ΦΥΣΙΚΗ ΚΑΤΕΥΘΥΝΣΗΣ
ΘΕΤΙΚΗΣ - ΤΕΧΝΟΛΟΓΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ
ΑΠΑΝΤΗΣΕΙΣ

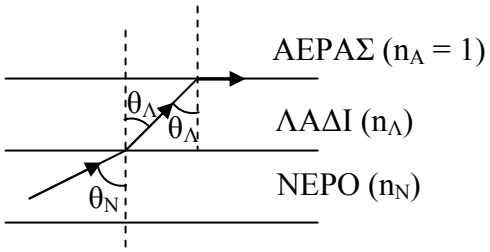
ΘΕΜΑ Α

Α1. γ **Α2.** β **Α3**. γ **Α4.** γ

Α5. α. Σ β. Σ γ. Λ δ. Λ ε. Σ

ΘΕΜΑ Β

Β1.



Εφόσον $n_\Lambda > n_N$ η ακτίνα διαθλάται στο λάδι.

Snell : $ημθ_N \cdot n_N = ημθ_\Lambda \cdot n_\Lambda \Rightarrow \frac{ημθ_\Lambda}{ημθ_N} = \frac{n_N}{n_\Lambda} < 1 \Rightarrow ημθ_\Lambda < ημθ_N \Rightarrow θ_\Lambda < θ_N$

Η ακτίνα πλησιάζει στην κάθετη

Οπότε πέφτει στη διαχωριστική επιφάνεια ΛΑΔΙ – ΑΕΡΑΣ με $θ_\Lambda$

Εφόσον κατά τη διάδοση από το νερό στον αέρα $θ_N = θ_{crit_1} \Rightarrow ημθ_N = ημθ_{crit_1} = \frac{1}{n_N}$ (1)

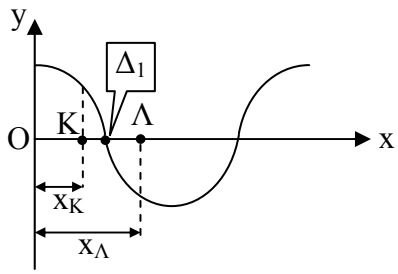
<u>Snell</u> στο νερό – λάδι :

$$ημθ_N \cdot n_N = ημθ_\Lambda \cdot n_\Lambda \overset{(1)}{\Rightarrow} \frac{1}{n_N} \cdot n_N = ημθ_\Lambda \cdot n_\Lambda \Rightarrow ημθ_\Lambda = \frac{1}{n_\Lambda}$$

<u>Στο ΛΑΔΙ – ΑΕΡΑΣ</u> : $ημθ_{crit_2} = \frac{1}{n_\Lambda}$;ara $θ_\Lambda = θ_{crit_2}$

Σωστό το γ

Β2.



$$x_K = \frac{\lambda}{4} - \frac{\lambda}{6} = \frac{\lambda}{12}$$

$$υ_{K_{max}} = ω|A_K| = ω\left|2A \cdot συν2π\frac{\frac{\lambda}{12}}{\lambda}\right| = ωA\sqrt{3} \quad (1)$$

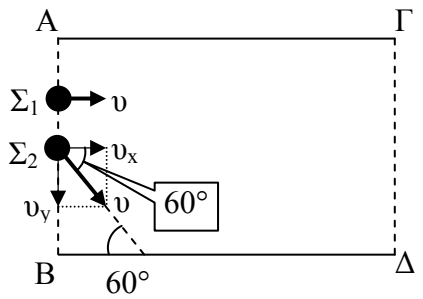
$$x_{\Lambda} = \frac{\lambda}{4} + \frac{\lambda}{12} = \frac{\lambda}{3}$$

$$\upsilon_{\Lambda_{max}} = \omega\left|A_{\Lambda}\right| = \omega\left|2A \cdot \sigma\upsilon\nu 2\pi \frac{\frac{\lambda}{3}}{\lambda}\right| = \omega A$$

Άρα $\dfrac{\upsilon_{K_{max}}}{\upsilon_{\Lambda_{max}}} = \sqrt{3}$

Σωστό το α

Β3.



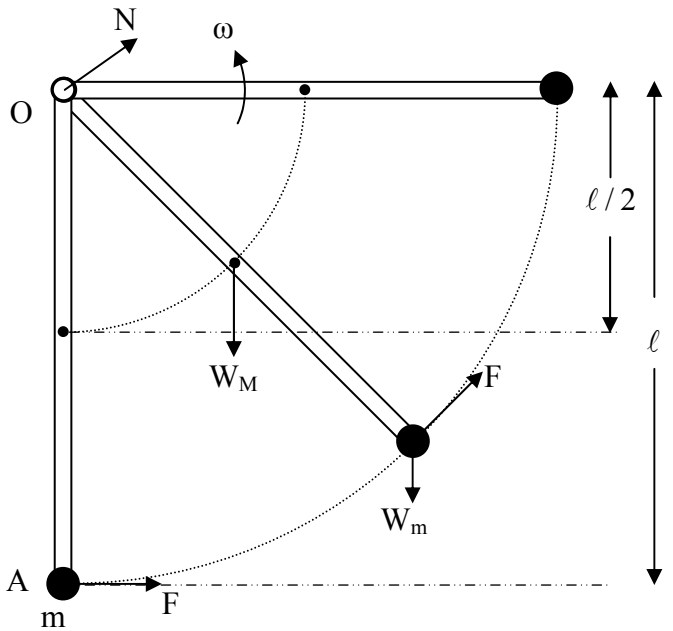
$$\Sigma 1:\ x_{A\Gamma} = \upsilon t_1 \Rightarrow t_1 = \frac{x_{A\Gamma}}{\upsilon} \quad (1)$$

$$\Sigma 2:\ x_{A\Gamma} = \upsilon_x t_2 \xrightarrow{\upsilon_x = \upsilon\sigma\upsilon\nu 60° = \frac{\upsilon}{2}} x_{A\Gamma} = \frac{\upsilon}{2} t_2 \Rightarrow t_2 = 2\frac{x_{A\Gamma}}{\upsilon} \quad (2)$$

$$(1),\ (2) \Rightarrow t_2 = 2t_1$$

Σωστό το Α

ΘΕΜΑ Γ



Γ1.

$$I_0 = I_{cm} + M\left(\frac{\ell}{2}\right)^2 + m\ell^2 \Rightarrow I_0 = \frac{1}{12}m\ell^2 + M\frac{\ell^2}{4} + m\ell^2 \Rightarrow$$

$$\Rightarrow I_0 = \frac{M\ell^2}{3} + m\ell^2 \Rightarrow I_0 = 0,45\,kgm^2$$

Γ2.

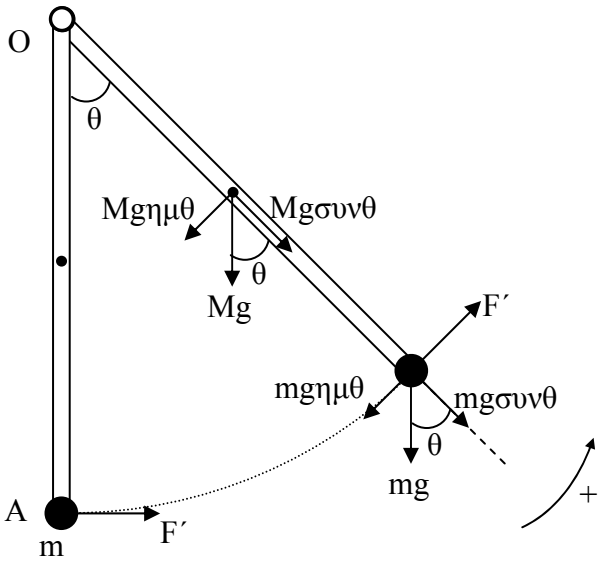
$$W_F = \tau \cdot \theta = F \cdot \ell \cdot \frac{\pi}{2} = \frac{120}{\pi}\ell\frac{\pi}{2} \Rightarrow W_F = 60\ell = 18J$$

Γ3. ΘΜΚΕ

$$k_{ΤΕΛ} - k_{ΑΡΧ} = W_F + W_M + W_N + W_m \xrightarrow[W_m = -\Delta U = -mg\ell,\ W_N = 0]{W_M = -\Delta U = -Mg\ell/2}$$

$$\Rightarrow \frac{1}{2}I_0 \cdot \omega^2 = W_F + \left(-Mg\frac{\ell}{2} - mg\ell\right) \Rightarrow \omega = 0$$

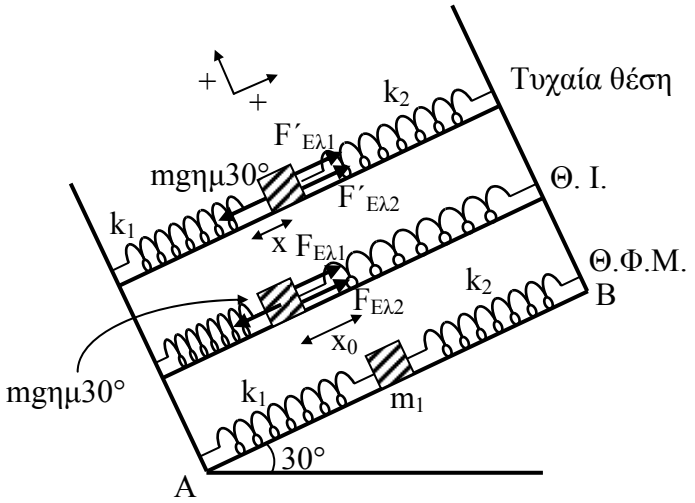
Γ4.



Έχω K_{max} όταν

$$\Sigma\tau = 0 \Rightarrow F'\ell - Mg\eta\mu\theta\frac{\ell}{2} - mg\eta\mu\theta\ell = 0 \Rightarrow \eta\mu\theta = \frac{F'}{\frac{Mg}{2} + mg} \Rightarrow \eta\mu\theta = \frac{\sqrt{3}}{2} \Rightarrow \theta = 60^o$$

ΘΕΜΑ Δ



Δ1. Στη ΘΙ

$$\Sigma F = 0 \longrightarrow F_{ΕΛ1} + F_{ΕΛ2} - mg\eta\mu30^o = 0$$

$$\Rightarrow m_1 g\eta\mu30^o = (k_1 + k_2)x_o \quad (1)$$

τυχαία θέση

$$\Sigma F = -mg\eta\mu 30^o + k_1(x_o - x) + k_2(x_o - x) \Rightarrow$$
$$\Rightarrow \Sigma F = -mg\eta\mu 30^o + (k_1 + k_2)x_o - (k_1 + k_2)x \Rightarrow$$
$$\xrightarrow{(1)} \Sigma F = -(k_1 + k_2)x$$

Άρα Α.Α.Τ. με $D = k_1 + k_2 \rightarrow D = 200N/m$

Δ2. $x = A\eta\mu(\omega t + \varphi_o) \quad (2)$

$$\omega = \sqrt{\frac{k_1 + k_2}{m_1}} = 10r/s$$

$$A = x_o \xrightarrow{(1)} A = \frac{m_1 g\eta\mu 30^o}{k_1 + k_2} \Rightarrow A = 0,05m$$

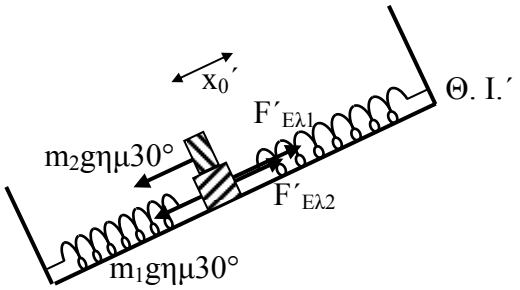
$$t = 0 : x = +A \Rightarrow \varphi_o = \frac{\pi}{2} r$$

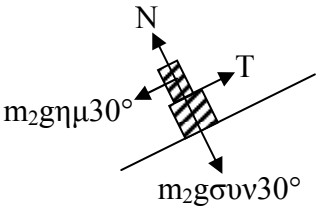
$$(2) \rightarrow x = 0,05\eta\mu\left(10t + \frac{\pi}{2}\right) \quad (SI)$$

Δ3.

$$D_2 = m_2\omega'^2 = m_2\frac{k_1 + k_2}{m_1 + m_2} \Rightarrow D_2 = 150N/m$$

Δ4.





Για να μη χάνει επαφή: $T \le \mu N \Rightarrow \mu \ge \frac{T}{N} \quad (2)$

$$\overrightarrow{\Sigma F}y = 0 \Rightarrow N = m_2 g\sigma\upsilon\nu 30° = 30\sqrt{3}N$$

Το m_2 εκτελεί ΓΑΤ:

$$\overrightarrow{\Sigma F} = -Dy \xrightarrow{y=A'} \Rightarrow -T + m_2 g\eta\mu 30° = -D_2 A' \quad (3)$$

Για το σύστημα στη νέα θέση ισορροπίας :

$$\overrightarrow{\Sigma F}x = 0 \Rightarrow (m_1 + m_2)g\eta\mu 30° = (k_1 + k_2)x_o' \Rightarrow x_o' = \frac{(m_1 + m_2)g\eta\mu 30°}{k_1 + k_2} = 0,2\ m = A'$$

$$(3) \Rightarrow T = D_2 A' + m_2 g\eta\mu 30° \Rightarrow T = 60N$$

$$(2) \Rightarrow \mu \ge \frac{60}{30\sqrt{3}} \Rightarrow \mu \ge \frac{2\sqrt{3}}{3} \quad . \quad \text{Άρα } \mu_{min} = \frac{2\sqrt{3}}{3}$$