

Answer on Question #65590-Physics-Mechanics-Relativity

An insect of mass 20 g crawls from the center to the outside edge of a rotating disc of mass 200g and radius 20 cm. The disk was initially rotating at 22.0 rads⁻¹. What will be its final angular velocity? What is the change in the kinetic energy of the system?

Solution

From the conservation of momentum:

$$I_1\omega_1 = I_2\omega_2$$

$$\omega_2 = \frac{I_1\omega_1}{I_2} = \frac{\frac{1}{2}Mr^2}{\frac{1}{2}Mr^2 + mr^2}\omega_1 = \frac{M}{M + 2m} = \frac{200}{200 + 2(20)}22 = 18.3 \frac{\text{rad}}{\text{s}}.$$

The change in kinetic energy:

$$\Delta K = \frac{I_2\omega_2^2}{2} - \frac{I_1\omega_1^2}{2} = \frac{1}{2} \left(\left[0.02(0.2)^2 + \frac{0.2}{2}(0.2)^2 \right] (18.3)^2 - \frac{0.2}{2}(0.2)^2(22)^2 \right) = -164 J.$$

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