25. studenoga 2016 Auditorne

sigoran podatak dolazi nam elektromagnetski val
ne dolazi zvučni val

Zadatak 1.

$m = 60\,g$

$\vartheta(t) = \underbrace{(0{,}08\ rad)}_{\vartheta_0} \cos\left[\underbrace{(4{,}43\ rad/s)}_{\omega} t + \varphi\right]$

$v = \Omega \ell$

$\omega = 4{,}43\,s^{-1}$

$\omega^2 = \frac{g}{\ell} \Rightarrow \ell = \frac{g}{\omega^2}$

$\vartheta_0 = 0{,}08$

$\vartheta(t) = \vartheta_0 \cos(\omega t + \varphi)$

$E_k = ?$ max

$E_k = \frac{m v^2}{2}$; moramo naći max brzinu

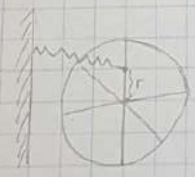
$\Omega(t) = \dot{\vartheta}(t) = \vartheta_0 \cdot (-\omega) \underbrace{\sin(\omega t + \varphi)}_{-1}$

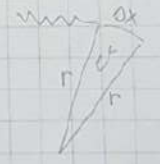
$\Omega(t)_{max} = \vartheta_0 \cdot \omega$

$v_{max} = \vartheta_0 \cdot \omega \cdot \frac{g}{\omega^2} = \vartheta_0 \frac{g}{\omega}$

$E_k = \frac{m v_{max}^2}{2} = \frac{1}{2} m \cdot \vartheta_0 \frac{g}{\omega}$

Zadatak 2.





$\Delta x = r\vartheta$

$m = 2{,}6\,kg$

R, ℓ?

$m = 0{,}1\,kg$

$k = 25\ N/m$

$r = \frac{3}{4} R$

$I\ddot{\vartheta} = -k\Delta x \cdot r$

$I = MR^2 + 6\,\frac{MR^2}{3}$

$I\ddot{\vartheta} = -k \cdot r^2 \vartheta$

$R^2(M + 2m)\ddot{\vartheta} + kr^2\vartheta = 0$

$\ddot{\vartheta} + \frac{\frac{9}{16} R^2 k}{R^2(M+2m)} \vartheta = 0$

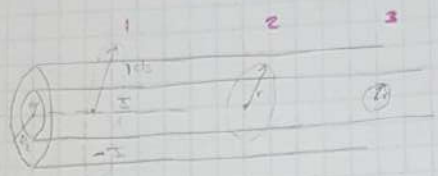
$T = ?$

$\ddot{\vartheta} + \omega^2 \vartheta = 0$

$\omega^2 = \frac{g}{16} \quad \frac{k}{M+2m}$

$T = \frac{4}{3}\sqrt{\frac{M+2m}{k}} \cdot 2\pi$

Zadatak 3.



① $r > R_2$

$\oint \vec{B}\, d\vec{s} = \mu_0 I_{ob}$

$B(r) \oint ds = B \cdot \int_0^{2\pi} r\, d\varphi = B \cdot 2\pi \cdot r$ - uglavnom se koristi ta formula, duljina zad. nede biti

$B\, 2\pi r - \mu_0 (I - I) = 0$

$r > R_2 \quad B(r) = 0$

② $R_1 < r < R_2$

$\oint B\, ds = \mu_0 I_{ob}$

$2\pi r\, B = \mu_0 I_0$

$B(r) = \frac{\mu_0 I_0}{2\pi r}$

③ $r < R_1$

$J = \frac{dI}{dA}$

→ gustoća struje

$\oint B\, ds = \mu_0 I_{ob}$

$B\, 2\pi r = \mu_0 \iint J\, dA$

$B\, 2\pi r = \mu_0 J \iint dA$

$B\, 2\pi r = \mu_0 J \cdot r^2 \pi$

$B\, 2\pi r = \mu_0 \frac{I}{R^2 \pi} \cdot r^2 \pi$

$B(r) = \frac{\mu_0 I r}{2\pi R_1^2}$

* $J = \frac{dI}{dA}$

→ ako je dovršen cijeli vodič $J = \frac{I}{R_1^2 \pi}$

Zadatak 4.

$v_0 = 3{,}6 \cdot 10^6 \ m/s$

$\vec{B} = (B_x, B_y, B_z)$

$F = ?$

$\vec{F}_L = q\vec{v} \times \vec{B}$

$\vec{v} = v_0 \vec{x}$

$\vec{B} = B_x \vec{x} + B_y \vec{y} + B_z \vec{z}$

$$\vec{v}_x \vec{B} = \begin{vmatrix} \vec{x} & \vec{y} & \vec{z} \\ v_0 & 0 & 0 \\ B_x & B_y & B_z \end{vmatrix} = \vec{x}(0-0) - \vec{y}(v_0 B_z - 0) + \vec{z}(v_0 B_y - 0)$$

$\vec{v} \times \vec{B} = -\vec{y} v_0 B_z + \vec{z} v_0 B_y$

$\vec{F} = e v_0 (B_z \vec{y} - B_y \vec{z})$

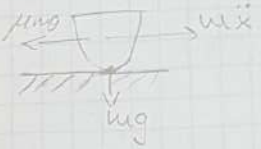
$|\vec{F}| = \vec{F} \cdot \vec{F} = e v_0 \cdot \sqrt{B_z^2 + B_y^2} = 3{,}43 \cdot 10^{-16} \ N$

* imaju formule u žutim!

Zadatak 5.

$A = 0{,}5 \ m$

$\mu = 0{,}42$



$x(t) = A \cos(\omega t + \varphi)$

$\mu mg > m\ddot{x}$

$\ddot{x} = -A\omega^2 \underbrace{\cos(\omega t + \varphi)}_{-1}$

$\ddot{x}_{max}(t) = \omega^2 A$

$\mu m g = \omega^2 A \cdot m$

$\omega^2 = \frac{\mu g}{A}$ $\qquad \omega = 2\pi f$

$f = \frac{1}{2\pi} \sqrt{\frac{\mu g}{A}}$

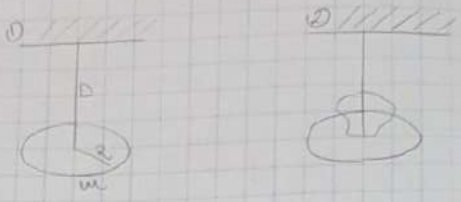
Zadatak 6.

$m = 200g$

$R = 20cm$

$T_1 = 2,2s$

$T_2 = 3,8s$



$$T_1 = 2\pi\sqrt{\frac{I_O}{D}} \qquad T_2 = 2\pi\sqrt{\frac{I_O + I}{D}}$$

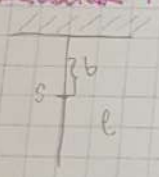
$$I_O = \frac{mR^2}{2}$$

$$\frac{T_1}{T_2} = \frac{\sqrt{\frac{I_O}{D}}}{\sqrt{\frac{I_O + I}{D}}} \qquad \left(\frac{T_1}{T_2}\right)^2 = \frac{I_O}{I_O + I}$$

$$I = I_O\left[\left(\frac{T_2}{T_1}\right)^2 - 1\right]$$

$$I = \frac{mR}{2}\left[\left(\frac{T_2}{T_1}\right)^2 - 1\right]$$

Zadatak 7.



$$T = 2\pi\sqrt{\frac{I}{mg \cdot b}}$$

$$I = \frac{me^2}{12} + mb^2$$

$$T = 2\pi\sqrt{\frac{\frac{me^2}{12} + mb^2}{mgb}}$$

$$\frac{T\sqrt{g}}{2\pi} = \sqrt{\frac{e^2}{12b} + b}$$

tražimo minimum

$$\frac{dT}{db} = 0$$

$$\frac{dT^2}{db} = \overbrace{\left(-\frac{e^2}{12b^2} + 1\right)}^{0}$$

$$e^2 = 12b^2$$

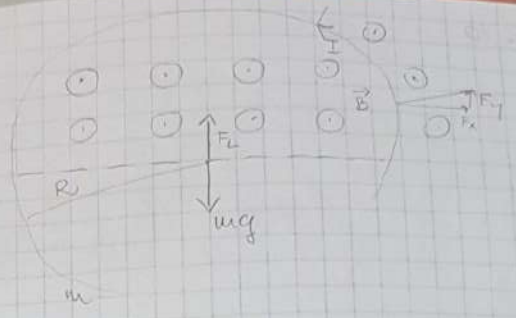
$$b = \frac{e}{\sqrt{12}}$$

Zadatak 8.

$B = 0,1\ T$

$m = 10\ g$

$R = 30\ cm$



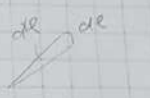
$F_L = mg$

$F = I \vec{l} \times \vec{B}$

$dF = I\, dl\, B$

$F_x = 0$ (jer se međusobno poništavaju)

$F_y = IB \int \sin\theta\, dl$



$dl = R\, d\varphi$

$F_y = IB \int_0^{\pi} R \sin\vartheta\, d\vartheta$

$F_y = IB \cdot (+\cos\vartheta)\Big|_0^{\pi}$

$= 2IBR$

$\Rightarrow 2IBR = mg$

$I = \frac{mg}{2BR}$

Zadatak 9.

$A = 44\ mm$

$a_1 = A \sin(\omega t - kx)$

$a_2 = A \sin(\omega t - kx + \rho)$

* fali dva zadatka
→ imaju i istu brzinu širenja

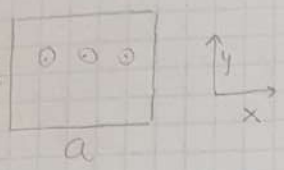
$a_1 + a_2 = A\left[\sin(\omega t - kx) + \sin(\omega t - kx + \rho)\right]$

$= 2A \sin\left(\omega t - kx + \frac{\rho}{2}\right) \cos\left(\frac{\rho}{2}\right)$

$A_2 = 2A \cos\rho/2$

$\cos\frac{\rho}{2} = \frac{A_2}{2A}$

Zadatak 10.



$B = Ayt^2$

$A = 0{,}5\ T/ms^2$

$t_1 = 4\,s$

$a = 120\ cm$

$$\mathcal{E}(t) = -\frac{\partial \Phi}{\partial t} = -\frac{\partial}{\partial t} \iint B\,dA$$

$$= -\frac{\partial}{\partial t} \iint A \cdot y t^2 \cdot dA \qquad dA = dx\,dy$$

$$= -\frac{\partial}{\partial t} \int_0^a dx \int_0^a A y t^2\,dy$$

$$= -\frac{\partial}{\partial t} A t^2 \frac{a^3}{2} \qquad A t^2 \frac{a^2}{2} \int_0^a dx$$

$$= -A a^3 t$$

$\mathcal{E}(t = 4s) =$

Zadatak 11.

$$y(x,t) = A\, e^{(ax - bt)}$$

$A = 0{,}5\ cm$

$a = 3\ cm^{-1}$

$b = 4\ s^{-1}$

$$y(x \pm vt) = A\, e^{a\left(x - \frac{b}{a} t\right)}$$

$$v = \frac{b}{a}$$

Zadatak 12.

$d = 1\,mm$

$L = 3\,m$

$f = 200\,Hz$

$A = 2\,cm$

$\rho = 7800\ kg/m^3$

$E_{okv} = ?$

$y(x,t) = A \sin \omega t \cdot \sin \frac{\pi x}{L}$

$\dot{y} = \omega A \underbrace{\cos \omega t}_{1} \cdot \sin \frac{\pi x}{L}$

$\dot{y} = \omega A \sin \frac{\pi x}{L}$

$dE = \frac{dm\, v^2}{2} \qquad \lambda = \frac{dm}{dx}$

$dE = \frac{\lambda}{2} \omega^2 A^2 \sin^2 \frac{\pi x}{L} dx$

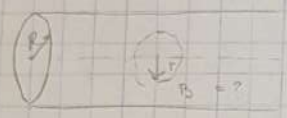
$E = \frac{\lambda \omega^2 A^2}{2} \int_0^L \sin^2 \frac{\pi x}{L} dx = \frac{\lambda}{2} A^2 \omega^2 \frac{1}{2} L$

$\rho = \frac{m}{V} = \frac{m}{\left(\frac{d}{2}\right)^2 \cdot \pi \cdot L}$

$E = \frac{m}{2} A^2 \omega^2 \frac{1}{2} 2$

$E = \left(\frac{d}{2}\right)^2 \cdot \pi \cdot L\, A^2 \omega^2 \cdot \frac{1}{2}$

Zadatak 13.



$J = ar$

$$\oint B\,ds = \mu_0 I_{ob}$$

$$2\pi r B = \iint J\,dA$$

$$2\pi r B = \int_0^r r \cdot a \cdot r\,dr \int_0^{2\pi} d\varphi$$

$dA = r\,dr\,d\varphi$

$$2\pi r B = \mu_0 \frac{r^3}{3} 2\pi$$

$$B = \frac{\mu_0 r^2 a}{3}$$