

Fizika 2 – 1. domaća zadaća – 2010/11

Zadatak 1.

$$l = 2m, r = 2mm, \Delta l = 1mm, E = 117.6GPa, F = ?$$

$$E = \frac{\frac{F}{S}}{\frac{\Delta l}{l}} \rightarrow F = \frac{SE\Delta l}{l} = 738.9N$$

Zadatak 2.

$$l = 4m, r = 2mm, m = 20kg, E = 196GPa, \Delta l = ?$$

$$E = \frac{\frac{F}{S}}{\frac{\Delta l}{l}} \rightarrow \Delta l = \frac{mgl}{r^2\pi E} = 0.3186mm$$

Zadatak 3.

$$\rho_{Pb} = 11400kg/m^3, \rho_{mv} = 1040kg/m^3, \sigma = 2 \cdot 10^7 Pa, h = ?$$

$$\sigma = \frac{F}{S} = \frac{G - U}{S} = \frac{mg - \rho_{mv}gV_{ur}}{S} = \frac{\rho_{Pb}V_{ur}g - \rho_{mv}gV_{ur}}{S} = \frac{\rho_{Pb}Shg - \rho_{mv}gSh}{S} = hg(\rho_{Pb} - \rho_{mv})$$

$$h = \frac{\sigma}{\rho_{Pb} - \rho_{mv}} = 196.789m$$

Zadatak 4.

$$l = 20cm, d = 2cm, \omega = 200rad/s, P = 14.92kW, G = 8 \cdot 10^{10}Pa, \vartheta = ?$$

$$P = M\omega \rightarrow M = \frac{P}{\omega}$$

$$\vartheta = \frac{2lM}{Gr^4\pi} = \frac{2Pl}{Gr^4\pi\omega} = 0.011872958rad = 0.68^\circ$$

Zadatak 5.

$$\Delta l_1 = 4cm, \Delta l_2 = 5cm, T = ?$$

$$mg = k\Delta l \rightarrow T = 2\pi \sqrt{\frac{m}{k_{uk}}} = 2\pi \sqrt{\frac{m}{\frac{k_1 k_2}{k_1 + k_2}}} = 2\pi \sqrt{\frac{m}{\frac{mg}{\Delta l_1 + \Delta l_2}}} = 2\pi \sqrt{\frac{\Delta l_1 + \Delta l_2}{g}} = 0.60182s$$

Zadatak 6.

$$s(t) = A \sin(\omega t + \varphi)$$

$$s(0) = 0.06m = A \sin \varphi$$

$$v(t) = s'(t) = A\omega \cos(\omega t + \varphi)$$

$$v(0) = A\omega \cos \varphi = 0.05\pi m/s$$

$$T = \frac{2\pi}{\omega} = 2s \rightarrow \omega = \pi rad/s$$

$$A \sin \varphi = 0.06$$

$$A \cos \varphi = 0.05$$

$$A^2 = 0.06^2 + 0.05^2 = 0.0061 \rightarrow A = 0.0781m = 7.81cm$$

$$\operatorname{tg} \varphi = \frac{0.06}{0.05} \rightarrow \varphi = 0.876rad = 50.19^\circ$$

Zadatak 7.

$$F_{tr} = F_{el}$$

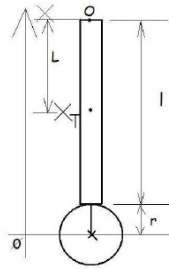
$$\mu mg = kA \rightarrow \frac{\mu g}{A} = \frac{k}{m} \rightarrow \sqrt{\frac{\mu g}{A}} = \sqrt{\frac{k}{m}} = \omega = 2\pi f \rightarrow f = \frac{1}{2\pi} \sqrt{\frac{\mu g}{A}} = 0.352Hz$$

Zadatak 8.

$$l_1 = 1.8m, l_2 = 0.9m, T_{uk} = ?$$

$$T_{uk} = \frac{T_1}{2} + \frac{T_2}{2} = \frac{2\pi}{2\sqrt{g}} (\sqrt{l_1} + \sqrt{l_2}) = 2.297s$$

Zadatak 9.



$$T = 2\pi \sqrt{\frac{I}{m_{uk}gL}}$$

$$I = I_{stapa} + I_{kugle} = \left(\frac{Ml^2}{12} + \frac{Ml^2}{4}\right) + \left(\frac{2mr^2}{5} + m(l+r)^2\right) = \frac{Ml^2}{12} + \frac{2mr^2}{5} + m(l+r)^2$$

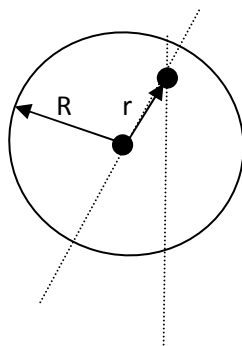
$$x_T = \frac{m \cdot 0 + M\left(\frac{l}{2} + r\right)}{m + M} = \frac{M\left(\frac{l}{2} + r\right)}{m + M}$$

$$L = l + r - x_T = \frac{m(l+r) + \frac{Ml}{2}}{m + M}$$

$$T = 2\pi \sqrt{\frac{\frac{Ml^2}{12} + \frac{2mr^2}{5} + m(l+r)^2}{(m+M)g \frac{m(l+r) + \frac{Ml}{2}}{m+M}}} = 2 \rightarrow m = \dots = 1.37kg$$

$$\rho = \frac{m}{V} = \frac{m}{\frac{4}{3}r^3\pi} = 2610.52kg/m^3$$

Zadatak 10.



$$T = 2\pi \sqrt{\frac{I}{mgL}} = 2\pi \sqrt{\frac{I_0 + mL^2}{mgL}} = 2\pi \sqrt{\frac{\frac{mR^2}{2} + mr^2}{mgr}} = 2\pi \sqrt{\frac{R^2 + 2r^2}{2gr}}$$

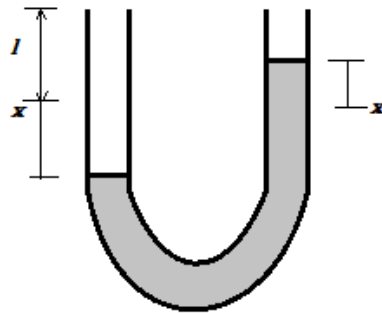
$$T = T(r)$$

$$T'(r) = 0 = \frac{2\pi}{2\sqrt{\frac{R^2 + 2r^2}{2gr}}} \frac{4r \cdot 2gr - (R^2 + 2r^2)2g}{4g^2r^2}$$

$$4r \cdot 2gr - (R^2 + 2r^2)2g = 0$$

$$8gr^2 - 2R^2g - 4r^2g = 4r^2g - 2R^2g = 0 \rightarrow 2r^2 = R^2 \rightarrow r = \frac{R}{\sqrt{2}}$$

Zadatak 11.



$$F = (p_1 - p_2)S + 2xS\rho g$$

$$p_1 V_1 = p_0 V_0, \quad p_2 V_2 = p_0 V_0$$

$$V_1 = S(l - x), \quad V_2 = S(l + x), \quad V_0 = Sl$$

$$p_1 = \frac{p_0 l}{l - x}, \quad p_2 = \frac{p_0 l}{l + x}$$

$$p_1 - p_2 = p_0 l \left(\frac{1}{l - x} - \frac{1}{l + x} \right) \approx \frac{2p_0}{l} x$$

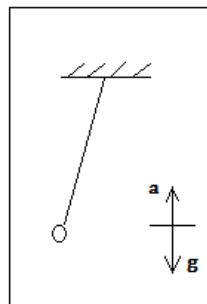
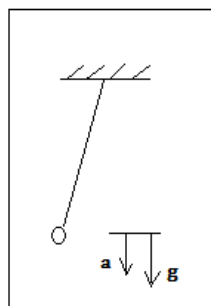
$$-ma = F$$

$$-m \frac{d^2 x}{dt^2} = (p_1 - p_2)S + 2xS\rho g$$

$$\frac{d^2 x}{dt^2} + \frac{2S(p_0 + \rho gl)}{ml} x = 0 \rightarrow \omega = \sqrt{\frac{2S(p_0 + \rho gl)}{ml}} = 2\pi f$$

$$f = \frac{1}{2\pi} \sqrt{\frac{2r^2 \pi (p_0 + \rho gl)}{ml}}$$

Zadatak 12.



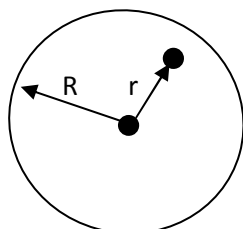
1. slučaj:

$$T = 2\pi \sqrt{\frac{l}{g_{uk}}} = 2\pi \sqrt{\frac{l}{(g + a)}}$$

2. slučaj:

$$T = 2\pi \sqrt{\frac{l}{g_{uk}}} = 2\pi \sqrt{\frac{l}{(g - a)}}$$

Zadatak 13.



$$T_1 = 2\pi \sqrt{\frac{I}{mgL_1}} = 2\pi \sqrt{\frac{\frac{2mR^2}{5} + mr_1^2}{mgr_1}} = 2\pi \sqrt{\frac{2mR^2 + 5mr_1^2}{5mgr_1}}$$

$$T_2 = 2\pi \sqrt{\frac{I}{mgL_2}} = 2\pi \sqrt{\frac{\frac{2mR^2}{5} + mr_2^2}{mgr_2}} = 2\pi \sqrt{\frac{2mR^2 + 5mr_2^2}{5mgr_2}}$$

$$\frac{T_1}{T_2} = 0.5 = \sqrt{\frac{(2mR^2 + 5mr_1^2)r_2}{(2mR^2 + 5mr_2^2)r_1}} \rightarrow r_2^2 - 0.52r_2 + 0.004 = 0 \rightarrow r_2 = 0.78cm$$

Zadatak 14.

$$I_{kugle} = \frac{2}{5}mr^2 \rightarrow I_{uk} = \frac{2}{5}mr^2 + m(l+r)^2$$

$$T_{fizičko} = 2\pi \sqrt{\frac{I_{uk}}{mg(l+r)}} = 2\pi \sqrt{\frac{\frac{2}{5}mr^2 + m(l+r)^2}{mg(l+r)}} = 2\pi \sqrt{\frac{\frac{2}{5}r^2 + (l+r)^2}{g(l+r)}} = 3.492007707s$$

$$T_{matematičko} = 2\pi \sqrt{\frac{l+r}{g}} = 3.491939245s$$

$$\Delta T = T_{fizičko} - T_{matematičko} = 6.85 \cdot 10^{-5}s$$

Zadatak 15.

$$\omega_0 = \frac{2\pi}{T_0}$$

$$\omega = \sqrt{\omega_0^2 - \delta^2} = \frac{2\pi}{T} \rightarrow \delta^2 = \omega_0^2 - \left(\frac{2\pi}{T}\right)^2 = 4\pi^2 \left(\frac{1}{T_0^2} - \frac{1}{T^2}\right) \rightarrow \delta = 4.9s^{-1}$$

Zadatak 16.

$$v = \sqrt{\frac{F}{\mu}} \rightarrow F = v^2\mu = (\lambda f)^2\mu = \lambda^2 f^2 \mu$$

$$F_1 = F_2, \quad V_1 = V_2, \quad \lambda_1 = \lambda_2$$

$$\mu = \frac{m}{l} = \frac{\rho V}{l}$$

$$\lambda_1^2 f_1^2 \mu_1 = \lambda_2^2 f_2^2 \mu_2 \rightarrow f_1 = f_2 \sqrt{\frac{\rho_2}{\rho_1}} = 171.6Hz$$

Zadatak 17.

$$f_2 - f_1 = 6$$

$$\frac{v_1}{v_2} = \sqrt{\frac{\mu_2}{\mu_1}} = \sqrt{\frac{\frac{m_2}{l_2}}{\frac{m_1}{l_1}}} = \sqrt{\frac{\frac{\rho r^2 \pi l_2}{l_2}}{\frac{\rho r^2 \pi l_1}{l_1}}} = 1$$

$$v_1 = v_2 \rightarrow \lambda_1 f_1 = \lambda_2 f_2 \rightarrow 2l_1 f_1 = 2l_2 f_2 \rightarrow f_1 = \frac{l_2}{l_1} f_2$$

$$f_2 - f_1 = f_2 - \frac{l_2}{l_1} f_2 = 6 \rightarrow f_2 = \frac{6}{1 - \frac{l_2}{l_1}} = 300 \text{ Hz}$$

$$f_1 = 294 \text{ Hz}$$

Zadatak 18.

$$s_1 = 0.03 \sin\left(2t + \frac{1}{4}x\right)$$

$$s_2 = 0.03 \sin\left(2t - \frac{1}{4}x + a\right)$$

$$y(x, t) = s_1 + s_2 = 0.06 \sin\left(2t + \frac{a}{2}\right) \cos\left(\frac{1}{4}x + \frac{a}{2}\right)$$

$$x = 0.03, \quad y = 0$$

$$0 = 0.06 \sin\left(2t + \frac{a}{2}\right) \cos\left(0.0075 + \frac{a}{2}\right)$$

$$0.0075 + \frac{a}{2} = \frac{\pi}{2} \rightarrow a = 3.1266$$

$$s_2 = 0.03 \sin\left(2t - \frac{1}{4}x + 3.1266\right)$$