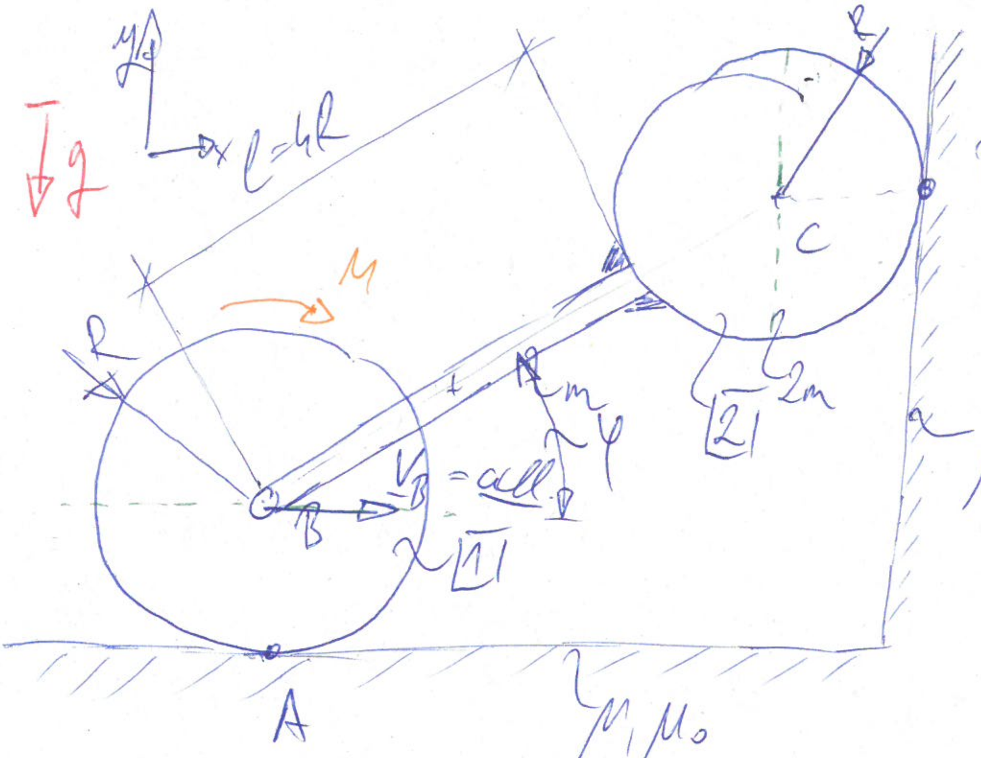


$m_1 = 6\,[kg]$

$m = 3\,[kg]$

$R = 0.3\,[m]$

$v_B = 0.3\,[m/s]$

$\varphi = 30\,[°]$

$\mu_0 = 1.0$

$\mu = 0.1$

$g = 9.81\,[m/s^2]$

1, gyorsulásállapot súlyponti mennyiségekkel, P_2, G_2

2, SZTA, mozgásegyenlet

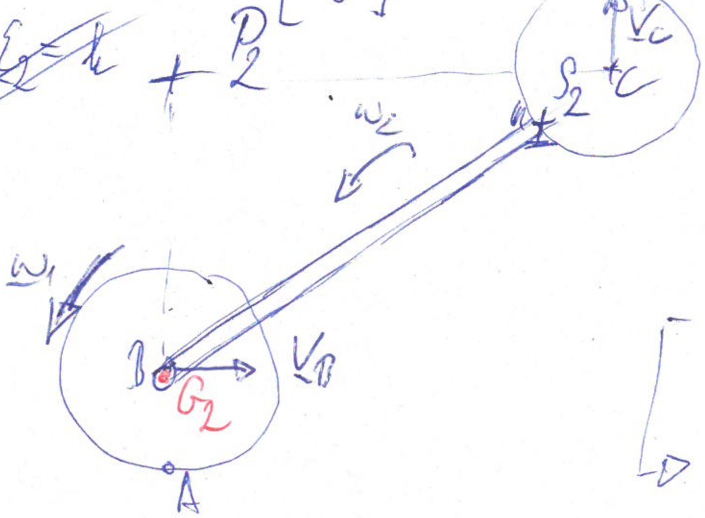
3, M = ?, valóban gördül

4, M munkája, D pontban súrlódásos elhanyagolással, függőleges állapotban

Tfh gördül

1/ Kinematika

$\underline{v}_A = \underline{0}$, $\underline{v}_B = \begin{bmatrix} v_B \\ 0 \\ 0 \end{bmatrix}$, $\underline{v}_C = v_C \cdot \underline{j}$, $\underline{\omega}_1 = \omega_1 \cdot \underline{k}$, $\cancel{\underline{\varepsilon}_1 = \varepsilon_1 \underline{k}}$, $\underline{\omega}_2 = \omega_2 \underline{k}$, $\cancel{\underline{\varepsilon}_2 = \underline{k}}$



$\underline{v}_B = \underline{v}_A + \underline{\omega}_1 \times \underline{r}_{AB}$, $\underline{r}_{AB} = R \cdot \underline{j}$

$\rightarrow \omega_1 = -v_B/R = -1\,[rad/s]$

$\underline{v}_C = \underline{v}_B + \underline{\omega}_2 \times \underline{r}_{BC}$, $\underline{r}_{BC} = \cancel{5R}\,(l+R) \begin{bmatrix} \cos\varphi \\ \sin\varphi \\ 0 \end{bmatrix}$

$\rightarrow \omega_2 = \dfrac{v_B}{\sin\varphi\,(l+R)}$, $v_C = v_B \dfrac{\cos\varphi}{\sin\varphi}$

$\omega_2 = 0.4\,[rad/s]$, $v_C = 0.520\,[m/s]$

$\underline{a}_B = \underline{a}_A + \underline{\varepsilon}_1 \times \underline{r}_{AB} - \omega_1^2 \underline{r}_{AB}$; , $\underline{\varepsilon}_1 = \varepsilon_1 \underline{k}$, $\underline{a}_A = a_A \cdot \underline{j}$, $\underline{a}_B = \underline{0}$

$\varepsilon_1 = 0 \left[{rad}/{s^2}\right]$, $a_A = R\omega_1^2 = 0.3 \left[{m}/{s^2}\right]$

$\underline{a}_C = \underline{a}_B + \underline{\varepsilon}_2 \times \underline{r}_{BC} - \omega_2^2 \underline{r}_{BC}$, $\underline{\varepsilon}_2 = \varepsilon_2 \underline{k}$, $\underline{a}_C = a_C \cdot \underline{j}$, $\underline{a}_B = \underline{0}$

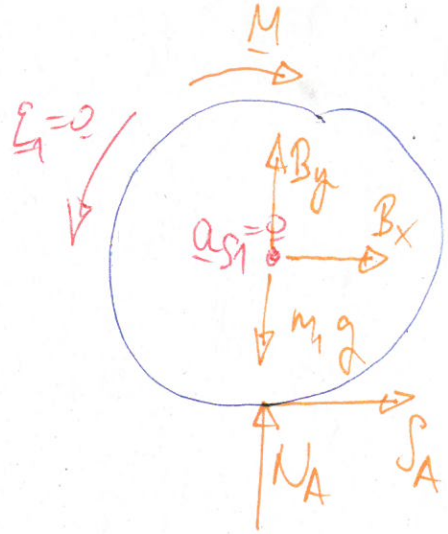
$\varepsilon_2 = -\omega_2^2 \frac{\cos(\varphi)}{\sin(\varphi)} = -0.277 \left[{rad}/{s^2}\right]$, $a_C = -\omega_2^2 (l+R) \frac{1}{\sin(\varphi)} = -0.4 \left[{m}/{s^2}\right]$

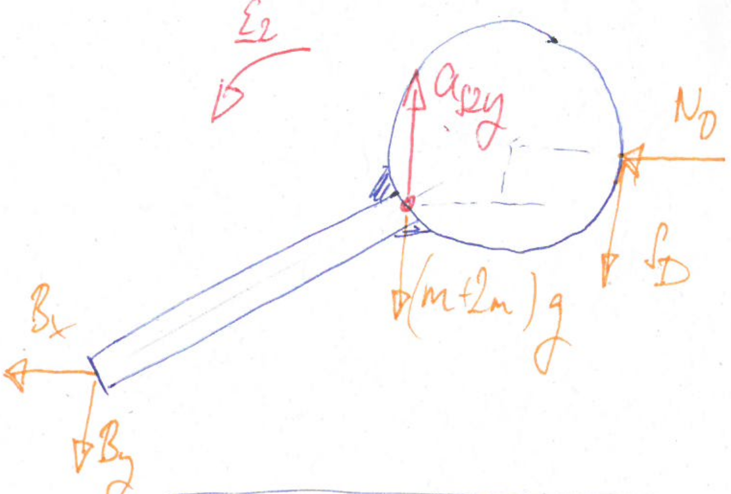
$$\underline{r}_{BS2} = \frac{1}{m+2m}\left(m\frac{l}{2}\begin{bmatrix}\cos\varphi\\ \sin\varphi\\ 0\end{bmatrix} + 2m(l+R)\begin{bmatrix}\cos\varphi\\ \sin\varphi\\ 0\end{bmatrix}\right) = 4R\begin{bmatrix}\cos\varphi\\ \sin\varphi\\ 0\end{bmatrix}$$

$$\underline{a}_{S2} = \underline{a}_B + \underline{\varepsilon}_2 \times \underline{r}_{BS2} - \omega_2^2 \underline{r}_{BS2} = \begin{bmatrix}0\\ a_{S2y}\\ 0\end{bmatrix} = \begin{bmatrix}0\\ -0.384\\ 0\end{bmatrix}\left[{m}/{s^2}\right]$$

1. test $[B = S_1]$ $[\underline{0}, \underline{0}]_{S_1}$, 2. test $[a_{S2y}, \varepsilon_2]$ P_2, G_2 ✓

SZTATI'





1. test

$\underline{\dot{I}} = \underline{F}$ → x: $m_1 0 = S_A + B_x$

→ y: $m_1 0 = N_A + B_y - m_1 g$

$\underline{\dot{\Pi}}_{S1} = \underline{M}_{S1}$ → z: $\Theta_1 \cdot 0 = S_A \cdot R - M$

2. test

x: $(m+2m)0 = -B_x - N_D$

$\underline{\dot{I}} = \underline{F}$ → y: $(m+2m)a_{S2y} = -B_y - S_D - (m+2m)g$

$\underline{\dot{\Pi}}_{S2} = \underline{M}_{S2}$ → z: $\Theta_{S2} \cdot \varepsilon_2 = B_y 4R\cos\varphi + B_x 4R\sin\varphi + N_D \cdot R\sin\varphi - S_D R(1+\cos\varphi)$

$N_A, S_A, B_x, B_y, N_D, S_D, M$

3) $\Theta_{s2} = \frac{1}{12} m l^2 + m\left(\frac{l}{2}\right)^2 + \frac{1}{2}(2m)R^2 + (2m)R^2 = 2.25\,[kg\,m^2]$

Súrlódik!

$S_D = \mu N_D$

$$
\begin{array}{ccccccc}
N_A & S_A & B_x & B_y & N_D & S_D & M
\end{array}
$$

$$
\begin{bmatrix}
0 & 1 & 1 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & R & 0 & 0 & 0 & 0 & -1 \\
0 & 0 & -1 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & -1 & 0 & -1 & 0 \\
0 & 0 & -4R\sin\varphi & 4R\cos\varphi & R\sin\varphi & -R(1+\cos\varphi) & 0 \\
0 & 0 & 0 & 0 & \mu & 1 & 0
\end{bmatrix}
\begin{bmatrix} N_A \\ S_A \\ B_x \\ B_y \\ N_D \\ S_D \\ M \end{bmatrix}
=
\begin{bmatrix} 0 \\ m_1 g \\ 0 \\ 0 \\ 3m(a_{S2y}+g) \\ \Theta_{s2}\varepsilon_2 \\ 0 \end{bmatrix}
$$

$N_A = 158.5\,[N]$, $S_A = 148.4\,[N]$, $B_x = -148.4\,[N]$, $B_y = -93.67\,[N]$, $N_D = 148.4\,[N]$

$S_D = 14.83\,[N]$, $M = 44.50\,[Nm]$

$\frac{S_A}{N_A} = 0.94 < \mu_0$ gördül ✓

Munkatétel

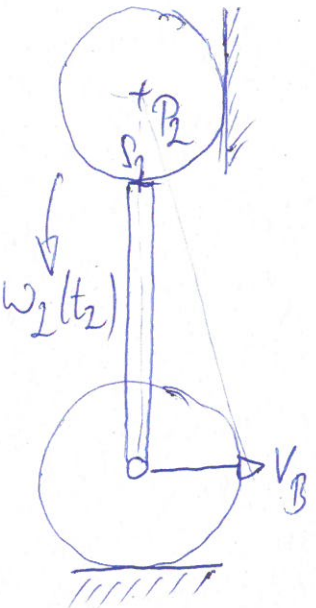
$T_2 - T_1 = W_{12}$

t_1:

$$T_1 = \frac{1}{2} m_1 v_B^2 + \frac{1}{2}\Theta_{S1}\omega_1^2 + \frac{1}{2} 3m\, v_{S2}^2 + \frac{1}{2}\Theta_{S2}\omega_2^2$$

$$\underline{v}_{S2} = \underline{v}_B + \underline{\omega}_2 \times \underline{r}_{BS_2} = \begin{bmatrix} 0.06 \\ 0.416 \\ 0 \end{bmatrix} [m/s]$$

t_2:



$$\omega_2 = \frac{v_B}{l+R} = 0.2 \, [rad/s]$$

$$v_{S2}(t_2) = 0.24 \, [m/s]$$

$$T_2 = \frac{1}{2} m_1 v_B^2 + \frac{1}{2}\Theta_{S1}\omega_1^2 + \frac{1}{2} 3m\, v_{S2}(t_2)^2 + \frac{1}{2}\Theta_{S2}\omega_2(t_2)^2$$

$$W_{12} = -(U_2 - U_1) + W_{12}^M = -3mg(l - l\sin\varphi) + W_{12}^M$$

$$\frac{1}{2} 3m\left(v_{S2}(t_2)^2 - v_{S2}(t_1)^2\right) + \frac{1}{2}\Theta_{S2}\left(\omega_2(t_2)^2 - \omega_1(t_1)^2\right) = -3mg(l - l\sin\varphi) + W_{12}^M$$

$$W_{12}^M = 53.62 \, [J]$$