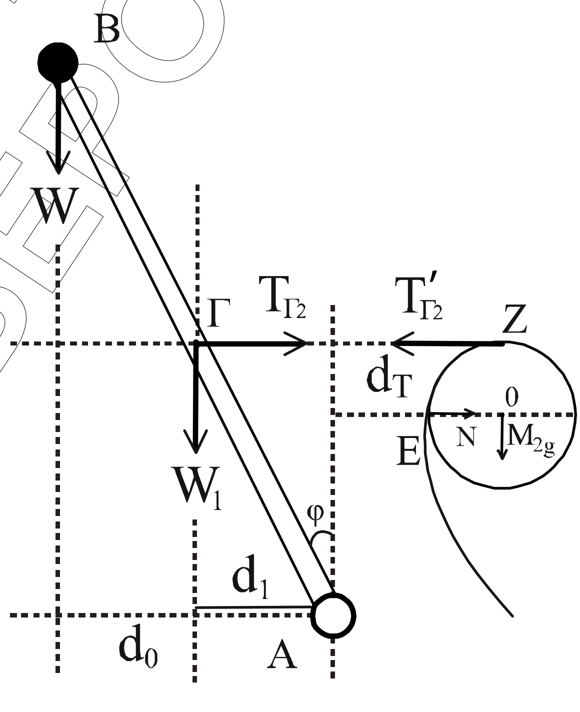
ΘΕΜΑ Δ

$M_1 = 6kg$
$L = 1m$

$M = 1kg$

$r = 0,1\ m$

$KE = R = 2,8\ m$



Δ1. **i)** $T_{r_2} = \;;$

ii) $M_2 = \;;$

i) Ισορροπία για ράβδο:

$$\Sigma_{\tau_{(A)}} = 0 \Rightarrow \tau_{w_{\delta(A)}} + \tau_{w_{1(A)}} - \tau_{r_{2(A)}} = 0 \Rightarrow$$

$$\Rightarrow w_\delta \cdot \ell ημφ + w_1 \frac{\ell}{2} ημφ - \tau_{r_2} \frac{\ell}{2} συνφ = 0 \Rightarrow$$

$$\Rightarrow mg\ell ημφ + M_1 g \frac{\ell}{2} ημφ = \tau_{r_2} \frac{\ell}{2} συνφ \Rightarrow$$

$$\Rightarrow 1 \cdot 10 \cdot 0,6 + \frac{6 \cdot 10 \cdot 0,6}{2} = \tau_{r_2} \frac{0,8}{2} \Rightarrow$$

$$\Rightarrow 0,4\tau_{r_2} = 6 + 18 \Rightarrow \tau_{r_2} = \frac{24}{0,4} \Rightarrow \tau_{r_2} = \frac{240}{4} \Rightarrow \boxed{\tau_{r_2} = 60\,N}$$

ii)

$$\Sigma_{\tau_{(E)}} = 0 \Rightarrow \tau_{2_{r_2(E)}} \tau_{w_{(E)}} = 0 \Rightarrow$$

$$\Rightarrow T_{r_2} \cdot R - Mg \cdot R = 0 \Rightarrow$$

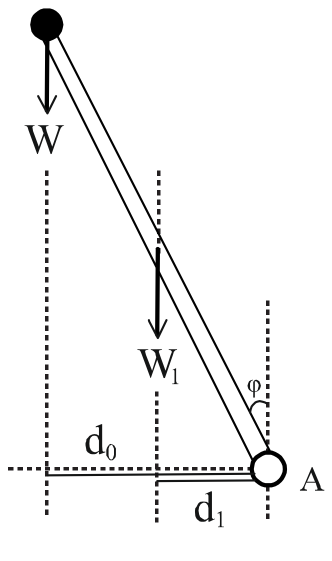
$$\Rightarrow M = \frac{\tau_{r_2}}{g} \Rightarrow \boxed{M = 6\,kg}$$

Δ2.

$$I_{συστ_{(A)}} = I_{\rho_{(A)}} + I_{m_{(A)}} \Rightarrow I_{συστ_{(A)}} = \frac{1}{3} M_1 L^2 + mL^2 \Rightarrow$$

$$\Rightarrow I_{συστ_{(A)}} = \frac{1}{3} \cdot 6 \cdot 1^2 + 1 \cdot 1^2 \Rightarrow I_{συστ_{(A)}} = 2 + 1 \Rightarrow \boxed{I_{συστ_{(A)}} = 3\,kgm^2}$$

$$I_{\rho_{(A)}} = \frac{1}{3} M_1 L^2$$

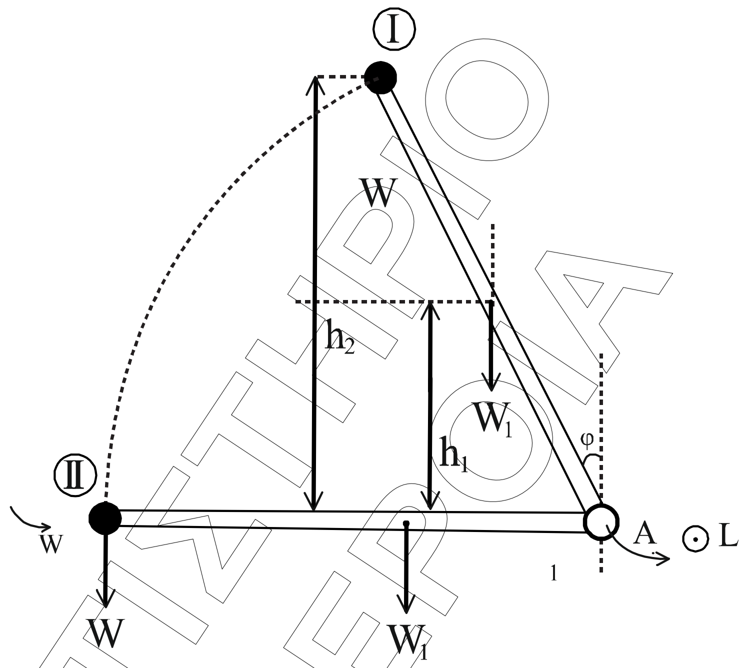


$$\Sigma_{\tau_{(A)}} = I_{(A)\alpha_{\gamma\omega\nu}} \Rightarrow \frac{\tau_{w_{(A)}} + \tau_{w_{1(A)}}}{I} = 0 \Rightarrow \alpha_{\gamma\omega\nu} \Rightarrow$$

$$\Rightarrow \alpha_{\gamma\omega\nu} = \frac{mg\ell\eta\mu\varphi + M_1 g\frac{\ell}{2}\eta\mu\varphi}{I} \Rightarrow \alpha_{\gamma\omega\nu} = \frac{1\cdot10\cdot1\cdot0,6 + 6\cdot10\frac{1}{2}\cdot0,6}{3} \Rightarrow$$

$$\Rightarrow \alpha_{\gamma\omega\nu} = \frac{6+18}{3} \Rightarrow \alpha_{\gamma\omega\nu} = \frac{24}{3} \Rightarrow \boxed{\alpha_{\gamma\omega\nu} = 8\frac{r}{s^2}}$$

Δ3. **i)**



$$\Theta MKE_{I\rightarrow II}: \Delta u = W_{w_1} + W_w$$

$$\frac{1}{2}I_{(A)}w^2 = m_1 g h_1 + mgh_2 \Rightarrow \frac{1}{2}I_{(A)}w^2 = m_1 g\frac{\ell}{2}\sigma\upsilon\nu\varphi + mg\ell\sigma\upsilon\nu\varphi \Rightarrow$$

$$\Rightarrow w = \sqrt{\frac{1}{2}\left(m_1 g\frac{\ell}{2}\sigma\upsilon\nu\varphi + mg\ell\sigma\upsilon\nu\varphi\right)} \Rightarrow w = \sqrt{\frac{2}{3}\left(6^3\cdot10\cdot\frac{1}{2}\cdot0,8 + 1\cdot10\cdot1\cdot0,8\right)} \Rightarrow$$

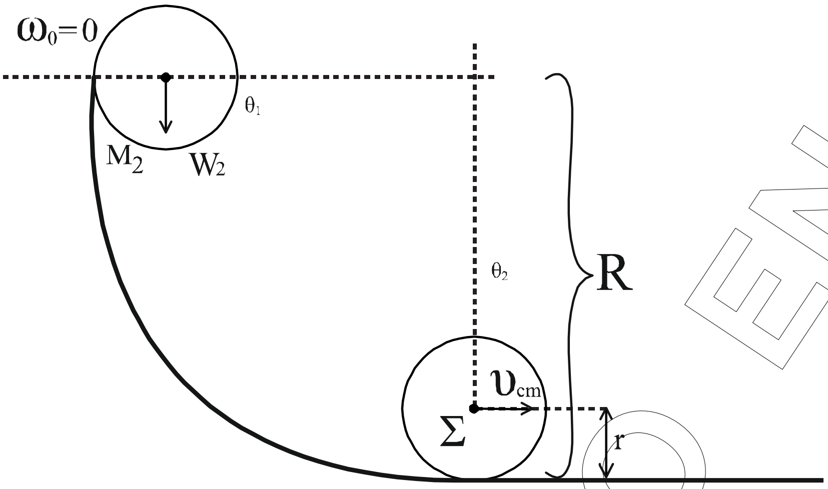
$$\Rightarrow w = \sqrt{\frac{2}{3}(24+8)} = \sqrt{2\frac{32}{3}} = \sqrt{\frac{64}{3}} = \frac{8}{\sqrt{3}} \Rightarrow \boxed{w = \frac{8\sqrt{3}}{3}\,r/s}$$

$$\Delta L = L_{\tau\sigma} - \underset{\substack{0 \\ w_{0\rightarrow0}}}{L_{\alpha\rho\chi}} \Rightarrow \Delta L = I_w = \boxed{\Delta L = 8\sqrt{3}\,kg\frac{m^2}{s}}$$

ii) ΔL ⊙

Δ4.

$$I_{cm\delta} = \frac{1}{2} \cdot M_2 \cdot r^2$$



$$\text{ΘΜΚΕ } (1 \to 2): \ \Delta K = W_\omega \Rightarrow \frac{1}{2} \cdot I_2 \cdot \omega^2 + \frac{1}{2} \cdot M_2 \cdot \upsilon_{cm}{}^2 = M_2 \cdot g \cdot (R - r) \Rightarrow$$

$$\Rightarrow \frac{1}{2} \cdot \frac{1}{2} \cdot M_2 \cdot r^2 \cdot \frac{\upsilon_{cm}{}^2}{r^2} + \frac{1}{2} \cdot M_2 \cdot \upsilon_{cm}{}^2 = M_2 \cdot g \cdot (R - r) \Rightarrow$$

$$\Rightarrow \frac{1}{4} \cdot M_2 \cdot \upsilon_{cm}{}^2 + \frac{1}{2} \cdot M_2 \cdot \upsilon_{cm}{}^2 = M_2 \cdot g \cdot (R - r) \Rightarrow$$

$$\Rightarrow \frac{3}{4} \cdot \upsilon_{cm}{}^2 = g \cdot (R - r) \Rightarrow \upsilon_{cm} = \sqrt{\frac{4}{3} \cdot g \cdot (R - r)} \Rightarrow \upsilon_{cm} = \sqrt{\frac{4}{3} \cdot 10 \cdot (2{,}7)} = \sqrt{4 \cdot 9} =$$

$$= 2 \cdot 3 \Rightarrow \upsilon_{cm} = 6\,m/s$$

Δ5. Το μήκος της τροχιάς του cm του δίσκου είναι:

$$\left. \begin{aligned} S_{cm} = \theta_{cm} \cdot R_{cm} = \theta (R - r) \\ \theta = \frac{\pi}{2} rad \end{aligned} \right\} \Rightarrow \left. \begin{aligned} S_{cm} = \frac{\pi}{2}(R - r) \\ S_{cm} = \theta \cdot r \end{aligned} \right\} \Rightarrow \frac{\pi}{2}(R - r) = \theta \cdot r \Rightarrow$$

$$\Rightarrow \left. \begin{aligned} \theta = \frac{\pi}{2} \cdot \frac{R - r}{r} \Rightarrow \theta = \frac{27\pi}{2} rad \\ N = \frac{\theta}{2\pi} \end{aligned} \right\} \Rightarrow \boxed{N = \frac{27}{4} \pi\varepsilon\rho}$$

Από τη στιγμή που φτάνει στο λείο οριζόντιο επίπεδο:

$$\left. \theta = \frac{\pi}{2} rad \right\} \Rightarrow \left. \begin{aligned} S_{cm} = \frac{\pi}{2}(R - r) \\ S_{cm} = \theta \cdot r \end{aligned} \right\} \Rightarrow \frac{\pi}{2}(R - r) = \theta \cdot r \Rightarrow$$

$$\upsilon_{cm} = 6\,m/s = \sigma\tau\alpha\theta.$$

$$S = \theta \cdot r = N \cdot 2\pi r \Rightarrow N = \frac{S}{2\pi r} \Rightarrow \boxed{N = 5\,\pi\varepsilon\rho}$$