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1) $x = A_1 \cos wt$ $\qquad$ $x = A_1 \cos wt \rightarrow \cos wt = \frac{x}{A_1}$

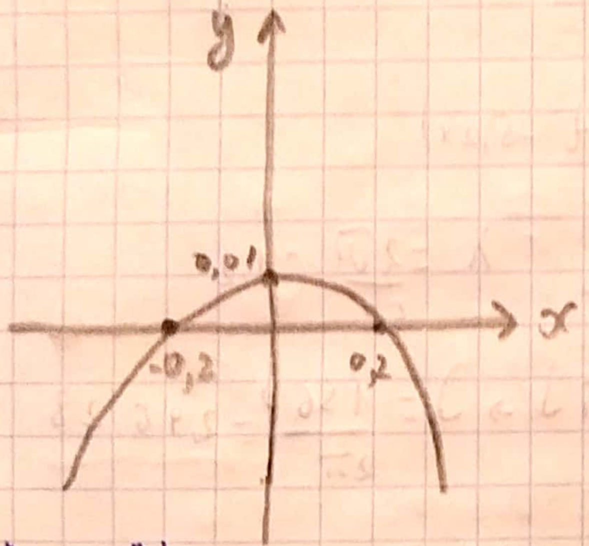
$y = -A_2 \cos 2wt$ $\qquad$ $y = -A_2 \cos 2wt = -A_2 (2\cos^2 wt - 1)$

$A_1 = 2$ см $\qquad$ $y = +A_2 - A_2 \cdot \frac{2x^2}{A_1^2}$

$A_2 = 1$ см

$f(x,y) = 0 - ?$ $\qquad$ $F = y + x^2 \cdot \frac{A_2}{A_1^2} - A_2 = 0$

$$F = y + \frac{1}{4}x^2 - 0{,}01 = 0$$




2) $A_1 = A_2 = A$

$T_1 = T_2$

$\Delta\varphi - ?$

$T_1 = T_2 \Rightarrow w_1 = w_2$

$A^2 = A_1^2 + A_2^2 + 2A_1A_2 \cos\Delta\varphi$

$A^2 = A^2 + A^2 + 2A^2 \cos\Delta\varphi \;\Big|\; : A^2$

$\cos\Delta\varphi = -\frac{1}{2}$, $\Delta\varphi \in [0; 2\pi]$

$$\left\{ \begin{array}{l} \Delta\varphi = \frac{2\pi}{3} \\ \Delta\varphi = \frac{4\pi}{3} \end{array} \right.$$

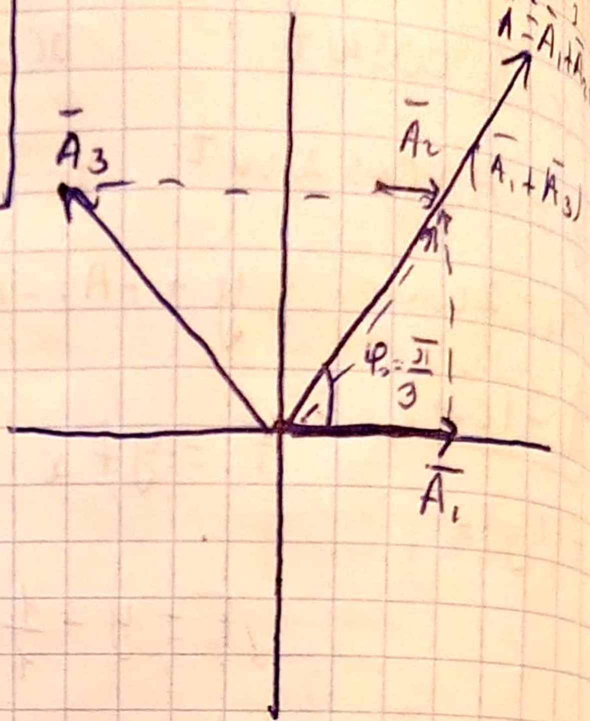
3. $T_1 = T_2 = T_3 = 2c$

$A_1 = A_2 = A_3 = 3$ см

$\varphi_1 = 0,\ \varphi_2 = \pi/3\ \ \varphi_3 = 2\pi/3$

$A = ?\ \varphi_0 = ?$

$T_1 = T_2 = T_3 \Rightarrow \omega_1 = \omega_2 = \omega_3$




$|\bar{A}_1 + \bar{A}_3| = |\bar{A}_2|$

$|A_1 + A_2 + A_3| = 2|A_2| = 6$ см

$\varphi_0 = \varphi_2 = \frac{\pi}{3}$

4. $\xi(x,t) = A\cos(1560t - 5{,}2x)$

$\nu = ?$

$v = ?$

$\lambda = ?$

$\frac{2\pi}{\lambda} = 5{,}2 \quad \lambda = \frac{2\pi}{5{,}2} = 1{,}2$

$1560 = 2\pi\nu \rightarrow \nu = \frac{1560}{2\pi} = 246{,}28$

$v = \lambda\nu = 297{,}9$

5. $\xi = 60\cos(1800t - 5{,}3x)$ $\quad \lambda = \frac{2\pi}{k} = \frac{2\pi}{5{,}3}$ м

$[\xi] = [$мкм$]$

$\frac{A}{\lambda} = ?$

$\frac{A}{\lambda} = \frac{0{,}6 \cdot 10^{-4} \cdot 5{,}3}{3\pi}$

$A_{\xi} = 108\,000 \cdot 10^{-6} = 0{,}108$ м/с

$\nu = \frac{\lambda}{T} = \frac{\lambda\omega}{2\pi} = \frac{1800}{5{,}3}$ м/с

$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega}$

(6) $T = 1{,}2\,c$

$a = 2\,см$

$v = 15\,м/с$

$x = 45\,м$

$t = 4\,с$

$\xi(x,t) = ?$

$w = \frac{2\pi}{T} \Rightarrow \lambda = vT = 18\,м$

$w = 5{,}23\,c^{-1}$

$\xi(x,t) = a\cos\left(wt - \frac{2\pi}{\lambda}x\right)$

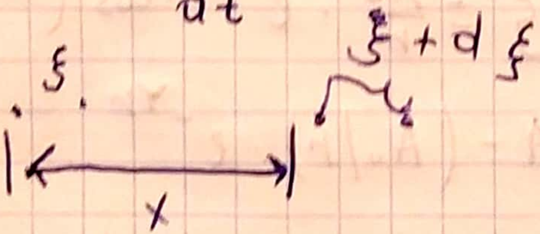
$\xi(45, 4) = 0{,}02\,м$

(7) $\xi$

$\frac{v_{cp}}{v_{ол}} ?$

$\xi(x,t) = A\cos(wt - kx)$

$v_{cp} = \frac{d\xi}{dt} = -Aw\sin(wt - kx)$



$\varepsilon = \frac{d\xi}{dx}$ – относительная деформация

$\varepsilon = A\sin(wt - kx)$

$\frac{v_{cp}}{\varepsilon} = \left|-\frac{w}{k}\right| = v$

(8) $l$

$v = a\sqrt{T}$

$a = const$

$T = T_1 + \frac{T_2 - T_1}{l}x \; [0 < x < l]$

$dT = \left(\frac{T_2 - T_1}{l}\right)dx$

$$dt = \frac{dx}{a\sqrt{T}}$$

$$dt = \frac{1}{a\sqrt{T}}\left(\frac{l\,dT}{T_2 - T_1}\right)$$

$$\int_0^t dt = \frac{l}{a(T_2 - T_1)}\int_{T_1}^{T_2}\frac{dT}{\sqrt{T}}$$, или $t = \frac{2l}{(T_2 - T_1)}\left(\sqrt{T_2} - \sqrt{T_1}\right)$

$$t = \frac{2l}{a\left(\sqrt{T_1} - \sqrt{T_2}\right)}$$

9. $\nu = 1450$ Гц

$r_1 = 5$ м

$A_1 = 5$ м

$A_1 = 50 \cdot 10^{-6}$ м

$r = 10$ м

$A_2 = A_1 / \eta$

$\eta = 3$

а) $\gamma$

б) $v_m$ - ? (в точке A)

$$\xi = \frac{A_0}{r} \cdot e^{-\gamma r} \cdot \cos(\omega t - kr)$$

$$A = (A_0 / r) \cdot e^{-\gamma r}$$

$$A_1 = (A_0 / r_1) \cdot e^{-\gamma r_1}$$

$$A_2 = (A_0 / r_2) \cdot e^{-\gamma r_2}$$

$$\eta = \frac{r_2}{r_1} \cdot \frac{e^{-\gamma r_1}}{e^{-\gamma r_2}} = \frac{r_2}{r_1} \cdot e^{-\gamma r_1 + \gamma r_2} = \frac{r_2}{r_1} \cdot e^{\gamma(r_2 - r_1)}$$

$\eta = (r_2 / r_1) \cdot e^{\gamma(r_2 - r_1)}$ отсюда $\eta r_1 / r_2 = e^{\gamma(r_2 - r_1)}$

$$\ln(\eta r_1/r_2) = \gamma(r_2 - r_1)$$

$$\gamma = \frac{\ln\left(\frac{2r_1}{r_2}\right)}{r_2 - r_1}$$

$$\gamma = \ln(3\cdot 5/10)/(10-5) \simeq 0{,}08\ м^{-1}$$

б) $V = \partial\xi/\partial t = (A_0/r)\cdot e^{-\gamma r_1}(-w\sin(wt - kr))$

$w = 2\pi\nu$

$$V = -(2\pi\nu A_0/r)\, e^{-\gamma r}\cdot\sin(wt - kr)$$

$$V_m = \frac{2\pi\nu A_0}{r}\cdot e^{-\gamma r}$$

$$\gamma = \frac{\ln\left(\frac{\eta r_1}{r_2}\right)}{r_2 - r_1} \simeq 0{,}08\ м^{-1} \qquad V_m = 2\pi\nu A_1/\eta \simeq 0{,}154$$

10. $l_1 = 10\,м$

$l_2 = 16\,м$

$T = 0{,}04\,с$

$V = 300\,м/с$

$\lambda - ?$

$$\Delta\varphi = 2\pi\frac{l}{\lambda}$$

$$\lambda = VT$$

$$\Delta\varphi = 2\pi\frac{l}{\lambda} = 2\pi\frac{l_2 - l_1}{VT} =$$

$$= 2\cdot 3{,}14\cdot\frac{16-10}{300\cdot 0{,}04} = 3{,}14 = \pi\ рад$$

Ответ: $\Delta\varphi = \pi$ рад

Сканировано с CamScanner