Answer on Question #41141, Physics, Mechanics | Kinematics | Dynamics

A solid cylinder of mass 2 kg and radius 20cm is rotating about its axis with a frequency of 10 Hz. What is the rotational kinetic energy of the cylinder?

Solution:

The kinetic energy of a rotating object is analogous to linear kinetic energy and can be expressed in terms of the moment of inertia and angular velocity. The total kinetic energy of an extended object can be expressed as the sum of the translational kinetic energy of the center of mass and the rotational kinetic energy about the center of mass. For a given fixed axis of rotation, the rotational kinetic energy can be expressed in the form

$$KE_{rotational} = \frac{1}{2} I\omega^2$$

where ω is the angular velocity, *I* is moment of inertia.

The moment of inertia of a cylinder is

$$I = \frac{1}{2} mR^2$$

The angular velocity is

$$\omega = 2\pi f$$

where f is the frequency.

Thus,

$$KE_{rotational} = \frac{1}{4} mR^2 (2\pi f)^2$$

$$KE_{rotational} = \frac{1}{4} \cdot 2 \cdot 0.2^2 (2 \cdot 3.14 \cdot 10)^2 = 78.9 \approx 79 \text{ J}$$

Answer. $KE_{rotational} = 79$ J.