Answer on Question #65764 – Physics – Mechanics | Relativity

Question:

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:

We need to find moments of inertia of the system with insect in center I_i and on the outside edge of a disk I_f:

$$I_i = \frac{m_{disc}\, r^2}{2} = \frac{1}{2} \cdot 0.2 \cdot 0.04 = 0.004\ kg \cdot m^2;$$

$$I_f = \frac{m_{disc}\, r^2}{2} + m_{insect} r^2 = \frac{1}{2} \cdot 0.2 \cdot 0.04 + 0.02 \cdot 0.04 = 0.0048\ kg \cdot m^2;$$

Angular momentum remains, so, we can find final angular velocity:

$\omega_i I_i = \omega_f I_f \Rightarrow \omega_f = \frac{\omega_i I_i}{I_f} = \frac{22 \cdot 0.004}{0.0048} = \frac{55}{3} \approx 18.3 \frac{rad}{s};$

The change in kinetic energy of the system is:

$\Delta W = \frac{I_f \omega_f^2}{2} - \frac{I_i \omega_i^2}{2} = -0.164\ J;$

Answer:

$\omega_f = 18.3 \frac{rad}{s}, \Delta W = -0.164\ J.$