Πανελλήνιες Φυσική Γ Λυκείου 2017

Θέμα Β

B1. Στην ΘΙ, θα ισχύει

$$\begin{aligned} \Sigma F = 0 \implies \\ F_{\varepsilon\lambda} - mg = 0 \implies \\ k\Delta l = mg \implies \\ \Delta l = \frac{mg}{k} \end{aligned}$$

Επειδή στη ΘΦΜ ισχύει $v = 0$, άρα $\Delta l = A$ και χάρις ΑΔΕΤ

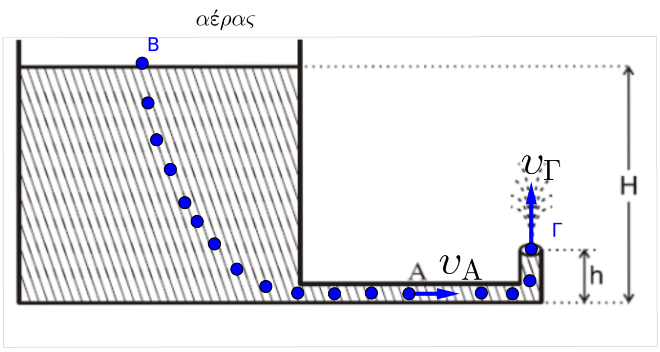
$$E_{\tau\alpha\lambda_{(\Gamma)}} = E_{\tau\alpha\lambda_{(\Gamma')}} \implies K_\Gamma + U_\Gamma = K'_\Gamma + U'_\Gamma \implies$$
$$\frac{1}{2}DA^2 = \frac{1}{2}kx_2^2 \implies x_2 = A$$

έτσι

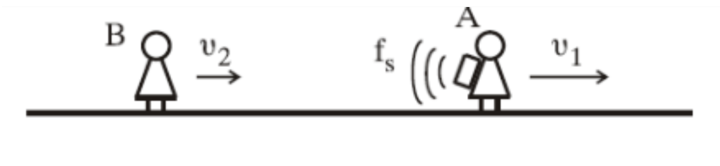
$$U_{\varepsilon\lambda_{max}} = \frac{1}{2}k\left(2A\right)^2 = \frac{1}{2}4A^2 = 2k\frac{m^2g^2}{k^2} = \frac{2m^2g^2}{k^2}$$

άρα σωστό το (ii)

B2. Από εξίσωση Bernoulli



B3. Ο παρατηρητής Β πλησιάζει την πηγή Α και η πηγή απομακρύνεται από τον παρατηρητή Β άρα θα ισχύει



$$f_{\mathrm{B}} = \frac{\upsilon_{\eta\chi} + \upsilon_2}{\upsilon_{\eta\chi} + \upsilon_1} f_s = \frac{\upsilon_{\eta\chi} + \dfrac{\upsilon_{\eta\chi}}{10}}{\upsilon_{\eta\chi} + \dfrac{\upsilon_{\eta\chi}}{5}} f_s = \frac{\dfrac{11\upsilon_{\eta\chi}}{10}}{\dfrac{6\upsilon_{\eta\chi}}{10}} f_s = \frac{11 \cdot 5}{10 \cdot 6} f_s = \frac{11}{12} f_s$$

άρα το σωστό είναι το (ii)

Θέμα Γ

Γ1.

$$-A \rightarrow A : \Delta t = \frac{T}{2}$$

σε Δt διαταραχή σε απόσταση $\Delta x = 4cm = 0,04m$.

$$v_\delta = \frac{\Delta x}{\Delta t} = \frac{0,04}{0,4} = 0,1m/s$$

$$v_\delta = \frac{\lambda}{T} \implies \lambda = 0,08m$$

Το Δm εκτελεί α.α.τ.:

$$D = \Delta m \cdot \omega^2 = \Delta m \frac{4\pi^2}{T^2} = 10^{-6}\frac{4\pi^2}{0,64} = \frac{\pi^2}{16}10^{-4}\frac{N}{m}$$

$$E_T = \frac{1}{2}D \cdot A^2 \implies 5\pi^2 10^{-7} = \frac{1}{2} \cdot \frac{\pi^2}{16}10^{-4}A^2 \implies A^2 = 0,16 \implies A = 0,4m \text{ (πλάτος)}$$

Γ2. Η εξίσωση του κύματος είναι:

$$y = A\eta\mu\left(\frac{2\pi t}{T} - \frac{2\pi x}{\lambda}\right) = 0,4\eta\mu\left(\frac{5\pi t}{2} - 25\pi x\right) \text{ (SI)}$$

Στιγμιότυπο την $t_1 = 1,4s$

$$x_1 = v_\delta t_1 = 0,1 \cdot 1,4 = 0,14m$$

$$N_1 = \frac{x_1}{\lambda} = \frac{0,14}{0,08} = \frac{14}{8} = \frac{7}{4} \text{ μήκη κύματος}$$

ή

$$t_1 = 0 \implies \frac{5\pi \cdot 1,4}{2} - 25\pi x_1 = 0 \implies x_1 = 0,14m$$

$$y_0 = 0,4\eta\mu(3,5\pi) = -0,4m$$

$$y_{t_1} = \begin{cases} 0,4\eta\mu\left(\frac{5\pi t}{2} - 25\pi x\right), & 0 \leq x \leq 0,14m \\ 0, & 0,14m < x \end{cases}$$

Γ3. ΑΔΕ$_{\tau\alpha\lambda}$ για Δm

$$E_T = K + U \implies E_T = K + \frac{1}{2}Dy^2 \overset{y=\frac{A}{2}}{\implies} E_T = K + \frac{1}{2}D\frac{A^2}{4} \implies$$
$$E_T = K + \frac{1}{4}E_T \implies K = \frac{3}{4}E_T = \frac{3}{4}5\pi^2 10^{-7} = \frac{3\pi^2}{8}10^{-6}J$$

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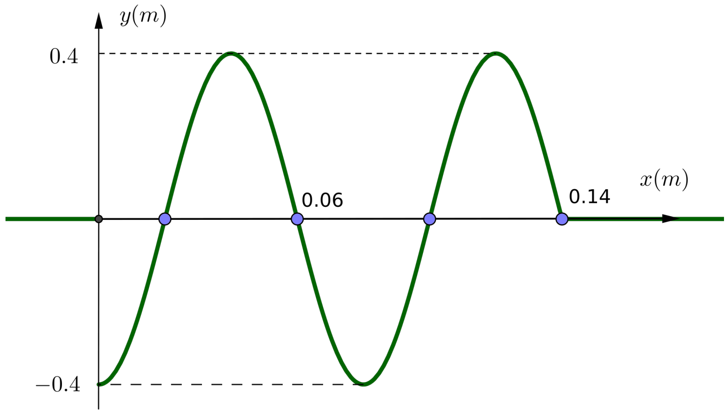


$$y = A\eta\mu\varphi = \frac{A}{2} \implies \eta\mu\varphi = \frac{1}{2} \implies \varphi = \begin{cases} 2k\pi + \frac{\pi}{6} & (1) \\ 2k\pi + \frac{5\pi}{6} & (2) \end{cases}$$

$$v = \omega A\sigma\upsilon\nu\varphi = \begin{cases} = \omega A\sigma\upsilon\nu\left(2k\pi + \frac{\pi}{6}\right) = \frac{\omega A\sqrt{3}}{2} \\ \omega A\sigma\upsilon\nu\left(2k\pi + \frac{5\pi}{6}\right) = -\frac{\omega A\sqrt{3}}{2} \end{cases}$$

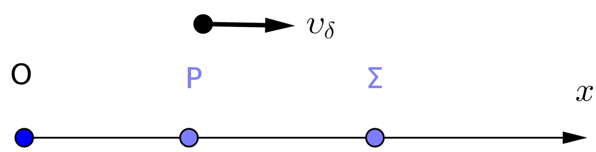
$$K = \frac{1}{2}\Delta m \cdot v^2 = \frac{1}{2}\Delta m\left(\pm\frac{\omega A\sqrt{3}}{2}\right)^2 = \frac{1}{2}\Delta m \cdot \frac{\omega^2 A^2 3}{4} = \frac{3}{4}\cdot\frac{1}{2}D\cdot A^2 = \frac{3}{4}E_T$$

Γ4.

$$\varphi_{\mathrm{P}} - \varphi_{\Sigma} = \frac{3\pi}{2}rad, (\varphi_{\mathrm{P}} > \varphi_{\Sigma})$$

$$\left.\begin{array}{r} y_{\mathrm{P}} = 0,4m = A \\ y_{\mathrm{P}} = A\eta\mu\varphi_{\mathrm{P}} \end{array}\right\} \eta\mu\varphi_{\mathrm{P}} = 1 \implies \varphi_{\mathrm{P}} = 2k\pi + \frac{\pi}{2}, k = 0, 1, 2, \ldots$$

$$2k\pi + \frac{\pi}{2} - \varphi_{\Sigma} = \frac{3\pi}{2} \implies \varphi_{\Sigma} = 2k\pi - \pi$$



Άρα

$$v_{\Sigma} = \frac{5\pi}{2}\cdot 0,4\cdot\sigma\upsilon\nu\left(2k\pi - \pi\right) \implies v_{\Sigma} = -\pi\frac{m}{s}$$

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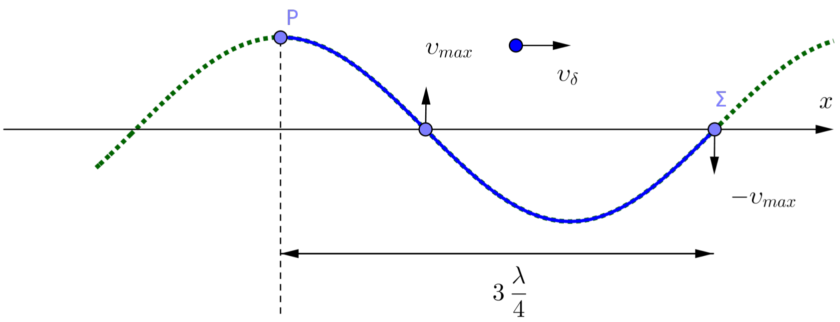
$$\varphi_{\mathrm{P}} - \Phi_{\Sigma} = \frac{3\pi}{2} \implies$$

$$\left.\begin{array}{l} \frac{5\pi t}{2} - 25\pi x_{\mathrm{P}} - \left(\frac{5\pi t}{2} - 25\pi x_{\Sigma}\right) = \frac{3\pi}{2} \implies x_{\Sigma} - x_{\mathrm{P}} = \frac{3}{50} \\ \frac{2\pi t}{T} - \frac{2\pi x_{\mathrm{P}}}{\lambda} - \left(\frac{2\pi t}{T} - \frac{2\pi x_{\Sigma}}{\lambda}\right) = \frac{3\pi}{2} \implies x_{\Sigma} - x_{\mathrm{P}} = \frac{3\lambda}{4} \end{array}\right\} \implies \frac{3\lambda}{4} = \frac{3}{50} \implies \lambda = 0,08 = \frac{4}{50}m$$



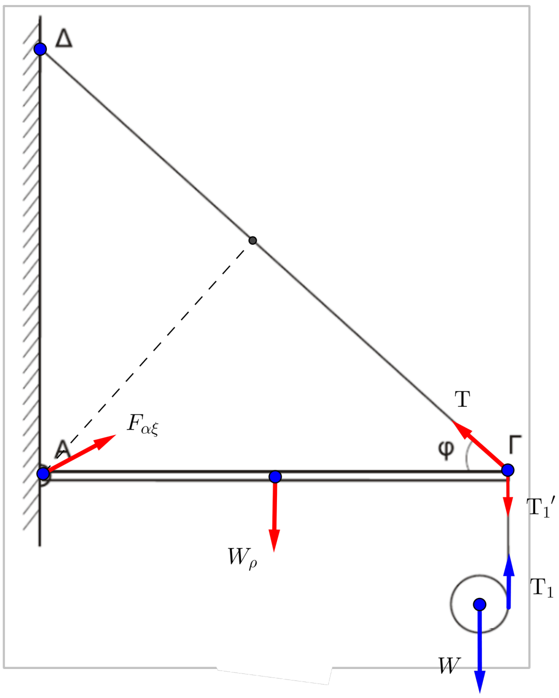
όταν $y_{\mathrm{P}} = A$,

$$\upsilon_{\Sigma} = -\omega A = -\pi\frac{m}{s}$$

Θέμα Δ

Δ1.

$$\Sigma F = m \cdot a_m \implies W - T_1 = m \cdot a_m\} \, T_1 = \frac{m \cdot a_{cm}}{2}, W = \frac{3m \cdot a_{cm}}{2}$$



$$0 = \upsilon_{\Gamma} = \upsilon_{Z} = \upsilon_{cm} - \upsilon_{\gamma\rho_{\mathrm{Z}}} \implies \upsilon_{cm} = \omega R \implies a_{cm} = a_{\gamma}R \implies a_{cm} = \frac{2}{3}g = \frac{20}{3}\frac{m}{s}$$

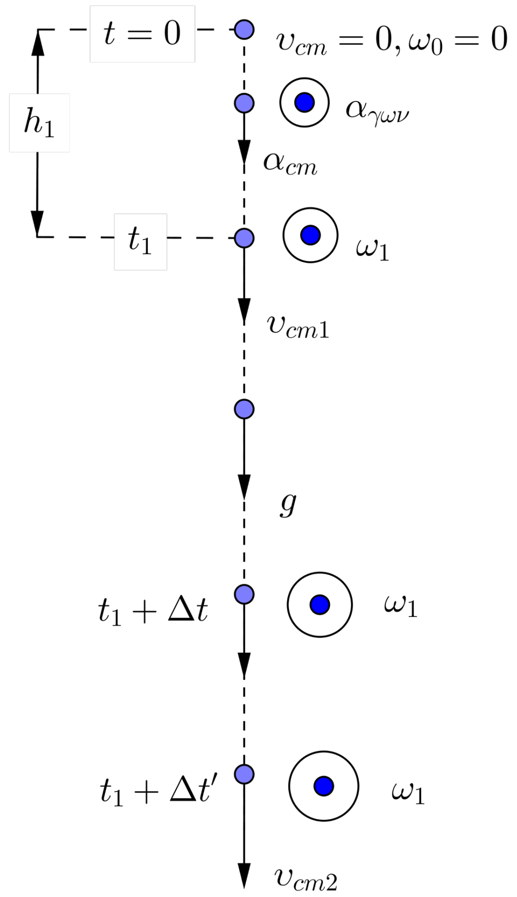
$$T_1' = T_1 = \frac{2 \cdot 20}{2 \cdot 3} = \frac{20}{3} N$$

Δ2. Για τη ράβδο που ισορροπεί:

$$\Sigma_{\tau_{(A)}} = 0 \implies w_\rho \cdot \frac{l}{2} + T_1' \cdot l - T \cdot l \cdot \eta\mu\varphi = 0 \implies T = \frac{100}{3} N$$

Δ3. Την t_1, $h_1 = 0,3m$

$$h_1 = \frac{1}{2} a_{cm} t_1^2 \implies 0,3 = \frac{1}{2} \cdot \frac{20}{3} t_1^2 \implies t_1 = 0,3s$$



$$a_{\gamma\omega\nu} = \frac{a_{cm}}{R} = \frac{200}{3} r/s^2$$

$$w_1 = a_{\gamma\omega\nu} t_1 = 20 r/s$$

$t \to t_1 + \Delta t$:

$$\tau_{w_{cm}} = 0 = \frac{\Delta L}{\Delta t} \implies L_{t_1} = L_{t_1 + \Delta_t}$$

Η μόνη δύναμη που ασκείται στο δίσκο είναι το βάρος W.

Όπου

$$L_{t_1} = I \cdot W_1$$

$$I = \frac{1}{2}mp^2 = \frac{1}{2} \cdot 2 \cdot 0,1^2 = 0,01kgm^2$$

Άρα

$$L_{t_1} = 0,2kg\frac{m^2}{s} = L_{t_1+\Delta t}$$

ή $\Theta\mathrm{MKE}_{(0\to h_1)}$:

$$\left.\begin{array}{c} \text{μετ: } \frac{1}{2}mv_{cm}^2 - 0 = W \cdot h_1 - T_1 \cdot h_1 \\ \text{στρ: } \frac{1}{2}I\omega^2 - 0 = +(T_1 \cdot R) \cdot \theta_1 \\ v_{cm} = \omega_1 \cdot R \\ x_{cm} = \theta \cdot R \implies h_1 = \theta_1 \cdot R \end{array}\right\} \implies$$

$$\frac{1}{2}mv_{cm}^2 + \frac{1}{2}I\omega_1^2 = mgh_1 \implies$$

$$\frac{1}{2}v_{cm}^2 + \frac{1}{4} \cdot v_{cm}^2 = gh_1 \implies v_{cm}^2 = \frac{4gh_1}{3} \implies v_{cm} = 2m/s \implies \omega_1 = 20r/s \implies$$

$$L_{t_1} = I\omega_1 = 0,2kg\frac{m^2}{s}$$

Η δύναμη T_1 δε μετατοπίζει το σημείο εφαρμογής της, αφού κάθε στιγμή ασκείται σε διαφορετικό σημείο του δίσκου, λειτουργεί δηλαδή όπως η στατική τριβή στη Κ.Χ.Ο. Επομένως η μηχανική ενέργεια του δίσκου διατηρείται.

$\mathrm{A\Delta ME}_{(0,h_1)}$:

$$K_(0) + U_(0) = K_{(t_1)} + U_{(t_1)}$$

$$0 + mgh_1 = \left(\frac{1}{2}mv_{cm}^2 + \frac{1}{2}I\omega_1^2\right) + 0$$

$$\left.\begin{array}{c} K_{\sigma\tau\rho} = \frac{1}{2}I\omega_1^2 \\ L = I\omega \end{array}\right\} K_{\sigma\tau\rho} = \frac{L^2}{2I}$$

$$mgh_1 = \frac{1}{2}m\omega^2R^2 + \frac{1}{2}I\omega^2$$

$$mgh_1 = I\omega^2 + \frac{1}{2}I\omega^2 = 3 \cdot \frac{1}{2}I\omega^2$$

$$mgh_1 = 3K_{(\sigma\tau\rho)} = \frac{3L^2}{2I}$$

$$9 \cdot 10 \cdot 0,3 = \frac{3L_{t_1}^2}{2 \cdot 0,01} \implies L_{t_1} = 0,2kg\frac{m^2}{s}$$

Δ3. $t_2 = t_1 + \Delta t'$:

$$\frac{K_{\sigma\tau\rho(t_2)}}{K_{\mu\varepsilon\tau(t_2)}} = \frac{\frac{1}{2}I\omega_2^2}{\frac{1}{2}mv_{cm_2}^2}$$

$t_1 = t_2$:

$$\Sigma\tau_{cm} = 0 \implies \omega_2 = \omega_1 = 20r/s$$
$$\Sigma F = m \cdot a_{cm} \implies W = m \cdot a_{cm} \implies a_{cm} = g = 10m/s^2$$
$$v_{cm_2} = v_{cm_1} + g \cdot \Delta t' = 2 + 10 \cdot 0,1 = 3m/s$$

$$\frac{K_{\pi\varepsilon\rho}}{K_{\mu\varepsilon\tau}} = \frac{\frac{1}{2}I\omega^2}{\frac{1}{2}mv^2} = \frac{\frac{1}{2}mR^2\omega_2^2}{mv_2^2} = \frac{2}{9}$$
$$\frac{K_{\pi\varepsilon\rho}}{K_{\mu\varepsilon\tau}} = \frac{2}{9}$$