Answer on Question #55295-Physics-Mechanics-Kinematics-Dynamics

A large 3kg object hangs from a rope wound on a 40 kg wheel. The wheel has an actual radius of 0.75m and a radius of gyration of 0.60m. Find the angular acceleration and the distance through which the weight will fall in the first 10s.

Solution

The second Newton's law for rotational motion:

$$\alpha = \frac{\tau}{I},$$

where α is the angular acceleration, τ is torque, $I = Mr_g^2$ is moment of inertia.

$$\alpha = \frac{mgr}{Mr_g^2} = \frac{3 \cdot 9.8 \cdot 0.75}{40 \cdot 0.60^2} = 1.5 \frac{rad}{s^2}.$$

The distance through which the weight will fall in the first 10s is

$$l = r\theta = r\frac{\alpha t^2}{2} = \frac{0.75 \cdot 1.5 \cdot 10^2}{2} = 56\ m.$$