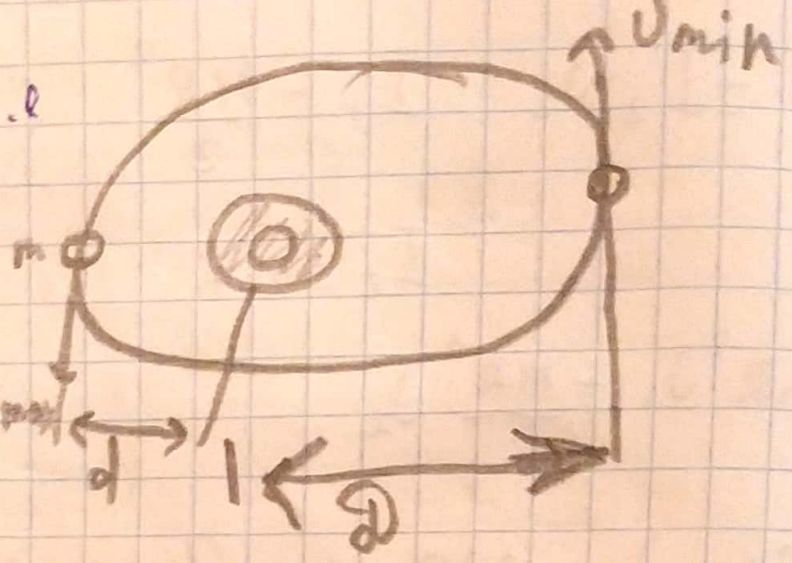
9) $D = 35{,}2$ а.е

$d = 0{,}6$ а.е

$\frac{J_{max}}{J_{min}} - ?$



$I_d \omega_d = I_D \omega_D$

$m d^2 \omega_d = m D^2 \omega_D$

$\omega_d = \frac{J_{max}}{d}$ $\omega_D = \frac{J_{min}}{D}$

$d J_{max} = D J_{min}$

$\frac{J_{max}}{J_{min}} = \frac{D}{d} = \frac{35{,}2}{0{,}6} \approx 59$

Д/З – 10

Колебания

1) $J = 50\ Гц$

$A = 1{,}9$ см

$\varphi = 30°$

$x(t) - ?$

$\omega = 2\pi J = 100\pi\ с^{-1}$

$\varphi_0 = \frac{\pi}{6}$

$x = 1{,}9 \cos\left(100\pi t + \frac{\pi}{6}\right)$

(2) $T = 0,5c$

$a_{max} = 15,8 м/с^2$

$A = ?$

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

$x = A\cos(\omega t + \varphi_0)$

$\dot{x} = A\omega\cos(\omega t + \varphi_0)$

$\ddot{x} = A\omega^2\cos(\omega t + \varphi_0) \Rightarrow a_{max} = A\omega^2$

$A = \frac{a_{max}}{\omega^2} = \frac{15,8 м/с^2 \cdot 0,5^2}{4\pi^2} \approx 0,1 м$

(3) $A = 10 см = 0,1 м$

$T = 5c$

$\vartheta_{max} - ?$

$a_{max} - ?$

$\vartheta_{max} = A \cdot \omega \quad (1)$

$\omega = \frac{2\pi}{T} \quad (2)$

$\vartheta_{max} = A \cdot \frac{2\pi}{T} \quad (3)$

$\vartheta_{max} = 0,1 \cdot \frac{2 \cdot 3,14}{5} = 0,1256 м/с$

$a_{max} = 4 \cdot \omega^2$

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

$a_{max} = A \cdot \left(\frac{2\pi}{T}\right)^2$

$a_{max} = 0,1 \left(\frac{2 \cdot 3,14}{5}\right)^2 = 0,158 м/с^2$

(4) $m = 0,4 кг$

$f_{max} = 16 Н$

$A = 0,1 м$

$\omega = ?$

$x = A\sin(\omega t + \varphi_0)$

$\frac{dx}{dt} = \vartheta = A\omega\cos(\omega t + \varphi_0)$

$\frac{d\vartheta}{dt} = a = -A\omega^2\sin(\omega t + \varphi_0)$

$\sum \vec{F} = m\vec{a}$

$f = ma = -mA\omega^2\sin(\omega t + \varphi_0)$

$F_{max} = m A \omega^2$

$\omega = \sqrt{\frac{F_{max}}{mA}} = \sqrt{\frac{16}{0,4 \cdot 0,1}} = \frac{2}{0,1} = 20 c^{-1}$

5.

$x = 50 \sin\left(\frac{\pi}{3} t\right)$ | $x = 50 \sin\left(\frac{\pi}{3} t\right)$

$m = 2 кг$ | $A = 50 см$

$E = ?$ | $\omega = \frac{\pi}{3} с^{-1}$

$F_{max} = ?$

$\frac{dx}{dt} = \vartheta = 50 \frac{\pi}{3} \cos\left(\frac{\pi}{3} t\right)$

$\frac{d\vartheta}{dt} = a = -\frac{50\pi^2}{9} \sin\left(\frac{\pi}{3} t\right)$

$\sum \vec{F} = m\vec{a} \quad F = -\frac{50\pi^2}{9} m \sin\left(\frac{\pi}{3} t\right)$

$F_{max} = \frac{50\pi^2}{9} = 109,66 Н$

$W = \frac{m\omega^2 A^2}{2} = \frac{2 \cdot \pi^2 \cdot 50^2}{18} = 2741,56 Дж$

6. $\omega_0 t + \varphi$ | $x = X \sin(\omega t + \varphi_0)$

$\frac{T}{\Pi} = ?$ | $\dot{x} = X\omega \cos(\omega t + \varphi_0)$

$\ddot{x} = X\omega^2 \sin(\omega t + \varphi_0)$

$T = \frac{m\dot{x}^2}{2} \quad \Pi = -\int f dx \cdot (-\int m \ddot{x} dx) = \int m X \omega^2 \sin(\omega t + \varphi_0) dx$

$= \frac{m x^2}{2} + C$

$\frac{T}{\Pi} = \frac{m X^2 w^2 \cos^2(wt+\varphi_0) x}{2 \cdot m x^2 w^2 \sin^2(wt+\varphi_0)} = \frac{1}{tg^2(wt+\varphi_0)} =$

$= tg^2(wt+\varphi_0') = \underline{tg^2 \varphi}$

7. $x = \frac{A}{2}$

$T = 6c$

$\underline{\varphi_0 = 0}$

$t - ?$

$x = A \sin(\varphi_0 + wt)$

$\varphi_0 = 0$

$x = A \sin(wt)$

$\frac{A}{2} = A \sin(wt)$

$\sin(wt) = \frac{1}{2}$

$wt = \frac{\Pi}{6}$

$w = \frac{2\Pi}{T}$

$\frac{2\Pi t}{T} = \frac{\Pi}{6}$

$\frac{t}{T} = \frac{1}{12}$

$t = \frac{T}{12} = \frac{6}{12} = \underline{0,5c}$

8. $T_1 = 6c$ $\quad x_1 = A_1 \cos(\omega_1 t + \varphi_0)$

$T_2 = 5c$ $\quad x_2 = A_2 \cos(\omega_2 t + \varphi_0)$

$\tau = ?$ $\quad \omega_1 = \frac{2\pi}{T_1}$ $\quad \omega_2 = \frac{2\pi}{T_2}$

$$\cos(\omega_1 t + \varphi_0) = \cos(\omega_2 t + \varphi_0)$$

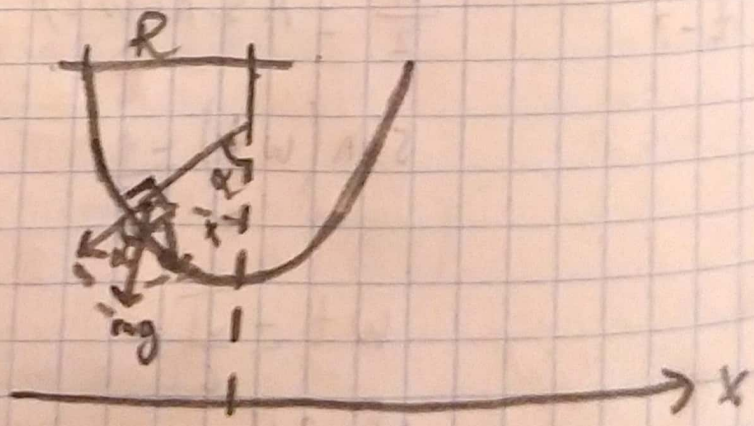
$$\omega_1 t + \varphi_0 = \omega_2 t + \varphi_0 + 2\pi k$$

$$\frac{2\pi}{T_1} t = \frac{2\pi}{T_2} t + 2\pi k \quad | : 2\pi$$

$$\frac{t}{T_1} = \frac{t}{T_2} + k \qquad t = \frac{k T_1 T_2}{T_2 - T_1} \qquad \tau = t|_{k=-1} = \frac{-1 \cdot 5 \cdot 6}{5-6} = 30c$$

9. $R = 2{,}5\,м$

$T - ?$



$$mg \sin\alpha = ma$$

$$\sin\alpha = -\frac{x}{R}$$

$$-mg\frac{x}{R} = ma$$

$$a + x\frac{g}{R} = 0 \qquad a + \omega^2 x = 0$$

$$\omega^2 = \frac{g}{R} \qquad \omega = \sqrt{\frac{g}{R}}$$

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

$$T = 2\pi\sqrt{\frac{R}{g}}$$

$$T = 2 \cdot 3{,}14 \cdot \sqrt{\frac{2{,}5}{10}} = 3{,}14\,c$$

10. $\omega = 10\pi$

$\varphi_0 = \pi$

$x = A\cos(\omega t + \varphi_0)$

$\tau = ?$

$x(0) = A\cos\pi = -A$

$v(0) = \omega A \sin\pi = 0$

$v(\tau) = -\omega A$

$x(\tau) = 0 \Rightarrow \omega\tau = \frac{\pi}{2}$

$$\omega\tau = \frac{\pi}{2\omega} = \frac{\pi}{2\pi \cdot 5} = \frac{1}{40}\,c$$