UNIVERZITET U NIŠU
ELEKTRONSKI FAKULTET
PREDMET: FIZIKA

01.10.2026.

1. Sa iste visine su puštena dva tela da slobodno padaju, pri čemu je drugo telo pušteno 0.5 s posle prvog tela. Odrediti vreme od početka kretanja prvog tela posle koga će rastojanje između tela biti 5 m. Odrediti visinu sa koje su tela puštena ako se zna da kada prvo telo dodirne zemlju drugo telo je prešlo polovinu puta. Ubrzanje Zemljine teže je $g = 9.81\ ms^{-2}$.

2. Stakleni sud termičkog koeficijenta zapreminskog širenja $\gamma_s = 2.4 \cdot 10\text{-}5\ K^{-1}$ napunjen je do vrha nekom tečnošću na temperaturi $t_1 = 20\ °C$. Tečnost koja se nalazi u sudu na toj temperaturi ima masu $m_1 = 50$ g. Kada je stakleni sud do vrha napunjen istom tečnošću na temperaturi $t_2 = 50\ °C$, onda je masa tečnosti u sudu $m_2 = 49$ g. Naći vrednost toplotnog koeficijenta zapreminskog širenja γ_t te tečnosti.

3. Idealni dvoatomni gas koristi se kao radno telo u toplotnom motoru, čiji radni ciklus sastoji od: (a) izohornog zagrevanja od pritiska $p_1 = 5 \cdot 10^5$ Pa do pritiska $p_2 = 2.5p_1$, pri $V_1 = 1.5$ l; (b) izobarnog širenja do zapremine $V_3 = 3.5V_2$; (c) izotermnog širenje do pritiska $p_4 = p_1$ i zapremine $V_4 = 1.5V_3$; (d) izobarnog sabijanje do početnog stanja. Koliki rad izvrši motor u toku ovog ciklusa? Koliki je njegov stepen korisnog dejstva?

4. Energija matematičkog klatna opadne za 30 % za 12 s. Kolika je dužina klatna ako je logaritamski dekrement prigušenja $2{,}5 \cdot 10^{-2}$. Ubrzanje Zemljine teže je $g = 9{,}81\ ms^{-2}$.

5. Tanko simetrično bikonveksno sočivo izradjeno od stakla indeksa prelamanja $n = 1.75$, nalazi se u vazduhu indeksa prelamanja $n_o = 1$. Kada se na rastojanju od 10 cm od njegovog optičkog centra postavi svetao predmet, dobije se realan trostruko uvećan lik. Odrediti poluprečnik krivine ovog sočiva.

Predmetni nastavnici

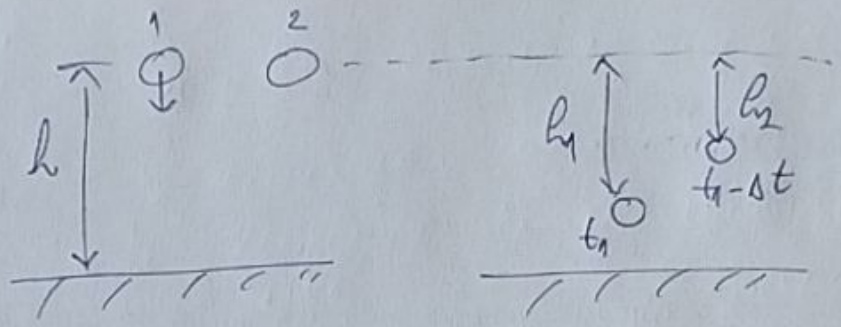
1. $\Delta t = 0{,}5\,s$

$\Delta h = 5\,m$

$g = 9{,}81\,\frac{m}{s^2}$

$t_1 = ?$

$h = ?$



$\Delta h = h_1 - h_2$ (2)

$h_1 = \frac{g t_1^2}{2}$ (2)

$h_2 = \frac{g(t_1 - \Delta t)^2}{2}$ (2)

$\Delta h = \frac{g t_1^2}{2} - \frac{g t^2}{2} + g t_1 \Delta t + \frac{g \Delta t^2}{2}$

$g t_1 \Delta t = \Delta h + \frac{g \Delta t^2}{2}$

$t_1 = \frac{\Delta h + \frac{g \Delta t^2}{2}}{g \Delta t}$ (2)

$t_1 = \frac{5 + \frac{9{,}81 \cdot 0{,}5^2}{2}}{9{,}81 \cdot 0{,}5} = 1{,}2\,s$ (2)

$h = \frac{g t^2}{2}$ (2)

$\frac{h}{2} = g\frac{(t - \Delta t)^2}{2}$ (2)

$h = g(t - \Delta t)^2$

$\frac{g t^2}{2} = g(t - \Delta t)^2$

$t^2 = 2t^2 - 4t\Delta t + 2\Delta t^2$

$t^2 - 4t\Delta t + 2\Delta t^2 = 0$ (2)

$t_{1,2} = \frac{4\Delta t \pm \sqrt{16\Delta t^2 - 8\Delta t^2}}{2} = \frac{4\Delta t \pm \sqrt{8\Delta t^2}}{2}$

$t_{1,2} = \frac{4\Delta t \pm 2\sqrt{2}\Delta t}{2} = (2 \pm \sqrt{2})\Delta t$

$t_1 = (2 + \sqrt{2})\Delta t = 1{,}7\,s$ (2)

$t_2 = (2 - \sqrt{2})\Delta t$ ✗

$h = 14{,}17\,m$ (2)

2. $\gamma_s = 2{,}4 \cdot 10^{-5}\,K^{-1}$

$t_1 = 20°C$

$m_1 = 50g$

$t_2 = 50°C$

$m_2 = 49g$

$\gamma_t = ?$

$\Delta t = t_2 - t_1 = 30°C$

V_1 - početna zapremina suda i tečnosti na t_1

V_2 - zapremina suda i tečnosti na temp. t_2

V_2' - zapremina tečnosti (uključujući tečnost van suda)

(2) $m_1 = \rho_1 \cdot V_1 \rightarrow \rho_1 = \frac{m_1}{V_1}$

(2) $m_2 = \rho_2 \cdot V_2 \rightarrow \rho_2 = \frac{m_2}{V_2}$

(2) $V_2 = V_1(1+\gamma_s \Delta t)$

(2) $m_1 = \rho_2 \cdot V_2'$

(2) $V_2' = V_1(1+\gamma_t \Delta t)$

$\rho_1 V_1 = \rho_2 V_1 (1+\gamma_t \Delta t)$

$\rho_1 = \rho_2 (1+\gamma_t \Delta t)$ (3)

$\frac{m_1}{V_1} = \frac{m_2}{V_2}(1+\gamma_t \Delta t)$ (2)

$\frac{m_1}{V_1} = \frac{m_2}{V_1(1+\gamma_s \Delta t)}(1+\gamma_t \Delta t)$

$m_1(1+\gamma_s \Delta t) = m_2(1+\gamma_t \Delta t)$

$1+\gamma_t \Delta t = \frac{m_1(1+\gamma_s \Delta t)}{m_2}$

$\gamma_t = \frac{\frac{m_1}{m_2}(1+\gamma_s \Delta t)-1}{\Delta t}$ (3) $= \frac{\frac{50}{49}(1+2{,}4 \cdot 10^{-5} \cdot 30)-1}{30}$

$\gamma_t = 7 \cdot 10^{-4}\,K^{-1}$ (2)

$i = 5$

(3)

1-2 $V = \text{const.}$

$A_{12} = 0$ (2)

$Q_{12} = \Delta U_{12} = U_2 - U_1 = \frac{i}{2} p_2 V_2 - \frac{i}{2} p_1 V_1 = \frac{5}{2}(2{,}5 p_1 V_1 - p_1 V_1)$

$= \frac{5}{2} 1{,}5 \cdot p_1 V_1 = \underline{3{,}75 p_1 V_1}$ (2)

2-3 $p = \text{const.}$

$A_{23} = \int_{V_2}^{V_3} p_2 \, dV = p_2 (V_3 - V_2) = 2{,}5 p_1 (3{,}5 V_1 - V_1) = \underline{6{,}25 p_1 V_1}$ (2)

$\Delta U_{23} = \frac{5}{2}(p_3 V_3 - p_2 V_2) = \frac{5}{2}(2{,}5 p_1 \cdot 3{,}5 \cdot V_1 - 2{,}5 p_1 V_1) = \underline{15{,}625 p_1 V_1}$ (2)

$Q_{23} = \underline{21{,}875 p_1 V_1}$

3-4 $T = \text{const.}$

$\Delta U_{34} = 0$ (2)

$A_{34} = \int_{V_3}^{V_4} p \, dV = \int_{V_3}^{V_4} \frac{nRT_3}{V} dV = nRT_3 \int_{V_3}^{V_4} \frac{dV}{V} = p_3 V_3 \ln \frac{V_4}{V_3} = 2{,}5 p_1 3{,}5 V_1 \ln 1{,}5$

$= \underline{3{,}547 p_1 V_1}$ (2)

$Q_{34} = \underline{3{,}547 p_1 V_1}$

4-1 $p = \text{const}$

$A_{41} = \int_{V_4}^{V_1} p_4 \, dV = p_1 (V_1 - V_4) = p_1 (V_1 - 1{,}5 \cdot 3{,}5 V_1) = \underline{-4{,}25 p_1 V_1}$ (2)

$A = 0 + 6{,}25 p_1 V_1 + 3{,}547 p_1 V_1 - 4{,}25 p_1 V_1 = \underline{5{,}547 p_1 V_1} = 5{,}547 \cdot 5 \cdot 10^5 \cdot 0{,}015$

$= \underline{41602{,}5 \text{ J}}$ (2)

$Q = 3{,}75 p_1 V_1 + 21{,}875 p_1 V_1 + 3{,}547 p_1 V_1 = \underline{29{,}172 p_1 V_1}$

$\eta = \frac{A}{Q} = \frac{5{,}547}{29{,}172} = 0{,}1901 \approx \underline{19\%}$ (2)

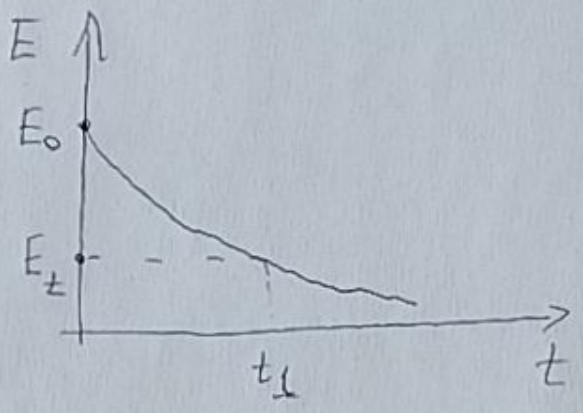
4. $\Delta E = 30\%$

$t_1 = 12\,s$

$l = ?$

$\lambda = 2{,}5 \cdot 10^{-2}$

$g = 9{,}81 \frac{m}{s^2}$



$T = 2\pi \sqrt{\frac{l}{g}}$ 2

$\frac{T}{2\pi} = \sqrt{\frac{l}{g}} \quad /^2$

$\frac{T^2}{4\pi^2} = \frac{l}{g}$

$l = g \cdot \frac{T^2}{4\pi^2}$

$\lambda = B \cdot T_t$ 2

$T_t = \frac{2\pi}{\sqrt{\omega_0^2 - B^2}}$ 3

$\sqrt{\omega_0^2 - B^2} = \frac{2\pi}{\frac{\lambda}{B}} \quad /^2$

$\frac{4\pi^2}{T^2} - B^2 = \frac{4\pi^2 B^2}{\lambda^2}$

$E_t = 0{,}7 \cdot E_0$

$E_t = E_0 \cdot e^{-2Bt_1}$ 2

$0{,}7 \cdot E_0 = E_0 \cdot e^{-2Bt_1} \quad / \ln$

$-2Bt_1 = \ln(0{,}7)$

$B = \frac{\ln(0{,}7)}{-2\,t_1}$

$B = 0{,}015$ 5

$\frac{4\pi^2}{T^2} = \frac{4\pi^2 B^2}{\lambda^2} + B^2$

$T^2 = \frac{4\pi^2}{\frac{4\pi^2 B^2}{\lambda^2} + B^2}$

$T = \sqrt{\frac{4\pi^2}{\frac{4\pi^2 B^2}{\lambda^2} + B^2}}$

$T = 1{,}67\,s$ 6

$l = g \frac{T^2}{4\pi^2} = 0{,}69\,m$

5. $n = 1.75$ $V = 3$ 2p

$n_0 = 1$ $V = -\frac{\ell}{p}$ 2

$p = 10\,cm$ $V = -3$

$-3 = -\frac{\ell}{10}$

$\ell = 30\,cm$ 3

$R = ?$

$\frac{1}{f} = \frac{1}{p} + \frac{1}{\ell}$

$\frac{1}{f} = \frac{1}{10} + \frac{1}{30} = \frac{4}{30}$

$f = \frac{30}{4} = 7.5\,cm$

$\boxed{f = 7{,}5\,cm}$ 5

$\frac{1}{f} = \left(\frac{n}{n_0} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 3

$R_1 = R \quad R_2 = -R$

$\frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{R} - \frac{1}{-R} = \frac{2}{R}$

$\frac{1}{f} = (1.75 - 1)\frac{2}{R}$

$\frac{1}{f} = 0.75\frac{2}{R} = \frac{1.5}{R}$

$R = 1.5f$ 2

$R = 1.5 \cdot 7{,}5$

$\boxed{R = 11{,}25\,cm}$ 5