Answer on Question #39930 – Physics – Mechanics | Kinametics | Dynamics

1. A circular disc rotates on a thin air film with a period of 0.3second. Its moment of inertia about its axis of rotation is 0.06kg/m*2. A small mass is dropped onto the disc and rotates with it. The moment of inertia of the mass about axis of rotation is 0.04kg/m*2. Determine final period of rotating disc and mass.

$T = 0.3s$ $I = 0.06kg \cdot m^2$ $I_1 = 0.04kg \cdot m^2$	*Solution.*
$T_1, m - ?$	The angular velocity of the disc is $\omega = \frac{2\pi}{T}$. The momentum of the disc is $L = I\omega = \frac{2\pi I}{T}$.

The momentum of the conservative system keeps the constant. So, $L = \frac{2\pi I}{T} = (I + I_1)\omega_1$ and new angular velocity becomes $\omega_1 = \frac{2\pi I}{T(I + I_1)}$.

Thus, new period equals to $T_1 = \frac{2\pi}{\omega_1}$, $\boxed{T_1 = \left(1 + \frac{I_1}{I}\right)T}$.

The moment of inertia of the mass about axis of rotation is $I_1 = mr^2$, where r is distance from the mass to the axis. So, $\boxed{m = I_1 / r^2}$. As there is no info about this distance, we cannot evaluate it and this quantity remains in symbolic form.

Let check the dimensions.

$[T_1] = s$, $[m] = \frac{kg \cdot m^2}{m^2} = kg$.

Let evaluate the quantities.

$$T_1 = \left(1 + \frac{0.04}{0.06}\right) \cdot 0.3 = 0.5(s).$$

Answer: $0.5s$, $m = \frac{I_1}{r^2}$.