Θέμα 1°

Α1. – 2

Α2. – 1

Α3. – 3

Α4. – 3

Α5.: **1** – Λ, **2** – Λ, **3** – Σ, **4** – Σ, **5** – Σ

Θέμα 2°

Β1. – 2

$$\varphi_M - \varphi_K = 2\pi \Rightarrow 2\pi\frac{(AK)-(AM)}{\lambda} = 2\pi \Rightarrow$$

$$\sqrt{d^2+(MK)^2} - d = \lambda \Rightarrow d^2+(MK)^2 = (d+\lambda)^2 \Rightarrow$$

$$(MK) = \sqrt{(d+\lambda)^2 - d^2} \Rightarrow (MK) = \sqrt{60^2 - 40^2}\ \text{cm} = \sqrt{3200}\ \text{cm} \Rightarrow (MK) = 20\sqrt{5}\ \text{cm}$$

Β2. – 1

$$\ell = (N-1)\frac{\lambda}{2} = (N-1)\frac{\ell}{8} \Rightarrow N = 9$$ δεσμοί και $N-1$ κοιλίες.

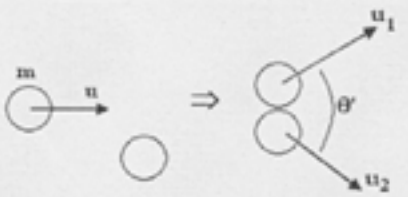
Β3. – 1

Ο τροχός εκτελεί μεταφορική κίνηση

$$\text{Α.Δ.Κ.Ε.} \Rightarrow mgR = \frac{1}{2}mu_{cm}^2 \Rightarrow u_{cm} = \sqrt{2gR}$$

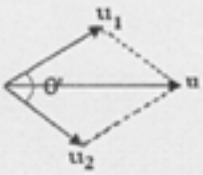
Θέμα 3°

Γ1.



$$\vec{P}_{\pi\rho} = \vec{P}_{\mu} \Rightarrow m\vec{u} = m\vec{u}_1 + m\vec{u}_2 \Rightarrow \vec{u} = \vec{u}_1 + \vec{u}_2 \Rightarrow u^2 = u_1^2 + u_2^2 + 2u_1u_2\sigma\upsilon\nu\theta' \quad \textbf{(1)}$$

$$K_{\alpha\rho} = K_{\mu} \Rightarrow \frac{1}{2}mu^2 = \frac{1}{2}mu_1^2 + \frac{1}{2}mu_2^2 \Rightarrow u^2 = u_1^2 + u_2^2 \quad (2)$$



Από τις **(1)** και **(2)** $\Rightarrow 2u_1u_2\sigma\upsilon\nu\theta' = 0 \Rightarrow \sigma\upsilon\nu\theta' = 0 \Rightarrow \theta' = \frac{\pi}{2}$

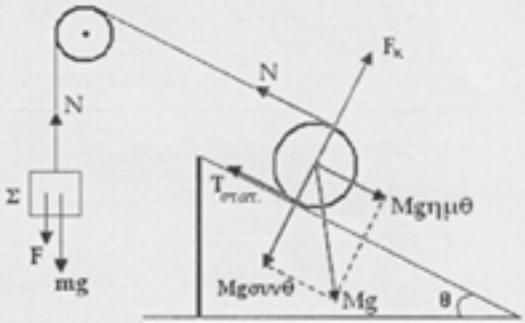
Γ2. $\alpha = \dfrac{\Delta K_2}{K_1} = \dfrac{\frac{1}{2}m(u\,\eta\mu 30^\circ)^2}{\frac{1}{2}mu^2} = \dfrac{1}{4} = 0{,}25$ ή 25%

Γ3. $\vec{F}_{21} = \dfrac{\Delta\vec{P}_2}{\Delta t} \Rightarrow F_{21} = \dfrac{mu_2}{\Delta t} = \dfrac{mu\,\eta\mu 30^\circ}{\Delta t} \Rightarrow F_{21} = \dfrac{1\cdot 10\cdot\frac{1}{2}}{10^{-2}}N = 500N$

$\vec{F}_{21} = -\vec{F}_{12}$

Γ4. $\ell = \sqrt{x_1^2 + x_2^2} = \sqrt{(u_1t)^2 + (u_2t)^2} = t\sqrt{u_1^2 + u_2^2} = ut = 10\,m$

Θέμα 4°



Δ1. Ισορροπία κυλίνδρου: $\Sigma\tau_{cm} = 0 \Rightarrow NR - T_{\sigma\tau}R = 0 \Rightarrow N = T_{\sigma\tau.}$ **(1)**

$$\Sigma F_x = 0 \Rightarrow N + T_{\sigma\tau\alpha\tau.} = Mg\,\eta\mu\theta \Rightarrow N = T_{\sigma\tau\alpha\tau.} = \frac{Mg\,\eta\mu\theta}{2} \quad (2)$$

Ισορροπία σώματος: $\Sigma F = 0 \Rightarrow N - F - mg = 0 \Rightarrow F = \dfrac{M}{2}g\,\eta\mu\theta - mg \Rightarrow F = 25N$

Δ2. Κίνηση κυλίνδρου: $\Sigma F = M\alpha_{cm} \Rightarrow Mg\eta\mu\theta - N - T_{στατ.} = M\alpha_{cm}$ **(1)**

$$\Sigma\tau_{cm} = I_{cm}\alpha_\gamma \Rightarrow T_{στατ.}R - NR = \frac{MR^2}{2}\alpha_\gamma \quad \textbf{(2)}$$

$$Mg\eta\mu\theta - 2N = \frac{3}{2}M\cdot\alpha_{cm} \ \textbf{(3)},\ \alpha_{cm} = \alpha_\gamma R$$

Για το σώμα Σ: $N - mg = m\alpha \Rightarrow N - mg = m2\cdot\alpha_{cm} \Rightarrow 2N - 2mg = 4m\alpha_{cm}$ **(4)**

Από τις **(3)** και **(4)** $\Rightarrow$ $Mg\eta\mu\theta - 2mg = \alpha_{cm}\left(4m + \frac{3}{2}M\right) \Rightarrow$

$$\alpha_{cm} = \frac{50N}{40kg} = 1{,}25\,m/s^2$$

και $\alpha = 2{,}5\,m/s^2$

Από την εξίσωση **(4)** $\Rightarrow$ $N = mg + 2m\alpha_{cm} = 25N + 5kg1{,}25m/s^2 = 31{,}25\,N$

και τότε η **(2)** $\Rightarrow$ $T_{στατ.} = N + \frac{M}{2}\alpha_{cm} \Rightarrow T_{στατ.} = 31{,}25\,N + 12{,}5\,N = 43{,}75\,N$

$$T_{στατ.} \le T_{ορ.} = \mu F_\kappa \Rightarrow \mu \ge \frac{T_{στατ.}}{F_\kappa} = \frac{43{,}75}{170} \Rightarrow \mu_{min} \cong 0{,}26$$

Δ3. $\frac{dU}{dt} = Mg\eta\mu\theta\cdot u_{cm} \Rightarrow \frac{dU}{dt} = 100\,N\cdot 1{,}25\frac{m}{s} = 125\frac{J}{s}$

$\frac{dE_M}{dt} = N\cdot u \Rightarrow \frac{dE_M}{dt} = 31{,}25\,N\cdot 2{,}5\frac{m}{s} = 78{,}125\frac{J}{s}$