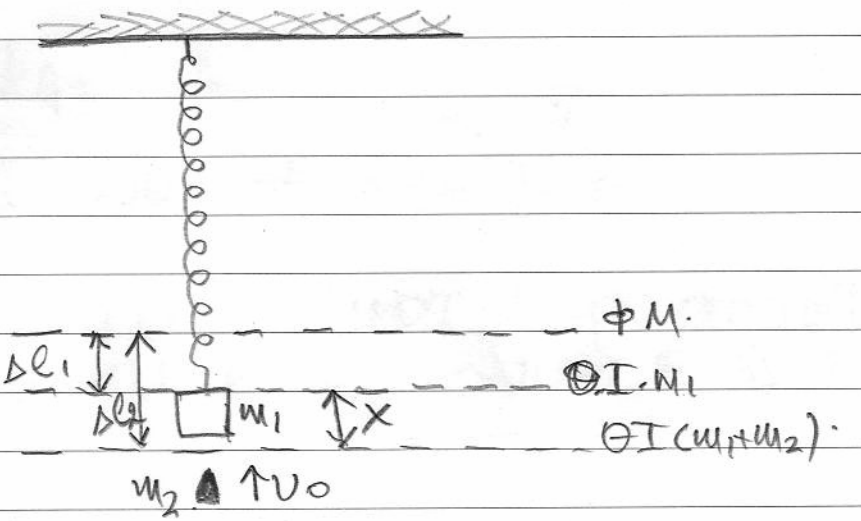
Λύση.



$m_1 = m_2 = 2\,kg$.
$k = 400\,N/m$.
$v_0 = \sqrt{3}\,m/s$.
$g = 10\,m/s$.

α) $\Sigma F = 0 \Rightarrow k\Delta l_1 = m_1 g \Rightarrow \Delta l_1 = \frac{m_1 g}{k} = 0{,}05\,m$.

β) ΑΔΟ: $m_1 \cdot 0 + m_2 \cdot v_0 = (m_1 + m_2)V \Rightarrow V = \frac{m_2 v_0}{m_1 + m_2} = \frac{\sqrt{3}}{2}\,m/s$

γ) $\Sigma F = 0 \Rightarrow k\Delta l_2 = (m_1 + m_2)g \Rightarrow \Delta l_2 = \frac{40}{400} = 0{,}1\,m$

Άρα $x = 0{,}05\,m$.

Έστω $x = A\eta\mu(\omega t + \varphi_0)$ $\quad \omega = \sqrt{\frac{k}{m_1 + m_2}} = 10\,rad/s$.

Ισχύει $E = K + U \Rightarrow \frac{1}{2}kA^2 = \frac{1}{2}(m_1 + m_2)V^2 + \frac{1}{2}kx^2 \Rightarrow$

$400A^2 = 4 \cdot \frac{3}{4} + 400 \cdot 25 \cdot 10^{-4} \Rightarrow 400A^2 = 4 \Rightarrow A = 0{,}1\,m$

Για $t_0 = 0$ έχουμε $0{,}05 = 0{,}1\eta\mu\varphi_0 \Rightarrow \eta\mu\varphi_0 = \eta\mu\frac{\pi}{6} \Rightarrow$

$\varphi_0 = \frac{\pi}{6}$ ή $\varphi_0 = \frac{5\pi}{6}$. Αλλά $V > 0$ οπότε $\varphi_0 = \frac{\pi}{6}\,rad$

Άρα $x = 0{,}1\eta\mu\left(10t + \frac{\pi}{6}\right)$, (SI)

δ) $E = K + U \Rightarrow E = 2U \Rightarrow \frac{1}{2}kA^2 = kx^2 \Rightarrow x = \frac{A\sqrt{2}}{2}$.

Άρα $\frac{A\sqrt{2}}{2} = A\eta\mu\left(10t + \frac{\pi}{6}\right) \Rightarrow \eta\mu\left(10t + \frac{\pi}{6}\right) = \eta\mu\frac{\pi}{4} \Rightarrow$

$10t + \frac{\pi}{6} = 2k\pi + \frac{\pi}{4} \xrightarrow{k=0} 10t + \frac{\pi}{6} = \frac{\pi}{4} \Rightarrow$

$10t = \frac{\pi}{4} - \frac{\pi}{6} \Rightarrow 10t = \frac{\pi}{12} \Rightarrow t = \frac{\pi}{120}$ s.

Για τα θέματα 1 και 2 οι απαντήσεις βρίσκονται στο σχολικό βιβλίο.