Lösungsvorschlag

Klausur B SoSe 09
Maschbau

1.) Marssonde: $\Delta x = 228 \cdot 10^6\ \text{km}$ $\quad v_p = 3 \cdot 10^5\ \frac{\text{km}}{\text{s}}$

$$\Rightarrow \Delta t = \frac{\Delta x}{v_p} = \underline{\underline{760\ \text{sec}}}$$

2.) Bambusrohr: offen $f_0 = 200\ \text{Hz}$ $\quad$ zu $f_1 = ?$

$$v_p = \lambda_0 f_0 = \lambda_1 \cdot f_1 \qquad \lambda_0 = 2L \qquad \lambda_1 = 4L$$

$$\Rightarrow \frac{2L}{4L} \cdot f_0 = f_1 = \frac{f_0}{2} = \underline{\underline{100\ \text{Hz}}}$$

3.) Gitarrensaite: $v_p = 900\ \frac{\text{m}}{\text{s}}$ $\quad L = 1\ \text{m}$ $\quad f_n$ close to 1300 Hz

$$n \cdot \frac{\lambda_n}{2} = L \qquad f_n = \frac{v_p}{\lambda_n} = \frac{n \cdot v_p}{2L} = 450\ \text{Hz},\ 900\ \text{Hz},\ \underline{\underline{1350\ \text{Hz}}}$$

$$\Rightarrow \lambda_n = \frac{2L}{n}$$

4.) unged. Kreiswelle: $d_1 = 20\ \text{cm}$ $\quad A_1 = 3\ \text{mm}$ $\quad d_2 = 50\ \text{cm}$

$$A_2 = ? \qquad A_i = \frac{\alpha}{\sqrt{r_i}} \Rightarrow \frac{A_1}{A_2} = \sqrt{\frac{d_2}{d_1}} \Rightarrow A_2 = A_1 \cdot \sqrt{\frac{d_1}{d_2}}$$

$$= \underline{\underline{1{,}9\ \text{mm}}}$$

5.) lange Stange: $m = 50\ \text{kg}$ $\quad A = 5{,}0°$ $\quad T = 4 \cdot \Delta t = 6\ \text{s}$ $\quad g = 9{,}81\ \frac{\text{m}}{\text{s}^2}$

$$L = ? \qquad \omega = \frac{2\pi}{T} = \sqrt{\frac{g}{L}} \Rightarrow L = \frac{g \cdot T^2}{4\pi^2} = \underline{\underline{8{,}9\ \text{m}}}$$

6.) Selbe Stange: $v_{max} = ?$ $T = 6\,s$ $A = 5° = 0{,}087$ $L = 8{,}9\,m$

$$x(t) = A \cdot L \cdot \cos \omega t \Rightarrow v(t) = -AL\omega \cdot \sin(\omega t)$$

unten $\omega t = 0$

$$\Rightarrow v = \frac{A \cdot L \cdot 2\pi}{T} = \underline{\underline{0{,}81\,\frac{m}{s}}}$$

7.) Selbe Stange: $\Delta T = 600\,s \Rightarrow A(\Delta T) = 3°$ $\widetilde{\Delta T} = 1200\,s$

$$A(t) = A \cdot e^{-t/\tau} \Rightarrow e^{-\frac{\Delta T}{\tau}} = \frac{A(\Delta T)}{A} \Rightarrow \tau = \Delta T / \ln \frac{A}{A(\Delta T)}$$

$$= 1174\,sec$$

$$\Rightarrow A(\widetilde{\Delta T}) = A \cdot e^{-\widetilde{\Delta T}/\tau} = \underline{\underline{1{,}8°}}$$

8.) 2 Wellen: $A = 2\,cm$ $\varphi_1 = 0$ $\varphi_2 = \frac{\pi}{2}$

$$\Rightarrow s_{ges}(x,t) = A\left(\cos(\omega t - kx) + \cos\left(\omega t - kx + \frac{\pi}{2}\right)\right)$$

$$= \underbrace{2A \cdot \cos\frac{\pi}{4}}_{\tilde{A}} \cdot \cos\left(\omega t - kx + \frac{\pi}{4}\right) = \underline{\underline{2{,}82\,cm}} \cdot \ldots$$

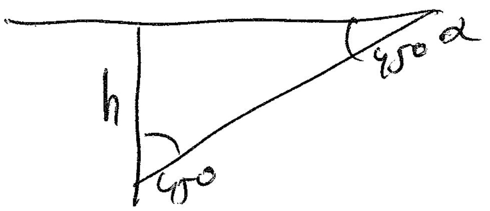
9.) Auto + Insassen: $M = 800\,kg$ $m = 70\,kg \Rightarrow M_{Ges} = 1080\,kg$

$$\lambda = 20\,m \quad v = 20\,\frac{m}{s} \Rightarrow f = \frac{v}{\lambda} = 1\,Hz$$

$$\Rightarrow 2\pi f = \sqrt{\frac{D}{4 \cdot m}} \Rightarrow D = 4\pi^2 f^2 \cdot 4 \cdot m \;\; ~~= 42.636\,\frac{N}{m}~~$$

$$4 \cdot m \cdot g = D \cdot \Delta x \Rightarrow \Delta x = \frac{4 \cdot m \cdot g}{D} = 0{,}0016\,m = \underline{\underline{0{,}16\,cm}}$$

10.) Düsenflugzeug: $h = 3,0\,km$ $\alpha = 45°$ $v_p = 330\,m/s$



$$\sin\alpha = \frac{v_p}{v_Q} \Rightarrow v_Q = \frac{v_p}{\sin\alpha} = 467\,\frac{m}{s}$$

11.) angeregte Saite: $f_0 = 200\,Hz$ $f_i = 100; 200; 300\,Hz$
$A_i = 0{,}4;\ 4;\ ?\ cm$

$$A(\omega) = \frac{F_0/m}{\sqrt{(\omega_0^2-\omega_i^2) + \frac{\omega_i^2}{\tau^2}}} \Rightarrow \frac{A_2}{A_1} = \sqrt{\frac{(\omega_0^2-\omega_1^2)^2 + \frac{\omega_1^2}{\tau^2}}{\frac{\omega_2^2}{\tau^2}}}$$

$$= \frac{\sqrt{\tau^2(\omega_0^2-\omega_1^2)^2+\omega_1^2}}{\omega_2} \Rightarrow \tau = \underbrace{\sqrt{\left(\frac{A_2}{A_1}\right)^2 - \left(\frac{\omega_1}{\omega_2}\right)^2}}_{9{,}99} \cdot \underbrace{\frac{\omega_2}{|\omega_1^2-\omega_0^2|}}_{1{,}06\cdot 10^{-3}\,s} = 0{,}0106\,s$$

$$\Rightarrow A_3 = A_2 \cdot \frac{\frac{\omega_2}{\tau}}{\sqrt{(\omega_0^2-\omega_3^2)^2 + \frac{\omega_3^2}{\tau^2}}} = A_2 \cdot \frac{\overbrace{\omega_2}^{5026}}{\underbrace{\sqrt{\tau^2(\omega_0^2-\omega_3^2)^2+\omega_3^2}}_{4{,}4\cdot 10^8}} = \underline{\underline{0{,}24\,cm}}$$

12.) Mikroskop: $D = 20\,cm$ $G_1 = 0{,}1\,cm$ $g_1 = 1\,cm$
$f_1 = 0{,}95\,cm$ $f_2 = 1{,}1\,cm$

$$\Rightarrow b_1 = \frac{1}{\frac{1}{f_1} - \frac{1}{g_1}} = 19\,cm \Rightarrow g_2 = D - b_1 = 1\,cm$$

$$B_1 = G_1 \cdot \frac{b_1}{g_1} = 1{,}9\,cm = G_2 \Rightarrow b_2 = \frac{1}{\frac{1}{f_2} - \frac{1}{g_2}} = -11\,cm$$

$$\Rightarrow B_2 = G_2 \cdot \frac{b_2}{g_2} = \underline{\underline{20{,}9\,cm}}$$