Concursul PROSOFT@NT – ȘTIINȚE
Secțiunea Fizică – Proba teoretică, 02.03.2017

Barem de corectare

Problema 1

$\theta_1 = \omega_1 t$, $\theta_2 = \omega_2 t$ (0.5p)

Acele sunt in prelungire: $\theta_2 = \theta_1 + \pi$ de unde rezulta $t_1 = \dfrac{\pi}{\omega_2 - \omega_1}$. (0.5p)

Acele se suprapun: $\theta_2 = \theta_1 + 2\pi$ de unde $t_2 = \dfrac{2\pi}{\omega_2 - \omega_1} = 2t_1$ (0.5p)

Numeric: $\omega_1 = \dfrac{\pi}{6} rad/ora$, $\omega_2 = \dfrac{2\pi}{1} rad/ora$ si rezulta

$t_1 = 0.545\, ore = 0h32\min 42\sec$, $t_2 = 1.09\, ore = 1h5\min 24\sec$ (0.5p)

(2p)

Problema 2

Aplicand principiul al doilea al mecanicii pentru cele doua corpuri:

$$m\ddot{x}_1 + kx_1 + k'(x_1 - x_2) = 0$$

$$m\ddot{x}_2 + kx_2 - k'(x_1 - x_2) = 0$$

(1p)

Impunem solutiile de forma: $x_1 = A_1 \cos\omega t$, $x_2 = A_2 \cos\omega t$, dupa simplificari obtinem sistemul de ecuatii: (0.5p)

$$\left(\frac{k+k'}{m} - \omega^2\right) A_1 - \frac{k'}{m} A_2 = 0$$

$$-\frac{k'}{m} A_1 + \left(\frac{k+k'}{m} - \omega^2\right) A_2 = 0$$

(0.5p)

ce admite solutii nebanale daca

$$\begin{vmatrix} \frac{k+k'}{m} - \omega^2 & -\frac{k'}{m} \\ -\frac{k'}{m} & \frac{k+k'}{m} - \omega^2 \end{vmatrix} = 0$$

(0.5p)

si astfel

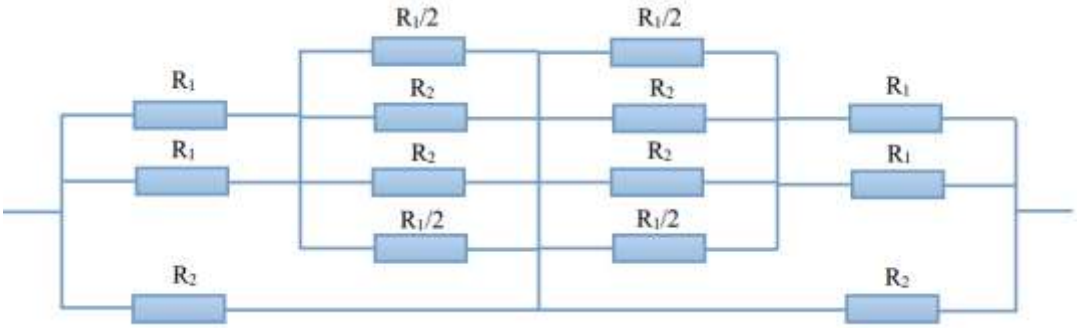
$$\omega_1 = \sqrt{\frac{k}{m}}, \qquad \omega_2 = \sqrt{\frac{k+2k'}{m}}$$

(0.5p)

(3p)

Problema 3

Din considerente de simetrie circuitul echivalent este:



Circuitul echivalent (0.5p)

$R_1 = ar_l$

$R_2 = ar_l\sqrt{1+\frac{h^2}{a^2}} = anr_l$

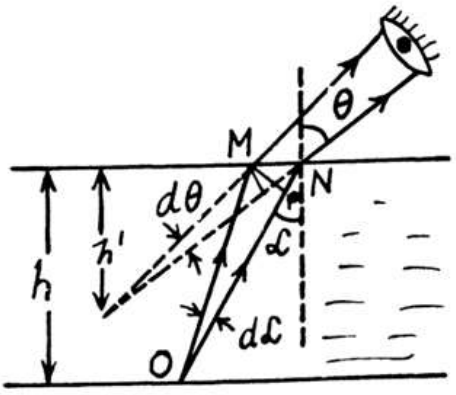
$\mathrm{R}_{\text{echiv}} = \frac{2n(1+3n)}{4n^2+5n+1}ar_l$ (0.5p)

a) h = 0, n=1, $\mathrm{R}_{\text{echiv}} = \frac{8}{10}ar_l$ (0.5p)

b) $h = a\sqrt{3}$, n = 2, $\mathrm{R}_{\text{echiv}} = \frac{28}{27}ar_l$ (0.5p)

(2p)

Problema 4



Mersul razelor: (0.5p)

Din figura observam ca

$\sin d\alpha = \frac{MP}{OM} = \frac{MN\cos\alpha\cos(\alpha+d\alpha)}{h} \cong \frac{MN\cos^2\alpha}{h}$ si similar $\sin d\theta \cong \frac{MN\cos^2\alpha}{h'}$

iar $h' = \dfrac{h\cos^2\theta}{\cos^2\alpha}\dfrac{d\alpha}{d\theta}$ (0.5p)

Din legea refractiei $n\sin\alpha = \sin\theta$ putem scrie $\cos\alpha = \sqrt{\dfrac{n^2 - \sin^2\theta}{n^2}}$ iar diferentiind obtinem: $\dfrac{d\alpha}{d\theta} = \dfrac{\cos\theta}{n\cos\alpha}$. (0.5p)

In final $h' = \dfrac{n^2 h\cos^3\theta}{\left(n^2 - \sin^2\theta\right)^{3/2}}$. (0.5p)

(2p)

Total: 10 puncte

Nota: Metodele alternative de rezolvare a problemelor vor fi punctate corespunzator.

Observație: Nota finală va fi media aritmetică a notelor obținute la cele două probe: teoretică și practică.

Președinte: conf. dr. Ioan Dumitru