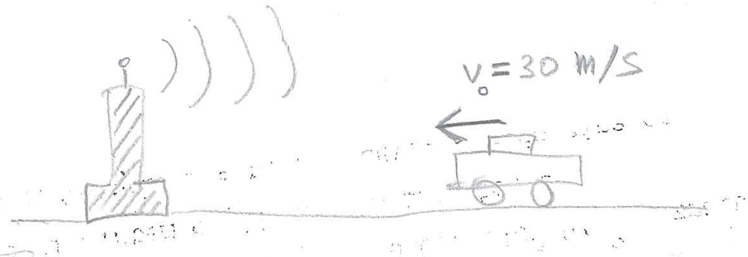
V5 | SB/208/18 | VALE | VAL

Avtomobil se s hitrostjo 30 m/s približuje tovarniški sireni, ki ima frekvenco 500 s^{-1}. Kakšna je frekvenca zvoka sirene, ki jo zazna voznik avtomobila, če je hitrost zvoka 340 m/s?

$c = 340$ m/s , $\nu = 500\ s^{-1}$

$v_0 = 30$ m/s ,



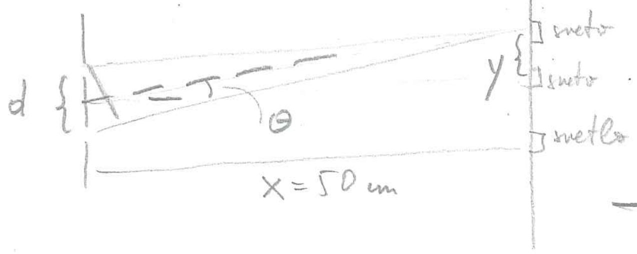
$\lambda = \lambda'$ $c = \nu \cdot \lambda$

$\frac{c}{\nu} = \frac{c'}{\nu'}$ $c' = c + v_0$

$$\nu' = \frac{c'}{c}\nu = \frac{c+v_0}{c}\cdot\nu = \nu\left(1+\frac{v_0}{c}\right) = \underline{544\ s^{-1}}$$

V6 | SB/233/1

Monokromatična svetloba iz točkastega svetila pada dve paralelni pokončni tanki reži, ki sta oddaljeni druga od druge 0.8 mm. Interferenčni vzorec gledamo na 50 cm oddaljenem zaslonu. Razlja prvima dvema int. svetlima pasovoma je 0.304 mm? Kakšna je valovna dolžina svetlobe?



$d = 0.8$ mm
$x = 50$ cm
$y = 0.304$ mm

$\lambda = ?$

svetli pasovi

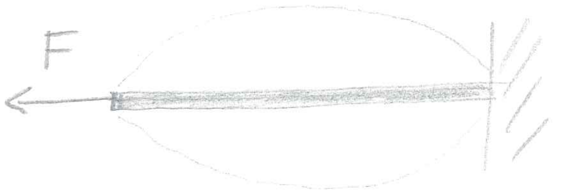
$d \sin\Theta = m \cdot \lambda$

1) $m = 1$: $d\sin\Theta = \lambda$

2) $tg\,\Theta = \frac{y}{x}$, če $\Theta \ll 1 \Rightarrow tg\,\Theta \cong \sin\Theta$

$$d\left(\frac{y}{x}\right) = \lambda = \underline{486\ nm}$$

4. Jeklena in srebrna žica, ki imata isti premer in dolžino, sta napeti z enako silo. Kolikšna je osnovna frekvenca nihanja srebrne žice, če je osnovna frekvenca nihanja železne žice 200 s^{-1}? (ρ_{Fe} = 7,8 kg/dm^3, ρ_{Ag} = 10,6 kg/dm^3)



$\{F, S, l, \lambda\}$ enaki

Sch 209/36

$\nu_{Fe} = 200\ s^{-1}$

$\nu_{Ag} = ?$

$$c = \sqrt{\frac{F}{\rho S}}$$

$$c = \nu \cdot \lambda$$

$$\lambda_{Fe} = \frac{c_{Fe}}{\nu_{Fe}} \qquad \lambda_{Ag} = \frac{c_{Ag}}{\nu_{Ag}}$$

$$\lambda_{Fe} = \lambda_{Ag}$$

$$\frac{c_{Fe}}{\nu_{Fe}} = \frac{c_{Ag}}{\nu_{Ag}}$$

$\Downarrow$

$$\nu_{Ag} = \frac{c_{Ag}}{c_{Fe}} \cdot \nu_{Fe} = \sqrt{\frac{F \rho_{Fe} \cdot S}{\rho_{Ag} S F}} \cdot \nu_{Fe} = \sqrt{\frac{\rho_{Fe}}{\rho_{Ag}}} \cdot \nu_{Fe}$$

$$\nu_{Ag} = \sqrt{\frac{7.8}{10.6}} \cdot 200\ s^{-1} = 171.6\ s^{-1}$$

4

1442

5. Opiši harmonski potujoči transvenzalni val, ki se širi po zelo dolgi struni preseka 2 mm^2 in gostote $6\cdot 10^3$ kg/m^3, če je napeta s silo 110 N. Struno vzbujamo na njenem začetku s frekvenco 100 s^{-1} tako, da je amplituda odmika 2 mm. Kolikšna je povprečna gostota energijskega toka, ki se širi po struni ?

$S = 2\cdot 10^{-6}\ m^2$

$\rho = 6\cdot 10^3\ kg/m^3$

$F = 110\ N$

$\nu = 100\ s^{-1}$

$s_0 = 2\cdot 10^{-3}\ m$

$$s = s_0 \cdot \cos(\omega t - kx)$$

$$\omega = 2\pi\nu = 628{,}3\ s^{-1}$$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi\cdot\nu}{c} = \frac{2\pi\nu}{\sqrt{\frac{F}{\rho\cdot S}}} = 6.56\ m^{-1}$$

$$s = 0{,}002\,m \cdot \cos\left(628{,}3\cdot\frac{t}{s} - \frac{6.56}{m}\cdot x\right)$$

$$c = \sqrt{\frac{F}{\rho\cdot S}} = 95.74\ \frac{m}{s}$$

$$j = \frac{P}{S} = \frac{W}{S\cdot t} = \frac{V\,\overline{w}}{S\cdot t} = \frac{S\cdot x\cdot\overline{w}}{St} = c\cdot\overline{w} = \frac{1}{2}c\cdot\rho\,\omega^2\cdot s_0^2$$

$$\overline{w} = \rho \overline{v^2} = \rho\omega^2 s_0^2 \cdot \overline{\cos^2(\ )} = \frac{1}{2}\rho\omega^2 s_0^2$$

$$w = \rho v^2 = \underbrace{\frac{1}{2}\rho v^2}_{w_k} + \underbrace{\frac{1}{2}\rho v^2}_{w_{pr}}$$

$$j = \frac{1}{2}c\rho\omega^2 s_0^2 = 4{,}54\cdot 10^5\ W/m^2$$

$10^{-3}\cdot 10^4$ 10^{-6} $= 10$

(5)

5) Jeklena struna je napeta s silo 100 N. Za koliko odstotkov se poveča osnovna frekvenca nihanja strune, če se sila poveča za 2 odstotka?

$$c = \lambda\nu = \sqrt{\frac{F}{\rho S}} \Rightarrow \boxed{\nu = \frac{1}{\lambda}\sqrt{\frac{F}{\rho S}}} \quad d\nu = \frac{1}{2\lambda\sqrt{F\rho S}}\,dF$$

$$\frac{d\nu}{\nu} = \frac{1}{2}\frac{dF}{F} \rightarrow \underline{\text{za } 1\%}$$

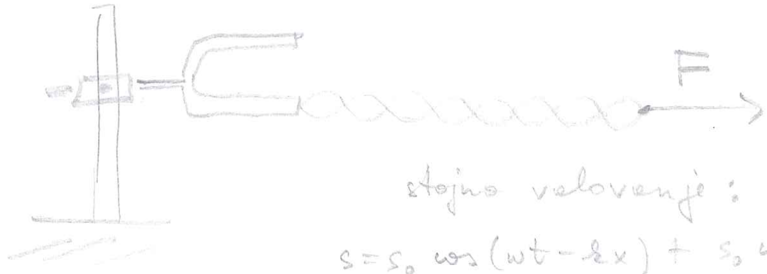
$$\frac{d\nu}{\nu} = \frac{dF}{2\lambda\sqrt{F\rho S}} \cdot \frac{\lambda\sqrt{\rho S}}{\sqrt{F}} = \frac{1}{2}\frac{dF}{F}$$

$$\boxed{c = \sqrt{\frac{F}{\rho S}}}$$

VAL Izpit 1991

4. Struna mase 0,25 g in dolžine 1 m je na enem koncu s silo 4 N pripeta na glasbene vilice. Struna niha v 8 segmentih. S kakšno frekvenco nihajo glasbene vilice ?

$$c = \sqrt{\frac{F}{\rho S}}$$



stojno valovanje:

$s = s_0 \cos(\omega t - kx) + s_0 \cos(\omega t + kx)$

$= 2 s_0 \cos kx \cos \omega t$

$l = 1\,m$

$m = 0{,}25 \cdot 10^{-3}\,kg$

$F = 4\,N$

$l = 4\lambda \Rightarrow \lambda = l/4$

$\rho S l = m \Rightarrow \rho S = \frac{m}{l} \Rightarrow c = \sqrt{\frac{F \cdot l}{m}}$

$c = \nu \cdot \lambda$

$\nu = \frac{c}{\lambda} = \sqrt{\frac{F \cdot l}{m}} / \lambda \Longrightarrow$

$$\nu = 4 \cdot \sqrt{\frac{F \cdot l}{m}} / l = 506\,s^{-1}$$

5. Glasbene vilice napravijo 284 vibracij na sekundo. Izračunajte valovno dolžino zvoka, ki ga oddajajo vilice pri temperaturi zraka 25°C ? Hitrost zvoka pri 0°C je 331 m/s. 14.9.

$T = 25°C = 298\ K$

$T_0 = 273\ K$

$c_0 = 331\ m/s$

$\nu = 284\ s^{-1}$

$c = \nu \cdot \lambda$

$c = \sqrt{\frac{\chi R T}{M}}$

$c = c_0 \sqrt{\frac{T}{T_0}} = 346\ m/s$

$\lambda = c/\nu = 1.22\ m$

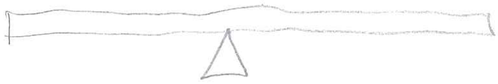
$\frac{p}{\rho} = \frac{RT}{M}$

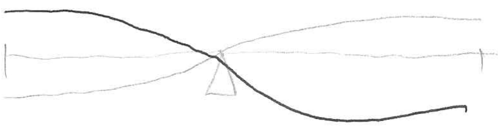
5. Kovinska palica dolžine 1m je vpeta na sredini. Kakšne so tri najnižje frekvence transverzalnega valovanja, ki jih lahko vzbudimo v palici, če je hitrost širjenja motnje v palici enaka 700 m/s?

1993

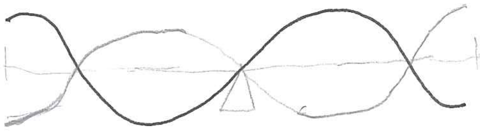
$l = 1\,m$

$c = 700\ m/s$

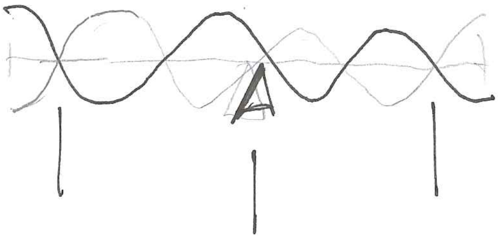




$l = \frac{\lambda_0}{2}$: $\nu_0 = \frac{c}{\lambda} = \frac{c}{2l} = \frac{700\,m}{2\,m\,s} = 350\,s^{-1}$



$l = \frac{3\lambda_1}{2}$: $\nu = \frac{c}{\lambda_1} = \frac{3c}{2l} = 3\nu_0 = 1050\,s^{-1}$



$l = \frac{5\lambda_2}{2}$: $\nu = \frac{c}{\lambda_2} = \frac{5c}{2l} = 5\nu_0 = 1750\,s^{-1}$

$\nu_0 = 350\,s^{-1}$

$\nu_1 = 1050\,s^{-1}$

$\nu_2 = 1750\,s^{-1}$

(11) VAL 1 VAL

7. Podaj numeričen izraz za funkcijo y = y(x,t), ki opisuje širjenje potujočega transverzalnega vala na dolgi struni preseka S = 1 mm^2, gostote $\rho = 8.10^3$ kg/m^3, če je ta napeta s silo F = 100 N. Struno vzbuja vzmetno nihalo, sestavljeno iz mase m = 0,1 kg in vzmeti s konstanto k = 1000 N/m. (izpit 14.12.1990)

ρ, S, F, m, k

$$c = \sqrt{\frac{F}{\rho \cdot S}} = 111.8 \frac{m}{s}$$

$$\sqrt{\frac{100}{10^{-6} \cdot 8 \cdot 10^3}} = \sqrt{\frac{10^5}{8}} = 111.8 \frac{m}{s}$$

$mg = kx_0$ (ravnovesje)

$$ma = mg - k(x_0 + x)$$

$$ma = -kx$$

$$a = -\frac{k}{m}x$$

$$x = x_0 \cos\omega t$$

$$v = \dot{x} = -x_0 \omega \sin\omega t$$

$$a = \ddot{x} = -x_0 \omega^2 \cos\omega t$$

$$a = -\omega^2 x$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\omega = \sqrt{\frac{1000}{0.1}} = \sqrt{10^4} = 10^2 \, s^{-1}$$

$$y = y_0 \sin\left[\omega\left(t - \frac{x}{c}\right)\right]$$

$$y = y_0 \sin\left(\omega t - \frac{\omega}{c}x\right)$$

$$y = y_0 \sin(100t - 0.9x)$$

$$k = \frac{\omega}{c} \rightarrow c = \frac{\omega}{k}$$

(8)

4. Podaj numeričen izraz za funkcijo s = s(x,t), ki opisuje širjenje potujočega transverzalnega vala po dolgi struni preseka 3 mm^2 in gostote $7 \cdot 10^3$ kg/m^3, če je napeta s silo 140 N. Struno vzbujamo na njenem začetku z nihalom, ki je opisano pri prejšnji nalogi. Amplituda odmika strune je 3 mm. Amplituda nihanja plošče je majhna. 1992

OT. A-L

(3) ⇒ $\nu = \frac{1}{t_0} = 0{,}284$

$S = 3 \cdot 10^{-6}\ m^2$

$\rho = 7 \cdot 10^{3}\ kg/m^3$

$F = 140\ N$

$s_0 = 3 \cdot 10^{-3}\ m$

$c = \sqrt{\frac{F}{\rho \cdot S}} = 81.65\ \frac{m}{s}$ ✓

$k = \frac{\omega}{c} = \frac{2\pi\nu}{c} = 2{,}185 \cdot 10^{-2}\ m^{-1}$ ✓

$s = s_0 \sin(\omega t - kx)$

$\omega = 2\pi\nu = 1{,}785\ s^{-1}$ ✓

$$s = 3 \cdot 10^{-3}\,m \cdot \sin\left[(1{,}785\ s^{-1})\,t - (2{,}185 \cdot 10^{-2}\ m^{-1})\,x\right]$$

1992

4. Dolgo struno preseka 2 mm^2 in gostote $7\cdot10^3$ kg/m^3, ki je napeta s silo 100 N, vzbujamo ~~na njenem začetku~~ (s frekvenco $1 s^{-1}$) z nihalom, ~~ki je opisano pri prejšnji nalogi,~~ tako, da je amplituda odmika strune 3 mm. Kolikšna je povprečna gostota energijskega toka transverzalnega vala, ki se širi po struni ? ~~Nihalo niha z majhnimi odmiki.~~

M-7

$\nu = 1 s^{-1}$

$S = 2\cdot10^{-6} m^2$

$\rho = 7\cdot10^3 kg/m^3$

$F = 100 N$

$s_0 = 3\cdot10^{-3} m$

$$s = s_0\cdot\cos(\omega t - kx)$$

$$j = \frac{P}{S} = \frac{W}{St} = \frac{V\cdot w}{S\cdot t} = \frac{Sx\bar{w}}{S\cdot t} = \bar{w}\cdot c$$

$$\bar{w} = \overline{\rho v^2} = \overline{\rho\omega^2 s_0^2\cos^2()} = \frac{1}{2}\rho\omega^2 s_0^2$$

$$c = \sqrt{\frac{F}{\rho S}}$$

$$j = \frac{1}{2}\cdot c\cdot\rho\cdot\omega^2\cdot s_0^2 =$$

$$= \frac{1}{2}\sqrt{\frac{F}{\rho\cdot S}}\cdot\rho\cdot4\pi^2\nu^2 s_0^2 =$$

$$= \frac{1}{2}\sqrt{\frac{F\cdot\rho}{S}}\cdot4\pi^2\nu^2 s_0^2 = 105\ W/m^2$$ ✓

če $\nu = \frac{66}{60} = 1{,}1 s^{-1}$ $\Rightarrow$ $j = 127\ W/m^2$

4. Točkasto zvočilo oddaja zvok enakomerno na vse strani. Mož, ki je 50 m oddaljen od zvočila, sliši zvok jakosti 30 db, žena, ki je 100 m oddaljena od zvočila pa komaj še sliši ta zvok. Kakšen je absorpcijski koeficient zraka za zvok ?

$$j = \frac{P}{4\pi r^2} \cdot e^{-\mu r}$$

$$j_1 = \frac{P}{4\pi r_1^2} e^{-\mu r_1} \qquad \frac{P}{4\pi} = j_1 r_1^2 e^{\mu r_1}$$

$$j_2 = j_0 = \frac{P}{4\pi r_2^2} e^{-\mu r_2} = \frac{j_1 r_1^2 e^{\mu r_1} e^{-\mu r_2}}{r_2^2}$$

$$J_1 = 10 \log \frac{j_1}{j_0} \qquad 10^{\frac{J_1}{10}} = \frac{j_1}{j_0} \qquad j_1 = j_0 \cdot 10^{\frac{J_1}{10}} = j_0 e^{\frac{J_1}{10} \ln 10}$$

$$j_2 = \frac{j_0 \cdot e^{\frac{J_1}{10} \ln 10} e^{-\mu(r_2 - r_1)} r_1^2}{r_2^2} = j_0$$

$$e^{\mu(r_2 - r_1)} = e^{\frac{J_1 \ln 10}{10}} \frac{r_1^2}{r_2^2}$$

$$\mu = \frac{1}{r_2 - r_1} \left[\frac{J_1 \ln 10}{10} + 2 \ln \frac{r_1}{r_2} \right] = 0.055 \, m^{-1}$$

1992

3. Na kitari sta vpeti po 0.9 m dolgi struni iz medenine in jekla. Struni uglasimo na enako osnovno frekvenco 440 s^{-1} pri temperaturi 20 °C. Kitaro nato odnesemo na prosto, kjer je temperatura − 5 °C. Kolikšno frekvenco utripanja slišimo na prostem, če zabrenkamo po obeh strunah? Deformacije kitare zaradi spremembe temperature so zanemarljive. Prožnostni model jekla je $2{,}06\cdot10^{11}\ N\cdot m^{-2}$, temperaturni koeficient linearnega raztezka $1{,}1\cdot10^{-5}\ K^{-1}$ in gostota jekla $7{,}8\cdot10^{3}\ kg\cdot m^{-3}$. Prožnostni modul medenine pa je $1{,}27\cdot10^{11}\ N\cdot m^{-2}$, temperaturni koeficient linearnega raztezka $1{,}9\cdot10^{-5}\ K^{-1}$ in gostota medenine $8{,}5\cdot10^{3}\ kg\cdot m^{-3}$

FOR

$l = 0.9\,m,\quad \nu_0 = 440\,s^{-1}$

$\Delta T = 25\,°C,\quad T_1 = 20\,°C,\ T_2 = -5\,°C$

$E_j = 2{,}06\cdot10^{11}\ N/m^2$

$\alpha_j = 1{,}1\cdot10^{-5}\ K^{-1}$

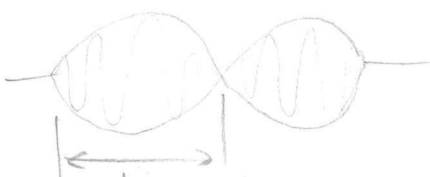
$\rho_j = 7{,}8\cdot10^{3}\ kg/m^3$

$E_m = 1{,}27\cdot10^{11}\ N/m^2$

$\alpha_m = 1{,}9\cdot10^{-5}\ K^{-1}$

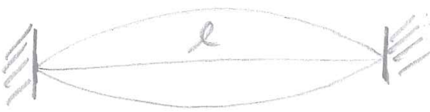
$\rho_m = 8{,}5\cdot10^{3}\ kg/m^3$

$s = s_0\cos\omega_1 t + s_0\cos\omega_2 t = 2s_0\cos\left[\frac{1}{2}(\omega_2-\omega_1)t\right]\cos\omega t$



$\frac{1}{2}(\omega_2-\omega_1)\cdot t_u = \pi \Longrightarrow$

$$\nu_u = \frac{1}{t_u} = \nu_2 - \nu_1$$



$$\nu_0 = \frac{c}{\lambda} = \frac{c}{2l} = \frac{1}{2l}\sqrt{\frac{F}{\rho S}} \Rightarrow F = \nu_0^2\,4l^2\cdot\rho\cdot S$$

$$\begin{cases} T_1: & \frac{F_1}{S} = E\frac{\Delta x_1}{l_1} \\ T_2: & \frac{F_2}{S} = E\frac{\Delta x_1 + \Delta l}{l_2} \end{cases}$$

$$\frac{\Delta F}{S} = \frac{F_2 - F_1}{S} = E\left(\frac{\Delta x_1+\Delta l}{l_2} - \frac{\Delta x_1}{l_1}\right) \approx E\frac{\Delta l}{l}$$

$$\frac{\Delta F}{S} = E\frac{\Delta l}{l} = E\alpha\Delta T$$

$$d\nu_0 = \frac{1}{2l}\cdot\frac{1}{2}\frac{1}{\sqrt{\rho S F}}\,dF$$

$$\frac{d\nu_0}{\nu_0} = \frac{1}{2l}\cdot\frac{1}{2}\frac{1\cdot 2l\cdot\sqrt{\rho S}}{\sqrt{\rho S}\sqrt{F}\sqrt{F}}\,dF$$

$\Downarrow$

$$\frac{\Delta\nu_0}{\nu_0} = \frac{1}{2}\frac{\Delta F}{F} = \frac{1}{2}\frac{S E\alpha\Delta T}{\nu_0^2\,4l^2\rho S}$$

$\Downarrow$

$$\frac{\Delta\nu_0}{\nu_0} = \frac{E\alpha\Delta T}{8l^2\nu_0^2\rho}$$

$$\nu_u = \nu_j - \nu_m = \frac{\Delta T}{8l^2\nu_0}\left(\frac{\alpha_j E_j}{\rho_j} - \frac{\alpha_m E_m}{\rho_m}\right) = 5{,}8\cdot10^{-2}\ s^{-1}$$

VAL 8

V8

VAL

Naloga : SB/208/20

Dva zvočna valovanja imata intenziteto (gostoto zvočnega energijskega toka) 10 in 500 mikroW/cm^2 . Koliko decibelov glasnejši je drugi zvočni signal ?

$w = \rho v^2$

$P = \frac{V \cdot \bar{w}}{t}$, $V = S \cdot c \cdot t$

$j = \frac{P}{S} = c\bar{w}$

$$j = \frac{1}{2} c \rho \omega^2 s_0^2$$

$j_1 = 10$ W/cm^2

$j_2 = 500$ W/cm^2

$$\text{glasnost} = 10 \log \frac{j}{j_0} \text{ [decibel]}$$ j_0 = referenca

$$(\text{glasnost})_2 - (\text{glasnost})_1 = 10\left(\log \frac{j_2}{j_0} - \log \frac{j_1}{j_0}\right) = 10 \cdot \log \frac{j_2}{j_1} =$$

$$= 10 \log 50 = 10 \cdot (1.7) = 17 \text{ decibelov}$$

V10

Naloga : SB/208/19

Izračunaj intenziteto (gostoto zvočnega energijskega toka) zvočnega valovanja pri tlaku 10^5 N/m^2, če je vrekvenca 800 s^{-1}, in amplituda 0.ool cm. Gostota kisika v katerem potuje zvočni signal je 0.001 g/cm^3. Konstanta za kisik je 1.4 .

$\nu = 800$ s^{-1}

$s_0 = 0.001$ cm

$\rho = 0.001293$ g/cm^3, $p = 10^5 \frac{N}{m^2}$

$K = 1.4$

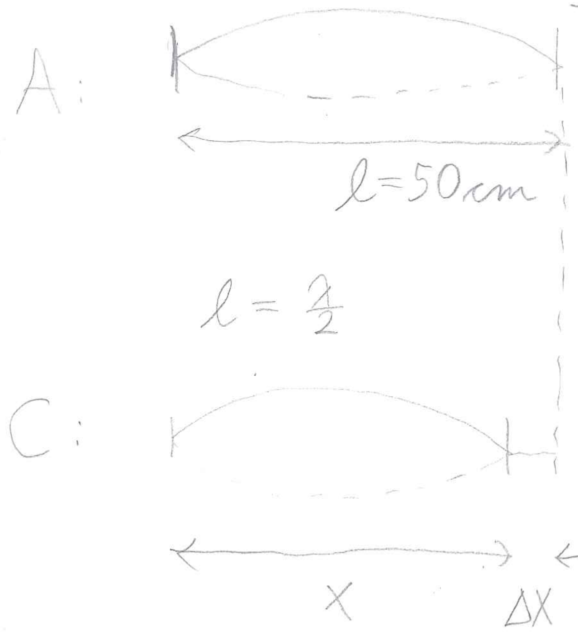
$$c = \sqrt{\frac{Kp}{\rho}}$$

$$j = \frac{1}{2} c \rho \omega^2 s_0^2 \cong \frac{1}{2}\sqrt{\frac{Kp}{\rho}} \rho \omega^2 s_0^2$$

5. Violinska struna je dolga 50 cm. Struna sama ustvari ton A (440 Hz). Za koliko moramo skrajšati struno (s pritiskom na struno), da zaigramo ton C (528 Hz)?

$\nu_A = 440\ Hz$

$\nu_C = 528\ Hz$



$l = \frac{\lambda}{2}$

$$c = \lambda \nu = \sqrt{\frac{F}{\rho S}}$$

$$c_A = c_C$$

$$\lambda_A \cdot \nu_A = \lambda_C \cdot \nu_C$$

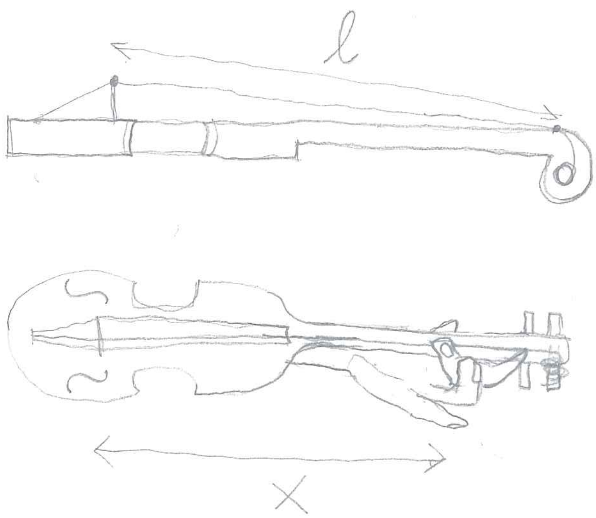
$$2l \cdot \nu_A = 2x \cdot \nu_C$$

$$x = \frac{l \nu_A}{\nu_C} = 50\,cm \frac{440\,s}{528\,s} =$$

$$= 41{,}67\,cm$$

$$\Delta x = l - x = 50\,cm - 41{,}67\,cm =$$

$$= \underline{\underline{8{,}33\,cm}}$$



Struno moramo skrajšati za 8,33 cm.

1995

5. Površina bobniča je $8 \cdot 10^{-5}$ m^2. Kolikšen energijski tok prejme bobnič od zvočnega valovanja z glasnostjo 40 db, če se nič valovanja ne odbije ? ($j_o = 10^{-12}$ W/m^2).

$S = 8 \cdot 10^{-5}\ m^2$
$\beta = 40$

glasnost $\beta = 10 \log\left(\frac{j}{j_o}\right)$

$\beta = 10 \log\left(\frac{j}{j_o}\right)$

$\frac{\beta}{10} = \log \frac{j}{j_o} \Rightarrow j = j_o\, 10^{\beta/10}$

$P = j \cdot S = j_o \cdot 10^{\beta/10} \cdot S =$

$= 10^{-12} \cdot 10^{4} \cdot 8 \cdot 10^{-5}\ W =$

$= 8 \cdot 10^{-13}\ W$

12

SB/205/5

VAL

VAL 3

Izračunaj hitrost zvoka v plinu helija pri T = 800°C in tlaku (p = 2.3 · 10⁵ Nm⁻².) Molekularna teža helija je 4, razmerje spec. toplot κ pa 1.66

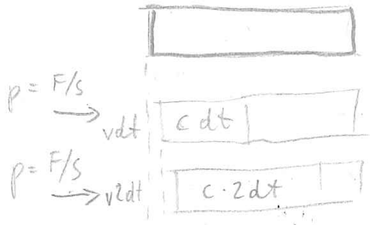
$T = 800\,°C$

odveč podatek $\left(p = 2.3 \cdot 10^5 \frac{N}{m^2}\right)$

$\kappa = 1.66$

$$-\chi\, dp = \frac{dV}{V} \qquad -\chi \cdot p = \frac{\Delta V}{V}$$

stebriček plina:



$$\chi = -\frac{dV}{V \cdot dp} = \frac{S v dt}{S c dt (F/S)} = \frac{v S}{c F} \quad \text{(Hook's law)}$$

OHR. GIBALNE KOLIČINE: $\Delta G = F dt = \rho S c dt \cdot v \Rightarrow F = \rho S c v$ $\Rightarrow$

$$\Rightarrow \chi = \frac{v \cdot S}{c \cdot \rho \cdot S \cdot c v} = \frac{1}{c^2 \rho} \Rightarrow c = \frac{1}{\sqrt{\chi \cdot \rho}}$$

Temperatura plina po kateri se širi motnja ni konstantna, v zgoščini je večja ⇒ ne računamo z izotermno stisljivostjo, pač pa z ADIABATNO stisljivostjo (Strnad str. 149 in 216)

$$p V^\kappa = konst. \Rightarrow p \kappa V^{\kappa-1} dV + dp V^\kappa = 0 \Rightarrow$$

$$-\frac{1}{V}\frac{dV}{dp} = \frac{1}{\kappa p} = \chi_s \qquad \chi_s = \frac{1}{\kappa p} \quad \text{adiabatna stisljivost}$$

torej $c = \sqrt{\frac{\kappa p}{\rho}}$ $\quad pV = \frac{m}{M} R T \Rightarrow p\left(\frac{V}{m}\right) = \frac{p}{\rho} = \frac{RT}{M} \Rightarrow$

$$\Rightarrow c = \sqrt{\frac{\kappa R T}{M}} = 1.92 \cdot 10^3 \frac{m}{s}$$