20-R-KIN-DK-38

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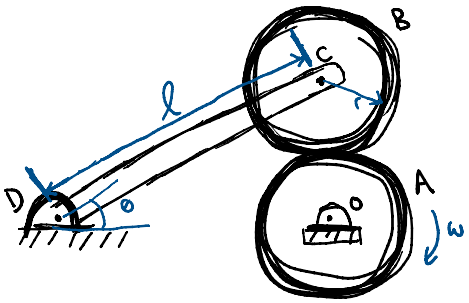
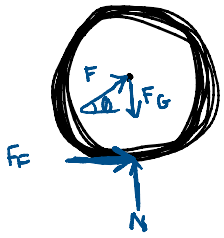
20-R-KIN-DK-38 Advanced Rotation (RBK)

Inspiration: 17-77 Hibbeler

An engineering student is working on an experimental drive system that utilizes two wheels to shift between drive and neutral. Wheel A rotates with a constant angular velocity of ***omega_A = 15 rad/s*** and has a mass of ***m_A = 1.1 kg***. Wheel B has a mass of ***m_B = 1.6 kg***. and is initially at rest when it is put into contact with wheel A. If the coefficient of kinetic friction between the two wheels is ***mu_k = 0.3***, determine the time required for wheel B to reach the same angular speed as wheel A. Assume the two wheels can be modelled as disks with radius ***r = 0.1 m*** and that the mass of bar CD is negligible. The length of bar CD is given as ***l = 0.8 m*** and the angle is ***theta = 30*** degrees.





$$I_C = \frac{1}{2}mr^2 = \frac{1}{2}(1.6)(0.1)^2 = 0.008$$

$$\sum F_x = ma_{Gx} = 0.3N + F\cos 30 = 0 \qquad 0.3N = -F\cos 30$$

$$\sum F_y = ma_{Gy} = N - F_G + F\sin 30 = 0 \qquad N = (1.6)(9.81) - F\sin 30$$

$$\sum M_C = 0.3N(0.1) = I_C\alpha = 0.008\alpha \qquad 0.03N = 0.008\alpha$$

$$0.3(1.6)(9.81) - 0.3F\sin 30 = -F\cos 30$$

$$4.7088 = \frac{3-10\sqrt{3}}{20}F \qquad F = -6.5763.. \qquad N = 18.98415$$

$$\alpha = 71.1905681\ rad/s^2$$

$$\omega = \omega_0 + \alpha t \quad \Rightarrow \quad 15 = 0 + 71.1905681t \qquad \boxed{t = 0.2107\ s}$$