Answer on Question #65595 – Physics – Mechanics | Relativity

Question:

A solid cylinder of mass 3.0 kg and radius 1.0 m is rotating about its axis with a speed of 40 rad s−1. Calculate the torque which must be applied to bring it to rest in 10s. What would be the power required?

Solution:

The torque is:

$$\vec{\tau} = \vec{r} \times \vec{F} = \frac{d\vec{L}}{dt} = I\frac{d\vec{\omega}}{dt} = I\vec{\beta};$$

We can find the moment of inertia for cylinder:

$$I = \frac{mr^2}{2} = \frac{3 \cdot 1^2}{2} = 1.5\ kg \cdot m^2;$$

Consider that cylinder slows uniformly:

$$\beta = \frac{\Delta\omega}{\Delta t} = \frac{40}{10} = 4\frac{rad}{s^2};$$

Now we can find the torque and power:

$$\tau = \frac{dL}{dt} = I\frac{d\omega}{dt} = I\beta = 1.5 \cdot 4 = 6\ N \cdot m;$$

$$P = \tau\omega = 6 \cdot 40 = 240\ W.$$

Answer:

$$\tau = 6\ N \cdot m;$$

$$P = 240\ W.$$