**Answer on Question #65592-Mechanics - Relativity**

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

**Solution**

The second Newton's law for rotation

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

Here $J = \frac{mr^2}{2} = \frac{3\times1^2}{2} = 1.5\ \mathrm{kg\cdot m^2}$ is the moment of inertia, $\Delta\omega = \omega - \omega_0 = 0 - 40 = -40\frac{\mathrm{rad}}{\mathrm{s}}$.

So the torque

$$M = J\frac{\Delta\omega}{\Delta t} = 1.5\frac{-40}{10} = -6\ \mathrm{N\cdot m}.$$

The work done is equal the change in kinetic energy

$$\mathrm{W} = \Delta\mathrm{E} = \frac{J\omega^2}{2} - \frac{J\omega_0^2}{2} = 0 - \frac{1.5\times40^2}{2} = -1200\ \mathrm{J}.$$

The power required

$$\mathrm{P} = \frac{W}{t} = \frac{1200}{10} = 120\ \mathrm{W}.$$

**Answer** $M = 6\ \mathrm{N\cdot m},\ \ \mathrm{P} = 120\ \mathrm{W}.$