

1) $f = 200 \text{ Hz}$, $\Delta A = 3 \text{ mm}$ ~~$\Delta A = 3 \text{ mm}$~~ $\rightarrow \Delta c = \Delta A \cdot f = 3 \text{ mm} \cdot 200 \text{ Hz} = 0,6 \frac{\text{m}}{\text{s}} \rightarrow \text{A}$

$\lambda = \frac{c}{f} \rightarrow \Delta \lambda = \lambda_2 - \lambda_1 = \frac{c_2}{f} - \frac{c_1}{f} = \frac{1}{f} (c_2 - c_1) = \frac{1}{f} (\Delta c)$

2) $v = \sqrt{\frac{E}{\rho}} \rightarrow [v] = \left[\frac{\text{N}}{\text{m}^2} \frac{\text{kg}}{\text{m}^3} \right] = \frac{\frac{\text{kg} \cdot \text{m}}{\text{s}^2 \cdot \text{m}^2} \cdot \frac{\text{kg}}{\text{m}^3}}{\frac{\text{kg}}{\text{m}^3}} = \frac{\text{m}^2}{\text{s}^2} = 1 \rightarrow \text{A}$

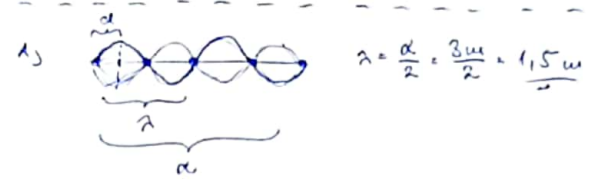
3) D D D $\lambda_1 = \lambda_2 \rightarrow \lambda_1 = 2 \lambda_2 \rightarrow \frac{d_1}{d_2} = \frac{\lambda_1 / 2}{\lambda_2 / 4} = 2 \rightarrow \text{A}$

8) C D C

2) prizma : $n(\lambda) \rightarrow$ udál jobban fon
optikai rács : $\sin \alpha_n(\lambda) = \frac{n \lambda}{d} \rightarrow \text{C}$
u pirazol jobban fon

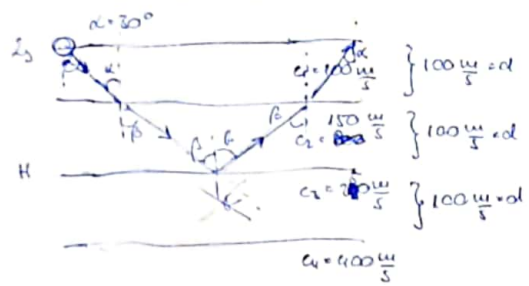
3) $P_1 = P_2 \rightarrow \Delta E_1 \cdot \Delta f_1 = \Delta E_2 \cdot \Delta f_2$ $E_n = h \nu = h f$
 $N_1 E_1 = N_1 h f_1 = N_2 E_2 = N_2 h f_2 \rightarrow \frac{N_1}{N_2} = \frac{f_2}{f_1} \rightarrow \text{B}$

1) $\lambda = 3 \text{ m}$; $f = 20 \text{ Hz}$; 3 csomópont (+ a végele)

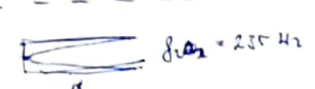
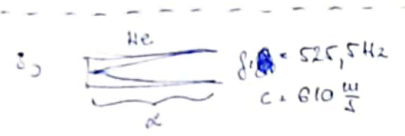


2) $d = \frac{\lambda}{4} = \frac{1,5 \text{ m}}{4} = 0,375 \text{ m}$

3) $c = \lambda f = 1,5 \text{ m} \cdot 20 \text{ Hz} = 30 \frac{\text{m}}{\text{s}}$



1) $\alpha = 30^\circ \rightarrow$ Snellius - Descartes. $\frac{\sin \alpha}{\sin \beta} = \frac{c_1}{c_2} \rightarrow \sin \beta = \frac{c_1}{c_2} \sin \alpha = \frac{100}{150} \sin 30^\circ = 0,33 \rightarrow \beta = 19,47^\circ$
 $\alpha \in [0^\circ, 90^\circ]$
 $\frac{\sin \alpha}{\sin \beta} = \frac{c_1}{c_2} \rightarrow \sin \beta = \frac{c_1}{c_2} \sin \alpha = \frac{100}{150} \sin 30^\circ = 0,33$
 $\beta = 19,47^\circ$
 $H = 2 \cdot d = 2 \cdot 100 \text{ m} = 200 \text{ m}$



1) $\lambda_1 = \frac{c_1}{f_1} = \frac{610 \frac{\text{m}}{\text{s}}}{525,5 \text{ Hz}} \approx 1,1608 \text{ m} \rightarrow \alpha = \frac{\lambda_1}{4} \approx 0,2902 \text{ m} \approx 29 \text{ cm}$
 $\lambda_1 = \lambda_2 \rightarrow \frac{c_1}{f_1} = \frac{c_2}{f_2} \rightarrow c_2 = \frac{f_2}{f_1} c_1 = \frac{235 \text{ Hz}}{525,5 \text{ Hz}} \cdot 610 \frac{\text{m}}{\text{s}} \approx 272,5 \frac{\text{m}}{\text{s}}$

2) $3 \lambda_1' = \lambda_1 \rightarrow 3 \frac{c_1}{f_1'} = \frac{c_1}{f_1} \rightarrow f_1' = 3 f_1 = 3 \cdot 525,5 \text{ Hz} = 1576,5 \text{ Hz}$
 $3 \lambda_2' = \lambda_2 \rightarrow 3 \frac{c_2}{f_2'} = \frac{c_2}{f_2} \rightarrow f_2' = 3 f_2 = 3 \cdot 235 \text{ Hz} = 705 \text{ Hz}$
 $\alpha = \frac{3 \lambda_1'}{4}$
 $\alpha = \frac{\lambda_2'}{4}$

1) $c = 343 \frac{\text{m}}{\text{s}}$
 $\alpha = 33 \text{ cm} = 0,33 \text{ m}$
alaphang : $\alpha = \frac{\lambda}{2}$; $f = \frac{c}{\lambda} = \frac{c}{2\alpha} = \frac{343 \frac{\text{m}}{\text{s}}}{2 \cdot 0,33 \text{ m}} \approx 518,5 \text{ Hz}$
1. felharmonikus : $\alpha = \lambda$; $f = \frac{c}{\lambda} = \frac{c}{\alpha} = \frac{343 \frac{\text{m}}{\text{s}}}{0,33 \text{ m}} \approx 1037 \text{ Hz}$