**Task:**

A clown pedals a unicycle applying an average torque of 7.50 Nm to its wheel. The wheel has a mass of 2.50 kg with an outside diameter of 0.600 m and an inside diameter of 0.525 m. The unicyclist and the unicycle have a combined mass of 90.0 kg. What is his translational and tangential acceleration? Be careful! Only the wheel's mass rotates but the total mass accelerates horizontally. [Answer: 0.285 m/s2]

Solution:
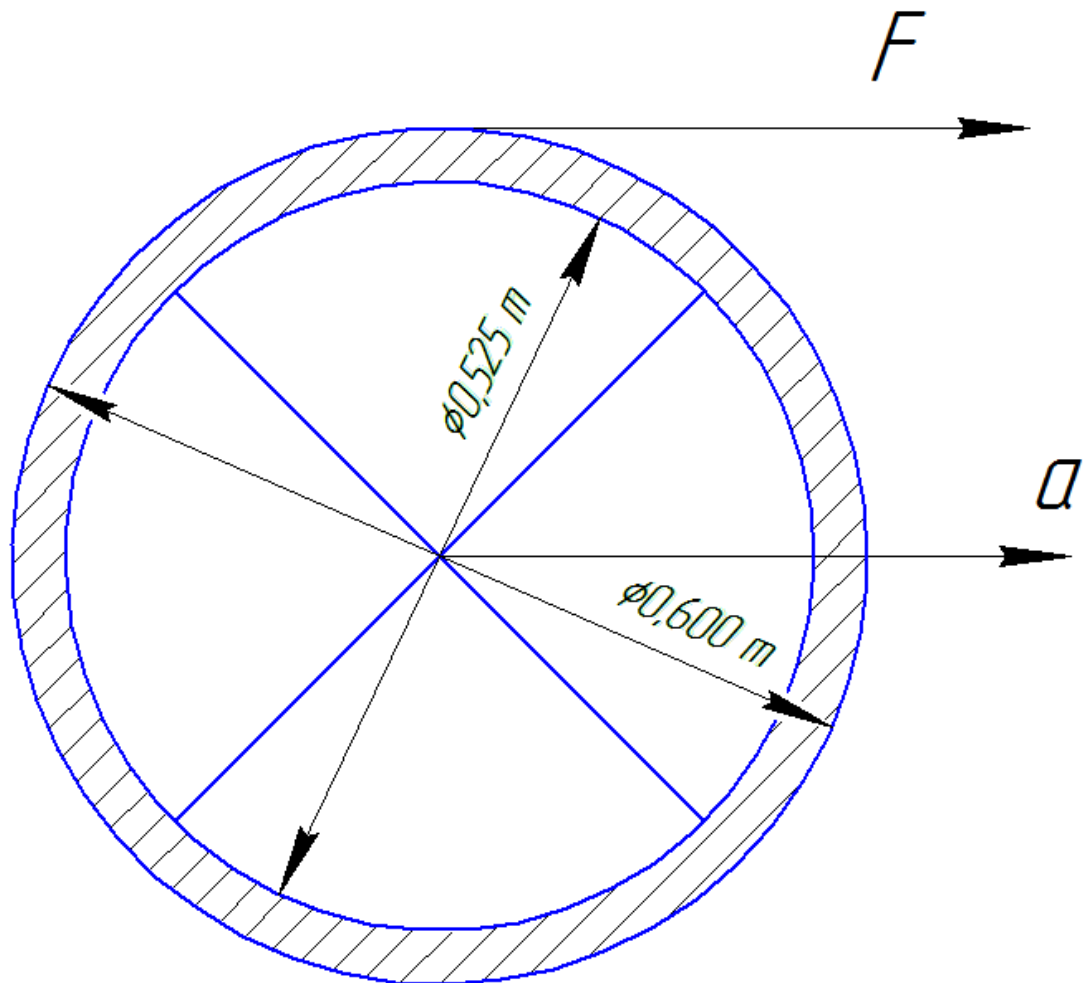
$$\tau_{net} = \frac{dL}{dt} = \frac{dI\omega}{dt} = \frac{Id\omega}{dt} = I \cdot \alpha = 7.5 \, Nm$$

$$I = \frac{1}{8}\left(m_{wheel} + m_{unicyclist}\right)(0.6^2 m^2 + 0.525^2 m^2) = \frac{1}{8} \cdot 90 \, kg \cdot 0.635625 \, m^2 =$$

$$= 7.15078125 \, kg \cdot m^2$$

$$\alpha = 0.9534375 \frac{rad}{s^2}$$

$$\alpha = \frac{d\omega}{dt} = \frac{d\frac{v}{0.3}}{dt} = \frac{1}{0.3}\frac{dv}{dt} = \frac{1}{0.3}a_{tan}$$

$$a_{tan} = 0.28603125 \frac{m}{s^2}$$

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Answer:

$$a = 0.28603125 \frac{m}{s^2}$$