

LF midterm 09.10.09

1

① $x = x_0 \sin \omega t; x_0 = 5 \text{ cm}$

$$v = \omega x_0 \cos \omega t$$

$$a = -\omega^2 x_0 \sin \omega t; \omega^2 x_0 = 45 \text{ cm/s}^2$$

$$\Rightarrow \omega^2 = 9 \text{ s}^{-2} \Rightarrow v_{\max} = \omega x_0 = 3 \text{ s}^{-1} \cdot 5 \text{ cm} = 15 \text{ cm/s}$$

(A)

② Fra figur: $\lambda = 50 \text{ cm} = 0.50 \text{ m}$

$$f = v/\lambda = \sqrt{S/\mu}/\lambda = \sqrt{100/0.040}/0.50$$

$$= (10/0.2)/0.50 = 100 \text{ Hz}$$

(C)

③ $v = \sqrt{S/\mu} = 50 \text{ m/s}$

(C)

④ N2 $\Rightarrow m\ddot{x} = -b\dot{x} - kx + F_0 \cos(2\pi ft)$

$$\Rightarrow m\ddot{x} + b\dot{x} + kx = F_0 \cos(2\pi ft)$$

$$K2 \Rightarrow L\ddot{q} + R\dot{q} + \frac{1}{C}q = V_0 \cos(2\pi ft)$$

$$\Rightarrow L \leftrightarrow m, R \leftrightarrow b \text{ osv.}$$

$$\Rightarrow \Delta f_m = b/2\pi m \leftrightarrow \Delta f_e = R/2\pi L$$

(A)

⑤ Med G i ro blir strekk/sammenpressing av hver av fjærene lik utsvinget til hver av de to O-atomene. Dermed

$$M\ddot{s} = -ks \Rightarrow \ddot{s} + \frac{k}{M}s = 0 \Rightarrow \omega = \sqrt{k/M}$$

(B)

⑥ $\rho = 8940 \text{ kg/m}^3, Y = 128 \text{ GPa} = 128 \cdot 10^9 \text{ N/m}^2$

$$\Rightarrow v = \sqrt{\frac{128 \cdot 10^9}{8940}} = 3784 \text{ m/s}$$

(D)

(2)

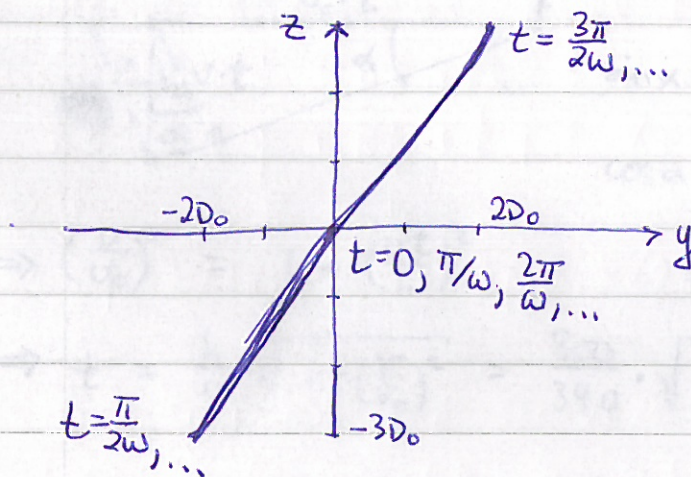
(7) Fra formelsamling: $\frac{y_{ro}}{y_{to}} = \frac{\sqrt{\mu_2} - \sqrt{\mu_1}}{2\sqrt{\mu_1}}$

$$\left. \begin{aligned} v_i &= \sqrt{S/\mu_i} \quad ; \quad i=1,2 \\ v_i &= \lambda_i f \quad ; \quad i=1,2 \end{aligned} \right\} \Rightarrow \sqrt{\mu_i} = \frac{\sqrt{S}}{\lambda_i f} \quad ; \quad i=1,2$$

$$\Rightarrow \frac{y_{ro}}{y_{to}} = \frac{\frac{1}{\lambda_2} - \frac{1}{\lambda_1}}{\frac{2}{\lambda_1}} = \frac{\lambda_1 - \lambda_2}{2\lambda_2} \stackrel{\text{Fra figur!}}{=} \frac{4 - \frac{8}{6}}{2 \cdot \frac{8}{6}} = 1$$

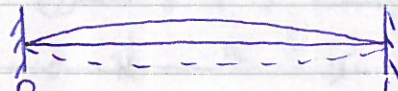
(C)

(8) $\vec{D}(x,t) = (2D_0 \hat{y} + 3D_0 \hat{z}) \sin(kx - \omega t)$
 Se på f.eks $x=0$: $-(2\hat{y} + 3\hat{z})D_0 \sin \omega t$



Dvs lineær-
polarisert

(B)

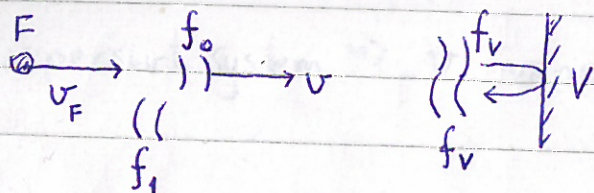
(9)  $L = \frac{\lambda}{2} = 0.75 \text{ m}$

$$\Rightarrow f = \frac{v}{\lambda} = \frac{\sqrt{S/\mu}}{\lambda} = \frac{\sqrt{S \cdot L/\mu}}{2L} = \sqrt{\frac{S}{4\mu L}} = \sqrt{\frac{173}{4 \cdot 0.006 \cdot 0.75}} \text{ Hz}$$

$$= 98 \text{ Hz}$$

(D)

10



$$f_1 = (1 + v_F/v) f_0 = (1 + v_F/v) \cdot \frac{f_0}{1 - v_F/v}$$

$$= \frac{1 + 10/340}{1 - 10/340} \cdot 100 \text{ kHz} = 106 \text{ kHz}$$

3

B

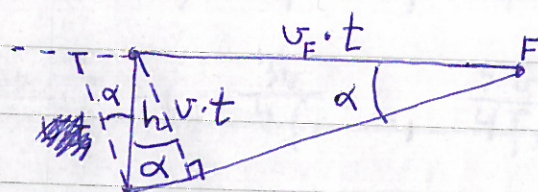
11

$$\Delta p = 0 \text{ i begge ender} \Rightarrow L = \lambda/2$$

$$v = \lambda f \Rightarrow L = v/2f = \frac{340}{2 \cdot 480} = 0,354 \text{ m} = 354 \text{ mm}$$

C

12



$$\sin \alpha = \frac{v}{v_F} = \sqrt{1 - \cos^2 \alpha}$$

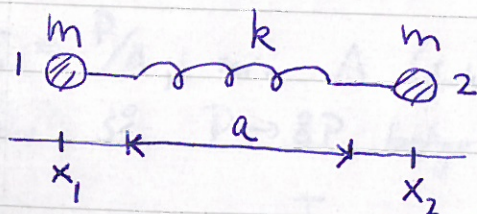
$$\cos \alpha = vt/h$$

$$\Rightarrow \left(\frac{v}{v_F}\right)^2 = 1 - \left(\frac{vt}{h}\right)^2$$

$$\Rightarrow t = \frac{h}{v} \sqrt{1 - \left(\frac{v}{v_F}\right)^2} = \frac{800}{340} \cdot \sqrt{1 - \frac{1}{1,75^2}} \approx 1,9 \text{ s}$$

B

13



$$\text{Strek i fjæra: } x_2 - x_1 - a = s$$

$$\begin{aligned} \Rightarrow m \ddot{x}_1 &= k(x_2 - x_1 - a) \\ m \ddot{x}_2 &= -k(x_2 - x_1 - a) \end{aligned} \Rightarrow \begin{aligned} m \ddot{s} &= -2ks \\ \ddot{s} + \frac{2k}{m} s &= 0 \end{aligned} \Rightarrow \omega = \sqrt{2k/m}$$

D

(14) Dispersivt system $\Rightarrow v$ varierer med f

(4)

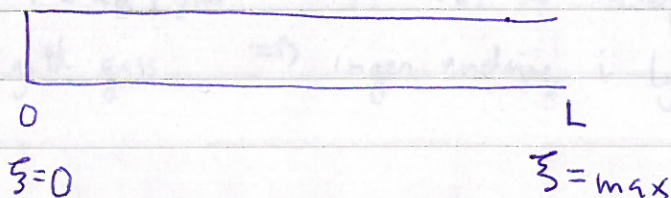
(B)

(15) $T_s = \frac{1}{f_s} = \frac{1}{|f_2 - f_1|}$; $f_1 = 440 \text{ s}^{-1}$, $T_s = 1 \text{ s}$

$\Rightarrow |f_2 - 440| \text{ s}^{-1} = 1 \text{ s}^{-1} \Rightarrow f_2 = 439 \text{ eller } 441 \text{ Hz}$

(D)

(16)



$\Rightarrow \frac{\lambda_1}{4} = L, \frac{\lambda_2 \cdot 3}{4} = L, \frac{\lambda_3 \cdot 5}{4} = L, \dots, \frac{\lambda_n \cdot (2n-1)}{4} = L$

$\Rightarrow \frac{v}{4f_1} = L, \frac{3v}{4f_2} = L, \frac{5v}{4f_3} = L, \dots, \frac{(2n-1)v}{4f_n} = L$

$\Rightarrow f_{n+1} - f_n = \frac{v}{4L} \{ [2(n+1)-1] - [2n-1] \} = \frac{v}{4L} \cdot 2 = \frac{v}{2L}$

$\Rightarrow L = \frac{v}{2(f_{n+1} - f_n)} = \frac{340 \text{ m/s}}{2 \cdot 68 \text{ 1/s}} = 2,5 \text{ m}$

(C)

(17) $I = P/A$, men A (f.eks. din tromme hinde) ændres ikke, så $P \rightarrow 8P$ betyr $I \rightarrow 8I$. Dermed:

$\beta_1 = 10 \log \frac{I}{I_0}$, $\beta_2 = 10 \log \frac{8I}{I_0}$

$\Rightarrow \beta_2 - \beta_1 = 10 \log 8 = \underline{9 \text{ dB}}$

(B)

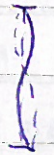
(5)

(18) Generellt l sning, ar $\frac{\partial^2 \xi}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 \xi}{\partial t^2}$ er

$$\xi(x, t) = f(x - vt) + g(x + vt)$$

(C)

(19)



))) →

Samme frekvens!

(B)

(20)

$$v = \sqrt{\gamma k_B T / m}$$

kun avh. av temperaturen
for gitt gass $\Rightarrow$ ingen endring i lydhastigheten

(B)

(21)

$$\xi(x, t) = \xi_0 \sin(kx - \omega t)$$

$$\Delta p = -B \partial \xi / \partial x = -\gamma_p \partial \xi / \partial x \quad (\text{se formelark})$$

$$\Rightarrow \frac{\partial \xi}{\partial t} = -\omega \xi_0 \cos(kx - \omega t)$$

$$\Delta p = -\gamma_p k \xi_0 \cos(kx - \omega t)$$

$$\Rightarrow \frac{\Delta p}{\partial \xi / \partial t} = \frac{\gamma_p k}{\omega} = \frac{\gamma_p}{v} = \frac{\gamma_p}{\sqrt{\gamma_p / \rho}} = \sqrt{\gamma_p \rho}$$

↑
formelark

(A)

(22)

$$P = 50 \cdot 10^3 \text{ W}$$

$$A = 4\pi r^2 = 4\pi \cdot (3000)^2 \text{ m}^2$$

$$\Rightarrow I = \frac{P}{A} = \frac{50 \cdot 10^3}{4\pi \cdot 9 \cdot 10^6} \text{ W/m}^2 = 4.42 \cdot 10^{-4} \text{ W/m}^2$$

$$= 442 \cdot 10^{-6} \text{ W/m}^2 = 442 \mu\text{W/m}^2$$

(C)

(6)

$$(23) \quad I = P/A = P/4\pi r^2$$

$$\Rightarrow r = \sqrt{\frac{P}{4\pi I}} = \sqrt{\frac{50 \cdot 10^3}{4\pi \cdot 10^{-6}}} \text{ m} = 63078 \text{ m} \approx \underline{63 \text{ km}}$$

(B)

$$(24) \quad \omega = a k^\alpha \Rightarrow v_f = \frac{\omega}{k} = a k^{\alpha-1} = a \left(\frac{2\pi}{\lambda}\right)^{\alpha-1} \\ = a' \lambda^{1-\alpha} \Rightarrow \text{ikke C}$$

$$v_g = \frac{d\omega}{dk} = \alpha a k^{\alpha-1} = \alpha \cdot v_f \Rightarrow A \text{ er riktig!}$$

$$v_g \neq v_f \text{ hvis } \alpha \neq 1 \Rightarrow B \text{ er feil}$$

(A)

$$v_g = a'' \lambda^{1-\alpha} \Rightarrow v_g \text{ \u00f8kter med \u00f8kende } \lambda \\ \text{hvis } \alpha > 0 \Rightarrow D \text{ er feil}$$

$$(25) \quad \omega = \sqrt{gk} \Rightarrow v_f = \frac{\omega}{k} = \sqrt{g/k} = \sqrt{g\lambda/2\pi}$$

$$\Rightarrow \text{St\u00f8rre } v_f \text{ for st\u00f8rre } \lambda$$

$$\Rightarrow \text{B\u00f8lger med st\u00f8rre } \lambda \text{ sl\u00e5r f\u00f8rst mot land}$$

(C)