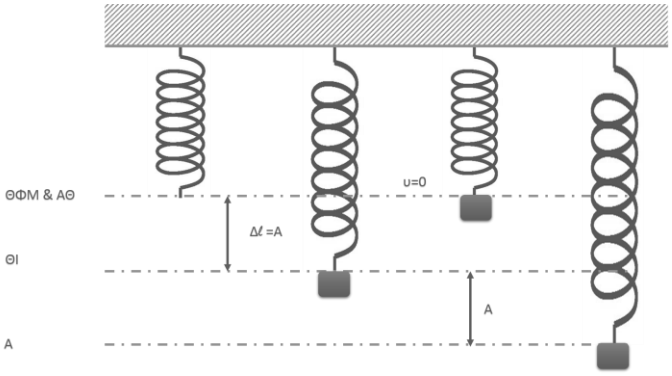
Α Π Α Ν Τ Η Σ Ε Ι Σ

ΘΕΜΑ Α

Α1) δ, **Α2)** γ, **Α3)** α, **Α4)** δ **Α5)** Λ, Σ, Σ, Σ, Λ

ΘΕΜΑ Β

B_1) Σωστό το (ii)



Ισχύει ότι: Α =Δl

$$\Sigma F = 0 \Leftrightarrow mg = K.\Delta l \Leftrightarrow \Delta l = \frac{mg}{k} \quad \text{άρα } A = \frac{mg}{k}$$

$$U_{ΕΛΑΤ_{max}} = \frac{1}{2}\cdot(\Delta\ell + A)^2 = \frac{1}{2}k\cdot(2A)^2 \Leftrightarrow$$

$$\Leftrightarrow U_{ΕΛΑΤ_{max}} = \frac{1}{2}\cdot\cancel{k}\cdot 4\frac{m^2g^2}{\cancel{k^2}} \Leftrightarrow$$

$$\Leftrightarrow U_{ΕΛΑΤ_{max}} = \frac{2m^2g^2}{k}$$

B_2) Σωστό το (iii)

Ισχύει ότι $Π_A=Π_z \Leftrightarrow A_Au_A=A_zu_z \Leftrightarrow u_A=u_z$ (1)

Bernoulli από το Γ → Ζ

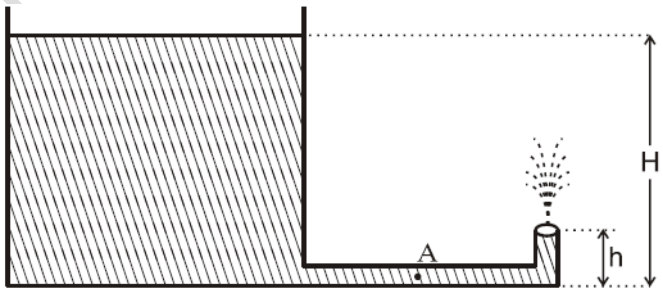
$$P_\Gamma + \frac{1}{2}\rho u_\Gamma^2 + \rho gH = P_Z + \frac{1}{2}\rho u_z^2 + \rho gh$$

Όμως $P_Γ=P_z=P_{ατμ}$

$u_Γ=0$

άρα

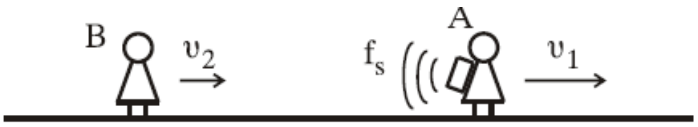
$$\rho g5h = \frac{1}{2}\rho u_z^2 + \rho gh \Leftrightarrow \frac{1}{2}u_z^2 = 4gh \Leftrightarrow u_z = 2\sqrt{2gh} \quad \text{άρα} \quad u_A = 2\sqrt{2gh}$$



Σχήμα 2

B_3) σωστό το (ii)

$$f_B = \frac{u_{ηχ}+u_2}{u_{ηχ}+u_1}fs = \frac{\frac{11u_{ηχ}}{10}}{\frac{12u_{ηχ}}{10}}fs \Leftrightarrow f_B = \frac{11}{12}fs$$



Σχήμα 3

ΘΕΜΑ Γ

$Δm = 10^{-6}kg$

$E_Τ=5π^2 \cdot 10^{-7}J$

$Δt = 0,4s$

$Γ_1$) Ισχύει

$$\Delta t = \frac{T}{2} \Leftrightarrow T = 0,8s$$

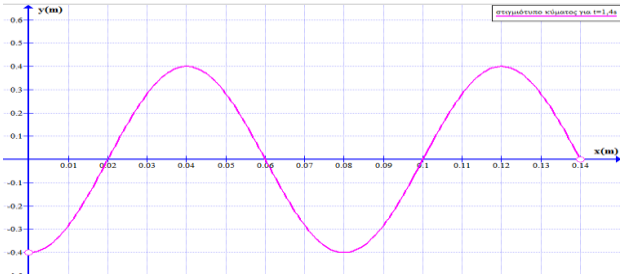
$$\Delta x = u.\Delta t \Leftrightarrow \Delta x = \frac{\lambda}{T}\cdot\frac{T}{2} \Leftrightarrow \Delta x = \frac{\lambda}{2} \Leftrightarrow \lambda = 8cm \Leftrightarrow \lambda = 8.10^{-2}m$$

$\Delta x = 4cm = 4 \cdot 10^{-2}m$ $\omega = \frac{2\pi}{T} = \frac{2\pi}{0,8} \Leftrightarrow \omega = 2,5\pi rad/s$

$\Phi_P - \Phi_\Sigma = \frac{3\pi}{2} rad$

$$E = \frac{1}{2}DA^2 \Leftrightarrow A^2 = \frac{2E}{\Delta m.\omega^2} \Leftrightarrow A^2 = \frac{4}{25} \Leftrightarrow A = 0,4m$$

Γ2) $u = \frac{\lambda}{T} = \frac{8 \cdot 10^{-2}}{0,8} \Leftrightarrow u = 0,1m/s$



$$y = A\eta\mu 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right) \Leftrightarrow y = 0,4\eta\mu 2\pi\left(\frac{5t}{4} - 12,5x\right)(S.I.)$$

$$u = \frac{x}{t} \Leftrightarrow x = ut \Leftrightarrow x = 0,14m$$

$$\frac{x}{\lambda} = \frac{0,14}{0,08} = \frac{14}{8} = \frac{7}{4} \Leftrightarrow x = \frac{7\lambda}{4}$$

Άρα το στιγμιότυπο του κύματος είναι

Γ3) $K = E - U \Leftrightarrow K = E - Dy^2/2 \Leftrightarrow K = E - \Delta m.\omega^2 \cdot y^2/2 \Leftrightarrow K = E - \frac{E}{4} \Leftrightarrow K = \frac{3E}{4} \Leftrightarrow K = 15\pi^2 \cdot 10^{-7}/4 \Leftrightarrow$

$K = 3,75\pi^2 \cdot 10^{-7}J$

Γ4) $y_P = A\eta\mu\varphi_P \Leftrightarrow A = A\eta\mu\varphi_P \Leftrightarrow \eta\mu\varphi_P = \eta\mu\pi/2 \Leftrightarrow \varphi_P = 2k\pi + \pi/2$

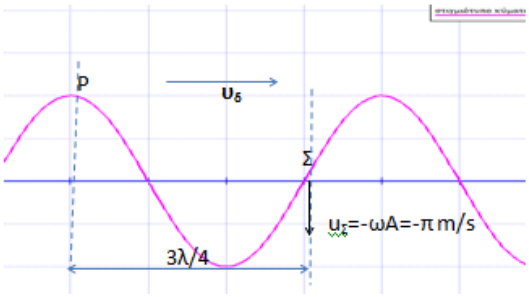
Άρα $\varphi_P - \varphi_\Sigma =$

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

Άρα $u_\Sigma = \omega \cdot A\sigma\upsilon\nu\varphi_\Sigma \Leftrightarrow u_\Sigma = 2,5\pi \cdot 0,4 \cdot \sigma\upsilon\nu(2k\pi - \pi)$

για k =0 : $u_\Sigma = +\pi\,\sigma\upsilon\nu(-\pi)$ άρα το κύμα δεν έχει φτάσει στο Σ άρα $u_\Sigma = 0$.

για $k \geq 1$ $u_\Sigma = +\pi\,\sigma\upsilon\nu(\pi) \Leftrightarrow$ $\boxed{u_\Sigma = -\pi\ m/s}$



2ος τρόπος

Επίσης $\Delta\varphi = 2\pi\frac{\Delta x}{\lambda} \Leftrightarrow \frac{3\pi}{2} = 2\pi\frac{\Delta x}{\lambda} \Leftrightarrow \Delta x = \frac{3\lambda}{4}$ όμως

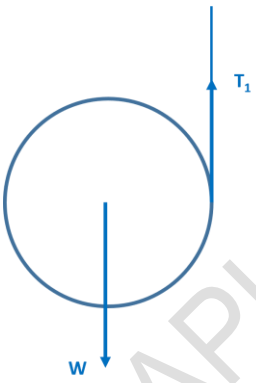
$\Phi_P > \Phi_\Sigma$ άρα $x_P < x_\Sigma$

Έστω ένα στιγμιότυπο με $y_P = +A$ άρα $u_\Sigma = -u_{max} \Leftrightarrow u_\Sigma = -\omega \cdot A \Leftrightarrow$ **$u_\Sigma = -\pi\ m/s$**

ΘΕΜΑ Δ

M = 4kg
m=2kg
R= 0,1m

Δ1) Για το δίσκο ισχύει: $\Sigma F = ma_{cm}$
$\Leftrightarrow w - T_1 = ma_{cm} \Leftrightarrow$
$\Leftrightarrow 20 - T_1 = 2a_{cm}$ (1)



$$\Sigma\tau = I\cdot\alpha_{\gamma\omega\nu} \Leftrightarrow T_1R = \frac{1}{2}mR^2\frac{a_{cm}}{R} \Leftrightarrow T_1 = a_{cm}(2)$$

$$\alpha_{cm} = \frac{20}{3}m/s^2$$

$$T_1 = \frac{20}{3}N$$

Δ2) Για την ράβδο $\Sigma T_{(A)} = 0 \Leftrightarrow -w_P\cdot\frac{A\Gamma}{2} - T_1\cdot A\Gamma + T_{2y}\cdot A\Gamma = 0$

$$\Leftrightarrow -20 - \frac{20}{3} + T_{2y} = 0 \Leftrightarrow T_{2y} = \frac{80}{3} \Leftrightarrow T_2\cdot\eta\mu\varphi = \frac{80}{3} \Leftrightarrow$$

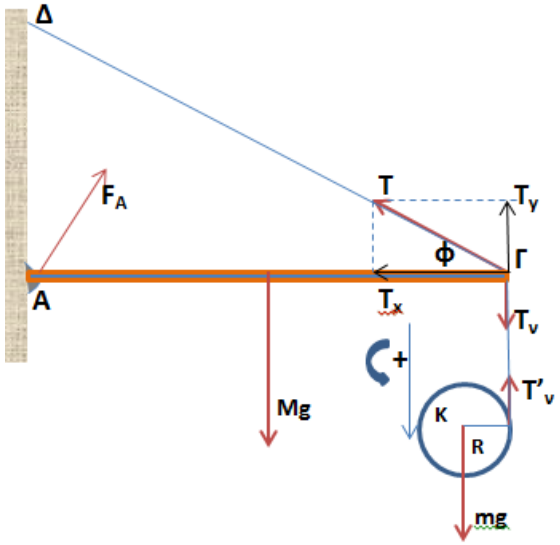
$$\Leftrightarrow T_2\cdot\frac{8}{10} = \frac{80}{3} \Leftrightarrow T_2\cdot\frac{100}{3}N$$

Δ3) Ισχύει

$$h = \frac{1}{2}a_{cm}t^2 \Leftrightarrow t = 0,3s$$

$$u = a_{cm}t \Leftrightarrow u = \frac{20}{3}\cdot 0,3 \Leftrightarrow U = 2m/s$$

Άρα $u_{cm} = \omega.R \Leftrightarrow \omega = \frac{u_{cm}}{R} = \frac{2}{0,1} \Leftrightarrow \omega = 20rad/s$



Όταν το νήμα κοπεί ισχύει:
$\Sigma F = ma' \Leftrightarrow mg = ma' \Leftrightarrow a' = g$
και $\Sigma\tau = 0$ άρα ω = σταθερή άρα **ω = 20rad/s**
$L = I\cdot\omega = mR^2\cdot\omega/2 \Leftrightarrow L=0,2Kg.m^2/s$

Δ4) Για τη μεταφορική
$u = u_0 + a't \Leftrightarrow u = u_0 + gt \Leftrightarrow u = 2 + 10\cdot 0,1 \Leftrightarrow$ **u = 3m/s**

$$\frac{K_{ΠΕΡ}}{K_{ΜΕΤ}} = \frac{\frac{1}{2}I\omega^2}{\frac{1}{2}mu^2} = \frac{\frac{1}{2}\frac{1}{2}mR^2\omega^2}{\frac{1}{2}mu^2} = \frac{1}{100}\cdot 200 \Leftrightarrow \frac{K_{ΠΕΡ}}{K_{ΜΕΤ}} = \frac{2}{9}$$