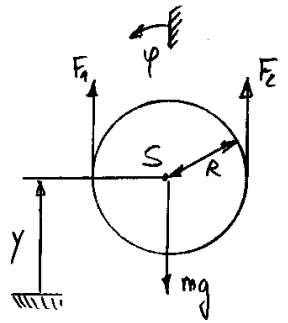
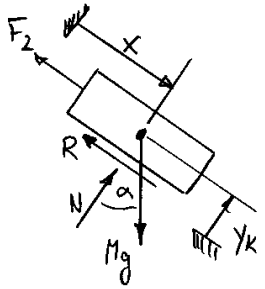
Lösung

(a) Freischneiden





Impulssatz Walze

$$m\ddot{y} = F_1 + F_2 - mg \quad (1)$$

Impulssatz Klotz

$$M\ddot{x} = Mg\sin\alpha - F_2 - R \quad (2)$$

$$M\ddot{y}_k = N - Mg\cos\alpha = 0 \quad (3)$$

Drallsatz Walze

$$\Theta_s\ddot{\varphi} = R(\bar{F}_2 - \bar{F}_1) \quad (4)$$

Reibgesetz

$$R = \mu N \overset{(3)}{=} \mu Mg\cos\alpha$$

(b) Kinematik

$$y = R\cdot\varphi \quad (5) \qquad \Rightarrow \ddot{y} = R\ddot{\varphi}$$

$$x = 2R\varphi \quad (6) \qquad \Rightarrow \ddot{x} = 2R\ddot{\varphi}$$

(c) Beschleunigung $\ddot{y}$?

aus (2) mit (5), (6):

$$F_2 = Mg(\sin\alpha - \mu\cos\alpha) - 2M\ddot{y}$$

F_2 in (4) mit (5):

$$\frac{\Theta_s}{R}\ddot{y} = R(F_2 - F_1) \Rightarrow F_1 = F_2 - \frac{\Theta_s}{R^2}\ddot{y}$$

$$= Mg(\sin\alpha - \mu\cos\alpha) - \ddot{y}\left(2M + \frac{\Theta_s}{R^2}\right)$$

F_2 und F_1 in (1):

$$m\ddot{y} = Mg(\sin\alpha - \mu\cos\alpha) - 2M\ddot{y}_s + Mg(\sin\alpha - \mu\cos\alpha) - \ddot{y}_s\left(2M + \frac{\Theta_s}{R^2}\right) - mg$$

$$\Rightarrow \ddot{y} = \frac{2M(\sin\alpha - \mu\cos\alpha) - m}{m + 4M + \frac{\Theta_s}{R^2}} \cdot g$$