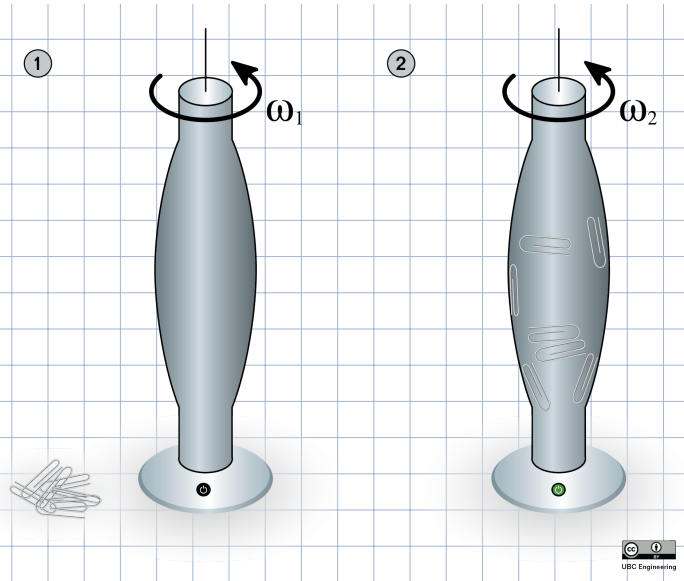
Your new rotating magnetic decoration has arrived, and you turn it on to see how it looks. The decoration accelerates to an angular velocity of 5 rad/s, has a radius of gyration about long axis of k = 12 cm and a mass m = 400 g. You decide it looks good and turn it off, letting it spin freely at the same angular velocity. After leaving for a short while, you come back to find your box of paperclips knocked over and empty. All the paperclips are now stuck to the magnetic decoration. If each paperclip has a mass of $m_{paperclip}$ = 2 g and increases the decoration's average radius of gyration by 0.3 mm, how many paperclips are there if the angular velocity decreases to 2.1 rad/s?

Assume the decoration continues to spin freely and the paperclips are uniformly distributed around the decoration.



- $I_{G1}\omega_1 = I_{G2}\omega_2$ (Conservation of Angular Momentum)

  $\hookrightarrow I = mk^2$

  $I_{G1} = m_1 k_1^2$

  $I_{G2} = m_2 k_2^2$

  $\hookrightarrow m_2 = m_1 + (0.002\,kg)n$

  $\hookrightarrow k_2 = k_1 + (0.0003\,m)n$

$$m_1 k_1^2 \omega_1 = (m_1 + 0.002\,kg\,n)(k_1 + 0.0003\,m\,n)^2 \omega_2$$

$$(0.4\text{kg})(0.12\text{m})^2(5\text{rad/s}) = (0.4\text{kg} + 0.002\text{kg/n})(0.12\text{m} + 0.0003\text{m/n})^2(2.1\text{rad/s})$$

↳ solver ⇒ $\boxed{n = 102}$