ML: Harm. Swg. und Wellen

(1) $m = 100\,kg$, $A_0 = 2m$, $a_{max} = 50\,ms^{-2}$

a) $\omega_0 = \sqrt{k/m}$; $a_{max} = A_0 \omega_0^2$

$\Rightarrow \omega_0^2 = \frac{a_{max}}{A_0}$

$\Rightarrow \omega_0^2 = \frac{a_{max}}{A_0} = \frac{k}{m} \Rightarrow \omega = \sqrt{\frac{a_{max}}{A_0}} = 5s^{-1}$

$\frac{m \cdot a_{max}}{A_0} = k \approx 2'500\,Nm^{-1}$

b) A_{max} bei $t = 0 \longrightarrow \cos(\omega_0 t)$

$s(t) = A_0 \cdot \cos(\omega_0 t)$ $\quad (f = 0.5\,Hz)$

$s(t) = 2m \cdot \cos\left(\frac{5}{s} \cdot t\right)$

c) $v_{max} = A_0 \omega_0 = 2m \cdot 5 \cdot s^{-1} = 10\,m/s$

d) $E = \frac{1}{2} k A_0^2 = \frac{1}{2} m v_{max}^2 = \frac{1}{2} m A_0^2 \omega_0^2 \cong 5'000\,J$

(2) $\rho = 7.85 \cdot 10^3\,kg\,m^{-3}$, $E = 2.1 \cdot 10^{11}\,Nm^{-2}$

$v = \sqrt{\frac{E}{\rho}} \cong 5'172\,m/s$

(3) $c = 3 \cdot 10^8 \, m/s$

a) $\lambda = 3'000\,m$; $\lambda \cdot f = c \Rightarrow f = \frac{c}{\lambda} \cong$ <u>100 kHz</u>

b) $f = 103.6\,MHz$; $\lambda = \frac{c}{f} \cong$ <u>2.9 Meter</u>

c) $f = 50\,Hz$; $\lambda = \frac{c}{f} \cong$ <u>6'000 km</u>

d) $f \cdot \lambda = c$, aber $1 \cdot 10^9\,Hz \cdot 1\,m = 10^9\,m/s > c$

↳ NEIN

(4) a) $\Psi(x,t) = A_0 \cos(kx - 200t)$, $\lambda = \frac{\pi}{5} m$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{\frac{\pi}{5} m} = \frac{10\pi}{\pi} m^{-1} = \underline{10\,m^{-1}}$$

b) $v = 100\,m/s$; $v = \frac{\omega}{k}$

$$k = \frac{\omega}{v} = \frac{10\pi \cdot s^{-1}}{100\,m s^{-1}} = \underline{\frac{\pi}{10} m^{-1}}$$

c) $T = 0.000'15\,s$, $v = 330\,m/s$

$f = \frac{1}{T}$, $\omega = 2\pi f \Rightarrow \omega = \frac{2\pi}{T} \cong$ <u>12'566.4 s^{-1}</u>

$\lambda \cdot f = v \Rightarrow \lambda = \frac{v}{f} = v \cdot T$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{v \cdot T} \cong \underline{38.1\,m^{-1}}$$

(5) $F = 10'000\,N$, $v = 100\,m/s$; $v = \sqrt{\frac{\sigma}{\rho}}$

$\sigma = \frac{F}{A} = \frac{F}{\pi r^2}$; $(A = \pi r^2)$

$$\Rightarrow v = \sqrt{\frac{\sigma}{\rho}} = \sqrt{\frac{\frac{F}{\pi r^2}}{\frac{S}{1}}} = \sqrt{\frac{F}{\pi r^2 \rho}} = \frac{1}{r}\sqrt{\frac{F}{\pi \rho}}$$

$$\Rightarrow r = \frac{1}{v}\sqrt{\frac{F}{\pi \rho}}, \quad d = 2r \cong \underline{12.7\,mm}$$