Answer Question #66347, Physics / Mechanics | Relativity

An insect of mass 20g crawls from the centre to the outside edge of a rotating disc of mass 200g and radius 20cm. The disc was initially rotating at 22.0 rad/s. What is the change in the kinetic energy of the system?

Solution:

Using Law of conservation of angular momentum

$$J_1\omega_1=J_2\,\omega_2$$

We find is J_1

$$J_1=Mr^2/2$$

$$J_1=0.2\ X\ (0.2)^2/2=0.2x0.2x0.2/2=4x\ 10^{-3}\ kgm^2$$

We find is J_2

$$J_2=Mr^2/2 + mr^2$$

$$J_2=4x10^{-3} + 0.02\ x(\ 0.2)^2 = 4.8x\ 10^{-3}\ kgm^2$$

Now, we find is ω_2

$$\omega_2=(J_1/J_2)\omega_1$$

$$\omega_2 = (\ 4x\ 10^{-3}/4.8\ x\ 10^{-3})\ x\ 22 = 18.3\ rad/s$$

Change in K.E

$$\Delta K = J_2\omega_2^2/2- J_1\omega 1^2/2$$

$$\Delta K = [(4.8\ x1\ 10^{-3}\ x\ 18.3\ x\ 18.3)\ /\ 2\ ]\ --\ [(4x\ 10^{-3}\ x\ 22\ x\ 22)/2] =-164.3\ J$$

Answer: -164.3 J