Answer on Question #49084, Physics, Mechanics | Kinematics | Dynamics

Question:

3. A solid disk of radius 0.50 m and a mass of 0.10 kg is moving with a linear or translational velocity of 5.00 m/s. Determine the disk's:
a. Translational kinetic energy.
b. Rotational kinetic energy if rotating while translating.

Solution:

a) From the formula for the translational kinetic energy we have:

$$KE_t = \frac{1}{2}mv^2 = 0.5 \cdot 0.1kg \cdot \left(5.0\frac{m}{s}\right)^2 = 1.25J.$$

b) By the definition of the rotational kinetic energy we have:

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

where I is the moment of inertia and ω is the angular velocity.

For the solid disk the moment of inertia is

$$I = \frac{1}{2}mr^2 = 0.5 \cdot 0.1kg \cdot (0.5m)^2 = 0.0125kg \cdot m^2.$$

From the relationship between angular and linear variables we know that $v = r\omega$. So, from this formula we can find angular velocity:

$$\omega = \frac{v}{r} = \frac{5.0\,m/s}{0.5m} = 10\frac{rad}{s}.$$

Then, substituting the moment of inertia and the angular velocity to the formula for the rotational kinetic energy we obtain:

$$KE_{rot} = 0.5 \cdot 0.0125kg \cdot m^2 \cdot (10\frac{rad}{s})^2 = 0.625J$$

Answer:

a) $KE_t = 1.25J$

b) $KE_{rot} = 0.625J$