Answer on Question #66877-Physics-Classical Mechanics

a solid cylinder of mass 3.0 kg and radius 1.0 m is rotating about its axis with a speed of 40 rad per second. Calculate the torque which must be applied to bring it to rest in 10 seconds . what would be the power required

Solution

The Newton's second law for rotation motion

$$M = J\frac{\Delta\omega}{\Delta t}.$$

Here M is torque, $J = \frac{mR^2}{2}$ - moment of inertia of a solid cylinder.

So

$$M = \frac{mR^2}{2}\frac{\Delta\omega}{\Delta t}$$

$$= \frac{3\times1^2}{2}\frac{40-0}{10}$$

$$= 6\ \text{N}\cdot\text{m}.$$

The power would be required

$$P = \frac{\text{Work done}}{\text{time}} = \frac{\frac{J\omega^2}{2}}{t} = \frac{mR^2\omega^2}{4t}$$

$$= \frac{1\times1^2\times40^2}{4\times10}$$

$$= 40\ \text{W}.$$

Answer: $M = 6\ \text{N}\cdot\text{m}$, $P = 40\ \text{W}$.