AKADEMIA EDUKACYJNO - INŻYNIERSKA

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MATURA STUDIA PRAKTYKA STAŻ PRACA BIZNES PRZEMYSŁ STEAM

KOMPLEKSOWE WSPARCIE EDUKACYJNE **ON – LINE** NA KAŻDYM ETAPIE KSZTAŁCENIA INŻYNIERSKIEGO

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MECHANIKA II

"KINEMATYKA PUNKTU MATERIALNEGO"

PROJEKT

Oblicz:

- położenie
- prędkość liniową
- przyspieszenie liniowe
- promień krzywizny

dla punktu materialnego spozycjonowanego w kartezjańskim układzie współrzędnych prostokątnych w danej chwili czasu.

DANE:

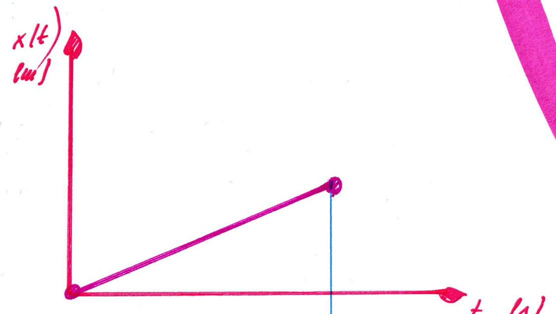
$x(t), y(t), T = OK$

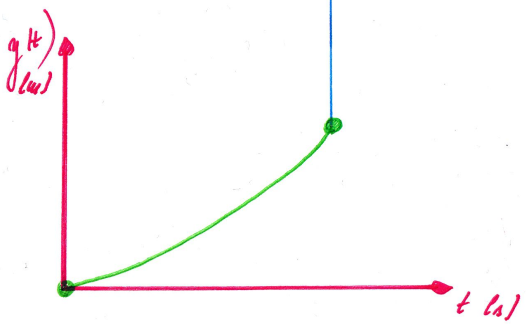
SZUKAM:

$y(x), V, a, \rho = ?$

1)

$$\begin{cases} x(t) = 4t \\ y(t) = 16t^2 - 1 \\ \tau = \frac{1}{2}\ [s] \end{cases}$$





1) ANALIZA KIN. TRAJEKTORII.

$$\begin{cases} \text{I)}\ x(t) = 4t \\ \text{II)}\ y(t) = 16t^2 - 1 \end{cases}$$

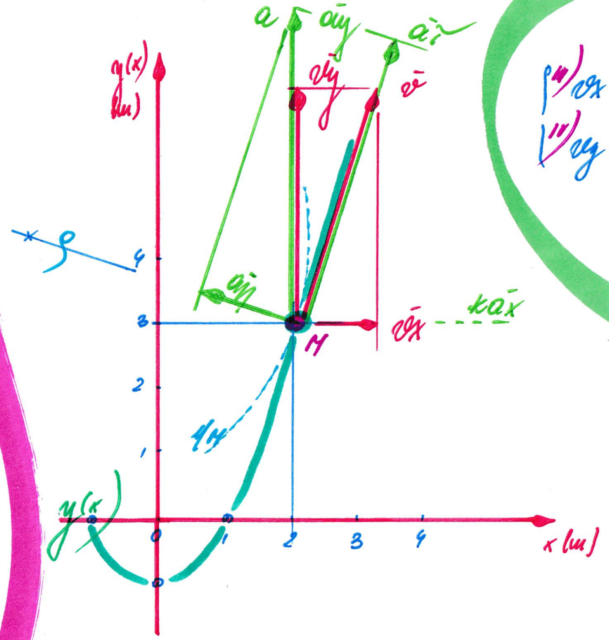
$\tau = \frac{1}{2}\ [s]$

$$\begin{cases} \text{I)}\ x(\tau = \frac{1}{2}) = 2\ [m] \\ \text{II)}\ y(\tau = \frac{1}{2}) = 3 \end{cases}$$

I) $t = \frac{1}{4} x$

II) $y(x) = 16 \cdot \left(\frac{1}{4} x\right)^2 - 1$

$y(x) = x^2 - 1$



$\tau = \frac{1}{2}\ [s]$

$$\begin{cases} \text{III)}\ v_x(\tau = \frac{1}{2}) = 4\ [m/s] \\ \text{IV)}\ v_y(\tau = \frac{1}{2}) = 16 \end{cases}$$

$\bar{v} = \bar{v}_x + \bar{v}_y$

$v = \sqrt{v_x^2 + v_y^2}$

$\Rightarrow v(\tau = \frac{1}{2}) = \sqrt{(4)^2 + (16)^2} = 16{,}5\ [m/s]$

2) ANALIZA KIN. PRĘDKOŚCI.

$$\begin{cases} \text{III)}\ v_x(t) = x'(t) \\ \text{IV)}\ v_y(t) = y'(t) \end{cases} \Rightarrow \begin{cases} \text{III)}\ v_x(t) = (4t)' = 4\ [m/s] \\ \text{IV)}\ v_y(t) = (16t^2 - 1)' = 32t \end{cases}$$

3) ANALIZA KIN. POSPEŠKOVA

$$\text{(V)}\; a_x(t) = v_x'(t)$$
$$\text{(VI)}\; a_y(t) = v_y'(t)$$

$\Rightarrow$

$$\text{(V)}\; a_x(t) = 0 \quad [m/s^2]$$
$$\text{(VI)}\; a_y(t) = (32t)' = 32$$

$$\tau = \tfrac{1}{2} \; [s]$$

$$\text{(V)}\; a_x(\tau = \tfrac{1}{2}) = 0 \quad [m/s^2]$$
$$\text{(VI)}\; a_y(\tau = \tfrac{1}{2}) = 32$$

$$\bar{a} = \bar{a}_x + \bar{a}_y = \bar{a}_n + \bar{a}_\tau$$
$$a^2 = a_x^2 + a_y^2 = a_n^2 + a_\tau^2$$

$$a_\tau(t) = \frac{dv(t)}{dt} \Rightarrow v'(t) = a_\tau(t)$$

$$\Rightarrow a_\tau(t) = v'(t) = \left[\left(v_x^2(t) + v_y^2(t)\right)^{\frac{1}{2}}\right]' = \frac{1}{2}\left(v_x^2(t) + v_y^2(t)\right)^{-\frac{1}{2}} \cdot \left(v_x^2(t) + v_y^2(t)\right)' =$$

$$= \frac{2 v_x(t) \cdot v_x'(t) + 2 v_y(t) \cdot v_y'(t)}{2\sqrt{v_x^2(t) + v_y^2(t)}} = \frac{v_x(t) a_x(t) + v_y(t) a_y(t)}{v(t)} = \frac{v_x \cdot a_x + v_y \cdot a_y}{v}$$

$$\tau = \tfrac{1}{2} \; [s]$$

$$a_\tau(\tau = \tfrac{1}{2}) = \frac{4 \cdot 0 + 16 \cdot 32}{16{,}5} = 31 \quad [m/s^2]$$

$$a_n^2 = a^2 - a_\tau^2$$

$$\Rightarrow a_n^2 = (32)^2 - (31)^2$$
$$a_n^2 = 63$$
$$a_n = 7{,}93 \quad [m/s^2]$$

$$\tau = m \cdot a_n = \frac{m v^2}{\rho}$$

$$\Rightarrow \rho = \frac{v^2}{a_n} = \frac{(16{,}5)^2}{7{,}93} = 34{,}33 \; [m]$$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