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

"DYNAMIKA BRYŁY SZTYWNEJ – RUCH PŁASKI"

PROJEKT

Oblicz:

- równanie ruchu
- siłę tarcia

środka ciężkości dla układu toczącego się jednorodnego koła.

DANE:

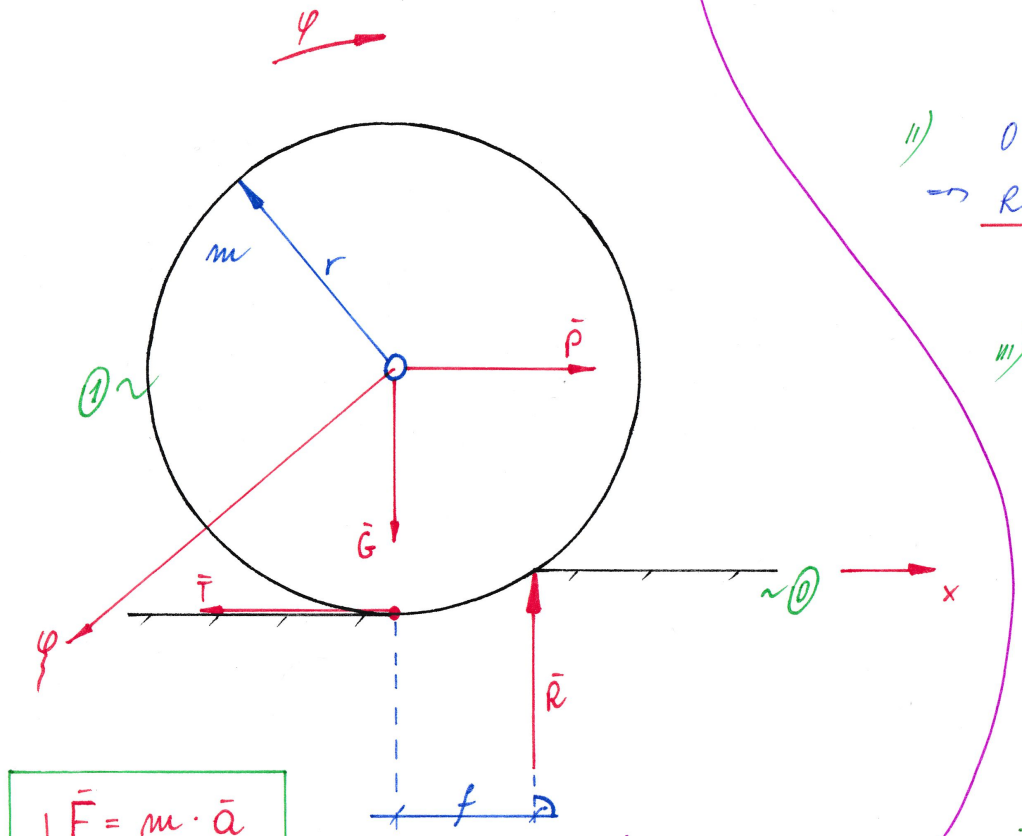
1) $r_1, f_1, \alpha, m_1, F_1 = OK$

SZUKAM:

$x_1(t), \varphi_1(t), T = ?$

D: $m, r, f, \bar{P}$ = ✓

SZ: $\ddot{x}, \ddot{\varphi}, \bar{T}$ = ?



$$\begin{cases} \bar{F} = m \cdot \bar{a} \\ \bar{M} = \bar{I} \cdot \bar{\varepsilon} \end{cases}$$

1) ANALIZA KINEMATYCZNA - PRZYSPIESZENIA.

$$\begin{cases} \text{I)} \ \sum \bar{F}_{ix} = m\ddot{x} = \bar{P} - \bar{T} \\ \text{II)} \ \sum \bar{F}_{iy} = m\ddot{y} = \bar{R} - \bar{G} \\ \text{III)} \ \sum \bar{M}_{i\xi} = \bar{I} \cdot \ddot{\varphi} = \bar{I} \cdot r - R \cdot f \end{cases} \quad 3?$$

$G = m \cdot g$

$\ddot{x} = \ddot{\varphi} \cdot r$

$\bar{I} = \frac{1}{2} m r^2$

$y = 0$

$\dot{y} = 0$

$\ddot{y} = 0$

II) $0 = R - G$

$\Rightarrow R = mg$

I) $m\ddot{x} = P - \bar{T}$

$\bar{T} = P - m\ddot{x}$

III) $\frac{1}{2} m r^2 \cdot \frac{\ddot{x}}{r} = (P - m\ddot{x}) \cdot r - mgf$

$\frac{1}{2} m r \ddot{x} = Pr - mr\ddot{x} - mgf$

$\frac{3}{2} m r \ddot{x} = Pr - mgf$

$\ddot{x} = \frac{2}{3mr}(Pr - mgf)$

$\ddot{x}(t) = \frac{2}{3}\left(\frac{P}{m} - \frac{gf}{r}\right)$

$\ddot{\varphi} = \frac{\ddot{x}}{r} \Rightarrow \ddot{\varphi}(t) = \frac{2}{3r}\left(\frac{P}{m} - \frac{gf}{r}\right)$

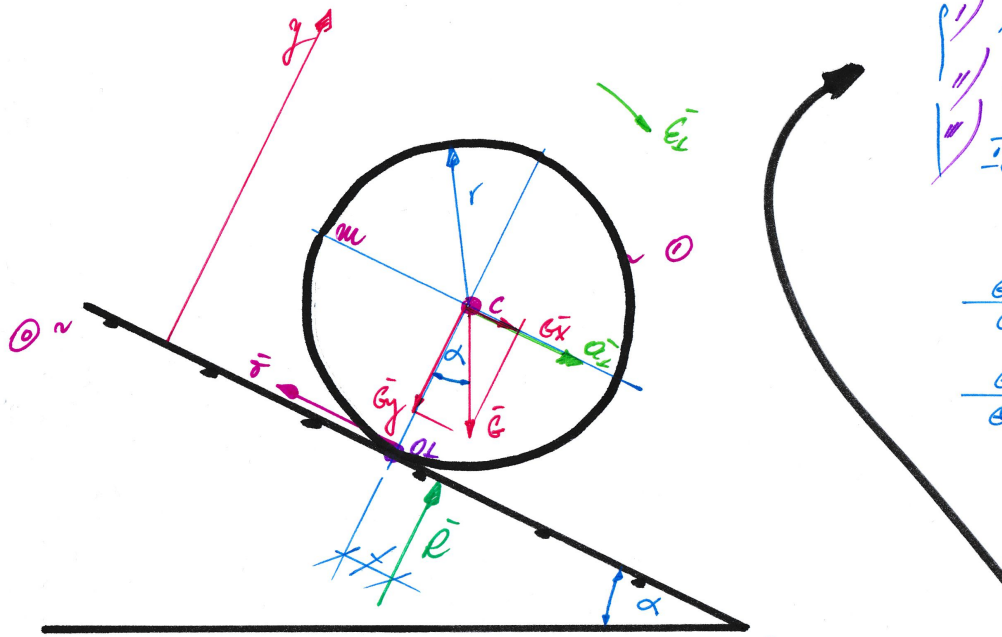
2) ANALIZA DYNAMICZNA - NIĆ TARCIA.

$\bar{T} = P - m\ddot{x} \Rightarrow \bar{T} = P - \frac{2}{3} m \left(\frac{P}{m} - \frac{gf}{r}\right)$

21)

D: $m, \bar{I}, r, f, \alpha, \mu \to \infty$

sz: $\ddot{x}(t) = ?$



$$\begin{cases} I) & m\ddot{x} = G_x - T \\ II) & 0 = R - G_y \\ III) & \bar{I}_C \ddot{\varphi} = T \cdot r - R \cdot f \end{cases}$$

$$\frac{G_x}{G} = \sin\alpha \Rightarrow G_x = mg\sin\alpha$$

$$\frac{G_y}{G} = \cos\alpha \Rightarrow G_y = mg\cos\alpha$$

$$\bar{I}_C = \frac{1}{2} m r^2$$

$$\begin{cases} I) & m\ddot{x} = mg\sin\alpha - T \\ II) & 0 = R - mg\cos\alpha \\ III) & \frac{1}{2} m r^2 \ddot{\varphi} = T \cdot r - R \cdot f \end{cases}$$

$$\bar{T} = m \cdot \bar{a}$$

$$\begin{cases} I) & \sum F_{ix} = m\ddot{x} = G_x - T \\ II) & \sum F_{iy} = m\ddot{y}^{\,0} = R - G_y \\ III) & \sum M_{iC} = \bar{I}_C \ddot{\varphi} = T \cdot r - R \cdot f \end{cases}$$

II)

$$0 = R - mg\cos\alpha$$

$$\Rightarrow R = mg\cos\alpha$$

II) $Q = mg\cos\alpha$

I) $m\ddot{x} = mg\sin\alpha - \bar{T}$

III) $\frac{1}{2}mr^2\ddot{\varphi} = \bar{T}\cdot r - mgf\cos\alpha$ 3?

$$\begin{cases} x = \varphi\cdot r \\ \dot{x} = \dot{\varphi}\cdot r \\ \ddot{x} = \ddot{\varphi}\cdot r \end{cases}$$

$$\Rightarrow \begin{cases} \text{I)} & m\ddot{x} = mg\sin\alpha - \bar{T} \\ \text{III)} & \frac{1}{2}mr^2\cdot\frac{\ddot{x}}{r} = \bar{T}\cdot r - mgf\cos\alpha \end{cases}$$

I) $m\ddot{x} = mg\sin\alpha - \bar{T}$

III) $\frac{1}{2}mr\ddot{x} = \bar{T}\cdot r - mgf\cos\alpha$ 2?

1) $\bar{T} = mg\sin\alpha - m\ddot{x}$

III) $\frac{1}{2}mr\ddot{x} = \bar{T}\cdot r - mgf\cos\alpha$

$\frac{1}{2}mr\ddot{x} = (mg\sin\alpha - m\ddot{x})\cdot r - mgf\cos\alpha$

$\frac{1}{2}mr\ddot{x} = mgr\sin\alpha - mr\ddot{x} - mgf\cos\alpha$

$mr\ddot{x} + \frac{1}{2}mr\ddot{x} = mgr\sin\alpha - mgf\cos\alpha$

$\frac{3}{2}mr\ddot{x} = mgr\sin\alpha - mgf\cos\alpha \quad /:m$

$\frac{3}{2}r\ddot{x} = gr\sin\alpha - gf\cos\alpha \quad /:r$

$\frac{3}{2}\ddot{x} = g\sin\alpha - \frac{gf\cos\alpha}{r}$

$\frac{3}{2}\ddot{x} = g\left(\sin\alpha - \frac{f}{r}\cos\alpha\right) \quad /\cdot\frac{2}{3}$

$$\ddot{x}(t) = \frac{2}{3}g\left(\sin\alpha - \frac{f}{r}\cos\alpha\right)$$ $a(t) = \ddot{x}(t)$

$$\begin{cases} \ddot{x} = \ddot{\varphi}\cdot r \Rightarrow \ddot{\varphi} = \frac{\ddot{x}}{r} \end{cases}$$

$$\Rightarrow \ddot{\varphi}(t) = \frac{2g}{3r}\left(\sin\alpha - \frac{f}{r}\cos\alpha\right)$$ $\varepsilon(t) = \ddot{\varphi}(t)$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