1.

$x(t) = A\cos\omega t + B\sin\omega t$
$x(t) = C\cos(\omega t + \varphi_c)$
$x(t) = D\sin(\omega t + \varphi_s)$

$A\cos\omega t + B\sin\omega t = C\cos(\omega t + \varphi_c)$
$A\cos\omega t + B\sin\omega t = C\cos\omega t\cos\varphi_c - C\sin\omega t \cdot \sin\varphi_c$

$A = C\cos\varphi_c$
$B = -C\sin\varphi_c$

$A\cos\omega t + B\sin\omega t = D\sin(\omega t + \varphi_s)$
$A\cos\omega t + B\sin\omega t = D\sin\omega t\cos\varphi_s + D\cos\omega t\sin\varphi_s$

$A = D\sin\varphi_s$
$B = D\cos\varphi_s$

$A^2 = C^2\cos^2\varphi_c$
$B^2 = C^2\sin^2\varphi_c$

$A^2 + B^2 = C^2(\cos^2\varphi_c + \sin^2\varphi_c)$
$A^2 + B^2 = C^2$
$C = \sqrt{A^2 + B^2}$

$tg\,\varphi_c = \frac{B}{A} \Rightarrow \varphi_c = arctg\,\frac{B}{A}$

$A^2 = D^2\sin^2\varphi_s$
$B^2 = D^2\cos^2\varphi_s$

$A^2 + B^2 = D^2$
$D = \sqrt{A^2 + B^2}$

$tg\,\varphi_s = \frac{B}{A}$

$\varphi_s = arctg\,\frac{B}{A}$

$C\cos(\omega t + \varphi_c) = D\sin(\omega t + \varphi_s)$
$C\cos(\omega t + \varphi_c + \frac{\pi}{2} - \frac{\pi}{2}) = D\sin(\omega t + \varphi_s)$

$C\left(\cos(\omega t + \varphi_c + \frac{\pi}{2})\cos\frac{\pi}{2} + \sin(\omega t + \varphi_c + \frac{\pi}{2})\sin\frac{\pi}{2}\right) = D\sin(\omega t + \varphi_s)$

($\cos\frac{\pi}{2} = 0$, $\sin\frac{\pi}{2} = 1$)

$C\sin(\omega t + \varphi_c + \frac{\pi}{2}) = D\sin(\omega t + \varphi_s)$

$C = D$ $\quad \varphi_s = \varphi_c + \frac{\pi}{2}$ $\quad \varphi_c = \varphi_s - \frac{\pi}{2}$

$D = C$

Nisu sve jedinstveno zadane jer se neke ponavljaju (ovise o zadanom kutu)

2.

$$m\ddot{x} = -kx - mg \;/\; m$$

$$\ddot{x} = -\frac{k}{w}x - g$$

$$\ddot{x} + w^2 x = -g$$

$$x(t) = A\cos(wt) + C$$

$$x = C$$

$$0 + w^2 C = -g \Rightarrow C = -\frac{g}{w^2}$$

$$\boxed{x(t) = A\cos(wt) - \frac{g}{w^2}}$$

$x(0) = 0 \Rightarrow x(0) = A - \frac{g}{w^2}$ $\qquad v(0) = 0 \qquad \dot{x}(t) = -Aw\cos(wt)$

$$A = \frac{g}{w^2}$$

$$\boxed{x(t) = \frac{g}{w^2}\cos(wt) - \frac{g}{w^2}}$$

3.

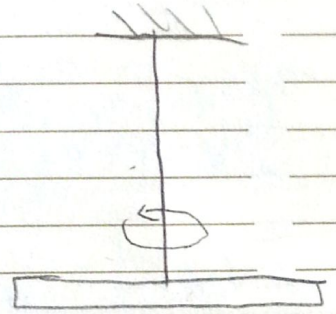
$k = \frac{E \cdot S}{L}$ ako prepolovimo oprugu konstanta nove opruge (duple krace) je dva puta veci

$k_1 = 2k$

$k_{uk} = 2k + 2k = 4k$

$\frac{T}{T_1} = \sqrt{\frac{\frac{m}{k}}{\frac{m}{4k}}} = 2$

4. $D = 10\,mNm$
$L = 1\,m$
$m = 0{,}1\,kg$
$m' = 0{,}05\,kg$



D

$$\omega = \sqrt{\frac{D}{I}}$$

$$I = \frac{1}{12} m L^2 = 0{,}0133\ kg\,m^2$$

$$\omega = \sqrt{\frac{10 \cdot 10^{-3}}{0{,}0133}} = \frac{\sqrt{3}}{2}\ s^{-1}$$

$$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} = 7{,}25\ s$$

$$I' = \frac{1}{12} m L^2 + m'\left(\frac{L}{2}\right)^2 + m'\left(\frac{L}{2}\right)^2$$

$$= \frac{1}{12} m L^2 + \frac{1}{2} m' \frac{L^2}{4} = 0{,}0383\ kg\,m^2$$

$$\omega' = \sqrt{\frac{D}{I'}} = 0{,}511\ s^{-1}$$

$$T' = \frac{2\pi}{\omega'} = 12{,}3\ s$$

ADRESAR

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7.

$d = 10\ m$ $\quad I = ?$

$d = 30\ m$ $\quad I = 100\ W/m^2$

5.

$L = 1\ m$

$r = 1\ cm = 0{,}01\ m$

$L = 2\ m$

$R = 2\ mm = 0{,}02\ m$

$\varrho_{Fe} = 7870\ kg/m^3$

$m_1 = \varrho \cdot V = \varrho_{Fe} \cdot r^2 \pi \cdot L$

$m_1 = 2{,}472\ kg$

$m_2 = \varrho_{Fe} R^2 \pi \cdot L = 19{,}8\ kg$

1. slučaj

$I_1 = \frac{m_1 L^2}{3} + \frac{m_2 L^2}{12} + m_2 (2L)^2$

$= 86{,}624\ kg m^2$

$\frac{T_1}{T_2} = \frac{2\pi \sqrt{\frac{I_1}{Mgd_1}}}{2\pi \sqrt{\frac{I_2}{Mgd_2}}} = \sqrt{\frac{\frac{I_1}{Mgd_1}}{\frac{I_2}{Mgd_2}}}$

$\frac{T_1}{T_2} = \sqrt{\frac{I_1 \cdot d_2}{I_2 \cdot d_1}} = 1{,}15$

T

polusfera $= 2r^2\pi$

$\bar{P} = I \cdot S = I \cdot 2R^2 \pi$

$P_1 = P_2$

$P_1 = 2100 \cdot 30^2 \pi$

$I = \frac{P_2}{S_2} = \frac{P_1}{S_2} = \frac{2 \cdot 100 \cdot 30^2 \pi}{2 \cdot 10^2 \cdot \pi}$

$I = 900\ W/m^2$

$X_T = \frac{m_1 \frac{1}{2} + m_2 \cdot 2L}{m_1 + m_2}$

$X_T = 1{,}83\ m$

2. slučaj.

$I_2 = \frac{m_2 L^2}{3} + \frac{m_1 L^2}{12} + m_1 \left(\frac{5L}{2}\right)^2$

$I_2 = 42{,}056\ kg m^2$

$d_2 = 3 - X_T$

U V

6.

a) $\psi(x,t) = \psi_1(x,t) + \psi_2(x,t) = \frac{A}{2}\cos(kx-\omega t) + \frac{A}{2}\cos(kx+\omega t)$

$\sin(a \pm b) = \sin a \cos b \pm \cos a \sin b$

$= \frac{A}{2}\left[\cos kx \cos\omega t + \sin kx \sin\omega t + \cos kx \cos\omega t - \sin kx \sin\omega t\right]$

$= \frac{A}{2}\left(2\cos kx \cos\omega t\right) = A\cos kx \cos\omega t$

b)

putujući val $\psi(x,t) = A\cos(\omega t - kx)$

$\psi(x,t) = A\cos\omega t \cos kx + A\sin\omega t \sin kx$

$= A\left(\frac{\cos(\omega t - kx) + \cos(\omega t + kx)}{2}\right) + A\left(\frac{\cos(\omega t - kx) - \cos(\omega t + kx)}{2}\right)$

$= A\left(\frac{\cos(\omega t - kx) + \cos(\omega t + kx) + \cos(\omega t - kx) - \cos(\omega t + kx)}{2}\right)$

$= A\left(\frac{2\cos(\omega t - kx)}{2}\right) = A\cos(\omega t - kx)$

8.

$$\xi(x,t) = 3\,mm \cos(2\,s^{-1} t - 4{,}3\,m^{-1} x) \qquad (\omega t - kx)$$

$$A = 3\,mm$$

$\omega = k \cdot v$ $\qquad \omega = 2\,s^{-1}$ $\qquad k = \frac{4}{3}\frac{s}{m}$

$$v = \frac{\omega}{k} = 1{,}5\,\frac{m}{s}$$

$\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi} = 3{,}14\,Hz$

$v_1 = 1{,}1\,\frac{m}{s}$

$$f' = f\,\frac{v - v_1}{v - v_i \to 0} = 0{,}84\,Hz$$

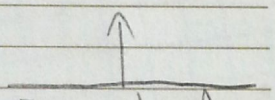
$$\omega' = 2\pi f' = 5{,}264\,s^{-1}$$

$v_2 = v - v_1$ $\qquad k = \frac{\omega'}{v - v_1} = 13{,}16\,m^{-1}$

$$\boxed{\xi_1(x,t) = 3\,mm\,(5{,}264\,s^{-1} t - 13{,}16\,m^{-1} x)}$$

E

9. $\Delta v = 0{,}05\,c$
$\lambda = 700\,nm$
zrcalo 2



F Doppler:

$f' = f \frac{V \pm V_p}{V \mp V_i}$ gornji - prema, donji - od

zrcalo 2 (miruje)
zrcalo 1 (giba)

1. zrcalo 2 primatelj, zrcalo 1 šalje

$f' = f \frac{c}{c - 0{,}05c} = f \frac{1}{1 - 0{,}05}$

$\frac{\nu}{\nu'} = \frac{\lambda}{\lambda} \frac{1}{0{,}95} \Rightarrow \lambda' = \lambda \cdot 0{,}95$

$\lambda' = 665\,nm$

2. zrcalo 2 šalje, 1 prima

$f'' = f' \frac{c + 0{,}05c}{c} = f' \; 1{,}05 \Rightarrow \lambda'' = \frac{\lambda'}{1{,}05} = 633.33\,nm$

3. zrcalo 1 šalje, 2 prima

$f''' = f'' \frac{c}{c - 0{,}05c} \Rightarrow \lambda''' = \lambda'' \cdot 0{,}95 = 601{,}67\,nm$

4. 2 šalje, 1 prima

$\lambda^{IV} = \frac{\lambda'''}{1{,}05} = 573.016\,nm$

5. 1 šalje, 2 prima

$\lambda^{V} = \lambda^{IV} \cdot 0{,}95 = 544.365\,nm$

6. 2 šalje, 1 prima

$\lambda^{VI} = \frac{\lambda^{V}}{1{,}05} = 518.44\,nm$

7. 1 šalje, 2 prima

$\lambda^{VII} = \lambda^{VI} \cdot 0{,}95 = 492.52\,nm$

na zrcalo 2

če se prva pojavi